

JMAP  
REGENTS BY STATE  
STANDARD: TOPIC

NY Algebra II Regents Exam Questions from  
Spring 2015 to January 2024 Sorted by  
State Standard: Topic

[www.jmap.org](http://www.jmap.org)

# TABLE OF CONTENTS

TOPIC	STANDARD	SUBTOPIC	QUESTION #
RATE	F.IF.B.6	Rate of Change .....	1
QUADRATICS	A.REI.B.4 A.REI.B.4 A.REI.B.4 G.GPE.A.2	Solving Quadratics..... Using the Discriminant..... Complex Conjugate Root Theorem..... Graphing Quadratic Functions.....	20 34 39 41
POLYNOMIALS	A.SSE.A.2 A.APR.B.3 A.APR.B.3 F.BF.A.3 F.IF.B.4 F.IF.C.7 A.APR.B.2 A.APR.C.4	Factoring Polynomials..... Solving Polynomial Equations..... Graphing Polynomial Functions..... Graphing Polynomial Functions..... Graphing Polynomial Functions..... Graphing Polynomial Functions..... Remainder and Factor Theorems..... Polynomial Identities.....	58 80 90 97 98 109 121 140
RADICALS	N.RN.A.2 A.REI.A.2 N.RN.A.1 N.RN.A.2 N.CN.A.2	Operations with Radicals..... Solving Radicals..... Radicals and Rational Exponents..... Radicals and Rational Exponents..... Operations with Complex Numbers.....	153 158 177 181 203
POWERS	A.SSE.B.3 F.BF.A.1 F.LE.A.2 F.LE.B.5 F.IF.B.4 F.IF.B.4 F.IF.C.7 F.IF.C.7 F.LE.A.4 F.LE.A.4 F.LE.A.4 F.LE.A.4 A.CED.A.1 A.CED.A.1 A.CED.A.1	Modeling Exponential Functions..... Modeling Exponential Functions..... Modeling Exponential Functions..... Modeling Exponential Functions..... Evaluating Exponential Expressions..... Evaluating Logarithmic Expressions..... Graphing Exponential Functions..... Graphing Logarithmic Functions..... Express Exponentials as Logarithms..... Exponential Equations..... Exponential Growth..... Exponential Decay..... Exponential Equations..... Exponential Growth..... Exponential Decay.....	222 237 245 250 257 264 265 275 287 288 295 302 307 308 313
RATIONALS	A.APR.D.6 A.APR.D.6 A.APR.D.6 A.APR.D.7 A.CED.A.1 A.REI.A.2	Undefined Rationals..... Expressions with Negative Expressions..... Rational Expressions..... Addition and Subtraction of Rationals..... Modeling Rationals..... Solving Rationals.....	315 316 318 344 348 353
SYSTEMS	A.REI.C.6 A.REI.C.7 A.REI.D.11 A.REI.D.11	Solving Linear Systems..... Quadratic-Linear Systems..... Quadratic-Linear Systems..... Other Systems.....	373 384 400 401
FUNCTIONS	F.BF.A.1 F.LE.A.2 F.IF.C.9 F.BF.B.3	Operations with Functions..... Families of Functions..... Comparing Functions..... Transformations with Functions.....	427 438 441 449

	F.BF.B.3	Even and Odd Functions.....	451
	F.BF.B.4	Inverse of Functions .....	458
SEQUENCES AND SERIES	F.BF.A.1	Sequences .....	474
	F.IF.A.3	Sequences .....	484
	F.BF.A.2	Sequences .....	487
	F.BF.B.6	Sigma Notation .....	504
	A.SSE.B.4	Series .....	506
TRIGONOMETRY	F.TF.A.1	Unit Circle .....	520
	F.TF.A.2	Unit Circle .....	522
	F.TF.A.2	Reciprocal Trigonometric Relationships .....	525
	F.TF.A.2	Finding the Terminal Side of an Angle .....	526
	F.TF.A.2	Reference Angles.....	527
	F.TF.A.2	Determining Trigonometric Functions .....	528
	F.TF.C.8	Determining Trigonometric Functions .....	532
	F.TF.C.8	Simplifying Trigonometric Identities .....	541
	F.TF.B.5	Modeling Trigonometric Functions.....	542
	F.IF.B.4	Graphing Trigonometric Functions .....	548
F.IF.C.7	Graphing Trigonometric Functions .....	562	
CONICS	G.GPE.A.1	Equations of Conics.....	584
GRAPHS AND STATISTICS	S.IC.A.2	Analysis of Data .....	585
	S.IC.B.3	Analysis of Data .....	598
	S.IC.B.4	Analysis of Data .....	618
	S.IC.B.5	Analysis of Data .....	625
	S.IC.B.6	Analysis of Data .....	636
	S.ID.B.6	Regression .....	640
	S.ID.A.4	Normal Distributions .....	648
PROBABILITY	S.CP.B.7	Theoretical Probability .....	667
	S.CP.A.2	Probability of Compound Events.....	670
	S.CP.A.1	Venn Diagrams .....	674
	S.CP.A.3	Conditional Probability.....	676
	S.CP.A.4	Conditional Probability.....	683
	S.CP.B.6	Conditional Probability.....	695

## Algebra II Regents Exam Questions by State Standard: Topic

### RATE

#### F.IF.B.6: RATE OF CHANGE

- 1 Joelle has a credit card that has a 19.2% annual interest rate compounded monthly. She owes a total balance of  $B$  dollars after  $m$  months. Assuming she makes no payments on her account, the table below illustrates the balance she owes after  $m$  months.

<b>m</b>	<b>B</b>
0	100.00
10	1172.00
19	1352.00
36	1770.80
60	2591.90
69	2990.00
72	3135.80
73	3186.00

Over which interval of time is her average rate of change for the balance on her credit card account the greatest?

- |                        |                        |
|------------------------|------------------------|
| 1 month 10 to month 60 | 3 month 36 to month 72 |
| 2 month 19 to month 69 | 4 month 60 to month 73 |
- 2 The population of Austin, Texas from 1850 to 2010 is summarized in the table below.

<b>Year</b>	1850	1870	1890	1910	1930	1950	1970	1990	2010
<b>Population</b>	629	4428	14,575	29,860	53,120	132,459	251,808	494,290	790,390

Over which period of time was the average rate of change in population the greatest?

- |                |                |
|----------------|----------------|
| 1 1850 to 1910 | 3 1950 to 1970 |
| 2 1990 to 2010 | 4 1890 to 1970 |
- 3 The distance needed to stop a car after applying the brakes varies directly with the square of the car's speed. The table below shows stopping distances for various speeds.

<b>Speed (mph)</b>	10	20	30	40	50	60	70
<b>Distance (ft)</b>	6.25	25	56.25	100	156.25	225	306.25

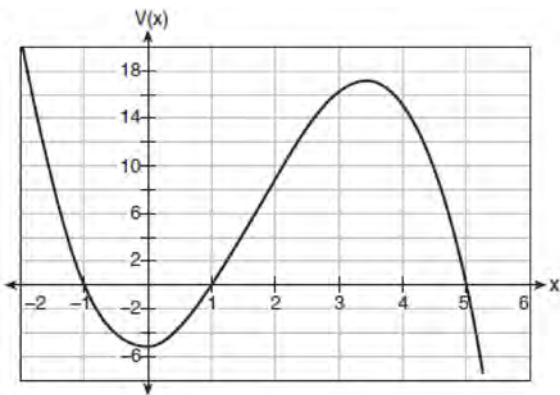
Determine the average rate of change in braking distance, in ft/mph, between one car traveling at 50 mph and one traveling at 70 mph. Explain what this rate of change means as it relates to braking distance.

4 The table below shows the number of hours of daylight on the first day of each month in Rochester, NY.

Month	Hours of Daylight
Jan.	9.4
Feb.	10.6
March	11.9
April	13.9
May	14.7
June	15.4
July	15.1
Aug.	13.9
Sept.	12.5
Oct.	11.1
Nov.	9.7
Dec.	9.0

Given the data, what is the average rate of change in hours of daylight per month from January 1st to April 1st? Interpret what this means in the context of the problem.

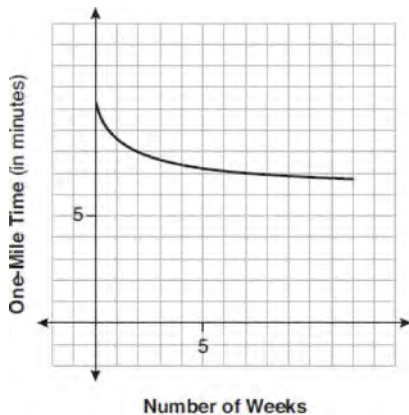
5 A cardboard box manufacturing company is building boxes with length represented by  $x + 1$ , width by  $5 - x$ , and height by  $x - 1$ . The volume of the box is modeled by the function below.



Over which interval is the volume of the box changing at the fastest average rate?

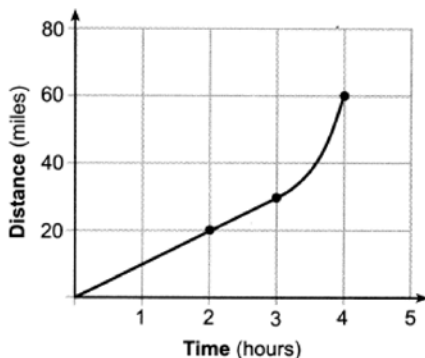
- 1 [1,2]
- 2 [1,3.5]
- 3 [1,5]
- 4 [0,3.5]

- 6 Irma initially ran one mile in over ten minutes. She then began a training program to reduce her one-mile time. She recorded her one-mile time once a week for twelve consecutive weeks, as modeled in the graph below.



Which statement regarding Irma's one-mile training program is correct?

- 1 Her one-mile speed increased as the number of weeks increased.
  - 2 Her one-mile speed decreased as the number of weeks increased.
  - 3 If the trend continues, she will run under a six-minute mile by week thirteen.
  - 4 She reduced her one-mile time the most between weeks ten and twelve.
- 7 Determine the average rate of change, in mph, from 2 to 4 hours on the graph shown below.



- 8 The function  $N(x) = 90(0.86)^x + 69$  can be used to predict the temperature of a cup of hot chocolate in degrees Fahrenheit after  $x$  minutes. What is the approximate average rate of change of the temperature of the hot chocolate, in degrees per minute, over the interval  $[0,6]$ ?
- 1  $-8.93$
  - 2  $-0.11$
  - 3  $0.11$
  - 4  $8.93$
- 9 An initial investment of \$1000 reaches a value,  $V(t)$ , according to the model  $V(t) = 1000(1.01)^{4t}$ , where  $t$  is the time in years. Determine the average rate of change, to the nearest dollar per year, of this investment from year 2 to year 7.
- 10 A fruit fly population can be modeled by the equation  $P = 10(1.27)^t$ , where  $P$  represents the number of fruit flies after  $t$  days. What is the average rate of change of the population, rounded to the nearest hundredth, over the interval  $[0, 10.5]$ ? Include appropriate units in your answer.
- 11 The function  $N(t) = 100e^{-0.023t}$  models the number of grams in a sample of cesium-137 that remain after  $t$  years. On which interval is the sample's average rate of decay the fastest?
- 1  $[1, 10]$
  - 2  $[10, 20]$
  - 3  $[15, 25]$
  - 4  $[1, 30]$
- 12 The world population was 2560 million people in 1950 and 3040 million in 1960 and can be modeled by the function  $p(t) = 2560e^{0.017185t}$ , where  $t$  is time in years after 1950 and  $p(t)$  is the population in millions. Determine the average rate of change of  $p(t)$  in millions of people per year, from  $4 \leq t \leq 8$ . Round your answer to the nearest hundredth.

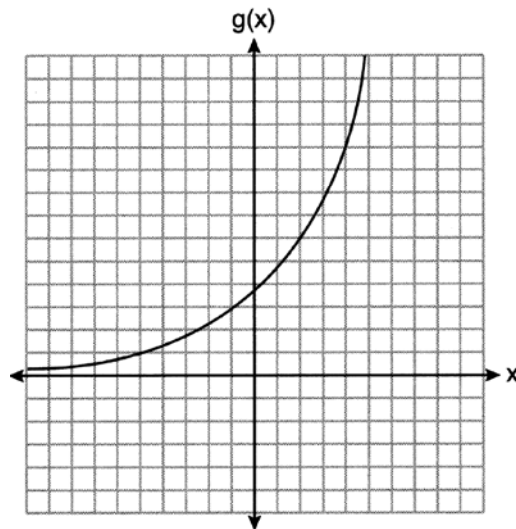
- 13 The value of a new car depreciates over time. Greg purchased a new car in June 2011. The value,  $V$ , of his car after  $t$  years can be modeled by the equation  $\log_{0.8}\left(\frac{V}{17000}\right) = t$ . What is the average decreasing rate of change per year of the value of the car from June 2012 to June 2014, to the *nearest ten dollars per year*?
- 1 1960
  - 2 2180
  - 3 2450
  - 4 2770
- 14 The equation  $t = \frac{1}{0.0105} \ln\left(\frac{A}{5000}\right)$  relates time,  $t$ , in years, to the amount of money,  $A$ , earned by a \$5000 investment. Which statement accurately describes the relationship between the average rates of change of  $t$  on the intervals [6000, 8000] and [9000, 12,000]?
- 1 A comparison cannot be made because the intervals are different sizes.
  - 2 The average rate of change is equal for both intervals.
  - 3 The average rate of change is larger for the interval [6000, 8000].
  - 4 The average rate of change is larger for the interval [9000, 12,000].
- 15 The average monthly high temperature in Buffalo, in degrees Fahrenheit, can be modeled by the function  $B(t) = 25.29 \sin(0.4895t - 1.9752) + 55.2877$ , where  $t$  is the month number (January = 1). State, to the *nearest tenth*, the average monthly rate of temperature change between August and November. Explain its meaning in the given context.
- 16 The monthly high temperature ( $^{\circ}\text{F}$ ) in Buffalo, New York can be modeled by  $B(m) = 24.9 \sin(0.5m - 2.05) + 55.25$ , where  $m$  is the number of the month and January = 1. Find the average rate of change in the monthly high temperature between June and October, to the *nearest hundredth*. Explain what this value represents in the given context.
- 17 The function  $f(x) = 2^{-0.25x} \cdot \sin\left(\frac{\pi}{2}x\right)$  represents a damped sound wave function. What is the average rate of change for this function on the interval  $[-7, 7]$ , to the *nearest hundredth*?
- 1 -3.66
  - 2 -0.30
  - 3 -0.26
  - 4 3.36

18 Which function shown below has a greater average rate of change on the interval  $[-2,4]$ ? Justify your answer.

$x$	$f(x)$
-4	0.3125
-3	0.625
-2	1.25
-1	2.5
0	5
1	10
2	20
3	40
4	80
5	160
6	320

$$g(x) = 4x^3 - 5x^2 + 3$$

19 Consider the graph of  $g$  and the table representing  $t$  below.



$x$	$t(x)$
-1	3
0	5
1	2
2	-5
3	-1
4	3

Over the interval  $[2,4]$ , which statement regarding the average rate of change for  $g$  and  $t$  is true?

- |   |   |   |  |
|---|---|---|--|
| 1 | $g$ has a greater average rate of change. | 3 | The average rate of change for $g$ is twice the average rate of change for $t$ . |
| 2 | The average rates of change are equal.    | 4 | The average rate of change for $g$ is half the average rate of change for $t$ .  |



## QUADRATICS

### A.REI.B.4: SOLVING QUADRATICS

- 20 The solution to the equation  $4x^2 + 98 = 0$  is
- 1  $\pm 7$
  - 2  $\pm 7i$
  - 3  $\pm \frac{7\sqrt{2}}{2}$
  - 4  $\pm \frac{7i\sqrt{2}}{2}$
- 21 What is the solution when the equation  $wx^2 + w = 0$  is solved for  $x$ , where  $w$  is a positive integer?
- 1  $-1$
  - 2  $0$
  - 3  $6$
  - 4  $\pm i$
- 22 The roots of the equation  $x^2 + 2x + 5 = 0$  are
- 1  $-3$  and  $1$
  - 2  $-1$ , only
  - 3  $-1 + 2i$  and  $-1 - 2i$
  - 4  $-1 + 4i$  and  $-1 - 4i$
- 23 The roots of the equation  $x^2 - 4x = -13$  are
- 1  $2 \pm 3i$
  - 2  $2 \pm 6i$
  - 3  $2 \pm \sqrt{17}$
  - 4  $2 \pm \sqrt{13}$
- 24 The roots of the equation  $0 = x^2 + 6x + 10$  in simplest  $a + bi$  form are
- 1  $-3 \pm 2i$
  - 2  $-6 \pm i$
  - 3  $-3 \pm i$
  - 4  $-3 \pm i\sqrt{2}$
- 25 The solutions to the equation  $-\frac{1}{2}x^2 = -6x + 20$  are
- 1  $-6 \pm 2i$
  - 2  $-6 \pm 2\sqrt{19}$
  - 3  $6 \pm 2i$
  - 4  $6 \pm 2\sqrt{19}$
- 26 a) Algebraically determine the roots, in simplest  $a + bi$  form, to the equation below.
- $$x^2 - 2x + 7 = 4x - 10$$
- b) Consider the system of equations below.
- $$y = x^2 - 2x + 7$$
- $$y = 4x - 10$$
- The graph of this system confirms the solution from part a is imaginary. Explain why.
- 27 A solution of the equation  $2x^2 + 3x + 2 = 0$  is
- 1  $-\frac{3}{4} + \frac{1}{4}i\sqrt{7}$
  - 2  $-\frac{3}{4} + \frac{1}{4}i$
  - 3  $-\frac{3}{4} + \frac{1}{4}\sqrt{7}$
  - 4  $\frac{1}{2}$
- 28 The roots of the equation  $3x^2 + 2x = -7$  are
- 1  $-2, -\frac{1}{3}$
  - 2  $-\frac{7}{3}, 1$
  - 3  $-\frac{1}{3} \pm \frac{2i\sqrt{5}}{3}$
  - 4  $-\frac{1}{3} \pm \frac{\sqrt{11}}{3}$

29 The solutions to the equation  $5x^2 - 2x + 13 = 9$  are

- 1  $\frac{1}{5} \pm \frac{\sqrt{21}}{5}$
- 2  $\frac{1}{5} \pm \frac{\sqrt{19}}{5} i$
- 3  $\frac{1}{5} \pm \frac{\sqrt{66}}{5} i$
- 4  $\frac{1}{5} \pm \frac{\sqrt{66}}{5}$

30 The solution to the equation  $18x^2 - 24x + 87 = 0$  is

- 1  $-\frac{2}{3} \pm 6i\sqrt{158}$
- 2  $-\frac{2}{3} \pm \frac{1}{6} i\sqrt{158}$
- 3  $\frac{2}{3} \pm 6i\sqrt{158}$
- 4  $\frac{2}{3} \pm \frac{1}{6} i\sqrt{158}$

31 If a solution of  $2(2x - 1) = 5x^2$  is expressed in simplest  $a + bi$  form, the value of  $b$  is

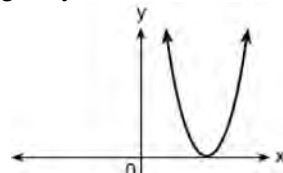
- 1  $\frac{\sqrt{6}}{5} i$
- 2  $\frac{\sqrt{6}}{5}$
- 3  $\frac{1}{5} i$
- 4  $\frac{1}{5}$

32 Solve the equation  $2x^2 + 5x + 8 = 0$ . Express the answer in  $a + bi$  form.

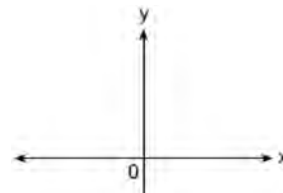
33 Solve the equation  $3x^2 + 5x + 8 = 0$ . Write your solution in  $a + bi$  form.

A.REI.B.4: USING THE DISCRIMINANT

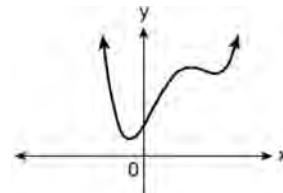
34 Which graph shows a quadratic function with two imaginary zeros?



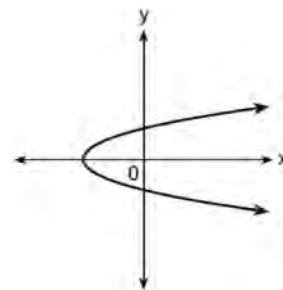
1



2

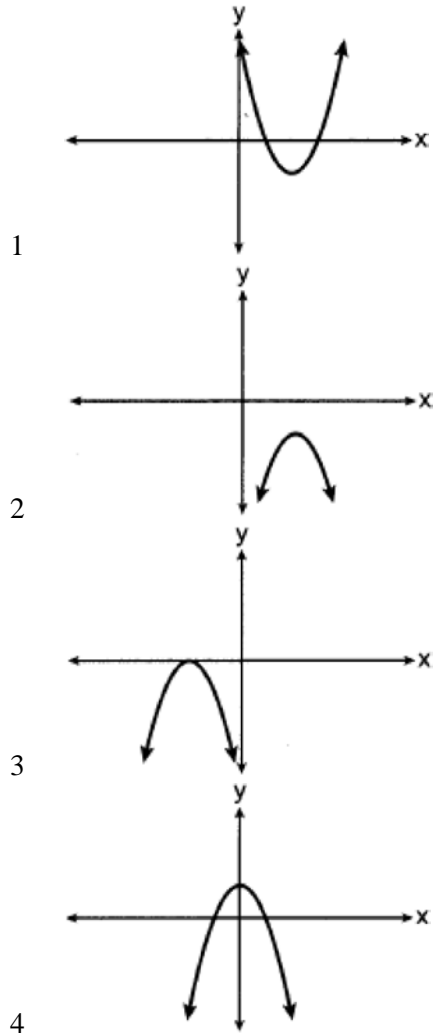


3

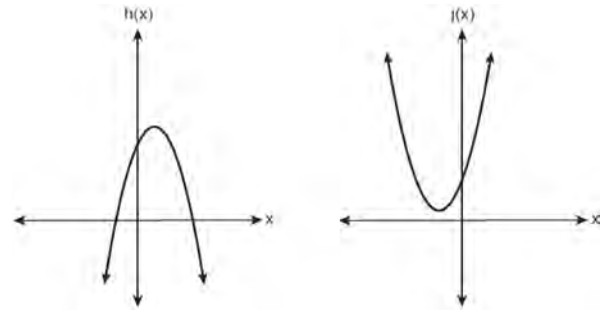


4

35 Which graph has imaginary roots?



36 In the quadratic formula,  $b^2 - 4ac$  is called the discriminant. The function  $f(x)$  has a discriminant value of 8, and  $g(x)$  has a discriminant value of  $-16$ . The quadratic graphs,  $h(x)$  and  $j(x)$ , are shown below.



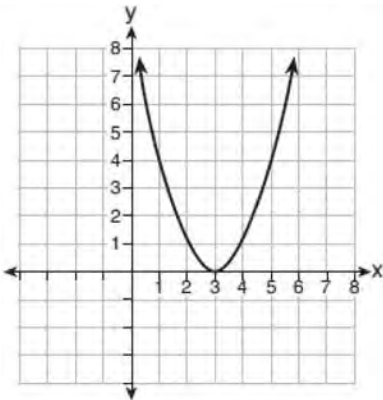
Which quadratic functions have imaginary roots?

- 1  $g(x)$  and  $h(x)$
- 2  $g(x)$  and  $j(x)$
- 3  $f(x)$  and  $h(x)$
- 4  $f(x)$  and  $j(x)$

- 37 Which representation of a quadratic has imaginary roots?

x	y
-2.5	2
-2.0	0
-1.5	-1
-1.0	-1
-0.5	0
0.0	2

- 1  
 2  $2(x+3)^2 = 64$



- 3  
 4  $2x^2 + 32 = 0$

- 38 Does the equation  $x^2 - 4x + 13 = 0$  have imaginary solutions? Justify your answer.

A.REI.B.4: COMPLEX CONJUGATE ROOT THEOREM

- 39 Which equation has roots of  $3+i$  and  $3-i$ ?
- 1  $x^2 - 6x + 10 = 0$
  - 2  $x^2 + 6x - 10 = 0$
  - 3  $x^2 - 10x + 6 = 0$
  - 4  $x^2 + 10x - 6 = 0$

- 40 Which equation has  $1-i$  as a solution?
- 1  $x^2 + 2x - 2 = 0$
  - 2  $x^2 + 2x + 2 = 0$
  - 3  $x^2 - 2x - 2 = 0$
  - 4  $x^2 - 2x + 2 = 0$

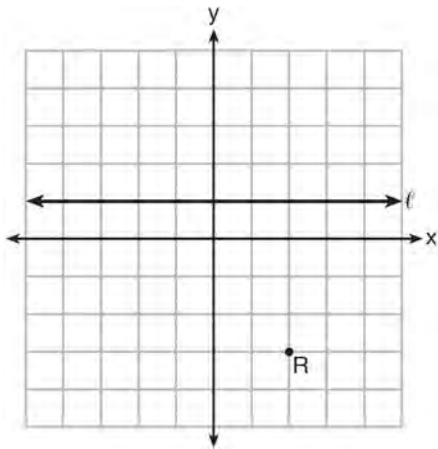
G.GPE.A.2: GRAPHING QUADRATIC FUNCTIONS

- 41 The parabola described by the equation  $y = \frac{1}{12}(x-2)^2 + 2$  has the directrix at  $y = -1$ . The focus of the parabola is
- 1  $(2, -1)$
  - 2  $(2, 2)$
  - 3  $(2, 3)$
  - 4  $(2, 5)$

- 42 What is the equation of the directrix for the parabola  $-8(y-3) = (x+4)^2$ ?
- 1  $y = 5$
  - 2  $y = 1$
  - 3  $y = -2$
  - 4  $y = -6$

- 43 A parabola has a directrix of  $y = 3$  and a vertex at  $(2, 1)$ . Which ordered pair is the focus of the parabola?
- 1  $(2, -1)$
  - 2  $(2, 0)$
  - 3  $(2, 2)$
  - 4  $(2, 5)$

- 44 Which equation represents the set of points equidistant from line  $\ell$  and point  $R$  shown on the graph below?



- 1  $y = -\frac{1}{8}(x+2)^2 + 1$
  - 2  $y = -\frac{1}{8}(x+2)^2 - 1$
  - 3  $y = -\frac{1}{8}(x-2)^2 + 1$
  - 4  $y = -\frac{1}{8}(x-2)^2 - 1$
- 45 The equation of the parabola that has its focus at the point  $(-3, 2)$  and directrix at  $y = 0$  is

- 1  $y = \frac{1}{4}(x+3)^2 + 1$
- 2  $y = \frac{1}{4}(x-3)^2 + 1$
- 3  $y = \frac{1}{8}(x+3)^2 + 1$
- 4  $y = \frac{1}{8}(x-3)^2 + 1$

- 46 Which equation represents the equation of the parabola with focus  $(-3, 3)$  and directrix  $y = 7$ ?

- 1  $y = \frac{1}{8}(x+3)^2 - 5$
- 2  $y = \frac{1}{8}(x-3)^2 + 5$
- 3  $y = -\frac{1}{8}(x+3)^2 + 5$
- 4  $y = -\frac{1}{8}(x-3)^2 + 5$

- 47 A parabola that has a vertex at  $(2, 1)$  and a focus of  $(2, -3)$  has an equation of

- 1  $y = \frac{1}{16}(x-2)^2 + 1$
- 2  $y = -\frac{1}{16}(x+2)^2 - 1$
- 3  $y = -\frac{1}{16}(x-2)^2 + 1$
- 4  $y = -\frac{1}{16}(x-2)^2 - 3$

- 48 Which equation represents a parabola with a focus of  $(0, 4)$  and a directrix of  $y = 2$ ?

- 1  $y = x^2 + 3$
- 2  $y = -x^2 + 1$
- 3  $y = \frac{x^2}{2} + 3$
- 4  $y = \frac{x^2}{4} + 3$

- 49 A parabola has its focus at  $(1, 2)$  and its directrix is  $y = -2$ . The equation of this parabola could be

- 1  $y = 8(x+1)^2$
- 2  $y = \frac{1}{8}(x+1)^2$
- 3  $y = 8(x-1)^2$
- 4  $y = \frac{1}{8}(x-1)^2$

50 Which equation represents a parabola with the focus at  $(0, -1)$  and the directrix of  $y = 1$ ?

- 1  $x^2 = -8y$
- 2  $x^2 = -4y$
- 3  $x^2 = 8y$
- 4  $x^2 = 4y$

51 If the focus of a parabola is  $(0, 6)$  and the directrix is  $y = 4$ , what is an equation for the parabola?

- 1  $y^2 = 4(x - 5)$
- 2  $x^2 = 4(y - 5)$
- 3  $y^2 = 8(x - 5)$
- 4  $x^2 = 8(y - 6)$

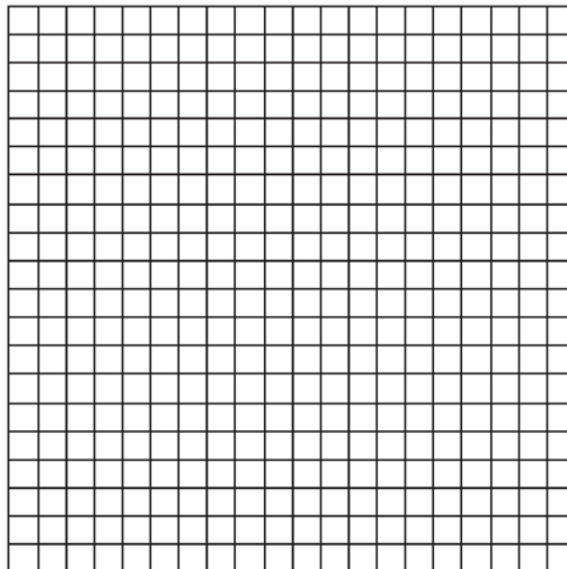
52 Which equation represents a parabola with a focus of  $(-2, 5)$  and a directrix of  $y = 9$ ?

- 1  $(y - 7)^2 = 8(x + 2)$
- 2  $(y - 7)^2 = -8(x + 2)$
- 3  $(x + 2)^2 = 8(y - 7)$
- 4  $(x + 2)^2 = -8(y - 7)$

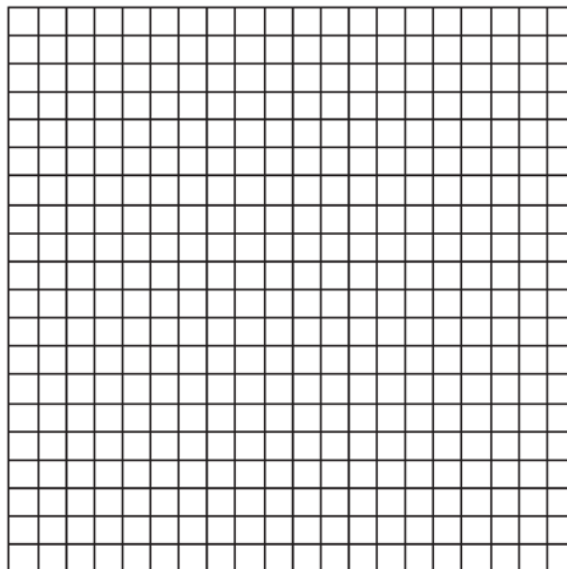
53 Which equation represents a parabola with a focus of  $(4, -3)$  and directrix of  $y = 1$ ?

- 1  $(x - 1)^2 = 4(y + 3)$
- 2  $(x - 1)^2 = -8(y - 3)$
- 3  $(x + 4)^2 = 4(y - 3)$
- 4  $(x - 4)^2 = -8(y + 1)$

54 The parabola  $y = -\frac{1}{20}(x - 3)^2 + 6$  has its focus at  $(3, 1)$ . Determine and state the equation of the directrix. (The use of the grid below is optional.)



55 Determine an equation for the parabola with focus  $(4, -1)$  and directrix  $y = -5$ . (Use of the grid below is optional.)



56 The directrix of the parabola  $12(y + 3) = (x - 4)^2$  has the equation  $y = -6$ . Find the coordinates of the focus of the parabola.

57 Consider the parabola given by  $y = \frac{1}{4}x^2 + x + 8$  with vertex  $(-2, 7)$  and focus  $(-2, 8)$ . Use this information to explain how to determine the equation of the directrix.

### A.SSE.A.2: FACTORING POLYNOMIALS

58 When factored completely,  $m^5 + m^3 - 6m$  is equivalent to

- 1  $(m + 3)(m - 2)$
- 2  $(m^2 + 3m)(m^2 - 2)$
- 3  $m(m^4 + m^2 - 6)$
- 4  $m(m^2 + 3)(m^2 - 2)$

59 Which expression is *not* equivalent to  $36x^6 - 25y^4$ ?

- 1  $6^2(x^3)^2 - 5^2(y^2)^2$
- 2  $(6x^3 - 5y^2)(6x^3 + 5y^2)$
- 3  $(6x^6 - 5y^4)(6x^6 + 5y^4)$
- 4  $(3 \bullet 2x^3 - 5y^2)(3 \bullet 2x^3 + 5y^2)$

60 If  $(a^3 + 27) = (a + 3)(a^2 + ma + 9)$ , then  $m$  equals

- 1  $-9$
- 2  $-3$
- 3  $3$
- 4  $6$

61 Which expression is equivalent to  $x^6y^4(x^4 - 16) - 9(x^4 - 16)$ ?

- 1  $x^{10}y^4 - 16x^6y^4 - 9x^4 - 144$
- 2  $(x^6y^4 - 9)(x + 2)^3(x - 2)$
- 3  $(x^3y^2 + 3)(x^3y^2 - 3)(x + 2)^2(x - 2)^2$
- 4  $(x^3y^2 + 3)(x^3y^2 - 3)(x^2 + 4)(x^2 - 4)$

62 The completely factored form of  $2d^4 + 6d^3 - 18d^2 - 54d$  is

- 1  $2d(d^2 - 9)(d + 3)$
- 2  $2d(d^2 + 9)(d + 3)$
- 3  $2d(d + 3)^2(d - 3)$
- 4  $2d(d - 3)^2(d + 3)$

63 The completely factored form of  $n^4 - 9n^2 + 4n^3 - 36n - 12n^2 + 108$  is

- 1  $(n^2 - 9)(n + 6)(n - 2)$
- 2  $(n + 3)(n - 3)(n + 6)(n - 2)$
- 3  $(n - 3)(n - 3)(n + 6)(n - 2)$
- 4  $(n + 3)(n - 3)(n - 6)(n + 2)$

64 What is the completely factored form of  $k^4 - 4k^2 + 8k^3 - 32k + 12k^2 - 48$ ?

- 1  $(k - 2)(k - 2)(k + 3)(k + 4)$
- 2  $(k - 2)(k - 2)(k + 6)(k + 2)$
- 3  $(k + 2)(k - 2)(k + 3)(k + 4)$
- 4  $(k + 2)(k - 2)(k + 6)(k + 2)$

65 Which factorization is *incorrect*?

- 1  $4k^2 - 49 = (2k + 7)(2k - 7)$
- 2  $a^3 - 8b^3 = (a - 2b)(a^2 + 2ab + 4b^2)$
- 3  $m^3 + 3m^2 - 4m + 12 = (m - 2)^2(m + 3)$
- 4  $t^3 + 5t^2 + 6t + t^2 + 5t + 6 = (t + 1)(t + 2)(t + 3)$

66 Which expression has been rewritten correctly to form a true statement?

- 1  $(x + 2)^2 + 2(x + 2) - 8 = (x + 6)x$
- 2  $x^4 + 4x^2 + 9x^2y^2 - 36y^2 = (x + 3y)^2(x - 2)^2$
- 3  $x^3 + 3x^2 - 4xy^2 - 12y^2 = (x - 2y)(x + 3)^2$
- 4  $(x^2 - 4)^2 - 5(x^2 - 4) - 6 = (x^2 - 7)(x^2 - 6)$

- 67 When the expression  $(x + 2)^2 + 4(x + 2) + 3$  is rewritten as the product of two binomials, the result is
- 1  $(x + 3)(x + 1)$
  - 2  $(x + 5)(x + 3)$
  - 3  $(x + 2)(x + 2)$
  - 4  $(x + 6)(x + 1)$
- 68 Which expression is equivalent to  $(x + 2)^2 - 5(x + 2) + 6$ ?
- 1  $x(x - 1)$
  - 2  $(x - 3)(x - 2)$
  - 3  $(x - 4)(x + 3)$
  - 4  $(x - 6)(x + 1)$
- 69 The expression  $(x + a)^2 + 5(x + a) + 4$  is equivalent to
- 1  $(a + 1)(a + 4)$
  - 2  $(x + 1)(x + 4)$
  - 3  $(x + a + 1)(x + a + 4)$
  - 4  $x^2 + a^2 + 5x + 5a + 4$
- 70 The expression  $(x^2 + 3)^2 - 2(x^2 + 3) - 24$  is equivalent to
- 1  $(x^2 + 9)(x^2 - 1)$
  - 2  $(x^2 - 3)(x^2 + 7)$
  - 3  $x^4 - 2x^2 - 21$
  - 4  $x^4 + 4x^2 - 9$
- 71 Over the set of integers, factor the expression  $x^4 - 4x^2 - 12$ .
- 72 Over the set of integers, completely factor  $x^4 - 5x^2 + 4$ .
- 73 Factor the expression  $x^3 - 2x^2 - 9x + 18$  completely.
- 74 Factor  $x^3 + 4x^2 - 9x - 36$  completely.
- 75 Factor the expression  $2x^3 - 3x^2 - 18x + 27$  completely.
- 76 Over the set of integers, factor the expression  $4x^3 - x^2 + 16x - 4$  completely.
- 77 Factor completely over the set of integers:  $-2x^4 + x^3 + 18x^2 - 9x$
- 78 Completely factor the following expression:  $x^2 + 3xy + 3x^3 + y$
- 79 Rewrite the expression  $(4x^2 + 5x)^2 - 5(4x^2 + 5x) - 6$  as a product of four linear factors.

A.APR.B.3: SOLVING POLYNOMIAL EQUATIONS

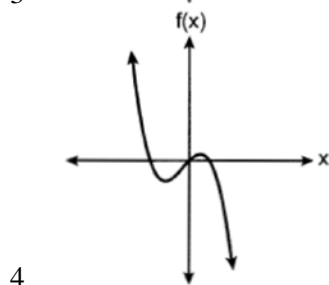
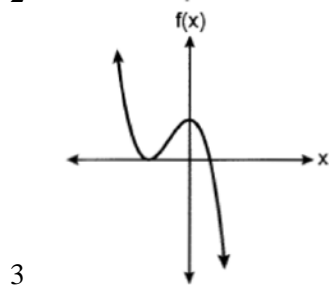
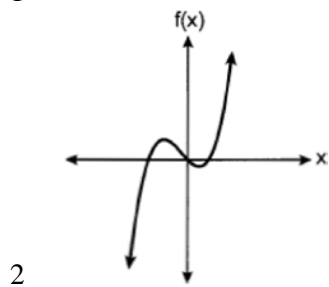
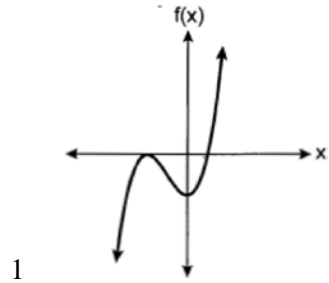
- 80 What are the zeros of  $P(m) = (m^2 - 4)(m^2 + 1)$ ?
- 1 2 and -2, only
  - 2 2, -2, and -4
  - 3 -4,  $i$ , and  $-i$
  - 4 2, -2,  $i$ , and  $-i$
- 81 Given  $c(m) = m^3 - 2m^2 + 4m - 8$ , the solution of  $c(m) = 0$  is
- 1  $\pm 2$
  - 2 2, only
  - 3  $2i, 2$
  - 4  $\pm 2i, 2$



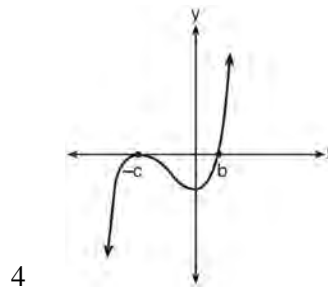
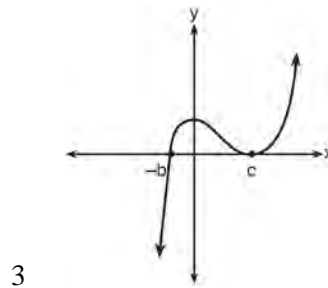
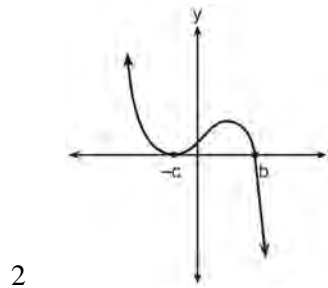
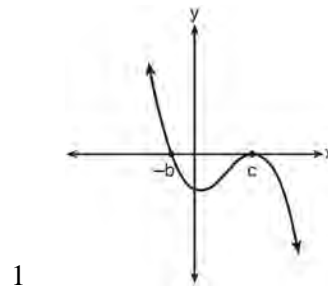
- 82 The zeros for  $f(x) = x^4 - 4x^3 - 9x^2 + 36x$  are
- 1  $\{0, \pm 3, 4\}$
  - 2  $\{0, 3, 4\}$
  - 3  $\{0, \pm 3, -4\}$
  - 4  $\{0, 3, -4\}$
- 83 What are the zeros of  
 $s(x) = x^4 - 9x^2 + 3x^3 - 27x - 10x^2 + 90$ ?
- 1  $\{-3, -2, 5\}$
  - 2  $\{-2, 3, 5\}$
  - 3  $\{-3, -2, 3, 5\}$
  - 4  $\{-5, -3, 2, 3\}$
- 84 When factoring to reveal the roots of the equation  
 $x^3 + 2x^2 - 9x - 18 = 0$ , which equations can be used?
- I.  $x^2(x + 2) - 9(x + 2) = 0$
  - II.  $x(x^2 - 9) + 2(x^2 - 9) = 0$
  - III.  $(x - 2)(x^2 - 9) = 0$
- 1 I and II, only
  - 2 I and III, only
  - 3 II and III, only
  - 4 I, II, and III
- 85 Given 3 is a root of  $f(x) = x^4 - x^3 - 21x^2 + 45x$ ,  
 what are the other unique roots of  $f(x)$ ?
- 1  $-5$ , only
  - 2  $-5$  and  $0$
  - 3  $-3$ ,  $1$  and  $5$
  - 4  $-5$ ,  $-3$  and  $0$
- 86 Which statement regarding polynomials and their zeros is true?
- 1  $f(x) = (x^2 - 1)(x + a)$  has zeros of  $1$  and  $-a$ , only.
  - 2  $f(x) = x^3 - ax^2 + 16x - 16a$  has zeros of  $4$  and  $a$ , only.
  - 3  $f(x) = (x^2 + 25)(x + a)$  has zeros of  $\pm 5$  and  $-a$ .
  - 4  $f(x) = x^3 - ax^2 - 9x + 9a$  has zeros of  $\pm 3$  and  $a$ .
- 87 Evan graphed a cubic function,  
 $f(x) = ax^3 + bx^2 + cx + d$ , and determined the roots  
 of  $f(x)$  to be  $\pm 1$  and  $2$ . What is the value of  $b$ , if  
 $a = 1$ ?
- 1  $1$
  - 2  $2$
  - 3  $-1$
  - 4  $-2$
- 88 Algebraically determine the zeros of the function  
 below.
- $$r(x) = 3x^3 + 12x^2 - 3x - 12$$
- 89 Given  $z(x) = 6x^3 + bx^2 - 52x + 15$ ,  $z(2) = 35$ , and  
 $z(-5) = 0$ , algebraically determine all the zeros of  
 $z(x)$ .

A.APR.B.3: GRAPHING POLYNOMIAL EQUATIONS

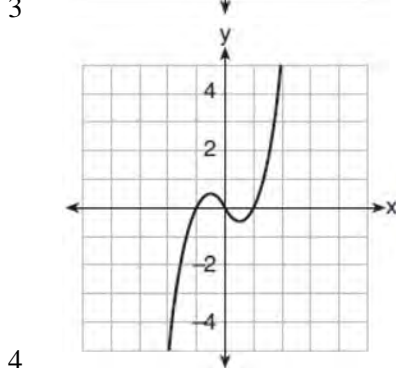
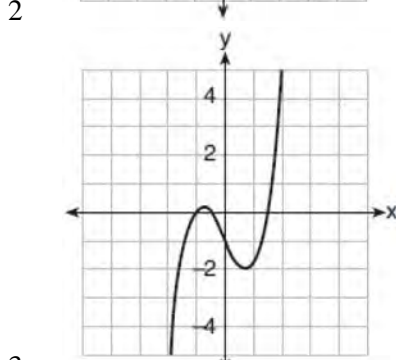
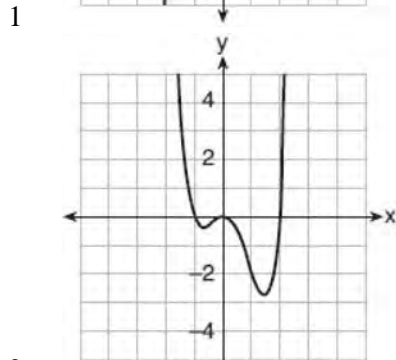
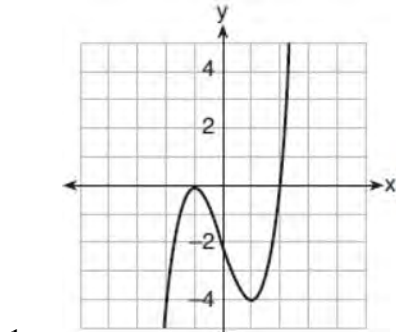
90 Which graph best represents the graph of  $f(x) = (x+a)^2(x-b)$ , where  $a$  and  $b$  are positive real numbers?



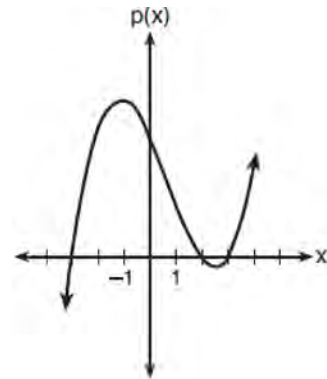
91 If  $a$ ,  $b$ , and  $c$  are all positive real numbers, which graph could represent the sketch of the graph of  $p(x) = -a(x+b)(x^2 - 2cx + c^2)$ ?



92 Which graph represents a polynomial function that contains  $x^2 + 2x + 1$  as a factor?



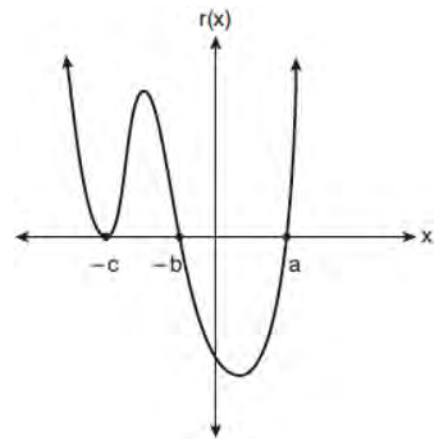
93 The graph of the function  $p(x)$  is sketched below.



Which equation could represent  $p(x)$ ?

- 1  $p(x) = (x^2 - 9)(x - 2)$
- 2  $p(x) = x^3 - 2x^2 + 9x + 18$
- 3  $p(x) = (x^2 + 9)(x - 2)$
- 4  $p(x) = x^3 + 2x^2 - 9x - 18$

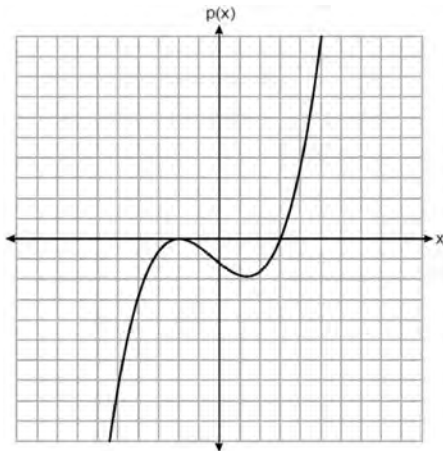
94 A sketch of  $r(x)$  is shown below.



An equation for  $r(x)$  could be

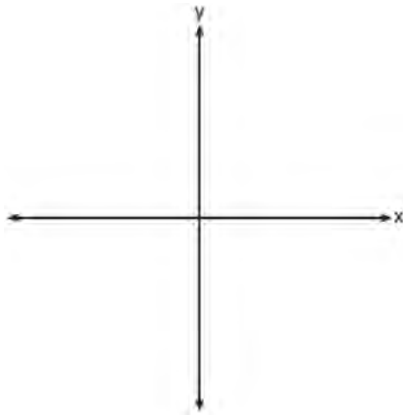
- 1  $r(x) = (x - a)(x + b)(x + c)$
- 2  $r(x) = (x + a)(x - b)(x - c)^2$
- 3  $r(x) = (x + a)(x - b)(x - c)$
- 4  $r(x) = (x - a)(x + b)(x + c)^2$

- 95 The graph of a cubic polynomial function  $p(x)$  is shown below.



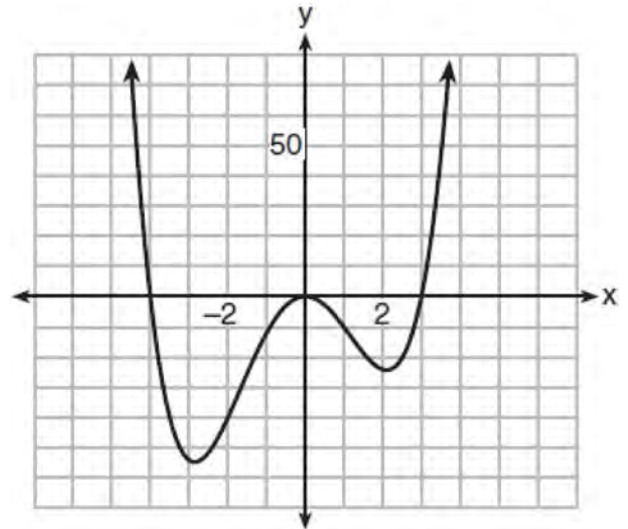
If  $p(x)$  is written as a product of linear factors, which factor would appear twice?

- 1  $x - 2$
  - 2  $x + 2$
  - 3  $x - 3$
  - 4  $x + 3$
- 96 On the axes below, sketch a possible function  $p(x) = (x - a)(x - b)(x + c)$ , where  $a$ ,  $b$ , and  $c$  are positive,  $a > b$ , and  $p(x)$  has a positive  $y$ -intercept of  $d$ . Label all intercepts.



F.BF.B.3: GRAPHING POLYNOMIAL EQUATIONS

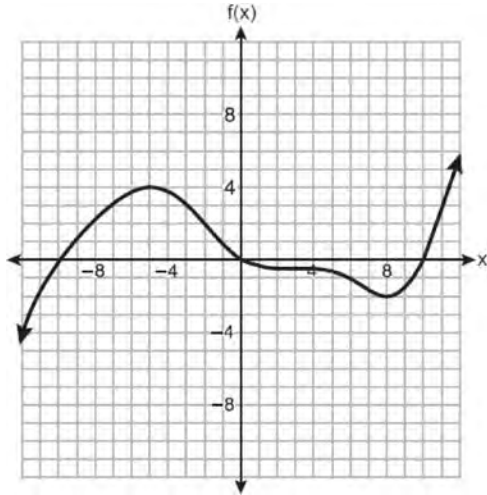
- 97 The graph of  $y = f(x)$  is shown below. The function has a leading coefficient of 1.



Write an equation for  $f(x)$ . The function  $g$  is formed by translating function  $f$  left 2 units. Write an equation for  $g(x)$ .

F.IF.B.4: GRAPHING POLYNOMIAL  
FUNCTIONS

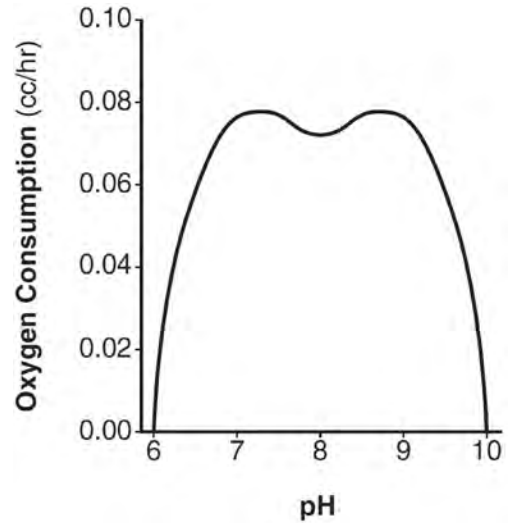
98 The graph of the function  $f(x)$  is shown below.



In which interval is  $f(x)$  always positive?

- 1  $(-2, 4)$
- 2  $(0, 10)$
- 3  $(-12, -5)$
- 4  $(-10, 0)$

99 There was a study done on oxygen consumption of snails as a function of pH, and the result was a degree 4 polynomial function whose graph is shown below.



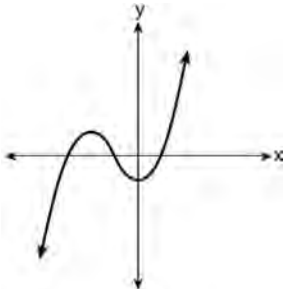
- Which statement about this function is *incorrect*?
- 1 The degree of the polynomial is even.
  - 2 There is a positive leading coefficient.
  - 3 At two pH values, there is a relative maximum value.
  - 4 There are two intervals where the function is decreasing.

100 Consider the end behavior description below.

- as  $x \rightarrow -\infty, f(x) \rightarrow \infty$
- as  $x \rightarrow \infty, f(x) \rightarrow -\infty$

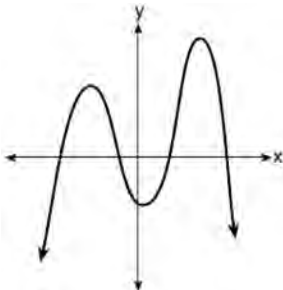
Which function satisfies the given conditions?

1  $f(x) = x^4 + 2x^2 + 1$



2

3  $f(x) = -x^3 + 2x - 6$



4

101 Given  $f(x) = x^4 - x^3 - 6x^2$ , for what values of  $x$  will  $f(x) > 0$ ?

- 1  $x < -2$ , only
- 2  $x < -2$  or  $x > 3$
- 3  $x < -2$  or  $0 \leq x \leq 3$
- 4  $x > 3$ , only

102 The function below models the average price of gas in a small town since January 1st.

$G(t) = -0.0049t^4 + 0.0923t^3 - 0.56t^2 + 1.166t + 3.23$ , where  $0 \leq t \leq 10$ .

If  $G(t)$  is the average price of gas in dollars and  $t$  represents the number of months since January 1st, the absolute maximum  $G(t)$  reaches over the given domain is about

- 1 \$1.60
- 2 \$3.92
- 3 \$4.01
- 4 \$7.73

103 The average cost of a gallon of milk in the United States between the years of 1995 and 2018 can be modeled by the equation

$P(t) = -0.0004t^3 + 0.0114t^2 - 0.0150t + 2.6602$ ,

where  $P(t)$  represents the cost, in dollars, and  $t$  is time in years since January 1995. During this time period, in what year did  $P(t)$  reach its maximum?

- 1 1995
- 2 2013
- 3 2014
- 4 2018

104 An estimate of the number of milligrams of a medication in the bloodstream  $t$  hours after 400 mg has been taken can be modeled by the function below.

$I(t) = 0.5t^4 + 3.45t^3 - 96.65t^2 + 347.7t$ , where  $0 \leq t \leq 6$

Over what time interval does the amount of medication in the bloodstream strictly increase?

- 1 0 to 2 hours
- 2 0 to 3 hours
- 3 2 to 6 hours
- 4 3 to 6 hours

105 A polynomial equation of degree three,  $p(x)$ , is used to model the volume of a rectangular box. The graph of  $p(x)$  has  $x$  intercepts at  $-2$ ,  $10$ , and  $14$ . Which statements regarding  $p(x)$  could be true?

- A. The equation of  $p(x) = (x - 2)(x + 10)(x + 14)$ .
- B. The equation of  $p(x) = -(x + 2)(x - 10)(x - 14)$ .
- C. The maximum volume occurs when  $x = 10$ .
- D. The maximum volume of the box is approximately 56.

- 1 A and C
- 2 A and D
- 3 B and C
- 4 B and D

106 Which description could represent the graph of

$$f(x) = 4x^2(x + a) - x - a, \text{ if } a \text{ is an integer?}$$

- 1 As  $x \rightarrow -\infty, f(x) \rightarrow \infty$ , as  $x \rightarrow \infty, f(x) \rightarrow \infty$ , and the graph has 3  $x$ -intercepts.
- 2 As  $x \rightarrow -\infty, f(x) \rightarrow -\infty$ , as  $x \rightarrow \infty, f(x) \rightarrow \infty$ , and the graph has 3  $x$ -intercepts.
- 3 As  $x \rightarrow -\infty, f(x) \rightarrow \infty$ , as  $x \rightarrow \infty, f(x) \rightarrow -\infty$ , and the graph has 4  $x$ -intercepts.
- 4 As  $x \rightarrow -\infty, f(x) \rightarrow -\infty$ , as  $x \rightarrow \infty, f(x) \rightarrow \infty$ , and the graph has 4  $x$ -intercepts.

107 Consider a cubic polynomial with the characteristics below.

- exactly one real root
- as  $x \rightarrow \infty, f(x) \rightarrow -\infty$

Given  $a > 0$  and  $b > 0$ , which equation represents a cubic polynomial with these characteristics?

- 1  $f(x) = (x - a)(x^2 + b)$
- 2  $f(x) = (a - x)(x^2 + b)$
- 3  $f(x) = (a - x^2)(x^2 + b)$
- 4  $f(x) = (x - a)(b - x^2)$

108 Factor completely over the set of integers:

$$16x^4 - 81. \text{ Sara graphed the polynomial}$$

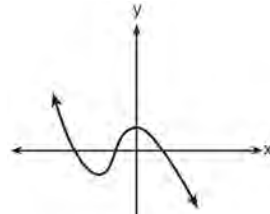
$$y = 16x^4 - 81 \text{ and stated "All the roots of}$$

$$y = 16x^4 - 81 \text{ are real." Is Sara correct? Explain your reasoning.}$$

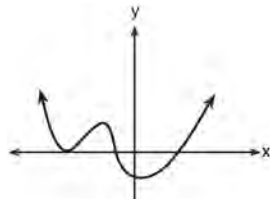
F.IF.C.7: GRAPHING POLYNOMIAL FUNCTIONS

109 Which graph has the following characteristics?

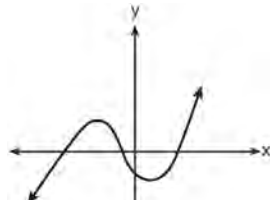
- three real zeros
- as  $x \rightarrow -\infty, f(x) \rightarrow -\infty$
- as  $x \rightarrow \infty, f(x) \rightarrow \infty$



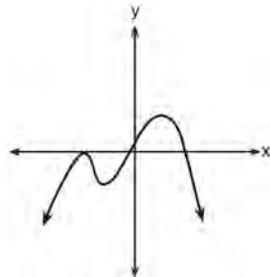
1



2

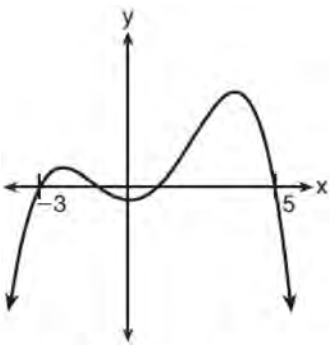
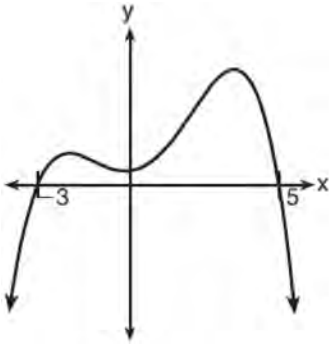
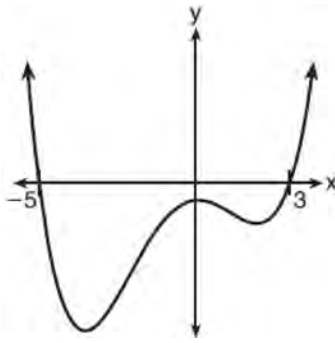
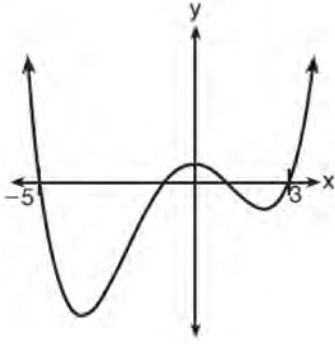


3

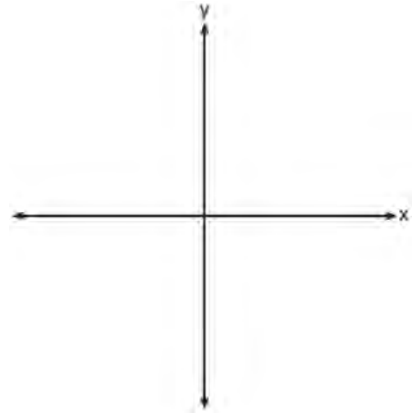


4

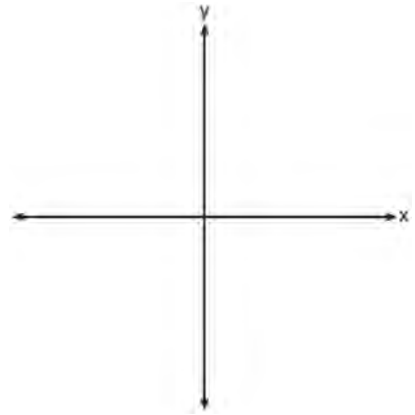
- 110 A 4th degree polynomial has zeros  $-5$ ,  $3$ ,  $i$ , and  $-i$ . Which graph could represent the function defined by this polynomial?



- 111 Patricia creates a cubic polynomial function,  $p(x)$ , with a leading coefficient of 1. The zeros of the function are 2, 3, and  $-6$ . Write an equation for  $p(x)$ . Sketch  $y = p(x)$  on the set of axes below.

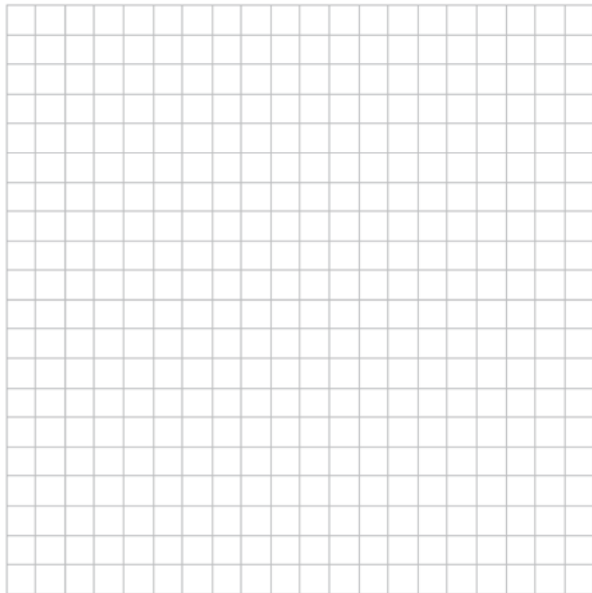


- 112 The zeros of a quartic polynomial function are 2,  $-2$ , 4, and  $-4$ . Use the zeros to construct a possible sketch of the function, on the set of axes below.

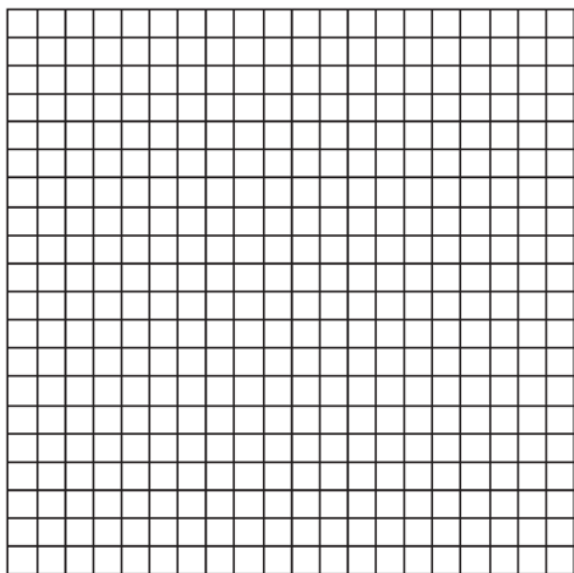




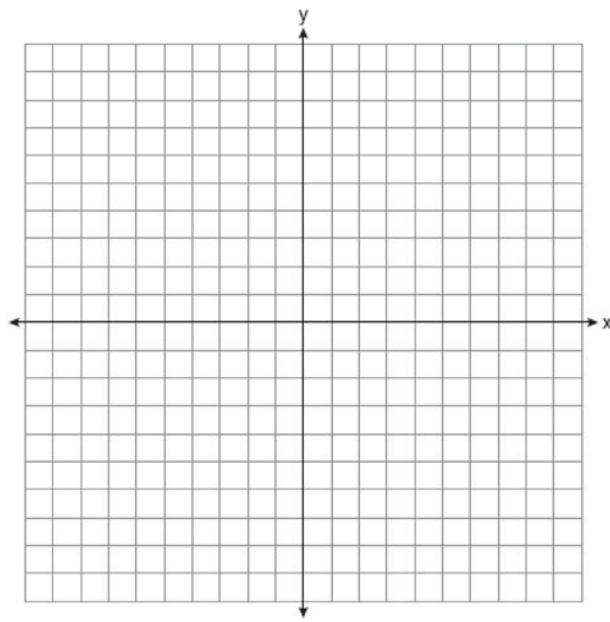
- 113 On the grid below, sketch a cubic polynomial whose zeros are 1, 3, and -2.



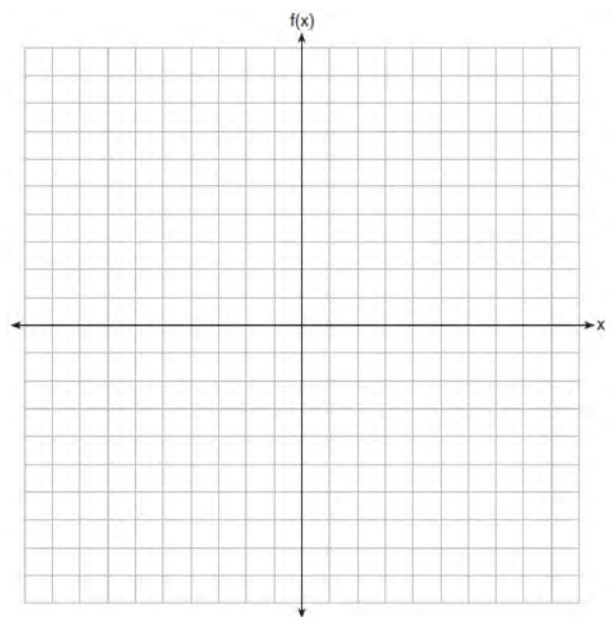
- 114 The zeros of a quartic polynomial function  $h$  are  $-1, \pm 2,$  and  $3$ . Sketch a graph of  $y = h(x)$  on the grid below.



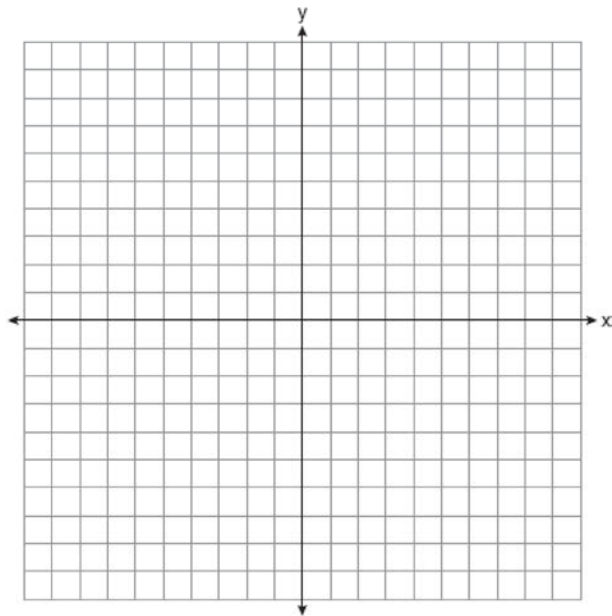
- 115 Graph  $y = x^3 - 4x^2 + 2x + 7$  on the set of axes below.



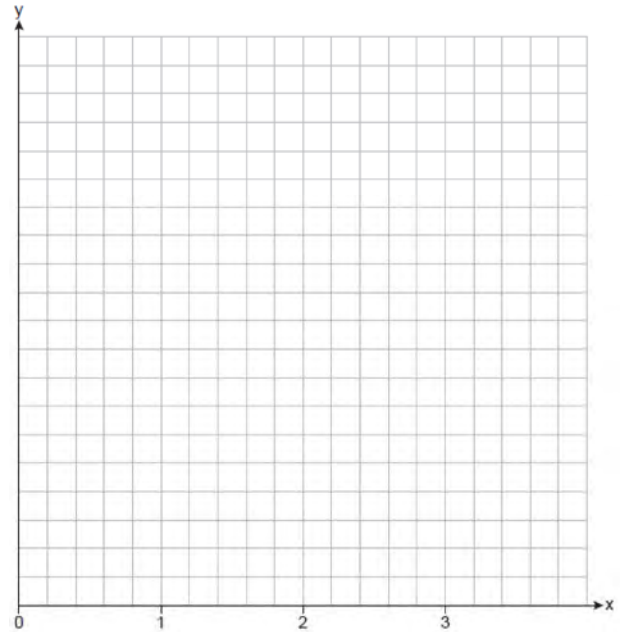
- 116 On the grid below, graph the function  $f(x) = x^3 - 6x^2 + 9x + 6$  on the domain  $-1 \leq x \leq 4$ .



- 117 Find algebraically the zeros for  
 $p(x) = x^3 + x^2 - 4x - 4$ . On the set of axes below,  
graph  $y = p(x)$ .



- 118 The function  $v(x) = x(3 - x)(x + 4)$  models the volume, in cubic inches, of a rectangular solid for  $0 \leq x \leq 3$ . Graph  $y = v(x)$  over the domain  $0 \leq x \leq 3$ .



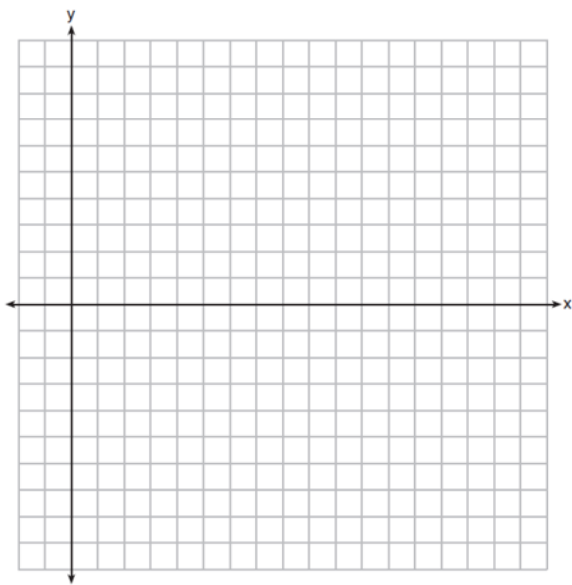
To the *nearest tenth of a cubic inch*, what is the maximum volume of the rectangular solid?

- 119 A major car company analyzes its revenue,  $R(x)$ , and costs  $C(x)$ , in millions of dollars over a fifteen-year period. The company represents its revenue and costs as a function of time, in years,  $x$ , using the given functions.

$$R(x) = 550x^3 - 12,000x^2 + 83,000x + 7000$$

$$C(x) = 880x^3 - 21,000x^2 + 150,000x - 160,000$$

The company's profits can be represented as the difference between its revenue and costs. Write the profit function,  $P(x)$ , as a polynomial in standard form. Graph  $y = P(x)$  on the set of axes below over the domain  $2 \leq x \leq 16$ .

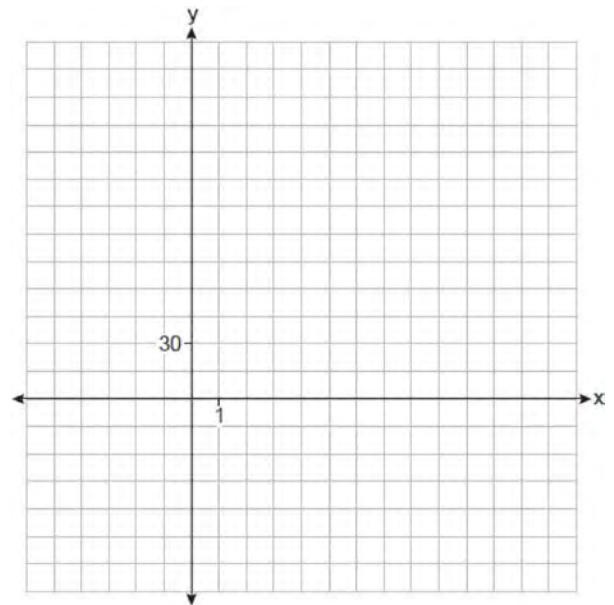


Over the given domain, state when the company was the least profitable and the most profitable, to the *nearest year*. Explain how you determined your answer.

- 120 A manufacturer of sweatshirts finds that profits and costs fluctuate depending on the number of products created. Creating more products doesn't always increase profits because it requires additional costs, such as building a larger facility or hiring more workers. The manufacturer determines the profit,  $p(x)$ , in thousands of dollars, as a function of the number of sweatshirts sold,  $x$ , in thousands. This function,  $p$ , is given below.

$$p(x) = -x^3 + 11x^2 - 7x - 69$$

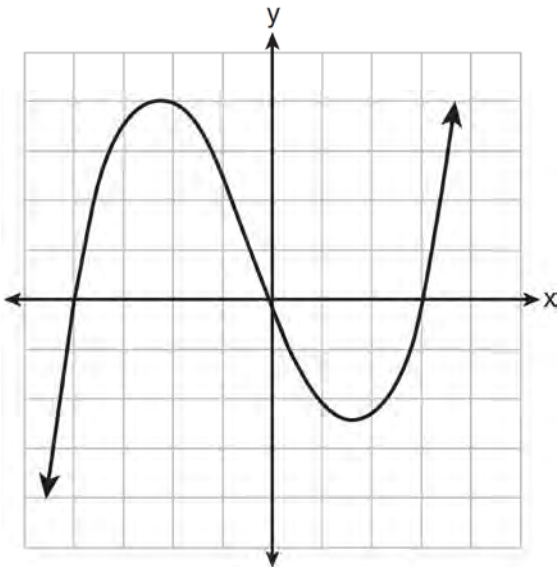
Graph  $y = p(x)$ , over the interval  $0 \leq x \leq 9$ , on the set of axes below.



Over the given interval, state the coordinates of the maximum of  $p$  and round all values to the *nearest integer*. Explain what this point represents in terms of the number of sweatshirts sold and profit. Determine how many sweatshirts, to the *nearest whole sweatshirt*, the manufacturer would need to produce in order to first make a positive profit. Justify your answer.

A.APR.B.2: REMAINDER AND FACTOR THEOREMS

121 The graph of  $p(x)$  is shown below.



What is the remainder when  $p(x)$  is divided by  $x + 4$ ?

- 1  $x - 4$
  - 2  $-4$
  - 3  $0$
  - 4  $4$
- 122 If  $p(x) = 2x^3 - 3x + 5$ , what is the remainder of  $p(x) \div (x - 5)$ ?
- 1  $-230$
  - 2  $0$
  - 3  $40$
  - 4  $240$
- 123 Which binomial is *not* a factor of the expression  $x^3 - 11x^2 + 16x + 84$ ?
- 1  $x + 2$
  - 2  $x + 4$
  - 3  $x - 6$
  - 4  $x - 7$

124 Which expression is a factor of

$$x^4 - x^3 - 11x^2 + 5x + 30?$$

- 1  $x + 2$
  - 2  $x - 2$
  - 3  $x + 5$
  - 4  $x - 5$
- 125 Which binomial is a factor of  $x^4 - 4x^2 - 4x + 8$ ?
- 1  $x - 2$
  - 2  $x + 2$
  - 3  $x - 4$
  - 4  $x + 4$
- 126 Given  $P(x) = x^3 - 3x^2 - 2x + 4$ , which statement is true?
- 1  $(x - 1)$  is a factor because  $P(-1) = 2$ .
  - 2  $(x + 1)$  is a factor because  $P(-1) = 2$ .
  - 3  $(x + 1)$  is a factor because  $P(1) = 0$ .
  - 4  $(x - 1)$  is a factor because  $P(1) = 0$ .
- 127 For the polynomial  $p(x)$ , if  $p(3) = 0$ , it can be concluded that
- 1  $x + 3$  is a factor of  $p(x)$
  - 2  $x - 3$  is a factor of  $p(x)$
  - 3 when  $p(x)$  is divided by 3, the remainder is zero
  - 4 when  $p(x)$  is divided by  $-3$ , the remainder is zero
- 128 When  $g(x)$  is divided by  $x + 4$ , the remainder is 0. Given  $g(x) = x^4 + 3x^3 - 6x^2 - 6x + 8$ , which conclusion about  $g(x)$  is true?
- 1  $g(4) = 0$
  - 2  $g(-4) = 0$
  - 3  $x - 4$  is a factor of  $g(x)$ .
  - 4 No conclusion can be made regarding  $g(x)$ .

- 129 Consider the function  $f(x) = 2x^3 + x^2 - 18x - 9$ . Which statement is true?
- $2x - 1$  is a factor of  $f(x)$ .
  - $x - 3$  is a factor of  $f(x)$ .
  - $f(3) \neq f\left(-\frac{1}{2}\right)$
  - $f\left(\frac{1}{2}\right) = 0$
- 130 If  $f(x) = 2x^4 - x^3 - 16x + 8$ , then  $f\left(\frac{1}{2}\right)$
- equals 0 and  $2x + 1$  is a factor of  $f(x)$
  - equals 0 and  $2x - 1$  is a factor of  $f(x)$
  - does not equal 0 and  $2x + 1$  is not a factor of  $f(x)$
  - does not equal 0 and  $2x - 1$  is a factor of  $f(x)$
- 131 Use an appropriate procedure to show that  $x - 4$  is a factor of the function  $f(x) = 2x^3 - 5x^2 - 11x - 4$ . Explain your answer.
- 132 Show why  $x - 3$  is a factor of  $m(x) = x^3 - x^2 - 5x - 3$ . Justify your answer.
- 133 Determine if  $x - 5$  is a factor of  $2x^3 - 4x^2 - 7x - 10$ . Explain your answer.
- 134 Given  $r(x) = x^3 - 4x^2 + 4x - 6$ , find the value of  $r(2)$ . What does your answer tell you about  $x - 2$  as a factor of  $r(x)$ ? Explain.
- 135 Determine if  $x + 4$  is a factor of  $2x^3 + 10x^2 + 4x - 16$ . Explain your answer.
- 136 Evaluate  $j(-1)$  given  $j(x) = 2x^4 - x^3 - 35x^2 + 16x + 48$ . Explain what your answer tells you about  $x + 1$  as a factor. Algebraically find the remaining zeros of  $j(x)$ .
- 137 Determine for which polynomial(s)  $(x + 2)$  is a factor. Explain your answer.
- $$P(x) = x^4 - 3x^3 - 16x - 12$$
- $$Q(x) = x^3 - 3x^2 - 16x - 12$$
- 138 If  $x - 1$  is a factor of  $x^3 - kx^2 + 2x$ , what is the value of  $k$ ?
- 0
  - 2
  - 3
  - 3
- 139 The polynomial function  $g(x) = x^3 + ax^2 - 5x + 6$  has a factor of  $(x - 3)$ . Determine the value of  $a$ .

A.APR.C.4: POLYNOMIAL IDENTITIES

- 140 Emmeline is working on one side of a polynomial identity proof used to form Pythagorean triples. Her work is shown below:
- $$(5x)^2 + (5x^2 - 5)^2$$
- Step 1:  $25x^2 + (5x^2 - 5)^2$
- Step 2:  $25x^2 + 25x^2 + 25$
- Step 3:  $50x^2 + 25$
- Step 4:  $75x^2$
- What statement is true regarding Emmeline's work?
- Emmeline's work is entirely correct.
  - There is a mistake in step 2, only.
  - There are mistakes in step 2 and step 4.
  - There is a mistake in step 4, only.

Algebra II Regents Exam Questions by State Standard: Topic

[www.jmap.org](http://www.jmap.org)

- 141 The expression  $(x + a)(x + b)$  can *not* be written as
- 1  $a(x + b) + x(x + b)$
  - 2  $x^2 + abx + ab$
  - 3  $x^2 + (a + b)x + ab$
  - 4  $x(x + a) + b(x + a)$
- 142 Given the following polynomials
- $$x = (a + b + c)^2$$
- $$y = a^2 + b^2 + c^2$$
- $$z = ab + bc + ac$$
- Which identity is true?
- 1  $x = y - z$
  - 2  $x = y + z$
  - 3  $x = y - 2z$
  - 4  $x = y + 2z$
- 143 Which statement(s) are true for all real numbers?
- I  $(x - y)^2 = x^2 + y^2$
  - II  $(x + y)^3 = x^3 + 3xy + y^3$
- 1 I, only
  - 2 II, only
  - 3 I and II
  - 4 neither I nor II
- 144 Mr. Farison gave his class the three mathematical rules shown below to either prove or disprove. Which rules can be proved for all real numbers?
- I  $(m + p)^2 = m^2 + 2mp + p^2$
  - II  $(x + y)^3 = x^3 + 3xy + y^3$
  - III  $(a^2 + b^2)^2 = (a^2 - b^2)^2 + (2ab)^2$
- 1 I, only
  - 2 I and II
  - 3 II and III
  - 4 I and III
- 145 How many equations below are identities?
- $x^2 + y^2 = (x^2 - y^2) + (2xy)^2$
  - $x^3 + y^3 = (x - y) + (x^2 - xy + y^2)$
  - $x^4 + y^4 = (x - y)(x - y)(x^2 + y^2)$
- 1 1
  - 2 2
  - 3 3
  - 4 0
- 146 Which equation represents a polynomial identity?
- 1  $x^3 + y^3 = (x + y)^3$
  - 2  $x^3 + y^3 = (x + y)(x^2 - xy + y^2)$
  - 3  $x^3 + y^3 = (x + y)(x^2 - xy - y^2)$
  - 4  $x^3 + y^3 = (x - y)(x^2 + xy + y^2)$
- 147 Which equation does *not* represent an identity?
- 1  $x^2 - y^2 = (x + y)(x - y)$
  - 2  $(x - y)^2 = (x - y)(x - y)$
  - 3  $(x + y)^2 = x^2 + 2xy + y^2$
  - 4  $(x + y)^3 = x^3 + 3xy + y^3$

148 Given the polynomial identity  $x^6 + y^6 = (x^2 + y^2)(x^4 - x^2y^2 + y^4)$ , which equation must also be true for all values of  $x$  and  $y$ ?

1  $x^6 + y^6 = x^2(x^4 - x^2y^2 + y^4) + y^2(x^4 - x^2y^2 + y^4)$

2  $x^6 + y^6 = (x^2 + y^2)(x^2 - y^2)(x^2 - y^2)$

3  $(x^3 + y^3)^2 = (x^2 + y^2)(x^4 - x^2y^2 + y^4)$

4  $(x^6 + y^6) - (x^2 + y^2) = x^4 - x^2y^2 + y^4$

149 Erin and Christa were working on cubing binomials for math homework. Erin believed they could save time with a shortcut. She wrote down the rule below for Christa to follow.

$$(a + b)^3 = a^3 + b^3$$

Does Erin's shortcut always work? Justify your result algebraically.

150 Verify the following Pythagorean identity for all values of  $x$  and  $y$ :

$$(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$$

151 Algebraically prove that the difference of the squares of any two consecutive integers is an odd integer.

152 Algebraically determine the values of  $h$  and  $k$  to correctly complete the identity stated below.

$$2x^3 - 10x^2 + 11x - 7 = (x - 4)(2x^2 + hx + 3) + k$$

## RADICALS

### N.RN.A.2: OPERATIONS WITH RADICALS

153 For  $x > 0$ , which expression is equivalent to

$$\frac{\sqrt[3]{x^2} \cdot \sqrt{x^5}}{\sqrt[6]{x}} ?$$

1  $x$

2  $x^{\frac{3}{2}}$

3  $x^3$

4  $x^{10}$

154 Given  $y > 0$ , the expression  $\sqrt{3x^2y} \cdot \sqrt[3]{27x^3y^2}$  is equivalent to

1  $81x^5y^3$

2  $3^{1.5}x^2y$

3  $3^{\frac{5}{2}}x^2y^{\frac{5}{3}}$

4  $3^{\frac{3}{2}}x^2y^{\frac{7}{6}}$

155 The expression  $\left(a^3\sqrt{2b^2}\right)\left(\sqrt[3]{4a^2b}\right)$  is equivalent to

1  $2ab^3\sqrt{a^2}$

2  $2ab$

3  $2ab^3\sqrt[3]{2a^2}$

4  $2a^2b^3\sqrt[3]{2b}$

156 For positive values of  $x$ , which expression is

equivalent to  $\sqrt{16x^2} \cdot x^{\frac{2}{3}} + \sqrt[3]{8x^5}$

- 1  $6^5\sqrt{x^3}$
- 2  $6^3\sqrt{x^5}$
- 3  $4^3\sqrt{x^2} + 2^3\sqrt{x^5}$
- 4  $4\sqrt{x^3} + 2^5\sqrt{x^3}$

157 Write  $\sqrt[3]{x} \cdot \sqrt{x}$  as a single term with a rational exponent.

162 The solution set for the equation  $b = \sqrt{2b^2 - 64}$  is

- 1  $\{-8\}$
- 2  $\{8\}$
- 3  $\{\pm 8\}$
- 4  $\{\}$

163 The value(s) of  $x$  that satisfy

$$\sqrt{x^2 - 4x - 5} = 2x - 10$$

- 1  $\{5\}$
- 2  $\{7\}$
- 3  $\{5, 7\}$
- 4  $\{3, 5, 7\}$

A.REI.A.2: SOLVING RADICALS

158 The solution set for the equation  $\sqrt{56-x} = x$  is

- 1  $\{-8, 7\}$
- 2  $\{-7, 8\}$
- 3  $\{7\}$
- 4  $\{\}$

164 The solution set for the equation

$$\sqrt{x+14} - \sqrt{2x+5} = 1$$

- 1  $\{-6\}$
- 2  $\{2\}$
- 3  $\{18\}$
- 4  $\{2, 22\}$

159 What is the solution set of  $x = \sqrt{3x+40}$ ?

- 1  $\{-5, 8\}$
- 2  $\{8\}$
- 3  $\{-4, 10\}$
- 4  $\{\}$

165 Solve the given equation algebraically for all values of  $x$ .  $3\sqrt{x} - 2x = -5$

166 Determine the solution of  $\sqrt{3x+7} = x - 1$  algebraically.

160 The solution set for the equation  $\sqrt{3(x+6)} = x$  is

- 1  $\{6, -3\}$
- 2  $\{-6, 3\}$
- 3  $\{6\}$
- 4  $\{-3\}$

167 Solve algebraically for all values of  $x$ :

$$\sqrt{4x+1} = 11-x$$

168 Solve algebraically for all values of  $x$ :

$$\sqrt{x-4} + x = 6$$

161 What is the solution set for  $x$  in the equation below?

$$\sqrt{x+1} - 1 = x$$

- 1  $\{1\}$
- 2  $\{0\}$
- 3  $\{-1, 0\}$
- 4  $\{0, 1\}$

169 Solve algebraically for all values of  $x$ :

$$\sqrt{x-5} + x = 7$$



- 170 Algebraically solve for  $x$ :  $2x = 6 + 2\sqrt{x-1}$
- 171 Solve the equation  $\sqrt{2x-7} + x = 5$  algebraically, and justify the solution set.
- 172 Solve the equation  $\sqrt{49-10x} + 5 = 2x$  algebraically.
- 173 Solve algebraically for all values of  $x$ :  
 $\sqrt{6-2x} + x = 2(x+15) - 9$
- 174 The speed of a tidal wave,  $s$ , in hundreds of miles per hour, can be modeled by the equation  $s = \sqrt{t} - 2t + 6$ , where  $t$  represents the time from its origin in hours. Algebraically determine the time when  $s = 0$ . How much faster was the tidal wave traveling after 1 hour than 3 hours, to the *nearest mile per hour*? Justify your answer.
- 175 A Foucault pendulum can be used to demonstrate that the Earth rotates. The time,  $t$ , in seconds, that it takes for one swing or period of the pendulum can be modeled by the equation  $t = 2\pi\sqrt{\frac{L}{g}}$  where  $L$  is the length of the pendulum in meters and  $g$  is a constant of  $9.81 \text{ m/s}^2$ . The first Foucault pendulum was constructed in 1851 and has a pendulum length of 67 m. Determine, to the *nearest tenth of a second*, the time it takes this pendulum to complete one swing. Another Foucault pendulum at the United Nations building takes 9.6 seconds to complete one swing. Determine, to the *nearest tenth of a meter*, the length of this pendulum.

- 176 The Beaufort Wind Scale was devised by British Rear Admiral Sir Francis Beaufort, in 1805 based upon observations of the effects of the wind. Beaufort numbers,  $B$ , are determined by the equation  $B = 1.69\sqrt{s + 4.45} - 3.49$ , where  $s$  is the speed of the wind in mph, and  $B$  is rounded to the nearest integer from 0 to 12.

Beaufort Wind Scale	
Beaufort Number	Force of Wind
0	Calm
1	Light air
2	Light breeze
3	Gentle breeze
4	Moderate breeze
5	Fresh breeze
6	Steady breeze
7	Moderate gale
8	Fresh gale
9	Strong gale
10	Whole gale
11	Storm
12	Hurricane

Using the table above, classify the force of wind at a speed of 30 mph. Justify your answer. In 1946, the scale was extended to accommodate strong hurricanes. A strong hurricane received a  $B$  value of exactly 15. Algebraically determine the value of  $s$ , to the *nearest mph*. Any  $B$  values that round to 10 receive a Beaufort number of 10. Using technology, find an approximate range of wind speeds, to the *nearest mph*, associated with a Beaufort number of 10.

N.RN.A.1: RADICALS AND RATIONAL EXPONENTS

- 177 Explain why  $81^{\frac{3}{4}}$  equals 27.

- 178 Explain how  $\left(3^{\frac{1}{5}}\right)^2$  can be written as the equivalent radical expression  $\sqrt[5]{9}$ .

- 179 Explain what a rational exponent, such as  $\frac{5}{2}$  means.

Use this explanation to evaluate  $9^{\frac{5}{2}}$ .

- 180 Explain how  $(-8)^{\frac{4}{3}}$  can be evaluated using properties of rational exponents to result in an integer answer.

N.RN.A.2: RADICALS AND RATIONAL EXPONENTS

181 For all positive values of  $x$ , which expression is

equivalent to  $x^{\frac{3}{4}}$ ?

- 1  $\sqrt[4]{x^3}$
- 2  $\sqrt[3]{x^4}$
- 3  $(x^3)^4$
- 4  $3(x^4)$

182 Which expression is an equivalent form of  $a^5\sqrt{a^4}$ ?

- 1  $a$
- 2  $a^{\frac{9}{5}}$
- 3  $a^{\frac{9}{4}}$
- 4  $a^{\frac{1}{5}}$

183 The expression  $\sqrt[4]{81x^8y^6}$  is equivalent to

- 1  $3x^2y^{\frac{3}{2}}$
- 2  $3x^4y^2$
- 3  $9x^2y^{\frac{3}{2}}$
- 4  $9x^4y^2$

184 Which equation is equivalent to  $P = 210x^{\frac{4}{3}}y^{\frac{7}{3}}$

- 1  $P = \sqrt[3]{210x^4y^7}$
- 2  $P = 70xy^2\sqrt[3]{xy}$
- 3  $P = 210xy^2\sqrt[3]{xy}$
- 4  $P = 210xy^2\sqrt[3]{x^3y^5}$

185 When  $b > 0$  and  $d$  is a positive integer, the

expression  $(3b)^{\frac{2}{d}}$  is equivalent to

- 1  $\frac{1}{(\sqrt[d]{3b})^2}$
- 2  $(\sqrt{3b})^d$
- 3  $\frac{1}{\sqrt{3b^d}}$
- 4  $(\sqrt[d]{3b})^2$

186 Given  $x > 0$ , the expression  $\frac{x^{\frac{1}{5}}}{x^{\frac{1}{2}}}$  can be rewritten as

- 1  $\sqrt[3]{x}$
- 2  $-\sqrt[10]{x^3}$
- 3  $\frac{1}{\sqrt[10]{x^3}}$
- 4  $\sqrt[3]{x^{10}}$

187 The expression  $\left(\frac{m^2}{m^{\frac{1}{3}}}\right)^{-\frac{1}{2}}$  is equivalent to

- 1  $-\sqrt[6]{m^5}$
- 2  $\frac{1}{\sqrt[6]{m^5}}$
- 3  $-m^5\sqrt{m}$
- 4  $\frac{1}{m^5\sqrt{m}}$

188 What does  $\left(\frac{-54x^9}{y^4}\right)^{\frac{2}{3}}$  equal?

1  $\frac{9ix^6\sqrt[3]{4}}{y^2\sqrt[3]{y^2}}$

2  $\frac{9ix^6\sqrt[3]{4}}{y^2\sqrt[3]{y^2}}$

3  $\frac{9x^6\sqrt[3]{4}}{y^2\sqrt[3]{y}}$

4  $\frac{9x^6\sqrt[3]{4}}{y^2\sqrt[3]{y^2}}$

189 If  $n = \sqrt{a^5}$  and  $m = a$ , where  $a > 0$ , an expression for  $\frac{n}{m}$  could be

1  $a^{\frac{5}{2}}$

2  $a^4$

3  $\sqrt[3]{a^2}$

4  $\sqrt{a^3}$

190 For  $x \geq 0$ , which equation is *false*?

1  $(x^{\frac{3}{2}})^2 = \sqrt[4]{x^3}$

2  $(x^3)^{\frac{1}{4}} = \sqrt[4]{x^3}$

3  $(x^{\frac{3}{2}})^{\frac{1}{2}} = \sqrt[4]{x^3}$

4  $(x^{\frac{2}{3}})^2 = \sqrt[3]{x^4}$

191 For  $x \neq 0$ , which expressions are equivalent to one divided by the sixth root of  $x$ ?

I.  $\frac{\sqrt[6]{x}}{\sqrt[3]{x}}$  II.  $\frac{x^{\frac{1}{6}}}{x^{\frac{1}{3}}}$  III.  $x^{\frac{-1}{6}}$

- 1 I and II, only
- 2 I and III, only
- 3 II and III, only
- 4 I, II, and III

192 Given  $x$  and  $y$  are positive, which expressions are equivalent to  $\frac{x^3}{y}$ ?

I.  $\left(\frac{y}{x^3}\right)^{-1}$  II.  $\sqrt[3]{x^9}(y^{-1})$  III.  $\frac{x^6\sqrt[4]{y^8}}{x^3y^3}$

- 1 I and II, only
- 2 I and III, only
- 3 II and III, only
- 4 I, II, and III

193 For  $x \neq 0$  and  $y \neq 0$ ,  $\sqrt[3]{81x^{15}y^9} = 3^a x^5 y^3$ . Determine the value of  $a$ .

194 Kenzie believes that for  $x \geq 0$ , the expression  $\left(\sqrt[7]{x^2}\right)\left(\sqrt[5]{x^3}\right)$  is equivalent to  $\sqrt[35]{x^6}$ . Is she correct? Justify your response algebraically.

195 For  $n$  and  $p > 0$ , is the expression

$\left(p^2 n^{\frac{1}{2}}\right)^8 \sqrt{p^5 n^4}$  equivalent to  $p^{18} n^6 \sqrt{p}$ ?

Justify your answer.

196 Write  $\frac{x\sqrt{x^3}}{\sqrt[3]{x^5}}$  as a single term in simplest form, with a rational exponent.

197 When  $\left(\frac{1}{\sqrt[3]{y^2}}\right)y^4$  is written in the form  $y^n$ , what is the value of  $n$ ? Justify your answer.

198 Use the properties of rational exponents to determine the value of  $y$  for the equation:

$$\frac{\sqrt[3]{x^8}}{(x^4)^{\frac{1}{3}}} = x^y, x > 1$$

199 Express the fraction  $\frac{2x^{\frac{3}{2}}}{(16x^4)^{\frac{1}{4}}}$  in simplest radical form.

200 Justify why  $\frac{\sqrt[3]{x^2y^5}}{\sqrt[4]{x^3y^4}}$  is equivalent to  $x^{-\frac{1}{12}}y^{\frac{2}{3}}$  using properties of rational exponents, where  $x \neq 0$  and  $y \neq 0$ .

201 Given the equal terms  $\sqrt[3]{x^5}$  and  $y^{\frac{5}{6}}$ , determine and state  $y$ , in terms of  $x$ .

202 Given  $a > 0$ , solve the equation  $a^{x+1} = \sqrt[3]{a^2}$  for  $x$  algebraically.

### N.CN.A.2: OPERATIONS WITH COMPLEX NUMBERS

203 The expression  $3i(ai - 6i^2)$  is equivalent to

- 1  $3a + 18i$
- 2  $3a - 18i$
- 3  $-3a + 18i$
- 4  $-3a - 18i$

204 The expression  $6xi^3(-4xi + 5)$  is equivalent to

- 1  $2x - 5i$
- 2  $-24x^2 - 30xi$
- 3  $-24x^2 + 30x - i$
- 4  $26x - 24x^2i - 5i$

205 Given that  $i$  is the imaginary unit, the expression  $(x - 2i)^2$  is equivalent to

- 1  $x^2 + 4$
- 2  $x^2 - 4$
- 3  $x^2 - 2xi - 4$
- 4  $x^2 - 4xi - 4$

206 Which expression is equivalent to  $(3k - 2i)^2$ , where  $i$  is the imaginary unit?

- 1  $9k^2 - 4$
- 2  $9k^2 + 4$
- 3  $9k^2 - 12ki - 4$
- 4  $9k^2 - 12ki + 4$

207 Given  $i$  is the imaginary unit,  $(2 - yi)^2$  in simplest form is

- 1  $y^2 - 4yi + 4$
- 2  $-y^2 - 4yi + 4$
- 3  $-y^2 + 4$
- 4  $y^2 + 4$

- 208 The expression  $6 - (3x - 2i)^2$  is equivalent to
- 1  $-9x^2 + 12xi + 10$
  - 2  $9x^2 - 12xi + 2$
  - 3  $-9x^2 + 10$
  - 4  $-9x^2 + 12xi - 4i + 6$
- 209 Where  $i$  is the imaginary unit, the expression  $(x + 3i)^2 - (2x - 3i)^2$  is equivalent to
- 1  $-3x^2$
  - 2  $-3x^2 - 18$
  - 3  $-3x^2 + 18xi$
  - 4  $-3x^2 - 6xi - 18$
- 210 If  $A = -3 + 5i$ ,  $B = 4 - 2i$ , and  $C = 1 + 6i$ , where  $i$  is the imaginary unit, then  $A - BC$  equals
- 1  $5 - 17i$
  - 2  $5 + 27i$
  - 3  $-19 - 17i$
  - 4  $-19 + 27i$
- 211 Which expression is equivalent to  $(2x - i)^2 - (2x - i)(2x + 3i)$  where  $i$  is the imaginary unit and  $x$  is a real number?
- 1  $-4 - 8xi$
  - 2  $-4 - 4xi$
  - 3  $2$
  - 4  $8x - 4i$
- 212 Expressed in simplest  $a + bi$  form,  $(7 - 3i) + (x - 2i)^2 - (4i + 2x^2)$  is
- 1  $(3 - x^2) - (4x + 7)i$
  - 2  $(3 + 3x^2) - (4x + 7)i$
  - 3  $(3 - x^2) - 7i$
  - 4  $(3 + 3x^2) - 7i$
- 213 Which expression is equivalent to  $(x + yi)(x^2 - xyi - y^2)$ , where  $i$  is the imaginary unit?
- 1  $x^3 + y^3i$
  - 2  $x^3 - xy^2 - (xy^2 + y^3)i$
  - 3  $x^3 - 2xy^2 - y^3i$
  - 4  $x^3 - y^3i$
- 214 If  $(6 - ki)^2 = 27 - 36i$ , the value of  $k$  is
- 1  $-36$
  - 2  $-3$
  - 3  $3$
  - 4  $6$
- 215 Elizabeth tried to find the product of  $(2 + 4i)$  and  $(3 - i)$ , and her work is shown below.
- $$\begin{aligned} &(2 + 4i)(3 - i) \\ &= 6 - 2i + 12i - 4i^2 \\ &= 6 + 10i - 4i^2 \\ &= 6 + 10i - 4(1) \\ &= 6 + 10i - 4 \\ &= 2 + 10i \end{aligned}$$
- Identify the error in the process shown and determine the correct product of  $(2 + 4i)$  and  $(3 - i)$ .
- 216 Given  $i$  is the imaginary unit, simplify  $(5xi^3 - 4i)^2$  as a polynomial in standard form.
- 217 Express  $(2xi^3 - 3y)^2$  in simplest form.
- 218 Simplify  $xi(i - 7i)^2$ , where  $i$  is the imaginary unit.
- 219 Write  $(5 + 2yi)(4 - 3i) - (5 - 2yi)(4 - 3i)$  in  $a + bi$  form, where  $y$  is a real number.

220 Express  $(1 - i)^3$  in  $a + bi$  form.

221 Write  $-\frac{1}{2}i^3(\sqrt{-9} - 4) - 3i^2$  in simplest  $a + bi$  form.

## POWERS

### A.SSE.B.3: MODELING EXPONENTIAL FUNCTIONS

222 A student studying public policy created a model for the population of Detroit, where the population decreased 25% over a decade. He used the model  $P = 714(0.75)^d$ , where  $P$  is the population, in thousands,  $d$  decades after 2010. Another student, Suzanne, wants to use a model that would predict the population after  $y$  years. Suzanne's model is best represented by

- 1  $P = 714(0.6500)^y$
- 2  $P = 714(0.8500)^y$
- 3  $P = 714(0.9716)^y$
- 4  $P = 714(0.9750)^y$

223 A study of the annual population of the red-winged blackbird in Ft. Mill, South Carolina, shows the population,  $B(t)$ , can be represented by the function  $B(t) = 750(1.16)^t$ , where the  $t$  represents the number of years since the study began. In terms of the monthly rate of growth, the population of red-winged blackbirds can be best approximated by the function

- 1  $B(t) = 750(1.012)^t$
- 2  $B(t) = 750(1.012)^{12t}$
- 3  $B(t) = 750(1.16)^{12t}$
- 4  $B(t) = 750(1.16)^{\frac{t}{12}}$

224 Stephanie found that the number of white-winged cross bills in an area can be represented by the formula  $C = 550(1.08)^t$ , where  $t$  represents the number of years since 2010. Which equation correctly represents the number of white-winged cross bills in terms of the monthly rate of population growth?

- 1  $C = 550(1.00643)^t$
- 2  $C = 550(1.00643)^{12t}$
- 3  $C = 550(1.00643)^{\frac{t}{12}}$
- 4  $C = 550(1.00643)^{t+12}$

225 Julia deposits \$2000 into a savings account that earns 4% interest per year. The exponential function that models this savings account is  $y = 2000(1.04)^t$ , where  $t$  is the time in years. Which equation correctly represents the amount of money in her savings account in terms of the monthly growth rate?

- 1  $y = 166.67(1.04)^{0.12t}$
- 2  $y = 2000(1.01)^t$
- 3  $y = 2000(1.0032737)^{12t}$
- 4  $y = 166.67(1.0032737)^t$

226 A study of the red tailed hawk population in a given area shows the population,  $H(t)$ , can be represented by the function  $H(t) = 50(1.19)^t$  where  $t$  represents the number of years since the study began. In terms of the monthly rate of growth, the population can be best approximated by the function

- 1  $H(t) = 50(1.015)^{12t}$
- 2  $H(t) = 50(1.15)^{\frac{t}{12}}$
- 3  $H(t) = 50(1.19)^{12t}$
- 4  $H(t) = 50(1.19)^{\frac{t}{12}}$

- 227 A study of black bears in the Adirondacks reveals that their population can be represented by the function  $P(t) = 3500(1.025)^t$ , where  $t$  is the number of years since the study began. Which function is correctly rewritten to reveal the monthly growth rate of the black bear population?
- $P(t) = 3500(1.00206)^{12t}$
  - $P(t) = 3500(1.00206)^{\frac{t}{12}}$
  - $P(t) = 3500(1.34489)^{12t}$
  - $P(t) = 3500(1.34489)^{\frac{t}{12}}$
- 228 The growth of a \$500 investment can be modeled by the function  $P(t) = 500(1.03)^t$ , where  $t$  represents time in years. In terms of the monthly rate of growth, the value of the investment can be best approximated by
- $P(t) = 500(1.00247)^{12t}$
  - $P(t) = 500(1.00247)^t$
  - $P(t) = 500(1.03)^{12t}$
  - $P(t) = 500(1.03)^{\frac{t}{12}}$
- 229 Mia has a student loan that is in deferment, meaning that she does not need to make payments right now. The balance of her loan account during her deferment can be represented by the function  $f(x) = 35,000(1.0325)^x$ , where  $x$  is the number of years since the deferment began. If the bank decides to calculate her balance showing a monthly growth rate, an approximately equivalent function would be
- $f(x) = 35,000(1.0027)^{12x}$
  - $f(x) = 35,000(1.0027)^{\frac{x}{12}}$
  - $f(x) = 35,000(1.0325)^{12x}$
  - $f(x) = 35,000(1.0325)^{\frac{x}{12}}$
- 230 According to the USGS, an agency within the Department of Interior of the United States, the frog population in the U.S. is decreasing at the rate of 3.79% per year. A student created a model,  $P = 12,150(0.962)^t$ , to estimate the population in a pond after  $t$  years. The student then created a model that would predict the population after  $d$  decades. This model is best represented by
- $P = 12,150(0.461)^d$
  - $P = 12,150(0.679)^d$
  - $P = 12,150(0.996)^d$
  - $P = 12,150(0.998)^d$
- 231 The amount of a substance,  $A(t)$ , that remains after  $t$  days can be given by the equation  $A(t) = A_0(0.5)^{\frac{t}{0.0803}}$ , where  $A_0$  represents the initial amount of the substance. An equivalent form of this equation is
- $A(t) = A_0(0.000178)^t$
  - $A(t) = A_0(0.945861)^t$
  - $A(t) = A_0(0.04015)^t$
  - $A(t) = A_0(1.08361)^t$
- 232 Iridium-192 is an isotope of iridium and has a half-life of 73.83 days. If a laboratory experiment begins with 100 grams of Iridium-192, the number of grams,  $A$ , of Iridium-192 present after  $t$  days would be  $A = 100\left(\frac{1}{2}\right)^{\frac{t}{73.83}}$ . Which equation approximates the amount of Iridium-192 present after  $t$  days?
- $A = 100\left(\frac{73.83}{2}\right)^t$
  - $A = 100\left(\frac{1}{147.66}\right)^t$
  - $A = 100(0.990656)^t$
  - $A = 100(0.116381)^t$



- 233 On average, college seniors graduating in 2012 could compute their growing student loan debt using the function  $D(t) = 29,400(1.068)^t$ , where  $t$  is time in years. Which expression is equivalent to  $29,400(1.068)^t$  and could be used by students to identify an approximate daily interest rate on their loans?

- 1  $29,400 \left( 1.068^{\frac{1}{365}} \right)^t$
- 2  $29,400 \left( \frac{1.068}{365} \right)^{365t}$
- 3  $29,400 \left( 1 + \frac{0.068}{365} \right)^t$
- 4  $29,400 \left( 1.068^{\frac{1}{365}} \right)^{365t}$

- 234 For a given time,  $x$ , in seconds, an electric current,  $y$ , can be represented by  $y = 2.5 \left( 1 - 2.7^{-.10x} \right)$ .

Which equation is *not* equivalent?

- 1  $y = 2.5 - 2.5 \left( 2.7^{-.10x} \right)$
- 2  $y = 2.5 - 2.5 \left( \left( 2.7^2 \right)^{-.05x} \right)$
- 3  $y = 2.5 - 2.5 \left( \frac{1}{2.7^{.10x}} \right)$
- 4  $y = 2.5 - 2.5 \left( 2.7^{-2} \right) \left( 2.7^{.05x} \right)$

- 235 Luminescence is the emission of light that is not caused by heat. A luminescent substance decays according to the function below.

$$I = I_0 e^{3 \left( -\frac{t}{0.6} \right)}$$

This function can be best approximated by

- 1  $I = I_0 e^{\left( \frac{-t}{0.18} \right)}$
- 2  $I = I_0 e^{5t}$
- 3  $I = I_0 (0.0067)^t$
- 4  $I = I_0 (0.0497)^{0.6t}$

- 236 Kelly-Ann has \$20,000 to invest. She puts half of the money into an account that grows at an annual rate of 0.9% compounded monthly. At the same time, she puts the other half of the money into an account that grows continuously at an annual rate of 0.8%. Which function represents the value of Kelly-Ann's investments after  $t$  years?

- 1  $f(t) = 10,000(1.9)^t + 10,000e^{0.8t}$
- 2  $f(t) = 10,000(1.009)^t + 10,000e^{0.008t}$
- 3  $f(t) = 10,000(1.075)^{12t} + 10,000e^{0.8t}$
- 4  $f(t) = 10,000(1.00075)^{12t} + 10,000e^{0.008t}$

**Algebra II Regents Exam Questions by State Standard: Topic**

F.BF.A.1: MODELING EXPONENTIAL FUNCTIONS

- 237 Audra is interested in studying the number of students entering kindergarten in the Ahlville Central School District over the next several years. Using data dating back to 2015, she determines that the number of kindergarteners is decreasing at an exponential rate. She creates a formula to model this situation  $y = a(b)^x$ , where  $x$  is the number of years since 2015 and  $y$  is the number of students entering kindergarten. If there were 105 students entering kindergarten in Ahlville in 2015, which statement about Audra's formula is true?
- 1  $a$  is positive and  $b$  is negative.
  - 2  $a$  is negative and  $b$  is positive.
  - 3 Both  $a$  and  $b$  are positive.
  - 4 Both  $a$  and  $b$  are negative.
- 238 The element Americium has a half-life of 25 minutes. Given an initial amount,  $A_0$ , which expression could be used to determine the amount of Americium remaining after  $t$  minutes?
- 1  $A_0 \left(\frac{1}{2}\right)^{\frac{t}{25}}$
  - 2  $A_0(25)^{\frac{t}{2}}$
  - 3  $25 \left(\frac{1}{2}\right)^t$
  - 4  $A_0 \left(\frac{1}{2}\right)^{25t}$
- 239 Camryn puts \$400 into a savings account that earns 6% annually. The amount in her account can be modeled by  $C(t) = 400(1.06)^t$  where  $t$  is the time in years. Which expression best approximates the amount of money in her account using a weekly growth rate?
- 1  $400(1.001153846)^t$
  - 2  $400(1.001121184)^t$
  - 3  $400(1.001153846)^{52t}$
  - 4  $400(1.001121184)^{52t}$
- 240 Last year, the total revenue for Home Style, a national restaurant chain, increased 5.25% over the previous year. If this trend were to continue, which expression could the company's chief financial officer use to approximate their monthly percent increase in revenue? [Let  $m$  represent months.]
- 1  $(1.0525)^m$
  - 2  $(1.0525)^{\frac{12}{m}}$
  - 3  $(1.00427)^m$
  - 4  $(1.00427)^{\frac{m}{12}}$
- 241 A payday loan company makes loans between \$100 and \$1000 available to customers. Every 14 days, customers are charged 30% interest with compounding. In 2013, Remi took out a \$300 payday loan. Which expression can be used to calculate the amount she would owe, in dollars, after one year if she did not make payments?
- 1  $300(.30)^{\frac{14}{365}}$
  - 2  $300(1.30)^{\frac{14}{365}}$
  - 3  $300(.30)^{\frac{365}{14}}$
  - 4  $300(1.30)^{\frac{365}{14}}$

- 242 Susan won \$2,000 and invested it into an account with an annual interest rate of 3.2%. If her investment were compounded monthly, which expression best represents the value of her investment after  $t$  years?
- 1  $2000(1.003)^{12t}$
  - 2  $2000(1.032)^{\frac{t}{12}}$
  - 3  $2064^{\frac{t}{12}}$
  - 4  $\frac{2000(1.032)^t}{12}$
- 243 According to a pricing website, Indroid phones lose 58% of their cash value over 1.5 years. Which expression can be used to estimate the value of a \$300 Indroid phone in 1.5 years?
- 1  $300e^{-0.87}$
  - 2  $300e^{-0.63}$
  - 3  $300e^{-0.58}$
  - 4  $300e^{-0.42}$
- 244 Biologists are studying a new bacterium. They create a culture with 100 of the bacteria and anticipate that the number of bacteria will double every 30 hours. Write an equation for the number of bacteria,  $B$ , in terms of the number of hours,  $t$ , since the experiment began.

F.LE.A.2: MODELING EXPONENTIAL EQUATIONS

- 245 Sodium iodide-131, used to treat certain medical conditions, has a half-life of 1.8 hours. The data table below shows the amount of sodium iodide-131, rounded to the nearest thousandth, as the dose fades over time.

<b>Number of Half Lives</b>	1	2	3	4	5
<b>Amount of Sodium Iodide-131</b>	139.000	69.500	34.750	17.375	8.688

What approximate amount of sodium iodide-131 will remain in the body after 18 hours?

- |         |         |
|---------|---------|
| 1 0.001 | 3 0.271 |
| 2 0.136 | 4 0.543 |
- 246 A rabbit population doubles every 4 weeks. There are currently five rabbits in a restricted area. If  $t$  represents the time, in weeks, and  $P(t)$  is the population of rabbits with respect to time, about how many rabbits will there be in 98 days?
- 1 56
  - 2 152
  - 3 3688
  - 4 81,920
- 247 If \$5000 is put into a savings account that pays 3.5% interest compounded monthly, how much money, to the *nearest ten cents*, would be in that account after 6 years, assuming no money was added or withdrawn?
- 1 \$5177.80
  - 2 \$5941.30
  - 3 \$6146.30
  - 4 \$6166.50

- 248 A population of 950 bacteria grows continuously at a rate of 4.75% per day. Write an exponential function,  $N(t)$ , that represents the bacterial population after  $t$  days and explain the reason for your choice of base. Determine the bacterial population after 36 hours, to the *nearest bacterium*.
- 249 Titanium-44 is a radioactive isotope such that every 63 years, its mass decreases by half. For a sample of titanium-44 with an initial mass of 100 grams, write a function that will give the mass of the sample remaining after any amount of time. Define all variables. Scientists sometimes use the average yearly decrease in mass for estimation purposes. Use the average yearly decrease in mass of the sample between year 0 and year 10 to predict the amount of the sample remaining after 40 years. Round your answer to the *nearest tenth*. Is the actual mass of the sample or the estimated mass greater after 40 years? Justify your answer.
- F.L.E.B.5: MODELING EXPONENTIAL EQUATIONS**
- 250 The value of an automobile  $t$  years after it was purchased is given by the function  $V = 38,000(0.84)^t$ . Which statement is true?
- 1 The value of the car increases 84% each year.
  - 2 The value of the car decreases 84% each year.
  - 3 The value of the car increases 16% each year.
  - 4 The value of the car decreases 16% each year.
- 251 An equation to represent the value of a car after  $t$  months of ownership is  $v = 32,000(0.81)^{\frac{t}{12}}$ . Which statement is *not* correct?
- 1 The car lost approximately 19% of its value each month.
  - 2 The car maintained approximately 98% of its value each month.
  - 3 The value of the car when it was purchased was \$32,000.
  - 4 The value of the car 1 year after it was purchased was \$25,920.
- 252 A certain pain reliever is taken in 220 mg dosages and has a half-life of 12 hours. The function  $A = 220\left(\frac{1}{2}\right)^{\frac{t}{12}}$  can be used to model this situation, where  $A$  is the amount of pain reliever in milligrams remaining in the body after  $t$  hours. According to this function, which statement is true?
- 1 Every hour, the amount of pain reliever remaining is cut in half.
  - 2 In 12 hours, there is no pain reliever remaining in the body.
  - 3 In 24 hours, there is no pain reliever remaining in the body.
  - 4 In 12 hours, 110 mg of pain reliever is remaining.
- 253 The amount of a substance,  $A(t)$ , in grams, remaining after  $t$  days is modeled by  $A(t) = 50(0.5)^{\frac{t}{3}}$ . Which statement is false?
- 1 In 20 days, there is no substance remaining.
  - 2 After two half-lives, there is 25% of the substance remaining.
  - 3 The amount of the substance remaining can also be modeled by  $A(t) = 50(2)^{\frac{-t}{3}}$ .
  - 4 After one week, there is less than 10g of the substance remaining.
- 254 If  $f(t) = 50(.5)^{\frac{t}{5715}}$  represents a mass, in grams, of carbon-14 remaining after  $t$  years, which statement(s) must be true?
- I. The mass of the carbon-14 is decreasing by half each year.
  - II. The mass of the original sample is 50 g.
- 1 I, only
  - 2 II, only
  - 3 I and II
  - 4 neither I nor II

255 The function  $p(t) = 110e^{0.03922t}$  models the population of a city, in millions,  $t$  years after 2010. As of today, consider the following two statements:

- I. The current population is 110 million.
- II. The population increases continuously by approximately 3.9% per year.

This model supports

- 1 I, only
- 2 II, only
- 3 both I and II
- 4 neither I nor II

256 A savings account,  $S$ , has an initial value of \$50. The account grows at a 2% interest rate compounded  $n$  times per year,  $t$ , according to the function below.

$$S(t) = 50 \left( 1 + \frac{.02}{n} \right)^{nt}$$

Which statement about the account is correct?

- 1 As the value of  $n$  increases, the amount of interest per year decreases.
- 2 As the value of  $n$  increases, the value of the account approaches the function  $S(t) = 50e^{0.02t}$ .
- 3 As the value of  $n$  decreases to one, the amount of interest per year increases.
- 4 As the value of  $n$  decreases to one, the value of the account approaches the function  $S(t) = 50(1 - 0.02)^t$ .

F.IF.B.4: EVALUATING EXPONENTIAL EXPRESSIONS

257 The temperature,  $F$ , in degrees Fahrenheit, after  $t$  hours of a roast put into an oven is given by the equation  $F = 325 - 185e^{-0.4t}$ . What was the temperature of the roast when it was put into the oven?

- 1 325
- 2 200
- 3 185
- 4 140

258 Monthly mortgage payments can be found using the formula below, where  $M$  is the monthly payment,  $P$  is the amount borrowed,  $r$  is the annual interest rate, and  $n$  is the total number of monthly payments.

$$M = \frac{P \left( \frac{r}{12} \right) \left( 1 + \frac{r}{12} \right)^n}{\left( 1 + \frac{r}{12} \right)^n - 1}$$

If Adam takes out a 15-year mortgage, borrowing \$240,000 at an annual interest rate of 4.5%, his monthly payment will be

- 1 \$1379.09
- 2 \$1604.80
- 3 \$1835.98
- 4 \$9011.94

259 The George family would like to borrow \$45,000 to purchase a new boat. They qualified for a loan with an annual interest rate of 6.75%. The monthly loan payment can be found using the formula below.

$$M = \frac{P \left( \frac{r}{12} \right) \left( 1 + \frac{r}{12} \right)^n}{\left( 1 + \frac{r}{12} \right)^n - 1}$$

$M$  = monthly payment

$P$  = amount borrowed

$r$  = annual interest rate

$n$  = number of monthly payments

What is the monthly payment if they would like to pay off the loan in five years?

- 1 \$262.99
- 2 \$252.13
- 3 \$915.24
- 4 \$885.76

- 260 Robert is buying a car that costs \$22,000. After a down payment of \$4000, he borrows the remainder from a bank, a six year loan at 6.24% annual interest rate. The following formula can be used to calculate his monthly loan payment.

$$R = \frac{(P)(i)}{1 - (1 + i)^{-t}}$$

$R$  = monthly payment

$P$  = loan amount

$i$  = monthly interest rate

$t$  = time, in months

Robert's monthly payment will be

- 1 \$298.31
  - 2 \$300.36
  - 3 \$307.35
  - 4 \$367.10
- 261 The Wells family is looking to purchase a home in a suburb of Rochester with a 30-year mortgage that has an annual interest rate of 3.6%. The house the family wants to purchase is \$152,500 and they will make a \$15,250 down payment and borrow the remainder. Use the formula below to determine their monthly payment, to the *nearest dollar*.

$$M = \frac{P \left( \frac{r}{12} \right) \left( 1 + \frac{r}{12} \right)^n}{\left( 1 + \frac{r}{12} \right)^n - 1}$$

$M$  = monthly payment

$P$  = amount borrowed

$r$  = annual interest rate

$n$  = total number of monthly payments

- 262 Using the formula below, determine the monthly payment on a 5-year car loan with a monthly percentage rate of 0.625% for a car with an original cost of \$21,000 and a \$1000 down payment, to the *nearest cent*.

$$P_n = PMT \left( \frac{1 - (1 + i)^{-n}}{i} \right)$$

$P_n$  = present amount borrowed

$n$  = number of monthly pay periods

$PMT$  = monthly payment

$i$  = interest rate per month

The affordable monthly payment is \$300 for the same time period. Determine an appropriate down payment, to the *nearest dollar*.

- 263 Jim is looking to buy a vacation home for \$172,600 near his favorite southern beach. The formula to compute a mortgage payment,  $M$ , is

$$M = P \cdot \frac{r(1+r)^N}{(1+r)^N - 1} \text{ where } P \text{ is the principal}$$

amount of the loan,  $r$  is the monthly interest rate, and  $N$  is the number of monthly payments. Jim's bank offers a monthly interest rate of 0.305% for a 15-year mortgage. With no down payment, determine Jim's mortgage payment, rounded to the *nearest dollar*. Algebraically determine and state the down payment, rounded to the *nearest dollar*, that Jim needs to make in order for his mortgage payment to be \$1100.

F.IF.B.4: EVALUATING LOGARITHMIC EXPRESSIONS

264 The loudness of sound is measured in units called decibels (dB). These units are measured by first assigning an intensity  $I_0$  to a very soft sound that is called the threshold sound. The sound to be measured is assigned an intensity,  $I$ , and the decibel rating,  $d$ , of this sound is found using  $d = 10 \log \frac{I}{I_0}$ . The threshold sound audible to the average person is  $1.0 \times 10^{-12}$  W/m<sup>2</sup> (watts per square meter). Consider the following sound level classifications:

Moderate	45-69 dB
Loud	70-89 dB
Very loud	90-109 dB
Deafening	>110 dB

How would a sound with intensity  $6.3 \times 10^{-3}$  W/m<sup>2</sup> be classified?

- |            |             |
|------------|-------------|
| 1 moderate | 3 very loud |
| 2 loud     | 4 deafening |

F.IF.C.7: GRAPHING EXPONENTIAL FUNCTIONS

265 Which function represents exponential decay?

- $y = 2^{0.3t}$
- $y = 1.2^{3t}$
- $y = \left(\frac{1}{2}\right)^{-t}$
- $y = 5^{-t}$

266 Which function represents exponential decay?

- $p(x) = \left(\frac{1}{4}\right)^{-x}$
- $q(x) = 1.8^{-x}$
- $r(x) = 2.3^{2x}$
- $s(x) = 4^{\frac{x}{2}}$

267 If the function  $g(x) = ab^x$  represents exponential growth, which statement about  $g(x)$  is *false*?

- $a > 0$  and  $b > 1$
- The  $y$ -intercept is  $(0, a)$ .
- The asymptote is  $y = 0$ .
- The  $x$ -intercept is  $(b, 0)$ .

268 Which statement is true about the graph of

$$f(x) = \left(\frac{1}{8}\right)^x ?$$

- The graph is always increasing.
- The graph is always decreasing.
- The graph passes through  $(1, 0)$ .
- The graph has an asymptote,  $x = 0$ .

269 Given  $f(x) = 3^{x-1} + 2$ , as  $x \rightarrow -\infty$

- $f(x) \rightarrow -1$
- $f(x) \rightarrow 0$
- $f(x) \rightarrow 2$
- $f(x) \rightarrow -\infty$

- 270 Describe the transformation applied to the graph of  $p(x) = 2^x$  that forms the new function  $q(x) = 2^{x-3} + 4$ .

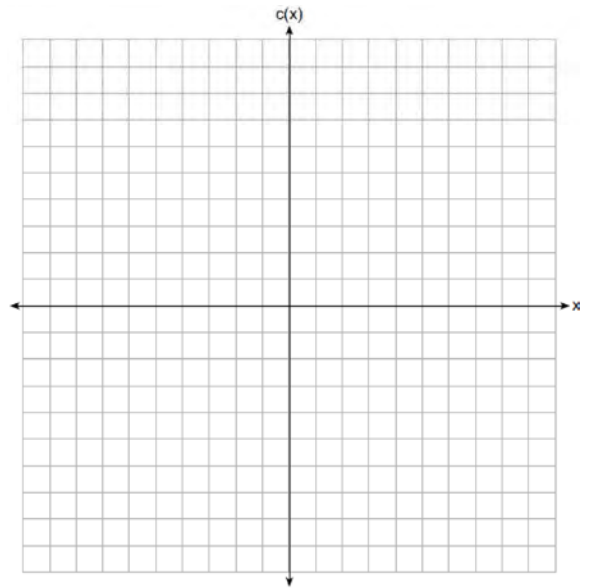
- 271 The population of bacteria,  $P(t)$ , in hundreds, after  $t$  hours can be modeled by the function  $P(t) = 37e^{0.0532t}$ . Determine whether the population is increasing or decreasing over time. Explain your reasoning.

- 272 The function  $M(t)$  represents the mass of radium over time,  $t$ , in years.

$$M(t) = 100e^{\frac{\left(\ln \frac{1}{2}\right)t}{1590}}$$

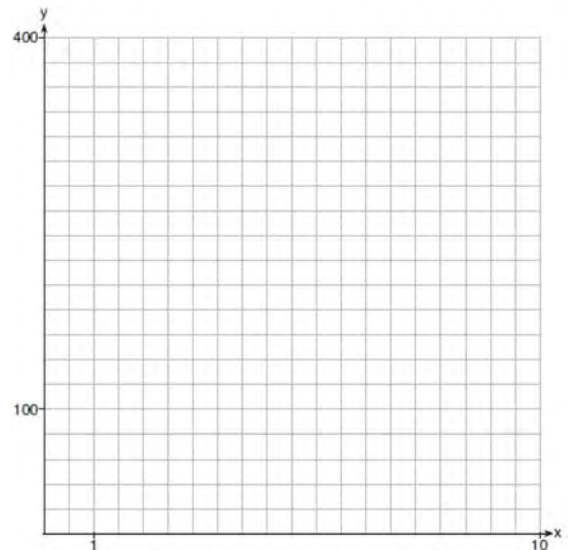
Determine if the function  $M(t)$  represents growth or decay. Explain your reasoning.

- 273 Graph  $c(x) = -9(3)^{x-4} + 2$  on the axes below.



Describe the end behavior of  $c(x)$  as  $x$  approaches positive infinity. Describe the end behavior of  $c(x)$  as  $x$  approaches negative infinity.

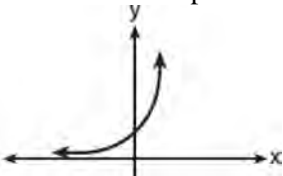
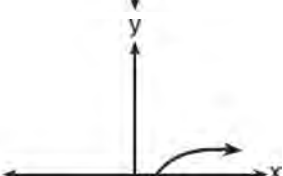
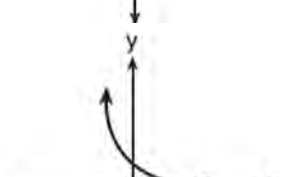
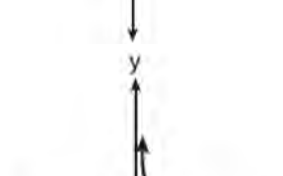
- 274 Graph  $y = 400(.85)^{2x} - 6$  on the set of axes below.



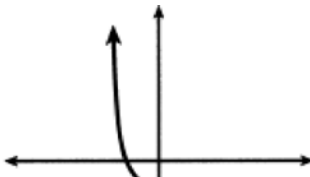


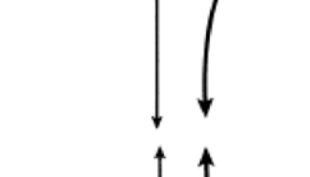


F.IF.C.7: GRAPHING LOGARITHMIC  
 FUNCTIONS

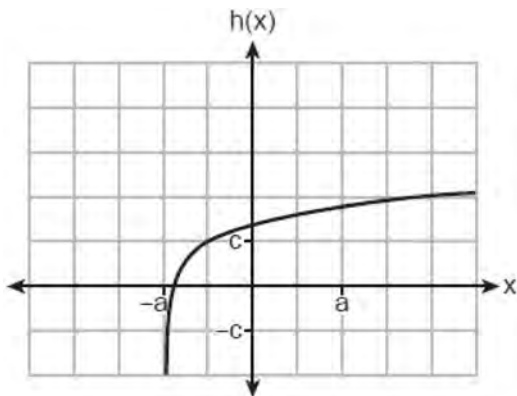
275 Which sketch best represents the graph of  $x = 3^y$ ?

- 1 
- 2 
- 3 
- 4 

276 Which sketch could represent the function  $m(x) = -\log_{100}(x - 2)$ ?

- 1 
- 2 
- 3 
- 4 

277 Which equation best represents the graph below?



- 1  $h(x) = \log(x + a) + c$
- 2  $h(x) = \log(x - a) + c$
- 3  $h(x) = \log(x + a) - c$
- 4  $h(x) = \log(x - a) - c$

278 The graph of  $y = \log_2 x$  is translated to the right 1 unit and down 1 unit. The coordinates of the  $x$ -intercept of the translated graph are

- 1  $(0, 0)$
- 2  $(1, 0)$
- 3  $(2, 0)$
- 4  $(3, 0)$

279 If  $f(x) = \log_3 x$  and  $g(x)$  is the image of  $f(x)$  after a translation five units to the left, which equation represents  $g(x)$ ?

- 1  $g(x) = \log_3(x + 5)$
- 2  $g(x) = \log_3 x + 5$
- 3  $g(x) = \log_3(x - 5)$
- 4  $g(x) = \log_3 x - 5$

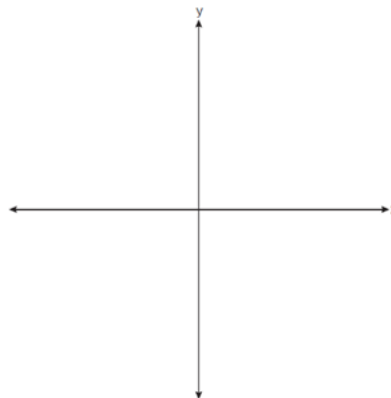
280 Which statement about the graph of  $c(x) = \log_6 x$  is *false*?

- 1 The asymptote has equation  $y = 0$ .
- 2 The graph has no  $y$ -intercept.
- 3 The domain is the set of positive reals.
- 4 The range is the set of all real numbers.

281 Which statement below about the graph of  $f(x) = -\log(x + 4) + 2$  is true?

- 1  $f(x)$  has a  $y$ -intercept at  $(0, 2)$ .
- 2  $-f(x)$  has a  $y$ -intercept at  $(0, 2)$ .
- 3 As  $x \rightarrow \infty, f(x) \rightarrow \infty$ .
- 4  $x \rightarrow -4, f(x) \rightarrow \infty$ .

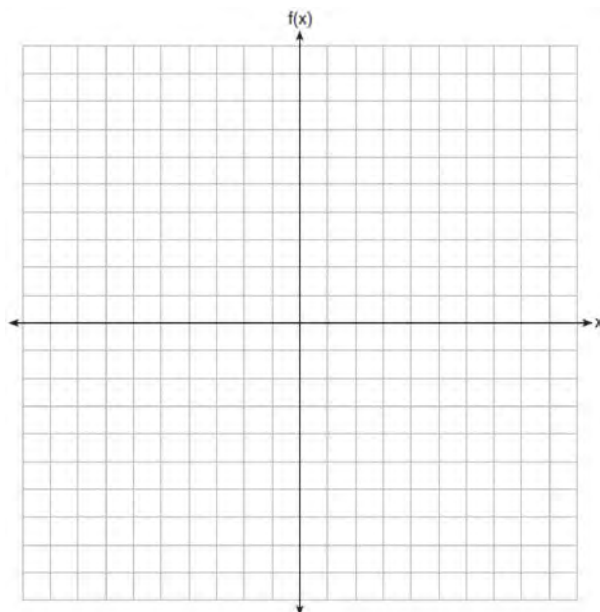
282 Sketch  $p(x) = -\log_2(x + 3) + 2$  on the axes below.



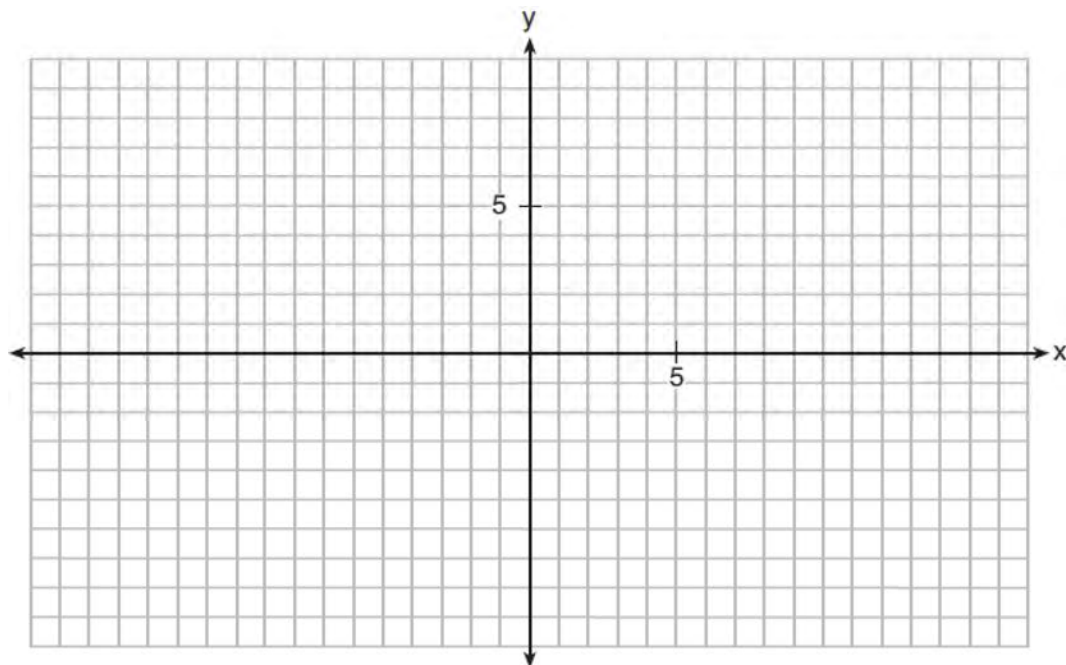
Describe the end behavior of  $p(x)$  as  $x \rightarrow -3$ .

Describe the end behavior of  $p(x)$  as  $x \rightarrow \infty$

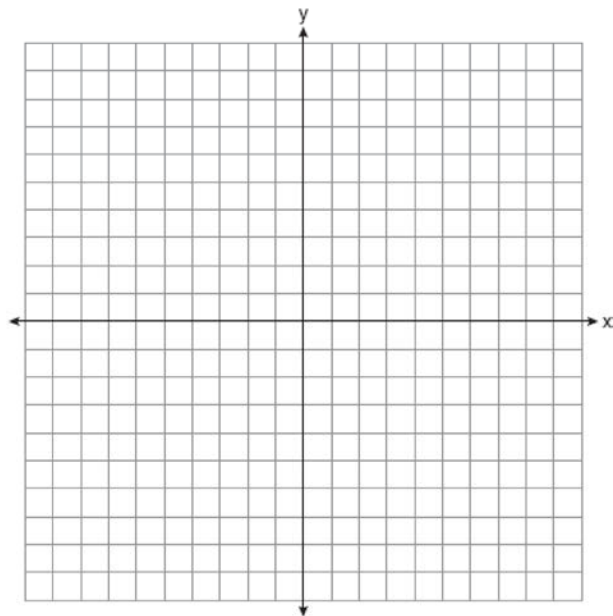
283 Graph  $f(x) = \log_2(x + 6)$  on the set of axes below.



284 On the grid below, graph the function  $y = \log_2(x - 3) + 1$

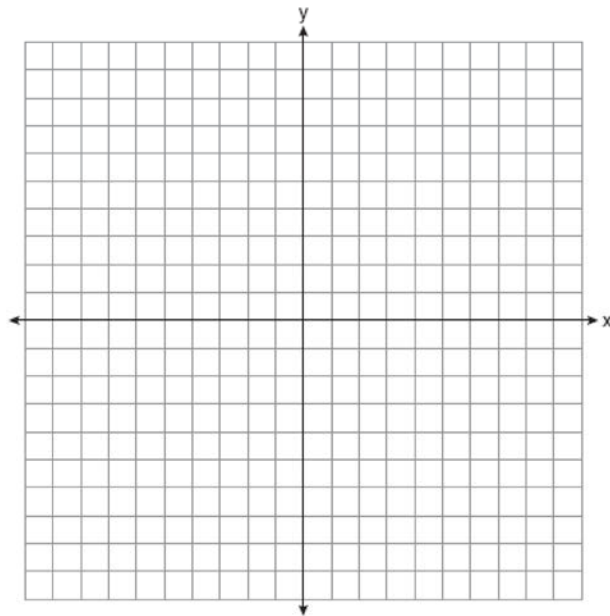


- 285 Graph  $y = \log_2(x + 3) - 5$  on the set of axes below.  
 Use an appropriate scale to include *both* intercepts.



Describe the behavior of the given function as  $x$  approaches  $-3$  and as  $x$  approaches positive infinity.

- 286 Graph the following function on the axes below.  
 $f(x) = \log_3(2 - x)$



State the domain of  $f$ . State the equation of the asymptote.

F.L.E.A.4: EXPRESS EXPONENTIALS AS LOGARITHMS

- 287 Given  $p \neq q$ ,  $p = \left(\frac{1}{2}\right)^q$ , expressed in logarithmic form, is equivalent to

- 1  $\log_p\left(\frac{1}{2}\right) = q$
- 2  $\log_q(p) = \frac{1}{2}$
- 3  $\log_{\frac{1}{2}}(p) = q$
- 4  $\log_{\frac{1}{2}}(q) = p$

F.L.E.A.4: EXPONENTIAL EQUATIONS

288 If  $ae^{bt} = c$ , where  $a$ ,  $b$ , and  $c$  are positive, then  $t$  equals

1  $\ln\left(\frac{c}{ab}\right)$

2  $\ln\left(\frac{cb}{a}\right)$

3  $\frac{\ln\left(\frac{c}{a}\right)}{b}$

4  $\frac{\ln\left(\frac{c}{a}\right)}{\ln b}$

289 The solution to the equation  $5e^{x+2} = 7$  is

1  $-2 + \ln\left(\frac{7}{5}\right)$

2  $\left(\frac{\ln 7}{\ln 5}\right) - 2$

3  $\frac{-3}{5}$

4  $-2 + \ln(2)$

290 What is the solution to  $8(2^{x+3}) = 48$ ?

1  $x = \frac{\ln 6}{\ln 2} - 3$

2  $x = 0$

3  $x = \frac{\ln 48}{\ln 16} - 3$

4  $x = \ln 4 - 3$

291 The solution of  $87e^{0.3x} = 5918$ , to the nearest thousandth, is

1 0.583

2 1.945

3 4.220

4 14.066

292 To the nearest tenth, the solution to the equation  $4300e^{0.07x} - 123 = 5000$  is

1 1.1

2 2.5

3 6.3

4 68.5

293 Which expression is *not* a solution to the equation

$2^t = \sqrt{10}$ ?

1  $\frac{1}{2} \log_2 10$

2  $\log_2 \sqrt{10}$

3  $\log_4 10$

4  $\log_{10} 4$

294 Solve algebraically for  $x$  to the nearest thousandth:

$2e^{0.49x} = 15$

F.L.E.A.4: EXPONENTIAL GROWTH

295 A local university has a current enrollment of 12,000 students. The enrollment is increasing continuously at a rate of 2.5% each year. Which logarithm is equal to the number of years it will take for the population to increase to 15,000 students?

1  $\frac{\ln 1.25}{0.25}$

2  $\frac{\ln 3000}{0.025}$

3  $\frac{\ln 1.25}{2.5}$

4  $\frac{\ln 1.25}{0.025}$

296 Judith puts \$5000 into an investment account with interest compounded continuously. Which approximate annual rate is needed for the account to grow to \$9110 after 30 years?

- 1 2%
- 2 2.2%
- 3 0.02%
- 4 0.022%

297 Determine, to the *nearest tenth of a year*, how long it would take an investment to double at a  $3\frac{3}{4}\%$  interest rate, compounded continuously.

298 When observed by researchers under a microscope, a smartphone screen contained approximately 11,000 bacteria per square inch. Bacteria, under normal conditions, double in population every 20 minutes.

a) Assuming an initial value of 11,000 bacteria, write a function,  $p(t)$ , that can be used to model the population of bacteria,  $p$ , on a smartphone screen, where  $t$  represents the time in minutes after it is first observed under a microscope.

b) Using  $p(t)$  from part *a*, determine algebraically, to the *nearest hundredth of a minute*, the amount of time it would take for a smartphone screen that was not touched or cleaned to have a population of 1,000,000 bacteria per square inch.

299 After sitting out of the refrigerator for a while, a turkey at room temperature ( $68^{\circ}\text{F}$ ) is placed into an oven at 8 a.m., when the oven temperature is  $325^{\circ}\text{F}$ . Newton's Law of Heating explains that the temperature of the turkey will increase proportionally to the difference between the temperature of the turkey and the temperature of the oven, as given by the formula below:

$$T = T_a + (T_0 - T_a)e^{-kt}$$

$T_a$  = the temperature surrounding the object

$T_0$  = the initial temperature of the object

$t$  = the time in hours

$T$  = the temperature of the object after  $t$  hours

$k$  = decay constant

The turkey reaches the temperature of approximately  $100^{\circ}\text{F}$  after 2 hours. Find the value of  $k$ , to the *nearest thousandth*, and write an equation to determine the temperature of the turkey after  $t$  hours. Determine the Fahrenheit temperature of the turkey, to the *nearest degree*, at 3 p.m.

300 A house purchased 5 years ago for \$100,000 was just sold for \$135,000. Assuming exponential growth, approximate the annual growth rate, to the *nearest percent*.

301 In New York State, the minimum wage has grown exponentially. In 1966, the minimum wage was \$1.25 an hour and in 2015, it was \$8.75. Algebraically determine the rate of growth to the *nearest percent*.

F.LE.A.4: EXPONENTIAL DECAY

- 302 The Fahrenheit temperature,  $F(t)$ , of a heated object at time  $t$ , in minutes, can be modeled by the function below.  $F_s$  is the surrounding temperature,  $F_0$  is the initial temperature of the object, and  $k$  is a constant.

$$F(t) = F_s + (F_0 - F_s)e^{-kt}$$

Coffee at a temperature of  $195^\circ\text{F}$  is poured into a container. The room temperature is kept at a constant  $68^\circ\text{F}$  and  $k = 0.05$ . Coffee is safe to drink when its temperature is, at most,  $120^\circ\text{F}$ . To the *nearest minute*, how long will it take until the coffee is safe to drink?

- 1 7
  - 2 10
  - 3 11
  - 4 18
- 303 The half-life of iodine-131 is 8 days. The percent of the isotope left in the body  $d$  days after being introduced is  $I = 100\left(\frac{1}{2}\right)^{\frac{d}{8}}$ . When this equation is written in terms of the number  $e$ , the base of the natural logarithm, it is equivalent to  $I = 100e^{kd}$ . What is the approximate value of the constant,  $k$ ?
- 1  $-0.087$
  - 2  $0.087$
  - 3  $-11.542$
  - 4  $11.542$
- 304 One of the medical uses of Iodine-131 (I-131), a radioactive isotope of iodine, is to enhance x-ray images. The half-life of I-131 is approximately 8.02 days. A patient is injected with 20 milligrams of I-131. Determine, to the *nearest day*, the amount of time needed before the amount of I-131 in the patient's body is approximately 7 milligrams.

- 305 The half-life of a radioactive substance is 15 years. Write an equation that can be used to determine the amount,  $s(t)$ , of 200 grams of this substance that remains after  $t$  years. Determine algebraically, to the *nearest year*, how long it will take for  $\frac{1}{10}$  of this substance to remain.
- 306 A radioactive substance has a mass of 140 g at 3 p.m. and 100 g at 8 p.m. Write an equation in the form  $A = A_0\left(\frac{1}{2}\right)^{\frac{t}{h}}$  that models this situation, where  $h$  is the constant representing the number of hours in the half-life,  $A_0$  is the initial mass, and  $A$  is the mass  $t$  hours after 3 p.m. Using this equation, solve for  $h$ , to the *nearest ten thousandth*. Determine when the mass of the radioactive substance will be 40 g. Round your answer to the *nearest tenth of an hour*.

A.CED.A.1: EXPONENTIAL EQUATIONS

- 307 What is the solution of  $2(3^{x+4}) = 56$ ?
- 1  $x = \log_3(28) - 4$
  - 2  $x = -1$
  - 3  $x = \log(25) - 4$
  - 4  $x = \frac{\log(56)}{\log(6)} - 4$

A.CED.A.1: EXPONENTIAL GROWTH

- 308 Carla wants to start a college fund for her daughter Lila. She puts \$63,000 into an account that grows at a rate of 2.55% per year, compounded monthly. Write a function,  $C(t)$ , that represents the amount of money in the account  $t$  years after the account is opened, given that no more money is deposited into or withdrawn from the account. Calculate algebraically the number of years it will take for the account to reach \$100,000, to the *nearest hundredth of a year*.

- 309 Seth's parents gave him \$5000 to invest for his 16th birthday. He is considering two investment options. Option *A* will pay him 4.5% interest compounded annually. Option *B* will pay him 4.6% compounded quarterly. Write a function of option *A* and option *B* that calculates the value of each account after  $n$  years. Seth plans to use the money after he graduates from college in 6 years. Determine how much more money option *B* will earn than option *A* to the *nearest cent*. Algebraically determine, to the *nearest tenth of a year*, how long it would take for option *B* to double Seth's initial investment.

- 310 The Manford family started savings accounts for their twins, Abby and Brett, on the day they were born. They invested \$8000 in an account for each child. Abby's account pays 4.2% annual interest compounded quarterly. Brett's account pays 3.9% annual interest compounded continuously. Write a function,  $A(t)$ , for Abby's account and a function,  $B(t)$ , for Brett's account that calculates the value of each account after  $t$  years. Determine who will have more money in their account when the twins turn 18 years old, and find the difference in the amounts in the accounts to the *nearest cent*. Algebraically determine, to the *nearest tenth of a year*, how long it takes for Brett's account to triple in value.

- 311 Monthly mortgage payments can be found using the formula below:

$$M = \frac{P\left(\frac{r}{12}\right)\left(1 + \frac{r}{12}\right)^n}{\left(1 + \frac{r}{12}\right)^n - 1}$$

$M$  = monthly payment

$P$  = amount borrowed

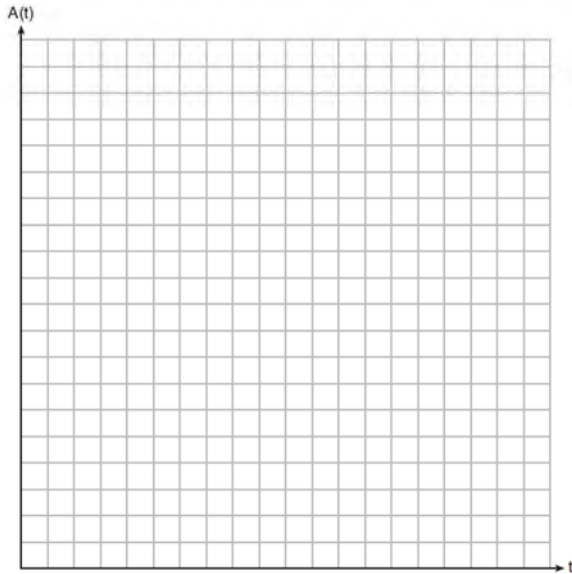
$r$  = annual interest rate

$n$  = number of monthly payments

The Banks family would like to borrow \$120,000 to purchase a home. They qualified for an annual interest rate of 4.8%. Algebraically determine the *fewest* number of whole years the Banks family would need to include in the mortgage agreement in order to have a monthly payment of no more than \$720.



- 312 Tony is evaluating his retirement savings. He currently has \$318,000 in his account, which earns an interest rate of 7% compounded annually. He wants to determine how much he will have in the account in the future, even if he makes no additional contributions to the account. Write a function,  $A(t)$ , to represent the amount of money that will be in his account in  $t$  years. Graph  $A(t)$  where  $0 \leq t \leq 20$  on the set of axes below.



Tony's goal is to save \$1,000,000. Determine algebraically, to the *nearest year*, how many years it will take for him to achieve his goal. Explain how your graph of  $A(t)$  confirms your answer.

A.CED.A.1: EXPONENTIAL DECAY

- 313 A retailer advertises that items will be discounted by 10% every Monday until they are sold. In how many weeks will an item costing \$50 first be sold for under half price?
- 1 7
  - 2 6
  - 3 5
  - 4 4

- 314 Objects cool at different rates based on the formula below.

$$T = (T_0 - T_R)e^{-rt} + T_R$$

$T_0$ : initial temperature

$T_R$ : room temperature

$r$ : rate of cooling of the object

$t$ : time in minutes that the object

cools to a temperature,  $T$

Mark makes T-shirts using a hot press to transfer designs to the shirts. He removes a shirt from a press that heats the shirt to 400°F. The rate of cooling for the shirt is 0.0735 and the room temperature is 75°F. Using this information, write an equation for the temperature of the shirt,  $T$ , after  $t$  minutes. Use the equation to find the temperature of the shirt, to the *nearest degree*, after five minutes. At the same time, Mark's friend Jeanine removes a hoodie from a press that heats the hoodie to 450°F. After eight minutes, the hoodie measured 270°F. The room temperature is still 75°F. Determine the rate of cooling of the hoodie, to the *nearest ten thousandth*. The T-shirt and hoodie were removed at the same time. Determine when the temperature will be the same, to the *nearest minute*.

## RATIONALS

A.APR.D.6: UNDEFINED RATIONALS

- 315 The function  $f(x) = \frac{x-3}{x^2+2x-8}$  is undefined when  $x$  equals
- 1 2 or -4
  - 2 4 or -2
  - 3 3, only
  - 4 2, only

A.APR.D.6: EXPRESSIONS WITH NEGATIVE EXPONENTS

316 The expression  $\frac{-3x^2 - 5x + 2}{x^3 + 2x^2}$  can be rewritten as

- 1  $\frac{-3x - 3}{x^2 + 2x}$
- 2  $\frac{-3x - 1}{x^2}$
- 3  $-3x^{-1} + 1$
- 4  $-3x^{-1} + x^{-2}$

317 Given that  $\left(\frac{y^{\frac{17}{8}}}{y^{\frac{5}{4}}}\right)^{-4} = y^n$ , where  $y > 0$ , determine the value of  $n$ .

A.APR.D.6: RATIONAL EXPRESSIONS

318 Written in simplest form, the fraction  $\frac{x^3 - 9x}{9 - x^2}$ ,

where  $x \neq \pm 3$ , is equivalent to

- 1  $-x$
- 2  $x$
- 3  $\frac{-x(x+3)}{(3+x)}$
- 4  $\frac{x(x-3)}{(3-x)}$

319 Which expression(s) are equivalent to  $\frac{x^2 - 4x}{2x}$ ,

where  $x \neq 0$ ?

I.  $\frac{x}{2} - 2$     II.  $\frac{x-4}{2}$     III.  $\frac{x-1}{2} - \frac{3}{2}$

- 1 II, only
- 2 I and II
- 3 II and III
- 4 I, II, and III

320 For all values of  $x$  for which the expression is defined,  $\frac{x^2 + 3x}{x^2 + 5x + 6}$  is equivalent to

- 1  $1 - \frac{x}{x+2}$
- 2  $\frac{x}{x+2}$
- 3  $\frac{3x}{5x+6}$
- 4  $1 + \frac{1}{2x+6}$

321 Written in simplest form,  $\frac{c^2 - d^2}{d^2 + cd - 2c^2}$  where  $c \neq d$ , is equivalent to

- 1  $\frac{c+d}{d+2c}$
- 2  $\frac{c-d}{d+2c}$
- 3  $\frac{-c-d}{d+2c}$
- 4  $\frac{-c+d}{d+2c}$

322 For all values of  $x$  for which the expression is defined,  $\frac{x^3 + 2x^2 - 9x - 18}{x^3 - x^2 - 6x}$ , in simplest form, is

equivalent to

- 1 3
- 2  $-\frac{17}{2}$
- 3  $\frac{x+3}{x}$
- 4  $\frac{x^2 - 9}{x(x-3)}$

- 323 Which expression can be rewritten as  $(x+7)(x-1)$ ?
- $(x+3)^2 - 16$
  - $(x+3)^2 - 10(x+3) - 2(x+3) + 20$
  - $\frac{(x-1)(x^2 - 6x - 7)}{(x+1)}$
  - $\frac{(x+7)(x^2 + 4x + 3)}{(x+3)}$
- 324 For all values of  $x$  for which the expression is defined, write the expression below in simplest form.
- $$\frac{2x^3 + x^2 - 18x - 9}{3x - x^2}$$
- 325 Given  $x \neq -2$ , the expression  $\frac{2x^2 + 5x + 8}{x+2}$  is equivalent to
- $2x^2 + \frac{9}{x+2}$
  - $2x + \frac{7}{x+2}$
  - $2x + 1 + \frac{6}{x+2}$
  - $2x + 9 - \frac{10}{x+2}$
- 326 The expression  $\frac{x^3 + 2x^2 + x + 6}{x+2}$  is equivalent to
- $x^2 + 3$
  - $x^2 + 1 + \frac{4}{x+2}$
  - $2x^2 + x + 6$
  - $2x^2 + 1 + \frac{4}{x+2}$
- 327 Given  $x \neq -3$ , which expression is equivalent to  $\frac{2x^3 + 3x^2 - 4x + 5}{x+3}$ ?
- $2x^3 + 9x^2 + 23x + 74$
  - $2x^2 - 3x + 5 - \frac{10}{x+3}$
  - $2x^3 - 3x^2 + 5x - 10$
  - $2x^2 + 9x + 23 + \frac{74}{x+3}$
- 328 Given  $x \neq -3$ , the expression  $\frac{2x^3 + 7x^2 - 3x - 25}{x+3}$  is equivalent to
- $2x^2 + x - 6 - \frac{7}{x+3}$
  - $2x^2 + 13x - 36 + \frac{83}{x+3}$
  - $2x^2 + x - 13$
  - $x^2 + 4x - 15 + \frac{20}{x+3}$
- 329 Which expression is equivalent to  $\frac{2x^4 + 8x^3 - 25x^2 - 6x + 14}{x+6}$ ?
- $2x^3 + 4x^2 + x - 12 + \frac{86}{x+6}$
  - $2x^3 - 4x^2 - x + 14$
  - $2x^3 - 4x^2 - x + \frac{14}{x+6}$
  - $2x^3 - 4x^2 - x$
- 330 Which expression is equivalent to  $\frac{x^3 - 2}{x-2}$ ?
- $x^2$
  - $x^2 + 2x + 4 + \frac{6}{x-2}$
  - $x^2 - 2$
  - $x^2 - 2x + 4 - \frac{10}{x-2}$

331 The expression  $\frac{x^4 - 5x^2 + 4x + 14}{x + 2}$  is equivalent to

1  $x^3 - 2x^2 - x + 6 + \frac{2}{x + 2}$

2  $x^3 - 5x + 4 - \frac{14}{x + 2}$

3  $x^3 + 2x^2 - x + 2 + \frac{18}{x + 2}$

4  $x^3 + 2x^2 - 9x + 22 - \frac{30}{x + 2}$

332 The rational expression  $\frac{2x^4 - 5x^2 + 3x - 2}{x - 3}$  is equivalent to

1  $2x^3 - 5x - 12 - \frac{38}{x - 3}$

2  $2x^3 + 6x^2 + 13x + 42 + \frac{124}{x - 3}$

3  $2x^3 - 5x + 18 - \frac{56}{x - 3}$

4  $2x^3 - 6x^2 + 13x - 36 + \frac{106}{x - 3}$

333 What is the quotient when  $10x^3 - 3x^2 - 7x + 3$  is divided by  $2x - 1$ ?

1  $5x^2 + x + 3$

2  $5x^2 - x + 3$

3  $5x^2 - x - 3$

4  $5x^2 + x - 3$

334 The expression  $\frac{6x^3 + 17x^2 + 10x + 2}{2x + 3}$  equals

1  $3x^2 + 4x - 1 + \frac{5}{2x + 3}$

2  $6x^2 + 8x - 2 + \frac{5}{2x + 3}$

3  $6x^2 - x + 13 - \frac{37}{2x + 3}$

4  $3x^2 + 13x + \frac{49}{2} + \frac{151}{2x + 3}$

335 The expression  $\frac{9x^2 - 2}{3x + 1}$  is equivalent to

1  $3x - 1 - \frac{1}{3x + 1}$

2  $3x - 1 + \frac{1}{3x + 1}$

3  $3x + 1 - \frac{1}{3x + 1}$

4  $3x + 1 + \frac{1}{3x + 1}$

336 The expression  $\frac{4x^3 + 5x + 10}{2x + 3}$  is equivalent to

1  $2x^2 + 3x - 7 + \frac{31}{2x + 3}$

2  $2x^2 - 3x + 7 - \frac{11}{2x + 3}$

3  $2x^2 + 2.5x + 5 + \frac{15}{2x + 3}$

4  $2x^2 - 2.5x - 5 - \frac{20}{2x + 3}$

337 Which expression is equivalent to  $\frac{4x^3 + 9x - 5}{2x - 1}$ ,

where  $x \neq \frac{1}{2}$ ?

1  $2x^2 + x + 5$

2  $2x^2 + \frac{11}{2} + \frac{1}{2(2x - 1)}$

3  $2x^2 - x + 5$

4  $2x^2 - x + 4 + \frac{1}{2x - 1}$

338 Which expression is equivalent to  $\frac{2x^3 + 2x - 7}{2x + 4}$ ?

1  $x^2 - 2x + 5 - \frac{27}{2x + 4}$

2  $x^2 - 1 - \frac{3}{2x + 4}$

3  $x^2 + 2x + 5 + \frac{13}{2x + 4}$

4  $x^2 + 2x - 3 + \frac{5}{2x + 4}$

339 Given  $f(x) = 3x^2 + 7x - 20$  and  $g(x) = x - 2$ , state the quotient and remainder of  $\frac{f(x)}{g(x)}$ , in the form

$$q(x) + \frac{r(x)}{g(x)}.$$

340 Given  $a(x) = x^4 + 2x^3 + 4x - 10$  and  $b(x) = x + 2$ , determine  $\frac{a(x)}{b(x)}$  in the form  $q(x) + \frac{r(x)}{b(x)}$ . Is  $b(x)$  a factor of  $a(x)$ ? Explain.

341 Given  $f(x) = 3x^3 - 4x^2 + 2x - 1$  and  $g(x) = x - 4$ , state the quotient and remainder of  $\frac{f(x)}{g(x)}$ , in the form  $q(x) + \frac{r(x)}{g(x)}$ . Is  $x = 4$  a root of  $f(x)$ ? Explain your answer.

342 Determine the quotient and remainder when  $(6a^3 + 11a^2 - 4a - 9)$  is divided by  $(3a - 2)$ . Express your answer in the form  $q(a) + \frac{r(a)}{d(a)}$ .

343 When the function  $p(x)$  is divided by  $x - 1$  the quotient is  $x^2 + 7 + \frac{5}{x - 1}$ . State  $p(x)$  in standard form.

A.APR.D.7: ADDITION AND SUBTRACTION OF RATIONALS

344 The expression  $\frac{x^2 + 12}{x^2 + 3}$  can be rewritten as

1  $\frac{10}{x^2 + 3}$

2  $1 + \frac{9}{x^2 + 3}$

3  $x + 9$

4 4

345 The expression  $\frac{x^2 + 6}{x^2 + 4}$  is equivalent to

1  $\frac{6}{4}$

2  $1 + \frac{10}{x^2 + 4}$

3  $1 - \frac{2}{x^2 + 4}$

4  $1 + \frac{2}{x^2 + 4}$

346 The expression  $2 - \frac{x - 1}{x + 2}$  is equivalent to

1  $1 - \frac{3}{x + 2}$

2  $1 + \frac{3}{x + 2}$

3  $1 - \frac{1}{x + 2}$

4  $1 + \frac{1}{x + 2}$

- 347 Algebraically prove that  $\frac{x^3 + 9}{x^3 + 8} = 1 + \frac{1}{x^3 + 8}$ ,  
where  $x \neq -2$ .

A.CED.A.1: MODELING RATIONALS

- 348 A manufacturing plant produces two different-sized containers of peanuts. One container weighs  $x$  ounces and the other weighs  $y$  pounds. If a gift set can hold one of each size container, which expression represents the number of gift sets needed to hold 124 ounces?

- 1  $\frac{124}{16x + y}$
- 2  $\frac{x + 16y}{124}$
- 3  $\frac{124}{x + 16y}$
- 4  $\frac{16x + y}{124}$

- 349 Julie averaged 85 on the first three tests of the semester in her mathematics class. If she scores 93 on each of the remaining tests, her average will be 90. Which equation could be used to determine how many tests,  $T$ , are left in the semester?

- 1  $\frac{255 + 93T}{3T} = 90$
- 2  $\frac{255 + 90T}{3T} = 93$
- 3  $\frac{255 + 93T}{T + 3} = 90$
- 4  $\frac{255 + 90T}{T + 3} = 93$

- 350 A rush-hour commuter train has arrived on time 64 of its first 80 days. As arrivals continue, which equation can be used to find  $x$ , the number of consecutive days that the train must arrive on schedule to raise its on-time performance rate to 90%?

- 1  $\frac{64}{80 + x} = \frac{90}{100}$
- 2  $\frac{64 + x}{80 + x} = \frac{90}{100}$
- 3  $\frac{64 + x}{80} = \frac{90}{100}$
- 4  $\frac{x}{80 + x} = \frac{90}{100}$

- 351 Mallory wants to buy a new window air conditioning unit. The cost for the unit is \$329.99. If she plans to run the unit three months out of the year for an annual operating cost of \$108.78, which function models the cost per year over the lifetime of the unit,  $C(n)$ , in terms of the number of years,  $n$ , that she owns the air conditioner.

- 1  $C(n) = 329.99 + 108.78n$
- 2  $C(n) = 329.99 + 326.34n$
- 3  $C(n) = \frac{329.99 + 108.78n}{n}$
- 4  $C(n) = \frac{329.99 + 326.34n}{n}$

- 352 A number, minus twenty times its reciprocal, equals eight. The number is

- 1 10 or  $-2$
- 2 10 or 2
- 3  $-10$  or  $-2$
- 4  $-10$  or 2

A.REI.A.2: SOLVING RATIONALS

- 353 The focal length,  $F$ , of a camera's lens is related to the distance of the object from the lens,  $J$ , and the distance to the image area in the camera,  $W$ , by the formula below.

$$\frac{1}{J} + \frac{1}{W} = \frac{1}{F}$$

When this equation is solved for  $J$  in terms of  $F$  and  $W$ ,  $J$  equals

- 1  $F - W$
- 2  $\frac{FW}{F - W}$
- 3  $\frac{FW}{W - F}$
- 4  $\frac{1}{F} - \frac{1}{W}$

- 354 What is the solution set of the equation

$$\frac{2}{x} - \frac{3x}{x+3} = \frac{x}{x+3}?$$

- 1  $\{3\}$
- 2  $\left\{\frac{3}{2}\right\}$
- 3  $\{-2, 3\}$
- 4  $\left\{-1, \frac{3}{2}\right\}$

- 355 What is the solution set of the equation

$$\frac{2}{3x+1} = \frac{1}{x} - \frac{6x}{3x+1}?$$

- 1  $\left\{-\frac{1}{3}, \frac{1}{2}\right\}$
- 2  $\left\{-\frac{1}{3}\right\}$
- 3  $\left\{\frac{1}{2}\right\}$
- 4  $\left\{\frac{1}{3}, -2\right\}$

- 356 What is the solution set of the equation

$$\frac{x+2}{x} + \frac{x}{3} = \frac{2x^2+6}{3x}?$$

- 1  $\{-3\}$
- 2  $\{-3, 0\}$
- 3  $\{3\}$
- 4  $\{0, 3\}$

- 357 What is the solution set of the equation

$$\frac{10}{x^2-2x} + \frac{4}{x} = \frac{5}{x-2}?$$

- 1  $\{0, 2\}$
- 2  $\{0\}$
- 3  $\{2\}$
- 4  $\{\}$

- 358 The solution set of  $\frac{x+3}{x-5} + \frac{6}{x+2} = \frac{6+10x}{(x-5)(x+2)}$  is

- 1  $\{-6\}$
- 2  $\{5\}$
- 3  $\{-6, 5\}$
- 4  $\{-5, 6\}$

- 359 What is the solution set of the equation

$$\frac{4}{k^2-8k+12} = \frac{k}{k-2} + \frac{1}{k-6}?$$

- 1  $\{-1, 6\}$
- 2  $\{1, -6\}$
- 3  $\{-1\}$
- 4  $\{1\}$

- 360 What is the solution, if any, of the equation

$$\frac{2}{x+3} - \frac{3}{4-x} = \frac{2x-2}{x^2-x-12}?$$

- 1  $-1$
- 2  $-5$
- 3 all real numbers
- 4 no real solution

361 What is the solution set of the equation

$$\frac{3x+25}{x+7} - 5 = \frac{3}{x}?$$

- 1  $\left\{\frac{3}{2}, 7\right\}$
- 2  $\left\{\frac{7}{2}, -3\right\}$
- 3  $\left\{-\frac{3}{2}, 7\right\}$
- 4  $\left\{-\frac{7}{2}, -3\right\}$

362 The solutions to  $x + 3 - \frac{4}{x-1} = 5$  are

- 1  $\frac{3}{2} \pm \frac{\sqrt{17}}{2}$
- 2  $\frac{3}{2} \pm \frac{\sqrt{17}}{2} i$
- 3  $\frac{3}{2} \pm \frac{\sqrt{33}}{2}$
- 4  $\frac{3}{2} \pm \frac{\sqrt{33}}{2} i$

363 To solve  $\frac{2x}{x-2} - \frac{11}{x} = \frac{8}{x^2-2x}$ , Ren multiplied

both sides by the least common denominator.

Which statement is true?

- 1 2 is an extraneous solution.
- 2  $\frac{7}{2}$  is an extraneous solution.
- 3 0 and 2 are extraneous solutions.
- 4 This equation does not contain any extraneous solutions.

364 To solve the equation  $\frac{7}{x+7} + \frac{4x}{x-7} = \frac{3x+7}{x-7}$ ,

Joan's first step is to multiply both sides by the least common denominator. Which statement is true?

- 1 -14 is an extraneous solution.
- 2 7 and -7 are extraneous solutions.
- 3 7 is an extraneous solution.
- 4 There are no extraneous solutions.

365 Solve for  $x$ :  $\frac{1}{x} - \frac{1}{3} = -\frac{1}{3x}$

366 Solve algebraically for  $n$ :  $\frac{2}{n^2} + \frac{3}{n} = \frac{4}{n^2}$

367 Solve for all values of  $p$ :  $\frac{3p}{p-5} - \frac{2}{p+3} = \frac{p}{p+3}$

368 Solve for  $x$  algebraically:

$$\frac{1}{x-6} + \frac{x}{x-2} = \frac{4}{x^2-8x+12}$$

369 Algebraically solve for  $x$ :  $\frac{-3}{x+3} + \frac{1}{2} = \frac{x}{6} - \frac{1}{2}$

370 Algebraically solve for  $x$ :  $\frac{7}{2x} - \frac{2}{x+1} = \frac{1}{4}$



- 371 A formula for work problems involving two people is shown below.

$$\frac{1}{t_1} + \frac{1}{t_2} = \frac{1}{t_b}$$

$t_1$  = the time taken by the first person to complete the job

$t_2$  = the time taken by the second person to complete the job

$t_b$  = the time it takes for them working together to complete the job  
 Fred and Barney are carpenters who build the same model desk. It takes Fred eight hours to build the desk while it only takes Barney six hours. Write an equation that can be used to find the time it would take both carpenters working together to build a desk. Determine, to the *nearest tenth of an hour*, how long it would take Fred and Barney working together to build a desk.

- 372 Sarah is fighting a sinus infection. Her doctor prescribed a nasal spray and an antibiotic to fight the infection. The active ingredients, in milligrams, remaining in the bloodstream from the nasal spray,  $n(t)$ , and the antibiotic,  $a(t)$ , are modeled in the functions below, where  $t$  is the time in hours since the medications were taken.

$$n(t) = \frac{t+1}{t+5} + \frac{18}{t^2 + 8t + 15}$$

$$a(t) = \frac{9}{t+3}$$

Determine which drug is made with a greater initial amount of active ingredient. Justify your answer. Sarah's doctor told her to take both drugs at the same time. Determine algebraically the number of hours after taking the medications when both medications will have the same amount of active ingredient remaining in her bloodstream.

## SYSTEMS

### A.REI.C.6: SOLVING LINEAR SYSTEMS

- 373 For the system shown below, what is the value of  $z$ ?

$$y = -2x + 14$$

$$3x - 4z = 2$$

$$3x - y = 16$$

- 1 5
- 2 2
- 3 6
- 4 4

- 374 Consider the system of equations below?

$$x + 2y - z = 1$$

$$-x - 3y + 2z = 0$$

$$2x - 4y + z = 10$$

What is the solution to the given system of equations?

- 1 (1, 1, 2)
- 2 (3, -1, 0)
- 3 (5, -1, 2)
- 4 (3, 5, 8)

- 375 What is the solution for the system of equations below?

$$x + y + z = 2$$

$$x - 2y - z = -4$$

$$x - 9y + z = -18$$

- 1 (-2, 2, 2)
- 2 (-2, -2, 6)
- 3 (0, 2, 0)
- 4 (0, 2, 4)

Algebra II Regents Exam Questions by State Standard: Topic

[www.jmap.org](http://www.jmap.org)

- 376 Which value is *not* contained in the solution of the system shown below?

$$a + 5b - c = -20$$

$$4a - 5b + 4c = 19$$

$$-a - 5b - 5c = 2$$

- 1 -2
- 2 2
- 3 3
- 4 -3

- 377 Consider the system of equations below:

$$x + y - z = 6$$

$$2x - 3y + 2z = -19$$

$$-x + 4y - z = 17$$

Which number is *not* the value of any variable in the solution of the system?

- 1 -1
- 2 2
- 3 3
- 4 -4

- 378 Consider the system below.

$$x + y + z = 9$$

$$x - y - z = -1$$

$$x - y + z = 21$$

Which value is *not* in the solution,  $(x, y, z)$ , of the system?

- 1 -8
- 2 -6
- 3 11
- 4 4

- 379 Solve the following system of equations algebraically for all values of  $x$ ,  $y$ , and  $z$ :

$$x + 3y + 5z = 45$$

$$6x - 3y + 2z = -10$$

$$-2x + 3y + 8z = 72$$

- 380 Solve the following system of equations algebraically for all values of  $x$ ,  $y$ , and  $z$ :

$$x + y + z = 1$$

$$2x + 4y + 6z = 2$$

$$-x + 3y - 5z = 11$$

- 381 Solve the following system of equations algebraically for all values of  $x$ ,  $y$ , and  $z$ :

$$2x + 3y - 4z = -1$$

$$x - 2y + 5z = 3$$

$$-4x + y + z = 16$$

- 382 Solve the following system of equations algebraically for all values of  $a$ ,  $b$ , and  $c$ .

$$a + 4b + 6c = 23$$

$$a + 2b + c = 2$$

$$6b + 2c = a + 14$$

- 383 Solve the following system of equations algebraically for  $x$ ,  $y$ , and  $z$ .

$$2x + 4y - 3z = 12$$

$$3x - 2y + 2z = -9$$

$$-x + y - 3z = 0$$

A.REI.C.7: QUADRATIC-LINEAR SYSTEMS

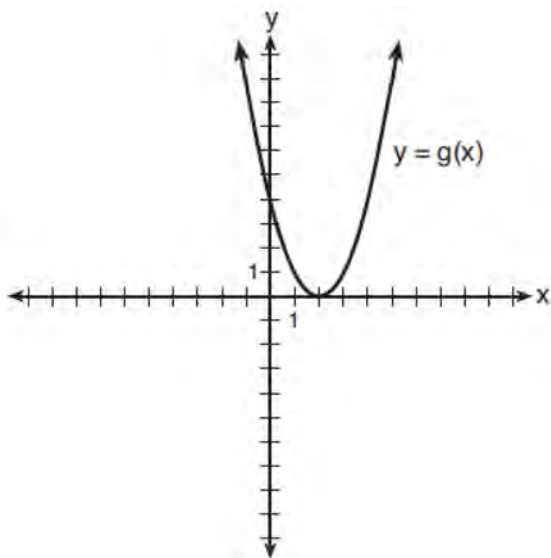
- 384 How many real solutions exist for the system of equations below?

$$y = \frac{1}{4}x - 8$$

$$y = \frac{1}{2}x^2 + 2x$$

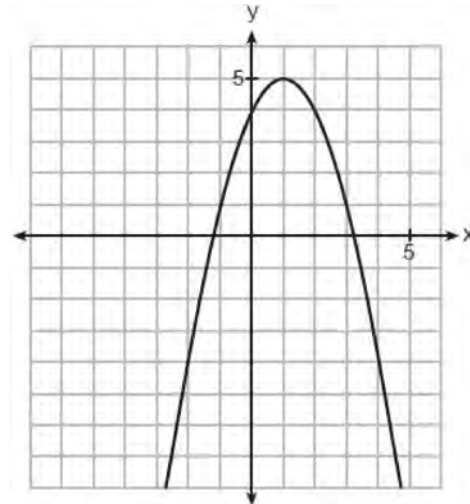
- 1 1
- 2 2
- 3 3
- 4 0

- 385 What is the solution to the system of equations  $y = 3x - 2$  and  $y = g(x)$  where  $g(x)$  is defined by the function below?



- 1  $\{(0, -2)\}$
- 2  $\{(0, -2), (1, 6)\}$
- 3  $\{(1, 6)\}$
- 4  $\{(1, 1), (6, 16)\}$

- 386 The graph of a quadratic function is shown below.



When the graph of  $x + y = 4$  is drawn on the same axes, one solution to this system is

- 1  $(4, 0)$
  - 2  $(1, 5)$
  - 3  $(2, 2)$
  - 4  $(3, 1)$
- 387 The graphs of the equations  $y = x^2 + 4x - 1$  and  $y + 3 = x$  are drawn on the same set of axes. One solution of this system is
- 1  $(-5, -2)$
  - 2  $(-1, -4)$
  - 3  $(1, 4)$
  - 4  $(-2, -1)$
- 388 What is the solution set of the following system of equations?

$$y = 3x + 6$$

$$y = (x + 4)^2 - 10$$

- 1  $\{(-5, -9)\}$
- 2  $\{(5, 21)\}$
- 3  $\{(0, 6), (-5, -9)\}$
- 4  $\{(0, 6), (5, 21)\}$

Algebra II Regents Exam Questions by State Standard: Topic

[www.jmap.org](http://www.jmap.org)

- 389 What are the solution(s) to the system of equations shown below?

$$x^2 + y^2 = 5$$

$$y = 2x$$

- 1  $x = 1$  and  $x = -1$
  - 2  $x = 1$
  - 3  $(1, 2)$  and  $(-1, -2)$
  - 4  $(1, 2)$ , only
- 390 Given  $y = -2x$  and  $x^2 + y^2 = 5$ , the point of intersection in Quadrant II is
- 1  $(1, -2)$
  - 2  $(-2, 1)$
  - 3  $(-1, 1)$
  - 4  $(-1, 2)$

- 391 Consider the system shown below.

$$2x - y = 4$$

$$(x + 3)^2 + y^2 = 8$$

The two solutions of the system can be described as

- 1 both imaginary
  - 2 both irrational
  - 3 both rational
  - 4 one rational and one irrational
- 392 Algebraically determine the values of  $x$  that satisfy the system of equations below:
- $$y = x^2 + 8x - 5$$
- $$y = 8x - 4$$
- 393 Algebraically determine the solution set for the system of equations below.
- $$y = 2x^2 - 7x + 4$$
- $$y = 11 - 2x$$

- 394 Algebraically determine the values of  $x$  that satisfy the system of equations below.

$$y = -2x + 1$$

$$y = -2x^2 + 3x + 1$$

- 395 Solve the system of equations algebraically.

$$x^2 + y^2 = 25$$

$$y + 5 = 2x$$

- 396 Solve the following system of equations algebraically.  $x^2 + y^2 = 400$

$$y = x - 28$$

- 397 Solve the system of equations shown below algebraically.

$$(x - 3)^2 + (y + 2)^2 = 16$$

$$2x + 2y = 10$$

- 398 Algebraically solve the following system of equations.

$$(x - 2)^2 + (y - 3)^2 = 16$$

$$x + y - 1 = 0$$

- 399 Algebraically solve the system:

$$(x - 2)^2 + (y - 3)^2 = 20$$

$$y = -2x + 7$$

A.REI.D.11: QUADRATIC-LINEAR SYSTEMS

400 Sally’s high school is planning their spring musical. The revenue,  $R$ , generated can be determined by the function  $R(t) = -33t^2 + 360t$ , where  $t$  represents the price of a ticket. The production cost,  $C$ , of the musical is represented by the function  $C(t) = 700 + 5t$ . What is the highest ticket price, to the *nearest dollar*, they can charge in order to *not* lose money on the event?

- 1  $t = 3$
- 2  $t = 5$
- 3  $t = 8$
- 4  $t = 11$

A.REI.D.11: OTHER SYSTEMS

401 If  $f(x) = (x^2 + 3x + 2)(x^2 - 4x + 3)$  and  $g(x) = x^2 - 9$ , then how many real solutions are there to the equation  $f(x) = g(x)$ ?

- 1 1
- 2 2
- 3 6
- 4 4

402 How many solutions exist for

$$\frac{1}{1-x^2} = -|3x-2| + 5?$$

- 1 1
- 2 2
- 3 3
- 4 4

403 What is the total number of points of intersection of the graphs of the equations  $y = e^x$  and  $xy = 20$ ?

- 1 1
- 2 2
- 3 3
- 4 0

404 After examining the functions  $f(x) = \ln(x + 2)$  and  $g(x) = e^{x-1}$  over the interval  $(-2, 3]$ , Lexi determined that the correct number of solutions to the equation  $f(x) = g(x)$  is

- 1 1
- 2 2
- 3 3
- 4 0

405 Selected values for the functions  $f$  and  $g$  are shown in the tables below.

$x$	$f(x)$		$x$	$g(x)$
-3.12	-4.88		-2.01	-1.01
0	-6		0	0.58
1.23	-4.77		8.52	2.53
8.52	2.53		13.11	3.01
9.01	3.01		16.52	3.29

A solution to the equation  $f(x) = g(x)$  is

- 1 0
- 2 2.53
- 3 3.01
- 4 8.52

Algebra II Regents Exam Questions by State Standard: Topic

[www.jmap.org](http://www.jmap.org)

- 406 Which value, to the *nearest tenth*, is *not* a solution of  $p(x) = q(x)$  if  $p(x) = x^3 + 3x^2 - 3x - 1$  and  $q(x) = 3x + 8$ ?
- 1 -3.9
  - 2 -1.1
  - 3 2.1
  - 4 4.7
- 407 If  $f(x) = 3|x| - 1$  and  $g(x) = 0.03x^3 - x + 1$ , an approximate solution for the equation  $f(x) = g(x)$  is
- 1 1.96
  - 2 11.29
  - 3  $(-0.99, 1.96)$
  - 4  $(11.29, 32.87)$
- 408 Given:  $h(x) = \frac{2}{9}x^3 + \frac{8}{9}x^2 - \frac{16}{13}x + 2$   
 $k(x) = -|0.7x| + 5$   
 State the solutions to the equation  $h(x) = k(x)$ , rounded to the *nearest hundredth*.
- 409 To the *nearest tenth*, the value of  $x$  that satisfies  $2^x = -2x + 11$  is
- 1 2.5
  - 2 2.6
  - 3 5.8
  - 4 5.9
- 410 The equations  $y = 3t + 6$  and  $y = (1.82)^t$  approximately model the growth of two separate populations where  $t > 0$ . What is the best approximation of the time,  $t$ , at which the populations are the same?
- 1 -1.9
  - 2 0.3
  - 3 5.1
  - 4 21.3
- 411 For which approximate value(s) of  $x$  will  $\log(x + 5) = |x - 1| - 3$ ?
- 1 5, 1
  - 2 -2.41, 0.41
  - 3 -2.41, 5
  - 4 5, only
- 412 For which values of  $x$ , rounded to the *nearest hundredth*, will  $|x^2 - 9| - 3 = \log_3 x$ ?
- 1 2.29 and 3.63
  - 2 2.37 and 3.54
  - 3 2.84 and 3.17
  - 4 2.92 and 3.06
- 413 When  $g(x) = \frac{2}{x+2}$  and  $h(x) = \log(x+1) + 3$  are graphed on the same set of axes, which coordinates best approximate their point of intersection?
- 1  $(-0.9, 1.8)$
  - 2  $(-0.9, 1.9)$
  - 3  $(1.4, 3.3)$
  - 4  $(1.4, 3.4)$
- 414 If  $p(x) = 2\ln(x) - 1$  and  $m(x) = \ln(x + 6)$ , then what is the solution for  $p(x) = m(x)$ ?
- 1 1.65
  - 2 3.14
  - 3 5.62
  - 4 no solution
- 415 Which value, to the *nearest tenth*, is the *smallest* solution of  $f(x) = g(x)$  if  $f(x) = 3\sin\left(\frac{1}{2}x\right) - 1$  and  $g(x) = x^3 - 2x + 1$ ?
- 1 -3.6
  - 2 -2.1
  - 3 -1.8
  - 4 1.4

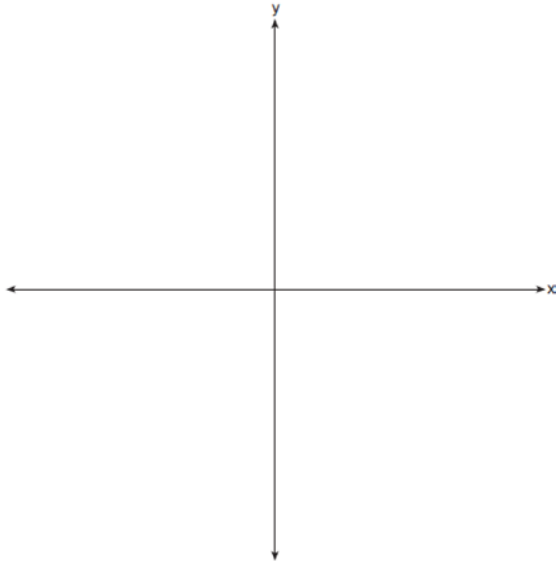
- 416 The populations of two small towns at the beginning of 2018 and their annual population growth rate are shown in the table below.

Town	Population	Annual Population Growth Rate
Jonesville	1240	6% increase
Williamstown	890	11% increase

Assuming the trend continues, approximately how many years after the beginning of 2018 will it take for the populations to be equal?

- |                        |                          |
|------------------------|--------------------------|
| <p>1 7</p> <p>2 20</p> | <p>3 68</p> <p>4 125</p> |
|------------------------|--------------------------|
- 417 Pedro and Bobby each own an ant farm. Pedro starts with 100 ants and says his farm is growing exponentially at a rate of 15% per month. Bobby starts with 350 ants and says his farm is steadily decreasing by 5 ants per month. Assuming both boys are accurate in describing the population of their ant farms, after how many months will they both have approximately the same number of ants?
- 1 7
- 2 8
- 3 13
- 4 36
- 418 Researchers in a local area found that the population of rabbits with an initial population of 20 grew continuously at the rate of 5% per month. The fox population had an initial value of 30 and grew continuously at the rate of 3% per month. Find, to the *nearest tenth of a month*, how long it takes for these populations to be equal.
- 419 On a certain tropical island, there are currently 500 palm trees and 200 flamingos. Suppose the palm tree population is decreasing at an annual rate of 3% per year and the flamingo population is growing at a continuous rate of 2% per year. Write two functions,  $P(x)$  and  $F(x)$ , that represent the number of palm trees and flamingos on this island, respectively,  $x$  years from now. State the solution to the equation  $P(x) = F(x)$ , rounded to the *nearest year*. Interpret the meaning of this value within the given context.
- 420 During the summer, Adam saved \$4000 and Betty saved \$3500. Adam deposited his money in Bank *A* at an annual rate of 2.4% compounded monthly. Betty deposited her money in Bank *B* at an annual rate of 4% compounded quarterly. Write two functions that represent the value of each account after  $t$  years if no other deposits or withdrawals are made, where Adam's account value is represented by  $A(t)$ , and Betty's by  $B(t)$ . Using technology, determine, to the *nearest tenth of a year*, how long it will take for the two accounts to have the same amount of money in them. Justify your answer.

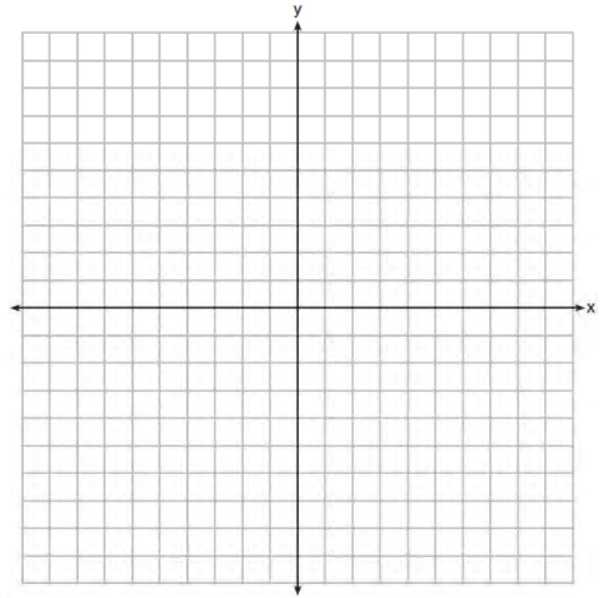
- 421 Sketch the graphs of  $r(x) = \frac{1}{x}$  and  $a(x) = |x| - 3$  on the set of axes below. Determine, to the *nearest tenth*, the positive solution of  $r(x) = a(x)$ .



- 422 On the set of axes below, graph  $y = f(x)$  and  $y = g(x)$  for the given functions.

$$f(x) = x^3 - 3x^2$$

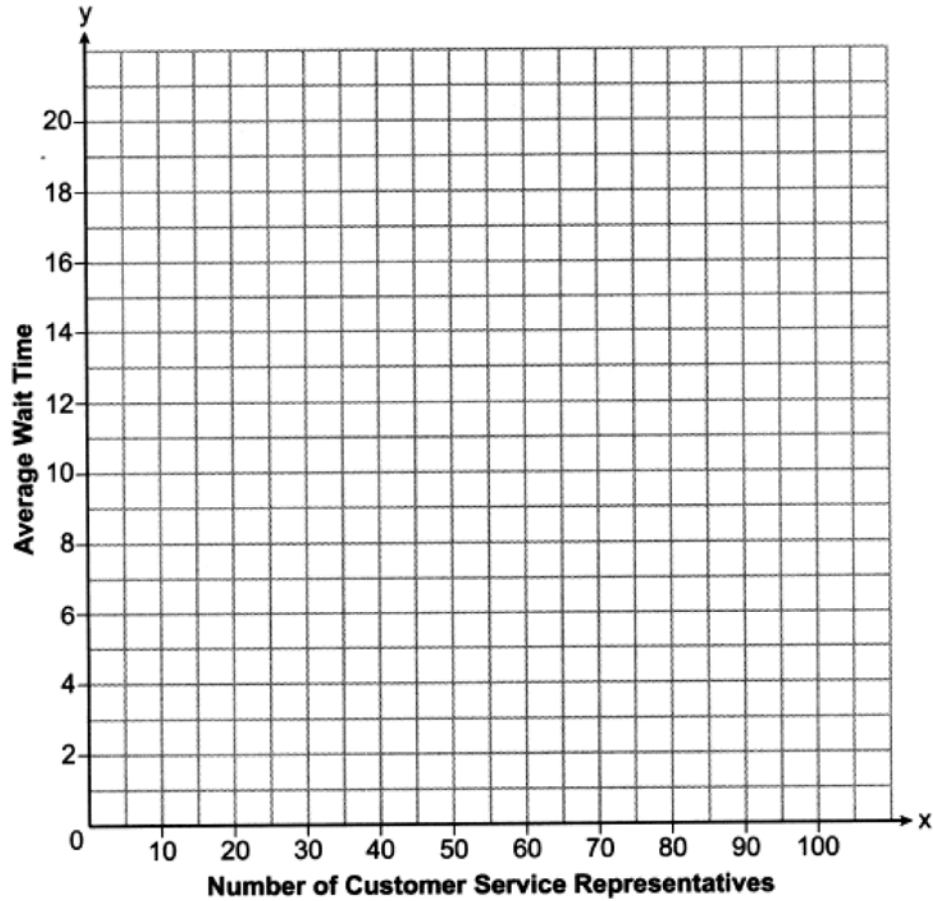
$$g(x) = 2x - 5$$



State the number of solutions to the equation  $f(x) = g(x)$ .

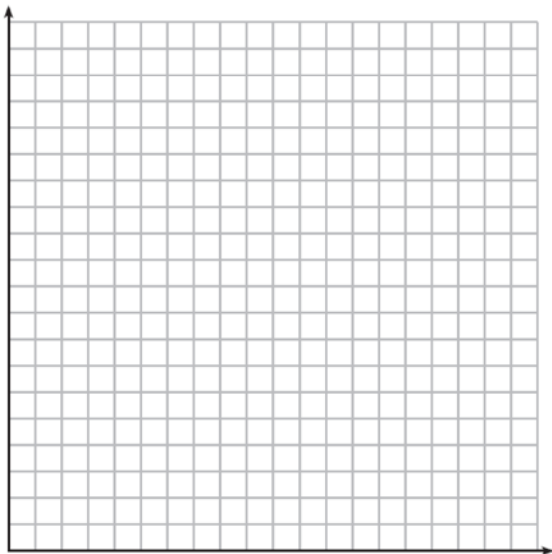


- 423 A technology company is comparing two plans for speeding up its technical support time. Plan A can be modeled by the function  $A(x) = 15.7(0.98)^x$  and plan B can be modeled by the function  $B(x) = 11(0.99)^x$  where  $x$  is the number of customer service representatives employed by the company and  $A(x)$  and  $B(x)$  represent the average wait time, in minutes, of each customer. Graph  $A(x)$  and  $B(x)$  in the interval  $0 \leq x \leq 100$  on the set of axes below.



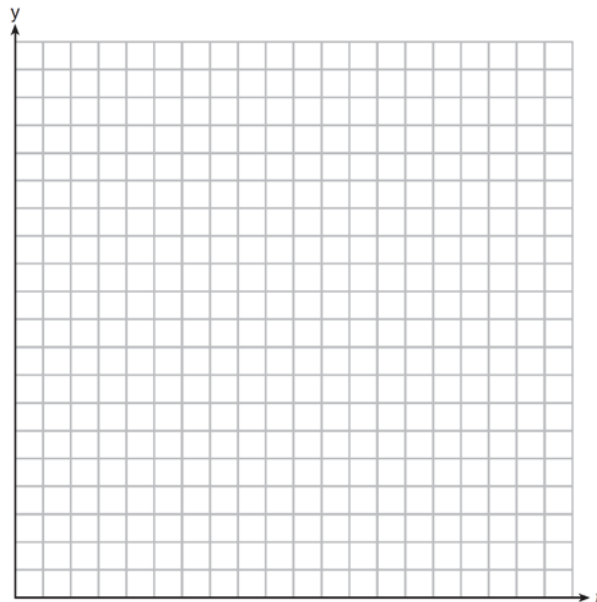
To the *nearest integer*, solve the equation  $A(x) = B(x)$ . Determine, to the *nearest minute*,  $B(100) - A(100)$ . Explain what this value represents in the given context.

- 424 The value of a certain small passenger car based on its use in years is modeled by  $V(t) = 28482.698(0.684)^t$ , where  $V(t)$  is the value in dollars and  $t$  is the time in years. Zach had to take out a loan to purchase the small passenger car. The function  $Z(t) = 22151.327(0.778)^t$ , where  $Z(t)$  is measured in dollars, and  $t$  is the time in years, models the unpaid amount of Zach's loan over time. Graph  $V(t)$  and  $Z(t)$  over the interval  $0 \leq t \leq 5$ , on the set of axes below.



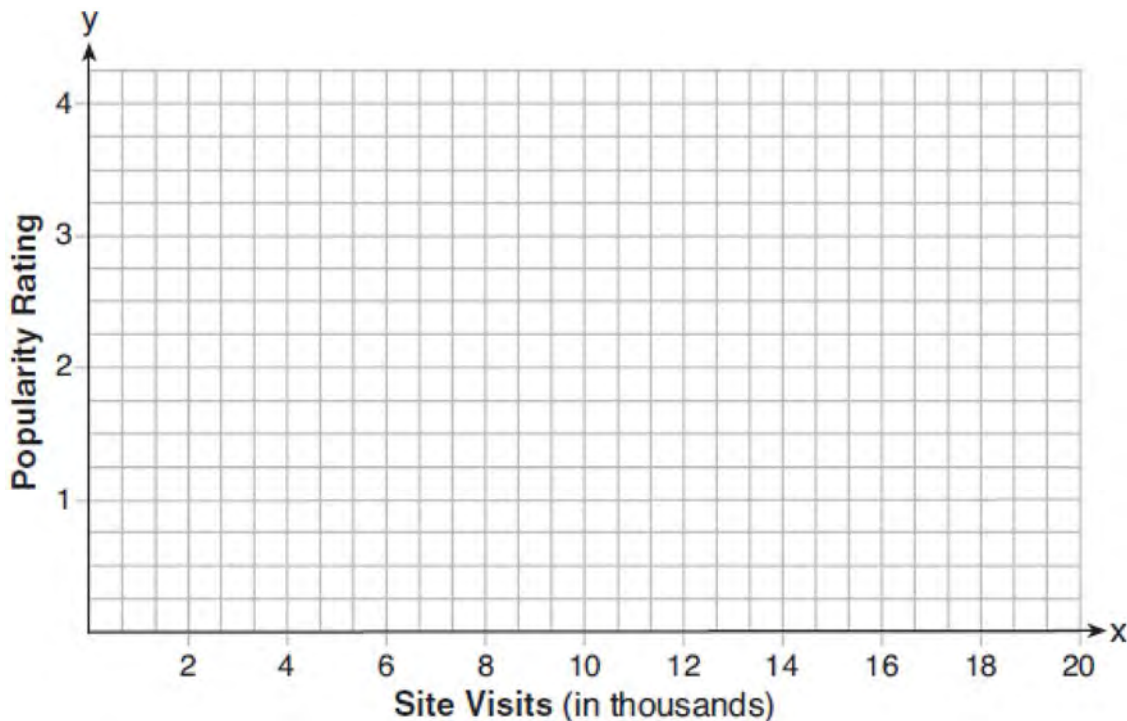
State when  $V(t) = Z(t)$ , to the *nearest hundredth*, and interpret its meaning in the context of the problem. Zach takes out an insurance policy that requires him to pay a \$3000 deductible in case of a collision. Zach will cancel the collision policy when the value of his car equals his deductible. To the *nearest year*, how long will it take Zach to cancel this policy? Justify your answer.

- 425 Drugs break down in the human body at different rates and therefore must be prescribed by doctors carefully to prevent complications, such as overdosing. The breakdown of a drug is represented by the function  $N(t) = N_0(e)^{-rt}$ , where  $N(t)$  is the amount left in the body,  $N_0$  is the initial dosage,  $r$  is the decay rate, and  $t$  is time in hours. Patient A,  $A(t)$ , is given 800 milligrams of a drug with a decay rate of 0.347. Patient B,  $B(t)$ , is given 400 milligrams of another drug with a decay rate of 0.231. Write two functions,  $A(t)$  and  $B(t)$ , to represent the breakdown of the respective drug given to each patient. Graph each function on the set of axes below.



To the *nearest hour*,  $t$ , when does the amount of the given drug remaining in patient B begin to exceed the amount of the given drug remaining in patient A? The doctor will allow patient A to take another 800 milligram dose of the drug once only 15% of the original dose is left in the body. Determine, to the *nearest tenth of an hour*, how long patient A will have to wait to take another 800 milligram dose of the drug.

- 426 Website popularity ratings are often determined using models that incorporate the number of visits per week a website receives. One model for ranking websites is  $P(x) = \log(x - 4)$ , where  $x$  is the number of visits per week in thousands and  $P(x)$  is the website's popularity rating. According to this model, if a website is visited 16,000 times in one week, what is its popularity rating, rounded to the *nearest tenth*? Graph  $y = P(x)$  on the axes below.



An alternative rating model is represented by  $R(x) = \frac{1}{2}x - 6$ , where  $x$  is the number of visits per week in thousands. Graph  $R(x)$  on the same set of axes. For what number of weekly visits will the two models provide the same rating?

## FUNCTIONS

### F.BF.A.1: OPERATIONS WITH FUNCTIONS

- 427 If  $p(x) = ab^x$  and  $r(x) = cd^x$ , then  $p(x) \cdot r(x)$  equals

- 1  $ac(b + d)^x$
- 2  $ac(b + d)^{2x}$
- 3  $ac(bd)^x$
- 4  $ac(bd)^{x^2}$

- 428 For all real values of  $x$ , if  $f(x) = (x - 3)^2$  and  $g(x) = (x + 3)^2$ , what is  $f(x) - g(x)$ ?

- 1  $-18$
- 2  $0$
- 3  $-12x$
- 4  $2x^2 - 12x - 18$

- 429 Given  $f(x) = 2x^2 + 7x - 15$  and  $g(x) = 3 - 2x$ , what is  $\frac{f(x)}{g(x)}$  for all defined values?
- $-x - 5$
  - $-x + 5$
  - $x - 5$
  - $x + 5$
- 430 If  $f(x) = x^2 + 9$  and  $g(x) = x + 3$ , which operation would not result in a polynomial expression?
- $f(x) + g(x)$
  - $f(x) - g(x)$
  - $f(x) \cdot g(x)$
  - $f(x) \div g(x)$
- 431 If  $g(c) = 1 - c^2$  and  $m(c) = c + 1$ , then which statement is *not* true?
- $g(c) \cdot m(c) = 1 + c - c^2 - c^3$
  - $g(c) + m(c) = 2 + c - c^2$
  - $m(c) - g(c) = c + c^2$
  - $\frac{m(c)}{g(c)} = \frac{-1}{1 - c}$
- 432 Chet has \$1200 invested in a bank account modeled by the function  $P(n) = 1200(1.002)^n$ , where  $P(n)$  is the value of his account, in dollars, after  $n$  months. Chet's debt is modeled by the function  $Q(n) = 100n$ , where  $Q(n)$  is the value of debt, in dollars, after  $n$  months. After  $n$  months, which function represents Chet's net worth,  $R(n)$ ?
- $R(n) = 1200(1.002)^n + 100n$
  - $R(n) = 1200(1.002)^{12n} + 100n$
  - $R(n) = 1200(1.002)^n - 100n$
  - $R(n) = 1200(1.002)^{12n} - 100n$
- 433 A manufacturing company has developed a cost model,  $C(x) = 0.15x^3 + 0.01x^2 + 2x + 120$ , where  $x$  is the number of items sold, in thousands. The sales price can be modeled by  $S(x) = 30 - 0.01x$ . Therefore, revenue is modeled by  $R(x) = x \cdot S(x)$ . The company's profit,  $P(x) = R(x) - C(x)$ , could be modeled by
- $0.15x^3 + 0.02x^2 - 28x + 120$
  - $-0.15x^3 - 0.02x^2 + 28x - 120$
  - $-0.15x^3 + 0.01x^2 - 2.01x - 120$
  - $-0.15x^3 + 32x + 120$
- 434 Stone Manufacturing has developed a cost model,  $C(x) = 0.18x^3 + 0.02x^2 + 4x + 180$ , where  $x$  is the number of sprockets sold, in thousands. The sales price can be modeled by  $S(x) = 95.4 - 6x$  and the company's revenue by  $R(x) = x \cdot S(x)$ . The company's profits,  $R(x) - C(x)$ , could be modeled by
- $0.18x^3 + 6.02x^2 + 91.4x + 180$
  - $0.18x^3 - 5.98x^2 - 91.4x + 180$
  - $-0.18x^3 - 6.02x^2 + 91.4x - 180$
  - $0.18x^3 + 5.98x^2 + 99.4x + 180$
- 435 The profit function,  $p(x)$ , for a company is the cost function,  $c(x)$ , subtracted from the revenue function,  $r(x)$ . The profit function for the Acme Corporation is  $p(x) = -0.5x^2 + 250x - 300$  and the revenue function is  $r(x) = -0.3x^2 + 150x$ . The cost function for the Acme Corporation is
- $c(x) = 0.2x^2 - 100x + 300$
  - $c(x) = 0.2x^2 + 100x + 300$
  - $c(x) = -0.2x^2 + 100x - 300$
  - $c(x) = -0.8x^2 + 400x - 300$
- 436 Given:  $f(x) = 2x^2 + x - 3$  and  $g(x) = x - 1$   
Express  $f(x) \cdot g(x) - [f(x) + g(x)]$  as a polynomial in standard form.

- 437 Write the expression  $A(x) \cdot B(x) - 3C(x)$  as a polynomial in standard form.

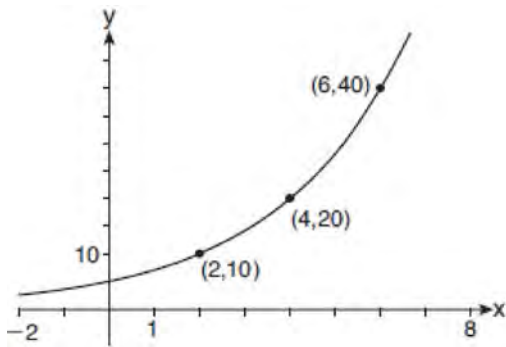
$$A(x) = x^3 + 2x - 1$$

$$B(x) = x^2 + 7$$

$$C(x) = x^4 - 5x$$

F.LE.A.2: FAMILIES OF FUNCTIONS

- 438 The graph of  $y = f(x)$  is shown below.



Which expression defines  $f(x)$ ?

- 1  $2x$
- 2  $5(2^x)$
- 3  $5(2^{\frac{x}{2}})$
- 4  $5(2^{2x})$

- 439 Which table best represents an exponential relationship?

x	y
1	8
2	4
3	2
4	1
5	$\frac{1}{2}$

1

x	y
8	0
4	1
0	2
-4	3
-8	4

2

x	y
0	0
1	1
2	4
3	9
4	16

3

x	y
1	1
2	8
3	27
4	64
5	125

4

- 440 Perry invested in property that cost him \$1500. Five years later it was worth \$3000, and 10 years from his original purchase, it was worth \$6000. Assuming the growth rate remains the same, which type of function could he create to find the value of his investment 30 years from his original purchase?
- 1 exponential function
  - 2 linear function
  - 3 quadratic function
  - 4 trigonometric function

**F.IF.C.9: COMPARING FUNCTIONS**

- 441 The  $x$ -value of which function's  $x$ -intercept is larger,  $f$  or  $h$ ? Justify your answer.

$$f(x) = \log(x - 4)$$

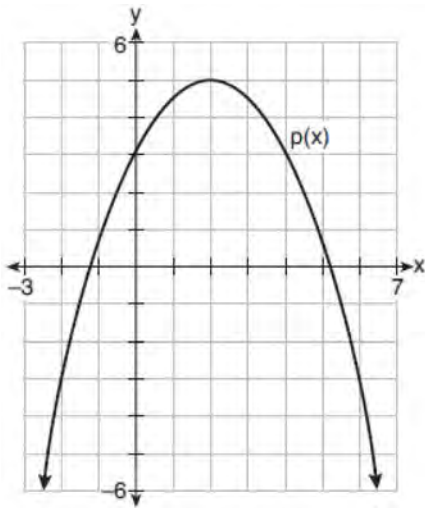
$x$	$h(x)$
-1	6
0	4
1	2
2	0
3	-2

- 442 Consider the function  $h(x) = 2 \sin(3x) + 1$  and the function  $q$  represented in the table below.

$x$	$q(x)$
-2	-8
-1	0
0	0
1	-2
2	0

Determine which function has the *smaller* minimum value for the domain  $[-2, 2]$ . Justify your answer.

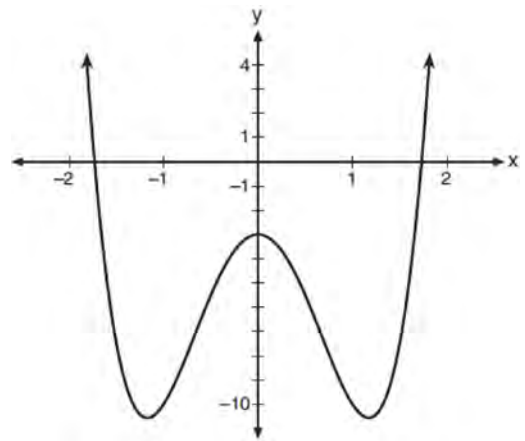
443 Consider  $f(x) = 4x^2 + 6x - 3$ , and  $p(x)$  defined by the graph below.



The difference between the values of the maximum of  $p$  and minimum of  $f$  is

- 1 0.25
- 2 1.25
- 3 3.25
- 4 10.25

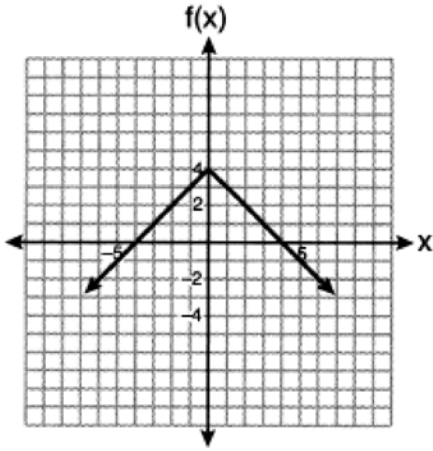
444 Consider the function  $p(x) = 3x^3 + x^2 - 5x$  and the graph of  $y = m(x)$  below.



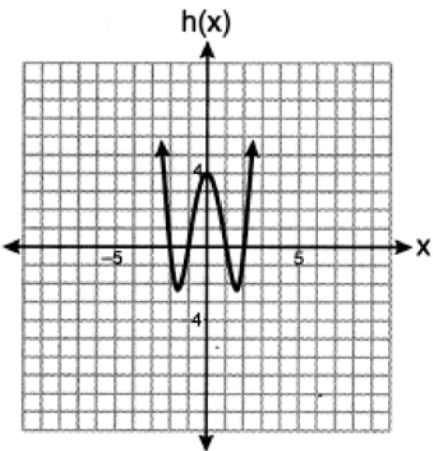
Which statement is true?

- 1  $p(x)$  has three real roots and  $m(x)$  has two real roots.
- 2  $p(x)$  has one real root and  $m(x)$  has two real roots.
- 3  $p(x)$  has two real roots and  $m(x)$  has three real roots.
- 4  $p(x)$  has three real roots and  $m(x)$  has four real roots.

445 Which function has a maximum y-value of 4 and a midline of  $y = 1$ ?

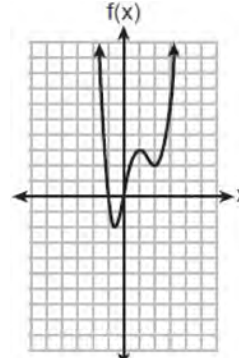


- 1
- 2  $g(x) = -3 \cos(x) + 1$

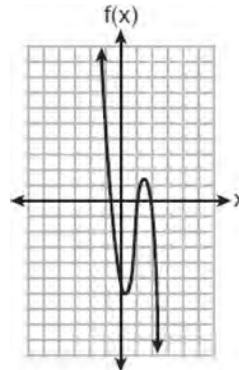


- 3
- 4  $j(x) = 4 \sin(x) + 1$

446 Which function has the characteristic as  $x \rightarrow -\infty, f(x) \rightarrow -\infty$ ?



1



2

3  $f(x) = 5(4)^{-x}$

4  $f(x) = -\log_5(-x)$

447 Which function has the greatest y-intercept?

1  $f(x) = 4 \sin(2x)$

2  $g(x) = 3x^4 + 2x^3 + 7$

3  $h(x) = 5e^{2x} + 3$

4  $j(x) = 6 \log_2(3x + 4)$



448 Which statement regarding the graphs of the functions below is *untrue*?

$$f(x) = 3 \sin 2x, \text{ from } -\pi < x < \pi$$

$$g(x) = (x - 0.5)(x + 4)(x - 2)$$

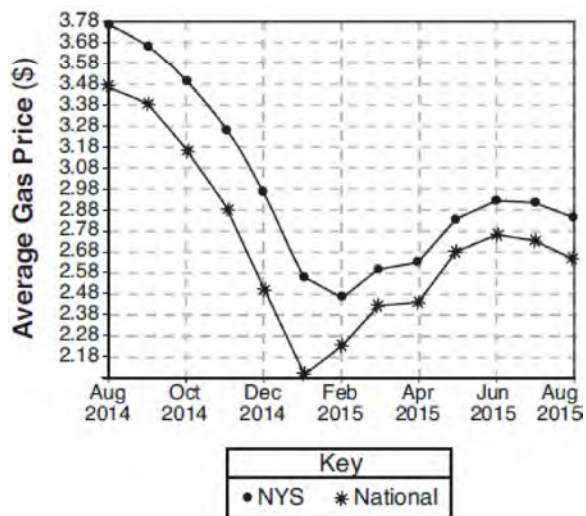
$$h(x) = \log_2 x$$

$$j(x) = -|4x - 2| + 3$$

- 1  $f(x)$  and  $j(x)$  have a maximum  $y$ -value of 3.
- 2  $f(x)$ ,  $h(x)$ , and  $j(x)$  have one  $y$ -intercept.
- 3  $g(x)$  and  $j(x)$  have the same end behavior as  $x \rightarrow -\infty$ .
- 4  $g(x)$ ,  $h(x)$ , and  $j(x)$  have rational zeros.

**F.BF.B.3: TRANSFORMATIONS WITH FUNCTIONS**

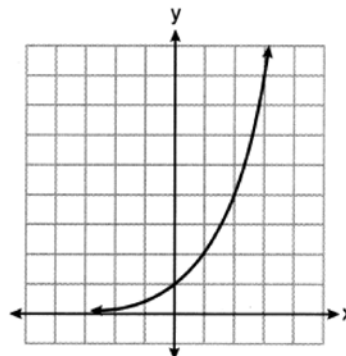
449 The graph below represents national and New York State average gas prices.



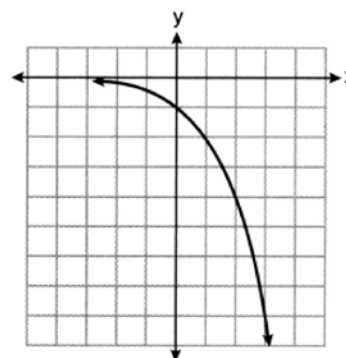
If New York State's gas prices are modeled by  $G(x)$  and  $C > 0$ , which expression best approximates the national average  $x$  months from August 2014?

- 1  $G(x + C)$
- 2  $G(x) + C$
- 3  $G(x - C)$
- 4  $G(x) - C$

450 Consider the function  $y = h(x)$ , defined by the graph below.



Which equation could be used to represent the graph shown below?



- 1  $y = h(x) - 2$
- 2  $y = h(x - 2)$
- 3  $y = -h(x)$
- 4  $y = h(-x)$

**F.BF.B.3: EVEN AND ODD FUNCTIONS**

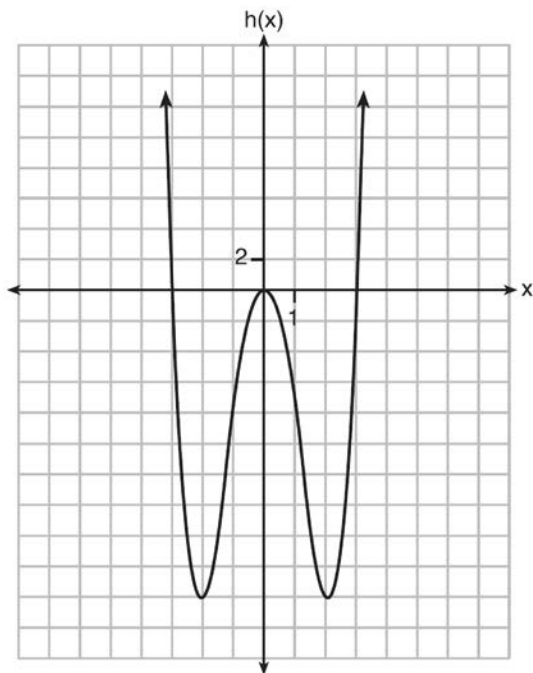
451 If  $f(x)$  is an even function, which function must also be even?

- 1  $f(x - 2)$
- 2  $f(x) + 3$
- 3  $f(x + 1)$
- 4  $f(x + 1) + 3$

452 Functions  $f$ ,  $g$ , and  $h$  are given below.

$$f(x) = \sin(2x)$$

$$g(x) = f(x) + 1$$



Which statement is true about functions  $f$ ,  $g$ , and  $h$ ?

- 1  $f(x)$  and  $g(x)$  are odd,  $h(x)$  is even.
- 2  $f(x)$  and  $g(x)$  are even,  $h(x)$  is odd.
- 3  $f(x)$  is odd,  $g(x)$  is neither,  $h(x)$  is even.
- 4  $f(x)$  is even,  $g(x)$  is neither,  $h(x)$  is odd.

453 Which equation represents an odd function?

- 1  $y = \sin x$
- 2  $y = \cos x$
- 3  $y = (x + 1)^3$
- 4  $y = e^{5x}$

454 Which function is even?

- 1  $f(x) = \sin x$
- 2  $f(x) = x^2 - 4$
- 3  $f(x) = |x - 2| + 5$
- 4  $f(x) = x^4 + 3x^3 + 4$

455 For  $f(x) = \cos x$ , which statement is true?

- 1  $2f(x)$  and  $f(2x)$  are even functions.
- 2  $f(2x)$  and  $f(x) + 2$  are odd functions.
- 3  $2f(x)$  and  $f\left(x + \frac{\pi}{2}\right)$  are odd functions.
- 4  $f(x) + 2$  is an odd function and  $f\left(x + \frac{\pi}{2}\right)$  is an even function.

456 Which function is even?

- 1  $f(x) = x^3 + 2$
- 2  $f(x) = x^2 + 1$
- 3  $f(x) = |x + 2|$
- 4  $f(x) = \sin(2x)$

457 Algebraically determine whether the function

$$j(x) = x^4 - 3x^2 - 4$$

is odd, even, or neither.

#### F.BF.B.4: INVERSE OF FUNCTIONS

458 What is the inverse of the function  $y = 4x + 5$ ?

- 1  $x = \frac{1}{4}y - \frac{5}{4}$
- 2  $y = \frac{1}{4}x - \frac{5}{4}$
- 3  $y = 4x - 5$
- 4  $y = \frac{1}{4x + 5}$

459 If  $f(x) = 12x - 4$ , then the inverse function  $f^{-1}(x)$  is

- 1  $f^{-1}(x) = \frac{x+1}{3}$
- 2  $f^{-1}(x) = \frac{x}{3} + 1$
- 3  $f^{-1}(x) = \frac{x+4}{12}$
- 4  $f^{-1}(x) = \frac{x}{12} + 4$

- 460 What is the inverse of  $f(x) = -6(x - 2)$ ?
- $f^{-1}(x) = -2 - \frac{x}{6}$
  - $f^{-1}(x) = 2 - \frac{x}{6}$
  - $f^{-1}(x) = \frac{1}{-6(x - 2)}$
  - $f^{-1}(x) = 6(x + 2)$
- 461 Given  $f(x) = \frac{1}{2}x + 8$ , which equation represents the inverse,  $g(x)$ ?
- $g(x) = 2x - 8$
  - $g(x) = 2x - 16$
  - $g(x) = -\frac{1}{2}x + 8$
  - $g(x) = -\frac{1}{2}x - 16$
- 462 If  $f(x) = \frac{1}{2}x + 2$ , then the inverse function is
- $f^{-1}(x) = -\frac{1}{2}x - 2$
  - $f^{-1}(x) = \frac{1}{2}x - 1$
  - $f^{-1}(x) = 2x - 4$
  - $f^{-1}(x) = 2x + 2$
- 463 The inverse of  $f(x) = -6x + \frac{1}{2}$  is
- $f^{-1}(x) = 6x - \frac{1}{2}$
  - $f^{-1}(x) = \frac{1}{-6x + \frac{1}{2}}$
  - $f^{-1}(x) = -\frac{1}{6}x + \frac{1}{12}$
  - $f^{-1}(x) = -\frac{1}{6}x + 2$
- 464 Given  $f^{-1}(x) = -\frac{3}{4}x + 2$ , which equation represents  $f(x)$ ?
- $f(x) = \frac{4}{3}x - \frac{8}{3}$
  - $f(x) = -\frac{4}{3}x + \frac{8}{3}$
  - $f(x) = \frac{3}{4}x - 2$
  - $f(x) = -\frac{3}{4}x + 2$
- 465 Given the inverse function  $f^{-1}(x) = \frac{2}{3}x + \frac{1}{6}$ , which function represents  $f(x)$ ?
- $f(x) = -\frac{2}{3}x + \frac{1}{6}$
  - $f(x) = -\frac{3}{2}x + \frac{1}{4}$
  - $f(x) = \frac{3}{2}x - \frac{1}{4}$
  - $f(x) = \frac{3}{2}x - \frac{1}{6}$
- 466 Given  $f(x) = -\frac{2}{5}x + 4$ , which statement is true of the inverse function  $f^{-1}(x)$ ?
- $f^{-1}(x)$  is a line with slope  $\frac{5}{2}$ .
  - $f^{-1}(x)$  is a line with slope  $\frac{2}{5}$ .
  - $f^{-1}(x)$  passes through the point  $(6, -5)$ .
  - $f^{-1}(x)$  has a y-intercept at  $(0, -4)$ .
- 467 What is the inverse of  $f(x) = x^3 - 2$ ?
- $f^{-1}(x) = \sqrt[3]{x} + 2$
  - $f^{-1}(x) = \pm\sqrt[3]{x} + 2$
  - $f^{-1}(x) = \sqrt[3]{x + 2}$
  - $f^{-1}(x) = \pm\sqrt[3]{x + 2}$

468 Given  $f(x) = x^3 - 3$  and  $f^{-1}(x) = \sqrt[3]{x - 3b}$ , the value of  $b$  is

- 1 1
- 2 -1
- 3 3
- 4 -3

469 For the function  $f(x) = (x - 3)^3 + 1$ , find  $f^{-1}(x)$ .

470 What is the inverse of the function  $y = \log_3 x$ ?

- 1  $y = x^3$
- 2  $y = \log_x 3$
- 3  $y = 3^x$
- 4  $x = 3^y$

471 If  $f(x) = a^x$  where  $a > 1$ , then the inverse of the function is

- 1  $f^{-1}(x) = \log_x a$
- 2  $f^{-1}(x) = a \log x$
- 3  $f^{-1}(x) = \log_a x$
- 4  $f^{-1}(x) = x \log a$

472 What is the inverse of  $f(x) = \frac{x}{x+2}$ , where  $x \neq -2$ ?

- 1  $f^{-1}(x) = \frac{2x}{x-1}$
- 2  $f^{-1}(x) = \frac{-2x}{x-1}$
- 3  $f^{-1}(x) = \frac{x}{x-2}$
- 4  $f^{-1}(x) = \frac{-x}{x-2}$

473 The inverse of the function  $f(x) = \frac{x+1}{x-2}$  is

- 1  $f^{-1}(x) = \frac{x+1}{x+2}$
- 2  $f^{-1}(x) = \frac{2x+1}{x-1}$
- 3  $f^{-1}(x) = \frac{x+1}{x-2}$
- 4  $f^{-1}(x) = \frac{x-1}{x+1}$

## SEQUENCES AND SERIES

### F.BF.A.1: SEQUENCES

474 Given  $f(9) = -2$ , which function can be used to generate the sequence  $-8, -7.25, -6.5, -5.75, \dots$ ?

- 1  $f(n) = -8 + 0.75n$
- 2  $f(n) = -8 - 0.75(n - 1)$
- 3  $f(n) = -8.75 + 0.75n$
- 4  $f(n) = -0.75 + 8(n - 1)$

475 When a ball bounces, the heights of consecutive bounces form a geometric sequence. The height of the first bounce is 121 centimeters and the height of the third bounce is 64 centimeters. To the nearest centimeter, what is the height of the fifth bounce?

- 1 25
- 2 34
- 3 36
- 4 42

476 The seventh term of the geometric sequence  $\sqrt{6}, -2\sqrt{3}, 2\sqrt{6}, -4\sqrt{3}, \dots$  is

- 1  $6\sqrt{6}$
- 2  $-6\sqrt{3}$
- 3  $8\sqrt{6}$
- 4  $-8\sqrt{3}$

**Algebra II Regents Exam Questions by State Standard: Topic**

- 477 The formula below can be used to model which scenario?

$$a_1 = 3000$$

$$a_n = 0.80a_{n-1}$$

- 1 The first row of a stadium has 3000 seats, and each row thereafter has 80 more seats than the row in front of it.
- 2 The last row of a stadium has 3000 seats, and each row before it has 80 fewer seats than the row behind it.
- 3 A bank account starts with a deposit of \$3000, and each year it grows by 80%.
- 4 The initial value of a specialty toy is \$3000, and its value each of the following years is 20% less.

- 478 The eighth and tenth terms of a sequence are 64 and 100. If the sequence is either arithmetic or geometric, the ninth term can *not* be

- 1 -82
- 2 -80
- 3 80
- 4 82

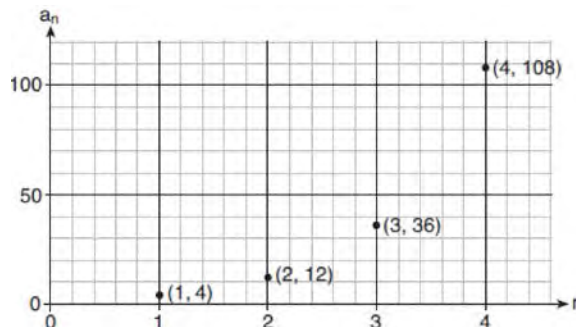
- 479 Write a recursive formula for the sequence 189, 63, 21, 7, . . . .

- 480 Write a recursive formula for the sequence 6, 9, 13.5, 20.25, . . .

- 481 While experimenting with her calculator, Candy creates the sequence 4, 9, 19, 39, 79, .... Write a recursive formula for Candy's sequence. Determine the eighth term in Candy's sequence.

- 482 Simon lost his library card and has an overdue library book. When the book was 5 days late, he owed \$2.25 to replace his library card and pay the fine for the overdue book. When the book was 21 days late, he owed \$6.25 to replace his library card and pay the fine for the overdue book. Suppose the total amount Simon owes when the book is  $n$  days late can be determined by an arithmetic sequence. Determine a formula for  $a_n$ , the  $n$ th term of this sequence. Use the formula to determine the amount of money, in dollars, Simon needs to pay when the book is 60 days late.

- 483 Write a recursive formula,  $a_n$ , to describe the sequence graphed below.



F.IF.A.3: SEQUENCES

- 484 Consider the following patterns:

I. 16, -12, 9, -6.75, . . .

II. 1, 4, 9, 16, . . .

III. 6, 18, 30, 42, . . .

IV.  $\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \frac{4}{5}, \dots$

Which pattern is geometric?

- 1 I
- 2 II
- 3 III
- 4 IV

- 485 A function is defined as  $a_n = a_{n-1} + \log_{n+1}(n-1)$ , where  $a_1 = 8$ . What is the value of  $a_3$ ?
- 1 8
  - 2 8.5
  - 3 9.2
  - 4 10
- 486 Which situation could be modeled using a geometric sequence?
- 1 A cell phone company charges \$30.00 per month for 2 gigabytes of data and \$12.50 for each additional gigabyte of data.
  - 2 The temperature in your car is  $79^\circ$ . You lower the temperature of your air conditioning by  $2^\circ$  every 3 minutes in order to find a comfortable temperature.
  - 3 David's parents have set a limit of 50 minutes per week that he may play online games during the school year. However, they will increase his time by 5% per week for the next ten weeks.
  - 4 Sarah has \$100.00 in her piggy bank and saves an additional \$15.00 each week.
- F.BF.A.2: SEQUENCES**
- 487 At her job, Pat earns \$25,000 the first year and receives a raise of \$1000 each year. The explicit formula for the  $n$ th term of this sequence is  $a_n = 25,000 + (n-1)1000$ . Which rule best represents the equivalent recursive formula?
- 1  $a_n = 24,000 + 1000n$
  - 2  $a_n = 25,000 + 1000n$
  - 3  $a_1 = 25,000, a_n = a_{n-1} + 1000$
  - 4  $a_1 = 25,000, a_n = a_{n+1} + 1000$
- 488 Savannah just got contact lenses. Her doctor said she can wear them 2 hours the first day, and can then increase the length of time by 30 minutes each day. If this pattern continues, which formula would *not* be appropriate to determine the length of time, in either minutes or hours, she could wear her contact lenses on the  $n$ th day?
- 1  $a_1 = 120$
  - 2  $a_n = a_{n-1} + 30$
  - 3  $a_n = 90 + 30n$
  - 4  $a_1 = 2$
- $a_n = a_{n-1} + 0.5$
- $a_n = 2.5 + 0.5n$
- 489 A recursive formula for the sequence 18, 9, 4.5, ... is
- 1  $g_1 = 18$
  - 2  $g_n = \frac{1}{2}g_{n-1}$
  - 3  $g_n = 18\left(\frac{1}{2}\right)^{n-1}$
  - 4  $g_1 = 18$
- $g_n = 2g_{n-1}$
- $g_n = 18(2)^{n-1}$
- 490 A recursive formula for the sequence 64, 48, 36, ... is
- 1  $a_n = 64(0.75)^{n-1}$
  - 2  $a_1 = 64$
  - 3  $a_n = a_{n-1} - 16$
  - 4  $a_n = 64 + (n-1)(-16)$
- $a_1 = 64$
- $a_n = 0.75a_{n-1}$

- 491 A recursive formula for the sequence 40, 30, 22.5, ... is

1  $g_n = 40\left(\frac{3}{4}\right)^n$

2  $g_1 = 40$

$g_n = g_{n-1} - 10$

3  $g_n = 40\left(\frac{3}{4}\right)^{n-1}$

4  $g_1 = 40$

$g_n = \frac{3}{4}g_{n-1}$

- 492 The sequence  $a_1 = 6, a_n = 3a_{n-1}$  can also be written as

1  $a_n = 6 \cdot 3^n$

2  $a_n = 6 \cdot 3^{n+1}$

3  $a_n = 2 \cdot 3^n$

4  $a_n = 2 \cdot 3^{n+1}$

- 493 After Roger's surgery, his doctor administered pain medication in the following amounts in milligrams over four days.

Day (n)	1	2	3	4
Dosage (m)	2000	1680	1411.2	1185.4

How can this sequence best be modeled recursively?

1  $m_1 = 2000$

$m_n = m_{n-1} - 320$

2  $m_n = 2000(0.84)^{n-1}$

3  $m_1 = 2000$

$m_n = (0.84)m_{n-1}$

4  $m_n = 2000(0.84)^{n+1}$

- 494 A tree farm initially has 150 trees. Each year, 20% of the trees are cut down and 80 seedlings are planted. Which recursive formula models the number of trees,  $a_n$ , after  $n$  years?

1  $a_1 = 150$

$a_n = a_{n-1}(0.2) + 80$

2  $a_1 = 150$

$a_n = a_{n-1}(0.8) + 80$

3  $a_n = 150(0.2)^n + 80$

4  $a_n = 150(0.8)^n + 80$

- 495 The population of Jamesburg for the years 2010-2013, respectively, was reported as follows: 250,000 250,937 251,878 252,822

How can this sequence be recursively modeled?

1  $j_n = 250,000(1.00375)^{n-1}$

2  $j_n = 250,000 + 937^{(n-1)}$

3  $j_1 = 250,000$

$j_n = 1.00375j_{n-1}$

4  $j_1 = 250,000$

$j_n = j_{n-1} + 937$

496 In 2010, the population of New York State was approximately 19,378,000 with an annual growth rate of 1.5%. Assuming the growth rate is maintained for a large number of years, which equation can be used to predict the population of New York State  $t$  years after 2010?

1  $P_t = 19,378,000(1.5)^t$

2  $P_0 = 19,378,000$

$$P_t = 19,378,000 + 1.015P_{t-1}$$

3  $P_t = 19,378,000(1.015)^{t-1}$

4  $P_0 = 19,378,000$

$$P_t = 1.015P_{t-1}$$

497 The average depreciation rate of a new boat is approximately 8% per year. If a new boat is purchased at a price of \$75,000, which model is a recursive formula representing the value of the boat  $n$  years after it was purchased?

1  $a_n = 75,000(0.08)^n$

2  $a_0 = 75,000$

$$a_n = (0.92)^n$$

3  $a_n = 75,000(1.08)^n$

4  $a_0 = 75,000$

$$a_n = 0.92(a_{n-1})$$

498 The Rickerts decided to set up an account for their daughter to pay for her college education. The day their daughter was born, they deposited \$1000 in an account that pays 1.8% compounded annually. Beginning with her first birthday, they deposit an additional \$750 into the account on each of her birthdays. Which expression correctly represents the amount of money in the account  $n$  years after their daughter was born?

1  $a_n = 1000(1.018)^n + 750$

2  $a_n = 1000(1.018)^n + 750n$

3  $a_0 = 1000$

$$a_n = a_{n-1}(1.018) + 750$$

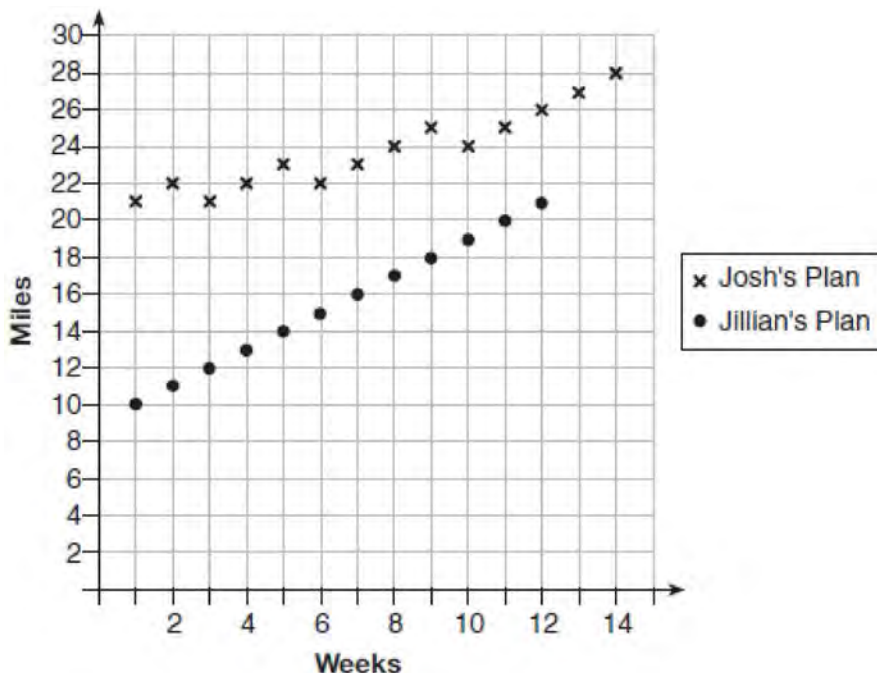
4  $a_0 = 1000$

$$a_n = a_{n-1}(1.018) + 750n$$

499 The explicit formula  $a_n = 6 + 6n$  represents the number of seats in each row in a movie theater, where  $n$  represents the row number. Rewrite this formula in recursive form.



500 Elaina has decided to run the Buffalo half-marathon in May. She researched training plans on the Internet and is looking at two possible plans: Jillian's 12-week plan and Josh's 14-week plan. The number of miles run per week for each plan is plotted below.



Which one of the plans follows an arithmetic pattern? Explain how you arrived at your answer. Write a recursive definition to represent the number of miles run each week for the duration of the plan you chose. Jillian's plan has an alternative if Elaina wanted to train instead for a full 26-mile marathon. Week one would start at 13 miles and follow the same pattern for the half-marathon, but it would continue for 14 weeks. Write an explicit formula, in *simplest form*, to represent the number of miles run each week for the full-marathon training plan.

501 The recursive formula to describe a sequence is shown below.

$$a_1 = 3$$

$$a_n = 1 + 2a_{n-1}$$

State the first four terms of this sequence. Can this sequence be represented using an explicit geometric formula? Justify your answer.

502 Write an explicit formula for  $a_n$ , the  $n$ th term of the recursively defined sequence below.

$$a_1 = x + 1$$

$$a_n = x(a_{n-1})$$

For what values of  $x$  would  $a_n = 0$  when  $n > 1$ ?

- 503 The population, in millions of people, of the United States can be represented by the recursive formula below, where  $a_0$  represents the population in 1910 and  $n$  represents the number of years since 1910.

$$a_0 = 92.2$$

$$a_n = 1.015a_{n-1}$$

Identify the percentage of the annual rate of growth from the equation  $a_n = 1.015a_{n-1}$ . Write an exponential function,  $P$ , where  $P(t)$  represents the United States population in millions of people, and  $t$  is the number of years since 1910. According to this model, determine algebraically the number of years it takes for the population of the United States to be approximately 300 million people. Round your answer to the *nearest year*.

F.BF.B.6: SIGMA NOTATION

- 504 Kristin wants to increase her running endurance. According to experts, a gradual mileage increase of 10% per week can reduce the risk of injury. If Kristin runs 8 miles in week one, which expression can help her find the total number of miles she will have run over the course of her 6-week training program?

1  $\sum_{n=1}^6 8(1.10)^{n-1}$

2  $\sum_{n=1}^6 8(1.10)^n$

3  $\frac{8 - 8(1.10)^6}{0.90}$

4  $\frac{8 - 8(0.10)^n}{1.10}$

- 505 A company fired several employees in order to save money. The amount of money the company saved per year over five years following the loss of employees is shown in the table below.

Year	Amount Saved (in dollars)
1	59,000
2	64,900
3	71,390
4	78,529
5	86,381.9

Which expression determines the total amount of money saved by the company over 5 years?

1  $\frac{59,000 - 59,000(1.1)^5}{1 - 1.1}$

2  $\frac{59,000 - 59,000(0.1)^5}{1 - 0.1}$

3  $\sum_{n=1}^5 59,000(1.1)^n$

4  $\sum_{n=1}^5 59,000(0.1)^{n-1}$

A.SSE.B.4: SERIES

- 506 Jake wants to buy a car and hopes to save at least \$5000 for a down payment. The table below summarizes the amount of money he plans to save each week.

Week	1	2	3	4	5
Money Saved, in Dollars	2	5	12.5	31.25	...

Based on this plan, which expression should he use to determine how much he has saved in  $n$  weeks?

- 1  $\frac{2 - 2(2.5^n)}{1 - 2.5}$                       3  $\frac{1 - 2.5^n}{1 - 2.5}$   
 2  $\frac{2 - 2(2.5^{n-1})}{1 - 2.5}$                       4  $\frac{1 - 2.5^{n-1}}{1 - 2.5}$

- 507 Jasmine decides to put \$100 in a savings account each month. The account pays 3% annual interest, compounded monthly. How much money,  $S$ , will Jasmine have after one year?

- 1  $S = 100(1.03)^{12}$   
 2  $S = \frac{100 - 100(1.0025)^{12}}{1 - 1.0025}$   
 3  $S = 100(1.0025)^{12}$   
 4  $S = \frac{100 - 100(1.03)^{12}}{1 - 1.03}$

- 508 John and Margaret deposit \$500 into a savings account for their son on his first birthday. They continue to make a deposit of \$500 on the child's birthday, with the last deposit being made on the child's 21st birthday. If the account pays 4% annual interest, which equation represents the amount of money in the account after the last deposit is made?

- 1  $S_{21} = 500(1.04)^{21}$   
 2  $S_{21} = \frac{500(1 - 1.04^{21})}{1 - 1.04}$   
 3  $S_{21} = 500(1.04)^{20} + 500$   
 4  $S_{21} = \frac{500(1 - 0.04^{21})}{1 - 1.04}$

- 509 Beginning July 1, 2019, Michelle deposited \$250 into an account that yields 0.15% each month. She continued to make \$250 deposits into this account on the first of each month for 3 years. Which expression represents the amount of money that was in the account after her last deposit was made on June 1, 2022?

- 1  $250(1.0015)^3$   
 2  $250(1.0015)^{36}$   
 3  $\frac{250 - 250(1.0015)^3}{1 - 1.0015}$   
 4  $\frac{250 - 250(1.0015)^{36}}{1 - 1.0015}$

- 510 A ball is dropped from a height of 32 feet. It bounces and rebounds 80% of the height from which it was falling. What is the total downward distance, in feet, the ball traveled up to the 12th bounce?

- 1 29  
 2 58  
 3 120  
 4 149

Algebra II Regents Exam Questions by State Standard: Topic

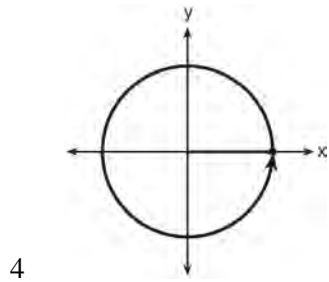
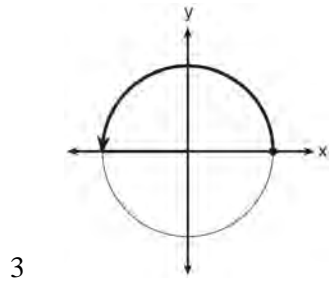
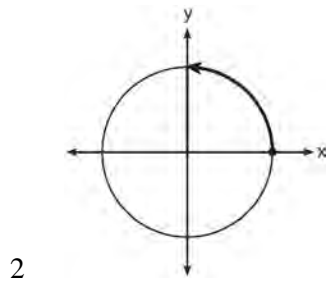
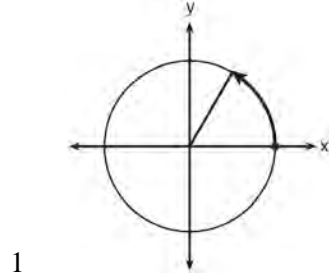
[www.jmap.org](http://www.jmap.org)

- 511 The sum of the first 20 terms of the series  $-2 + 6 - 18 + 54 - \dots$  is
- 1  $-610$
  - 2  $-59$
  - 3  $1,743,392,200$
  - 4  $2,324,522,934$
- 512 The first term of a geometric sequence is 8 and the fourth term is 216. What is the sum of the first 12 terms of the corresponding series?
- 1 236,192
  - 2 708,584
  - 3 2,125,760
  - 4 6,377,288
- 513 Brian deposited 1 cent into an empty non-interest bearing bank account on the first day of the month. He then additionally deposited 3 cents on the second day, 9 cents on the third day, and 27 cents on the fourth day. What would be the total amount of money in the account at the end of the 20th day if the pattern continued?
- 1 \$11,622,614.67
  - 2 \$17,433,922.00
  - 3 \$116,226,146.80
  - 4 \$1,743,392,200.00
- 514 A 7-year lease for office space states that the annual rent is \$85,000 for the first year and will increase by 6% each additional year of the lease. What will the total rent expense be for the entire 7-year lease?
- 1 \$42,809.63
  - 2 \$90,425.53
  - 3 \$595,000.00
  - 4 \$713,476.20
- 515 Given the geometric series  $300 + 360 + 432 + 518.4 + \dots$ , write a geometric series formula,  $S_n$ , for the sum of the first  $n$  terms. Use the formula to find the sum of the first 10 terms, to the *nearest tenth*.
- 516 Rowan is training to run in a race. He runs 15 miles in the first week, and each week following, he runs 3% more than the week before. Using a geometric series formula, find the total number of miles Rowan runs over the first ten weeks of training, rounded to the *nearest thousandth*.
- 517 The initial push of a child on a swing causes the swing to travel a total of 6 feet. Each successive swing travels 80% of the distance of the previous swing. Determine the total distance, to the *nearest hundredth of a foot*, a child travels in the first five swings.
- 518 Alexa earns \$33,000 in her first year of teaching and earns a 4% increase in each successive year. Write a geometric series formula,  $S_n$ , for Alexa's total earnings over  $n$  years. Use this formula to find Alexa's total earnings for her first 15 years of teaching, to the *nearest cent*.
- 519 Sonja is cutting wire to construct a mobile. She cuts 100 inches for the first piece, 80 inches for the second piece, and 64 inches for the third piece. Assuming this pattern continues, write an explicit equation for  $a_n$ , the length in inches of the  $n$ th piece. Sonja only has 40 feet of wire to use for the project and wants to cut 20 pieces total for the mobile using her pattern. Will she have enough wire? Justify your answer.

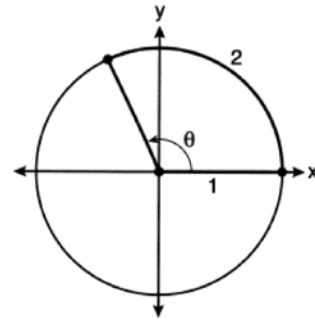
# TRIGONOMETRY

## F.TF.A.1: UNIT CIRCLE

520 Which diagram shows an angle rotation of 1 radian on the unit circle?



521 An angle,  $\theta$ , is rotated counterclockwise on the unit circle, with its terminal side in the second quadrant, as shown in the diagram below.

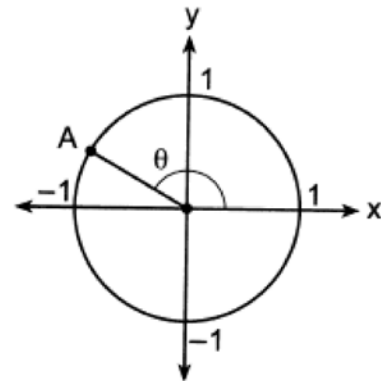


Which value represents the radian measure of angle  $\theta$ ?

- 1 1
- 2 2
- 3 65.4
- 4 114.6

## F.TF.A.2: UNIT CIRCLE

522 In the diagram of a unit circle below, point A,  $\left(-\frac{\sqrt{3}}{2}, \frac{1}{2}\right)$ , represents the point where the terminal side of  $\theta$  intersects the unit circle.



What is  $m\angle\theta$ ?

- 1  $30^\circ$
- 2  $120^\circ$
- 3  $135^\circ$
- 4  $150^\circ$

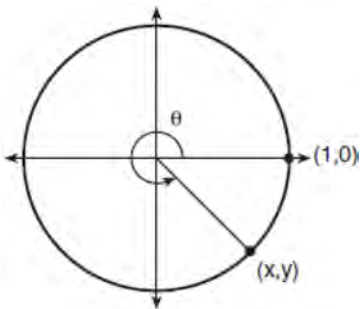
- 523 The terminal side of  $\theta$ , an angle in standard position, intersects the unit circle at  $P\left(-\frac{1}{3}, -\frac{\sqrt{8}}{3}\right)$ .

What is the value of  $\sec \theta$ ?

- 1  $-3$
  - 2  $-\frac{3\sqrt{8}}{8}$
  - 3  $-\frac{1}{3}$
  - 4  $-\frac{\sqrt{8}}{3}$
- 524 Point  $M\left(t, \frac{4}{7}\right)$  is located in the second quadrant on the unit circle. Determine the exact value of  $t$ .

F.TF.A.2: RECIPROCAL TRIGONOMETRIC RELATIONSHIPS

- 525 Using the unit circle below, explain why  $\csc \theta = \frac{1}{y}$ .



F.TF.A.2: FINDING THE TERMINAL SIDE OF AN ANGLE

- 526 Natalia's teacher has given her the following information about angle  $\theta$ .

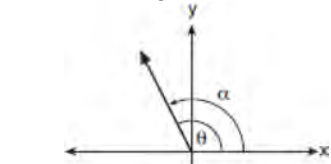
- $\pi < \theta < 2\pi$

- $\cos \theta = \frac{\sqrt{3}}{4}$

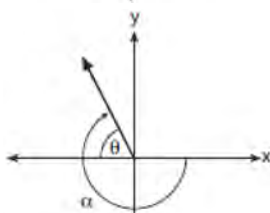
Explain how Natalia can determine if the value of  $\tan \theta$  is positive or negative.

F.TF.A.2: REFERENCE ANGLES

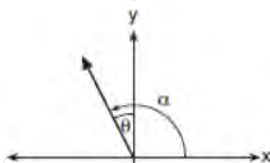
- 527 Which diagram represents an angle,  $\alpha$ , measuring  $\frac{13\pi}{20}$  radians drawn in standard position, and its reference angle,  $\theta$ ?



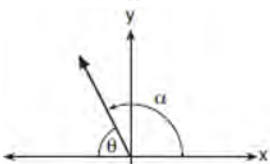
1



2



3



4

F.TF.A.2: DETERMINING TRIGONOMETRIC FUNCTIONS

- 528 If the terminal side of angle  $\theta$ , in standard position, passes through point  $(-4,3)$ , what is the numerical value of  $\sin \theta$ ?

1  $\frac{3}{5}$

2  $\frac{4}{5}$

3  $-\frac{3}{5}$

4  $-\frac{4}{5}$

- 529 A circle centered at the origin has a radius of 10 units. The terminal side of an angle,  $\theta$ , intercepts the circle in Quadrant II at point  $C$ . The  $y$ -coordinate of point  $C$  is 8. What is the value of  $\cos \theta$ ?

1  $-\frac{3}{5}$

2  $-\frac{3}{4}$

3  $\frac{3}{5}$

4  $\frac{4}{5}$

- 530 If  $\theta$  is an angle in standard position whose terminal side passes through the point  $(-2,-3)$ , what is the numerical value of  $\tan \theta$ ?

1  $\frac{2}{3}$

2  $\frac{3}{2}$

3  $-\frac{2}{\sqrt{13}}$

4  $-\frac{3}{\sqrt{13}}$

- 531 An angle,  $\theta$ , is in standard position and its terminal side passes through the point  $(2, -1)$ . Find the *exact* value of  $\sin \theta$ .

F.T.F.C.8: DETERMINING TRIGONOMETRIC FUNCTIONS

- 532 Given  $\cos \theta = \frac{7}{25}$ , where  $\theta$  is an angle in standard position terminating in quadrant IV, and  $\sin^2 \theta + \cos^2 \theta = 1$ , what is the value of  $\tan \theta$ ?

- 1  $-\frac{24}{25}$
- 2  $-\frac{24}{7}$
- 3  $\frac{24}{25}$
- 4  $\frac{24}{7}$

- 533 Given  $\tan \theta = -\frac{4}{3}$  where  $\frac{\pi}{2} < \theta < \pi$ , what is the value of  $\sec \theta$ ?

- 1  $-\frac{5}{3}$
- 2  $-\frac{3}{5}$
- 3  $\frac{4}{5}$
- 4  $\frac{5}{3}$

- 534 Given that  $\sin^2 \theta + \cos^2 \theta = 1$  and  $\sin \theta = -\frac{\sqrt{2}}{5}$ , what is a possible value of  $\cos \theta$ ?

- 1  $\frac{5 + \sqrt{2}}{5}$
- 2  $\frac{\sqrt{23}}{5}$
- 3  $\frac{3\sqrt{3}}{5}$
- 4  $\frac{\sqrt{35}}{5}$

- 535 If  $\cos \theta = -\frac{3}{4}$  and  $\theta$  is in Quadrant III, then  $\sin \theta$  is equivalent to

- 1  $-\frac{\sqrt{7}}{4}$
- 2  $\frac{\sqrt{7}}{4}$
- 3  $-\frac{5}{4}$
- 4  $\frac{5}{4}$

- 536 If  $\cos A = \frac{\sqrt{5}}{3}$  and  $\tan A < 0$ , what is the value of  $\sin A$ ?

- 1  $\frac{2}{3}$
- 2  $-\frac{\sqrt{5}}{3}$
- 3  $-\frac{2}{3}$
- 4  $\frac{3}{\sqrt{5}}$



537 What is the value of  $\tan \theta$  when  $\sin \theta = \frac{2}{5}$  and  $\theta$  is in quadrant II?

- 1  $\frac{-\sqrt{21}}{5}$
- 2  $\frac{-\sqrt{21}}{2}$
- 3  $\frac{-2}{\sqrt{21}}$
- 4  $\frac{2}{\sqrt{21}}$

538 Given  $\tan \theta = \frac{7}{24}$ , and  $\theta$  terminates in Quadrant III, determine the value of  $\cos \theta$ .

539 Using the identity  $\sin^2 \theta + \cos^2 \theta = 1$ , find the value of  $\tan \theta$ , to the *nearest hundredth*, if  $\cos \theta$  is  $-0.7$  and  $\theta$  is in Quadrant II.

540 Given  $\cos A = \frac{3}{\sqrt{10}}$  and  $\cot A = -3$ , determine the value of  $\sin A$  in radical form.

F.TF.C.8: PROVING TRIGONOMETRIC IDENTITIES

541 If  $\sin^2(32^\circ) + \cos^2(M) = 1$ , then  $M$  equals

- 1  $32^\circ$
- 2  $58^\circ$
- 3  $68^\circ$
- 4  $72^\circ$

F.TF.B.5: MODELING TRIGONOMETRIC FUNCTIONS

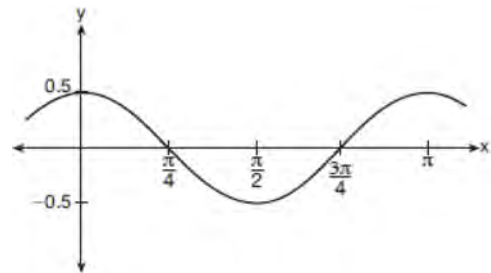
542 The voltage used by most households can be modeled by a sine function. The maximum voltage is 120 volts, and there are 60 cycles *every second*. Which equation best represents the value of the voltage as it flows through the electric wires, where  $t$  is time in seconds?

- 1  $V = 120 \sin(t)$
- 2  $V = 120 \sin(60t)$
- 3  $V = 120 \sin(60\pi t)$
- 4  $V = 120 \sin(120\pi t)$

543 Which function's graph has a period of 8 and reaches a maximum height of 1 if at least one full period is graphed?

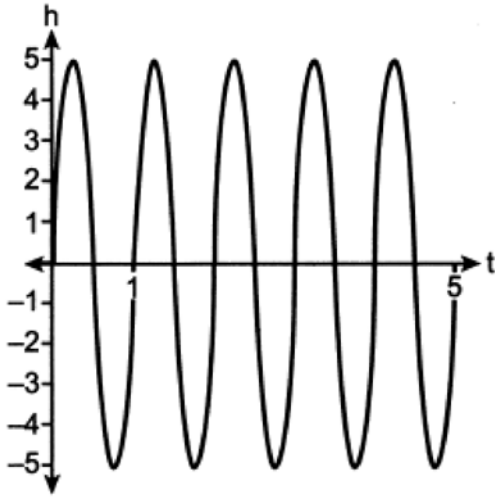
- 1  $y = -4 \cos\left(\frac{\pi}{4}x\right) - 3$
- 2  $y = -4 \cos\left(\frac{\pi}{4}x\right) + 5$
- 3  $y = -4 \cos(8x) - 3$
- 4  $y = -4 \cos(8x) + 5$

544 Which equation is represented by the graph shown below?



- 1  $y = \frac{1}{2} \cos 2x$
- 2  $y = \cos x$
- 3  $y = \frac{1}{2} \cos x$
- 4  $y = 2 \cos \frac{1}{2}x$

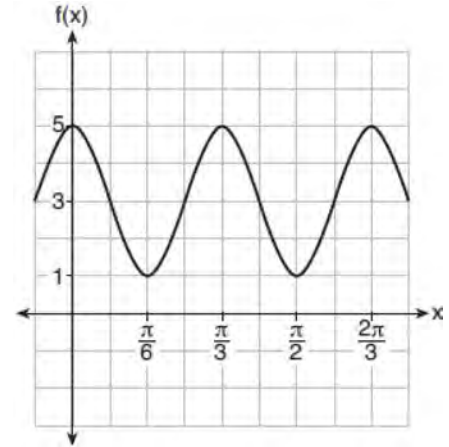
- 545 A cyclist pedals a bike at a rate of 60 revolutions per minute. The height,  $h$ , of a pedal at time  $t$ , in seconds, is plotted below.



The graph can be modeled by the function  $h(t) = 5 \sin(kt)$ , where  $k$  is equal to

- 1 1
- 2  $2\pi$
- 3 60
- 4  $\frac{\pi}{30}$

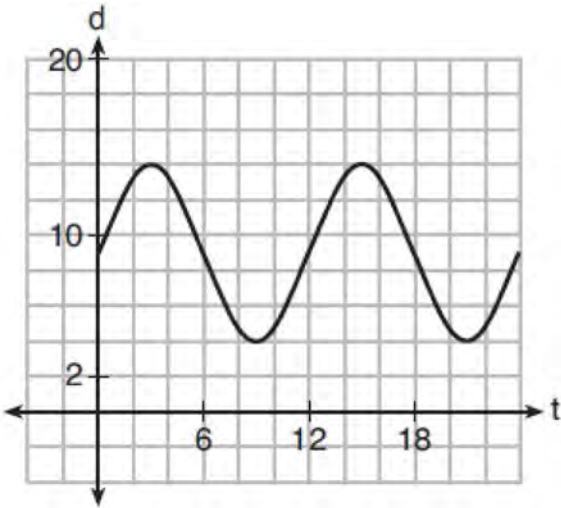
- 546 The function  $f(x) = a \cos bx + c$  is plotted on the graph shown below.



What are the values of  $a$ ,  $b$ , and  $c$ ?

- 1  $a = 2, b = 6, c = 3$
- 2  $a = 2, b = 3, c = 1$
- 3  $a = 4, b = 6, c = 5$
- 4  $a = 4, b = \frac{\pi}{3}, c = 3$

- 547 The depth of the water at a marker 20 feet from the shore in a bay is depicted in the graph below.



If the depth,  $d$ , is measured in feet and time,  $t$ , is measured in hours since midnight, what is an equation for the depth of the water at the marker?

- 1  $d = 5 \cos\left(\frac{\pi}{6} t\right) + 9$
- 2  $d = 9 \cos\left(\frac{\pi}{6} t\right) + 5$
- 3  $d = 9 \sin\left(\frac{\pi}{6} t\right) + 5$
- 4  $d = 5 \sin\left(\frac{\pi}{6} t\right) + 9$

F.IF.B.4: GRAPHING TRIGONOMETRIC FUNCTIONS

- 548 Relative to the graph of  $y = 3 \sin x$ , what is the shift of the graph of  $y = 3 \sin\left(x + \frac{\pi}{3}\right)$ ?
- 1  $\frac{\pi}{3}$  right
  - 2  $\frac{\pi}{3}$  left
  - 3  $\frac{\pi}{3}$  up
  - 4  $\frac{\pi}{3}$  down
- 549 Given the parent function  $p(x) = \cos x$ , which phrase best describes the transformation used to obtain the graph of  $g(x) = \cos(x + a) - b$ , if  $a$  and  $b$  are positive constants?
- 1 right  $a$  units, up  $b$  units
  - 2 right  $a$  units, down  $b$  units
  - 3 left  $a$  units, up  $b$  units
  - 4 left  $a$  units, down  $b$  units
- 550 The temperature, in degrees Fahrenheit, in Times Square during a day in August can be predicted by the function  $T(x) = 8 \sin(0.3x - 3) + 74$ , where  $x$  is the number of hours after midnight. According to this model, the predicted temperature, to the nearest degree Fahrenheit, at 7 P.M. is
- 1 68
  - 2 74
  - 3 77
  - 4 81
- 551 The hours of daylight,  $y$ , in Utica in days,  $x$ , from January 1, 2013 can be modeled by the equation  $y = 3.06 \sin(0.017x - 1.40) + 12.23$ . How many hours of daylight, to the nearest tenth, does this model predict for February 14, 2013?
- 1 9.4
  - 2 10.4
  - 3 12.1
  - 4 12.2

- 552 The Ferris wheel at the landmark Navy Pier in Chicago takes 7 minutes to make one full rotation. The height,  $H$ , in feet, above the ground of one of the six-person cars can be modeled by
- $$H(t) = 70 \sin\left(\frac{2\pi}{7}(t - 1.75)\right) + 80,$$
- where  $t$  is time, in minutes. Using  $H(t)$  for one full rotation, this car's minimum height, in feet, is
- 1 150
  - 2 70
  - 3 10
  - 4 0
- 553 The average monthly temperature,  $T(m)$ , in degrees Fahrenheit, over a 12 month period, can be modeled by  $T(m) = -23 \cos\left(\frac{\pi}{6}m\right) + 56$ , where  $m$  is in months. What is the range of temperatures, in degrees Fahrenheit, of this function?
- 1  $[-23, 23]$
  - 2  $[33, 79]$
  - 3  $[-23, 56]$
  - 4  $[-79, 33]$
- 554 A sine function increasing through the origin can be used to model light waves. Violet light has a wavelength of 400 nanometers. Over which interval is the height of the wave *decreasing*, only?
- 1  $(0, 200)$
  - 2  $(100, 300)$
  - 3  $(200, 400)$
  - 4  $(300, 400)$
- 555 As  $x$  increases from 0 to  $\frac{\pi}{2}$ , the graph of the equation  $y = 2 \tan x$  will
- 1 increase from 0 to 2
  - 2 decrease from 0 to  $-2$
  - 3 increase without limit
  - 4 decrease without limit
- 556 As  $\theta$  increases from  $-\frac{\pi}{2}$  to 0 radians, the value of  $\cos \theta$  will
- 1 decrease from 1 to 0
  - 2 decrease from 0 to  $-1$
  - 3 increase from  $-1$  to 0
  - 4 increase from 0 to 1
- 557 Given  $p(\theta) = 3 \sin\left(\frac{1}{2}\theta\right)$  on the interval  $-\pi < \theta < \pi$ , the function  $p$
- 1 decreases, then increases
  - 2 increases, then decreases
  - 3 decreases throughout the interval
  - 4 increases throughout the interval
- 558 The depth of the water,  $d(t)$ , in feet, on a given day at Thunder Bay,  $t$  hours after midnight is modeled by  $d(t) = 5 \sin\left(\frac{\pi}{6}(t - 5)\right) + 7$ . Which statement about the Thunder Bay tide is *false*?
- 1 A low tide occurred at 2 a.m.
  - 2 The maximum depth of the water was 12 feet.
  - 3 The water depth at 9 a.m. was approximately 11 feet.
  - 4 The difference in water depth between high tide and low tide is 14 feet.

- 559 Based on climate data that have been collected in Bar Harbor, Maine, the average monthly temperature, in degrees F, can be modeled by the equation  $B(x) = 23.914 \sin(0.508x - 2.116) + 55.300$ . The same governmental agency collected average monthly temperature data for Phoenix, Arizona, and found the temperatures could be modeled by the equation  $P(x) = 20.238 \sin(0.525x - 2.148) + 86.729$ . Which statement can *not* be concluded based on the average monthly temperature models  $x$  months after starting data collection?
- 1 The average monthly temperature variation is more in Bar Harbor than in Phoenix.
  - 2 The midline average monthly temperature for Bar Harbor is lower than the midline temperature for Phoenix.
  - 3 The maximum average monthly temperature for Bar Harbor is  $79^\circ$  F, to the nearest degree.
  - 4 The minimum average monthly temperature for Phoenix is  $20^\circ$  F, to the nearest degree.

- 560 A person's lung capacity can be modeled by the function  $C(t) = 250 \sin\left(\frac{2\pi}{5}t\right) + 2450$ , where  $C(t)$  represents the volume in mL present in the lungs after  $t$  seconds. State the maximum value of this function over one full cycle, and explain what this value represents.

- 561 The height,  $h(t)$  in cm, of a piston, is given by the equation  $h(t) = 12 \cos\left(\frac{\pi}{3}t\right) + 8$ , where  $t$  represents the number of seconds since the measurements began. Determine the average rate of change, in cm/sec, of the piston's height on the interval  $1 \leq t \leq 2$ . At what value(s) of  $t$ , to the *nearest tenth of a second*, does  $h(t) = 0$  in the interval  $1 \leq t \leq 5$ ? Justify your answer.

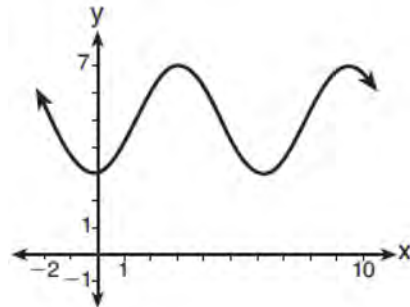
F.IF.C.7: GRAPHING TRIGONOMETRIC FUNCTIONS

- 562 The equation below can be used to model the height of a tide in feet,  $H(t)$ , on a beach at  $t$  hours.

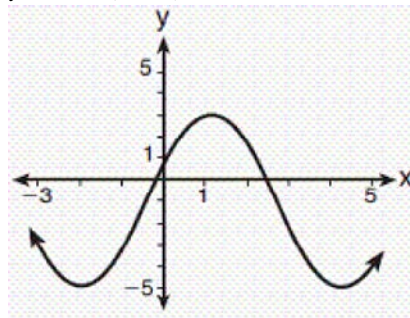
$$H(t) = 4.8 \sin\left(\frac{\pi}{6}(t+3)\right) + 5.1$$

Using this function, the amplitude of the tide is

- 1  $\frac{\pi}{6}$
  - 2 4.8
  - 3 3
  - 4 5.1
- 563 Which sinusoid has the greatest amplitude?

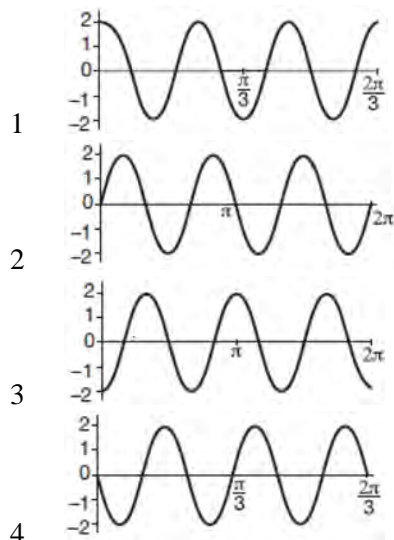


- 1
- 2  $y = 3 \sin(\theta - 3) + 5$



- 3
- 4  $y = -5 \sin(\theta - 1) - 3$

- 564 Which graph represents a cosine function with no horizontal shift, an amplitude of 2, and a period of  $\frac{2\pi}{3}$ ?



- 565 The height above ground for a person riding a Ferris wheel after  $t$  seconds is modeled by  $h(t) = 150 \sin\left(\frac{\pi}{45}t + 67.5\right) + 160$  feet. How many seconds does it take to go from the bottom of the wheel to the top of the wheel?
- 1 10
  - 2 45
  - 3 90
  - 4 150

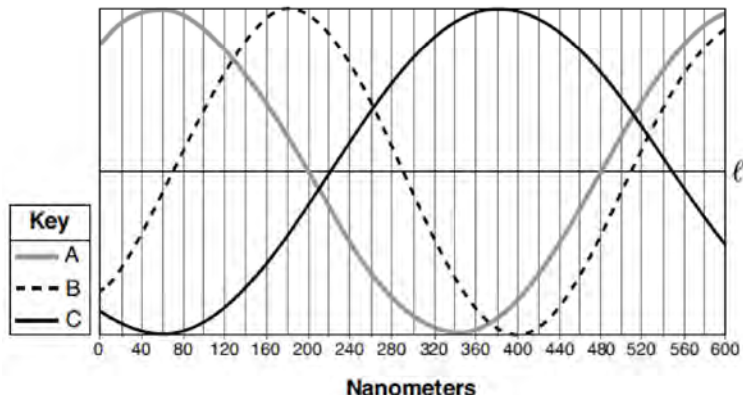
- 566 Which statement is *incorrect* for the graph of the function  $y = -3 \cos\left[\frac{\pi}{3}(x - 4)\right] + 7$ ?

- 1 The period is 6.
- 2 The amplitude is 3.
- 3 The range is  $[4, 10]$ .
- 4 The midline is  $y = -4$ .

- 567 Tides are a periodic rise and fall of ocean water. On a typical day at a seaport, to predict the time of the next high tide, the most important value to have would be the
- 1 time between consecutive low tides
  - 2 time when the tide height is 20 feet
  - 3 average depth of water over a 24-hour period
  - 4 difference between the water heights at low and high tide

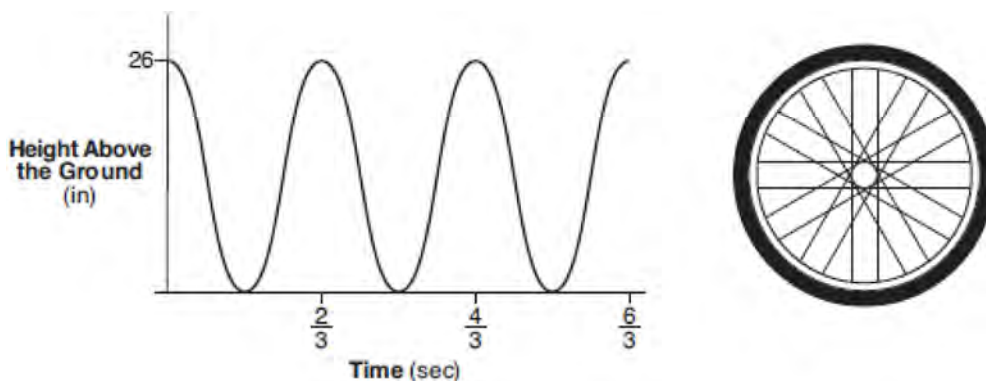
- 568 The average monthly temperature of a city can be modeled by a cosine graph. Melissa has been living in Phoenix, Arizona, where the average annual temperature is  $75^\circ\text{F}$ . She would like to move, and live in a location where the average annual temperature is  $62^\circ\text{F}$ . When examining the graphs of the average monthly temperatures for various locations, Melissa should focus on the
- 1 amplitude
  - 2 horizontal shift
  - 3 period
  - 4 midline

- 569 Visible light can be represented by sinusoidal waves. Three visible light waves are shown in the graph below. The midline of each wave is labeled  $\ell$ .



Based on the graph, which light wave has the longest period? Justify your answer.

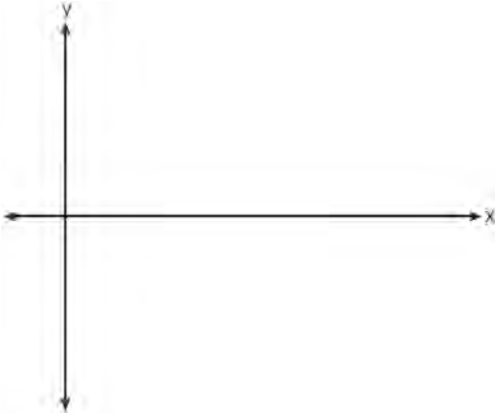
- 570 The graph below represents the height above the ground,  $h$ , in inches, of a point on a triathlete's bike wheel during a training ride in terms of time,  $t$ , in seconds.



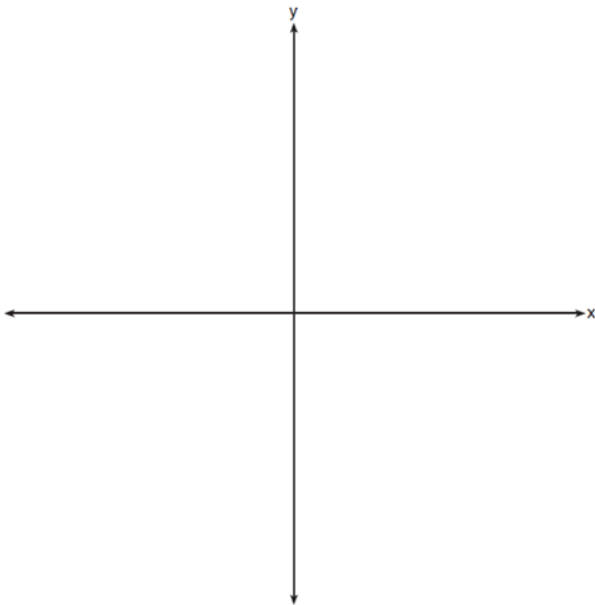
Identify the period of the graph and describe what the period represents in this context.

- 571 On July 21, 2016, the water level in Puget Sound, WA reached a high of 10.1 ft at 6 a.m. and a low of  $-2$  ft at 12:30 p.m. Across the country in Long Island, NY, Shinnecock Bay's water level reached a high of 2.5 ft at 10:42 p.m. and a low of  $-0.1$  ft at 5:31 a.m. The water levels of both locations are affected by the tides and can be modeled by sinusoidal functions. Determine the difference in amplitudes, in feet, for these two locations.
- 572 The volume of air in a person's lungs, as the person breathes in and out, can be modeled by a sine graph. A scientist is studying the differences in this volume for people at rest compared to people told to take a deep breath. When examining the graphs, should the scientist focus on the amplitude, period, or midline? Explain your choice.

- 573 On the coordinate plane below, sketch *at least one* cycle of a cosine function with a midline at  $y = -2$ , an amplitude of 3, and a period of  $\frac{\pi}{2}$ .

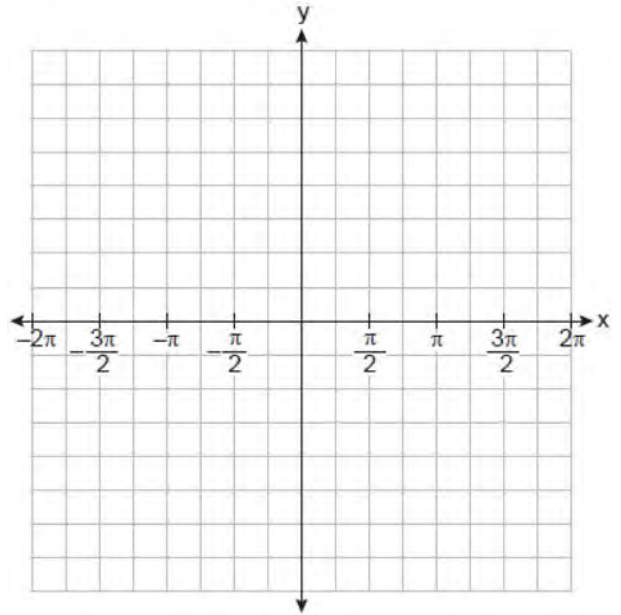


- 574 a) On the axes below, sketch *at least one* cycle of a sine curve with an amplitude of 2, a midline at  $y = -\frac{3}{2}$ , and a period of  $2\pi$ .



- b) Explain any differences between a sketch of  $y = 2 \sin\left(x - \frac{\pi}{3}\right) - \frac{3}{2}$  and the sketch from part a.

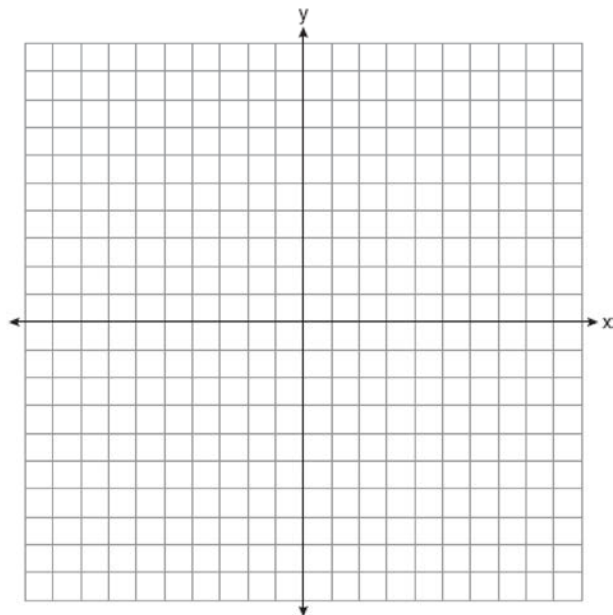
- 575 On the graph below, draw at least one complete cycle of a sine graph passing through point  $(0, 2)$  that has an amplitude of 3, a period of  $\pi$ , and a midline at  $y = 2$ .



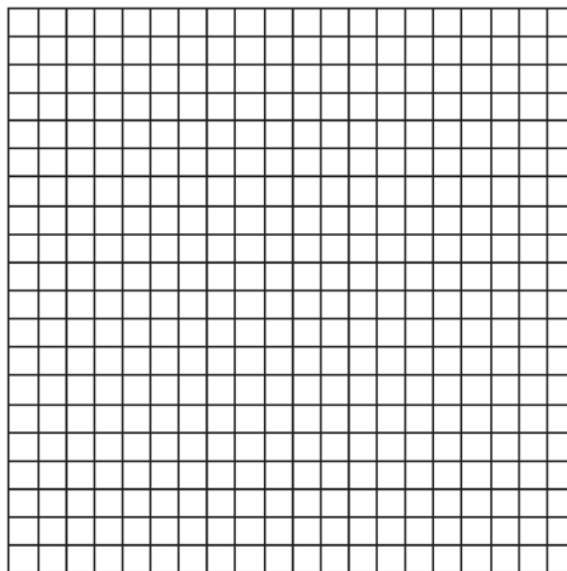
Based on your graph, state an interval in which the graph is increasing.



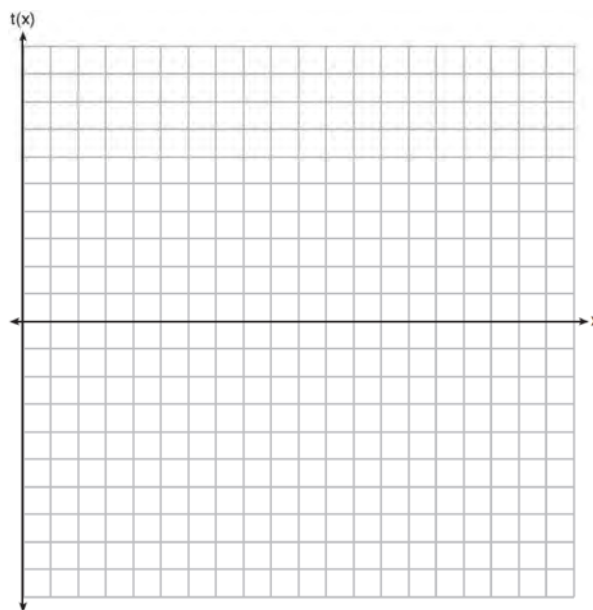
- 576 On the axes below, graph *one* cycle of a cosine function with amplitude 3, period  $\frac{\pi}{2}$ , midline  $y = -1$ , and passing through the point  $(0, 2)$ .



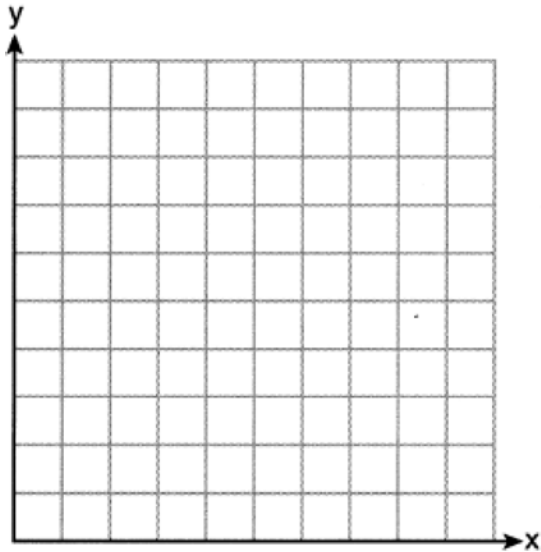
- 577 Write an equation for a sine function with an amplitude of 2 and a period of  $\frac{\pi}{2}$ . On the grid below, sketch the graph of the equation in the interval 0 to  $2\pi$ .



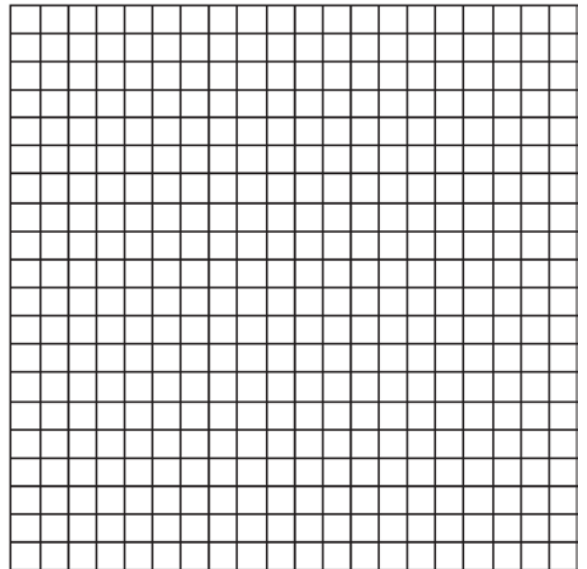
- 578 Graph  $t(x) = 3 \sin(2x) + 2$  over the domain  $[0, 2\pi]$  on the set of axes below.



- 579 Graph  $y = 2 \cos\left(\frac{1}{2}x\right) + 5$  on the interval  $[0, 2\pi]$ , using the axes below.

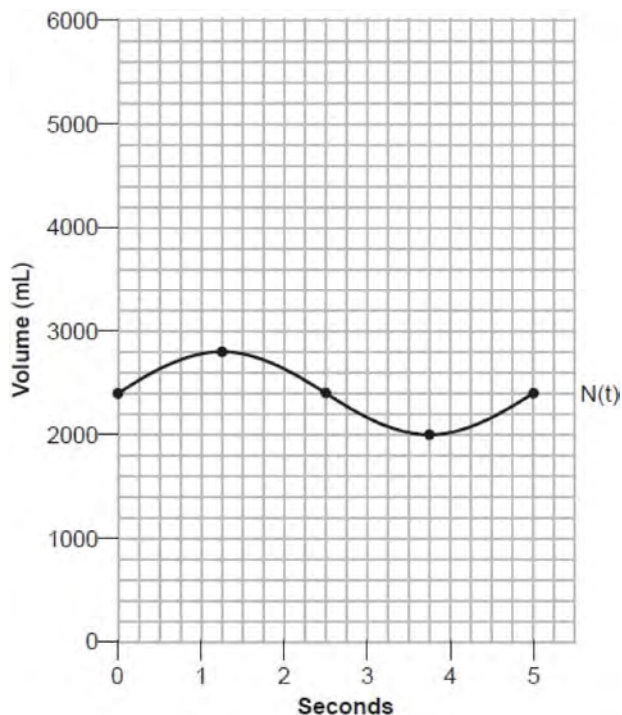


- 580 Griffin is riding his bike down the street in Churchville, N.Y. at a constant speed, when a nail gets caught in one of his tires. The height of the nail above the ground, in inches, can be represented by the trigonometric function  $f(t) = -13 \cos(0.8\pi t) + 13$ , where  $t$  represents the time (in seconds) since the nail first became caught in the tire. Determine the period of  $f(t)$ . Interpret what the period represents in this context. On the grid below, graph *at least one* cycle of  $f(t)$  that includes the y-intercept of the function.



Does the height of the nail ever reach 30 inches above the ground? Justify your answer.

- 581 The volume of air in an average lung during breathing can be modeled by the graph below.

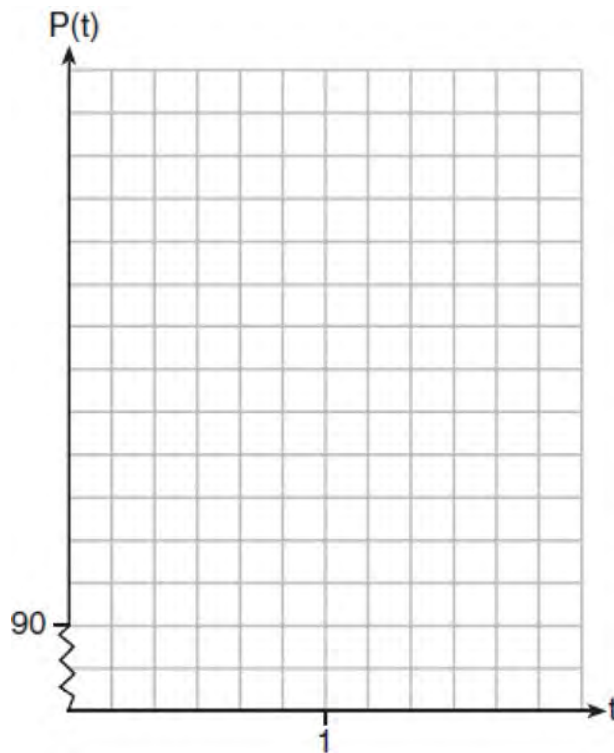


Using the graph, write an equation for  $N(t)$ , in the form  $N(t) = A \sin(Bt) + C$ . That same lung, when engaged in exercise, has a volume that can be modeled by  $E(t) = 2000 \sin(\pi t) + 3200$ , where  $E(t)$  is volume in mL and  $t$  is time in seconds. Graph *at least one* cycle of  $E(t)$  on the same grid as  $N(t)$ . How many times during the 5-second interval will  $N(t) = E(t)$ ?

- 582 The resting blood pressure of an adult patient can be modeled by the function  $P$  below, where  $P(t)$  is the pressure in millimeters of mercury after time  $t$  in seconds.

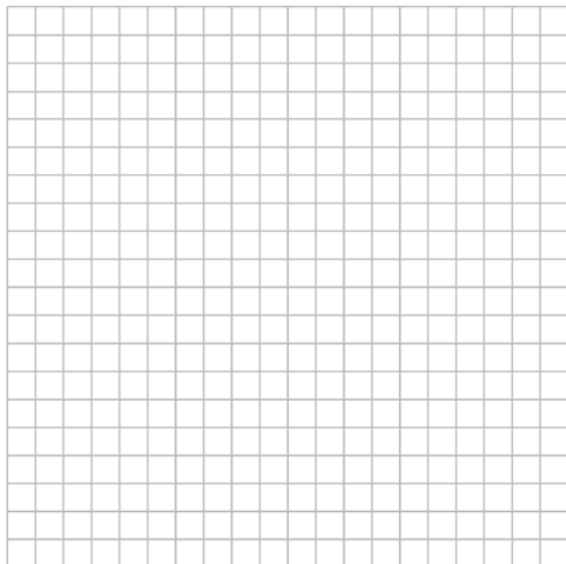
$$P(t) = 24 \cos(3\pi t) + 120$$

On the set of axes below, graph  $y = P(t)$  over the domain  $0 \leq t \leq 2$ .



Determine the period of  $P$ . Explain what this value represents in the given context. Normal resting blood pressure for an adult is 120 over 80. This means that the blood pressure oscillates between a maximum of 120 and a minimum of 80. Adults with high blood pressure (above 140 over 90) and adults with low blood pressure (below 90 over 60) may be at risk for health disorders. Classify the given patient's blood pressure as low, normal, or high and explain your reasoning.

- 583 The ocean tides near Carter Beach follow a repeating pattern over time, with the amount of time between each low and high tide remaining relatively constant. On a certain day, low tide occurred at 8:30 a.m. and high tide occurred at 3:00 p.m. At high tide, the water level was 12 inches above the average local sea level; at low tide it was 12 inches below the average local sea level. Assume that high tide and low tide are the maximum and minimum water levels each day, respectively. Write a cosine function of the form  $f(t) = A \cos(Bt)$ , where  $A$  and  $B$  are real numbers, that models the water level,  $f(t)$ , in inches above or below the average Carter Beach sea level, as a function of the time measured in  $t$  hours since 8:30 a.m. On the grid below, graph one cycle of this function.



People who fish in Carter Beach know that a certain species of fish is most plentiful when the water level is increasing. Explain whether you would recommend fishing for this species at 7:30 p.m. or 10:30 p.m. using evidence from the given context.

## CONICS

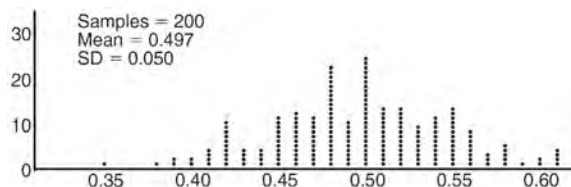
### G.GPE.A.1: EQUATIONS OF CIRCLES

- 584 The equation  $4x^2 - 24x + 4y^2 + 72y = 76$  is equivalent to
- $4(x - 3)^2 + 4(y + 9)^2 = 76$
  - $4(x - 3)^2 + 4(y + 9)^2 = 121$
  - $4(x - 3)^2 + 4(y + 9)^2 = 166$
  - $4(x - 3)^2 + 4(y + 9)^2 = 436$

## GRAPHS AND STATISTICS

### S.IC.A.2: ANALYSIS OF DATA

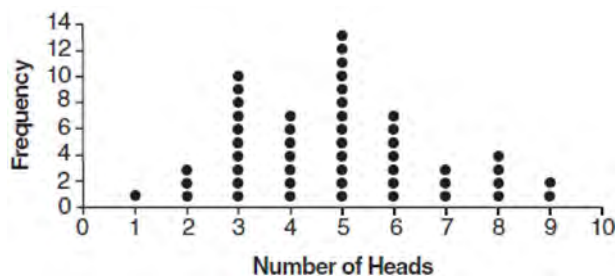
- 585 Anne has a coin. She does not know if it is a fair coin. She flipped the coin 100 times and obtained 73 heads and 27 tails. She ran a computer simulation of 200 samples of 100 fair coin flips. The output of the proportion of heads is shown below.



Given the results of her coin flips and of her computer simulation, which statement is most accurate?

- 73 of the computer's next 100 coin flips will be heads.
- 50 of her next 100 coin flips will be heads.
- Her coin is not fair.
- Her coin is fair.

586 The results of simulating tossing a coin 10 times, recording the number of heads, and repeating this 50 times are shown in the graph below.



Based on the results of the simulation, which statement is *false*?

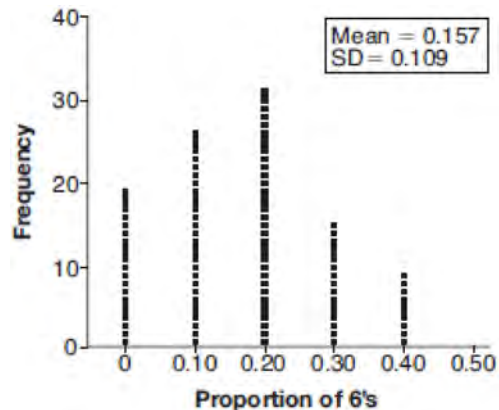
- 1 Five heads occurred most often, which is consistent with the theoretical probability of obtaining a heads.
- 2 Eight heads is unusual, as it falls outside the middle 95% of the data.
- 3 Obtaining three heads or fewer occurred 28% of the time.
- 4 Seven heads is not unusual, as it falls within the middle 95% of the data.

587 A game spinner is divided into 6 equally sized regions, as shown in the diagram below.



For Miles to win, the spinner must land on the number 6. After spinning the spinner 10 times, and losing all 10 times, Miles complained that the spinner is unfair. At home, his dad ran 100 simulations of spinning the spinner 10 times, assuming the probability of winning each spin is  $\frac{1}{6}$ .

The output of the simulation is shown in the diagram below.



Which explanation is appropriate for Miles and his dad to make?

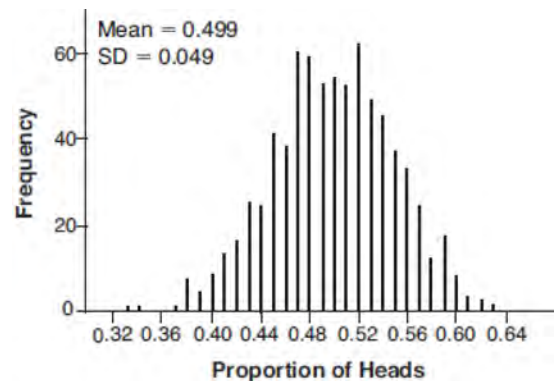
- 1 The spinner was likely unfair, since the number 6 failed to occur in about 20% of the simulations.
- 2 The spinner was likely unfair, since the spinner should have landed on the number 6 by the sixth spin.
- 3 The spinner was likely not unfair, since the number 6 failed to occur in about 20% of the simulations.
- 4 The spinner was likely not unfair, since in the output the player wins once or twice in the majority of the simulations.

588 An orange-juice processing plant receives a truckload of oranges. The quality control team randomly chooses three pails of oranges, each containing 50 oranges, from the truckload. Identify the sample and the population in the given scenario. State *one* conclusion that the quality control team could make about the population if 5% of the sample was found to be unsatisfactory.

589 A survey was given to 1250 randomly selected high school students at the end of their junior year. The survey offered four post-graduation options: two-year college, four-year college, military, or work. Of the 1250 responses, 475 chose a four-year college. State *one* possible conclusion that can be made about the population of high school juniors, based on this survey.

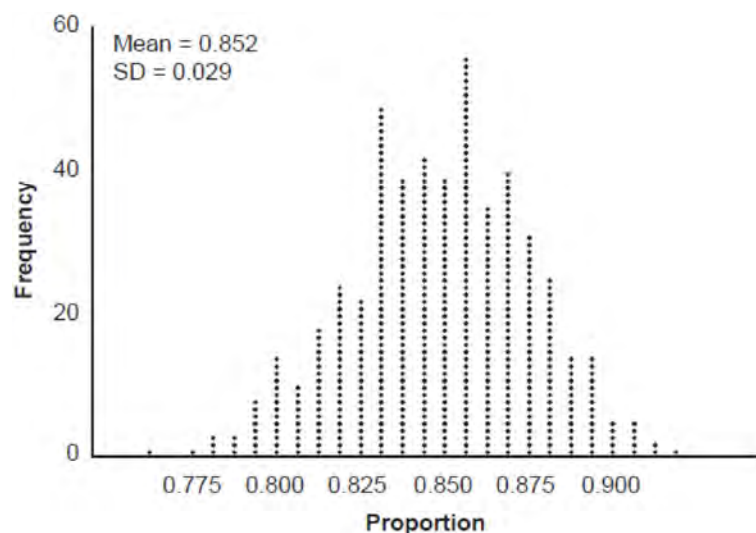
590 Mrs. Jones had hundreds of jelly beans in a bag that contained equal numbers of six different flavors. Her student randomly selected four jelly beans and they were all black licorice. Her student complained and said "What are the odds I got all of that kind?" Mrs. Jones replied, "simulate rolling a die 250 times and tell me if four black licorice jelly beans is unusual." Explain how this simulation could be used to solve the problem.

591 Robin flips a coin 100 times. It lands heads up 43 times, and she wonders if the coin is unfair. She runs a computer simulation of 750 samples of 100 fair coin flips. The output of the proportion of heads is shown below.



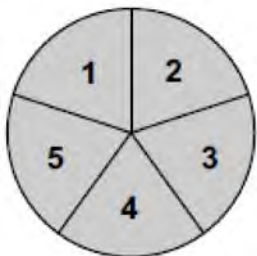
Do the results of the simulation provide strong evidence that Robin's coin is unfair? Explain your answer.

592 An app design company believes that the proportion of high school students who have purchased apps on their smartphones in the past 3 months is 0.85. A simulation of 500 samples of 150 students was run based on this proportion and the results are shown below.

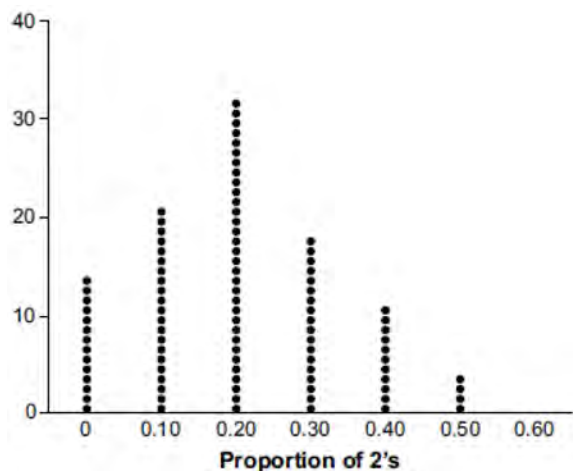


Suppose a sample of 150 students from your high school showed that 88% of students had purchased apps on their smartphones in the past 3 months. Based on the simulation, would the results from your high school give the app design company reason to believe their assumption is *incorrect*? Explain.

593 Joette is playing a carnival game. To win a prize, one has to correctly guess which of five equally sized regions a spinner will land on, as shown in the diagram below.

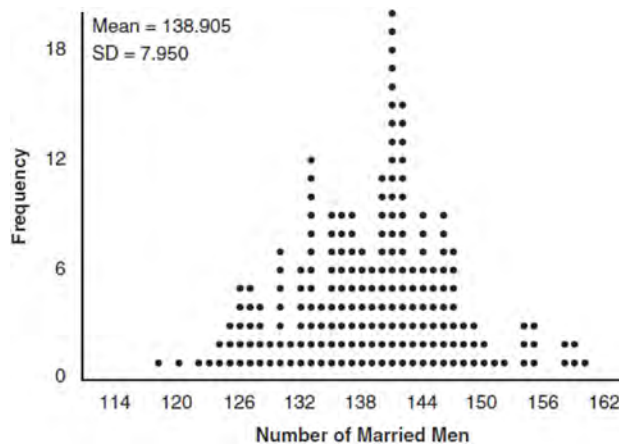


She complains that the game is unfair because her favorite number, 2, has only been spun once in ten times she played the game. State the proportion of 2's that were spun. State the theoretical probability of spinning a 2. The simulation output below shows the results of simulating ten spins of a fair spinner, repeated 100 times.



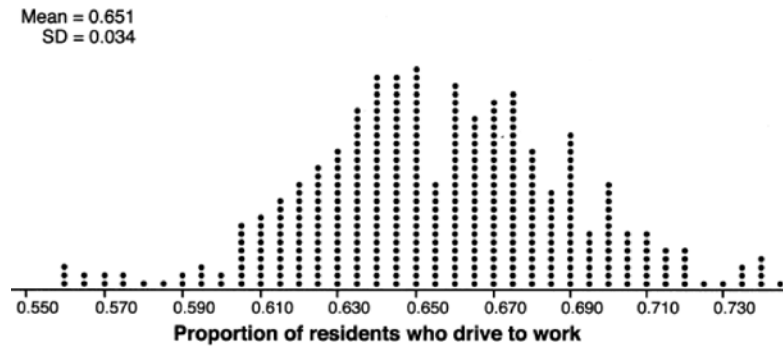
Does the output indicate that the carnival game was unfair? Explain your answer.

594 In a random sample of 250 men in the United States, age 21 or older, 139 are married. The graph below simulated samples of 250 men, 200 times, assuming that 139 of the men are married.



- Based on the simulation, create an interval in which the middle 95% of the number of married men may fall. Round your answer to the *nearest integer*.
- A study claims "50 percent of men 21 and older in the United States are married." Do your results from part a contradict this claim? Explain.

- 595 In order to decrease the percentage of its residents who drive to work, a large city launches a campaign to encourage people to use public transportation instead. Before starting the campaign, the city's Department of Transportation uses census data to estimate that 65% of its residents drive to work. The Department of Transportation conducts a simulation, shown below, run 400 times based on this estimate. Each dot represents the proportion of 200 randomly selected residents who drive to work.



Use the simulation results to construct a plausible interval containing the middle 95% of the data. Round your answer to the *nearest hundredth*. One year after launching the campaign, the Department of Transportation conducts a survey of 200 randomly selected city residents and finds that 122 of them drive to work. Should the department conclude that the city's campaign was effective? Use statistical evidence from the simulation to explain your answer.



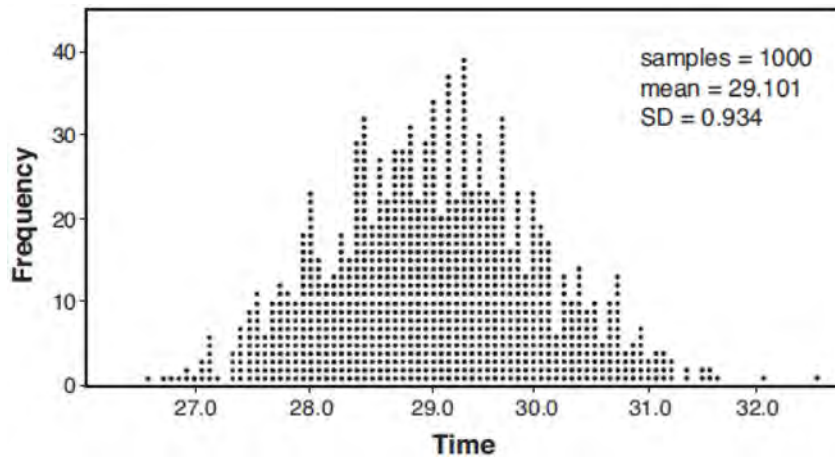
Algebra II Regents Exam Questions by State Standard: Topic

[www.jmap.org](http://www.jmap.org)

- 596 A radio station claims to its advertisers that the mean number of minutes commuters listen to the station is 30. The station conducted a survey of 500 of their listeners who commute. The sample statistics are shown below.

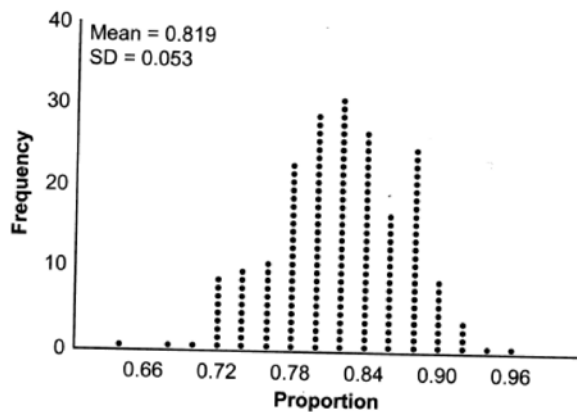
$\bar{x}$	29.11
$s_x$	20.718

A simulation was run 1000 times based upon the results of the survey. The results of the simulation appear below.



Based on the simulation results, is the claim that commuters listen to the station on average 30 minutes plausible? Explain your response including an interval containing the middle 95% of the data, rounded to the *nearest hundredth*.

- 597 State officials claim 82% of a community want to repeal the 30 mph speed limit on an expressway. A community organization devises a simulation based on the claim that 82% of the community supports the repeal. Each dot on the graph below represents the proportion of community members who support the repeal. The graph shows 200 simulated surveys, each of sample size 60.



Based on the simulation, determine an interval containing the middle 95% of plausible proportions. Round your answer to the *nearest thousandth*. The community organization conducted its own sample survey of 60 people and found 70% supported the repeal. Based on the results of the simulation, explain why the organization should question the State officials' claim.

S.IC.B.3: ANALYSIS OF DATA

- 598 According to a study, 45% of Americans have type O blood. If a random number generator produces three-digit values from 000 to 999, which values would represent those having type O blood?
- 1 between 000 and 045, inclusive
  - 2 between 000 and 444, inclusive
  - 3 between 000 and 449, inclusive
  - 4 between 000 and 450, inclusive
- 599 Which statement about statistical analysis is *false*?
- 1 Experiments can suggest patterns and relationships in data.
  - 2 Experiments can determine cause and effect relationships.
  - 3 Observational studies can determine cause and effect relationships.
  - 4 Observational studies can suggest patterns and relationships in data.
- 600 Which investigation technique is most often used to determine if a single variable has an impact on a given population?
- 1 observational study
  - 2 random survey
  - 3 controlled experiment
  - 4 formal interview
- 601 A researcher randomly divides 50 bean plants into two groups. He puts one group by a window to receive natural light and the second group under artificial light. He records the growth of the plants weekly. Which data collection method is described in this situation?
- 1 observational study
  - 2 controlled experiment
  - 3 survey
  - 4 systematic sample
- 602 A sociologist reviews randomly selected surveillance videos from a public park over a period of several years and records the amount of time people spent on a smartphone. The statistical procedure the sociologist used is called
- 1 a census
  - 2 an experiment
  - 3 an observational study
  - 4 a sample survey

- 603 A veterinary pharmaceutical company plans to test a new drug to treat a common intestinal infection among puppies. The puppies are randomly assigned to two equal groups. Half of the puppies will receive the drug, and the other half will receive a placebo. The veterinarians monitor the puppies. This is an example of which study method?
- 1 census
  - 2 observational study
  - 3 survey
  - 4 controlled experiment
- 604 A researcher wants to determine if room-darkening shades cause people to sleep longer. Which method of data collection is most appropriate?
- 1 census
  - 2 survey
  - 3 observation study
  - 4 controlled experiment
- 605 In watching auditions for lead singer in a band, Liem became curious as to whether there is an association between how animated the lead singer is and the amount of applause from the audience. He decided to watch each singer and rate the singer on a scale of 1 to 5, where 1 is the least animated and 5 is the most animated. He did this for all 5 nights of auditions and found that the more animated singers did receive louder applause. The study Liem conducted would be best described as
- 1 experimental
  - 2 observational
  - 3 a sample survey
  - 4 a random assignment
- 606 A cafeteria food manager studied the lunchtime eating habits of a group of employees in their office building. The purpose of the study was to determine the proportion of employees who purchased lunch in the cafeteria, brought their lunch from home, or purchased lunch from an outside vendor. This collection of data would best be classified as
- 1 a census
  - 2 an experiment
  - 3 an observational study
  - 4 a simulation
- 607 A group of high school students wanted to collect information on how many times per week students exercised. If they want the *least* biased results they should survey every fifth student at the school who is
- 1 entering the gym
  - 2 in the junior class
  - 3 entering the library
  - 4 entering the building
- 608 A random sample of 100 people that would best estimate the proportion of all registered voters in a district who support improvements to the high school football field should be drawn from registered voters in the district at a
- 1 football game
  - 2 supermarket
  - 3 school fund-raiser
  - 4 high school band concert

- 609 Cheap and Fast gas station is conducting a consumer satisfaction survey. Which method of collecting data would most likely lead to a biased sample?
- 1 interviewing every 5th customer to come into the station
  - 2 interviewing customers chosen at random by a computer at the checkout
  - 3 interviewing customers who call an 800 number posted on the customers' receipts
  - 4 interviewing every customer who comes into the station on a day of the week chosen at random out of a hat
- 610 The operator of the local mall wants to find out how many of the mall's employees make purchases in the food court when they are working. She hopes to use these data to increase the rent and attract new food vendors. In total, there are 1023 employees who work at the mall. The best method to obtain a random sample of the employees would be to survey
- 1 all 170 employees at each of the larger stores
  - 2 50% of the 90 employees of the food court
  - 3 every employee
  - 4 every 30th employee entering each mall entrance for one week
- 611 Mrs. Favata's statistics class wants to conduct a survey to see how students feel about changing the school mascot's name. Which plan is the best process for gathering an appropriate sample?
- 1 Survey students in a random sample of senior homerooms.
  - 2 Survey every tenth student entering art classes in the school.
  - 3 Survey every fourth student entering the cafeteria during each lunch period.
  - 4 Survey all members of the school's varsity sports teams.
- 612 Which scenario is best described as an observational study?
- 1 For a class project, students in Health class ask every tenth student entering the school if they eat breakfast in the morning.
  - 2 A social researcher wants to learn whether or not there is a link between attendance and grades. She gathers data from 15 school districts.
  - 3 A researcher wants to learn whether or not there is a link between children's daily amount of physical activity and their overall energy level. During lunch at the local high school, she distributed a short questionnaire to students in the cafeteria.
  - 4 Sixty seniors taking a course in Advanced Algebra Concepts are randomly divided into two classes. One class uses a graphing calculator all the time, and the other class never uses graphing calculators. A guidance counselor wants to determine whether there is a link between graphing calculator use and students' final exam grades.
- 613 Which statement about data collection is most accurate?
- 1 A survey about parenting styles given to every tenth student entering the library will provide unbiased results.
  - 2 An observational study allows a researcher to determine the cause of an outcome.
  - 3 Margin of error increases as sample size increases.
  - 4 A survey collected from a random sample of students in a school can be used to represent the opinions of the school population.

- 614 Which statement(s) about statistical studies is true?
- I. A survey of all English classes in a high school would be a good sample to determine the number of hours students throughout the school spend studying.
  - II. A survey of all ninth graders in a high school would be a good sample to determine the number of student parking spaces needed at that high school.
  - III. A survey of all students in one lunch period in a high school would be a good sample to determine the number of hours adults spend on social media websites.
  - IV. A survey of all Calculus students in a high school would be a good sample to determine the number of students throughout the school who don't like math.
- 1 I, only
  - 2 II, only
  - 3 I and III
  - 4 III and IV

615 Describe how a controlled experiment can be created to examine the effect of ingredient  $X$  in a toothpaste.

616 Chuck's Trucking Company has decided to initiate an Employee of the Month program. To determine the recipient, they put the following sign on the back of each truck.

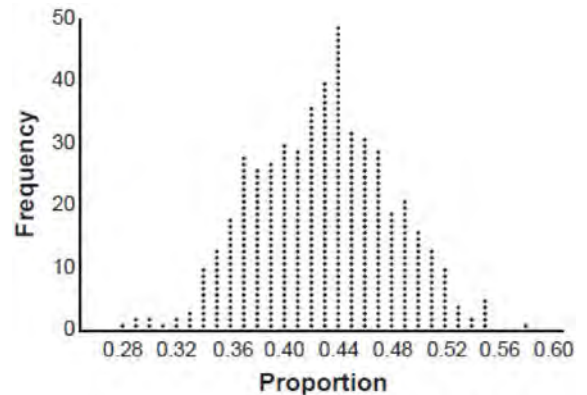


The driver who receives the highest number of positive comments will win the recognition. Explain *one* statistical bias in this data collection method.

617 The business office of a local college wishes to determine the methods of payment that will be used by students when buying books at the beginning of a semester. Explain how the office can gather an appropriate sample that minimizes bias.

S.IC.B.4: ANALYSIS OF DATA

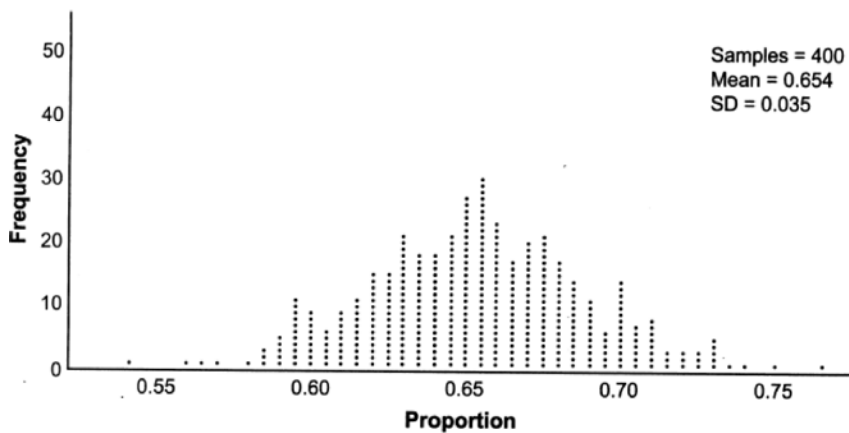
618 Marissa and Sydney are trying to determine if there is enough interest in their school to put on a senior musical. They randomly surveyed 100 members of the senior class and 43% of them said they would be interested in being in a senior musical. Marissa and Sydney then conducted a simulation of 500 more surveys, each of 100 seniors, assuming that 43% of the senior class would be interested in being in the musical. The output of the simulation is shown below.



The standard deviation of the simulation is closest to

- 1 0.02
- 2 0.05
- 3 0.09
- 4 0.43

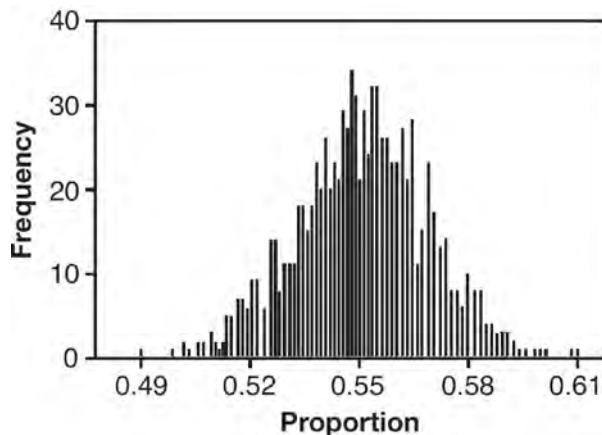
- 619 Betty conducted a survey of her class to see if they like pizza. She gathered 200 responses and 65% of the voters said they did like pizza. Betty then ran a simulation of 400 more surveys, each with 200 responses, assuming that 65% of the voters would like pizza. The output of the simulation is shown below.



Considering the middle 95% of the data, what is the margin of error for the simulation?

- |   |      |   |      |
|---|------|---|------|
| 1 | 0.01 | 3 | 0.05 |
| 2 | 0.02 | 4 | 0.07 |

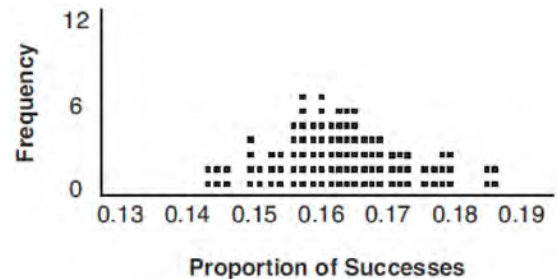
- 620 A candidate for political office commissioned a poll. His staff received responses from 900 likely voters and 55% of them said they would vote for the candidate. The staff then conducted a simulation of 1000 more polls of 900 voters, assuming that 55% of voters would vote for their candidate. The output of the simulation is shown in the diagram below.



Given this output, and assuming a 95% confidence level, the margin of error for the poll is closest to

- 1 0.01
- 2 0.03
- 3 0.06
- 4 0.12

- 621 A study conducted in 2004 in New York City found that 212 out of 1334 participants had hypertension. Kim ran a simulation of 100 studies based on these data. The output of the simulation is shown in the diagram below.



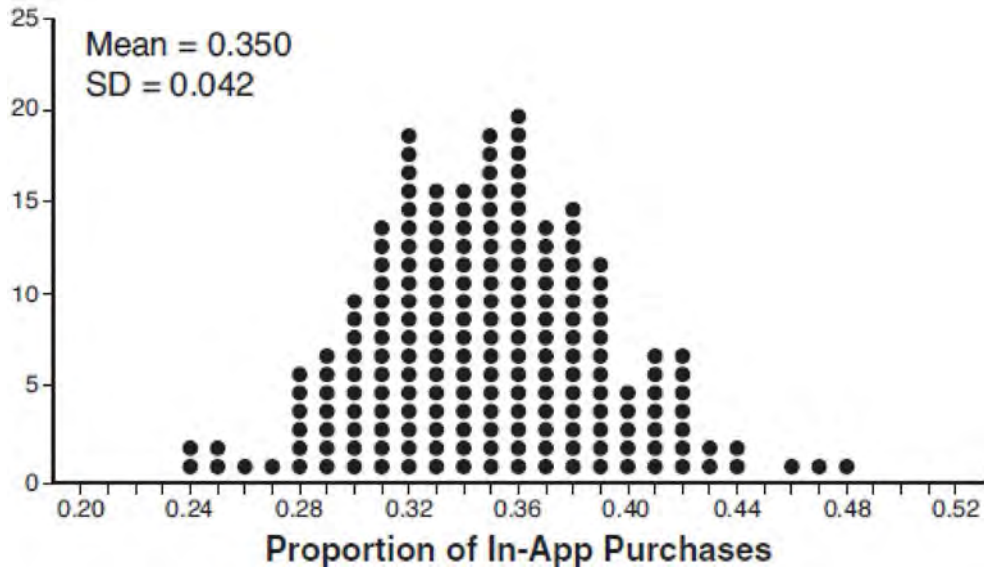
At a 95% confidence level, the proportion of New York City residents with hypertension and the margin of error are closest to

- 1 proportion  $\approx .16$ ; margin of error  $\approx .01$
- 2 proportion  $\approx .16$ ; margin of error  $\approx .02$
- 3 proportion  $\approx .01$ ; margin of error  $\approx .16$
- 4 proportion  $\approx .02$ ; margin of error  $\approx .16$

- 622 A company wishes to determine the cooking time for one pound of spaghetti. The company's technicians cooked one pound of spaghetti and recorded the time needed for the spaghetti to be ready to eat. Repeating this process 35 times resulted in an approximately normal distribution, with a mean of 9.82 minutes and a standard deviation of 1.4 minutes. In which interval should the middle 95% of cooking times fall?

- 1 (8.42, 11.22)
- 2 (7.02, 12.62)
- 3 (9.35, 10.29)
- 4 (6.82, 11.32)

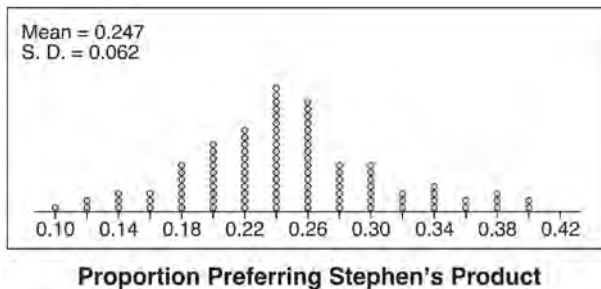
623 Some smart-phone applications contain "in-app" purchases, which allow users to purchase special content within the application. A random sample of 140 users found that 35 percent made in-app purchases. A simulation was conducted with 200 samples of 140 users assuming 35 percent of the samples make in-app purchases. The approximately normal results are shown below.



Considering the middle 95% of the data, determine the margin of error, to the *nearest hundredth*, for the simulated results. In the given context, explain what this value represents.



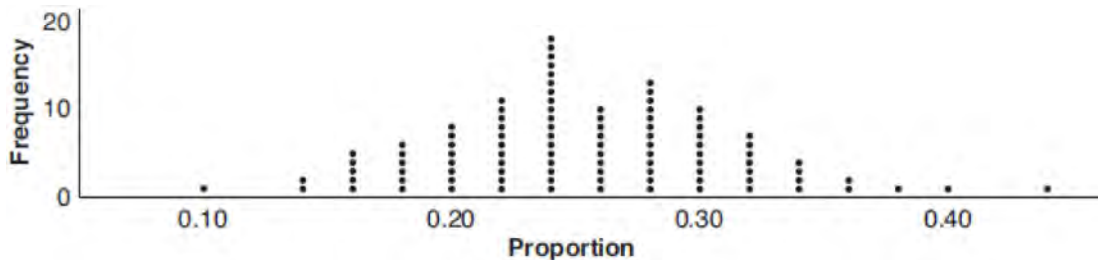
624 Stephen’s Beverage Company is considering whether to produce a new brand of cola. The company will launch the product if at least 25% of cola drinkers will buy the product. Fifty cola drinkers are randomly selected to take a blind taste-test of products *A*, *B*, and the new product. Nine out of fifty participants preferred Stephen’s new cola to products *A* and *B*. The company then devised a simulation based on the requirement that 25% of cola drinkers will buy the product. Each dot in the graph shown below represents the proportion of people who preferred Stephen’s new product, each of sample size 50, simulated 100 times.



Assume the set of data is approximately normal and the company wants to be 95% confident of its results. Does the sample proportion obtained from the blind taste-test, nine out of fifty, fall within the margin of error developed from the simulation? Justify your answer. The company decides to continue developing the product even though only nine out of fifty participants preferred its brand of cola in the taste-test. Describe how the simulation data could be used to support this decision.

S.IC.B.5: ANALYSIS OF DATA

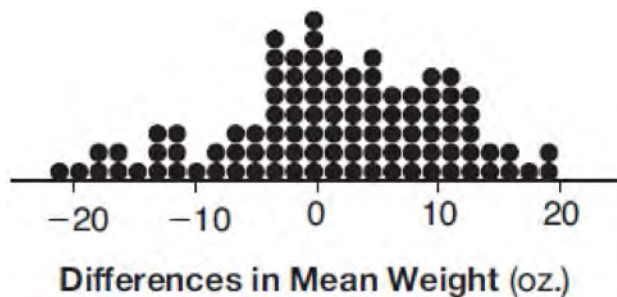
625 A group of students was trying to determine the proportion of candies in a bag that are blue. The company claims that 24% of candies in bags are blue. A simulation was run 100 times with a sample size of 50, based on the premise that 24% of the candies are blue. The approximately normal results of the simulation are shown in the dot plot below.



The simulation results in a mean of 0.254 and a standard deviation of 0.060. Based on this simulation, what is a plausible interval containing the middle 95% of the data?

- |   |                |   |                 |
|---|----------------|---|-----------------|
| 1 | (0.194, 0.314) | 3 | (-0.448, 0.568) |
| 2 | (0.134, 0.374) | 4 | (0.254, 0.374)  |

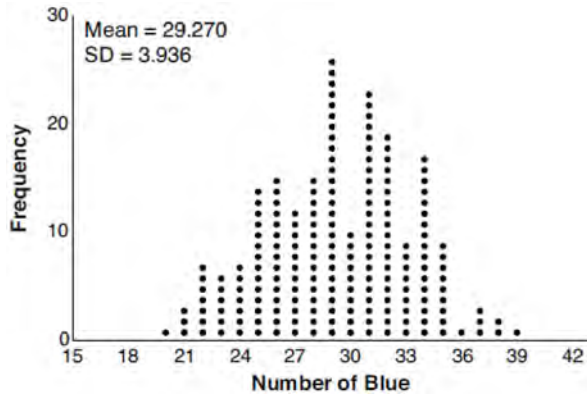
626 Gabriel performed an experiment to see if planting 13 tomato plants in black plastic mulch leads to larger tomatoes than if 13 plants are planted without mulch. He observed that the average weight of the tomatoes from tomato plants grown in black plastic mulch was 5 ounces greater than those from the plants planted without mulch. To determine if the observed difference is statistically significant, he rerandomized the tomato groups 100 times to study these random differences in the mean weights. The output of his simulation is summarized in the dotplot below.



Given these results, what is an appropriate inference that can be drawn?

- |   |   |
|---|---|
| <p>1 There was no effect observed between the two groups.</p> <p>2 There was an effect observed that could be due to the random assignment of plants to the groups.</p> | <p>3 There is strong evidence to support the hypothesis that tomatoes from plants planted in black plastic mulch are larger than those planted without mulch.</p> <p>4 There is strong evidence to support the hypothesis that tomatoes from plants planted without mulch are larger than those planted in black plastic mulch.</p> |
|---|---|

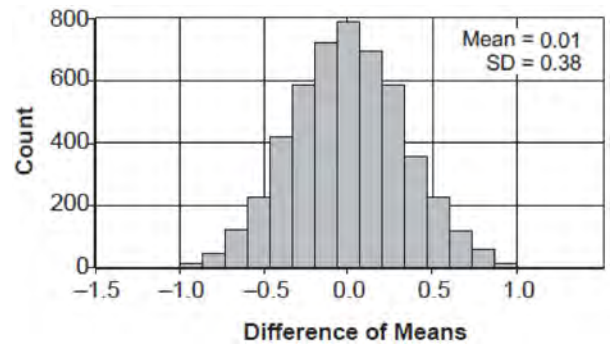
627 The J& B candy company claims that 45% of the candies it produces are blue, 30% are brown, and 25% are yellow. Each bag holds 65 candies. A simulation was run 200 times, each of sample size 65, based on the premise that 45% of the candies are blue. The results of the simulation are shown below.



Bonnie purchased a bag of J& B's candy and counted 24 blue candies. What inference can be made regarding a bag of J& B's with only 24 blue candies?

- 1 The company is not meeting their production standard.
- 2 Bonnie's bag was a rarity and the company should not be concerned.
- 3 The company should change their claim to 37% blue candies are produced.
- 4 Bonnie's bag is within the middle 95% of the simulated data supporting the company's claim.

628 Two classes of students were entered into an experiment to see whether using an interactive whiteboard leads to better grades. It was observed that the mean grade of students in the class with the interactive whiteboard was 0.6 points higher than the class without it. To determine if the observed difference is statistically significant, the classes were rerandomized 5000 times to study these random differences in the mean grades. The output of the simulation is summarized in the histogram below.



Determine an interval containing the middle 95% of the simulation results. Round your answer to the *nearest hundredth*. Does the interval indicate that the difference between the classes' grades is significant? Explain.

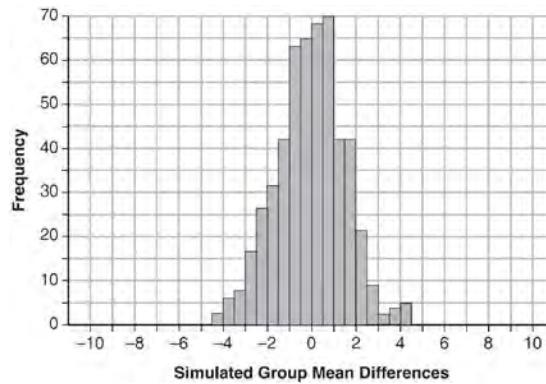
Algebra II Regents Exam Questions by State Standard: Topic

[www.jmap.org](http://www.jmap.org)

629 Seventy-two students are randomly divided into two equally-sized study groups. Each member of the first group (group 1) is to meet with a tutor after school twice each week for one hour. The second group (group 2), is given an online subscription to a tutorial account that they can access for a maximum of two hours each week. Students in both groups are given the same tests during the year. A summary of the two groups' final grades is shown below:

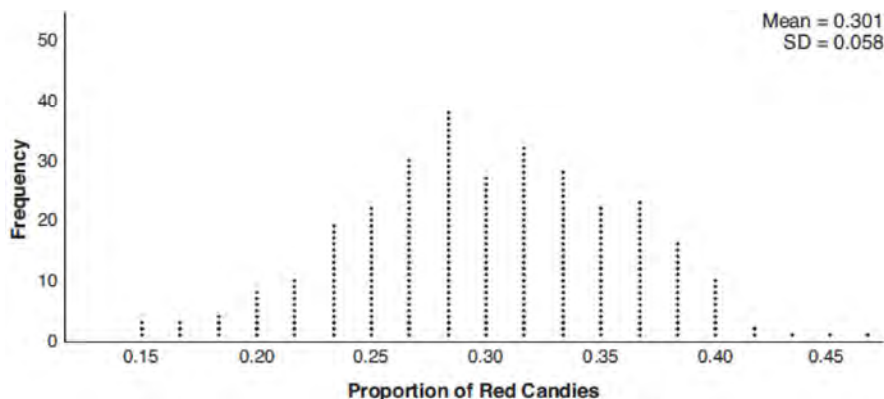
	Group 1	Group 2
$\bar{x}$	80.16	83.8
$S_x$	6.9	5.2

Calculate the mean difference in the final grades (group 1 – group 2) and explain its meaning in the context of the problem. A simulation was conducted in which the students' final grades were rerandomized 500 times. The results are shown below.



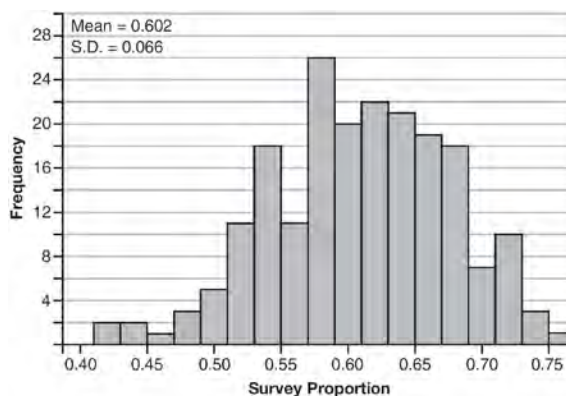
Use the simulation to determine if there is a significant difference in the final grades. Explain your answer.

- 630 Mary bought a pack of candy. The manufacturer claims that 30% of the candies manufactured are red. In her pack, 14 of the 60 candies are red. She ran a simulation of 300 samples, assuming the manufacturer is correct. The results are shown below.



Based on the simulation, determine the middle 95% of plausible values that the proportion of red candies in a pack is within. Based on the simulation, is it unusual that Mary’s pack had 14 red candies out of a total of 60? Explain.

- 631 Fifty-five students attending the prom were randomly selected to participate in a survey about the music choice at the prom. Sixty percent responded that a DJ would be preferred over a band. Members of the prom committee thought that the vote would have 50% for the DJ and 50% for the band. A simulation was run 200 times, each of sample size 55, based on the premise that 60% of the students would prefer a DJ. The approximate normal simulation results are shown below.

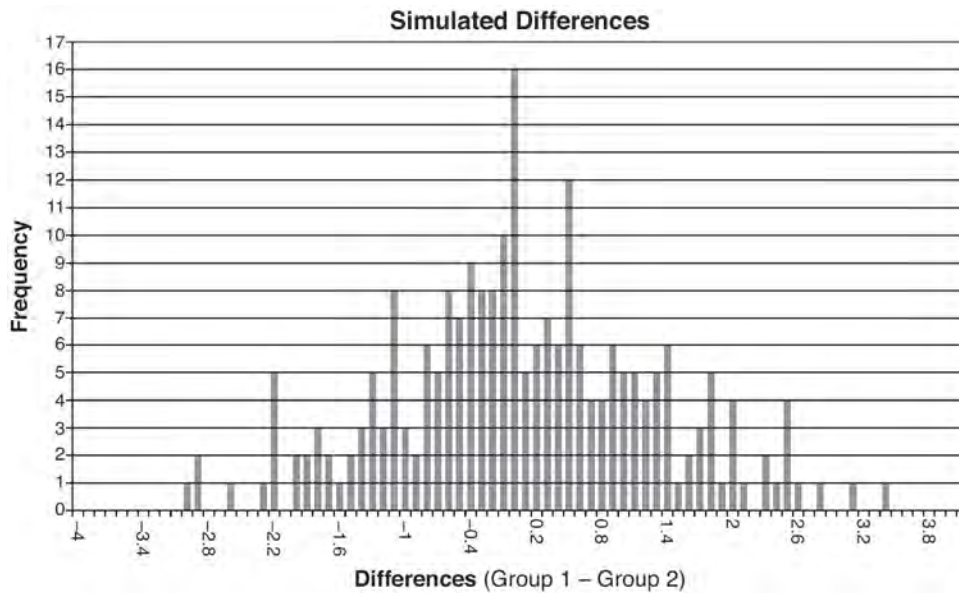


Using the results of the simulation, determine a plausible interval containing the middle 95% of the data. Round all values to the *nearest hundredth*. Members of the prom committee are concerned that a vote of all students attending the prom may produce a 50% – 50% split. Explain what statistical evidence supports this concern.

632 Ayva designed an experiment to determine the effect of a new energy drink on a group of 20 volunteer students. Ten students were randomly selected to form group 1 while the remaining 10 made up group 2. Each student in group 1 drank one energy drink, and each student in group 2 drank one cola drink. Ten minutes later, their times were recorded for reading the same paragraph of a novel. The results of the experiment are shown below.

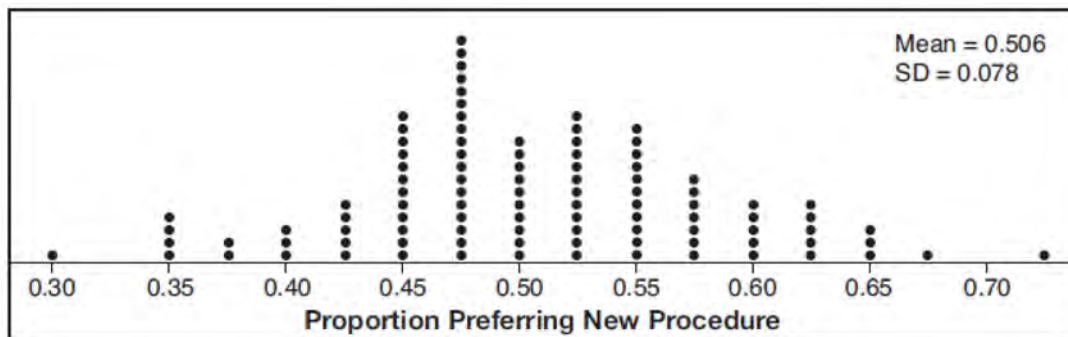
Group 1 (seconds)	Group 2 (seconds)
17.4	23.3
18.1	18.8
18.2	22.1
19.6	12.7
18.6	16.9
16.2	24.4
16.1	21.2
15.3	21.2
17.8	16.3
19.7	14.5
Mean = 17.7	Mean = 19.1

Ayva thinks drinking energy drinks makes students read faster. Using information from the experimental design or the results, explain why Ayva's hypothesis may be *incorrect*. Using the given results, Ayva randomly mixes the 20 reading times, splits them into two groups of 10, and simulates the difference of the means 232 times.



Ayva has decided that the difference in mean reading times is not an unusual occurrence. Support her decision using the results of the simulation. Explain your reasoning.

633 Charlie's Automotive Dealership is considering implementing a new check-in procedure for customers who are bringing their vehicles for routine maintenance. The dealership will launch the procedure if 50% or more of the customers give the new procedure a favorable rating when compared to the current procedure. The dealership devises a simulation based on the minimal requirement that 50% of the customers prefer the new procedure. Each dot on the graph below represents the proportion of the customers who preferred the new check-in procedure, each of sample size 40, simulated 100 times.

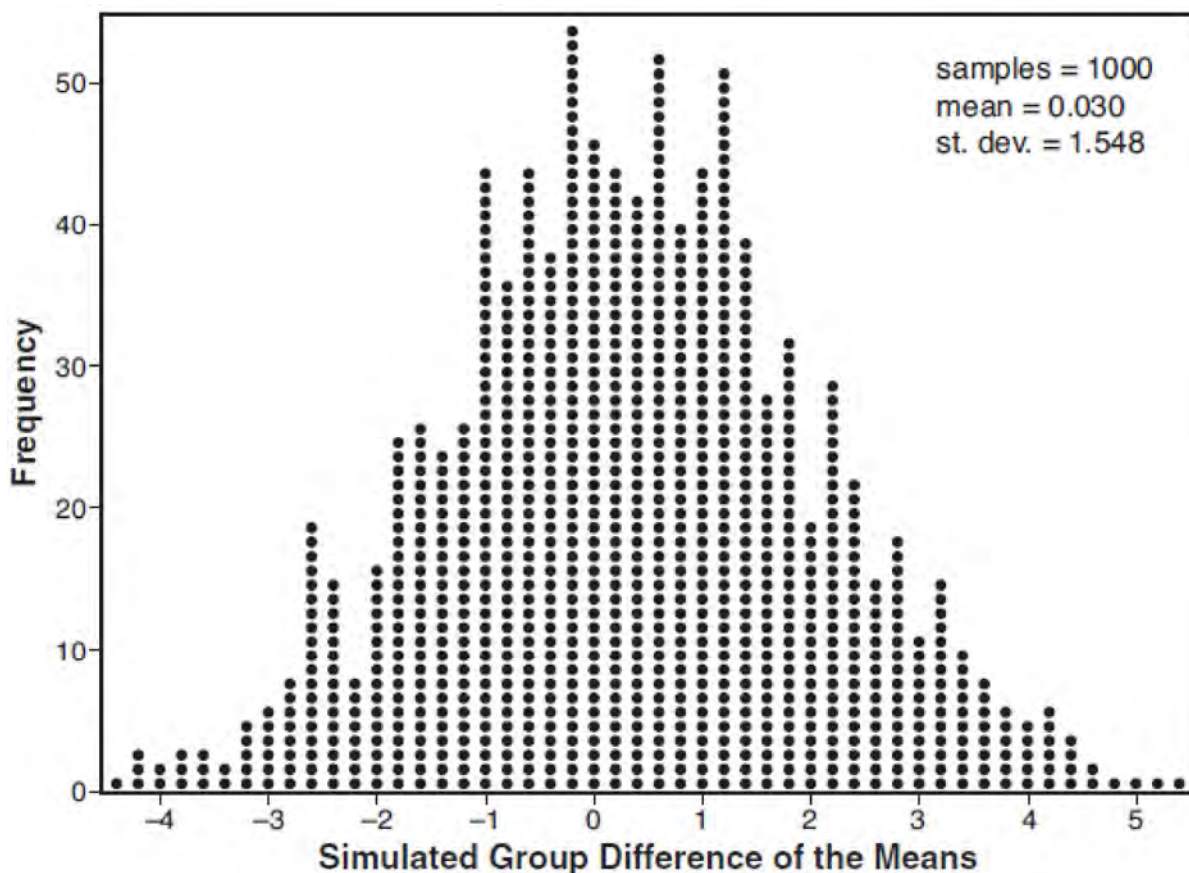


Assume the set of data is approximately normal and the dealership wants to be 95% confident of its results. Determine an interval containing the plausible sample values for which the dealership will launch the new procedure. Round your answer to the *nearest hundredth*. Forty customers are selected randomly to undergo the new check-in procedure and the proportion of customers who prefer the new procedure is 32.5%. The dealership decides *not* to implement the new check-in procedure based on the results of the study. Use statistical evidence to explain this decision.

- 634 Joseph was curious to determine if scent improves memory. A test was created where better memory is indicated by higher test scores. A controlled experiment was performed where one group was given the test on scented paper and the other group was given the test on unscented paper. The summary statistics from the experiment are given below.

	Scented Paper	Unscented Paper
$\bar{x}$	23	18
$s_x$	2.898	2.408

Calculate the difference in means in the experimental test grades (scented -unscented). A simulation was conducted in which the subjects' scores were rerandomized into two groups 1000 times. The differences of the group means were calculated each time. The results are shown below.



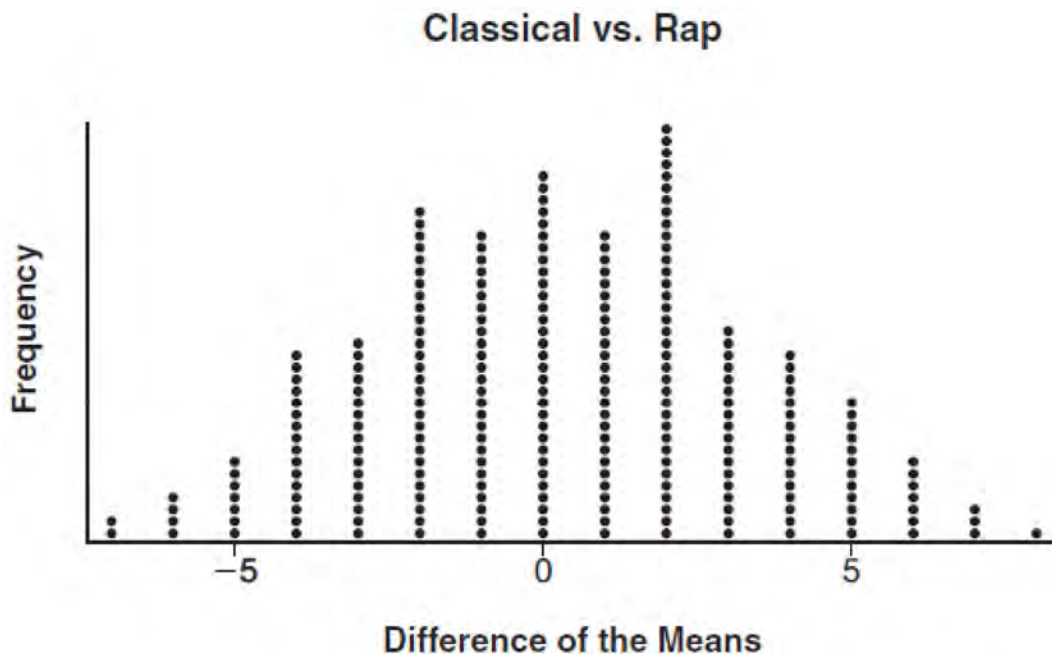
Use the simulation results to determine the interval representing the middle 95% of the difference in means, to the nearest hundredth. Is the difference in means in Joseph's experiment statistically significant based on the simulation? Explain.



635 To determine if the type of music played while taking a quiz has a relationship to results, 16 students were randomly assigned to either a room softly playing classical music or a room softly playing rap music. The results on the quiz were as follows:

Classical: 74, 83, 77, 77, 84, 82, 90, 89  
Rap: 77, 80, 78, 74, 69, 72, 78, 69

John correctly rounded the difference of the means of his experimental groups as 7. How did John obtain this value and what does it represent in the given context? Justify your answer. To determine if there is any significance in this value, John rerandomized the 16 scores into two groups of 8, calculated the difference of the means, and simulated this process 250 times as shown below.



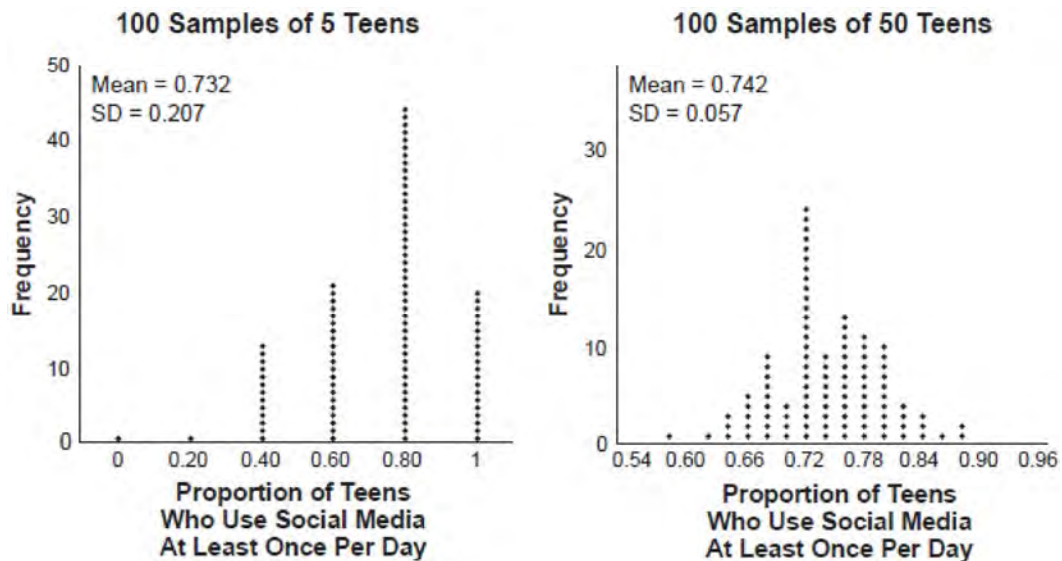
Does the simulation support the theory that there may be a significant difference in quiz scores? Explain.

**S.IC.B.6: ANALYSIS OF DATA**

- 636 A public opinion poll was conducted on behalf of Mayor Ortega's reelection campaign shortly before the election. 264 out of 550 likely voters said they would vote for Mayor Ortega; the rest said they would vote for his opponent. Which statement is *least* appropriate to make, according to the results of the poll?
- 1 There is a 48% chance that Mayor Ortega will win the election.
  - 2 The point estimate ( $\hat{p}$ ) of voters who will vote for Mayor Ortega is 48%.
  - 3 It is most likely that between 44% and 52% of voters will vote for Mayor Ortega.
  - 4 Due to the margin of error, an inference cannot be made regarding whether Mayor Ortega or his opponent is most likely to win the election.

- 637 The Hot and Tasty Coffee chain conducts a survey of its customers at its location at the Staten Island ferry terminal. After the survey is completed, the statistical consultant states that 70% of customers who took the survey said the most important factor in choosing where to get their coffee is how fast they are served. Based on this result, Hot and Tasty Coffee can infer that
- 1 most of its customers in New York State care most about being served quickly
  - 2 coffee drinkers care less about taste and more about being served quickly
  - 3 most of its customers at the Staten Island ferry terminal care most about being served quickly
  - 4 most of its customers at transportation terminals and stations care most about being served quickly

- 638 Two surveys were conducted to estimate the proportion of teens who use social media at least once per day.



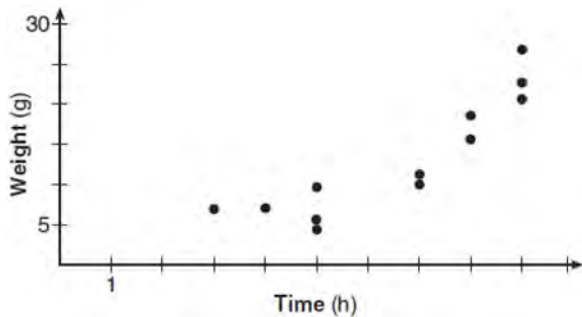
Based on these results, it was determined that approximately 75% of teens use social media at least once per day. What is the best explanation of the difference in the results between the two surveys?

- 1 The smaller sample size of five teens resulted in a smaller margin of error and should provide a more accurate estimate.
- 2 The smaller sample size of five teens resulted in a bigger margin of error and should provide a more accurate estimate.
- 3 The larger sample size of 50 teens resulted in a smaller margin of error and should provide a more accurate estimate.
- 4 The larger sample size of 50 teens resulted in a bigger margin of error and should provide a more accurate estimate.

639 Elizabeth waited for 6 minutes at the drive thru at her favorite fast-food restaurant the last time she visited. She was upset about having to wait that long and notified the manager. The manager assured her that her experience was very unusual and that it would not happen again. A study of customers commissioned by this restaurant found an approximately normal distribution of results. The mean wait time was 226 seconds and the standard deviation was 38 seconds. Given these data, and using a 95% level of confidence, was Elizabeth's wait time unusual? Justify your answer.

S.ID.B.6: REGRESSION

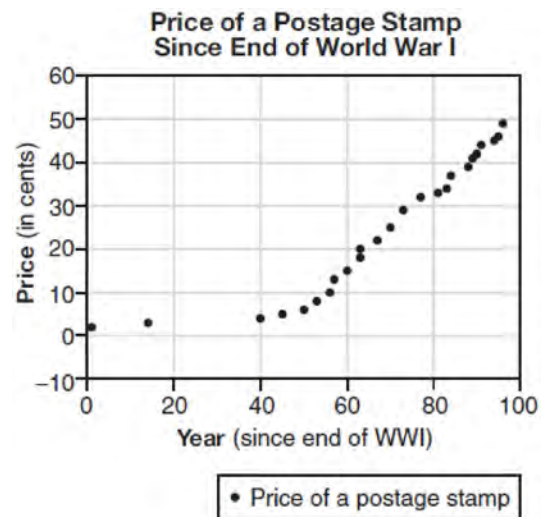
640 A scatterplot showing the weight,  $w$ , in grams, of each crystal after growing  $t$  hours is shown below.



The relationship between weight,  $w$ , and time,  $t$ , is best modeled by

- 1  $w = 4^t + 5$
- 2  $w = (1.4)^t + 2$
- 3  $w = 5(2.1)^t$
- 4  $w = 8(.75)^t$

641 The price of a postage stamp in the years since the end of World War I is shown in the scatterplot below.



The equation that best models the price, in cents, of a postage stamp based on these data is

- 1  $y = 0.59x - 14.82$
- 2  $y = 1.04(1.43)^x$
- 3  $y = 1.43(1.04)^x$
- 4  $y = 24 \sin(14x) + 25$



- 646 Using a microscope, a researcher observed and recorded the number of bacteria spores on a large sample of uniformly sized pieces of meat kept at room temperature. A summary of the data she recorded is shown in the table below.

Hours (x)	Average Number of Spores (y)
0	4
0.5	10
1	15
2	60
3	260
4	1130
6	16,380

Using these data, write an exponential regression equation, rounding all values to the *nearest thousandth*. The researcher knows that people are likely to suffer from food-borne illness if the number of spores exceeds 100. Using the exponential regression equation, determine the maximum amount of time, to the *nearest quarter hour*, that the meat can be kept at room temperature safely.

- 647 The table below gives air pressures in kPa at selected altitudes above sea level measured in kilometers.

<b>x</b>	<b>Altitude (km)</b>	0	1	2	3	4	5
<b>y</b>	<b>Air Pressure (kPa)</b>	101	90	79	70	62	54

Write an exponential regression equation that models these data rounding all values to the *nearest thousandth*. Use this equation to algebraically determine the altitude, to the *nearest hundredth* of a kilometer, when the air pressure is 29 kPa.

#### S.ID.A.4: NORMAL DISTRIBUTIONS

- 648 Suppose two sets of test scores have the same mean, but different standard deviations,  $\sigma_1$  and  $\sigma_2$ , with  $\sigma_2 > \sigma_1$ . Which statement best describes the variability of these data sets?
- 1 Data set one has the greater variability.
  - 2 Data set two has the greater variability.
  - 3 The variability will be the same for each data set.
  - 4 No conclusion can be made regarding the variability of either set.

- 649 In 2013, approximately 1.6 million students took the Critical Reading portion of the SAT exam. The mean score, the modal score, and the standard deviation were calculated to be 496, 430, and 115, respectively. Which interval reflects 95% of the Critical Reading scores?

- 1  $430 \pm 115$
- 2  $430 \pm 230$
- 3  $496 \pm 115$
- 4  $496 \pm 230$

- 650 There are 400 students in the senior class at Oak Creek High School. All of these students took the SAT. The distribution of their SAT scores is approximately normal. The number of students who scored within 2 standard deviations of the mean is approximately
- 1 75
  - 2 95
  - 3 300
  - 4 380
- 651 The heights of women in the United States are normally distributed with a mean of 64 inches and a standard deviation of 2.75 inches. The percent of women whose heights are between 64 and 69.5 inches, to the *nearest whole percent*, is
- 1 6
  - 2 48
  - 3 68
  - 4 95
- 652 The lifespan of a 60-watt lightbulb produced by a company is normally distributed with a mean of 1450 hours and a standard deviation of 8.5 hours. If a 60-watt lightbulb produced by this company is selected at random, what is the probability that its lifespan will be between 1440 and 1465 hours?
- 1 0.3803
  - 2 0.4612
  - 3 0.8415
  - 4 0.9612
- 653 The distribution of the diameters of ball bearings made under a given manufacturing process is normally distributed with a mean of 4 cm and a standard deviation of 0.2 cm. What proportion of the ball bearings will have a diameter less than 3.7 cm?
- 1 0.0668
  - 2 0.4332
  - 3 0.8664
  - 4 0.9500
- 654 The weights of bags of Graseck's Chocolate Candies are normally distributed with a mean of 4.3 ounces and a standard deviation of 0.05 ounces. What is the probability that a bag of these chocolate candies weighs less than 4.27 ounces?
- 1 0.2257
  - 2 0.2743
  - 3 0.7257
  - 4 0.7757
- 655 A population is normally distributed with a mean of 23 and a standard deviation of 1.2. The percentage of the population that falls below 21, to the *nearest hundredth*, is
- 1 0.05
  - 2 4.78
  - 3 8.29
  - 4 91.30
- 656 The mean intelligence quotient (IQ) score is 100, with a standard deviation of 15, and the scores are normally distributed. Given this information, the approximate percentage of the population with an IQ greater than 130 is closest to
- 1 2%
  - 2 31%
  - 3 48%
  - 4 95%
- 657 The heights of the students at Central High School can be modeled by a normal distribution with a mean of 68.1 and a standard deviation of 3.4 inches. According to this model, approximately what percent of the students would have a height less than 60 inches or greater than 75 inches?
- 1 0.86%
  - 2 1.26%
  - 3 2.12%
  - 4 2.98%

Algebra II Regents Exam Questions by State Standard: Topic

[www.jmap.org](http://www.jmap.org)

- 658 The heights of the 3300 students at Oceanview High School are approximately normally distributed with a mean of 65.5 inches and a standard deviation of 2.9 inches. The number of students at Oceanview who are between 64 and 68 inches tall is closest to
- 1 1660
  - 2 1070
  - 3 2244
  - 4 1640
- 659 There are 440 students at Thomas Paine High School enrolled in U.S. History. On the April report card, the students' grades are approximately normally distributed with a mean of 79 and a standard deviation of 7. Students who earn a grade less than or equal to 64.9 must attend summer school. The number of students who must attend summer school for U.S. History is closest to
- 1 3
  - 2 5
  - 3 10
  - 4 22
- 660 The scores on a mathematics college-entry exam are normally distributed with a mean of 68 and standard deviation 7.2. Students scoring higher than one standard deviation above the mean will not be enrolled in the mathematics tutoring program. How many of the 750 incoming students can be expected to be enrolled in the tutoring program?
- 1 631
  - 2 512
  - 3 238
  - 4 119
- 661 The scores on a collegiate mathematics readiness assessment are approximately normally distributed with a mean of 680 and a standard deviation of 120. Determine the percentage of scores between 690 and 900, to the *nearest percent*.
- 662 The weight of a bag of pears at the local market averages 8 pounds with a standard deviation of 0.5 pound. The weights of all the bags of pears at the market closely follow a normal distribution. Determine what percentage of bags, to the *nearest integer*, weighed *less* than 8.25 pounds.
- 663 The scores of a recent test taken by 1200 students had an approximately normal distribution with a mean of 225 and a standard deviation of 18. Determine the number of students who scored between 200 and 245.
- 664 The heights of the members of a ski club are normally distributed. The average height is 64.7 inches with a standard deviation of 4.3 inches. Determine the percentage of club members, to the *nearest percent*, who are between 67 inches and 72 inches tall.
- 665 According to a study done at a hospital, the average weight of a newborn baby is 3.39 kg, with a standard deviation of 0.55 kg. The weights of all the newborns in this hospital closely follow a normal distribution. Last year, 9256 babies were born at this hospital. Determine, to the *nearest integer*, approximately how many babies weighed more than 4 kg.
- 666 Two versions of a standardized test are given, an April version and a May version. The statistics for the April version show a mean score of 480 and a standard deviation of 24. The statistics for the May version show a mean score of 510 and a standard deviation of 20. Assume the scores are normally distributed. Joanne took the April version and scored in the interval 510-540. What is the probability, to the *nearest ten thousandth*, that a test paper selected at random from the April version scored in the same interval? Maria took the May version. In what interval must Maria score to claim she scored as well as Joanne?

## PROBABILITY

### S.CP.B.7: THEORETICAL PROBABILITY

667 In a survey of people who recently bought a laptop, 45% said they were looking for a large screen, 31% said they were looking for a fast processor, and 58% said they wanted a large screen or a fast processor. If a survey respondent is selected at random, what is the probability that the respondent wanted both a large screen and a fast processor?

- 1 76%
- 2 14%
- 3 77%
- 4 18%

668 The probability that Gary and Jane have a child with blue eyes is 0.25, and the probability that they have a child with blond hair is 0.5. The probability that they have a child with both blue eyes and blond hair is 0.125. Given this information, the events blue eyes and blond hair are

- I: dependent
- II: independent
- III: mutually exclusive

- 1 I, only
- 2 II, only
- 3 I and III
- 4 II and III

669 A suburban high school has a population of 1376 students. The number of students who participate in sports is 649. The number of students who participate in music is 433. If the probability that a student participates in either sports or music is  $\frac{974}{1376}$ , what is the probability that a student participates in both sports and music?

### S.CP.A.2: PROBABILITY OF COMPOUND EVENTS

670 On a given school day, the probability that Nick oversleeps is 48% and the probability he has a pop quiz is 25%. Assuming these two events are independent, what is the probability that Nick oversleeps and has a pop quiz on the same day?

- 1 73%
- 2 36%
- 3 23%
- 4 12%

671 Given  $P(A) = \frac{1}{3}$  and  $P(B) = \frac{5}{12}$ , where  $A$  and  $B$  are independent events, determine  $P(A \cap B)$ .

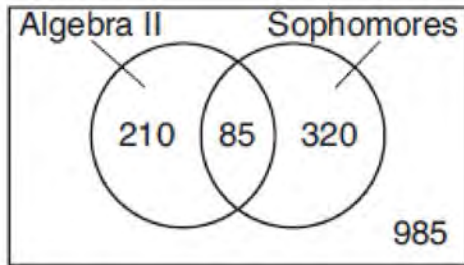
672 Given events  $A$  and  $B$ , such that  $P(A) = 0.6$ ,  $P(B) = 0.5$ , and  $P(A \cup B) = 0.8$ , determine whether  $A$  and  $B$  are independent or dependent.

673 In contract negotiations between a local government agency and its workers, it is estimated that there is a 50% chance that an agreement will be reached on the salaries of the workers. It is estimated that there is a 70% chance that there will be an agreement on the insurance benefits. There is a 20% chance that no agreement will be reached on either issue. Find the probability that an agreement will be reached on *both* issues. Based on this answer, determine whether the agreement on salaries and the agreement on insurance are independent events. Justify your answer.



S.CP.A.1: VENN DIAGRAMS

- 674 Data for the students enrolled in a local high school are shown in the Venn diagram below.



If a student from the high school is selected at random, what is the probability that the student is a sophomore given that the student is enrolled in Algebra II?

- 1  $\frac{85}{210}$
  - 2  $\frac{85}{295}$
  - 3  $\frac{85}{405}$
  - 4  $\frac{85}{1600}$
- 675 In a group of 40 people, 20 have brown hair, 22 have blue eyes, and 15 have both brown hair and blue eyes. How many people have neither brown hair nor blue eyes?
- 1 0
  - 2 13
  - 3 27
  - 4 32

S.CP.A.3: CONDITIONAL PROBABILITY

- 676 Which situation best describes conditional probability?
- 1 finding the probability of an event occurring two or more times
  - 2 finding the probability of an event occurring only once
  - 3 finding the probability of two independent events occurring at the same time
  - 4 finding the probability of an event occurring given another event had already occurred
- 677 Sean's team has a baseball game tomorrow. He pitches 50% of the games. There is a 40% chance of rain during the game tomorrow. If the probability that it rains given that Sean pitches is 40%, it can be concluded that these two events are
- 1 independent
  - 2 dependent
  - 3 mutually exclusive
  - 4 complements
- 678 A fast-food restaurant analyzes data to better serve its customers. After its analysis, it discovers that the events  $D$ , that a customer uses the drive-thru, and  $F$ , that a customer orders French fries, are independent. The following data are given in a report:

$$P(F) = 0.8$$

$$P(F \cap D) = 0.456$$

Given this information,  $P(F|D)$  is

- 1 0.344
- 2 0.3648
- 3 0.57
- 4 0.8

- 679 Consider the probability statements regarding events  $A$  and  $B$  below.

$$P(A \text{ or } B) = 0.3;$$

$$P(A \text{ and } B) = 0.2; \text{ and}$$

$$P(A|B) = 0.8$$

What is  $P(B)$ ?

- 1 0.1
  - 2 0.25
  - 3 0.375
  - 4 0.667
- 680 Suppose events  $A$  and  $B$  are independent and  $P(A \text{ and } B)$  is 0.2. Which statement could be true?
- 1  $P(A) = 0.4, P(B) = 0.3, P(A \text{ or } B) = 0.5$
  - 2  $P(A) = 0.8, P(B) = 0.25$
  - 3  $P(A|B) = 0.2, P(B) = 0.2$
  - 4  $P(A) = 0.15, P(B) = 0.05$

- 681 The probability that a resident of a housing community opposes spending money for community improvement on plumbing issues is 0.8. The probability that a resident favors spending money on improving walkways given that the resident opposes spending money on plumbing issues is 0.85. Determine the probability that a randomly selected resident opposes spending money on plumbing issues and favors spending money on walkways.

- 682 A student is chosen at random from the student body at a given high school. The probability that the student selects Math as the favorite subject is  $\frac{1}{4}$ . The probability that the student chosen is a junior is  $\frac{116}{459}$ . If the probability that the student selected is a junior or that the student chooses Math as the favorite subject is  $\frac{47}{108}$ , what is the exact probability that the student selected is a junior whose favorite subject is Math? Are the events "the student is a junior" and "the student's favorite subject is Math" independent of each other? Explain your answer.

#### S.CP.A.4: CONDITIONAL PROBABILITY

- 683 Consider the data in the table below.

	Right Handed	Left Handed
Male	87	13
Female	89	11

What is the probability that a randomly selected person is male given the person is left handed?

- 1  $\frac{13}{200}$
- 2  $\frac{13}{100}$
- 3  $\frac{13}{50}$
- 4  $\frac{13}{24}$



687 Data collected about jogging from students with two older siblings are shown in the table below.

	<b>Neither Sibling Jogs</b>	<b>One Sibling Jogs</b>	<b>Both Siblings Jog</b>
<b>Student Does Not Jog</b>	1168	1823	1380
<b>Student Jogs</b>	188	416	400

Using these data, determine whether a student with two older siblings is more likely to jog if one sibling jogs or if both siblings jog. Justify your answer.

688 The results of a poll of 200 students are shown in the table below:

	<b>Preferred Music Style</b>		
	<b>Techno</b>	<b>Rap</b>	<b>Country</b>
<b>Female</b>	54	25	27
<b>Male</b>	36	40	18

For this group of students, do these data suggest that gender and preferred music styles are independent of each other? Justify your answer.

689 The table below shows the results of gender and music preference. Based on these data, determine if the events "the person is female" and "the person prefers classic rock" are independent of each other. Justify your answer.

	<b>Rap</b>	<b>Techno</b>	<b>Classic Rock</b>	<b>Classical</b>
<b>Male</b>	39	17	42	12
<b>Female</b>	17	37	36	15

690 The relative frequency table shows the proportion of a population who have a given eye color and the proportion of the same population who wear glasses.

	<b>Wear Glasses</b>	<b>Don't Wear Glasses</b>
<b>Blue Eyes</b>	0.14	0.26
<b>Brown Eyes</b>	0.11	0.24
<b>Green Eyes</b>	0.10	0.15

Given the data, are the events of having blue eyes and wearing glasses independent? Justify your answer.

- 691 The results of a survey of the student body at Central High School about television viewing preferences are shown below.

	Comedy Series	Drama Series	Reality Series	Total
Males	95	65	70	230
Females	80	70	110	260
Total	175	135	180	490

Are the events “student is a male” and “student prefers reality series” independent of each other? Justify your answer.

- 692 Juan and Filipe practice at the driving range before playing golf. The number of wins and corresponding practice times for each player are shown in the table below.

	Juan Wins	Felipe Wins
Short Practice Time	8	10
Long Practice Time	15	12

Given that the practice time was long, determine the exact probability that Filipe wins the next match. Determine whether or not the two events “Filipe wins” and “long practice time” are independent. Justify your answer.

- 693 A public radio station held a fund-raiser. The table below summarizes the donor category and method of donation.

		Donor Category	
		Supporter	Patron
Method of Donation	Phone calls	400	672
	Online	1200	2016

To the *nearest thousandth*, find the probability that a randomly selected donor was categorized as a supporter, given that the donation was made online. Do these data indicate that being a supporter is independent of donating online? Justify your answer.

- 694 A researcher wants to determine if nut allergies and milk allergies are related to each other. The researcher surveyed 1500 people and asked them if they are allergic to nuts or milk. The survey results are summarized in the table below.

	Allergic to Nuts	Not Allergic to Nuts
Allergic to Milk	3	42
Not Allergic to Milk	12	1443

Determine the probability that a randomly selected survey respondent is allergic to milk. Determine the probability that a randomly selected survey respondent is allergic to milk, given that the person is allergic to nuts. Based on the survey data, determine whether nut allergies and milk allergies are independent events. Justify your answer.

#### S.CP.B.6: CONDITIONAL PROBABILITY

- 695 At Andrew Jackson High School, students are only allowed to enroll in AP U.S. History if they have already taken AP World History or AP European History. Out of 825 incoming seniors, 165 took AP World History, 66 took AP European History, and 33 took both. Given this information, determine the probability a randomly selected incoming senior is allowed to enroll in AP U.S. History.
- 696 A study was designed to test the effectiveness of a new drug. Half of the volunteers received the drug. The other half received a sugar pill. The probability of a volunteer receiving the drug and getting well was 40%. What is the probability of a volunteer getting well, given that the volunteer received the drug?
- 697 The guidance department has reported that of the senior class, 2.3% are members of key club,  $K$ , 8.6% are enrolled in AP Physics,  $P$ , and 1.9% are in both. Determine the probability of  $P$  given  $K$ , to the *nearest tenth of a percent*. The principal would like a basic interpretation of these results. Write a statement relating your calculated probabilities to student enrollment in the given situation.

## Algebra II Regents Exam Questions by State Standard: Topic Answer Section

1 ANS: 4

$$(1) \frac{B(60) - B(10)}{60 - 10} \approx 28\% \quad (2) \frac{B(69) - B(19)}{69 - 19} \approx 33\% \quad (3) \frac{B(72) - B(36)}{72 - 36} \approx 38\% \quad (4) \frac{B(73) - B(60)}{73 - 60} \approx 46\%$$

PTS: 2 REF: 011721aii NAT: F.IF.B.6 TOP: Rate of Change

2 ANS: 2

$$1) \frac{29860 - 629}{1910 - 1850} \approx 487; \quad 2) \frac{790390 - 494290}{2010 - 1990} \approx 14805; \quad 3) \frac{251808 - 132459}{1970 - 1950} \approx 5967; \quad 4) \frac{251808 - 14575}{1970 - 1890} \approx 2965$$

PTS: 2 REF: 062301aii NAT: F.IF.B.6 TOP: Rate of Change

3 ANS:

$$\frac{306.25 - 156.25}{70 - 50} = \frac{150}{20} = 7.5 \quad \text{Between 50-70 mph, each additional mph in speed requires 7.5 more feet to stop.}$$

PTS: 2 REF: 081631aii NAT: F.IF.B.6 TOP: Rate of Change

4 ANS:

$$\frac{13.9 - 9.4}{4 - 1} = 1.5 \quad \text{The average rate of change in the number of hours of daylight from January 1-April 1 is 1.5.}$$

PTS: 2 REF: 061925aii NAT: F.IF.B.6 TOP: Rate of Change

5 ANS: 1

$$(1) \frac{9 - 0}{2 - 1} = 9 \quad (2) \frac{17 - 0}{3.5 - 1} = 6.8 \quad (3) \frac{0 - 0}{5 - 1} = 0 \quad (4) \frac{17 - -5}{3.5 - 1} \approx 6.3$$

PTS: 2 REF: 011724aii NAT: F.IF.B.6 TOP: Rate of Change

6 ANS: 1

PTS: 2 TOP: Rate of Change

REF: 061904aii NAT: F.IF.B.6

7 ANS:

$$\frac{60 - 20}{4 - 2} = \frac{40}{2} = 20$$

PTS: 2 REF: 082225aii NAT: F.IF.B.6 TOP: Rate of Change

8 ANS: 1

$$\frac{N(6) - N(0)}{6 - 0} \approx -8.93$$

PTS: 2 REF: 012012aii NAT: F.IF.B.6 TOP: Rate of Change

9 ANS:

$$\frac{V(7) - V(2)}{7 - 2} \approx 48$$

PTS: 2 REF: 012427aii NAT: F.IF.B.6 TOP: Rate of Change

10 ANS:

$$\frac{P(10.5) - P(0)}{10.5 - 0} \approx 10.76 \text{ fruit flies per day}$$

PTS: 2 REF: 082332aai NAT: F.IF.B.6 TOP: Rate of Change

11 ANS: 1

$$\frac{N(10) - N(1)}{10 - 1} \approx -2.03, \frac{N(20) - N(10)}{20 - 10} \approx -1.63, \frac{N(25) - N(15)}{25 - 15} \approx -1.46, \frac{N(30) - N(1)}{30 - 1} \approx -1.64$$

PTS: 2 REF: 061807aai NAT: F.IF.B.6 TOP: Rate of Change

12 ANS:

$$\frac{p(8) - p(4)}{8 - 4} \approx 48.78$$

PTS: 2 REF: 081827aai NAT: F.IF.B.6 TOP: Rate of Change

13 ANS: 3

$$\log_{0.8} \left( \frac{V}{17000} \right) = t \quad \frac{17,000(0.8)^3 - 17,000(0.8)^1}{3 - 1} \approx -2450$$

$$0.8^t = \frac{V}{17000}$$

$$V = 17000(0.8)^t$$

PTS: 2 REF: 081709aai NAT: F.IF.B.6 TOP: Rate of Change

14 ANS: 3

The screenshot shows a TI-84 Plus calculator window with the following content:

```

1.1 | *Doc | RAD | Done
Define r(a) = 1 / 0.0105 * ln(a / 5000)
r(8000) - r(6000) / (8000 - 6000) = 0.013699
r(12000) - r(9000) / (12000 - 9000) = 0.009133

```

PTS: 2 REF: 081922aai NAT: F.IF.B.6 TOP: Rate of Change

15 ANS:

$\frac{B(11) - B(8)}{11 - 8} \approx -10.1$  The average monthly high temperature decreases  $10.1^\circ$  each month from August to November.

PTS: 2 REF: 011930aai NAT: F.IF.B.6 TOP: Rate of Change



16 ANS:

$\frac{B(10) - B(6)}{10 - 6} \approx -3.88$ . The average monthly high temperature decreases about  $4^\circ$  each month from June and October.

PTS: 4 REF: 012336aai NAT: F.IF.B.6 TOP: Rate of Change

17 ANS: 3

$$\frac{f(7) - f(-7)}{7 - (-7)} = \frac{2^{-0.25(7)} \cdot \sin\left(\frac{\pi}{2}(7)\right) - 2^{-0.25(-7)} \cdot \sin\left(\frac{\pi}{2}(-7)\right)}{14} \approx -0.26$$

PTS: 2 REF: 061721aai NAT: F.IF.B.6 TOP: Rate of Change

18 ANS:

$$\frac{f(4) - f(-2)}{4 - (-2)} = \frac{80 - 1.25}{6} = 13.125 \quad g(x) \text{ has a greater rate of change}$$

$$\frac{g(4) - g(-2)}{4 - (-2)} = \frac{179 - (-49)}{6} = 38$$

PTS: 4 REF: 061636aai NAT: F.IF.B.6 TOP: Rate of Change

19 ANS: 4

$$g(x): \frac{10 - 6}{4 - 2} = 2 \quad t(x): \frac{3 - (-5)}{4 - 2} = 4$$

PTS: 2 REF: 062212ai NAT: F.IF.B.6 TOP: Rate of Change

20 ANS: 4

$$4x^2 = -98$$

$$x^2 = -\frac{98}{4}$$

$$x^2 = -\frac{49}{2}$$

$$x = \pm \sqrt{-\frac{49}{2}} = \pm \frac{7i}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \pm \frac{7i\sqrt{2}}{2}$$

PTS: 2 REF: 061707aai NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | taking square roots

21 ANS: 4

$$wx^2 + w = 0$$

$$w(x^2 + 1) = 0$$

$$x^2 = -1$$

$$x = \pm i$$

PTS: 2 REF: 061912aai NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | taking square roots

22 ANS: 3

$$x^2 + 2x + 1 = -5 + 1$$

$$(x + 1)^2 = -4$$

$$x + 1 = \pm 2i$$

$$x = -1 \pm 2i$$

PTS: 2 REF: 081703aai NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | completing the square

23 ANS: 1

$$x^2 - 4x + 4 = -13 + 4$$

$$(x - 2)^2 = -9$$

$$x - 2 = \pm 3i$$

$$x = 2 \pm 3i$$

PTS: 2 REF: 062312aai NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | completing the square

24 ANS: 3

$$x^2 + 6x + 9 = -10 + 9$$

$$(x + 3)^2 = -1$$

$$x + 3 = \pm i$$

$$x = -3 \pm i$$

PTS: 2 REF: 012416aai NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | completing the square

25 ANS: 3

$$-2\left(-\frac{1}{2}x^2 = -6x + 20\right)$$

$$x^2 - 12x = -40$$

$$x^2 - 12x + 36 = -40 + 36$$

$$(x - 6)^2 = -4$$

$$x - 6 = \pm 2i$$

$$x = 6 \pm 2i$$

PTS: 2 REF: fall1504aii NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | completing the square

26 ANS:

$$x^2 - 6x = -17 \quad \text{The solution is imaginary because the parabola and line do not intersect.}$$

$$x^2 - 6x + 9 = -17 + 9$$

$$(x - 3)^2 = -8$$

$$x - 3 = \pm 2i\sqrt{2}$$

$$x = 3 \pm 2i\sqrt{2}$$

PTS: 4 REF: 081936aii NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | completing the square

27 ANS: 1

$$x = \frac{-3 \pm \sqrt{3^2 - 4(2)(2)}}{2(2)} = \frac{-3 \pm \sqrt{-7}}{4} = -\frac{3}{4} \pm \frac{i\sqrt{7}}{4}$$

PTS: 2 REF: 061612aii NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | quadratic formula

28 ANS: 3

$$x = \frac{-2 \pm \sqrt{2^2 - 4(3)(7)}}{2(3)} = \frac{-2 \pm \sqrt{-80}}{6} = \frac{-2 \pm i\sqrt{16}\sqrt{5}}{6} = -\frac{1}{3} \pm \frac{2i\sqrt{5}}{3}$$

PTS: 2 REF: 081809aii NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | quadratic formula

29 ANS: 2

$$x = \frac{2 \pm \sqrt{(-2)^2 - 4(5)(4)}}{2(5)} = \frac{2 \pm \sqrt{-76}}{10} = \frac{2 \pm i\sqrt{4}\sqrt{19}}{10} = \frac{1}{5} \pm \frac{i\sqrt{19}}{5}$$

PTS: 2 REF: 011905aii NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | quadratic formula

30 ANS: 4

$$x = \frac{8 \pm \sqrt{(-8)^2 - 4(6)(29)}}{2(6)} = \frac{8 \pm \sqrt{-632}}{12} = \frac{8 \pm i\sqrt{4}\sqrt{158}}{12} = \frac{2}{3} \pm \frac{1}{6}i\sqrt{158}$$

PTS: 2 REF: 011711aai NAT: A.REI.B.4 TOP: Solving Quadratics  
KEY: complex solutions | quadratic formula

31 ANS: 2

$$5x^2 - 4x + 2 = 0 \quad \frac{4 \pm \sqrt{(-4)^2 - 4(5)(2)}}{2(5)} = \frac{4 \pm \sqrt{-24}}{10} = \frac{4 \pm 2i\sqrt{6}}{10} = \frac{2 \pm i\sqrt{6}}{5}$$

PTS: 2 REF: 012020aai NAT: A.REI.B.4 TOP: Solving Quadratics  
KEY: complex solutions | quadratic formula

32 ANS:

$$x = \frac{-5 \pm \sqrt{5^2 - 4(2)(8)}}{2(2)} = -\frac{5}{4} \pm \frac{i\sqrt{39}}{4}$$

PTS: 2 REF: 061827aai NAT: A.REI.B.4 TOP: Solving Quadratics  
KEY: complex solutions | quadratic formula

33 ANS:

$$x = \frac{-5 \pm \sqrt{5^2 - 4(3)(8)}}{2(3)} = -\frac{5}{6} \pm \frac{i\sqrt{71}}{6}$$

PTS: 2 REF: 082327aai NAT: A.REI.B.4 TOP: Solving Quadratics  
KEY: complex solutions | quadratic formula

34 ANS: 2

1) 1 real, mult. 2; 3) not a quadratic; 4) not a function.

PTS: 2 REF: 012324aai NAT: A.REI.B.4 TOP: Using the Discriminant

35 ANS: 2

PTS: 2

REF: 012402aai

NAT: A.REI.B.4

TOP: Using the Discriminant

KEY: determine nature of roots given equation

36 ANS: 2

PTS: 2

REF: 082308aai

NAT: A.REI.B.4

TOP: Using the Discriminant

KEY: determine nature of roots given equation, graph, table

37 ANS: 4

(1) quadratic has two roots and both are real  $(-2,0)$  and  $(-0.5,0)$ , (2)  $x = \pm\sqrt{32} - 3$ , (3) the real root is 3, with a multiplicity of 2, (4)  $x = \pm 4i$

PTS: 2 REF: 011909aai NAT: A.REI.B.4 TOP: Using the Discriminant  
KEY: determine nature of roots given equation, graph, table

38 ANS:

$$b^2 - 4ac = (-4)^2 - 4(1)(13) = 16 - 52 = -36 \text{ imaginary}$$

PTS: 2 REF: 062225aai NAT: A.REI.B.4 TOP: Using the Discriminant  
KEY: determine nature of roots given equation, graph, table

39 ANS: 1

The product of the roots equals  $(3+i)(3-i) = 9 - i^2 = 10 = \frac{c}{a}$ . OR

$$(x - (3+i))(x - (3-i)) = 0$$

$$(x - 3 - i)(x - 3 + i) = 0$$

$$((x - 3) - i)((x - 3) + i) = 0$$

$$(x - 3)^2 - i^2 = 0$$

$$x^2 - 6x + 9 + 1 = 0$$

$$x^2 - 6x + 10 = 0$$

PTS: 2 REF: 082208aai NAT: A.REI.B.4 TOP: Complex Conjugate Root Theorem

40 ANS: 4

If  $1 - i$  is one solution, the other is  $1 + i$ .  $(x - (1 - i))(x - (1 + i)) = 0$

$$x^2 - x - ix - x + ix + (1 - i^2) = 0$$

$$x^2 - 2x + 2 = 0$$

PTS: 2 REF: 081601aai NAT: A.REI.B.4 TOP: Complex Conjugate Root Theorem

41 ANS: 4

The vertex is  $(2, 2)$  and  $p = 3$ .  $3 + 2 = 5$

PTS: 2 REF: 081823aai NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

42 ANS: 1

In vertex form, the parabola is  $y = -\frac{1}{4(2)}(x + 4)^2 + 3$ . The vertex is  $(-4, 3)$  and  $p = 2$ .  $3 + 2 = 5$

PTS: 2 REF: 011816aai NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

43 ANS: 1

The vertical distance from the directrix to the vertex,  $p$ , is 2. The vertical distance from the vertex to the focus must also be 2.

PTS: 2 REF: 062213aai NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

44 ANS: 4

The vertex is  $(2, -1)$  and  $p = 2$ .  $y = -\frac{1}{4(2)}(x - 2)^2 - 1$

PTS: 2 REF: 081619aai NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

45 ANS: 1

Distance from the focus to the directrix is 2, so  $p = 1$ . Vertex is  $(-3, 1)$ .  $y = \frac{1}{4(1)}(x + 3)^2 + 1$

PTS: 2 REF: 012409aai NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

46 ANS: 3

The vertex is  $(-3,5)$  and  $p = 2$ .  $y = \frac{-1}{4(2)}(x+3)^2 + 5$

PTS: 2 REF: 011914aai NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

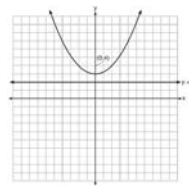
47 ANS: 3

The distance from the vertex to the focus,  $p$ , is 4. Since the focus is below the vertex,  $p$  is negative.

$$y = -\frac{1}{4(4)}(x-2)^2 + 1$$

PTS: 2 REF: 082212aai NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

48 ANS: 4



A parabola with a focus of  $(0,4)$  and a directrix of  $y = 2$  is sketched as follows: By inspection, it is determined that the vertex of the parabola is  $(0,3)$ . It is also evident that the distance,  $p$ , between the vertex and the focus is 1. It is possible to use the formula  $(x-h)^2 = 4p(y-k)$  to derive the equation of the parabola as follows:  $(x-0)^2 = 4(1)(y-3)$

$$x^2 = 4y - 12$$

$$x^2 + 12 = 4y$$

$$\frac{x^2}{4} + 3 = y$$

or A point  $(x,y)$  on the parabola must be the same distance from the focus as it is from the directrix. For any such point  $(x,y)$ , the distance to the focus is  $\sqrt{(x-0)^2 + (y-4)^2}$  and the distance to the directrix is  $y-2$ . Setting this equal leads to:  $x^2 + y^2 - 8y + 16 = y^2 - 4y + 4$

$$x^2 + 16 = 4y + 4$$

$$\frac{x^2}{4} + 3 = y$$

PTS: 2 REF: spr1502aai NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

49 ANS: 4

The vertex is  $(1,0)$  and  $p = 2$ .  $y = \frac{1}{4(2)}(x-1)^2 + 0$

PTS: 2 REF: 061717aai NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

50 ANS: 2

The vertex of the parabola is  $(0,0)$ . The distance,  $p$ , between the vertex and the focus or the vertex and the

directrix is 1.  $y = \frac{-1}{4p}(x-h)^2 + k$

$$y = \frac{-1}{4(1)}(x-0)^2 + 0$$

$$y = -\frac{1}{4}x^2$$

PTS: 2 REF: 081706aai NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

51 ANS: 2

Since the distance from the focus to the directrix is 2,  $p = 1$  and the vertex of the parabola is  $(0,5)$ .

$$y = \frac{1}{4p}(x-h)^2 + k$$

$$y = \frac{1}{4(1)}(x-0)^2 + 5$$

$$y = \frac{1}{4}x^2 + 5$$

$$y - 5 = \frac{1}{4}x^2$$

$$4(y - 5) = x^2$$

PTS: 2 REF: 062323aai NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

52 ANS: 4

$\frac{5+9}{2} = 7$ , vertex:  $(-2,7)$ ;  $p = 7 - 9 = -2$ ,  $y = \frac{1}{4(-2)}(x+2)^2 + 7$

$$y - 7 = \frac{1}{-8}(x+2)^2$$

$$-8(y - 7) = (x+2)^2$$

PTS: 2 REF: 061821aai NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

53 ANS: 4

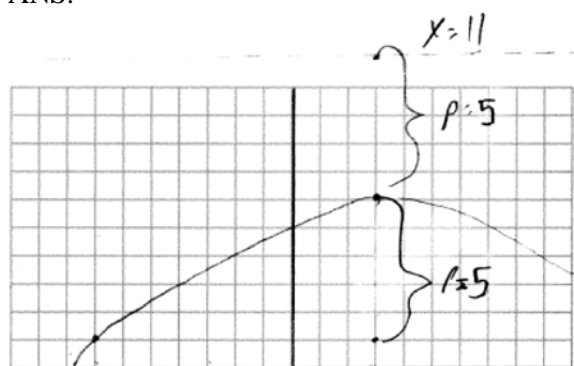
The distance between the focus and directrix is  $1 - (-3) = 4$ .  $p$  is half this distance, or 2. The vertex of the parabola is  $(4,-1)$ . Since the directrix is above the focus, the parabola faces downward.  $y = -\frac{1}{4p}(x-h)^2 + k$

$$y = -\frac{1}{4(2)}(x-4)^2 - 1$$

$$y + 1 = -\frac{1}{8}(x-4)^2$$

PTS: 2 REF: 012322aai NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

54 ANS:

vertex (3, 6), focus (3, 1),  $p = 5$ , directrix  $y = 6 + 5 = 11$ 

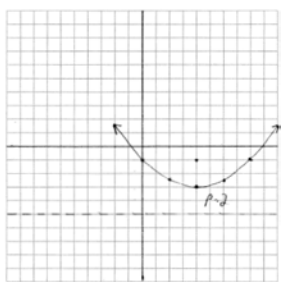
PTS: 2

REF: 012028aai

NAT: G.GPE.A.2

TOP: Graphing Quadratic Functions

55 ANS:



$$y = \frac{1}{4(2)}(x-4)^2 - 3$$

$$y = \frac{-1 + -5}{2} = -3. \text{ The vertex is } (4, -3) \text{ and } p = 2.$$

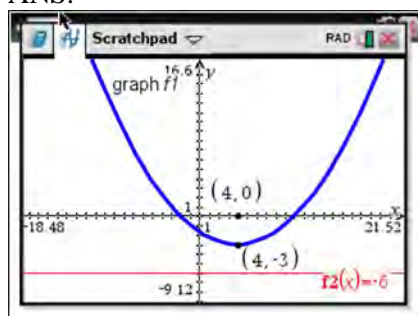
PTS: 4

REF: 061935aai

NAT: G.GPE.A.2

TOP: Graphing Quadratic Functions

56 ANS:



The vertex of the parabola is (4, -3). The  $x$ -coordinate of the focus and the vertex is the same. Since the distance from the vertex to the directrix is 3, the distance from the vertex to the focus is 3, so the  $y$ -coordinate of the focus is 0. The coordinates of the focus are (4, 0).

PTS: 2

REF: 061630aai

NAT: G.GPE.A.2

TOP: Graphing Quadratic Functions

57 ANS:

$p$  is the distance from the focus to the vertex:  $8 - 7 = 1$ .  $p$  is the distance from the directrix to the vertex:

$$1 = 7 - d. \quad y = 6$$

$$d = 6$$

PTS: 2

REF: 082330aai

NAT: G.GPE.A.2

TOP: Graphing Quadratic Functions



58 ANS: 4

$$m^5 + m^3 - 6m = m(m^4 + m^2 - 6) = m(m^2 + 3)(m^2 - 2)$$

PTS: 2 REF: 011703aai NAT: A.SSE.A.2 TOP: Factoring Polynomials  
KEY: higher power

59 ANS: 3 PTS: 2 REF: 062302aai NAT: A.SSE.A.2  
TOP: Factoring Polynomials

60 ANS: 2 PTS: 2 REF: 081904aai NAT: A.SSE.A.2  
TOP: Factoring Polynomials KEY: higher power

61 ANS: 4

$$(x^6 y^4 - 9)(x^4 - 16)$$

$$(x^3 y^2 + 3)(x^3 y^2 - 3)(x^2 + 4)(x^2 - 4)$$

PTS: 2 REF: 081814aai NAT: A.SSE.A.2 TOP: Factoring Polynomials  
KEY: factoring by grouping

62 ANS: 3

$$2d(d^3 + 3d^2 - 9d - 27)$$

$$2d(d^2(d + 3) - 9(d + 3))$$

$$2d(d^2 - 9)(d + 3)$$

$$2d(d + 3)(d - 3)(d + 3)$$

$$2d(d + 3)^2(d - 3)$$

PTS: 2 REF: 081615aai NAT: A.SSE.A.2 TOP: Factoring Polynomials  
KEY: factoring by grouping

63 ANS: 2

$$n^2(n^2 - 9) + 4n(n^2 - 9) - 12(n^2 - 9)$$

$$(n^2 + 4n - 12)(n^2 - 9)$$

$$(n + 6)(n - 2)(n + 3)(n - 3)$$

PTS: 2 REF: 061911aai NAT: A.SSE.A.2 TOP: Factoring Polynomials  
KEY: factoring by grouping

64 ANS: 4

$$k^4 - 4k^2 + 8k^3 - 32k + 12k^2 - 48$$

$$k^2(k^2 - 4) + 8k(k^2 - 4) + 12(k^2 - 4)$$

$$(k^2 - 4)(k^2 + 8k + 12)$$

$$(k + 2)(k - 2)(k + 6)(k + 2)$$

PTS: 2 REF: fall1505aai NAT: A.SSE.A.2 TOP: Factoring Polynomials  
KEY: factoring by grouping

65 ANS: 3

$$(m-2)^2(m+3) = (m^2 - 4m + 4)(m+3) = m^3 + 3m^2 - 4m^2 - 12m + 4m + 12 = m^3 - m^2 - 8m + 12$$

PTS: 2 REF: 081605aai NAT: A.SSE.A.2 TOP: Factoring Polynomials  
KEY: factoring by grouping

66 ANS: 1

1) let  $y = x + 2$ , then  $y^2 + 2y - 8$ 

$$(y+4)(y-2)$$

$$(x+2+4)(x+2-2)$$

$$(x+6)x$$

PTS: 2 REF: 081715aai NAT: A.SSE.A.2 TOP: Factoring Polynomials  
KEY: multivariable

67 ANS: 2

$$u = x + 2 \quad u^2 + 4u + 3$$

$$(u+3)(u+1)$$

$$(x+2+3)(x+2+1)$$

$$(x+5)(x+3)$$

PTS: 2 REF: 081901aai NAT: A.SSE.A.2 TOP: Factoring Polynomials  
KEY: higher power

68 ANS: 1

$$u = x + 2 \quad u^2 - 5u + 6$$

$$(u-3)(u-2)$$

$$(x+2-3)(x+2-2)$$

$$(x-1)x$$

PTS: 2 REF: 012301aai NAT: A.SSE.A.2 TOP: Factoring Polynomials  
KEY: higher power

69 ANS: 3

$$(x+a)^2 + 5(x+a) + 4 \quad \text{let } u = x + a$$

$$u^2 + 5u + 4$$

$$(u+4)(u+1)$$

$$(x+a+4)(x+a+1)$$

PTS: 2 REF: 012006aai NAT: A.SSE.A.2 TOP: Factoring Polynomials  
KEY: multivariable

70 ANS: 2

$$(x^2 + 3)^2 - 2(x^2 + 3) - 24 \text{ let } u = x^2 + 3$$

$$u^2 - 2u - 24$$

$$(u - 6)(u + 4)$$

$$(x^2 + 3 - 6)(x^2 + 3 + 4)$$

PTS: 2

REF: 062310aai

NAT: A.SSE.A.2

TOP: Factoring Polynomials

71 ANS:

$$(x^2 - 6)(x^2 + 2)$$

PTS: 2

REF: 081825aai

NAT: A.SSE.A.2

TOP: Factoring Polynomials

KEY: higher power

72 ANS:

$$x^4 - 5x^2 + 4$$

$$(x^2 - 4)(x^2 - 1)$$

$$(x + 2)(x - 2)(x + 1)(x - 1)$$

PTS: 2

REF: 012331aai

NAT: A.SSE.A.2

TOP: Factoring Polynomials

73 ANS:

$$x^3 - 2x^2 - 9x + 18 = x^2(x - 2) - 9(x - 2) = (x^2 - 9)(x - 2) = (x + 3)(x - 3)(x - 2)$$

PTS: 2

REF: 082226aai

NAT: A.SSE.A.2

TOP: Factoring Polynomials

KEY: factoring by grouping

74 ANS:

$$x^3 + 4x^2 - 9x - 36 = x^2(x + 4) - 9(x + 4) = (x^2 - 9)(x + 4) = (x + 3)(x - 3)(x + 4)$$

PTS: 2

REF: 012425aai

NAT: A.SSE.A.2

TOP: Factoring Polynomials

75 ANS:

$$2x^3 - 3x^2 - 18x + 27$$

$$x^2(2x - 3) - 9(2x - 3)$$

$$(x^2 - 9)(2x - 3)$$

$$(x + 3)(x - 3)(2x - 3)$$

PTS: 2

REF: 082325aai

NAT: A.SSE.A.2

TOP: Factoring Polynomials

76 ANS:

$$x^2(4x - 1) + 4(4x - 1) = (x^2 + 4)(4x - 1)$$

PTS: 2

REF: 061727aai

NAT: A.SSE.A.2

TOP: Factoring Polynomials

KEY: factoring by grouping

77 ANS:

$$-x(2x^3 - x^2 - 18x + 9)$$

$$-x(x^2(2x - 1) - 9(2x - 1))$$

$$-x(x^2 - 9)(2x - 1)$$

$$-x(x + 3)(x - 3)(2x - 1)$$

PTS: 2                    REF: 062228aai            NAT: A.SSE.A.2            TOP: Factoring Polynomials  
 KEY: factoring by grouping

78 ANS:

$$3x^3 + x^2 + 3xy + y = x^2(3x + 1) + y(3x + 1) = (x^2 + y)(3x + 1)$$

PTS: 2                    REF: 011828aai            NAT: A.SSE.A.2            TOP: Factoring Polynomials  
 KEY: factoring by grouping

79 ANS:

The expression is of the form  $y^2 - 5y - 6$  or  $(y - 6)(y + 1)$ . Let  $y = 4x^2 + 5x$ :

$$(4x^2 + 5x - 6)(4x^2 + 5x + 1)$$

$$(4x - 3)(x + 2)(4x + 1)(x + 1)$$

PTS: 2                    REF: fall1512aai            NAT: A.SSE.A.2            TOP: Factoring Polynomials  
 KEY: a>1

80 ANS: 4

PTS: 2

REF: 081708aai

NAT: A.APR.B.3

TOP: Solving Polynomial Equations

81 ANS: 4

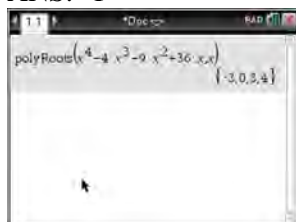
$$m^3 - 2m^2 + 4m - 8 = 0$$

$$m^2(m - 2) + 4(m - 2) = 0$$

$$(m^2 + 4)(m - 2) = 0$$

PTS: 2                    REF: 081821aai            NAT: A.APR.B.3            TOP: Solving Polynomial Equations

82 ANS: 1



$$x^4 - 4x^3 - 9x^2 + 36x = 0$$

$$x^3(x-4) - 9x(x-4) = 0$$

$$(x^3 - 9x)(x-4) = 0$$

$$x(x^2 - 9)(x-4) = 0$$

$$x(x+3)(x-3)(x-4) = 0$$

$$x = 0, \pm 3, 4$$

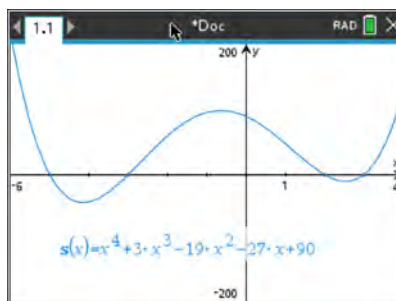
PTS: 2

REF: 061606aai

NAT: A.APR.B.3

TOP: Solving Polynomial Equations

83 ANS: 4



$$s(x) = x^4 - 9x^2 + 3x^3 - 27x - 10x^2 + 90$$

$$= x^2(x^2 - 9) + 3x(x^2 - 9) - 10(x^2 - 9)$$

$$= (x^2 + 3x - 10)(x^2 - 9)$$

$$= (x+5)(x-2)(x+3)(x-3)$$

PTS: 2

REF: 062303aai

NAT: A.APR.B.3

TOP: Solving Polynomial Equations

84 ANS: 1

$$x^3 + 2x^2 - 9x - 18 = 0 \quad x^3 - 9x + 2x^2 - 18 = 0 \quad x^3 - 9x + 2x^2 - 18 = 0$$

$$x^2(x+2) - 9(x+2) = 0 \quad x(x^2 - 9) + 2(x^2 - 9) = 0 \quad x(x^2 - 9) + 2(x^2 - 9) = 0$$

$$(x+2)(x^2 - 9) = 0$$

PTS: 2

REF: 011903aai

NAT: A.APR.B.3

TOP: Solving Polynomial Equations

85 ANS: 2

$$\begin{array}{r} 3 \ 1 \ -1 \ -21 \ 45 \ 0 \\ \phantom{3} \phantom{1} \phantom{-1} \ 3 \ 6 \ -45 \ 0 \\ \phantom{3} \phantom{1} \ 1 \ 2 \ -15 \ 0 \ 0 \end{array}$$

$$x^3 + 2x^2 - 15x = 0$$

$$x(x^2 + 2x - 15) = 0$$

$$x(x+5)(x-3) = 0$$

$$x = 0, -5, 3$$

PTS: 2 REF: 012403aai NAT: A.APR.B.3 TOP: Solving Polynomial Equations

86 ANS: 4

1)  $-1$  is also a zero. 2)  $x^2(x-a) + 16(x-a) = (x^2 + 16)(x-a)$   $a$  is the only zero. 3)  $-a$  is the only zero. 4)  $x^2(x-a) - 9(x-a) = (x^2 - 9)(x-a)$ .

PTS: 2 REF: 012019aai NAT: A.APR.B.3 TOP: Solving Polynomial Equations

87 ANS: 4

$$f(x) = (x+1)(x-1)(x-2) = (x^2 - 1)(x-2) = x^3 - 2x^2 - x + 2$$

PTS: 2 REF: 081921aai NAT: A.APR.B.3 TOP: Solving Polynomial Equations

88 ANS:

$$3(x^3 + 4x^2 - x - 4) = 0$$

$$(x^2(x+4) - (x+4)) = 0$$

$$(x^2 - 1)(x+4) = 0$$

$$x = \pm 1, -4$$

PTS: 2 REF: 012325aai NAT: A.APR.B.3 TOP: Solving Polynomial Equations

89 ANS:

$$0 = 6(-5)^3 + b(-5)^2 - 52(-5) + 15 \quad z(x) = 6x^3 + 19x^2 - 52x + 15$$

$$0 = -750 + 25b + 260 + 15$$

$$475 = 25b$$

$$19 = b$$

$$\begin{array}{r|rrrr} -5 & 6 & 19 & -52 & 15 \\ & & -30 & 55 & 15 \\ \hline & 6 & -11 & 3 & 0 \end{array}$$

$$6x^2 - 11x + 3 = 0$$

$$(2x-3)(3x-1) = 0$$

$$x = \frac{3}{2}, \frac{1}{3}, -5$$

PTS: 4 REF: fall1515aai NAT: A.APR.B.3 TOP: Solving Polynomial Equations

90 ANS: 1                   PTS: 2                   REF: 012405aia           NAT: A.APR.B.3  
TOP: Graphing Polynomial Functions

91 ANS: 1  
The zeros of the polynomial are at  $-b$ , and  $c$ . The sketch of a polynomial of degree 3 with a negative leading coefficient should have end behavior showing as  $x$  goes to negative infinity,  $f(x)$  goes to positive infinity. The multiplicities of the roots are correctly represented in the graph.

PTS: 2                   REF: spr1501aia           NAT: A.APR.B.3           TOP: Graphing Polynomial Functions  
KEY: bimodalgraph

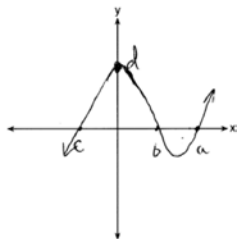
92 ANS: 1  
 $x^2 + 2x + 1 = (x + 1)^2$

PTS: 2                   REF: 011919aia           NAT: A.APR.B.3           TOP: Graphing Polynomial Functions  
93 ANS: 1                   PTS: 2                   REF: 061701aia           NAT: A.APR.B.3  
TOP: Graphing Polynomial Functions

94 ANS: 4                   PTS: 2                   REF: 061921aia           NAT: A.APR.B.3  
TOP: Graphing Polynomial Functions

95 ANS: 2                   PTS: 2                   REF: 082324aia           NAT: A.APR.B.3  
TOP: Graphing Polynomial Functions

96 ANS:



PTS: 2                   REF: 081732aia           NAT: A.APR.B.3           TOP: Graphing Polynomial Functions

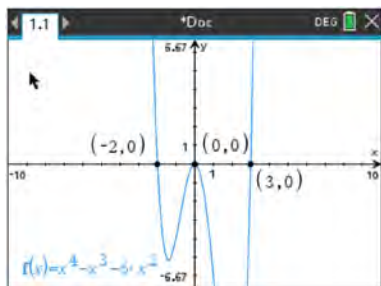
97 ANS:  
 $f(x) = x^2(x + 4)(x - 3)$ ;  $g(x) = (x + 2)^2(x + 6)(x - 1)$

PTS: 4                   REF: 011836aia           NAT: F.BF.B.3           TOP: Graphing Polynomial Functions  
98 ANS: 4                   PTS: 2                   REF: 082318aia           NAT: F.IF.B.4  
TOP: Graphing Polynomial Functions

99 ANS: 2                   PTS: 2                   REF: 061620aia           NAT: F.IF.B.4  
TOP: Graphing Polynomial Functions

100 ANS: 3                   PTS: 2                   REF: 012005aia           NAT: F.IF.B.4  
TOP: Graphing Polynomial Functions

101 ANS: 2



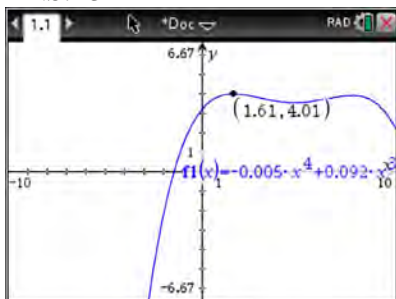
PTS: 2

REF: 012316aai

NAT: F.IF.B.4

TOP: Graphing Polynomial Functions

102 ANS: 3



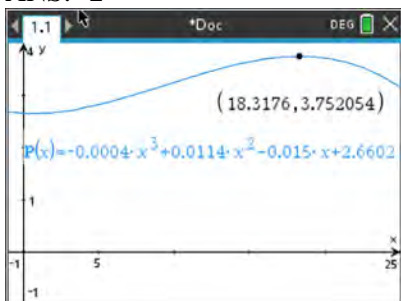
PTS: 2

REF: 011817aai

NAT: F.IF.B.4

TOP: Graphing Polynomial Functions

103 ANS: 2



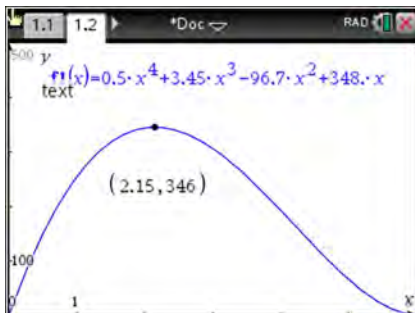
PTS: 2

REF: 012414aai

NAT: F.IF.B.4

TOP: Graphing Polynomial Functions

104 ANS: 1



PTS: 2

REF: 011908aai

NAT: F.IF.B.4

TOP: Graphing Polynomial Functions



105 ANS: 4

The maximum volume of  $p(x) = -(x+2)(x-10)(x-14)$  is about 56, at  $x = 12.1$ 

PTS: 2 REF: 081712aai NAT: F.IF.B.4 TOP: Graphing Polynomial Functions

106 ANS: 2 PTS: 2 REF: 081908aai NAT: F.IF.B.4

TOP: Graphing Polynomial Functions

107 ANS: 2

1)  $x \rightarrow \infty, f(x) \rightarrow \infty$ ; 3) quartic polynomial; 4) three real roots

PTS: 2 REF: 012318aai NAT: F.IF.B.4 TOP: Graphing Polynomial Functions

108 ANS:

 $16x^4 - 81 = (4x^2 + 9)(4x^2 - 9) = (4x^2 + 9)(2x + 3)(2x - 3)$ . No, because  $\pm \frac{3i}{2}$  are roots.

PTS: 4 REF: 061933aai NAT: F.IF.B.4 TOP: Graphing Polynomial Functions

109 ANS: 3

The graph shows three real zeros, and has end behavior matching the given end behavior.

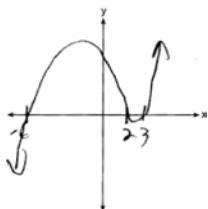
PTS: 2 REF: 061604aai NAT: F.IF.C.7 TOP: Graphing Polynomial Functions

KEY: bimodalgraph

110 ANS: 2 PTS: 2 REF: 061816aai NAT: F.IF.C.7

TOP: Graphing Polynomial Functions KEY: bimodalgraph

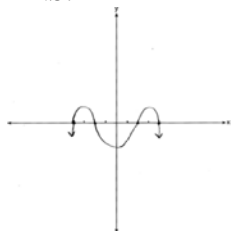
111 ANS:



$$p(x) = (x-2)(x-3)(x+6)$$

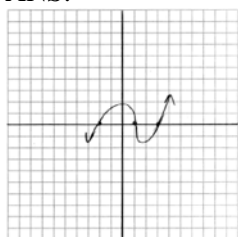
PTS: 4 REF: 062333aai NAT: F.IF.C.7 TOP: Graphing Polynomial Functions

112 ANS:



PTS: 2 REF: 011926aai NAT: F.IF.C.7 TOP: Graphing Polynomial Functions

113 ANS:



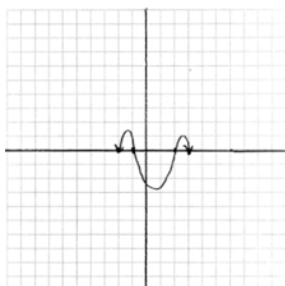
PTS: 2

REF: 011729aai

NAT: F.IF.C.7

TOP: Graphing Polynomial Functions

114 ANS:



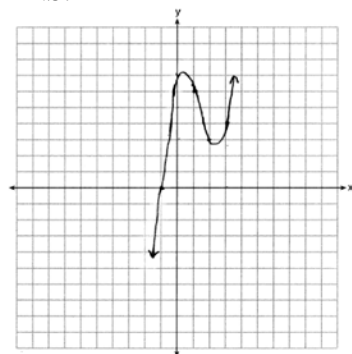
PTS: 2

REF: 011831aai

NAT: F.IF.C.7

TOP: Graphing Polynomial Functions

115 ANS:



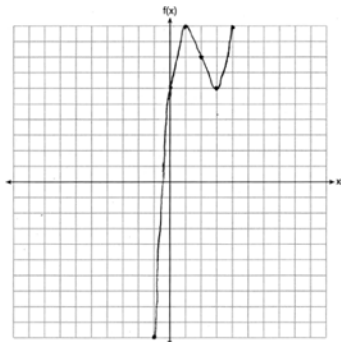
PTS: 2

REF: 012032aai

NAT: F.IF.C.7

TOP: Graphing Polynomial Functions

116 ANS:



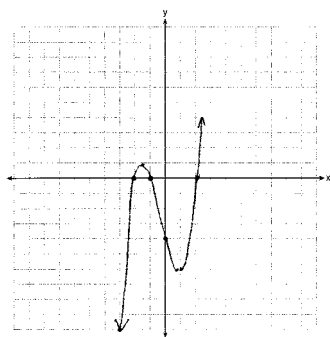
PTS: 2

REF: 061826aai

NAT: F.IF.C.7

TOP: Graphing Polynomial Functions

117 ANS:



$$0 = x^2(x + 1) - 4(x + 1)$$

$$0 = (x^2 - 4)(x + 1)$$

$$0 = (x + 2)(x - 2)(x + 1)$$

$$x = -2, -1, 2$$

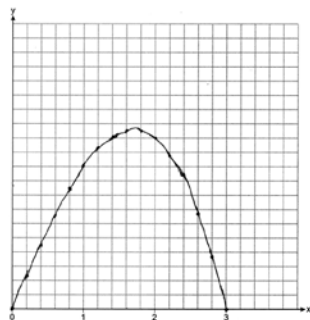
PTS: 4

REF: 081633aii

NAT: F.IF.C.7

TOP: Graphing Polynomial Functions

118 ANS:



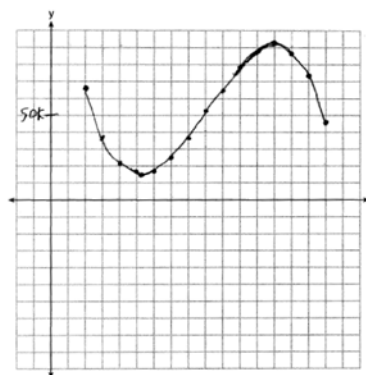
PTS: 4

REF: 082234aii

NAT: F.IF.C.7

TOP: Graphing Polynomial Functions

119 ANS:



$P(x) = R(x) - C(x) = -330x^3 + 9000x^2 - 67000x + 167000$   
 5 because there is a minimum in  $P(x)$ . Most profitable at year 13 because there is a maximum in  $P(x)$ .

Least profitable at year

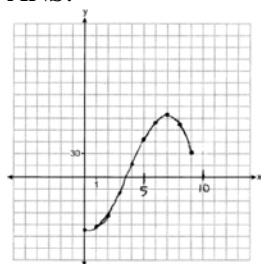
PTS: 6

REF: 081837aii

NAT: F.IF.C.7

TOP: Graphing Polynomial Functions

120 ANS:



(7,78) If 7000 sweatshirts are sold, the profit is \$78,000. 3,549, because that is when  $p(x)$  is first greater than 0.

PTS: 6 REF: 012437aai NAT: F.IF.C.7 TOP: Graphing Polynomial Functions

121 ANS: 3

Since  $x + 4$  is a factor of  $p(x)$ , there is no remainder.

PTS: 2 REF: 081621aai NAT: A.APR.B.2 TOP: Remainder and Factor Theorems

122 ANS: 4

$$p(5) = 2(5)^3 - 3(5) + 5 = 240$$

PTS: 2 REF: 011819aai NAT: A.APR.B.2 TOP: Remainder and Factor Theorems

123 ANS: 2

$$\begin{array}{r|rrrr} -4 & 1 & -11 & 16 & 84 \\ & & -4 & 60 & -304 \\ \hline & 1 & -15 & 76 & \end{array}$$

Since there is a remainder when the cubic is divided by  $x + 4$ , this binomial is not a factor.

PTS: 2 REF: 081720aai NAT: A.APR.B.2 TOP: Remainder and Factor Theorems

124 ANS: 1

$$\begin{array}{r|rrrrr} -2 & 1 & -1 & -11 & 5 & 30 \\ & & -2 & 6 & 10 & -30 \\ \hline & 1 & -3 & -5 & 15 & 0 \end{array}$$

Since there is no remainder when the quartic is divided by  $x + 2$ , this binomial is a factor.

PTS: 2 REF: 082320aai NAT: A.APR.B.2 TOP: Remainder and Factor Theorems

125 ANS: 1

$$\begin{array}{r|rrrrr} 2 & 1 & 0 & -4 & -4 & 8 \\ & & 2 & 4 & 0 & -8 \\ \hline & 1 & 2 & 0 & -4 & 0 \end{array}$$

Since there is no remainder when the quartic is divided by  $x - 2$ , this binomial is a factor.

PTS: 2 REF: 061711aai NAT: A.APR.B.2 TOP: Remainder and Factor Theorems

126 ANS: 4

PTS: 2 TOP: Remainder and Factor Theorems

REF: 061907aai NAT: A.APR.B.2

127 ANS: 2

PTS: 2 TOP: Remainder and Factor Theorems

REF: 062206aai NAT: A.APR.B.2

128 ANS: 2

PTS: 2 TOP: Remainder and Factor Theorems

REF: 011720aai NAT: A.APR.B.2

129 ANS: 2

$$2x^3 + x^2 - 18x - 9$$

$$x^2(2x + 1) - 9(2x + 1)$$

$$(x^2 - 9)(2x + 1)$$

$$(x + 3)(x - 3)(2x + 1)$$

PTS: 2 REF: 082206aai NAT: A.APR.B.2 TOP: Remainder and Factor Theorems

130 ANS: 2

$$2x^4 - x^3 - 16x + 8 = 0$$

$$x^3(2x - 1) - 8(2x - 1) = 0$$

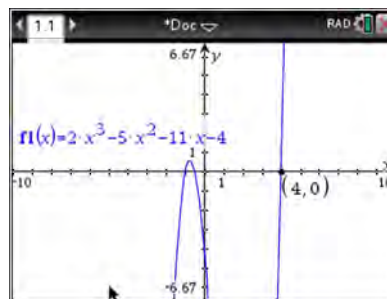
$$(x^3 - 8)(2x - 1) = 0$$

$$x = 2, \frac{1}{2}$$

PTS: 2 REF: 012307aai NAT: A.APR.B.2 TOP: Remainder and Factor Theorems

131 ANS:

$f(4) = 2(4)^3 - 5(4)^2 - 11(4) - 4 = 128 - 80 - 44 - 4 = 0$  Any method that demonstrates 4 is a zero of  $f(x)$  confirms



that  $x - 4$  is a factor, as suggested by the Remainder Theorem.

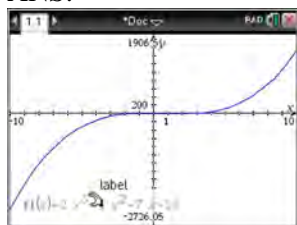
PTS: 2 REF: spr1507aai NAT: A.APR.B.2 TOP: Remainder and Factor Theorems

132 ANS:

$m(3) = 3^3 - 3^2 - 5(3) - 3 = 27 - 9 - 15 - 3 = 0$  Since  $m(3) = 0$ , there is no remainder when  $m(x)$  is divided by  $x - 3$ , and so  $x - 3$  is a factor.

PTS: 2 REF: 012026aai NAT: A.APR.B.2 TOP: Remainder and Factor Theorems

133 ANS:



$$x - 5 \overline{) 2x^3 - 4x^2 - 7x - 10} \quad \text{Since there is a remainder, } x - 5 \text{ is not a factor.}$$

$$\underline{2x^3 - 10x^2}$$

$$6x^2 - 7x$$

$$\underline{6x^2 - 30x}$$

$$23x - 10$$

$$\underline{23x - 115}$$

$$105$$

PTS: 2 REF: 061627aia NAT: A.APR.B.2 TOP: Remainder and Factor Theorems

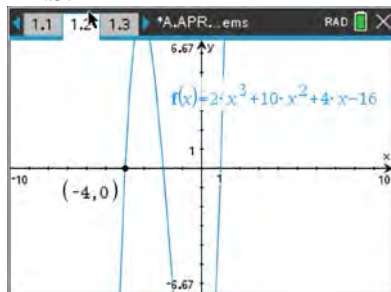
134 ANS:

$r(2) = -6$ . Since there is a remainder when the cubic is divided by  $x - 2$ , this binomial is not a factor.

$$\begin{array}{r|rrrr} 2 & 1 & -4 & 4 & 6 \\ & & 2 & -4 & 0 \\ \hline & 1 & -2 & 0 & -6 \end{array}$$

PTS: 2 REF: 061725aia NAT: A.APR.B.2 TOP: Remainder and Factor Theorems

135 ANS:



Since  $-4$  is a zero,  $x + 4$  is a factor.

PTS: 2 REF: 012426aia NAT: A.APR.B.2 TOP: Remainder and Factor Theorems

136 ANS:

$$j(-1) = 2(-1)^4 - (-1)^3 - 35(-1)^2 + 16(-1) + 48 = 2 + 1 - 35 - 16 + 48 = 0; \quad x + 1 \text{ is a factor of } j(x);$$

$$2x^3 - 3x^2 - 32x + 48 = 0$$

$$x^2(2x - 3) - 16(2x - 3) = 0$$

$$(x^2 - 16)(2x - 3) = 0$$

$$x = \pm 4, \frac{3}{2}$$

PTS: 4      REF: 081834aai      NAT: A.APR.B.2      TOP: Remainder and Factor Theorems

137 ANS:

$$P(-2) = 60 \quad Q(-2) = 0 \quad (x + 2) \text{ is a factor of } Q(x) \text{ since } Q(-2) = 0.$$

PTS: 2      REF: 081929aai      NAT: A.APR.B.2      TOP: Remainder and Factor Theorems

138 ANS: 3

$$1^3 - k(1)^2 + 2(1) = 0$$

$$k = 3$$

PTS: 2      REF: 061812aai      NAT: A.APR.B.2      TOP: Remainder and Factor Theorems

139 ANS:

$$g(3) = 0; \quad 0 = 3^3 + a(3)^2 - 5(3) + 6$$

$$0 = 27 + 9a - 15 + 6$$

$$-18 = 9a$$

$$a = -2$$

PTS: 2      REF: 062328aai      NAT: A.APR.B.2      TOP: Remainder and Factor Theorems

140 ANS: 3

TOP: Polynomial Identities

PTS: 2

REF: 012003aai

NAT: A.APR.C.4

141 ANS: 2

PTS: 2

REF: 011806aai

NAT: A.APR.C.4

142 ANS: 4

REF: 061822aai

NAT: A.APR.C.4

TOP: Polynomial Identities

143 ANS: 4

PTS: 2

REF: 061902aai

NAT: A.APR.C.4

TOP: Polynomial Identities

REF: 061902aai

NAT: A.APR.C.4

TOP: Polynomial Identities

144 ANS: 4

$$(x+y)^3 = x^3 + 3x^2y + 3xy^2 + y^3 \neq x^3 + 3xy + y^3$$

PTS: 2 REF: 081620aai NAT: A.APR.C.4 TOP: Polynomial Identities

145 ANS: 4

$$(x^2 - y^2) + (2xy)^2 = x^2 + 4x^2y^2 - y^2$$

$$(x-y) + (x^2 - xy + y^2) = x^2 + x - y - xy + y^2$$

$$(x-y)(x-y)(x^2 + y^2) = (x^2 - 2xy + y^2)(x^2 + y^2) = x^4 - 2x^3y + x^2y^2 + x^2y^2 - 2xy^3 + y^4$$

PTS: 2 REF: 062322aai NAT: A.APR.C.4 TOP: Polynomial Identities

146 ANS: 2

PTS: 2

REF: 012311aai NAT: A.APR.C.4

TOP: Polynomial Identities

147 ANS: 4

$$(x+y)^3 = x^3 + 3x^2y + 3xy^2 + y^3$$

PTS: 2 REF: 012417aai NAT: A.APR.C.4 TOP: Polynomial Identities

148 ANS: 1

$$2) (x^4 - x^2y^2 + y^4) \neq (x^2 - y^2)(x^2 - y^2); 3) x^6 + y^6 \neq (x^3 + y^3)^2; 4) \frac{x^6 + y^6}{x^2 + y^2} \neq x^6 + y^6 - (x^2 + y^2)$$

PTS: 2 REF: 082219aai NAT: A.APR.C.4 TOP: Polynomial Identities

149 ANS:

$$(a+b)^3 = a^3 + b^3$$

No. Erin's shortcut only works if  $a = 0$ ,  $b = 0$  or  $a = -b$ .

$$a^3 + 3a^2b + 3ab^2 + b^3 = a^3 + b^3$$

$$3ab^2 + 3a^2b = 0$$

$$3ab(b+a) = 0$$

$$a = 0, b = 0, a = -b$$

PTS: 2 REF: 011927aai NAT: A.APR.C.4 TOP: Polynomial Identities

150 ANS:

$$(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$$

$$x^4 + 2x^2y^2 + y^4 = x^4 - 2x^2y^2 + y^4 + 4x^2y^2$$

$$x^4 + 2x^2y^2 + y^4 = x^4 + 2x^2y^2 + y^4$$

PTS: 2 REF: 081727aai NAT: A.APR.C.4 TOP: Polynomial Identities

151 ANS:

Let  $x$  equal the first integer and  $x + 1$  equal the next.  $(x+1)^2 - x^2 = x^2 + 2x + 1 - x^2 = 2x + 1$ .  $2x + 1$  is an odd integer.

PTS: 2 REF: fall1511aai NAT: A.APR.C.4 TOP: Polynomial Identities



152 ANS:

$$2x^3 - 10x^2 + 11x - 7 = 2x^3 + hx^2 + 3x - 8x^2 - 4hx - 12 + k \quad h = -2$$

$$-2x^2 + 8x + 5 = hx^2 - 4hx + k \quad k = 5$$

PTS: 4 REF: 011733aai NAT: A.APR.C.4 TOP: Polynomial Identities

153 ANS: 3

$$\frac{x^{\frac{2}{3}} \cdot x^{\frac{5}{2}}}{x^{\frac{1}{6}}} = \frac{x^{\frac{4}{6}} \cdot x^{\frac{15}{6}}}{x^{\frac{1}{6}}} = x^{\frac{18}{6}} = x^3$$

PTS: 2 REF: 081812aai NAT: N.RN.A.2 TOP: Operations with Radicals  
KEY: with variables, index > 2

154 ANS: 4

$$\sqrt{3x^2y} \cdot \sqrt[3]{27x^3y^2} = 3^{\frac{1}{2}}x^1y^{\frac{1}{2}} \cdot 3^{\frac{2}{3}}x^1y^{\frac{2}{3}} = 3^{\frac{3}{2}}x^2y^{\frac{7}{6}}$$

PTS: 2 REF: 081914aai NAT: N.RN.A.2 TOP: Operations with Radicals  
KEY: with variables, index > 2

155 ANS: 1

$$\left(a^{\frac{3}{2}}\sqrt{2b^2}\right)\left(\sqrt[3]{4a^2b}\right) = a^{\frac{3}{2}}\sqrt[3]{8a^2b^3} = 2ab^{\frac{1}{2}}\sqrt{a^2}$$

PTS: 2 REF: 082213aai NAT: N.RN.A.2 TOP: Operations with Radicals  
KEY: with variables, index > 2

156 ANS: 2

$$4x \cdot x^{\frac{2}{3}} + 2x^{\frac{5}{3}} = 4x^{\frac{5}{3}} + 2x^{\frac{5}{3}} = 6x^{\frac{5}{3}} = 6^{\frac{1}{3}}\sqrt{x^5}$$

PTS: 2 REF: 061820aai NAT: N.RN.A.2 TOP: Operations with Radicals  
KEY: with variables, index > 2

157 ANS:

$$\sqrt[3]{x} \cdot \sqrt{x} = x^{\frac{1}{3}} \cdot x^{\frac{1}{2}} = x^{\frac{2}{6}} \cdot x^{\frac{3}{6}} = x^{\frac{5}{6}}$$

PTS: 2 REF: 061731aai NAT: N.RN.A.2 TOP: Operations with Radicals  
KEY: with variables, index > 2

158 ANS: 3

$$\sqrt{56-x} = x \quad -8 \text{ is extraneous.}$$

$$56-x = x^2$$

$$0 = x^2 + x - 56$$

$$0 = (x+8)(x-7)$$

$$x = 7$$

PTS: 2 REF: 061605aai NAT: A.REI.A.2 TOP: Solving Radicals

KEY: extraneous solutions

159 ANS: 2

$$x^2 = 3x + 40. \quad x = -5 \text{ is an extraneous solution.}$$

$$x^2 - 3x - 40 = 0$$

$$(x-8)(x+5) = 0$$

$$x = 8, -5$$

PTS: 2 REF: 012010aai NAT: A.REI.A.2 TOP: Solving Radicals

KEY: extraneous solutions

160 ANS: 3

$$\sqrt{3x+18} = x \quad -3 \text{ is extraneous.}$$

$$3x+18 = x^2$$

$$x^2 - 3x - 18 = 0$$

$$(x-6)(x+3) = 0$$

$$x = 6, -3$$

PTS: 2 REF: 082315aai NAT: A.REI.A.2 TOP: Solving Radicals

KEY: extraneous solutions

161 ANS: 3

$$\sqrt{x+1} = x+1$$

$$x+1 = x^2 + 2x + 1$$

$$0 = x^2 + x$$

$$0 = x(x+1)$$

$$x = -1, 0$$

PTS: 2 REF: 011802aai NAT: A.REI.A.2 TOP: Solving Radicals

KEY: extraneous solutions

162 ANS: 2

$$b^2 = 2b^2 - 64 \quad -8 \text{ is extraneous.}$$

$$-b^2 = -64$$

$$b = \pm 8$$

PTS: 2 REF: 061919aai NAT: A.REI.A.2 TOP: Solving Radicals

KEY: extraneous solutions

163 ANS: 3

$$x^2 - 4x - 5 = 4x^2 - 40x + 100$$

$$3x^2 - 36x + 105 = 0$$

$$x^2 - 12x + 35 = 0$$

$$(x - 7)(x - 5) = 0$$

$$x = 5, 7$$

PTS: 2 REF: 081807aai NAT: A.REI.A.2 TOP: Solving Radicals

KEY: extraneous solutions

164 ANS: 2

$$\sqrt{x+14} = \sqrt{2x+5} + 1 \qquad \sqrt{22+14} - \sqrt{2(22)+5} = 1$$

$$x + 14 = 2x + 5 + 2\sqrt{2x+5} + 1 \qquad 6 - 7 \neq 1$$

$$-x + 8 = 2\sqrt{2x+5}$$

$$x^2 - 16x + 64 = 8x + 20$$

$$x^2 - 24x + 44 = 0$$

$$(x - 22)(x - 2) = 0$$

$$x = 2, 22$$

PTS: 2 REF: 081704aai NAT: A.REI.A.2 TOP: Solving Radicals

KEY: advanced

165 ANS:

$$3\sqrt{x} - 2x = -5 \quad 1 \text{ is extraneous.}$$

$$3\sqrt{x} = 2x - 5$$

$$9x = 4x^2 - 20x + 25$$

$$4x^2 - 29x + 25 = 0$$

$$(4x - 25)(x - 1) = 0$$

$$x = \frac{25}{4}, 1$$

PTS: 4 REF: 011936aia NAT: A.REI.A.2 TOP: Solving Radicals  
KEY: extraneous solutions

166 ANS:

$$3x + 7 = x^2 - 2x + 1 \quad -1 \text{ is extraneous.}$$

$$0 = x^2 - 5x - 6$$

$$0 = (x - 6)(x + 1)$$

$$x = 6, -1$$

PTS: 2 REF: 062326aia NAT: A.REI.A.2 TOP: Solving Radicals  
KEY: extraneous solutions

167 ANS:

$$\sqrt{4x + 1} = 11 - x \quad 20 \text{ is extraneous.}$$

$$4x + 1 = 121 - 22x + x^2$$

$$0 = x^2 - 26x + 120$$

$$0 = (x - 6)(x - 20)$$

$$x = 6, 20$$

PTS: 2 REF: 082227aia NAT: A.REI.A.2 TOP: Solving Radicals  
KEY: extraneous solutions

168 ANS:

$$\sqrt{x - 4} = -x + 6 \quad \sqrt{x - 4} = -8 + 6 = -2 \text{ is extraneous.}$$

$$x - 4 = x^2 - 12x + 36$$

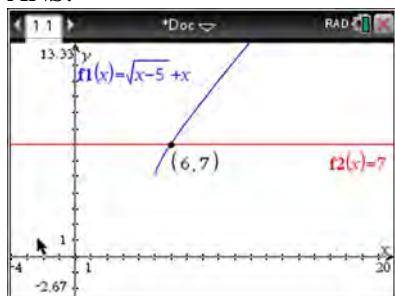
$$0 = x^2 - 13x + 40$$

$$0 = (x - 8)(x - 5)$$

$$x = 5, 8$$

PTS: 2 REF: 061730aia NAT: A.REI.A.2 TOP: Solving Radicals  
KEY: extraneous solutions

169 ANS:



$$\sqrt{x-5} = -x+7 \quad \sqrt{x-5} = -9+7 = -2 \text{ is extraneous.}$$

$$x-5 = x^2 - 14x + 49$$

$$0 = x^2 - 15x + 54$$

$$0 = (x-6)(x-9)$$

$$x = 6, 9$$

PTS: 2 REF: spr1508aii NAT: A.REI.A.2 TOP: Solving Radicals

KEY: extraneous solutions

170 ANS:

$$2x-6 = 2\sqrt{x-1} \quad 2 \text{ is extraneous.}$$

$$4x^2 - 24x + 36 = 4(x-1)$$

$$x^2 - 6x + 9 = x - 1$$

$$x^2 - 7x + 10 = 0$$

$$(x-5)(x-2) = 0$$

$$x = 2, 5$$

PTS: 4 REF: 012434aii NAT: A.REI.A.2 TOP: Solving Radicals

KEY: extraneous solutions

171 ANS:

$$\left(\sqrt{2x-7}\right)^2 = (5-x)^2 \quad \sqrt{2(4)-7} + 4 = 5 \quad \sqrt{2(8)-7} + 8 = 5$$

$$2x-7 = 25 - 10x + x^2 \quad \sqrt{1} = 1 \quad \sqrt{9} \neq -3$$

$$0 = x^2 - 12x + 32$$

$$0 = (x-8)(x-4)$$

$$x = 4, 8$$

PTS: 4 REF: 081635aii NAT: A.REI.A.2 TOP: Solving Radicals

KEY: extraneous solutions

172 ANS:

$$\sqrt{49-10x} = 2x-5 \quad -\frac{3}{2} \text{ is extraneous.}$$

$$49-10x = 4x^2 - 20x + 25$$

$$0 = 4x^2 - 10x - 24$$

$$0 = 2x^2 - 5x - 12$$

$$0 = (2x+3)(x-4)$$

$$x = -\frac{3}{2}, 4$$

PTS: 4 REF: 012333aii NAT: A.REI.A.2 TOP: Solving Radicals

KEY: extraneous solutions

173 ANS:

$$\sqrt{6-2x} + x = 2x + 30 - 9 \quad \sqrt{6-2(-29)} \neq -29 + 21, \text{ so } -29 \text{ is extraneous.}$$

$$\sqrt{6-2x} = x + 21 \quad \sqrt{64} \neq -8$$

$$6-2x = x^2 + 42x + 441$$

$$x^2 + 44x + 435 = 0$$

$$(x+29)(x+15) = 0$$

$$x = -29, -15$$

PTS: 4 REF: 061833aii NAT: A.REI.A.2 TOP: Solving Radicals

KEY: extraneous solutions

174 ANS:

$$0 = \sqrt{t} - 2t + 6 \quad 2\left(\frac{9}{4}\right) - 6 < 0, \text{ so } \frac{9}{4} \text{ is extraneous.}$$

$$2t - 6 = \sqrt{t}$$

$$4t^2 - 24t + 36 = t$$

$$4t^2 - 25t + 36 = 0$$

$$(4t-9)(t-4) = 0$$

$$t = \frac{9}{4}, 4$$

$$(\sqrt{1} - 2(1) + 6) - (\sqrt{3} - 2(3) + 6) = 5 - \sqrt{3} \approx 3.268 \text{ 327 mph}$$

PTS: 6 REF: 011737aii NAT: A.REI.A.2 TOP: Solving Radicals

KEY: context

175 ANS:

$$t = 2\pi\sqrt{\frac{67}{9.81}} \approx 16.4 \quad 9.6 = 2\pi\sqrt{\frac{L}{9.81}}$$

$$L \approx 22.9$$

PTS: 4 REF: 062234aai NAT: A.REI.A.2 TOP: Solving Radicals

KEY: context

176 ANS:

$B = 1.69\sqrt{30 + 4.45} - 3.49 \approx 6$ , which is a steady breeze.

$$15 = 1.69\sqrt{s + 4.45} - 3.49$$

$$18.49 = 1.69\sqrt{s + 4.45}$$

$$\frac{18.49}{1.69} = \sqrt{s + 4.45}$$

$$\left(\frac{18.49}{1.69}\right)^2 = s + 4.45$$

$$s = \left(\frac{18.49}{1.69}\right)^2 - 4.45$$

$$s \approx 115$$

$$9.5 = 1.69\sqrt{s + 4.45} - 3.49$$

$$10.49 = 1.69\sqrt{s + 4.45} - 3.49 \quad 55-64$$

$$12.99 = 1.69\sqrt{s + 4.45}$$

$$13.98 = 1.69\sqrt{s + 4.45}$$

$$\frac{12.99}{1.69} = \sqrt{s + 4.45}$$

$$\frac{13.98}{1.69} = \sqrt{s + 4.45}$$

$$\left(\frac{12.99}{1.69}\right)^2 = s + 4.45$$

$$\left(\frac{13.98}{1.69}\right)^2 = s + 4.45$$

$$s = \left(\frac{12.99}{1.69}\right)^2 - 4.45$$

$$s = \left(\frac{13.98}{1.69}\right)^2 - 4.45$$

$$s \approx 55$$

$$s \approx 64$$

PTS: 6 REF: 081937aai NAT: A.REI.A.2 TOP: Solving Radicals

KEY: context

177 ANS:

The denominator of the rational exponent represents the index of a root, and the 4th root of 81 is 3 and  $3^3$  is 27.

PTS: 2 REF: 011832aai NAT: N.RN.A.1 TOP: Radicals and Rational Exponents

178 ANS:

Applying the commutative property,  $\left(3^{\frac{1}{5}}\right)^2$  can be rewritten as  $\left(3^2\right)^{\frac{1}{5}}$  or  $9^{\frac{1}{5}}$ . A fractional exponent can be rewritten as a radical with the denominator as the index, or  $9^{\frac{1}{5}} = \sqrt[5]{9}$ .

PTS: 2 REF: 081626aai NAT: N.RN.A.1 TOP: Radicals and Rational Exponents

179 ANS:

The denominator of the rational exponent represents the index of a root, and the numerator of the rational exponent represents the power of the base.  $\left(\sqrt{9}\right)^5 = 243$

PTS: 2 REF: 081926aai NAT: N.RN.A.1 TOP: Radicals and Rational Exponents

180 ANS:

Rewrite  $\frac{4}{3}$  as  $\frac{1}{3} \cdot \frac{4}{1}$ , using the power of a power rule.

PTS: 2 REF: 081725aai NAT: N.RN.A.1 TOP: Radicals and Rational Exponents

181 ANS: 1

PTS: 2 REF: 062201aai NAT: N.RN.A.2

TOP: Radicals and Rational Exponents

182 ANS: 2

$$a^5\sqrt[5]{a^4} = a^{\frac{5}{5}} \cdot a^{\frac{4}{5}} = a^{\frac{9}{5}}$$

PTS: 2 REF: 062306aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents

183 ANS: 1

$$\sqrt[4]{81x^8y^6} = 81^{\frac{1}{4}} x^{\frac{8}{4}} y^{\frac{6}{4}} = 3x^2y^{\frac{3}{2}}$$

PTS: 2 REF: 012001aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents

KEY: variables

184 ANS: 3

$$P = 210x^{\frac{4}{3}}y^{\frac{7}{3}} = 210x^{\frac{3}{3}}x^{\frac{1}{3}}y^{\frac{6}{3}}y^{\frac{1}{3}} = 210x \cdot x^{\frac{1}{3}}y^2y^{\frac{1}{3}} = 210xy^2\sqrt[3]{xy}$$

PTS: 2 REF: 012413aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents

185 ANS: 4

PTS: 2 REF: 061601aai NAT: N.RN.A.2

TOP: Radicals and Rational Exponents KEY: variables

186 ANS: 3

$$\frac{x^{\frac{1}{5}}}{x^{\frac{1}{2}}} = x^{\frac{1}{5} - \frac{1}{2}} = x^{-\frac{3}{10}} = \frac{1}{x^{\frac{3}{10}}} = \frac{1}{\sqrt[10]{x^3}}$$

PTS: 2 REF: 012312aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents



187 ANS: 2

$$\left(m^{\frac{5}{3}}\right)^{-\frac{1}{2}} = m^{-\frac{5}{6}} = \frac{1}{\sqrt[6]{m^5}}$$

PTS: 2 REF: 011707aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents  
KEY: variables

188 ANS: 4

$$\left(\frac{-54x^9}{y^4}\right)^{\frac{2}{3}} = \frac{(2 \cdot -27)^{\frac{2}{3}} x^{\frac{18}{3}}}{y^{\frac{8}{3}}} = \frac{2^{\frac{2}{3}} \cdot 9x^6}{y^2 \cdot y^{\frac{2}{3}}} = \frac{9x^6 \sqrt[3]{4}}{y^2 \sqrt[3]{y^2}}$$

PTS: 2 REF: 081723aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents  
KEY: variables

189 ANS: 4

$$\frac{n}{m} = \frac{\sqrt{a^5}}{a} = \frac{a^{\frac{5}{2}}}{a^{\frac{2}{2}}} = a^{\frac{3}{2}} = \sqrt{a^3}$$

PTS: 2 REF: 011811aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents  
KEY: variables

190 ANS: 1

$$(x^{\frac{3}{2}})^2 = x^3$$

PTS: 2 REF: 061908aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents  
KEY: variables

191 ANS: 4

PTS: 2

REF: 061716aai

NAT: N.RN.A.2

TOP: Radicals and Rational Exponents

KEY: variables

192 ANS: 4

$$\text{I. } \left(\frac{y}{x^3}\right)^{-1} = \frac{x^3}{y}; \text{ II. } \sqrt[3]{x^9} (y^{-1}) = \frac{x^{\frac{9}{3}}}{y} = \frac{x^3}{y}; \text{ III. } \frac{x^{64} \sqrt{y^8}}{x^3 y^3} = \frac{x^3 y^{\frac{8}{4}}}{y^3} = \frac{x^3}{y}$$

PTS: 2 REF: 062320aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents

193 ANS:

$$\sqrt[3]{81} = \sqrt[3]{3^4} = 3^{\frac{4}{3}} \quad a = \frac{4}{3}$$

PTS: 2 REF: 062230aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents  
KEY: variables

194 ANS:

$$\text{No. } \left(\sqrt[7]{x^2}\right)\left(\sqrt[5]{x^3}\right) = x^{\frac{2}{7}} \cdot x^{\frac{3}{5}} = x^{\frac{31}{35}} = \sqrt[35]{x^{31}}$$

PTS: 2 REF: 061929aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents  
KEY: variables

195 ANS:

$$\left(p^2 n^{\frac{1}{2}}\right)^8 \sqrt{p^5 n^4} = \left(p^{16} n^4\right) p^2 n^2 \sqrt{p} = p^{18} n^6 \sqrt{p}$$

PTS: 2 REF: 012025aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents

196 ANS:

$$\frac{x \cdot x^{\frac{3}{2}}}{x^{\frac{5}{3}}} = \frac{x^{\frac{6}{6}} \cdot x^{\frac{9}{6}}}{x^{\frac{10}{6}}} = x^{\frac{5}{6}}$$

PTS: 2 REF: 082331aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents

197 ANS:

$$\left(\frac{1}{\sqrt[3]{y^2}}\right) y^4 = \frac{y^{\frac{12}{3}}}{\frac{y^{\frac{10}{3}}}{y^{\frac{2}{3}}}} = y^{\frac{10}{3}} \quad n = \frac{10}{3}$$

PTS: 2 REF: 012428aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents

198 ANS:

$$\frac{x^{\frac{8}{3}}}{x^{\frac{4}{3}}} = x^y$$

$$x^{\frac{4}{3}} = x^y$$

$$\frac{4}{3} = y$$

PTS: 2 REF: spr1505aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents  
KEY: numbers

199 ANS:

$$\frac{2x^{\frac{3}{2}}}{2x^{\frac{2}{2}}} = x^{\frac{1}{2}} = \sqrt{x}$$

PTS: 2

REF: 081826aai

NAT: N.RN.A.2

TOP: Radicals and Rational Exponents

KEY: variables

200 ANS:

$$\frac{\sqrt[3]{x^2 y^5}}{\sqrt[4]{x^3 y^4}} = \frac{x^{\frac{2}{3}} y^{\frac{5}{3}}}{x^{\frac{3}{4}} y^{\frac{4}{4}}} = \frac{x^{\frac{8}{12}} y^{\frac{20}{12}}}{x^{\frac{9}{12}} y^{\frac{12}{12}}} = x^{-\frac{1}{12}} y^{\frac{2}{3}}$$

PTS: 2

REF: 011925aai

NAT: N.RN.A.2

TOP: Radicals and Rational Exponents

KEY: variables

201 ANS:

$$\left(x^{\frac{5}{3}}\right)^{\frac{6}{5}} = \left(y^{\frac{5}{6}}\right)^{\frac{6}{5}}$$

$$x^2 = y$$

PTS: 2

REF: 011730aai

NAT: N.RN.A.2

TOP: Radicals and Rational Exponents

KEY: variables

202 ANS:

$$a^{x+1} = a^{\frac{2}{3}}$$

$$x+1 = \frac{2}{3}$$

$$x = -\frac{1}{3}$$

PTS: 2

REF: 012326aai

NAT: N.RN.A.2

TOP: Radicals and Rational Exponents

203 ANS: 3

$$3i(ai - 6i^2) = 3ai^2 - 18i^3 = -3a + 18i$$

PTS: 2

REF: 062307aai

NAT: N.CN.A.2

TOP: Operations with Complex Numbers

204 ANS: 2

$$6xi^3(-4xi + 5) = -24x^2 i^4 + 30xi^3 = -24x^2(1) + 30x(-1) = -24x^2 - 30xi$$

PTS: 2

REF: 061704aai

NAT: N.CN.A.2

TOP: Operations with Complex Numbers

- 205 ANS: 4  
 $(x - 2i)(x - 2i) = x^2 - 4xi + 4i^2 = x^2 - 4xi - 4$
- PTS: 2 REF: 082202aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers
- 206 ANS: 3  
 $(3k - 2i)^2 = 9k^2 - 12ki + 4i^2 = 9k^2 - 12ki - 4$
- PTS: 2 REF: 081702aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers
- 207 ANS: 2  
 $(2 - yi)(2 - yi) = 4 - 4yi + y^2i^2 = -y^2 - 4yi + 4$
- PTS: 2 REF: 061603aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers
- 208 ANS: 1  
 $6 - (3x - 2i)(3x - 2i) = 6 - (9x^2 - 12xi + 4i^2) = 6 - 9x^2 + 12xi + 4 = -9x^2 + 12xi + 10$
- PTS: 2 REF: 061915aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers
- 209 ANS: 3  
 $(x + 3i)^2 - (2x - 3i)^2 = x^2 + 6xi + 9i^2 - (4x^2 - 12xi + 9i^2) = -3x^2 + 18xi$
- PTS: 2 REF: 061805aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers
- 210 ANS: 3  
 $-3 + 5i - (4 + 24i - 2i - 12i^2) = -3 + 5i - (16 + 22i) = -19 - 17i$
- PTS: 2 REF: 081815aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers
- 211 ANS: 1  
 $(2x - i)^2 - (2x - i)(2x + 3i)$   
 $(2x - i)[(2x - i) - (2x + 3i)]$   
 $(2x - i)(-4i)$   
 $-8xi + 4i^2$   
 $-8xi - 4$
- PTS: 2 REF: 011911aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers
- 212 ANS: 1  
 $7 - 3i + x^2 - 4xi + 4i^2 - 4i - 2x^2 = 7 - 7i - x^2 - 4xi - 4 = 3 - x^2 - 4xi - 7i = (3 - x^2) - (4x + 7)i$
- PTS: 2 REF: 012022aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers
- 213 ANS: 4  
 $x^3 - x^2yi - xy^2 + x^2yi - xy^2i^2 - y^3i = x^3 - xy^2 - xy^2(-1) - y^3i = x^3 - y^3i$
- PTS: 2 REF: 062223aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers

214 ANS: 3

$$(6 - ki)^2 = 27 - 36i$$

$$36 - 12ki + k^2 i^2 = 27 - 36i$$

$$9 - k^2 - 12ki = -36i$$

Set real part equal to real part:  $9 - k^2 = 0$  Set imaginary part equal to imaginary part:  $-12ki = -36i$ 

$$k = \pm 3$$

$$\frac{-12ki}{-12i} = \frac{-36i}{-12i}$$

$$k = 3$$

PTS: 2 REF: 012308aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers

215 ANS:

$$i^2 = -1, \text{ and not } 1; 10 + 10i$$

PTS: 2 REF: 011825aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers

216 ANS:

$$(5xi^3 - 4i)^2 = (-5xi - 4i)^2 = 25x^2 i^2 + 40xi^2 + 16i^2 = -25x^2 - 40x - 16$$

PTS: 2 REF: 082329aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers

217 ANS:

$$(2xi^3 - 3y)^2 = 4x^2 i^6 - 12xyi^3 + 9y^2 = -4x^2 + 12xyi + 9y^2$$

PTS: 2 REF: 012431aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers

218 ANS:

$$xi(-6i)^2 = xi(36i^2) = 36xi^3 = -36xi$$

PTS: 2 REF: 081627aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers

219 ANS:

$$(4 - 3i)(5 + 2yi - 5 + 2yi)$$

$$(4 - 3i)(4yi)$$

$$16yi - 12yi^2$$

$$12y + 16yi$$

PTS: 2 REF: spr1506aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers

220 ANS:

$$(1 - i)(1 - i)(1 - i) = (1 - 2i + i^2)(1 - i) = -2i(1 - i) = -2i + 2i^2 = -2 - 2i$$

PTS: 2 REF: 011725aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers

221 ANS:

$$-\frac{1}{2}i^3(3i - 4) - 3i^2 = -\frac{3}{2}i^4 + 2i^3 - 3i^2 = -\frac{3}{2} - 2i + 3 = \frac{3}{2} - 2i$$

PTS: 2 REF: 081927aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers

222 ANS: 3

$$0.75^{\frac{1}{10}} \approx .9716$$

PTS: 2 REF: 061713aii NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

223 ANS: 2

$$B(t) = 750 \left( 1.16^{\frac{1}{12}} \right)^{12t} \approx 750(1.012)^{12t} \quad B(t) = 750 \left( 1 + \frac{0.16}{12} \right)^{12t}$$

is wrong, because the growth is an annual rate

that is not compounded monthly.

PTS: 2 REF: spr1504aii NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

224 ANS: 2

$$1.00643^{12} \approx 1.08$$

PTS: 2 REF: 081808aii NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

225 ANS: 3

$$1.04^{\frac{1}{12}} \approx 1.0032737$$

PTS: 2 REF: 011906aii NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

226 ANS: 1

$$50(1.19^{\frac{1}{12}})^{12t} \approx 50(1.015)^{12t}$$

PTS: 2 REF: 012424aii NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

227 ANS: 1

$$1.025^{\frac{1}{12}} \approx 1.00206$$

PTS: 2 REF: 081924aii NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

228 ANS: 1

$$\left( 1.03^{\frac{1}{12}} \right)^{12t} \approx 1.00247^{12t}$$

PTS: 2 REF: 062224aii NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

229 ANS: 1

$$1.0325^{\frac{1}{12}} \approx 1.0027$$

PTS: 2 REF: 012323aii NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

230 ANS: 2

$$.962^{10} \approx .679$$

PTS: 2 REF: 082311aii NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

231 ANS: 1

$$0.5^{\frac{1}{0.0803}} \approx 0.000178$$

PTS: 2 REF: 082224aai NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

232 ANS: 3

$$\left(\frac{1}{2}\right)^{\frac{1}{73.83}} \approx 0.990656$$

PTS: 2 REF: 081710aai NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

233 ANS: 4

$$1 \text{ year} = 365 \text{ days}$$

PTS: 2 REF: 061823aai NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

234 ANS: 4

PTS: 2 REF: 011808aai NAT: A.SSE.B.3

TOP: Modeling Exponential Functions

235 ANS: 3

$$e^{\left(\frac{-3}{0.6}\right)} \approx 0.006738$$

PTS: 2 REF: 062315aai NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

236 ANS: 4

$$1 + \frac{.009}{12} = 1.00075$$

PTS: 2 REF: 011918aai NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

## Algebra II Regents Exam Questions by State Standard: Topic Answer Section

- 237 ANS: 3  
 $a = 105, 0 < b < 1$
- PTS: 2 REF: 082314aai NAT: F.BF.A.1 TOP: Modeling Exponential Functions
- 238 ANS: 1 PTS: 2 REF: 082309aai NAT: F.BF.A.1  
 TOP: Modeling Exponential Functions
- 239 ANS: 4  
 $1.06^{\frac{1}{52}}$
- PTS: 2 REF: 061924aai NAT: F.BF.A.1 TOP: Modeling Exponential Functions
- 240 ANS: 3  
 $1.0525^{\frac{1}{12}} \approx 1.00427$
- PTS: 2 REF: 061621aai NAT: F.BF.A.1 TOP: Modeling Exponential Functions
- 241 ANS: 4 PTS: 2 REF: 081622aai NAT: F.BF.A.1  
 TOP: Modeling Exponential Functions
- 242 ANS: 1  
 $2000 \left( 1 + \frac{.032}{12} \right)^{12t} \approx 2000(1.003)^{12t}$
- PTS: 2 REF: 012004aai NAT: F.BF.A.1 TOP: Modeling Exponential Functions
- 243 ANS: 1  
 $\frac{A}{P} = e^{rt}$   
 $0.42 = e^{rt}$   
 $\ln 0.42 = \ln e^{rt}$   
 $-0.87 \approx rt$
- PTS: 2 REF: 011723aai NAT: F.BF.A.1 TOP: Modeling Exponential Functions
- 244 ANS:  
 $B(t) = 100(2)^{\frac{t}{30}}$
- PTS: 2 REF: 012031aai NAT: F.BF.A.1 TOP: Modeling Exponential Functions
- 245 ANS: 3  
 $y = 278(0.5)^{\frac{18}{1.8}} \approx 0.271$
- PTS: 2 REF: 011920aai NAT: F.LE.A.2 TOP: Modeling Exponential Functions



246 ANS: 1

$$P(28) = 5(2)^{\frac{98}{28}} \approx 56$$

PTS: 2 REF: 011702aai NAT: F.LE.A.2 TOP: Modeling Exponential Functions

247 ANS: 4

$$5000 \left( 1 + \frac{.035}{12} \right)^{12 \cdot 6} \approx 6166.50$$

PTS: 2 REF: 081917aai NAT: F.LE.A.2 TOP: Modeling Exponential Functions

248 ANS:

$$N(t) = 950e^{0.0475t} \text{ The base is } e \text{ because growth is continuous. } N\left(\frac{36}{24}\right) \approx 1020$$

PTS: 4 REF: 081933aai NAT: F.LE.A.2 TOP: Modeling Exponential Functions

249 ANS:

$A(t) = 100(0.5)^{\frac{t}{63}}$ , where  $t$  is time in years, and  $A(t)$  is the amount of titanium-44 left after  $t$  years.

$$\frac{A(10) - A(0)}{10 - 0} = \frac{89.58132 - 100}{10} = -1.041868 \text{ The estimated mass at } t = 40 \text{ is } 100 - 40(-1.041868) \approx 58.3. \text{ The}$$

actual mass is  $A(40) = 100(0.5)^{\frac{40}{63}} \approx 64.3976$ . The estimated mass is less than the actual mass.

PTS: 6 REF: fall1517aai NAT: F.LE.A.2 TOP: Modeling Exponential Functions

250 ANS: 4 PTS: 2 REF: 012303aai NAT: F.LE.B.5

TOP: Modeling Exponential Functions

251 ANS: 1

The car lost approximately 19% of its value each year.

PTS: 2 REF: 081613aai NAT: F.LE.B.5 TOP: Modeling Exponential Functions

252 ANS: 4 PTS: 2 REF: 011805aai NAT: F.LE.B.5

TOP: Modeling Exponential Functions

253 ANS: 1

1)  $A(20) > 0$ ; 2)  $.5 \times .5 = .25$ ; 3) true; 4)  $A(7) \approx 9.9$

PTS: 2 REF: 082211aai NAT: F.LE.B.5 TOP: Modeling Exponential Functions

254 ANS: 2

The mass of the carbon-14 is decreasing by half every 5715 years.

PTS: 2 REF: 062211aai NAT: F.LE.B.5 TOP: Modeling Exponential Functions

255 ANS: 2

The 2010 population is 110 million.

PTS: 2 REF: 061718aai NAT: F.LE.B.5 TOP: Modeling Exponential Functions

256 ANS: 2 PTS: 2 REF: 061917aai NAT: F.LE.B.5

TOP: Modeling Exponential Functions

257 ANS: 4

$$F = 325 - 185e^{-0.4(0)} = 325 - 185 = 140$$

PTS: 2 REF: 012415aai NAT: F.IF.B.4 TOP: Evaluating Exponential Expressions

258 ANS: 3

$$M = \frac{240000 \left( \frac{4.5\%}{12} \right) \left( 1 + \frac{4.5\%}{12} \right)^{15 \times 12}}{\left( 1 + \frac{4.5\%}{12} \right)^{15 \times 12} - 1} \approx 1835.98$$

PTS: 2 REF: 062209aai NAT: F.IF.B.4 TOP: Evaluating Exponential Expressions

259 ANS: 4

$$M = \frac{45000 \left( \frac{6.75\%}{12} \right) \left( 1 + \frac{6.75\%}{12} \right)^{5 \times 12}}{\left( 1 + \frac{6.75\%}{12} \right)^{5 \times 12} - 1} \approx 885.76$$

PTS: 2 REF: 082316aai NAT: F.IF.B.4 TOP: Evaluating Exponential Expressions

260 ANS: 2

$$i = \frac{6.24\%}{12} = .52\% \quad R = \frac{(18000)(.52\%)}{1 - (1 + .52\%)^{-12 \cdot 6}} \approx 300.36$$

PTS: 2 REF: 012420aai NAT: F.IF.B.4 TOP: Evaluating Exponential Expressions

261 ANS:

$$M = \frac{(152500 - 15250) \left( \frac{.036}{12} \right) \left( 1 + \frac{.036}{12} \right)^{360}}{\left( 1 + \frac{.036}{12} \right)^{360} - 1} \approx 624$$

PTS: 2 REF: 061831aai NAT: F.IF.B.4 TOP: Evaluating Exponential Expressions

262 ANS:

$$20000 = PMT \left( \frac{1 - (1 + .00625)^{-60}}{0.00625} \right) \quad 21000 - x = 300 \left( \frac{1 - (1 + .00625)^{-60}}{0.00625} \right)$$

$$PMT \approx 400.76$$

$$x \approx 6028$$

PTS: 4 REF: 011736aai NAT: F.IF.B.4 TOP: Evaluating Exponential Expressions

263 ANS:

$$M = 172600 \cdot \frac{0.00305(1 + 0.00305)^{12 \cdot 15}}{(1 + 0.00305)^{12 \cdot 15} - 1} \approx 1247 \quad 1100 = (172600 - x) \cdot \frac{0.00305(1 + 0.00305)^{12 \cdot 15}}{(1 + 0.00305)^{12 \cdot 15} - 1}$$

$$1100 \approx (172600 - x) \cdot (0.007228)$$

$$152193 \approx 172600 - x$$

$$20407 \approx x$$

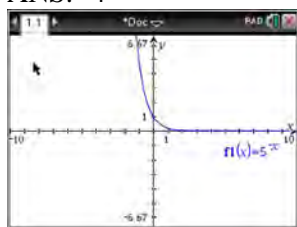
PTS: 4 REF: 061734aai NAT: F.IF.B.4 TOP: Evaluating Exponential Expressions

264 ANS: 3

$$d = 10 \log \frac{6.3 \times 10^{-3}}{1.0 \times 10^{-12}} \approx 98$$

PTS: 2 REF: 011715aai NAT: F.IF.B.4 TOP: Evaluating Logarithmic Expressions

265 ANS: 4



$$y = 5^{-x} = \left(\frac{1}{5}\right)^x$$

PTS: 2 REF: 061615aai NAT: F.IF.C.7 TOP: Graphing Exponential Functions

266 ANS: 2

$$p(x) = 4^x, q(x) = \left(\frac{5}{9}\right)^x, r(x) = 5.29^x, s(x) = 2^x$$

PTS: 2 REF: 012304aai NAT: F.IF.C.7 TOP: Graphing Exponential Functions

267 ANS: 4

There is no  $x$ -intercept.

PTS: 2 REF: 011823aai NAT: F.IF.C.7 TOP: Graphing Exponential Functions

268 ANS: 2

PTS: 2

REF: 061802aai

NAT: F.IF.C.7

TOP: Graphing Exponential Functions

269 ANS: 3

PTS: 2

REF: 082214aai

NAT: F.IF.C.7

TOP: Graphing Exponential Functions

270 ANS:

Translation 3 units right and 4 units up

PTS: 2 REF: 012027aai NAT: F.IF.C.7 TOP: Graphing Exponential Functions

271 ANS:

 $e^{0.0532} > 1$ , so  $P(t)$  is increasing.

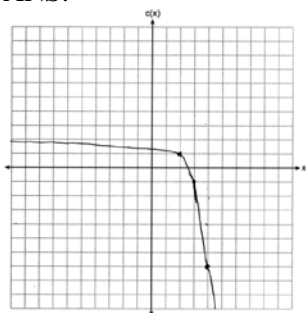
PTS: 2 REF: 062327aai NAT: F.IF.C.7 TOP: Graphing Exponential Functions

272 ANS:

$$0 < e^{\frac{\left(\ln \frac{1}{2}\right)}{1590}} < 1, \text{ so } M(t) \text{ represents decay.}$$

PTS: 2 REF: 011728aai NAT: F.IF.C.7 TOP: Graphing Exponential Functions

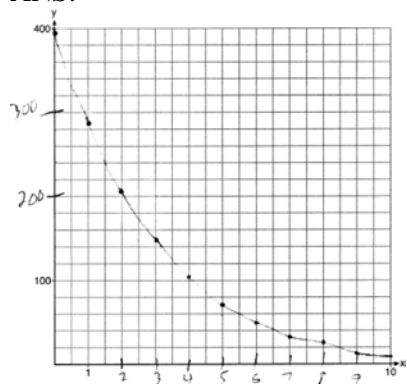
273 ANS:



As  $x \rightarrow \infty, c(x) \rightarrow -\infty$ . As  $x \rightarrow -\infty, c(x) \rightarrow 2$ .

PTS: 4 REF: 012335aai NAT: F.IF.C.7 TOP: Graphing Exponential Functions

274 ANS:



PTS: 2 REF: 061729aai NAT: F.IF.C.7 TOP: Graphing Exponential Functions

275 ANS: 2 PTS: 2 REF: 081816aai NAT: F.IF.C.7

TOP: Graphing Logarithmic Functions KEY: bimodalgraph

276 ANS: 4

Translate the parent log function 2 to the right and reflect over the  $x$ -axis.

PTS: 2 REF: 082207aai NAT: F.IF.C.7 TOP: Graphing Logarithmic Functions

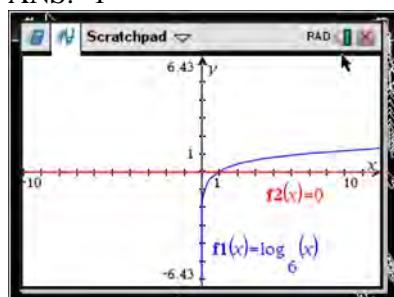
277 ANS: 1 PTS: 2 REF: 062308aai NAT: F.IF.C.7

TOP: Graphing Logarithmic Functions

278 ANS: 4  
 $\log_2(x - 1) - 1 = 0$   
 $\log_2(x - 1) = 1$   
 $x - 1 = 2^1$   
 $x = 3$

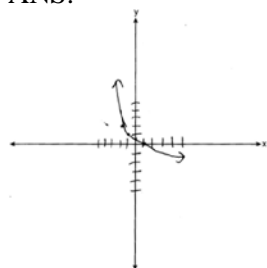
PTS: 2 REF: 061819aai NAT: F.IF.C.7 TOP: Graphing Logarithmic Functions  
 279 ANS: 1 PTS: 2 REF: 011902aai NAT: F.IF.C.7  
 TOP: Graphing Logarithmic Functions

280 ANS: 1



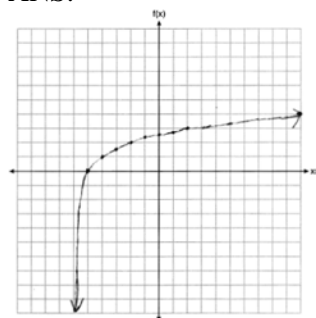
PTS: 2 REF: 061618aai NAT: F.IF.C.7 TOP: Graphing Logarithmic Functions  
 281 ANS: 4 PTS: 2 REF: 062215aai NAT: F.IF.C.7  
 TOP: Graphing Logarithmic Functions

282 ANS:



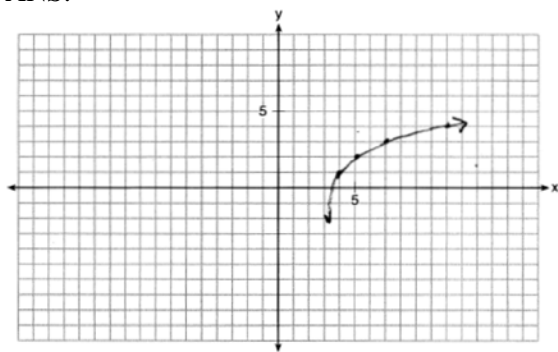
As  $x \rightarrow -3, y \rightarrow \infty$ . As  $x \rightarrow \infty, y \rightarrow -\infty$ .

PTS: 4 REF: 082333aai NAT: F.IF.C.7 TOP: Graphing Logarithmic Functions  
 283 ANS:



PTS: 2 REF: 061927aai NAT: F.IF.C.7 TOP: Graphing Logarithmic Functions

284 ANS:



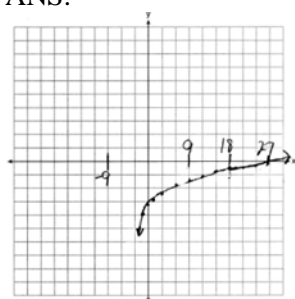
PTS: 2

REF: 011932aii

NAT: F.IF.C.7

TOP: Graphing Logarithmic Functions

285 ANS:



As  $x \rightarrow -3, y \rightarrow -\infty$ . As  $x \rightarrow \infty, y \rightarrow \infty$ .

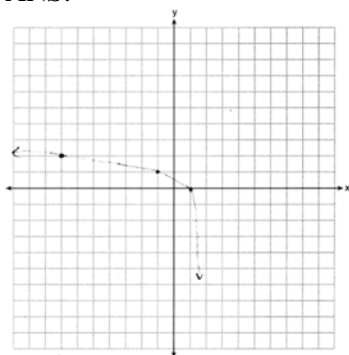
PTS: 4

REF: 061735aii

NAT: F.IF.C.7

TOP: Graphing Logarithmic Functions

286 ANS:



Domain:  $x < 2$ , Asymptote  $x = 2$

PTS: 4

REF: 012034aii

NAT: F.IF.C.7

TOP: Graphing Logarithmic Functions

287 ANS: 3

PTS: 2

REF: 012404aii

NAT: A.APR.B.3

TOP: Express Exponentials as Logarithms

288 ANS: 3

$$e^{bt} = \frac{c}{a}$$

$$\ln e^{bt} = \ln \frac{c}{a}$$

$$bt \ln e = \ln \frac{c}{a}$$

$$t = \frac{\ln \frac{c}{a}}{b}$$

PTS: 2 REF: 011813aai NAT: F.LE.A.4 TOP: Exponential Equations

KEY: without common base

289 ANS: 1

$$\ln e^{x+2} = \ln \frac{7}{5}$$

$$(x+2) \ln e = \ln \frac{7}{5}$$

$$x = -2 + \ln \frac{7}{5}$$

PTS: 2 REF: 062207aai NAT: F.LE.A.4 TOP: Exponential Equations

KEY: without common base

290 ANS: 1

$$8(2^{x+3}) = 48$$

$$2^{x+3} = 6$$

$$(x+3) \ln 2 = \ln 6$$

$$x+3 = \frac{\ln 6}{\ln 2}$$

$$x = \frac{\ln 6}{\ln 2} - 3$$

PTS: 2 REF: 061702aai NAT: F.LE.A.4 TOP: Exponential Equations

KEY: without common base

291 ANS: 4

$$\ln e^{0.3x} = \ln \frac{5918}{87}$$

$$x = \frac{\ln \frac{5918}{87}}{0.3}$$

PTS: 2 REF: 081801aai NAT: F.LE.A.4 TOP: Exponential Equations

KEY: without common base

292 ANS: 2

$$4300e^{0.07x} = 5123$$

$$\ln e^{0.07x} = \ln \frac{5123}{4300}$$

$$0.07x = \ln \frac{5123}{4300}$$

$$x = \frac{\ln \frac{5123}{4300}}{0.07}$$

$$x \approx 2.5$$

PTS: 2 REF: 012302aia NAT: F.LE.A.4 TOP: Exponential Equations

KEY: without common base

293 ANS: 4

$$\log 2^t = \log \sqrt{10} \quad 2) \frac{\log \sqrt{10}}{\log 2} = \log_2 \sqrt{10}, \quad 1) \log_2 \sqrt{10} = \log_2 10^{\frac{1}{2}} = \frac{1}{2} \log_2 10, \quad 3) \log_4 10 = \frac{\log_2 10}{\log_2 4} = \frac{1}{2} \log_2 10$$

$$t \log 2 = \log \sqrt{10}$$

$$t = \frac{\log \sqrt{10}}{\log 2}$$

PTS: 2 REF: 012009aia NAT: F.LE.A.4 TOP: Exponential Equations

KEY: without common base

294 ANS:

$$\ln e^{0.49x} = \ln 7.5$$

$$0.49x = \ln 7.5$$

$$x = \frac{\ln 7.5}{0.49} \approx 4.112$$

PTS: 2 REF: 062330aia NAT: F.LE.A.4 TOP: Exponential Equations

KEY: without common base

295 ANS: 4

$$\frac{15000}{12000} = \frac{12000e^{.025t}}{12000}$$

$$1.25 = e^{.025t}$$

$$\ln 1.25 = \ln e^{.025t}$$

$$\ln 1.25 = .025t$$

$$\frac{\ln 1.25}{.025} = t$$

PTS: 2 REF: 082209aia NAT: F.LE.A.4 TOP: Exponential Growth



296 ANS: 1

$$9110 = 5000e^{30r}$$

$$\ln \frac{911}{500} = \ln e^{30r}$$

$$\frac{\ln \frac{911}{500}}{30} = r$$

$$r \approx .02$$

PTS: 2

REF: 011810aai

NAT: F.LE.A.4

TOP: Exponential Growth

297 ANS:

$$2 = e^{0.0375t}$$

$$t \approx 18.5$$

PTS: 4

REF: 081835aai

NAT: F.LE.A.4

TOP: Exponential Growth

298 ANS:

$$\text{a) } p(t) = 11000(2)^{\frac{t}{20}}; \text{ b) } \frac{1000000}{11000} = \frac{11000(2)^{\frac{t}{20}}}{11000}$$

$$\log \frac{1000}{11} = \log 2^{\frac{t}{20}}$$

$$\log \frac{1000}{11} = \frac{t \cdot \log 2}{20}$$

$$\frac{20 \log \frac{1000}{11}}{\log 2} = t$$

$$t \approx 130.13$$

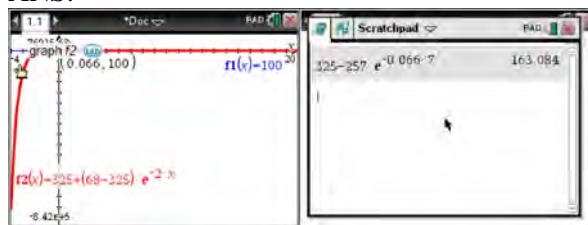
PTS: 4

REF: 082233aai

NAT: F.LE.A.4

TOP: Exponential Growth

299 ANS:



$$100 = 325 + (68 - 325)e^{-2k} \quad T = 325 - 257e^{-0.066t}$$

$$-225 = -257e^{-2k} \quad T = 325 - 257e^{-0.066(7)} \approx 163$$

$$k = \frac{\ln\left(\frac{-225}{-257}\right)}{-2}$$

$$k \approx 0.066$$

PTS: 4 REF: fall1513aai NAT: F.LE.A.4 TOP: Exponential Growth

300 ANS:

$$A = Pe^{rt}$$

$$135000 = 100000e^{5r}$$

$$1.35 = e^{5r}$$

$$\ln 1.35 = \ln e^{5r}$$

$$\ln 1.35 = 5r$$

$$.06 \approx r \text{ or } 6\%$$

PTS: 2 REF: 061632aai NAT: F.LE.A.4 TOP: Exponential Growth

301 ANS:

$$4\% \quad 8.75 = 1.25(1+r)^{49} \text{ or } 8.75 = 1.25e^{49r}$$

$$7 = (1+r)^{49} \quad \ln 7 = \ln e^{49r}$$

$$r+1 = \sqrt[49]{7} \quad \ln 7 = 49r$$

$$r \approx .04 \quad r = \frac{\ln 7}{49}$$

$$r \approx .04$$

PTS: 2 REF: 081730aai NAT: F.LE.A.4 TOP: Exponential Growth

302 ANS: 4

$$120 = 68 + (195 - 68)e^{-0.05t}$$

$$52 = 127e^{-0.05t}$$

$$\ln \frac{52}{127} = \ln e^{-0.05t}$$

$$\ln \frac{52}{127} = -0.05t$$

$$\frac{\ln \frac{52}{127}}{-0.05} = t$$

$$18 \approx t$$

PTS: 2

REF: 081918aaii

NAT: F.LE.A.4

TOP: Exponential Decay

303 ANS: 1

$$100 \left( \frac{1}{2} \right)^{\frac{d}{8}} = 100e^{kd}$$

$$\left( \frac{1}{2} \right)^{\frac{1}{8}} = e^k$$

$$k \approx -0.087$$

PTS: 2

REF: 061818aaii

NAT: F.LE.A.4

TOP: Exponential Decay

304 ANS:

$$7 = 20(0.5)^{\frac{t}{8.02}}$$

$$\log 0.35 = \log 0.5^{\frac{t}{8.02}}$$

$$\log 0.35 = \frac{t \log 0.5}{8.02}$$

$$\frac{8.02 \log 0.35}{\log 0.5} = t$$

$$t \approx 12$$

PTS: 4

REF: 081634aaii

NAT: F.LE.A.4

TOP: Exponential Decay

305 ANS:

$$s(t) = 200(0.5)^{\frac{t}{15}} \quad \frac{1}{10} = (0.5)^{\frac{t}{15}}$$

$$\log \frac{1}{10} = \log(0.5)^{\frac{t}{15}}$$

$$-1 = \frac{t \cdot \log(0.5)}{15}$$

$$t = \frac{-15}{\log(0.5)} \approx 50$$

PTS: 4 REF: 061934aii NAT: F.LE.A.4 TOP: Exponential Decay

306 ANS:

$$100 = 140 \left(\frac{1}{2}\right)^{\frac{5}{h}} \quad \log \frac{100}{140} = \log \left(\frac{1}{2}\right)^{\frac{5}{h}} \quad 40 = 140 \left(\frac{1}{2}\right)^{\frac{t}{10.3002}}$$

$$\log \frac{5}{7} = \frac{5}{h} \log \frac{1}{2} \quad \log \frac{2}{7} = \log \left(\frac{1}{2}\right)^{\frac{t}{10.3002}}$$

$$h = \frac{5 \log \frac{1}{2}}{\log \frac{5}{7}} \approx 10.3002 \quad \log \frac{2}{7} = \frac{t \log \left(\frac{1}{2}\right)}{10.3002}$$

$$t = \frac{10.3002 \log \frac{2}{7}}{\log \frac{1}{2}} \approx 18.6$$

PTS: 6 REF: 061737aii NAT: F.LE.A.4 TOP: Exponential Decay

307 ANS: 1

$$\log 3^{x+4} = \log 28$$

$$\frac{(x+4) \log 3}{\log 3} = \frac{\log 28}{\log 3}$$

$$x+4 = \frac{\log 28}{\log 3}$$

$$x = \log_3 28 - 4$$

PTS: 2 REF: 082306aii NAT: A.CED.A.1 TOP: Exponential Equations  
KEY: without common base

308 ANS:

$$C(t) = 63000 \left(1 + \frac{0.0255}{12}\right)^{12t} = 100000$$

$$12t \log(1.002125) = \log \frac{100}{63}$$

$$t \approx 18.14$$

PTS: 4 REF: 061835aia NAT: A.CED.A.1 TOP: Exponential Growth

309 ANS:

$$A = 5000(1.045)^n \quad 5000 \left(1 + \frac{.046}{4}\right)^{4(6)} - 5000(1.045)^6 \approx 6578.87 - 6511.30 \approx 67.57 \quad 10000 = 5000 \left(1 + \frac{.046}{4}\right)^{4n}$$

$$B = 5000 \left(1 + \frac{.046}{4}\right)^{4n}$$

$$2 = 1.0115^{4n}$$

$$\log 2 = 4n \cdot \log 1.0115$$

$$n = \frac{\log 2}{4 \log 1.0115}$$

$$n \approx 15.2$$

PTS: 6 REF: 081637aia NAT: A.CED.A.1 TOP: Exponential Growth

310 ANS:

$$A(t) = 8000 \left(1 + \frac{.042}{4}\right)^{4t} \quad A(18) = 16970.900 \quad 24000 = 8000e^{.039t}$$

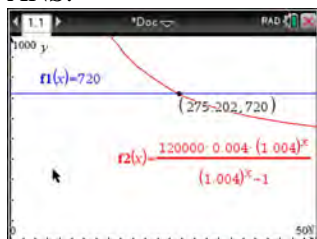
$$B(t) = 8000e^{.039t} \quad B(18) = \underline{16142.274} \quad \ln 3 = \ln e^{.039t}$$

$$828.63 \quad \ln 3 = .039t$$

$$t \approx 28.2$$

PTS: 6 REF: 082337aia NAT: A.CED.A.1 TOP: Exponential Growth

311 ANS:



$$720 = \frac{120000 \left( \frac{.048}{12} \right) \left( 1 + \frac{.048}{12} \right)^n}{\left( 1 + \frac{.048}{12} \right)^n - 1} \frac{275.2}{12} \approx 23 \text{ years}$$

$$720(1.004)^n - 720 = 480(1.004)^n$$

$$240(1.004)^n = 720$$

$$1.004^n = 3$$

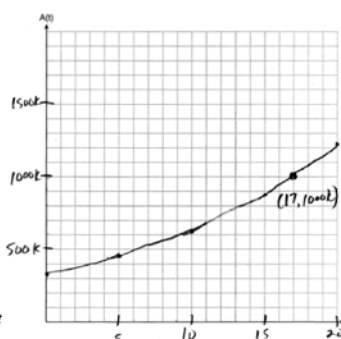
$$n \log 1.004 = \log 3$$

$$n \approx 275.2 \text{ months}$$

PTS: 4

REF: spr1509aii NAT: A.CED.A.1 TOP: Exponential Growth

312 ANS:



$$A(t) = 318000(1.07)^t$$

$$318000(1.07)^t = 1000000 \quad \text{The graph of } A(t) \text{ nearly intersects}$$

$$1.07^t = \frac{1000}{318}$$

$$t \log 1.07 = \log \frac{1000}{318}$$

$$t = \frac{\log \frac{1000}{318}}{\log 1.07}$$

$$t \approx 17$$

the point (17, 1000000).

PTS: 6

REF: 011937aii NAT: A.CED.A.1 TOP: Exponential Growth

313 ANS: 1

$$50(.9)^t = 25$$

$$t \approx 6.57$$

PTS: 2 REF: 082317aai NAT: A.CED.A.1 TOP: Exponential Decay

314 ANS:

$$T = (400 - 75)e^{-0.0735t} + 75, 325e^{-0.0735(5)} + 75 \approx 300, 270 = (450 - 75)e^{-8r} + 75, 325e^{-0.0735t} + 75 = 375e^{-0.0817t} + 75$$

$$r \approx 0.0817 \qquad t \approx 17$$

PTS: 6 REF: 012337aai NAT: A.CED.A.1 TOP: Exponential Decay

315 ANS: 1

$$x^2 + 2x - 8 = 0$$

$$(x + 4)(x - 2) = 0$$

$$x = -4, 2$$

PTS: 2 REF: 081701aai NAT: A.APR.D.6 TOP: Undefined Rationals

316 ANS: 4

$$\frac{-3x^2 - 5x + 2}{x^3 + 2x^2} = \frac{(-3x + 1)(x + 2)}{x^2(x + 2)} = \frac{-3x}{x^2} + \frac{1}{x^2} = -3x^{-1} + x^{-2}$$

PTS: 2 REF: 061723aai NAT: A.APR.D.6 TOP: Expressions with Negative Exponents  
KEY: variables

317 ANS:

$$\left( \frac{y^{\frac{17}{8}}}{y^{\frac{10}{8}}} \right)^{-4} = y^n \quad n = -\frac{7}{2}$$

$$\left( \frac{7}{y^{\frac{7}{8}}} \right)^{-4} = y^n$$

$$y^{-\frac{7}{2}} = y^n$$

PTS: 2 REF: 082228aai NAT: A.APR.D.6 TOP: Expressions with Negative Exponents  
KEY: variables

318 ANS: 1

$$\frac{x(x^2 - 9)}{-(x^2 - 9)} = -x$$

PTS: 2 REF: 012023aai NAT: A.APR.D.6 TOP: Rational Expressions  
KEY: factoring

319 ANS: 4

$$\frac{x^2 - 4x}{2x} = \frac{x(x-4)}{2x} = \frac{x-4}{2} = \frac{x}{2} - 2 = \frac{x-1}{2} - \frac{3}{2} = \frac{x-1-3}{2} = \frac{x-4}{2}$$

PTS: 2 REF: 011921aii NAT: A.APR.D.6 TOP: Rational Expressions  
KEY: factoring

320 ANS: 2

$$\frac{x^2 + 3x}{x^2 + 5x + 6} = \frac{x(x+3)}{(x+2)(x+3)}$$

PTS: 2 REF: 082215aii NAT: A.APR.D.6 TOP: Rational Expressions  
KEY: factoring

321 ANS: 3

$$\frac{c^2 - d^2}{d^2 + cd - 2c^2} = \frac{(c+d)(c-d)}{(d+2c)(d-c)} = \frac{-(c+d)}{d+2c} = \frac{-c-d}{d+2c}$$

PTS: 2 REF: 011818aii NAT: A.APR.D.6 TOP: Rational Expressions  
KEY: factoring

322 ANS: 3

$$\frac{x^2(x+2) - 9(x+2)}{x(x^2 - x - 6)} = \frac{(x^2 - 9)(x+2)}{x(x-3)(x+2)} = \frac{(x+3)(x-3)}{x(x-3)} = \frac{x+3}{x}$$

PTS: 2 REF: 061803aii NAT: A.APR.D.6 TOP: Rational Expressions  
KEY: factoring

323 ANS: 1

$$1) (x+3)^2 - 16 = x^2 + 6x + 9 - 16 = x^2 + 6x - 7 = (x+7)(x-1); 2) \quad u = x + 3 \quad ; 3)$$

$$u^2 - 10u - 2u + 20$$

$$u(u-10) - 2(u-10)$$

$$(u-2)(u-10)$$

$$(x+3-2)(x+3-10)$$

$$(x+1)(x-7)$$

$$\frac{(x-1)(x-7)(x+1)}{(x+1)} = (x-1)(x-7); 4) \frac{(x+7)(x+1)(x+3)}{(x+3)} = (x+7)(x+1)$$

PTS: 2 REF: 061808aii NAT: A.APR.D.6 TOP: Rational Expressions  
KEY: factoring

324 ANS:

$$\frac{x^2(2x+1) - 9(2x+1)}{x(3-x)} = \frac{(x^2-9)(2x+1)}{x(3-x)} = \frac{(x+3)(x-3)(2x+1)}{x(3-x)} = \frac{(x+3)(2x+1)}{-x}$$

PTS: 2 REF: 062331ai NAT: A.APR.D.6 TOP: Rational Expressions  
KEY: factoring



325 ANS: 3

$$\begin{array}{r}
 \phantom{x+2} \overline{2x+1} \\
 x+2 \overline{) 2x^2 + 5x + 8} \\
 \underline{2x^2 + 4x} \phantom{+ 8} \\
 \phantom{2x^2 +} x + 8 \\
 \phantom{2x^2 +} \underline{x+2} \\
 \phantom{2x^2 +} 6
 \end{array}$$

PTS: 2 REF: 012007aai NAT: A.APR.D.6 TOP: Rational Expressions

KEY: division

326 ANS: 2

$$\begin{array}{r}
 \phantom{x+2} \overline{x^2 + 0x + 1} \\
 x+2 \overline{) x^3 + 2x^2 + x + 6} \\
 \underline{x^3 + 2x^2} \phantom{+ x + 6} \\
 \phantom{x^3 +} 0x^2 + x \phantom{+ 6} \\
 \phantom{x^3 +} \underline{0x^2 + 0x} \\
 \phantom{x^3 +} x + 6 \\
 \phantom{x^3 +} \underline{x+2} \\
 \phantom{x^3 +} 4
 \end{array}$$

PTS: 2 REF: 081611aai NAT: A.APR.D.6 TOP: Rational Expressions

KEY: division

327 ANS: 2

$$\begin{array}{r}
 \phantom{x+3} \overline{2x^2 - 3x + 5} \\
 x+3 \overline{) 2x^3 + 3x^2 - 4x + 5} \\
 \underline{2x^3 + 6x^2} \phantom{- 4x + 5} \\
 \phantom{2x^3 +} -3x^2 - 4x \phantom{+ 5} \\
 \phantom{2x^3 +} \underline{-3x^2 - 9x} \\
 \phantom{2x^3 +} 5x + 5 \\
 \phantom{2x^3 +} \underline{5x + 15} \\
 \phantom{2x^3 +} -10
 \end{array}$$

PTS: 2 REF: 082302aai NAT: A.APR.D.6 TOP: Rational Expressions

KEY: division

328 ANS: 1

$$\begin{array}{r}
 \phantom{x+3} \overline{2x^2 + x - 6} \\
 x+3 \overline{) 2x^3 + 7x^2 - 3x - 25} \\
 \underline{2x^3 + 6x^2} \phantom{- 3x - 25} \\
 \phantom{2x^3 + } x^2 - 3x \phantom{- 25} \\
 \underline{\phantom{2x^3 + } x^2 + 3x} \phantom{- 25} \\
 \phantom{2x^3 + } \phantom{x^2 - } -6x - 25 \\
 \underline{\phantom{2x^3 + } -6x - 18} \\
 \phantom{2x^3 + } \phantom{x^2 - } \phantom{-6x - } -7
 \end{array}$$

PTS: 2 REF: 062203aai NAT: A.APR.D.6 TOP: Rational Expressions

KEY: division

329 ANS: 3

$$\begin{array}{r}
 \phantom{x+6} \overline{2x^3 - 4x^2 - x + \frac{14}{x+6}} \\
 x+6 \overline{) 2x^4 + 8x^3 - 25x^2 - 6x + 14} \\
 \underline{2x^4 + 12x^3} \\
 \phantom{2x^4 + } -4x^3 - 25x^2 - 6x + 14 \\
 \underline{\phantom{2x^4 + } -4x^3 - 24x^2} \\
 \phantom{2x^4 + } \phantom{-4x^3 - } -x^2 - 6x + 14 \\
 \underline{\phantom{2x^4 + } -x^2 - 6x} \\
 \phantom{2x^4 + } \phantom{-4x^3 - } \phantom{-x^2 - } 14
 \end{array}$$

PTS: 2 REF: 081805aai NAT: A.APR.D.6 TOP: Rational Expressions

KEY: division

330 ANS: 2

$$\begin{array}{r}
 \phantom{x-2} \overline{) \phantom{x^3} x^2 + 2x + 4} \\
 x-2 \overline{) x^3 - 0x^2 + 0x - 2} \\
 \underline{x^3 - 2x^2} \phantom{+ 0x} \\
 2x^2 + 0x \\
 \underline{2x^2 - 4x} \\
 4x - 2 \\
 \underline{4x - 8} \\
 6
 \end{array}$$

PTS: 2 REF: 082217aai NAT: A.APR.D.6 TOP: Rational Expressions  
 KEY: division

331 ANS: 1

$$\begin{array}{r}
 \phantom{x+2} \overline{) \phantom{x^4} x^3 - 2x^2 - x + 6} \\
 x+2 \overline{) x^4 + 0x^3 - 5x^2 + 4x + 14} \\
 \underline{x^4 + 2x^3} \\
 -2x^3 - 5x^2 \\
 \underline{-2x^3 - 4x^2} \\
 -x^2 + 4x \\
 \underline{-x^2 - 2x} \\
 6x + 14 \\
 \underline{6x + 12} \\
 2
 \end{array}$$

PTS: 2 REF: 012305aai NAT: A.APR.D.6 TOP: Rational Expressions  
 KEY: division

332 ANS: 2

$$\begin{array}{r}
 2x^3 + 6x^2 + 13x + 42 \\
 x - 3 \overline{) 2x^4 + 0x^3 - 5x^2 + 3x - 2} \\
 \underline{2x^4 - 6x^3} \phantom{+ 3x - 2} \\
 6x^3 - 5x^2 \phantom{+ 3x - 2} \\
 \underline{6x^3 - 18x^2} \phantom{+ 3x - 2} \\
 13x^2 + 3x - 2 \\
 \underline{13x^2 - 39x} \phantom{- 2} \\
 42x - 2 \\
 \underline{42x - 126} \\
 124
 \end{array}$$

PTS: 2 REF: 012408aii NAT: A.APR.D.6 TOP: Rational Expressions  
 KEY: division

333 ANS: 4

$$\begin{array}{r}
 5x^2 + x - 3 \\
 2x - 1 \overline{) 10x^3 - 3x^2 - 7x + 3} \\
 \underline{10x^3 - 5x^2} \phantom{- 7x + 3} \\
 2x^2 - 7x + 3 \\
 \underline{2x^2 - x} \phantom{+ 3} \\
 -6x + 3 \\
 \underline{-6x + 3} \\
 0
 \end{array}$$

PTS: 2 REF: 011809aii NAT: A.APR.D.6 TOP: Rational Expressions  
 KEY: division

334 ANS: 1

$$\begin{array}{r}
 3x^2 + 4x - 1 \\
 2x + 3 \overline{) 6x^3 + 17x^2 + 10x + 2} \\
 \underline{6x^3 + 9x^2} \phantom{+ 10x + 2} \\
 8x^2 + 10x + 2 \\
 \underline{8x^2 + 12x} \phantom{+ 2} \\
 -2x + 2 \\
 \underline{-2x - 3} \\
 5
 \end{array}$$

PTS: 2 REF: fall1503aii NAT: A.APR.D.6 TOP: Rational Expressions  
 KEY: division

335 ANS: 1

$$\begin{array}{r}
 \phantom{3x+1} \overline{) 9x^2 + 0x - 2} \\
 \underline{3x - 1} \phantom{0} \\
 9x^2 + 0x - 2 \\
 \underline{9x^2 + 3x} \phantom{0} \\
 -3x - 2 \\
 \underline{-3x - 1} \\
 -1
 \end{array}$$

PTS: 2 REF: 081910aai NAT: A.APR.D.6 TOP: Rational Expressions

KEY: division

336 ANS: 2

$$\begin{array}{r}
 \phantom{2x+3} \overline{) 4x^3 + 0x^2 + 5x + 10} \\
 \underline{2x^2 - 3x + 7} \phantom{0} \\
 4x^3 + 0x^2 + 5x + 10 \\
 \underline{4x^3 + 6x^2} \phantom{0} \\
 -6x^2 + 5x + 10 \\
 \underline{-6x^2 - 9x} \phantom{0} \\
 14x + 10 \\
 \underline{14x + 21} \\
 -11
 \end{array}$$

PTS: 2 REF: 061614aai NAT: A.APR.D.6 TOP: Rational Expressions

KEY: division

337 ANS: 1

$$\begin{array}{r}
 \phantom{2x-1} \overline{) 4x^3 + 0x^2 + 9x - 5} \\
 \underline{2x^2 + x + 5} \phantom{0} \\
 4x^3 + 0x^2 + 9x - 5 \\
 \underline{4x^3 - 2x^2} \phantom{0} \\
 2x^2 + 9x - 5 \\
 \underline{2x^2 - x} \phantom{0} \\
 10x - 5 \\
 \underline{10x - 5} \\
 0
 \end{array}$$

PTS: 2 REF: 081713aai NAT: A.APR.D.6 TOP: Rational Expressions

KEY: division

338 ANS: 1

$$\begin{array}{r}
 \phantom{2x+4} \overline{) \phantom{2x^3} x^2 - 2x + 5} \\
 2x+4 \overline{) 2x^3 + 0x^2 + 2x - 7} \\
 \underline{2x^3 + 4x^2} \phantom{- 7} \\
 -4x^2 + 2x \phantom{- 7} \\
 \underline{-4x^2 - 8x} \phantom{- 7} \\
 10x - 7 \\
 \underline{10x + 20} \\
 -27
 \end{array}$$

PTS: 2 REF: 062313aai NAT: A.APR.D.6 TOP: Rational Expressions  
 KEY: division

339 ANS:

$$\begin{array}{r}
 \phantom{x-2} \overline{) \phantom{3x^2} 3x + 13} \\
 x-2 \overline{) 3x^2 + 7x - 20} \quad 3x + 13 + \frac{6}{x-2} \\
 \underline{3x^2 - 6x} \phantom{- 20} \\
 13x - 20 \\
 \underline{13x - 26} \\
 6
 \end{array}$$

PTS: 2 REF: 011732aai NAT: A.APR.D.6 TOP: Rational Expressions  
 KEY: division

340 ANS:

$$\begin{array}{r}
 \phantom{x+2} \overline{) \phantom{x^4} x^3 + 4} \\
 x+2 \overline{) x^4 + 2x^3 + 4x - 10} \quad x^3 + 4 - \frac{18}{x+2}. \text{ No, because there is a remainder.} \\
 \underline{x^4 + 2x^3} \phantom{+ 4x - 10} \\
 4x - 10 \\
 \underline{4x + 8} \\
 -18
 \end{array}$$

PTS: 4 REF: 011934aai NAT: A.APR.D.6 TOP: Rational Expressions  
 KEY: division

341 ANS:

$$\begin{array}{r}
 3x^2 + 8x + 34 \\
 x-4 \overline{) 3x^3 - 4x^2 + 2x - 1} \quad 3x^2 + 8x + 34 + \frac{135}{x-4} \quad x=4 \text{ is not a root of } f(x) \text{ because } \frac{f(x)}{g(x)} \text{ has a remainder.} \\
 \underline{3x^3 - 12x^2} \\
 8x^2 + 2x \\
 \underline{8x^2 - 32x} \\
 34x - 1 \\
 \underline{34x - 136} \\
 135
 \end{array}$$

PTS: 4      REF: 082235aia      NAT: A.APR.D.6      TOP: Rational Expressions  
 KEY: division

342 ANS:

$$\begin{array}{r}
 2a^2 + 5a + 2 \\
 3a-2 \overline{) 6a^3 + 11a^2 - 4a - 9} \quad 2a^2 + 5a + 2 - \frac{5}{3a-2} \\
 \underline{6a^3 - 4a^2} \\
 15a^2 - 4a \\
 \underline{15a^2 - 10a} \\
 6a - 9 \\
 \underline{6a - 4} \\
 -5
 \end{array}$$

PTS: 2      REF: 061829aia      NAT: A.APR.D.6      TOP: Rational Expressions  
 KEY: division

343 ANS:

$$\frac{p(x)}{x-1} = x^2 + 7 + \frac{5}{x-1}$$

$$p(x) = x^3 - x^2 + 7x - 7 + 5$$

$$p(x) = x^3 - x^2 + 7x - 2$$

PTS: 2      REF: 061930aia      NAT: A.APR.D.6      TOP: Rational Expressions  
 KEY: division

344 ANS: 2

$$\frac{x^2 + 12}{x^2 + 3} = \frac{x^2 + 3}{x^2 + 3} + \frac{9}{x^2 + 3} = 1 + \frac{9}{x^2 + 3}$$

PTS: 2      REF: 062218aia      NAT: A.APR.D.7      TOP: Addition and Subtraction of Rationals

345 ANS: 4

$$\frac{x^2+6}{x^2+4} = \frac{x^2+4}{x^2+4} + \frac{2}{x^2+4} = 1 + \frac{2}{x^2+4}$$

PTS: 2 REF: 082321aii NAT: A.APR.D.7 TOP: Addition and Subtraction of Rationals

346 ANS: 2

$$2 - \frac{x-1}{x+2}$$

$$1 + \frac{x+2}{x+2} - \frac{x-1}{x+2}$$

$$1 + \frac{x+2-(x-1)}{x+2}$$

$$1 + \frac{3}{x+2}$$

PTS: 2 REF: 081907aii NAT: A.APR.D.7 TOP: Addition and Subtraction of Rationals

347 ANS:

$$\frac{x^3+9}{x^3+8} = \frac{x^3+8}{x^3+8} + \frac{1}{x^3+8}$$

$$\frac{x^3+9}{x^3+8} = \frac{x^3+9}{x^3+8}$$

PTS: 2 REF: 061631aii NAT: A.APR.D.7 TOP: Addition and Subtraction of Rationals

348 ANS: 3 PTS: 2 REF: 061824aii NAT: A.CED.A.1

TOP: Modeling Rationals

349 ANS: 3 PTS: 2 REF: 061602aii NAT: A.CED.A.1

TOP: Modeling Rationals

350 ANS: 2 PTS: 2 REF: 082222aii NAT: A.CED.A.1

TOP: Modeling Rationals

351 ANS: 3 PTS: 2 REF: 061722aii NAT: A.CED.A.1

TOP: Modeling Rationals

352 ANS: 1

$$x - \frac{20}{x} = 8$$

$$x^2 - 8x - 20 = 0$$

$$(x-10)(x+2) = 0$$

$$x = 10, -2$$

PTS: 2 REF: 061916aii NAT: A.CED.A.1 TOP: Modeling Rationals



353 ANS: 3

$$\frac{1}{J} = \frac{1}{F} - \frac{1}{W}$$

$$\frac{1}{J} = \frac{W-F}{FW}$$

$$J = \frac{FW}{W-F}$$

PTS: 2 REF: 081617aai NAT: A.REI.A.2 TOP: Solving Rationals

KEY: rational solutions

354 ANS: 4

$$\frac{2}{x} = \frac{4x}{x+3}$$

$$2x+6 = 4x^2$$

$$4x^2 - 2x - 6 = 0$$

$$2(2x^2 - x - 3) = 0$$

$$(2x-3)(x+1) = 0$$

$$x = \frac{3}{2}, -1$$

PTS: 2 REF: 061809aai NAT: A.REI.A.2 TOP: Solving Rationals

355 ANS: 3

$$\frac{2}{3x+1} = \frac{1}{x} - \frac{6x}{3x+1} - \frac{1}{3} \text{ is extraneous.}$$

$$\frac{6x+2}{3x+1} = \frac{1}{x}$$

$$6x^2 + 2x = 3x + 1$$

$$6x^2 - x - 1 = 0$$

$$(2x-1)(3x+1) = 0$$

$$x = \frac{1}{2}, -\frac{1}{3}$$

PTS: 2 REF: 011915aai NAT: A.REI.A.2 TOP: Solving Rationals

356 ANS: 3

$$\frac{x+2}{x} + \frac{x}{3} = \frac{2x^2+6}{3x} \quad 0 \text{ is extraneous.}$$

$$\frac{x^2+3x+6}{3x} = \frac{2x^2+6}{3x}$$

$$x^2+3x+6 = 2x^2+6$$

$$x^2 - 3x = 0$$

$$x(x-3) = 0$$

$$x = 0, 3$$

PTS: 2 REF: 012309aai NAT: A.REI.A.2 TOP: Solving Rationals

357 ANS: 4

$$x(x-2) \left( \frac{10}{x^2-2x} + \frac{4}{x} = \frac{5}{x-2} \right) \quad 2 \text{ is extraneous.}$$

$$10 + 4(x-2) = 5x$$

$$10 + 4x - 8 = 5x$$

$$2 = x$$

PTS: 2 REF: 081915aai NAT: A.REI.A.2 TOP: Solving Rationals

KEY: rational solutions

358 ANS: 1

$$\frac{(x+3)(x+2)}{(x-5)(x+2)} + \frac{6(x-5)}{(x+2)(x-5)} = \frac{6+10x}{(x-5)(x+2)} \quad 5 \text{ is extraneous.}$$

$$x^2 + 5x + 6 + 6x - 30 = 10x + 6$$

$$x^2 + x - 30 = 0$$

$$(x+6)(x-5) = 0$$

$$x = -6, 5$$

PTS: 2 REF: 062319aai NAT: A.REI.A.2 TOP: Solving Rationals

359 ANS: 3

$$\frac{4}{k^2-8k+12} = \frac{k(k-6)+(k-2)}{k^2-8k+12} \quad k = 6 \text{ is extraneous}$$

$$4 = k^2 - 6k + k - 2$$

$$0 = k^2 - 5k - 6$$

$$0 = (k-6)(k+1)$$

$$k = 6, -1$$

PTS: 2 REF: 082218aai NAT: A.REI.A.2 TOP: Solving Rationals

360 ANS: 1

$$\frac{2(x-4)}{(x+3)(x-4)} + \frac{3(x+3)}{(x-4)(x+3)} = \frac{2x-2}{x^2-x-12}$$

$$2x - 8 + 3x + 9 = 2x - 2$$

$$3x = -3$$

$$x = -1$$

PTS: 2

REF: 011717aii

NAT: A.REI.A.2

TOP: Solving Rationals

KEY: rational solutions

361 ANS: 4

$$x(x+7) \left[ \frac{3x+25}{x+7} - 5 = \frac{3}{x} \right]$$

$$x(3x+25) - 5x(x+7) = 3(x+7)$$

$$3x^2 + 25x - 5x^2 - 35x = 3x + 21$$

$$2x^2 + 13x + 21 = 0$$

$$(2x+7)(x+3) = 0$$

$$x = -\frac{7}{2}, -3$$

PTS: 2

REF: fall1501aii

NAT: A.REI.A.2

TOP: Solving Rationals

KEY: rational solutions

362 ANS: 1

$$x - \frac{4}{x-1} = 2 \quad x = \frac{3 \pm \sqrt{(-3)^2 - 4(1)(-2)}}{2(1)} = \frac{3 \pm \sqrt{17}}{2}$$

$$x(x-1) - 4 = 2(x-1)$$

$$x^2 - x - 4 = 2x - 2$$

$$x^2 - 3x - 2 = 0$$

PTS: 2

REF: 011812aii

NAT: A.REI.A.2

TOP: Solving Rationals

KEY: rational solutions

363 ANS: 1

$$\frac{2x}{x-2} \left( \frac{x}{x} \right) - \frac{11}{x} \left( \frac{x-2}{x-2} \right) = \frac{8}{x^2 - 2x}$$

$$2x^2 - 11x + 22 = 8$$

$$2x^2 - 11x + 14 = 0$$

$$(2x - 7)(x - 2) = 0$$

$$x = \frac{7}{2}, 2$$

PTS: 2

REF: 061719aaii

NAT: A.REI.A.2

TOP: Solving Rationals

364 ANS: 3

$$\left( x^2 - 49 \right) \left( \frac{7}{x+7} + \frac{4x}{x-7} = \frac{3x+7}{x-7} \right)$$

$$7(x-7) + 4x(x+7) = (3x+7)(x+7)$$

$$7x - 49 + 4x^2 + 28x = 3x^2 + 21x + 7x + 49$$

$$4x^2 + 35x - 49 = 3x^2 + 28x + 49$$

$$x^2 + 7x - 98 = 0$$

$$(x + 14)(x - 7) = 0$$

$$x = -14, 7$$

PTS: 2

REF: 012422aaii

NAT: A.REI.A.2

TOP: Solving Rationals

365 ANS:

$$\frac{1}{x} - \frac{1}{3} = -\frac{1}{3x}$$

$$\frac{3-x}{3x} = -\frac{1}{3x}$$

$$3-x = -1$$

$$x = 4$$

PTS: 2

REF: 061625aaii

NAT: A.REI.A.2

TOP: Solving Rationals

KEY: rational solutions

366 ANS:

$$\frac{3}{n} = \frac{2}{n^2} \quad 0 \text{ is an extraneous solution.}$$

$$3n^2 = 2n$$

$$3n^2 - 2n = 0$$

$$n(3n - 2) = 0$$

$$n = 0, \frac{2}{3}$$

PTS: 2

REF: 062227aaii

NAT: A.REI.A.2

TOP: Solving Rationals

367 ANS:

$$\frac{3p}{p-5} = \frac{p+2}{p+3}$$

$$3p^2 + 9p = p^2 - 3p - 10$$

$$2p^2 + 12p + 10 = 0$$

$$p^2 + 6p + 5 = 0$$

$$(p+5)(p+1) = 0$$

$$p = -5, -1$$

PTS: 4

REF: 081733aaii

NAT: A.REI.A.2

TOP: Solving Rationals

KEY: rational solutions

368 ANS:

$$\frac{x-2}{(x-6)(x-2)} + \frac{x(x-6)}{(x-6)(x-2)} = \frac{4}{(x-6)(x-2)}. \quad 6 \text{ is extraneous.}$$

$$x-2+x^2-6x=4$$

$$x^2-5x-6=0$$

$$(x-6)(x+1)=0$$

$$x = 6, -1$$

PTS: 4

REF: 082334aaii

NAT: A.REI.A.2

TOP: Solving Rationals

369 ANS:

$$-6(x+3)\left(\frac{-3}{x+3} - \frac{x}{6} + 1 = 0\right)$$

$$18 + x(x+3) - 6(x+3) = 0$$

$$18 + x^2 + 3x - 6x - 18 = 0$$

$$x^2 - 3x = 0$$

$$x(x-3) = 0$$

$$x = 0, 3$$

PTS: 2 REF: 081829aai NAT: A.REI.A.2 TOP: Solving Rationals

KEY: rational solutions

370 ANS:

$$\frac{7}{2x} - \frac{2}{x+1} = \frac{1}{4}$$

$$\frac{7x+7-4x}{2x^2+2x} = \frac{1}{4}$$

$$2x^2 + 2x = 12x + 28$$

$$x^2 - 5x - 14 = 0$$

$$(x-7)(x+2) = 0$$

$$x = 7, -2$$

PTS: 2 REF: 061926aai NAT: A.REI.A.2 TOP: Solving Rationals

KEY: rational solutions

371 ANS:

$$\frac{1}{8} + \frac{1}{6} = \frac{1}{t_b}; \quad \frac{24t_b}{8} + \frac{24t_b}{6} = \frac{24t_b}{t_b}$$

$$3t_b + 4t_b = 24$$

$$t_b = \frac{24}{7} \approx 3.4$$

PTS: 2 REF: 011827aai NAT: A.REI.A.2 TOP: Solving Rationals

372 ANS:

$$\begin{aligned} \text{antibiotic } n(0) &= \frac{0+1}{0+5} + \frac{18}{0^2+8(0)+15} = \frac{3}{15} + \frac{18}{15} = \frac{21}{15} & \frac{t+1}{t+5} + \frac{18}{t^2+8t+15} &= \frac{9}{t+3} \\ a(0) &= \frac{9}{0+3} = 3 & \frac{(t+1)(t+3)}{(t+5)(t+3)} + \frac{18}{(t+3)(t+5)} &= \frac{9(t+5)}{(t+3)(t+5)} \\ & & t^2 + 4t + 3 + 18 &= 9t + 45 \\ & & t^2 - 5t - 24 &= 0 \\ & & (t-8)(t+3) &= 0 \\ & & t &= 8 \end{aligned}$$

PTS: 6 REF: 012037aai NAT: A.REI.A.2 TOP: Solving Rationals  
KEY: rational solutions

373 ANS: 4

$$\begin{aligned} 3x - (-2x + 14) &= 16 & 3(6) - 4z &= 2 \\ 5x &= 30 & -4z &= -16 \\ x &= 6 & z &= 4 \end{aligned}$$

PTS: 2 REF: 011803aai NAT: A.REI.C.6 TOP: Solving Linear Systems  
KEY: three variables

374 ANS: 2

$$\begin{aligned} 2x + 4y - 2z &= 2 & -x - 3y + 2z &= 0 & x + y &= 2 & 3 + 2y - z &= 1 & 2y - z &= -2 \\ -x - 3y + 2z &= 0 & 4x - 8y + 2z &= 20 & x - y &= 4 & 6 - 4y + z &= 10 & 2(-1) - z &= -2 \\ x + y &= 2 & 5x - 5y &= 20 & 2x &= 6 & 2y - z &= -2 & z &= 0 \\ & & x - y &= 4 & x &= 3 & -4y + z &= 4 \\ & & & & -2y &= 2 \\ & & & & y &= -1 \end{aligned}$$

PTS: 2 REF: 062208aai NAT: A.REI.C.6 TOP: Solving Linear Systems  
KEY: three variables

375 ANS: 3

$$\begin{aligned} x + y + z &= 2 & x - 2y - z &= -4 & 2x - y &= -2 & x + 2 + z &= 2 & x + z &= 0 & 0 + 2 + z &= 2 \\ x - 2y - z &= -4 & x - 9y + z &= -18 & 2x - 11y &= -22 & x - 2(2) - z &= -4 & x - z &= 0 & z &= 0 \\ 2x - y &= -2 & 2x - 11y &= -22 & 10y &= 20 & & & 2x &= 0 \\ & & & & y &= 2 & & & x &= 0 \end{aligned}$$

PTS: 2 REF: 062311aai NAT: A.REI.C.6 TOP: Solving Linear Systems  
KEY: three variables

376 ANS: 2

Combining (1) and (3):  $-6c = -18$  Combining (1) and (2):  $5a + 3c = -1$  Using (3):  $-(-2) - 5b - 5(3) = 2$ 

$$c = 3$$

$$5a + 3(3) = -1$$

$$2 - 5b - 15 = 2$$

$$5a = -10$$

$$b = -3$$

$$a = -2$$

PTS: 2 REF: 081623aai NAT: A.REI.C.6 TOP: Solving Linear Systems

KEY: three variables

377 ANS: 2

$$x + y - z = 6 \quad 2x + 2y - 2z = 12 \quad 5y - 4z = 31 \quad 5y - 2(-4) = 23 \quad x + 3 - (-4) = 6$$

$$\underline{-x + 4y - z = 17} \quad \underline{2x - 3y + 2z = -19} \quad \underline{5y - 2z = 23} \quad 5y = 15 \quad x = -1$$

$$5y - 2z = 23 \quad 5y - 4z = 31 \quad -2z = 8 \quad y = 3$$

$$z = -4$$

PTS: 2 REF: 061923aai NAT: A.REI.C.6 TOP: Solving Linear Systems

KEY: three variables

378 ANS: 1

$$x + y + z = 9 \quad 4 - y - z = -1 \quad 4 - 6 + z = 9$$

$$\underline{x - y - z = -1} \quad 4 - y + z = 21 \quad z = 11$$

$$2x = 8 \quad -y - z = -5$$

$$x = 4 \quad \underline{-y + z = 17}$$

$$-2y = 12$$

$$y = -6$$

PTS: 2 REF: 012018aai NAT: A.REI.C.6 TOP: Solving Linear Systems

KEY: three variables

379 ANS:

$$6x - 3y + 2z = -10 \quad x + 3y + 5z = 45 \quad 4x + 10z = 62 \quad 4x + 4(7) = 20 \quad 6(-2) - 3y + 2(7) = -10$$

$$-2x + 3y + 8z = 72 \quad 6x - 3y + 2z = -10 \quad 4x + 4z = 20 \quad 4x = -8 \quad -3y = -12$$

$$4x + 10z = 62 \quad 7x + 7z = 35 \quad 6z = 42 \quad x = -2 \quad y = 4$$

$$4x + 4z = 20 \quad z = 7$$

PTS: 4 REF: spr1510aai NAT: A.REI.C.6 TOP: Solving Linear Systems

KEY: three variables



380 ANS:

$$\begin{array}{ccccccc}
 x+y+z=1 & x+y+z=1 & x+y+z=1 & -2z-z=3 & y-(-1)=3 & x+2-1=1 & \\
 x+2y+3z=1 & \underline{x+2y+3z=1} & \underline{-x+3y-5z=11} & -3z=3 & y=2 & x=0 & \\
 -x+3y-5z=11 & y+2z=0 & 4y-4z=12 & z=-1 & & & \\
 & y=-2z & y-z=3 & & & & 
 \end{array}$$

PTS: 4 REF: 061733aii NAT: A.REI.C.6 TOP: Solving Linear Systems  
KEY: three variables

381 ANS:

$$\begin{array}{ccccccc}
 4x+6y-8z=-2 & 4x+6y-8z=-2 & 4x-8y+20z=12 & z+2=3z-4 & y=3+2 & -4x+5+3=16 & \\
 4x-8y+20z=12 & \underline{-4x+y+z=16} & \underline{-4x+y+z=16} & 6=2z & =5 & -4x=8 & \\
 -4x+y+z=16 & 7y-7z=14 & -7y+21z=28 & z=3 & & x=-2 & \\
 & y-z=2 & y-3z=-4 & & & & \\
 & y=z+2 & y=3z-4 & & & & 
 \end{array}$$

PTS: 4 REF: 081833aii NAT: A.REI.C.6 TOP: Solving Linear Systems  
KEY: three variables

382 ANS:

$$\begin{array}{ccccccc}
 a+4b+6c=23 & a+2b+c=2 & 8b+3c=16 & 2b+5(4)=21 & a+4\left(\frac{1}{2}\right)+6(4)=23 & & \\
 \underline{a+2b+c=2} & \underline{-a+6b+2c=14} & \underline{8b+20c=84} & 2b=1 & a+2+24=23 & & \\
 2b+5c=21 & 8b+3c=16 & 17c=68 & b=\frac{1}{2} & a=-3 & & \\
 & & c=4 & & & & 
 \end{array}$$

PTS: 4 REF: 011933aii NAT: A.REI.C.6 TOP: Solving Linear Systems  
KEY: three variables

383 ANS:

$$\begin{array}{ccccccc}
 2x+4y-3z=12 & 2x+4y-3z=12 & 8x+z=-6 & 32x+4z=-24 & 8(-1)+z=-6 & -(-1)+y-3(2)=0 & \\
 2(3x-2y+2z=-9) & 6x-4y+4z=-18 & 2x-8z=-18 & \underline{x-4z=-9} & z=2 & y=5 & \\
 4(-x+y-3z=0) & -4x+4y-12z=0 & & 33x=-33 & & & \\
 & & & x=-1 & & & 
 \end{array}$$

PTS: 4 REF: 082335aii NAT: A.REI.C.6 TOP: Solving Linear Systems  
KEY: three variables

384 ANS: 4

$$\frac{1}{2}x^2 + 2x = \frac{1}{4}x - 8 \quad b^2 - 4ac$$

$$2x^2 + 8x = x - 32 \quad 7^2 - 4(2)(32) < 0$$

$$2x^2 + 7x + 32 = 0$$

PTS: 2 REF: 012310aai NAT: A.REI.C.7 TOP: Quadratic-Linear Systems

385 ANS: 4

$$y = g(x) = (x - 2)^2 \quad (x - 2)^2 = 3x - 2 \quad y = 3(6) - 2 = 16$$

$$x^2 - 4x + 4 = 3x - 2 \quad y = 3(1) - 2 = 1$$

$$x^2 - 7x + 6 = 0$$

$$(x - 6)(x - 1) = 0$$

$$x = 6, 1$$

PTS: 2 REF: 011705aai NAT: A.REI.C.7 TOP: Quadratic-Linear Systems

386 ANS: 4

$$y = -(x - 1)^2 + 5 \quad 3 + y = 4$$

$$4 - x = -x^2 + 2x - 1 + 5 \quad y = 1$$

$$x^2 - 3x = 0$$

$$x(x - 3) = 0$$

$$x = 0, 3$$

PTS: 2 REF: 082305aai NAT: A.REI.C.7 TOP: Quadratic-Linear Systems

387 ANS: 2

$$x^2 + 4x - 1 = x - 3 \quad y + 3 = -1$$

$$x^2 + 3x + 2 = 0 \quad y = -4$$

$$(x + 2)(x + 1) = 0$$

$$x = -2, -1$$

PTS: 2 REF: 061801aai NAT: A.REI.C.7 TOP: Quadratic-Linear Systems

388 ANS: 3

$$(x+4)^2 - 10 = 3x+6 \quad y = 3(-5)+6 = -9$$

$$x^2 + 8x + 16 - 10 = 3x+6 \quad y = 3(0)+6 = 6$$

$$x^2 + 5x = 0$$

$$x(x+5) = 0$$

$$x = -5, 0$$

PTS: 2 REF: 061903aai NAT: A.REI.C.7 TOP: Quadratic-Linear Systems

389 ANS: 3

$$x^2 + (2x)^2 = 5 \quad y = 2x = \pm 2$$

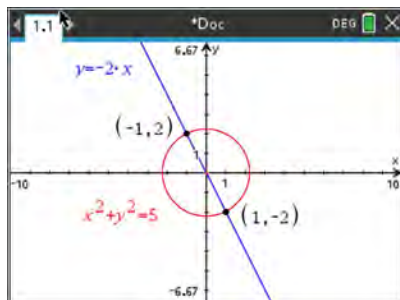
$$x^2 + 4x^2 = 5$$

$$5x^2 = 5$$

$$x = \pm 1$$

PTS: 2 REF: 081916aai NAT: A.REI.C.7 TOP: Quadratic-Linear Systems

390 ANS: 4



$$x^2 + (-2x)^2 = 5 \quad y = -2(-1) = 2$$

$$5x^2 = 5$$

$$x^2 = 1$$

$$x = \pm 1$$

PTS: 2 REF: 012407aai NAT: A.REI.C.7 TOP: Quadratic-Linear Systems

391 ANS: 1

$$(x+3)^2 + (2x-4)^2 = 8 \quad b^2 - 4ac$$

$$x^2 + 6x + 9 + 4x^2 - 16x + 16 = 8 \quad 100 - 4(5)(17) < 0$$

$$5x^2 - 10x + 17 = 0$$

PTS: 2 REF: 081719aai NAT: A.REI.C.7 TOP: Quadratic-Linear Systems

392 ANS:

$$x^2 + 8x - 5 = 8x - 4$$

$$x^2 - 1 = 0$$

$$x = \pm 1$$

PTS: 2

REF: 082326aai

NAT: A.REI.C.7

TOP: Quadratic-Linear Systems

393 ANS:

$$2x^2 - 7x + 4 = 11 - 2x \quad y = 11 - 2\left(\frac{7}{2}\right) = 4 \quad \left\{ \left(\frac{7}{2}, 4\right), (-1, 13) \right\}$$

$$2x^2 - 5x - 7 = 0$$

$$y = 11 - 2(-1) = 13$$

$$(2x - 7)(x + 1) = 0$$

$$x = \frac{7}{2}, -1$$

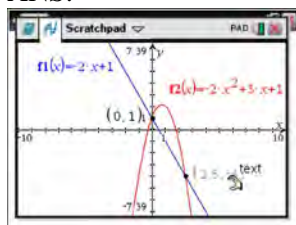
PTS: 2

REF: 082232aai

NAT: A.REI.C.7

TOP: Quadratic-Linear Systems

394 ANS:



$$-2x + 1 = -2x^2 + 3x + 1$$

$$2x^2 - 5x = 0$$

$$x(2x - 5) = 0$$

$$x = 0, \frac{5}{2}$$

PTS: 2

REF: fall1507aai

NAT: A.REI.C.7

TOP: Quadratic-Linear Systems

395 ANS:

$$x^2 + (2x - 5)^2 = 25 \quad y + 5 = 2(0) \quad y + 5 = 2(4) \quad (0, -5), (4, 3)$$

$$x^2 + 4x^2 - 20x + 25 = 25 \quad y = -5 \quad y = 3$$

$$5x^2 - 20x = 0$$

$$5x(x - 4) = 0$$

$$x = 0, 4$$

PTS: 4

REF: 062236aai

NAT: A.REI.C.7

TOP: Quadratic-Linear Systems

396 ANS:

$$x^2 + (x - 28)^2 = 400 \quad y = 12 - 28 = -16 \quad y = 16 - 28 = -12$$

$$x^2 + x^2 - 56x + 784 = 400$$

$$2x^2 - 56x + 384 = 0$$

$$x^2 - 28x + 192 = 0$$

$$(x - 16)(x - 12) = 0$$

$$x = 12, 16$$

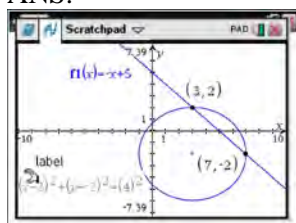
PTS: 2

REF: 081831aii

NAT: A.REI.C.7

TOP: Quadratic-Linear Systems

397 ANS:



$$y = -x + 5 \quad y = -7 + 5 = -2$$

$$(x - 3)^2 + (-x + 5 + 2)^2 = 16 \quad y = -3 + 5 = 2$$

$$x^2 - 6x + 9 + x^2 - 14x + 49 = 16$$

$$2x^2 - 20x + 42 = 0$$

$$x^2 - 10x + 21 = 0$$

$$(x - 7)(x - 3) = 0$$

$$x = 7, 3$$

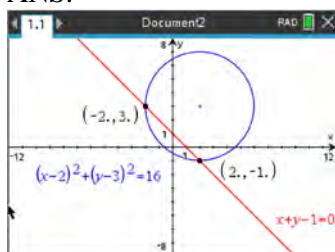
PTS: 4

REF: 061633aii

NAT: A.REI.C.7

TOP: Quadratic-Linear Systems

398 ANS:



$$y = -x + 1 \quad y = -2 + 1 = -1 \quad (2, -1)$$

$$(x - 2)^2 + (-x + 1 - 3)^2 = 16 \quad y = 2 + 1 = 3 \quad (-2, 3)$$

$$x^2 - 4x + 4 + x^2 + 4x + 4 = 16$$

$$2x^2 = 8$$

$$x = -2, 2$$

PTS: 4

REF: 012035aii

NAT: A.REI.C.7

TOP: Quadratic-Linear Systems

399 ANS:

$$(x-2)^2 + (-2x+7-3)^2 = 20 \quad y = -2(0)+7 = 7 \quad (0,7), (4,-1)$$

$$(x-2)^2 + (-2x+4)^2 = 20 \quad y = -2(4)+7 = -1$$

$$x^2 - 4x + 4 + 4x^2 - 16x + 16 = 20$$

$$5x^2 - 20x = 0$$

$$5x(x-4) = 0$$

$$x = 0, 4$$

PTS: 4

REF: 062335aaii

NAT: A.REI.C.7

TOP: Quadratic-Linear Systems

400 ANS: 3

$$-33t^2 + 360t = 700 + 5t$$

$$-33t^2 + 355t - 700 = 0$$

$$t = \frac{-355 \pm \sqrt{355^2 - 4(-33)(-700)}}{2(-33)} \approx 3,8$$

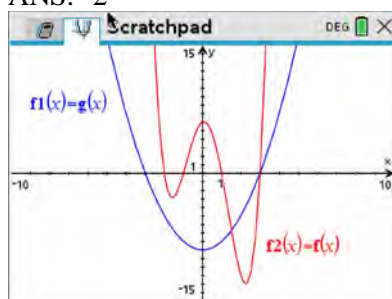
PTS: 2

REF: 081606aaii

NAT: A.REI.D.11

TOP: Quadratic-Linear Systems

401 ANS: 2



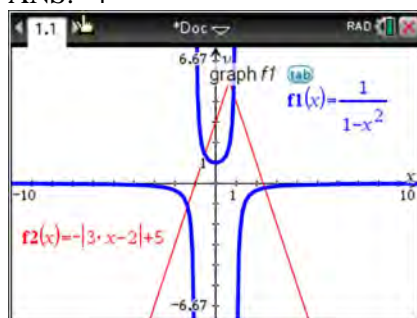
PTS: 2

REF: 082319aaii

NAT: A.REI.D.11

TOP: Other Systems

402 ANS: 4



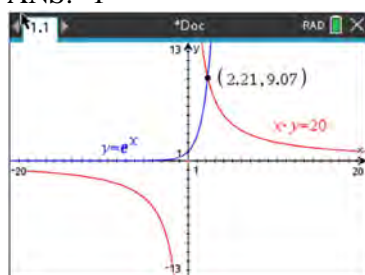
PTS: 2

REF: 011924aaii

NAT: A.REI.D.11

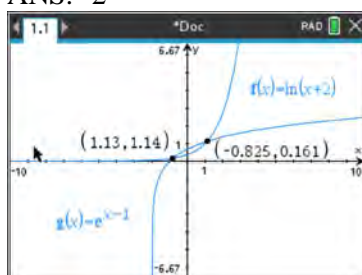
TOP: Other Systems

403 ANS: 1



PTS: 2 REF: 082210aai NAT: A.REI.D.11 TOP: Other Systems

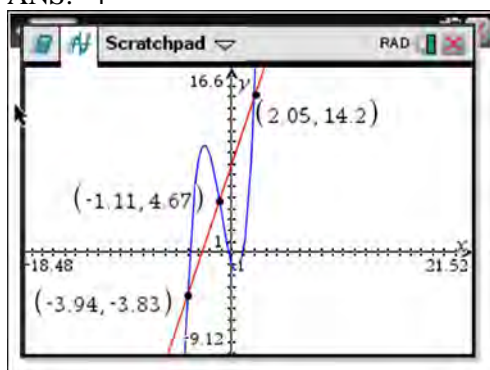
404 ANS: 2



PTS: 2 REF: 081920aai NAT: A.REI.D.11 TOP: Other Systems

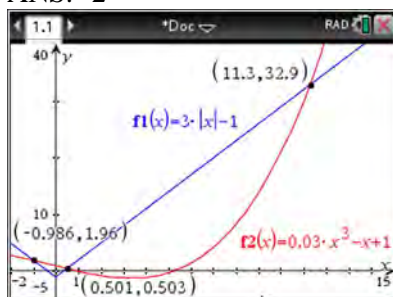
405 ANS: 4 PTS: 2 REF: 061914aai NAT: A.REI.D.11  
TOP: Other Systems

406 ANS: 4



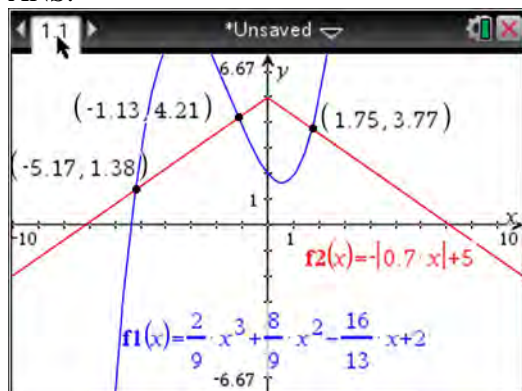
PTS: 2 REF: 061622aai NAT: A.REI.D.11 TOP: Other Systems

407 ANS: 2



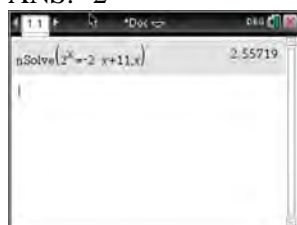
PTS: 2 REF: 061705aai NAT: A.REI.D.11 TOP: Other Systems

408 ANS:



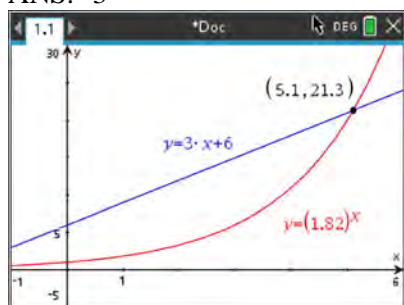
PTS: 2 REF: fall1510aai NAT: A.REI.D.11 TOP: Other Systems

409 ANS: 2



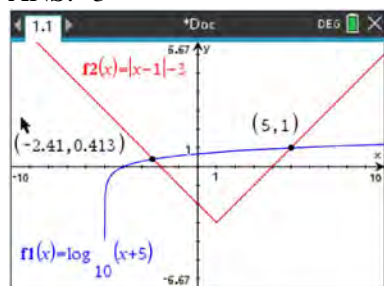
PTS: 2 REF: 081603aai NAT: A.REI.D.11 TOP: Other Systems

410 ANS: 3



PTS: 2 REF: 012406aai NAT: A.REI.D.11 TOP: Other Systems

411 ANS: 3

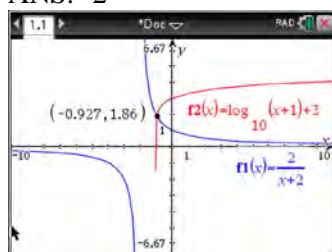


PTS: 2 REF: 012317aai NAT: A.REI.D.11 TOP: Other Systems

412 ANS: 1 PTS: 2 REF: 011814aai NAT: A.REI.D.11 TOP: Other Systems



413 ANS: 2



PTS: 2

REF: 011712aai

NAT: A.REI.D.11

TOP: Other Systems

414 ANS: 3

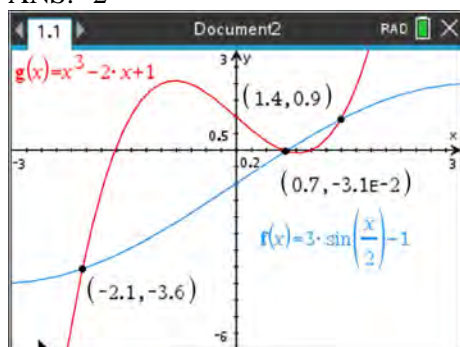
PTS: 2

REF: 081819aai

NAT: A.REI.D.11

TOP: Other Systems

415 ANS: 2



PTS: 2

REF: 012021aai

NAT: A.REI.D.11

TOP: Other Systems

416 ANS: 1

$$1240(1.06)^x = 890(1.11)^x$$

$$x \approx 7$$

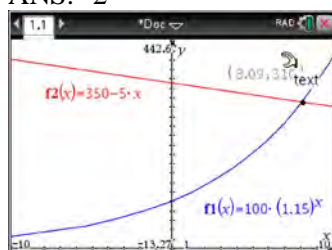
PTS: 2

REF: 061814aai

NAT: A.REI.D.11

TOP: Other Systems

417 ANS: 2



PTS: 2

REF: 011716aai

NAT: A.REI.D.11

TOP: Other Systems

418 ANS:

$$20e^{.05t} = 30e^{.03t}$$

$$\frac{\frac{2}{3}e^{.05t}}{e^{.05t}} = \frac{e^{.03t}}{e^{.05t}}$$

$$\ln \frac{2}{3} = \ln e^{-.02t}$$

$$\ln \frac{2}{3} = -.02t \ln e$$

$$\frac{\ln \frac{2}{3}}{-.02} = t$$

$$20.3 \approx t$$

PTS: 2 REF: 011829aai NAT: A.REI.D.11 TOP: Other Systems

419 ANS:

$P(x) = 500(0.97)^x$ ; 18; The number of palm trees and flamingos will be equal in 18 years.

$$F(x) = 200e^{0.02x}$$

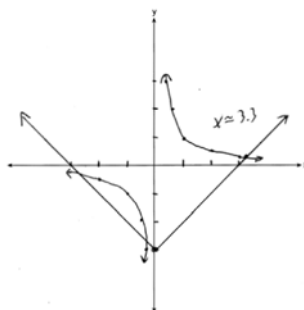
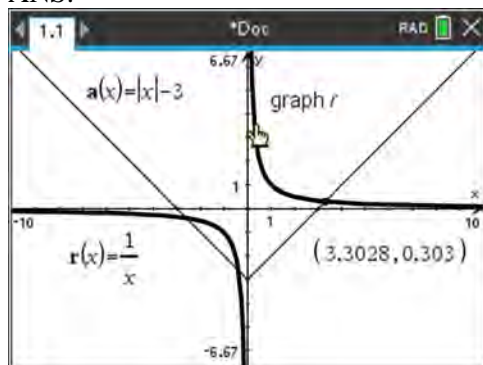
PTS: 4 REF: 062336aai NAT: A.REI.D.11 TOP: Other Systems

420 ANS:

$$A(t) = 4000 \left( 1 + \frac{2.4\%}{12} \right)^{12t} \quad B(t) = 3500 \left( 1 + \frac{4\%}{4} \right)^{4t} \quad 8.4, \text{ the value of } t \text{ for which } A(t) = B(t)$$

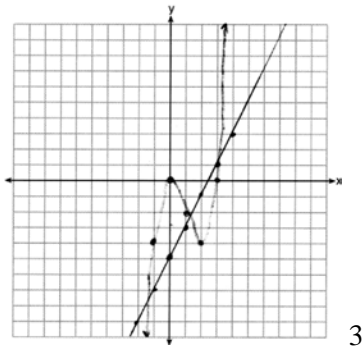
PTS: 4 REF: 012435aai NAT: A.REI.D.11 TOP: Other Systems

421 ANS:



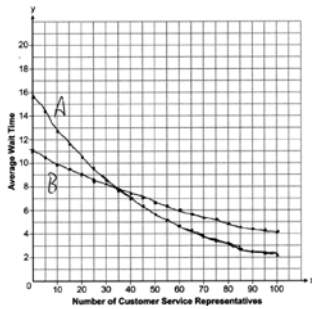
PTS: 2 REF: 081932aai NAT: A.REI.D.11 TOP: Other Systems

422 ANS:



PTS: 4 REF: 062233aii NAT: A.REI.D.11 TOP: Other Systems

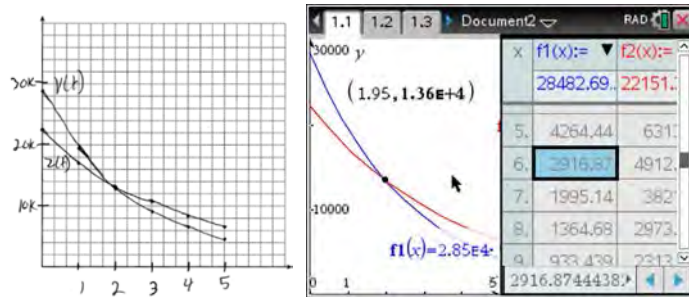
423 ANS:



35;  $B(100) - A(100) \approx 2$ , which represents the difference of the average wait time when there are 100 CSRs between the plans.

PTS: 6 REF: 082237aii NAT: A.REI.D.11 TOP: Other Systems

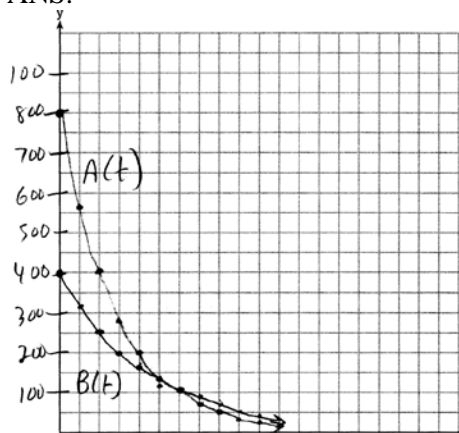
424 ANS:



At 1.95 years, the value of the car equals the loan balance. Zach can cancel the policy after 6 years.

PTS: 4 REF: 081737aii NAT: A.REI.D.11 TOP: Other Systems

425 ANS:



$$A(t) = 800e^{-0.347t}$$

$$800e^{-0.347t} = 400e^{-0.231t} \quad 0.15 = e^{-0.347t}$$

$$B(t) = 400e^{-0.231t}$$

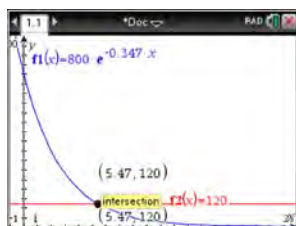
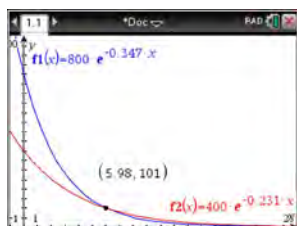
$$\ln 2e^{-0.347t} = \ln e^{-0.231t} \quad \ln 0.15 = \ln e^{-0.347t}$$

$$\ln 2 + \ln e^{-0.347t} = \ln e^{-0.231t} \quad \ln 0.15 = -0.347t \cdot \ln e$$

$$\ln 2 - 0.347t = -0.231t \quad 5.5 \approx t$$

$$\ln 2 = 0.116t$$

$$6 \approx t$$



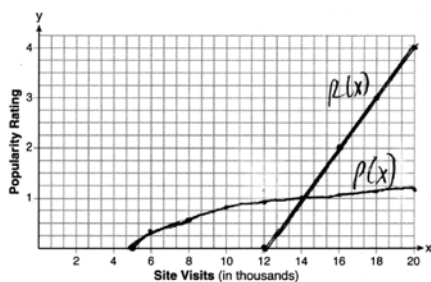
PTS: 6

REF: 061637a11

NAT: A.REI.D.11

TOP: Other Systems

426 ANS:



$$P(16) = \log(16 - 4) \approx 1.1, \quad 14000$$

PTS: 6

REF: 061837a11

NAT: A.REI.D.11

TOP: Other Systems

427 ANS: 3

PTS: 2

REF: 011710a11

NAT: F.BF.A.1

TOP: Operations with Functions

428 ANS: 3

$$x^2 - 6x + 9 - (x^2 + 6x + 9) = -12x$$

PTS: 2

REF: 062210a11

NAT: F.BF.A.1

TOP: Operations with Functions

429 ANS: 1

$$\frac{f(x)}{g(x)} = \frac{2x^2 + 7x - 15}{3 - 2x} = \frac{(2x - 3)(x + 5)}{-(2x - 3)} = \frac{x + 5}{-1} = -x - 5$$

PTS: 2 REF: 012412aai NAT: F.BF.A.1 TOP: Operations with Functions

430 ANS: 4 PTS: 2 REF: 081803aai NAT: F.BF.A.1  
TOP: Operations with Functions

431 ANS: 4

$$\frac{m(c)}{g(c)} = \frac{c + 1}{1 - c^2} = \frac{c + 1}{(1 + c)(1 - c)} = \frac{1}{1 - c}$$

PTS: 2 REF: 061608aai NAT: F.BF.A.1 TOP: Operations with Functions

432 ANS: 3 PTS: 2 REF: 012002aai NAT: F.BF.A.1  
TOP: Operations with Functions

433 ANS: 2

$$\begin{aligned} x(30 - 0.01x) - (0.15x^3 + 0.01x^2 + 2x + 120) &= 30x - 0.01x^2 - 0.15x^3 - 0.01x^2 - 2x - 120 \\ &= -0.15x^3 - 0.02x^2 + 28x - 120 \end{aligned}$$

PTS: 2 REF: 061709aai NAT: F.BF.A.1 TOP: Operations with Functions

434 ANS: 3

$$95.4x - 6x^2 - (0.18x^3 + 0.02x^2 + 4x + 180)$$

PTS: 2 REF: 082322aai NAT: F.BF.A.1 TOP: Operations with Functions

435 ANS: 1

$$p(x) = r(x) - c(x)$$

$$-0.5x^2 + 250x - 300 = -0.3x^2 + 150x - c(x)$$

$$c(x) = 0.2x^2 - 100x + 300$$

PTS: 2 REF: 061813aai NAT: F.BF.A.1 TOP: Operations with Functions

436 ANS:

$$(2x^2 + x - 3) \cdot (x - 1) - \left[ (2x^2 + x - 3) + (x - 1) \right]$$

$$(2x^3 - 2x^2 + x^2 - x - 3x + 3) - (2x^2 + 2x - 4)$$

$$2x^3 - 3x^2 - 6x + 7$$

PTS: 4 REF: 011833aai NAT: F.BF.A.1 TOP: Operations with Functions

437 ANS:

$$\begin{aligned} & (x^3 + 2x - 1)(x^2 + 7) - 3(x^4 - 5x) \\ & x^5 + 7x^3 + 2x^3 + 14x - x^2 - 7 - 3x^4 + 15x \\ & x^5 - 3x^4 + 9x^3 - x^2 + 29x - 7 \end{aligned}$$

PTS: 2 REF: 012330aai NAT: F.BF.A.1 TOP: Operations with Functions

438 ANS: 3 PTS: 2 REF: 061906aai NAT: F.LE.A.2  
TOP: Families of Functions

439 ANS: 1

2) linear, 3) quadratic, 4) cubic

PTS: 2 REF: 061920aai NAT: F.LE.A.2 TOP: Families of Functions

440 ANS: 1 PTS: 2 REF: 081903aai NAT: F.LE.A.2  
TOP: Families of Functions

441 ANS:

 $0 = \log_{10}(x - 4)$  The  $x$ -intercept of  $h$  is  $(2, 0)$ .  $f$  has the larger value.

$$10^0 = x - 4$$

$$1 = x - 4$$

$$x = 5$$

PTS: 2 REF: 081630aai NAT: F.IF.C.9 TOP: Comparing Functions

442 ANS:

 $q$  has the smaller minimum value for the domain  $[-2, 2]$ .  $h$ 's minimum is  $-1(2(-1) + 1)$  and  $q$ 's minimum is  $-8$ .

PTS: 2 REF: 011830aai NAT: F.IF.C.9 TOP: Comparing Functions

443 ANS: 4

The maximum of  $p$  is 5. The minimum of  $f$  is  $-\frac{21}{4}$  ( $x = \frac{-6}{2(4)} = -\frac{3}{4}$ )

$$f\left(-\frac{3}{4}\right) = 4\left(-\frac{3}{4}\right)^2 + 6\left(-\frac{3}{4}\right) - 3 = 4\left(\frac{9}{16}\right) - \frac{18}{4} - \frac{12}{4} = -\frac{21}{4}. \quad \frac{20}{4} - \left(-\frac{21}{4}\right) = \frac{41}{4} = 10.25$$

PTS: 2 REF: 011922aai NAT: F.IF.C.9 TOP: Comparing Functions

444 ANS: 1 PTS: 2 REF: 081804aai NAT: F.IF.C.9  
TOP: Comparing Functions445 ANS: 2 PTS: 2 REF: 062222aai NAT: F.IF.C.9  
TOP: Comparing Functions446 ANS: 4 PTS: 2 REF: 062309aai NAT: F.IF.C.9  
TOP: Comparing Functions

447 ANS: 4

$$f(0) = 4\sin(2(0)) = 0; \quad g(0) = 3(0)^4 + 2(0)^3 + 7 = 7; \quad h(0) = 5e^{2(0)} + 3 = 8; \quad j(0) = 6\log_2(3(0) + 4) = 12$$

PTS: 2 REF: 082310aai NAT: F.IF.C.9 TOP: Comparing Functions

- 448 ANS: 2  
 $h(x)$  does not have a y-intercept.
- PTS: 2 REF: 011719aai NAT: F.IF.C.9 TOP: Comparing Functions
- 449 ANS: 4 PTS: 2 REF: 081817aai NAT: F.BF.B.3  
 TOP: Transformations with Functions
- 450 ANS: 3 PTS: 2 REF: 062205aai NAT: F.BF.B.3  
 TOP: Transformations with Functions
- 451 ANS: 2 PTS: 2 REF: 081911aai NAT: F.BF.B.3  
 TOP: Even and Odd Functions
- 452 ANS: 3  
 $f(x) = -f(x)$ , so  $f(x)$  is odd.  $g(-x) \neq g(x)$ , so  $g(x)$  is not even.  $g(-x) \neq -g(x)$ , so  $g(x)$  is not odd.  $h(-x) = h(x)$ , so  $h(x)$  is even.
- PTS: 2 REF: fall1502aai NAT: F.BF.B.3 TOP: Even and Odd Functions
- 453 ANS: 1  
 The graph of  $y = \sin x$  is unchanged when rotated  $180^\circ$  about the origin.
- PTS: 2 REF: 081614aai NAT: F.BF.B.3 TOP: Even and Odd Functions
- 454 ANS: 2  
 $f(x) = f(-x)$   
 $x^2 - 4 = (-x)^2 - 4$   
 $x^2 - 4 = x^2 - 4$
- PTS: 2 REF: 061806aai NAT: F.BF.B.3 TOP: Even and Odd Functions
- 455 ANS: 1 PTS: 2 REF: 062318aai NAT: F.BF.B.3  
 TOP: Even and Odd Functions
- 456 ANS: 2  
 $f(x) = f(-x)$   
 $x^2 + 1 = (-x)^2 + 1$   
 $x^2 + 1 = x^2 + 1$
- PTS: 2 REF: 082323aai NAT: F.BF.B.3 TOP: Even and Odd Functions
- 457 ANS:  
 $j(-x) = (-x)^4 - 3(-x)^2 - 4 = x^2 - 3x^2 - 4$  Since  $j(x) = j(-x)$ , the function is even.
- PTS: 2 REF: 081731aai NAT: F.BF.B.3 TOP: Even and Odd Functions

458 ANS: 2  
 $x = 4y + 5$

$$x - 5 = 4y$$

$$\frac{1}{4}x - \frac{5}{4} = y$$

PTS: 2

REF: 061909aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: linear

459 ANS: 3

$$x = 12y - 4$$

$$x + 4 = 12y$$

$$\frac{x + 4}{12} = y$$

PTS: 2

REF: 082304aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: linear

460 ANS: 2

$$x = -6(y - 2)$$

$$-\frac{x}{6} = y - 2$$

$$-\frac{x}{6} + 2 = y$$

PTS: 2

REF: 011821aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: linear

461 ANS: 2

$$y = \frac{1}{2}x + 8 \quad x = \frac{1}{2}y + 8$$

$$2x = y + 16$$

$$y = 2x - 16$$

PTS: 2

REF: 081806aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: linear

462 ANS: 3

$$x = \frac{1}{2}y + 2$$

$$2x = y + 4$$

$$y = 2x - 4$$

PTS: 2

REF: 012315aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: linear



463 ANS: 3

$$y = -6x + \frac{1}{2}$$

$$x = -6y + \frac{1}{2}$$

$$x - \frac{1}{2} = -6y$$

$$-\frac{1}{6} \left( x - \frac{1}{2} \right) = y$$

PTS: 2

REF: 062217aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: linear

464 ANS: 2

$$x = -\frac{3}{4}y + 2$$

$$-4x = 3y - 8$$

$$-4x + 8 = 3y$$

$$-\frac{4}{3}x + \frac{8}{3} = y$$

PTS: 2

REF: 061616aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: linear

465 ANS: 3

$$x = \frac{2}{3}y + \frac{1}{6}$$

$$6x = 4y + 1$$

$$4y = 6x - 1$$

$$y = \frac{6}{4}x - \frac{1}{4}$$

PTS: 2

REF: 062321aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: linear

466 ANS: 3

$$x = -\frac{2y}{5} + 4 \quad y = -\frac{5}{2}(6) + 10 = -5$$

$$5x = -2y + 20$$

$$2y = -5x + 20$$

$$y = -\frac{5}{2}x + 10$$

PTS: 2

REF: 082223aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: linear

467 ANS: 3

$$y = x^3 - 2$$

$$x = y^3 - 2$$

$$x + 2 = y^3$$

$$\sqrt[3]{x + 2} = y$$

PTS: 2

REF: 061815aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: polynomial

468 ANS: 2

$$y = x^3 - 3$$

$$x = y^3 - 3$$

$$x + 3 = y^3$$

$$\sqrt[3]{x + 3} = y$$

PTS: 2

REF: 012419aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: polynomial

469 ANS:

$$x = (y - 3)^3 + 1$$

$$x - 1 = (y - 3)^3$$

$$\sqrt[3]{x - 1} = y - 3$$

$$\sqrt[3]{x - 1} + 3 = y$$

$$f^{-1}(x) = \sqrt[3]{x - 1} + 3$$

PTS: 2

REF: fall1509aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: polynomial

470 ANS: 3

PTS: 2

REF: 011708aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: exponential

471 ANS: 3

PTS: 2

REF: 011917aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: exponential

472 ANS: 2

$$x = \frac{y}{y+2}$$

$$xy + 2x = y$$

$$xy - y = -2x$$

$$y(x-1) = -2x$$

$$y = \frac{-2x}{x-1}$$

PTS: 2

REF: 081924aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: rational

473 ANS: 2

$$x = \frac{y+1}{y-2}$$

$$xy - 2x = y + 1$$

$$xy - y = 2x + 1$$

$$y(x-1) = 2x + 1$$

$$y = \frac{2x+1}{x-1}$$

PTS: 2

REF: 081714aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: rational

474 ANS: 3

PTS: 2

REF: 061720aai

NAT: F.BF.A.1

TOP: Sequences

KEY: function notation

475 ANS: 2

$$121(b)^2 = 64 \quad 64 \left( \frac{8}{11} \right)^2 \approx 34$$

$$b = \frac{8}{11}$$

PTS: 2

REF: 011904aai

NAT: F.BF.A.1

TOP: Sequences

KEY: explicit

476 ANS: 3

$$r = \frac{-2\sqrt{3}}{\sqrt{6}} = \frac{-2}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{-2\sqrt{2}}{2} = -\sqrt{2} \quad a_7 = \sqrt{6}(-\sqrt{2})^{7-1} = \sqrt{6}(-\sqrt{2})^6 = \sqrt{6} \cdot 2^3 = 8\sqrt{6}$$

PTS: 2

REF: 012410aai

NAT: F.BF.A.1

TOP: Sequences

KEY: explicit

## Algebra II Regents Exam Questions by State Standard: Topic Answer Section

477 ANS: 4

The scenario represents a decreasing geometric sequence with a common ratio of 0.80.

PTS: 2 REF: 061610aai NAT: F.BF.A.1 TOP: Sequences

KEY: recursive

478 ANS: 1

$$d = 18; r = \pm \frac{5}{4}$$

PTS: 2 REF: 011714aai NAT: F.BF.A.1 TOP: Sequences

KEY: explicit

479 ANS:

$$\frac{63}{189} = \frac{1}{3} a_1 = 189$$

$$a_n = \frac{1}{3} a_{n-1}$$

PTS: 2 REF: 062329aai NAT: F.BF.A.1 TOP: Sequences

KEY: recursive

480 ANS:

$$\frac{9}{6} = 1.5 a_1 = 6$$

$$a_n = 1.5 \cdot a_{n-1}$$

PTS: 2 REF: 061931aai NAT: F.BF.A.1 TOP: Sequences

KEY: recursive

481 ANS:

$$a_1 = 4 \quad a_8 = 639$$

$$a_n = 2a_{n-1} + 1$$

PTS: 2 REF: 081729aai NAT: F.BF.A.1 TOP: Sequences

KEY: recursive

482 ANS:

$$\frac{6.25 - 2.25}{21 - 5} = \frac{4}{16} = \$.25 \text{ fine per day. } 2.25 - 5(.25) = \$1 \text{ replacement fee. } a_n = 1.25 + (n - 1)(.25). a_{60} = \$16$$

PTS: 4 REF: 081734aai NAT: F.BF.A.1 TOP: Sequences

KEY: explicit

483 ANS:

$$a_1 = 4$$

$$a_n = 3a_{n-1}$$

PTS: 2 REF: 081931aii NAT: F.BF.A.1 TOP: Sequences

KEY: recursive

484 ANS: 1

$$\frac{-12}{16} = \frac{9}{-12} = \frac{-6.75}{9}$$

PTS: 2 REF: 012017aii NAT: F.IF.A.3 TOP: Sequences

KEY: difference or ratio

485 ANS: 2

$$a_2 = 8 + \log_{2+1} 1 = 8 + 0 = 8$$

$$a_3 = 8 + \log_{3+1} 2 = 8 + \frac{1}{2} = 8.5$$

PTS: 2 REF: 062221aii NAT: F.IF.A.3 TOP: Sequences

KEY: recursive

486 ANS: 3

TOP: Sequences

PTS: 2

KEY: difference or ratio

REF: 061910aii

NAT: F.IF.A.3

487 ANS: 3

TOP: Sequences

PTS: 2

REF: 011824aii

NAT: F.BF.A.2

488 ANS: 4

$$a_1 = 2.5 + 0.5(1) = 3$$

PTS: 2 REF: 011916aii NAT: F.BF.A.2 TOP: Sequences

489 ANS: 1

(2) is not recursive

PTS: 2 REF: 081608aii NAT: F.BF.A.2 TOP: Sequences

490 ANS: 4

1) is a correct formula, but not recursive

PTS: 2 REF: 082216aii NAT: F.BF.A.2 TOP: Sequences

491 ANS: 4

(1) and (3) are not recursive

PTS: 2 REF: 012013aii NAT: F.BF.A.2 TOP: Sequences

492 ANS: 3

TOP: Sequences

PTS: 2

REF: 081618aii

NAT: F.BF.A.2

493 ANS: 3

TOP: Sequences

PTS: 2

REF: 081909aii

NAT: F.BF.A.2

494 ANS: 2

TOP: Sequences

PTS: 2

REF: 012321aii

NAT: F.BF.A.2

495 ANS: 3                      PTS: 2                      REF: 061623aii                      NAT: F.BF.A.2  
TOP: Sequences

496 ANS: 4                      PTS: 2                      REF: 081624aii                      NAT: F.BF.A.2  
TOP: Sequences

497 ANS: 4                      PTS: 2                      REF: 081810aii                      NAT: F.BF.A.2  
TOP: Sequences

498 ANS: 3                      PTS: 2                      REF: 081724aii                      NAT: F.BF.A.2  
TOP: Sequences

499 ANS:  
 $a_1 = 12$   
 $a_n = a_{n-1} + 6$

PTS: 2                      REF: 012430aii                      NAT: F.BF.A.2                      TOP: Sequences

500 ANS:  
Jillian's plan, because distance increases by one mile each week.  $a_1 = 10$                        $a_n = n + 12$   
 $a_n = a_{n-1} + 1$

PTS: 4                      REF: 011734aii                      NAT: F.BF.A.2                      TOP: Sequences

501 ANS:  
 $a_1 = 3$   $a_2 = 7$   $a_3 = 15$   $a_4 = 31$ ; No, because there is no common ratio:  $\frac{7}{3} \neq \frac{15}{7}$

PTS: 2                      REF: 061830aii                      NAT: F.BF.A.2                      TOP: Sequences

502 ANS:  
 $a_n = x^{n-1}(x+1)$   $x^{n-1} = 0$   $x+1 = 0$   
 $x = 0$                        $x = -1$

PTS: 4                      REF: spr1511aii                      NAT: F.BF.A.2                      TOP: Sequences

503 ANS:  
1.5%;  $P(t) = 92.2(1.015)^t$ ;                       $\frac{300}{92.2} = (1.015)^t$   
 $\log \frac{300}{92.2} = t \log(1.015)$   
 $\frac{\log \frac{300}{92.2}}{\log(1.015)} = t$   
 $t \approx 79$

PTS: 6                      REF: 062237aii                      NAT: F.BF.A.2                      TOP: Sequences

504 ANS: 1                      PTS: 2                      REF: 081609aii                      NAT: F.BF.B.6  
TOP: Sigma Notation                      KEY: represent

505 ANS: 1                      PTS: 2                      REF: 082221aii                      NAT: F.BF.B.6  
TOP: Sigma Notation                      KEY: represent

- 506 ANS: 1                   PTS: 2                   REF: 081813aii           NAT: A.SSE.B.4  
TOP: Series               KEY: geometric
- 507 ANS: 2                   PTS: 2                   REF: 061724aii           NAT: A.SSE.B.4  
TOP: Series               KEY: geometric
- 508 ANS: 2                   PTS: 2                   REF: 062324aii           NAT: A.SSE.B.4  
TOP: Series               KEY: geometric
- 509 ANS: 4                   PTS: 2                   REF: 012423aii           NAT: A.SSE.B.4  
TOP: Series               KEY: geometric
- 510 ANS: 4

$$d = 32(.8)^{b-1} \quad S_n = \frac{32 - 32(.8)^{12}}{1 - .8} \approx 149$$

- PTS: 2                   REF: 081721aii           NAT: A.SSE.B.4           TOP: Series  
KEY: geometric
- 511 ANS: 3

$$S_{20} = \frac{-2 - (-2)(-3)^{20}}{1 - (-3)} = 1,743,392,200$$

- PTS: 2                   REF: 012306aii           NAT: A.SSE.B.4           TOP: Series  
KEY: geometric
- 512 ANS: 3

$$8r^3 = 216 \quad S_{12} = \frac{8 - 8(3)^{12}}{1 - 3} = 2125760$$

$$r^3 = 27$$

$$r = 3$$

- PTS: 2                   REF: 081902aii           NAT: A.SSE.B.4           TOP: Series  
KEY: geometric
- 513 ANS: 2

$$S_{20} = \frac{.01 - .01(3)^{20}}{1 - 3} = 17,433,922$$

- PTS: 2                   REF: 011822aii           NAT: A.SSE.B.4           TOP: Series  
KEY: geometric
- 514 ANS: 4

$$S_7 = \frac{85000 - 85000(1.06)^7}{1 - 1.06} \approx 713476.20$$

- PTS: 2                   REF: 061905aii           NAT: A.SSE.B.4           TOP: Series  
KEY: geometric

515 ANS:

$$r = \frac{360}{300} = 1.2 \quad S_n = \frac{300 - 300(1.2)^n}{1 - 1.2} \quad S_{10} = \frac{300 - 300(1.2)^{10}}{1 - 1.2} \approx 7787.6$$

PTS: 2                      REF: 012029aai                      NAT: A.SSE.B.4                      TOP: Series  
KEY: geometric

516 ANS:

$$S_{10} = \frac{15 - 15(1.03)^{10}}{1 - 1.03} \approx 171.958$$

PTS: 2                      REF: 011929aai                      NAT: A.SSE.B.4                      TOP: Series  
KEY: geometric

517 ANS:

$$S_5 = \frac{6 - 6(.8)^5}{1 - .8} \approx 20.17$$

PTS: 2                      REF: 062226aai                      NAT: A.SSE.B.4                      TOP: Series  
KEY: geometric

518 ANS:

$$S_n = \frac{33000 - 33000(1.04)^n}{1 - 1.04} \quad S_{15} = \frac{33000 - 33000(1.04)^{15}}{1 - 1.04} \approx 660778.39$$

PTS: 4                      REF: 061634aai                      NAT: A.SSE.B.4                      TOP: Series  
KEY: geometric

519 ANS:

$$a_n = 100(.8)^{n-1} \quad S_{20} = \frac{100 - 100(.8)^{20}}{1 - .8} \approx 494 \text{ No, because } 494 > 40 \times 12.$$

PTS: 4                      REF: 012033aai                      NAT: A.SSE.B.4                      TOP: Series  
KEY: geometric

520 ANS: 1                      PTS: 2                      REF: 081616aai                      NAT: F.TF.A.1

TOP: Unit Circle                      KEY: bimodalgraph

521 ANS: 2                      PTS: 2                      REF: 062219aai                      NAT: F.TF.A.1

TOP: Unit Circle

522 ANS: 4                      PTS: 2                      REF: 082205aai                      NAT: F.TF.A.2

TOP: Unit Circle

523 ANS: 1                      PTS: 2                      REF: 011815aai                      NAT: F.TF.A.2

TOP: Unit Circle



524 ANS:

$$t^2 + \left(\frac{4}{7}\right)^2 = 1 \quad -\frac{\sqrt{33}}{7}$$

$$t^2 + \frac{16}{49} = \frac{49}{49}$$

$$t^2 = \frac{33}{49}$$

$$t = \frac{\pm\sqrt{33}}{7}$$

PTS: 2 REF: 011931aii NAT: F.TF.A.2 TOP: Unit Circle

525 ANS:

$\csc \theta = \frac{1}{\sin \theta}$ , and  $\sin \theta$  on a unit circle represents the y value of a point on the unit circle. Since  $y = \sin \theta$ ,

$$\csc \theta = \frac{1}{y}.$$

PTS: 2 REF: 011727aii NAT: F.TF.A.2 TOP: Reciprocal Trigonometric Relationships

526 ANS:

$\pi < \theta < 2\pi \rightarrow$  Quadrant III or IV  $\theta$  must be in Quadrant IV, where  $\tan \theta$  is negative.

$$\cos \theta = \frac{\sqrt{3}}{4} \rightarrow \text{Quadrant I or IV}$$

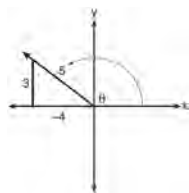
PTS: 2 REF: 012332aii NAT: F.TF.A.2 TOP: Finding the Terminal Side of an Angle

527 ANS: 4 PTS: 2 REF: 081707aii NAT: F.TF.A.2

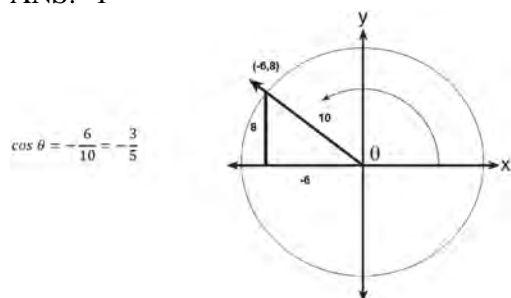
TOP: Reference Angles KEY: bimodalgraph

528 ANS: 1

A reference triangle can be sketched using the coordinates  $(-4, 3)$  in the second quadrant to find the value of  $\sin \theta$ .

PTS: 2 REF: spr1503aii NAT: F.TF.A.2 TOP: Determining Trigonometric Functions  
KEY: extension to reals

529 ANS: 1



PTS: 2 REF: 061617aai NAT: F.TF.A.2  
KEY: extension to reals

TOP: Determining Trigonometric Functions

530 ANS: 2

$$\sqrt{(-2)^2 + (-3)^2} = \sqrt{13}; \tan \theta = \frac{\sin \theta}{\cos \theta} = \frac{\frac{-3}{\sqrt{13}}}{\frac{-2}{\sqrt{13}}} = \frac{3}{2}$$

PTS: 2 REF: 062304aai NAT: F.TF.A.2  
KEY: extension to reals

TOP: Determining Trigonometric Functions

531 ANS:

$$\frac{-1}{\sqrt{2^2 + (-1)^2}} = -\frac{1}{\sqrt{5}}$$

PTS: 2 REF: 061832aai NAT: F.TF.A.2  
KEY: extension to reals

TOP: Determining Trigonometric Functions

532 ANS: 2

$$\text{If } \cos \theta = \frac{7}{25}, \sin \theta = \pm \frac{24}{25}, \text{ and } \tan \theta = \frac{\sin \theta}{\cos \theta} = \frac{\pm \frac{24}{25}}{\frac{7}{25}} = \pm \frac{24}{7}$$

PTS: 2 REF: 081811aai NAT: F.TF.C.8  
533 ANS: 1

TOP: Determining Trigonometric Functions

$$\cos \theta = -\frac{3}{5}; \sec \theta = -\frac{5}{3}$$

PTS: 2 REF: 012421aai NAT: F.TF.C.8  
534 ANS: 2

TOP: Determining Trigonometric Functions

$$\cos \theta = \pm \sqrt{1 - \left(\frac{-\sqrt{2}}{5}\right)^2} = \pm \sqrt{\frac{25}{25} - \frac{2}{25}} = \pm \frac{\sqrt{23}}{5}$$

PTS: 2 REF: 061712aai NAT: F.TF.C.8

TOP: Determining Trigonometric Functions

535 ANS: 1

$$-\sqrt{1 - \left(-\frac{3}{4}\right)^2} = -\sqrt{\frac{16}{16} - \frac{9}{16}} = -\sqrt{\frac{7}{16}} = -\frac{\sqrt{7}}{4}$$

PTS: 2

REF: 081905aai

NAT: F.TF.C.8

TOP: Determining Trigonometric Functions

536 ANS: 3

$$\sin^2 A + \left(\frac{\sqrt{5}}{3}\right)^2 = 1 \quad \text{Since } \tan A < 0, \sin A = -\frac{2}{3}$$

$$\sin^2 A + \frac{5}{9} = \frac{9}{9}$$

$$\sin^2 A = \frac{4}{9}$$

$$\sin A = \pm \frac{2}{3}$$

PTS: 2

REF: 012320aai

NAT: F.TF.C.8

TOP: Determining Trigonometric Functions

537 ANS: 3

$$\frac{-2}{\sqrt{5^2 - 2^2}} = \frac{-2}{\sqrt{21}}$$

PTS: 2

REF: 082312aai

NAT: F.TF.C.8

TOP: Determining Trigonometric Functions

538 ANS:

$$\tan \theta = \frac{\sin \theta}{\cos \theta} = \frac{-7/25}{-24/25} \quad \cos \theta = \frac{-24}{25}$$

PTS: 2

REF: 061928aai

NAT: F.TF.C.8

TOP: Determining Trigonometric Functions

539 ANS:

$$\sin^2 \theta + (-0.7)^2 = 1 \quad \text{Since } \theta \text{ is in Quadrant II, } \sin \theta = \sqrt{.51} \text{ and } \tan \theta = \frac{\sin \theta}{\cos \theta} = \frac{\sqrt{.51}}{-0.7} \approx -1.02$$

$$\sin^2 \theta = .51$$

$$\sin \theta = \pm \sqrt{.51}$$

PTS: 2

REF: 081628aai

NAT: F.TF.C.8

TOP: Determining Trigonometric Functions

540 ANS:

$$\cos A = \frac{\cos A}{\sin A}$$

$$-3 = \frac{\frac{3}{\sqrt{10}}}{\sin A}$$

$$\sin A = \frac{3}{-3\sqrt{10}} = -\frac{1}{\sqrt{10}}$$

PTS: 2 REF: 082229aai NAT: F.TF.C.8 TOP: Determining Trigonometric Functions

541 ANS: 1 PTS: 2 REF: 011704aai NAT: F.TF.C.8

TOP: Proving Trigonometric Identities KEY: basic

542 ANS: 4

$$\text{period} = \frac{2\pi}{B}$$

$$\frac{1}{60} = \frac{2\pi}{B}$$

$$B = 120\pi$$

PTS: 2 REF: 061624aai NAT: F.TF.B.5 TOP: Modeling Trigonometric Functions

543 ANS: 1

$$-4(-1) - 3 = 1 \quad 8 = \frac{2\pi}{b}$$

$$b = \frac{\pi}{4}$$

PTS: 2 REF: 081820aai NAT: F.TF.B.5 TOP: Modeling Trigonometric Functions

544 ANS: 1 PTS: 2 REF: 061708aai NAT: F.TF.B.5

TOP: Modeling Trigonometric Functions

545 ANS: 2

$$1 = \frac{2\pi}{k}$$

$$k = 2\pi$$

PTS: 2 REF: 012313aai NAT: F.TF.B.5 TOP: Modeling Trigonometric Functions

546 ANS: 1

The cosine function has been translated +3. Since the maximum is 5 and the minimum is 1, the amplitude is 2.

$$\frac{\pi}{3} = \frac{2\pi}{b}$$

$$b = 6$$

PTS: 2 REF: 011913aai NAT: F.TF.B.5 TOP: Modeling Trigonometric Functions

547 ANS: 4

$$a = \frac{14-4}{2} = 5, d = \frac{14+4}{2} = 9$$

PTS: 2 REF: 061810aai NAT: F.TF.B.5 TOP: Modeling Trigonometric Functions

548 ANS: 2 PTS: 2 REF: 011701aai NAT: F.IF.B.4

TOP: Graphing Trigonometric Functions

549 ANS: 4 PTS: 2 REF: 061706aai NAT: F.IF.B.4

TOP: Graphing Trigonometric Functions

550 ANS: 3

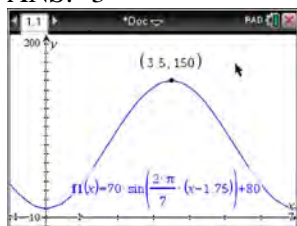
$$T(19) = 8 \sin(0.3(19) - 3) + 74 \approx 77$$

PTS: 2 REF: 061922aai NAT: F.IF.B.4 TOP: Graphing Trigonometric Functions

551 ANS: 2 PTS: 2 REF: 011804aai NAT: F.IF.B.4

TOP: Graphing Trigonometric Functions

552 ANS: 3



$H(t)$  is at a minimum at  $70(-1) + 80 = 10$

PTS: 2 REF: 061613aai NAT: F.IF.B.4 TOP: Graphing Trigonometric Functions

KEY: maximum/minimum

553 ANS: 2

$$-23(1) + 56 = 33; -23(-1) + 56 = 79$$

PTS: 2 REF: 062305aai NAT: F.IF.B.4 TOP: Graphing Trigonometric Functions

554 ANS: 2 PTS: 2 REF: 081610aai NAT: F.IF.B.4

TOP: Graphing Trigonometric Functions KEY: increasing/decreasing

555 ANS: 3 PTS: 2 REF: 081705aai NAT: F.IF.B.4

TOP: Graphing Trigonometric Functions KEY: increasing/decreasing

556 ANS: 4 PTS: 2 REF: 012016aai NAT: F.IF.B.4

TOP: Graphing Trigonometric Functions KEY: increasing/decreasing

557 ANS: 4 PTS: 2 REF: 082220aai NAT: F.IF.B.4

TOP: Graphing Trigonometric Functions

558 ANS: 4

$$1) d(2) = 2; 2) d(1) = 12; 3) d(9) \approx 11; 4) d(-1) = 2$$

PTS: 2 REF: 062220aai NAT: F.IF.B.4 TOP: Graphing Trigonometric Functions

559 ANS: 4

	Bar Harbor	Phoenix
<b>Minimum</b>	31.386	66.491
<b>Midline</b>	55.3	86.729
<b>Maximum</b>	79.214	106.967
<b>Range</b>	47.828	40.476

PTS: 2 REF: 061715aai NAT: F.IF.B.4 TOP: Graphing Trigonometric Functions  
KEY: maximum/minimum

560 ANS:

$250(1) + 2450 = 2700$  The maximum lung capacity of a person is 2700 mL.

PTS: 2 REF: 081928aai NAT: F.IF.B.4 TOP: Graphing Trigonometric Functions

561 ANS:

$\frac{h(2) - h(1)}{2 - 1} = -12$ ,  $h(t) = 0$  at  $t \approx 2.2, 3.8$ , using a graphing calculator to find where  $h(t) = 0$ .

PTS: 4 REF: 061836aai NAT: F.IF.B.4 TOP: Graphing Trigonometric Functions

562 ANS: 2

PTS: 2

REF: 082203aai

NAT: F.IF.C.7

TOP: Graphing Trigonometric Functions KEY: amplitude

563 ANS: 4

PTS: 2

REF: 081718aai

NAT: F.IF.C.7

TOP: Graphing Trigonometric Functions KEY: amplitude

564 ANS: 3

(3) repeats 3 times over  $2\pi$ .

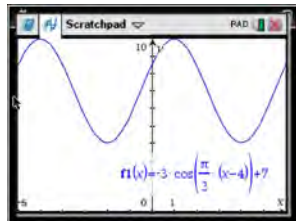
PTS: 2 REF: 011722aai NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions  
KEY: recognize | bimodalgraph

565 ANS: 2

$$P = \frac{2\pi}{\frac{\pi}{45}} = 90$$

PTS: 2 REF: 081822aai NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions  
KEY: period

566 ANS: 4



As the range is  $[4, 10]$ , the midline is  $y = \frac{4 + 10}{2} = 7$ .

PTS: 2 REF: fall1506aai NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions  
KEY: mixed

567 ANS: 1

The time of the next high tide will be the midpoint of consecutive low tides.

PTS: 2 REF: 011907aai NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions  
KEY: mixed

568 ANS: 4 PTS: 2 REF: 081912aai NAT: F.IF.C.7

TOP: Graphing Trigonometric Functions KEY: mixed

569 ANS:

Light wave C. The periods for A, B, and C are 280, 220 and 320.

PTS: 2 REF: 012030aai NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions  
KEY: period

570 ANS:

period is  $\frac{2}{3}$ . The wheel rotates once every  $\frac{2}{3}$  second.PTS: 2 REF: 061728aai NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions  
KEY: period

571 ANS:

$$\frac{10.1 - -2}{2} - \frac{2.5 - -0.1}{2} = 6.05 - 1.3 = 4.75$$

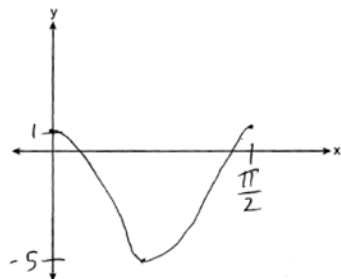
PTS: 2 REF: 081930aai NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions  
KEY: amplitude

572 ANS:

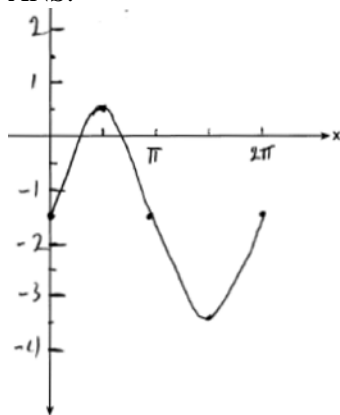
Amplitude, because the height of the graph shows the volume of the air.

PTS: 2 REF: 081625aai NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions  
KEY: mixed

573 ANS:

PTS: 2 REF: 082328aai NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions  
KEY: graph

574 ANS:



Part a sketch is shifted  $\frac{\pi}{3}$  units right.

PTS: 4

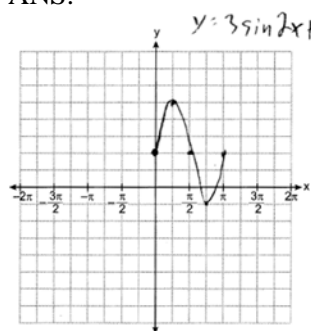
REF: 081735aai

NAT: F.IF.C.7

TOP: Graphing Trigonometric Functions

KEY: graph

575 ANS:



$$0 < x < \frac{\pi}{4}$$

PTS: 4

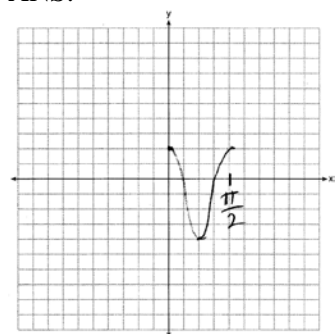
REF: 012436aai

NAT: F.IF.C.7

TOP: Graphing Trigonometric Functions

KEY: graph

576 ANS:



PTS: 2

REF: 061628aai

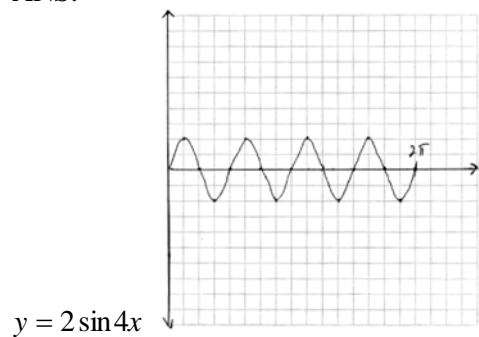
NAT: F.IF.C.7

TOP: Graphing Trigonometric Functions

KEY: graph



577 ANS:



PTS: 4

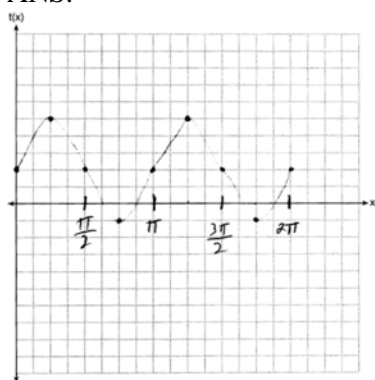
REF: 081934aai

NAT: F.IF.C.7

TOP: Graphing Trigonometric Functions

KEY: graph

578 ANS:



PTS: 2

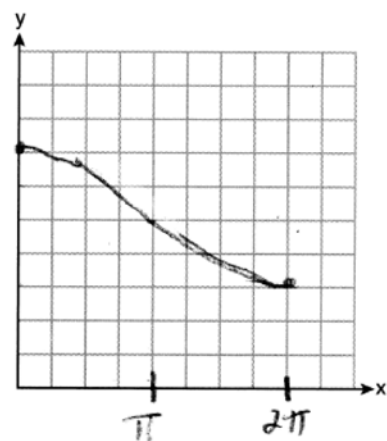
REF: 081830aai

NAT: F.IF.C.7

TOP: Graphing Trigonometric Functions

KEY: graph

579 ANS:



PTS: 2

REF: 062231aai

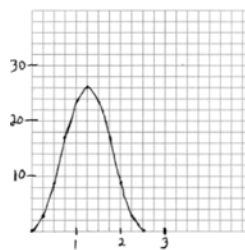
NAT: F.IF.C.7

TOP: Graphing Trigonometric Functions

KEY: graph

580 ANS:

period =  $\frac{2\pi}{0.8\pi} = 2.5$ . The wheel rotates once every 2.5 seconds.  
of  $f(t) = 26$ .



No, because the maximum

PTS: 6

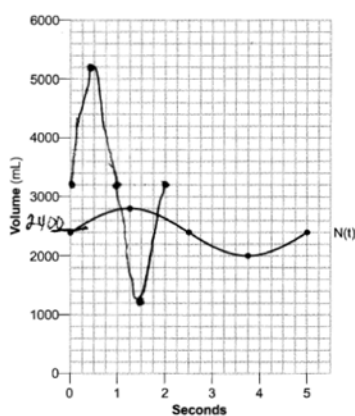
REF: 061937aai

NAT: F.IF.C.7

TOP: Graphing Trigonometric Functions

KEY: graph

581 ANS:



$$N(t) = 400 \sin\left(\frac{2\pi}{5} t\right) + 2400.$$

4 times.

PTS: 6

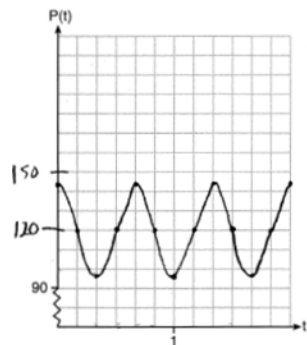
REF: 062337aai

NAT: F.IF.C.7

TOP: Graphing Trigonometric Functions

KEY: graph

582 ANS:



The period of  $P$  is  $\frac{2}{3}$ , which means the patient's blood pressure reaches a high every  $\frac{2}{3}$

second and a low every  $\frac{2}{3}$  second. The patient's blood pressure is high because 144 over 96 is greater than 120 over 80.

PTS: 6

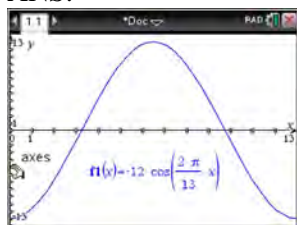
REF: 011837aai

NAT: F.IF.C.7

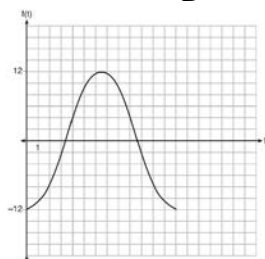
TOP: Graphing Trigonometric Functions

KEY: graph

583 ANS:



The amplitude, 12, can be interpreted from the situation, since the water level has a minimum of  $-12$  and a maximum of  $12$ . The value of  $A$  is  $-12$  since at  $8:30$  it is low tide. The period of the function is 13 hours, and is expressed in the function through the parameter  $B$ . By experimentation with technology or using the relation  $P = \frac{2\pi}{B}$  (where  $P$  is the period), it is determined that  $B = \frac{2\pi}{13}$ .



$$f(t) = -12 \cos\left(\frac{2\pi}{13} t\right)$$

In order to answer the question about when to fish, the student must interpret the function and determine which choice,  $7:30$  pm or  $10:30$  pm, is on an increasing interval. Since the function is increasing from  $t = 13$  to  $t = 19.5$  (which corresponds to  $9:30$  pm to  $4:00$  am),  $10:30$  is the appropriate choice.

PTS: 6      REF: spr1514aai      NAT: F.IF.C.7      TOP: Graphing Trigonometric Functions  
KEY: graph

584 ANS: 4

$$4(x^2 - 6x + 9) + 4(y^2 + 18y + 81) = 76 + 36 + 324$$

$$4(x - 3)^2 + 4(y + 9)^2 = 436$$

PTS: 2      REF: 061619aai      NAT: G.GPE.A.1      TOP: Equations of Circles  
KEY: completing the square

585 ANS: 3      PTS: 2      REF: 061607aai      NAT: S.IC.A.2  
TOP: Analysis of Data

586 ANS: 2      PTS: 2      REF: 011820aai      NAT: S.IC.A.2  
TOP: Analysis of Data

587 ANS: 3      PTS: 2      REF: 061710aai      NAT: S.IC.A.2  
TOP: Analysis of Data

588 ANS:

sample: pails of oranges; population: truckload of oranges. It is likely that about 5% of all the oranges are unsatisfactory.

PTS: 2      REF: 011726aai      NAT: S.IC.A.2      TOP: Analysis of Data

589 ANS:

About 38%  $\left(\frac{475}{1250}\right)$  of high school juniors in the population will choose a four-year college.

PTS: 2 REF: 012432aai NAT: S.IC.A.2 TOP: Analysis of Data

590 ANS:

Since there are six flavors, each flavor can be assigned a number, 1-6. Use the simulation to see the number of times the same number is rolled 4 times in a row.

PTS: 2 REF: 081728aai NAT: S.IC.A.2 TOP: Analysis of Data

591 ANS:

No.  $0.499 \pm 2(0.049) \rightarrow 0.401 - 0.597$ . Since 0.43 falls within this interval, Robin's coin is likely not unfair.

PTS: 2 REF: 061932aai NAT: S.IC.A.2 TOP: Analysis of Data

592 ANS:

No.  $0.852 \pm 2(0.029) \rightarrow 0.794 - 0.91$ . 0.88 falls within this interval.

PTS: 2 REF: 062332aai NAT: S.IC.A.2 TOP: Analysis of Data

593 ANS:

$\frac{1}{10}, \frac{1}{5}$ , and no, since 0.10 clearly falls within 95% of 0.20.

PTS: 4 REF: 012334aai NAT: S.IC.A.2 TOP: Analysis of Data

594 ANS:

$138.905 \pm 2 \cdot 7.95 = 123 - 155$ . No, since 125 (50% of 250) falls within the 95% interval.

PTS: 4 REF: 011835aai NAT: S.IC.A.2 TOP: Analysis of Data

595 ANS:

$.651 \pm 2 \cdot .034 = .58 - .72$ . No, since .61 (122/200) falls within the 95% interval.

PTS: 4 REF: 062235aai NAT: S.IC.A.2 TOP: Analysis of Data

596 ANS:

$29.101 \pm 2 \cdot 0.934 = 27.23 - 30.97$ . Yes, since 30 falls within the 95% interval.

PTS: 4 REF: 011935aai NAT: S.IC.A.2 TOP: Analysis of Data

597 ANS:

$.819 \pm 2 \cdot .053 = .713 - .925$ . Since .70 does not fall within the 95% interval.

PTS: 4 REF: 082236aai NAT: S.IC.A.2 TOP: Analysis of Data

598 ANS: 3

between 000 and 449, inclusive  $\rightarrow \frac{450}{1000} = 45\%$

PTS: 2 REF: 012024aai NAT: S.IC.B.3 TOP: Analysis of Data

KEY: type

599 ANS: 3

PTS: 2 REF: 011706aai NAT: S.IC.B.3  
TOP: Analysis of Data KEY: type

- 600 ANS: 3 PTS: 2 REF: 012015aai NAT: S.IC.B.3  
TOP: Analysis of Data KEY: type
- 601 ANS: 2 PTS: 2 REF: 081802aai NAT: S.IC.B.3  
TOP: Analysis of Data KEY: type
- 602 ANS: 3 PTS: 2 REF: 061901aai NAT: S.IC.B.3  
TOP: Analysis of Data KEY: type
- 603 ANS: 4 PTS: 2 REF: 081906aai NAT: S.IC.B.3  
TOP: Analysis of Data KEY: type
- 604 ANS: 4 PTS: 2 REF: 062216aai NAT: S.IC.B.3  
TOP: Analysis of Data KEY: type
- 605 ANS: 2 PTS: 2 REF: 082204aai NAT: S.IC.B.3  
TOP: Analysis of Data KEY: type
- 606 ANS: 3 PTS: 2 REF: 012401aai NAT: S.IC.B.3  
TOP: Analysis of Data
- 607 ANS: 4 PTS: 2 REF: 082301aai NAT: S.IC.B.3  
TOP: Analysis of Data
- 608 ANS: 2 PTS: 2 REF: 011910aai NAT: S.IC.B.3  
TOP: Analysis of Data KEY: bias
- 609 ANS: 3  
Self selection causes bias.
- PTS: 2 REF: 061703aai NAT: S.IC.B.3 TOP: Analysis of Data  
KEY: bias
- 610 ANS: 4 PTS: 2 REF: 011801aai NAT: S.IC.B.3  
TOP: Analysis of Data KEY: bias
- 611 ANS: 3  
To determine student opinion, survey the widest range of students.
- PTS: 2 REF: 062202aai NAT: S.IC.B.3 TOP: Analysis of Data  
KEY: bias
- 612 ANS: 2 PTS: 2 REF: 081717aai NAT: S.IC.B.3  
TOP: Analysis of Data KEY: type
- 613 ANS: 4 PTS: 2 REF: 012314aai NAT: S.IC.B.3  
TOP: Analysis of Data KEY: type
- 614 ANS: 1  
II. Ninth graders drive to school less often; III. Students know little about adults; IV. Calculus students love math!
- PTS: 2 REF: 081602aai NAT: S.IC.B.3 TOP: Analysis of Data  
KEY: bias
- 615 ANS:  
Randomly assign participants to two groups. One group uses the toothpaste with ingredient X and the other group uses the toothpaste without ingredient X.
- PTS: 2 REF: 061626aai NAT: S.IC.B.3 TOP: Analysis of Data  
KEY: type

616 ANS:

Self selection is a cause of bias because people with more free time are more likely to respond.

PTS: 2 REF: 061828aai NAT: S.IC.B.3 TOP: Analysis of Data

KEY: bias

617 ANS:

Pick random names from a list of all students and ask each one his method.

PTS: 2 REF: 062325aai NAT: S.IC.B.3 TOP: Analysis of Data

618 ANS: 2

$.43 \pm 2(0.05)$  contains about 95% of the data.

PTS: 2 REF: 062317aai NAT: S.IC.B.4 TOP: Analysis of Data

619 ANS: 4

$$2 \times 0.035 = 0.07 \text{ or } ME = \left( z \sqrt{\frac{p(1-p)}{n}} \right) = \left( 1.96 \sqrt{\frac{(0.65)(0.35)}{200}} \right) \approx 0.07$$

PTS: 2 REF: 012319aai NAT: S.IC.B.4 TOP: Analysis of Data

620 ANS: 2

$$ME = \left( z \sqrt{\frac{p(1-p)}{n}} \right) = \left( 1.96 \sqrt{\frac{(0.55)(0.45)}{900}} \right) \approx 0.03 \text{ or } \frac{1}{\sqrt{900}} \approx 0.03$$

PTS: 2 REF: 081612aai NAT: S.IC.B.4 TOP: Analysis of Data

621 ANS: 2

$$\frac{212}{1334} \approx .16 \quad ME = \left( z \sqrt{\frac{p(1-p)}{n}} \right) = \left( 1.96 \sqrt{\frac{(0.16)(0.84)}{1334}} \right) \approx 0.02 \text{ or } \frac{1}{\sqrt{1334}} \approx .027$$

PTS: 2 REF: 081716aai NAT: S.IC.B.4 TOP: Analysis of Data

622 ANS: 2

$9.82 \pm 2(1.4)$

PTS: 2 REF: 012411aai NAT: S.IC.B.4 TOP: Analysis of Data

623 ANS:

$2(0.042) = 0.084 \approx 0.08$  The percent of users making in-app purchases will be within 8% of 35%.

PTS: 2 REF: 081832aai NAT: S.IC.B.4 TOP: Analysis of Data

624 ANS:

Yes. The margin of error from this simulation indicates that 95% of the observations fall within  $\pm 0.12$  of the simulated proportion, 0.25. The margin of error can be estimated by multiplying the standard deviation, shown to

be 0.06 in the dotplot, by 2, or applying the estimated standard error formula,  $\left( \sqrt{\frac{p(1-p)}{n}} \right)$  or  $\left( \sqrt{\frac{(0.25)(0.75)}{50}} \right)$

and multiplying by 2. The interval  $0.25 \pm 0.12$  includes plausible values for the true proportion of people who prefer Stephen's new product. The company has evidence that the population proportion could be at least 25%. As seen in the dotplot, it can be expected to obtain a sample proportion of 0.18 (9 out of 50) or less several times, even when the population proportion is 0.25, due to sampling variability. Given this information, the results of the survey do not provide enough evidence to suggest that the true proportion is not at least 0.25, so the development of the product should continue at this time.

PTS: 4 REF: spr1512aii NAT: S.IC.B.4 TOP: Analysis of Data

625 ANS: 2

$0.254 \pm 2(0.060) \rightarrow (0.134, 0.374)$

PTS: 2 REF: 061913aii NAT: S.IC.B.5 TOP: Analysis of Data

626 ANS: 2

PTS: 2 REF: 011709aii NAT: S.IC.B.5  
TOP: Analysis of Data

627 ANS: 4

PTS: 2 REF: 012014aii NAT: S.IC.B.5  
TOP: Analysis of Data

628 ANS:

$0.01 \pm 2 \cdot 0.38 = -0.75 - 0.77$ . No, since 0.6 falls within the 95% interval.

PTS: 4 REF: 082336aii NAT: S.IC.B.5 TOP: Analysis of Data

629 ANS:

The mean difference between the students' final grades in group 1 and group 2 is  $-3.64$ . This value indicates that students who met with a tutor had a mean final grade of 3.64 points less than students who used an on-line subscription. One can infer whether this difference is due to the differences in intervention or due to which students were assigned to each group by using a simulation to rerandomize the students' final grades many (500) times. If the observed difference  $-3.64$  is the result of the assignment of students to groups alone, then a difference of  $-3.64$  or less should be observed fairly regularly in the simulation output. However, a difference of  $-3$  or less occurs in only about 2% of the rerandomizations. Therefore, it is quite unlikely that the assignment to groups alone accounts for the difference; rather, it is likely that the difference between the interventions themselves accounts for the difference between the two groups' mean final grades.

PTS: 4 REF: fall1514aii NAT: S.IC.B.5 TOP: Analysis of Data

630 ANS:

$0.301 \pm 2(0.058) \rightarrow 0.185 - 0.417 \frac{14}{60} \approx 0.23$ . It is not unusual because 0.23 falls within this interval.

PTS: 4 REF: 081935aii NAT: S.IC.B.5 TOP: Analysis of Data

631 ANS:

$0.602 \pm 2 \cdot 0.066 = 0.47 - 0.73$ . Since 0.50 falls within the 95% interval, this supports the concern there may be an even split.

PTS: 4 REF: 061635aii NAT: S.IC.B.5 TOP: Analysis of Data

- 632 ANS:  
Some of the students who did not drink energy drinks read faster than those who did drink energy drinks.  
 $17.7 - 19.1 = -1.4$  Differences of -1.4 and less occur  $\frac{25}{232}$  or about 10% of the time, so the difference is not unusual.
- PTS: 4 REF: 081636aii NAT: S.IC.B.5 TOP: Analysis of Data
- 633 ANS:  
 $0.506 \pm 2 \cdot 0.078 = 0.35 - 0.66$ . The 32.5% value falls below the 95% confidence level.
- PTS: 4 REF: 061736aii NAT: S.IC.B.5 TOP: Analysis of Data
- 634 ANS:  
 $23 - 18 = 5$ ,  $\bar{x} \pm 2\sigma = -3.07 - 3.13$ , Yes, a difference of 5 or more occurred three times out of a thousand, which is statistically significant.
- PTS: 4 REF: 061834aii NAT: S.IC.B.5 TOP: Analysis of Data
- 635 ANS:  
John found the means of the scores of the two rooms and subtracted the means. The mean score for the classical room was 7 higher than the rap room (82-75). Yes, there is less than a 5% chance this difference occurring due to random chance. It is likely the difference was due to the music.
- PTS: 4 REF: 081836aii NAT: S.IC.B.5 TOP: Analysis of Data
- 636 ANS: 1 PTS: 2 REF: 081722aii NAT: S.IC.B.6  
TOP: Analysis of Data
- 637 ANS: 3 PTS: 2 REF: 082201aii NAT: S.IC.B.3  
TOP: Analysis of Data KEY: type
- 638 ANS: 3 PTS: 2 REF: 012418aii NAT: S.IC.B.6  
TOP: Analysis of Data
- 639 ANS:  
Using a 95% level of confidence,  $\bar{x} \pm 2$  standard deviations sets the usual wait time as 150-302 seconds. 360 seconds is unusual.
- PTS: 2 REF: 081629aii NAT: S.IC.B.6 TOP: Analysis of Data
- 640 ANS: 2 PTS: 2 REF: 061804aii NAT: S.ID.B.6  
TOP: Regression KEY: choose model
- 641 ANS: 3  
The pattern suggests an exponential pattern, not linear or sinusoidal. A 4% growth rate is accurate, while a 43% growth rate is not.
- PTS: 2 REF: 011713aii NAT: S.ID.B.6 TOP: Regression  
KEY: choose model
- 642 ANS: 3  
 $y = 1.77(1.18)^x$   $y(41) \approx 1,850,950$
- PTS: 2 REF: 062314aii NAT: S.ID.B.6 TOP: Regression  
KEY: exponential



643 ANS:

$$D = 1.223(2.652)^A$$

PTS: 2

REF: 011826aai

NAT: S.ID.B.6

TOP: Regression

KEY: exponential

644 ANS:

$$y = 2.459(1.616)^x$$

PTS: 2

REF: 012329aai

NAT: S.ID.B.6

TOP: Regression

KEY: exponential

645 ANS:

$$F(t) = 169.136(.971)^t$$

PTS: 2

REF: 062232aai

NAT: S.ID.B.6

TOP: Regression

KEY: exponential

646 ANS:

$$y = 4.168(3.981)^x \quad 100 = 4.168(3.981)^x$$

$$\log \frac{100}{4.168} = \log(3.981)^x$$

$$\log \frac{100}{4.168} = x \log(3.981)$$

$$\frac{\log \frac{100}{4.168}}{\log(3.981)} = x$$

$$x \approx 2.25$$

PTS: 4

REF: 081736aai

NAT: S.ID.B.6

TOP: Regression

KEY: exponential

647 ANS:

$$y = 101.523(.883)^x \quad 29 = 101.523(.883)^x$$

$$\frac{29}{101.523} = (.883)^x$$

$$\log \frac{29}{101.523} = x \log(.883)$$

$$\frac{\log \frac{29}{101.523}}{\log(.883)} = x$$

$$x \approx 10.07$$

PTS: 4

REF: 012036aai

NAT: S.ID.B.6

TOP: Regression

KEY: exponential

648 ANS: 2

PTS: 2

REF: 011901aai

NAT: S.ID.A.4

TOP: Normal Distributions

KEY: mean and standard deviation

649 ANS: 4  
 $496 \pm 2(115)$

PTS: 2 REF: 011718aai NAT: S.ID.A.4 TOP: Normal Distributions  
 KEY: interval

650 ANS: 4  
 $400 \cdot .954 \approx 380$

PTS: 2 REF: 061918aai NAT: S.ID.A.4 TOP: Normal Distributions  
 KEY: predict

651 ANS: 2



$\bar{x} + 2\sigma$  represents approximately 48% of the data.

PTS: 2 REF: 061609aai NAT: S.ID.A.4 TOP: Normal Distributions  
 KEY: percent

652 ANS: 3



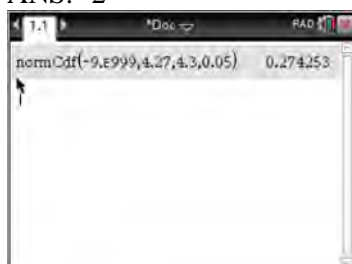
PTS: 2 REF: 081604aai NAT: S.ID.A.4 TOP: Normal Distributions  
 KEY: probability

653 ANS: 1



PTS: 2 REF: 081711aai NAT: S.ID.A.4 TOP: Normal Distributions  
 KEY: percent

654 ANS: 2



PTS: 2 REF: 061817aai NAT: S.ID.A.4 TOP: Normal Distributions  
 KEY: probability

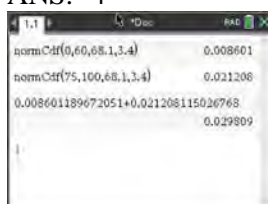
655 ANS: 2 PTS: 2 REF: 082313aai NAT: S.ID.A.4  
 TOP: Normal Distributions KEY: percent

656 ANS: 1



PTS: 2 REF: 081919aai NAT: S.ID.A.4 TOP: Normal Distributions  
 KEY: percent

657 ANS: 4



PTS: 2 REF: 062316aai NAT: S.ID.A.4 TOP: Normal Distributions  
 KEY: percent

658 ANS: 1 PTS: 2 REF: 062214aai NAT: S.ID.A.4  
 TOP: Normal Distributions KEY: predict

659 ANS: 3  
 $440 \times 2.3\% \approx 10$

PTS: 2 REF: 011807aai NAT: S.ID.A.4 TOP: Normal Distributions  
 KEY: predict

660 ANS: 1  
 $84.1\% \times 750 \approx 631$

PTS: 2 REF: 011923aai NAT: S.ID.A.4 TOP: Normal Distributions  
 KEY: predict

661 ANS:



43

PTS: 2 REF: 012328aai NAT: S.ID.A.4 TOP: Normal Distributions  
KEY: percent

662 ANS:



69

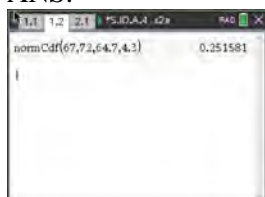
PTS: 2 REF: 061726aai NAT: S.ID.A.4 TOP: Normal Distributions  
KEY: percent

663 ANS:

$$1200 \cdot 0.784 \approx 941$$

PTS: 2 REF: 081828aai NAT: S.ID.A.4 TOP: Normal Distributions  
KEY: predict

664 ANS:



25

PTS: 2 REF: 012429aai NAT: S.ID.A.4 TOP: Normal Distributions  
KEY: percent

665 ANS:

$$0.133696 \times 9256 \approx 1237$$

PTS: 2 REF: 082230aai NAT: S.ID.A.4 TOP: Normal Distributions  
KEY: predict

666 ANS:

$$\text{normcdf}(510, 540, 480, 24) = 0.0994 \quad z = \frac{510 - 480}{24} = 1.25 \quad 1.25 = \frac{x - 510}{20} \quad 2.5 = \frac{x - 510}{20} \quad 535-560$$

$$z = \frac{540 - 480}{24} = 2.5 \quad x = 535 \quad x = 560$$

PTS: 4 REF: fall1516aai NAT: S.ID.A.4 TOP: Normal Distributions

KEY: probability

667 ANS: 4

$$45\% + 31\% - 58\% = 18\%$$

PTS: 2 REF: 082307aai NAT: S.CP.B.7 TOP: Theoretical Probability

668 ANS: 2

The events are independent because  $P(A \text{ and } B) = P(A) \cdot P(B)$ .

$$0.125 = 0.5 \cdot 0.25$$

If  $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) = 0.25 + 0.5 - .125 = 0.625$ , then the events are not mutually exclusive because  $P(A \text{ or } B) = P(A) + P(B)$ 

$$0.625 \neq 0.5 + 0.25$$

PTS: 2 REF: 061714aai NAT: S.CP.B.7 TOP: Theoretical Probability

669 ANS:

$$P(S \cap M) = P(S) + P(M) - P(S \cup M) = \frac{649}{1376} + \frac{433}{1376} - \frac{974}{1376} = \frac{108}{1376}$$

PTS: 2 REF: 061629aai NAT: S.CP.B.7 TOP: Theoretical Probability

670 ANS: 4

$$0.48 \cdot 0.25 = 0.12$$

PTS: 1 REF: 061811aai NAT: S.CP.A.2 TOP: Probability of Compound Events

KEY: probability

671 ANS:

$$\frac{1}{3} \times \frac{5}{12} = \frac{5}{36}$$

PTS: 2 REF: 012327aai NAT: S.CP.A.2 TOP: Probability of Compound Events

KEY: probability

672 ANS:

 $P(A \cup B) = P(A) + P(B) - P(A \cap B)$   $A$  and  $B$  are independent since  $P(A \cap B) = P(A) \cdot P(B)$ 

$$0.8 = 0.6 + 0.5 - P(A \cap B)$$

$$0.3 = 0.6 \cdot 0.5$$

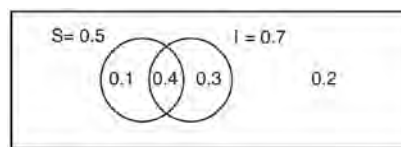
$$P(A \cap B) = 0.3$$

$$0.3 = 0.3$$

PTS: 2 REF: 081632aai NAT: S.CP.A.2 TOP: Probability of Compound Events

KEY: independence

673 ANS:



This scenario can be modeled with a Venn Diagram: Since  $P(S \cup I) = 0.2$ ,  $P(S \cup I) = 0.8$ . Then,  $P(S \cap I) = P(S) + P(I) - P(S \cup I)$  If  $S$  and  $I$  are independent, then the

$$= 0.5 + 0.7 - 0.8$$

$$= 0.4$$

Product Rule must be satisfied. However,  $(0.5)(0.7) \neq 0.4$ . Therefore, salary and insurance have not been treated independently.

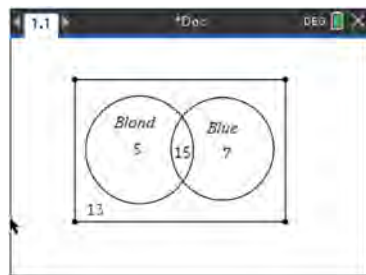
PTS: 4 REF: spr1513aii NAT: S.CP.A.2 TOP: Probability of Compound Events  
KEY: independence

674 ANS: 2

$$\frac{85}{210 + 85}$$

PTS: 2 REF: 081818aii NAT: S.CP.A.1 TOP: Venn Diagrams

675 ANS: 2



$$40 - (20 + 22 - 15) = 13$$

PTS: 2 REF: 062204aii NAT: S.CP.A.1 TOP: Venn Diagrams  
676 ANS: 4 PTS: 2 REF: 012008aii NAT: S.CP.A.3  
TOP: Conditional Probability

677 ANS: 1

The probability of rain equals the probability of rain, given that Sean pitches.

PTS: 2 REF: 061611aii NAT: S.CP.A.3 TOP: Conditional Probability  
678 ANS: 4 PTS: 2 REF: 081824aii NAT: S.CP.A.3  
TOP: Conditional Probability

679 ANS: 2

$$P(B) \cdot P(A|B) = P(A \text{ and } B)$$

$$P(B) \cdot 0.8 = 0.2$$

$$P(B) = 0.25$$

PTS: 2 REF: 081913aii NAT: S.CP.A.3 TOP: Conditional Probability

680 ANS: 2

(1)  $0.4 \cdot 0.3 \neq 0.2$ , (2)  $0.8 \cdot 0.25 = 0.2$ , (3)  $P(A|B) = P(A) = 0.2$ , (4)  $0.2 \neq 0.15 \cdot 0.05$ 

$$0.2 \neq 0.2 \cdot 0.2$$

PTS: 2 REF: 011912aai NAT: S.CP.A.3 TOP: Conditional Probability

681 ANS:

$$P(A + B) = P(A) \cdot P(B|A) = 0.8 \cdot 0.85 = 0.68$$

PTS: 2 REF: 011928aai NAT: S.CP.A.3 TOP: Conditional Probability

682 ANS:

$$\frac{47}{108} = \frac{1}{4} + \frac{116}{459} - P(M \text{ and } J); \text{ No, because } \frac{31}{459} \neq \frac{1}{4} \cdot \frac{116}{459}$$

$$P(M \text{ and } J) = \frac{31}{459}$$

PTS: 4 REF: 011834aai NAT: S.CP.A.3 TOP: Conditional Probability

683 ANS: 4

$$\frac{13}{13 + 11} = \frac{13}{24}$$

PTS: 2 REF: 012011aai NAT: S.CP.A.4 TOP: Conditional Probability

684 ANS: 1

$$\frac{20}{14 + 20 + 6} = \frac{1}{2}$$

PTS: 2 REF: 082303aai NAT: S.CP.A.4 TOP: Conditional Probability

685 ANS: 1

$$\frac{157}{25 + 47 + 157}$$

PTS: 2 REF: 081607aai NAT: S.CP.A.4 TOP: Conditional Probability

686 ANS:

$$\frac{103}{110 + 103} = \frac{103}{213}$$

PTS: 2 REF: 061825aai NAT: S.CP.A.4 TOP: Conditional Probability

687 ANS:

A student is more likely to jog if both siblings jog. 1 jogs:  $\frac{416}{2239} \approx 0.19$ . both jog:  $\frac{400}{1780} \approx 0.22$

PTS: 2 REF: 061732aai NAT: S.CP.A.4 TOP: Conditional Probability

688 ANS:

Based on these data, the two events do not appear to be independent.  $P(F) = \frac{106}{200} = 0.53$ , while

$P(F|T) = \frac{54}{90} = 0.6$ ,  $P(F|R) = \frac{25}{65} = 0.39$ , and  $P(F|C) = \frac{27}{45} = 0.6$ . The probability of being female are not the same as the conditional probabilities. This suggests that the events are not independent.

PTS: 2 REF: fall1508aai NAT: S.CP.A.4 TOP: Conditional Probability

689 ANS:

No, because  $P(F / CR) \neq P(F)$

$$\frac{36}{42+36} \neq \frac{17+37+36+15}{39+17+42+12+17+37+36+15}$$

$$\frac{36}{78} \neq \frac{105}{215}$$

$$\frac{6}{13} \neq \frac{21}{43}$$

PTS: 2 REF: 082231aai NAT: S.CP.A.4 TOP: Conditional Probability

690 ANS:

Yes.  $P(BI) = P(BI|GI)$

$$0.14 + 0.26 = \frac{.14}{.35}$$

$$.4 = .4$$

PTS: 2 REF: 062229aai NAT: S.CP.A.4 TOP: Conditional Probability

691 ANS:

No, because  $P(M / R) \neq P(M)$

$$\frac{70}{180} \neq \frac{230}{490}$$

$$0.38 \neq 0.47$$

PTS: 2 REF: 011731aai NAT: S.CP.A.4 TOP: Conditional Probability

692 ANS:

$P(F|L) = \frac{12}{27}$   $P(F) = \frac{22}{45}$  Since  $P(F|L) \neq P(F)$ , the events are not independent.

PTS: 4 REF: 061936aai NAT: S.CP.A.4 TOP: Conditional Probability

693 ANS:

$\frac{1200}{1200+2016} \approx .373$ . Yes, because  $\frac{1600}{4288} \approx .373$  also.

PTS: 4 REF: 062334aai NAT: S.CP.A.4 TOP: Conditional Probability



694 ANS:  
 $\frac{3+42}{1500} = 3\%$      $\frac{3}{3+12} = 20\%$  No, because a person is more likely to be allergic milk if he is also allergic to nuts.

PTS: 4                      REF: 012433aii      NAT: S.CP.A.4      TOP: Conditional Probability

695 ANS:  
 $\frac{165+66-33}{825} = \frac{198}{825}$

PTS: 2                      REF: 081925aii      NAT: S.CP.B.6      TOP: Conditional Probability

696 ANS:  
 $P(W/D) = \frac{P(W \wedge D)}{P(D)} = \frac{.4}{.5} = .8$

PTS: 2                      REF: 081726aii      NAT: S.CP.B.6      TOP: Conditional Probability

697 ANS:  
 $P(P/K) = \frac{P(P \wedge K)}{P(K)} = \frac{1.9}{2.3} \approx 82.6\%$  A key club member has an 82.6% probability of being enrolled in AP Physics.

PTS: 4                      REF: 011735aii      NAT: S.CP.B.6      TOP: Conditional Probability