

# JMAP

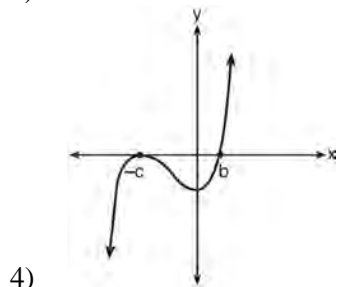
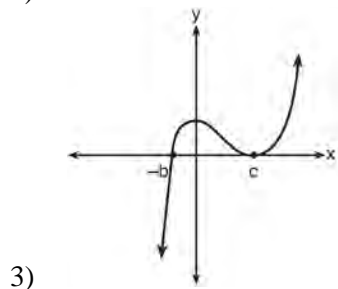
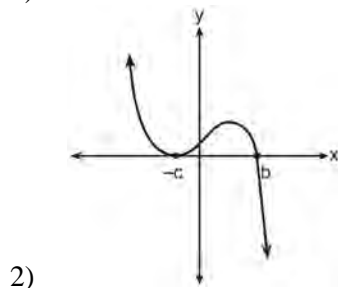
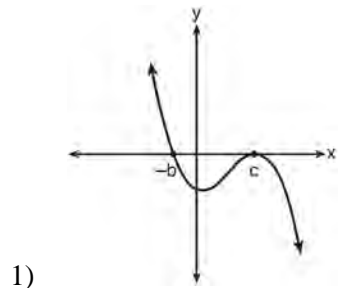
## REGENTS BY DATE

NY Algebra II Regents Exam Questions  
from Spring 2015 to August 2022 Sorted by Date

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**2015 Algebra II Common Core State Standards Sample Items**

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



- 2 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)  $y = \frac{x^2}{4} + 3$
- 3 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)  $-\frac{4}{5}$
- 4 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)  $B(t) = 750(1.16)^{\frac{t}{12}}$
- 5 Use the properties of rational exponents to determine the value of  $y$  for the equation:

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

Algebra II Sample Items 2015

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- 6 Write  $(5 + 2yi)(4 - 3i) - (5 - 2yi)(4 - 3i)$  in  $a + bi$  form, where  $y$  is a real number.
- 7 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.
- 8 Solve algebraically for all values of  $x$ :  
 $\sqrt{x - 5} + x = 7$
- 9 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.

- 10 Solve the following system of equations algebraically for all values of  $x$ ,  $y$ , and  $z$ :
- $$x + 3y + 5z = 45$$
- $$6x - 3y + 2z = -10$$
- $$-2x + 3y + 8z = 72$$

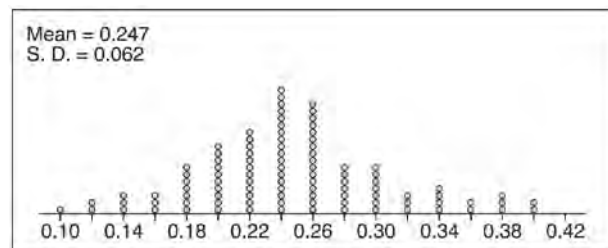
- 11 Write an explicit formula for  $a_n$ , the  $n$ th term of the recursively defined sequence below.

$$a_1 = x + 1$$

$$a_n = x(a_{n-1})$$

For what values of  $x$  would  $a_n = 0$  when  $n > 1$ ?

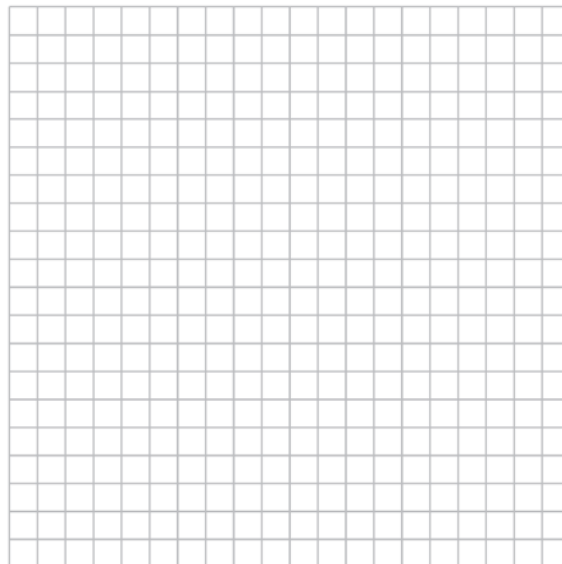
- 12 Stephen's Beverage Company is considering whether to produce a new brand of cola. The company will launch the product if at least 25% of cola drinkers will buy the product. Fifty cola drinkers are randomly selected to take a blind taste-test of products  $A$ ,  $B$ , and the new product. Nine out 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.

13 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.

14 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.

15 What is the solution set of the equation

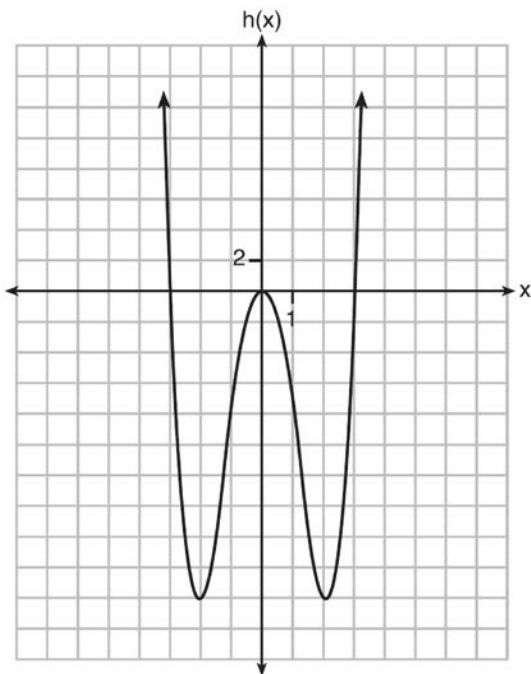
$$\frac{3x+25}{x+7} - 5 = \frac{3}{x}?$$

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

16 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.

17 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)  $3x^2 + 13x + \frac{49}{2} + \frac{151}{2x+3}$

18 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)  $6 \pm 2\sqrt{19}$

19 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)  $(k+2)(k-2)(k+6)(k+2)$

20 Which statement is *incorrect* for the graph of the

$$\text{function } y = -3 \cos\left[\frac{\pi}{3}(x-4)\right] + 7?$$

- 1) The period is 6.
- 2) The amplitude is 3.
- 3) The range is  $[4, 10]$ .
- 4) The midline is  $y = -4$ .

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

$$y = -2x + 1$$

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

- 22 The results of a poll of 200 students are shown in the table below:

	Preferred Music Style		
	Techno	Rap	Country
Female	54	25	27
Male	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.

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

24 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*.

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

- 26 Rewrite the expression

$$(4x^2 + 5x)^2 - 5(4x^2 + 5x) - 6$$

as a product of four linear factors.

- 27 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

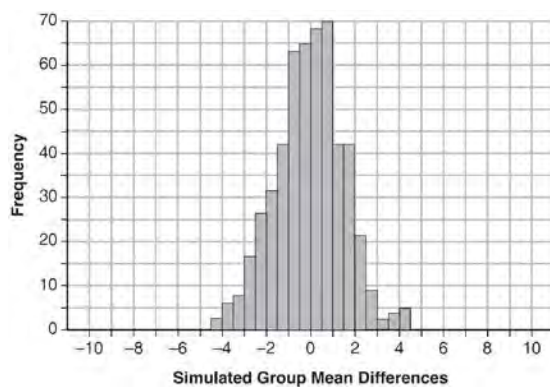
$k$  = decay constant

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.

- 28 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.

- 29 Given  $z(x) = 6x^3 + bx^2 - 52x + 15$ ,  $z(2) = 35$ , and  $z(-5) = 0$ , algebraically determine all the zeros of  $z(x)$ .
- 30 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?
- 31 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.

**0616AII Common Core State Standards**

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

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

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

2)  $\left(\sqrt{3b}\right)^d$

3)  $\frac{1}{\sqrt{3b^d}}$

4)  $\left(\sqrt[d]{3b}\right)^2$

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

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

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

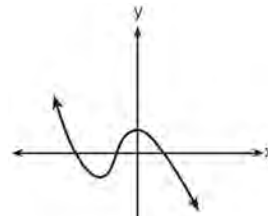
2)  $-y^2 - 4yi + 4$

3)  $-y^2 + 4$

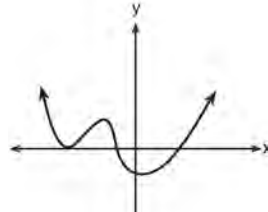
4)  $y^2 + 4$

- 4 Which graph has the following characteristics?

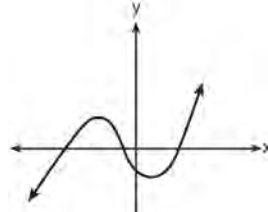
- three real zeros
- as  $x \rightarrow -\infty$ ,  $f(x) \rightarrow -\infty$
- as  $x \rightarrow \infty$ ,  $f(x) \rightarrow \infty$



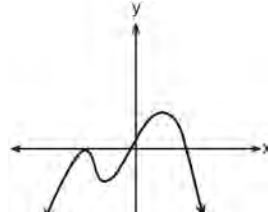
1)



2)



3)



4)

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

1)  $\{-8, 7\}$

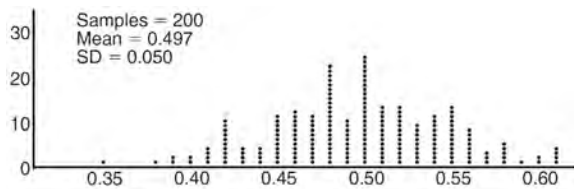
2)  $\{-7, 8\}$

3)  $\{7\}$

4)  $\{\}$



- 6 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)  $\{0, 3, -4\}$
- 7 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?

- 1) 73 of the computer's next 100 coin flips will be heads.
  - 2) 50 of her next 100 coin flips will be heads.
  - 3) Her coin is not fair.
  - 4) Her coin is fair.
- 8 If  $g(c) = 1 - c^2$  and  $m(c) = c + 1$ , then which statement is *not* true?
- 1)  $g(c) \cdot m(c) = 1 + c - c^2 - c^3$
  - 2)  $g(c) + m(c) = 2 + c - c^2$
  - 3)  $m(c) - g(c) = c + c^2$
  - 4)  $\frac{m(c)}{g(c)} = \frac{-1}{1 - c}$
- 9 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

- 10 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.
- 11 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
- 12 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)  $\frac{1}{2}$

- 13 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

$$H(t) = 70 \sin\left(\frac{2\pi}{7}(t - 1.75)\right) + 80, \text{ where } t \text{ is time,}$$

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
- 14 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)  $2x^2 - 2.5x - 5 - \frac{20}{2x + 3}$

- 15 Which function represents exponential decay?

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

- 16 Given  $f^{-1}(x) = -\frac{3}{4}x + 2$ , which equation represents  $f(x)$ ?

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

- 17 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)  $\frac{4}{5}$

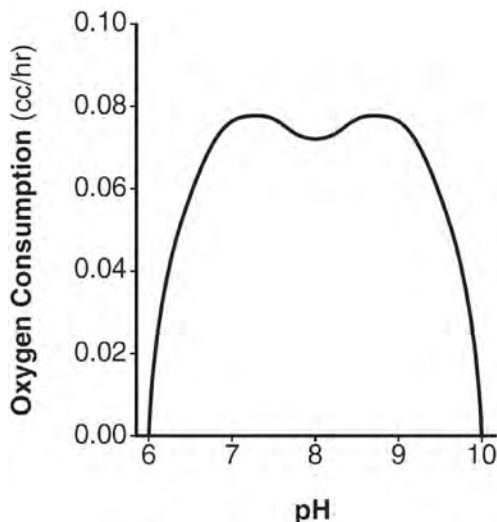
- 18 Which statement about the graph of  $c(x) = \log_6 x$  is *false*?

- 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.

- 19 The equation  $4x^2 - 24x + 4y^2 + 72y = 76$  is equivalent to

- 1)  $4(x - 3)^2 + 4(y + 9)^2 = 76$
- 2)  $4(x - 3)^2 + 4(y + 9)^2 = 121$
- 3)  $4(x - 3)^2 + 4(y + 9)^2 = 166$
- 4)  $4(x - 3)^2 + 4(y + 9)^2 = 436$

- 20 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.
- 21 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)  $(1.0525)^{\frac{m}{12}}$
  - 3)  $(1.00427)^m$
  - 4)  $(1.00427)^{\frac{m}{12}}$

- 22 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

- 23 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)  $j_1 = 250,000$   
 $j_n = j_{n-1} + 937$

- 24 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?

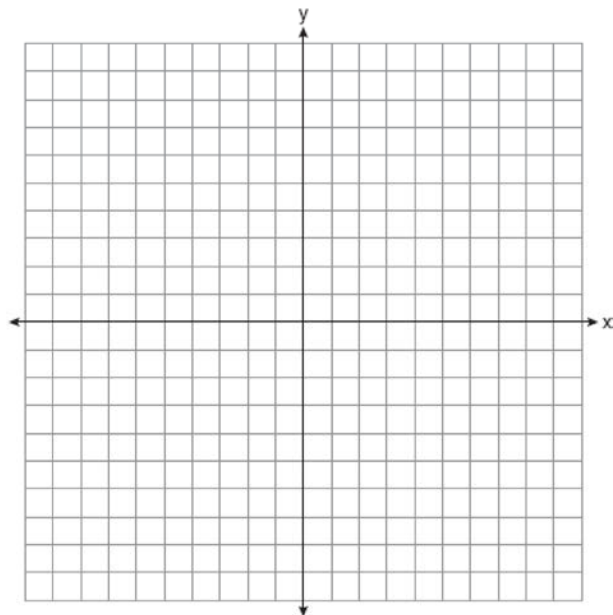
- 1)  $V = 120 \sin(t)$
- 2)  $V = 120 \sin(60t)$
- 3)  $V = 120 \sin(60\pi t)$
- 4)  $V = 120 \sin(120\pi t)$

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

- 26 Describe how a controlled experiment can be created to examine the effect of ingredient X in a toothpaste.

- 27 Determine if  $x - 5$  is a factor of  $2x^3 - 4x^2 - 7x - 10$ . Explain your answer.

- 28 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  $(0, 2)$ .



- 29 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?

- 30 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.

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

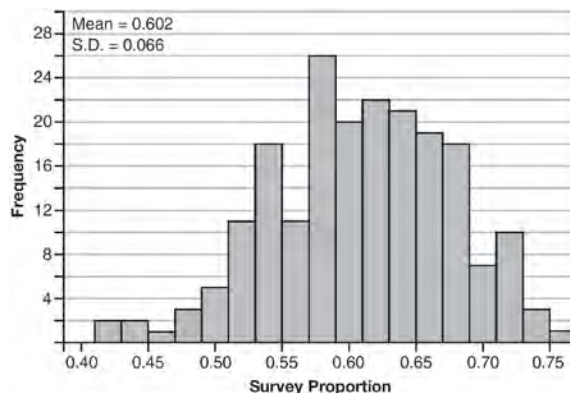
- 32 A house purchased 5 years ago for \$100,000 was just sold for \$135,000. Assuming exponential growth, approximate the annual growth rate, to the *nearest percent*.

- 33 Solve the system of equations shown below algebraically.

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

$$2x + 2y = 10$$

- 34 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*.
- 35 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.



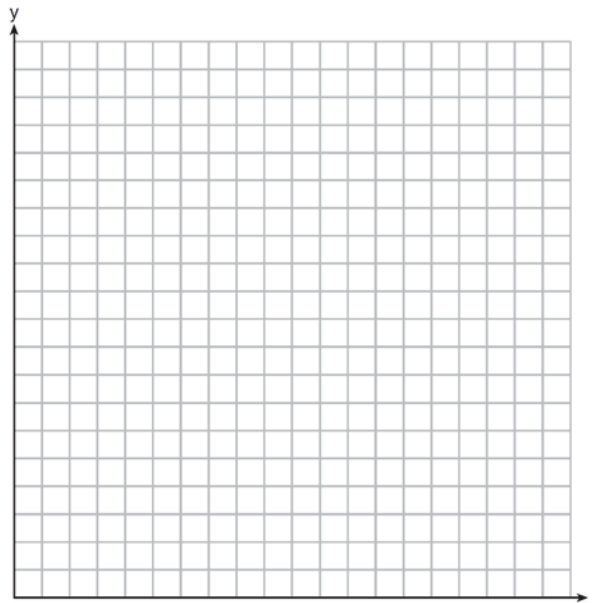
Using the results of the simulation, determine a plausible interval containing the middle 95% of the data. Round all values to the *nearest hundredth*. Members of the prom committee are concerned that a vote of all students attending the prom may produce a 50% – 50% split. Explain what statistical evidence supports this concern.

36 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

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

37 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.

**0816AII Common Core State Standards**

- 1 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)  $x^2 - 2x + 2 = 0$
- 2 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
- 3 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
- 4 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
- 5 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)  $t^3 + 5t^2 + 6t + t^2 + 5t + 6 = (t + 1)(t + 2)(t + 3)$
- 6 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)  $t = 11$

- 7 The set of data in the table below shows the results of a survey on the number of messages that people of different ages text on their cell phones each month.

Age Group	Text Messages per Month		
	0–10	11–50	Over 50
15–18	4	37	68
19–22	6	25	87
23–60	25	47	157

If a person from this survey is selected at random, what is the probability that the person texts over 50 messages per month given that the person is between the ages of 23 and 60?

- 1)  $\frac{157}{229}$   
 2)  $\frac{157}{312}$   
 3)  $\frac{157}{384}$   
 4)  $\frac{157}{456}$
- 8 A recursive formula for the sequence 18, 9, 4.5, ... is

1)  $g_1 = 18$

$$g_n = \frac{1}{2}g_{n-1}$$

2)  $g_n = 18\left(\frac{1}{2}\right)^{n-1}$

3)  $g_1 = 18$

$$g_n = 2g_{n-1}$$

4)  $g_n = 18(2)^{n-1}$

- 9 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)  $\frac{8 - 8(0.10)^n}{1.10}$

- 10 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)

- 11 The expression  $\frac{x^3 + 2x^2 + x + 6}{x + 2}$  is equivalent to

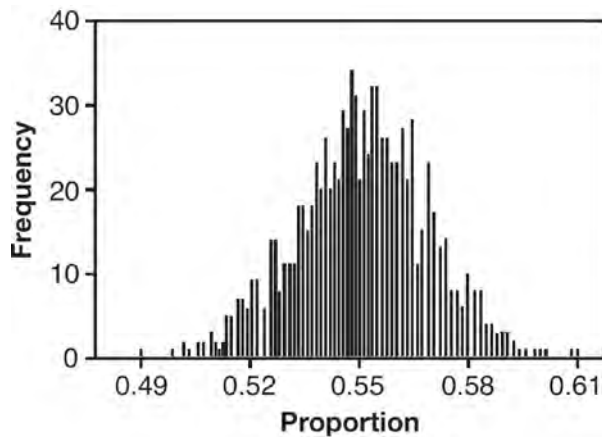
1)  $x^2 + 3$

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

3)  $2x^2 + x + 6$

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

- 12 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
- 13 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.

- 14 Which equation represents an odd function?

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

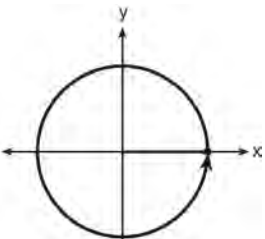
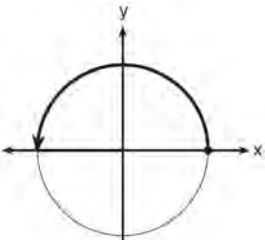
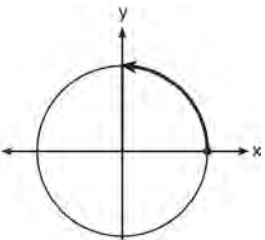
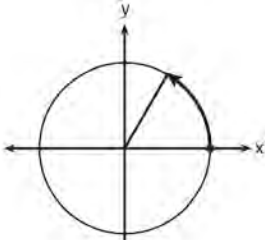
- 15 The completely factored form of

$$2d^4 + 6d^3 - 18d^2 - 54d$$

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



- 16 Which diagram shows an angle rotation of 1 radian on the unit circle?



- 17 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.

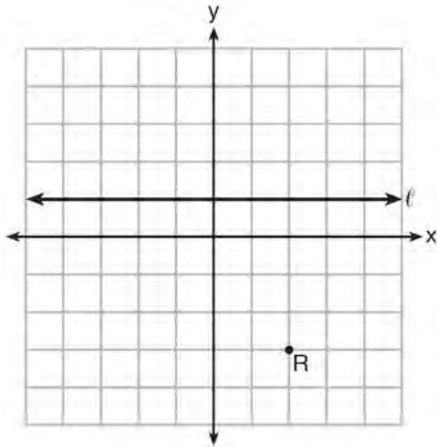
$$\frac{1}{J} + \frac{1}{W} = \frac{1}{F}$$

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)  $\frac{1}{F} - \frac{1}{W}$
- 18 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)  $a_n = 2 \cdot 3^{n+1}$

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



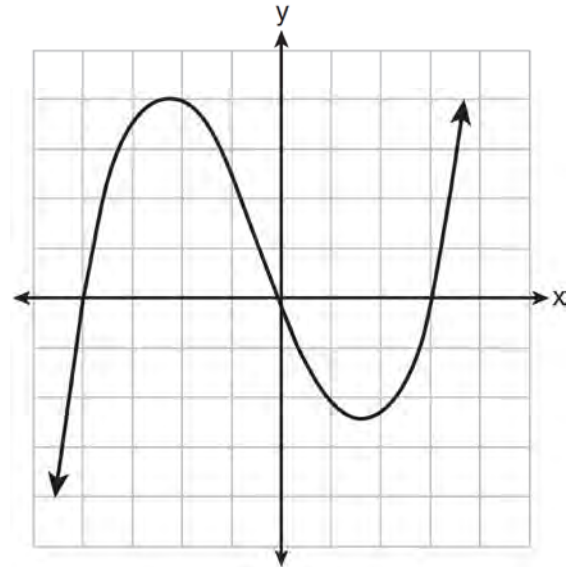
- 1)  $y = -\frac{1}{8}(x+2)^2 + 1$
- 2)  $y = -\frac{1}{8}(x+2)^2 - 1$
- 3)  $y = -\frac{1}{8}(x-2)^2 + 1$
- 4)  $y = -\frac{1}{8}(x-2)^2 - 1$

- 20 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

- 21 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)  $4$

- 22 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)  $300(1.30)^{\frac{365}{14}}$

- 23 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)  $-3$
- 24 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)  $P_0 = 19,378,000$

$$P_t = 1.015P_{t-1}$$

- 25 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.

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

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

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

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

- 27 Simplify  $xi(i - 7i)^2$ , where  $i$  is the imaginary unit.

- 28 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.

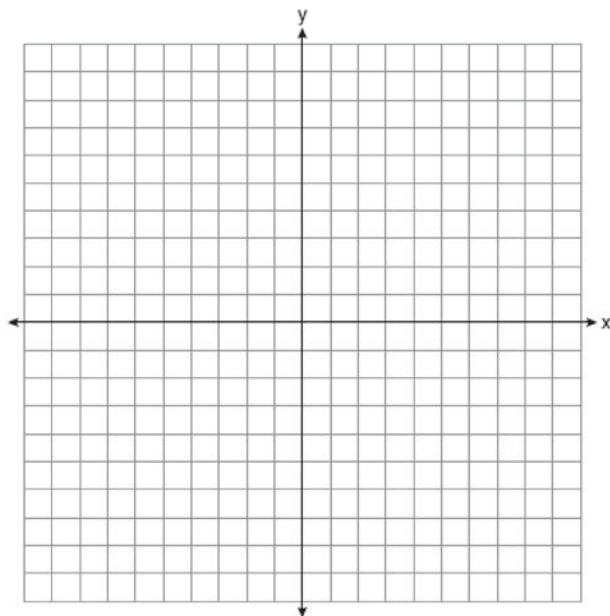
- 29 Elizabeth waited for 6 minutes at the drive thru at her favorite fast-food restaurant the last time she visited. She was upset about having to wait that long and notified the manager. The manager assured her that her experience was very unusual and that it would not happen again. A study of customers 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.

- 31 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.

- 32 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.
- 33 Find algebraically the zeros for  $p(x) = x^3 + x^2 - 4x - 4$ . On the set of axes below, graph  $y = p(x)$ .

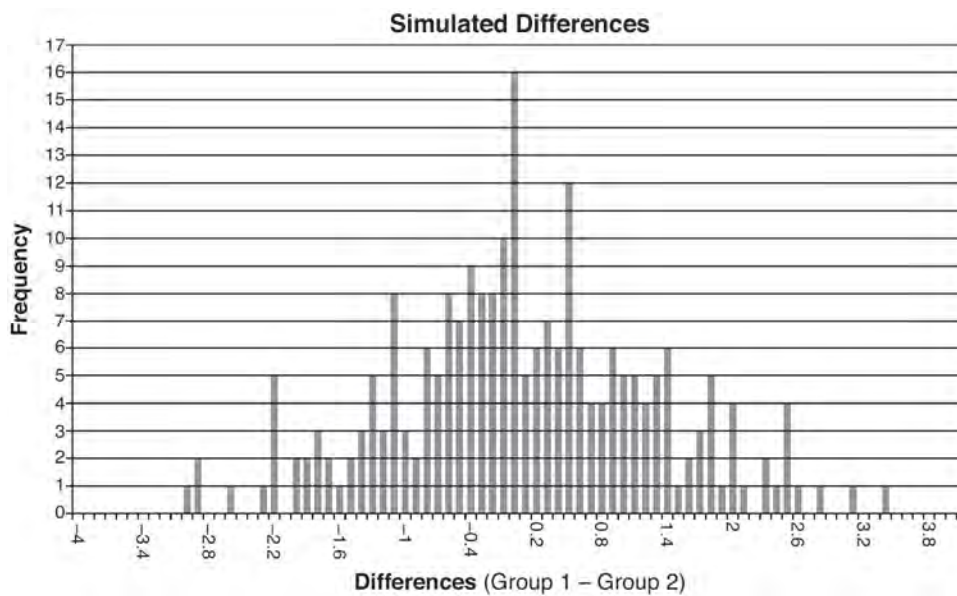


- 34 One of the medical uses of Iodine-131 (I-131), a radioactive isotope of iodine, is to enhance x-ray images. The half-life of I-131 is approximately 8.02 days. A patient is injected with 20 milligrams of I-131. Determine, to the *nearest day*, the amount of time needed before the amount of I-131 in the patient's body is approximately 7 milligrams.
- 35 Solve the equation  $\sqrt{2x - 7} + x = 5$  algebraically, and justify the solution set.

- 36 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.

- 37 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.

**0117AII Common Core State Standards**

1 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

2 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

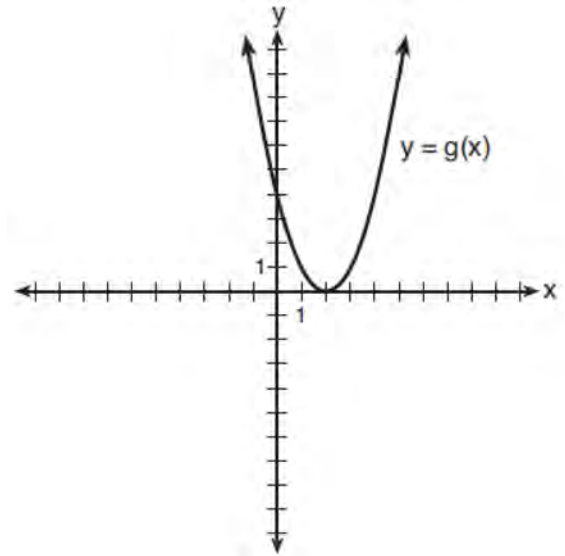
3 Factored completely,  $m^5 + m^3 - 6m$  is equivalent to

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

4 If  $\sin^2(32^\circ) + \cos^2(M) = 1$ , then  $M$  equals

- 1)  $32^\circ$
- 2)  $58^\circ$
- 3)  $68^\circ$
- 4)  $72^\circ$

5 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)  $\{(1, 1), (6, 16)\}$

6 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.

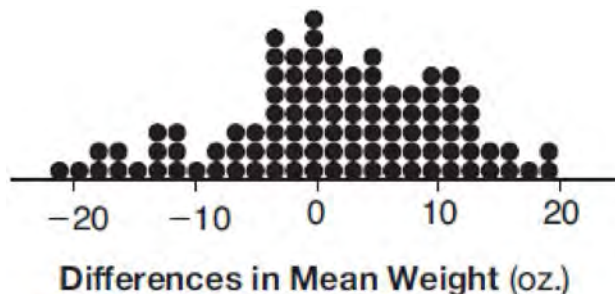
7 The expression  $\left(\frac{m^2}{m^{\frac{1}{3}}}\right)^{-\frac{1}{2}}$  is equivalent to

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

8 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)  $x = 3^y$

9 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?

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1) There was no effect observed between the two groups.</li> <li>2) There was an effect observed that could be due to the random assignment of plants to the groups.</li> </ol> | <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> </ol> |
|--|--|

10 If  $p(x) = ab^x$  and  $r(x) = cd^x$ , then  $p(x) \bullet r(x)$  equals

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



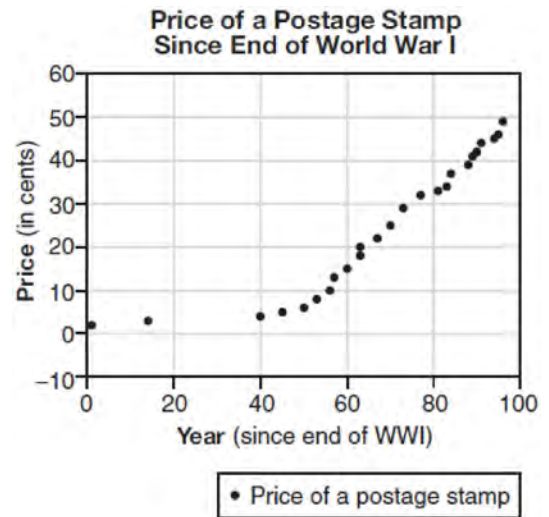
11 The solution to the equation  $18x^2 - 24x + 87 = 0$  is

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

12 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)  $(1.4, 3.4)$

13 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)  $y = 24 \sin(14x) + 25$

14 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)  $82$

- 15 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?

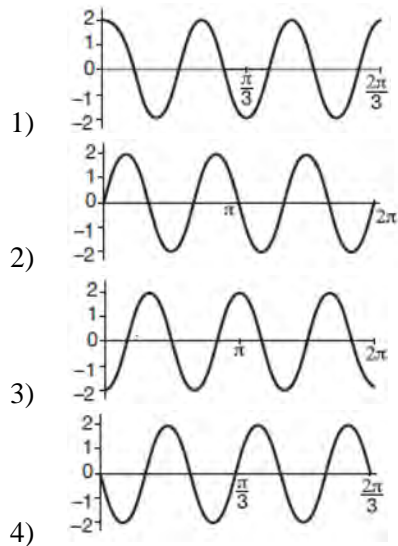
- 1) moderate  
2) loud  
3) very loud  
4) deafening
- 16 Pedro and Bobby each own an ant farm. Pedro starts with 100 ants and says his farm is growing exponentially at a rate of 15% per month. Bobby starts with 350 ants and says his farm is steadily decreasing by 5 ants per month. Assuming both boys 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
- 17 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
- 18 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)  $496 \pm 230$
- 19 Which statement regarding the graphs of the functions below is *untrue*?  
 $f(x) = 3 \sin 2x$ , 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.
- 20 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  $g(x)$ .

- 21 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.

$m$	$B$
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?

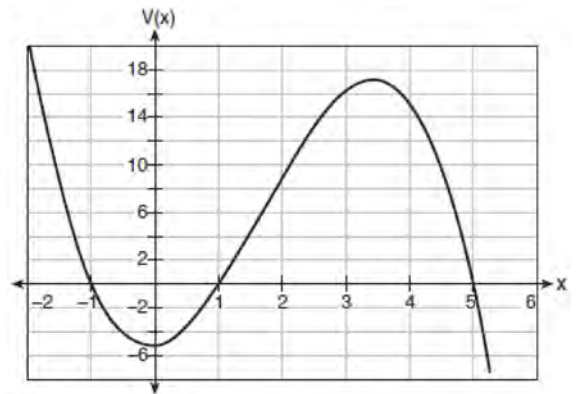
- 1) month 10 to month 60  
 2) month 19 to month 69  
 3) month 36 to month 72  
 4) month 60 to month 73
- 22 Which graph represents a cosine function with no horizontal shift, an amplitude of 2, and a period of  $\frac{2\pi}{3}$ ?



- 23 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)  $300e^{-0.42}$

- 24 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.

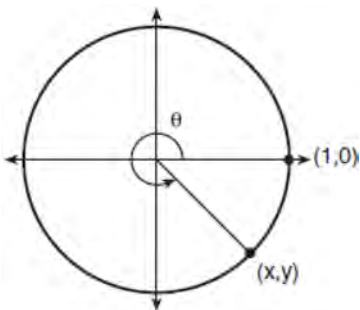


Over which interval is the volume of the box changing at the fastest average rate?

- 1)  $[1, 2]$   
 2)  $[1, 3.5]$   
 3)  $[1, 5]$   
 4)  $[0, 3.5]$
- 25 Express  $(1 - i)^3$  in  $a + bi$  form.

- 26 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.

- 27 Using the unit circle below, explain why  $\csc \theta = \frac{1}{y}$ .



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

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

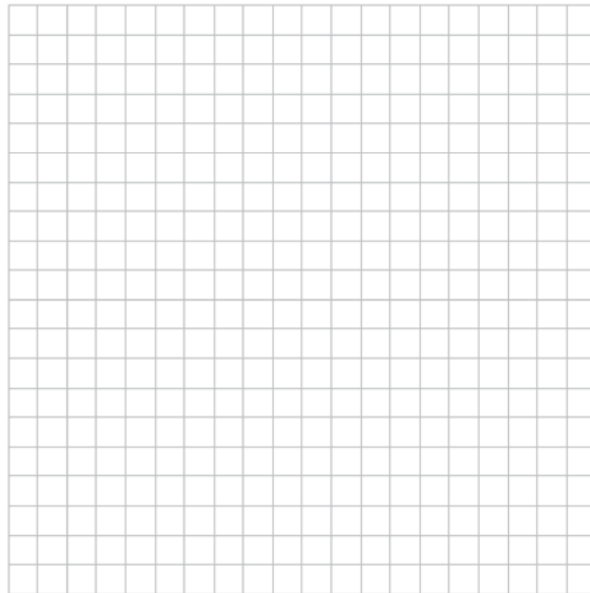
Determine if the function  $M(t)$  represents growth or decay. Explain your reasoning.

- 31 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.

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



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

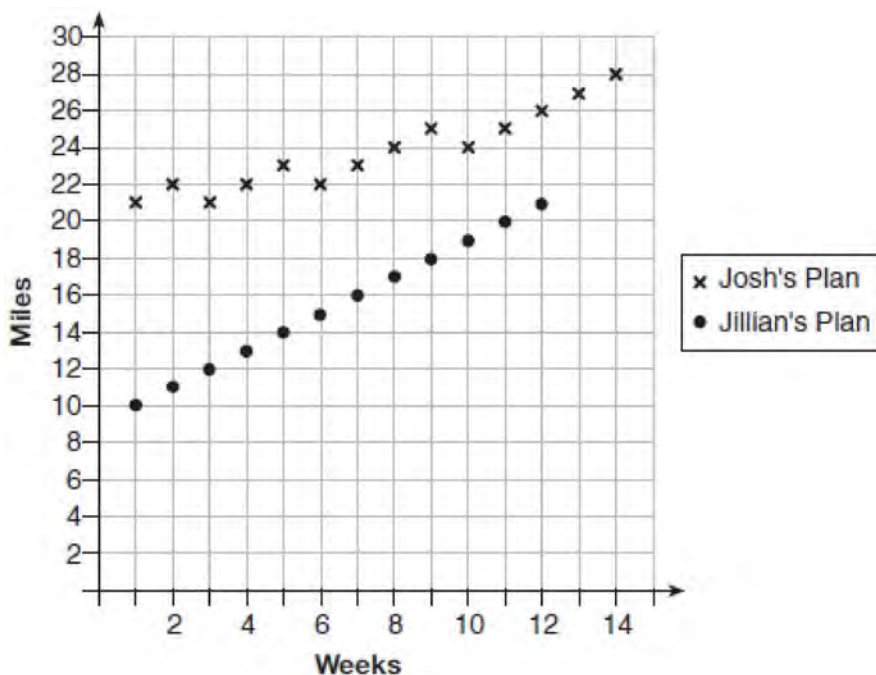
- 32 Given  $f(x) = 3x^2 + 7x - 20$  and  $g(x) = x - 2$ , state the quotient and remainder of  $\frac{f(x)}{g(x)}$ , in the form

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

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

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

- 34 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.

- 35 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.

- 36 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

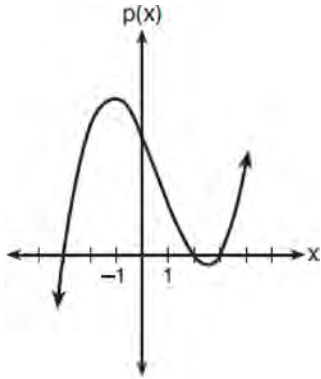
$i$  = interest rate per month

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

- 37 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.

## 0617aii

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

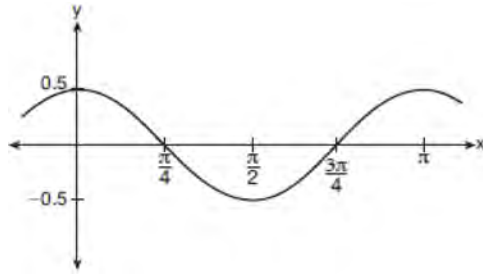


Which equation could represent  $p(x)$ ?

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

- 4 The expression  $6xi^3(-4xi + 5)$  is equivalent to
- 1)  $2x - 5i$
  - 2)  $-24x^2 - 30xi$
  - 3)  $-24x^2 + 30xi - i$
  - 4)  $26x - 24x^2i - 5i$
- 5 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)  $(11.29, 32.87)$
- 6 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
- 7 The solution to the equation  $4x^2 + 98 = 0$  is
- 1)  $\pm 7$
  - 2)  $\pm 7i$
  - 3)  $\pm \frac{7\sqrt{2}}{2}$
  - 4)  $\pm \frac{7i\sqrt{2}}{2}$

8 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)  $y = 2 \cos \frac{1}{2}x$

9 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

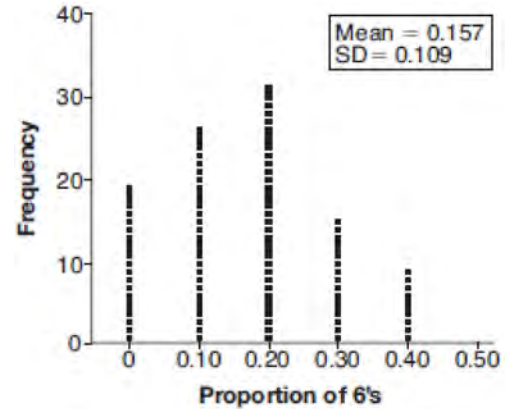
- 1)  $0.15x^3 + 0.02x^2 - 28x + 120$
- 2)  $-0.15x^3 - 0.02x^2 + 28x - 120$
- 3)  $-0.15x^3 + 0.01x^2 - 2.01x - 120$
- 4)  $-0.15x^3 + 32x + 120$

10 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.

11 Which binomial is a factor of  $x^4 - 4x^2 - 4x + 8$ ?

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



12 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)  $\frac{\sqrt{35}}{5}$

- 13 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)  $P = 714(0.9750)^y$

- 14 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

- 15 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.

- 16 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

- 17 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)  $y = 8(x - 1)^2$

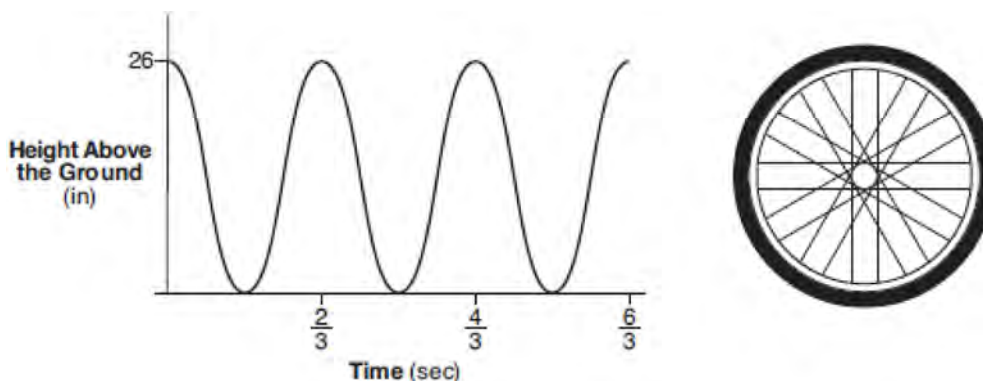
4)  $y = \frac{1}{8}(x - 1)^2$

- 18 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:
- The current population is 110 million.
  - The population increases continuously by approximately 3.9% per year.
- This model supports
- I, only
  - II, only
  - both I and II
  - neither I nor II
- 19 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?
- 2 is an extraneous solution.
  - $\frac{7}{2}$  is an extraneous solution.
  - 0 and 2 are extraneous solutions.
  - This equation does not contain any extraneous solutions.
- 20 Given  $f(9) = -2$ , which function can be used to generate the sequence  $-8, -7.25, -6.5, -5.75, \dots$ ?
- $f(n) = -8 + 0.75n$
  - $f(n) = -8 - 0.75(n - 1)$
  - $f(n) = -8.75 + 0.75n$
  - $f(n) = -0.75 + 8(n - 1)$
- 21 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?
- 3.66
  - 0.30
  - 0.26
  - 3.36
- 22 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.
- $C(n) = 329.99 + 108.78n$
  - $C(n) = 329.99 + 326.34n$
  - $C(n) = \frac{329.99 + 108.78n}{n}$
  - $C(n) = \frac{329.99 + 326.34n}{n}$
- 23 The expression  $\frac{-3x^2 - 5x + 2}{x^3 + 2x^2}$  can be rewritten as
- $\frac{-3x - 3}{x^2 + 2x}$
  - $\frac{-3x - 1}{x^2}$
  - $-3x^{-1} + 1$
  - $-3x^{-1} + x^{-2}$
- 24 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?
- $S = 100(1.03)^{12}$
  - $S = \frac{100 - 100(1.0025)^{12}}{1 - 1.0025}$
  - $S = 100(1.0025)^{12}$
  - $S = \frac{100 - 100(1.03)^{12}}{1 - 1.03}$
- 25 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.

- 26 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.

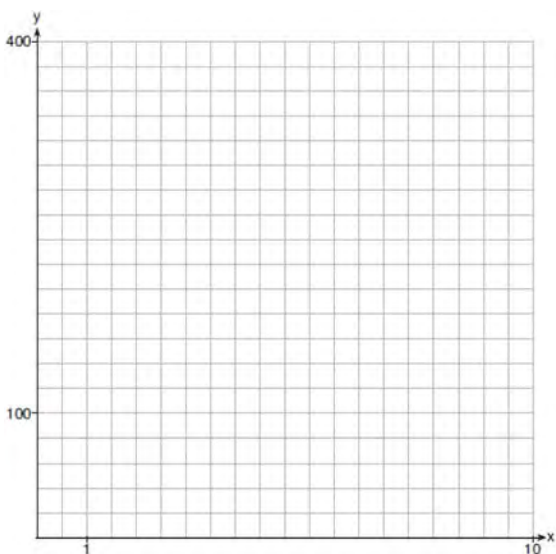
- 27 Over the set of integers, factor the expression  $4x^3 - x^2 + 16x - 4$  completely.

- 28 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.

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



- 30 Solve algebraically for all values of  $x$ :  $\sqrt{x-4} + x = 6$

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

32 Data collected about jogging from students with two older siblings are shown in the table below.

	Neither Sibling Jogs	One Sibling Jogs	Both Siblings Jog
Student Does Not Jog	1168	1823	1380
Student Jogs	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.

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

$$x + y + z = 1$$

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

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

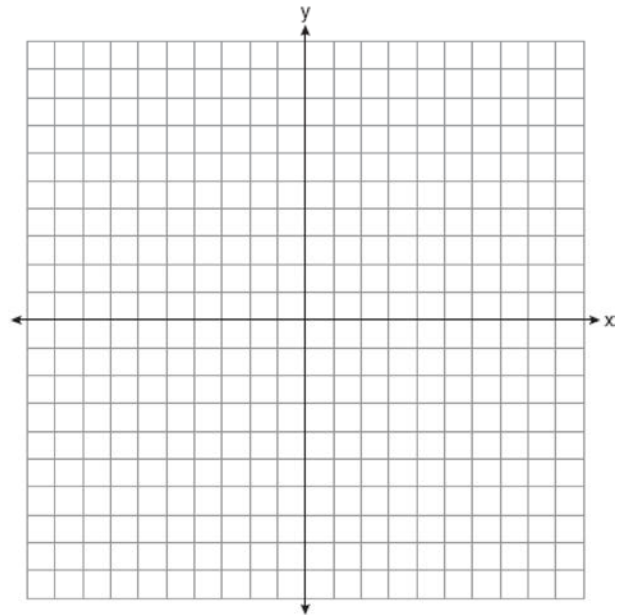
34 Jim is looking to buy a vacation home for \$172,600 near his favorite southern beach. The formula to compute a mortgage payment,  $M$ , is

$$M = P \cdot \frac{r(1+r)^N}{(1+r)^N - 1}$$

where  $P$  is the principal

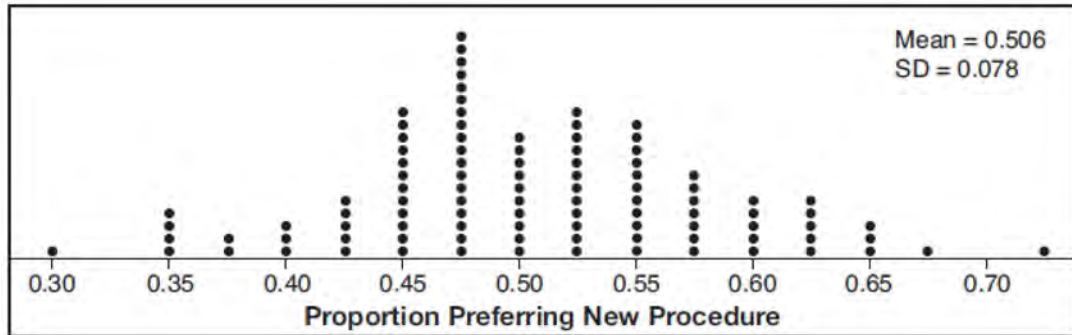
amount of the loan,  $r$  is the monthly interest rate, and  $N$  is the number of monthly payments. Jim's bank offers a monthly interest rate of 0.305% for a 15-year mortgage. With no down payment, determine Jim's mortgage payment, rounded to the nearest dollar. Algebraically determine and state the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

35 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.

- 36 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.

- 37 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

$$A = A_0 \left( \frac{1}{2} \right)^{\frac{t}{h}}$$

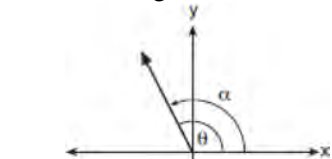
that models this situation, where  $h$  is the constant representing the number of hours in the half-life,

$A_0$  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*.

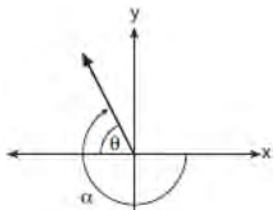
**0817AII Common Core State Standards**

- 1 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
- 2 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)  $9k^2 - 12ki + 4$
- 3 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  $-1 - 4i$
- 4 The solution set for the equation  $\sqrt{x+14} - \sqrt{2x+5} = 1$  is
- 1)  $\{-6\}$
  - 2)  $\{2\}$
  - 3)  $\{18\}$
  - 4)  $\{2, 22\}$
- 5 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
- 6 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)  $x^2 = 4y$

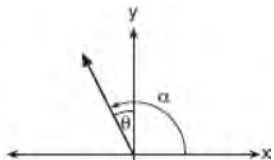
- 7 Which diagram represents an angle,  $\alpha$ , measuring  $\frac{13\pi}{20}$  radians drawn in standard position, and its reference angle,  $\theta$ ?



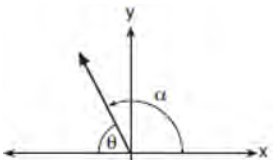
1)



2)



3)



4)

- 8 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  $-i$

- 9 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

- 10 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?

- 1)  $A = 100 \left( \frac{73.83}{2} \right)^t$
- 2)  $A = 100 \left( \frac{1}{147.66} \right)^t$
- 3)  $A = 100(0.990656)^t$
- 4)  $A = 100(0.116381)^t$

- 11 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

- 12 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

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

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

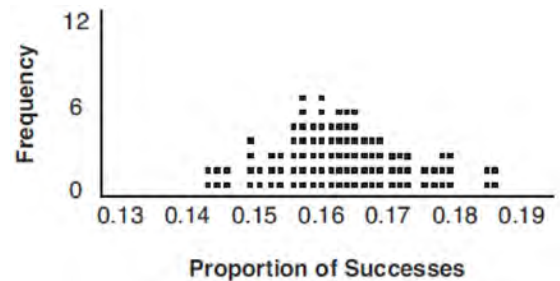
- 1)  $2x^2 + x + 5$   
 2)  $2x^2 + \frac{11}{2} + \frac{1}{2(2x - 1)}$   
 3)  $2x^2 - x + 5$   
 4)  $2x^2 - x + 4 + \frac{1}{2x - 1}$
- 14 The inverse of the function  $f(x) = \frac{x + 1}{x - 2}$  is

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

- 15 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)  $(x^2 - 4)^2 - 5(x^2 - 4) - 6 = (x^2 - 7)(x^2 - 6)$

- 16 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.



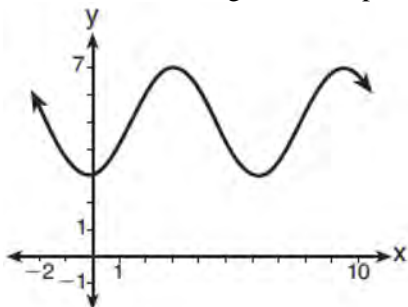
At a 95% confidence level, the proportion of New York City residents with hypertension and the margin of error are closest to

- 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  $\approx .16$

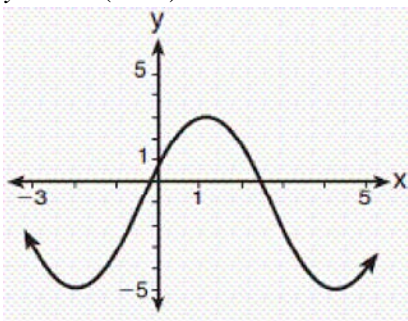


- 17 Which scenario is best described as an observational study?
- 1) For a class project, students in Health class ask every tenth student entering the school if they eat breakfast in the morning.
  - 2) A social researcher wants to learn whether or not there is a link between attendance and grades. 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.

- 18 Which sinusoid has the greatest amplitude?



- 1)
- 2)  $y = 3 \sin(\theta - 3) + 5$



- 3)
- 4)  $y = -5 \sin(\theta - 1) - 3$

- 19 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
- 20 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)  $x - 7$
- 21 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
- 22 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.

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

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

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

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

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

24 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)  $a_0 = 1000$

$$a_n = a_{n-1}(1.018) + 750n$$

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

26 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?

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

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

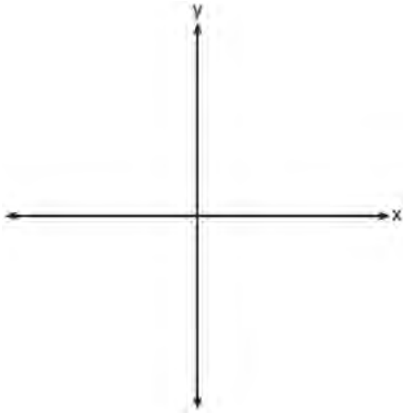
28 Mrs. Jones had hundreds of jelly beans in a bag that contained equal numbers of six different flavors. Her student randomly selected four jelly beans and they were all black licorice. Her student complained and said "What are the odds I got all of that kind?" Mrs. Jones replied, "simulate rolling 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.

29 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.

30 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.

31 Algebraically determine whether the function  $j(x) = x^4 - 3x^2 - 4$  is odd, even, or neither.

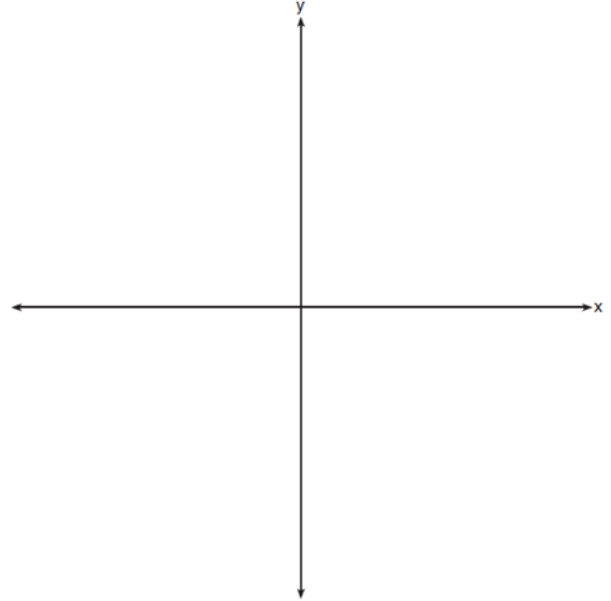
- 32 On the axes below, sketch a possible function  $p(x) = (x - a)(x - b)(x + c)$ , where  $a$ ,  $b$ , and  $c$  are positive,  $a > b$ , and  $p(x)$  has a positive  $y$ -intercept of  $d$ . Label all intercepts.



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

- 34 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.

- 35 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  $2\pi$ .



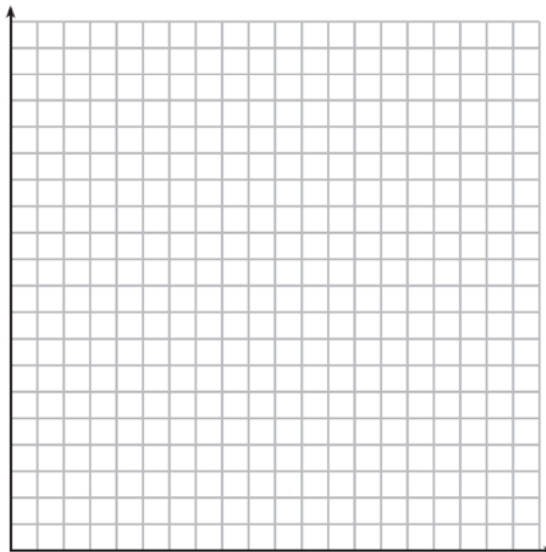
- b) Explain any differences between a sketch of  $y = 2 \sin\left(x - \frac{\pi}{3}\right) - \frac{3}{2}$  and the sketch from part a.

- 36 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.

- 37 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.

**0118AII Common Core State Standards**

1 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

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

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

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

3 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

4 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

5 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.

6 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)  $x(x+a) + b(x+a)$

- 7 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
- 3
  - 5
  - 10
  - 22
- 8 For a given time,  $x$ , in seconds, an electric current,  $y$ , can be represented by  $y = 2.5(1 - 2.7^{-10x})$ . Which equation is *not* equivalent?
- $y = 2.5 - 2.5(2.7^{-10x})$
  - $y = 2.5 - 2.5\left((2.7^2)^{-0.5x}\right)$
  - $y = 2.5 - 2.5\left(\frac{1}{2.7^{10x}}\right)$
  - $y = 2.5 - 2.5(2.7^{-2})(2.7^{0.5x})$
- 9 What is the quotient when  $10x^3 - 3x^2 - 7x + 3$  is divided by  $2x - 1$ ?
- $5x^2 + x + 3$
  - $5x^2 - x + 3$
  - $5x^2 - x - 3$
  - $5x^2 + x - 3$
- 10 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?
- 2%
  - 2.2%
  - 0.02%
  - 0.022%
- 11 If  $n = \sqrt{a^5}$  and  $m = a$ , where  $a > 0$ , an expression for  $\frac{n}{m}$  could be
- $a^{\frac{5}{2}}$
  - $a^4$
  - $\sqrt[3]{a^2}$
  - $\sqrt{a^3}$
- 12 The solutions to  $x + 3 - \frac{4}{x-1} = 5$  are
- $\frac{3}{2} \pm \frac{\sqrt{17}}{2}$
  - $\frac{3}{2} \pm \frac{\sqrt{17}}{2}i$
  - $\frac{3}{2} \pm \frac{\sqrt{33}}{2}$
  - $\frac{3}{2} \pm \frac{\sqrt{33}}{2}i$
- 13 If  $ae^{bt} = c$ , where  $a$ ,  $b$ , and  $c$  are positive, then  $t$  equals
- $\ln\left(\frac{c}{ab}\right)$
  - $\ln\left(\frac{cb}{a}\right)$
  - $\frac{\ln\left(\frac{c}{a}\right)}{b}$
  - $\frac{\ln\left(\frac{c}{a}\right)}{\ln b}$

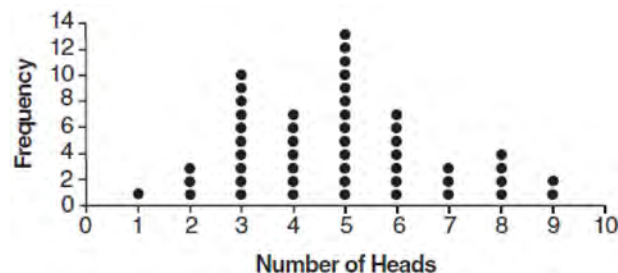
- 14 For which values of  $x$ , rounded to the *nearest hundredth*, will  $|x^2 - 9| - 3 = \log_3 x$ ?
- 1) 2.29 and 3.63
  - 2) 2.37 and 3.54
  - 3) 2.84 and 3.17
  - 4) 2.92 and 3.06
- 15 The terminal side of  $\theta$ , an angle in standard position, intersects the unit circle at  $P\left(-\frac{1}{3}, -\frac{\sqrt{8}}{3}\right)$ .
- What is the value of  $\sec \theta$ ?
- 1)  $-3$
  - 2)  $-\frac{3\sqrt{8}}{8}$
  - 3)  $-\frac{1}{3}$
  - 4)  $-\frac{\sqrt{8}}{3}$

- 16 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)  $y = -6$
- 17 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

- 18 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)  $\frac{-c + d}{d + 2c}$

- 19 If  $p(x) = 2x^3 - 3x + 5$ , what is the remainder of  $p(x) \div (x - 5)$ ?
- 1)  $-230$
  - 2)  $0$
  - 3)  $40$
  - 4)  $240$

- 20 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.

21 What is the inverse of  $f(x) = -6(x - 2)$ ?

- 1)  $f^{-1}(x) = -2 - \frac{x}{6}$
- 2)  $f^{-1}(x) = 2 - \frac{x}{6}$
- 3)  $f^{-1}(x) = \frac{1}{-6(x - 2)}$
- 4)  $f^{-1}(x) = 6(x + 2)$

22 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

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

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

26 A runner is using a nine-week training app to prepare for a "fun run." The table below represents the amount of the program completed,  $A$ , and the distance covered in a session,  $D$ , in miles.

<b>A</b>	$\frac{4}{9}$	$\frac{5}{9}$	$\frac{6}{9}$	$\frac{8}{9}$	1
<b>D</b>	2	2	2.25	3	3.25

Based on these data, write an exponential regression equation, rounded to the *nearest thousandth*, to model the distance the runner is able to complete in a session as she continues through the nine-week program.

24 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)  $a_1 = 25,000, a_n = a_{n+1} + 1000$

25 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  $(3 - i)$ .



- 27 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.

- 28 Completely factor the following expression:  
 $x^2 + 3xy + 3x^3 + y$

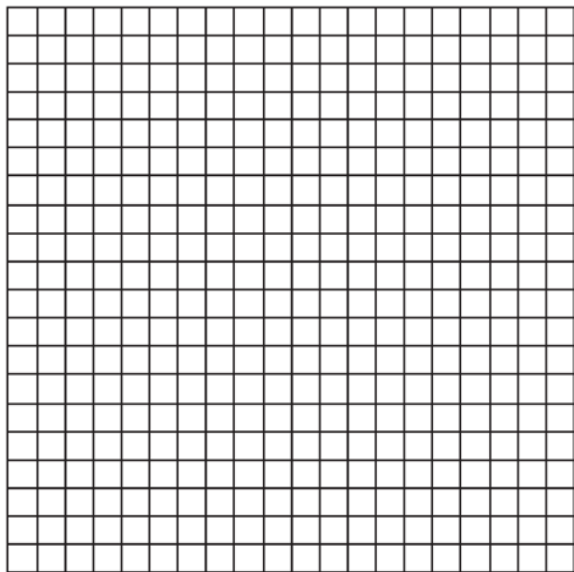
- 29 Researchers in a local area found that the population of rabbits with an initial population of 20 grew continuously at the rate of 5% per month. The fox population had an initial value of 30 and grew continuously at the rate of 3% per month. Find, to the *nearest tenth of a month*, how long it takes for these populations to be equal.

- 30 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

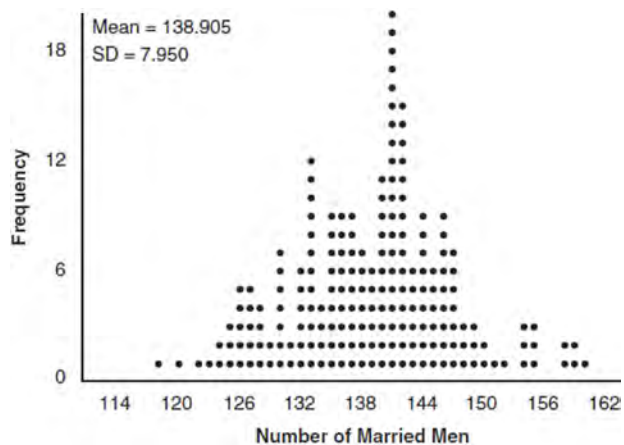
Determine which function has the *smaller* minimum value for the domain  $[-2, 2]$ . Justify your answer.

- 31 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.



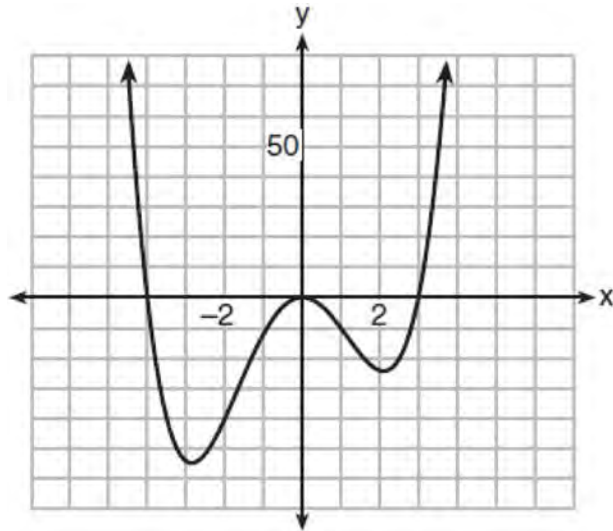
- 32 Explain why  $81^{\frac{3}{4}}$  equals 27.
- 33 Given:  $f(x) = 2x^2 + x - 3$  and  $g(x) = x - 1$   
Express  $f(x) \cdot g(x) - [f(x) + g(x)]$  as a polynomial in standard form.

- 34 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.
- 35 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.



- a) 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*.
- b) 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.

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

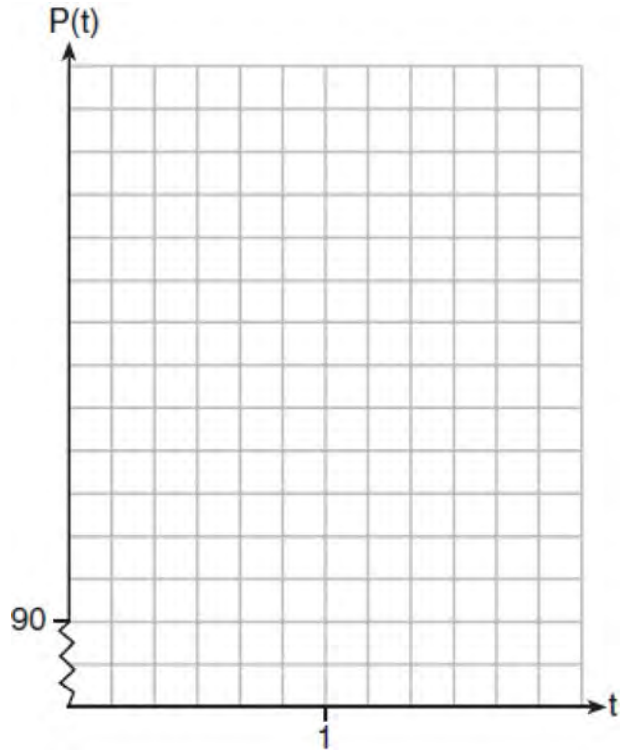


Write an equation for  $f(x)$ . The function  $g$  is formed by translating function  $f$  left 2 units. Write an equation for  $g(x)$ .

- 37 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.

## 0618aii

- 1 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)  $(-2, -1)$

- 2 Which statement is true about the graph of

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

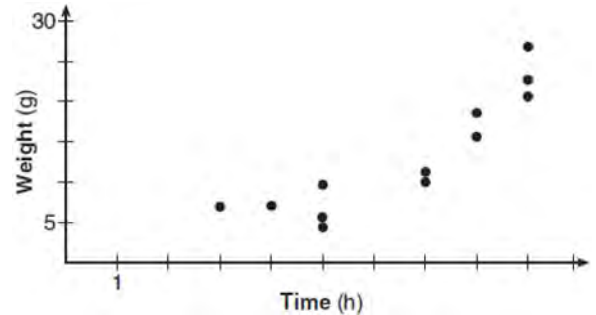
- 1) The graph is always increasing.
- 2) The graph is always decreasing.
- 3) The graph passes through  $(1, 0)$ .
- 4) The graph has an asymptote,  $x = 0$ .

- 3 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)  $\frac{x^2-9}{x(x-3)}$

- 4 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)  $w = 8(.75)^t$

- 5 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)  $-3x^2 - 6xi - 18$

- 6 Which function is even?

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

7 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)  $[1, 30]$

8 Which expression can be rewritten as  $(x + 7)(x - 1)$ ?

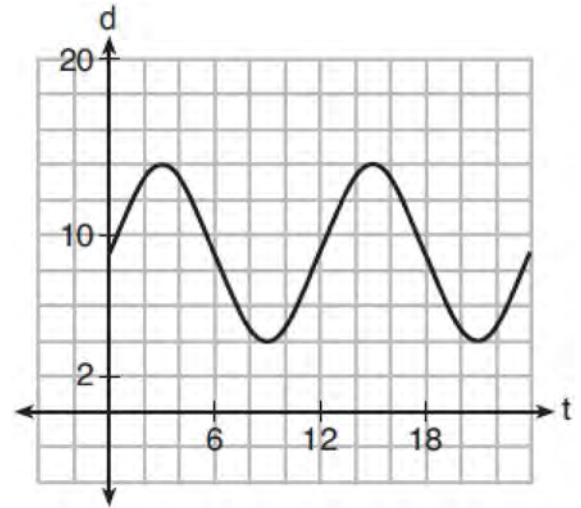
- 1)  $(x + 3)^2 - 16$
- 2)  $(x + 3)^2 - 10(x + 3) - 2(x + 3) + 20$
- 3)  $\frac{(x - 1)(x^2 - 6x - 7)}{(x + 1)}$
- 4)  $\frac{(x + 7)(x^2 + 4x + 3)}{(x + 3)}$

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

10 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)  $d = 5 \sin\left(\frac{\pi}{6}t\right) + 9$

11 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%

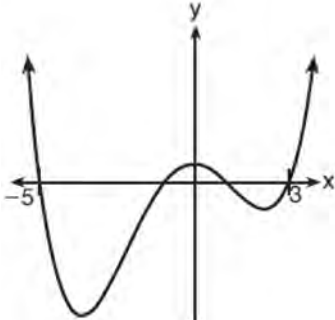
- 12 If  $x - 1$  is a factor of  $x^3 - kx^2 + 2x$ , what is the value of  $k$ ?
- 1) 0
  - 2) 2
  - 3) 3
  - 4) -3
- 13 The profit function,  $p(x)$ , for a company is the cost function,  $c(x)$ , subtracted from the revenue function,  $r(x)$ . The profit function for the Acme Corporation is  $p(x) = -0.5x^2 + 250x - 300$  and the revenue function is  $r(x) = -0.3x^2 + 150x$ . The cost function for the Acme Corporation is
- 1)  $c(x) = 0.2x^2 - 100x + 300$
  - 2)  $c(x) = 0.2x^2 + 100x + 300$
  - 3)  $c(x) = -0.2x^2 + 100x - 300$
  - 4)  $c(x) = -0.8x^2 + 400x - 300$
- 14 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

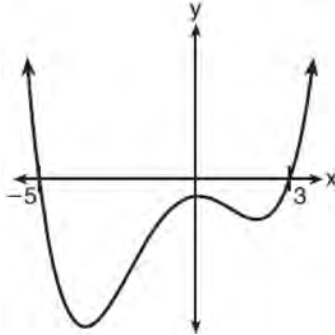
Assuming the trend continues, approximately how many years after the beginning of 2018 will it take for the populations to be equal?

- 1) 7
  - 2) 20
  - 3) 68
  - 4) 125
- 15 What is the inverse of  $f(x) = x^3 - 2$ ?
- 1)  $f^{-1}(x) = \sqrt[3]{x} + 2$
  - 2)  $f^{-1}(x) = \pm\sqrt[3]{x} + 2$
  - 3)  $f^{-1}(x) = \sqrt[3]{x+2}$
  - 4)  $f^{-1}(x) = \pm\sqrt[3]{x+2}$

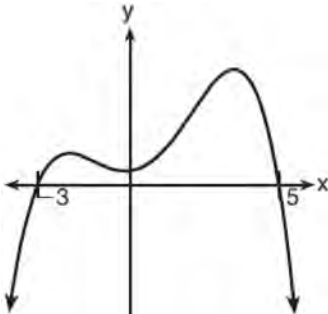
- 16 A 4th degree polynomial has zeros  $-5$ ,  $3$ ,  $i$ , and  $-i$ . Which graph could represent the function defined by this polynomial?



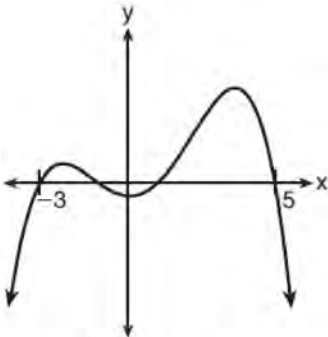
1)



2)



3)



4)

- 17 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

- 18 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)  $11.542$

- 19 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)  $(3,0)$

- 20 For positive values of  $x$ , which expression is

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

- 1)  $6\sqrt[3]{x^5}$
  - 2)  $6\sqrt[5]{x^3}$
  - 3)  $4\sqrt[3]{x^2} + 2\sqrt[3]{x^5}$
  - 4)  $4\sqrt{x^3} + 2\sqrt[5]{x^3}$
- 21 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)  $(x + 2)^2 = -8(y - 7)$

- 22 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)  $x = y + 2z$

- 23 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)  $29,400 \left( 1.068^{\frac{1}{365}} \right)^{365t}$

- 24 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)  $\frac{16x + y}{124}$

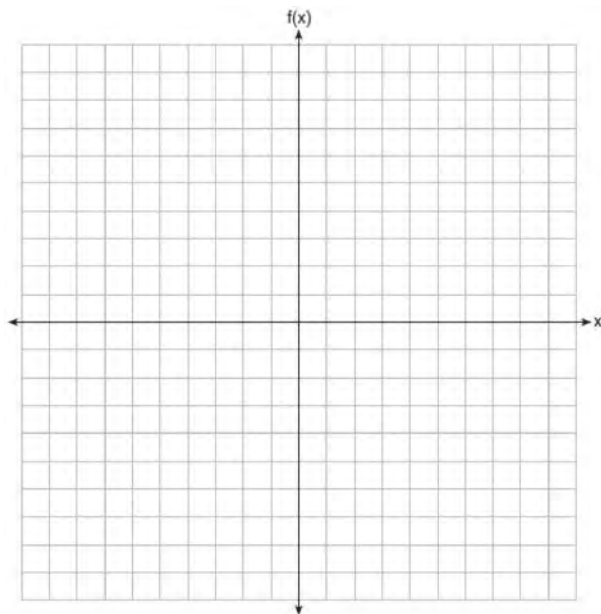


- 25 A survey about television-viewing preferences was given to randomly selected freshmen and seniors at Fairport High School. The results are shown in the table below.

Favorite Type of Program			
	Sports	Reality Show	Comedy Series
Senior	83	110	67
Freshmen	119	103	54

A student response is selected at random from the results. State the *exact* probability the student response is from a freshman, given the student prefers to watch reality shows on television.

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



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

- 28 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.

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

- 30 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.

- 31 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

- 32 An angle,  $\theta$ , is in standard position and its terminal side passes through the point  $(2, -1)$ . Find the *exact* value of  $\sin \theta$ .

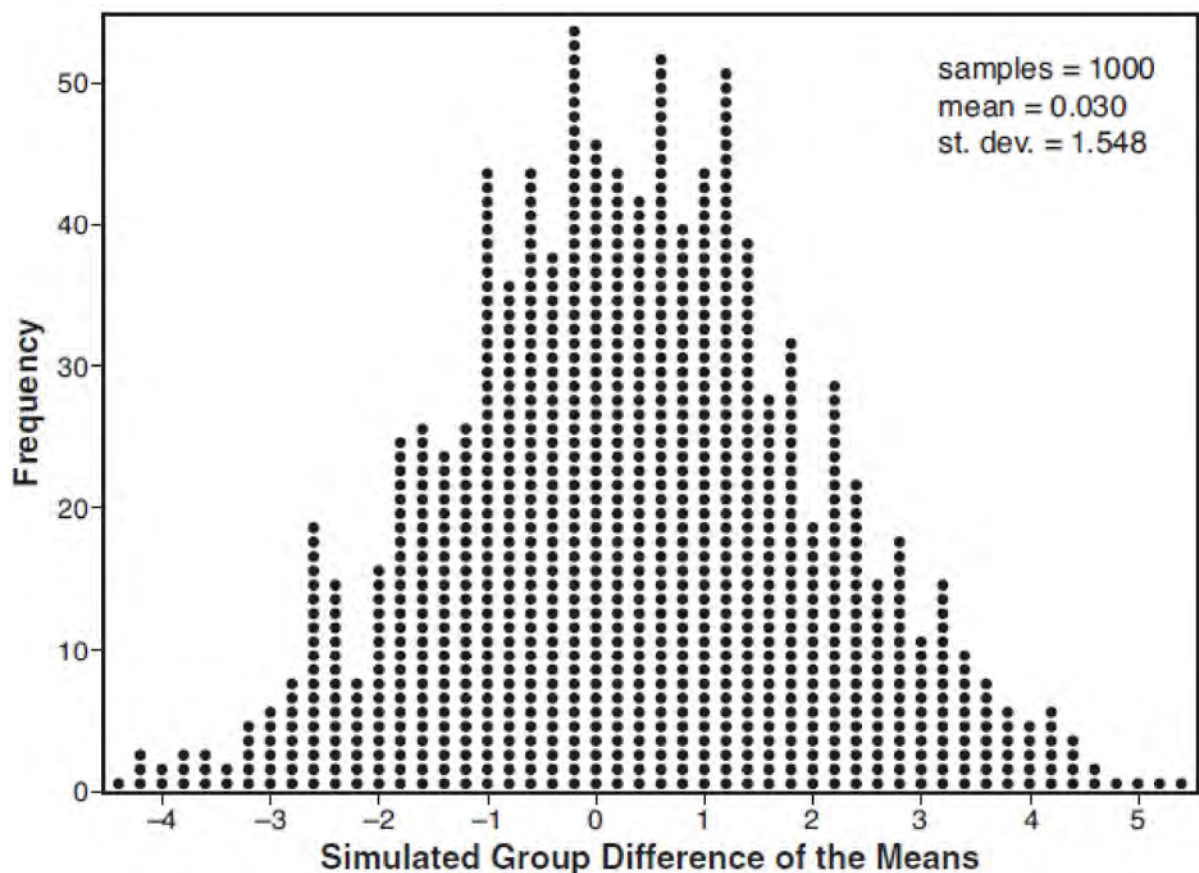
- 33 Solve algebraically for all values of  $x$ :

$$\sqrt{6 - 2x} + x = 2(x + 15) - 9$$

- 34 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.

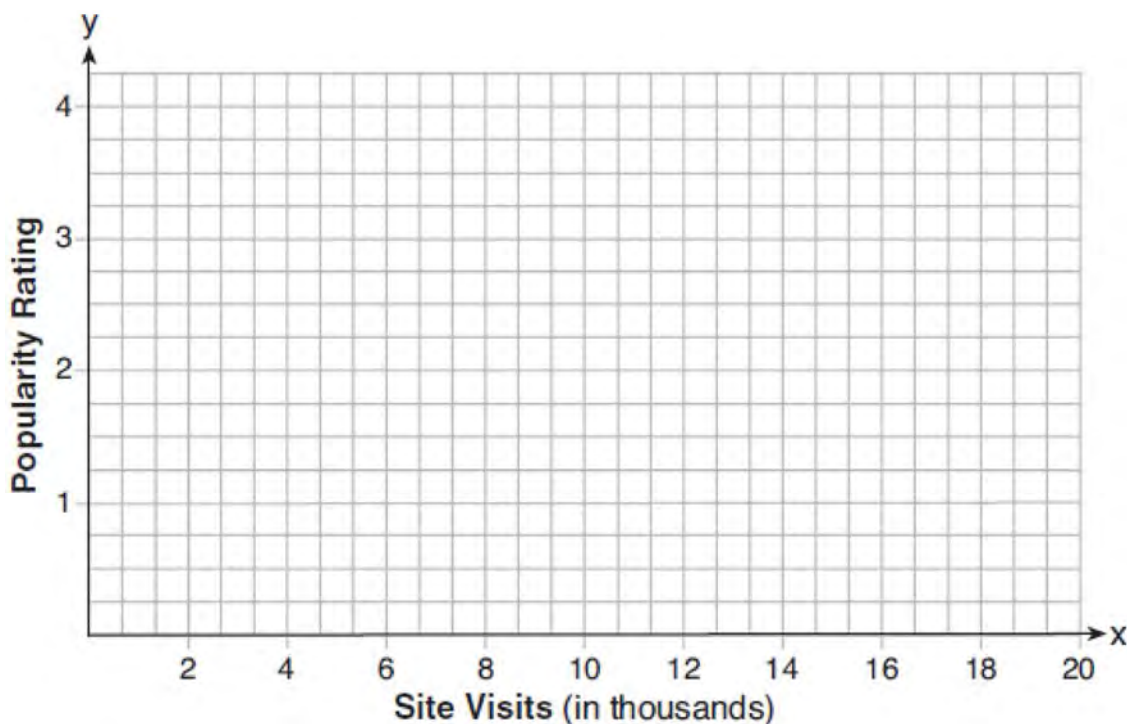
	Scented Paper	Unscented Paper
$\bar{x}$	23	18
$s_x$	2.898	2.408

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.

- 35 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*.
- 36 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.
- 37 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.

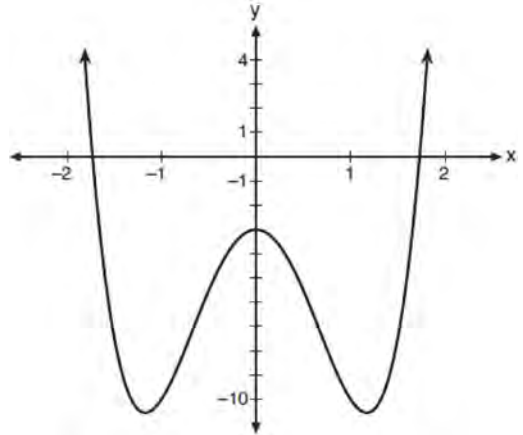


An alternative rating model is represented by  $R(x) = \frac{1}{2}x - 6$ , where  $x$  is the number of visits per week in thousands. Graph  $R(x)$  on the same set of axes. For what number of weekly visits will the two models provide the same rating?

**0818AII Common Core State Standards**

- 1 The solution of  $87e^{0.3x} = 5918$ , to the nearest thousandth, is
- 1) 0.583
  - 2) 1.945
  - 3) 4.220
  - 4) 14.066
- 2 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
- 3 If  $f(x) = x^2 + 9$  and  $g(x) = x + 3$ , which operation would not result in a polynomial expression?
- 1)  $f(x) + g(x)$
  - 2)  $f(x) - g(x)$
  - 3)  $f(x) \cdot g(x)$
  - 4)  $f(x) \div g(x)$

- 4 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.
- 5 Which expression is equivalent to  $\frac{2x^4 + 8x^3 - 25x^2 - 6x + 14}{x + 6}$ ?
- 1)  $2x^3 + 4x^2 + x - 12 + \frac{86}{x + 6}$
  - 2)  $2x^3 - 4x^2 - x + 14$
  - 3)  $2x^3 - 4x^2 - x + \frac{14}{x + 6}$
  - 4)  $2x^3 - 4x^2 - x$

- 6 Given  $f(x) = \frac{1}{2}x + 8$ , which equation represents the inverse,  $g(x)$ ?
- 1)  $g(x) = 2x - 8$
  - 2)  $g(x) = 2x - 16$
  - 3)  $g(x) = -\frac{1}{2}x + 8$
  - 4)  $g(x) = -\frac{1}{2}x - 16$
- 7 The value(s) of  $x$  that satisfy  $\sqrt{x^2 - 4x - 5} = 2x - 10$  are
- 1) {5}
  - 2) {7}
  - 3) {5, 7}
  - 4) {3, 5, 7}
- 8 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)  $C = 550(1.00643)^{t+12}$
- 9 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)  $-\frac{1}{3} \pm \frac{\sqrt{11}}{3}$
- 10 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)  $a_0 = 75,000$   
 $a_n = 0.92(a_{n-1})$
- 11 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)  $\frac{24}{7}$

- 12 For
- $x > 0$
- , which expression is equivalent to

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

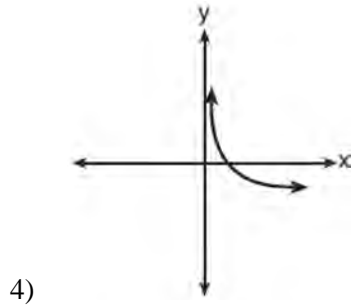
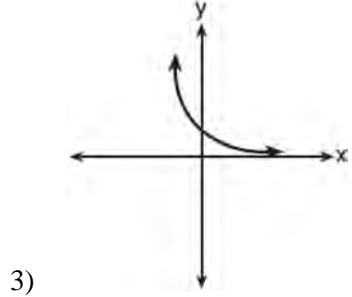
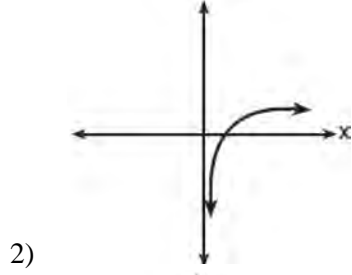
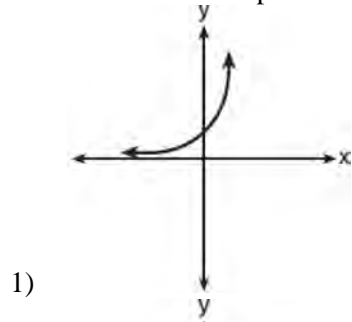
- 1)  $x$
- 2)  $x^{\frac{3}{2}}$
- 3)  $x^3$
- 4)  $x^{10}$
- 13 Jake wants to buy a car and hopes to save at least \$5000 for a down payment. The table below summarizes the amount of money he plans to save each week.

Week	1	2	3	4	5
Money Saved, in Dollars	2	5	12.5	31.25	...

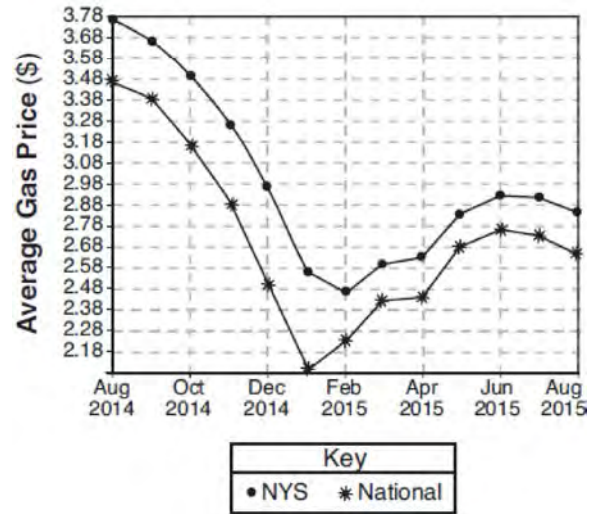
Based on this plan, which expression should he use to determine how much he has saved in  $n$  weeks?

- 1)  $\frac{2 - 2(2.5^n)}{1 - 2.5}$
- 2)  $\frac{2 - 2(2.5^{n-1})}{1 - 2.5}$
- 3)  $\frac{1 - 2.5^n}{1 - 2.5}$
- 4)  $\frac{1 - 2.5^{n-1}}{1 - 2.5}$
- 14 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)  $(x^3y^2 + 3)(x^3y^2 - 3)(x^2 + 4)(x^2 - 4)$
- 15 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)  $-19 + 27i$

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



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

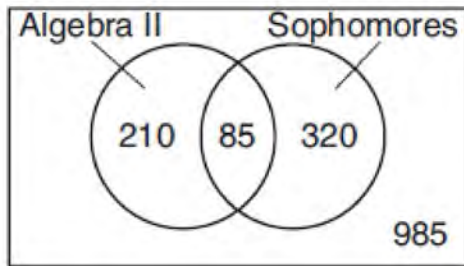


If New York State's gas prices are modeled by  $G(x)$  and  $C > 0$ , which expression best approximates the national average  $x$  months from August 2014?

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



- 18 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)  $\frac{85}{1600}$
- 19 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

- 20 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)  $y = -4\cos(8x) + 5$

- 21 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)  $\pm 2i, 2$

- 22 The height above ground for a person riding a Ferris wheel after  $t$  seconds is modeled by

$$h(t) = 150\sin\left(\frac{\pi}{45}t + 67.5\right) + 160 \text{ feet. How many}$$

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

- 23 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)

- 24 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

- 25 Over the set of integers, factor the expression  $x^4 - 4x^2 - 12$ .

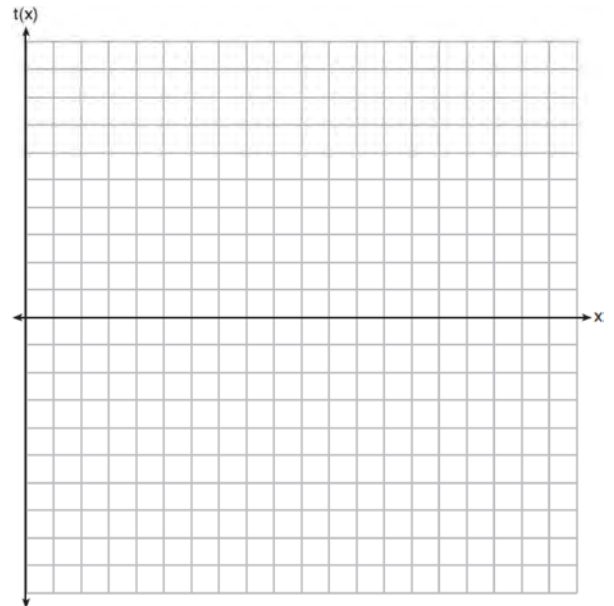
- 26 Express the fraction  $\frac{2x^{\frac{3}{2}}}{(16x^4)^{\frac{1}{4}}}$  in simplest radical form.

- 27 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*.

- 28 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.

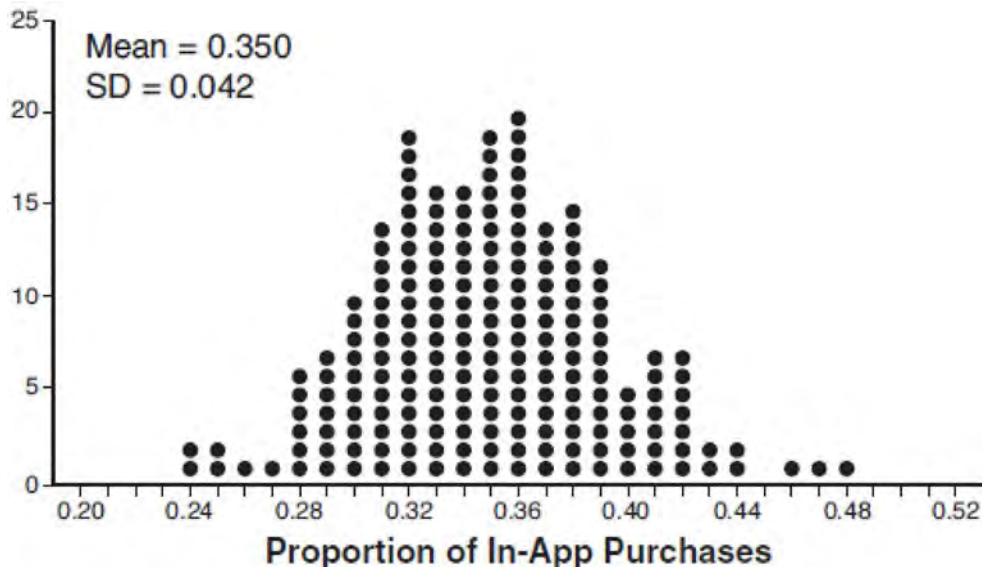
- 29 Algebraically solve for  $x$ :  $\frac{-3}{x+3} + \frac{1}{2} = \frac{x}{6} - \frac{1}{2}$

- 30 Graph  $t(x) = 3 \sin(2x) + 2$  over the domain  $[0, 2\pi]$  on the set of axes below.



- 31 Solve the following system of equations algebraically.  $x^2 + y^2 = 400$   
 $y = x - 28$

- 32 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.

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

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

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

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

- 34 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  $j(x)$ .

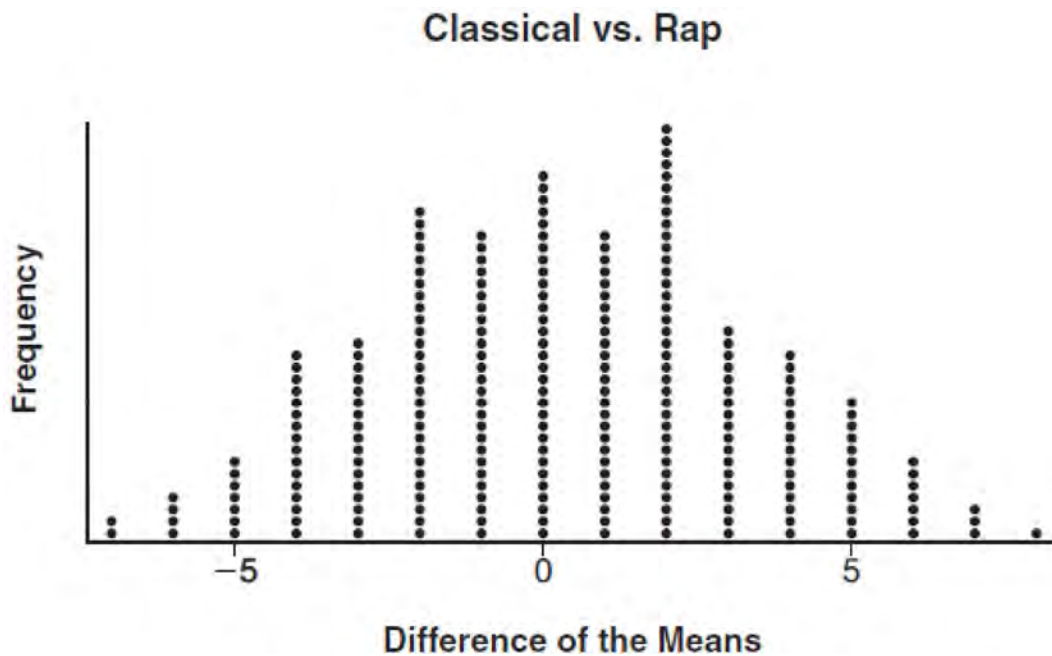
- 35 Determine, to the *nearest tenth of a year*, how long it would take an investment to double at a  $3\frac{3}{4}\%$  interest rate, compounded continuously.

- 36 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.



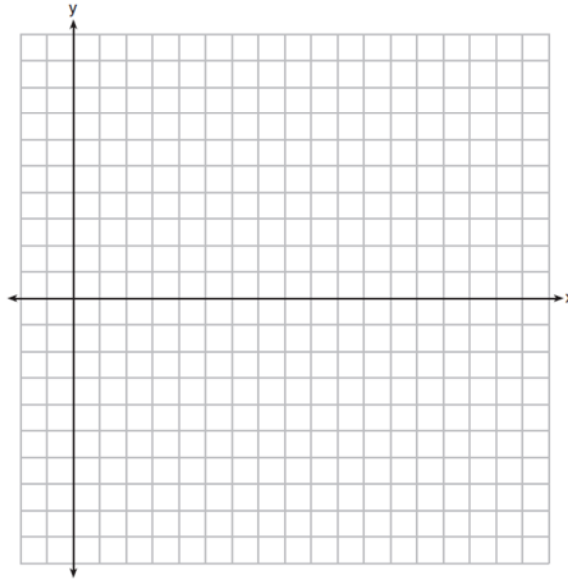
Does the simulation support the theory that there may be a significant difference in quiz scores? Explain.

- 37 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.

**0119AII Common Core State Standards**

- 1 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.      3) The variability will be the same for each data set.  
 2) Data set two has the greater variability.      4) No conclusion can be made regarding the variability of either set.
- 2 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)  $g(x) = \log_3(x + 5)$       3)  $g(x) = \log_3(x - 5)$   
 2)  $g(x) = \log_3 x + 5$       4)  $g(x) = \log_3 x - 5$
- 3 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      3) II and III, only  
 2) I and III, only      4) I, II, and III
- 4 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      3) 36  
 2) 34      4) 42
- 5 The solutions to the equation  $5x^2 - 2x + 13 = 9$  are
- 1)  $\frac{1}{5} \pm \frac{\sqrt{21}}{5}$       3)  $\frac{1}{5} \pm \frac{\sqrt{66}}{5}i$   
 2)  $\frac{1}{5} \pm \frac{\sqrt{19}}{5}i$       4)  $\frac{1}{5} \pm \frac{\sqrt{66}}{5}$
- 6 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)  $y = 166.67(1.04)^{0.12t}$       3)  $y = 2000(1.0032737)^{12t}$   
 2)  $y = 2000(1.01)^t$       4)  $y = 166.67(1.0032737)^t$

- 7 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

- 8 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.

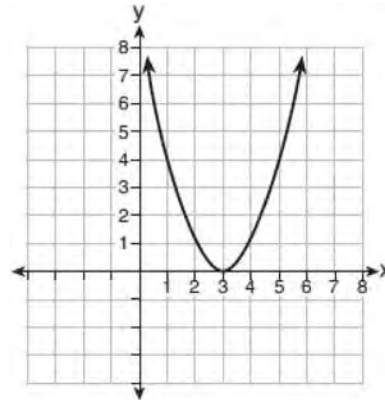
$$I(t) = 0.5t^4 + 3.45t^3 - 96.65t^2 + 347.7t,$$

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
- 9 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)  $2x^2 + 32 = 0$

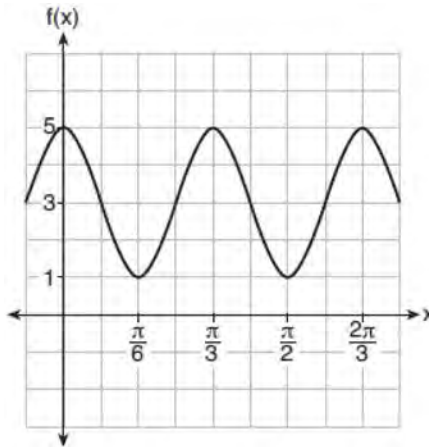
- 10 A random sample of 100 people that would best estimate the proportion of all registered voters in a district who support improvements to the high school football field should be drawn from registered voters in the district at a
- 1) football game
  - 2) supermarket
  - 3) school fund-raiser
  - 4) high school band concert

- 11 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)  $8x - 4i$

12 Suppose events  $A$  and  $B$  are independent and  $P(A \text{ and } B)$  is 0.2. Which statement could be true?

- 1)  $P(A) = 0.4, P(B) = 0.3, P(A \text{ or } B) = 0.5$       3)  $P(A|B) = 0.2, P(B) = 0.2$   
 2)  $P(A) = 0.8, P(B) = 0.25$                               4)  $P(A) = 0.15, P(B) = 0.05$

13 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)  $a = 2, b = 6, c = 3$     3)  $a = 4, b = 6, c = 5$   
 2)  $a = 2, b = 3, c = 1$     4)  $a = 4, b = \frac{\pi}{3}, c = 3$

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

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

15 What is the solution set of the equation  $\frac{2}{3x+1} = \frac{1}{x} - \frac{6x}{3x+1}$ ?

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



16 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)  $a_1 = 120$

3)  $a_1 = 2$

$a_n = a_{n-1} + 30$

$a_n = a_{n-1} + 0.5$

2)  $a_n = 90 + 30n$

4)  $a_n = 2.5 + 0.5n$

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

1)  $f^{-1}(x) = \log_x a$

3)  $f^{-1}(x) = \log_a x$

2)  $f^{-1}(x) = a \log x$

4)  $f^{-1}(x) = x \log a$

18 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?

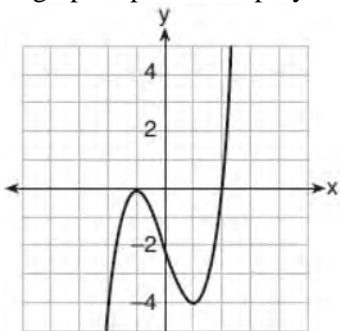
1)  $f(t) = 10,000(1.9)^t + 10,000e^{0.8t}$

3)  $f(t) = 10,000(1.075)^{12t} + 10,000e^{0.8t}$

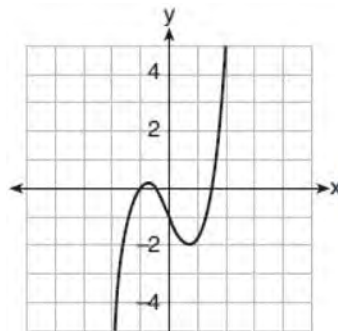
2)  $f(t) = 10,000(1.009)^t + 10,000e^{0.008t}$

4)  $f(t) = 10,000(1.00075)^{12t} + 10,000e^{0.008t}$

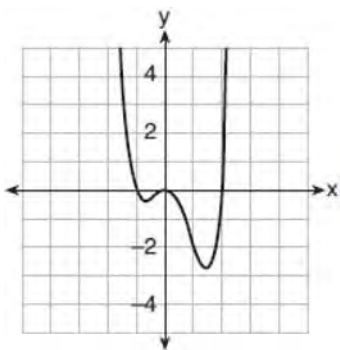
19 Which graph represents a polynomial function that contains  $x^2 + 2x + 1$  as a factor?



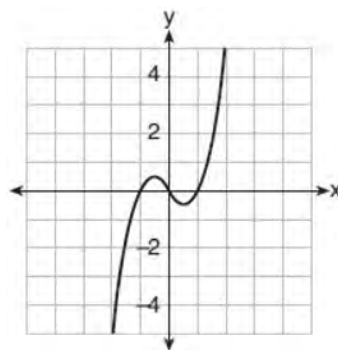
1)



3)



2)



4)

- 20 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.

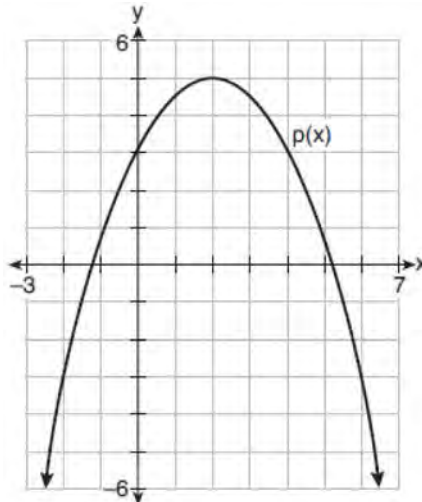
<b>Number of Half Lives</b>	1	2	3	4	5
<b>Amount of Sodium Iodide-131</b>	139.000	69.500	34.750	17.375	8.688

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

- 1) 0.001  
 2) 0.136  
 3) 0.271  
 4) 0.543
- 21 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
- 22 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

23 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?

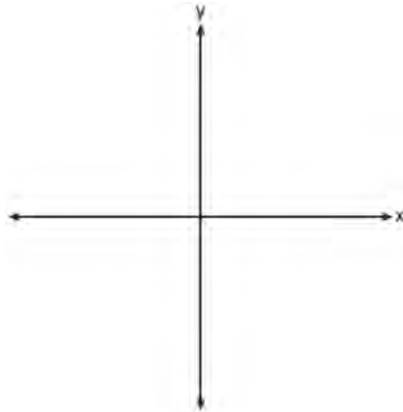
- |        |        |
|--------|--------|
| 1) 631 | 3) 238 |
| 2) 512 | 4) 119 |

24 How many solutions exist for  $\frac{1}{1-x^2} = -|3x-2| + 5$ ?

- |      |      |
|------|------|
| 1) 1 | 3) 3 |
| 2) 2 | 4) 4 |

25 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  $y \neq 0$ .

26 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.



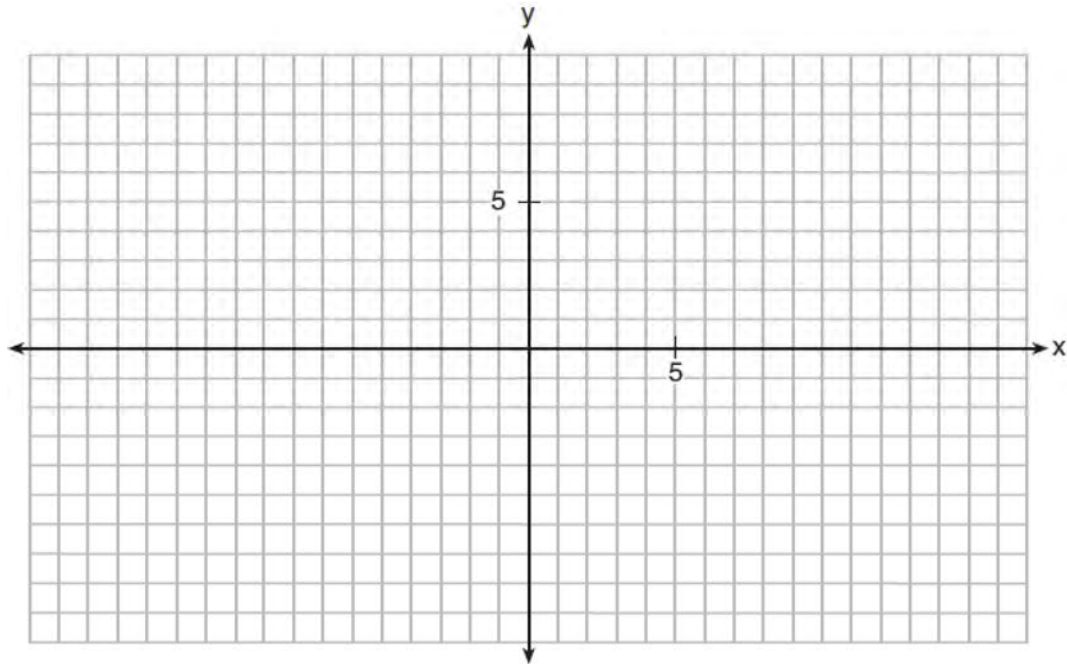
27 Erin and Christa were working on cubing binomials for math homework. Erin believed they could save time with a shortcut. She wrote down the rule below for Christa to follow.

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

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

28 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.

- 29 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*.
- 30 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.
- 31 Point  $M\left(t, \frac{4}{7}\right)$  is located in the second quadrant on the unit circle. Determine the exact value of  $t$ .
- 32 On the grid below, graph the function  $y = \log_2(x - 3) + 1$



- 33 Solve the following system of equations algebraically for all values of  $a$ ,  $b$ , and  $c$ .
- $$a + 4b + 6c = 23$$
- $$a + 2b + c = 2$$
- $$6b + 2c = a + 14$$

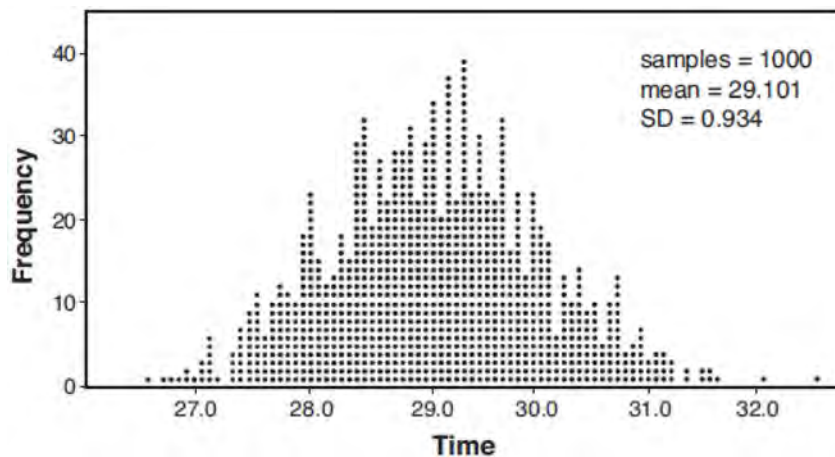
- 34 Given  $a(x) = x^4 + 2x^3 + 4x - 10$  and  $b(x) = x + 2$ , determine  $\frac{a(x)}{b(x)}$  in the form  $q(x) + \frac{r(x)}{b(x)}$ . Is  $b(x)$  a factor of  $a(x)$ ?

Explain.

- 35 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

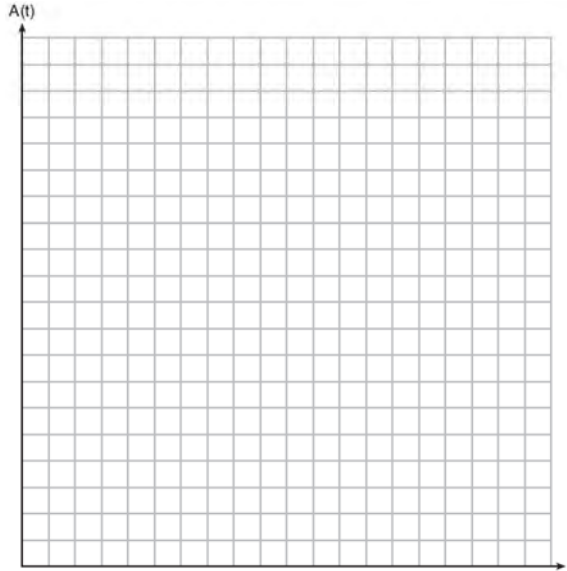
A simulation was run 1000 times based upon the results of the survey. The results of the simulation appear below.



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*.

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

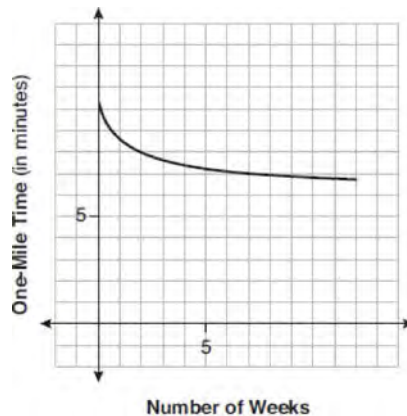
- 37 Tony is evaluating his retirement savings. He currently has \$318,000 in his account, which earns an interest rate of 7% compounded annually. He wants to determine how much he will have in the account in the future, even if he makes no additional contributions to the account. Write a function,  $A(t)$ , 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.

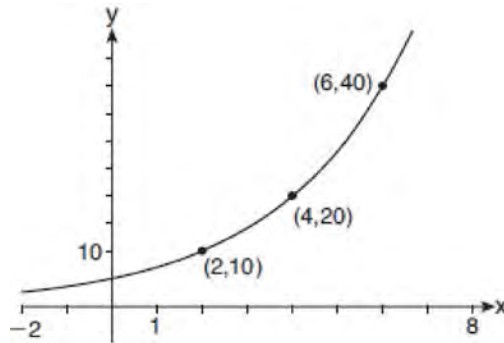
**0619aii**

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

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



Which expression defines  $f(x)$ ?

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

7 Given  $P(x) = x^3 - 3x^2 - 2x + 4$ , which statement is true?

- |  |   |
|--|---|
| 1) $(x - 1)$ is a factor because $P(-1) = 0$ . | 3) $(x + 1)$ is a factor because $P(1) = 0$ . |
| 2) $(x + 1)$ is a factor because $P(-1) = 2$ . | 4) $(x - 1)$ is a factor because $P(1) = 0$ . |

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

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

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

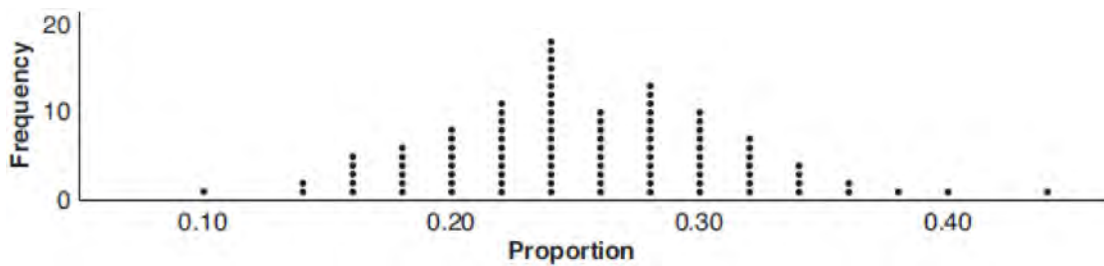
- |                                     |                           |
|-------------------------------------|---------------------------|
| 1) $x = \frac{1}{4}y - \frac{5}{4}$ | 3) $y = 4x - 5$           |
| 2) $y = \frac{1}{4}x - \frac{5}{4}$ | 4) $y = \frac{1}{4x + 5}$ |

10 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.  | 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. |
| 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. | 4) Sarah has \$100.00 in her piggy bank and saves an additional \$15.00 each week.   |



- 11 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)  $(n + 3)(n - 3)(n - 6)(n + 2)$
- 12 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)  $\pm i$
- 13 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)
  - 2) (0.134, 0.374)
  - 3) (-0.448, 0.568)
  - 4) (0.254, 0.374)
- 14 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
- 15 The expression  $6 - (3x - 2i)^2$  is equivalent to
- 1)  $-9x^2 + 12xi + 10$
  - 2)  $9x^2 - 12xi + 2$
  - 3)  $-9x^2 + 10$
  - 4)  $-9x^2 + 12xi - 4i + 6$

- 16 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

- 17 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  $S(t) = 50(1 - 0.02)^t$ .
- 18 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

- 19 The solution set for the equation  $b = \sqrt{2b^2 - 64}$  is
- 1)  $\{-8\}$
  - 2)  $\{8\}$
  - 3)  $\{\pm 8\}$
  - 4)  $\{\}$

- 20 Which table best represents an exponential relationship?

1) 

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

2) 

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

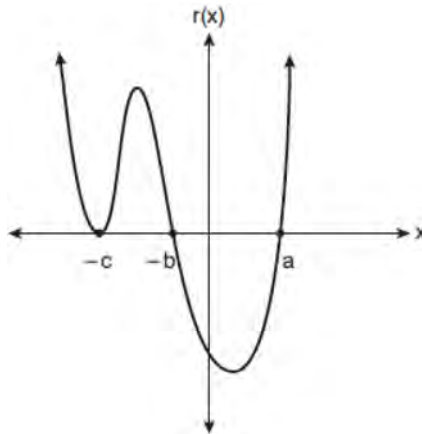
3) 

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

4) 

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

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



An equation for  $r(x)$  could be

- 1)  $r(x) = (x - a)(x + b)(x + c)$                       3)  $r(x) = (x + a)(x - b)(x - c)$   
 2)  $r(x) = (x + a)(x - b)(x - c)^2$                       4)  $r(x) = (x - a)(x + b)(x + c)^2$
- 22 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    3) 77  
 2) 74    4) 81
- 23 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    3) 3  
 2) 2    4) -4
- 24 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)  $400(1.001153846)^t$                                       3)  $400(1.001153846)^{52t}$   
 2)  $400(1.001121184)^t$                                       4)  $400(1.001121184)^{52t}$

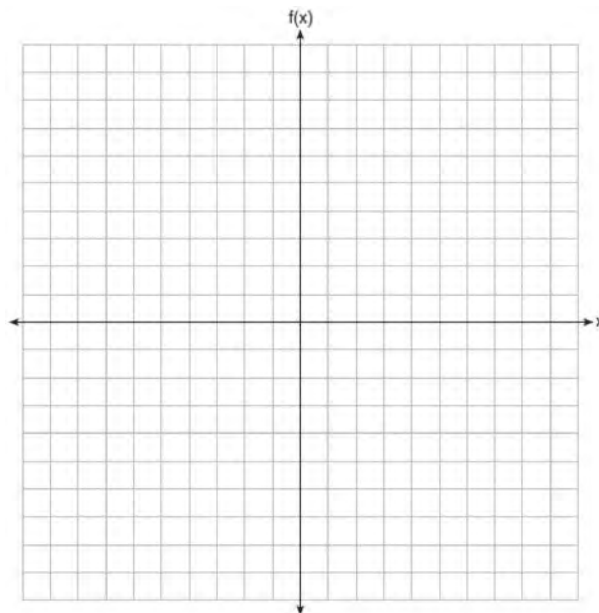
- 25 The table below shows the number of hours of daylight on the first day of each month in Rochester, NY.

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.

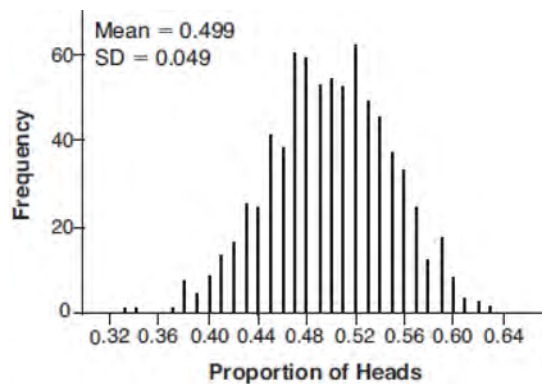
26 Algebraically solve for  $x$ :  $\frac{7}{2x} - \frac{2}{x+1} = \frac{1}{4}$

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



- 28 Given  $\tan \theta = \frac{7}{24}$ , and  $\theta$  terminates in Quadrant III, determine the value of  $\cos \theta$ .

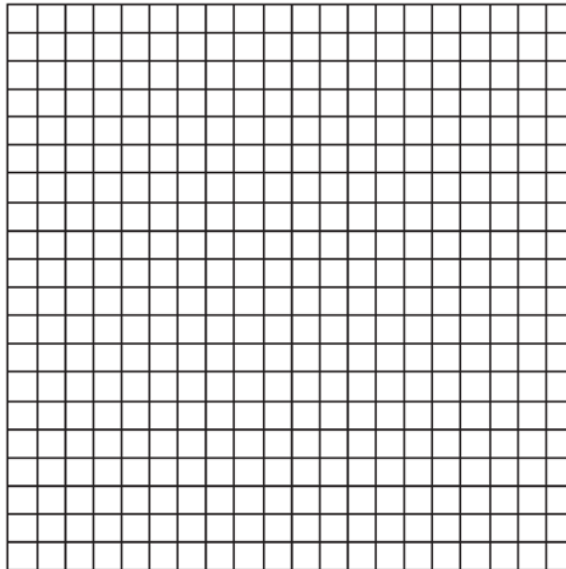
- 29 Kenzie believes that for  $x \geq 0$ , the expression  $\left(\sqrt[7]{x^2}\right)\left(\sqrt[5]{x^3}\right)$  is equivalent to  $\sqrt[35]{x^6}$ . Is she correct? Justify your response algebraically.
- 30 When the function  $p(x)$  is divided by  $x - 1$  the quotient is  $x^2 + 7 + \frac{5}{x - 1}$ . State  $p(x)$  in standard form.
- 31 Write a recursive formula for the sequence 6, 9, 13.5, 20.25, ...
- 32 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.

- 33 Factor completely over the set of integers:  $16x^4 - 81$ . Sara graphed the polynomial  $y = 16x^4 - 81$  and stated "All the roots of  $y = 16x^4 - 81$  are real." Is Sara correct? Explain your reasoning.
- 34 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.

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

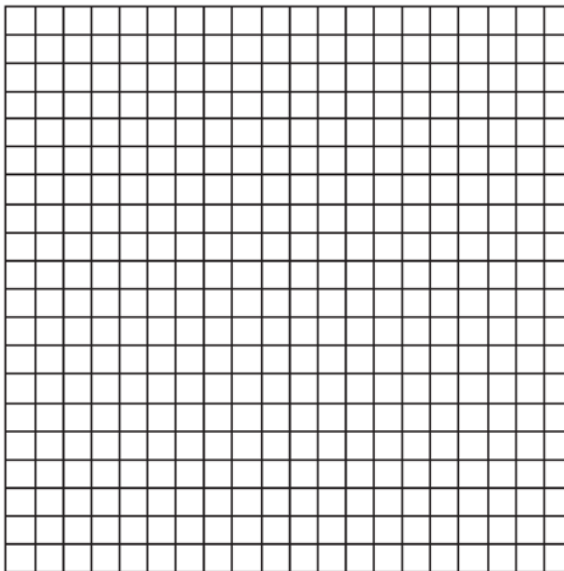


- 36 Juan and Filipe practice at the driving range before playing golf. The number of wins and corresponding practice times for each player are shown in the table below.

	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.

- 37 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.

**0819AII Regents Exam**

- 1 When the expression  $(x + 2)^2 + 4(x + 2) + 3$  is rewritten as the product of two binomials, the result is
- |                     |                     |
|---------------------|---------------------|
| 1) $(x + 3)(x + 1)$ | 3) $(x + 2)(x + 2)$ |
| 2) $(x + 5)(x + 3)$ | 4) $(x + 6)(x + 1)$ |
- 2 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 | 3) 2,125,760 |
| 2) 708,584 | 4) 6,377,288 |
- 3 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 | 3) quadratic function     |
| 2) linear function      | 4) trigonometric function |
- 4 If  $(a^3 + 27) = (a + 3)(a^2 + ma + 9)$ , then  $m$  equals
- |       |      |
|-------|------|
| 1) -9 | 3) 3 |
| 2) -3 | 4) 6 |
- 5 If  $\cos \theta = -\frac{3}{4}$  and  $\theta$  is in Quadrant III, then  $\sin \theta$  is equivalent to
- |                          |                   |
|--------------------------|-------------------|
| 1) $-\frac{\sqrt{7}}{4}$ | 3) $-\frac{5}{4}$ |
| 2) $\frac{\sqrt{7}}{4}$  | 4) $\frac{5}{4}$  |
- 6 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              | 3) survey                |
| 2) observational study | 4) controlled experiment |



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

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

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

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

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

8 Which description could represent the graph of  $f(x) = 4x^2(x+a) - x - a$ , if  $a$  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.

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

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

9 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)  $m_1 = 2000$

3)  $m_1 = 2000$

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

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

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

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

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

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

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

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

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

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

1)  $f(x - 2)$

3)  $f(x + 1)$

2)  $f(x) + 3$

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

- 12 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

- 13 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

- 14 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)  $3^{\frac{3}{2}}x^2y^{\frac{7}{6}}$

- 15 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)  $\{\}$

- 16 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

- 17 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

- 18 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
- 19 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%

- 20 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

- 21 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

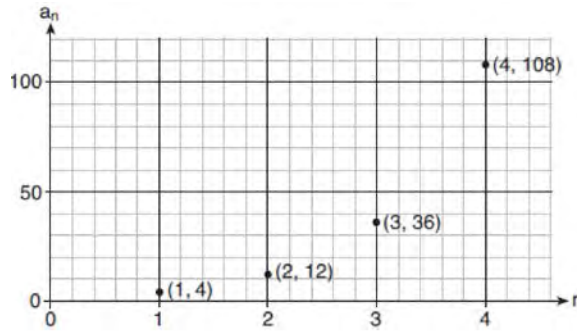
- 22 The equation  $t = \frac{1}{0.0105} \ln\left(\frac{A}{5000}\right)$  relates time,  $t$ , in years, to the amount of money,  $A$ , earned by a \$5000 investment. Which statement accurately describes the relationship between the average rates of change of  $t$  on the intervals  $[6000, 8000]$  and  $[9000, 12,000]$ ?
- 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  $[9000, 12,000]$ .

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

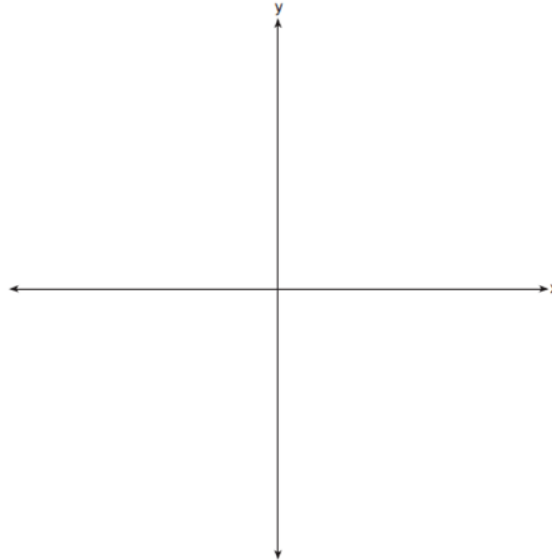
- 1)  $f^{-1}(x) = \frac{2x}{x-1}$   
2)  $f^{-1}(x) = \frac{-2x}{x-1}$   
3)  $f^{-1}(x) = \frac{x}{x-2}$   
4)  $f^{-1}(x) = \frac{-x}{x-2}$

- 24 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?
- 1)  $P(t) = 3500(1.00206)^{12t}$                       3)  $P(t) = 3500(1.34489)^{12t}$
- 2)  $P(t) = 3500(1.00206)^{\frac{t}{12}}$                       4)  $P(t) = 3500(1.34489)^{\frac{t}{12}}$
- 25 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.
- 26 Explain what a rational exponent, such as  $\frac{5}{2}$  means. Use this explanation to evaluate  $9^{\frac{5}{2}}$ .
- 27 Write  $-\frac{1}{2}i^3(\sqrt{-9} - 4) - 3i^2$  in simplest  $a + bi$  form.
- 28 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.
- 29 Determine for which polynomial(s)  $(x + 2)$  is a factor. Explain your answer.
- $$P(x) = x^4 - 3x^3 - 16x - 12$$
- $$Q(x) = x^3 - 3x^2 - 16x - 12$$
- 30 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.

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

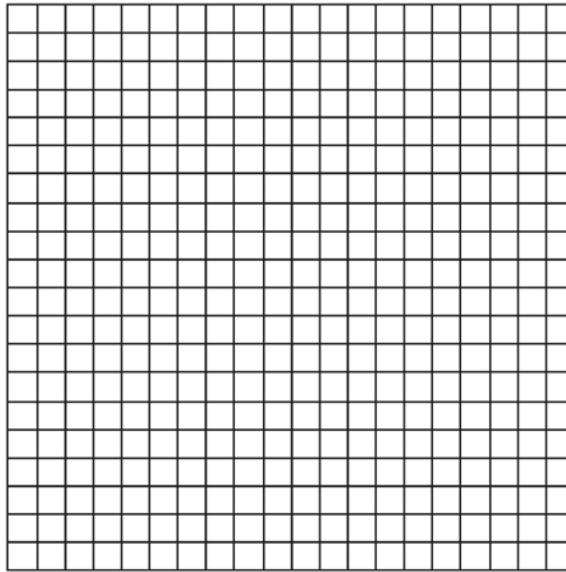


32 Sketch the graphs of  $r(x) = \frac{1}{x}$  and  $a(x) = |x| - 3$  on the set of axes below. Determine, to the *nearest tenth*, the positive solution of  $r(x) = a(x)$ .

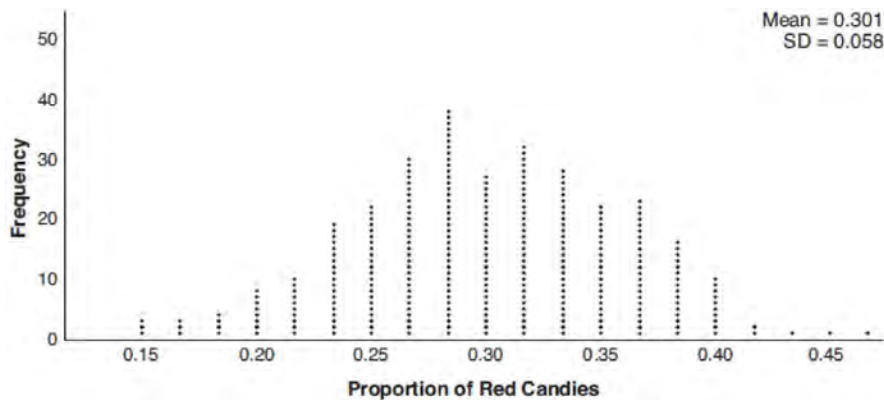


33 A population of 950 bacteria grows continuously at a rate of 4.75% per day. Write an exponential function,  $N(t)$ , that represents the bacterial population after  $t$  days and explain the reason for your choice of base. Determine the bacterial population after 36 hours, to the *nearest bacterium*.

- 34 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  $2\pi$ .



- 35 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.

- 36 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.

- 37 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.

**0120AII Common Core State Standards**

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

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

2 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,  $R(n)$ ?

- |                                      |                                      |
|--------------------------------------|--------------------------------------|
| 1) $R(n) = 1200(1.002)^n + 100n$     | 3) $R(n) = 1200(1.002)^n - 100n$     |
| 2) $R(n) = 1200(1.002)^{12n} + 100n$ | 4) $R(n) = 1200(1.002)^{12n} - 100n$ |

3 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?

- |   |   |
|---|---|
| 1) Emmeline's work is entirely correct. | 3) There are mistakes in step 2 and step 4. |
| 2) There is a mistake in step 2, only.  | 4) There is a mistake in step 4, only.      |

4 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?

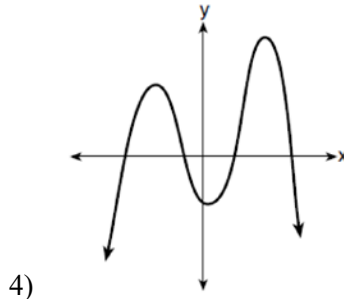
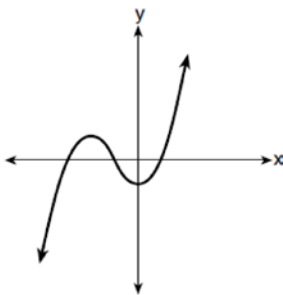
- |                                 |                               |
|---------------------------------|-------------------------------|
| 1) $2000(1.003)^{12t}$          | 3) $2064^{\frac{t}{12}}$      |
| 2) $2000(1.032)^{\frac{t}{12}}$ | 4) $\frac{2000(1.032)^t}{12}$ |

5 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) $f(x) = x^4 + 2x^2 + 1$ | 3) $f(x) = -x^3 + 2x - 6$ |
|----------------------------|---------------------------|





- 6 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)  $x^2 + a^2 + 5x + 5a + 4$
- 7 Given  $x \neq -2$ , the expression  $\frac{2x^2 + 5x + 8}{x + 2}$  is equivalent to
- 1)  $2x^2 + \frac{9}{x + 2}$
  - 2)  $2x + \frac{7}{x + 2}$
  - 3)  $2x + 1 + \frac{6}{x + 2}$
  - 4)  $2x + 9 - \frac{10}{x + 2}$
- 8 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
- 9 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)  $\log_{10} 4$
- 10 What is the solution set of  $x = \sqrt{3x + 40}$ ?
- 1)  $\{-5, 8\}$
  - 2)  $\{8\}$
  - 3)  $\{-4, 10\}$
  - 4)  $\{\}$
- 11 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)  $\frac{13}{24}$
- 12 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)  $8.93$

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

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

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

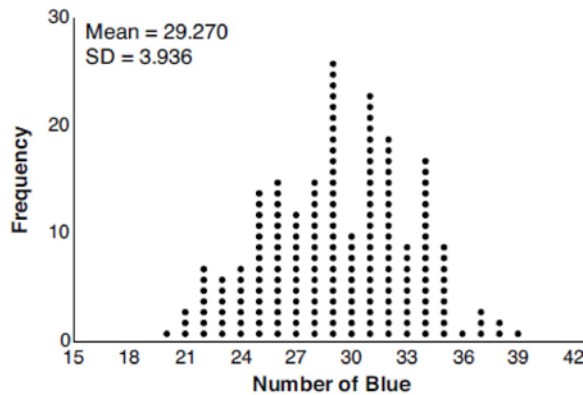
2)  $g_1 = 40$

4)  $g_1 = 40$

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

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

14 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.              | 3) The company should change their claim to 37% blue candies are produced.                     |
| 2) Bonnie's bag was a rarity and the company should not be concerned. | 4) Bonnie's bag is within the middle 95% of the simulated data supporting the company's claim. |

15 Which investigation technique is most often used to determine if a single variable has an impact on a given population?

- |                        |                          |
|------------------------|--------------------------|
| 1) observational study | 3) controlled experiment |
| 2) random survey       | 4) formal interview      |

16 As  $\theta$  increases from  $-\frac{\pi}{2}$  to 0 radians, the value of  $\cos \theta$  will

- |                            |                            |
|----------------------------|----------------------------|
| 1) decrease from 1 to 0    | 3) increase from $-1$ to 0 |
| 2) decrease from 0 to $-1$ | 4) increase from 0 to 1    |

17 Consider the following patterns:

I.  $16, -12, 9, -6.75, \dots$

II.  $1, 4, 9, 16, \dots$

III.  $6, 18, 30, 42, \dots$

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

18 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)  $4$

19 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  $a$ .

20 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)  $\frac{1}{5}$

21 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)  $1.4$

22 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)  $(3 + 3x^2) - 7i$

23 Written in simplest form, the fraction  $\frac{x^3 - 9x}{9 - x^2}$ , where  $x \neq \pm 3$ , is equivalent to

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

24 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?

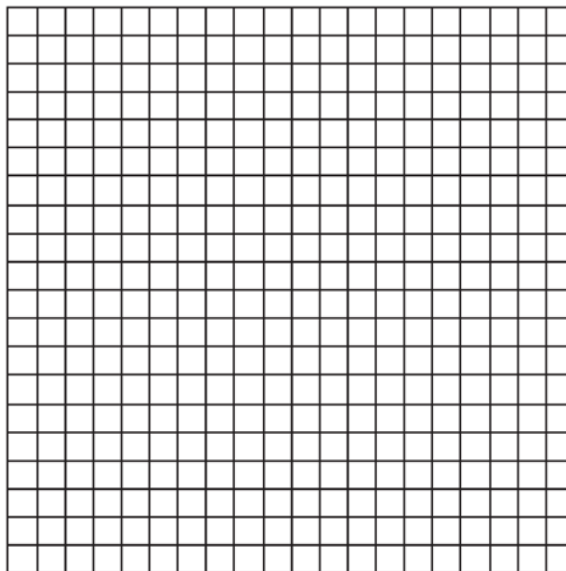
- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| 1) between 000 and 045, inclusive | 3) between 000 and 449, inclusive |
| 2) between 000 and 444, inclusive | 4) between 000 and 450, inclusive |

25 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.

26 Show why  $x - 3$  is a factor of  $m(x) = x^3 - x^2 - 5x - 3$ . Justify your answer.

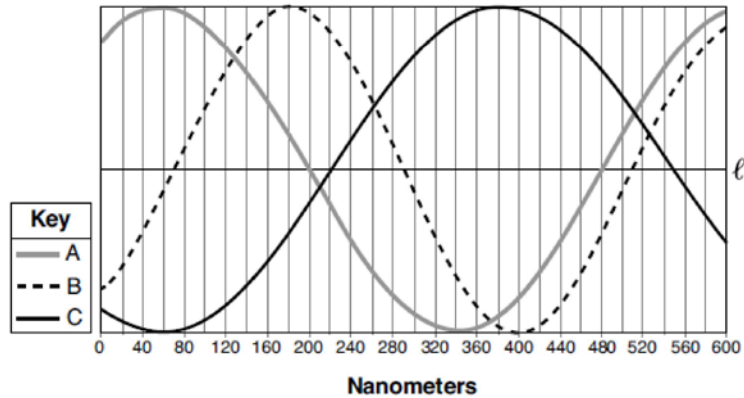
27 Describe the transformation applied to the graph of  $p(x) = 2^x$  that forms the new function  $q(x) = 2^{x-3} + 4$ .

28 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.)



29 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*.

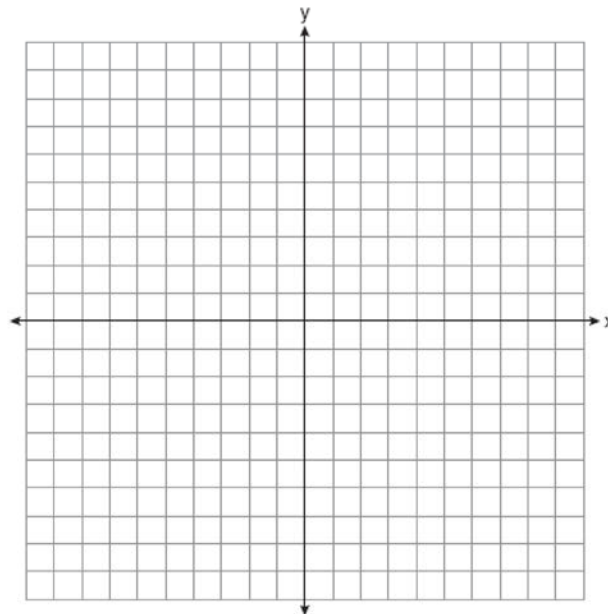
- 30 Visible light can be represented by sinusoidal waves. Three visible light waves are shown in the graph below. The midline of each wave is labeled  $\ell$ .



Based on the graph, which light wave has the longest period? Justify your answer.

- 31 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.

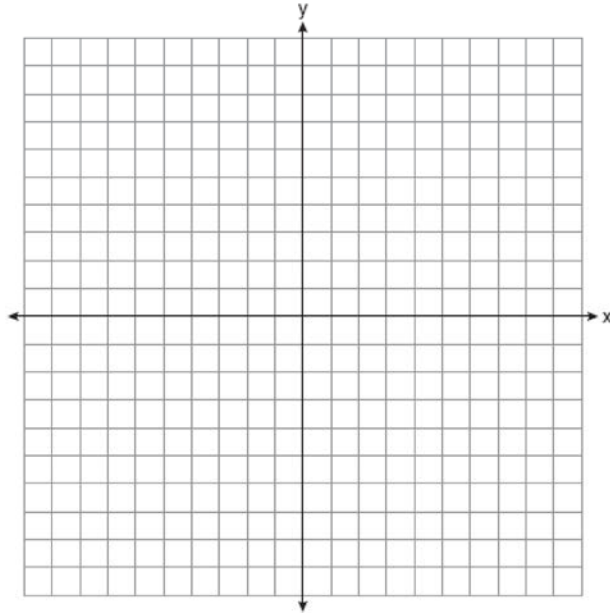
- 32 Graph  $y = x^3 - 4x^2 + 2x + 7$  on the set of axes below.



- 33 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.

- 34 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.

- 35 Algebraically solve the following system of equations.

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

$$x + y - 1 = 0$$

- 36 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.

- 37 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.

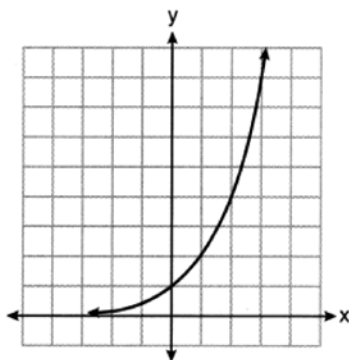
$$n(t) = \frac{t+1}{t+5} + \frac{18}{t^2 + 8t + 15}$$

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

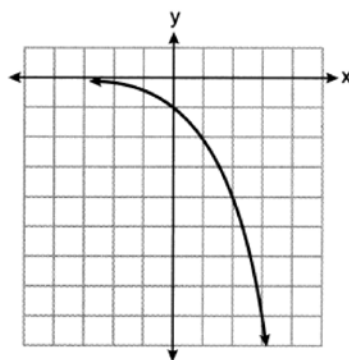
Determine which drug is made with a greater initial amount of active ingredient. Justify your answer. Sarah's doctor told her to take both drugs at the same time. Determine algebraically the number of hours after taking the medications when both medications will have the same amount of active ingredient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



- 5 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)  $y = h(-x)$
- 6 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
- 7 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)  $-2 + \ln(2)$



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

9 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                      3) \$1835.98  
2) \$1604.80                      4) \$9011.94

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

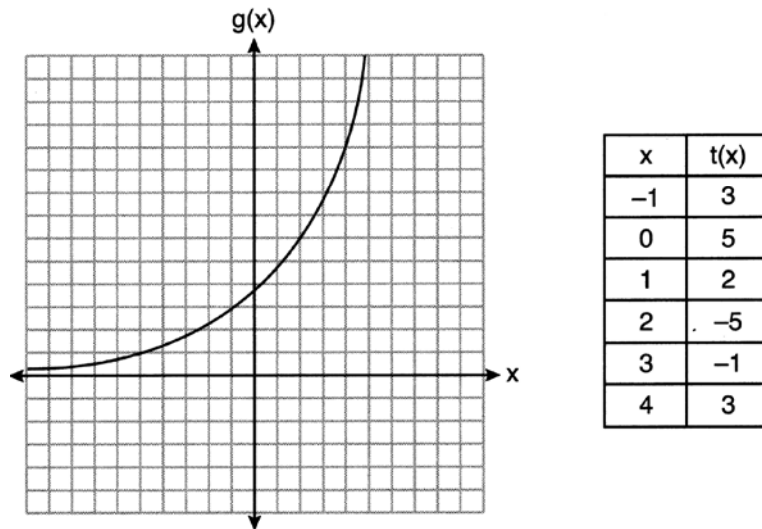
- 1) -18                              3) -12x  
2) 0                                4)  $2x^2 - 12x - 18$

11 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                              3) I and II  
2) II, only                              4) neither I nor II

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



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.
- 2) The average rates of change are equal.
- 3) The average rate of change for  $g$  is twice the average rate of change for  $t$ .
- 4) The average rate of change for  $g$  is half the average rate of change for  $t$ .

13 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)  $(2, 5)$

14 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

15 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)  $x \rightarrow -4, f(x) \rightarrow \infty$ .

16 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

17 The inverse of  $f(x) = -6x + \frac{1}{2}$  is

1)  $f^{-1}(x) = 6x - \frac{1}{2}$

3)  $f^{-1}(x) = -\frac{1}{6}x + \frac{1}{12}$

2)  $f^{-1}(x) = \frac{1}{-6x + \frac{1}{2}}$

4)  $f^{-1}(x) = -\frac{1}{6}x + 2$

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

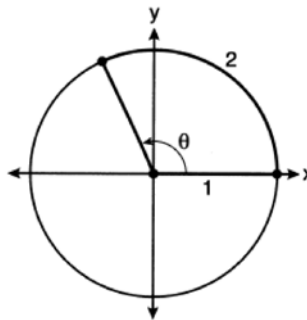
1)  $\frac{10}{x^2 + 3}$

3)  $x + 9$

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

4) 4

19 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

3) 65.4

2) 2

4) 114.6

20 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.

3) The water depth at 9 a.m. was approximately 11 feet.

2) The maximum depth of the water was 12 feet.

4) The difference in water depth between high tide and low tide is 14 feet.

21 A function is defined as  $a_n = a_{n-1} + \log_{n+1}(n-1)$ , where  $a_1 = 8$ . What is the value of  $a_3$ ?

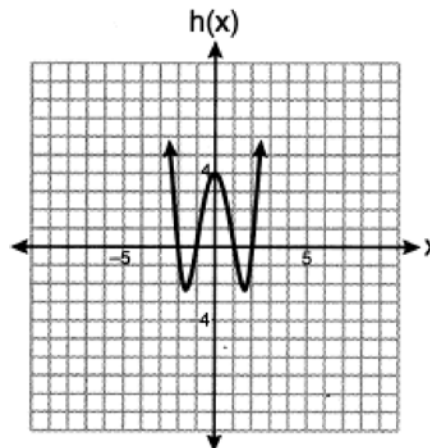
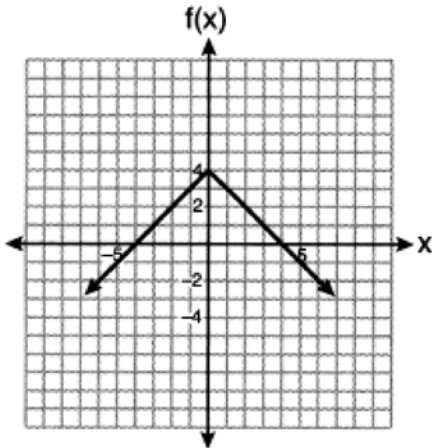
1) 8

3) 9.2

2) 8.5

4) 10

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



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

23 Which expression is equivalent to  $(x + yi)(x^2 - xyi - y^2)$ , where  $i$  is the imaginary unit?

- 1)  $x^3 + y^3 i$       3)  $x^3 - 2xy^2 - y^3 i$   
 2)  $x^3 - xy^2 - (xy^2 + y^3)i$       4)  $x^3 - y^3 i$

24 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

- 1)  $P(t) = 500(1.00247)^{12t}$       3)  $P(t) = 500(1.03)^{12t}$   
 2)  $P(t) = 500(1.00247)^t$       4)  $P(t) = 500(1.03)^{\frac{t}{12}}$

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

26 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.

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

28 Factor completely over the set of integers:  $-2x^4 + x^3 + 18x^2 - 9x$

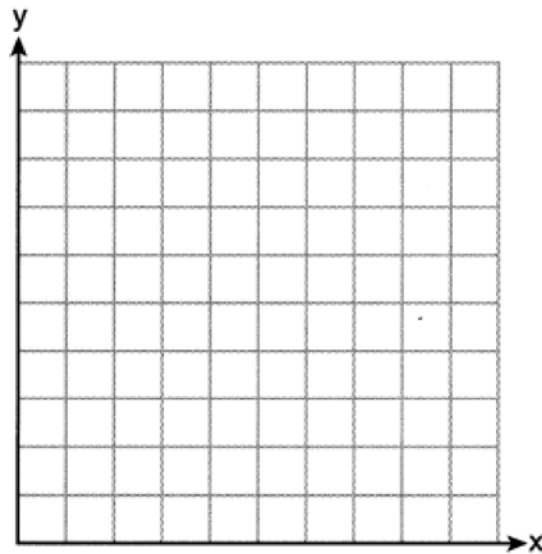
- 29 The relative frequency table shows the proportion of a population who have a given eye color and the proportion of the same population who wear glasses.

	<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.

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

- 31 Graph  $y = 2 \cos\left(\frac{1}{2}x\right) + 5$  on the interval  $[0, 2\pi]$ , using the axes below.



- 32 A cup of coffee is left out on a countertop to cool. The table below represents the temperature,  $F(t)$ , in degrees Fahrenheit, of the coffee after it is left out for  $t$  minutes.

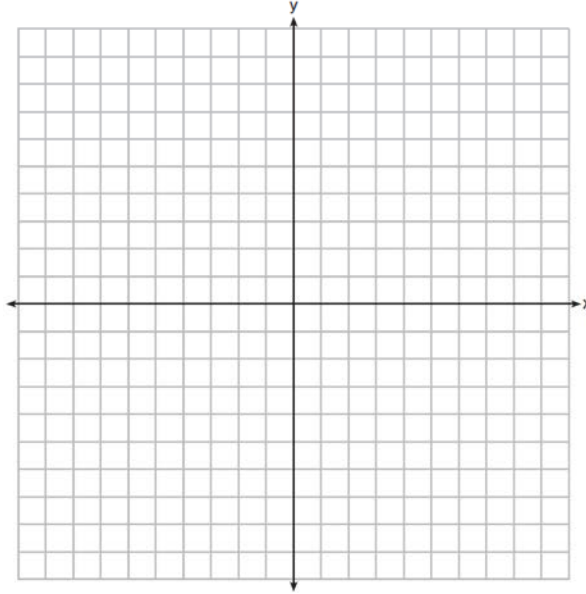
<b>t</b>	0	5	10	15	20	25
<b>F(t)</b>	180	144	120	104	93.3	86.2

Based on these data, write an exponential regression equation,  $F(t)$ , to model the temperature of the coffee. Round all values to the *nearest thousandth*.

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

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

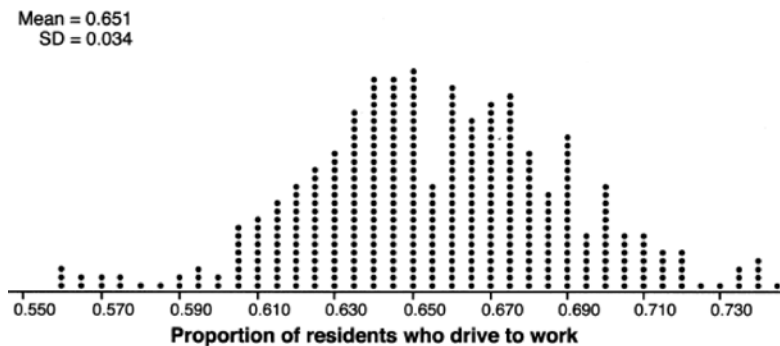
$$g(x) = 2x - 5$$



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

- 34 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.

- 35 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.

- 36 Solve the system of equations algebraically.

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

$$y + 5 = 2x$$

- 37 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*.

**0822aii**

- 1 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

- 2 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)  $x^2 - 4xi - 4$

- 3 The equation below can be used to model the height of a tide in feet,  $H(t)$ , on a beach at  $t$  hours.

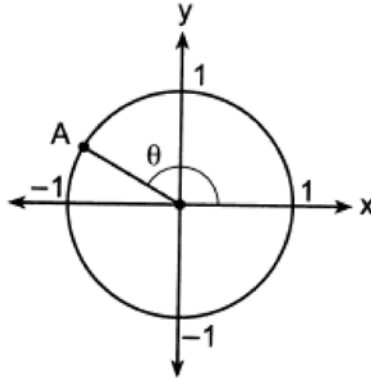
$$H(t) = 4.8 \sin\left(\frac{\pi}{6}(t + 3)\right) + 5.1$$

Using this function, the amplitude of the tide is

- 1)  $\frac{\pi}{6}$
  - 2) 4.8
  - 3) 3
  - 4) 5.1
- 4 In watching auditions for lead singer in a band, Liem became curious as to whether there is an association between how animated the leadsinger 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

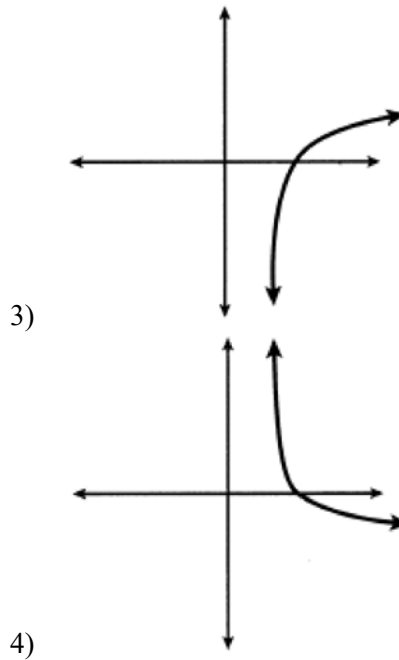
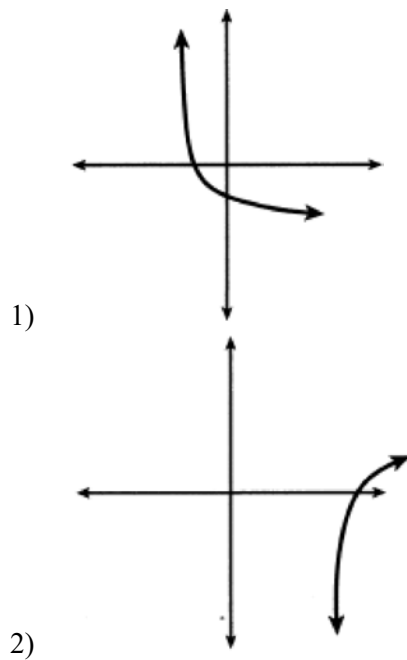


- 5 In the diagram of a unit circle below, point  $A$ ,  $\left(-\frac{\sqrt{3}}{2}, \frac{1}{2}\right)$ , represents the point where the terminal side of  $\theta$  intersects the unit circle.



What is  $m\angle\theta$ ?

- |                |                |
|----------------|----------------|
| 1) $30^\circ$  | 3) $135^\circ$ |
| 2) $120^\circ$ | 4) $150^\circ$ |
- 6 Consider the function  $f(x) = 2x^3 + x^2 - 18x - 9$ . Which statement is true?
- |                                     |   |
|-------------------------------------|---|
| 1) $2x - 1$ is a factor of $f(x)$ . | 3) $f(3) \neq f\left(-\frac{1}{2}\right)$ |
| 2) $x - 3$ is a factor of $f(x)$ .  | 4) $f\left(\frac{1}{2}\right) = 0$        |
- 7 Which sketch could represent the function  $m(x) = -\log_{100}(x - 2)$ ?



- 8 Which equation has roots of  $3 + i$  and  $3 - i$ ?
- 1)  $x^2 - 6x + 10 = 0$                       3)  $x^2 - 10x + 6 = 0$   
 2)  $x^2 + 6x - 10 = 0$                       4)  $x^2 + 10x - 6 = 0$
- 9 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)  $\frac{\ln 1.25}{0.25}$                                       3)  $\frac{\ln 1.25}{2.5}$   
 2)  $\frac{\ln 3000}{0.025}$                                       4)  $\frac{\ln 1.25}{0.025}$
- 10 What is the total number of points of intersection of the graphs of the equations  $y = e^x$  and  $xy = 20$ ?
- 1) 1    3) 3  
 2) 2    4) 0
- 11 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.                      3) The amount of the substance remaining can also be modeled by  $A(t) = 50(2)^{\frac{-t}{3}}$ .  
 2) After two half-lives, there is 25% of the substance remaining.                      4) After one week, there is less than 10g of the substance remaining.
- 12 A parabola that has a vertex at  $(2, 1)$  and a focus of  $(2, -3)$  has an equation of
- 1)  $y = \frac{1}{16}(x - 2)^2 + 1$                       3)  $y = -\frac{1}{16}(x - 2)^2 + 1$   
 2)  $y = -\frac{1}{16}(x + 2)^2 - 1$                       4)  $y = -\frac{1}{16}(x - 2)^2 - 3$
- 13 The expression  $\left(a^3\sqrt{2b^2}\right)\left(\sqrt[3]{4a^2b}\right)$  is equivalent to
- 1)  $2ab^3\sqrt{a^2}$                                       3)  $2ab^3\sqrt[3]{2a^2}$   
 2)  $2ab$     4)  $2a^2b^3\sqrt[3]{2b}$
- 14 Given  $f(x) = 3^{x-1} + 2$ , as  $x \rightarrow -\infty$
- 1)  $f(x) \rightarrow -1$                                       3)  $f(x) \rightarrow 2$   
 2)  $f(x) \rightarrow 0$                                       4)  $f(x) \rightarrow -\infty$



- 21 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)  $\frac{59,000 - 59,000(1.1)^5}{1 - 1.1}$       3)  $\sum_{n=1}^5 59,000(1.1)^n$   
 2)  $\frac{59,000 - 59,000(0.1)^5}{1 - 0.1}$       4)  $\sum_{n=1}^5 59,000(0.1)^{n-1}$

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

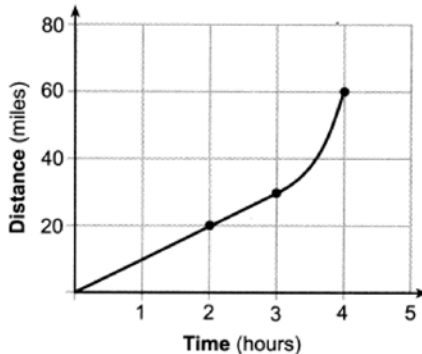
- 23 Given  $f(x) = -\frac{2}{5}x + 4$ , which statement is true of the inverse function  $f^{-1}(x)$ ?

- 1)  $f^{-1}(x)$  is a line with slope  $\frac{5}{2}$ .      3)  $f^{-1}(x)$  passes through the point  $(6, -5)$ .  
 2)  $f^{-1}(x)$  is a line with slope  $\frac{2}{5}$ .      4)  $f^{-1}(x)$  has a  $y$ -intercept at  $(0, -4)$ .

- 24 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

- 1)  $A(t) = A_0(0.000178)^t$       3)  $A(t) = A_0(0.04015)^t$   
 2)  $A(t) = A_0(0.945861)^t$       4)  $A(t) = A_0(1.08361)^t$

- 25 Determine the average rate of change, in mph, from 2 to 4 hours on the graph shown below.



- 26 Factor the expression  $x^3 - 2x^2 - 9x + 18$  completely.
- 27 Solve algebraically for all values of  $x$ :  $\sqrt{4x+1} = 11-x$

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

29 Given  $\cos A = \frac{3}{\sqrt{10}}$  and  $\cot A = -3$ , determine the value of  $\sin A$  in radical form.

- 30 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.
- 31 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.

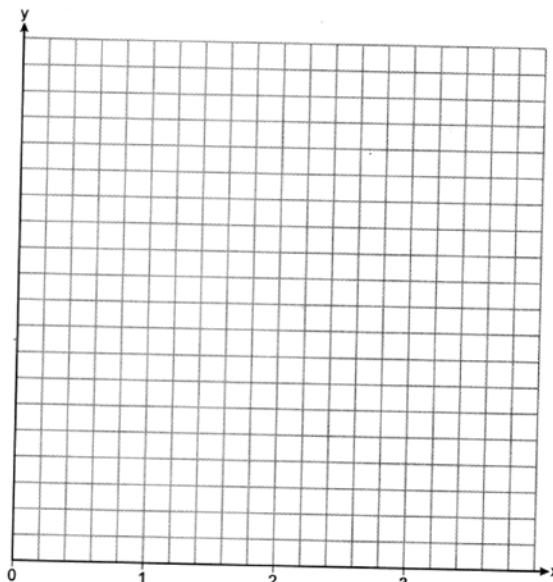
	<b>Rap</b>	<b>Techno</b>	<b>Classic Rock</b>	<b>Classical</b>
<b>Male</b>	39	17	42	12
<b>Female</b>	17	37	36	15

- 32 Algebraically determine the solution set for the system of equations below.

$$y = 2x^2 - 7x + 4$$

$$y = 11 - 2x$$

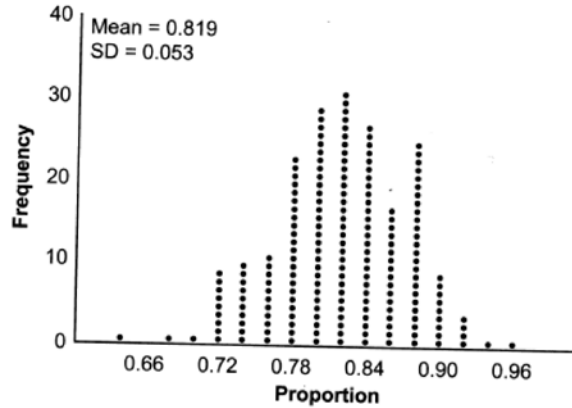
- 33 When observed by researchers under a microscope, a smartphone screen contained approximately 11,000 bacteria per square inch. Bacteria, under normal conditions, double in population every 20 minutes.
- Assuming an initial value of 11,000 bacteria, write a function,  $p(t)$ , that can be used to 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.
  - 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.
- 34 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?

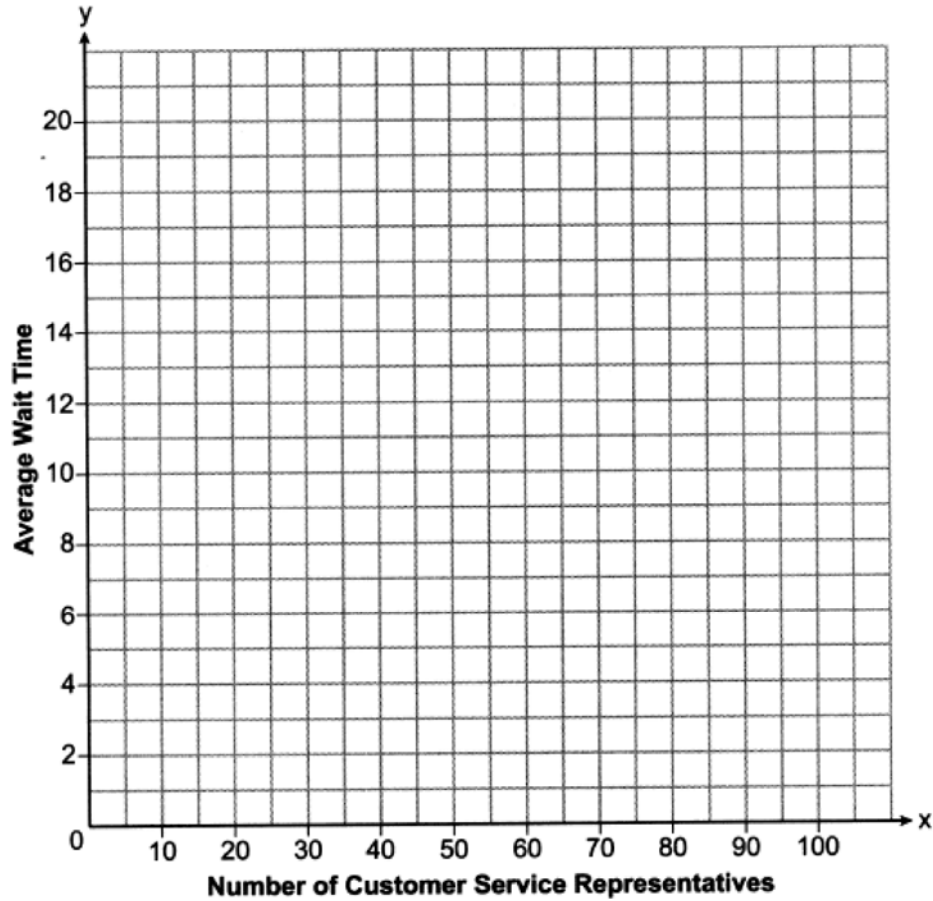
- 35 Given  $f(x) = 3x^3 - 4x^2 + 2x - 1$  and  $g(x) = x - 4$ , state the quotient and remainder of  $\frac{f(x)}{g(x)}$ , in the form  $q(x) + \frac{r(x)}{g(x)}$ . Is  $x = 4$  a root of  $f(x)$ ? Explain your answer.

- 36 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.

- 37 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.



## 2015 Algebra II Common Core State Standards Sample Items

## Answer Section

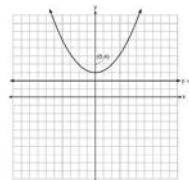
1 ANS: 1

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: spr1501aii NAT: F.IF.C.7 TOP: Graphing Polynomial Functions

KEY: bimodalgraph

2 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:  $x^2 + y^2 - 8y + 16 = y^2 - 4y + 4$

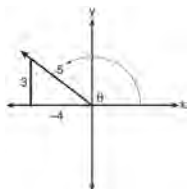
$$x^2 + 16 = 4y + 4$$

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

PTS: 2 REF: spr1502aii NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

3 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

4 ANS: 2

$B(t) = 750 \left( 1.16^{\frac{1}{12}} \right)^{12t} \approx 750(1.012)^{12t}$      $B(t) = 750 \left( 1 + \frac{0.16}{12} \right)^{12t}$  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

KEY: AII

5 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: spr1505aii

NAT: N.RN.A.2

TOP: Radicals and Rational Exponents

KEY: numbers

6 ANS:

$$(4 - 3i)(5 + 2yi - 5 + 2yi)$$

$$(4 - 3i)(4yi)$$

$$16yi - 12yi^2$$

$$12y + 16yi$$

PTS: 2

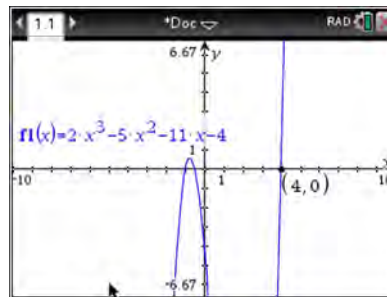
REF: spr1506aii

NAT: N.CN.A.2

TOP: Operations with Complex Numbers

7 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.

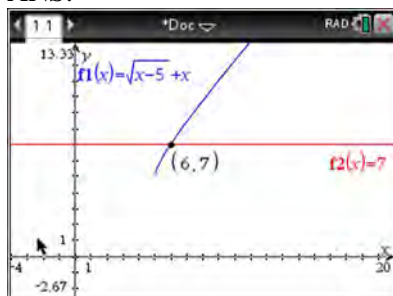
PTS: 2

REF: spr1507aii

NAT: A.APR.B.2

TOP: Remainder Theorem

8 ANS:



$$\sqrt{x-5} = -x+7 \quad \sqrt{x-5} = -9+7 = -2 \text{ is extraneous.}$$

$$x-5 = x^2 - 14x + 49$$

$$0 = x^2 - 15x + 54$$

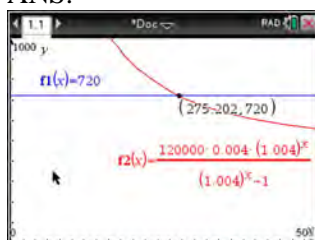
$$0 = (x-6)(x-9)$$

$$x = 6, 9$$

PTS: 2 REF: spr1508aii NAT: A.REI.A.2 TOP: Solving Radicals

KEY: extraneous solutions

9 ANS:



$$720 = \frac{120000 \left( \frac{.048}{12} \right) \left( 1 + \frac{.048}{12} \right)^n}{\left( 1 + \frac{.048}{12} \right)^n - 1} \frac{275.2}{12} \approx 23 \text{ years}$$

$$720(1.004)^n - 720 = 480(1.004)^n$$

$$240(1.004)^n = 720$$

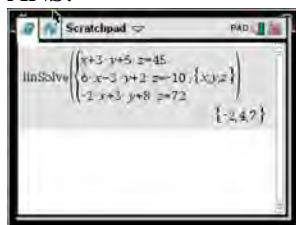
$$1.004^n = 3$$

$$n \log 1.004 = \log 3$$

$$n \approx 275.2 \text{ months}$$

PTS: 4 REF: spr1509aii NAT: A.CED.A.1 TOP: Exponential Growth

10 ANS:



$$6x - 3y + 2z = -10 \quad x + 3y + 5z = 45 \quad 4x + 10z = 62 \quad 4x + 4(7) = 20$$

$$-2x + 3y + 8z = 72 \quad 6x - 3y + 2z = -10 \quad 4x + 4z = 20 \quad 4x = -8$$

$$4x + 10z = 62 \quad 7x + 7z = 35 \quad 6z = 42 \quad x = -2$$

$$4x + 4z = 20 \quad z = 7$$

$$6(-2) - 3y + 2(7) = -10$$

$$-3y = -12$$

$$y = 4$$

PTS: 4 REF: spr1510aia NAT: A.REI.C.6 TOP: Solving Linear Systems

KEY: three variables

11 ANS:

$$a_n = x^{n-1}(x+1) \quad x^{n-1} = 0 \quad x+1 = 0$$

$$x = 0 \quad x = -1$$

PTS: 4 REF: spr1511aia NAT: F.BF.A.2 TOP: Sequences

12 ANS:

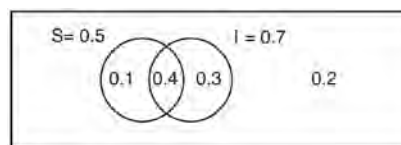
Yes. The margin of error from this simulation indicates that 95% of the observations fall within  $\pm 0.12$  of the simulated proportion, 0.25. The margin of error can be estimated by multiplying the standard deviation, shown to

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: spr1512aia NAT: S.IC.B.4 TOP: Analysis of Data

13 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

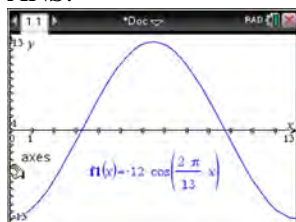
$$= 0.5 + 0.7 - 0.8$$

$$= 0.4$$

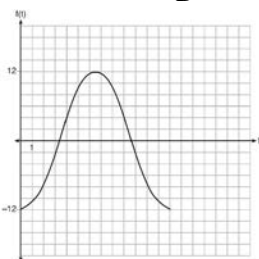
Product Rule must be satisfied. However,  $(0.5)(0.7) \neq 0.4$ . Therefore, salary and insurance have not been treated independently.

PTS: 4 REF: spr1513aii NAT: S.CP.A.2 TOP: Probability of Compound Events  
KEY: independence

14 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  $B = \frac{2\pi}{13}$ .

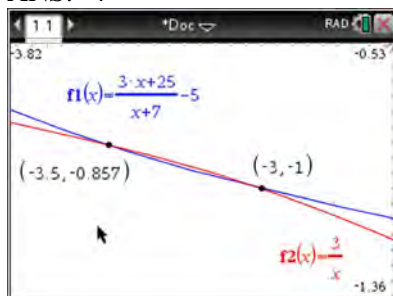


$$f(t) = -12 \cos\left(\frac{2\pi}{13} t\right)$$

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: spr1514aii NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions  
KEY: graph

15 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

16 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: fall1502aii NAT: F.BF.B.3 TOP: Even and Odd Functions

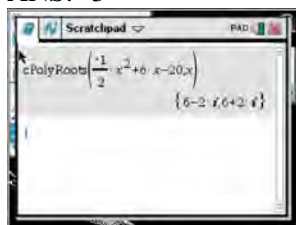
17 ANS: 1

$$\begin{array}{r} 3x^2 + 4x - 1 \\ 2x+3 \overline{) 6x^3 + 17x^2 + 10x + 2} \\ \underline{6x^3 + 9x^2} \phantom{+ 2} \\ 8x^2 + 10x \phantom{+ 2} \\ \underline{8x^2 + 12x} \phantom{+ 2} \\ -2x + 2 \phantom{+ 2} \\ \underline{-2x - 3} \phantom{+ 2} \\ 5 \end{array}$$

PTS: 2 REF: fall1503aii NAT: A.APR.D.6 TOP: Rational Expressions

KEY: division

18 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: fall1504aia NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | completing the square

19 ANS: 4

$$k^4 - 4k^2 + 8k^3 - 32k + 12k^2 - 48$$

$$k^2(k^2 - 4) + 8k(k^2 - 4) + 12(k^2 - 4)$$

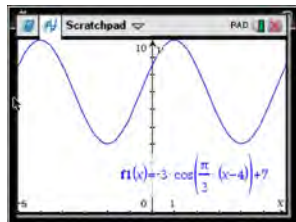
$$(k^2 - 4)(k^2 + 8k + 12)$$

$$(k + 2)(k - 2)(k + 6)(k + 2)$$

PTS: 2 REF: fall1505aia NAT: A.SSE.A.2 TOP: Factoring Polynomials

KEY: factoring by grouping

20 ANS: 4

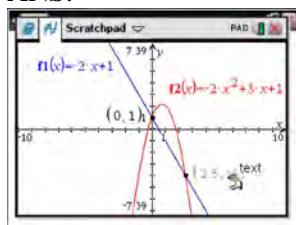


As the range is  $[4, 10]$ , the midline is  $y = \frac{4 + 10}{2} = 7$ .

PTS: 2 REF: fall1506aia NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions

KEY: mixed

21 ANS:



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

$$2x^2 - 5x = 0$$

$$x(2x - 5) = 0$$

$$x = 0, \frac{5}{2}$$

PTS: 2 REF: fall1507aia NAT: A.REI.C.7 TOP: Quadratic-Linear Systems  
KEY: AII

22 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: fall1508aia NAT: S.CP.A.4 TOP: Conditional Probability

23 ANS:

$$x = (y - 3)^3 + 1$$

$$x - 1 = (y - 3)^3$$

$$\sqrt[3]{x - 1} = y - 3$$

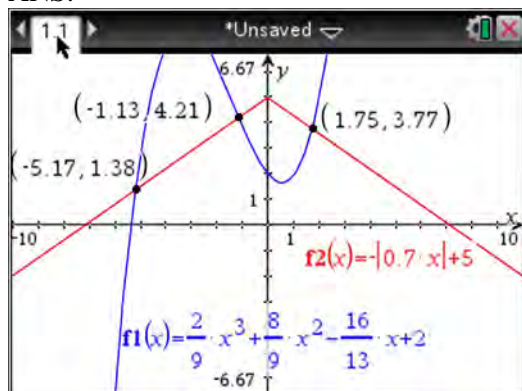
$$\sqrt[3]{x - 1} + 3 = y$$

$$f^{-1}(x) = \sqrt[3]{x - 1} + 3$$

PTS: 2 REF: fall1509aia NAT: F.BF.B.4 TOP: Inverse of Functions  
KEY: other



24 ANS:



PTS: 2 REF: fall1510aai NAT: A.REI.D.11 TOP: Other Systems  
KEY: AII

25 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

26 ANS:

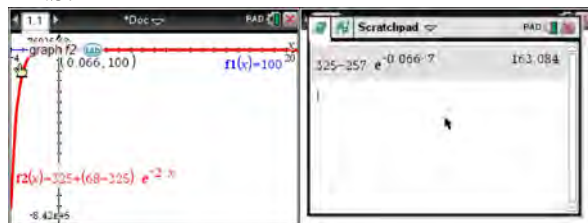
The expression is of the form  $y^2 - 5y - 6$  or  $(y - 6)(y + 1)$ . Let  $y = 4x^2 + 5x$ :

$$(4x^2 + 5x - 6)(4x^2 + 5x + 1)$$

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

PTS: 2 REF: fall1512aai NAT: A.SSE.A.2 TOP: Factoring Polynomials  
KEY: a>1

27 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

28 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

29 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: fall1515aii NAT: A.APR.B.2 TOP: Remainder Theorem

30 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: fall1516aii NAT: S.ID.A.4 TOP: Normal Distributions

KEY: probability

31 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.

$$\frac{A(10) - A(0)}{10 - 0} = \frac{89.58132 - 100}{10} = -1.041868 \quad \text{The estimated mass at } t = 40 \text{ is } 100 - 40(-1.041868) \approx 58.3. \quad \text{The}$$

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: fall1517aii NAT: F.LE.A.2 TOP: Modeling Exponential Functions

KEY: All

## 0616AII Common Core State Standards

## Answer Section

- 1 ANS: 4                    PTS: 2                    REF: 061601aai           NAT: N.RN.A.2  
 TOP: Radicals and Rational Exponents           KEY: variables
- 2 ANS: 3                    PTS: 2                    REF: 061602aai           NAT: A.CED.A.1  
 TOP: Modeling Rationals

3 ANS: 2

$$(2 - yi)(2 - yi) = 4 - 4yi + y^2 i^2 = -y^2 - 4yi + 4$$

PTS: 2                    REF: 061603aai           NAT: N.CN.A.2           TOP: Operations with Complex Numbers

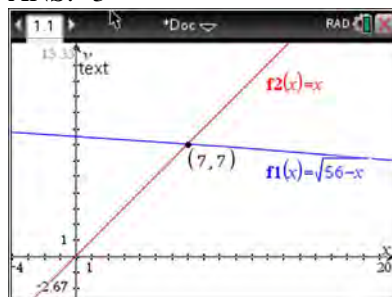
4 ANS: 3

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

5 ANS: 3



$$\sqrt{56-x} = x \quad -8 \text{ is extraneous.}$$

$$56-x = x^2$$

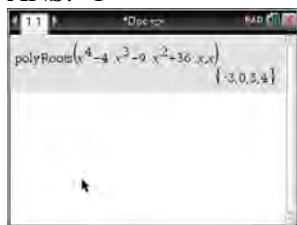
$$0 = x^2 + x - 56$$

$$0 = (x+8)(x-7)$$

$$x = 7$$

PTS: 2                    REF: 061605aai           NAT: A.REI.A.2           TOP: Solving Radicals  
 KEY: extraneous solutions

6 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: 061606aia NAT: A.APR.B.3 TOP: Zeros of Polynomials

KEY: All

7 ANS: 3 PTS: 2 REF: 061607aia NAT: S.IC.A.2

TOP: Analysis of Data

8 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: 061608aia NAT: F.BF.A.1 TOP: Operations with Functions

9 ANS: 2



$\bar{x} + 2\sigma$  represents approximately 48% of the data.

PTS: 2 REF: 061609aia NAT: S.ID.A.4 TOP: Normal Distributions

KEY: percent

10 ANS: 4

The scenario represents a decreasing geometric sequence with a common ratio of 0.80.

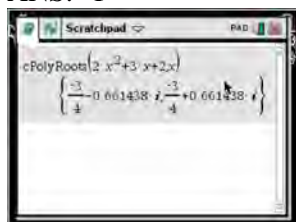
PTS: 2 REF: 061610aia NAT: F.BF.A.2 TOP: Sequences

11 ANS: 1

The probability of rain equals the probability of rain, given that Sean pitches.

PTS: 2 REF: 061611aia NAT: S.CP.A.3 TOP: Conditional Probability

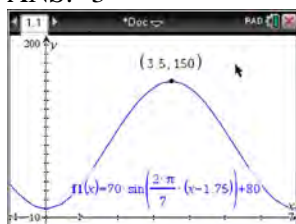
12 ANS: 1



$$x = \frac{-3 \pm \sqrt{3^2 - 4(2)(2)}}{2(2)} = \frac{-3 \pm \sqrt{-7}}{4} = -\frac{3}{4} \pm \frac{i\sqrt{7}}{4}$$

PTS: 2 REF: 061612aai NAT: A.REI.B.4 TOP: Solving Quadratics  
KEY: complex solutions | quadratic formula

13 ANS: 3



$H(t)$  is at a minimum at  $70(-1) + 80 = 10$

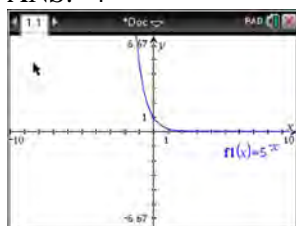
PTS: 2 REF: 061613aai NAT: F.IF.B.4 TOP: Graphing Trigonometric Functions  
KEY: maximum/minimum

14 ANS: 2

$$\begin{array}{r} 2x^2 - 3x + 7 \\ 2x + 3 \overline{) 4x^3 + 0x^2 + 5x + 10} \\ \underline{4x^3 + 6x^2} \phantom{+ 10} \\ -6x^2 + 5x \phantom{+ 10} \\ \underline{-6x^2 - 9x} \phantom{+ 10} \\ 14x + 10 \\ \underline{14x + 21} \\ -11 \end{array}$$

PTS: 2 REF: 061614aai NAT: A.APR.D.6 TOP: Rational Expressions  
KEY: division

15 ANS: 4



$$y = 5^{-x} = \left(\frac{1}{5}\right)^x$$

PTS: 2 REF: 061615aai NAT: F.IF.C.7 TOP: Graphing Exponential Functions

16 ANS: 2

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

$$-4x = 3y - 8$$

$$-4x + 8 = 3y$$

$$-\frac{4}{3}x + \frac{8}{3} = y$$

PTS: 2

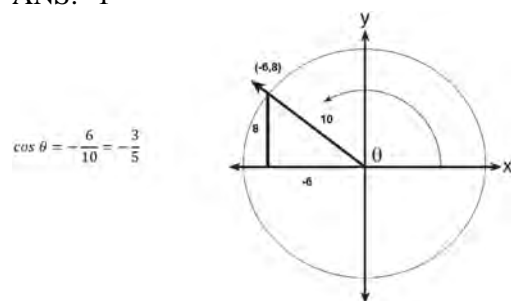
REF: 061616aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: linear

17 ANS: 1



PTS: 2

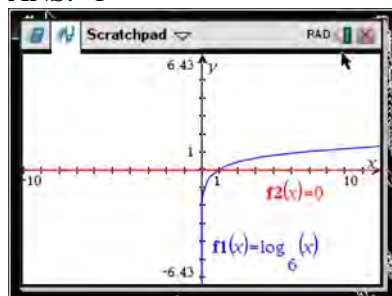
REF: 061617aai

NAT: F.TF.A.2

TOP: Determining Trigonometric Functions

KEY: extension to reals

18 ANS: 1



PTS: 2

REF: 061618aai

NAT: F.IF.C.7

TOP: Graphing Logarithmic Functions

19 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

20 ANS: 2

PTS: 2

REF: 061620aai

NAT: F.IF.B.4

TOP: Graphing Polynomial Functions

21 ANS: 3

$$1.0525^{\frac{1}{12}} \approx 1.00427$$

PTS: 2

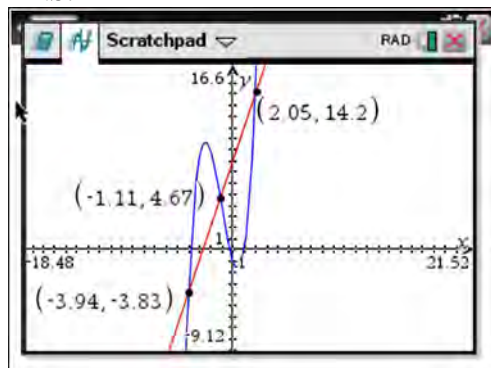
REF: 061621aii

NAT: F.BF.A.1

TOP: Modeling Exponential Functions

KEY: AII

22 ANS: 4



PTS: 2

REF: 061622aii

NAT: A.REI.D.11

TOP: Other Systems

KEY: AII

23 ANS: 3

PTS: 2

REF: 061623aii

NAT: F.BF.A.2

TOP: Sequences

24 ANS: 4

$$\text{period} = \frac{2\pi}{B}$$

$$\frac{1}{60} = \frac{2\pi}{B}$$

$$B = 120\pi$$

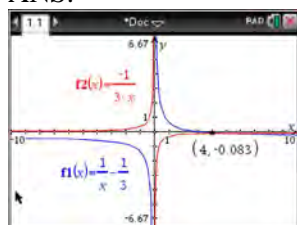
PTS: 2

REF: 061624aii

NAT: F.TF.B.5

TOP: Modeling Trigonometric Functions

25 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: 061625aii

NAT: A.REI.A.2

TOP: Solving Rationals

KEY: rational solutions

26 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

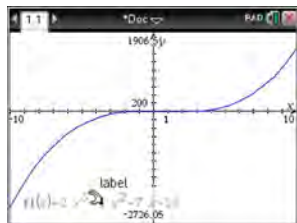
REF: 061626aai

NAT: S.IC.B.3

TOP: Analysis of Data

KEY: type

27 ANS:



$$x - 5 \overline{) 2x^3 - 4x^2 - 7x - 10} \quad \text{Since there is a remainder, } x - 5 \text{ is not a factor.}$$

$$\underline{2x^3 - 10x^2}$$

$$6x^2 - 7x$$

$$\underline{6x^2 - 30x}$$

$$23x - 10$$

$$\underline{23x - 115}$$

$$105$$

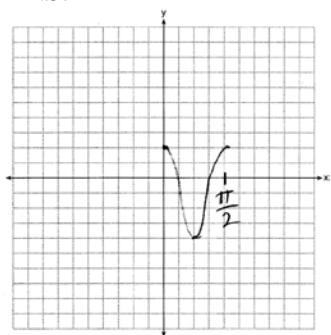
PTS: 2

REF: 061627aai

NAT: A.APR.B.2

TOP: Remainder Theorem

28 ANS:



PTS: 2

REF: 061628aai

NAT: F.IF.C.7

TOP: Graphing Trigonometric Functions

KEY: graph

29 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

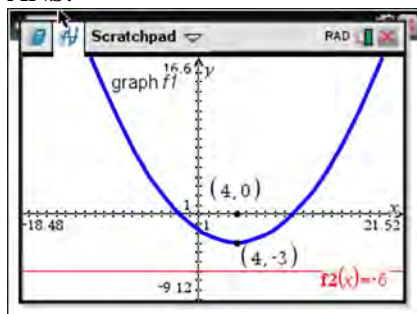
REF: 061629aai

NAT: S.CP.B.7

TOP: Theoretical Probability



30 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

31 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: 061631aai NAT: A.APR.C.4 TOP: Polynomial Identities

32 ANS:

$$A = Pe^{rt}$$

$$135000 = 100000e^{5r}$$

$$1.35 = e^{5r}$$

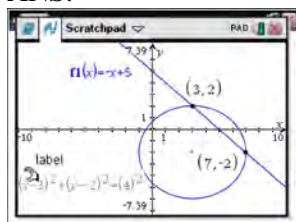
$$\ln 1.35 = \ln e^{5r}$$

$$\ln 1.35 = 5r$$

$$.06 \approx r \text{ or } 6\%$$

PTS: 2 REF: 061632aai NAT: F.LE.A.4 TOP: Exponential Growth

33 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: 061633aai NAT: A.REI.C.7 TOP: Quadratic-Linear Systems

KEY: AII

34 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

35 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: 061635aai NAT: S.IC.B.5 TOP: Analysis of Data

36 ANS:

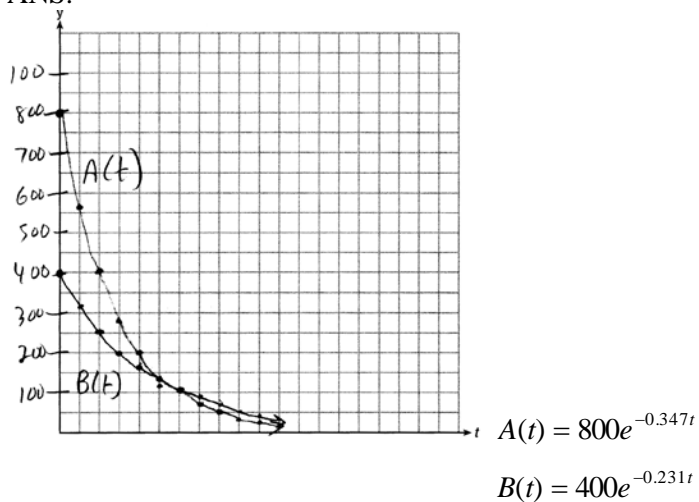
$$\frac{f(4) - f(-2)}{4 - (-2)} = \frac{80 - 1.25}{6} = 13.125 \quad g(x) \text{ has a greater rate of change}$$

$$\frac{g(4) - g(-2)}{4 - (-2)} = \frac{179 - (-49)}{6} = 38$$

PTS: 4 REF: 061636aai NAT: F.IF.C.9 TOP: Comparing Functions

KEY: AII

37 ANS:



$$800e^{-0.347t} = 400e^{-0.231t} \quad 0.15 = e^{-0.347t}$$

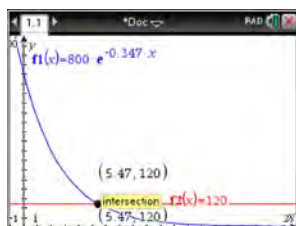
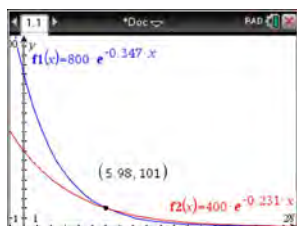
$$\ln 2e^{-0.347t} = \ln e^{-0.231t} \quad \ln 0.15 = \ln e^{-0.347t}$$

$$\ln 2 + \ln e^{-0.347t} = \ln e^{-0.231t} \quad \ln 0.15 = -0.347t \cdot \ln e$$

$$\ln 2 - 0.347t = -0.231t \quad 5.5 \approx t$$

$$\ln 2 = 0.116t$$

$$6 \approx t$$



PTS: 6  
KEY: All

REF: 061637a11 NAT: A.REI.D.11 TOP: Other Systems

## 0816AII Common Core State Standards

## Answer Section

1 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

2 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

3 ANS: 2



PTS: 2 REF: 081603aai NAT: A.REI.D.11 TOP: Other Systems

KEY: All

4 ANS: 3



PTS: 2 REF: 081604aai NAT: S.ID.A.4 TOP: Normal Distributions

KEY: probability

5 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

6 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: 081606aai

NAT: A.REI.D.11

TOP: Quadratic-Linear Systems

KEY: All

7 ANS: 1

$$\frac{157}{25 + 47 + 157}$$

PTS: 2

REF: 081607aai

NAT: S.CP.A.4

TOP: Conditional Probability

8 ANS: 1

(2) is not recursive

PTS: 2

REF: 081608aai

NAT: F.BF.A.2

TOP: Sequences

9 ANS: 1

PTS: 2

REF: 081609aai

NAT: F.BF.B.6

TOP: Sigma Notation

KEY: represent

10 ANS: 2

PTS: 2

REF: 081610aai

NAT: F.IF.B.4

TOP: Graphing Trigonometric Functions KEY: increasing/decreasing

11 ANS: 2

$$\begin{array}{r} x^2 + 0x + 1 \\ x+2 \overline{) x^3 + 2x^2 + x + 6} \\ \underline{x^3 + 2x^2} \phantom{+ x + 6} \\ 0x^2 + x \phantom{+ 6} \\ \underline{0x^2 + 0x} \phantom{+ 6} \\ x + 6 \\ \underline{x + 2} \\ 4 \end{array}$$

PTS: 2

REF: 081611aai

NAT: A.APR.D.6

TOP: Rational Expressions

KEY: division

12 ANS: 2

$$ME = \left( z \sqrt{\frac{p(1-p)}{n}} \right) = \left( 1.96 \sqrt{\frac{(0.55)(0.45)}{900}} \right) \approx 0.03$$

PTS: 2

REF: 081612aai

NAT: S.IC.B.4

TOP: Analysis of Data

- 13 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

- 14 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

- 15 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

- 16 ANS: 1 PTS: 2 REF: 081616aai NAT: F.TF.A.1  
TOP: Unit Circle KEY: bimodalgraph

- 17 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

- 18 ANS: 3 PTS: 2 REF: 081618aai NAT: F.LE.A.2  
TOP: Sequences

- 19 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

- 20 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

- 21 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 Theorem

22 ANS: 4                      PTS: 2                      REF: 081622aai                      NAT: F.BF.A.1  
TOP: Modeling Exponential Functions                      KEY: All

23 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

24 ANS: 4                      PTS: 2                      REF: 081624aai                      NAT: F.BF.A.2  
TOP: Sequences

25 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

26 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

27 ANS:

$$xi(-6i)^2 = xi(36i^2) = 36xi^3 = -36xi$$

PTS: 2                      REF: 081627aai                      NAT: N.CN.A.2                      TOP: Operations with Complex Numbers

28 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

29 ANS:

Using a 95% level of confidence,  $x \pm 2$  standard deviations sets the usual wait time as 150-302 seconds. 360 seconds is unusual.

PTS: 2                      REF: 081629aai                      NAT: S.IC.B.6                      TOP: Analysis of Data

30 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

KEY: AII

31 ANS:

$\frac{306.25 - 156.25}{70 - 50} = \frac{150}{20} = 7.5$  Between 50-70 mph, each additional mph in speed requires 7.5 more feet to stop.

PTS: 2

REF: 081631aai

NAT: F.IF.B.6

TOP: Rate of Change

KEY: AII

32 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

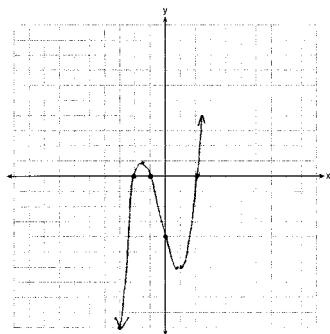
REF: 081632aai

NAT: S.CP.A.2

TOP: Probability of Compound Events

KEY: independence

33 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: 081633aai

NAT: F.IF.C.7

TOP: Graphing Polynomial Functions



34 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: 081634aai NAT: F.LE.A.4 TOP: Exponential Decay

35 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: 081635aai NAT: A.REI.A.2 TOP: Solving Radicals

KEY: extraneous solutions

36 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: 081636aai NAT: S.IC.B.5 TOP: Analysis of Data

37 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: 081637aai NAT: A.CED.A.1 TOP: Exponential Growth

## 0117AII Common Core State Standards

## Answer Section

1 ANS: 2 PTS: 2 REF: 011701aai NAT: F.IF.B.4  
TOP: Graphing Trigonometric Functions

2 ANS: 1

$$P(28) = 5(2)^{\frac{98}{28}} \approx 56$$

PTS: 2 REF: 011702aai NAT: F.LE.A.2 TOP: Modeling Exponential Functions  
KEY: AII

3 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 AII

4 ANS: 1 PTS: 2 REF: 011704aai NAT: F.TF.C.8  
TOP: Simplifying Trigonometric Expressions

5 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  
KEY: AII

6 ANS: 3 PTS: 2 REF: 011706aai NAT: S.IC.B.3  
TOP: Analysis of Data KEY: type

7 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

8 ANS: 3 PTS: 2 REF: 011708aai NAT: F.BF.B.4  
TOP: Inverse of Functions KEY: other

9 ANS: 2 PTS: 2 REF: 011709aai NAT: S.IC.B.5  
TOP: Analysis of Data

10 ANS: 3 PTS: 2 REF: 011710aai NAT: F.BF.A.1  
TOP: Operations with Functions

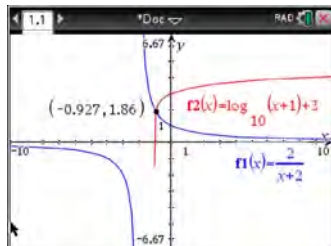
11 ANS: 4

$$x = \frac{8 \pm \sqrt{(-8)^2 - 4(6)(29)}}{2(6)} = \frac{8 \pm \sqrt{-632}}{12} = \frac{8 \pm i\sqrt{4}\sqrt{158}}{12} = \frac{2}{3} \pm \frac{1}{6}i\sqrt{158}$$

PTS: 2 REF: 011711aai NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | quadratic formula

12 ANS: 2



PTS: 2 REF: 011712aai NAT: A.REI.D.11 TOP: Other Systems

KEY: All

13 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: 011713aai NAT: S.ID.B.6 TOP: Regression

KEY: choose model

14 ANS: 1

$$d = 18; r = \pm \frac{5}{4}$$

PTS: 2 REF: 011714aai NAT: F.IF.A.3 TOP: Sequences

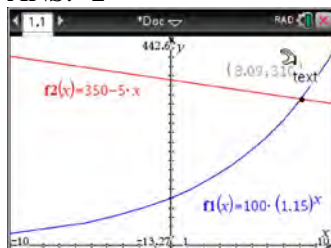
KEY: term

15 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

16 ANS: 2



PTS: 2 REF: 011716aai NAT: A.REI.D.11 TOP: Other Systems

KEY: All

17 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: 011717aai NAT: A.REI.A.2 TOP: Solving Rationals  
KEY: rational solutions

18 ANS: 4

$$496 \pm 2(115)$$

PTS: 2 REF: 011718aai NAT: S.ID.A.4 TOP: Normal Distributions  
KEY: interval

19 ANS: 2

$h(x)$  does not have a  $y$ -intercept.

PTS: 2 REF: 011719aai NAT: F.IF.C.9 TOP: Comparing Functions

20 ANS: 2

PTS: 2

REF: 011720aai

NAT: A.APR.B.2

TOP: Remainder Theorem

21 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: 011721aai NAT: F.IF.B.6 TOP: Rate of Change  
KEY: All

22 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

23 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  
KEY: All

24 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: 011724aai NAT: F.IF.B.6 TOP: Rate of Change  
KEY: AII

25 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

26 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

27 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  $y = \sin \theta$ ,  
 $\csc \theta = \frac{1}{y}$ .

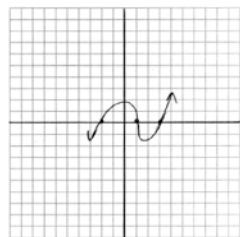
PTS: 2 REF: 011727aai NAT: F.TF.A.2 TOP: Reciprocal Trigonometric Relationships

28 ANS:

$\left( \ln \frac{1}{2} \right)$   
 $\frac{\quad}{1590}$  is negative, so  $M(t)$  represents decay.

PTS: 2 REF: 011728aai NAT: F.IF.C.7 TOP: Graphing Exponential Functions

29 ANS:



PTS: 2 REF: 011729aai NAT: F.IF.C.7 TOP: Graphing Polynomial Functions

30 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

31 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

32 ANS:

$$x-2 \overline{) \begin{array}{r} 3x+13 \\ 3x^2+7x-20 \\ \underline{3x^2-6x} \\ 13x-20 \\ \underline{13x-26} \\ 6 \end{array}}$$

PTS: 2 REF: 011732aai NAT: A.APR.D.6 TOP: Division of Polynomials

33 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

34 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: 011734aai NAT: F.LE.A.2 TOP: Sequences

35 ANS:

$$P(P/K) = \frac{P(P \wedge K)}{P(K)} = \frac{1.9}{2.3} \approx 82.6\% \quad \text{A key club member has an 82.6\% probability of being enrolled in AP Physics.}$$

PTS: 4 REF: 011735aai NAT: S.CP.B.6 TOP: Conditional Probability

36 ANS:

$$20000 = PMT \left( \frac{1 - (1 + 0.00625)^{-60}}{0.00625} \right) \quad 21000 - x = 300 \left( \frac{1 - (1 + 0.00625)^{-60}}{0.00625} \right)$$

$$PMT \approx 400.76$$

$$x \approx 6028$$

PTS: 4

REF: 011736aaii

NAT: A.SSE.B.4

TOP: Series

37 ANS:

$$0 = \sqrt{t} - 2t + 6 \quad 2\left(\frac{9}{4}\right) - 6 < 0, \text{ so } \frac{9}{4} \text{ is extraneous.}$$

$$2t - 6 = \sqrt{t}$$

$$4t^2 - 24t + 36 = t$$

$$4t^2 - 25t + 36 = 0$$

$$(4t - 9)(t - 4) = 0$$

$$t = \frac{9}{4}, 4$$

$$(\sqrt{1} - 2(1) + 6) - (\sqrt{3} - 2(3) + 6) = 5 - \sqrt{3} \approx 3.268 \quad 327 \text{ mph}$$

PTS: 6

REF: 011737aaii

NAT: A.REI.A.2

TOP: Solving Radicals

KEY: context

## 0617aii

## Answer Section

1 ANS: 1 PTS: 2 REF: 061701aii NAT: A.APR.B.3  
TOP: Zeros of Polynomials KEY: AII

2 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: 061702aii NAT: F.LE.A.4 TOP: Exponential Equations  
KEY: without common base

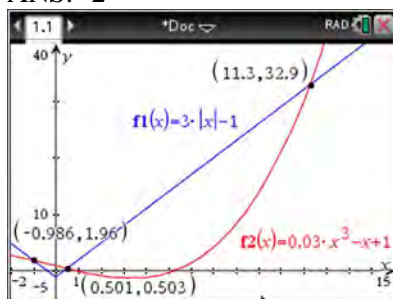
3 ANS: 3  
Self selection causes bias.

PTS: 2 REF: 061703aii NAT: S.IC.B.3 TOP: Analysis of Data  
KEY: bias

4 ANS: 2  
 $6xi^3(-4xi+5) = -24x^2i^4 + 30xi^3 = -24x^2(1) + 30x(-1) = -24x^2 - 30xi$

PTS: 2 REF: 061704aii NAT: N.CN.A.2 TOP: Operations with Complex Numbers

5 ANS: 2



PTS: 2 REF: 061705aii NAT: A.REI.D.11 TOP: Other Systems  
KEY: AII

6 ANS: 4 PTS: 2 REF: 061706aii NAT: F.IF.B.4  
TOP: Graphing Trigonometric Functions



7 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: 061707aia NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | taking square roots

8 ANS: 1 PTS: 2 REF: 061708aia NAT: F.TF.B.5

TOP: Modeling Trigonometric Functions

9 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: 061709aia NAT: F.BF.A.1 TOP: Operations with Functions

10 ANS: 3 PTS: 2 REF: 061710aia NAT: S.IC.A.2

TOP: Analysis of Data

11 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: 061711aia NAT: A.APR.B.2 TOP: Remainder Theorem

12 ANS: 2

$$\cos \theta = \pm \sqrt{1 - \left(\frac{-\sqrt{2}}{5}\right)^2} = \pm \sqrt{\frac{25}{25} - \frac{2}{25}} = \pm \frac{\sqrt{23}}{5}$$

PTS: 2 REF: 061712aia NAT: F.TF.C.8 TOP: Determining Trigonometric Functions

13 ANS: 3

$$0.75^{\frac{1}{10}} \approx .9716$$

PTS: 2 REF: 061713aia NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

KEY: All

14 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

15 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

16 ANS: 4

PTS: 2

REF: 061716aai

NAT: N.RN.A.2

TOP: Radicals and Rational Exponents

KEY: variables

17 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

18 ANS: 2

The 2010 population is 110 million.

PTS: 2

REF: 061718aai

NAT: F.LE.B.5

TOP: Modeling Exponential Functions

19 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: 061719aai

NAT: A.REI.A.2

TOP: Solving Rationals

20 ANS: 3

PTS: 2

REF: 061720aai

NAT: F.LE.A.2

TOP: Sequences

KEY: All

21 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: 061721aia NAT: F.IF.B.6 TOP: Rate of Change  
KEY: All

22 ANS: 3 PTS: 2 REF: 061722aia NAT: A.CED.A.1  
TOP: Modeling Rationals

23 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: 061723aia NAT: A.APR.D.6 TOP: Expressions with Negative Exponents  
KEY: variables

24 ANS: 2 PTS: 2 REF: 061724aia NAT: A.SSE.B.4  
TOP: Series

25 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 Theorem

26 ANS:



69

PTS: 2 REF: 061726aia NAT: S.ID.A.4 TOP: Normal Distributions  
KEY: percent

27 ANS:

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

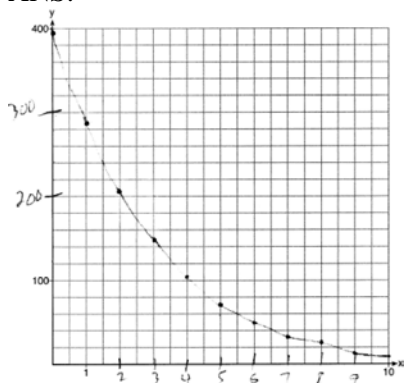
PTS: 2 REF: 061727aia NAT: A.SSE.A.2 TOP: Factoring Polynomials  
KEY: factoring by grouping

28 ANS:

period is  $\frac{2}{3}$ . The wheel rotates once every  $\frac{2}{3}$  second.

PTS: 2 REF: 061728aia NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions  
KEY: period

29 ANS:



PTS: 2

REF: 061729aai

NAT: F.IF.C.7

TOP: Graphing Exponential Functions

KEY: All

30 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: 061730aai

NAT: A.REI.A.2

TOP: Solving Radicals

KEY: extraneous solutions

31 ANS:

$$\sqrt[3]{x} \cdot \sqrt{x} = x^{\frac{1}{3}} \cdot x^{\frac{1}{2}} = x^{\frac{3}{6}} \cdot x^{\frac{3}{6}} = x^{\frac{5}{6}}$$

PTS: 2

REF: 061731aai

NAT: N.RN.A.2

TOP: Operations with Radicals

KEY: with variables, index &gt; 2

32 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

33 ANS:

$$x+y+z=1 \quad 2x+2y+2z=2 \quad -2z-z=3 \quad y-(-1)=3 \quad x+2-1=1$$

$$\underline{-x+3y-5z=11} \quad \underline{2x+4y+6z=2} \quad -3z=3 \quad y=2 \quad x=0$$

$$4y-4z=12 \quad 2y+4z=0 \quad z=-1$$

$$y-z=3 \quad y+2z=0$$

$$y=-2z$$

PTS: 4

REF: 061733aai

NAT: A.REI.C.6

TOP: Solving Linear Systems

KEY: three variables

34 ANS:

$$M = 172600 \cdot \frac{0.00305(1 + 0.00305)^{12 \cdot 15}}{(1 + 0.00305)^{12 \cdot 15} - 1} \approx 1247 \quad 1100 = (172600 - x) \cdot \frac{0.00305(1 + 0.00305)^{12 \cdot 15}}{(1 + 0.00305)^{12 \cdot 15} - 1}$$

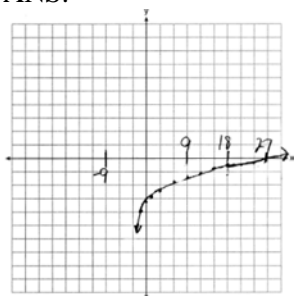
$$1100 \approx (172600 - x) \cdot (0.007228)$$

$$152193 \approx 172600 - x$$

$$20407 \approx x$$

PTS: 4 REF: 061734aai NAT: A.SSE.B.4 TOP: Series

35 ANS:

As  $x \rightarrow -3$ ,  $y \rightarrow -\infty$ . As  $x \rightarrow \infty$ ,  $y \rightarrow \infty$ .

PTS: 4 REF: 061735aai NAT: F.IF.C.7 TOP: Graphing Logarithmic Functions

36 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: 061736aai NAT: S.IC.B.5 TOP: Analysis of Data

37 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: 061737aai NAT: F.LE.A.4 TOP: Exponential Decay

## 0817AII Common Core State Standards Answer Section

1 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

2 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

3 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

4 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

5 ANS: 3

PTS: 2

REF: 081705aai

NAT: F.IF.B.4

TOP: Graphing Trigonometric Functions KEY: increasing/decreasing

6 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

7 ANS: 4 PTS: 2 REF: 081707aai NAT: F.TF.A.2

TOP: Reference Angles

8 ANS: 4 PTS: 2 REF: 081708aai NAT: A.APR.B.3

TOP: Zeros of Polynomials KEY: AII

9 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

KEY: AII

10 ANS: 3

$$\left(\frac{1}{2}\right)^{73.83} \approx 0.990656$$

PTS: 2 REF: 081710aai NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

KEY: AII

11 ANS: 1



PTS: 2 REF: 081711aai NAT: S.ID.A.4 TOP: Normal Distributions

KEY: percent

12 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

13 ANS: 1

$$\begin{array}{r}
 2x^2 + x + 5 \\
 2x - 1 \overline{) 4x^3 + 0x^2 + 9x - 5} \\
 \underline{4x^3 - 2x^2} \phantom{+ 9x - 5} \\
 2x^2 + 9x \phantom{- 5} \\
 \underline{2x^2 - x} \phantom{- 5} \\
 10x - 5 \\
 \underline{10x - 5} \\
 0
 \end{array}$$

PTS: 2

REF: 081713aai

NAT: A.APR.D.6

TOP: Rational Expressions

14 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: equations

15 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

16 ANS: 2

$$ME = \left( z \sqrt{\frac{p(1-p)}{n}} \right) = \left( 1.96 \sqrt{\frac{(0.16)(0.84)}{1334}} \right) \approx 0.02$$

PTS: 2

REF: 081716aai

NAT: S.IC.B.4

TOP: Analysis of Data



17 ANS: 2                      PTS: 2                      REF: 081717aii                      NAT: S.IC.B.3  
TOP: Analysis of Data                      KEY: type

18 ANS: 4                      PTS: 2                      REF: 081718aii                      NAT: F.IF.C.7  
TOP: Graphing Trigonometric Functions                      KEY: amplitude

19 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: 081719aii                      NAT: A.REI.C.7                      TOP: Quadratic-Linear Systems

KEY: All

20 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: 081720aii                      NAT: A.APR.B.2                      TOP: Remainder Theorem

21 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

22 ANS: 1                      PTS: 2                      REF: 081722aii                      NAT: S.IC.B.6  
TOP: Analysis of Data

23 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: 081723aii                      NAT: N.RN.A.2                      TOP: Radicals and Rational Exponents

KEY: variables

24 ANS: 3                      PTS: 2                      REF: 081724aii                      NAT: F.BF.A.2

TOP: Sequences

25 ANS:

Rewrite  $\frac{4}{3}$  as  $\frac{1}{3} \cdot \frac{4}{1}$ , using the power of a power rule.

PTS: 2                      REF: 081725aii                      NAT: N.RN.A.1                      TOP: Radicals and Rational Exponents

26 ANS:

$$P(W/D) = \frac{P(W \wedge D)}{P(D)} = \frac{.4}{.5} \approx .8$$

PTS: 2                      REF: 081726aii                      NAT: S.CP.B.6                      TOP: Conditional Probability

27 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

28 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

29 ANS:

$$a_1 = 4 \quad a_8 = 639$$

$$a_n = 2a_{n-1} + 1$$

PTS: 2 REF: 081729aai NAT: F.LE.A.2 TOP: Sequences

30 ANS:

$$8.75 = 1.25x^{49} \quad 4$$

$$7 = x^{49}$$

$$x = \sqrt[49]{7} \approx 1.04$$

PTS: 2 REF: 081730aai NAT: F.LE.A.4 TOP: Exponential Growth

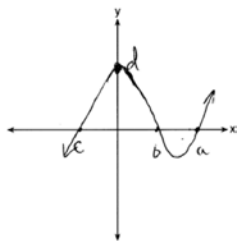
31 ANS:

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

Since  $j(x) = j(-x)$ , the function is even.

PTS: 2 REF: 081731aai NAT: F.BF.B.3 TOP: Even and Odd Functions

32 ANS:

PTS: 2 REF: 081732aai NAT: F.IF.C.7 TOP: Graphing Polynomial Functions  
KEY: All

33 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: 081733aii NAT: A.REI.A.2 TOP: Solving Rationals

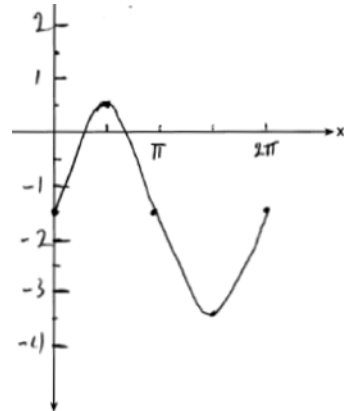
KEY: rational solutions

34 ANS:

$$\frac{6.25 - 2.25}{21 - 5} = \frac{4}{16} = \$0.25 \text{ fine per day. } 2.25 - 5(.25) = \$1 \text{ replacement fee. } a_n = 1.25 + (n-1)(.25). a_{60} = \$16$$

PTS: 4 REF: 081734aii NAT: F.LE.A.2 TOP: Sequences

35 ANS:

Part a sketch is shifted  $\frac{\pi}{3}$  units right.

PTS: 4 REF: 081735aii NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions

KEY: graph

36 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

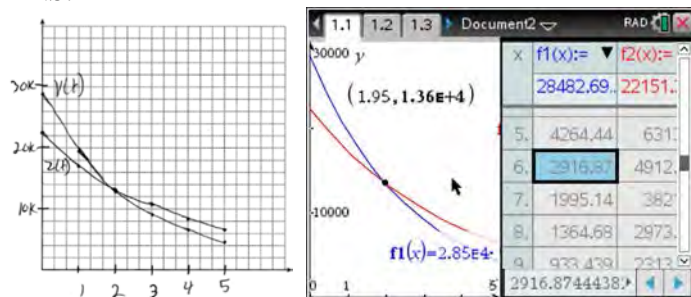
REF: 081736aii

NAT: S.ID.B.6

TOP: Regression

KEY: exponential AII

37 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

KEY: AII

## 0118AII Common Core State Standards

## Answer Section

- 1 ANS: 4                      PTS: 2                      REF: 011801aai           NAT: S.IC.B.3  
TOP: Analysis of Data                      KEY: bias
- 2 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
- 3 ANS: 4  
 $3x - (-2x + 14) = 16$      $3(6) - 4z = 2$   
 $5x = 30$                        $-4z = -16$   
 $x = 6$                                $z = 4$
- PTS: 2                      REF: 011803aai           NAT: A.REI.C.6           TOP: Solving Linear Systems  
KEY: three variables
- 4 ANS: 2                      PTS: 2                      REF: 011804aai           NAT: F.TF.A.2  
TOP: Determining Trigonometric Functions                      KEY: radians
- 5 ANS: 4                      PTS: 2                      REF: 011805aai           NAT: F.LE.B.5  
TOP: Modeling Exponential Functions
- 6 ANS: 2                      PTS: 2                      REF: 011806aai           NAT: A.APR.C.4  
TOP: Polynomial Identities
- 7 ANS: 3  
 $440 \times 2.3\% \approx 10$
- PTS: 2                      REF: 011807aai           NAT: S.ID.A.4           TOP: Normal Distributions  
KEY: predict
- 8 ANS: 4                      PTS: 2                      REF: 011808aai           NAT: A.SSE.B.3  
TOP: Modeling Exponential Functions                      KEY: All

9 ANS: 4

$$\begin{array}{r}
 \phantom{2x-1} \overline{) 10x^3 - 3x^2 - 7x + 3} \\
 \underline{10x^3 - 5x^2} \phantom{+ 3} \\
 2x^2 - 7x \phantom{+ 3} \\
 \underline{2x^2 - x} \phantom{+ 3} \\
 -6x + 3 \\
 \underline{-6x + 3} \\
 0
 \end{array}$$

PTS: 2 REF: 011809aai NAT: A.APR.D.6 TOP: Rational Expressions

10 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

11 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

12 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: 011812aai NAT: A.REI.A.2 TOP: Solving Rationals

KEY: rational solutions

13 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 Growth

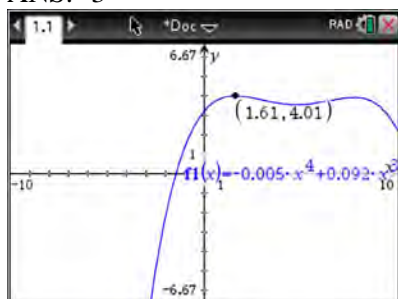
14 ANS: 1 PTS: 2 REF: 011814aai NAT: A.REI.D.11  
TOP: Other Systems KEY: AII15 ANS: 1 PTS: 2 REF: 011815aai NAT: F.TF.A.2  
TOP: Unit Circle

16 ANS: 1

In vertex form, the parabola is  $y = -\frac{1}{4}(x+4)^2 + 3$ . The vertex is  $(-4, 3)$  and  $p = 2$ .  $3 + 2 = 5$

PTS: 2 REF: 011816aai NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

17 ANS: 3



PTS: 2 REF: 011817aai NAT: F.IF.B.4 TOP: Graphing Polynomial Functions

18 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: 011818aai NAT: A.APR.D.6 TOP: Rational Expressions

KEY:  $a > 0$ 

19 ANS: 4

$$p(5) = 2(5)^3 - 3(5) + 5 = 240$$

PTS: 2 REF: 011819aai NAT: A.APR.B.2 TOP: Remainder Theorem

20 ANS: 2 PTS: 2 REF: 011820aai NAT: S.IC.A.2  
TOP: Analysis of Data

21 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: equations

22 ANS: 2

$$S_{20} = \frac{.01 - .01(3)^{20}}{1 - 3} = 17,433,922$$

PTS: 2 REF: 011822aai NAT: A.SSE.B.4 TOP: Series

23 ANS: 4

There is no  $x$ -intercept.

PTS: 2 REF: 011823aai NAT: F.IF.C.7 TOP: Graphing Exponential Functions  
 KEY: All

24 ANS: 3

PTS: 2

REF: 011824aai

NAT: F.BF.A.2

TOP: Sequences

25 ANS:

$$i^2 = -1, \text{ and not } 1; 10 + 10i$$

PTS: 2 REF: 011825aai NAT: N.CN.A.2 TOP: Operations with Complex Numbers

26 ANS:

$$D = 1.223(2.652)^A$$

PTS: 2 REF: 011826aai NAT: S.ID.B.6 TOP: Regression  
 KEY: exponential All

27 ANS:

$$\frac{1}{8} + \frac{1}{6} = \frac{1}{t_b}; \frac{24t_b}{8} + \frac{24t_b}{6} = \frac{24t_b}{t_b}$$

$$3t_b + 4t_b = 24$$

$$t_b = \frac{24}{7} \approx 3.4$$

PTS: 2 REF: 011827aai NAT: A.CED.A.1 TOP: Modeling Rationals

28 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



29 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

KEY: AII

30 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

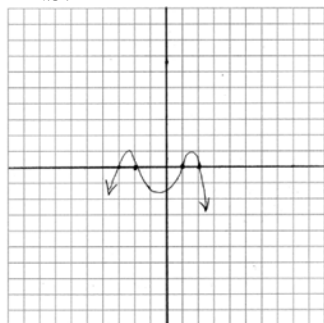
REF: 011830aai

NAT: F.IF.C.9

TOP: Comparing Functions

KEY: AII

31 ANS:



PTS: 2

REF: 011831aai

NAT: F.IF.C.7

TOP: Graphing Polynomial Functions

32 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

33 ANS:

$$\begin{aligned} & (2x^2 + x - 3) \cdot (x - 1) - \left[ (2x^2 + x - 3) + (x - 1) \right] \\ & (2x^3 - 2x^2 + x^2 - x - 3x + 3) - (2x^2 + 2x - 4) \\ & 2x^3 - 3x^2 - 6x + 7 \end{aligned}$$

PTS: 4 REF: 011833aai NAT: F.BF.A.1 TOP: Operations with Functions

34 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

35 ANS:

$138.905 \pm 2 \cdot 7.95 = 123 - 155$ . No, since 125 (50% of 250) falls within the 95% interval.

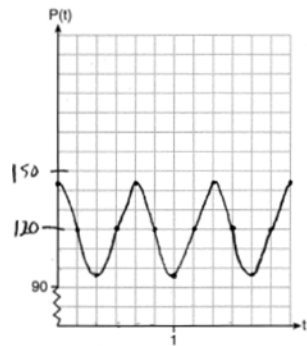
PTS: 4 REF: 011835aai NAT: S.IC.A.2 TOP: Analysis of Data

36 ANS:

$$f(x) = x^2(x + 4)(x - 3); \quad g(x) = (x + 2)^2(x + 6)(x - 1)$$

PTS: 4 REF: 011836aai NAT: A.APR.B.3 TOP: Zeros of Polynomials

37 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

## 0618aII

## Answer Section

1 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: 061801aII NAT: A.REI.C.7 TOP: Quadratic-Linear Systems  
KEY: AII

2 ANS: 2 PTS: 2 REF: 061802aII NAT: F.IF.C.7  
TOP: Graphing Exponential Functions KEY: AII

3 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

4 ANS: 2 PTS: 2 REF: 061804aII NAT: S.ID.B.6  
TOP: Regression KEY: choose model

5 ANS: 3

$$(x + 3i)^2 - (2x - 3i)^2 = x^2 + 6xi + 9i^2 - (4x^2 - 12xi + 9i^2) = -3x^2 - 18xi$$

PTS: 2 REF: 061805aII NAT: N.CN.A.2 TOP: Operations with Complex Numbers

6 ANS: 2

$$f(x) = f(-x)$$

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

$$x^2 - 4 = x^2 - 4$$

PTS: 2 REF: 061806aII NAT: F.BF.B.3 TOP: Even and Odd Functions

7 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: 061807aII NAT: F.IF.B.6 TOP: Rate of Change  
KEY: AII

8 ANS: 1

$$(x + 7)(x - 1) = x^2 + 6x - 7 = x^2 + 6x + 9 - 7 - 9 = (x + 3)^2 - 16$$

PTS: 2 REF: 061808aII NAT: A.APR.C.4 TOP: Polynomial Identities

9 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

10 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

11 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

12 ANS: 3

$$1^3 - k(1)^2 + 2(1) = 0$$

$$k = 3$$

PTS: 2 REF: 061812aai NAT: A.APR.B.3 TOP: Zeros of Polynomials

KEY: All

13 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

14 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

KEY: All

15 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: other

16 ANS: 2

PTS: 2

REF: 061816aai

NAT: F.IF.C.7

TOP: Graphing Polynomial Functions

KEY: bimodalgraph

17 ANS: 2



PTS: 2

REF: 061817aai

NAT: S.ID.A.4

TOP: Normal Distributions

KEY: probability

18 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: 061818aai

NAT: A.SSE.B.3

TOP: Modeling Exponential Functions

KEY: AII

19 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

20 ANS: 2

$$4x \cdot x^{\frac{2}{3}} + 2x^{\frac{5}{3}} = 4x^{\frac{5}{3}} + 2x^{\frac{5}{3}} = 6x^{\frac{5}{3}} = 6\sqrt[3]{x^5}$$

PTS: 2 REF: 061820aai NAT: N.RN.A.2 TOP: Operations with Radicals  
KEY: with variables, index > 2

21 ANS: 4

$$\frac{5+9}{2} = 7, \text{ vertex: } (-2, 7); p = 7 - 9 = -2, y = \frac{1}{4(-2)}(x+2)^2 + 7$$

$$y - 7 = \frac{1}{-8}(x+2)^2$$

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

PTS: 2 REF: 061821aai NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

22 ANS: 4

$$(a + b + c)^2 = a^2 + ab + ac + ab + b^2 + bc + ac + ab + c^2$$

$$x = a^2 + b^2 + c^2 + 2(ab + bc + ac)$$

$$x = y + 2z$$

PTS: 2 REF: 061822aai NAT: A.APR.C.4 TOP: Polynomial Identities

23 ANS: 4

$$1 \text{ year} = 365 \text{ days}$$

PTS: 2 REF: 061823aai NAT: A.SSE.B.3 TOP: Modeling Exponential Functions  
KEY: All

24 ANS: 3

PTS: 2

REF: 061824aai

NAT: A.CED.A.1

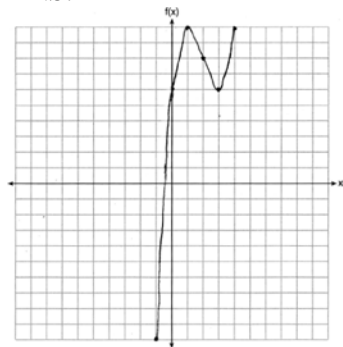
TOP: Modeling Rationals

25 ANS:

$$\frac{103}{110+103} = \frac{103}{213}$$

PTS: 2 REF: 061825aai NAT: S.CP.A.4 TOP: Conditional Probability

26 ANS:



PTS: 2 REF: 061826aai NAT: F.IF.C.7 TOP: Graphing Polynomial Functions

27 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: 061827aia NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | quadratic formula

28 ANS:

Self selection is a cause of bias because people with more free time are more likely to respond.

PTS: 2 REF: 061828aia NAT: S.IC.B.3 TOP: Analysis of Data

KEY: bias

29 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: Division of Polynomials

30 ANS:

 $a_1 = 3 \quad a_2 = 7 \quad a_3 = 15 \quad a_4 = 31$ ; No, because there is no common ratio:  $\frac{7}{3} \neq \frac{15}{7}$ 

PTS: 2 REF: 061830aia NAT: F.IF.A.3 TOP: Sequences

KEY: term

31 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: 061831aia NAT: A.SSE.B.4 TOP: Series

32 ANS:

$$\frac{-1}{\sqrt{2^2 + (-1)^2}} = -\frac{1}{\sqrt{5}}$$

PTS: 2 REF: 061832aai NAT: F.TF.A.2 TOP: Determining Trigonometric Functions  
KEY: extension to reals

33 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: 061833aai NAT: A.REI.A.2 TOP: Solving Radicals  
KEY: extraneous solutions

34 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: 061834aai NAT: S.IC.B.5 TOP: Analysis of Data

35 ANS:

$$C(t) = 63000 \left(1 + \frac{0.0255}{12}\right)^{12t} = 63000 \left(1 + \frac{0.0255}{12}\right)^{12t} = 100000$$

$$12t \log(1.002125) = \log \frac{100}{63}$$

$$t \approx 18.14$$

PTS: 4 REF: 061835aai NAT: A.CED.A.1 TOP: Exponential Growth

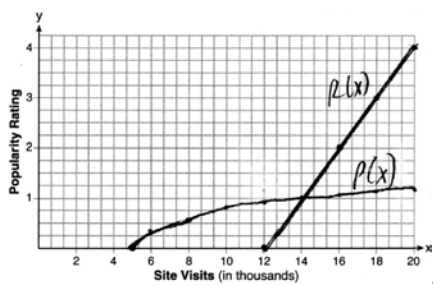
36 ANS:

$$\frac{h(2) - h(1)}{2 - 1} = -12, \quad h(t) = 0 \text{ at } t \approx 2.2, 3.8, \text{ using a graphing calculator to find where } h(t) = 0.$$

PTS: 4 REF: 061836aai NAT: F.IF.B.4 TOP: Graphing Trigonometric Functions



37 ANS:



$P(16) = \log(16 - 4) \approx 1.1$ , , 14000

PTS: 6 REF: 061837a11 NAT: A.REI.D.11 TOP: Other Systems  
 KEY: A11

## 0818AII Common Core State Standards Answer Section

1 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

2 ANS: 2

PTS: 2

REF: 081802aai

NAT: S.IC.B.3

TOP: Analysis of Data

KEY: type

3 ANS: 4

PTS: 2

REF: 081803aai

NAT: F.BF.A.1

TOP: Operations with Functions

4 ANS: 1

PTS: 2

REF: 081804aai

NAT: F.IF.C.9

TOP: Comparing Functions

5 ANS: 3

$$\begin{array}{r}
 2x^3 - 4x^2 - x + \frac{14}{x+6} \\
 x+6 \overline{) 2x^4 + 8x^3 - 25x^2 - 6x + 14} \\
 \underline{2x^4 + 12x^3} \phantom{- 6x + 14} \\
 -4x^3 - 25x^2 \phantom{- 6x + 14} \\
 \underline{-4x^3 - 24x^2} \phantom{- 6x + 14} \\
 -x^2 - 6x \phantom{+ 14} \\
 \underline{-x^2 - 6x} \\
 14
 \end{array}$$

PTS: 2

REF: 081805aai

NAT: A.APR.D.6

TOP: Rational Expressions

KEY: division

6 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

7 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: 081807aia NAT: A.REI.A.2 TOP: Solving Radicals

KEY: extraneous solutions

8 ANS: 2

$$1.00643^{12} \approx 1.08$$

PTS: 2 REF: 081808aia NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

9 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: 081809aia NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | quadratic formula

10 ANS: 4 PTS: 2 REF: 081810aia NAT: F.LE.A.2

TOP: Sequences

11 ANS: 2

$$\text{If } \cos \theta = \frac{7}{25}, \sin \theta = \pm \frac{24}{25}, \text{ and } \tan \theta = \frac{\sin \theta}{\cos \theta} = \frac{-\frac{24}{25}}{\frac{7}{25}} = -\frac{24}{7}$$

PTS: 2 REF: 081811aia NAT: F.TF.C.8 TOP: Determining Trigonometric Functions

12 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: 081812aia NAT: N.RN.A.2 TOP: Operations with Radicals

KEY: with variables, index &gt; 2

13 ANS: 1 PTS: 2 REF: 081813aia NAT: A.SSE.B.4

TOP: Series

14 ANS: 4

$$(x^6y^4 - 9)(x^4 - 16)$$

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

PTS: 2 REF: 081814aai NAT: A.SSE.A.2

TOP: Factoring the Difference of Perfect Squares

KEY: multivariable AII

15 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

16 ANS: 2

PTS: 2

REF: 081816aai

NAT: F.IF.C.7

TOP: Graphing Logarithmic Functions

KEY: bimodalgraph

17 ANS: 4

PTS: 2

REF: 081817aai

NAT: F.BF.B.3

TOP: Transformations with Functions

18 ANS: 2

$$\frac{85}{210 + 85}$$

PTS: 2

REF: 081818aai

NAT: S.CP.A.1

TOP: Venn Diagrams

19 ANS: 3

PTS: 2

REF: 081819aai

NAT: A.REI.D.11

TOP: Other Systems

20 ANS: 1

$$-4(-1) - 3 = 1 \quad 8 = \frac{2\pi}{b}$$

$$b = \frac{\pi}{4}$$

PTS: 2

REF: 081820aai

NAT: F.IF.B.4

TOP: Graphing Trigonometric Functions

KEY: maximum/minimum

21 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.D.6

TOP: Solving Polynomial Equations

22 ANS: 2

$$P = \frac{2\pi}{\frac{\pi}{45}} = 90$$

PTS: 2

REF: 081822aai

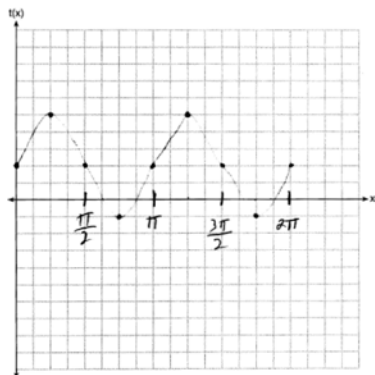
NAT: F.IF.C.7

TOP: Graphing Trigonometric Functions

KEY: period

- 23 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
- 24 ANS: 4 PTS: 2 REF: 081824aai NAT: S.CP.A.3  
TOP: Conditional Probability
- 25 ANS:  
 $(x^2 - 6)(x^2 + 2)$
- PTS: 2 REF: 081825aai NAT: A.SSE.A.2 TOP: Factoring Polynomials  
KEY: higher power
- 26 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
- 27 ANS:  
 $\frac{p(8) - p(4)}{8 - 4} \approx 48.78$
- PTS: 2 REF: 081827aai NAT: F.IF.B.6 TOP: Rate of Change
- 28 ANS:  
 $1200 \cdot 0.784 \approx 941$
- PTS: 2 REF: 081828aai NAT: S.ID.A.4 TOP: Normal Distributions  
KEY: predict
- 29 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

30 ANS:



PTS: 2 REF: 081830aai NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions  
KEY: graph

31 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: 081831aai NAT: A.REI.C.7 TOP: Quadratic-Linear Systems

32 ANS:

$2(0.042) = 0.084 \approx 0.08$  The percent of users making in-app purchases will be within 4% of 35%.

PTS: 2 REF: 081832aai NAT: S.IC.B.4 TOP: Analysis of Data

33 ANS:

$$4x + 6y - 8z = -2 \quad 4x - 8y + 20z = 12 \quad z + 2 = 3z - 4 \quad y = 3 + 2 = 5 \quad -4x + 5 + 3 = 16$$

$$\underline{-4x + y + z = 16} \quad \underline{-4x + y + z = 16} \quad 6 = 2z \quad -4x = 8$$

$$7y - 7z = 14 \quad -7y + 21z = 28 \quad z = 3 \quad x = -2$$

$$y - z = 2 \quad y - 3z = -4$$

$$y = z + 2 \quad y = 3z - 4$$

PTS: 4 REF: 081833aai NAT: A.REI.C.6 TOP: Solving Linear Systems  
KEY: three variables

34 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: 081834aaii

NAT: A.APR.B.2

TOP: Remainder Theorem

35 ANS:

$$2 = e^{0.0375t}$$

$$t \approx 18.5$$

PTS: 4

REF: 081835aaii

NAT: F.LE.A.4

TOP: Exponential Growth

36 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.

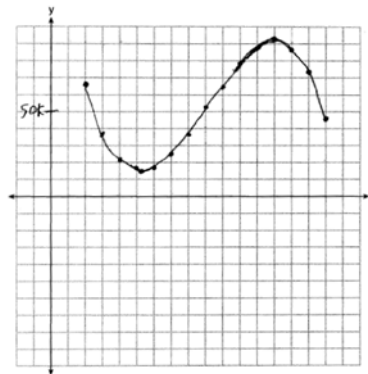
PTS: 4

REF: 081836aaii

NAT: S.IC.B.5

TOP: Analysis of Data

37 ANS:



$$P(x) = R(x) - C(x) = -330x^3 + 9000x^2 - 67000x + 167000$$

Least profitable at year 5 because there is a minimum in  $P(x)$ . Most profitable at year 13 because there is a maximum in  $P(x)$ .

PTS: 6

REF: 081837aaii

NAT: F.IF.C.7

TOP: Graphing Polynomial Functions

## 0119AII Common Core State Standards

## Answer Section

1 ANS: 2                      PTS: 2                      REF: 011901aai      NAT: S.ID.A.4  
TOP: Normal Distributions                      KEY: mean and standard deviation

2 ANS: 1                      PTS: 2                      REF: 011902aai      NAT: F.IF.C.7  
TOP: Graphing Logarithmic Functions

3 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

4 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.IF.A.3      TOP: Sequences  
KEY: term

5 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: 011905aai      NAT: A.REI.B.4      TOP: Solving Quadratics  
KEY: complex solutions | quadratic formula

6 ANS: 3

$$1.04^{\frac{1}{12}} \approx 1.0032737$$

PTS: 2                      REF: 011906aai      NAT: A.SSE.B.3      TOP: Modeling Exponential Functions

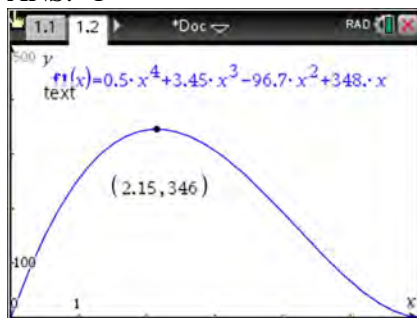
7 ANS: 1

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



8 ANS: 1



PTS: 2 REF: 011908aia NAT: F.IF.B.4 TOP: Graphing Polynomial Functions

9 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: 011909aia NAT: A.REI.B.4 TOP: Using the Discriminant

KEY: determine nature of roots given equation, graph, table

10 ANS: 2 PTS: 2 REF: 011910aia NAT: S.IC.B.3  
TOP: Analysis of Data KEY: bias

11 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: 011911aia NAT: N.CN.A.2 TOP: Operations with Complex Numbers

12 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: 011912aia NAT: S.CP.A.3 TOP: Conditional Probability

13 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: 011913aia NAT: F.TF.B.5 TOP: Modeling Trigonometric Functions

14 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

15 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

16 ANS: 4

$$a_1 = 2.5 + 0.5(1) = 3$$

PTS: 2 REF: 011916aai NAT: F.LE.A.2 TOP: Sequences

17 ANS: 3

PTS: 2

REF: 011917aai

NAT: F.BF.B.4

TOP: Inverse of Functions

KEY: other

18 ANS: 4

$$1 + \frac{.009}{12} = 1.00075$$

PTS: 2 REF: 011918aai NAT: A.SSE.B.3 TOP: Modeling Exponential Functions

19 ANS: 1

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

PTS: 2 REF: 011919aai NAT: A.APR.B.3 TOP: Graphing Polynomial Functions

20 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

21 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: 011921aai NAT: A.APR.D.6 TOP: Rational Expressions

KEY: factoring

22 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

23 ANS: 1

$$84.1\% \times 750 \approx 631$$

PTS: 2

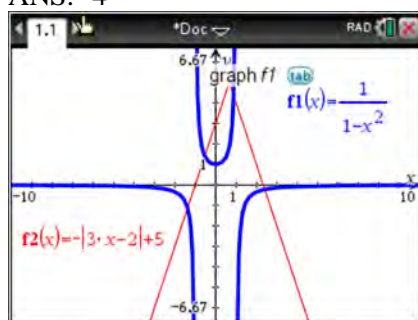
REF: 011923aai

NAT: S.ID.A.4

TOP: Normal Distributions

KEY: predict

24 ANS: 4



PTS: 2

REF: 011924aai

NAT: A.REI.D.11

TOP: Other Systems

25 ANS:

$$\frac{\sqrt[3]{x^2 y^5}}{\sqrt[4]{x^3 y^4}} = \frac{x^{\frac{2}{3}} y^{\frac{5}{3}}}{x^{\frac{3}{4}} y^1} = x^{\frac{8}{12} - \frac{9}{12}} y^{\frac{20}{12} - \frac{12}{12}} = x^{-\frac{1}{12}} y^{\frac{2}{3}}$$

PTS: 2

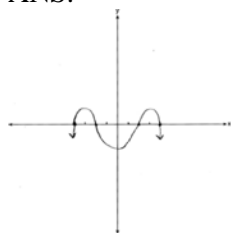
REF: 011925aai

NAT: N.RN.A.2

TOP: Radicals and Rational Exponents

KEY: variables

26 ANS:



PTS: 2

REF: 011926aai

NAT: F.IF.C.7

TOP: Graphing Polynomial Functions

27 ANS:

$$(a+b)^3 = a^3 + b^3 \quad \text{No. Erin's shortcut only works if } a = 0, b = 0 \text{ or } a = -b.$$

$$a^3 + 3a^2b + 3ab^2 + b^3 = a^3 + b^3$$

$$3ab^2 + 3a^2b = 0$$

$$3ab(b+a) = 0$$

$$a = 0, b = 0, a = -b$$

PTS: 2 REF: 011927aia NAT: A.APR.C.4 TOP: Polynomial Identities

28 ANS:

$$P(A+B) = P(A) \cdot P(B|A) = 0.8 \cdot 0.85 = 0.68$$

PTS: 2 REF: 011928aia NAT: S.CP.A.3 TOP: Conditional Probability

29 ANS:

$$S_{10} = \frac{15 - 15(1.03)^{10}}{1 - 1.03} \approx 171.958$$

PTS: 2 REF: 011929aia NAT: A.SSE.B.4 TOP: Series

30 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: 011930aia NAT: F.IF.B.6 TOP: Rate of Change

31 ANS:

$$t^2 + \left(\frac{4}{7}\right)^2 = 1 \quad -\frac{\sqrt{33}}{7}$$

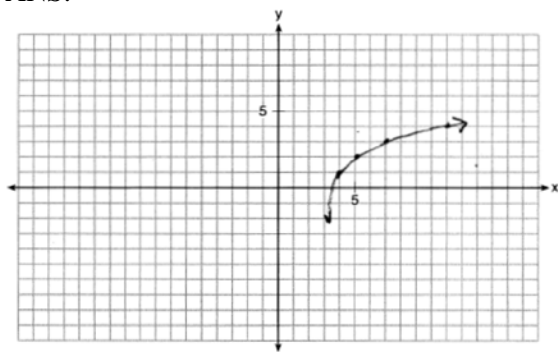
$$t^2 + \frac{16}{49} = \frac{49}{49}$$

$$t^2 = \frac{33}{49}$$

$$t = \frac{\pm\sqrt{33}}{7}$$

PTS: 2 REF: 011931aia NAT: F.TF.A.2 TOP: Unit Circle

32 ANS:



PTS: 2 REF: 011932aai NAT: F.IF.C.7 TOP: Graphing Logarithmic Functions

33 ANS:

$$\begin{array}{r}
 a + 4b + 6c = 23 \quad a + 2b + c = 2 \quad 8b + 3c = 16 \quad 2b + 5(4) = 21 \quad a + 4\left(\frac{1}{2}\right) + 6(4) = 23 \\
 \underline{a + 2b + c = 2} \quad \underline{-a + 6b + 2c = 14} \quad \underline{8b + 20c = 84} \quad 2b = 1 \quad a + 2 + 24 = 23 \\
 2b + 5c = 21 \quad 8b + 3c = 16 \quad 17c = 68 \quad b = \frac{1}{2} \quad a = -3 \\
 \qquad \qquad \qquad c = 4
 \end{array}$$

PTS: 4 REF: 011933aai NAT: A.REI.C.6 TOP: Solving Linear Systems

KEY: three variables

34 ANS:

$$\begin{array}{r}
 x^3 + 4 \\
 x + 2 \overline{) x^4 + 2x^3 + 4x - 10} \quad x^3 + 4 - \frac{18}{x+2}. \text{ No, because there is a remainder.}
 \end{array}$$

$$\begin{array}{r}
 \underline{x^4 + 2x^3} \\
 4x - 10 \\
 \underline{4x + 8} \\
 -18
 \end{array}$$

PTS: 4 REF: 011934aai NAT: A.REI.C.6 TOP: Rational Expressions

KEY: division

35 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

36 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

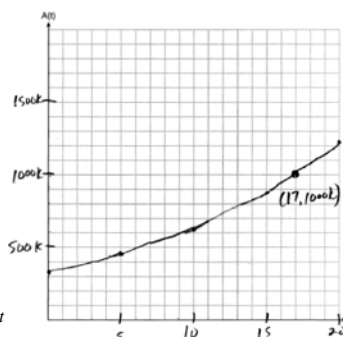
REF: 011936aai

NAT: A.REI.A.2

TOP: Solving Radicals

KEY: extraneous solutions

37 ANS:



$$A(t) = 318000(1.07)^t$$

$$318000(1.07)^t = 1000000$$

The graph of  $A(t)$  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: 011937aai

NAT: A.CED.A.1

TOP: Exponential Growth

## 0619aii

## Answer Section

1 ANS: 3                      PTS: 2                      REF: 061901aii                      NAT: S.IC.B.3  
TOP: Analysis of Data                      KEY: type

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

PTS: 2                      REF: 061902aii                      NAT: A.APR.C.4                      TOP: Polynomial Identities  
3 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: 061903aii                      NAT: A.REI.C.7                      TOP: Quadratic-Linear Systems  
4 ANS: 1                      PTS: 2                      REF: 061904aii                      NAT: F.IF.B.4  
TOP: Relating Graphs to Events

5 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  
6 ANS: 3                      PTS: 2                      REF: 061906aii                      NAT: F.LE.A.2  
TOP: Families of Functions  
7 ANS: 4                      PTS: 2                      REF: 061907aii                      NAT: A.APR.B.2  
TOP: Remainder Theorem

8 ANS: 1  
 $(x^{\frac{3}{2}})^2 = x^3$

PTS: 2                      REF: 061908aii                      NAT: N.RN.A.2                      TOP: Radicals and Rational Exponents  
KEY: variables

9 ANS: 2  
 $x = 4y + 5$   
 $x - 5 = 4y$   
 $\frac{1}{4}x - \frac{5}{4} = y$

PTS: 2                      REF: 061909aii                      NAT: F.BF.B.4                      TOP: Inverse of Functions  
KEY: linear

10 ANS: 3                      PTS: 2                      REF: 061910aai                      NAT: F.BF.A.2  
TOP: Sequences

11 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

12 ANS: 4  

$$wx^2 + w = 0$$

$$wx^2 = -w$$

$$x^2 = -1$$

$$x = \pm i$$

PTS: 2                      REF: 061912aai                      NAT: A.REI.B.4                      TOP: Solving Quadratics  
KEY: complex solutions | taking square roots

13 ANS: 2  

$$0.254 \pm 2(0.060) \rightarrow (0.134, 0.374)$$

PTS: 2                      REF: 061913aai                      NAT: S.IC.B.5                      TOP: Analysis of Data  
14 ANS: 4                      PTS: 2                      REF: 061914aai                      NAT: A.REI.D.11  
TOP: Other Systems

15 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  
16 ANS: 1

$$x - \frac{20}{x} = 8$$

$$x^2 - 8x - 20 = 0$$

$$(x - 10)(x + 2) = 0$$

$$x = 10, -2$$

PTS: 2                      REF: 061916aai                      NAT: A.CED.A.1                      TOP: Modeling Rationals  
17 ANS: 2                      PTS: 2                      REF: 061917aai                      NAT: F.LE.B.5  
TOP: Modeling Exponential Functions



18 ANS: 4  
 $400 \cdot .954 \approx 380$

PTS: 2 REF: 061918aai NAT: S.ID.A.4 TOP: Normal Distributions  
 KEY: predict

19 ANS: 2  
 $b^2 = 2b^2 - 64$   $-8$  is extraneous.

$$-b^2 = -64$$

$$b = \pm 8$$

PTS: 2 REF: 061919aai NAT: A.REI.A.2 TOP: Solving Radicals  
 KEY: extraneous solutions

20 ANS: 1  
 2) linear, 3) quadratic, 4) cubic

PTS: 2 REF: 061920aai NAT: F.LE.A.2 TOP: Families of Functions

21 ANS: 4 PTS: 2 REF: 061921aai NAT: A.APR.B.3  
 TOP: Graphing Polynomial Functions

22 ANS: 3  
 $T(19) = 8 \sin(0.3(19) - 3) + 74 \approx 77$

PTS: 2 REF: 061922aai NAT: F.TF.A.2 TOP: Determining Trigonometric Functions  
 KEY: radians

23 ANS: 2  
 $x + y - z = 6$   $2x + 2y - 2z = 12$   $5y - 4z = 31$   $5y - 2(-4) = 23$   $x + 3 - (-4) = 6$

$$\frac{-x + 4y - z = 17}{5y - 2z = 23} \quad \frac{2x - 3y + 2z = -19}{5y - 4z = 31} \quad \frac{5y - 2z = 23}{-2z = 8} \quad 5y = 15 \quad x = -1$$

$$5y - 2z = 23 \quad 5y - 4z = 31 \quad -2z = 8 \quad y = 3$$

$$z = -4$$

PTS: 2 REF: 061923aai NAT: A.REI.C.6 TOP: Solving Linear Systems  
 KEY: three variables

24 ANS: 4  
 $1.06^{\frac{1}{52}}$

PTS: 2 REF: 061924aai NAT: F.BF.A.1 TOP: Modeling Exponential Functions

25 ANS:  
 $\frac{13.9 - 9.4}{4 - 1} = 1.5$  The average rate of change in the number of hours of daylight from January 1-April 1 is 1.5.

PTS: 2 REF: 061925aai NAT: F.IF.B.6 TOP: Rate of Change

26 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

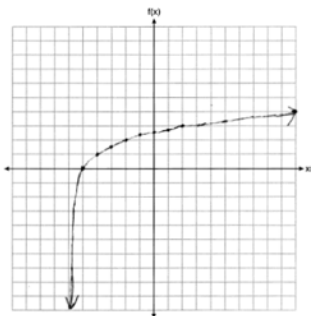
REF: 061926aai

NAT: A.REI.A.2

TOP: Solving Rationals

KEY: rational solutions

27 ANS:



PTS: 2

REF: 061927aai

NAT: F.IF.C.7

TOP: Graphing Logarithmic Functions

28 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

29 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

30 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: 061930aai NAT: A.APR.D.6 TOP: Rational Expressions  
KEY: division

31 ANS:

$$\frac{9}{6} = 1.5 \quad a_1 = 6$$

$$a_n = 1.5 \cdot a_{n-1}$$

PTS: 2 REF: 061931aai NAT: F.BF.A.2 TOP: Sequences

32 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

33 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.C.7 TOP: Graphing Polynomial Functions

34 ANS:

$$s(t) = 200(0.5)^{\frac{t}{15}} \quad \frac{1}{10} = (0.5)^{\frac{t}{15}}$$

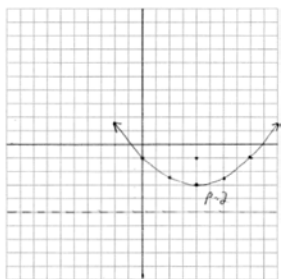
$$\log \frac{1}{10} = \log(0.5)^{\frac{t}{15}}$$

$$-1 = \frac{t \cdot \log(0.5)}{15}$$

$$t = \frac{-15}{\log(0.5)} \approx 50$$

PTS: 4 REF: 061934aai NAT: F.LE.A.4 TOP: Exponential Decay

35 ANS:



$$y = \frac{1}{4(2)}(x-4)^2 - 3 \quad y = \frac{-1 + -5}{2} = -3. \text{ The vertex is } (4, -3) \text{ and } p = 2.$$

PTS: 4

REF: 061935aai

NAT: G.GPE.A.2

TOP: Graphing Quadratic Functions

36 ANS:

$$P(F|L) = \frac{12}{27} \quad P(F) = \frac{22}{45} \quad \text{Since } P(F|L) \neq P(F), \text{ the events are not independent.}$$

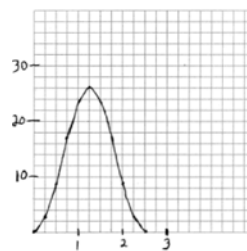
PTS: 4

REF: 061936aai

NAT: S.CP.A.4

TOP: Conditional Probability

37 ANS:



$$\text{period} = \frac{2\pi}{0.8\pi} = 2.5. \text{ The wheel rotates once every 2.5 seconds.}$$

of  $f(t) = 26$ .

No, because the maximum

PTS: 6

REF: 061937aai

NAT: F.IF.C.7

TOP: Graphing Trigonometric Functions

KEY: graph

## 0819AII Regents Exam Answer Section

1 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

2 ANS: 3

$$8r^3 = 216 \quad S_{12} = \frac{8 - 8(3)^{12}}{1 - 3} = 2125760$$

$$r^3 = 27$$

$$r = 3$$

PTS: 2 REF: 081902aai NAT: A.SSE.B.4 TOP: Series

3 ANS: 1

PTS: 2

REF: 081903aai NAT: F.LE.A.2

TOP: Families of Functions

4 ANS: 2

PTS: 2

REF: 081904aai NAT: A.SSE.A.2

TOP: Factoring Polynomials

KEY: higher power

5 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

6 ANS: 4

PTS: 2

REF: 081906aai NAT: S.IC.B.3

TOP: Analysis of Data

KEY: type

7 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: 081907aai NAT: A.APR.D.7 TOP: Addition and Subtraction of Rationals

8 ANS: 2

PTS: 2

REF: 081908aai NAT: F.IF.B.4

TOP: Graphing Polynomial Functions

- 9 ANS: 3                      PTS: 2                      REF: 081909aai                      NAT: F.LE.A.2  
 TOP: Sequences                      KEY: recursive

10 ANS: 1

$$\begin{array}{r} 3x-1 \\ 3x+1 \overline{) 9x^2+0x-2} \\ \underline{9x^2+3x} \phantom{-2} \\ -3x-2 \\ \underline{-3x-1} \\ -1 \end{array}$$

PTS: 2                      REF: 081910aai                      NAT: A.APR.D.6                      TOP: Rational Expressions  
 KEY: division

11 ANS: 2                      PTS: 2                      REF: 081911aai                      NAT: F.BF.B.3  
 TOP: Even and Odd Functions

12 ANS: 4                      PTS: 2                      REF: 081912aai                      NAT: F.IF.C.7  
 TOP: Graphing Trigonometric Functions                      KEY: mixed

13 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: 081913aai                      NAT: S.CP.A.3                      TOP: Conditional Probability

14 ANS: 4

$$\sqrt{3x^2y} \cdot \sqrt[3]{27x^3y^2} = 3^{\frac{1}{2}}xy^{\frac{1}{2}} \cdot 3^{\frac{2}{3}}xy^{\frac{2}{3}} = 3^{\frac{3}{2}}x^2y^{\frac{7}{6}}$$

PTS: 2                      REF: 081914aai                      NAT: N.RN.A.2                      TOP: Operations with Radicals  
 KEY: with variables, index > 2

15 ANS: 4

$$x(x-2) \left( \frac{10}{x^2-2x} + \frac{4}{x} = \frac{5}{x-2} \right) \text{ 2 is extraneous.}$$

$$10 + 4(x-2) = 5x$$

$$10 + 4x - 8 = 5x$$

$$2 = x$$

PTS: 2                      REF: 081915aai                      NAT: A.REI.A.2                      TOP: Solving Rationals  
 KEY: rational solutions

16 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

17 ANS: 4

$$5000 \left( 1 + \frac{.035}{12} \right)^{12 \cdot 6} \approx 6166.50$$

PTS: 2

REF: 081917aai

NAT: A.CED.A.1

TOP: Exponential Growth

18 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: 081918aai

NAT: F.LE.A.4

TOP: Exponential Decay

19 ANS: 1



PTS: 2

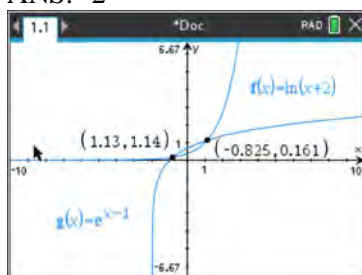
REF: 081919aai

NAT: S.ID.A.4

TOP: Normal Distributions

KEY: percent

20 ANS: 2



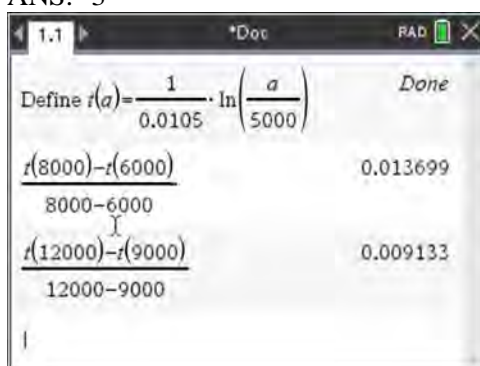
PTS: 2 REF: 081920aai NAT: A.REI.D.11 TOP: Other Systems

21 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: Graphing Polynomial Functions

22 ANS: 3



PTS: 2 REF: 081922aai NAT: F.IF.B.6 TOP: Rate of Change

23 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: other

24 ANS: 1

$$1.025^{\frac{1}{12}} \approx 1.00206$$

PTS: 2 REF: 081924aai NAT: A.SSE.B.3 TOP: Modeling Exponential Functions



25 ANS:

$$\frac{165 + 66 - 33}{825} = \frac{198}{825}$$

PTS: 2 REF: 081925aai NAT: S.CP.B.6 TOP: Conditional Probability

26 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.  $(\sqrt{9})^5 = 243$

PTS: 2 REF: 081926aai NAT: N.RN.A.1 TOP: Radicals and Rational Exponents

27 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

28 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

29 ANS:

$P(-2) = 60$   $Q(-2) = 0$   $(x+2)$  is a factor of  $Q(x)$  since  $Q(-2) = 0$ .

PTS: 2 REF: 081929aai NAT: A.APR.B.2 TOP: Remainder Theorem

30 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

31 ANS:

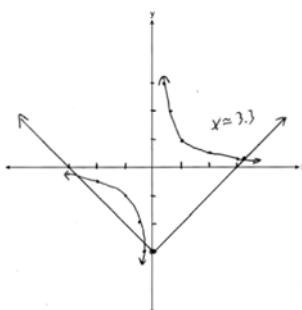
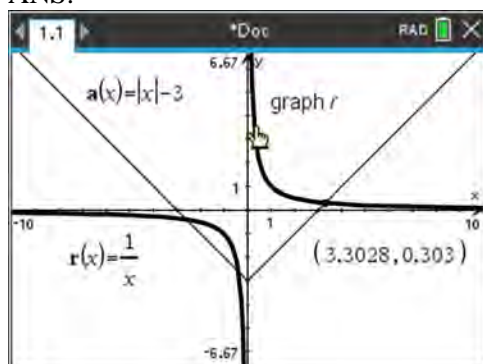
$$a_1 = 4$$

$$a_n = 3a_{n-1}$$

PTS: 2 REF: 081931aai NAT: F.LE.A.2 TOP: Sequences

KEY: recursive

32 ANS:



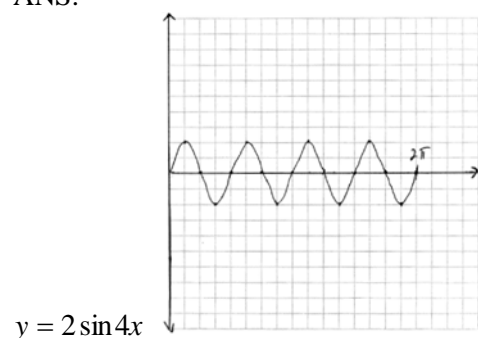
PTS: 2 REF: 081932aia NAT: A.REI.D.11 TOP: Other Systems

33 ANS:

$N(t) = 950e^{0.0475t}$  The base is  $e$  because growth is continuous.  $N\left(\frac{36}{24}\right) \approx 1020$

PTS: 4 REF: 081933aia NAT: F.LE.A.2 TOP: Modeling Exponential Functions

34 ANS:

PTS: 4 REF: 081934aia NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions  
KEY: graph

35 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: 081935aia NAT: S.IC.B.5 TOP: Analysis of Data

36 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

37 ANS:

$$B = 1.69\sqrt{30 + 4.45} - 3.49 \approx 6, \text{ which is a steady breeze.} \quad 15 = 1.69\sqrt{s + 4.45} - 3.49$$

$$18.49 = 1.69\sqrt{s + 4.45}$$

$$\frac{18.49}{1.69} = \sqrt{s + 4.45}$$

$$\left(\frac{18.49}{1.69}\right)^2 = s + 4.45$$

$$s = \left(\frac{18.49}{1.69}\right)^2 - 4.45$$

$$s \approx 115$$

$$9.5 = 1.69\sqrt{s + 4.45} - 3.49 \quad 10.49 = 1.69\sqrt{s + 4.45} - 3.49 \quad 55-64$$

$$12.99 = 1.69\sqrt{s + 4.45} \quad 13.98 = 1.69\sqrt{s + 4.45}$$

$$\frac{12.99}{1.69} = \sqrt{s + 4.45} \quad \frac{13.98}{1.69} = \sqrt{s + 4.45}$$

$$\left(\frac{12.99}{1.69}\right)^2 = s + 4.45 \quad \left(\frac{13.98}{1.69}\right)^2 = s + 4.45$$

$$s = \left(\frac{12.99}{1.69}\right)^2 - 4.45 \quad s = \left(\frac{13.98}{1.69}\right)^2 - 4.45$$

$$s \approx 55$$

$$s \approx 64$$

PTS: 6 REF: 081937aii NAT: A.REI.A.2 TOP: Solving Radicals

KEY: context

## 0120AII Common Core State Standards Answer Section

1 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

2 ANS: 3 PTS: 2 REF: 012002aai NAT: F.BF.A.1  
TOP: Operations with Functions

3 ANS: 3 PTS: 2 REF: 012003aai NAT: A.APR.C.4  
TOP: Polynomial Identities

4 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

5 ANS: 3 PTS: 2 REF: 012005aai NAT: F.IF.B.4  
TOP: Graphing Polynomial Functions

6 ANS: 3

$$(x+a)^2 + 5(x+a) + 4 \text{ let } u = x+a$$

$$u^2 + 5u + 4$$

$$(u+4)(u+1)$$

$$(x+a+4)(x+a+1)$$

PTS: 2 REF: 012006aai NAT: A.SSE.A.2 TOP: Factoring Polynomials  
KEY: multivariable

7 ANS: 3

$$\begin{array}{r} 2x+1 \\ x+2 \overline{) 2x^2+5x+8} \end{array}$$

$$\underline{2x^2+4x}$$

$$x+8$$

$$\underline{x+2}$$

$$6$$

PTS: 2 REF: 012007aai NAT: A.APR.D.6 TOP: Rational Expressions  
KEY: division

8 ANS: 4 PTS: 2 REF: 012008aai NAT: S.CP.A.3  
TOP: Conditional Probability

9 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: 012009aai NAT: F.LE.A.4 TOP: Exponential Equations

KEY: without common base

10 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

11 ANS: 4

$$\frac{13}{13+11} = \frac{13}{24}$$

PTS: 2 REF: 012011aai NAT: S.CP.A.4 TOP: Conditional Probability

12 ANS: 1

$$\frac{N(6) - N(0)}{6 - 0} \approx -8.93$$

PTS: 2 REF: 012012aai NAT: F.IF.B.6 TOP: Rate of Change

13 ANS: 4

(1) and (3) are not recursive

PTS: 2 REF: 012013aai NAT: F.LE.A.2 TOP: Sequences

KEY: recursive

14 ANS: 4 PTS: 2 REF: 012014aai NAT: S.IC.B.5

TOP: Analysis of Data

15 ANS: 3 PTS: 2 REF: 012015aai NAT: S.IC.B.3

TOP: Analysis of Data KEY: type

16 ANS: 4 PTS: 2 REF: 012016aai NAT: F.IF.B.4

TOP: Graphing Trigonometric Functions KEY: increasing/decreasing

17 ANS: 1

$$\frac{-12}{16} = \frac{9}{-12} = \frac{-6.75}{9}$$

PTS: 2 REF: 012017aai NAT: F.IF.A.3 TOP: Sequences

KEY: difference or ratio

18 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

19 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

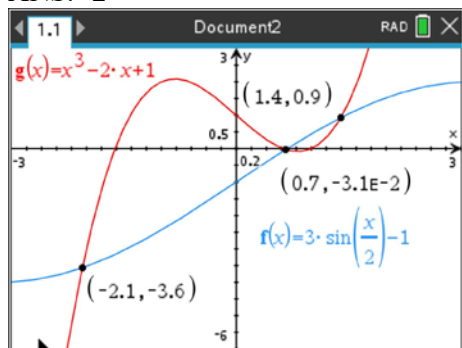
20 ANS: 2

$$5x^2 - 4x + 2 = 0 \quad \frac{4 \pm \sqrt{(-4)^2 - 4(5)(2)}}{2(5)} = \frac{4 \pm \sqrt{-24}}{10} = \frac{4 \pm 2i\sqrt{6}}{10} = \frac{2 \pm i\sqrt{6}}{5}$$

PTS: 2 REF: 012020aai NAT: A.REI.B.4 TOP: Solving Quadratics

KEY: complex solutions | quadratic formula

21 ANS: 2



PTS: 2 REF: 012021aai NAT: A.REI.D.11 TOP: Other Systems

22 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

23 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

24 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

25 ANS:

$$\left(p^2 n^{\frac{1}{2}}\right)^8 \sqrt{p^5 n^4} = (p^{16} n^4) p^2 n^2 \sqrt{p} = p^{18} n^6 \sqrt{p}$$

PTS: 2 REF: 012025aai NAT: N.RN.A.2 TOP: Radicals and Rational Exponents

26 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.

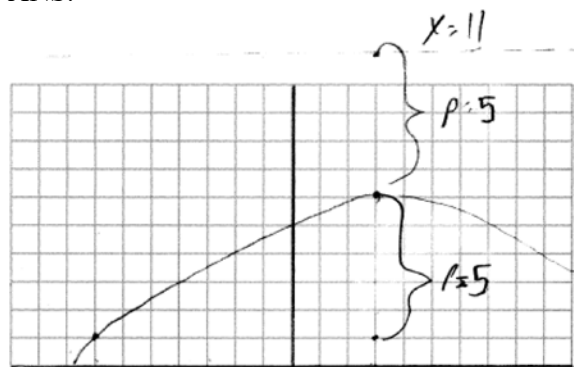
PTS: 2 REF: 012026aai NAT: A.APR.B.2 TOP: Remainder Theorem

27 ANS:

Translation 3 units right and 4 units up

PTS: 2 REF: 012027aai NAT: F.IF.C.7 TOP: Graphing Exponential Functions

28 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

29 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

- 30 ANS:  
Light wave C. The periods for A, B, and C are 280, 220 and 320.

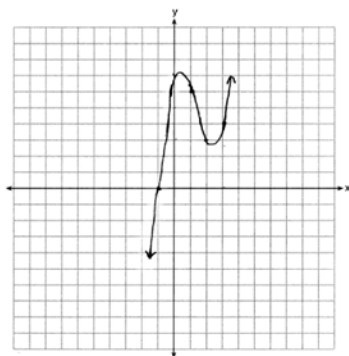
PTS: 2 REF: 012030aai NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions  
KEY: period

- 31 ANS:

$$B(t) = 100(2)^{\frac{t}{30}}$$

PTS: 2 REF: 012031aai NAT: F.LE.A.2 TOP: Modeling Exponential Functions

- 32 ANS:



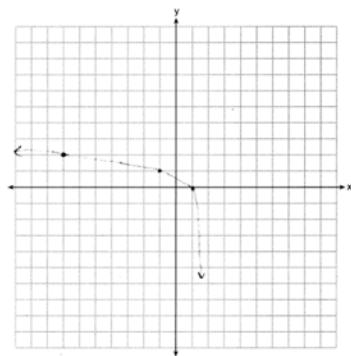
PTS: 2 REF: 012032aai NAT: F.IF.C.7 TOP: Graphing Polynomial Functions

- 33 ANS:

$$a_n = 100(.8)^{n-1} \quad S_{20} = \frac{100 - 100(.8)^{20}}{1 - .8} \approx 494 \quad \text{No, because } 494 > 40 \times 12.$$

PTS: 4 REF: 012033aai NAT: A.SSE.B.4 TOP: Series

- 34 ANS:

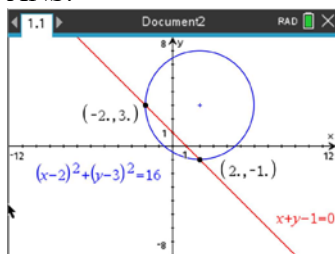


Domain:  $x < 2$ , Asymptote  $x = 2$

PTS: 4 REF: 012034aai NAT: F.IF.C.7 TOP: Graphing Logarithmic Functions



35 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: 012035aai NAT: A.REI.C.7 TOP: Quadratic-Linear Systems

36 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

37 ANS:

$$\text{antibiotic } n(0) = \frac{0+1}{0+5} + \frac{18}{0^2+8(0)+15} = \frac{3}{15} + \frac{18}{15} = \frac{21}{15}$$

$$\frac{t+1}{t+5} + \frac{18}{t^2+8t+15} = \frac{9}{t+3}$$

$$a(0) = \frac{9}{0+3} = 3$$

$$\frac{(t+1)(t+3)}{(t+5)(t+3)} + \frac{18}{(t+3)(t+5)} = \frac{9(t+5)}{(t+3)(t+5)}$$

$$t^2 + 4t + 3 + 18 = 9t + 45$$

$$t^2 - 5t - 24 = 0$$

$$(t-8)(t+3) = 0$$

$$t = 8$$

PTS: 6 REF: 012037aai NAT: A.REI.A.2 TOP: Solving Rationals

KEY: rational solutions

## 0622aii

## Answer Section

1 ANS: 1 PTS: 2 REF: 062201aii NAT: N.RN.A.2  
TOP: Radicals and Rational Exponents

2 ANS: 3  
To determine student opinion, survey the widest range of students.

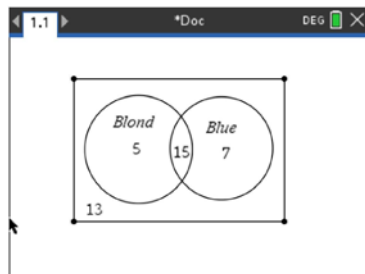
PTS: 2 REF: 062202aii NAT: S.IC.B.3 TOP: Analysis of Data  
KEY: bias

3 ANS: 1

$$\begin{array}{r}
 \phantom{x+3} \overline{) 2x^2 + x - 6} \\
 x+3 \overline{) 2x^3 + 7x^2 - 3x - 25} \\
 \underline{2x^3 + 6x^2} \phantom{- 3x - 25} \\
 \phantom{2x^3 + } x^2 - 3x \phantom{- 25} \\
 \underline{\phantom{2x^3 + } x^2 + 3x} \phantom{- 25} \\
 \phantom{2x^3 + } \phantom{x^2 - } -6x - 25 \\
 \underline{\phantom{2x^3 + } \phantom{x^2 - } -6x - 18} \\
 \phantom{2x^3 + } \phantom{x^2 - } \phantom{-6x - } -7
 \end{array}$$

PTS: 2 REF: 062203aii NAT: A.APR.D.6 TOP: Rational Expressions  
KEY: division

4 ANS: 2



$$40 - (20 + 22 - 15) = 13$$

PTS: 2 REF: 062204aii NAT: S.CP.A.1 TOP: Venn Diagrams

5 ANS: 3 PTS: 2 REF: 062205aii NAT: F.BF.B.3  
TOP: Transformations with Functions

6 ANS: 2 PTS: 2 REF: 062206aii NAT: A.APR.B.2  
TOP: Remainder Theorem

7 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

8 ANS: 2

$$2x + 4y - 2z = 2 \quad -x - 3y + 2z = 0 \quad x + y = 2 \quad 3 + 2y - z = 1 \quad 2y - z = -2$$

$$\underline{-x - 3y + 2z = 0} \quad \underline{4x - 8y + 2z = 20} \quad \underline{x - y = 4} \quad \underline{6 - 4y + z = 10} \quad \underline{2(-1) - z = -2}$$

$$x + y = 2 \quad 5x - 5y = 20 \quad 2x = 6 \quad 2y - z = -2 \quad z = 0$$

$$x - y = 4 \quad x = 3 \quad \underline{-4y + z = 4}$$

$$-2y = 2$$

$$y = -1$$

PTS: 2 REF: 062208aai NAT: A.REI.C.6 TOP: Solving Linear Systems

KEY: three variables

9 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

10 ANS: 3

$$x^2 - 6x + 9 - (x^2 + 6x + 9) = -12x$$

PTS: 2 REF: 062210aai NAT: F.BF.A.1 TOP: Operations with Functions

11 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

12 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.C.9 TOP: Comparing Functions

- 13 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

- 14 ANS: 1 PTS: 2 REF: 062214aai NAT: S.ID.A.4  
TOP: Normal Distributions KEY: predict

- 15 ANS: 4 PTS: 2 REF: 062215aai NAT: F.IF.C.7  
TOP: Graphing Logarithmic Functions

- 16 ANS: 4 PTS: 2 REF: 062216aai NAT: S.IC.B.3  
TOP: Analysis of Data KEY: type

- 17 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

- 18 ANS: 2

$$x^2 + 3 \overline{) x^2 + 0x + 12}$$

$$\underline{x^2 + 0x + 3}$$

9

PTS: 2 REF: 062218aai NAT: A.APR.D.6 TOP: Rational Expressions  
KEY: division

- 19 ANS: 2 PTS: 2 REF: 062219aai NAT: F.TF.A.1  
TOP: Unit Circle

- 20 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

- 21 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: 062221aai NAT: F.IF.A.3 TOP: Sequences

22 ANS: 2                    PTS: 2                    REF: 062222aii           NAT: F.IF.C.9  
TOP: Comparing Functions

23 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: 062223aii           NAT: N.CN.A.2           TOP: Operations with Complex Numbers  
24 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  
25 ANS:

$$b^2 - 4ac = (-4)^2 - 4(1)(13) = 16 - 52 = -36 \text{ imaginary}$$

PTS: 2                    REF: 062225aii           NAT: A.REI.B.4           TOP: Using the Discriminant  
KEY: determine nature of roots given equation, graph, table

26 ANS:  
 $S_5 = \frac{6 - 6(.8)^5}{1 - .8} \approx 20.17$

PTS: 2                    REF: 062226aii           NAT: A.SSE.B.4           TOP: Series  
27 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: 062228aii           NAT: A.REI.A.2           TOP: Solving Rationals  
28 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: 062228aii           NAT: A.SSE.A.2           TOP: Factoring Polynomials  
KEY: factoring by grouping

29 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

30 ANS:

$$\sqrt[3]{81} = \sqrt[3]{3^4} = 3^{\frac{4}{3}} \quad a = \frac{4}{3}$$

PTS: 2

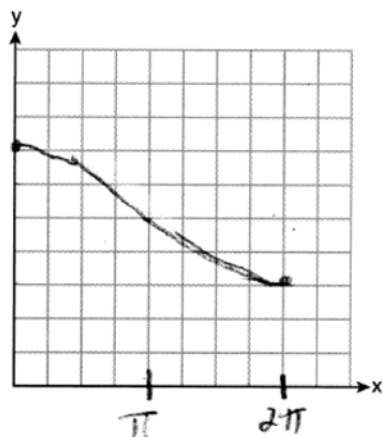
REF: 062230aai

NAT: N.RN.A.2

TOP: Radicals and Rational Exponents

KEY: variables

31 ANS:



PTS: 2

REF: 062231aai

NAT: F.IF.C.7

TOP: Graphing Trigonometric Functions

KEY: graph

32 ANS:

$$F(t) = 169.136(.971)^t$$

PTS: 2

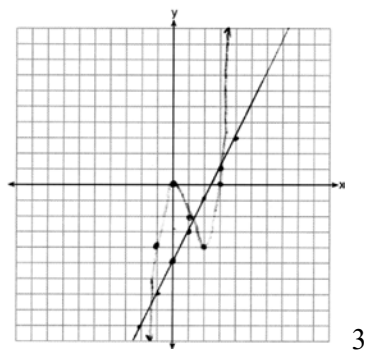
REF: 062232aai

NAT: S.ID.B.6

TOP: Regression

KEY: exponential

33 ANS:



PTS: 4 REF: 062233aai NAT: A.REI.D.11 TOP: Other Systems

34 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

35 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

36 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

37 ANS:

$$1.5\%; P(t) = 92.2(1.015)^t; \quad \frac{300}{92.2} = (1.015)^t$$

$$\log \frac{300}{92.2} = t \log(1.015)$$

$$\frac{\log \frac{300}{92.2}}{\log(1.015)} = t$$

$$t \approx 79$$

PTS: 6 REF: 062237aai NAT: A.CED.A.1 TOP: Exponential Growth

## 0822aii

## Answer Section

1 ANS: 3                      PTS: 2                      REF: 082201aii                      NAT: S.IC.B.3  
TOP: Analysis of Data                      KEY: type

2 ANS: 4

$$(x - 2i)(x - 2i) = x^2 - 4xi + 4i^2 = x^2 - 4xi - 4$$

PTS: 2                      REF: 082202aii                      NAT: N.CN.A.2                      TOP: Operations with Complex Numbers

3 ANS: 2                      PTS: 2                      REF: 082203aii                      NAT: F.IF.C.7  
TOP: Graphing Trigonometric Functions                      KEY: amplitude

4 ANS: 2                      PTS: 2                      REF: 082204aii                      NAT: S.IC.B.3  
TOP: Analysis of Data                      KEY: type

5 ANS: 4                      PTS: 2                      REF: 082205aii                      NAT: F.TF.A.2  
TOP: Unit Circle

6 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: 082206aii                      NAT: A.APR.B.2                      TOP: Remainder Theorem

7 ANS: 4

Translate the parent log function 2 to the right and reflect over the  $x$ -axis.

PTS: 2                      REF: 082207aii                      NAT: F.IF.C.7                      TOP: Graphing Logarithmic Functions

8 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: 082208aii                      NAT: A.REI.B.4                      TOP: Complex Conjugate Root Theorem



9 ANS: 4

$$\frac{15000}{12000} = \frac{12000e^{.025t}}{12000}$$

$$1.25 = e^{.025t}$$

$$\ln 1.25 = \ln e^{.025t}$$

$$\ln 1.25 = .025t$$

$$\frac{\ln 1.25}{.025} = t$$

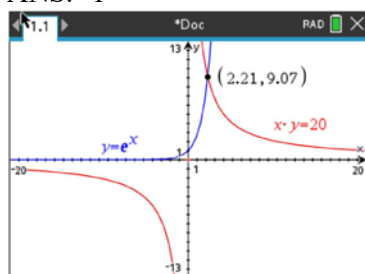
PTS: 2

REF: 082209aai

NAT: F.LE.A.4

TOP: Exponential Growth

10 ANS: 1



PTS: 2

REF: 082210aai

NAT: A.REI.D.11

TOP: Other Systems

11 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

12 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

13 ANS: 1

$$\left(a^3\sqrt{2b^2}\right)\left(\sqrt[3]{4a^2b}\right) = a^3\sqrt{8a^2b^3} = 2ab^3\sqrt{a^2}$$

PTS: 2

REF: 082213aai

NAT: N.RN.A.2

TOP: Operations with Radicals

KEY: with variables, index &gt; 2

14 ANS: 3

PTS: 2

REF: 082214aai

NAT: F.IF.C.7

TOP: Graphing Exponential Functions

15 ANS: 2

$$\frac{x^2 + 3x}{x^2 + 5x + 6} = \frac{x(x+3)}{(x+2)(x+3)}$$

PTS: 2

REF: 082215aai

NAT: A.APR.D.6

TOP: Rational Expressions

KEY: factoring

- 16 ANS: 4  
1) is a correct formula, but not recursive

PTS: 2 REF: 082216aai NAT: F.LE.A.2 TOP: Sequences  
KEY: recursive

- 17 ANS: 2

$$\begin{array}{r} x^2 + 2x + 4 \\ x - 2 \overline{) x^3 - 0x^2 + 0x - 2} \\ \underline{x^3 - 2x^2} \phantom{+ 0x - 2} \\ 2x^2 + 0x \phantom{- 2} \\ \underline{2x^2 - 4x} \phantom{- 2} \\ 4x - 2 \\ \underline{4x - 8} \\ 6 \end{array}$$

PTS: 2 REF: 082217aai NAT: A.APR.D.6 TOP: Rational Expressions  
KEY: division

- 18 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

- 19 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

- 20 ANS: 4 PTS: 2 REF: 082220aai NAT: F.IF.B.4  
TOP: Graphing Trigonometric Functions

- 21 ANS: 1 PTS: 2 REF: 082221aai NAT: F.BF.B.6  
TOP: Sigma Notation KEY: represent

- 22 ANS: 2 PTS: 2 REF: 082222aai NAT: A.CED.A.1  
TOP: Modeling Rationals

23 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

24 ANS: 1

$$0.5^{\frac{1}{0.0803}} \approx 0.000178$$

PTS: 2

REF: 082224aai

NAT: A.SSE.B.3

TOP: Modeling Exponential Functions

25 ANS:

$$\frac{60-20}{4-2} = \frac{40}{2} = 20$$

PTS: 2

REF: 082225aai

NAT: F.IF.B.6

TOP: Rate of Change

26 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

27 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: 082227aai

NAT: A.REI.A.2

TOP: Solving Radicals

KEY: extraneous solutions

28 ANS:

$$\left( \frac{y^{\frac{17}{8}}}{y^{\frac{10}{8}}} \right)^{-4} = y^n \quad n = -\frac{7}{2}$$

$$\left( y^{\frac{7}{8}} \right)^{-4} = y^n$$

$$y^{-\frac{7}{2}} = y^n$$

PTS: 2      REF: 082228aai      NAT: A.APR.D.6      TOP: Expressions with Negative Exponents  
KEY: variables

29 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

30 ANS:

$$0.133696 \times 9256 \approx 1237$$

PTS: 2      REF: 082230aai      NAT: S.ID.A.4      TOP: Normal Distributions  
KEY: predict

31 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

32 ANS:

$$2x^2 - 7x + 4 = 11 - 2x \quad y = 11 - 2\left(\frac{7}{2}\right) = 4 \quad \left\{ \left(\frac{7}{2}, 4\right), (-1, 13) \right\}$$

$$2x^2 - 5x - 7 = 0 \quad y = 11 - 2(-1) = 13$$

$$(2x - 7)(x + 1) = 0$$

$$x = \frac{7}{2}, -1$$

PTS: 2

REF: 082232aai

NAT: A.REI.C.7

TOP: Quadratic-Linear Systems

33 ANS:

$$\text{a) } p(t) = 11000(2)^{\frac{t}{20}}; \text{ b) } \frac{1000000}{11000} = \frac{11000(2)^{\frac{t}{20}}}{11000}$$

$$\log \frac{1000}{11} = \log 2^{\frac{t}{20}}$$

$$\log \frac{1000}{11} = \frac{t \cdot \log 2}{20}$$

$$\frac{20 \log \frac{1000}{11}}{\log 2} = t$$

$$t \approx 130.13$$

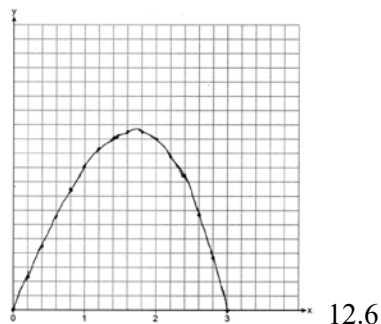
PTS: 4

REF: 082233aai

NAT: F.LE.A.4

TOP: Exponential Growth

34 ANS:



PTS: 4

REF: 082234aai

NAT: F.IF.C.7

TOP: Graphing Polynomial Functions

35 ANS:

$$\begin{array}{r}
 3x^2 + 8x + 34 \\
 x - 4 \overline{) 3x^3 - 4x^2 + 2x - 1} \\
 \underline{3x^3 - 12x^2} \phantom{+ 2x - 1} \\
 8x^2 + 2x \phantom{- 1} \\
 \underline{8x^2 - 32x} \phantom{- 1} \\
 34x - 1 \\
 \underline{34x - 136} \\
 135
 \end{array}$$

$x = 4$  is not a root of  $f(x)$  because  $\frac{f(x)}{g(x)}$  has a remainder.

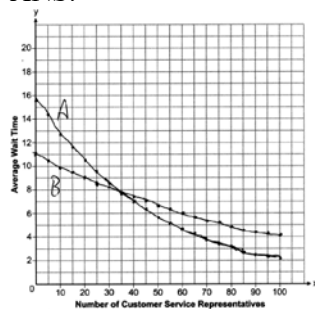
PTS: 4 REF: 082235aai NAT: A.APR.D.6 TOP: Rational Expressions  
 KEY: division

36 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

37 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: 082237aai NAT: A.REI.D.11 TOP: Other Systems