ALGEBRA

I

The University of the State of New York
REGENTS HIGH SCHOOL EXAMINATION

ALGEBRA I

Wednesday, January 23, 2019 — 1:15 to 4:15 p.m., only

Student Name ___Steve Watson___

School Name ___www. JMAP.org___

Print your name and the name of your school on the lines above.

A separate answer sheet for **Part I** has been provided to you. Follow the instructions from the proctor for completing the student information on your answer sheet.

This examination has four parts, with a total of 37 questions. You must answer all questions in this examination. Record your answers to the Part I multiple-choice questions on the separate answer sheet. Write your answers to the questions in **Parts II**, **III**, and **IV** directly in this booklet. All work should be written in pen, except for graphs and drawings, which should be done in pencil. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale.

The formulas that you may need to answer some questions in this examination are found at the end of the examination. This sheet is perforated so you may remove it from this booklet.

Scrap paper is not permitted for any part of this examination, but you may use the blank spaces in this booklet as scrap paper. A perforated sheet of scrap graph paper is provided at the end of this booklet for any question for which graphing may be helpful but is not required. You may remove this sheet from this booklet. Any work done on this sheet of scrap graph paper will *not* be scored.

When you have completed the examination, you must sign the statement printed at the end of the answer sheet, indicating that you had no unlawful knowledge of the questions or answers prior to the examination and that you have neither given nor received assistance in answering any of the questions during the examination. Your answer sheet cannot be accepted if you fail to sign this declaration.

Notice ...

**A graphing calculator and a straightedge (ruler) must be available for you to use while taking this examination.**

DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

Answer all 24 questions in this part. Each correct answer will receive 2 credits. No partial credit will be allowed. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale. For each statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Record your answers on your separate answer sheet. [48]

Use this space for computations.

1 The scatter plot below shows the relationship between the number of members in a family and the amount of the family's weekly grocery bill.

(6, 300)
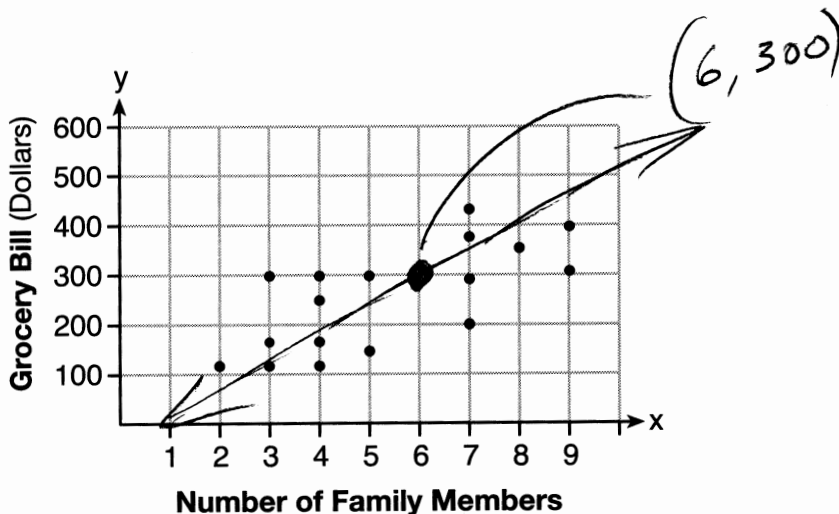
The most appropriate prediction of the grocery bill for a family that consists of six members is

(1) $100

(2) $300

(3) $400

(4) $500

2 The function $g(x)$ is defined as $g(x) = -2x^2 + 3x$. The value of $g(-3)$ is

(1) −27

(2) −9

(3) 27

(4) 45

Can be written as a ratio of two integers

$g(-3) = -2(-3)^2 + 3(-3)$

$g(-3) = -2(9) - 9$

$g(-3) = -18 - 9$

$g(-3) = -27$

3 Which expression results in a rational number?

(1) $\sqrt{121} - \sqrt{21} = 11 - \sqrt{21}$

(2) $\sqrt{25} \cdot \sqrt{50} = 5\sqrt{25}\sqrt{2}$
$= 5 \cdot 5\sqrt{2}$
$= 25\sqrt{2}$

(3) $\sqrt{36} \div \sqrt{225} = \frac{\sqrt{36}}{\sqrt{225}} = \frac{6}{15}$ } This is a rational number

(4) $3\sqrt{5} + 2\sqrt{5} = 7\sqrt{5}$

4 The math department needs to buy new textbooks and laptops for the computer science classroom. The textbooks cost $116.00 each, and the laptops cost $439.00 each. If the math department has $6500 to spend and purchases 30 textbooks, how many laptops can they buy?

(1) 6

(2) 7

(3) 11

(4) 12

Use this space for computations.

T represents # textbooks
L represents # laptops

$116T + 439L \le 6500$

$116(30) + 439L \le 6500$

$3480 + 439L \le 6500$
$-3480 \qquad -3480$
$439L \le 3020$

$L \le \dfrac{3020}{439}$

$L \le 6.879$

5 What is the solution to the equation $\dfrac{3}{5}\left(x + \dfrac{4}{3}\right) = 1.04$?

(1) $3.0\overline{6}$

(2) 0.4

(3) $-0.4\overline{8}$

(4) $-0.709\overline{3}$

$\dfrac{3}{5}\left(X + \dfrac{4}{3}\right) = 1.04$

(5) $3\left(X + \dfrac{4}{3}\right) = 5.20$

$3X + 4 = 5.20$

$3X + 4 = 5.20$
$\quad -4 \qquad -4$
$3X \qquad = 1.20$
$X \qquad = .40$

6 The area of a rectangle is represented by $3x^2 - 10x - 8$. Which expression can also be used to represent the area of the same rectangle?

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

(2) $(3x + 2)(x + 4)$
$\qquad = +8$

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

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

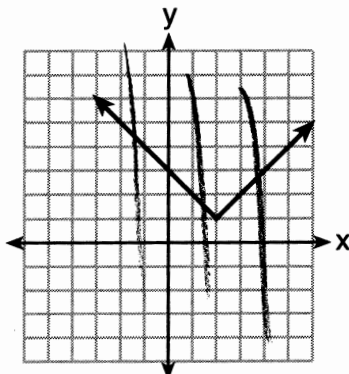$(3X + 2)(X - 4)$

$3X^2 - 12X + 2X - 8$

$3X^2 - 10X - 8$

7 Which relation does *not* represent a function?

x	1	2	3	4	5	6
y	3.2	4	5.1	6	7.4	8.8

(1)

$y = 3\sqrt{x + 1} - 2$

(3)

A function has one and only one Y for every value of X.

(2)

Passes vertical line test

(4)

each value of X has two values of Y. Therefore this is not a function.

8 Britney is solving a quadratic equation. Her first step is shown below.

Problem: $3x^2 - 8 - 10x = 3(2x + 3)$
Step 1: $3x^2 - 10x - 8 = 6x + 9$

distributive property

Which two properties did Britney use to get to step 1?

I. addition property of equality
Yes II. commutative property of addition
III. multiplication property of equality
Yes IV. distributive property of multiplication over addition
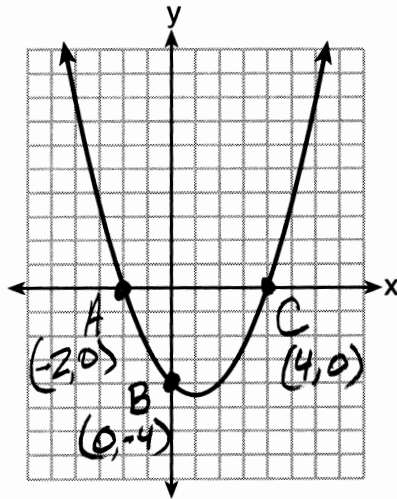
commutative property

(1) I and III

(3) II and III

(2) I and IV

(4) II and IV

9 The graph of $y = \frac{1}{2}x^2 - x - 4$ is shown below. The points $A(-2,0)$, $B(0,-4)$, and $C(4,0)$ lie on this graph.

Which of these points can determine the zeros of the equation $y = \frac{1}{2}x^2 - x - 4$?
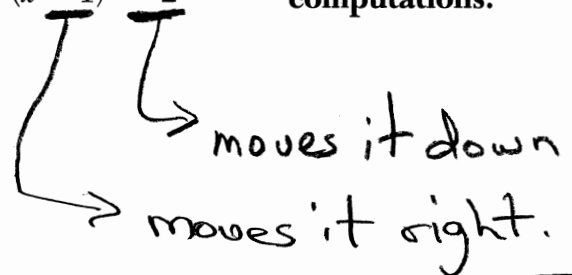
(1) A, only

(3) A and C, only

(2) B, only

(4) A, B, and C

10 Given the parent function $f(x) = x^3$, the function $g(x) = (x - 1)^3 - 2$ is the result of a shift of $f(x)$

(1) 1 unit left and 2 units down

(2) 1 unit left and 2 units up

(3) 1 unit right and 2 units down

(4) 1 unit right and 2 units up

[handwritten annotations: brackets pointing to $(x-1)^3 - 2$; "moves it down", "moves it right."]

11 If $C = 2a^2 - 5$ and $D = 3 - a$, then $C - 2D$ equals

(1) $2a^2 + a - 8$

(2) $2a^2 - a - 8$

(3) $2a^2 + 2a - 11$

(4) $2a^2 - a - 11$

[handwritten work:
$C \qquad - 2D$
$2a^2 - 5 - 2(3-a)$
$2a^2 - 5 - 6 + 2a$
$2a^2 - 11 + 2a$
$\boxed{2a^2 + 2a - 11}$ *]*

12 Marc bought a new laptop for $1250. He kept track of the value of the laptop over the next three years, as shown in the table below.

Years After Purchase	Value in Dollars
1	1000
2	800
3	640

[handwritten: "Value goes down"; $A = P(1 \pm r)^t$]

Which function can be used to determine the value of the laptop for x years after the purchase?

(1) $f(x) = 1000(1.2)^x$ *[increases]*

(2) $f(x) = 1000(0.8)^x$ *[decreases]*

(3) $f(x) = 1250(1.2)^x$ *[increases]*

(4) $f(x) = 1250(0.8)^x$ *[decreases]*

[handwritten: "purchase price"]

13 The height of a ball Doreen tossed into the air can be modeled by the function $h(x) = -4.9x^2 + 6x + 5$, where x is the time elapsed in seconds, and $h(x)$ is the height in meters. The number 5 in the function represents

(1) the initial height of the ball

(2) the time at which the ball reaches the ground

(3) the time at which the ball was at its highest point

(4) the maximum height the ball attained when thrown in the air

[handwritten: "quadratic term is $-4.9x^2$", "linear term is $6x$", "constant term is 5", "The initial height would be a constant"]

Use this space for computations.

14 The function $f(x) = 2x^2 + 6x - 12$ has a domain consisting of the integers from -2 to 1, inclusive. Which set represents the corresponding range values for $f(x)$?

(1) $\{-32, -20, -12, -4\}$ (3) $\{-32, -4\}$

(2) $\{-16, -12, -4\}$ (4) $\{-16, -4\}$

[handwritten table]

X (Domain)	Y (Range)
-2	-16
-1	-16
0	-12
1	-4

15 Which equation has the same solution as $x^2 + 8x - 33 = 0$?

(1) $(x + 4)^2 = 49$ (3) $(x + 4)^2 = 17$

(2) $(x - 4)^2 = 49$ (4) $(x - 4)^2 = 17$

[handwritten work]

$X^2 + 8X - 33 = 0$

$X^2 + 8X \quad = 33$

$X^2 + 8X + (4)^2 = 33 + (4)^2$

$(x + 4)^2 = 33 + 16$

$(x + 4)^2 = 49$

16 The table below shows the weights of Liam's pumpkin, $l(w)$, and Patricia's pumpkin, $p(w)$, over a four-week period where w represents the number of weeks. Liam's pumpkin grows at a constant rate. Patricia's pumpkin grows at a weekly rate of approximately 52%.

Weeks w	Weight in Pounds l(w)	Weight in Pounds p(w)
6	2.4	2.5
7	5.5	3.8
8	8.6	5.8
9	11.7	8.8

[handwritten table]

Weeks W	l(w)	p(w)
10	14.8	13.3
11	17.9	20.3
12	21	30.8
13	24.1	46.9

Assume the pumpkins continue to grow at these rates through week 13. When comparing the weights of both Liam's and Patricia's pumpkins in week 10 and week 13, which statement is true?

(1) Liam's pumpkin will weigh more in week 10 and week 13.

(2) Patricia's pumpkin will weigh more in week 10 and week 13.

(3) Liam's pumpkin will weigh more in week 10, and Patricia's pumpkin will weigh more in week 13.

(4) Patricia's pumpkin will weigh more in week 10, and Liam's pumpkin will weigh more in week 13.

17 The function $f(x)$ is graphed below.

f(x)
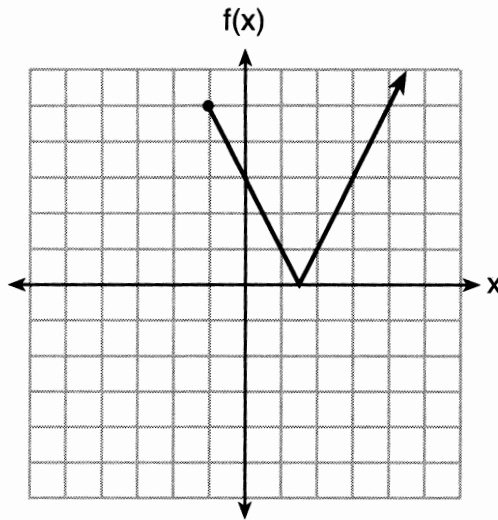
(handwritten) domain of x
range of y

The domain of this function is

(1) all positive real numbers   (3) $x \geq 0$

(2) all positive integers   (4) $x \geq -1$ *(circled)*

18 Which pair of equations would have $(-1,2)$ as a solution?

(1) $y = x + 3$ and $y = 2^x$

(2) $y = x - 1$ and $y = 2x$

(3) $y = x^2 - 3x - 2$ and $y = 4x + 6$ *(circled)*

(4) $2x + 3y = -4$ and $y = -\dfrac{1}{2}x - \dfrac{3}{2}$

(handwritten table)

x	y₁	y₂
-1	2	$.5$
-1	-2	-2
-1	2	2 ✓

19 Which function could be used to represent the sequence 8, 20, 50, 125, 312.5,..., given that $a_1 = 8$?

(1) $a_n = a_{n-1} + a_1$

(2) $a_n = 2.5(a_{n-1})$ *(circled)*

(3) $a_n = a_1 + 1.5(a_{n-1})$

(4) $a_n = (a_1)(a_{n-1})$

(handwritten)

(1) $a_n = a_{n-1} + a_1$

(2) $a_n = 2.5(a_{n-1})$

n	1	2	3	4	5
a_n	8	16			
a_n	8	20	50	125	312.5

20 The formula for electrical power, P, is $P = I^2R$, where I is current and R is resistance. The formula for I in terms of P and R is
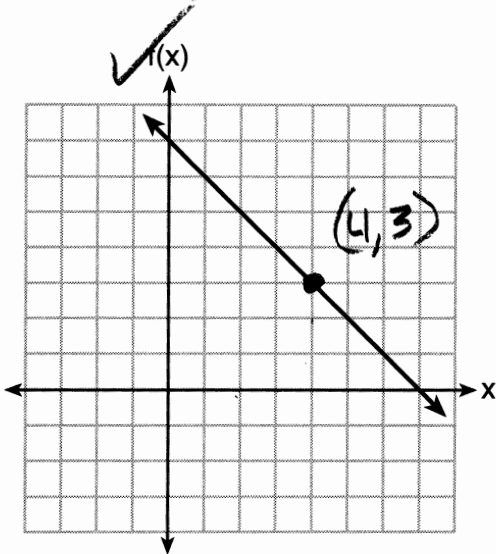
(1) $I = \left(\dfrac{P}{R}\right)^2$

(3) $I = (P - R)^2$

(2) $I = \sqrt{\dfrac{P}{R}}$

(4) $I = \sqrt{P - R}$

Handwritten computations:

$P = I^2 R$

$\dfrac{P}{R} = \dfrac{I^2 R}{R}$

$\dfrac{P}{R} = I^2$

$\sqrt{\dfrac{P}{R}} = I$

21 The functions $f(x)$, $q(x)$, and $p(x)$ are shown below.

$q(x) = (x - 1)^2 - 6$

$(4, 3)$

x	p(x)
2	5
3	4
4	3
5	4
6	5

Handwritten computations:

$q(4) = (4-1)^2 - 6$

$q(4) = (3)^2 - 6$

$q(4) = 9 - 6$

$(4, 3)\quad q(4) = 3$

When the input is 4, which functions have the same output value?

(1) $f(x)$ and $q(x)$, only

(3) $q(x)$ and $p(x)$, only

(2) $f(x)$ and $p(x)$, only

(4) $f(x)$, $q(x)$, and $p(x)$

22 Using the substitution method, Vito is solving the following system of equations algebraically:

$$y + 3x = -4 \longrightarrow y = -3x - 4$$
$$2x - 3y = -21$$

Which equivalent equation could Vito use?

(1) $2(-3x - 4) + 3x = -21$

(3) $2x - 3(-3x - 4) = -21$

(2) $2(3x - 4) + 3x = -21$

(4) $2x - 3(3x - 4) = -21$

23 Materials A and B decay over time. The function for the amount of material A is $A(t) = 1000(0.5)^{2t}$ and for the amount of material B is $B(t) = 1000(0.25)^t$, where t represents time in days. On which day will the amounts of material be equal?

(1) initial day, only

(3) day 5, only

(2) day 2, only

(4) every day

24 The following conversion was done correctly:

$$\frac{3 \text{ miles}}{1 \text{ hour}} \cdot \frac{1 \text{ hour}}{60 \text{ minutes}} \cdot \frac{5280 \text{ feet}}{1 \text{ mile}} \cdot \frac{12 \text{ inches}}{1 \text{ foot}}$$

What were the final units for this conversion?

(1) minutes per foot

(2) minutes per inch

(3) feet per minute

(4) inches per minute

Strategy: Put both functions in a graphing calculator and inspect the graph and table.

Remember: units can cancel.

Answer all 8 questions in this part. Each correct answer will receive 2 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit. All answers should be written in pen, except for graphs and drawings, which should be done in pencil.   [16]

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25 Solve algebraically for x: $3600 + 1.02x < 2000 + 1.04x$

$$3600 + 1.02x < 2000 + 1.04x$$
$$-1.02x \qquad\qquad -1.02x$$
$$3600 \qquad < 2000 + .02x$$
$$-2000 \qquad\qquad -2000$$
$$1600 \qquad < \qquad .02x$$
$$\frac{1600}{.02} \qquad < \qquad x$$

$$\boxed{80{,}000 \qquad < \qquad x}$$

26 The number of people who attended a school's last six basketball games increased as the team neared the state sectional games. The table below shows the data.

Δx

Game	13	14	15	16	17	18
Attendance	348	435	522	609	696	783

Δy 87   87   87   87   87

<u>State the type of function that best fits the given data.</u> Justify your choice of a function type.

This is a |linear function| because it has a constant rate of change.

$$slope = \frac{\Delta Y}{\Delta X} = \frac{87}{1} = 87$$

27 Solve $x^2 - 8x - 9 = 0$ algebraically.

$$= (x^2)(-9) = -9x^2$$

$$(x^2)(-9) = -9x^2$$

These factors sum to $-8x$

factors of $-9x^2$

x	$-9x$
$-x$	$+9x$
$3x$	$-3x$

$$(x-9)(x+1) = 0$$

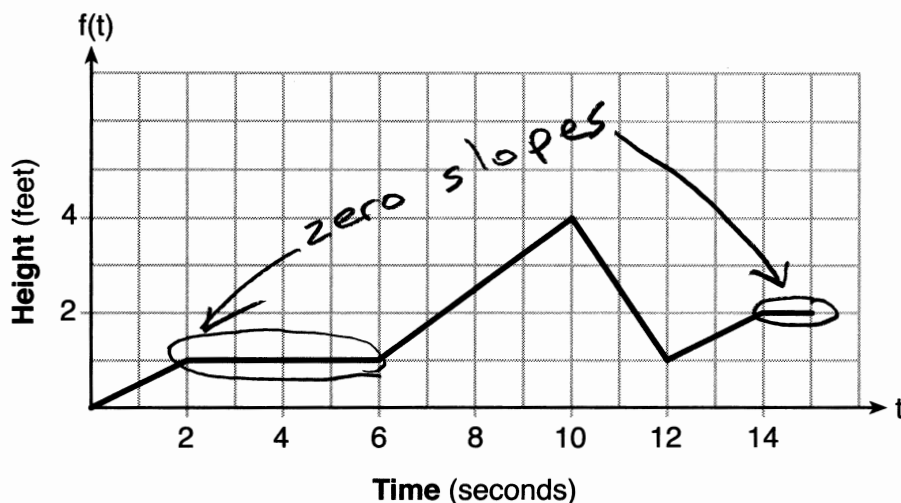| $x-9 = 0$ | $x+1 = 0$ |
| $\boxed{x=9}$ | $\boxed{x=-1}$ |

Explain the first step you used to solve the given equation.

I factored the trinomial.

Alternative strategies include

① Use the quadratic formula

② Complete the square.

28 The graph of $f(t)$ models the height, in feet, that a bee is flying above the ground with respect to the time it traveled in t seconds.
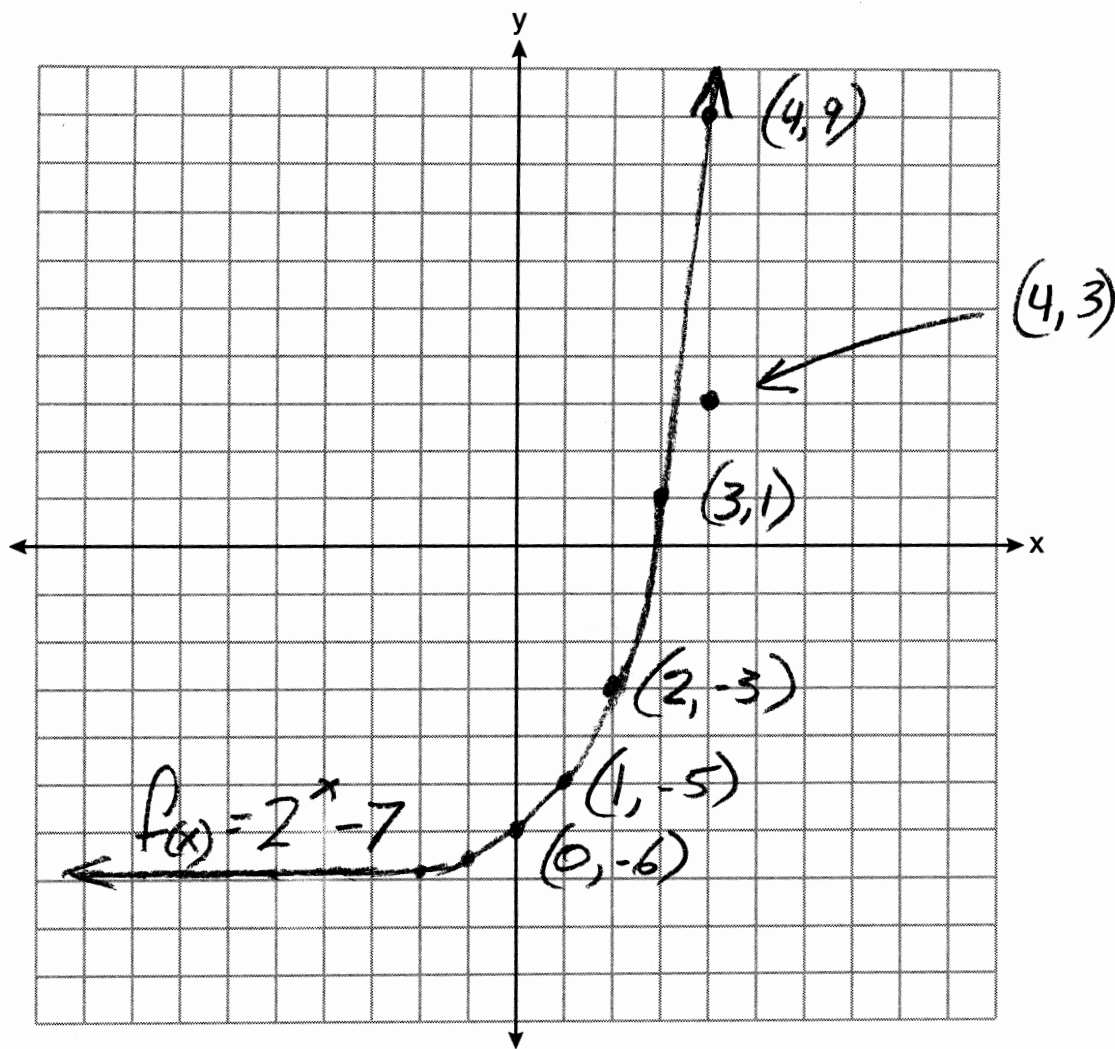

State all time intervals when the bee's rate of change is zero feet per second. Explain your reasoning.

$$2 \le t \le 6 \text{ and } 14 \le t \le 15$$

A horizontal line has a slope of zero, which means the rate of change is also zero. The bee has a constant height during these intervals where the line is horizontal.

29 Graph the function $f(x) = 2^x - 7$ on the set of axes below.

(4, 9)

(4, 3)

(3, 1)

$f(x) = 2^x - 7$

(2, -3)

(1, -5)

(0, -6)

If $g(x) = 1.5x - 3$, determine if $f(x) > g(x)$ when $x = 4$. Justify your answer.

$g(x) = 1.5x - 3$

$g(4) = 1.5(4) - 3$

$g(4) = 6 - 3$

$g(4) = 3$

$f(4) = 9$

True

$f(4) > g(4)$

$9 > 3$

30 Determine algebraically the zeros of $f(x) = 3x^3 + 21x^2 + 36x$.

$$3x^3 + 21x^2 + 36x = 0$$

$$x(3x^2 + 21x + 36) = 0$$

$$3x^2(36) = 108x^2$$

	x	4
3x	$3x^2$	12x
9	9x	36

1x   108x
2x   54x
3x   36x
4x   27x
6x   18x

$$x(x+4)(3x+9) = 0$$

+9x + 12x

These sum to 21

$\boxed{x=0}$	$x+4=0$	$3x+9=0$
	$\boxed{x=-4}$	$3x = -9$
		$\boxed{x=-3}$

Check using x-intercepts of graph in graphing calculator.

31 Santina is considering a vacation and has obtained high-temperature data from the last two weeks for Miami and Los Angeles.

Miami	76	75	83	73	60	66	76
	81	83	85	83	87	80	80

Los Angeles	74	63	65	67	65	65	65
	62	62	72	69	64	64	61

Which location has the least variability in temperatures? Explain how you arrived at your answer.

↳ Use range, inter-quartile range, or standard deviation to measure variability.

	Range	IQR	Standard Deviation
Miami	27	8	$\sigma = 7.23$
Los Angeles	13	4	$\sigma = 3.64$ ← less variability

I calculate 1 variable stats using a graphing calculator.

Los Angeles has the least variability

32 Solve the quadratic equation below for the exact values of x.

$$4x^2 - 5 = 75$$

$$4x^2 - 5 = 75$$
$$+5 \quad\quad +5$$
$$4x^2 = 80$$
$$\frac{4x^2}{4} = \frac{80}{4}$$
$$x^2 = 20$$
$$x = \pm\sqrt{20} \quad\leftarrow \text{this is a correct answer.}$$
$$x = \pm\sqrt{4}\sqrt{5}$$
$$\boxed{x = \pm 2\sqrt{5}}$$

Answer all 4 questions in this part. Each correct answer will receive 4 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit. All answers should be written in pen, except for graphs and drawings, which should be done in pencil. [16]

33 Marilyn collects old dolls. She purchases a doll for $450. Research shows this doll's value will increase by 2.5% each year.

Write an equation that determines the value, V, of the doll t years after purchase.

$$A = P(1 \pm r)^t$$
$$A = 450(1 + .025)^t$$
$$A = 450(1.025)^t$$

Assuming the doll's rate of appreciation remains the same, will the doll's value be doubled in 20 years? Justify your reasoning.

No

$$A = 450(1.025)^{20}$$
$$A = \$737.38$$

The doll would need to be worth $900⁰⁰ or more to double in value. (2 × 450 = 900).

$737.38 < $900.00

34 The data given in the table below show some of the results of a study comparing the height of a certain breed of dog, based upon its mass.

Mass (kg)	4.5	5	4	3.5	5.5	5	5	4	4	6	3.5	5.5
Height (cm)	41	40	35	38	43	44	37	39	42	44	31	30

Write the linear regression equation for these data, where x is the mass and y is the height. Round all values to the *nearest tenth*.

$$y = ax + b$$
$$a = 1.917$$
$$b = 29.798$$
$$r = .337$$

rounded
$$a = 1.9$$
$$b = 29.8$$

$$\boxed{y = 1.9x + 29.8}$$

State the value of the correlation coefficient to the *nearest tenth*, and explain what it indicates.

$$r = .337$$

rounded $\boxed{r = .3}$

The mass and height of a dog have a weak positive correlation.

35 Myranda received a movie gift card for $100 to her local theater. Matinee tickets cost $7.50 each and evening tickets cost $12.50 each.

If x represents the number of matinee tickets she could purchase, and y represents the number of evening tickets she could purchase, write an inequality that represents all the possible ways Myranda could spend her gift card on movies at the theater.

$$7.5x + 12.5y \leq 100$$

On the set of axes below, graph this inequality.

Number of Matinee Tickets
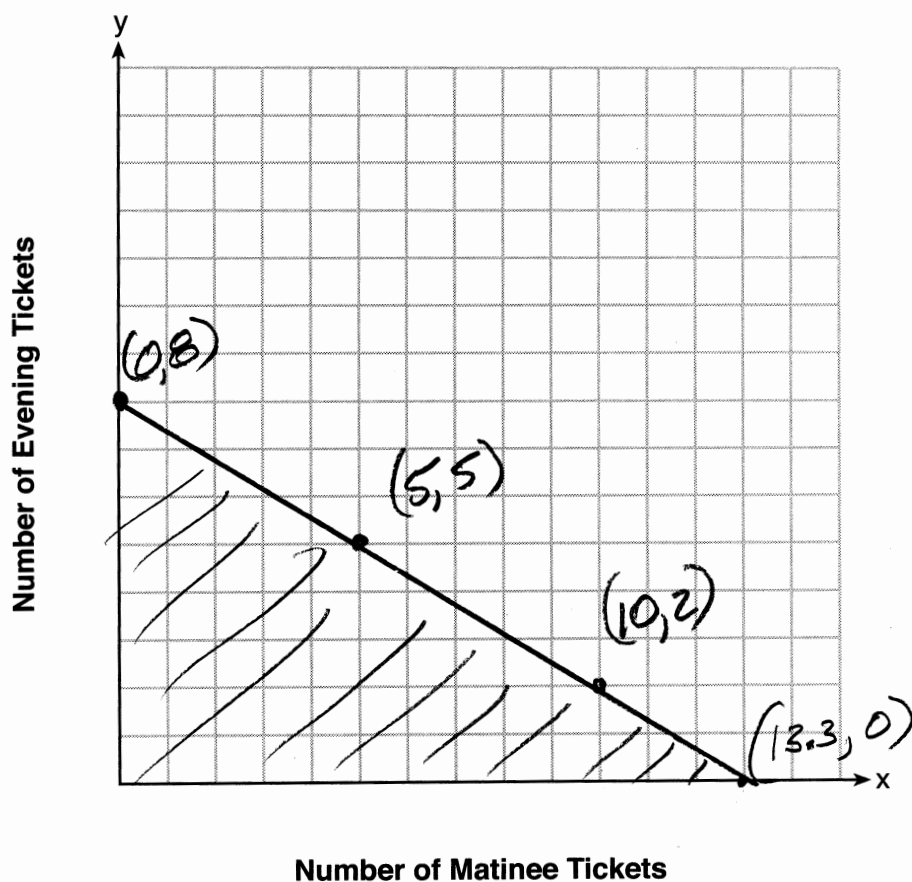
What is the maximum number of matinee tickets Myranda could purchase with her gift card? Explain your answer.

13   Thirteen is the largest integer value of x within the shaded solution set.

36 One spring day, Elroy noted the time of day and the temperature, in degrees Fahrenheit. His findings are stated below.   *(10, 62)*

(6, 50)   *(6+4, 50 + 3×4)*

At 6 a.m., the temperature was 50°F. For the next 4 hours, the temperature rose 3° per hour.
The next 6 hours, it rose 2° per hour.   *(4, 62 + 6×2) = (4, 74)*
The temperature then stayed steady until 6 p.m. *(6, 74)*
For the next 2 hours, the temperature dropped 1° per hour. *(8, 72)*
The temperature then dropped steadily until the temperature was 56°F at midnight. *(12, 56)*

On the set of axes below, graph Elroy's data.
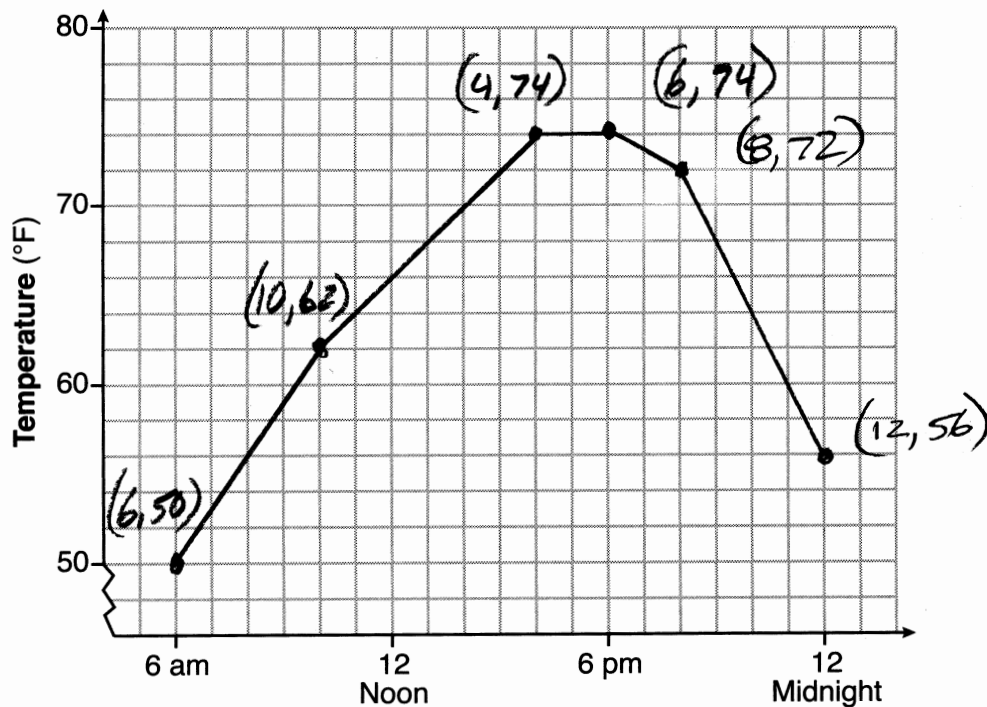
State the entire time interval for which the temperature was increasing.

From 6am until 4 pm

Determine the average rate of change, in degrees per hour, from 6:00 p.m. to midnight.

$$m = \frac{y_2 - y_1}{x_2 - x_1} \Rightarrow \frac{74 - 56}{6 - 12} \Rightarrow \frac{18}{-6} \Rightarrow \boxed{-3° \text{ per hour}}$$

(6, 74)
(12, 56)

Answer the question in this part. A correct answer will receive 6 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. Utilize the information provided to determine your answer. Note that diagrams are not necessarily drawn to scale. A correct numerical answer with no work shown will receive only 1 credit. All answers should be written in pen, except for graphs and drawings, which should be done in pencil. [6]

3 wheels   _2 wheels_

37 A recreation center ordered a total of 15 tricycles and bicycles from a sporting goods store. The number of wheels for all the tricycles and bicycles totaled 38. $3T + 2B = 38$

Write a linear system of equations that models this scenario, where _t_ represents the number of tricycles and _b_ represents the number of bicycles ordered.
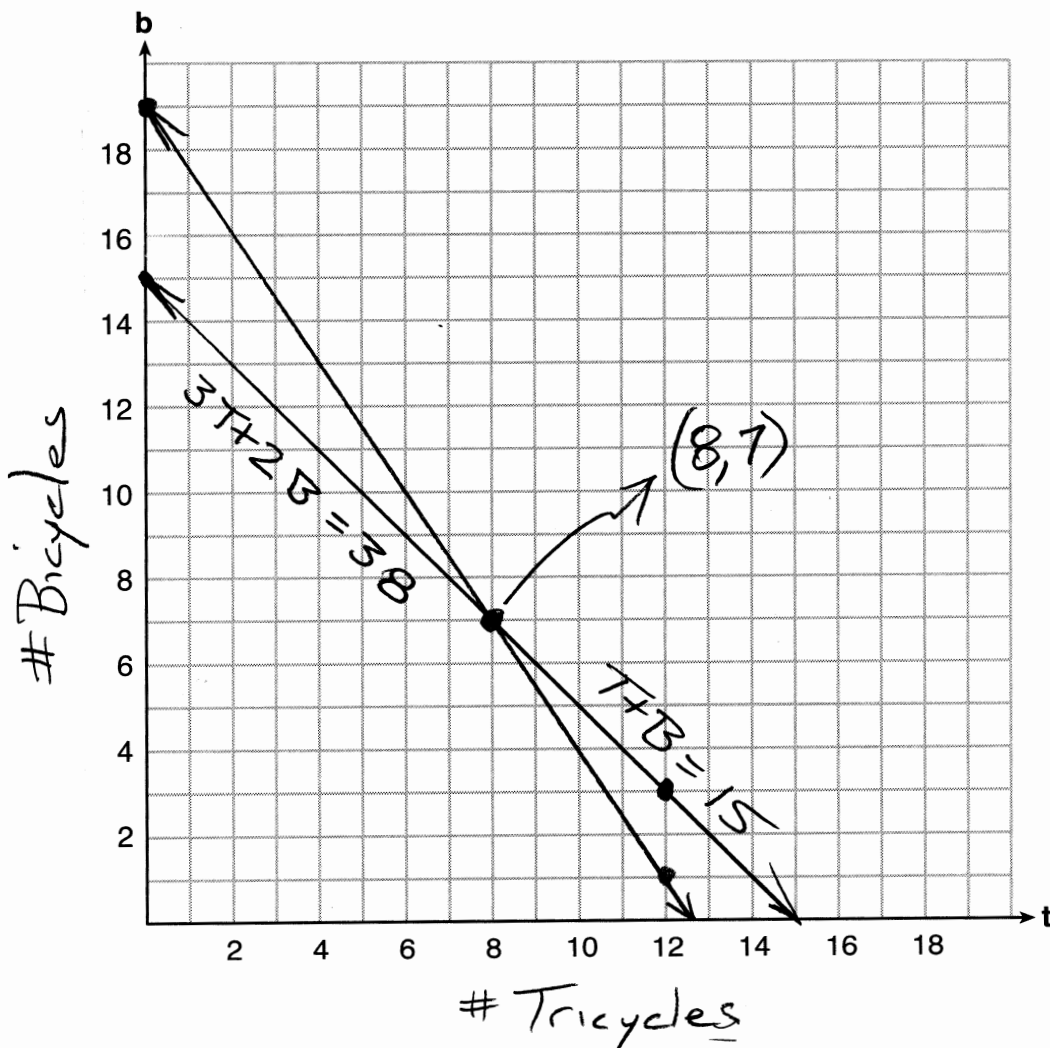
$$T + B = 15 \qquad x + y = 15 \qquad y = 15 - x$$
$$3T + 2B = 38 \qquad 3x + 2y = 38 \qquad y = \frac{(38 - 3x)}{2}$$

Calculator Inputs

On the set of axes below, graph this system of equations.

$(8, 7)$

Tricycles

Bicycles

$3T + 2B = 38$

$T + B = 15$

Question 37 is continued on the next page.

Based on your graph of this scenario, could the recreation center have ordered 10 tricycles?
Explain your reasoning.

No   The graphs do not intersect
where t = 10.