

**ALGEBRA I**
(Common Core)

Tuesday, June 13, 2017 — 1:15 to 4:15 p.m., only

Student Name Steve WatsonSchool Name www.jmap.org

The possession or use of any communications device is strictly prohibited when taking this examination. If you have or use any communications device, no matter how briefly, your examination will be invalidated and no score will be calculated for you.

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.

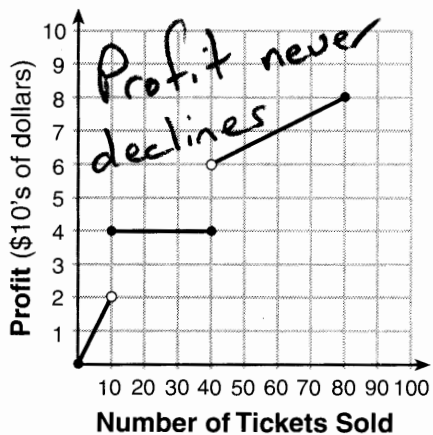
DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

Part I

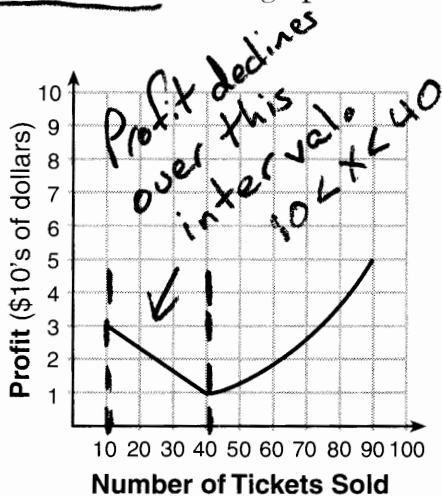
Answer all 24 questions in this part. Each correct answer will receive 2 credits. No partial credit will be allowed. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale. For each statement or question, choose the word or expression 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.

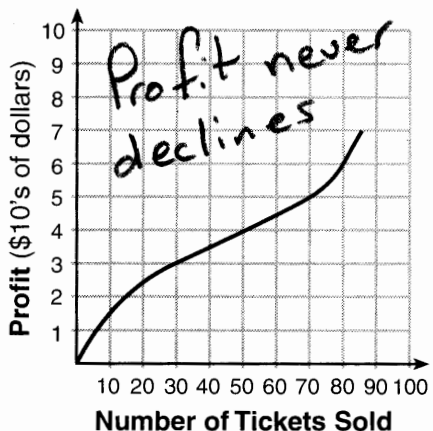
1 To keep track of his profits, the owner of a carnival booth decided to model his ticket sales on a graph. He found that his profits only declined when he sold between 10 and 40 tickets. Which graph could represent his profits?



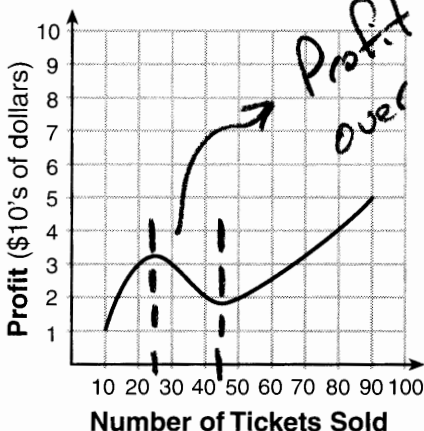
(1)



(3)



(2)



(4)

Vocabulary: Decline means to reduce or go down.

Use this space for computations.

2 The formula for the surface area of a right rectangular prism is $A = 2lw + 2hw + 2lh$, where l , w , and h represent the length, width, and height, respectively. Which term of this formula is not dependent on the height?

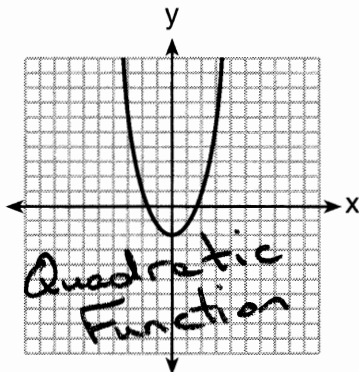
- (1) ~~A~~ Dependent Variable
(2) $2lw$

- (3) ~~$2hw$~~
(4) ~~$2lh$~~

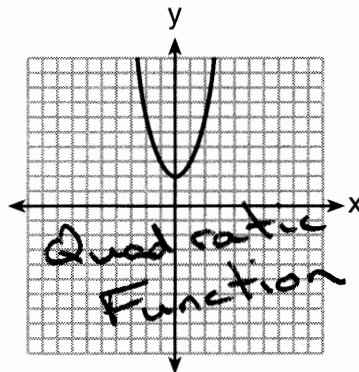
$A = 2lw + 2hw + 2lh$

Term #1 Term #2 Term #3 Term #4

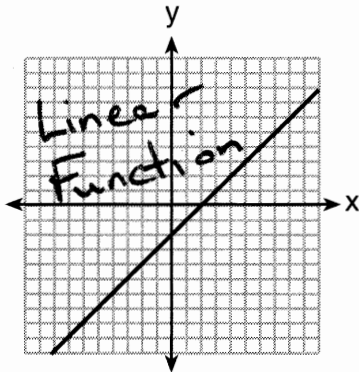
3 Which graph represents $y = \sqrt{x - 2}$?



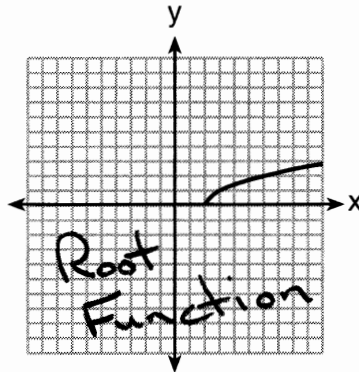
(1)



(3)



(2)

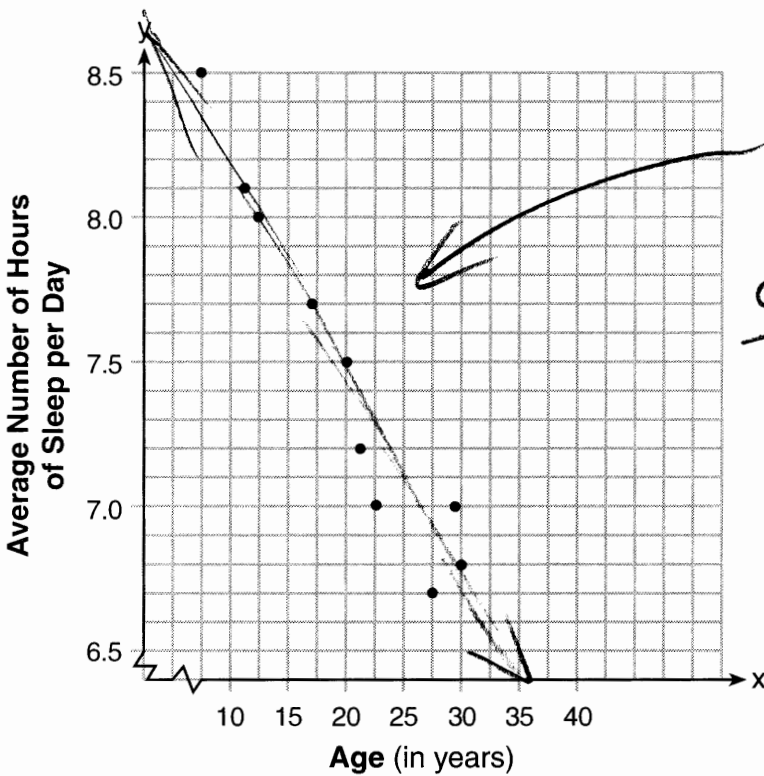


(4)

This is a root function.

Use this space for computations.

4 A student plotted the data from a sleep study as shown in the graph below.



average
The number of hours of sleep per day decreases as age increases.

The student used the equation of the line $y = -0.09x + 9.24$ to model the data. What does the rate of change represent in terms of these data?

- (1) The average number of hours of sleep per day ~~increases~~ 0.09 hour per year of age.
- (2) The average number of hours of sleep per day decreases 0.09 hour per year of age.
- (3) The average number of hours of sleep per day ~~increases~~ 9.24 hours per year of age.
- (4) The average number of hours of sleep per day decreases ~~9.24~~ hours per year of age.

$$y = -0.09x + 9.24$$

$$y = mx + b$$

$$m = \text{slope} = -0.09$$

$$b = y\text{-intercept} = 9.24$$

Use this space for computations.

5 Lynn, Jude, and Anne were given the function $f(x) = -2x^2 + 32$, and they were asked to find $f(3)$. Lynn's answer was 14, Jude's answer was 4, and Anne's answer was ± 4 . Who is correct?

- (1) Lynn, only (3) Anne, only
 (2) Jude, only (4) Both Lynn and Jude

$$f(x) = -2x^2 + 32$$

$$f(3) = -2(3)^2 + 32$$

$$f(3) = -2(9) + 32$$

$$f(3) = -18 + 32$$

$$f(3) = 14$$

Difference of Perfect Squares \rightarrow

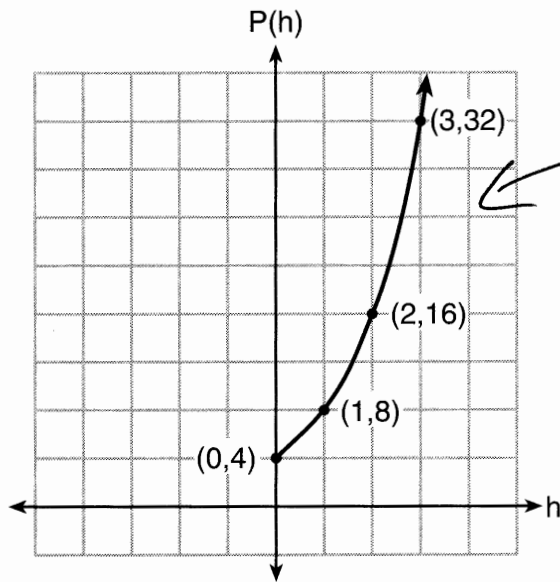
6 Which expression is equivalent to $16x^4 - 64$?

- (1) $(4x^2 - 8)^2$ (3) $(4x^2 + 8)(4x^2 - 8)$
 (2) $(8x^2 - 32)^2$ (4) $(8x^2 + 32)(8x^2 - 32)$

$$a^2 - b^2 = (a+b)(a-b)$$

$$16x^4 - 64 = (4x^2 + 8)(4x^2 - 8)$$

7 Vinny collects population data, $P(h)$, about a specific strain of bacteria over time in hours, h , as shown in the graph below.



This is the graph of an exponential function.

Which equation represents the graph of $P(h)$?

- (1) $P(h) = 4(2)^h$ ← exponent (3) $P(h) = 3h^2 + 0.2h + 4.2$
 (2) $P(h) = \frac{46}{5}h + \frac{6}{5}$ (4) $P(h) = \frac{2}{3}h^3 - h^2 + 3h + 4$

linear function
 $y = mx + b$

quadratic function
 $y = ax^2 + bx + c$

cubic function

8 What is the solution to the system of equations below?

$$y = 2x + 8$$

$$3(-2x + y) = 12$$

- (1) no solution
 (2) infinite solutions
 (3) $(-1, 6)$
 (4) $(\frac{1}{2}, 9)$

Use this space for computations.

Use Substitution

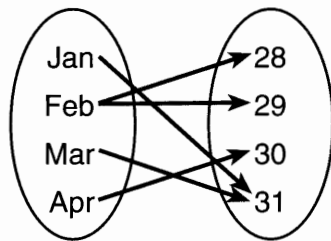
$$3[-2x + (2x + 8)] = 12$$

$$3(-2x + 2x + 8) = 12$$

$$3(8) = 12$$

$$24 \neq 12$$

9 A mapping is shown in the diagram below.



A function has one and only one output for each input.

This mapping is

- (1) a function, because Feb has two outputs, 28 and 29
 (2) a function, because two inputs, Jan and Mar, result in the output 31
 (3) not a function, because Feb has two outputs, 28 and 29
 (4) not a function, because two inputs, Jan and Mar, result in the output 31

10 Which polynomial function has zeros at -3 , 0 , and 4 ?

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

Zeros	Factors
$x = -3$	$(x + 3)$
$x = 0$	(x)
$x = 4$	$(x - 4)$

$$f(x) = (x + 3)(x)(x - 4)$$

Use this space for computations.

- 11 Jordan works for a landscape company during his summer vacation. He is paid \$12 per hour for mowing lawns and \$14 per hour for planting gardens. He can work a maximum of 40 hours per week, and would like to earn at least \$250 this week. If m represents the number of hours mowing lawns and g represents the number of hours planting gardens, which system of inequalities could be used to represent the given conditions?

- (1) $m + g \leq 40$ ✓
 $12m + 14g \geq 250$ ✓
- (2) $m + g \geq 40$ ✗
 $12m + 14g \leq 250$
- (3) $m + g \leq 40$ ✓
 $12m + 14g \geq 250$ ✗
- (4) $m + g \geq 40$ ✗
 $12m + 14g \geq 250$

Eq #1
 $m + g \leq 40$

Eq #2
 $12m + 14g \geq 250$

- 12 Anne invested \$1000 in an account with a 1.3% annual interest rate. She made no deposits or withdrawals on the account for 2 years. If interest was compounded annually, which equation represents the balance in the account after the 2 years?

- (1) $A = 1000(1 - 0.013)^2$ ✗
- (2) $A = 1000(1 + 0.013)^2$ ✓
- (3) $A = 1000(1 - 1.3)^2$ ✗
- (4) $A = 1000(1 + 1.3)^2$ ✗

P

$r = 0.013$

$t = 2$

$A = P(1+r)^t$

$A = 1000(1+0.013)^2$

$P = 1,000$

$r = 0.013$

$t = 2$

- 13 Which value would be a solution for x in the inequality $47 - 4x < 7$?

- (1) -13
- (2) -10
- (3) 10
- (4) 11

$47 - 4x < 7$

$-47 \quad -47$

$-4x < -40$

$D-4 \quad x > \frac{-40}{-4}$

$x > 10$

- 14 Bella recorded data and used her graphing calculator to find the equation for the line of best fit. She then used the correlation coefficient to determine the strength of the linear fit.

Which correlation coefficient represents the strongest linear relationship?

- (1) 0.9
- (2) 0.5
- (3) $|-0.3| = .3$
- (4) $|-0.8| = .8$

The correlation coefficient whose absolute value is closest to 1 is the strongest.

Use this space for computations.

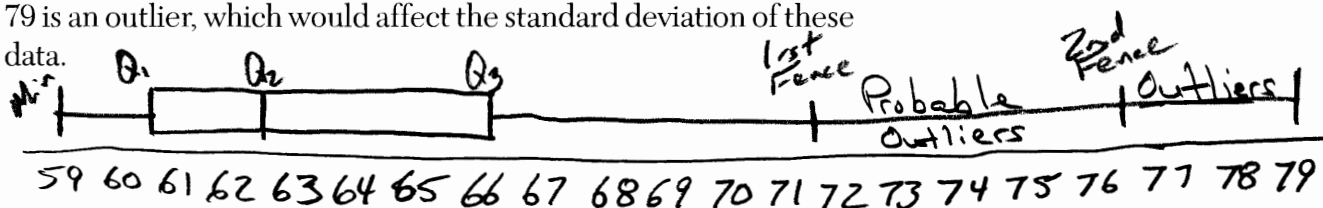
15 The heights, in inches, of 12 students are listed below.

61, 67, 72, 62, 65, 59, 60, 79, 60, 61, 64, 63

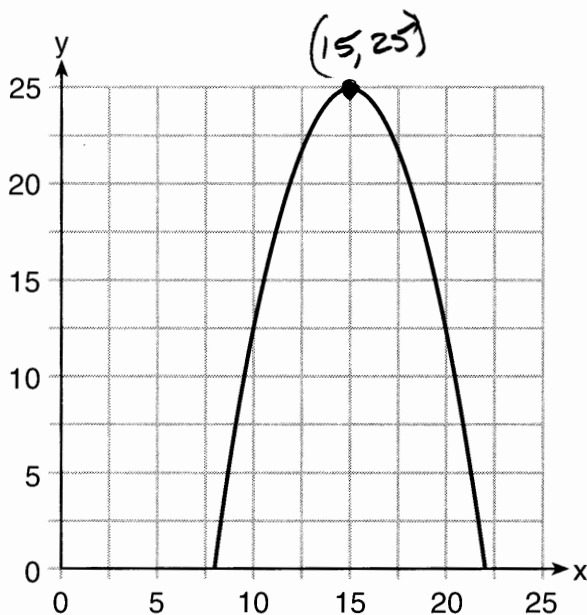
Which statement best describes the spread of these data?

- ~~(1) The set of data is evenly spread.~~
- ~~(2) The median of the data is 59.5.~~
- ~~(3) The set of data is skewed because 59 is the only value below 60.~~
- (4) 79 is an outlier, which would affect the standard deviation of these data.**

Use a graphing calculator to find one variable stats.



16 The graph of a quadratic function is shown below.



An equation that represents the function could be

- (1) $q(x) = \frac{1}{2}(x + 15)^2 - 25$
- (2) $q(x) = -\frac{1}{2}(x + 15)^2 - 25$
- (3) $q(x) = \frac{1}{2}(x - 15)^2 + 25$
- (4) $q(x) = -\frac{1}{2}(x - 15)^2 + 25$**

← Vertex Form shows the vertex at (15, 25)

Change this sign ↑

keep this sign ↑

17 Which statement is true about the quadratic functions $g(x)$, shown in the table below, and $f(x) = (x - 3)^2 + 2$?

Use this space for computations.

x	g(x)
0	4
1	-1
2	-4
3	-5
4	-4
5	-1
6	4

axis of symmetry \rightarrow
 $x=3$

$f(x) = (x-3)^2 + 2$ ← Vertex form
change sign keep sign
Vertex is $(3, 2)$
Vertex is $(3, -5)$
axis of symmetry $x=3$

~~(1)~~ They have the same vertex.

$(3, 2) \neq (3, -5)$

(2) They have the same zeros.

(3) They have the same axis of symmetry.

(4) They intersect at two points.

18 Given the function $f(n)$ defined by the following:

$f(1) = 2$

$f(n) = -5f(n - 1) + 2$

$f(1) = 2$ the set must begin with 2
 $f(2) = -5f(1) + 2$
 $f(2) = -5(2) + 2$
 $f(2) = -10 + 2$
 $f(2) = -8$ ← second ~~is~~ in set

Which set could represent the range of the function?

~~(1)~~ $\{2, 4, 6, 8, \dots\}$

~~(3)~~ $\{-8, -42, -208, 1042, \dots\}$

(2) $\{2, -8, 42, -208, \dots\}$

~~(4)~~ $\{-10, 50, -250, 1250, \dots\}$

19 An equation is given below.

$4(x - 7) = 0.3(x + 2) + 2.11$

The solution to the equation is

(1) 8.3

(3) 3

(2) 8.7

(4) -3

$4x - 28 = 0.3x + 0.6 + 2.11$
 $4x - 0.3x = 28 + 0.6 + 2.11$
 $3.7x = 30.71$
 $x = 8.3$

Use this space for computations.

20 A construction worker needs to move 120 ft^3 of dirt by using a wheelbarrow. One wheelbarrow load holds 8 ft^3 of dirt and each load takes him 10 minutes to complete. One correct way to figure out the number of hours he would need to complete this job is

- (1) $\frac{120 \text{ ft}^3}{1} \cdot \frac{10 \text{ min}}{1 \text{ load}} \cdot \frac{60 \text{ min}}{1 \text{ hr}} \cdot \frac{1 \text{ load}}{8 \text{ ft}^3}$
- (2) $\frac{120 \text{ ft}^3}{1} \cdot \frac{60 \text{ min}}{1 \text{ hr}} \cdot \frac{8 \text{ ft}^3}{10 \text{ min}} \cdot \frac{1}{1 \text{ load}}$
- (3) $\frac{120 \text{ ft}^3}{1} \cdot \frac{1 \text{ load}}{10 \text{ min}} \cdot \frac{8 \text{ ft}^3}{1 \text{ load}} \cdot \frac{1 \text{ hr}}{60 \text{ min}}$
- (4) $\frac{120 \text{ ft}^3}{1} \cdot \frac{1 \text{ load}}{8 \text{ ft}^3} \cdot \frac{10 \text{ min}}{1 \text{ load}} \cdot \frac{1 \text{ hr}}{60 \text{ min}}$

$\frac{\text{min}^2}{\text{h}}$ ← makes no sense

$\frac{\text{ft}^3}{\text{load}}$ ←

$\frac{\text{ft}^3 \text{ hr}}{\text{min}^2}$ ←

$\frac{\text{hr}}{1}$ ← The answer needs to be in hour units.

21 One characteristic of all linear functions is that they change by

- (1) equal factors over equal intervals
- (2) unequal factors over equal intervals
- (3) equal differences over equal intervals
- (4) unequal differences over equal intervals

Constant rate of change

22 What are the solutions to the equation $x^2 - 8x = 10$?

- (1) $4 \pm \sqrt{10}$ (3) $-4 \pm \sqrt{10}$
- (2) $4 \pm \sqrt{26}$ (4) $-4 \pm \sqrt{26}$

$$x^2 - 8x = 10$$

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

$$(x-4)^2 = 10 + 16$$

$$(x-4)^2 = 26$$

$$\sqrt{(x-4)^2} = \sqrt{26}$$

$$x-4 = \pm \sqrt{26}$$

$$x = 4 \pm \sqrt{26}$$

Use this space for computations.

23 The formula for blood flow rate is given by $F = \frac{p_1 - p_2}{r}$, where F is the flow rate, p_1 the initial pressure, p_2 the final pressure, and r the resistance created by blood vessel size. Which formula can not be derived from the given formula?

(1) $p_1 = Fr + p_2$

(2) $p_2 = p_1 - Fr$

(3) $r = F(p_2 - p_1)$

(4) $r = \frac{p_1 - p_2}{F}$

$$F = \frac{p_1 - p_2}{r}$$

$$rF = p_1 - p_2$$

$$r = \frac{p_1 - p_2}{F}$$

I (r) is this →

It can't be this

24 Morgan throws a ball up into the air. The height of the ball above the ground, in feet, is modeled by the function $h(t) = -16t^2 + 24t$, where t represents the time, in seconds, since the ball was thrown. What is the appropriate domain for this situation?

(1) $0 \leq t \leq 1.5$

(3) $0 \leq h(t) \leq 1.5$

(2) $0 \leq t \leq 9$

(4) $0 \leq h(t) \leq 9$

$$h(t) = -16t^2 + 24t$$

$$0 = -16t^2 + 24t$$

$$0 = -8t(2t - 3)$$

$$-8t = 0$$

$$2t - 3 = 0$$

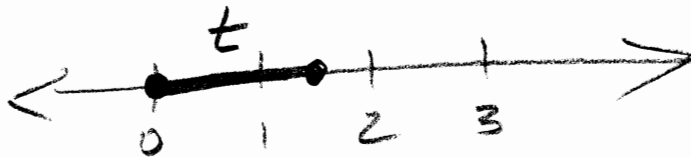
$$t = \frac{0}{-8}$$

$$2t = 3$$

$$t = \frac{3}{2}$$

$$t = 0$$

$$t = 1.5$$



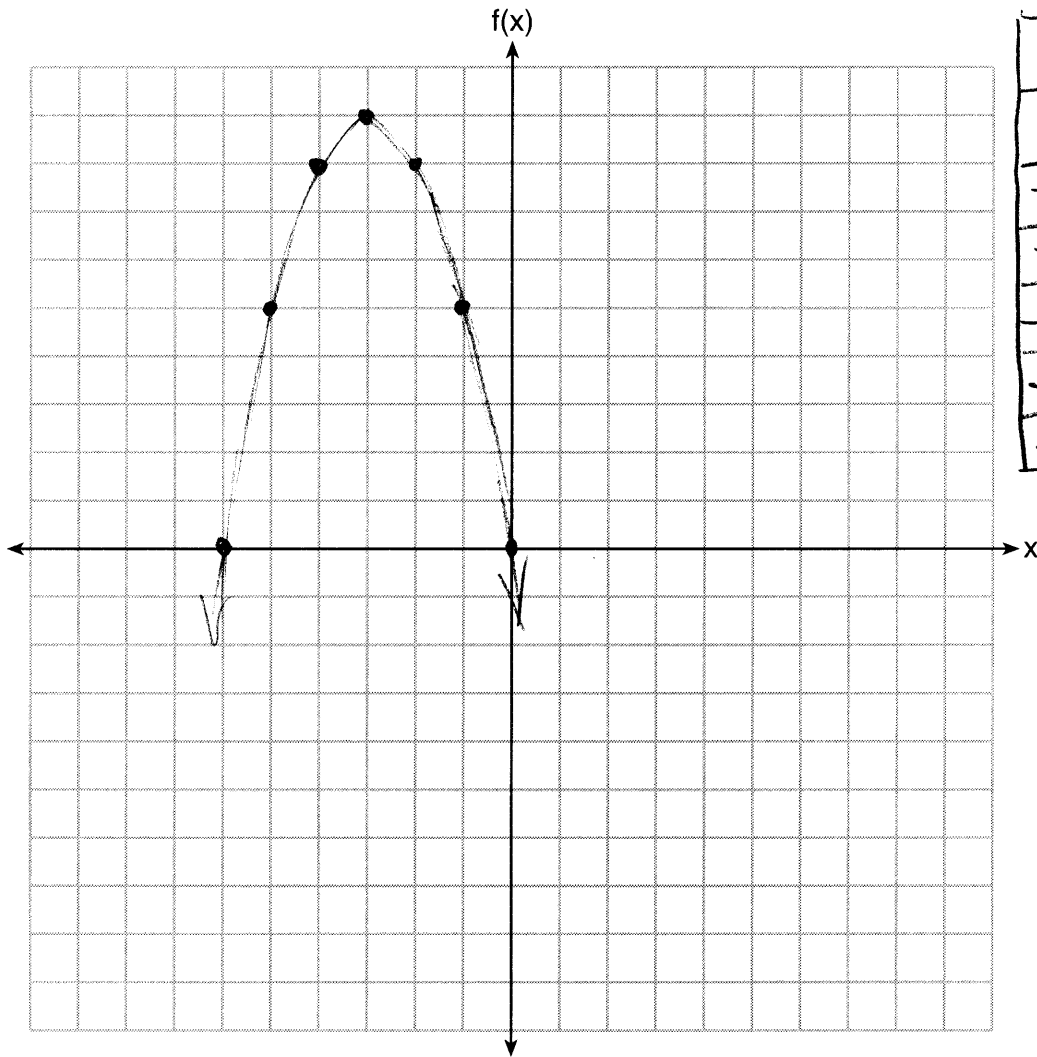
Part II

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]

25 Express in simplest form: $(3x^2 + 4x - 8) - (-2x^2 + 4x + 2)$

$$\begin{array}{r} 3x^2 + 4x - 8 \\ - (-2x^2 + 4x + 2) \\ \hline 5x^2 \qquad -10 \end{array}$$

26 Graph the function $f(x) = -x^2 - 6x$ on the set of axes below.



x	f(x)
0	0
-1	5
-2	8
-3	9
-4	8
-5	5
-6	0

State the coordinates of the vertex of the graph.

$(-3, 9)$

27 State whether $7 - \sqrt{2}$ is rational or irrational. Explain your answer.

Irrational

A rational number and an irrational number under addition and subtraction is always irrational.

$$7 - \sqrt{2} \approx 5.585786438$$

Does not repeat }
Does not end } Irrational

28 The value, $v(t)$, of a car depreciates according to the function $v(t) = P(.85)^t$, where P is the purchase price of the car and t is the time, in years, since the car was purchased. State the percent that the value of the car decreases by each year. Justify your answer.

Find r →

$$A = P(1 \pm r)^t$$
$$v(t) = P(.85)^t$$

$$1 - r = .85$$

$$-r = .85 - 1$$

$$-r = -.15$$

$$r = .15$$

The percent that the value of the car decreases each year is 15%.

total total

total sports

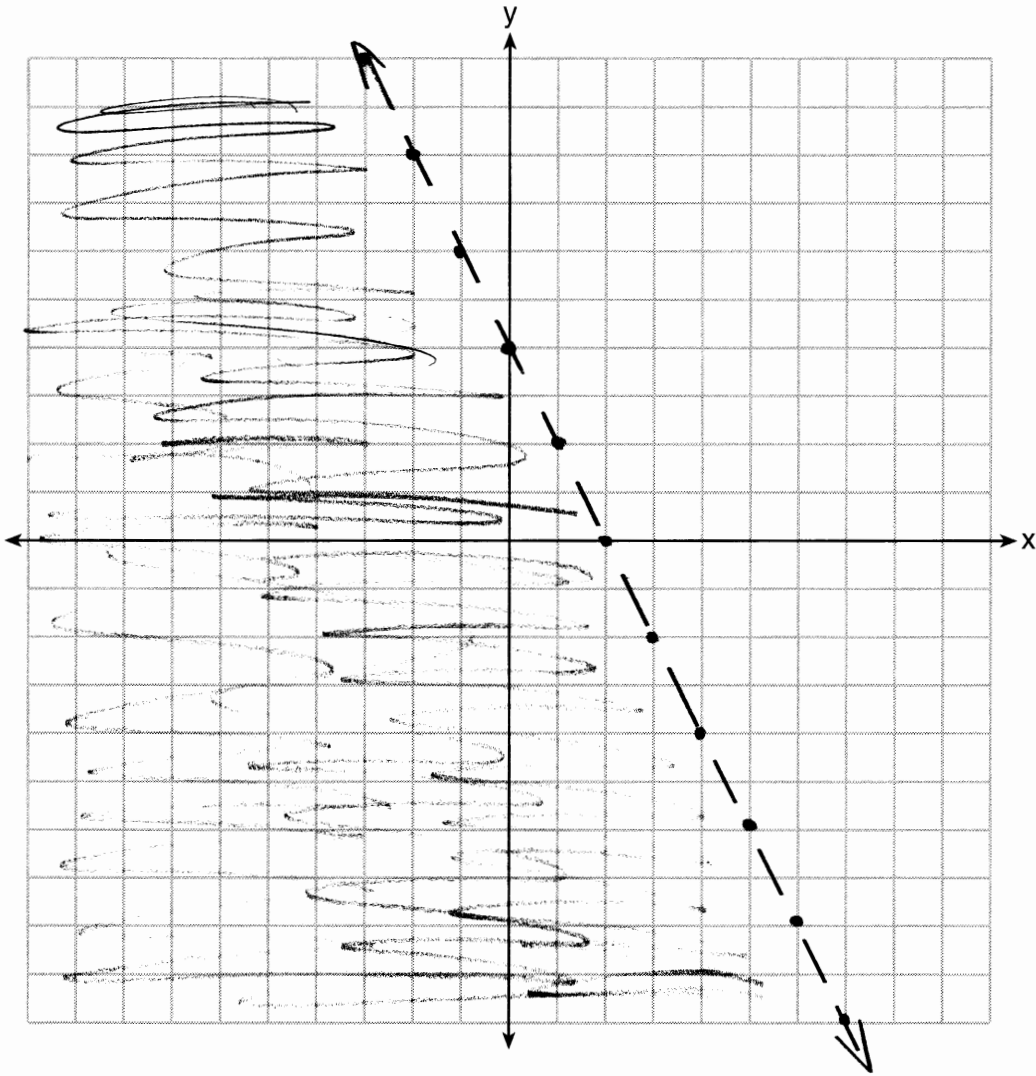
29 A survey of 100 students was taken. It was found that 60 students watched sports, and 34 of these students did not like pop music. Of the students who did not watch sports, 70% liked pop music. Complete the two-way frequency table.

	Watch Sports	Don't Watch Sports	Total
Like Pop	$60 - 34 = 26$	$.70 \times 40 = 28$	$26 + 28 = 54$
Don't Like Pop	<u>34</u>	$40 - 28 = 12$	$34 + 12 = 46$
Total	<u>60</u>	$100 - 60 = 40$	<u>100</u>

30 Graph the inequality $y + 4 < -2(x - 4)$ on the set of axes below.

$$y + 4 < -2x + 8$$

$$y < -2x + 4$$



31 If $f(x) = x^2$ and $g(x) = x$, determine the value(s) of x that satisfy the equation $f(x) = g(x)$.

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

$$g(x) = x$$

$$f(x) = g(x)$$

$$x^2 = x$$

$$x^2 - x = 0$$

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

$$x = 0$$

$$x - 1 = 0$$

$$x = 1$$

32 Describe the effect that each transformation below has on the function $f(x) = |x|$, where $a > 0$.

$$g(x) = |x - a|$$

Moves $f(x)$ "a" units to the right.

$$h(x) = |x| - a$$

Lowers $f(x)$ by "a" units.

Part III

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 The function $r(x)$ is defined by the expression $x^2 + 3x - 18$. Use factoring to determine the zeros of $r(x)$.

$$x^2 + 3x - 18 = 0$$

$$(x+6)(x-3) = 0$$

$$x+6 = 0$$

$$x = -6$$

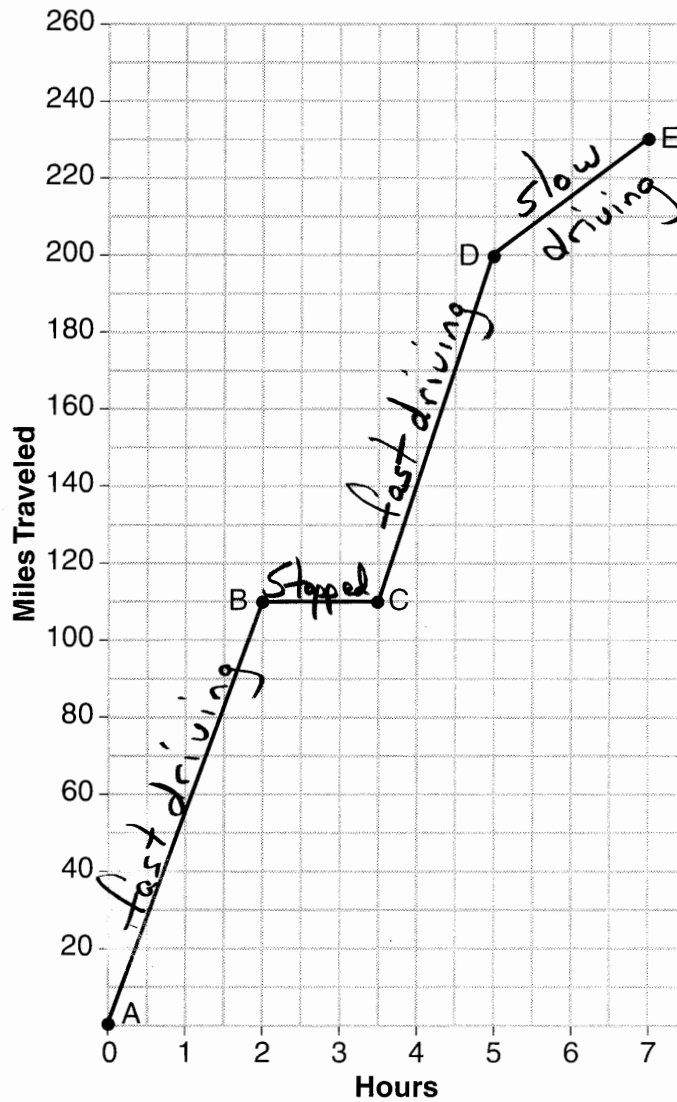
$$x-3 = 0$$

$$x = 3$$

Explain what the zeros represent on the graph of $r(x)$.

The zeros of a function are the x -values when $y = 0$.

34 The graph below models Craig's trip to visit his friend in another state. In the course of his travels, he encountered both highway and city driving.



Based on the graph, during which interval did Craig most likely drive in the city? Explain your reasoning.

DE, because you should drive slower in the city than on the highway.

Question 34 is continued on the next page.

Question 34 continued.

Explain what might have happened in the interval between B and C.

Craig might have stopped for lunch.

Determine Craig's average speed, to the nearest tenth of a mile per hour, for his entire trip.

$$\text{Speed} = \frac{\text{distance}}{\text{time}} = \frac{230 \text{ miles}}{7 \text{ hours}}$$

$$\frac{230}{7} = 32.857$$

32.9 miles per hour

35 Given:

$$g(x) = 2x^2 + 3x + 10$$

$$k(x) = 2x + 16$$

Solve the equation $g(x) = 2k(x)$ algebraically for x , to the *nearest tenth*.

$$g(x) = 2k(x)$$

$$2x^2 + 3x + 10 = 2(2x + 16)$$

$$2x^2 + 3x + 10 = 4x + 32$$

$$2x^2 - x - 22 = 0$$

$$a = 2 \quad b = -1 \quad c = -22$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{1 \pm \sqrt{1 - 4(2)(-22)}}{4}$$

$$x = \frac{1 \pm \sqrt{177}}{4}$$

$$x = \frac{1 + \sqrt{177}}{4} = 3.576033 \approx \boxed{3.6}$$

$$x = \frac{1 - \sqrt{177}}{4} = -3.076033 \approx \boxed{-3.1}$$

Explain why you chose the method you used to solve this quadratic equation.

Quadratic formula always works.

- 36 Michael has \$10 in his savings account. Option 1 will add \$100 to his account each week. Option 2 will double the amount in his account at the end of each week.

Write a function in terms of x to model each option of saving.

Option 1			Option 2	
Week	Amount		Week	Amount
0	10	$A(x) = 10 + 100x$	0	10
1	110		1	20
2	210	$B(x) = 10(2)^x$	2	40
3	310		3	80
4	410		4	160
5	510			

Michael wants to have at least \$700 in his account at the end of 7 weeks to buy a mountain bike. Determine which option(s) will enable him to reach his goal. Justify your answer.

$$A(7) = 10 + 100(7)$$

$$A(7) = 10 + 700$$

$$A(7) = 710$$

$$B(7) = 10(2)^7$$

$$B(7) = 10(128)$$

$$B(7) = 1280$$

Either option will enable Michael to reach his goal.

Part IV

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]

37 Central High School had five members on their swim team in 2010. Over the next several years, the team increased by an average of 10 members per year. The same school had 35 members in their chorus in 2010. The chorus saw an increase of 5 members per year.

Write a system of equations to model this situation, where x represents the number of years since 2010.

	2010	2011	2012	2013	2014	
x	0	1	2	3	4	
Swim Y_1	5	15	25	35	45	rate of change = 10
Chorus Y_2	35	40	45	50	55	rate of change = 5

y -intercepts \nearrow

$$Y_1 = 10x + 5$$

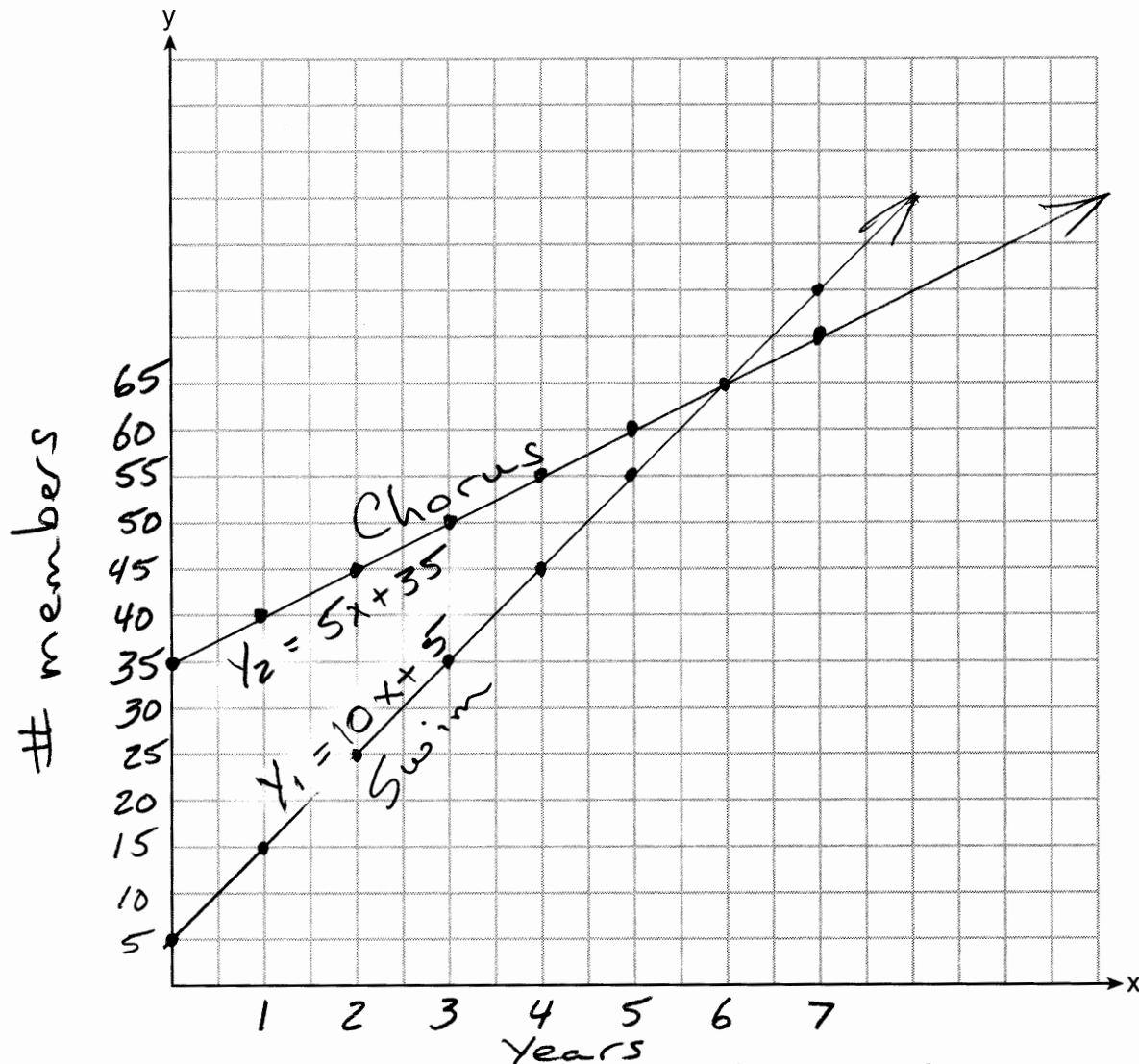
$$Y_2 = 5x + 35$$

$$y = mx + b$$

Question 37 is continued on the next page.

Question 37 continued.

Graph this system of equations on the set of axes below.



Explain in detail what each coordinate of the point of intersection of these equations means in the context of this problem.

In the sixth year, the swim team and the chorus will both have 65 members.