

Part I

Answer all 24 questions in this part. Each correct answer will receive 2 credits. No partial credit will be allowed. 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 in the space provided. [48]

1. Which expression is equivalent to $16x^2 - 36$?
 (1) $4(2x - 3)(2x - 3)$
 (2) $4(2x + 3)(2x - 3)$
 (3) $(4x - 6)(4x - 6)$
 (4) $(4x + 6)(4x + 6)$ 1 2
2. What is the solution set of the equation $(x - 2)(x - a) = 0$?
 (1) -2 and a (2) -2 and $-a$ (3) 2 and a (4) 2 and $-a$ 3

3. Analysis of data from a statistical study shows a linear relationship in the data with a correlation coefficient of -0.524 . Which statement best summarizes this result?

- (1) There is a strong positive correlation between the variables.
 (2) There is a strong negative correlation between the variables.
 (3) There is a moderate positive correlation between the variables.
 (4) There is a moderate negative correlation between the variables. 3 4

4. Boyle's Law involves the pressure and volume of gas in a container. It can be represented by the formula $P_1V_1 = P_2V_2$. When the formula is solved for P_2 , the result is

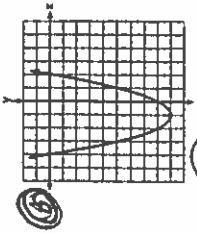
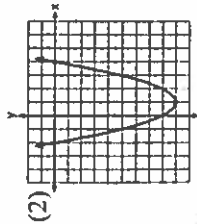
- (1) $P_1V_1V_2$ (2) $\frac{V_2}{P_1V_1}$ (3) $\frac{P_1V_1}{V_2}$ (4) $\frac{P_1V_2}{V_1}$ 4 3

5. A radio station did a survey to determine what kind of music to play by taking a sample of middle school, high school, and college students. They were asked which of three different types of music they prefer on the radio: hip-hop, alternative, or classic rock. The results are summarized in the table below.

	Hip-Hop	Alternative	Classic Rock
Middle School	28	18	4
High School	22	22	6
College	16	20	14

What percentage of college students prefer classic rock?
 (1) 14% (2) 28% (3) 33% (4) 58% 5 2

6. Which function has zeros of -4 and 2 ?
 (1) $f(x) = x^2 + 7x - 8$
 (2) $f(x) = x^2 + 7x - 8$
 (3) $g(x) = x^2 - 7x - 8$



7. Which expression is equivalent to $2(3g - 4) - (8g + 3)$?
 (1) $-2g - 1$ (2) $-2g - 5$ (3) $-2g - 7$ (4) $-2g - 11$ 6 4
 $6g - 8 - 8g - 3 = -2g - 11$

8. In 2014, the cost to mail a letter was 49¢ for up to one ounce. Every additional ounce cost 21¢. Which recursive function could be used to determine the cost of a 3-ounce letter, in cents?

- (1) $a_1 = 49; a_n = a_{n-1} + 21$ (3) $a_1 = 21; a_n = a_{n-1} + 49$
 (2) $a_1 = 0; a_n = 49a_{n-1} + 21$ (4) $a_1 = 0; a_n = 21a_{n-1} + 49$ 8 1

9. A car leaves Albany, NY, and travels west toward Buffalo, NY. The equation $D = 280 - 59t$ can be used to represent the distance, D , from Buffalo after t hours. In this equation, the 59 represents the

- (1) car's distance from Albany (3) distance between Buffalo and Albany
 (2) speed of the car (4) number of hours driving 9 2

10. Faith wants to use the formula $C(F) = \frac{5}{9}(F - 32)$ to convert degrees Fahrenheit, F , to degrees Celsius, $C(F)$. If Faith calculated $C(68)$, what would her result be?

- (1) 20° Celsius (2) 20° Fahrenheit (3) 154° Celsius (4) 154° Fahrenheit 10 1

11. Which scenario represents exponential growth?

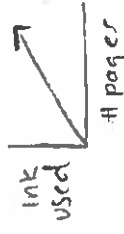
- (1) A water tank is filled at a rate of 2 gallons/minute.
 (2) A vine grows 6 inches every week.
 (3) A species of fly doubles its population every month during the summer.
 (4) A car increases its distance from a garage as it travels at a constant speed of 25 miles per hour. 11 3

12. What is the minimum value of the function $y = |x + 3| - 2$?

- (1) -2 (2) 2 (3) 3 (4) -3 12 1

13. What type of relationship exists between the number of pages printed on a printer and the amount of ink used by that printer?

- (1) positive correlation, but not causal
 (2) positive correlation, and causal
 (3) negative correlation, but not causal
 (4) negative correlation, and causal 13 2



14. A computer application generates a sequence of musical notes using the function $f(n) = 6(16)^n$, where n is the number of the note in the sequence and $f(n)$ is the note frequency in hertz. Which function will generate the same note sequence as $f(n)$?

- (1) $g(n) = 12(2)^{4n}$ (3) $p(n) = 12(4)^{2n}$
 (2) $h(n) = 6(2)^{4n}$ (4) $k(n) = 6(8)^{2n}$ 14 2

15. Which value of x is a solution to the equation $13 - 36x^2 = -12$?

- (1) $\frac{36}{25}$ (2) $\frac{25}{36}$ (3) $-\frac{6}{5}$ (4) $-\frac{5}{6}$ 15 4

16. Which point is a solution to the system?

- (1) $(1, \frac{1}{2})$ (2) $(0, 6)$ (3) $(-\frac{1}{2}, 5)$ (4) $(-3, 2)$ 16 4
 $2(\frac{1}{2}) < -12(1) + 4$
 $1 < -8$
 $2(0) < -12(0) + 4$
 $0 < 4$
 $2(-\frac{1}{2}) < -12(-\frac{1}{2}) + 4$
 $-1 < 36 + 4$
 $-1 < 40$
 $2(-3) < -12(-3) + 4$
 $-6 < 36 + 4$
 $-6 < 40$

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17. When the function $f(x) = x^2$ is multiplied by the value a , where $a > 1$, the graph of the new function, $g(x) = ax^2$
- (1) opens upward and is wider
 - (2) opens upward and is narrower
 - (3) opens downward and is wider
 - (4) opens downward and is narrower

17 2

18. Andy has \$310 in his account. Each week, w , he withdraws \$30 for his expenses. Which expression could be used if he wanted to find out how much money he had left after 8 weeks?

(1) $310 - 8w$ (2) $280 + 30(w - 1)$ (3) $310w - 30$ (4) $280 - 30(w - 1)$ 18 4

19. The daily cost of production in a factory is calculated using $c(x) = 200 + 16x$, where x is the number of complete products manufactured. Which set of numbers best defines the domain of $c(x)$?

(1) integers
(2) positive real numbers
(3) positive rational numbers
(4) whole numbers

19 4

20. Noah conducted a survey on sports participation. He created the following two dot plots to represent the number of students participating, by age, in soccer and basketball.



Soccer Players' Ages



Basketball Players' Ages

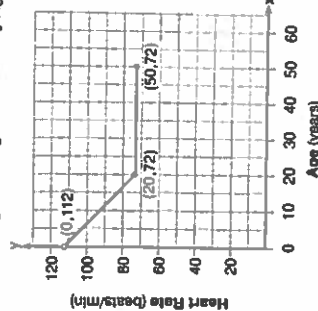
$\bar{x} = 9.9$

- Which statement about the given data sets is correct?

- (1) The data for soccer players are skewed right.
- (2) The data for soccer players have less spread than the data for basketball players.
- (3) The data for basketball players have the same median as the data for soccer players.
- (4) The data for basketball players have a greater mean than the data for soccer players.

20 4

Average Resting Heart Rate by Age



21. A graph of average resting heart rates is shown. The average resting heart rate for adults is 72 beats per minute, but doctors consider resting rates from 60-100 beats per minute within normal range.

Which statement about average resting heart rates is *not* supported by the graph?

- (1) A 10-year-old has the same average resting heart rate as a 20-year-old.
- (2) A 20-year-old has the same average resting heart rate as a 30-year-old.
- (3) A 40-year-old may have the same average resting heart rate for ten years.
- (4) The average resting heart rate for teenagers steadily decreases.

21 1

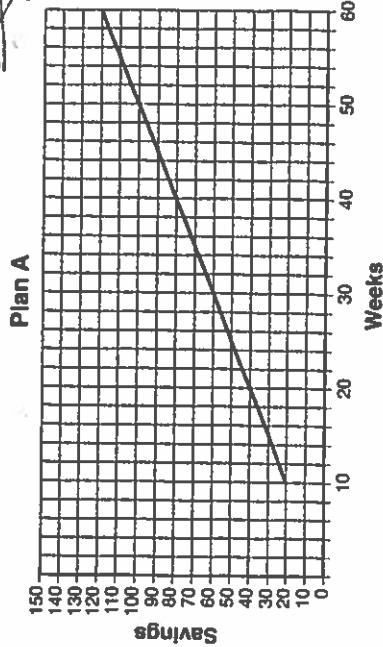
$2x^2 - 12x + 6 = 0$
 $2x^2 - 12x = -6$
 $2x^2 - 12x = -6$
 $2(x^2 - 6x + 9) = -6 + 18$

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22. The method of completing the square was used to solve the equation $2x^2 - 12x + 6 = 0$. Which equation is a correct step when using this method?
- (1) $(x - 3)^2 = 6$
 - (2) $(x - 3)^2 = -6$
 - (3) $(x - 3)^2 = 3$
 - (4) $(x - 3)^2 = -3$

22 1

23. Nancy works for a company that offers two types of savings plans. Plan A is represented on the graph below.



- Plan B is represented by the function $f(x) = 0.01 + 0.05x^2$, where x is the number of weeks. Nancy wants to have the highest savings possible after a year. Nancy picks Plan B. Her decision is

- (1) correct, because Plan B is an exponential function and will increase at a faster rate
- (2) correct, because Plan B is a quadratic function and will increase at a faster rate
- (3) incorrect, because Plan A will have a higher value after 1 year
- (4) incorrect, because Plan B is a quadratic function and will increase at a slower rate

23 2

24. The 2014 winner of the Boston Marathon runs as many as 120 miles per week. During the last few weeks of his training for an event, his mileage can be modeled by $M(w) = 120(90)^{w-1}$ where w represents the number of weeks since training began. Which statement is true about the model $M(w)$?

- (1) The number of miles he runs will increase by 90% each week.
- (2) The number of miles he runs will be 10% of the previous week.
- (3) $M(w)$ represents the total mileage run in a given week.
- (4) w represents the number of weeks left until his marathon.

24 3

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. In attempting to solve the system of equations $y = 3x - 2$ and $6x - 2y = 4$, John graphed the two equations on his graphing calculator. Because he saw only one line, John wrote that the answer to the system is the empty set. Is he correct? Explain your answer.

$$y = 3x - 2$$

$$\frac{6x - 2y = 4}{-6x} = \frac{-2y + 4}{-6x}$$

$$\frac{-2y = -6x + 4}{-2} = \frac{-6x + 4}{-2}$$

$$y = 3x - 2$$

same equation
* infinite # of solutions *

26. A typical marathon is 26.2 miles. Allan averages 12 kilometers per hour when running in marathons.

Determine how long it would take Allan to complete a marathon, to the nearest tenth of an hour. Justify your answer.

$$\frac{12 \text{ km}}{1 \text{ hour}} = \frac{1 \text{ km}}{7.44 \text{ hrs/mi}}$$

$$\frac{26.2 \text{ mi}}{1 \text{ hr.}} \times \text{hr.}$$

$$\frac{7.44 \cancel{\text{mi}} = 26.2}{7.44} \frac{7.44}{7.44}$$

27. Solve the inequality: $1.8 - 0.4y \geq 2.2 - 2y$

$$\frac{1.8 - 0.4y \geq 2.2 - 2y}{-1.8 + 2y} \quad | -1.8 + 2y$$

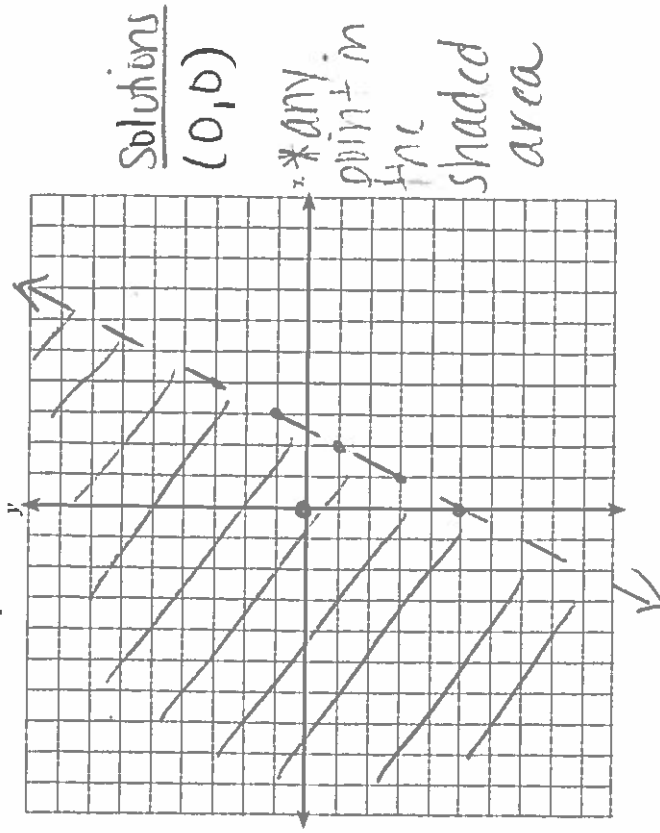
$$\frac{1.6y \geq 0.4}{1.6} \quad | \frac{1.6}{1.6}$$

$$y \geq 0.25$$

28. Jakob is working on his math homework. He decides that the sum of the expression $\frac{1}{3} + \frac{6\sqrt{5}}{7}$ must be rational because it is a fraction. Is Jakob correct? Explain your reasoning. = 2.249963028...

Irrational, it never ends. Also b/c $\sqrt{5}$ is irrational and when added to a rational number the sum is irrational.

29. Graph the inequality $y > 2x - 5$ on the set of axes below. State the coordinates of a point in its solution.



30. Sandy programmed a website's checkout process with an equation to calculate the amount customers will be charged when they download songs. The website offers a discount. If one song is bought at the full price of \$1.29, then each additional song is \$.99.

$$C(s) = 1.29 + 0.99(s-1)$$

Sandy figured she would be charged \$52.77 for 52 songs. Is this the correct amount? Justify your answer.

$$C(52) = 1.29 + 0.99(52-1)$$

$$C(52) = 51.78$$

31. A family is traveling from their home to a vacation resort hotel. The table below shows their distance from home as a function of time.

Time (hrs)	0	2	5	7
Distance (mi)	0	140	375	480

Determine the average rate of change between hour 2 and hour 7, including units.

$$\frac{480 - 140}{7 - 2} = \frac{340}{5} = 68 \text{ miles/hour}$$

32. Nora says that the graph of a circle is a function because she can trace the whole graph without picking up her pencil.

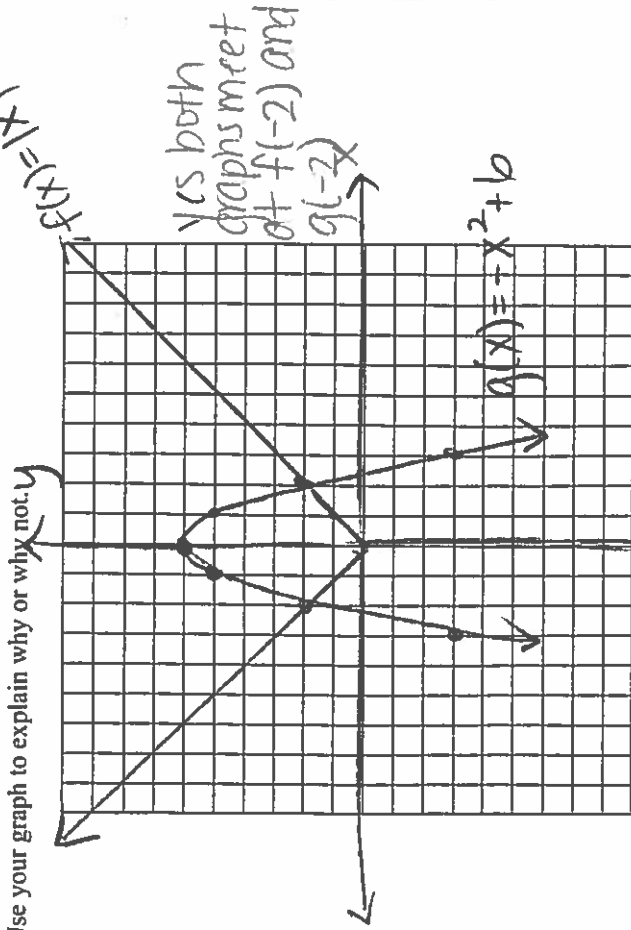
Mia says that a circle graph is *not* a function because multiple values of x map to the same y -value.

Determine if either one is correct, and justify your answer completely.

Both are incorrect b/c both do not pass the vertical line test. Just b/c you don't pick up the pencil doesn't mean it's a function and multiple x 's can map to same y -value but not vice versa.

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. Graph $f(x) = |x|$ and $g(x) = -x^2 + 6$ on the grid below. Does $f(-2) = g(-2)$? Use your graph to explain why or why not.



34. Two friends went to a restaurant and ordered one plain pizza and two sodas. Their bill totaled \$15.95. Later that day, five friends went to the same restaurant. They ordered three plain pizzas and each person had one soda. Their bill totaled \$45.90.

$$P = \text{pizza cost}$$

$$S = \text{soda cost}$$

Write and solve a system of equations to determine the price of one plain pizza.

[Only an algebraic solution can receive full credit.]

$$-3(P + 2S = 15.95) \rightarrow -3P - 6S = -47.85$$

$$3P + 5S = 45.90$$

$$P + 2(1.95) = 15.95$$

$$P = 12.05$$

$$-1S = -1.95$$

$$S = 1.95$$

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35. Tanya is making homemade greeting cards. The data table represents the amount she spends in dollars, $f(x)$, in terms of the number of cards she makes, x .

x	$f(x)$
4	7.50
6	9
9	11.25
10	12

Write a linear function, $f(x)$, that represents the data.

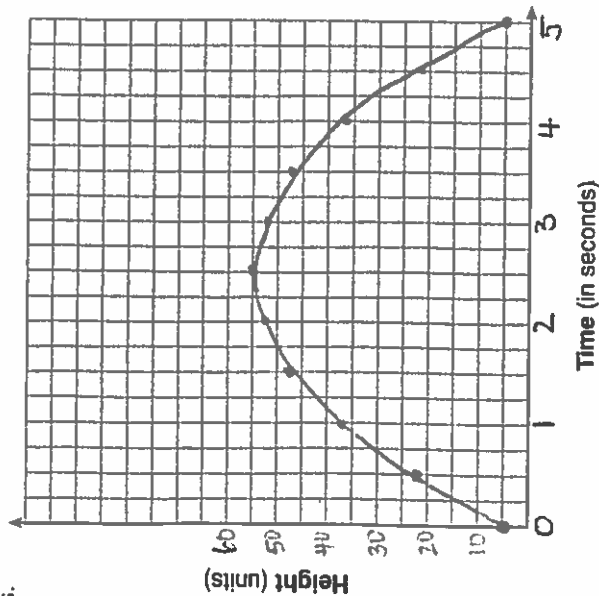
$f(x) = 0.75x + 4.50$

Explain what the slope and y-intercept of $f(x)$ mean in the given context.

slope = charges \$0.75 per card

y-int = costs \$4.50 initially to make cards

36. Alex launched a ball into the air. The height of the ball can be represented by the equation $h = -8t^2 + 40t + 5$, where h is the height, in units, and t is the time, in seconds, after the ball was launched. Graph the equation from $t = 0$ to $t = 5$ seconds.



State the coordinates of the vertex and explain its meaning in the context of the problem.

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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. Ian is borrowing \$1000 from his parents to buy a notebook computer. He plans to pay them back at the rate of \$60 per month. Ken is borrowing \$600 from his parents to purchase a snowboard. He plans to pay his parents back at the rate of \$20 per month.

Write an equation that can be used to determine after how many months the boys will owe the same amount.

Ian: $1000 - 60x = 600 - 20x$

Determine algebraically and state in how many months the two boys will owe the same amount. State the amount they will owe at this time.

10 months they will owe \$400

$$1000 - 60x = 600 - 20x$$

$$+60x \quad +60x$$

$$\frac{1000}{-600} = \frac{600}{-600} + \frac{40x}{-600}$$

$$-1.6667 = -1 + \frac{40x}{-600}$$

$$-0.6667 = \frac{40x}{-600}$$

$$\frac{400}{40} = \frac{40x}{40}$$

$$10 = x$$

Ian claims that he will have his loan paid off 6 months after he and Ken owe the same amount. Determine and state if Ian is correct. Explain your reasoning.

$1000 - 60(16) = 1000 - 960 = 40$ (left)

$600 - 20(16) = 600 - 320 = 280$ (left)

10 weeks to owe same amount + 6 weeks

Ian is incorrect, he will have \$40 left to still owe his parents.