

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]

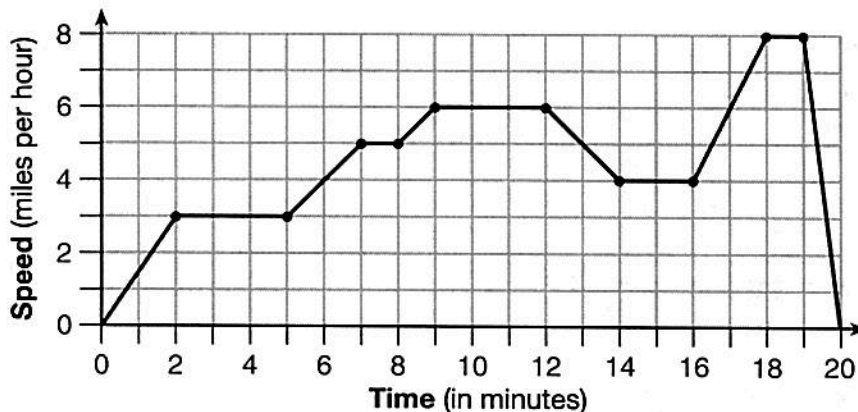
1 The cost of airing a commercial on television is modeled by the function $C(n) = 110n + 900$, where n is the number of times the commercial is aired. Based on this model, which statement is true?

- (1) The commercial costs \$0 to produce and \$110 per airing up to \$900.
- (2) The commercial costs \$110 to produce and \$900 each time it is aired.
- (3) The commercial costs \$900 to produce and \$110 each time it is aired.
- (4) The commercial costs \$1010 to produce and can air an unlimited number of times.

Use this space for computations.

Linear function
 $y = mx + b$
 $C(n) = 110n + 900$
 ↓ ↓
 constant rate of change initial cost

2 The graph below represents a jogger's speed during her 20-minute jog around her neighborhood.



Which statement best describes what the jogger was doing during the 9–12 minute interval of her jog?

- (1) She was standing still.
- (2) She was increasing her speed.
- (3) She was decreasing her speed.
- (4) She was jogging at a constant rate.

→ time increased, but speed at a rate of 6mph remains the same.

factor → DOTS

Use this space for computations.

3 If the area of a rectangle is expressed as $x^4 - 9y^2$, then the product of the length and the width of the rectangle could be expressed as

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

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

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

(4) $(x^4 + y)(x - 9y)$

$A = L \cdot w$

$x^4 - 9y^2 = (x^2 - 3y)(x^2 + 3y)$

4 Which table represents a function?

x-values do not repeat

x	2	4	2	4
f(x)	3	5	7	9

(1)

x	3	5	7	9
f(x)	2	4	2	4

(3)

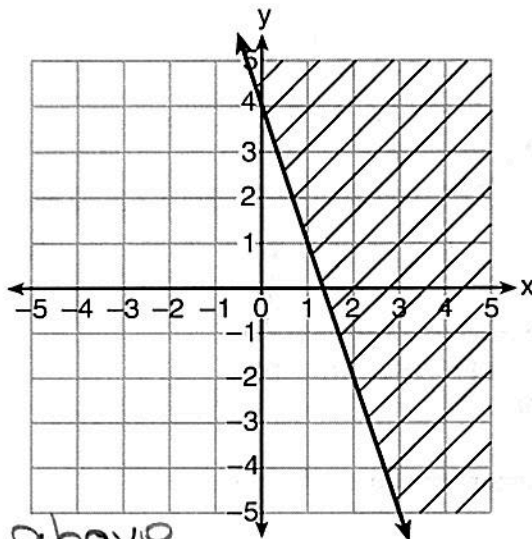
x	0	-1	0	1
f(x)	0	1	-1	0

(2)

x	0	1	-1	0
f(x)	0	-1	0	1

(4)

5 Which inequality is represented in the graph below?



Shade above
 $m = -3$ $b = 4$

(1) $y \geq -3x + 4$

(3) $y \geq -4x - 3$

(2) $y \leq -3x + 4$

(4) $y \leq -4x - 3$

$x = \# \text{ of lbs of apples}$
 $y = \# \text{ of lbs of peaches}$

Use this space for
 computations.

- 6 Mo's farm stand sold a total of 165 pounds of apples and peaches. She sold apples for \$1.75 per pound and peaches for \$2.50 per pound. If she made \$337.50, how many pounds of peaches did she sell?

(1) 11

(2) 18

(3) 65

(4) 100

$$x + y = 165$$

$$1.75x + 2.50y = 337.50$$

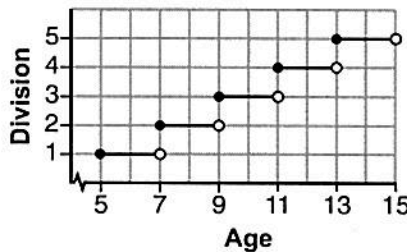
$$\begin{array}{r} -1.75x - 1.75y = -288.75 \\ + 1.75x + 2.50y = 337.50 \\ \hline \end{array}$$

$$\begin{array}{r} .75y = 48.75 \\ \hline .75 \quad .75 \\ \hline \end{array}$$

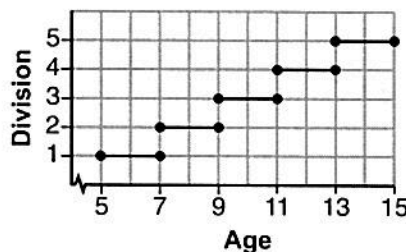
$$y = 65$$

age 5 is included \rightarrow closed circle

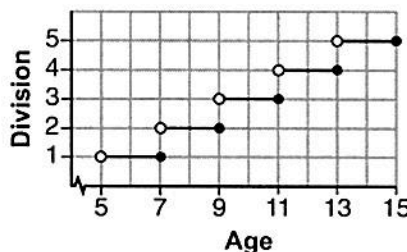
- 7 Morgan can start wrestling at age 5 in Division 1. He remains in that division until his next odd birthday when he is required to move up to the next division level. Which graph correctly represents this information?



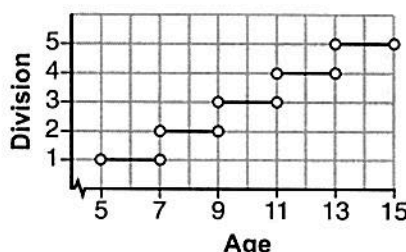
(1)



(3)



(2)



(4)

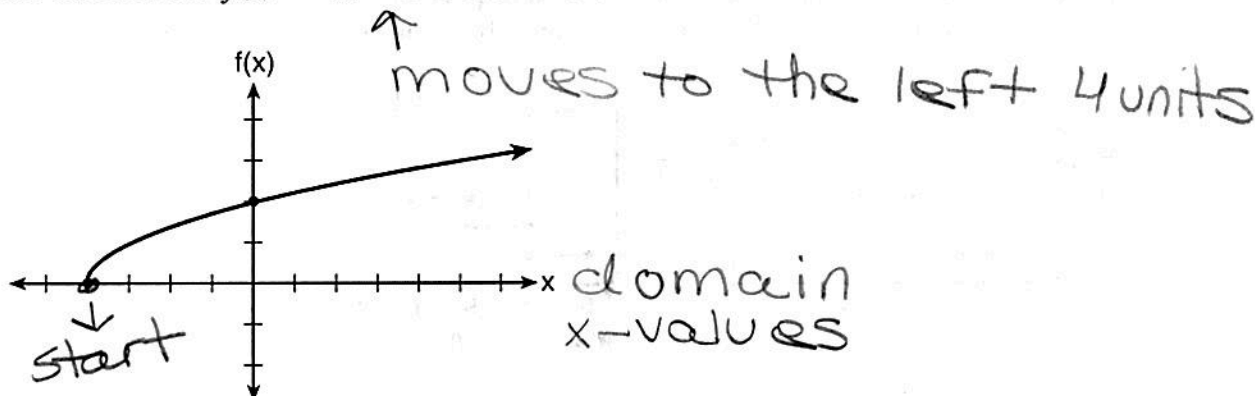
8 Which statement is not always true?

- (1) The sum of two rational numbers is rational.
- (2) The product of two irrational numbers is rational.
- (3) The sum of a rational number and an irrational number is irrational.
- (4) The product of a nonzero rational number and an irrational number is irrational.

Use this space for computations.

$$\begin{array}{c} \text{Irr} \quad \text{Irr} \\ \downarrow \quad \downarrow \\ \sqrt{7} \cdot \sqrt{7} = 7 \\ \uparrow \\ \text{rational} \end{array}$$

9 The graph of the function $f(x) = \sqrt{x+4}$ is shown below.



The domain of the function is

- (1) $\{x|x > 0\}$
- (2) $\{x|x \geq 0\}$
- (3) $\{x|x > -4\}$
- (4) $\{x|x \geq -4\}$

10 What are the zeros of the function $f(x) = x^2 - 13x - 30$?

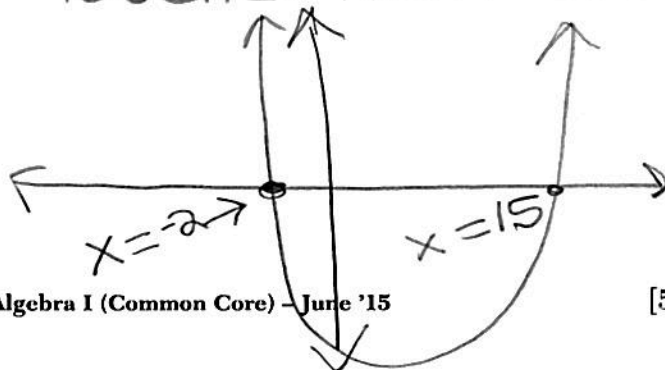
- (1) -10 and 3
- (2) 10 and -3
- (3) -15 and 2
- (4) 15 and -2

Quadratic function

Factor → Easy to

$$\frac{(x-15)(x+2)}{x=15 \mid x=-2} = 0$$

where the parabola touches the x-axis : when $y=0$ on the table



x	y
-2	0
15	0

- 11 Joey enlarged a 3-inch by 5-inch photograph on a copy machine. He enlarged it four times. The table below shows the area of the photograph after each enlargement.

Enlargement	0	1	2	3	4
Area (square inches)	15	18.8	23.4	29.3	36.6

Use this space for computations.

$$\begin{aligned} & (x_1, y_1) \\ & (x_2, y_2) \end{aligned}$$

What is the average rate of change of the area from the original photograph to the fourth enlargement, to the nearest tenth?

- (1) 4.3
(2) 4.5
(3) 5.4
(4) 6.0

slope formula

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

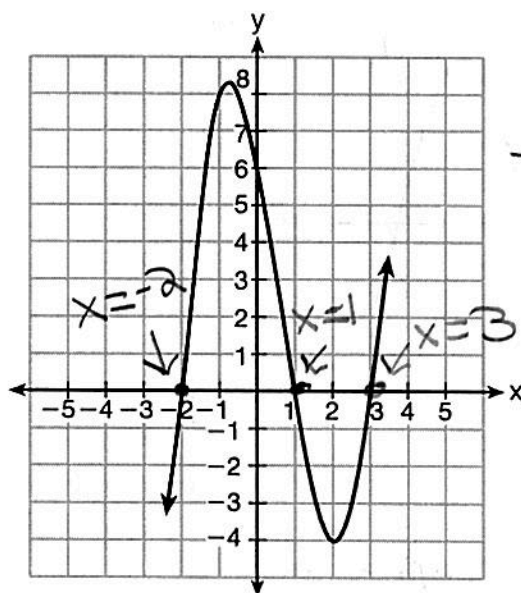
$$m = \frac{36.6 - 15}{4 - 0}$$

$$m = \frac{21.6}{4}$$

$$m = 5.4$$

- 12 Which equation(s) represent the graph below?

- I $y = (x + 2)(x^2 - 4x - 12)$
II $y = (x - 3)(x^2 + x - 2)$
III $y = (x - 1)(x^2 - 5x - 6)$



Easy tri

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

$$\frac{(x - 3)(x + 2)(x - 1)}{x = 3 \quad x = -2 \quad x = 1} = 0$$

(1) I, only

(2) II, only

(3) I and II

(4) II and III

use calc
graph

Use this space for computations.

- 13 A laboratory technician studied the population growth of a colony of bacteria. He recorded the number of bacteria every other day, as shown in the partial table below.

t (time, in days)	0	2	4
f(t) (bacteria)	25	15,625	9,765,625

Plug in (0, 25)

$$f(0) = 25^0 + 1$$

Which function would accurately model the technician's data?

(1) $f(t) = 25^t$

(3) $f(t) = 25t$

(2) $f(t) = 25^{t+1}$

(4) $f(t) = 25(t + 1)$

$$f(0) = 25^1$$

$$f(0) = 25$$

calc → table

- 14 Which quadratic function has the largest maximum?

$$h(x) = (3 - x)(2 + x)$$

$$k(x) = -5x^2 - 12x + 4$$

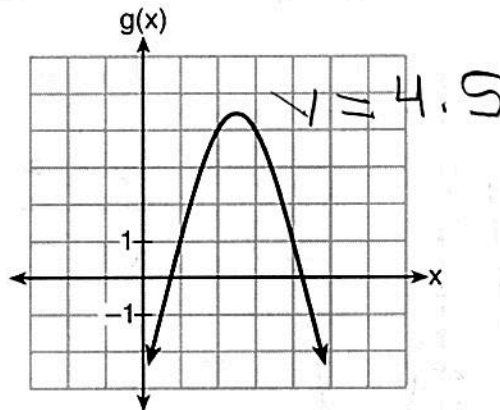
$$y = 11.2$$

(1) $y = 6.25$

(3)

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

$$y = 9$$



(2)

(4)

- 15 If $f(x) = 3^x$ and $g(x) = 2x + 5$, at which value of x is $f(x) < g(x)$?

(1) -1

(3) -3

(2) 2

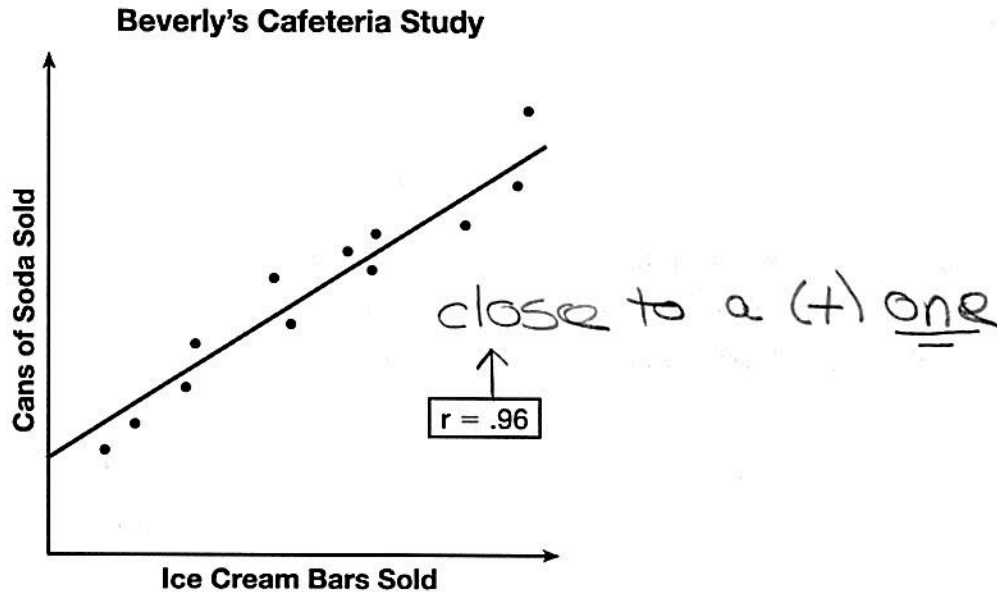
(4) 4

x	f(x)	g(x)
-3	.03704	-1
-1	.33333	3
2	9	9
4	81	13

[OVER]

Use this space for computations.

- 16 Beverly did a study this past spring using data she collected from a cafeteria. She recorded data weekly for ice cream sales and soda sales. Beverly found the line of best fit and the correlation coefficient, as shown in the diagram below.



Given this information, which statement(s) can correctly be concluded?

- I. Eating more ice cream causes a person to become thirsty.
- II. Drinking more soda causes a person to become hungry.
- III. There is a strong correlation between ice cream sales and soda sales.

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

points are close together

- 17 The function $V(t) = 1350(1.017)^t$ represents the value $V(t)$, in dollars, of a comic book t years after its purchase. The yearly rate of appreciation of the comic book is

- (1) 17%
- (2) 1.7%
- (3) 1.017%
- (4) 0.017%

$$1 + .017 \rightarrow 1.017$$

1.7%

Use this space for computations.

18 When directed to solve a quadratic equation by completing the square, Sam arrived at the equation $(x - \frac{5}{2})^2 = \frac{13}{4}$. Which equation could have been the original equation given to Sam?

(1) $x^2 + 5x + 7 = 0$

(3) $x^2 - 5x + 7 = 0$

(2) $x^2 + 5x + 3 = 0$

(4) $x^2 - 5x + 3 = 0$

b-value $(-\frac{5}{2})^2$

$$x^2 - 5x + \frac{10}{4} = -3 + \frac{10}{4}$$

19 The distance a free falling object has traveled can be modeled by the equation $d = \frac{1}{2}at^2$, where a is acceleration due to gravity and t is the amount of time the object has fallen. What is t in terms of a and d ?

(1) $t = \sqrt{\frac{da}{2}}$

(3) $t = (\frac{da}{d})^2$

(2) $d = \frac{1}{2}at^2$ (2)

(2) $t = \sqrt{\frac{2d}{a}}$

(4) $t = (\frac{2d}{a})^2$

$\frac{2d}{a} = \frac{at^2}{a}$

20 The table below shows the annual salaries for the 24 members of a professional sports team in terms of millions of dollars.

0.5	0.5	0.6	0.7	0.75	0.8
1.0	1.0	1.1	1.25	1.3	1.4
1.4	1.8	2.5	3.7	3.8	4
4.2	4.6	5.1	6	6.3	7.2

$\sqrt{\frac{2d}{a}} = \sqrt{t^2}$

one more player

+10

The team signs an additional player to a contract worth 10 million dollars per year. Which statement about the median and mean is true?

(1) Both will increase.

(2) Only the median will increase.

(3) Only the mean will increase.

(4) Neither will change.

original median = 1.4

New median = 1.4

Use this space for computations.

- 21 A student is asked to solve the equation $4(3x - 1)^2 - 17 = 83$.
The student's solution to the problem starts as

$$4(3x - 1)^2 = 100$$

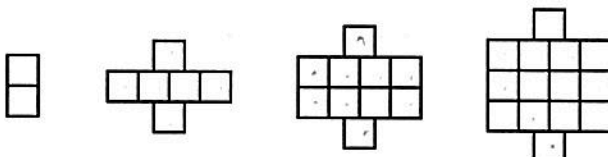
$$\sqrt{(3x - 1)^2} = \sqrt{25}$$

$$3x - 1 = \pm 5$$

A correct next step in the solution of the problem is

- (1) $3x - 1 = \pm 5$ (3) $9x^2 - 1 = 25$
(2) $3x - 1 = \pm 25$ (4) $9x^2 - 6x + 1 = 5$

- 22 A pattern of blocks is shown below.



$x=1$ Term 1 $x=2$ Term 2 $x=3$ Term 3 $x=4$ Term 4
 $y=2$ $y=6$ $y=10$ $y=14$

If the pattern of blocks continues, which formula(s) could be used to determine the number of blocks in the n th term?

I	II	III
$a_n = n + 4$	$a_1 = 2$ ✓ $a_n = a_{n-1} + 4$	$a_n = 4n - 2$

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

$n=1$
 $a_n = n + 4$

$a_1 = 1 + 4$

~~$a_1 = 5$~~

$n=2$
 $a_2 = a_{2-1} + 4$

$a_2 = a_1 + 4$

$a_2 = 2 + 4$

$a_2 = 6$ ✓

$x = \#$ of terms
 $y = \#$ of blocks

x	y
0	-2
1	2
2	6
3	10
4	14

$n=2$

$a_2 = 4(2) - 2$

$a_2 = 8 - 2$

$a_2 = 6$ ✓

Quadratic Equation

Standard form = -24

Use this space for computations.

23 What are the solutions to the equation $x^2 - 8x = 24$?

(1) $x = 4 \pm 2\sqrt{10}$

(3) $x = 4 \pm 2\sqrt{2}$

(2) $x = -4 \pm 2\sqrt{10}$

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

$$x^2 - 8x - 24 = 0$$

calc \rightarrow determine the roots on the graph

24 Natasha is planning a school celebration and wants to have live music and food for everyone who attends. She has found a band that will charge her \$750 and a caterer who will provide snacks and drinks for \$2.25 per person. If her goal is to keep the average cost per person between \$2.75 and \$3.25, how many people, p , must attend?

(1) $225 < p < 325$

(3) $500 < p < 1000$

(2) $325 < p < 750$

(4) $750 < p < 1500$

23) Completing the Square

$$x^2 - 8x = 24$$

$$b\text{-value} = \left(-\frac{8}{2}\right)^2 = 16$$

$$x^2 - 8x + 16 = 24 + 16$$

$$(x-4)(x-4) = 40$$

$$\sqrt{(x-4)^2} = \sqrt{40}$$

$$x-4 = \pm\sqrt{4}\sqrt{10}$$

$$x-4 = \pm 2\sqrt{10}$$

$$+4 \quad +4$$

$$x = 4 \pm 2\sqrt{10}$$

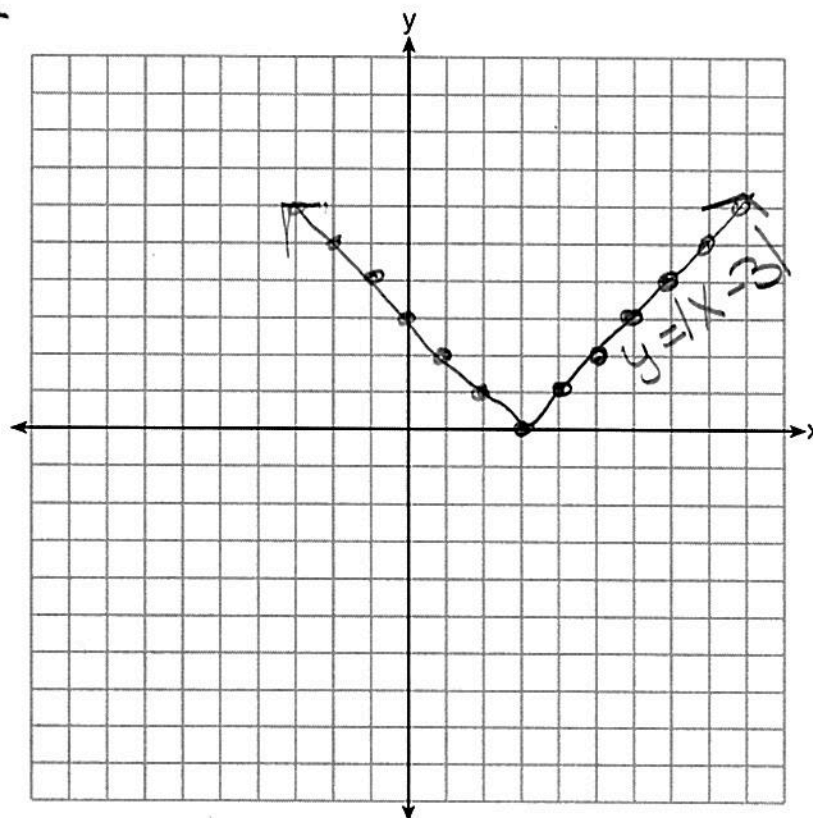
Part II

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 Graph the function $y = |x - 3|$ on the set of axes below.

absolute function
table

x	y
0	3
-1	2
-2	1
-3	0
-4	1
-5	2
-6	3



← inside

Explain how the graph of $y = |x - 3|$ has changed from the related graph $y = |x|$.

moves to the right.
three units

- 26 Alex is selling tickets to a school play. An adult ticket costs \$6.50 and a student ticket costs \$4.00. Alex sells x adult tickets and 12 student tickets. Write a function, $f(x)$, to represent how much money Alex collected from selling tickets.

\$6.50 \rightarrow constant rate of change

12(4) \rightarrow initial cost of tickets sold

$$f(x) = 6.50x + 48$$

- 27 John and Sarah are each saving money for a car. The total amount of money John will save is given by the function $f(x) = 60 + 5x$. The total amount of money Sarah will save is given by the function $g(x) = x^2 + 46$. After how many weeks, x , will they have the same amount of money saved? Explain how you arrived at your answer.

$$\begin{array}{rcl}
 f(x) & = & g(x) \\
 60 + 5x & = & x^2 + 46 \\
 -60 & & -60 \\
 \hline
 5x & = & x^2 - 14 \\
 -5x & & -5x \\
 \hline
 0 & = & x^2 - 5x - 14 \\
 (x - 7)(x + 2) & = & 0 \\
 \hline
 \boxed{x = 7} & | & x = -2 \\
 & & \text{reject b/c you can} \\
 & & \text{not have } (-) \text{ weeks}
 \end{array}$$

Q.E.D. x^2
S.F = 0

Easy tri

After 7 weeks both John & Sarah will have the same amount of \$

28 If the difference $(3x^2 - 2x + 5) - (x^2 + 3x - 2)$ is multiplied by $\frac{1}{2}x^2$, what is the result, written in standard form?

distribute the negative

$$(3x^2 - 2x + 5) - (x^2 + 3x - 2)$$

combine like terms

$$(3x^2 - 2x + 5 - x^2 - 3x + 2)$$

Distribute

$$\frac{1}{2}x^2(2x^2 - 5x + 7)$$

$$x^4 - \frac{5}{2}x^3 + \frac{7}{2}x^2$$

- 29 Dylan invested \$600 in a savings account at a 1.6% annual interest rate. He made no deposits or withdrawals on the account for 2 years. The interest was compounded annually. Find, to the nearest cent, the balance in the account after 2 years.

$$y = a (1 \pm r)^t \leftarrow \text{time}$$

\downarrow initial amount \downarrow rate in terms of a decimal

$$a = 600$$

$$r = 1.6\% \rightarrow .016 \text{ (decimal)}$$

$$t = 2$$

$$y = 600 (1 + .016)^2$$

$$y = 600 (1.016)^2$$

$$y = \$619.3536$$

$$\boxed{\$619.35}$$

30 Determine the smallest integer that makes $-3x + 7 - 5x < 15$ true.

$$-3x + 7 - 5x < 15$$

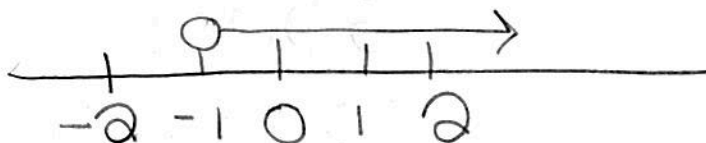
$$\begin{array}{r} -8x + 7 < 15 \\ -7 \quad -7 \\ \hline -8x < 8 \end{array}$$

rule: when
dividing by
a (-) you flip
the symbol

$$\rightarrow \frac{-8x}{-8} < \frac{8}{-8}$$

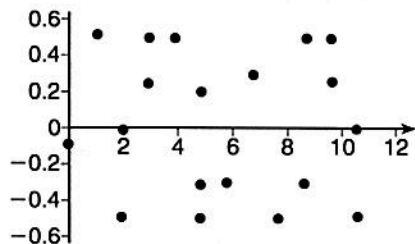
$$x > -1$$

open circle -
solution not
included

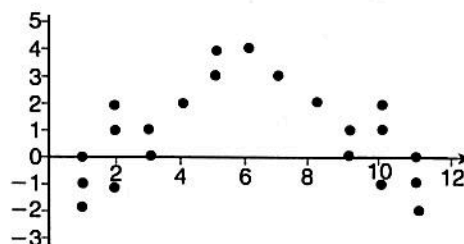


Smallest possible
integer is zero

31 The residual plots from two different sets of bivariate data are graphed below.



Graph A



Graph B

Explain, using evidence from graph A and graph B, which graph indicates that the model for the data is a good fit.

Graph A is a model for a good fit because it shows NO pattern.

- 32 A landscaper is creating a rectangular flower bed such that the width is half of the length. The area of the flower bed is 34 square feet. Write and solve an equation to determine the width of the flower bed, to the nearest tenth of a foot.

Let $x = \text{length}$

Let $\frac{1}{2}x = \text{width}$

$$\boxed{A = 34 \text{ ft}^2} \quad \begin{matrix} x \\ \frac{1}{2}x \end{matrix}$$

$$A = L \cdot w$$

$$34 = x \left(\frac{1}{2}x \right)$$

$$\left(\frac{2}{1} \right) 34 = \cancel{\frac{1}{2}} x^2 \left(\frac{2}{1} \right)$$

$$\sqrt{68} = \sqrt{x^2}$$

$$\pm 8.246 = x$$

$$\text{Length} = 8.2 \text{ ft}$$

$$\text{width} = \frac{1}{2}(8.2) = \boxed{4.1 \text{ ft}}$$

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 Albert says that the two systems of equations shown below have the same solutions.

First System	Second System
$8x + 9y = 48$	$8x + 9y = 48$
$12x + 5y = 21$	$-8.5y = -51$

Determine and state whether you agree with Albert. Justify your answer.

$$\begin{array}{r}
 12(8x + 9y = 48) \\
 -8(12x + 5y = 21) \\
 \hline
 96x + 108y = 576 \\
 -96x - 40y = -168 \\
 \hline
 68y = 408 \\
 \frac{68y}{68} = \frac{408}{68} \\
 \boxed{y = 6} \\
 \downarrow \\
 8x + 9y = 48 \\
 8x + 9(6) = 48 \\
 8x + 54 = 48 \\
 -54 \quad -54 \\
 \hline
 8x = -6 \\
 \frac{8x}{8} = \frac{-6}{8} \\
 \boxed{x = -\frac{3}{4}}
 \end{array}$$

$$\begin{array}{r}
 8x + 9y = 48 \\
 -8.5y = -51 \\
 \hline
 -8.5 \quad -8.5 \\
 \boxed{y = 6} \\
 \downarrow \\
 8x + 9y = 48 \\
 8x + 9(6) = 48 \\
 8x + 54 = 98 \\
 -54 \quad -54 \\
 \hline
 8x = -6 \\
 \frac{8x}{8} = \frac{-6}{8} \\
 \boxed{x = -\frac{3}{4}}
 \end{array}$$

Albert is correct

- 34 The equation to determine the weekly earnings of an employee at The Hamburger Shack is given by $w(x)$, where x is the number of hours worked.

$$w(x) = \begin{cases} 10x, & 0 \leq x \leq 40 \\ 15(x - 40) + 400, & x > 40 \end{cases}$$

Determine the difference in salary, in dollars, for an employee who works 52 hours versus one who works 32 hours.

$$x = 52$$

$$w(x) = 15(x - 40) + 400$$

$$w(52) = 15(52 - 40) + 400$$

$$w(52) = 15(12) + 400$$

$$w(52) = 580$$

$$x = 32$$

$$w(32) = 10(32)$$

$$w(32) = 320$$

$$580 - 320$$

$$\boxed{\$200}$$

Determine the number of hours an employee must work in order to earn \$445. Explain how you arrived at this answer.

$$w(x) = 15(x - 40) + 400$$

$$445 = 15x - 600 + 400$$

$$445 = 15x - 200$$

$$+200$$

$$+200$$

$$\frac{645}{15} = \frac{15x}{15}$$

$$43 = x$$

$$\boxed{43 \text{ hours}}$$

$x = \#$ of printers

$y = \#$ of computers

- 35 An on-line electronics store must sell at least \$2500 worth of printers and computers per day. Each printer costs \$50 and each computer costs \$500. The store can ship a maximum of 15 items per day.

$$\begin{array}{r} x + y \leq 15 \\ -x \quad -x \\ \hline y \leq -x + 15 \end{array}$$

$$y \leq -x + 15$$

$$m = -\frac{1}{1} \rightarrow b = 15$$

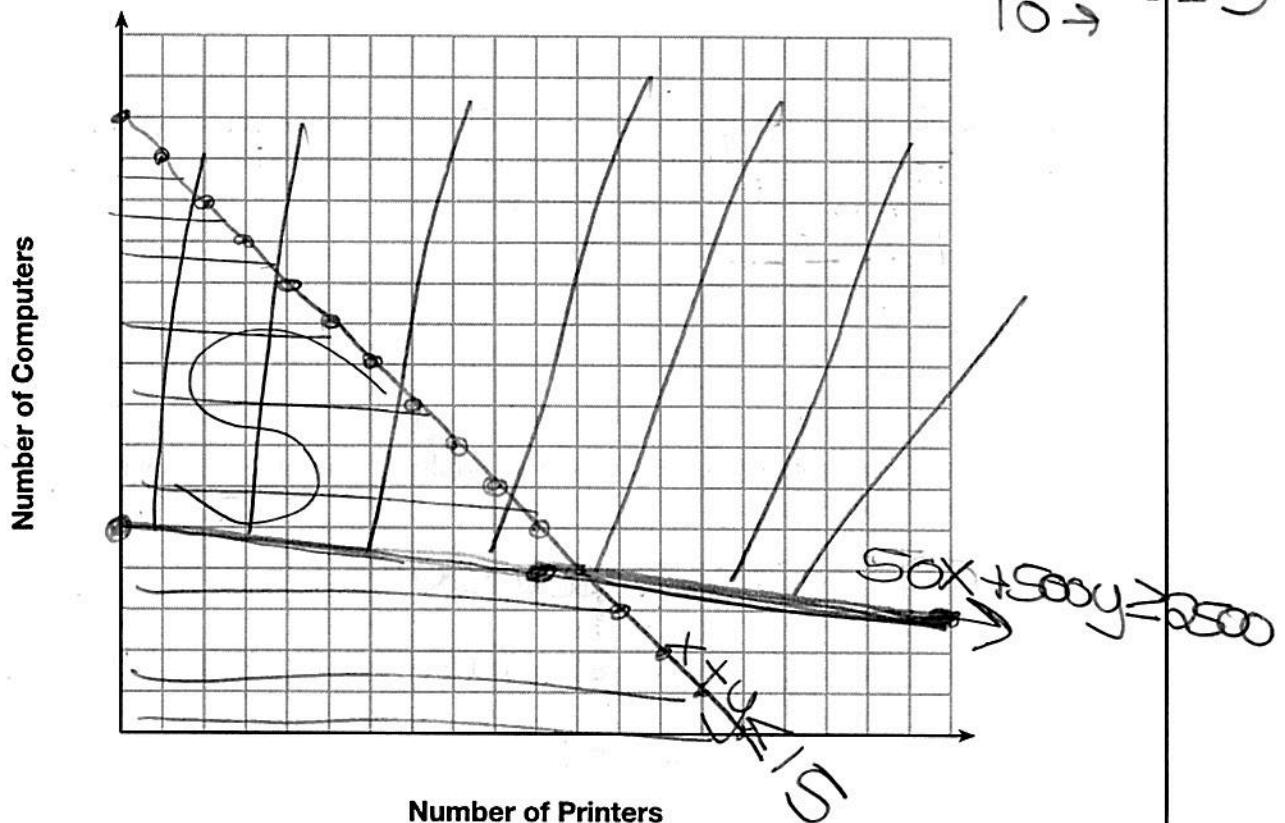
$$\begin{array}{r} 50x + 500y \geq 2500 \\ -50x \quad -50x \\ \hline 500y \geq -50x + 2500 \end{array}$$

$$\frac{500y}{500} \geq \frac{-50x}{500} + \frac{2500}{500}$$

$$y \geq -\frac{1}{10}x + 5$$

$$m = -\frac{1}{10} \rightarrow b = 5$$

On the set of axes below, graph a system of inequalities that models these constraints.



Determine a combination of printers and computers that would allow the electronics store to meet all of the constraints. Explain how you obtained your answer.

2 printers

7 computers

- 36 An application developer released a new app to be downloaded. The table below gives the number of downloads for the first four weeks after the launch of the app.

Number of Weeks	1	2	3	4
Number of Downloads	120	180	270	405

calc
StatL1L2
#0 Exp reg

Write an exponential equation that models these data.

$$y = ab^x$$

$$y = 80(1.5)^x$$

Use this model to predict how many downloads the developer would expect in the 26th week if this trend continues. Round your answer to the nearest download.

$$y = 80(1.5)^{26}$$

$$y = 3,030,140$$

$$x = 26$$

Would it be reasonable to use this model to predict the number of downloads past one year? Explain your reasoning.

NO, because as time takes place new & better apps are designed.

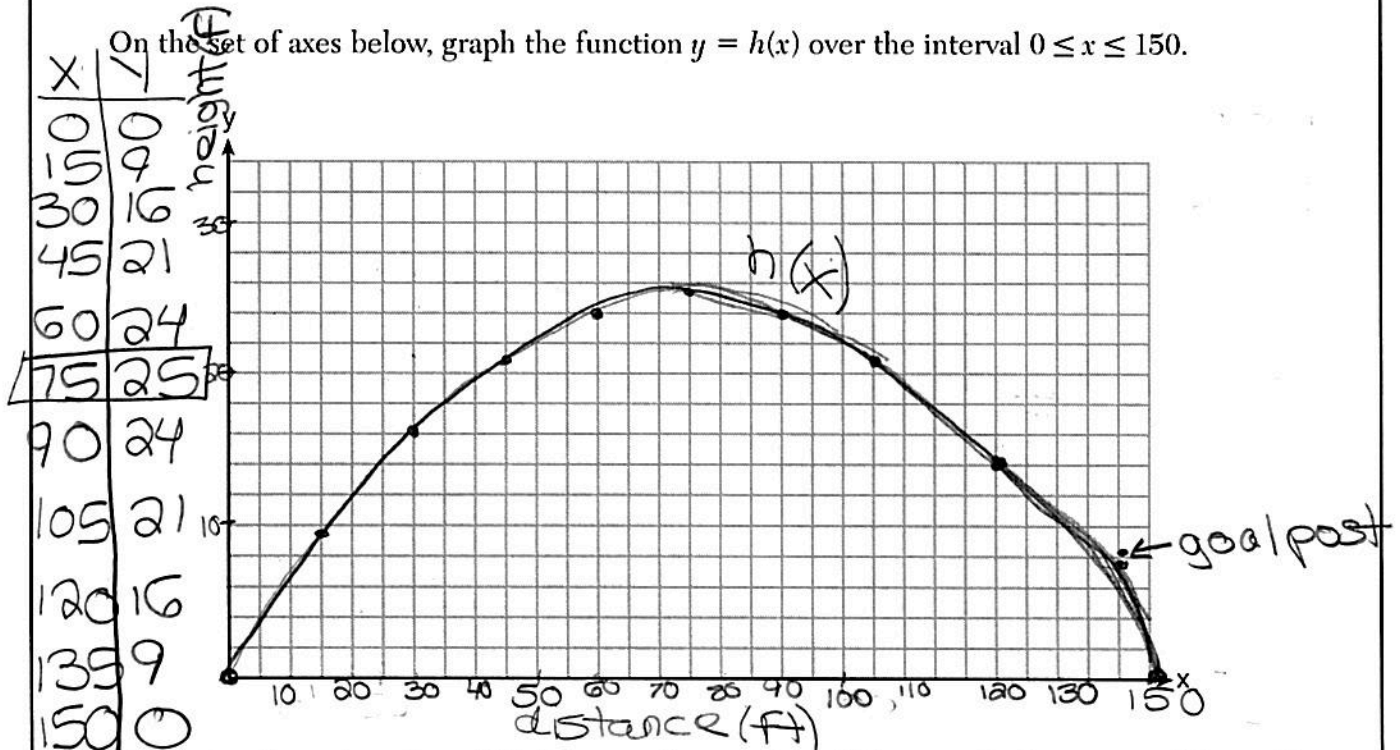
Part IV

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 for each question 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 written in pencil. [6]

Quadratic function → parabola

- 37 A football player attempts to kick a football over a goal post. The path of the football can be modeled by the function $h(x) = -\frac{1}{225}x^2 + \frac{2}{3}x$, where x is the horizontal distance from the kick, and $h(x)$ is the height of the football above the ground, when both are measured in feet.

On the set of axes below, graph the function $y = h(x)$ over the interval $0 \leq x \leq 150$.



Determine the vertex of $y = h(x)$. Interpret the meaning of this vertex in the context of the problem.

Vertex At 75 Feet it will be the highest point in the path of the football.
(75, 25)

The goal post is 10 feet high and 45 yards away from the kick. Will the ball be high enough to pass over the goal post? Justify your answer.

The path of the Football does not go past the goal post

$3(45) = 135$ feet (135, 9)
distance height

