

I

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

ALGEBRA I

Wednesday, January 24, 2024 — 1:15 to 4:15 p.m., only

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School 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.

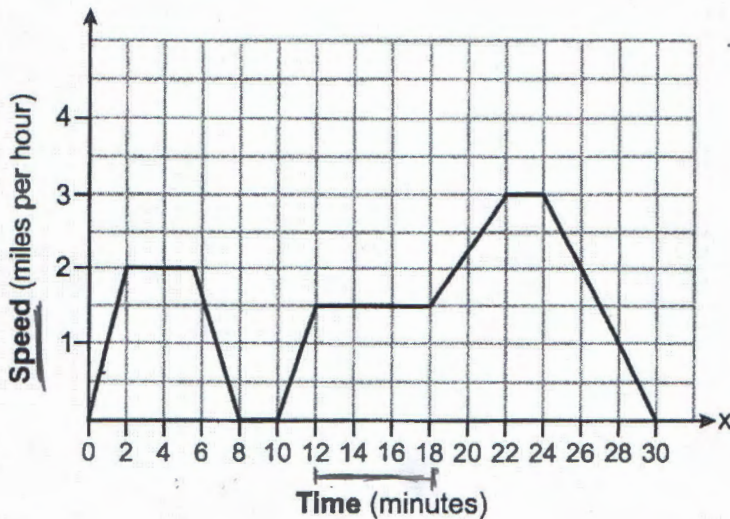
DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

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]

- 1 The graph below represents a dog walker's speed during his 30-minute walk around the neighborhood.

Use this space for computations.



Which statement best describes what the dog walker was doing during the 12-18 minute interval of his walk?

- (1) He was walking at a constant rate. - speed was 1.5 mph
- (2) He was increasing his speed. - no - speed did not change
- (3) He was decreasing his speed. - no - speed did not change
- (4) He was standing still. - no - speed was not zero

- 2 Given the relation: $\{(0,4), (2,6), (4,8), (x,7)\}$

Which value of x will make this relation a function?

- (1) 0 no (0,4) 6 yes
- (2) 2 no (2,6) (4) 4 no (4,8)

A function has one, and only one, value of y for every value of x .

3 The Speedy Jet Ski Rental Company charges an insurance fee and an hourly rental rate. The total cost is modeled by the function $R(x) = 30 + 40x$. Based on this model, which statements are true?

Use this space for computations.

- I. $R(x)$ represents the total cost. *Yes*
 II. x is the number of hours rented. *Yes*
 III. \$40 is the insurance fee. *No*
 IV. \$30 is the hourly rental rate. *No*

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

4 The eleventh term of the sequence 3, -6, 12, -24, ..., is

- (1) -3072
 3072
 (2) -6144
 (4) 6144

From Formula Page

$$a_n = a_1 r^{n-1}$$

$$a_{11} = 3(-2)^{11-1}$$

$$a_{11} = 3(-2)^{10}$$

$$a_{11} = 3(1024)$$

$$a_{11} = 3072$$

5 Which situation represents exponential growth?

- (1) Aidan adds \$10 to a jar each week.
 (2) A pine tree grows 1.5 feet per year.
 (3) Ella earns \$20 per hour babysitting.
 The number of people majoring in computer science doubles every 5 years.

6 The expression $(-x^2 + 3x - 7) - (4x^2 + 5x - 2)$ is equivalent to

- (1) $-5x^2 - 2x - 9$
 $-5x^2 - 2x - 5$
 (3) $-5x^2 + 8x - 9$
 (4) $-5x^2 + 8x - 5$

$$\begin{array}{r} -x^2 + 3x - 7 \\ -4x^2 - 5x + 2 \\ \hline -5x^2 - 2x - 5 \end{array}$$

Use this space for computations.

7 If $f(x) = x^2$, which function is the result of shifting $f(x)$ 3 units left and 2 units down?

- (1) ~~$g(x) = (x + 2)^2 - 3$~~ $j(x) = (x + 3)^2 - 2$
 (2) ~~$h(x) = (x - 2)^2 + 3$~~ (4) ~~$k(x) = (x - 3)^2 + 2$~~

8 An equation used to find the velocity of an object is given as $v^2 = u^2 + 2as$, where u is the initial velocity, v is the final velocity, a is the acceleration of the object, and s is the distance traveled.

When this equation is solved for a , the result is

- (1) $a = \frac{v^2 u^2}{2s}$ (3) $a = v^2 - u^2 - 2s$
 $a = \frac{v^2 - u^2}{2s}$ (4) $a = 2s(v^2 - u^2)$

$$v^2 = u^2 + 2as$$

$$v^2 - u^2 = 2as$$

$$\frac{v^2 - u^2}{2s} = a$$

9 Mrs. Smith's math class surveyed students to determine their favorite flavors of soft ice cream. The results are shown in the table below.

	Chocolate	Vanilla	Twist
Juniors	42	27	45
Seniors	67	42	21

Of the students who preferred chocolate, approximately what percentage were seniors?

- (1) 27.5 (3) 51.5
 (2) 44.7 61.5

$$42 + 67 = 109 \text{ total}$$

$$\frac{67 \text{ seniors}}{109 \text{ total}} = .61467$$

$$.61467 \times 100 = 61.467\%$$

$$\approx 61.45\%$$

$$f(1) = 4 \quad g(3) = 14$$

$$f(1) = (1)^2 + 2(1) + 1 \quad g(3) = 3(3) + 5$$

Use this space for computations.

10 If $f(x) = x^2 + 2x + 1$ and $g(x) = 3x + 5$, then what is the value of $f(1) - g(3)$?

- (1) 10 -10
 (2) 8 -8

$$f(1) - g(3) =$$

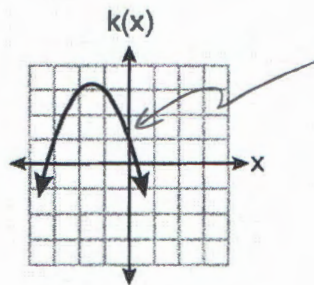
$$4 - 10 = \boxed{-10}$$

11 Which function has the largest y -intercept?

$f(x) = -4x - 1$ $g(x) = |x| + 3$
 (1) -1 +3

x	h(x)
-1	1.5
0	2
1	3
2	.5

(2) 2



(4) 1

12 Two texting plans are advertised. Plan A has a monthly fee of \$15 with a charge of \$0.08 per text. Plan B has a monthly fee of \$3 with a charge of \$0.12 per text. If t represents the number of text messages in a month, which inequality should be used to show that the cost of Plan A is less than the cost of Plan B?

- (1) $15 + 0.08t < 3 + 0.12t$ (3) $15t + 0.08 < 3t + 0.12$
 (2) $15 + 0.08t > 3 + 0.12t$ (4) $15t + 0.08 > 3t + 0.12$

$$\text{Plan A} = 15 + .08t$$

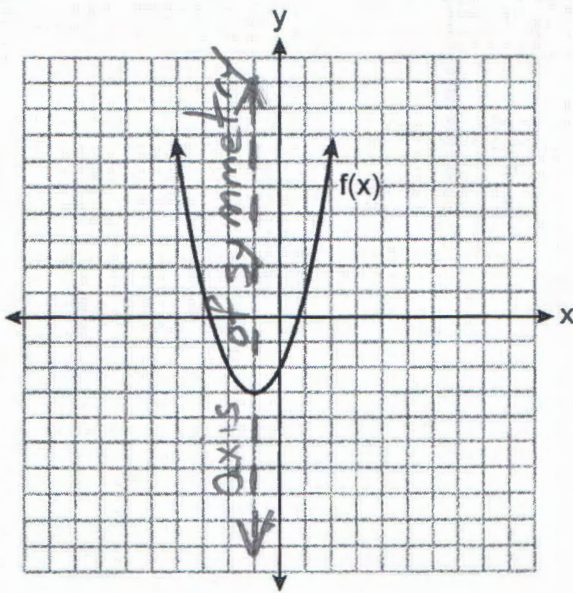
$$\text{Plan B} = 3 + .12t$$

Show that A is less than B

$$15 + .08t < 3 + .12t$$

Use this space for computations.

13 The function $f(x)$ is graphed on the set of axes below.



What is the equation of the axis of symmetry for $f(x)$?

- (1) $x = -1$ (3) $y = -1$
 (2) $x = -3$ (4) $y = -3$

14 What is the degree of the polynomial $5x - 3x^2 - 1 + 7x^3$?

- (1) 1 (3) 3
 (2) 2 (4) 5

The degree of an expression is the highest exponent.

15 The product of $(x^2 + 3x + 9)$ and $(x - 3)$ is

- (1) $x^3 - 27$ (3) $x^3 - 6x^2 - 18x - 27$
 (2) $x^2 + 4x + 6$ (4) $-6x^4 + x^3 - 18x^2 - 27$

$$\begin{array}{r}
 (x-3)(x^2+3x+9) \\
 \hline
 x(x^2) + x(3x) + x(9) + \\
 -3(x^2) - 3(3x) - 3(9) \\
 \hline
 x^3 + 3x^2 + 9x + 3x^2 - 9x - 27 \\
 \hline
 \boxed{x^3 - 27}
 \end{array}$$

16 The solution to $\frac{2}{3}(3 - 2x) = \frac{3}{4}$ is

- (1) $-\frac{11}{8}$ (3) $-\frac{33}{16}$
 (2) $\frac{5}{8}$ (4) $\frac{15}{16}$

$$\begin{array}{l}
 m\left(\frac{3}{7}\right) \\
 [6] \\
 m(4)
 \end{array}
 \begin{array}{l}
 \frac{2}{3}(3-2x) = \frac{3}{4} \\
 2(3-2x) = \frac{9}{4} \\
 8(3-2x) = 9 \\
 24 - 16x = 9
 \end{array}
 \rightarrow -16x = -15$$

$$\boxed{x = \frac{15}{16}}$$

Use this space for computations.

17 If $f(x) = 2x + 6$ and $g(x) = |x|$ are graphed on the same coordinate plane, for which value of x is $f(x) = g(x)$?

- (1) 6 -2
 (2) 2 -4
 (3) -2 -6
 (4) -6

Use graphing calculator.

18 What is the solution to the inequality $2x - 7 > 2.5x + 3$?

- (1) $x > -5$ $x > -20$
 (2) $x < -5$ $x < -20$

$$\begin{array}{r} 2x - 7 > 2.5x + 3 \\ -3 \qquad \qquad -3 \\ \hline 2x - 10 > 2.5x \\ -2x \qquad \qquad -2x \\ \hline -10 > .5x \\ \hline -20 > x \end{array}$$

M(2)

19 Three expressions are written below.

- A. $(2xy^2)^3$ Yes
 B. $(2x)^3 y^6$ Yes
 C. $(2x^2y^2)(4xy^3)$ $8x^3y^5$ No

Which expressions are equivalent to $8x^3y^6$?

- A and B, only A and C, only
 (2) B and C, only A, B, and C

20 Joe deposits \$4000 into a certificate of deposit (CD) at his local bank. The CD earns 3% interest, compounded annually. The value of the CD in x years can be found using the function

- (1) $f(x) = 4000 + 0.3x$ (3) $f(x) = 4000(1.3)^x$
 (2) $f(x) = 4000 + 0.03x$ (4) $f(x) = 4000(1.03)^x$

$A = P \leftarrow t \rightarrow \# \text{ of times compounded} = x$
 $\hookrightarrow \text{rate} = 100\% + 3\% = 1.03$
 $\hookrightarrow \text{principal} = 4000$

- 21 When factored completely, $-x^3 + 10x^2 + 24x$ is
- (1) $-x(x+4)(x-6)$ $-x(x+2)(x-12)$
 (2) $-x(x-4)(x-6)$ (4) $-x(x-2)(x+12)$

Use this space for computations.

$$-x^3 + 10x^2 + 24x$$

$$-x(x^2 - 10x - 24)$$

$$\underline{-x(x+2)(x-12)}$$

- 22 When the temperature is 59°F , the speed of sound at sea level is 1225 kilometers per hour. Which process could be used to convert this speed into feet per second?

$$\frac{\text{kilometers}}{\text{hour}} \Rightarrow \frac{\text{feet}}{\text{second}}$$

- (1) $\frac{1225 \text{ km}}{1 \text{ hr}} \cdot \frac{0.62 \text{ mi}}{1 \text{ km}} \cdot \frac{1 \text{ hr}}{60 \text{ min}} \cdot \frac{1 \text{ mi}}{5280 \text{ ft}} \cdot \frac{1 \text{ min}}{60 \text{ sec}}$
 $\frac{1225 \text{ km}}{1 \text{ hr}} \cdot \frac{0.62 \text{ mi}}{1 \text{ km}} \cdot \frac{5280 \text{ ft}}{1 \text{ mi}} \cdot \frac{1 \text{ hr}}{60 \text{ min}} \cdot \frac{1 \text{ min}}{60 \text{ sec}}$ $\frac{\text{ft}}{\text{sec}}$
 (3) $\frac{1225 \text{ km}}{1 \text{ hr}} \cdot \frac{1 \text{ km}}{0.62 \text{ mi}} \cdot \frac{5280 \text{ ft}}{1 \text{ mi}} \cdot \frac{1 \text{ hr}}{60 \text{ min}} \cdot \frac{1 \text{ min}}{60 \text{ sec}}$
 (4) $\frac{1225 \text{ km}}{1 \text{ hr}} \cdot \frac{0.62 \text{ mi}}{1 \text{ km}} \cdot \frac{5280 \text{ ft}}{1 \text{ mi}} \cdot \frac{60 \text{ min}}{1 \text{ hr}} \cdot \frac{1 \text{ min}}{60 \text{ sec}}$

- 23 The zeros of a polynomial function are -2 , 4 , and 0 . What are all the factors of this function?

Zeros	Factors
$x = -2$	$(x+2) = 0$
$x = 4$	$(x-4) = 0$
$x = 0$	$(x-0) = 0$

- (1) $(x+2)$ and $(x-4)$ x , $(x+2)$, and $(x-4)$
 (2) $(x-2)$ and $(x+4)$ (4) x , $(x-2)$, and $(x+4)$

- 24 What is the range of the function $f(x) = (x-4)^2 + 1$?

- (1) $x > 4$ (3) $f(x) > 1$
 (2) $x \geq 4$ $f(x) \geq 1$

domain of x
range of y

input $f(x) = (x-4)^2 + 1$ into graphing calculator. Inspect graph and table.

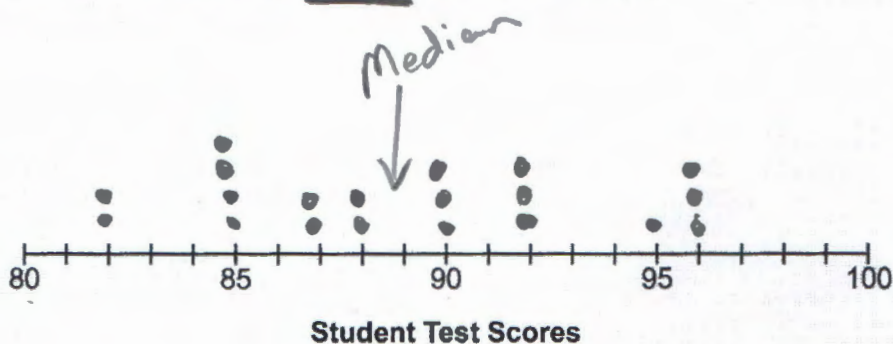
Part II

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 Student scores on a recent test are shown in the table below.

85	96	92	82	90
90	88	95	85	88
90	87	96	82	85
92	96	85	92	87

On the number line below, create a dot plot to model the data.



$$\text{median} = \frac{88 + 90}{2} = \frac{178}{2} = 89$$

State the median test score for the data set.

89

26 State whether $2\sqrt{3} + 6$ is rational or irrational. Explain your answer.

Irrational because $2\sqrt{3}$ is irrational and has a never ending, never repeating decimal representation, which begins with $3.464101615\dots$
If you add 6 to $2\sqrt{3}$, it becomes

$$\begin{array}{r} 3.464101615\dots \\ + 6 \\ \hline 9.464101615\dots \end{array}$$

The never ending, never repeating decimal part of $2\sqrt{3}$ just keeps on coming, which means that the sum of $2\sqrt{3}$ plus 6 will be irrational.

27 The table below shows data from a recent car trip for the Burke family.

Hours After Leaving (x)	1	2	3	4	5
Miles from Home (y)	45	112	178	238	305

State the average rate of change for the distance traveled between hours 2 and 4.
Include appropriate units.

$$\frac{2 \text{ hours}}{112 \text{ miles}} \Rightarrow \frac{4 \text{ hours}}{238 \text{ miles}}$$

$$\Delta \text{ hours} = 4 - 2 = 2 \text{ hours}$$

$$\Delta \text{ miles} = 238 - 112 = 126 \text{ miles}$$

The Burkes went 126 miles in 2 hours

$$\frac{\text{Miles}}{\text{Hours}} = \frac{126}{2} = \frac{63}{1} = \boxed{63 \text{ miles per hour}}$$

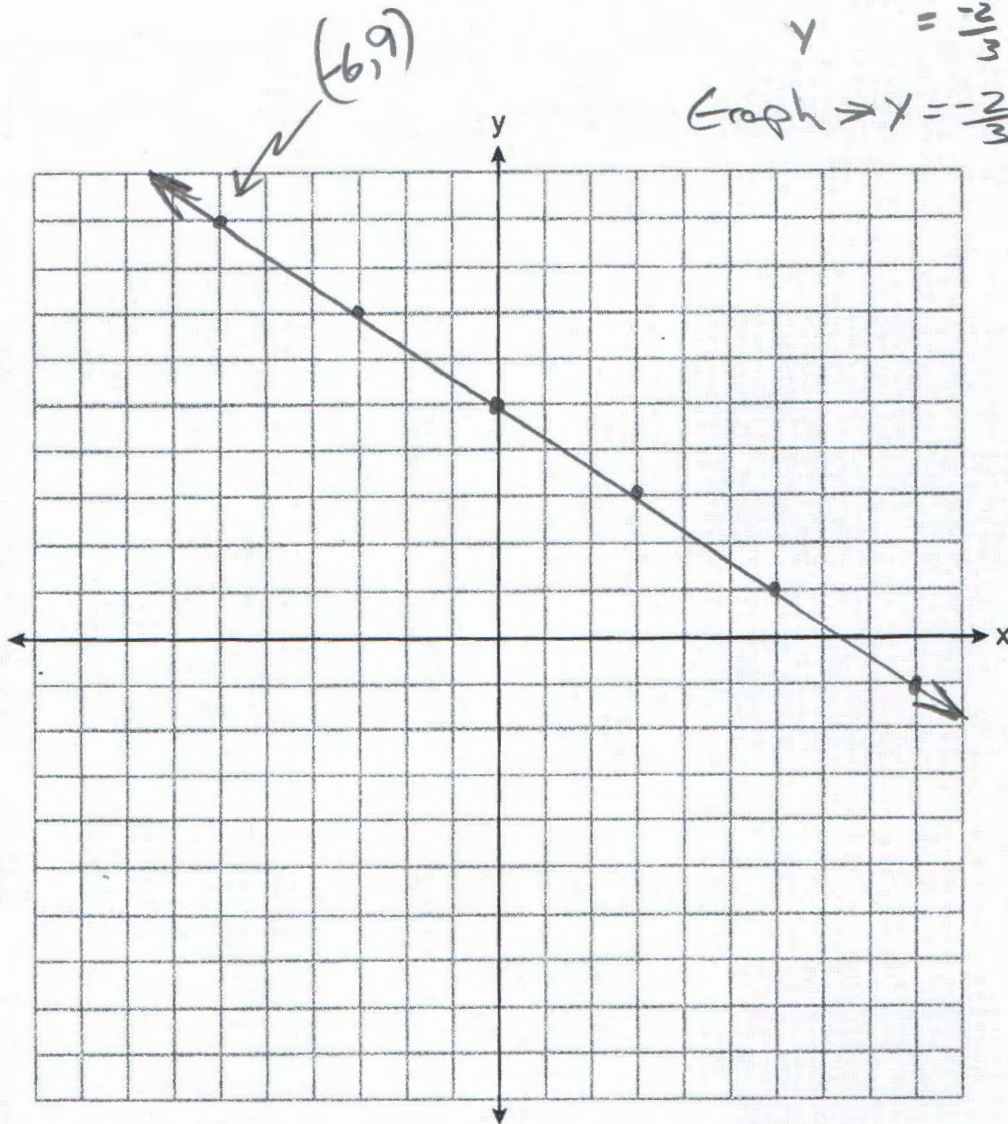
28 On the set of axes below, graph the equation $3y + 2x = 15$.

$$3y + 2x = 15$$

$$3y = -2x + 15$$

$$y = -\frac{2}{3}x + 5$$

Graph $\Rightarrow y = -\frac{2}{3}x + 5$
↑ slope ↑ y-intercept



Explain why $(-6, 9)$ is a solution to the equation.

$(-6, 9)$ is a solution because:

1) it falls on the line, and

2) it satisfies the equation $3y + 2x = 15$

29 Using the quadratic formula, solve $3x^2 - 2x - 6 = 0$ for all values of x .
Round your answers to the nearest hundredth.

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

$$3x^2 - 2x - 6 = 0$$

$$a=3 \quad b=-2 \quad c=-6$$

$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(3)(-6)}}{2(3)}$$

$$x = \frac{2 \pm \sqrt{4 + 72}}{6}$$

$$x = \frac{2 \pm \sqrt{76}}{6}$$

$$x = \frac{2 \pm 8.7178}{6}$$

$$x = \frac{2 + 8.7178}{6} = \frac{10.7178}{6} \approx \boxed{1.79}$$

$$x = \frac{2 - 8.7178}{6} = \frac{-6.7178}{6} \approx \boxed{-1.12}$$

30 The piecewise function $f(x)$ is given below.

$$f(x) = \begin{cases} 2x - 3, & x > 3 \\ -x^2 + 15, & x \leq 3 \end{cases}$$

State the value of $f(3)$.

Justify your answer.

$$f(3) = -x^2 + 15$$

$$f(3) = -(3)^2 + 15$$

$$f(3) = -9 + 15$$

$$f(3) = \boxed{6}$$

31 Express the equation $x^2 - 8x = -41$ in the form $(x - p)^2 = q$.

$$x^2 - 8x = -41$$

$$x^2 - 8x + \left(\frac{8}{2}\right)^2 = -41 + \left(\frac{8}{2}\right)^2$$

$$x^2 - 8x + (4)^2 = -41 + 4^2$$

$$x^2 - 8x + 16 = -41 + 16$$

$$(x - 4)^2 = -25$$

$$(x - p)^2 = q \quad \checkmark$$

Complete
the
square

32 Factor $36 - 4x^2$ completely.

$$36 - 4x^2$$
$$4(9 - x^2)$$
$$4(3+x)(3-x)$$

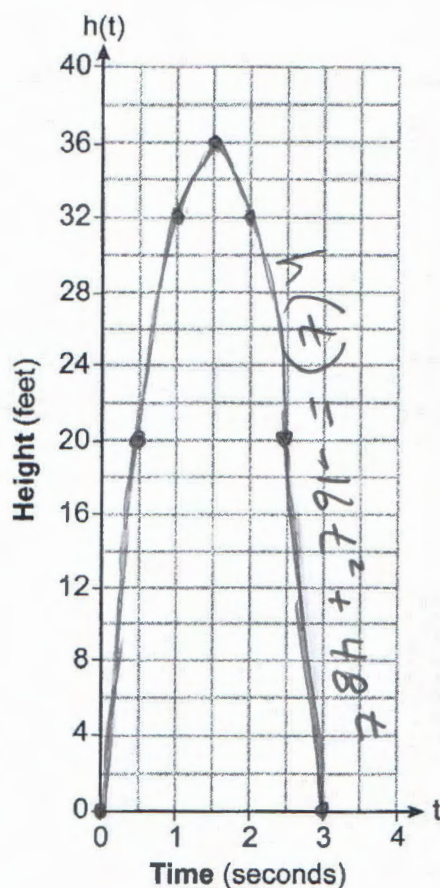
$$a^2 - b^2 = (a+b)(a-b)$$

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 While playing golf, Laura hit her ball from the ground. The height, in feet, of her golf ball can be modeled by $h(t) = -16t^2 + 48t$, where t is the time in seconds.

Graph $h(t)$ on the set of axes below.



Set table
increment
to 0.5

What is the maximum height, in feet, that the golf ball reaches on this hit?

36 feet

How many seconds does it take the golf ball to hit the ground?

3 seconds

34 The table below shows the number of SAT prep classes five students attended and the scores they received on the test.

Number of Prep Classes Attended (x)	3	1	6	7	6
Math SAT Score (y)	500	410	620	720	500

State the linear regression equation for this data set, rounding all values to the nearest hundredth.

Use graphing calculator.

$$y = 40.48x + 363.81$$

State the correlation coefficient, rounded to the nearest hundredth.

Turn diagnostics on.

$$0.84$$

State what this correlation coefficient indicates about the linear fit of the data.

There is a strong positive correlation between attendance at SAT prep classes and Math SAT scores.

$$\text{Julia} = 2x + 4$$

$$\text{Kelly} = x$$

35 Julia is 4 years older than twice Kelly's age, x . The product of their ages is 96.

Write an equation that models this situation.

$$x(2x+4) = 96$$

Determine Kelly's age algebraically.

Solution Strategy #1

$$2x^2 + 4x = 96$$

$$2x^2 + 4x - 96 = 0$$

$$a=2 \quad b=4 \quad c=-96$$

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

$$x = \frac{-4 \pm \sqrt{16 - 4(2)(-96)}}{4}$$

$$x = \frac{-4 \pm \sqrt{16 + 768}}{4}$$

Solution #2 (easier)

$$x(2x+4) = 96$$

$$2x^2 + 4x = 96$$

$$2x^2 + 4x - 96 = 0$$

$$x^2 + 2x - 48 = 0$$

$$(x-6)(x+8) = 0$$

$$x = 6$$

or

$$x = -8$$

$$x = \frac{-4 \pm \sqrt{784}}{4}$$

$$x = \frac{-4 \pm 28}{4}$$

$$x = \frac{24}{4} = 6$$

Kelly is 6 years old.

State the difference between Julia's and Kelly's ages, in years.

Julia is $(2(6) + 4)$ years old.

Julia is 16 years old.

The difference between Julia's and Kelly's ages is 10 years.

36 On the set of axes below, graph the following system of inequalities:

$$2x - y > 4$$

$$x + 3y > 6$$

$$-y > -2x + 4$$

$$3y > -x + 6$$

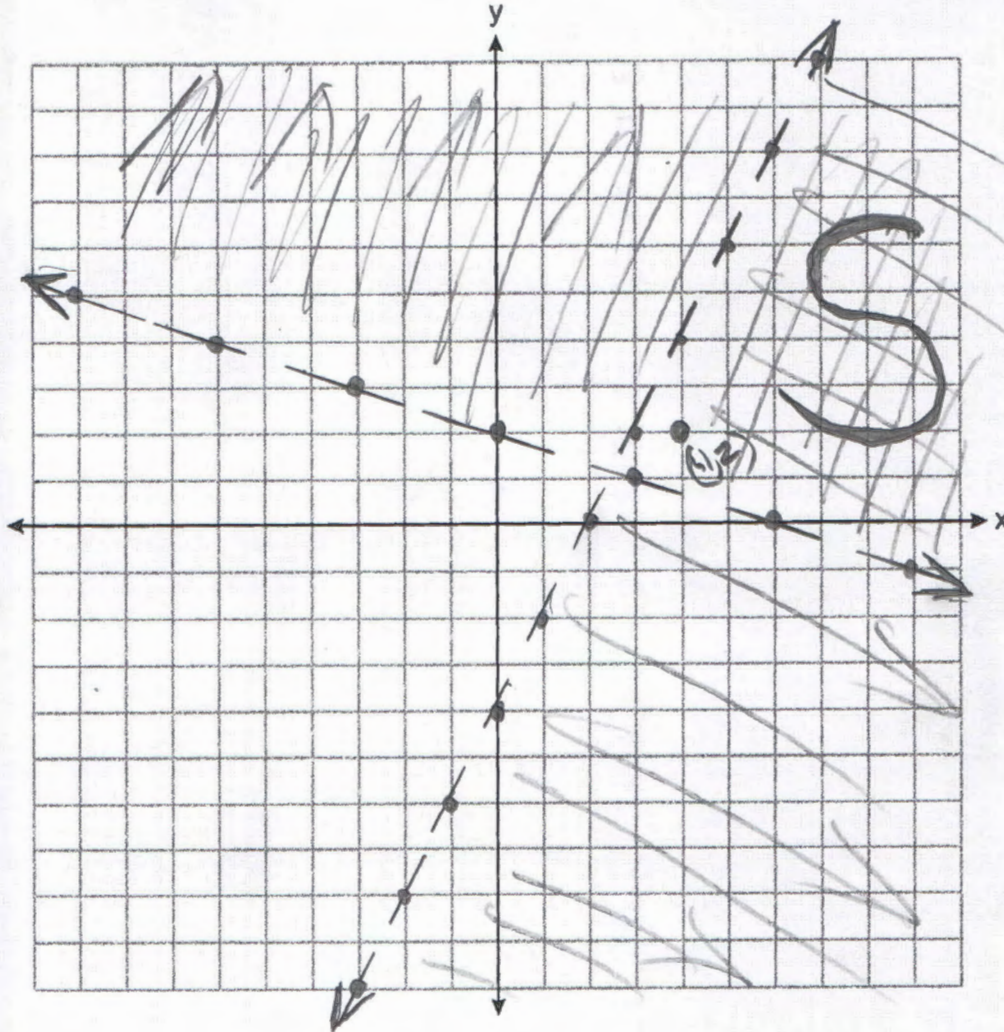
$y = mx + b$
Slope
Intercept
Form

$$y < 2x - 4$$

$$y > -\frac{1}{3}x + 2$$

Label the solution set S.

Both have dotted lines.



Is (4,2) a solution to this system? Justify your answer.

Yes

(4,2) is in the solution set of graph.
(4,2) also solves both inequalities algebraically.

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 Jim had a bag of coins. The number of nickels, n , and the number of quarters, q , totaled 28 coins. The combined value of the coins was \$4.

Write a system of equations that models this situation.

$$\begin{aligned} 5n + 25q &= 400 \\ n + q &= 28 \end{aligned}$$

Use your system of equations to algebraically determine both the number of quarters, q , and the number of nickels, n , that Jim had in the bag.

Check
 $5(15) + 25(13) = 400$
 $15 + 13 = 28$

$$\begin{aligned} 5n + 25q &= 400 \\ n + q &= 28 \\ n &= 28 - q \\ 5(28 - q) + 25q &= 400 \\ 140 - 5q + 25q &= 400 \\ 20q &= 260 \\ q &= 13 \end{aligned}$$

$$\begin{aligned} n + q &= 28 \\ n + 13 &= 28 \\ n &= 15 \end{aligned}$$

Jim had
 15 nickles and
 13 quarters

Jim was given an additional \$3.00 that was made up of equal numbers of nickels and quarters. How many of each coin was he given? Justify your answer.

$$25n + 5n = 300$$

$$30n = 300$$

$$n = 10$$

Jim received

10 more quarters and
 10 more nickels