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

ALGEBRA I

Thursday, June 15, 2023 — 1:15 to 4:15 p.m., only

Student Name Steve Watson

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]

Use this space for computations.

1 The expression $9m^2 - 100$ is equivalent to

(1) $(3m - 10)(3m + 10)$ ●
(3) $(3m - 50)(3m + 50)$
(2) $(3m - 10)(3m - 10)$
(4) $(3m - 50)(3m - 50)$

Difference of squares
$a^2 - b^2 = (a+b)(a-b)$
$9m^2 - 100 = (3m+10)(3m-10)$

2 Which expression represents an irrational number?

(1) $\sqrt{16} + \sqrt{1}$ $4+1=5$
● $\sqrt{36} + \sqrt{7}$ $6+\sqrt{7}$
(2) $\sqrt{25} + \sqrt{4}$ $5+2=7$
(4) $\sqrt{49} + \sqrt{9}$ $7+3=10$

3 Which linear equation represents a line that passes through the point $(-3,-8)$?

● $y = 2x - 2$
(3) $y = 2x + 13$
(2) $y = 2x - 8$
(4) $y = 2x - 14$

Input each equation into a graphing calculator and check table to see if $(-3,-8)$ is in table of values.

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

(1) $2x^2 - 2x + 2$
(3) $2x^4 - 2x^2 + 2$
● $2x^2 + 2x + 10$
(4) $2x^4 - 2x^2 + 10$

Change the signs and add

$5x^2 - x + 4$
$-3x^2 + 3x + 6$
$2x^2 + 2x + 10$

5 The 24th term of the sequence $-5, -11, -17, -23, \ldots$ is

(1) -149
(3) 133
(2) -143
(4) 139

x	1	2	3	4	...	24
y	-5	-11	-17	-23	...	
		-6	-6	-6		

$y = 1 - 6x$
$y = 1 - 24x$
$y = 1 - 144$
$y = \boxed{143}$

Check in graphing calculator.

Use this space for computations.

6 When completing the square for $x^2 - 18x + 77 = 0$, which equation is a correct step in this process?

(1) $(x - 9)^2 = 4$ (3) $x = \pm 13$

(2) $(x - 3)^2 = 2$ (4) $x - 9 = \pm 9$

$x^2 - 18x + 77 = 0$

$x^2 - 18x = -77$

$x^2 - 18x + \left(\frac{-18}{2}\right)^2 = -77 + \left(\frac{-18}{2}\right)^2$

$x^2 - 18x + (-9)^2 = -77 + (-9)^2$

$x^2 - 18x + 81 = -77 + 81$

$(x-9)^2 = 4$

7 Which function will have the greatest value when $x > 1$?

Let $x = 2$

(1) $g(x) = 2(5)^x$ $g(x) = 50$ (3) $h(x) = 2x^2 + 5$ $h(x) = 13$

(2) $f(x) = 2x + 5$ $f(x) = 15$ (4) $k(x) = 2x^3 + 5$ $k(x) = 21$

8 Mike uses the equation $b = 1300(2.65)^x$ to determine the growth of bacteria in a laboratory setting. The exponent represents

(1) the total number of bacteria currently present → ~~1300~~ b

(2) the percent at which the bacteria are growing → 2.65

(3) the initial amount of bacteria → 1300

(4) the number of time periods → x

9 A company ships an average of 30,000 items each week. The approximate number of items shipped each minute is calculated using the conversion

→ $\frac{\text{items}}{\text{minutes}}$

(1) $\frac{30{,}000 \text{ items}}{1 \text{ week}} \cdot \frac{7 \text{ days}}{1 \text{ week}} \cdot \frac{60 \text{ min}}{1 \text{ hr}} \cdot \frac{1 \text{ day}}{24 \text{ hrs}}$ → $\frac{}{\text{week}^2\,\text{hr}^2}$

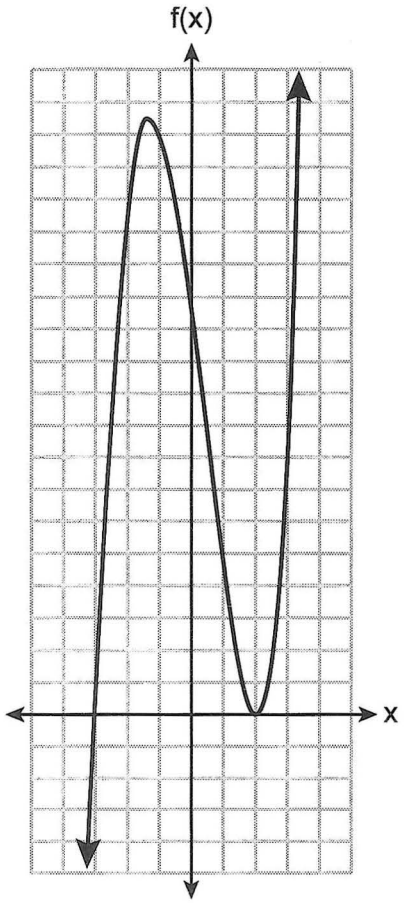
(2) $\frac{30{,}000 \text{ items}}{1 \text{ week}} \cdot \frac{1 \text{ week}}{7 \text{ days}} \cdot \frac{1 \text{ day}}{24 \text{ hrs}} \cdot \frac{1 \text{ hr}}{60 \text{ min}}$ → $\frac{30{,}000 \text{ items}}{60 \text{ min}}$

(3) $\frac{1 \text{ week}}{30{,}000 \text{ items}} \cdot \frac{1 \text{ week}}{7 \text{ days}} \cdot \frac{1 \text{ day}}{24 \text{ hrs}} \cdot \frac{1 \text{ hr}}{60 \text{ min}}$ → $\frac{}{\text{week}^2}$

(4) $\frac{1 \text{ week}}{30{,}000 \text{ items}} \cdot \frac{7 \text{ days}}{1 \text{ week}} \cdot \frac{24 \text{ hrs}}{1 \text{ day}} \cdot \frac{60 \text{ min}}{1 \text{ hr}}$ → $\frac{60 \text{ min}}{30{,}000 \text{ items}}$

10 A function is graphed below.

Use this space for computations.



Plug answer choices into graphing calculator and inspect table of values for (-3, 0), (-1, 18) and (2, 0).

A possible equation for this function is

~~(1)~~ $f(x) = (x + 2)(x - 3)$

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

~~(2)~~ $f(x) = (x - 2)(x + 3)$

~~(4)~~ $f(x) = (x - 2)(x + 3)(x - 12)$

11 If $g(x) = -x^2 - x + 5$, then $g(-4)$ is equal to

(1) -15

(3) 17

(2) -7

(4) 25

$g(x) = -x^2 - x + 5$

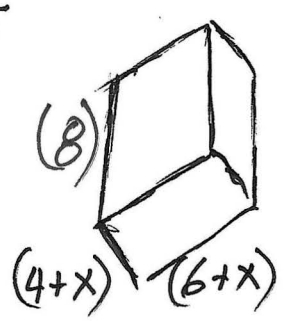
$g(-4) = -(-4)^2 - (-4) + 5$

$g(-4) = -16 + 4 + 5$

$g(-4) = -7$

12 A movie theater's popcorn box is a rectangular prism with a base that measures 6 inches by 4 inches and has a height of 8 inches. To create a larger box, both the length and the width will be increased by x inches. The height will remain the same. Which function represents the volume, $V(x)$, of the larger box?

$V = lwh$



(1) $V(x) = (6 + x)(4 + x)(8 + x)$

(2) $V(x) = (6 + x)(4 + x)(8)$

(3) $V(x) = (6 + x) + (4 + x) + (8 + x)$

(4) $V(x) = (6 + x) + (4 + x) + (8)$

Use this space for computations.

13 The expression $300(4)^{x+3}$ is equivalent to

(1) $300(4)^x(4)^3$ (3) $300(4)^x + 300(4)^3$

(2) $300(4^x)^3$ (4) $300^x(4)^3$

$(x^m)(x^n) = x^{m+n}$

14 Ashley only has 7 quarters and some dimes in her purse. She needs at least \$3.00 to pay for lunch. Which inequality could be used to determine the number of dimes, d, she needs in her purse to be able to pay for lunch?

(1) $1.75 + d \geq 3.00$ (3) $1.75 + d \leq 3.00$

(2) $1.75 + 0.10d \geq 3.00$ (4) $1.75 + 0.10d \leq 3.00$

\$1.75 .10d

$1.75 + .10d \geq 3.00$

15 The formula for the area of a trapezoid is $A = \frac{1}{2}(b_1 + b_2)h$.

The height, h, of the trapezoid may be expressed as

(1) $2A - b_1 - b_2$ (3) $\frac{1}{2}A - b_1 - b_2$

(2) $\frac{2A - b_1}{b_2}$ (4) $\frac{2A}{b_1 + b_2}$

$A = \frac{1}{2}(b_1 + b_2)h$

$2A = (b_1 + b_2)h$

$\frac{2A}{b_1 + b_2} = h$

16 The function $f(x) = |x|$ is multiplied by k to create the new function $g(x) = k|x|$. Which statement is true about the graphs of $f(x)$ and $g(x)$ if $k = \frac{1}{2}$?

(1) $g(x)$ is a reflection of $f(x)$ over the y-axis.

(2) $g(x)$ is a reflection of $f(x)$ over the x-axis.

(3) $g(x)$ is wider than $f(x)$.

(4) $g(x)$ is narrower than $f(x)$.

Input $f(x) = |x|$ and $g(x) = .5|x|$ into graphing calculator. Then inspect the graphs.

Use this space for computations.

17 Some adults were surveyed to find out if they would prefer to buy a sports utility vehicle (SUV) or a sports car. The results of the survey are summarized in the table below.

	SUV	Sports Car	Totals
Male	21	38	59
Female	135	46	181
Totals	156	84	240

84 adults preferred sports cars

38 of the 84 were males

$\frac{38}{84} = .45238$

$= 45.238\%$

Of the number of adults that preferred sports cars, approximately what percent were males?

(1) 15.8
(3) 64.4
(2) 45.2
(4) 82.6

18 The solution to $2x^2 = 72$ is

(1) {9,4}
(3) {6}
(2) {−4,9}
(●) {±6}

$2x^2 = 72$

$x^2 = 36$

$x = \sqrt{36}$

$x = \pm 6$

19 Three quadratic functions are given below.

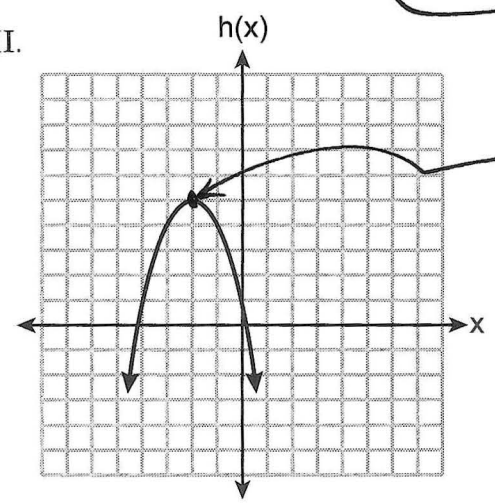
I. $f(x) = (x + 2)^2 + 5$ vertex is $(-2, 5)$ ← from graphing calculator

II.

x	−4	−3	−2	−1	0	1
g(x)	−3	2	5	5	2	−3

vertex is at $(-1.5, 5)$

III.



Only I and III have the same vertex.

Which of these functions have the same vertex?

(1) I and II, only
(●) I and III, only
(2) II and III, only
(4) I, II, and III

Use this space for computations.

20 The domain of the function $f(x) = x^2 + x - 12$ is

(1) $(-\infty,-4]$ (3) $[-4,3]$

(2) $(-\infty,\infty)$ (4) $[3,\infty)$

domain of x
range of y

21 A father makes a deal with his son regarding his weekly allowance. The first year, he agrees to pay his son a weekly allowance of \$10. Every subsequent year, the allowance is recalculated by doubling the previous year's weekly allowance and then subtracting 8. Which recursive formula could be used to calculate the son's weekly allowance in future years?

(1) $a_n = 2n - 8$

(2) $a_n = 2(n + 1) - 8$

(3) $a_1 = 10$
$a_{n+1} = 2a_n - 8$

(4) $a_1 = 10$
$a_{n+1} = 2(a_n - 8)$

n	1	2	3	4	5
$2a_n - 8$	10	20-8	24-8	32-8	48-8
a_n	10	12	16	24	40

Check

$a_{(3+1)} = 2a_3 - 8$
$a_4 = 2(16) - 8$
$a_4 = 32 - 8$
$a_4 = 24$ ✓

22 What is the solution to the inequality below?

$$4 - \frac{2}{5}x \geq \frac{1}{3}x + 15$$

(1) $x \leq 11$ (3) $x \leq -15$

(2) $x \geq 11$ (4) $x \geq -15$

$4 - \frac{2}{5}x \geq \frac{1}{3}x + 15$
M(5) $20 - 2x \geq \frac{5}{3}x + 75$
M(3) $60 - 6x \geq 5x + 225$
$-6x - 5x \geq 225 - 60$
$-11x \geq 165$
$x \leq -15$
Remember to change sign

23 Which statement is correct about the polynomial $3x^2 + 5x - 2$?

(1) It is a third-degree polynomial with a constant term of -2.

(2) It is a third-degree polynomial with a leading coefficient of 3.

(3) It is a second-degree polynomial with a constant term of 2.

(4) It is a second-degree polynomial with a leading coefficient of 3.

leading coefficient, degree, constant

24 A store manager is trying to determine if they should continue to sell a particular brand of nails. To model their profit, they use the function $p(n)$, where n is the number of boxes of these nails sold in a day. A reasonable domain for this function would be

(1) nonnegative integers (3) real numbers

(2) rational numbers (4) integers

0, 1, 2, 3, ...

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 Solve the equation algebraically for x:

$$-2.4(x + 1.4) = 6.8x - 22.68$$

$-2.4(x+1.4) = 6.8x - 22.68$

Transpose $-2.4x - 3.36 = 6.8x - 22.68$

$+2.4x$ $+22.68$

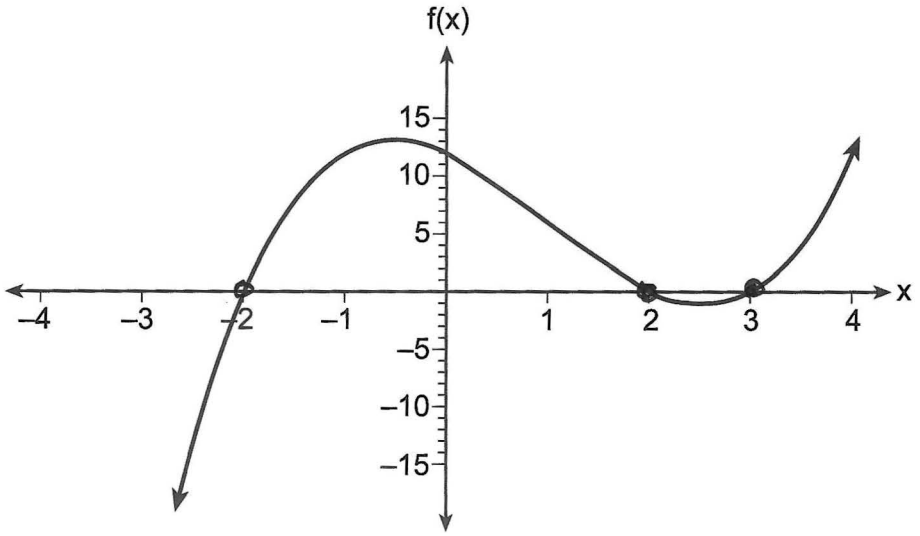
$22.68 - 3.36 = 6.8x + 2.4x$

$19.32 = 9.2x$

$\frac{19.32}{9.2} = x$

$\boxed{2.1} = x$

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



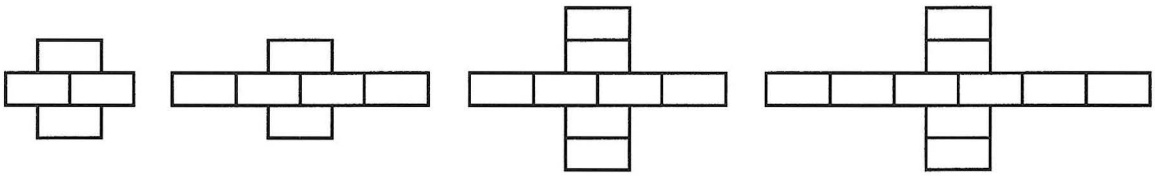
State the zeros of $f(x)$.

-2 2 3

Explain your reasoning.

The zeros of a function are the values of x when the value of y equals zero.

27 Breanna creates the pattern of blocks below in her art class.



I II III IV

4 blocks 6 blocks 8 blocks 10 blocks

A friend tells her that the number of blocks in the pattern is increasing exponentially.

Is her friend correct? No

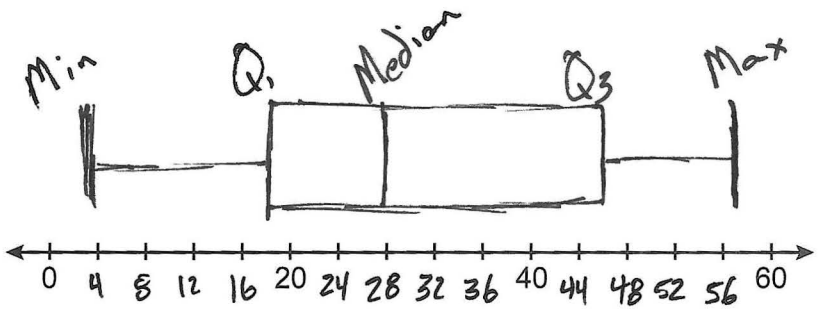
Explain your reasoning.

The number of blocks increases by a constant value.

28 The data set 20, 36, 52, 56, 24, 16, 40, 4, 28 represents the number of books purchased by nine book club members in a year.

Input values in graphing calculator and calculate 1 variable stats.

Construct a box plot for these data on the number line below.



Box plots must have 5 values

Minimum = 4

Q_1 = 18

Median = 28

Q_2 = 46

Maximum = 56

29 Given:

$$A = x + 5$$
$$B = x^2 - 18$$

Express $A^2 + B$ in standard form.

$A^2 + B$

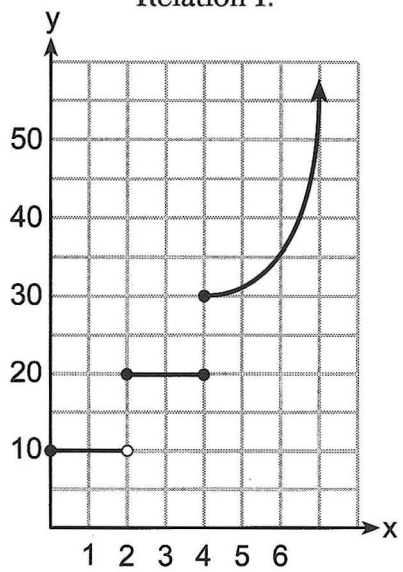
$(x+5)^2 + x^2 - 18$

$x^2+10x+25 + x^2 - 18$

$\boxed{2x^2 + 10x + 7}$

30 The two relations shown below are *not* functions.

Relation I:



Relation II:

$\{(-5,-2), (-4,0), (-2,1), (-1,3), (-4,4)\}$

Explain how you could change each relation so that they each become a function.

In relation I, change the closed dot at (4,20) to an open dot.

In relation II, remove the (-4,0) values.

31 Factor $2x^2 + 16x - 18$ completely.

$2x^2 + 16x - 18$

$2(x^2 + 8x - 9)$

$2(x+9)(x-1)$

32 Solve $3d^2 - 8d + 3 = 0$ algebraically for all values of d, rounding to the *nearest tenth*.

$$3d^2 - 8d + 3 = 0$$

$a = 3 \quad b = -8 \quad c = 3$

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

$$d = \frac{-(-8) \pm \sqrt{(-8)^2 - 4(3)(3)}}{2(3)}$$

$$d = \frac{8 \pm \sqrt{64 - 36}}{6}$$

$$d = \frac{8 \pm \sqrt{28}}{6}$$

$$d = \frac{8 + \sqrt{28}}{6} \qquad d = \frac{8 - \sqrt{28}}{6}$$

round to nearest tenth

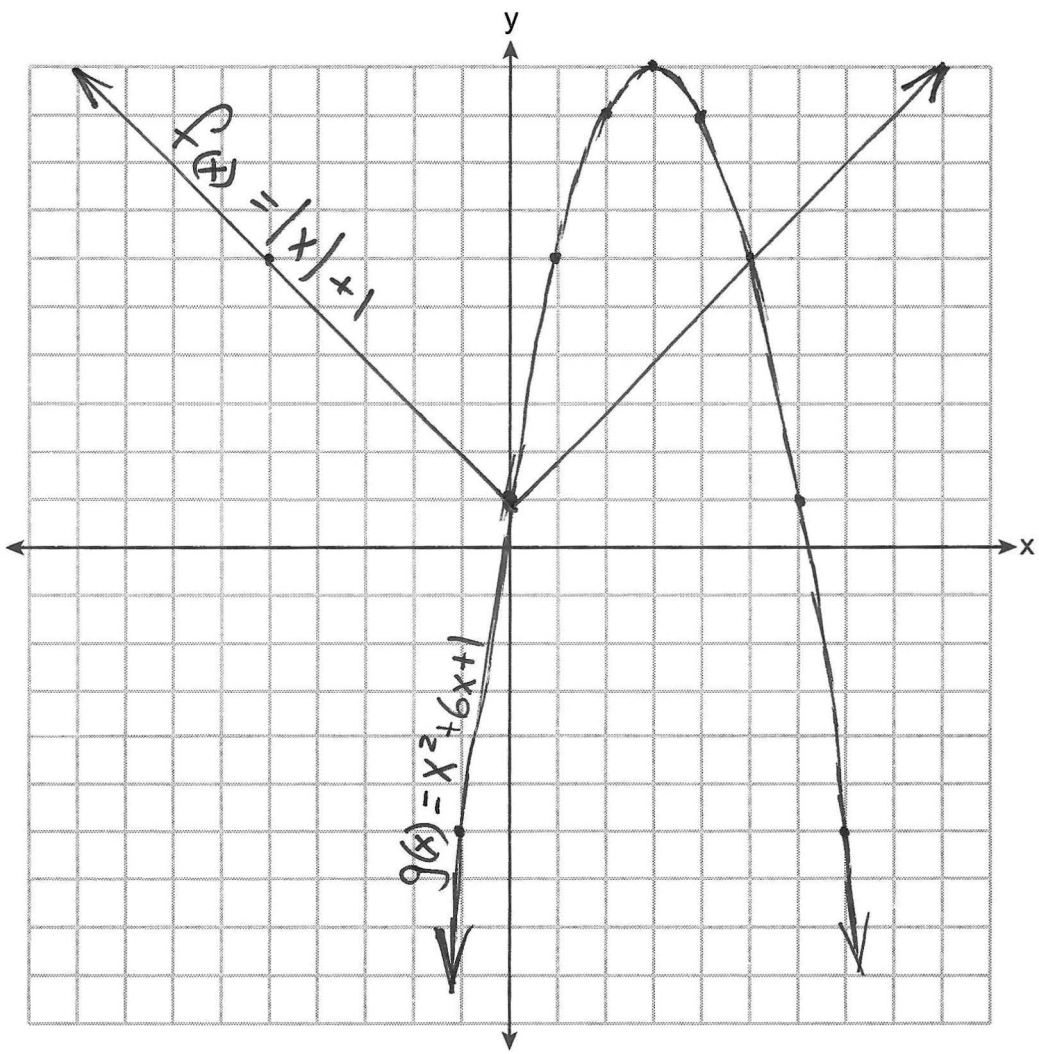
$d = 2.21525 \qquad d = .45141$

$d = \boxed{2.2} \qquad d = \boxed{.5}$

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 Graph $f(x) = |x| + 1$ and $g(x) = -x^2 + 6x + 1$ on the set of axes below.



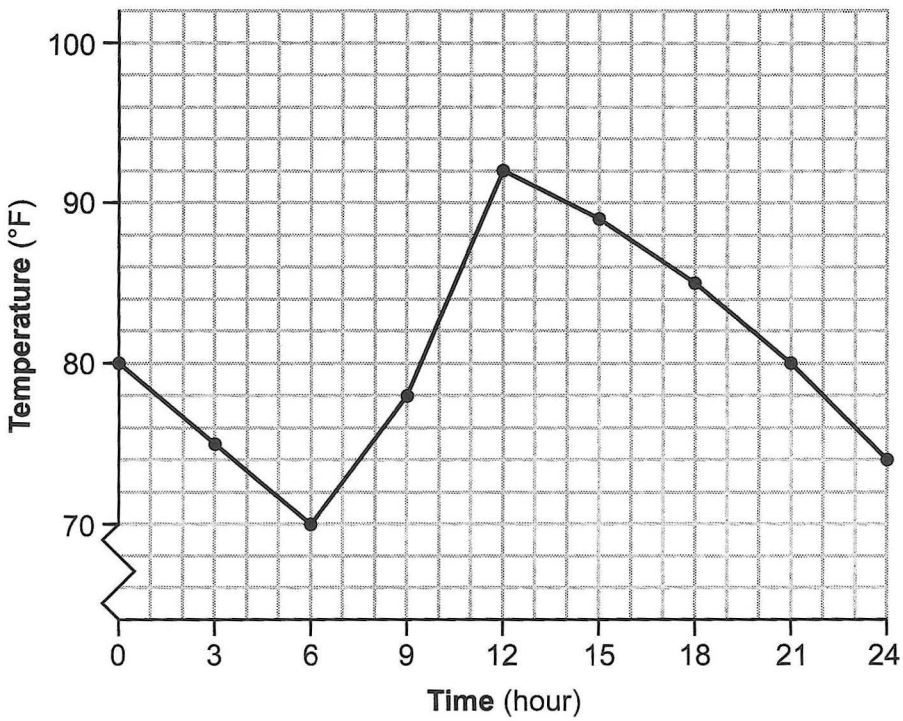
Based on your graph, determine all values of x for which $f(x) = g(x)$.

$g(x) = f(x)$ when $\boxed{x = 0}$ and $\boxed{x = 5}$.

34 Jean recorded temperatures over a 24-hour period one day in August in Syracuse, NY. Her results are shown in the table below.

Time (hour)	0	3	6	9	12	15	18	21	24
Temperature (°F)	80	75	70	78	92	89	85	80	74

Her data are modeled on the graph below.



State the entire interval over which the temperature is increasing.

$6 \leq x \leq 12$

State the three-hour interval that has the greatest rate of change in temperature.

$9 \leq x \leq 12$

State the average rate of change from hour 12 to hour 24. Explain what this means in the context of the problem.

Hour 12 (12, 92)

Hour 24 (24, 74)

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

$\frac{74 - 92}{24 - 12}$

$\frac{-18}{12} \rightarrow -1.5 \frac{\text{degrees}}{\text{hour}}$

The average rate of change is minus 1.5 degrees per hour, which means it is getting cooler.

35 Solve the following system of inequalities graphically on the set of axes below.

$x - 6 < 3y$

$\frac{1}{3}x - 2 < y$

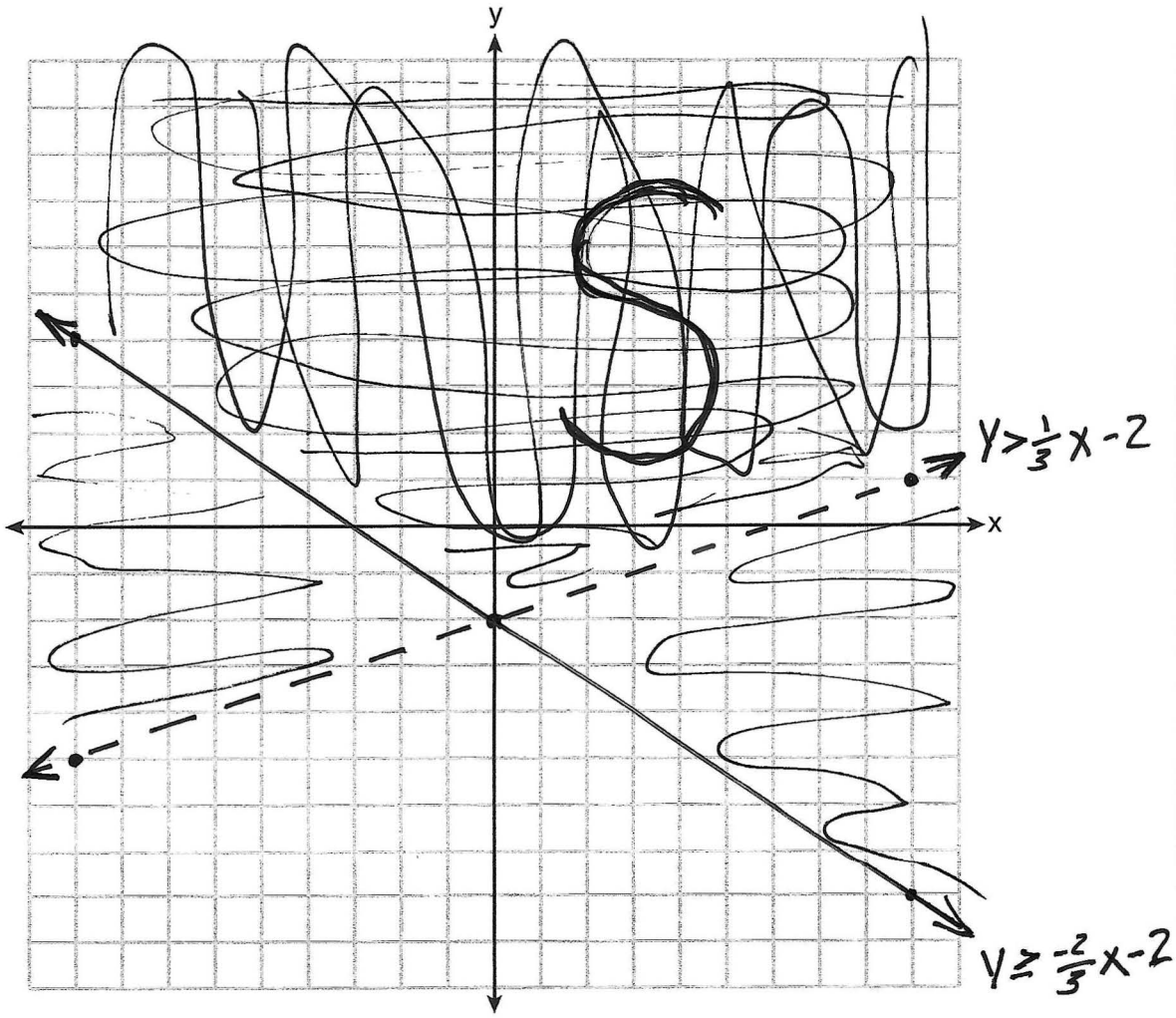
$y > \frac{1}{3}x - 2$

$2x + 3y \geq -6$
$x < 3y + 6$

$3y \geq -2x - 6$

$y \geq -\frac{2}{3}x - 2$

Label the solution set S.



Is the point $(4,-2)$ in the solution set? No

Explain your answer. $(4,-2)$ does not solve both inequalities.

$2x + 3y \geq -6$
$2(4) + 3(-2) \geq -6$
$8 - 6 \geq -6$
$2 \geq -6$ True

$x < 3y + 6$
$4 < 3(-2) + 6$
$4 < -6 + 6$
$4 < 0$ Not true

36 Suzanna collected information about a group of ponies and horses. She made a table showing the height, measured in hands (hh), and the weight, measured in pounds (lbs), of each pony and horse.

Calculate linear regression in graphing calculator. Turn diagnostics "ON" to get the correlation coefficient.

Height (hh) x	**Weight** (lbs) y
11	264
12	638
13	700
14	850
15	1000
16	1230
17	1495

Write the linear regression equation for this set of data. Round all values to the *nearest hundredth*.

$y = 184.89x - 1706.07$

State the correlation coefficient for the linear regression. Round your answer to the *nearest hundredth*.

$r = .99$

Explain what the correlation coefficient indicates about the linear fit of the data in the context of the problem.

There is a strong positive correlation between the height of a horse and the weight of a horse. Taller horses weigh more.

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 Dana went shopping for plants to put in her garden. She bought three roses and two daisies for $31.88. Later that day, she went back and bought two roses and one daisy for $18.92.

If r represents the cost of one rose and d represents the cost of one daisy, write a system of equations that models this situation.

Eq. 1 $3r + 2d = 31.88$

Eq 2 $2r + 1d = 18.92$

Use your system of equations to algebraically determine both the cost of one rose and the cost of one daisy.

Multiply Eq 1 by 2 $6r + 4d = 63.76$

Multiply Eq 2 by 3 $6r + 3d = 56.76$

Subtract Eq 2 from Eq 1 $d = 7.00$

One daisy costs $7.00

Substitute 7.00 for d in Eq 2

$2r + 7.00 = 18.92$

$2r = 11.92$

$r = 5.96$

One rose costs $5.96

Check

Eq. 1

$3(5.96) + 2(7) = 31.88$

$31.88 = 31.88$ ✓

Eq. 2

$2(5.96) + 7 = 18.92$

$18.92 = 18.92$ ✓

Question 37 is continued on the next page.

Question 37 continued

If Dana had waited until the plants were on sale, she would have paid $4.50 for each rose and $6.50 for each daisy. Determine the total amount of money she would have saved by buying all of her flowers during the sale.

Dana bought a total of 5 roses and 3 daisies.

$5(5.96) + 3(7) =$ Cost before the sale

$\$50.80 =$ Cost before the sale.

$5(4.50) + 3(6.50) =$ Cost during the sale.

$\$42.00 =$ Cost during the sale

$\$50.80 - \$42.00 = \$8.80$

Dana would have saved **$8.80** by buying the flowers during the sale.

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High School Math Reference Sheet

1 inch = 2.54 centimeters
1 meter = 39.37 inches
1 mile = 5280 feet
1 mile = 1760 yards
1 mile = 1.609 kilometers

1 kilometer = 0.62 mile
1 pound = 16 ounces
1 pound = 0.454 kilogram
1 kilogram = 2.2 pounds
1 ton = 2000 pounds

1 cup = 8 fluid ounces
1 pint = 2 cups
1 quart = 2 pints
1 gallon = 4 quarts
1 gallon = 3.785 liters
1 liter = 0.264 gallon
1 liter = 1000 cubic centimeters

Triangle	$A = \frac{1}{2}bh$
Parallelogram	$A = bh$
Circle	$A = \pi r^2$
Circle	$C = \pi d$ or $C = 2\pi r$
General Prisms	$V = Bh$
Cylinder	$V = \pi r^2 h$
Sphere	$V = \frac{4}{3}\pi r^3$
Cone	$V = \frac{1}{3}\pi r^2 h$
Pyramid	$V = \frac{1}{3}Bh$

Pythagorean Theorem	$a^2 + b^2 = c^2$
Quadratic Formula	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Arithmetic Sequence	$a_n = a_1 + (n - 1)d$
Geometric Sequence	$a_n = a_1 r^{n-1}$
Geometric Series	$S_n = \frac{a_1 - a_1 r^n}{1 - r}$ where $r \neq 1$
Radians	1 radian $= \frac{180}{\pi}$ degrees
Degrees	1 degree $= \frac{\pi}{180}$ radians
Exponential Growth/Decay	$A = A_0 e^{k(t - t_0)} + B_0$

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