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

ALGEBRA I

Wednesday, August 16, 2023 — 8:30 to 11:30 a.m., only

Student Name _____

School Name _____

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.

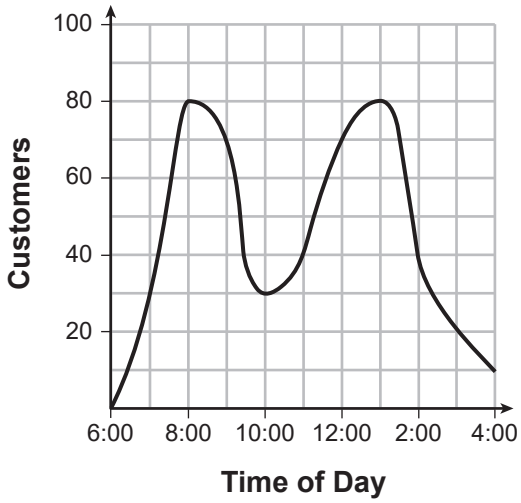
DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

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 A café owner tracks the number of customers during business hours. The graph below models the data.



Based on the graph, the café owner saw a continual

(1) increase in customers from 6:00 to 11:00

(2) increase in customers from 12:00 to 3:00

(3) decrease in customers from 1:00 to 4:00

(4) decrease in customers from 11:00 to 2:00

2 The expression $(3x^2 + 4x - 8) + 2(11 - 5x)$ is equivalent to

(1) $3x^2 - x + 5$

(2) $3x^2 - x + 14$

(3) $3x^2 - 6x + 14$

(4) $3x^2 + 14x + 14$

3 Which point is a solution to $y = x^3 - 2x$?

(1) $(-3,-21)$

(2) $(-2,10)$

(3) $(1,1)$

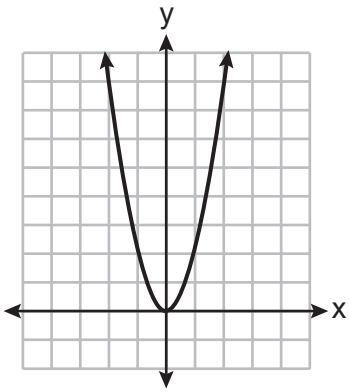
(4) $(4,2)$

Use this space for computations.

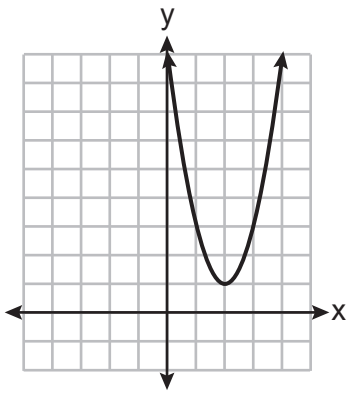
4 What is the value of x in the equation $\frac{5(2x - 4)}{3} + 9 = 14$?

(1) 1.9
(2) 3.5
(3) 5.3
(4) 8.9

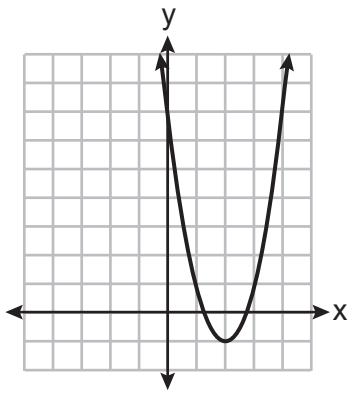
5 The graph of $y = f(x)$ is shown below.



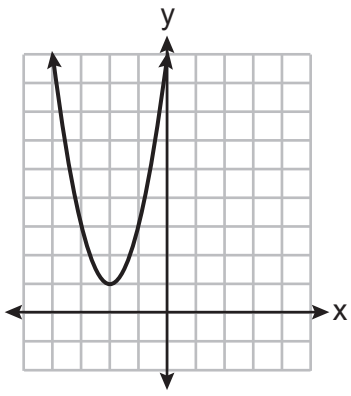
Which graph represents $y = f(x - 2) + 1$?



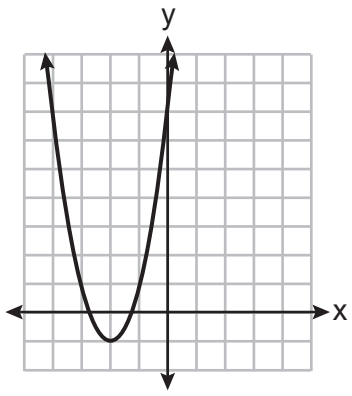
(1)



(3)



(2)



(4)

Use this space for computations.

6 The length of a rectangular flat-screen television is six inches less than twice its width, x. If the area of the television screen is 1100 square inches, which equation can be used to determine the width, in inches?

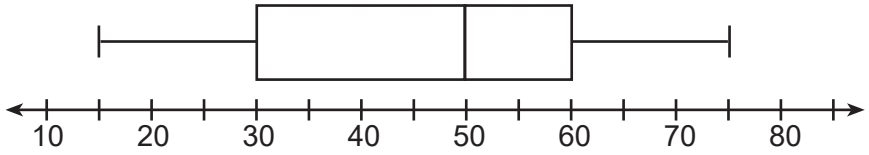
(1) $x(2x - 6) = 1100$

(2) $x(6 - 2x) = 1100$

(3) $2x + 2(2x - 6) = 1100$

(4) $2x + 2(6 - 2x) = 1100$

7 A box plot is shown below.



Which number represents the third quartile?

(1) 30

(2) 50

(3) 60

(4) 75

8 What is the product of $(2x + 7)$ and $(x - 3)$?

(1) $2x^2 - 21$

(2) $2x^2 + x - 21$

(3) $2x^2 + 4x - 21$

(4) $2x^2 + 13x - 21$

9 What is the degree of the polynomial $2x + x^3 + 5x^2$?

(1) 1

(2) 2

(3) 3

(4) 4

10 What is the solution to $-3(x - 6) > 2x - 2$?

(1) $x > 4$

(2) $x < 4$

(3) $x > -16$

(4) $x < -16$

Use this space for computations.

11 Three expressions are shown below.

I. $(x^3)^3$

II. $x^4 \cdot x^5$

III. $x^{10} \cdot x^{-1}$

Which expressions are equivalent for all positive values of x?

(1) I and II, only

(2) I and III, only

(3) II and III, only

(4) I, II, and III

12 Jim uses the equation $A = P(1 + 0.05)^t$ to find the amount of money in an account, A, of an investment, P, after t years. For this equation, which phrase describes the yearly rate of change?

(1) decreasing by 5%

(2) decreasing by 0.05%

(3) increasing by 5%

(4) increasing by 0.05%

13 What are the zeros of $m(x) = x(x^2 - 16)$?

(1) -4 and 4, only

(2) -8 and 8, only

(3) -4, 0, and 4

(4) -8, 0, and 8

14 For which function is the value of the y-intercept the *smallest*?

x	f(x)
−4	5
−2	4
0	3
2	2
4	1

(1)

x	h(x)
−1	3
0	2
1	3
2	6
3	11

(3)

$g(x) = |x| + 4$

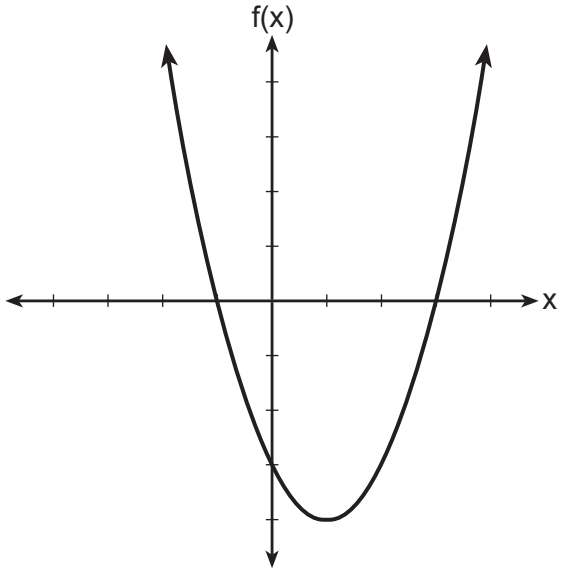
(2)

$k(x) = 5^x$

(4)

Use this space for computations.

15 The function f is graphed on the set of axes below.



What is a possible factorization of this function?

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

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

16 The range of $f(x) = x^2 + 2x - 5$ is the set of all real numbers

(1) less than or equal to -6

(2) greater than or equal to -6

(3) less than or equal to -1

(4) greater than or equal to -1

Use this space for computations.

17 Tables of values for four functions are shown below.

x	f(x)
0	6
1	7
2	10
3	15
4	22

x	h(x)
0	1
1	2
2	4
3	8
4	16

x	g(x)
0	0
1	−2
2	−2
3	0
4	4

x	j(x)
0	2
1	5
2	8
3	11
4	14

Which table best represents an exponential function?

(1) $f(x)$

(2) $g(x)$

(3) $h(x)$

(4) $j(x)$

18 If $f(x) = x^2 + 3x$, then which statement is true?

(1) $f(1) = f(-1)$

(2) $f(2) = f(-2)$

(3) $f(1) = f(2)$

(4) $f(-1) = f(-2)$

19 Jack started a new fitness program. The first day he did 10 push-ups. The program required him to increase the number of push-ups each day by doing 9 less than twice the number from the previous day. Which recursive formula correctly models Jack's new program, where n is the number of days and a_n is the number of push-ups on the nth day?

(1) $a_1 = 10$
$a_n = 2a_{n-1} - 9$

(2) $a_1 = 10$
$a_n = 9 - 2a_{n-1}$

(3) $a_1 = 10$
$a_n = 2(n - 1) - 9$

(4) $a_1 = 10$
$a_n = 9 - 2(n - 1)$

Use this space for computations.

20 Which equation is equivalent to $x^2 - 6x + 4 = 0$?

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

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

(3) $(x - 3)^2 = 6$

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

21 What is the equation of the line that passes through the point $(6,-3)$ and has a slope of $-\frac{4}{3}$?

(1) $3y = -4x + 15$

(2) $3y = -4x + 6$

(3) $-3y = 4x + 15$

(4) $-3y = 4x + 6$

22 The function $G(m)$ represents the amount of gasoline consumed by a car traveling m miles. An appropriate domain for this function would be

(1) integers

(2) rational numbers

(3) nonnegative integers

(4) nonnegative rational numbers

23 The table below shows the number of reported polio cases in Nigeria from 2006 to 2015.

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of Cases	1129	285	798	388	21	62	122	53	60	0

What is the average rate of change, to the *nearest hundredth*, of the number of reported polio cases per year in Nigeria from 2006 to 2013?

(1) -0.01

(2) -125.44

(3) -134.50

(4) -153.71

Use this space for computations.

24 Joe compared gas prices in England and New York State one day. In England, gas sold for 1.35 euros per liter, and one dollar equaled 0.622 euros. A correct way to figure out this cost, in dollars per gallon, is

(1) $\frac{1.35 \text{ euros}}{1 \text{ L}} \cdot \frac{1 \text{ L}}{0.264 \text{ gal}} \cdot \frac{\$1.00}{0.622 \text{ euros}}$

(2) $\frac{1.35 \text{ euros}}{1 \text{ L}} \cdot \frac{\$1.00}{0.622 \text{ euros}} \cdot \frac{0.264 \text{ gal}}{1 \text{ L}}$

(3) $\frac{1.35 \text{ euros}}{1 \text{ L}} \cdot \frac{1 \text{ L}}{0.264 \text{ gal}} \cdot \frac{0.622 \text{ euros}}{\$1.00}$

(4) $\frac{1.35 \text{ euros}}{1 \text{ L}} \cdot \frac{0.622 \text{ euros}}{\$1.00} \cdot \frac{0.264 \text{ gal}}{1 \text{ L}}$

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 Classify the expression $\frac{2}{\sqrt{144}} + \frac{\sqrt{169}}{3}$ as rational or irrational. Explain your reasoning.

26 Julia surveyed 150 of her classmates at City Middle School to determine their favorite animals. Of the 150 students, 46% were male.

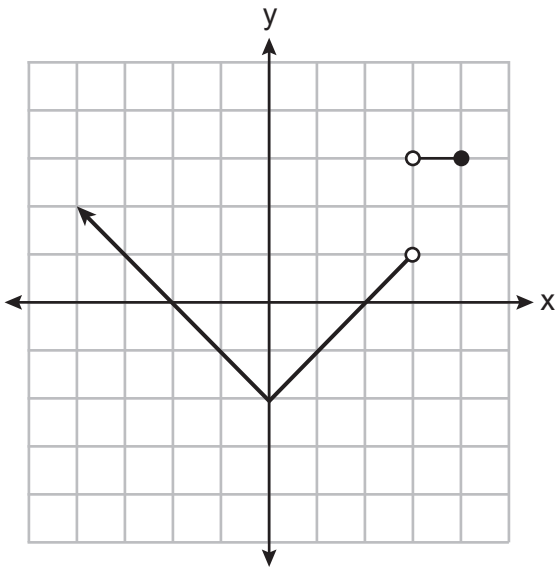
Forty-two students said their favorite animal was a horse, and $\frac{1}{3}$ of those students were female.

Of the 60 students who said dolphins were their favorite animal, 30% were male.

Using this information, complete the two-way frequency table below.

	Horse	Dolphin	Penguin	Total
Male				
Female				
Total				

27 Bryan said that the piecewise function graphed below has a domain of all real numbers.



State *two* reasons why Bryan is *incorrect*.

28 The formula $d = t\left(\frac{v_i + v_f}{2}\right)$ is used to calculate the distance, d, covered by an object in a given period of time, t.

Solve the formula for v_f, the final velocity, in terms of d, t, and v_i, the initial velocity.

29 Solve $x^2 - 9x = 36$ algebraically for all values of x.

30 Determine the common difference of the arithmetic sequence in which $a_1 = 5$ and $a_5 = 17$.

Determine the 21st term of this sequence.

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

32 Solve $x^2 + 3x - 9 = 0$ algebraically for all values of x. Round your answer to the *nearest hundredth.*

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 senior class at Hills High School is purchasing sports drinks and bottled water to sell at the school field day. At the local discount store, a case of sports drinks costs \$15.79, and a case of bottled water costs \$5.69. The senior class has \$125 to spend on the drinks.

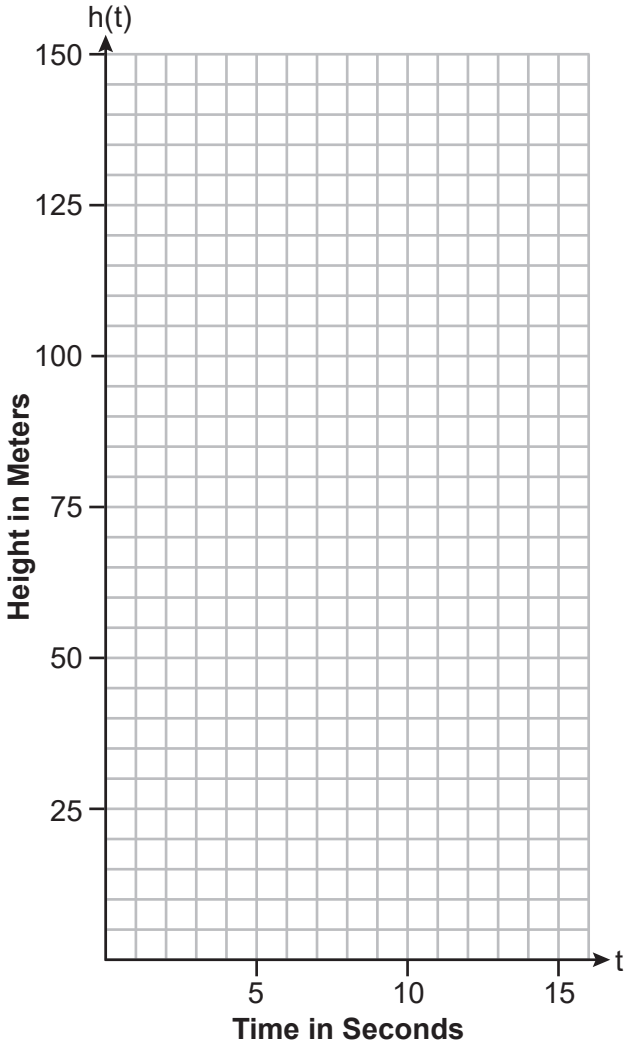
If x represents the number of cases of sports drinks and y represents the number of cases of bottled water purchased, write an inequality that models this situation.

Nine cases of bottled water are purchased for this year's field day. Use your inequality to determine algebraically the maximum number of full cases of sports drinks that can be purchased.

Explain your answer.

34 The path of a rocket is modeled by the function $h(t) = -4.9t^2 + 49t$, where h is the height, in meters, above the ground and t is the time, in seconds, after the rocket is launched.

Sketch the graph on the set of axes below.



State the vertex of this function.

Explain what the vertex means in the context of this situation.

35 A software company kept a record of their annual budget for advertising and their profit for each of the last eight years. These data are shown in the table below.

Annual Advertising Budget (in thousands, $) (x)	**Profit** (in millions, $) (y)
10	2.2
13	2.4
14	3.2
16	4.6
19	5.7
24	6.9
24	7.9
28	9.3

Write the linear regression equation for this set of data.

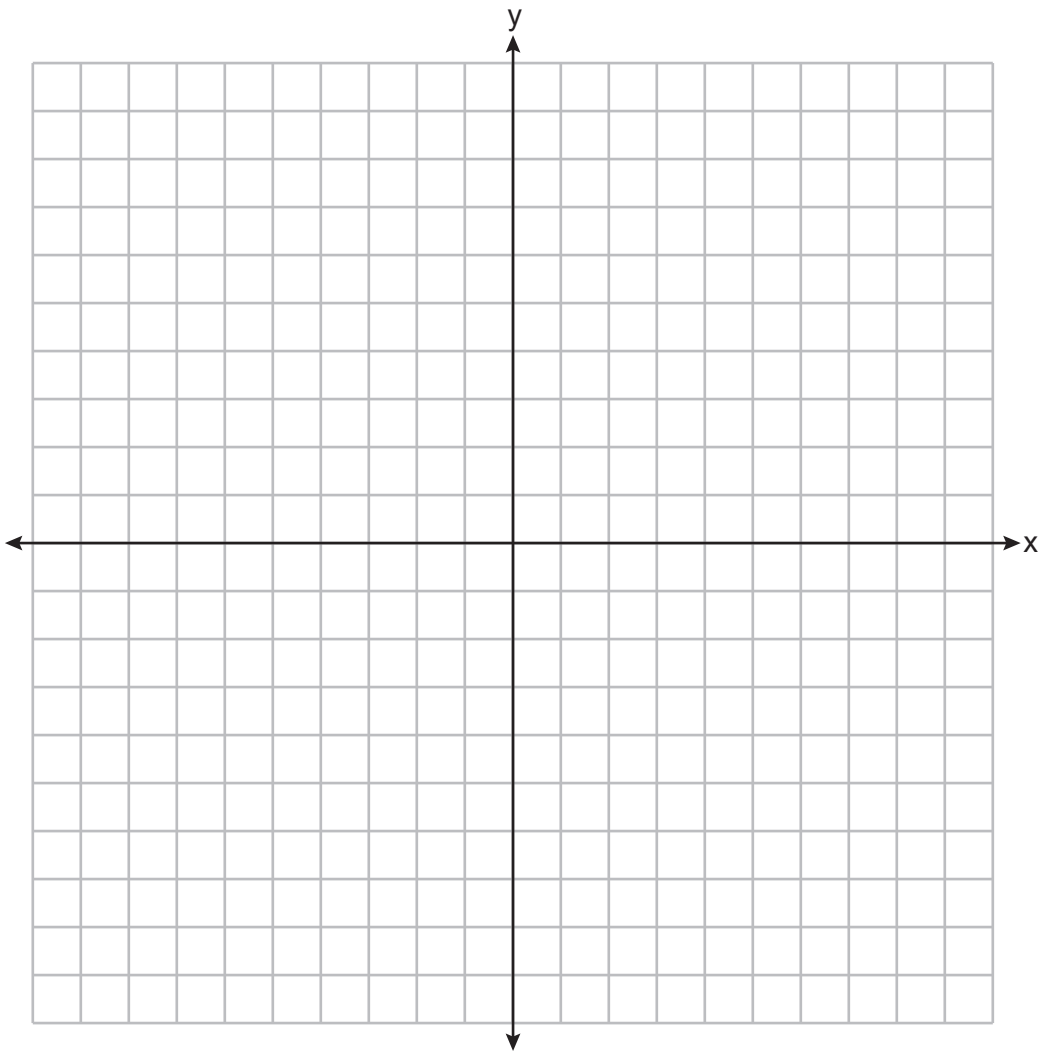
State, to the *nearest hundredth*, the correlation coefficient of these linear data.

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

36 Graph the following system of inequalities on the set of axes below:

$$-2y < 3x + 12$$
$$x \geq -3$$

Label the solution set *S*.



Allison thinks that (2,−9) is a solution to this system. Determine if Allison is correct.

Justify your answer.

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 Lydia wants to take art classes. She compares the cost at two art centers. Center *A* charges \$25 per hour and a registration fee of \$25. Center *B* charges \$15 per hour and a registration fee of \$75. Lydia plans to take x hours of classes.

Write an equation that models this situation, where *A* represents the total cost of Center *A*.

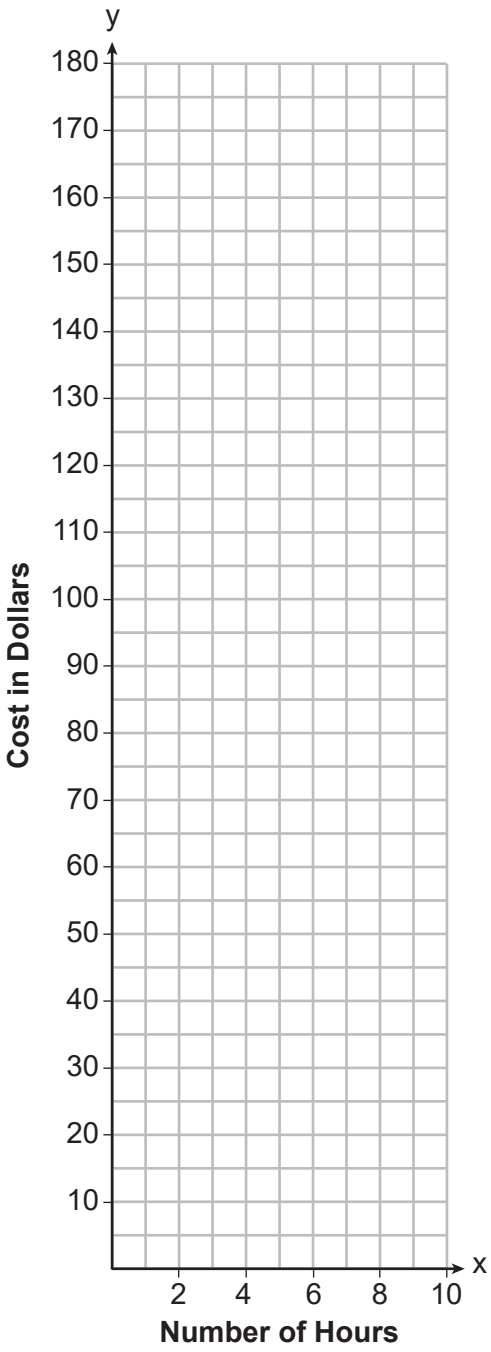
Write an equation that models this situation, where *B* represents the total cost of Center *B*.

If Lydia wants to take 10 hours of classes, use your equations to determine which center will cost *less*.

Question 37 is continued on the next page.

Question 37 continued

Graph your equations for Center *A* and Center *B* on the set of axes below.



State the number of hours of classes when the centers will cost the same.

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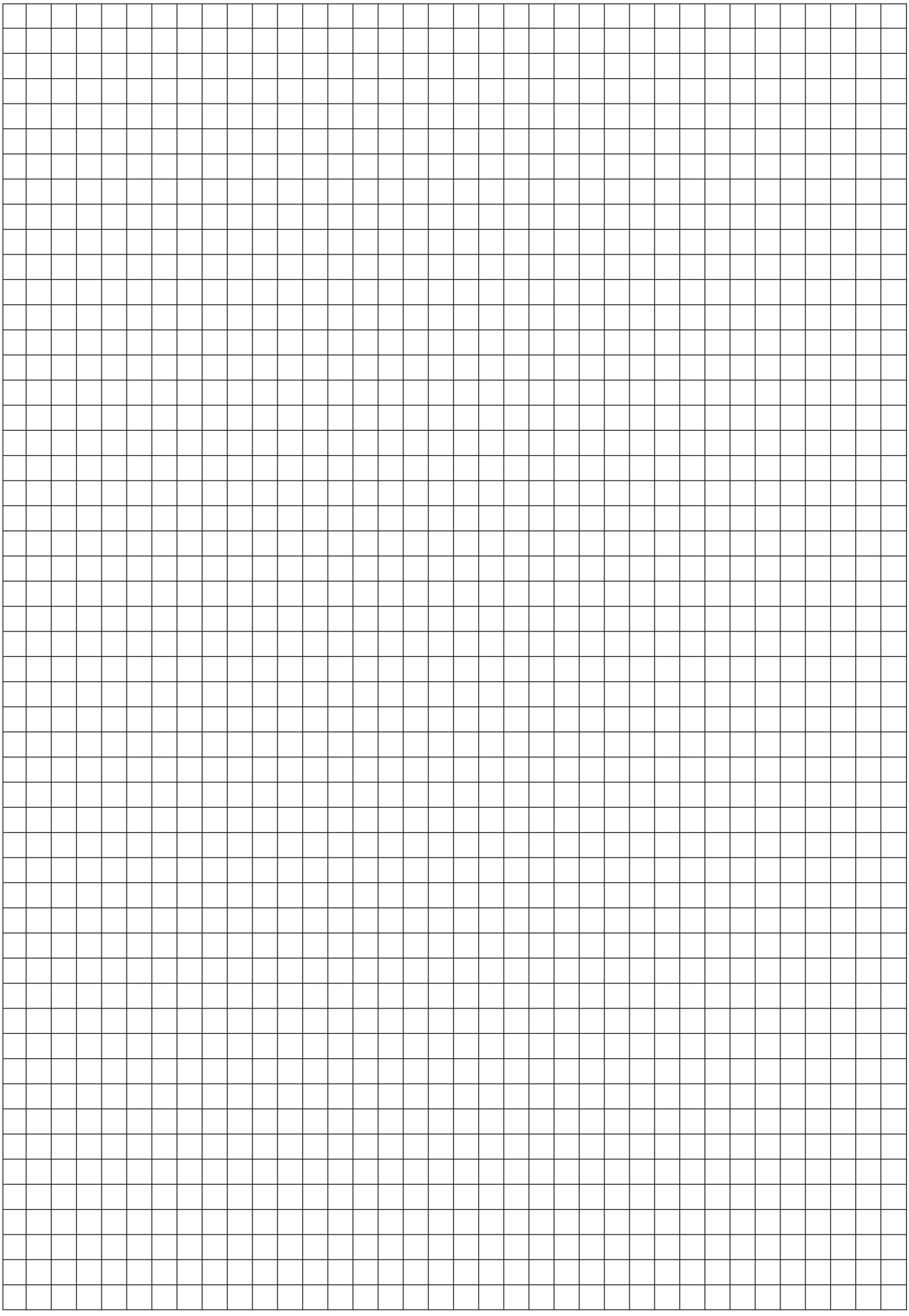

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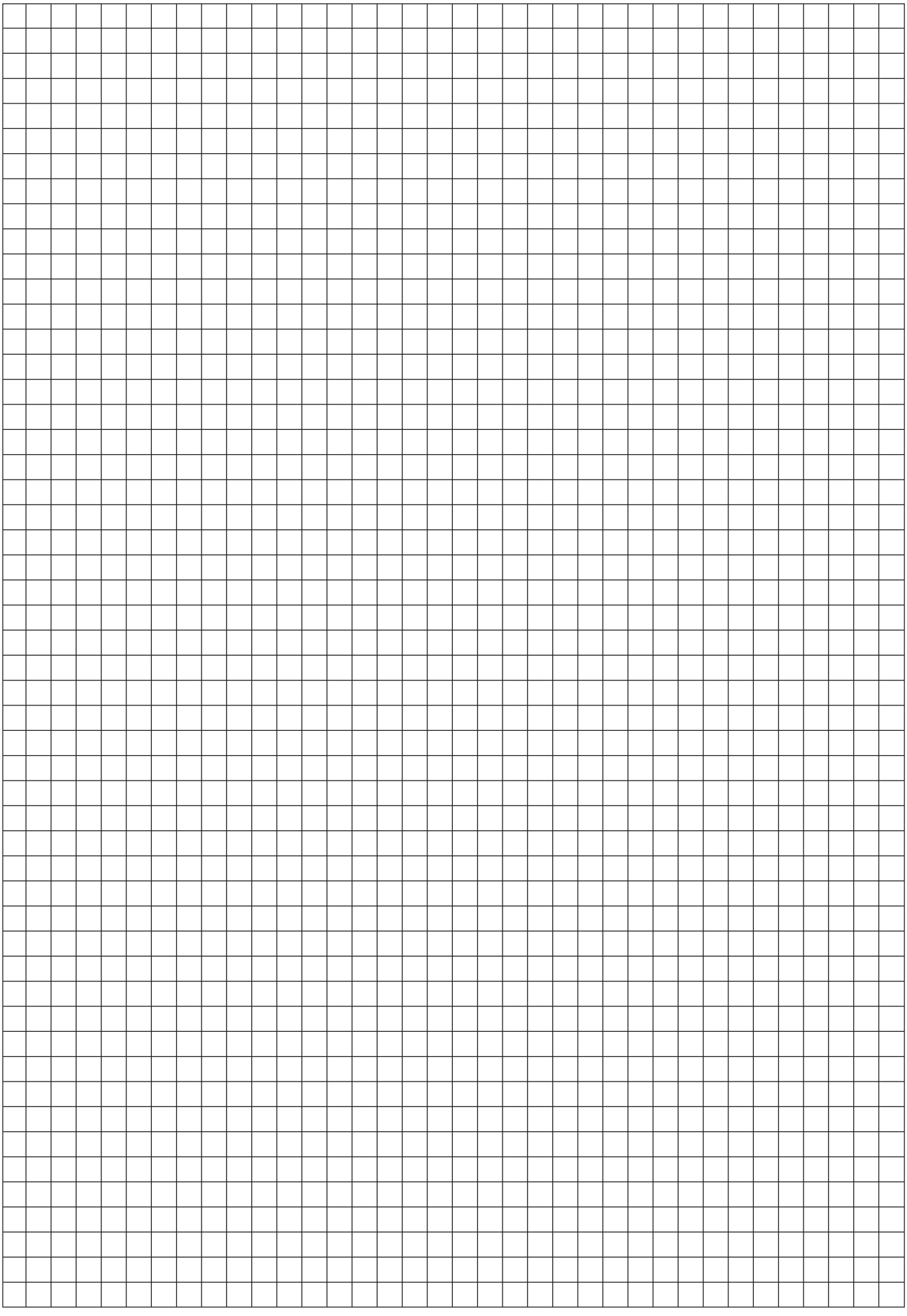

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High School Math Reference Sheet

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	$S_n = \frac{a_1 - a_1 r^n}{1 - \mathrm{r}}$ 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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