**ALGEBRA I****Thursday, August 16, 2018 — 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** The number of bacteria grown in a lab can be modeled by  $P(t) = 300 \cdot 2^{4t}$ , where  $t$  is the number of hours. Which expression is equivalent to  $P(t)$ ?

- (1)  $300 \cdot 8^t$     (3)  $300^t \cdot 2^4$
- (2)  $300 \cdot 16^t$     (4)  $300^{2t} \cdot 2^{2t}$

**2** During physical education class, Andrew recorded the exercise times in minutes and heart rates in beats per minute (bpm) of four of his classmates. Which table best represents a linear model of exercise time and heart rate?

**Student 1**

<b>Exercise Time (in minutes)</b>	<b>Heart Rate (bpm)</b>
0	60
1	65
2	70
3	75
4	80

(1)

**Student 3**

<b>Exercise Time (in minutes)</b>	<b>Heart Rate (bpm)</b>
0	58
1	65
2	70
3	75
4	79

(3)

**Student 2**

<b>Exercise Time (in minutes)</b>	<b>Heart Rate (bpm)</b>
0	62
1	70
2	83
3	88
4	90

(2)

**Student 4**

<b>Exercise Time (in minutes)</b>	<b>Heart Rate (bpm)</b>
0	62
1	65
2	66
3	73
4	75

(4)

**Use this space for  
computations.**

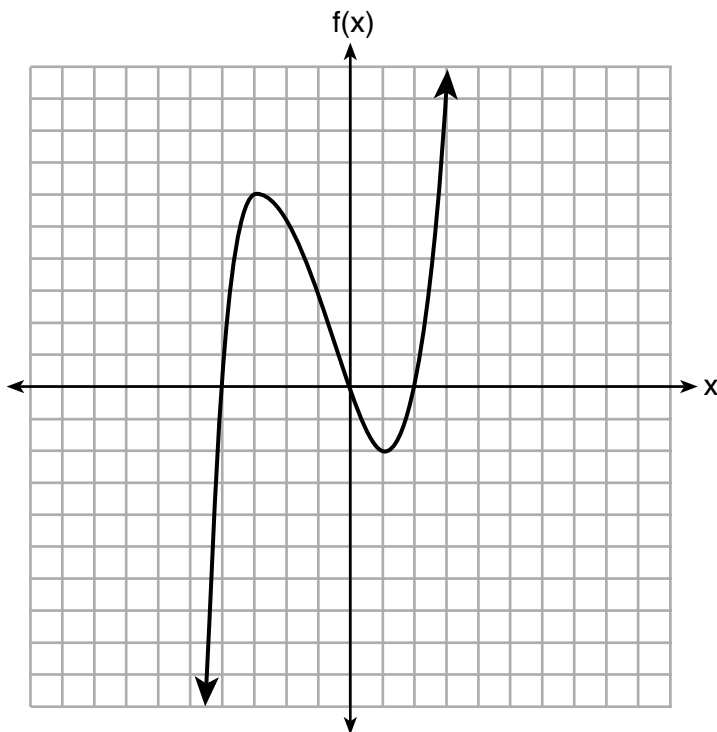
**3** David correctly factored the expression  $m^2 - 12m - 64$ .  
Which expression did he write?

- (1)  $(m - 8)(m - 8)$                       (3)  $(m - 16)(m + 4)$   
(2)  $(m - 8)(m + 8)$                       (4)  $(m + 16)(m - 4)$

**4** The solution to  $-2(1 - 4x) = 3x + 8$  is

- (1)  $\frac{6}{11}$     (3)  $-\frac{10}{7}$   
(2) 2    (4) -2

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



What is the value of  $f(-3)$ ?

- (1) 6    (3) -2  
(2) 2    (4) -4

**Use this space for computations.**

6 If the function  $f(x) = x^2$  has the domain  $\{0, 1, 4, 9\}$ , what is its range?

(1)  $\{0, 1, 2, 3\}$

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

(2)  $\{0, 1, 16, 81\}$

(4)  $\{0, -1, 1, -16, 16, -81, 81\}$

7 The expression  $4x^2 - 25$  is equivalent to

(1)  $(4x - 5)(x + 5)$

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

(2)  $(4x + 5)(x - 5)$

(4)  $(2x - 5)(2x - 5)$

8 Compared to the graph of  $f(x) = x^2$ , the graph of  $g(x) = (x - 2)^2 + 3$  is the result of translating  $f(x)$

(1) 2 units up and 3 units right

(2) 2 units down and 3 units up

(3) 2 units right and 3 units up

(4) 2 units left and 3 units right

9 Lizzy has 30 coins that total \$4.80. All of her coins are dimes,  $D$ , and quarters,  $Q$ . Which system of equations models this situation?

(1)  $D + Q = 4.80$

(3)  $D + Q = 30$

$.10D + .25Q = 30$

$.25D + .10Q = 4.80$

(2)  $D + Q = 30$

(4)  $D + Q = 4.80$

$.10D + .25Q = 4.80$

$.25D + .10Q = 30$

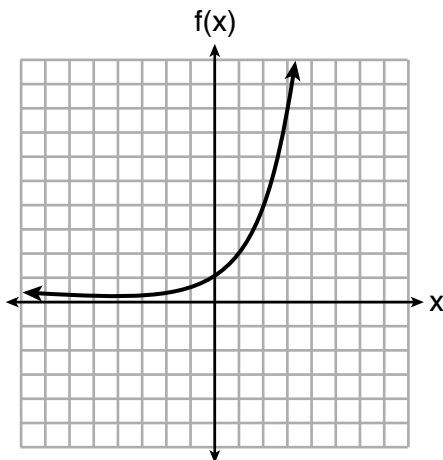
Use this space for computations.

- 10 Gretchen has \$50 that she can spend at the fair. Ride tickets cost \$1.25 each and game tickets cost \$2 each. She wants to go on a minimum of 10 rides and play at least 12 games.

Which system of inequalities represents this situation when  $r$  is the number of ride tickets purchased and  $g$  is the number of game tickets purchased?

- (1)  $1.25r + 2g < 50$   
 $r \leq 10$   
 $g > 12$
- (2)  $1.25r + 2g \leq 50$   
 $r \geq 10$   
 $g \geq 12$
- (3)  $1.25r + 2g \leq 50$   
 $r \geq 10$   
 $g > 12$
- (4)  $1.25r + 2g < 50$   
 $r \leq 10$   
 $g \geq 12$

- 11 Three functions are shown below.



$$g(x) = 3^x + 2$$

x	h(x)
-5	30
-4	14
-3	6
-2	2
-1	0
0	-1
1	-1.5
2	-1.75

Which statement is true?

- (1) The  $y$ -intercept for  $h(x)$  is greater than the  $y$ -intercept for  $f(x)$ .
- (2) The  $y$ -intercept for  $f(x)$  is greater than the  $y$ -intercept for  $g(x)$ .
- (3) The  $y$ -intercept for  $h(x)$  is greater than the  $y$ -intercept for both  $g(x)$  and  $f(x)$ .
- (4) The  $y$ -intercept for  $g(x)$  is greater than the  $y$ -intercept for both  $f(x)$  and  $h(x)$ .

Use this space for computations.

- 12 Olivia entered a baking contest. As part of the contest, she needs to demonstrate how to measure a gallon of milk if she only has a teaspoon measure. She converts the measurement using the ratios below:

$$\frac{4 \text{ quarts}}{1 \text{ gallon}} \cdot \frac{2 \text{ pints}}{1 \text{ quart}} \cdot \frac{2 \text{ cups}}{1 \text{ pint}} \cdot \frac{\frac{1}{4} \text{ cup}}{4 \text{ tablespoons}} \cdot \frac{3 \text{ teaspoons}}{1 \text{ tablespoon}}$$

Which ratio is *incorrectly* written in Olivia's conversion?

- (1)  $\frac{4 \text{ quarts}}{1 \text{ gallon}}$                       (3)  $\frac{\frac{1}{4} \text{ cup}}{4 \text{ tablespoons}}$
- (2)  $\frac{2 \text{ pints}}{1 \text{ quart}}$                       (4)  $\frac{3 \text{ teaspoons}}{1 \text{ tablespoon}}$

- 13 If  $y = 3x^3 + x^2 - 5$  and  $z = x^2 - 12$ , which polynomial is equivalent to  $2(y + z)$ ?

- (1)  $6x^3 + 4x^2 - 34$                       (3)  $6x^3 + 3x^2 - 22$
- (2)  $6x^3 + 3x^2 - 17$                       (4)  $6x^3 + 2x^2 - 17$

- 14 An outdoor club conducted a survey of its members. The members were asked to state their preference between skiing and snowboarding. Each member had to pick one. Of the 60 males, 45 stated they preferred to snowboard. Twenty-two of the 60 females preferred to ski. What is the relative frequency that a male prefers to ski?

- (1) 0.125                      (3)  $\overline{0.333}$
- (2) 0.25                      (4)  $\overline{0.405}$

Use this space for  
computations.

15 When the function  $g(x) = \begin{cases} 5x, & x \leq 3 \\ x^2 + 4, & x > 3 \end{cases}$  is graphed correctly, how should the points be drawn on the graph for an  $x$ -value of 3?

- (1) open circles at (3,15) and (3,13)
- (2) closed circles at (3,15) and (3,13)
- (3) an open circle at (3,15) and a closed circle at (3,13)
- (4) a closed circle at (3,15) and an open circle at (3,13)

16 If  $f(x) = 2x^2 + x - 3$ , which equation can be used to determine the zeros of the function?

- (1)  $0 = (2x - 3)(x + 1)$
- (2)  $0 = (2x + 3)(x - 1)$
- (3)  $0 = 2x(x + 1) - 3$
- (4)  $0 = 2x(x - 1) - 3(x + 1)$

17 Each day, a local dog shelter spends an average of \$2.40 on food per dog. The manager estimates the shelter's daily expenses, assuming there is at least one dog in the shelter, using the function  $E(x) = 30 + 2.40x$ .

Which statements regarding the function  $E(x)$  are correct?

- I.  $x$  represents the number of dogs at the shelter per day.
- II.  $x$  represents the number of volunteers at the shelter per day.
- III. 30 represents the shelter's total expenses per day.
- IV. 30 represents the shelter's nonfood expenses per day.

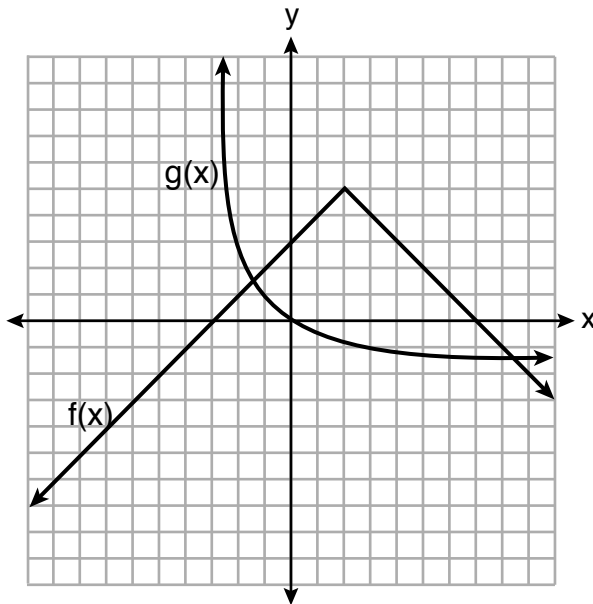
- (1) I and III
- (2) I and IV
- (3) II and III
- (4) II and IV

Use this space for  
computations.

18 Which point is *not* in the solution set of the equation  $3y + 2 = x^2 - 5x + 17$ ?

- (1)  $(-2, 10)$                       (3)  $(2, 3)$   
(2)  $(-1, 7)$                       (4)  $(5, 5)$

19 The functions  $f(x)$  and  $g(x)$  are graphed below.



Based on the graph, the solutions to the equation  $f(x) = g(x)$  are

- (1) the  $x$ -intercepts  
(2) the  $y$ -intercepts  
(3) the  $x$ -values of the points of intersection  
(4) the  $y$ -values of the points of intersection

20 For the sequence  $-27, -12, 3, 18, \dots$ , the expression that defines the  $n$ th term where  $a_1 = -27$  is

- (1)  $15 - 27n$                       (3)  $-27 + 15n$   
(2)  $15 - 27(n - 1)$               (4)  $-27 + 15(n - 1)$



**Use this space for  
computations.**

**21** The data obtained from a random sample of track athletes showed that as the foot size of the athlete decreased, the average running speed decreased. Which statement is best supported by the data?

- (1) Smaller foot sizes cause track athletes to run slower.
- (2) The sample of track athletes shows a causal relationship between foot size and running speed.
- (3) The sample of track athletes shows a correlation between foot size and running speed.
- (4) There is no correlation between foot size and running speed in track athletes.

**22** Which system of equations will yield the same solution as the system below?

$$\begin{aligned}x - y &= 3 \\ 2x - 3y &= -1\end{aligned}$$

- (1)  $-2x - 2y = -6$   
 $2x - 3y = -1$
- (2)  $-2x + 2y = 3$   
 $2x - 3y = -1$
- (3)  $2x - 2y = 6$   
 $2x - 3y = -1$
- (4)  $3x + 3y = 9$   
 $2x - 3y = -1$

**23** Which of the three situations given below is best modeled by an exponential function?

- I. A bacteria culture doubles in size every day.
- II. A plant grows by 1 inch every 4 days.
- III. The population of a town declines by 5% every 3 years.

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

**24** The length, width, and height of a rectangular box are represented by  $2x$ ,  $3x + 1$ , and  $5x - 6$ , respectively. When the volume is expressed as a polynomial in standard form, what is the coefficient of the 2nd term?

- (1)  $-13$
  - (2)  $13$
  - (3)  $-26$
  - (4)  $26$
-

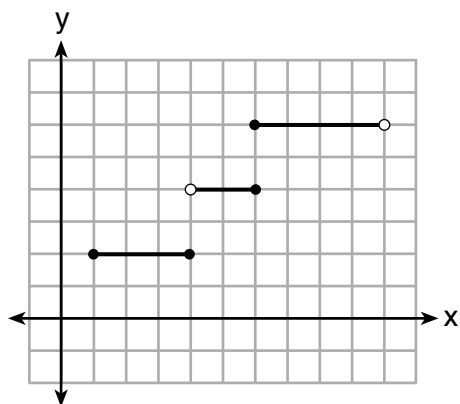
## Part II

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 Explain how to determine the zeros of  $f(x) = (x + 3)(x - 1)(x - 8)$ .

State the zeros of the function.

26 Four relations are shown below.



I

$$\{(1,2), (2,5), (3,8), (2,-5), (1,-2)\}$$

II

x	y
-4	1
0	3
4	5
6	6

III

$$y = x^2$$

IV

State which relation(s) are functions.

Explain why the other relation(s) are *not* functions.

27 The table below represents the height of a bird above the ground during flight, with  $P(t)$  representing height in feet and  $t$  representing time in seconds.

$t$	$P(t)$
0	6.71
3	6.26
4	6
9	3.41

Calculate the average rate of change from 3 to 9 seconds, in feet per second.

**28** Is the solution to the quadratic equation written below rational or irrational? Justify your answer.

$$0 = 2x^2 + 3x - 10$$

**29** The formula for converting degrees Fahrenheit ( $F$ ) to degrees Kelvin ( $K$ ) is:

$$K = \frac{5}{9}(F + 459.67)$$

Solve for  $F$ , in terms of  $K$ .

**30** Solve the following equation by completing the square:

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

**31** The students in Mrs. Lankford's 4th and 6th period Algebra classes took the same test. The results of the scores are shown in the following table:

	$\bar{x}$	$\sigma_x$	n	min	$Q_1$	med	$Q_3$	max
<b>4th Period</b>	77.75	10.79	20	58	69	76.5	87.5	96
<b>6th Period</b>	78.4	9.83	20	59	71.5	78	88	96

Based on these data, which class has the largest spread of test scores? Explain how you arrived at your answer.



**32** Write the first five terms of the recursive sequence defined below.

$$a_1 = 0$$

$$a_n = 2(a_{n-1})^2 - 1, \text{ for } n > 1$$

### 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** Sarah wants to buy a snowboard that has a total cost of \$580, including tax. She has already saved \$135 for it. At the end of each week, she is paid \$96 for babysitting and is going to save three-quarters of that for the snowboard.

Write an inequality that can be used to determine the *minimum* number of weeks Sarah needs to babysit to have enough money to purchase the snowboard.

Determine and state the *minimum* number of full weeks Sarah needs to babysit to have enough money to purchase this snowboard.

**34** A car was purchased for \$25,000. Research shows that the car has an average yearly depreciation rate of 18.5%.

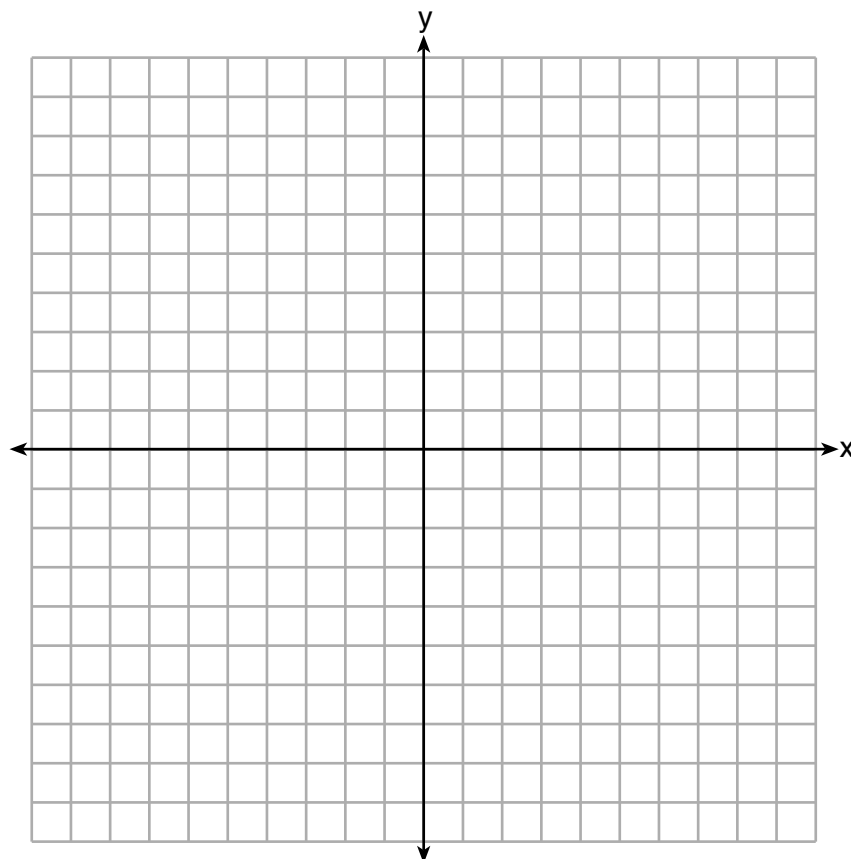
Create a function that will determine the value,  $V(t)$ , of the car  $t$  years after purchase.

Determine, to the *nearest cent*, how much the car will depreciate from year 3 to year 4.

**35** Graph the following system of inequalities on the set of axes below:

$$2y \geq 3x - 16$$

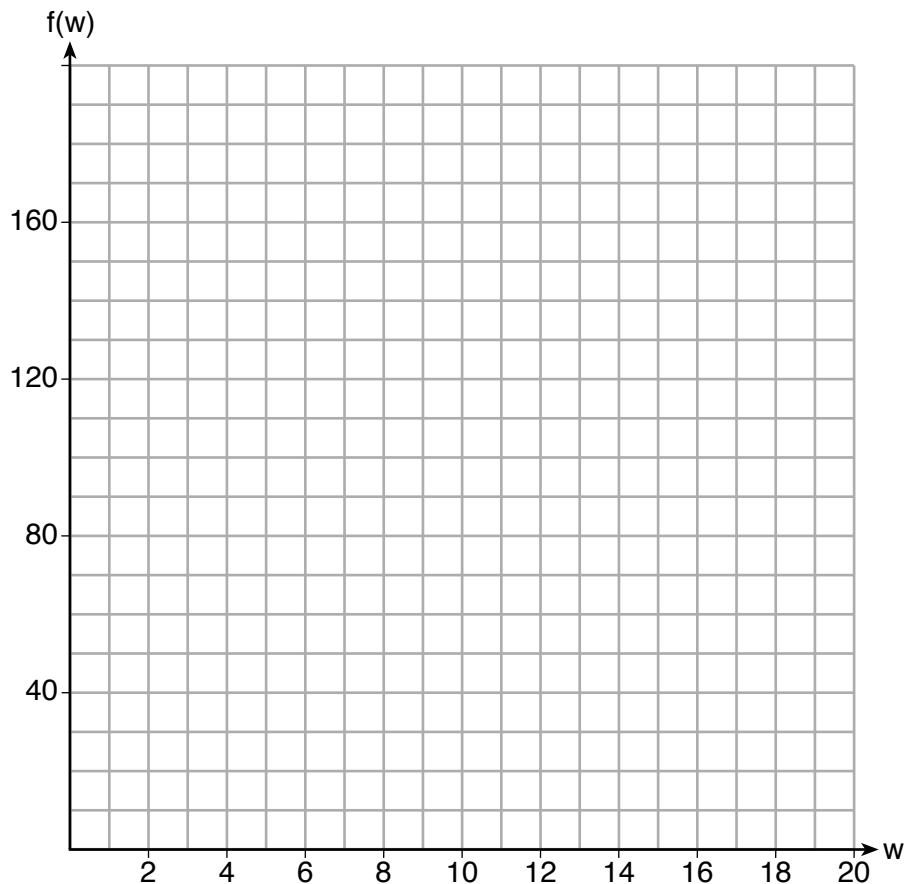
$$y + 2x > -5$$



Based upon your graph, explain why  $(6,1)$  is a solution to this system and why  $(-6,7)$  is *not* a solution to this system.

**36** Paul plans to have a rectangular garden adjacent to his garage. He will use 36 feet of fence to enclose three sides of the garden. The area of the garden, in square feet, can be modeled by  $f(w) = w(36 - 2w)$ , where  $w$  is the width in feet.

On the set of axes below, sketch the graph of  $f(w)$ .



Explain the meaning of the vertex in the context of the problem.

## 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** At the present time, Mrs. Bee's age is six years more than four times her son's age. Three years ago, she was seven times as old as her son was then.

If  $b$  represents Mrs. Bee's age now and  $s$  represents her son's age now, write a system of equations that could be used to model this scenario.

Use this system of equations to determine, algebraically, the ages of both Mrs. Bee and her son now.

Determine how many years from now Mrs. Bee will be three times as old as her son will be then.



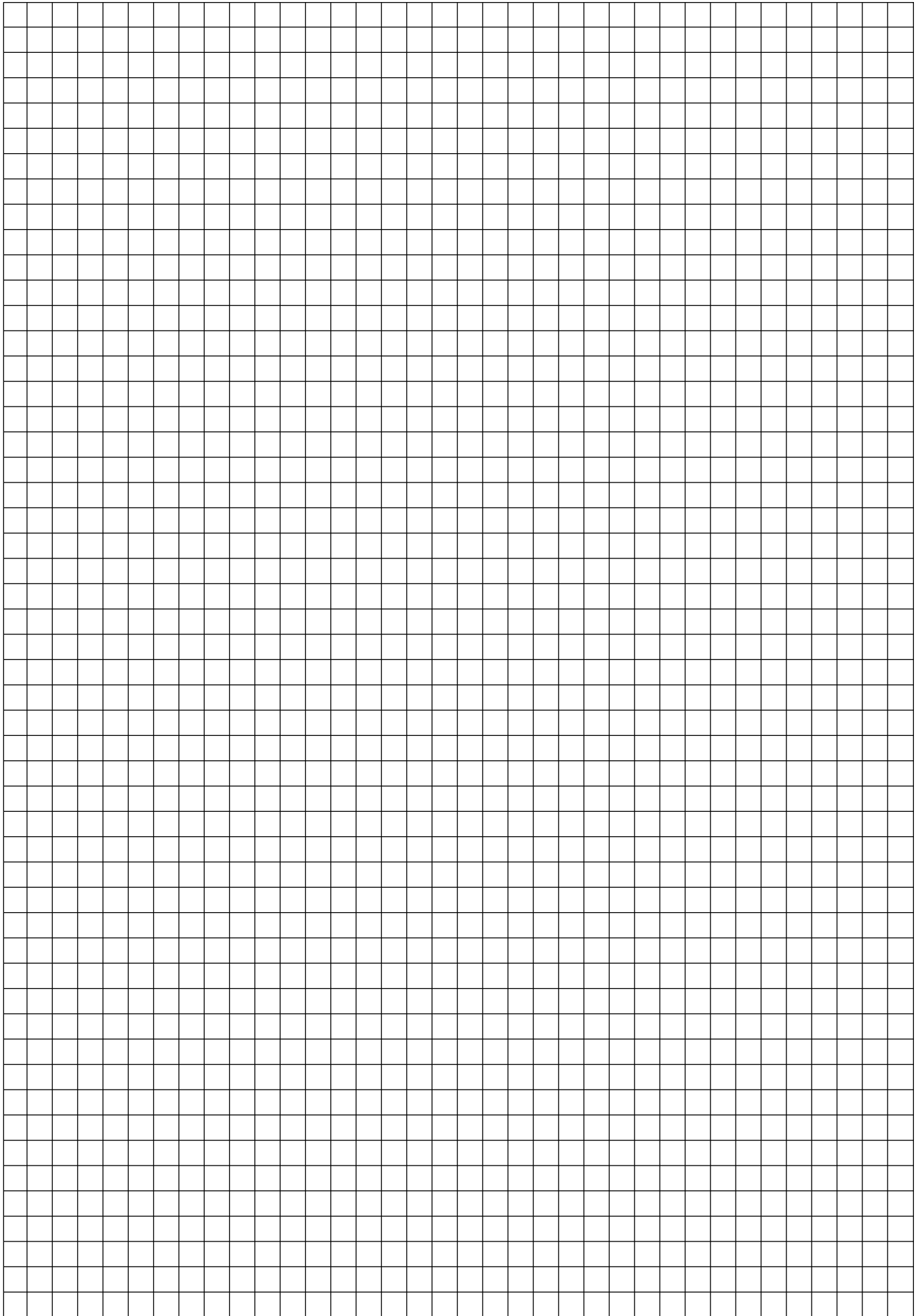




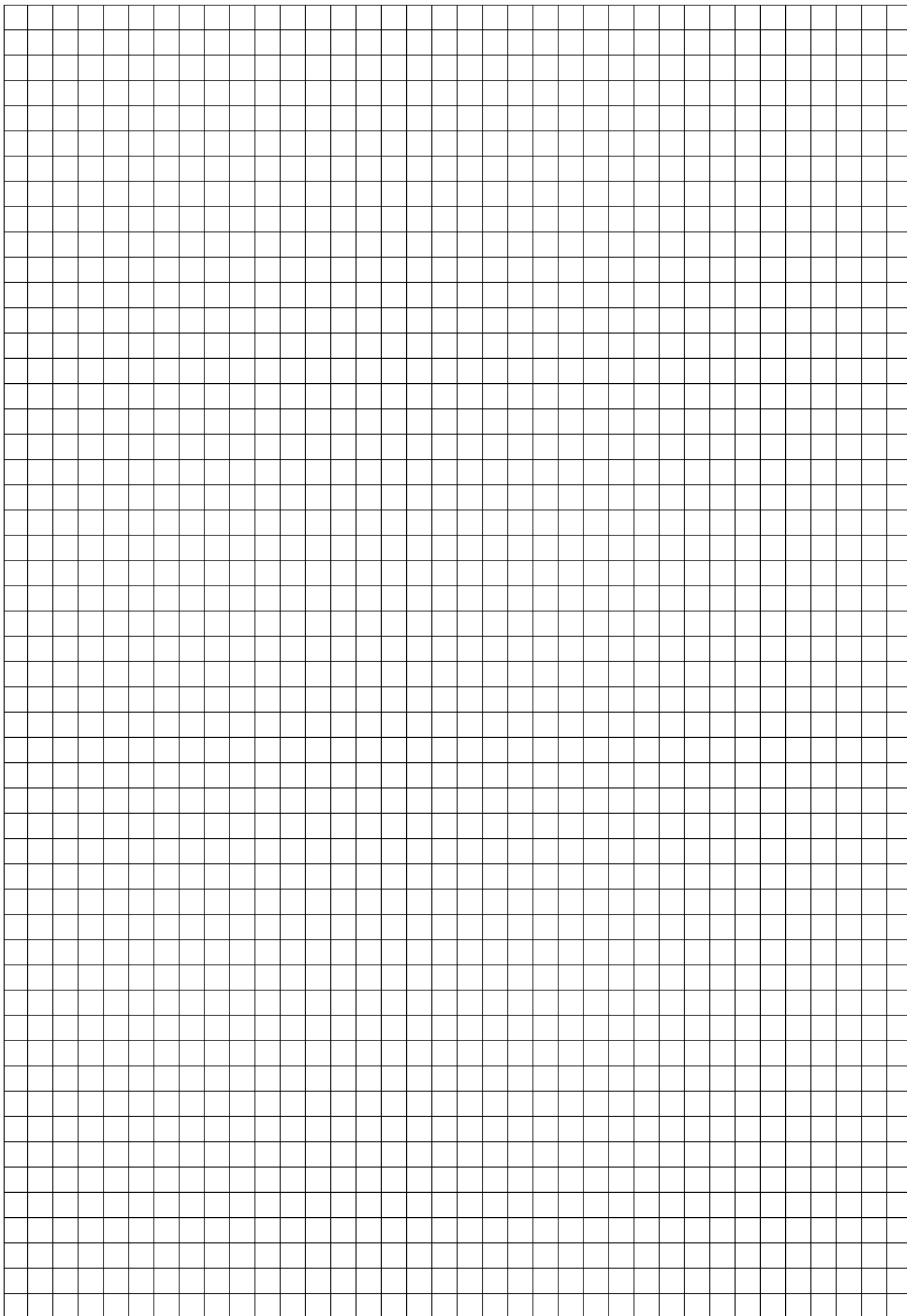
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## High School Math Reference Sheet

1 inch = 2.54 centimeters	1 kilometer = 0.62 mile	1 cup = 8 fluid ounces
1 meter = 39.37 inches	1 pound = 16 ounces	1 pint = 2 cups
1 mile = 5280 feet	1 pound = 0.454 kilogram	1 quart = 2 pints
1 mile = 1760 yards	1 kilogram = 2.2 pounds	1 gallon = 4 quarts
1 mile = 1.609 kilometers	1 ton = 2000 pounds	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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