**ALGEBRA I**

Wednesday, August 16, 2017 — 8:30 to 11:30 a.m., only

Student Name Mr. SibolSchool Name JMAP

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 A part of Jennifer's work to solve the equation $2(6x^2 - 3) = 11x^2 - x$ is shown below.

$$\text{Given: } 2(6x^2 - 3) = 11x^2 - x$$

$$\text{Step 1: } 12x^2 - 6 = 11x^2 - x$$

Which property justifies her first step?

- (1) identity property of multiplication
- (2) multiplication property of equality
- (3) commutative property of multiplication
- (4) distributive property of multiplication over subtraction

Use this space for computations.

- 2 Which value of x results in equal outputs for $j(x) = 3x - 2$ and $b(x) = |x + 2|$?

- (1) -2
- (2) 2
- (3) $\frac{2}{3}$
- (4) 4

$$\begin{aligned}x + 2 &= 3x - 2 \\ 4 &= 2x \\ 2 &= x\end{aligned}$$

- 3 The expression $49x^2 - 36$ is equivalent to

- (1) $(7x - 6)^2$
- (2) $(24.5x - 18)^2$
- (3) $(7x - 6)(7x + 6)$
- (4) $(24.5x - 18)(24.5x + 18)$

Use this space for computations.

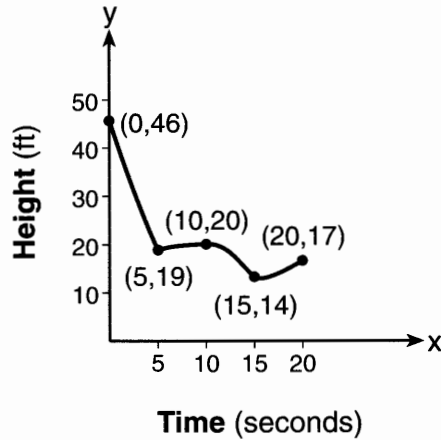
4 If $f(x) = \frac{1}{2}x^2 - \left(\frac{1}{4}x + 3\right)$, what is the value of $f(8)$?

- (1) 11
- (2) 17

(3) 27
(4) 33

$$f(8) = \frac{1}{2}(8)^2 - \left(\frac{1}{4}(8) + 3\right)$$
$$= 32 - 5 = 27$$

5 The graph below models the height of a remote-control helicopter over 20 seconds during flight.



Over which interval does the helicopter have the *slowest* average rate of change?

- (1) 0 to 5 seconds
- (2) 5 to 10 seconds
- (3) 10 to 15 seconds
- (4) 15 to 20 seconds

Smallest slope

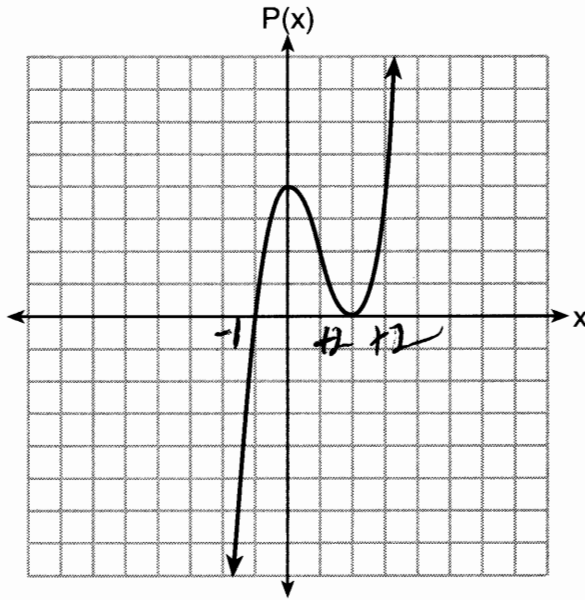
6 In the functions $f(x) = kx^2$ and $g(x) = |kx|$, k is a positive integer.

If k is replaced by $\frac{1}{2}$, which statement about these new functions is true?

- (1) The graphs of both $f(x)$ and $g(x)$ become wider.
- (2) The graph of $f(x)$ becomes narrower and the graph of $g(x)$ shifts left.
- (3) The graphs of both $f(x)$ and $g(x)$ shift vertically.
- (4) The graph of $f(x)$ shifts left and the graph of $g(x)$ becomes wider.

Use this space for
computations.

7 Wenona sketched the polynomial $P(x)$ as shown on the axes below.



Which equation could represent $P(x)$?

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

8 Which situation does *not* describe a causal relationship?

- (1) The higher the volume on a radio, the louder the sound will be.
(2) The faster a student types a research paper, the more pages the research paper will have.
(3) The shorter the time a car remains running, the less gasoline it will use.
(4) The slower the pace of a runner, the longer it will take the runner to finish the race.

9 A plumber has a set fee for a house call and charges by the hour for repairs. The total cost of her services can be modeled by $c(t) = 125t + 95$.

Which statements about this function are true?

- I. A house call fee costs \$95.
- II. The plumber charges \$125 per hour.
- III. The number of hours the job takes is represented by t .

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

10 What is the domain of the relation shown below?

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

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

11 What is the solution to the inequality $2 + \frac{4}{9}x \geq 4 + x$?

- (1) $x \leq -\frac{18}{5}$
 - (2) $x \geq -\frac{18}{5}$
 - (3) $x \leq \frac{54}{5}$
 - (4) $x \geq \frac{54}{5}$
- $$-2 \geq \frac{5}{9}x$$

$$-18 \geq 5x$$

$$\frac{-18}{5} \geq x$$

12 Konnor wants to burn 250 Calories while exercising for 45 minutes at the gym. On the treadmill, he can burn 6 Cal/min. On the stationary bike, he can burn 5 Cal/min.

If t represents the number of minutes on the treadmill and b represents the number of minutes on the stationary bike, which expression represents the number of Calories that Konnor can burn on the stationary bike?

- (1) b
- (2) $5b$
- (3) $45 - b$
- (4) $250 - 5b$

Use this space for computations.

13 Which value of x satisfies the equation $\frac{5}{6}\left(\frac{3}{8} - x\right) = 16$?

- (1) -19.575
 (2) -18.825

- (3) -16.3125
 (4) -15.6875

$$\frac{15}{48} - \frac{5}{6}x = 16$$

$$-\frac{5}{6}x = \frac{291}{16}$$

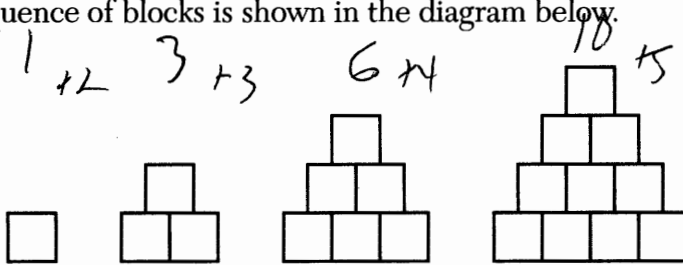
$$x = -18.825$$

14 If a population of 100 cells triples every hour, which function represents $p(t)$, the population after t hours?

- (1) $p(t) = 3(100)^t$
 (2) $p(t) = 100(3)^t$

- (3) $p(t) = 3t + 100$
 (4) $p(t) = 100t + 3$

15 A sequence of blocks is shown in the diagram below.



This sequence can be defined by the recursive function $a_1 = 1$ and $a_n = a_{n-1} + n$. Assuming the pattern continues, how many blocks will there be when $n = 7$?

- (1) 13
 (2) 21

- (3) 28
 (4) 36

16 Mario's \$15,000 car depreciates in value at a rate of 19% per year. The value, V , after t years can be modeled by the function $V = 15,000(0.81)^t$. Which function is equivalent to the original function?

- (1) $V = 15,000(0.9)^{9t}$
 (2) $V = 15,000(0.9)^{2t}$

- (3) $V = 15,000(0.9)^{\frac{t}{9}}$
 (4) $V = 15,000(0.9)^{\frac{t}{2}}$

$$(0.81)^t = ((0.9)^2)^t = (0.9)^{2t}$$

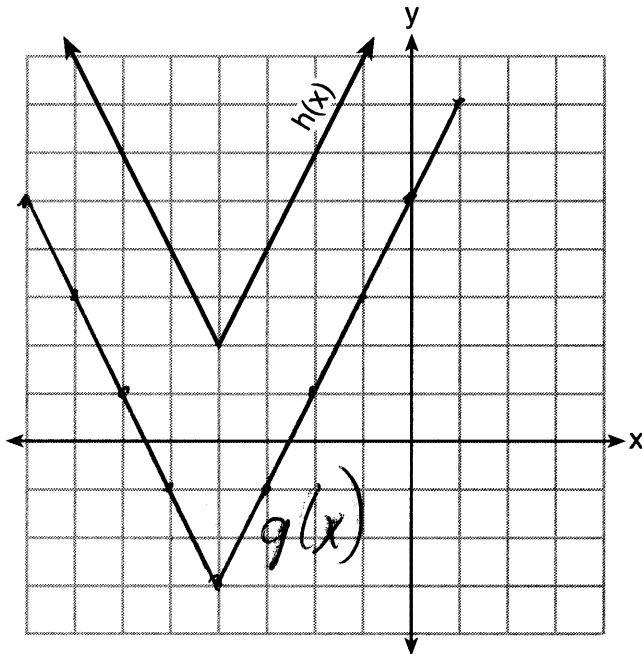
Use this space for computations.

17 The highest possible grade for a book report is 100. The teacher deducts 10 points for each day the report is late.

Which kind of function describes this situation?

- (1) linear (3) exponential growth
(2) quadratic (4) exponential decay

18 The function $h(x)$, which is graphed below, and the function $g(x) = 2|x + 4| - 3$ are given.



Which statements about these functions are true?

I. $g(x)$ has a lower minimum value than $h(x)$.

II. For all values of x , $h(x) < g(x)$.

III. For any value of x , $g(x) \neq h(x)$.

(1) I and II, only

(3) II and III, only

(2) I and III, only

(4) I, II, and III

Use this space for computations.

19 The zeros of the function $f(x) = 2x^3 + 12x - 10x^2$ are

(1) {2, 3}

(2) {-1, 6}

(3) {0, 2, 3}

(4) {0, -1, 6}

$$2x(x^2 + 6 - 5x) = 0$$
$$2x(x-3)(x-2) = 0$$

0 3 2

20 How many of the equations listed below represent the line passing through the points (2,3) and (4,-7)?

$$5x + y = 13$$

$$y + 7 = -5(x - 4)$$

$$y = -5x + 13$$

$$y - 7 = 5(x - 4)$$

$$\rightarrow y - 7 = 5x - 20$$

$$y = 5x - 13$$

(1) 1

(2) 2

(3) 3

(4) 4

21 The Ebola virus has an infection rate of 11% per day as compared to the SARS virus, which has a rate of 4% per day.

If there were one case of Ebola and 30 cases of SARS initially reported to authorities and cases are reported each day, which statement is true?

(1) At day 10 and day 53 there are more Ebola cases.

(2) At day 10 and day 53 there are more SARS cases.

(3) At day 10 there are more SARS cases, but at day 53 there are more Ebola cases.

(4) At day 10 there are more Ebola cases, but at day 53 there are more SARS cases.

$$E(10) = 1(1.11)^{10} \approx 3$$

$$E(53) = 1(1.11)^{53} \approx 252$$

$$S(10) = 30(1.04)^{10} \approx 44$$

$$S(53) = 30(1.04)^{53} \approx 239$$

Use this space for computations.

22 The results of a linear regression are shown below.

$$y = ax + b$$

$$a = -1.15785$$

$$b = 139.3171772$$

$$r = -0.896557832$$

$$r^2 = 0.8038159461$$

Which phrase best describes the relationship between x and y ?

- (1) strong negative correlation
- (2) strong positive correlation
- (3) weak negative correlation
- (4) weak positive correlation

23 Abigail's and Gina's ages are consecutive integers. Abigail is younger than Gina and Gina's age is represented by x . If the difference of the square of Gina's age and eight times Abigail's age is 17, which equation could be used to find Gina's age?

- (1) $(x + 1)^2 - 8x = 17$
- (2) $(x - 1)^2 - 8x = 17$
- (3) $x^2 - 8(x + 1) = 17$
- (4) $x^2 - 8(x - 1) = 17$

24 Which system of equations does *not* have the same solution as the system below?

$$4x + 3y = 10$$

$$-6x - 5y = -16$$

- (1) $-12x - 9y = -30$
 $12x + 10y = 32$
- (2) $20x + 15y = 50$
 $-18x - 15y = -48$
- (3) $24x + 18y = 60$
 $-24x - 20y = -64$
- (4) $40x + 30y = 100$
 ~~$36x + 30y = -96$~~

$$36x + 30y = 96$$

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 A teacher wrote the following set of numbers on the board:

$$a = \sqrt{20} \quad b = 2.5 \quad c = \sqrt{225}$$

Explain why $a + b$ is irrational, but $b + c$ is rational.

$a + b$ is irrational because it cannot be written as the ratio of two integers.

$b + c$ is rational because it can be written as the ratio of two numbers, $\frac{35}{2}$

26 Determine and state whether the sequence 1, 3, 9, 27, ... displays exponential behavior. Explain how you arrived at your decision.

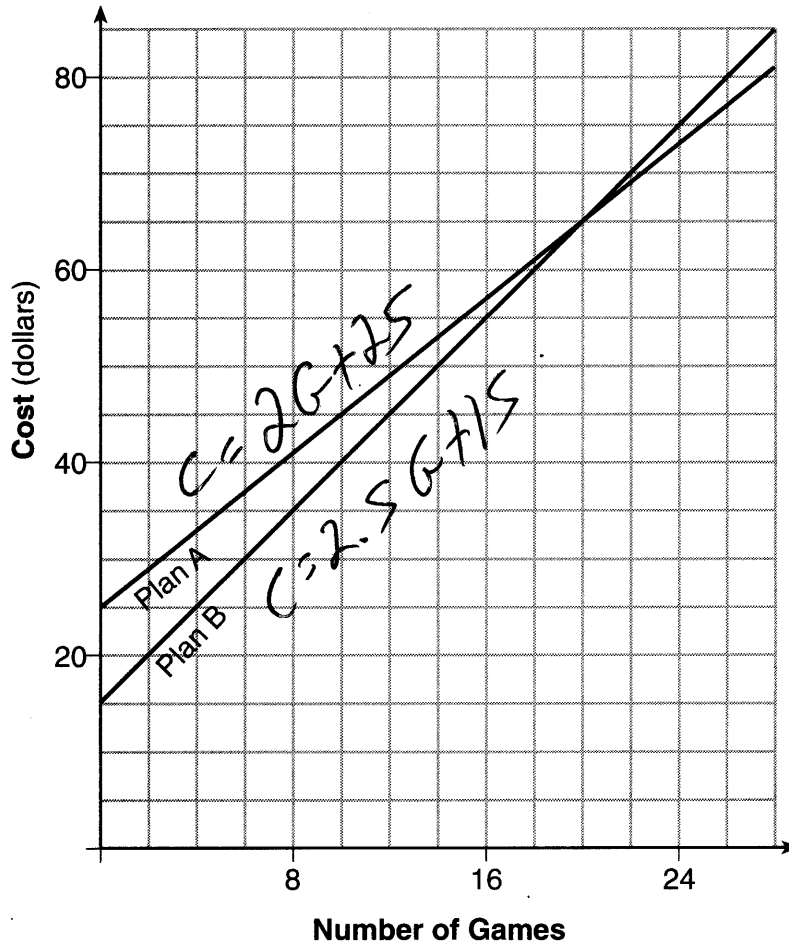
Yes, because the sequence has a common ratio, 3

27 Using the formula for the volume of a cone, express r in terms of V , h , and π .

$$V = \frac{1}{3} \pi r^2 h$$

$$\sqrt{\frac{3V}{\pi h}} = r$$

28 The graph below models the cost of renting video games with a membership in Plan A and Plan B.



Explain why Plan B is the better choice for Dylan if he only has \$50 to spend on video games, including a membership fee.

A: $50 = 2G + 25$
 $12.5 = G$

B: $50 = 2.5G + 15$
 $14 = G$

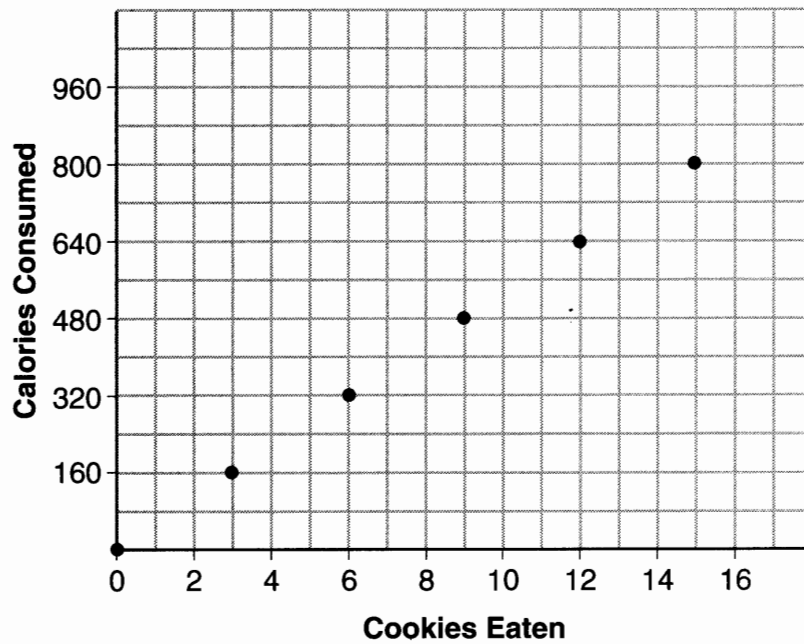
Dylan can buy 14 games with A, and only 12 games w/B

Bobby wants to spend \$65 on video games, including a membership fee. Which plan should he choose? Explain your answer.

It does not matter, as he can rent 20 games under either plan

$$65 = 2(20) + 25 = 2.5(20) + 15$$

29 Samantha purchases a package of sugar cookies. The nutrition label states that each serving size of 3 cookies contains 160 Calories. Samantha creates the graph below showing the number of cookies eaten and the number of Calories consumed.



Explain why it is appropriate for Samantha to draw a line through the points on the graph.

The data is continuous, i.e. a fraction of a cookie may be eaten

30 A two-inch-long grasshopper can jump a horizontal distance of 40 inches. An athlete, who is five feet nine, wants to cover a distance of one mile by jumping. If this person could jump at the same ratio of body-length to jump-length as the grasshopper, determine, to the *nearest jump*, how many jumps it would take this athlete to jump one mile.

$$\frac{2}{40} = \frac{5.75}{x}$$

$$x = 115$$

$$\frac{5280}{115} \approx 46$$

31 Write the expression $5x + 4x^2(2x + 7) - 6x^2 - 9x$ as a polynomial in standard form.

$$5x + 8x^3 + 28x^2 - 6x^2 - 9x$$

$$8x^3 + 22x^2 - 4x$$

32 Solve the equation $x^2 - 6x = 15$ by completing the square.

$$x^2 - 6x + 9 = 15 + 9$$

$$(x-3)^2 = 24$$

$$x-3 = \pm \sqrt{24}$$

$$x = 3 \pm 2\sqrt{6}$$

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 Loretta and her family are going on vacation. Their destination is 610 miles from their home. Loretta is going to share some of the driving with her dad. Her average speed while driving is 55 mph and her dad's average speed while driving is 65 mph.

The plan is for Loretta to drive for the first 4 hours of the trip and her dad to drive for the remainder of the trip. Determine the number of hours it will take her family to reach their destination.

$$610 - 55(4) = \frac{390}{65} = 4 + 6 = 10$$

After Loretta has been driving for 2 hours, she gets tired and asks her dad to take over. Determine, to the *nearest tenth of an hour*, how much time the family will save by having Loretta's dad drive for the remainder of the trip.

$$610 - 55(2) = \frac{500}{65} \approx 7.7 + 2 = \frac{9.7}{0.3} = 16.0$$

34 The heights, in feet, of former New York Knicks basketball players are listed below.

6.4	6.9	6.3	6.2	6.3	6.0	6.1	6.3	6.8	6.2
6.5	7.1	6.4	6.3	6.5	6.5	6.4	7.0	6.4	6.3
6.2	6.3	7.0	6.4	6.5	6.5	6.5	6.0	6.2	

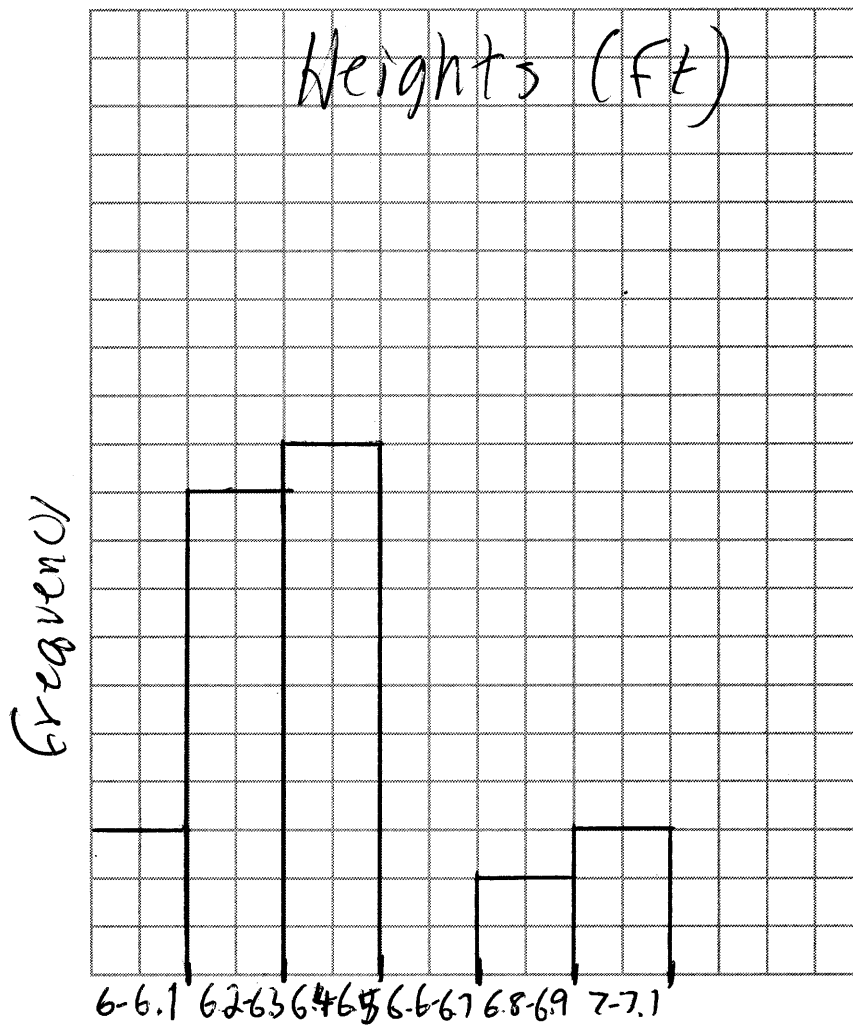
Using the heights given, complete the frequency table below.

Interval	Frequency
6.0 – 6.1	3
6.2 – 6.3	10
6.4 – 6.5	11
6.6 – 6.7	0
6.8 – 6.9	2
7.0 – 7.1	3

Question 34 is continued on the next page.

Question 34 continued.

Based on the frequency table created, draw and label a frequency histogram on the grid below.



Determine and state which interval contains the upper quartile. Justify your response.

Using graphing calculator, Q_3 is 6.5, which is in the 6.4-6.5 interval

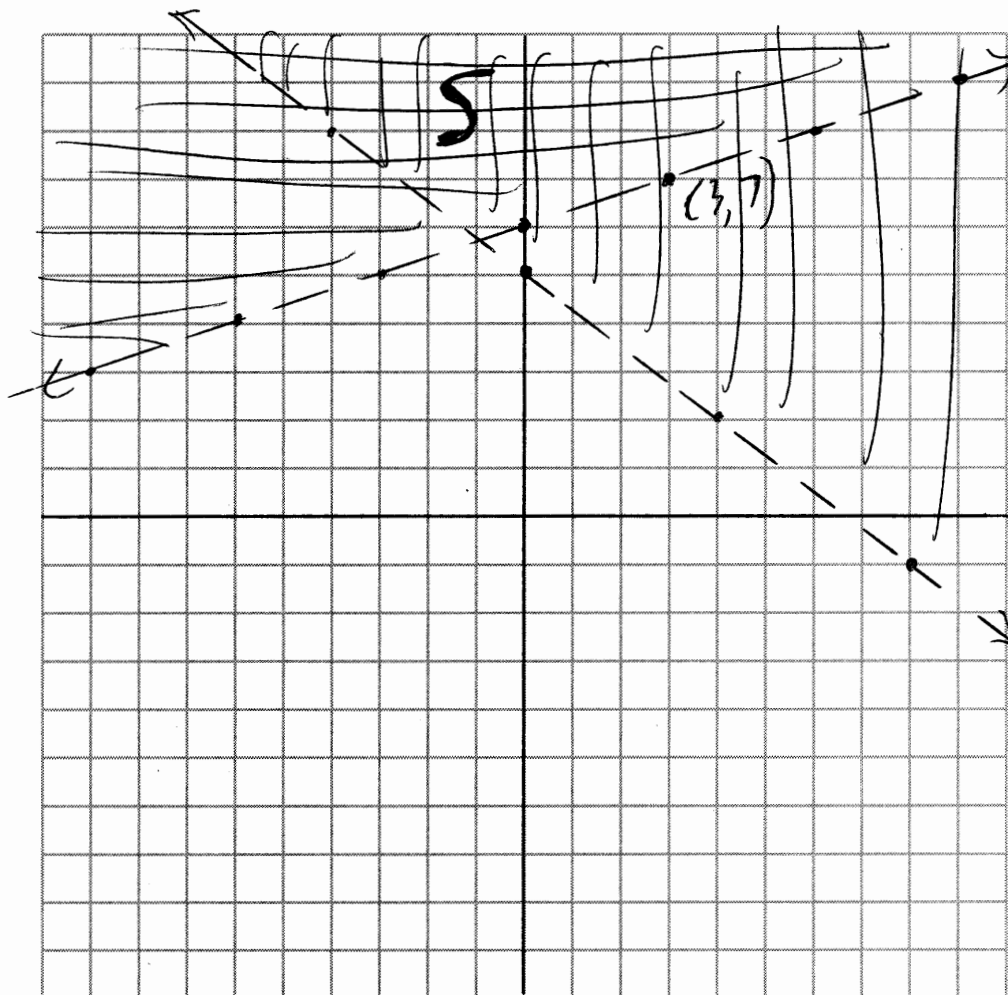
35 Solve the following system of inequalities graphically on the grid below and label the solution S.

$$3x + 4y > 20$$

$$x < 3y - 18$$

$$y > -\frac{3}{4}x + 5$$

$$y > \frac{1}{3}x + 6$$



Is the point (3,7) in the solution set? Explain your answer.

No. (3,7) is on the boundary line and not included in the solution set, because this is a strict inequality

- 36 An Air Force pilot is flying at a cruising altitude of 9000 feet and is forced to eject from her aircraft. The function $h(t) = -16t^2 + 128t + 9000$ models the height, in feet, of the pilot above the ground, where t is the time, in seconds, after she is ejected from the aircraft.

Determine and state the vertex of $h(t)$. Explain what the second coordinate of the vertex represents in the context of the problem.

$$x = \frac{-128}{2(-16)} = 4 \quad h(4) = -16(4)^2 + 128(4) + 9000$$
$$= 9256$$

$$(4, 9256)$$

The y -coordinate represents the pilot's height from ground after ejection.

After the pilot was ejected, what is the maximum number of feet she was above the aircraft's cruising altitude? Justify your answer.

$$9256 - 9000 = 256$$

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 Zeke and six of his friends are going to a baseball game. Their combined money totals \$28.50. At the game, hot dogs cost \$1.25 each, hamburgers cost \$2.50 each, and sodas cost \$0.50 each. Each person buys one soda. They spend all \$28.50 on food and soda.

Write an equation that can determine the number of hot dogs, x , and hamburgers, y , Zeke and his friends can buy.

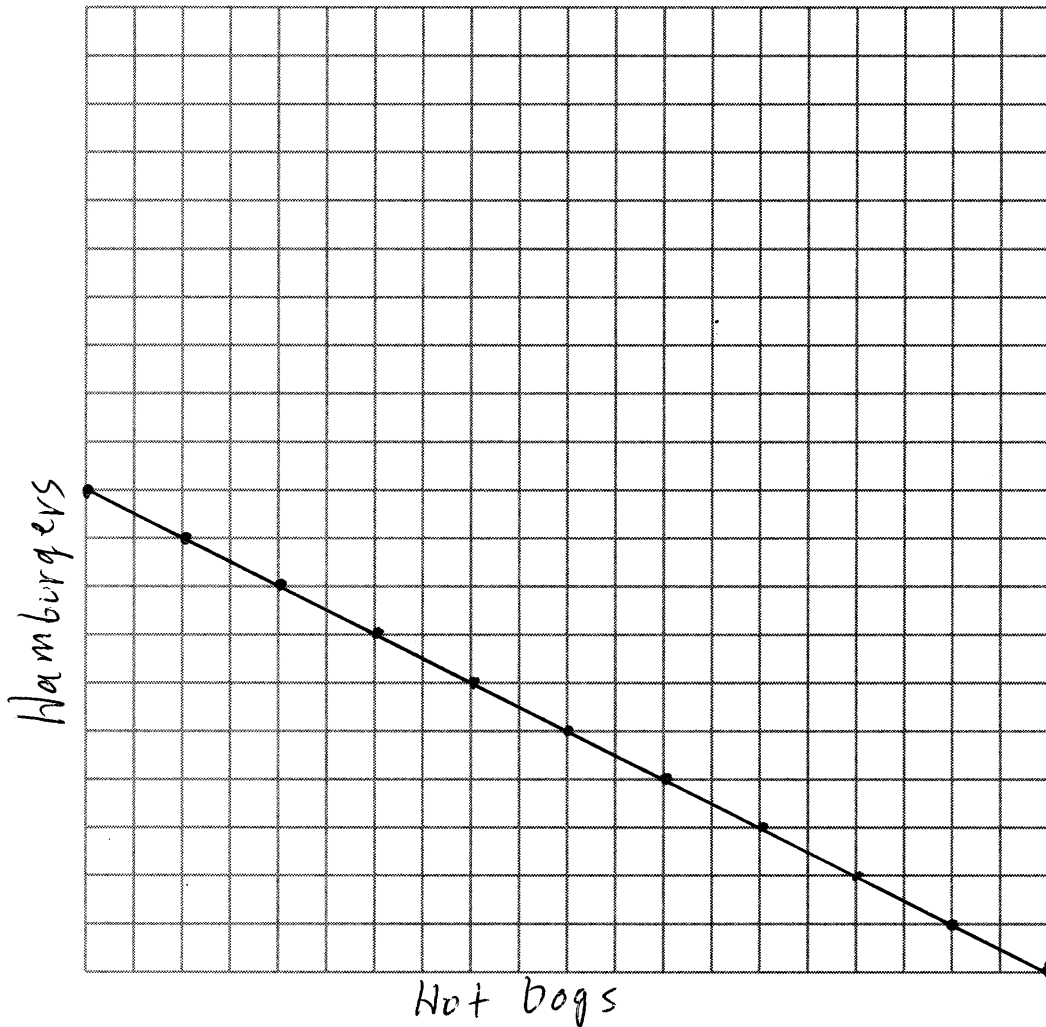
$$1.25x + 2.5y = 25$$

$$x + 2y = 20$$

Question 37 is continued on the next page.

Question 37 continued.

Graph your equation on the grid below.



Determine how many different combinations, including those combinations containing zero, of hot dogs and hamburgers Zeke and his friends can buy, spending all \$28.50. Explain your answer.

There are 11 different combinations, as each dot represents a possible combination.