**0817AI**

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

   Given: $2(6x^2 - 3) = 11x^2 - x$

   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

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

3   The expression $49x^2 - 36$ is equivalent to
   1) $(7x - 6)^2$
   2) $(24.5x - 18)^2$
   3) $(7x - 6)(7x + 6)$
   4) $(24.5x - 18)(24.5x + 18)$

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

5   The graph below models the height of a remote-control helicopter over 20 seconds during flight.
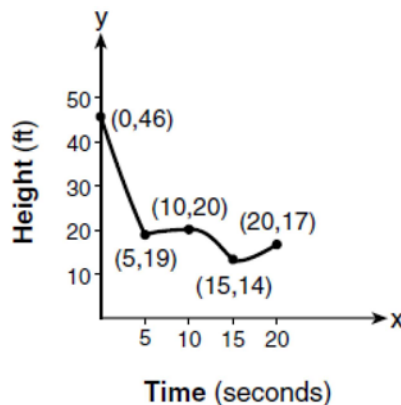
   Over which interval does the helicopter have the *slowest* average rate of change?
   1) 0 to 5 seconds
   2) 5 to 10 seconds
   3) 10 to 15 seconds
   4) 15 to 20 seconds

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.

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

P(x)
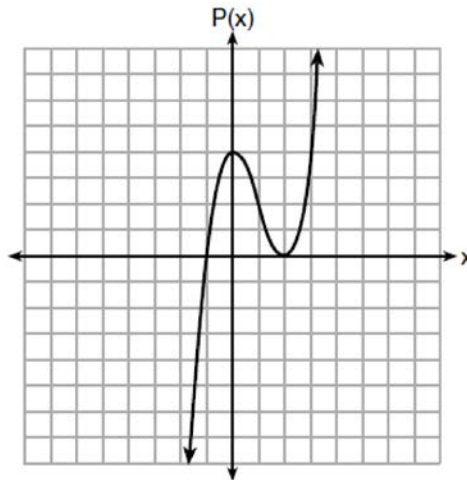
Which equation could represent $P(x)$?

1) $P(x) = (x + 1)(x - 2)^2$
2) $P(x) = (x - 1)(x + 2)^2$
3) $P(x) = (x + 1)(x - 2)$
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 paper will have.
3) The shorter the distance driven, the less gasoline that will be used.
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) $\{0,1,4\}$ 3) $\{-2,-1,0,1,2,4\}$
2) $\{-2,-1,0,1,2\}$ 4) $\{-2,-1,0,0,1,1,1,2,4,4\}$

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

1) $x \leq -\dfrac{18}{5}$ 3) $x \leq \dfrac{54}{5}$

2) $x \geq -\dfrac{18}{5}$ 4) $x \geq \dfrac{54}{5}$

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

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

1) -19.575 3) -16.3125
2) -18.825 4) -15.6875

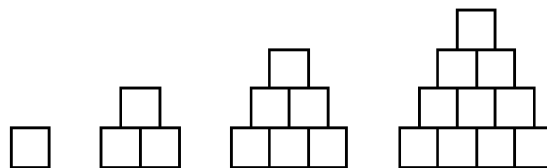14 If a population of 100 cells triples every hour, which function represents $p(t)$, the population after t hours?
1) $p(t)=3(100)^t$ 3) $p(t)=3t+100$
2) $p(t)=100(3)^t$ 4) $p(t)=100t+3$

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   3) 28
2) 21   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) $V = 15,000(0.9)^{\frac{t}{2}}$

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
2) quadratic
3) exponential growth
4) exponential decay

18 The function $h(x)$, which is graphed below, and the function $g(x) = 2|x + 4| - 3$ are given.
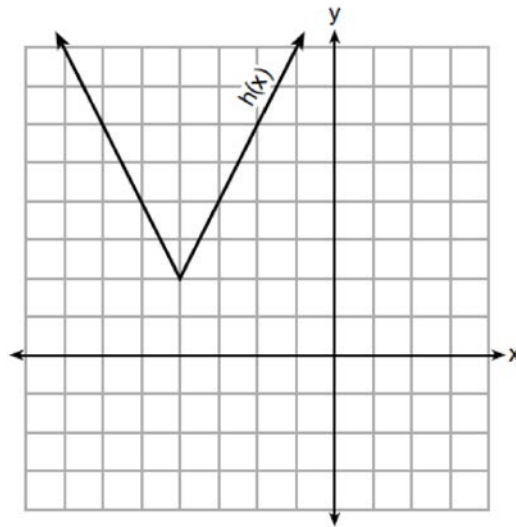
Which statements about these functions are true?
I. $g(x)$ has a lower minimum value than $h(x)$.
II. For all values of x, $h(x) < g(x)$.
III. For any value of x, $g(x) \neq h(x)$.
1) I and II, only
2) I and III, only
3) II and III, only
4) I, II, and III

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) $\{0,-1,6\}$

4

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

$$5x + y = 13$$

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

$$y = -5x + 13$$

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

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.

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) $40x + 30y = 100$
   $36x + 30y = -96$

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.

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

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

28 The graph below models the cost of renting video games with a membership in Plan A and Plan B.
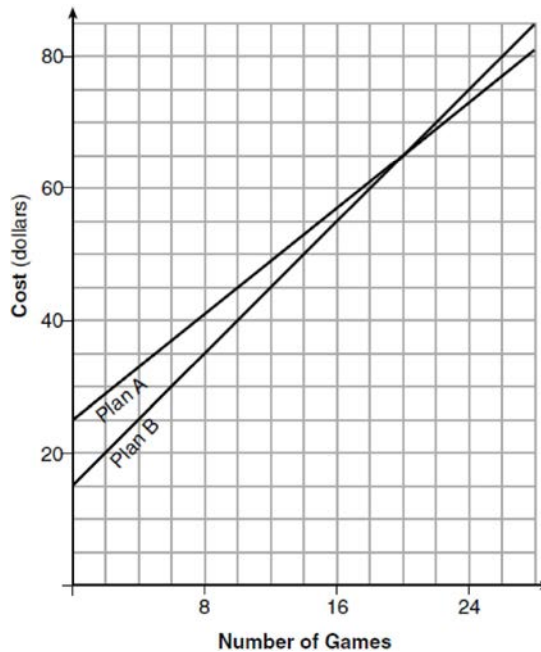
Explain why Plan B is the better choice for Dylan if he only has $50 to spend on video games, including a membership fee. Bobby wants to spend $65 on video games, including a membership fee. Which plan should he choose? Explain your answer.

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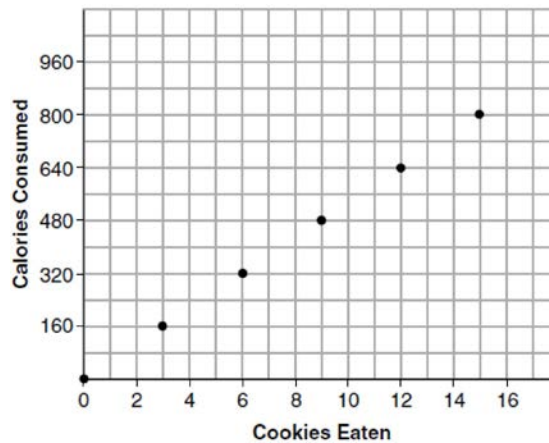
Explain why it is appropriate for Samantha to draw a line through the points on the graph.

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.

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

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

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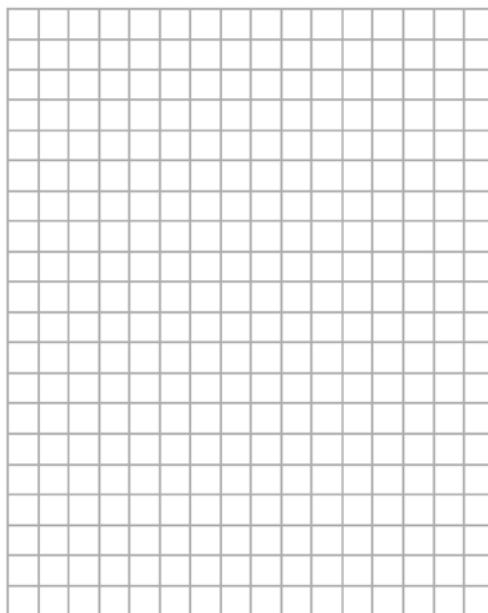
34 The heights, in feet, of former New York Knicks basketball players are listed below.

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	
6.2-6.3	
6.4-6.5	
6.6-6.7	
6.8-6.9	
7.0-7.1	

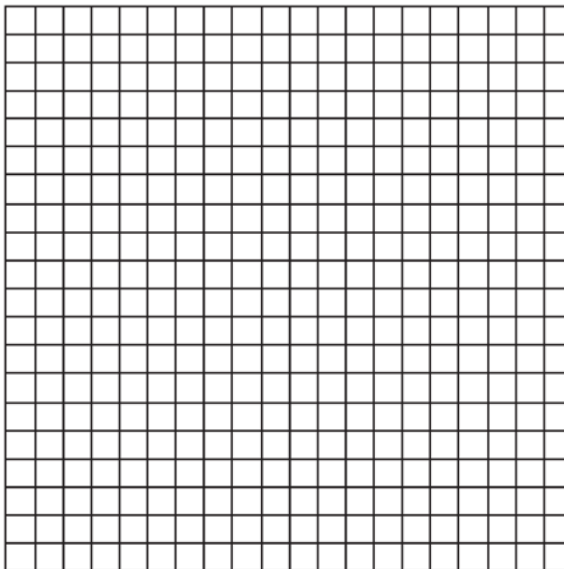Based on the frequency table created, draw and label a frequency histogram on the grid below.

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

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

$$3x + 4y > 20$$

$$x < 3y - 18$$

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

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

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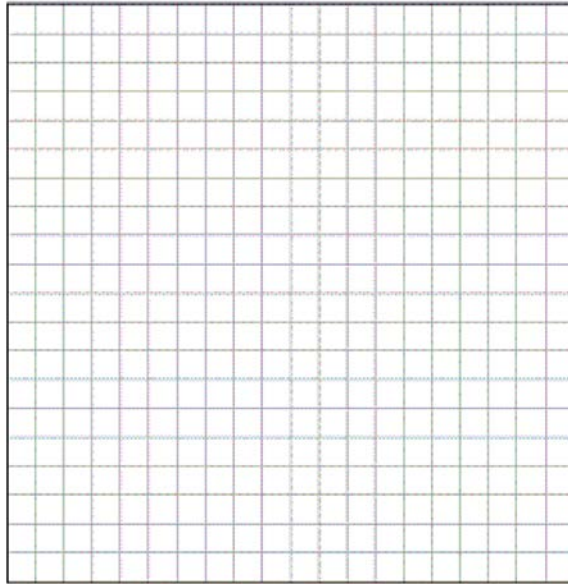
Determine how many different combinations, including those combinations containing zero, of hot dogs and
hamburgers Zeke and his friends can buy, spending all $28.50. Explain your answer.

0817AI
Answer Section

1 ANS: 4   PTS: 2   REF: 081701ai   NAT: A.REI.A.1
   TOP: Identifying Properties
2 ANS: 2
   $|x + 2| = 3x - 2$

   $x + 2 = 3x - 2$

   $4 = 2x$

   $x = 2$

   PTS: 2   REF: 081702ai   NAT: A.REI.D.11   TOP: Other Systems
3 ANS: 3   PTS: 2   REF: 081703ai   NAT: A.SSE.A.2
   TOP: Factoring the Difference of Perfect Squares   KEY: quadratic
4 ANS: 3

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

   PTS: 2   REF: 081704ai   NAT: F.IF.A.2   TOP: Functional Notation
5 ANS: 2
   The slope of a line connecting $(5, 19)$ and $(10, 20)$ is lowest.

   PTS: 2   REF: 081705ai   NAT: F.IF.B.6   TOP: Rate of Change
6 ANS: 1   PTS: 2   REF: 081706ai   NAT: F.BF.B.3
   TOP: Graphing Polynomial Functions
7 ANS: 1   PTS: 2   REF: 081707ai   NAT: A.APR.B.3
   TOP: Graphing Polynomial Functions
8 ANS: 2   PTS: 2   REF: 081708ai   NAT: S.ID.C.9
   TOP: Analysis of Data
9 ANS: 4   PTS: 2   REF: 081709ai   NAT: F.LE.B.5
   TOP: Modeling Linear Functions
10 ANS: 1   PTS: 2   REF: 081710ai   NAT: F.IF.A.2
   TOP: Domain and Range   KEY: limited domain
11 ANS: 1

   $2 + \dfrac{4}{9}x \geq 4 + x$

   $-2 \geq \dfrac{5}{9}x$

   $x \leq -\dfrac{18}{5}$

   PTS: 2   REF: 081711ai   NAT: A.REI.B.3   TOP: Solving Linear Inequalities
12 ANS: 2   PTS: 2   REF: 081712ai   NAT: A.SSE.A.1
   TOP: Modeling Expressions

13 ANS: 2

$$6\left(\frac{5}{6}\left(\frac{3}{8}-x\right)=16\right)$$

$$8\left(5\left(\frac{3}{8}-x\right)=96\right)$$

$$15-40x=768$$

$$-40x=753$$

$$x=-18.825$$

PTS: 2   REF: 081713ai   NAT: A.REI.B.3   TOP: Solving Linear Equations
KEY: fractional expressions

14 ANS: 2   PTS: 2   REF: 081714ai   NAT: F.LE.A.2
TOP: Families of Functions
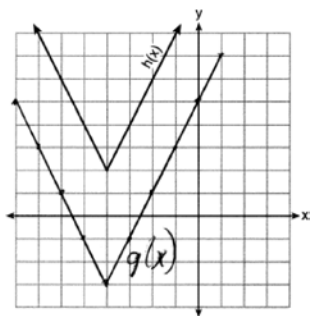
15 ANS: 3
1, 3, 6, 10, 15, 21, 28, ...

PTS: 2   REF: 081715ai   NAT: F.IF.A.3   TOP: Sequences
KEY: recursive

16 ANS: 2
$$V=15,000(0.81)^{t}=15,000((0.9)^{2})^{t}=15,000(0.9)^{2t}$$

PTS: 2   REF: 081716ai   NAT: A.SSE.B.3   TOP: Modeling Exponential Functions

17 ANS: 1   PTS: 2   REF: 081717ai   NAT: F.LE.A.1
TOP: Families of Functions

18 ANS: 2

PTS: 2   REF: 081718ai   NAT: F.IF.C.9   TOP: Comparing Functions

19 ANS: 3
$$2x^{3}+12x-10x^{2}=0$$

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

$$2x(x-3)(x-2)=0$$

$$x=0,2,3$$

PTS: 2   REF: 081719ai   NAT: A.APR.B.3   TOP: Zeros of Polynomials

20 ANS: 3

$m = \dfrac{3 - -7}{2 - 4} = -5 \quad 3 = (-5)(2) + b \quad y = -5x + 13$ represents the line passing through the points $(2,3)$ and $(4,-7)$. The

$\qquad\qquad\qquad\qquad b = 13$

fourth equation may be rewritten as $y = 5x - 13$, so is a different line.

PTS: 2   REF: 081720ai   NAT: A.REI.D.10   TOP: Writing Linear Equations
KEY: other forms

21 ANS: 3

$E(10) = 1(1.11)^{10} \approx 3 \quad\quad S(10) = 30(1.04)^{10} \approx 44$

$E(53) = 1(1.11)^{53} \approx 252 \quad S(53) = 30(1.04)^{53} \approx 239$

PTS: 2   REF: 081721ai   NAT: A.CED.A.1   TOP: Modeling Exponential Functions

22 ANS: 1   PTS: 2   REF: 081722ai   NAT: S.ID.C.8
TOP: Correlation Coefficient

23 ANS: 4   PTS: 2   REF: 081723ai   NAT: A.CED.A.1
TOP: Modeling Quadratics

24 ANS: 4

$36x + 30y = 96$

PTS: 2   REF: 081724ai   NAT: A.REI.C.6   TOP: Solving Linear Systems

25 ANS:

$a + b$ 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 integers, $\dfrac{35}{2}$.

PTS: 2   REF: 081725ai   NAT: N.RN.B.3   TOP: Operations with Radicals
KEY: classify

26 ANS:

Yes, because the sequence has a common ratio, 3.

PTS: 2   REF: 081726ai   NAT: F.IF.A.3   TOP: Sequences
KEY: difference or ratio

27 ANS:

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

$$3V = \pi r^2 h$$

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

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

PTS: 2   REF: 081727ai   NAT: A.CED.A.4   TOP: Transforming Formulas

28 ANS:
Plan *A*: $C = 2G + 25$, Plan *B*: $C = 2.5G + 15$. $50 = 2.5G + 15$ $50 = 2G + 25$ With Plan *B*, Dylan can rent 14

$$35 = 2.5G \qquad 25 = 2G$$

$$G = 14 \qquad G = 12.5$$

games, but with Plan *A*, Dylan can rent only 12. $65 = 2(20) + 25 = 2.5(20) + 15$ Bobby can choose either plan, as he could rent 20 games for $65 with both plans.

PTS: 2   REF: 081728ai   NAT: A.CED.A.3   TOP: Modeling Linear Systems

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

PTS: 2   REF: 081729ai   NAT: F.IF.B.4   TOP: Graphing Linear Functions

30 ANS:
$\dfrac{2}{40} = \dfrac{5.75}{x}$ $\dfrac{5280}{115} \approx 46$

$x = 115$

PTS: 2   REF: 081730ai   NAT: N.Q.A.2   TOP: Using Rate

31 ANS:
$5x + 4x^2(2x + 7) - 6x^2 - 9x = -4x + 8x^3 + 28x^2 - 6x^2 = 8x^3 + 22x^2 - 4x$

PTS: 2   REF: 081731ai   NAT: A.APR.A.1   TOP: Operations with Polynomials
KEY: multiplication

32 ANS:
$x^2 - 6x + 9 = 15 + 9$

$(x - 3)^2 = 24$

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

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

PTS: 2   REF: 081732ai   NAT: A.REI.B.4   TOP: Solving Quadratics
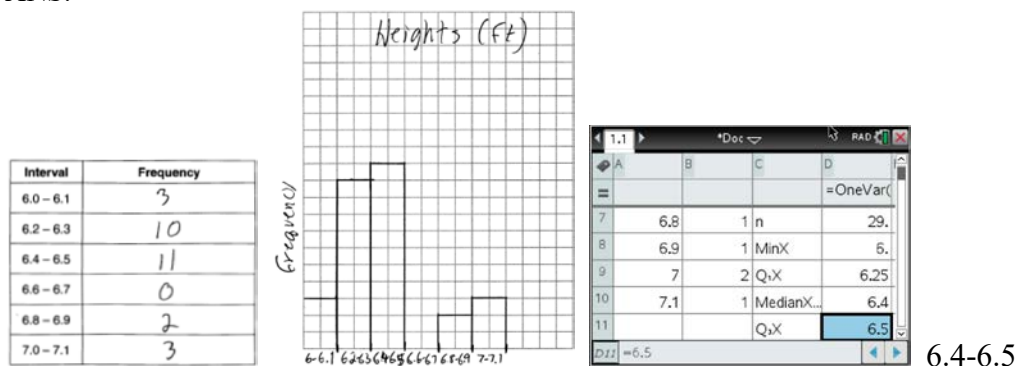KEY: completing the square

33 ANS:
$610 - 55(4) = 390$ $\dfrac{390}{65} = 6$ $4 + 6 = 10$ $610 - 55(2) = 500$ $\dfrac{500}{65} \approx 7.7$ $10 - (2 + 7.7) \approx 0.3$
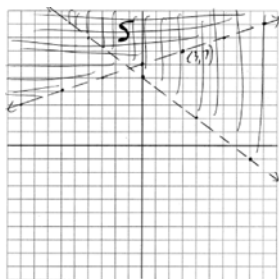
PTS: 4   REF: 081733ai   NAT: A.CED.A.2   TOP: Speed

34   ANS:

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

6.4-6.5

PTS: 4   REF: 081734ai   NAT: S.ID.A.1   TOP: Frequency Histograms
KEY: frequency histograms

35   ANS:

No, $(3,7)$ is on the boundary line, and not included in the solution set, because this is a strict inequality.
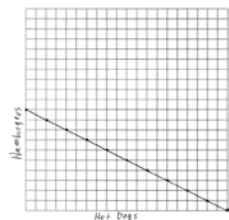
PTS: 4   REF: 081735ai   NAT: A.REI.D.12   TOP: Graphing Systems of Linear Inequalities
KEY: graph

36   ANS:

$x = \dfrac{-128}{2(-16)} = 4$ $h(4) = -16(4)^2 + 128(4) + 9000 = -256 + 512 + 9000 = 9256$ $(4, 9256)$. The y coordinate represents the pilot's height above the ground after ejection. $9256 - 9000 = 256$

PTS: 4   REF: 081736ai   NAT: F.IF.B.4   TOP: Graphing Quadratic Functions
KEY: context

37   ANS:

$1.25x + 2.5y = 25$ There are 11 combinations, as each dot represents a possible combination.
$x + 2y = 20$

PTS: 6   REF: 081737ai   NAT: A.CED.A.2   TOP: Graphing Linear Functions