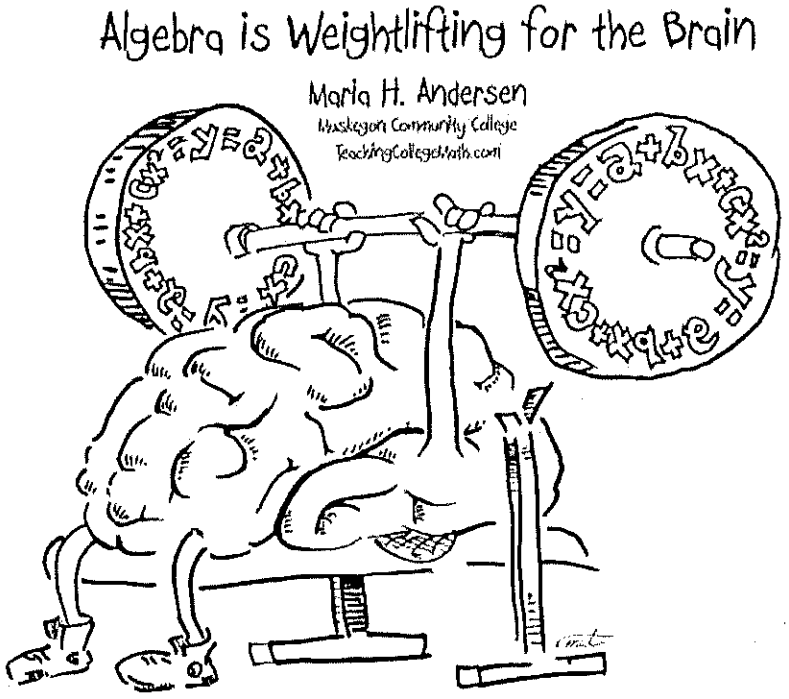
Patterns, Relations, & Algebra



MCAS Practice Problems

Name_____ PD____

1 The table below shows a linear relationship between the values of x and y.

Mark your answer here: 1. Ⓐ Ⓑ Ⓒ Ⓓ

x	y
1	1
2	6
3	11
4	16

Based on the relationship in the table, what is the value of y when $x = 7$?

A. 35

B. 31

C. 28

D. 21

2 The first five numbers of a quadratic sequence are shown below.

Mark your answer here: 2. Ⓐ Ⓑ Ⓒ Ⓓ

4, 6, 11, 19, 30, . . .

What is the next number in the sequence?

A. 44

B. 43

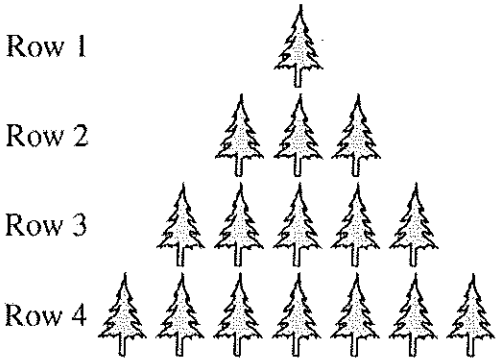
C. 42

D. 41

3 A tree farmer planted 4 rows of trees in a triangular pattern. The first row has 1 tree, the second row has 3 trees, the third row has 5 trees, and the fourth row has 7 trees, as shown in the diagram below.

Mark your answer here: 3. Ⓐ Ⓑ Ⓒ Ⓓ

Tree Farm Design



How many **additional** trees will the farmer need to plant if he wants to continue this linear pattern and add 4 more rows to the triangle?

A. 15

B. 33

C. 48

D. 64

4 The first four numbers in a geometric sequence are shown below.

Mark your answer here: 4. Ⓐ Ⓑ Ⓒ Ⓓ

2, 8, 32, 128, . . .

What is the next number in the sequence?

A. 160

B. 224

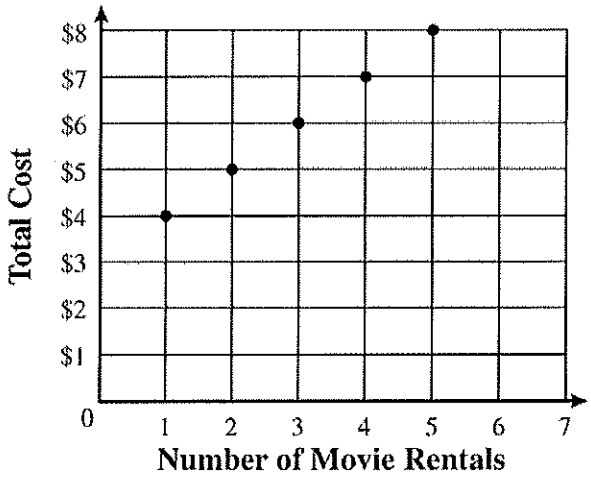
C. 256

D. 512

5 Spencer graphed the total monthly costs of renting different numbers of movies at Video Central, as shown below.

Mark your answer here: 5. Ⓐ Ⓑ Ⓒ Ⓓ

Total Monthly Cost of Movie Rentals



If the linear pattern shown by the graph continues, what would be the total monthly cost of 15 movie rentals?

A. $15

B. $18

C. $45

D. $60

6 The first six rows of a pattern are shown in the triangular array below.

Row 1						2					
Row 2					2		2				
Row 3				2		4		2			
Row 4			2		6		6		2		
Row 5		2		8		12		8		2	
Row 6	2		10		20		20		10		2
Row 7	?	?	?	?	?	?	?				

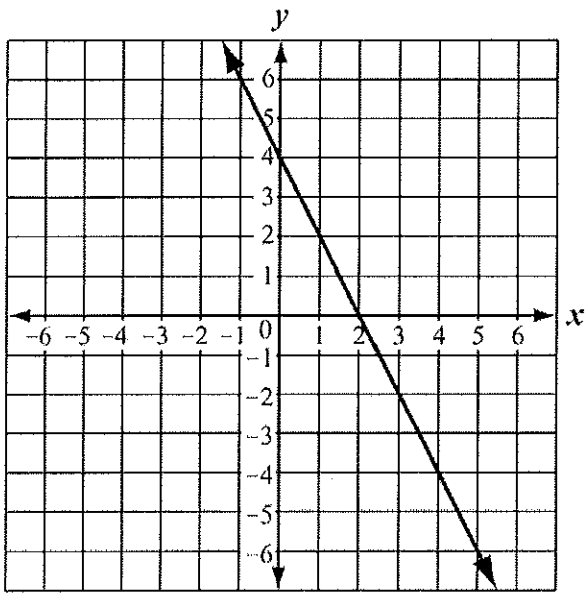
Each number in the array, other than 2, can be found by adding the two numbers in the preceding row that are diagonally above it. For example, $6 = 2 + 4$, as shown in the triangular array.

a. If the pattern continues, what are the seven numbers in Row 7? Show or explain how you got your answer.

Write your answer here:

1 A line is shown on the coordinate grid below.

Mark your answer here: 1. Ⓐ Ⓑ Ⓒ Ⓓ



Which of the following best represents an equation of the line?

A. $y = 2x + 2$

B. $y = \frac{1}{2}x + 4$

C. $y = -\frac{1}{2}x + 2$

D. $y = -2x + 4$

2 What is the slope of the line represented by the equation below?

Mark your answer here: 2. Ⓐ Ⓑ Ⓒ Ⓓ

$$3x + 2y = -8$$

A. -3

B. $-\frac{3}{2}$

C. $\frac{3}{2}$

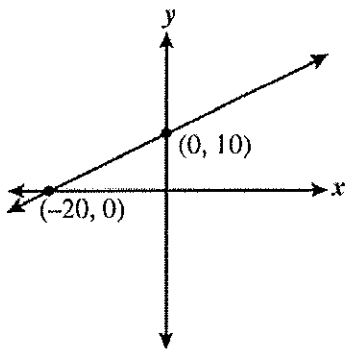
D. 3

3 Which of the following is the graph of the equation below?

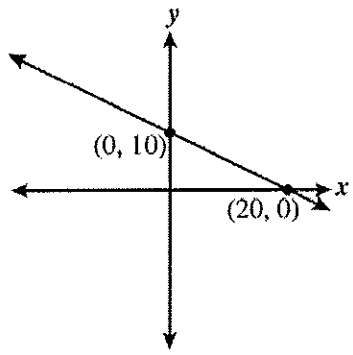
3. Ⓐ Ⓑ Ⓒ Ⓓ

$$y = -\frac{1}{2}x + 10$$

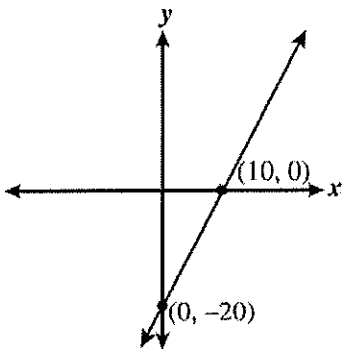
A.



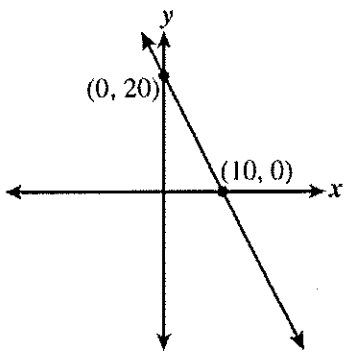
C.



B.



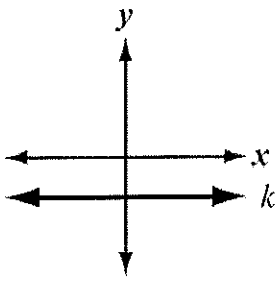
D.



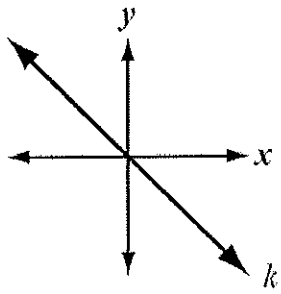
4 In which of the following graphs does line k best represent a line with a slope of 0?

Mark your answer here: 4. Ⓐ Ⓑ Ⓒ Ⓓ

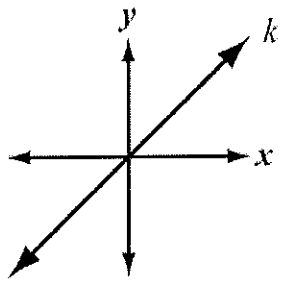
A.



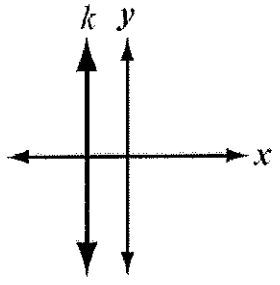
B.



C.

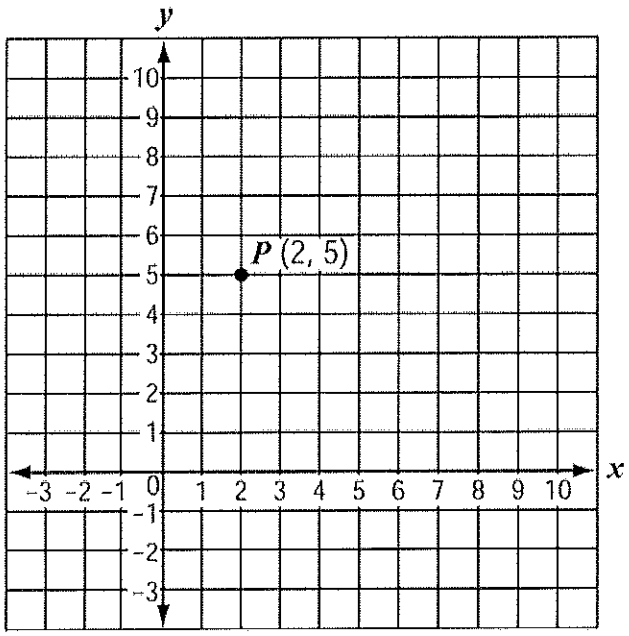


D.



Directions: For the problem below, use a separate piece of paper to write your answers. Your teacher will not count anything you write on this page.

5 Anthony plotted the point $P(2, 5)$ on a coordinate grid, as shown below.



Anthony then graphed line q on the same coordinate grid.

- Line q contains point P.
- The y-intercept of line q is the point with coordinates $(0, 4)$.

a. What is the slope of line q? Show or explain how you got your answer.

b. Write an equation of line q. Show or explain how you got your equation.

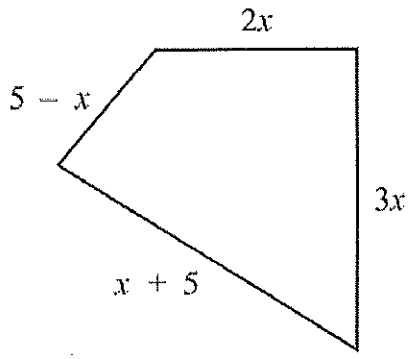
Anthony also graphed line n on the same coordinate grid. Line n contains point P and is perpendicular to line q.

c. What is the slope of line n? Show or explain how you got your answer.

d. Write an equation of line n. Show or explain how you got your equation.

1 A polygon and expressions representing its dimensions, in meters, are shown below.

Mark your answer here: 1. Ⓐ Ⓑ Ⓒ Ⓓ



Which of the following represents the perimeter, in meters, of the polygon?

A. $5x$

B. $15x$

C. $5x + 10$

D. $7x + 10$

2 Which of the following is equivalent to the expression below?

Mark your answer here: 2. Ⓐ Ⓑ Ⓒ Ⓓ

$(3x^2 + 2x - 8) - (2x^2 - 4x + 7)$

A. $x^2 + 6x - 15$

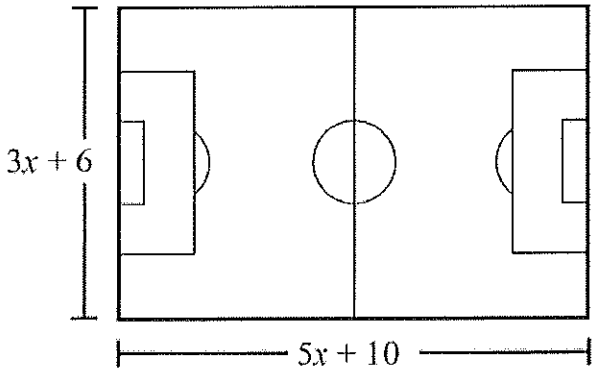
B. $x^2 - 2x - 15$

C. $x^2 + 6x - 1$

D. $x^2 - 2x - 1$

3 A rectangular soccer field and expressions representing its dimensions, in yards, are shown in the diagram below.

Mark your answer here: 3. Ⓐ Ⓑ Ⓒ Ⓓ



Which of the following expressions represents the perimeter, in yards, of the soccer field?

A. $48x$

B. $48x^4$

C. $16x + 32$

D. $16x^4 + 32$

4 Which of the following is equivalent to the expression below?

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

Mark your answer here: 4. Ⓐ Ⓑ Ⓒ Ⓓ

A. $2x^2 - 3x - 20$

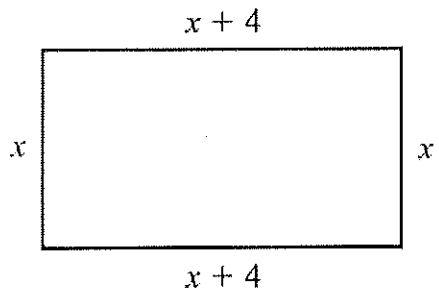
B. $2x^2 + 13x + 1$

C. $2x^2 - 20$

D. $2x^2 + 1$

5 A rectangle and expressions representing the lengths, in inches, of its sides are shown below.

Mark your answer here: 5. Ⓐ Ⓑ Ⓒ Ⓓ



Which of the following expressions represents the perimeter, in inches, of the rectangle?

A. $2x + 4$
B. $2x + 8$
C. $4x + 4$
D. $4x + 8$

6 Which of the following is equivalent to the expression below?

Mark your answer here: 6. Ⓐ Ⓑ Ⓒ Ⓓ

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

A. $x^2 - 7x - 10$
B. $x^2 - 3x - 10$
C. $x^2 + 3x - 10$
D. $x^2 + 7x - 10$

1 Which of the following is equivalent to the expression below?

Mark your answer here: 1. Ⓐ Ⓑ Ⓒ Ⓓ

$$x^2 + 3x - 28$$

A. $(x - 4)(x + 7)$

B. $(x + 4)(x - 7)$

C. $(x - 14)(x + 2)$

D. $(x + 14)(x - 2)$

2 Which of the following is equivalent to the expression below?

Mark your answer here: 2. Ⓐ Ⓑ Ⓒ Ⓓ

$$3(9x + 12) - (2x + 5)$$

A. $29x + 41$

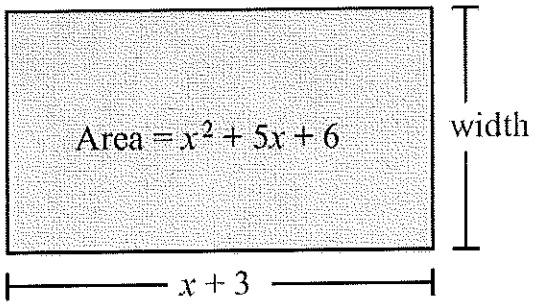
B. $25x + 31$

C. $29x + 17$

D. $25x + 7$

3 A diagram of Lynne's rectangular yard is shown below.

Mark your answer here: 3. Ⓐ Ⓑ Ⓒ Ⓓ



Expressions representing the area and length of Lynne's yard are as follows:

Area of yard: $x^2 + 5x + 6$

Length of yard: $x + 3$

Which of the following expressions represents the width of Lynne's yard?

A. $x + 1$

B. $x + 2$

C. $x + 3$

D. $x + 6$

1 What are the solutions of the equation below?

$$2n(3n - 12) = 0$$

Mark your answer here: 1. Ⓐ Ⓑ Ⓒ Ⓓ

A. 0 and 4

B. 0 and 12

C. 2 and 4

D. 2 and 12

2 What are the solutions of the equation below?

$$p^2 + 5 = 6p$$

Mark your answer here: 2. Ⓐ Ⓑ Ⓒ Ⓓ

A. 1 and 5

B. 2 and 3

C. −1 and −5

D. −2 and −3

3 What are all the solutions of the equation below?

Mark your answer here: 3. Ⓐ Ⓑ Ⓒ Ⓓ

$$x^2 - 10 = 0$$

A. $x = \sqrt{10}$; $x = -\sqrt{10}$

B. $x = 10$; $x = -10$

C. $x = \sqrt{5}$

D. $x = 5$

4 What is one value of x that makes the quadratic equation below true?

$$x^2 + x - 6 = 0$$

Write your answer here:

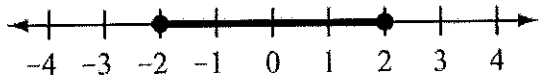
1

Mark your answer here: 1. Ⓐ Ⓑ Ⓒ Ⓓ

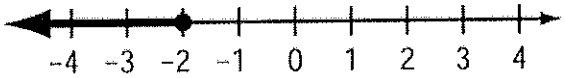
Which of the following graphs represents the solution of the inequality below?

$$|x| \leq 2$$

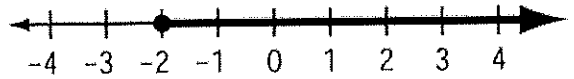
A.



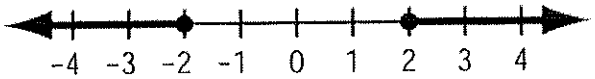
B.



C.



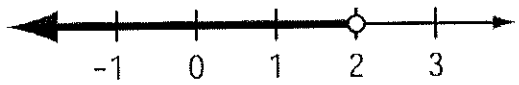
D.



2

Which of the following inequalities is graphed on the number line below?

Mark your answer here: 2. Ⓐ Ⓑ Ⓒ Ⓓ



A. $x < 2$

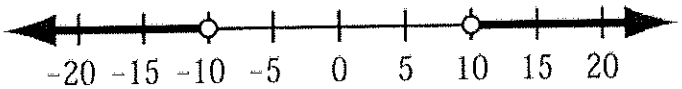
B. $x \leq 2$

C. $x > 2$

D. $x \geq 2$

3 The graph below is the solution of which of the following inequalities?

Mark your answer here: 3. Ⓐ Ⓑ Ⓒ Ⓓ



A. $|x| > 10$

B. $|x| < 10$

C. $x > 10$

D. $x < -10$

4 Joshua is designing a rectangular mirror.

- He let w = the width, in inches, of the mirror.
- The length of the mirror will be 6 inches more than the width.
- The perimeter of the mirror will be less than 96 inches and greater than 76 inches.

Which of the following inequalities shows the possible widths, in inches, of the mirror?

Mark your answer here: 4. Ⓐ Ⓑ Ⓒ Ⓓ

A. $13 < w < 18$

B. $16 < w < 21$

C. $19 < w < 24$

D. $35 < w < 45$

5 A technician earns $75 per hour working on computers. She has monthly business expenses of $800. Her profit is the difference between her monthly earnings and her monthly business expenses.

Which of the following inequalities can be used to find the number of hours, x, the technician will have to work on computers in a month to make a profit of more than $2000?

A. $800 - 75x < 2000$

B. $75x - 800 < 2000$

C. $800 - 75x > 2000$

D. $75x - 800 > 2000$

Mark your answer here: 5. Ⓐ Ⓑ Ⓒ Ⓓ

6 What is the solution of the equation below?

$$2x - 6 = 8$$

Write your answer here:

1 A large organization uses a phone tree to contact members.

- The director first contacts 3 members. This is the 1st set of calls.
- Each member who was contacted in the 1st set of calls then contacts 3 different members who were not previously contacted. This is the 2nd set of calls.
- The pattern continues with each member contacting 3 different members who were not previously contacted.

The table below shows the number of members contacted in each set of calls.

Phone Tree Calls

Set of Calls	Number of Members Contacted in This Set of Calls
1st	3
2nd	9
3rd	27
4th	81

If the pattern continues, what is the number of members who would be contacted in the 6th set of calls?

A. 216

B. 324

C. 486

D. 729

Mark your answer here: 1. Ⓐ Ⓑ Ⓒ Ⓓ

2 Melinda invested $1000 in a retirement account. The formula below shows the amount of money, A, that will be in her account at the end of t years.

$$A = 1000(1 + r)^t$$

In the formula, r is the interest rate, expressed as a decimal. Melinda's account has an interest rate of 6%.

Which of the following is closest to the amount that will be in Melinda's account at the end of 2 years?

A. $1120

B. $1124

C. $1256

D. $1360

Mark your answer here: 2. Ⓐ Ⓑ Ⓒ Ⓓ

3 A magazine had 4000 subscribers at the end of the year 2004. The number of subscribers increased by 10% each year as compared with the previous year.

Which of the following is closest to the number of subscribers at the end of the year 2007?

A. 4330

B. 4400

C. 5200

D. 5320

Mark your answer here: 3. Ⓐ Ⓑ Ⓒ Ⓓ

4 The label on a cereal box states the following:

- One serving of cereal contains 17 grams of carbohydrates.
- This number of grams is 6% of the maximum amount of carbohydrates that a person should eat in a day.

Based on this information, which of the following is closest to the maximum amount of carbohydrates that a person should eat in a day?

A. 1.02 grams

B. 2.83 grams

C. 102 grams

D. 283 grams

Mark your answer here: 4. Ⓐ Ⓑ Ⓒ Ⓓ

5 Laila is having shirts made with a logo printed on them to promote her band. The total cost consists of a one-time fee of $75 to have the logo designed plus $8 per shirt to print the logo.

Write an equation that Laila can use to determine the total cost, C, in dollars, to make x shirts.

Write your answer here:

Directions: For the problem below, use a separate piece of paper to write your answers. Your teacher will not count anything you write on this page.

6 Jason launched a model rocket from the ground. The formula below can be used to determine the height of the rocket above the ground at any time during the rocket's flight.

$$h = 16t(7 - t)$$

In the formula, h and t are defined as follows:

- t = the time, in seconds, that has elapsed since the rocket was launched
- h = the height, in feet, of the rocket above the ground at time t

Use the formula to answer the following questions.

a. What was the height, in feet, of the rocket 1 second after it was launched? Show your work.

b. What was the height, in feet, of the rocket 6 seconds after it was launched? Show your work.

c. The value of h was 0 when the rocket hit the ground. How many seconds after the rocket was launched did it hit the ground? Show your work.

d. How many seconds after the rocket was launched was the height of the rocket 160 feet? Show your work.

1 The only coins that Alexis has are dimes and quarters.

Mark your answer here: 1. Ⓐ Ⓑ Ⓒ Ⓓ

- Her coins have a total value of $5.80.
- She has a total of 40 coins.

Which of the following systems of equations can be used to find the number of dimes, d, and the number of quarters, q, that Alexis has?

A. $$\begin{aligned} d + q &= 5.80 \\ 40d + 40q &= 5.80 \end{aligned}$$

B. $$\begin{aligned} d + q &= 40 \\ 5.80d + 5.80q &= 40 \end{aligned}$$

C. $$\begin{aligned} d + q &= 5.80 \\ 0.10d + 0.25q &= 40 \end{aligned}$$

D. $$\begin{aligned} d + q &= 40 \\ 0.10d + 0.25q &= 5.80 \end{aligned}$$

2 Which of the following is the solution of the system of equations below?

Mark your answer here: 2. Ⓐ Ⓑ Ⓒ Ⓓ

$$\begin{aligned} 4x + y &= 5 \\ 2x - 3y &= 13 \end{aligned}$$

A. $x = 1;\ y = 1$

B. $x = 2;\ y = 3$

C. $x = 2;\ y = -3$

D. $x = 3;\ y = -7$

3 Sarah walked at a speed of 3 miles per hour. Beneta rode her bicycle at a speed of 9 miles per hour. They both traveled the same distance, but it took Sarah 4 more hours than it took Beneta.

How many hours did it take Beneta?

A. 2

B. 3

C. 4

D. 6

Mark your answer here: 3. Ⓐ Ⓑ Ⓒ Ⓓ

4 Last year, Kristen read a total of 30 fiction and non-fiction books. The number of non-fiction books was 5 less than 4 times the number of fiction books.

What is the total number of **fiction** books that Kristen read last year?

A. 5

B. 7

C. 23

D. 25

Mark your answer here: 4. Ⓐ Ⓑ Ⓒ Ⓓ

5 Which of the following values of x and y are solutions of the system of inequalities shown below?

Mark your answer here: 5. Ⓐ Ⓑ Ⓒ Ⓓ

$$x + 3y \leq 16$$
$$x + y \geq 10$$

A. $x = 2 ; y = 8$

B. $x = 9 ; y = 2$

C. $x = 1 ; y = 5$

D. $x = 7 ; y = 2$

6 Serena bought some small and large picture frames.

- She paid \$3 for each small picture frame.
- She paid \$5 for each large picture frame.
- She bought a total of 10 picture frames.
- She paid a total of \$36 for all the picture frames. There is no sales tax.

What is the number of **large** picture frames that Serena bought?

Write your answer here:

Directions: For the problem below, use a separate piece of paper to write your answers. Your teacher will not count anything you write on this page.

7 Mr. Gomez's mathematics test consists of multiple-choice and short-answer questions only.

- Each multiple-choice question is worth 3 points.
- Each short-answer question is worth 5 points.

Let x and y be defined as follows:

- x = the number of multiple-choice questions
- y = the number of short-answer questions

a. The test has a total of 30 questions. Write an equation in terms of x and y that represents this fact.

b. Write an expression in terms of x that represents the total point value of all the multiple-choice questions.

c. Write an expression in terms of y that represents the total point value of all the short-answer questions.

d. The test has a total of 100 points. Write an equation in terms of x and y that represents this fact.

e. Use your equations from parts (a) and (d) to determine how many multiple-choice questions **and** how many short-answer questions are on the test. Show your work.

MASSACHUSETTS DEPARTMENT OF ELEMENTARY AND SECONDARY EDUCATION

Massachusetts Comprehensive Assessment System
Grade 10 Mathematics Reference Sheet

AREA FORMULAS

square ..... $A = s^2$

rectangle ..... $A = bh$

parallelogram ..... $A = bh$

triangle ..... $A = \frac{1}{2}bh$

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

circle ..... $A = \pi r^2$

LATERAL SURFACE AREA FORMULAS

right rectangular prism ..... $LA = 2(hw) + 2(lh)$

right circular cylinder ..... $LA = 2\pi rh$

right circular cone ..... $LA = \pi r\ell$
(ℓ = slant height)

right square pyramid ..... $LA = 2s\ell$
(ℓ = slant height)

TOTAL SURFACE AREA FORMULAS

cube ..... $SA = 6s^2$

right rectangular prism ..... $SA = 2(lw) + 2(hw) + 2(lh)$

sphere ..... $SA = 4\pi r^2$

right circular cylinder ..... $SA = 2\pi r^2 + 2\pi rh$

right circular cone ..... $SA = \pi r^2 + \pi r\ell$
(ℓ = slant height)

right square pyramid ..... $SA = s^2 + 2s\ell$
(ℓ = slant height)

VOLUME FORMULAS

cube ..... $V = s^3$
(s = length of an edge)

right rectangular prism ..... $V = lwh$

OR

$V = Bh$
(B = area of a base)

sphere ..... $V = \frac{4}{3}\pi r^3$

right circular cylinder ..... $V = \pi r^2 h$

right circular cone ..... $V = \frac{1}{3}\pi r^2 h$

right square pyramid ..... $V = \frac{1}{3}s^2 h$

CIRCLE FORMULAS

$C = 2\pi r$

$A = \pi r^2$

SPECIAL RIGHT TRIANGLES