

## 1.

A publishing company ships books to schools, some of which are hardback textbooks and some are paperback workbooks. Each shipping box can hold a maximum of 20 textbooks or 64 workbooks. Each textbook takes up 192 cubic inches of space, and each workbook takes up 60 cubic inches of space. One box can hold a maximum of 3,840 cubic inches. The shipping department is packing a box containing both types of books. Which of the following systems of inequalities can the department use to determine how many textbooks,  $t$ , and workbooks,  $w$ , can be shipped in one box?

- $t \leq 20$
- (A)  $w \leq 64$   
 $60t + 192w \leq 3,840$
- $t \geq 20$
- (B)  $w \geq 64$   
 $192t + 60w \geq 3,840$
- (C)  $t \leq 20$   
 $w \leq 64$   
 $192t + 60w \leq 3,840$
- $t \leq 192$
- (D)  $w \leq 60$   
 $20t + 64w \leq 3,840$

**Difficulty:** Easy

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Use the Kaplan Method for Translating English into Math. The clue "holds a maximum" means it can hold exactly that much or less, so use the symbol  $\leq$ . This means you can eliminate B.

**Getting to the Answer:** The box can hold a maximum of 20 textbooks, so the first inequality is  $t \leq 20$ . The box can hold a maximum of 64 workbooks, so the second inequality is  $w \leq 64$  (eliminate D). The third inequality deals with the size of each book. The box can fit  $t$  textbooks multiplied by the size of the textbook, 192 cubic inches, and  $w$  workbooks multiplied by the size of the workbook, 60 cubic inches. The box can fit a maximum of 3,840 cubic inches total, so the last inequality is  $192t + 60w \leq 3,840$ .

## 2.

Which of the following does not represent a linear relationship?

- (A) 

<b>x</b>	-1	-4	-7	-10	-13
<b>y</b>	8	6	4	2	0
- (B) 

<b>x</b>	-3	-1	1	3	5
<b>y</b>	5	3	1	-1	-3
- (C) 

<b>x</b>	1	2	3	4	5
<b>y</b>	-5	-5	-5	-5	-5
- (D) 

<b>x</b>	-2	-1	0	1	2
<b>y</b>	4	1	0	1	4

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Check to see whether the change in the  $y$ -values compared with the change in the  $x$ -values is constant for each pair of values.

**Getting to the Answer:** The table in (D) does not represent a linear relationship because the  $x$ -values change by +1 each time, while the  $y$ -values change by -3, then -1, then +1, then +3. A linear relationship has a constant rate of change, which means it is either always increasing or always decreasing by the same amount. This data clearly changes direction and is therefore not linear.

3.

$$\begin{cases} Ax - 2y = 18 \\ Bx + 6y = 26 \end{cases}$$

If the graphs of the lines in the system of equations above intersect at  $(4, -1)$ , what is the value of  $\frac{B}{A}$ ?

- (A) -3
- (B)  $-\frac{1}{3}$
- (C)  $\frac{1}{2}$
- (D) **2**

**Difficulty:** Medium

**Category:** Heart of Algebra / Systems of Linear Equations

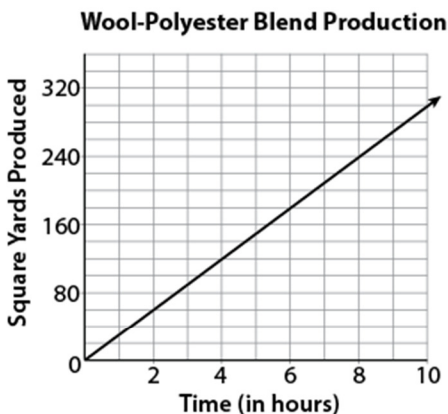
**Strategic Advice:** If the graphs intersect at  $(4, -1)$ , then the solution to the system is  $x = 4$  and  $y = -1$ . This means you can substitute these values into both equations and solve for  $A$  and  $B$ .

**Getting to the Answer:** Substitute the values of  $x$  and  $y$  into each equation and solve for  $A$  and  $B$ . Then, divide  $B$  by  $A$ .

$$\begin{array}{rcl} Ax - 2y = 18 & & Bx + 6y = 26 \\ A(4) - 2(-1) = 18 & & B(4) + 6(-1) = 26 \\ 4A + 2 = 18 & & 4B - 6 = 26 \\ 4A = 16 & & 4B = 32 \\ A = 4 & & B = 8 \end{array}$$

Therefore,  $\frac{B}{A} = \frac{8}{4} = 2$ .

4.



The figure above shows the rate at which a textile machine can produce a wool-polyester blend fabric. To produce a 100% polyester fabric, the same machine can produce 40 square yards per hour. Given that the company needs to fill an order for 2,400 square yards of each type of fabric, which of the following statements is true?

- (A) It will take half as long to make the blended fabric as the 100% polyester fabric.
- (B) It will take twice as long to make the blended fabric as the 100% polyester fabric.
- (C) **It will take 20 more hours to make the blended fabric than the 100% polyester fabric.**
- (D) It will take 20 fewer hours to make the blended fabric than the 100% polyester fabric.

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Start by finding the rate at which

the blended fabric is produced according to the

graph. To do this, find the slope by picking two

points and using the formula  $m = \frac{y_2 - y_1}{x_2 - x_1}$ . Pay careful

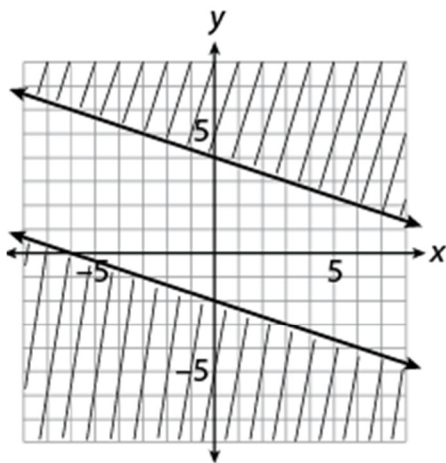
attention to how the grid-lines are labeled.

**Getting to the Answer:** Using the points (0, 0) and (2, 60), the slope is  $m = \frac{60 - 0}{2 - 0} = \frac{60}{2} = 30$ , which means the machine produces 30 square yards of the blended fabric per hour. The question states that the machine can produce the 100% polyester fabric at a rate of 40 square yards per hour. Now, determine how long it would take the machine to produce 2,400 yards of each fabric:

Blended:  $2,400 \div 30 = 80$  hours 100% polyester:  $2,400 \div 40 = 60$  hours

This means it will take 20 more hours to make the blended fabric than the 100% polyester fabric, which matches (C).

5.



Which of the following systems of inequalities could be represented by the graph shown?

(A)  $\begin{cases} 3x - y \geq 4 \\ 3x - y \leq -2 \end{cases}$

(B)  $\begin{cases} 3x + y \geq 4 \\ 3x + y \leq -2 \end{cases}$

(C)  $\begin{cases} x - 3y \geq 12 \\ x - 3y \leq -6 \end{cases}$

(D)  $\begin{cases} x + 3y \geq 12 \\ x + 3y \leq -6 \end{cases}$

**Difficulty:** Hard

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** The system in the graph shows shading on opposite sides of two parallel lines, which means there is no solution to the system. This means you're looking for two equations with the same slope, different  $y$ -intercepts, and different inequality symbols.

**Getting to the Answer:** The equations are all given in standard form ( $Ax + By = C$ ). It would be very time-intensive to convert all four systems to slope-intercept form, so look for ways to eliminate choices more quickly. Each line in the graph falls 1 unit and runs 3 units, so you need to find two lines that have a slope of  $-\frac{1}{3}$ . Use the trick  $m = \frac{-A}{B}$  to quickly determine the slopes. The lines in A have a slope of  $\frac{-3}{-1} = 3$ , so eliminate A; the lines in B have a slope of  $\frac{-3}{1} = -3$ , so eliminate B; the lines in C have a slope of  $\frac{-1}{-3} = \frac{1}{3}$ , so eliminate C (pay attention to the sign). This means (D) must be correct. The lines in (D) have a slope of  $\frac{-1}{3} = -\frac{1}{3}$ , which matches the graph. You don't have to check the shading because none of the other slopes were a match.

6.

If  $0.2x + 1.8 = 3 - 0.6x$ , what is the value of  $x$ ?

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Don't waste time trying to combine decimal numbers. Instead, multiply all of the numbers in the equation by 10 to get rid of the decimals. The resulting equation is much easier to solve.

**Getting to the Answer:** Multiplying each term in the equation by 10 moves the decimal one place to the right, which eliminates all the decimals.

$$10(0.2x + 1.8 = 3 - 0.6x)$$

$$2x + 18 = 30 - 6x$$

$$8x = 12$$

$$x = \frac{12}{8} = \frac{3}{2}$$

7.

Equation 1	
$x$	$y$
5	-8
4	-5
3	-2
2	1

Equation 2	
$x$	$y$
-8	3
-6	4
-4	5
-2	6

The tables above represent data points for two linear equations. If the two equations form a system, what is the  $x$ -coordinate of the solution to that system?

**Difficulty:** Medium

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** The solution to the system is the point that both tables will have in common, but the tables, as given, do not share any points. You could use the data to write the equation of each line and then solve the system, but this would use up valuable time on Test Day. Instead, whenever data is presented in a table, look for patterns that can be extended.

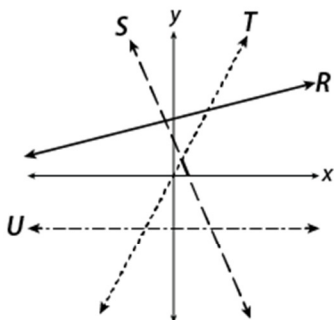
**Getting to the Answer:** In the table on the left, the  $x$ -values decrease by 1 each time and the  $y$ -values increase by 3. In the table on the right, the  $x$ -values increase by 2 each time and the  $y$ -values increase by 1. Use these patterns to continue the tables:

Equation 1	
$x$	$y$
5	-8
4	-5
3	-2
2	1
1	4
0	7

Equation 2	
$x$	$y$
-8	3
-6	4
-4	5
-2	6
0	7
2	8

The point  $(0, 7)$  satisfies both equations, so the  $x$ -coordinate of the solution to the system is 0.

8.



Which of the following lists correctly orders the lines in the figure above according to their slopes, from least to greatest?

- (A)  $R, T, S, U$
- (B)  $S, U, R, T$
- (C)  $S, R, U, T$
- (D)  $U, S, R, T$

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** A horizontal line has a slope of 0. Lines that slant downward from left to right have a negative slope, and lines that slant upward from left to right have a positive slope.

**Getting to the Answer:** Only one line has a negative slope,  $S$ , so it should come first in the list. This means you can eliminate A and D. Next comes the horizontal line with a slope of 0, which is line  $U$ . You can now eliminate C, which means (B) must be correct. To confirm (which isn't absolutely necessary), there are two lines with positive slopes:  $R$  and  $T$ . Line  $T$  has a steeper slant than line  $R$ , which means line  $T$  has a greater slope; therefore, the correct ordering is  $S, U, R, T$ .

## 9. Calculator

Price per Pencil	Projected Number of Units Sold
\$0.20	150,000
\$0.25	135,000
\$0.30	120,000
\$0.35	105,000
\$0.40	90,000
\$0.45	75,000

Generally, the price of an item is a good indicator of how many units of that item will be sold. The lower the price, the more units will be sold. A marketing department develops a table showing various price points and the projected number of units sold at that price point. Which of the following represents the linear relationship shown in the table, where  $x$  is the price and  $y$  is the number of units sold?

- (A)  $y = 0.03x + 150,000$   
(B)  $y = 300,000x + 75,000$   
(C)  $y = -300,000x + 90,000$   
(D)  $y = -300,000x + 210,000$

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Take a quick peek at the answer choices. The equations are given in slope-intercept form, so start by finding the slope.

**Getting to the Answer:** Find the slope by substituting two pairs of values from the table (try to pick easy ones, if possible) into the slope formula,  $m = \frac{y_2 - y_1}{x_2 - x_1}$ . Keep in mind that the projected number of units sold depends on the price, so the price is the independent variable ( $x$ ) and the projected number is the dependent variable ( $y$ ). Using the points (0.2, 150,000) and (0.4, 90,000), the slope is:

$$\begin{aligned} m &= \frac{150,000 - 90,000}{0.2 - 0.4} \\ &= \frac{60,000}{-0.2} \\ &= -300,000 \end{aligned}$$

This means you can eliminate A and B because the slope is not correct. Don't let B fool you—the projected number of units sold goes down as the price goes up, so there is an inverse relationship, which means the slope must be negative. To choose between C and D, you could find the  $y$ -intercept of the line, but this is a fairly time-intensive process. Instead, choose any pair of values from the table, such as (0.2, 150,000), and substitute into C and D only. Choice (D) is correct because  $150,000 = -300,000(0.2) + 210,000$  is a true statement.

## 10. Calculator

A mailing supply store sells small shipping boxes in packs of 8 or 20. If the store has 61 packs in stock totaling 800 small shipping boxes, how many packs have 20 boxes in them, assuming all the packs are full?

- (A) 26  
(B) 32  
(C) 35  
(D) 40

**Difficulty:** Medium

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Create a system of linear equations where  $e$  represents the number of packs with 8 boxes and  $t$  represents the number of packs with 20 boxes. Before selecting your final answer, make sure you answered the right question (the number of packs that have 20 boxes).

**Getting to the Answer:** The first equation should represent the total number of packs,  $e + t = 61$ . The second equation should represent the total number of boxes. Because  $e$  represents packs with 8 boxes and  $t$  represents packs with 20 boxes, the second equation should be  $8e + 20t = 800$ . Now, solve the system using substitution. Solve the first equation to find that  $e = 61 - t$ . Then, substitute the result into the second equation:

$$8e + 20t = 800$$

$$8(61 - t) + 20t = 800$$

$$488 - 8t + 20t = 800$$

$$488 + 12t = 800$$

$$12t = 312$$

$$t = 26$$

We assigned the variable  $t$  to the number of packs with 20 boxes, so 26 packs have 20 boxes. This is what the question asks for, so you don't need to find the value of  $e$ .