

1.

x	y
-1	7
0	5
1	3
2	1

If graphed, the ordered pairs in the table above would form a line. Where would this line intersect the x -axis?

- (A) $-2\frac{1}{2}$
 (B) $-\frac{1}{2}$
 (C) $2\frac{1}{2}$
 (D) 5

Difficulty: Medium

Category: Heart of Algebra / Linear Equations

Strategic Advice: Be careful—the 0 in the table is an x -value, which means it shows the y -intercept, not the x -intercept. You are looking for the point at which $y = 0$.

Getting to the Answer: You could use two of the points in the table and the slope formula to find the equation of the line, then substitute 0 for y and solve for x . However, this would use up valuable time. Instead, look for a pattern in the table. If you continue the pattern, the next ordered pair would be $(3, -1)$, which would mean the line has dropped below the x -axis. This means the graph of the line crosses the x -axis somewhere between the x -values of 2 and 3. The only answer choice that is between 2 and 3 is (C).

2.

Johanna picked 3 pounds of strawberries at a “pick-your-own” patch. At this particular patch, the cost is \$1.50 for the pail and \$3.99 per pound of strawberries picked. If a linear equation is created to represent the situation and written in the form $y = mx + b$, which piece of the equation would the value 13.47 in this scenario most likely represent?

- (A) b
 (B) m
 (C) x
 (D) y

Difficulty: Medium

Category: Heart of Algebra / Linear Equations

Strategic Advice: When a real-world scenario is modeled using a linear equation, b is a flat fee or starting amount, m is a unit rate, x represents the number of units, and y represents a total amount.

Getting to the Answer: Write the equation in words first, adding the variables as you go. The total cost, y , is equal to the cost per pound, m , multiplied by the number of pounds, x , and added to the cost of the pail, b . You can eliminate A and B because b is 1.50 (the cost of the pail) and m is 3.99 (the cost per pound). You can also eliminate C because Johanna picks 3 pounds, so x is 3. Choice (D) is correct because the total cost of picking 3 pounds is $3.99(3) + 1.50 = 13.47$. This means 13.47 most likely represents the total cost, y .

3.

If $y = 12 - x$ and $\frac{3y}{4} + 11 = \frac{-x}{2}$, what is the value of $\frac{x}{5} + \frac{y}{4}$?

- (A) $\frac{-1}{75}$
(B) $\frac{4}{4}$
(C) $\frac{19}{4}$
(D) 33

Difficulty: Hard

Category: Heart of Algebra / Systems of Linear Equations

Strategic Advice: Don't let all the fractions intimidate you. There are two equations and two variables, so solve this system the same way you would solve any other system of equations.

Getting to the Answer: The first equation is already solved perfectly for y , so use substitution. To make the second equation easier to work with, multiply it by 4 to clear the fractions (even though you may have noticed the tempting 4 in the denominator of the desired expression).

$$\begin{aligned}4\left(\frac{3y}{4} + 11 = \frac{-x}{2}\right) \\ 3y + 44 = -2x \\ 3(12 - x) + 44 = -2x \\ 36 - 3x + 44 = -2x \\ 80 - 3x = -2x \\ 80 = x\end{aligned}$$

Next, substitute 80 for x into the first equation and solve for y .

$$y = 12 - 80$$

$$y = -68$$

Finally, substitute the values you found into the expression in the question $\frac{x}{5} + \frac{y}{4}$:

$$\frac{80}{5} + \frac{(-68)}{4} = 16 + (-17) = -1$$

4. Calculator

Rasha volunteers at a charity that helps feed the homeless. He collects donations and then uses the money to buy food for care packages. This week, he collected \$145. Each care package will include canned vegetables and bags of rice in the ratio 3:1. The cans cost \$0.89 each, and the bags of rice cost \$3.49 each. Using the given ratio, what is the maximum number of complete vegetable/rice care packages Rasha can make?

Difficulty: Medium

Category: Heart of Algebra / Inequalities

Strategic Advice: When a question asks about a maximum (or minimum) amount, it usually means you need to create and solve an inequality.

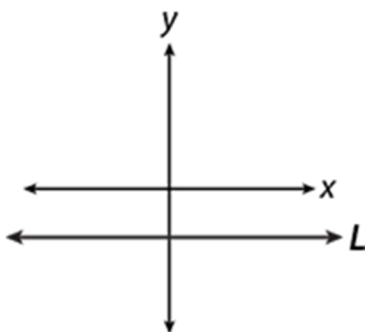
Getting to the Answer: Write the inequality in words first. The cost of 3 cans of vegetables plus the cost of 1 bag of rice, all multiplied by the number of care packages Rasha makes, must be less than or equal to the amount of money he collected, \$145. Because you are not asked to differentiate between cans and rice, they can be represented by the same variable. Just don't forget to multiply the cost of 1 can by 3 first ($\$0.89 \times 3 = \2.67). Let p represent the number of care packages:

$$(2.67 + 3.49)p \leq 145$$

$$6.16p \leq 145$$

$$p \leq 23.54$$

5.



Line L shown in the graph could be the graph of which equation?

- (A) $x + y = -2$
- (B) $x + y = 0$
- (C) $x + y - 2 = x$
- (D) $x + y + 2 = x$

Difficulty: Medium

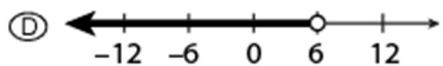
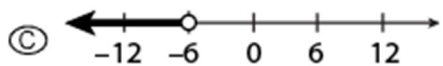
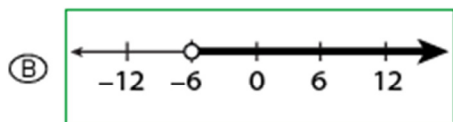
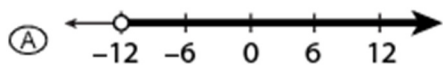
Category: Heart of Algebra / Linear Equations

Strategic Advice: Horizontal and vertical lines have special forms. A horizontal line has a slope of 0 and an equation that always looks like $y = b$, where b is a constant. A vertical line has an undefined slope and always looks like $x = b$.

Getting to the Answer: Line L shown in the graph is horizontal, so you are looking for an equation that once simplified (or written in $y = mx + b$ form) looks like $y = b$. In other words, all the x -terms must cancel out. In addition, because the line is below the x -axis, b must be a negative number. Check each answer choice to see if it takes on the desired form. Choice A $\rightarrow y = -x - 2$, so eliminate it. Choice B $\rightarrow y = -x$, so eliminate it. Choice C $\rightarrow y = 2$, which is in the correct form, but 2 is positive and the graph would be above the x -axis, so eliminate it. This means (D) must be correct—subtracting x and 2 from both sides of the equation results in $y = -2$, which could be the equation of line L .

6.

Which of the following number lines represents the solution to the inequality $3x + 29 > 5 - x$?



Difficulty: Easy

Category: Heart of Algebra / Inequalities

Strategic Advice: Solve the inequality using inverse operations. Then compare your answer with each of the number lines shown. Remember, on a number line, numbers to the right are greater than numbers to the left.

Getting to the Answer:

$$3x + 29 > 5 - x$$

$$4x + 29 > 5$$

$$4x > -24$$

$$x > -6$$

There should be an open dot at -6 , with shading to the right, so (B) is correct. Don't be fooled by C. You only reverse the inequality symbol when you multiply or divide by a negative number, not when the answer is negative.

7.

At the grocery store, Gigi buys apples, a magazine, and a gallon of milk. The apples are priced per pound. In her state, there is no sales tax on food. If the total cost of her items is given by the function $C(p) = 1.89p + 1.07(3.99) + 4.49$, then the term $1.07(3.99)$ most likely represents

- (A) the cost of one gallon of milk.
- (B) the per-pound cost of the apples.
- (C) the cost of the magazine, including tax.
- (D) the cost of the magazine, not including tax.

Difficulty: Medium

Category: Heart of Algebra / Linear Equations

Strategic Advice: In a real-world scenario, a onetime fee does not depend on the variable and is therefore a constant. A unit rate, however, is always multiplied by the independent variable.

Getting to the Answer: The total cost consists of the gallon of milk (a constant), the per-pound cost of the apples (which depends on the number of pounds), and the cost of the magazine (which is the only taxed item). The constant in the equation is 4.49 and is, therefore, the cost of the gallon of milk; 1.89 is being multiplied by p (the number of pounds), so $\$1.89$ must be the per-pound cost of the apples. That leaves the remaining term, $1.07(3.99)$, which must be the cost of the magazine ($\$3.99$) plus a 7% sales tax.

8.

When a homeowner hires a contractor to renovate a bathroom, the homeowner is charged for both labor and materials. By law, the contractor can charge sales tax on the materials, but not on the labor. If the contractor quotes the homeowner $\$3,000$ for materials and $\$40$ per hour for labor, and sales tax in the homeowner's state is 5.5%, which equation represents the total cost for the bathroom renovation if it takes the contractor h hours to complete the job?

- (A) $c = (40h + 3,000)(1.055)$
- (B) $c = 1.055(40 + 3,000)h$
- (C) $c = 40h(1.055) + 3,000$
- (D) $c = 40h + 1.055(3,000)$

Difficulty: Medium

Category: Heart of Algebra / Linear Equations

Strategic Advice: Organize information as you read the question; the total cost includes the labor cost, the cost of the materials, and the 5.5% tax on the *materials only*.

Getting to the Answer: If the contractor works h hours, the labor cost of the renovation is the per-hour rate (\$40) multiplied by the number of hours (h) or $40h$. To this amount, add the \$3,000 for materials, which are taxed at a rate of 5.5% and should therefore be multiplied by 1.055. The total cost is given by the equation $c = 40h + 1.055(3,000)$, which is (D).

9.

A picture framing shop sells ready-made frames and also does custom framing using different kinds and widths of wood or metal. The shop has a three-day sale. During the sale, for an 11-inch \times 14-inch frame, a ready-made frame costs \$12 and a custom frame costs \$30. Over the course of the three days, the shop sells ninety-two 11 \times 14 frames and collects \$1,788. Solving which system of equations would yield the number of 11 \times 14 ready-made frames r and the number of 11 \times 14 custom frames c that the shop sold during the three-day sale?

- (A) $\begin{cases} r + c = 92 \\ 12r + 30c = \frac{1,788}{3} \end{cases}$
- (B) $\begin{cases} r + c = 1,788 \\ 12r + 30c = 92 \times 3 \end{cases}$
- (C) $\begin{cases} r + c = 1,788 \\ 12r + 30c = 92 \end{cases}$
- (D) $\begin{cases} r + c = 92 \\ 12r + 30c = 1,788 \end{cases}$

Difficulty: Medium

Category: Heart of Algebra / Systems of Linear Equations

Strategic Advice: One equation should represent the total *number* of frames, while the other equation should represent the *revenue* from the frames.

Getting to the Answer: The number of custom frames c plus the number of ready-made frames r equals the total number of frames sold, 92. Therefore, one equation is $c + r = 92$. This means you can eliminate B and C. Now write the revenue equation: revenue per custom frame ($30c$) plus revenue per ready-made frame ($12r$) equals the total amount collected (1,788). The revenue equation is $30c + 12r = 1,788$. Don't let A fool you. The question says nothing about the revenue *per day* of the sale, so there is no reason to divide by 3. Choice (D) is correct.

10. Calculator

City	Cost per Square Foot
Detroit	\$62.45
Atlanta	\$74.19
New York City	\$288.58
San Francisco	\$420.99

In real estate, location is often the number one determinant of home prices. The table above shows the average price per square foot of houses in four cities. Assuming an average home size of 1,500 to 2,000 square feet, which inequality represents how much more in dollars a house in New York City would cost than in Detroit?

- (A) $x \geq 226.13$
- (B) $62.45 \leq x \leq 288.58$
- (C) $93,675 \leq x \leq 432,870$
- (D) $339,195 \leq x \leq 452,260$

Difficulty: Medium

Category: Heart of Algebra / Inequalities

Strategic Advice: The best way to answer this question is to pretend you are a homebuyer. How much more per square foot would your house cost in New York than Detroit? If the house was 1,500 square feet, how much more would this be? If the house was 2,000 square feet, how much more would this be?

Getting to the Answer: Based on the data in the table, a house would cost $\$288.58 - \$62.45 = \$226.13$ more per square foot in New York than in Detroit. If the house was 1,500 square feet, it would cost $1,500(226.13) = \$339,195$ more. If the house was 2,000 square feet, it would cost $2,000(226.13) = \$452,260$ more. So, the house would cost somewhere between $\$339,195$ and $\$452,260$ more, which can be expressed as the compound inequality $339,195 \leq x \leq 452,260$.