



Lesson 1

Problem 1

Tyler reads $\frac{2}{15}$ of a book on Monday, $\frac{1}{3}$ of it on Tuesday, $\frac{2}{9}$ of it on Wednesday, and $\frac{3}{4}$ of the remainder on Thursday. If he still has 14 pages left to read on Friday, how many pages are there in the book?

Solution

180 pages

Problem 2

Clare asks Andre to play the following number puzzle:

- Pick a number
- Add 2
- Multiply by 3
- Subtract 7
- Add your original number

Andre's final result is 27. Which number did he start with?

Solution

Andre's starting number was 7.

$3(x + 2) - 7 + x$ simplifies to $4x - 1$. $4x - 1 = 27$ has solution $x = 7$.

Problem 3

In a basketball game, Elena scores twice as many points as Tyler. Tyler scores four points fewer than Noah, and Noah scores three times as many points as Mai. If Mai scores 5 points, how many points did Elena score? Explain your reasoning.

Solution

22 points. Noah scores 15 points, which means Tyler scores 11 points, and Elena scores twice as many points as Tyler.

Problem 4

(from Unit 3, Lesson 12)

Select **all** of the given points in the coordinate plane that lie on the graph of the linear equation $4x - y = 3$.

- A. (-1, -7)
- B. (0, 3)
- C. ($\frac{3}{4}$, 0)
- D. (1, 1)
- E. (2, 5)
- F. (4, -1)

Solution

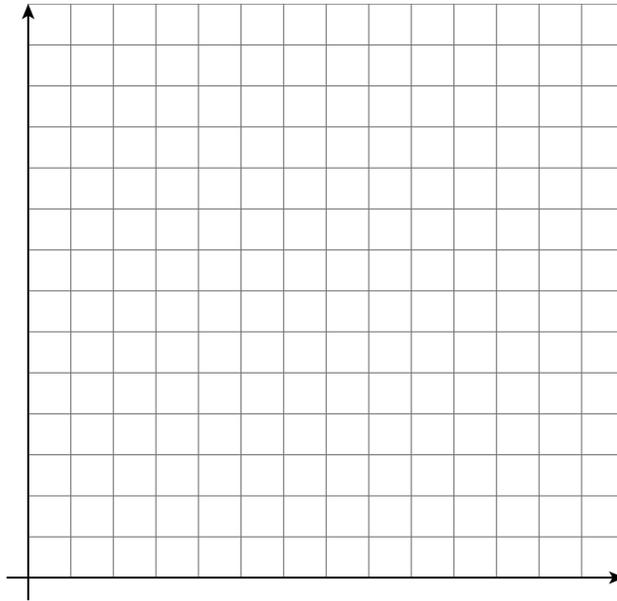
A, C, D, E

Problem 5

(from Unit 3, Lesson 5)

A store is designing the space for rows of nested shopping carts. Each row has a starting cart that is 4 feet long, followed by the nested carts (so 0 nested carts means there's just the starting cart). The store measured a row of 13 nested carts to be 23.5 feet long, and a row of 18 nested carts to be 31 feet long.

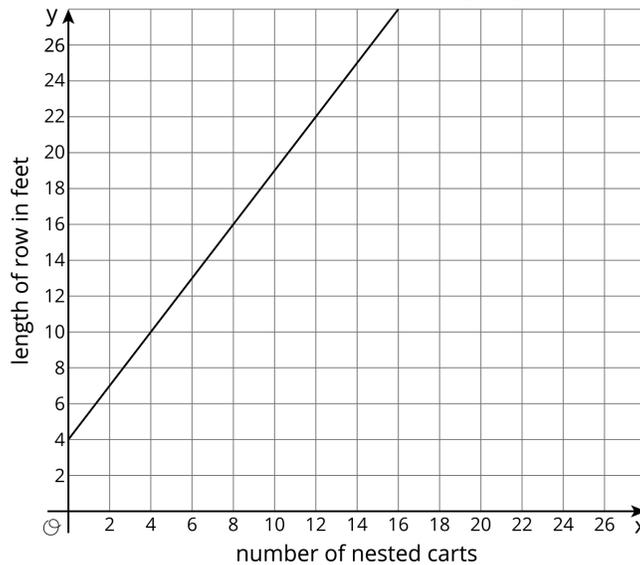
1. Create a graph of the situation.



2. How much does each nested cart add to the length of the row? Explain your reasoning.
3. If the store design allows for 43 feet for each row, how many total carts fit in a row?

Solution

- 1.

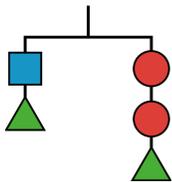


2. 1.5 feet. Explanations vary. Sample response: The slope, which can be found with the calculation $\frac{31-23.5}{18-13}$ tells the rate of change, or amount that each nested cart adds.
3. 26 nested carts, or 27 carts total. Explanations vary. Sample response: We can subtract 4 feet from 43 feet for the starting cart and then divide by 1.5 to find the number of nested carts that will fit. We can use a table and repeatedly add 1.5. There are 12 more feet from 31 to 43, so $12 \div 1.5$, or 8 more carts, can be added to 18.

Lesson 2

Problem 1

Which of the changes would keep the hanger in balance? Select all that apply.



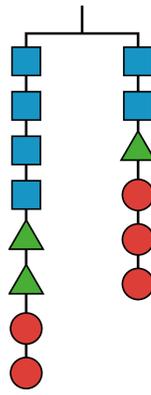
- A. Adding two circles on the left and a square on the right
- B. Adding 2 triangles to each side
- C. Adding two circles on the right and a square on the left
- D. Adding a circle on the left and a square on the right
- E. Adding a triangle on the left and a square on the right

Solution

A, B, C

Problem 2

Here is a balanced hanger diagram.



Each triangle weighs 2.5 pounds, each circle weighs 3 pounds, and x represents the weight of each square. Select *all* equations that represent the hanger.

- A. $x + x + x + x + 11 = x + 11.5$
- B. $2x = 0.5$
- C. $4x + 5 + 6 = 2x + 2.5 + 6$
- D. $2x + 2.5 = 3$
- E. $4x + 2.5 + 2.5 + 3 + 3 = 2x + 2.5 + 3 + 3 + 3$

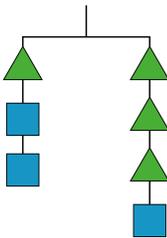
Solution

B, D, and E. A is missing an x on the right side of the equation and C is missing 3 on the right side.

Problem 3

What is the weight of a square if a triangle weighs 4 grams?

Explain your reasoning.



Solution

8 grams. There is one more square on the left than on the right and two more triangles on the right than on the left. So the square on the left balances with two triangles on the right.

Problem 4

(from Unit 4, Lesson 1)

Andre came up with the following puzzle. "I am three years younger than my brother, and I am 2 years older than my sister. My mom's age is one less than three times my brother's age. When you add all our ages, you get 87. What are our ages?"

1. Try to solve the puzzle.
2. Jada writes this equation for the sum of the ages: $(x) + (x + 3) + (x - 2) + 3(x + 3) - 1 = 87$. Explain the meaning of the variable and each term of the equation.
3. Write the equation with fewer terms.
4. Solve the puzzle if you haven't already.

Solution

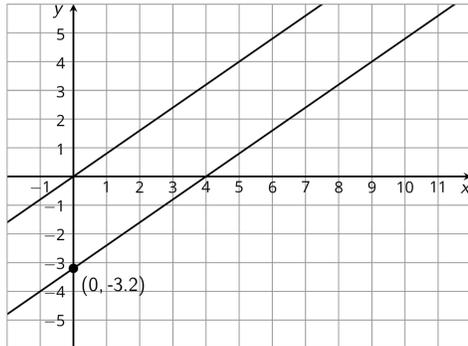
1. Answers vary.

2. x is the age of Andre; $x + 3$ is the age of Andre's brother; $x - 2$ is the age of Andre's sister; $3(x + 3) - 1$ is the age of Andre's mother; 87 is the total of all the ages.
3. Use the distributive property and combine like terms to get $6x + 9 = 87$.
4. Since $6x + 9 = 87$, we also know that $6x = 78$ and $x = 13$ are true. So, Andre is 13, his brother is 16, his sister is 11, and his mom is 47.

Problem 5

(from Unit 3, Lesson 8)

These two lines are parallel. Write an equation for each.



Solution

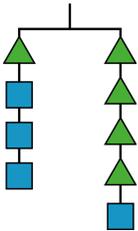
Answers vary. Possible responses:

- $y = 4/5x$ (or $\frac{y}{x} = \frac{4}{5}$, or $\frac{y-4}{x-5} = \frac{4}{5}$)
- $y = \frac{4}{5}(x - 4)$ (or $\frac{y}{x-4} = \frac{4}{5}$)

Lesson 3

Problem 1

In this hanger, the weight of the triangle is x and the weight of the square is y .



1. Write an equation using x and y to represent the hanger.
2. If x is 6, what is y ?

Solution

1. $x + 3y = 4x + y$
2. $y = 9$

Problem 2

Match each set of equations with the move that turned the first equation into the second.

- A. $6x + 9 = 4x - 3$
 $2x + 9 = -3$
- B. $-4(5x - 7) = -18$
 $5x - 7 = 4.5$

$$\begin{aligned} \text{C. } 8 - 10x &= 7 + 5x \\ 4 - 10x &= 3 + 5x \end{aligned}$$

$$\begin{aligned} \text{D. } \frac{-5x}{4} &= 4 \\ 5x &= -16 \end{aligned}$$

$$\begin{aligned} \text{E. } 12x + 4 &= 20x + 24 \\ 3x + 1 &= 5x + 6 \end{aligned}$$

1. Multiply both sides by $\frac{-1}{4}$
2. Multiply both sides by -4
3. Multiply both sides by $\frac{1}{4}$
4. Add $-4x$ to both sides
5. Add -4 to both sides

Solution

- A. 4
- B. 1
- C. 5
- D. 2
- E. 3

Problem 3

Andre and Diego were each trying to solve $2x + 6 = 3x - 8$. Describe the first step they each make to the equation.

1. The result of Andre's first step was $-x + 6 = -8$.
2. The result of Diego's first step was $6 = x - 8$.

Solution

1. Andre subtracted $3x$ from each side.
2. Diego subtracted $2x$ from each side.

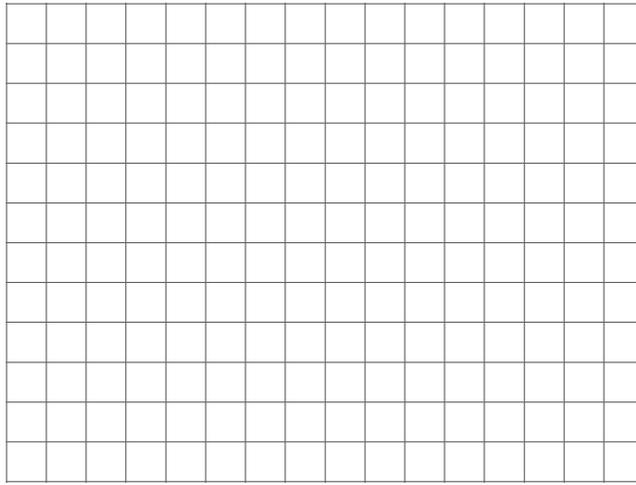
Problem 4

(from Unit 3, Lesson 11)

1. Complete the table with values for x or y that make this equation true: $3x + y = 15$.

x	2		6	0	3		
y		3				0	8

2. Create a graph, plot these points, and find the slope of the line that goes through them.



Solution

1.

x	2	4	6	0	3	5	$\frac{7}{3}$
y	9	3	-3	15	6	0	8

2. Slope = -3

Problem 5

(from Unit 3, Lesson 14)

Select **all** the situations for which only zero or positive solutions make sense.

- A. Measuring temperature in degrees Celsius at an Arctic outpost each day in January.
- B. The height of a candle as it burns over an hour.
- C. The elevation above sea level of a hiker descending into a canyon.
- D. The number of students remaining in school after 6:00 p.m.
- E. A bank account balance over a year.
- F. The temperature in degrees Fahrenheit of an oven used on a hot summer day.

Solution

B, D, F

Lesson 4

Problem 1

Mai and Tyler work on the equation $\frac{2}{5}b + 1 = -11$ together. Mai's solution is $b = -25$ and Tyler's is $b = -28$. Here is their work:

Mai:

$$\frac{2}{5}b + 1 = -11$$

$$\frac{2}{5}b = -10$$

$$b = -10 \cdot \frac{5}{2}$$

$$b = -25$$

Tyler:

$$\frac{2}{5}b + 1 = -11$$

$$2b + 1 = -55$$

$$2b = -56$$

$$b = -28$$

Do you agree with their solutions? Explain or show your reasoning.

Solution

No, they both have errors in their solutions. Explanations vary. Sample response: Mai added -1 on the left side and 1 on the right side of the equation. Tyler multiplied both sides of the equation by 5 but forgot to multiply the 1 by 5.

Problem 2

Solve $3(x - 4) = 12x$

Solution

$x = -\frac{4}{3}$. One way to solve is to distribute, subtract $3x$ from each side, and divide by 9. Another way is to first divide each side by 3, subtract x from each side, then divide each side by 3.

Problem 3

Describe what is being done in each step while solving the equation.

1. $2(-3x + 4) = 5x + 2$
2. $-6x + 8 = 5x + 2$
3. $8 = 11x + 2$
4. $6 = 11x$
5. $x = \frac{6}{11}$

Solution

1. Original equation
2. Distributive property
3. Add $6x$ to each side
4. Subtract 2 from each side
5. Multiply each side by $\frac{1}{11}$

Problem 4

Andre solved an equation, but when he checked his answer he saw his solution was incorrect. He knows he made a mistake, but he can't find it. Where is Andre's mistake and what is the solution to the equation?

$$\begin{aligned} -2(3x - 5) &= 4(x + 3) + 8 \\ -6x + 10 &= 4x + 12 + 8 \\ -6x + 10 &= 4x + 20 \\ 10 &= -2x + 20 \\ -10 &= -2x \\ 5 &= x \end{aligned}$$

Solution

Andre's mistake occurred in the transition from the 3rd line to the 4th line. He added $6x$ on the left side but subtracted $6x$ on the right side. The correct solution is $x = -1$.

Problem 5

(from Unit 3, Lesson 12)

Choose the equation that has solutions (5, 7) and (8, 13).

- A. $3x - y = 8$
- B. $y = x + 2$
- C. $y - x = 5$
- D. $y = 2x - 3$

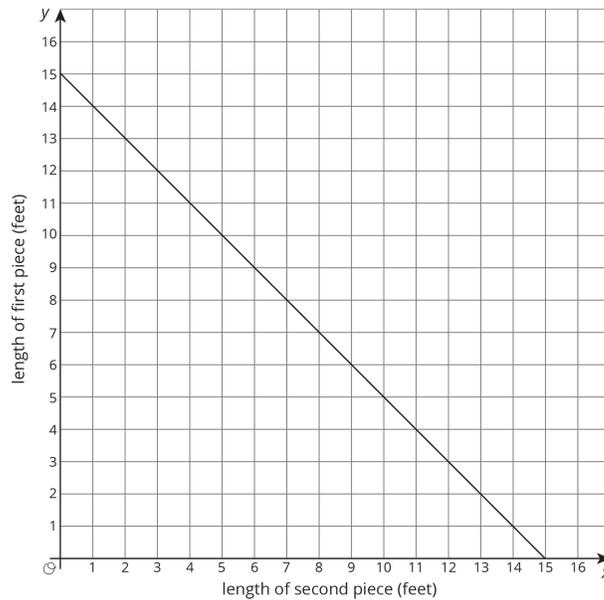
Solution

D

Problem 6

(from Unit 3, Lesson 9)

A length of ribbon is cut into two pieces to use in a craft project. The graph shows the length of the second piece, x , for each length of the first piece, y .



1. How long is the ribbon? Explain how you know.
2. What is the slope of the line?
3. Explain what the slope of the line represents and why it fits the story.

Solution

1. 15 feet. Explanations vary. Sample response: When the second piece is 0 feet long, the first is 15 feet long, so that is the length of the ribbon.
2. -1
3. Answers vary. Sample response: The slope shows the change in length of one piece for every 1 foot increase in length of the other piece. If one piece is 1 foot longer, the other is 1 foot shorter because the total of the two lengths is constant.

Lesson 5

Problem 1

Solve each of these equations. Explain or show your reasoning.

$$2(x + 5) = 3x + 1$$

$$3y - 4 = 6 - 2y$$

$$3(n + 2) = 9(6 - n)$$

Solution

1. $x = 9$. Responses vary. Sample response: Distribute 2 on the left side, add -1 to each side, then add $-2x$ to each side.
2. $y = 2$. Responses vary. Sample response: Distribute 2 on the right side, add $2y$ to each side, add 4 to each side, then divide each side by 5.
3. $n = 4$. Responses vary. Sample response: Divide each side by 3, distribute 3 on the right side, subtract 2 from each side, add $3n$ to each side, then divide each side by 4.

Problem 2

Clare was solving an equation, but when she checked her answer she saw her solution was incorrect. She knows she made a mistake, but she can't find it. Where is Clare's mistake and what is the solution to the equation?

$$\begin{aligned}
 12(5 + 2y) &= 4y - (5 - 9y) \\
 72 + 24y &= 4y - 5 - 9y \\
 72 + 24y &= -5y - 5 \\
 24y &= -5y - 77 \\
 29y &= -77 \\
 y &= \frac{-77}{29}
 \end{aligned}$$

Solution

Clare's mistake occurred in the transition from the 1st line to the 2nd line. She wrote $4y - 9y$ as $4y - 9y$ instead of $4y + 9y$ and $12(5)=72$ instead of $12(5)=60$. The correct solution is $y = -\frac{65}{11}$.

Problem 3

Solve each equation, and check your solution.

$$\frac{1}{9}(2m - 16) = \frac{1}{3}(2m + 4)$$

$$-4(r + 2) = 4(2 - 2r)$$

$$12(5 + 2y) = 4y - (6 - 9y)$$

Solution

$$1. m = -7$$

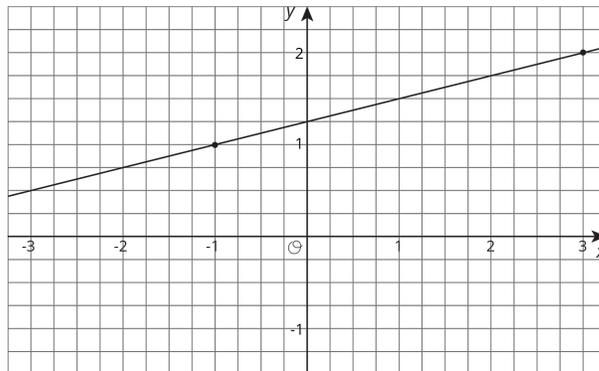
$$2. r = 4$$

$$3. y = -6$$

Problem 4

(from Unit 3, Lesson 13)

Here is the graph of a linear equation.



Select **all** true statements about the line and its equation.

- A. One solution of the equation is (3, 2).
- B. One solution of the equation is (-1, 1).
- C. One solution of the equation is $(1, \frac{3}{2})$.
- D. There are 2 solutions.
- E. There are infinitely many solutions.
- F. The equation of the line is $y = \frac{1}{4}x + \frac{5}{4}$.
- G. The equation of the line is $y = \frac{5}{4}x + \frac{1}{4}$.

Solution

A, B, C, E, F

Problem 5

(from Unit 3, Lesson 9)

A participant in a 21-mile walkathon walks at a steady rate of 3 miles per hour. He thinks, "The relationship between the number of miles left to walk and the number of hours I already walked can be represented by a line with slope -3." Do you agree with his claim? Explain your reasoning.

Solution

Yes. Explanations vary. Sample response: The walker completes 3 miles each hour, so 3 is subtracted for each 1 hour walked. Another sample response: Points on the graph of remaining miles (y) and hours walked (x) could be $(0, 21)$, $(1, 18)$, $(2, 15)$, $(3, 12)$, etc., so the line slopes down. Another sample response: The number of miles remaining decreases by 3 for every increase of 1 in the hours walked.

Lesson 6

Problem 1

Solve each of these equations. Explain or show your reasoning.

$$1. 2b + 8 - 5b + 3 = -13 + 8b - 5$$

$$2. 2x + 7 - 5x + 8 = 3(5 + 6x) - 12x$$

$$3. 2c - 3 = 2(6 - c) + 7c$$

Solution

1. $b = \frac{29}{11}$. Responses vary. Sample response: Collect like terms on each side, add 18 to each side, add $3x$ to each side, then divide each side by 11.

2. $x = 0$. Responses vary. Sample response: Collect like terms on the left side, distribute and collect like terms on the right side, add $3x$, subtract 15 from each side, then divide each side by 9.

3. $c = -5$. Responses vary. Sample response: Distribute and collect like terms on each side, subtract 12 from each side, subtract $2x$ from each side, then divide each side by 3.

Problem 2

Solve each equation and check your solution.

$$1. -3w - 4 = w + 3$$

$$2. 3(3 - 3x) = 2(x + 3) - 30$$

$$3. \frac{1}{3}(z + 4) - 6 = \frac{2}{3}(5 - z)$$

Solution

$$1. w = -\frac{7}{4}$$

$$2. x = 3$$

$$3. z = 8$$

Problem 3

Elena said the equation $9x + 15 = 3x + 15$ has no solutions because $9x$ is greater than $3x$. Do you agree with Elena? Explain your reasoning.

Solution

Elena is incorrect. Responses vary. Sample response: $9x > 3x$ when $x > 0$, but $9x < 3x$ when $x < 0$ and $9x = 3x$ when $x = 0$. The solution to the equation is $x = 0$.

Problem 4

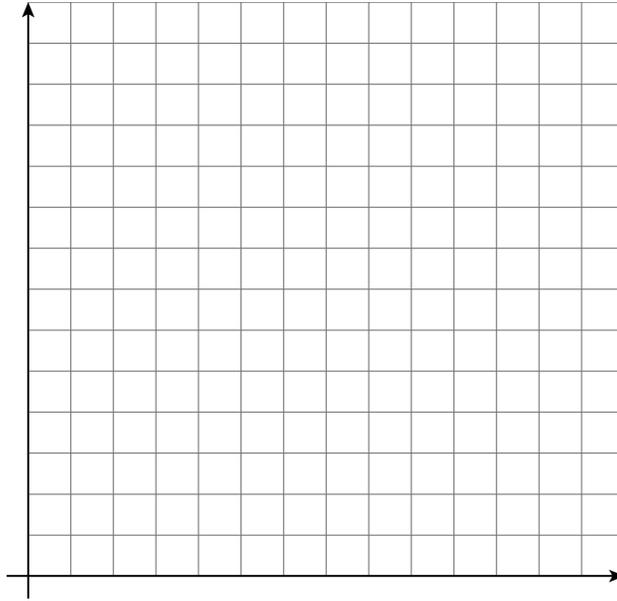
(from Unit 3, Lesson 3)

The table gives some sample data for two quantities, x and y , that are in a proportional relationship.

x	y
14	21
64	
	39
1	

1. Complete the table.

- Write an equation that represents the relationship between x and y shown in the table.
- Graph the relationship. Use a scale for the axes that shows all the points in the table.

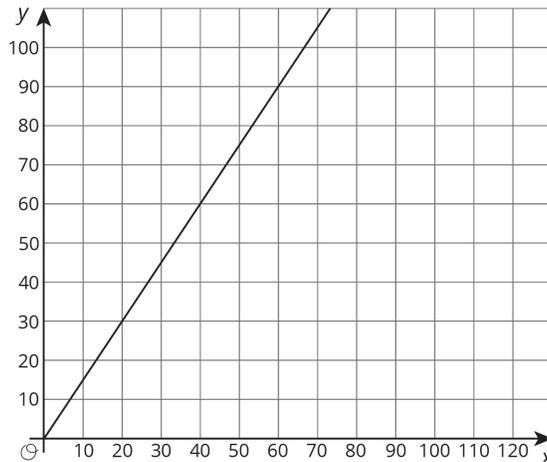


Solution

x	y
14	21
64	96
26	39
1	$\frac{3}{2}$

1. $y = \frac{3}{2}x$ (or equivalent)

2.



Lesson 7

Problem 1

For each equation, decide if it is always true or never true.

- $x - 13 = x + 1$
- $x + \frac{1}{2} = x - \frac{1}{2}$
- $2(x + 3) = 5x + 6 - 3x$
- $x - 3 = 2x - 3 - x$
- $3(x - 5) = 2(x - 5) + x$

Solution

1. Never true
2. Never true
3. Always true
4. Always true
5. Never true

Problem 2

Mai says that the equation $2x + 2 = x + 1$ has no solution because the left hand side is double the right hand side. Do you agree with Mai? Explain your reasoning.

Solution

Answers vary. Sample response: Mai is correct that $2x + 2 = 2(x + 1)$, so the left hand side in this equation is double the right hand side. But $-x$ and -1 can be added to both sides of the equation to get $x + 1 = 0$. So $x = -1$ is a solution. (This works because 0 is its own double, and it is the only number that is its own double.)

Problem 3

1. Write the other side of this equation so it's true for all values of x : $\frac{1}{2}(6x - 10) - x =$
2. Write the other side of this equation so it's true for no values of x : $\frac{1}{2}(6x - 10) - x =$

Solution

1. $2x - 5$ (or equivalent)
2. Answers vary. Sample response: $2x + 5$

Problem 4

Here is an equation that is true for all values of x : $5(x + 2) = 5x + 10$. Elena saw this equation and says she can tell $20(x + 2) + 31 = 4(5x + 10) + 31$ is also true for any value of x . How can she tell? Explain your reasoning.

Solution

Responses vary. Sample response: One could distribute the left side of the equation and show it is equal to the right side, but it is easier to see that each side of the original equation has been multiplied by 4 and added to 31. These moves keep both sides of the equation in balance, and so whatever values of x make the first equation true also make the second equation true.

Problem 5

(from Unit 4, Lesson 4)

Elena and Lin are trying to solve $\frac{1}{2}x + 3 = \frac{7}{2}x + 5$. Describe the change they each make to each side of the equation.

1. Elena's first step is to write $3 = \frac{7}{2}x - \frac{1}{2}x + 5$.
2. Lin's first step is to write $x + 6 = 7x + 10$.

Solution

1. Elena subtracted $\frac{1}{2}x$ from each side.
2. Lin multiplied each side by 2.

Problem 6

(from Unit 4, Lesson 6)

Solve each equation and check your solution.

$$3x - 6 = 4(2 - 3x) - 8x$$

$$\frac{1}{2}z + 6 = \frac{3}{2}(z + 6)$$

$$9 - 7w = 8w + 8$$

Solution

1. $x = \frac{14}{23}$

2. $z = -3$

3. $w = \frac{1}{15}$

Problem 7

(from Unit 3, Lesson 12)

The point $(-3, 6)$ is on a line with a slope of 4.

1. Find two more points on the line.
2. Write an equation for the line.

Solution

1. Answers vary. Sample response: $(-2, 10)$, $(-1, 14)$
2. $y = 4x + 18$ (or equivalent)

Lesson 8

Problem 1

Lin was looking at the equation $2x - 32 + 4(3x - 2462) = 14x$. She said, "I can tell right away there are no solutions, because on the left side, you will have $2x + 12x$ and a bunch of constants, but you have just $14x$ on the right side." Do you agree with Lin? Explain your reasoning.

Solution

Lin is correct. Responses vary. Sample response: Ignoring everything but the terms with x on the left side, we have $2x$ and $4(3x)$. In total, this will give $14x$. All of the constant terms on the left side are negative, so they won't cancel to 0. Therefore, we have $14x + \text{non-zero stuff} = 4x$, which will have no solutions.

Problem 2

Han was looking at the equation $6x - 4 + 2(5x + 2) = 16x$. He said, "I can tell right away there are no solutions, because on the left side, you will have $6x + 10x$ and a bunch of constants, but you have just $16x$ on the right side." Do you agree with Han? Explain your reasoning.

Solution

Han is incorrect. Responses vary. Sample response: Ignoring everything but the terms with x on the left side, we have $6x$ and $2(5x)$. In total, this will give $16x$. Collecting all the constant terms on the left side will give $-4 + 2(2)$, which is 0. Therefore, we have $16x + 0 = 16x$, which is true for all values of x .

Problem 3Decide whether each equation is true for all, one, or no values of x .

1. $6x - 4 = -4 + 6x$

2. $4x - 6 = 4x + 3$

3. $-2x + 4 = -3x + 4$

Solution

1. True for all values of x .
2. True for no values of x .
3. True for one value of x .

Problem 4

(from Unit 4, Lesson 4)

Solve each of these equations. Explain or show your reasoning.

- $3(x - 5) = 6$
- $2\left(x - \frac{2}{3}\right) = 0$
- $4x - 5 = 2 - x$

Solution

- $x = 7$. Explanations vary. Sample response: Multiply both sides by $\frac{1}{3}$, then add 5.
- $x = \frac{2}{3}$. Explanations vary. Sample response: Multiply both sides by $\frac{1}{2}$, then add $\frac{2}{3}$.
- $\frac{7}{5}$. Explanations vary. Sample response: Add x and 5 to both sides, then multiply by $\frac{1}{5}$.

Problem 5

(from Unit 3, Lesson 13)

The points $(-2, 0)$ and $(0, -6)$ are each on the graph of a linear equation. Is $(2, 6)$ also on the graph of this linear equation? Explain your reasoning.

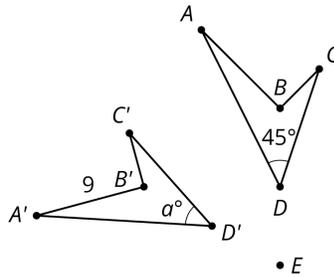
Solution

No. Answers vary. Sample response: If the two points are graphed with the line that goes through both of them, the line does not pass through the first quadrant where $(2, 6)$ is plotted.

Problem 6

(from Unit 1, Lesson 7)

In the picture triangle $A'B'C'$ is an image of triangle ABC after a rotation. The center of rotation is E .



- What is the length of side AB ? Explain how you know.
- What is the measure of angle D' ? Explain how you know.

Solution

- 9 units. Rotations preserve side lengths, and side $A'B'$ corresponds to side AB under this rotation.
- 45 degrees. Rotations preserve angle measures, and angles D and D' correspond to each other under this rotation.

Lesson 9**Problem 1**

Cell phone Plan A costs \$70 per month and comes with a free \$500 phone. Cell phone Plan B costs \$50 per month but does not come with a phone. If you buy the \$500 phone and choose Plan B, how many months is it until your cost is the same as Plan A's?

Solution

25 months

Problem 2

Priya and Han are biking in the same direction on the same path.

- Han is riding at a constant speed of 16 miles per hour. Write an expression that shows how many miles Han has gone after t hours.
- Priya started riding a half hour before Han. If Han has been riding for t hours, how long has Priya been riding?
- Priya is riding at a constant speed of 12 miles per hour. Write an expression that shows how many miles Priya has gone after Han has been riding for t hours.

4. Use your expressions to find when Han and Priya meet.

Solution

- $16t$ miles
- $t + \frac{1}{2}$ hours
- $12(t + \frac{1}{2})$
- $t = \frac{3}{2}$. To find when Han and Priya meet, set the two expressions equal to one another: $16t = 12(t + \frac{1}{2})$. They meet after Han rides for one and a half hours and Priya rides for two hours.

Problem 3

Which story matches the equation $-6 + 3x = 2 + 4x$?

- At 5 p.m., the temperatures recorded at two weather stations in Antarctica are -6 degrees and 2 degrees. The temperature changes at the same constant rate, x degrees per hour, throughout the night at both locations. The temperature at the first station 3 hours after this recording is the same as the temperature at the second station 4 hours after this recording.
- Elena and Kiran play a card game. Every time they collect a pair of matching cards, they earn x points. At one point in the game, Kiran has -6 points and Elena has 2 points. After Elena collects 3 pairs and Kiran collects 4 pairs, they have the same number of points.

Solution

A

Problem 4

For what value of x do the expressions $\frac{2}{3}x + 2$ and $\frac{4}{3}x - 6$ have the same value?

Solution

$$x = 12$$

Problem 5

(from Unit 4, Lesson 8)

Decide whether each equation is true for all, one, or no values of x .

- $2x + 8 = -3.5x + 19$
- $9(x - 2) = 7x + 5$
- $3(3x + 2) - 2x = 7x + 6$

Solution

- True for one value of x .
- True for one value of x .
- True for all values of x .

Problem 6

(from Unit 4, Lesson 6)

Solve each equation. Explain your reasoning.

- $3d + 16 = -2(5 - 3d)$
- $2k - 3(4 - k) = 3k + 4$
- $\frac{3y-6}{9} = \frac{4-2y}{-3}$

Solution

- $d = \frac{26}{3}$. Explanations vary. Sample response: Distribute on the right side of the equation, add 10 to each side, subtract $3d$ from each side, then divide each side by 3.

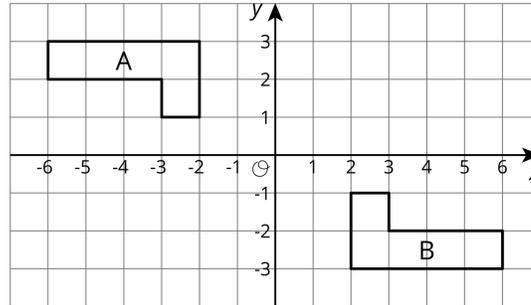
2. $k = 8$. Explanations vary. Sample response: Distribute and combine like terms on the left side, subtract $3k$ on each side, add 12 to each side, and then divide each side by 2.

3. $y = 2$. Explanations vary. Sample response: Multiply each side by 9, distribute -3 on the right side, subtract $3y$ on each side, add 12 to each side, and then divide each side by 3.

Problem 7

(from Unit 1, Lesson 7)

Describe a rigid transformation that takes Polygon A to Polygon B.



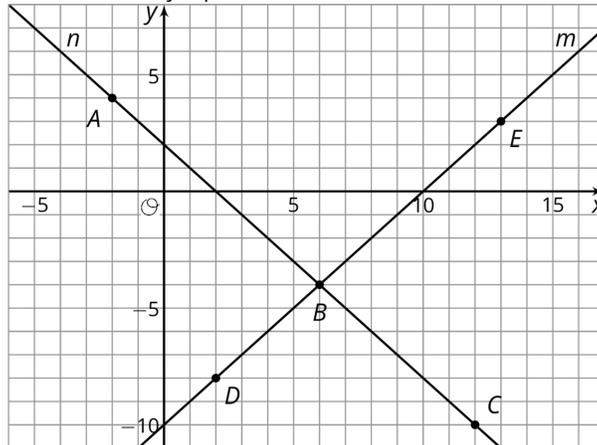
Solution

Answers vary. Sample response: Rotate Polygon A 180 degrees around $(0, 0)$.

Lesson 10

Problem 1

1. Match the lines m and n to the statements they represent:



- A set of points where the coordinates of each point have a sum of 2
- A set of points where the y -coordinate of each point is 10 less than its x -coordinate

2. Match the labeled points on the graph to statements about their coordinates:

- Two numbers with a sum of 2
- Two numbers where the y -coordinate is 10 less than the x -coordinate
- Two numbers with a sum of 2 and where the y -coordinate is 10 less than the x -coordinate

Solution

- n
 - m
- A, B, C
 - D, B, E
 - B

Problem 2

(from Unit 4, Lesson 7)

Here is an equation: $4x - 4 = 4x + \underline{\quad}$. What could you write in the blank so the equation would be true for:

1. No values of x
2. All values of x
3. One value of x

Solution

1. Answers vary. Sample response: 19. $4x - 4 = 4x + 19$ has no solutions.
2. Answers vary. Sample response: -4. $4x - 4 = 4x + -4$ is true for all values of x .
3. Answers vary. Sample response: $4x$. $4x - 4 = 4x + 4x$ has one solution ($x = -1$).

Problem 3

Mai earns \$7 per hour mowing her neighbors' lawns. She also earned \$14 for hauling away bags of recyclables for some neighbors.

Priya babysits her neighbor's children. The table shows the amount of money m she earns in h hours. Priya and Mai have agreed that when their earnings are the same, they will go to the movies together.

h	m
1	\$8.40
2	\$16.80
4	\$33.60

1. How many hours do they have to work before they go to the movies?
2. How much will they have earned?
3. Explain where the solution can be seen in tables of values, graphs, and equations that represent Priya's and Mai's hourly earnings.
4. Which representations did you make use of in your solution?

Solution

1. 10 hours
2. \$84
3. Explanations vary. Sample response: In the table of values we would see the same entry for h and m in both tables. In the graph, the solution is found in the coordinates of the point (h, m) where the graphs of the two relationships intersect. In the equations, it is the value of h when we set the two expressions for m equal to each other: $8.4h = 7h + 14$.
4. Answers vary.

Problem 4

(from Unit 4, Lesson 6)

For each equation, explain what you could do first to each side of the equation so that there would be no fractions. You do not have to solve the equations (unless you want more practice).

1. $\frac{3x - 4}{8} = \frac{x + 2}{3}$

2. $\frac{3(2 - r)}{4} = \frac{3 + r}{6}$

3. $\frac{4p + 3}{8} = \frac{p + 2}{4}$

4. $\frac{2(a-7)}{15} = \frac{a+4}{6}$

Solution

1. Explanations vary. Sample response: If you multiply each side by 24 (the least common multiple of 8 and 3), then the equation becomes $3(3x - 4) = 8(x + 2)$. (The solution is $x = 28$, for those who go the extra mile)
2. Explanations vary. Sample response: If you multiply each side by 12 (the least common multiple of 6 and 4), then the equation becomes $9(2 - r) = 2(3 + r)$. (The solution is $r = \frac{12}{11}$, for those who go the extra mile)
3. Explanations vary. Sample response: If you multiply each side by 8 (the least common multiple of 8 and 4), then the equation becomes $4p + 3 = 2(p + 2)$. (The solution is $p = \frac{1}{2}$, for those who go the extra mile)
4. Explanations vary. Sample response: If you multiply each side by 30 (the least common multiple of 6 and 15), then the equation becomes $4(a - 7) = 5(a + 4)$. (The solution is $a = -48$, for those who go the extra mile)

Lesson 11

Problem 1

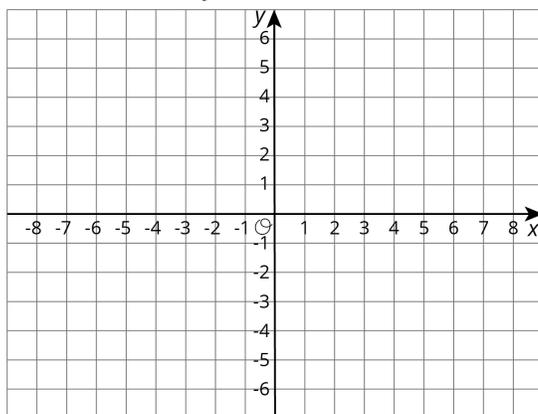
Diego has \$11 and begins saving \$5 each week toward buying a new phone. At the same time that Diego begins saving, Lin has \$60 and begins spending \$2 per week on supplies for her art class. Is there a week when they have the same amount of money? How much do they have at that time?

Solution

After 7 weeks, \$46

Problem 2

Use a graph to find x and y values that make both $y = \frac{2}{3}x + 3$ and $y = 2x - 5$ true.



Solution

(3, 1)

Problem 3

The point where the graphs of two equations intersect has y -coordinate 2. One equation is $y = -3x + 5$. Find the other equation if its graph has a slope of 1.

Solution

$y = x + 1$. $2 = -3x + 5$ is true when $x = 1$, so the line needed has a slope of 1 and contains the point (1, 2).

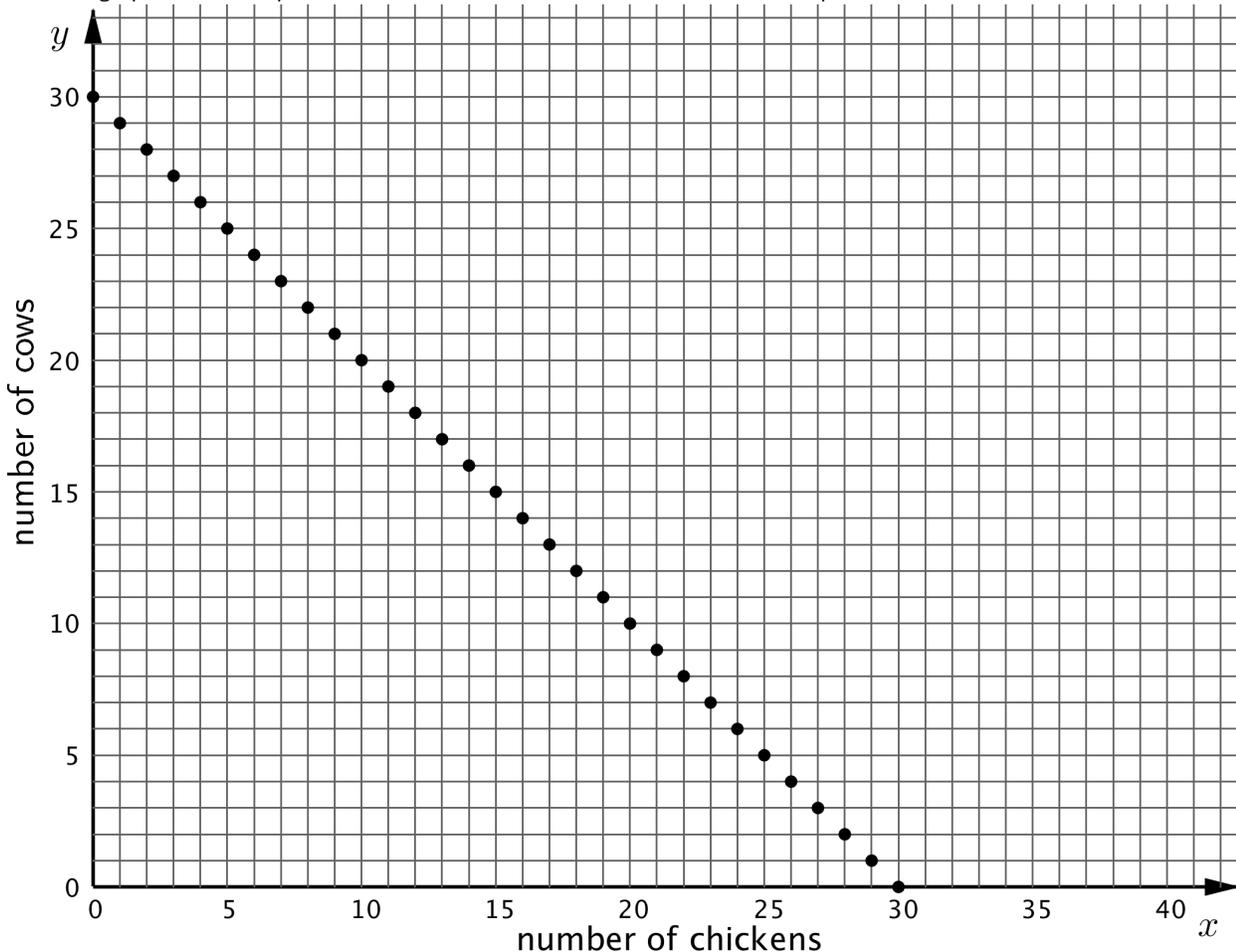
Problem 4

(from Unit 4, Lesson 10)

A farm has chickens and cows. All the cows have 4 legs and all the chickens have 2 legs. All together, there are 82 cow and chicken legs on the farm. Complete the table to show some possible combinations of chickens and cows to get 82 total legs.

number of chickens (x)	number of cows (y)
35	
7	
	10
19	
	5

Here is a graph that shows possible combinations of chickens and cows that add up to 30 animals:



If the farm has 30 chickens and cows, and there are 82 chicken and cow legs all together, then how many chickens and how many cows could the farm have?

Solution

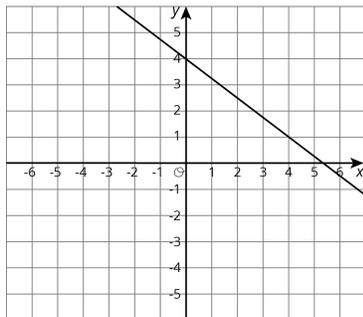
number of chickens (x)	number of cows (y)
35	3
7	17
21	10
19	11
31	5

Elena could have 19 chickens and 11 cows.

Lesson 12

Problem 1

Here is the graph for one equation in a system of equations:



1. Write a second equation for the system so it has infinitely many solutions.

- Write a second equation whose graph goes through $(0, 1)$ so the system has no solutions.
- Write a second equation whose graph goes through $(0, 2)$ so the system has one solution at $(4, 1)$.

Solution

- $y = \frac{3}{4}x + 4$
- $y = \frac{3}{4}x + 1$
- $y = \frac{1}{4}x + 2$

Problem 2

Create a second equation so the system has no solutions.

$$\begin{cases} y = \frac{3}{4}x - 4 \end{cases}$$

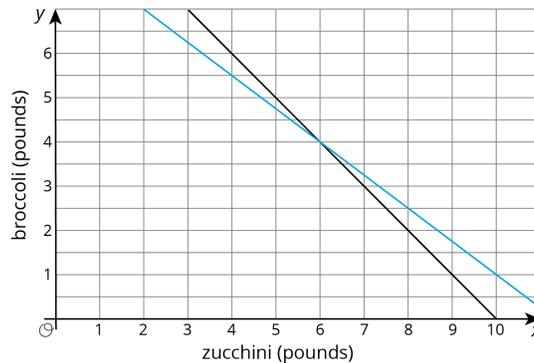
Solution

Answers vary. Any line of the form $y = \frac{3}{4}x + b$ will make it so the system has no solutions.

Problem 3

(from Unit 4, Lesson 10)

Andre is in charge of cooking broccoli and zucchini for a large group. He has to spend all \$17 he has and can carry 10 pounds of veggies. Zucchini costs \$1.50 per pound and broccoli costs \$2 per pound. One graph shows combinations of zucchini and broccoli that weigh 10 pounds and the other shows combinations of zucchini and broccoli that cost \$17.



- Name one combination of veggies that weighs 10 pounds but does not cost \$17.
- Name one combination of veggies that costs \$17 but does not weigh 10 pounds.
- How many pounds each of zucchini and broccoli can Andre get so that he spends all \$17 and gets 10 pounds of veggies?

Solution

- Answers vary. Sample response: 4 pounds of zucchini and 6 pounds of broccoli weigh 10 pounds, but do not cost \$17 because $(4, 6)$ is not on the line of combinations that cost \$17.
- Answers vary. Sample response: 2 pounds of zucchini and 7 pounds of broccoli together cost \$17 because $(2, 7)$ is on the \$17 line, but they only weigh 9 pounds.
- 6 pounds of zucchini, and 4 pounds of broccoli

Problem 4

(from Unit 4, Lesson 9)

The temperature in degrees Fahrenheit, F , is related to the temperature in degrees Celsius, C , by the equation

$$F = \frac{9}{5}C + 32$$

- In the Sahara desert, temperatures often reach 50 degrees Celsius. How many degrees Fahrenheit is this?
- In parts of Alaska, the temperatures can reach -60 degrees Fahrenheit. How many degrees Celsius is this?

3. There is one temperature where the degrees Fahrenheit and degrees Celsius are the same, so that $C = F$. Use the expression from the equation, where F is expressed in terms of C , to solve for this temperature.

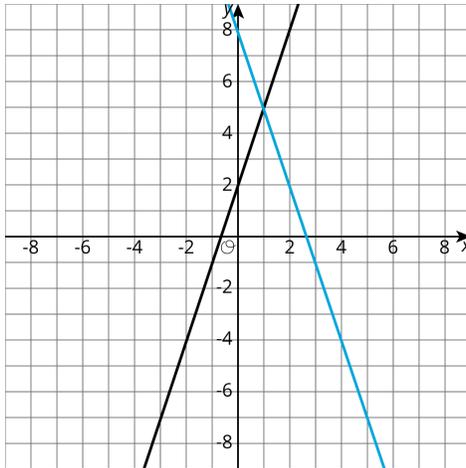
Solution

- 122 degrees Fahrenheit
- $-51\frac{1}{9}$ degrees Celsius
- $C = \frac{9}{5}C + 32$, $C = -40$

Lesson 13

Problem 1

1. Write equations for the lines shown.



- Describe how to find the solution to the corresponding system by looking at the graph.
- Describe how to find the solution to the corresponding system by using the equations.

Solution

- $y = 3x + 2$ and $y = 8 - 3x$
- The point where the two lines meet, $(1, 5)$
- Set the two expressions for y equal to each other and solve: $3x + 2 = 8 - 3x$, $6x = 6$, $x = 1$, $y = 3(1) + 2 = 5$

Problem 2

The solution to a system of equations is $(5, -19)$. Choose two equations that might make up the system.

- $y = -3x - 6$
- $y = 2x - 23$
- $y = -7x + 16$
- $y = x - 17$
- $y = -2x - 9$

Solution

C, E

Problem 3

Solve the system of equations: $\begin{cases} y = 4x - 3 \\ y = -2x + 9 \end{cases}$

Solution

$(2, 5)$

Problem 4

Solve the system of equations:
$$\begin{cases} y = \frac{5}{4}x - 2 \\ y = \frac{-1}{4}x + 19 \end{cases}$$

Solution(14, $15\frac{1}{2}$)**Problem 5**

(from Unit 4, Lesson 6)

Here is an equation: $\frac{15(x-3)}{5} = 3(2x-3)$

1. Solve the equation by using the distributive property first.
2. Solve the equation without using the distributive property.
3. Check your solution.

Solution

1. $x = 0$. Responses vary. Sample response:

$$\frac{15(x-3)}{5} = 3(2x-3)$$

$$\frac{15x-45}{5} = 6x-9 \quad \text{distributive property on each side}$$

$$3x-9 = 6x-9 \quad \text{divide each term in the numerator of the left side by 5}$$

$$3x = 6x \quad \text{add 9 to each side}$$

$$0 = 3x \quad \text{subtract 3x on each side}$$

$$0 = x \quad \text{divide each side by 3}$$

2. $x = 0$. Responses vary. Sample response:

$$\frac{15(x-3)}{5} = 3(2x-3)$$

$$15(x-3) = 15(2x-3) \quad \text{multiply each side by 5}$$

$$x-3 = 2x-3 \quad \text{divide each side by 15}$$

$$x = 2x \quad \text{add 3 to each side}$$

$$0 = x \quad \text{subtract x on each side}$$

$$\frac{15(0-3)}{5} = 3(2(0)-3) \quad \text{plug in } x = 0 \text{ to check if it is a solution}$$

3. $\frac{15(-3)}{5} = 3(-3)$ compute the values inside the parentheses on each side
 $3(-3) = 3(-3)$ divide the numerator by the denominator on the left side
 $-9 = -9$ multiply

This equation is true, so $x = 0$ is the solution.**Lesson 14****Problem 1**

Solve:
$$\begin{cases} y = 6x \\ 4x + y = 7 \end{cases}$$

Solution $(\frac{7}{10}, \frac{21}{5})$ **Problem 2**

Solve:
$$\begin{cases} y = 3x \\ x = -2y + 70 \end{cases}$$

Solution

(10, 30)

Problem 3Which equation, together with $y = -1.5x + 3$, makes a system with one solution?

- A. $y = -1.5x + 6$
- B. $y = -1.5x$
- C. $2y = -3x + 6$
- D. $2y + 3x = 6$

$$E. y = -2x + 3$$

Solution

E

Problem 4

The system $x - 6y = 4$, $3x - 18y = 4$ has no solution.

1. Change one constant or coefficient to make a new system with one solution.
2. Change one constant or coefficient to make a new system with an infinite number of solutions.

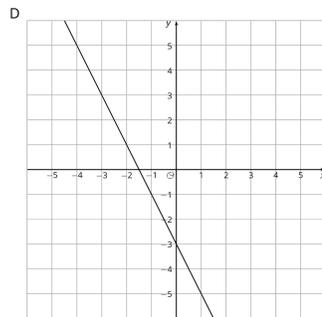
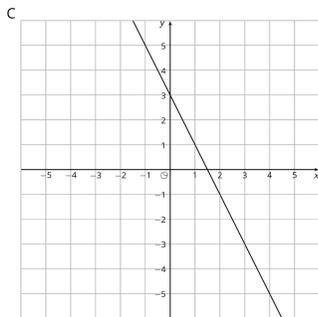
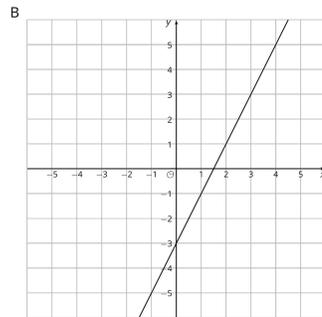
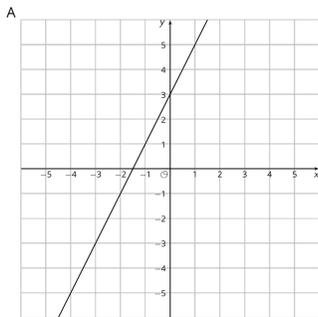
Solution

1. Answers vary. Sample response: $2x - 6y = 4$
2. Answers vary. Sample response: $3x - 18y = 12$

Problem 5

(from Unit 3, Lesson 11)

Match each graph to its equation.



1. $y = 2x + 3$
2. $y = -2x + 3$
3. $y = 2x - 3$
4. $y = -2x - 3$

Solution

1. A
2. C
3. B
4. D

Problem 6

(from Unit 3, Lesson 10)

Here are two points: $(-3, 4)$, $(1, 7)$. What is the slope of the line between them?

- A. $\frac{4}{3}$
- B. $\frac{1}{4}$
- C. $\frac{1}{6}$
- D. $\frac{2}{3}$

Solution

B

Lesson 15

Problem 1

Kiran and his cousin work during the summer for a landscaping company. Kiran's cousin has been working for the company longer, so his pay is 30% more than Kiran's. Last week his cousin worked 27 hours, and Kiran worked 23 hours. Together, they earned \$493.85. What is Kiran's hourly pay? Explain or show your reasoning.

Solution

\$8.50. Explanations vary. Sample response: n = Kiran's hourly wage and c = Kiran's cousin's hourly wage. $c = 1.3n$ and $27c + 23n = 493.85$. Substituting $1.3n$ for c yields the equation $27(1.3n) + 23n = 493.85$.

Problem 2

Decide which story can be represented by the system of equations $y = x + 6$ and $x + y = 100$. Explain your reasoning.

- Diego's teacher writes a test worth 100 points. There are 6 more multiple choice questions than short answer questions.
- Lin and her younger cousin measure their heights. They notice that Lin is 6 inches taller, and their heights add up to exactly 100 inches.

Solution

The second story. Explanations vary. Sample response: In the first story, $y = x + 6$ can be written where x and y represent the number of questions of each type, but the other fact is about points, so $x + y = 100$ does not make sense. In the second story, Lin's height can be represented by y , and her younger cousin's height can be represented by x .

Problem 3

Clare and Noah play a game in which they earn the same number of points for each goal and lose the same number of points for each penalty. Clare makes 6 goals and 3 penalties, ending the game with 6 points. Noah earns 8 goals and 9 penalties and ends the game with -22 points.

- Write a system of equations that describes Clare and Noah's outcomes. Use x to represent the number of points for a goal and y to represent the number of points for a penalty.
- Solve the system. What does your solution mean?

Solution

- Clare: $6x + 3y = 6$, Noah: $8x + 9y = -22$
- (4, -6). A goal earns 4 points and a penalty earns -6 points.

Problem 4

(from Unit 4, Lesson 14)

Solve: $\begin{cases} y = 6x - 8 \\ y = -3x + 10 \end{cases}$

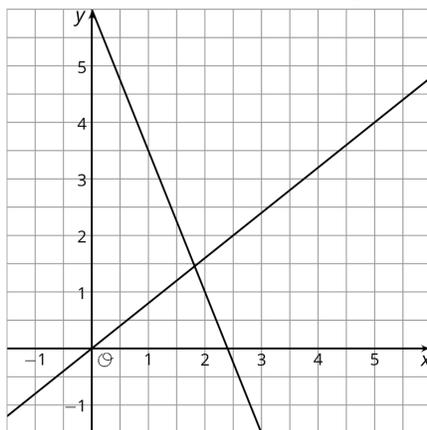
Solution

(2, 4). First solve $6x - 8 = -3x + 10$ for x and substitute that value into either of the original equations to solve for y .

Problem 5

(from Unit 4, Lesson 13)

- Estimate the coordinates of the point where the two lines meet.



2. Choose two equations that make up the system represented by the graph.

- a. $y = \frac{5}{4}x$
- b. $y = 6 - 2.5x$
- c. $y = 2.5x + 6$
- d. $y = 6 - 3x$
- e. $y = 0.8x$

3. Solve the system of equations and confirm the accuracy of your estimate.

Solution

1. Answers vary. Sample response: (1.8, 1.4)

2. b and e

3. $x \approx 1.82$, $y \approx 1.46$ (the exact values are $x = \frac{20}{11}$ and $y = \frac{16}{11}$). Find the x coordinate of the intersection point by solving $6 - 2.5x = 0.8x$. To find the y coordinate, substitute this value of x into either equation.

