

A.REI.D.10: Interpret Graphs as Sets of Solutions

EQUATIONS AND INEQUALITIES

A.REI.D.10: Interpret Graphs as Sets of Solutions

D. Represent and solve equations and inequalities graphically.

10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

Overview of Lesson

- activate prior knowledge and review learning objectives (see above)
 - explain vocabulary and/or big ideas associated with the lesson
 - connect assessment practices with curriculum
 - model an assessment problem and solution strategy
 - facilitate guided discussion of student activity
 - facilitate guided practice of student activity
 - [Selected problem set\(s\)](#)
 - facilitate a summary and share out of student work
- Homework – Write the Math Assignment**

BIG IDEAS

Three Facts About Graphs and Their Equations

1. The graph of an equation represents the set of all points that satisfy the equation (make the equation balance).
2. Each and every point on the graph of an equation represents a coordinate pair that can be substituted into the equation to make the equation true.
3. If a point is on the graph of the equation, the point is a solution to the equation.

How to Graph Linear Equations:

To graph a linear equation, you need to know either of the following:

- The coordinates of two points on the line, or
- The coordinates of one point on the line and the slope of the line.

Two Points: If you know two points on the line, simply plot both of them and draw a straight line passing through the two points.

One Point and the Slope: If you know one point on the line and the slope of the line, plot the point and use the slope to find a second point. Then, draw a straight line passing through the two points.

REGENTS PROBLEMS TYPICAL OF THIS STANDARD

1. The graph of a linear equation contains the points $(3, 11)$ and $(-2, 1)$. Which point also lies on the graph?
 - a. $(2, 1)$
 - b. $(2, 4)$
 - c. $(2, 6)$
 - d. $(2, 9)$

2. Sue and Kathy were doing their algebra homework. They were asked to write the equation of the line that passes through the points $(-3, 4)$ and $(6, 1)$. Sue wrote $y - 4 = -\frac{1}{3}(x + 3)$ and Kathy wrote $y = -\frac{1}{3}x + 3$. Justify why both students are correct.

3. On the set of axes below, draw the graph of the equation $y = -\frac{3}{4}x + 3$.



Is the point $(3, 2)$ a solution to the equation? Explain your answer based on the graph drawn.

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Answer Section

1. ANS: D

Strategy: Find the slope of the line between the two points, then use $y - mx + b$ to find the y-intercept, then write the equation of the line and determine which answer choice is also on the line.

STEP 1. Find the slope of the line that passes through the points (3, 11) and (-2, 1).

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 11}{-2 - 3} = \frac{-10}{-5} = 2$$

Write $y = 2x + b$

STEP 2. Use either given point and the equation $y = 2x + b$ to solve for b , the y-intercept. The following calculation uses the point (3,11).

$$y = 2x + b$$

$$11 = 2(3) + b$$

$$11 = 6 + b$$

$$5 = b$$

Write $y = 2x + 5$

STEP 3 Determine which answer choice balances the equation $y = 2x + 5$.

Use a graphing calculator

Plot1 Plot2 Plot3	X	Y1	
Y1=2X+5	-2	1	
Y2=	-1	3	
Y3=	0	5	
Y4=	1	7	
Y5=	2	9	
Y6=	3	11	
Y7=	4	13	
	X=2		

or simply solve the equation $y = 2x + 5$ for y when $x = 2$.

$$y = 2x + 5$$

$$y = 2(2) + 5$$

$$y = 4 + 5$$

$$y = 9$$

The point (2, 9) is also on the line.

PTS: 2 REF: 011511ai NAT: A.REI.D.10 TOP: Graphing Linear Functions

2. ANS:

Strategy: Input both equations in a graphing calculator and see if they produce the same outputs.

Sue's Equation y_1	Kathy's Equation y_2 $y_2 = -\frac{1}{3}x + 3$
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Lesson Plan

$y_1 - 4 = -\frac{1}{3}(x + 3)$ $y_1 = -\frac{1}{3}(x + 3) + 4$	
-----------------------------------------------------------------	--

Plot1 Plot2 Plot3	X	Y1	Y2	X	Y1	Y2
Y1 = (-1/3)(X+3) + 4	-6	5	5	0	3	3
Y2 = (-1/3)X + 3	-5	4.6667	4.6667	1	2.6667	2.6667
Y3 =	-4	4.3333	4.3333	2	2.3333	2.3333
Y4 =	-3	4	4	3	2	2
Y5 =	-2	3.6667	3.6667	4	1.6667	1.6667
Y6 =	-1	3.3333	3.3333	5	1.3333	1.3333
Y7 =	0	3	3	6	1	1
	X = -6			X = 6		

Both students are correct because both equations pass through the points $(-3, 4)$ and $(6, 1)$.

Alternate justification: Show that the points $(-3, 4)$ and $(6, 1)$ satisfy both equations.

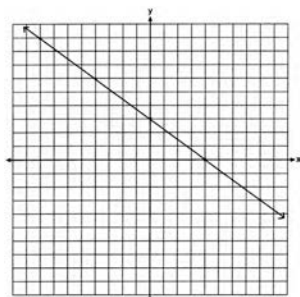
Sue's Equation y_1	Kathy's Equation y_2
$y - 4 = -\frac{1}{3}(x + 3)$	$y = -\frac{1}{3}x + 3$
$(-3, 4) \qquad (6, 1)$	$(-3, 4) \qquad (6, 1)$
$4 - 4 = -\frac{1}{3}(-3 + 3) \quad 1 - 4 = -\frac{1}{3}(6 + 3)$	$y = -\frac{1}{3}x + 3 \quad y = -\frac{1}{3}x + 3$
$0 = -\frac{1}{3}(0) \quad -3 = -\frac{1}{3}(9)$	$4 = -\frac{1}{3}(-3) + 3 \quad 1 = -\frac{1}{3}(6) + 3$
$0 = 0 \quad -3 = -3$	$4 = 1 + 3 \quad 1 = -2 + 3$
	$4 = 4 \quad 1 = 1$

Both students are correct because the points $(-3, 4)$ and $(6, 1)$ satisfy both equations.

PTS: 2 REF: 061629ai NAT: A.REI.D.10 TOP: Writing Linear Equations

KEY: other forms

3. ANS:



No, because $(3, 2)$ is not on the graph.

Strategy #1. Use the y-intercept and the slope to plot the graph of the line, then determine if the point $(3, 2)$ is on the graph.

STEP 1. Plot the y-intercept.

Lesson Plan

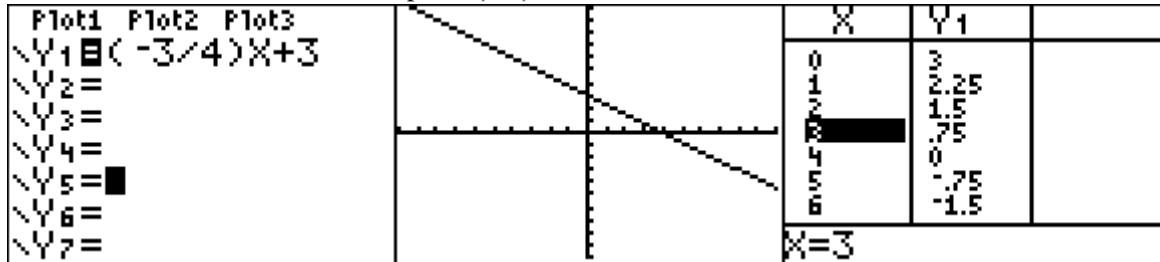
Plot $(0, 3)$. The given equation is in the slope intercept form of a line, $y = mx + b$, where b is the y-intercept. The value of b is 3, so the graph of the equation crosses the y axis at $(0, 3)$.

STEP 2. Use the slope of the line to find and plot a second point on the line. The given equation is in the slope intercept form of a line, $y = mx + b$, where m is the slope. The value of m is $-\frac{3}{4}$, so the graph of the equation has a negative slope that goes down three units and across four units. Starting at the y-intercept, $(0, 3)$, if you go down 3 and over 4, the graph of the line will pass through the point $(4, 0)$.

STEP 3. Use a straightedge to draw a line that passes through the points $(0, 3)$ and $(4, 0)$.

STEP 4. Inspect the graph to determine if the point $(3, 2)$ is on the line. It is not.

Strategy #2. Input the equation of the line into a graphing calculator, then use the table of values to plot the graph of the line and to determine if the point $(3, 2)$ is on the line.



Be sure to explain your answer in terms of the graph and not in terms of the table of values or the function rule.

PTS: 2

REF: 061429ai

NAT: A.REI.D.10

TOP: Graphing Linear Functions

Homework - Write the Math Assignment

START Write your name, date, topic of lesson, and class on your paper.

NAME: Mohammed Chen
 DATE: December 18, 2015
 LESSON: Missing Number in the Average
 CLASS: Z

PART 1a. Copy **the problem** from the lesson and underline/highlight key words.

PART 1b. State your understanding of **what the problem is asking**.

PART 1c. **Answer** the problem.

PART 1d. Explanation of **strategy** with all work shown.

PART 2a. Create **a new problem** that addresses the same math idea.

PART 2b. State your understanding of **what the new problem is asking**.

PART 2c. **Answer** the new problem.

PART 2d. Explanation of **strategy** used in solving the new problem with all work shown.

Clearly label each of the eight parts.

Grading Rubric

Each homework writing assignment is graded using a four point rubric, as follows:

Part 1. The Original Problem	Up to 2 points will be awarded for: a) correctly restating the original problem; b) explicitly stating what the original problem is asking; c) answering the original problem correctly; and d) explaining the math.
Part 2. My New Problem	Up to 2 points will be awarded for: a) creating a new problem similar to the original problem; b) explicitly stating what the new problem is asking; c) answering the new problem correctly; and d) explaining the math.

This assignment/activity is designed to incorporate elements of [Polya's four step universal algorithm](#) for problem solving with the idea that writing is thinking. Polya's four steps for solving any problem are:

1. Read and understand the problem.
2. Develop a strategy for solving the problem.
3. Execute the strategy.
4. Check the answer for reasonableness.

EXEMPLAR OF A WRITING THE MATH ASSIGNMENT

Part 1a. The Problem

TOP Electronics is a small business with five employees. The mean (average) weekly salary for the five employees is \$360. If the weekly salaries of four of the employees are \$340, \$340, \$345, and \$425, what is the salary of the fifth employee?

Part 1b. What is the problem asking?

Find the salary of the fifth employee.

Part 1c. Answer

The salary of the fifth employee is \$350 per week.

Part 1d. Explanation of Strategy

The arithmetic mean or average can be represented algebraically as:

$$\bar{X} = \frac{x_1 + x_2 + \dots + x_n}{n}$$

I put information from the problem into the formula. The problem says there are 5 employees, so $n = 5$. The problem also gives the mean (average) salary and the salaries of 4 of the employees. These numbers can be substituted into the formula as follows:

$$360 = \frac{340 + 340 + 345 + 425 + x_5}{5}$$

$$1800 = 340 + 340 + 345 + 425 + x_5$$

$$1800 = 1450 + x_5$$

$$1800 - 1450 = x_5$$

$$350 = x_5$$

$$\text{Check: } 360 = \frac{340 + 340 + 345 + 425 + 350}{5} = \frac{1800}{5} = 360$$

Part 2a. A New Problem

Joseph took five math exams this grading period and his average score on all of the exams is 88. He remembers that he received test scores of 78, 87, 94, and 96 on four of the examinations, but he has lost one examination and cannot remember what he scored on it. What was Joseph's score on the missing exam?

Part 2b. What is the new problem asking?

Find Joseph's score on the missing exam.

Part 2c. Answer to New Problem

Joseph received a score of 85 on the missing examination.

Part 2d. Explanation of Strategy

I substitute information from the problem into the formula for the arithmetic mean, as follows:

$$88 = \frac{78 + 87 + 94 + 96 + x_5}{5}$$

$$440 = 355 + x_5$$

$$85 = x_5$$

$$88 = \frac{78 + 87 + 94 + 96 + 85}{5} = \frac{440}{5} = 88$$

The answer makes sense.