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**POWER BASICS<sup>®</sup>**

# Algebra

Robert Taggart

# Table of Contents

<i>To the Student</i> .....	v
<b>Unit 1: Algebra Basics</b>	
Lesson 1: Negative and Positive Numbers .....	3
Lesson 2: Operations with Signed Numbers .....	11
Lesson 3: Algebra Concepts .....	25
Lesson 4: Algebraic Equations .....	36
Unit 1 Review .....	49
Unit 1 Applications .....	51
<b>Unit 2: Solving Equations and Inequalities</b>	
Lesson 5: Solving Equations .....	57
Lesson 6: Solving Inequalities .....	84
Unit 2 Review .....	102
Unit 2 Applications .....	103
<b>Unit 3: Graphing Linear Equations</b>	
Lesson 7: The Coordinate Plane .....	111
Lesson 8: Graphing Linear Equations .....	122
Lesson 9: Slope .....	132
Unit 3 Review .....	142
Unit 3 Application .....	145
<b>Unit 4: Polynomial Operations</b>	
Lesson 10: Adding and Subtracting Algebraic Expressions .....	149
Lesson 11: Multiplying and Dividing Algebraic Expressions .....	160
Lesson 12: Factoring .....	179
Unit 4 Review .....	207
Unit 4 Applications .....	208
<b>Unit 5: Quadratic Equations</b>	
Lesson 13: Quadratic Equations .....	215
Lesson 14: The Quadratic Formula .....	237
Unit 5 Review .....	251
Unit 5 Applications .....	254
<i>Appendixes</i> .....	257
A. <i>Table of Squares and Square Roots</i> .....	257
B. <i>Review of Rules and Formulas</i> .....	261
<i>Glossary</i> .....	285
<i>Index</i> .....	293

## LESSON 5: Solving Equations

**GOAL:** To learn how to simplify and solve equations and equations with squared variables

### WORDS TO KNOW

constant	exponent	square root
cubed	formula	squared
denominator	numerator	squared variable
distance formula	reciprocal	

### Solving Equations by Subtracting and Adding

When you solve an equation, you want to get the variable by itself. This way, you can find the value of the variable. Look at the equation below.

#### Example 1

$$x + 6 = 13$$

In this equation, you want to get the  $x$  by itself. To do this, you must get rid of the 6. Notice that 6 is being added to  $x$ . To get rid of the 6, do the opposite operation: Subtract 6. This is called doing the inverse operation. The word *inverse* means “opposite.” If you subtract 6 from the left side, you must subtract 6 from the right side, too. Then both sides of the equation remain the same.

$$x + 6 - 6 = 13 - 6$$

$$x = 7$$

By subtracting the same number from both sides of the equation, you get  $x$  by itself:  $x = 7$ . The solution is 7.

## Example 2

Try another equation:  $m - 30 = 67$ . In this equation, you want to get rid of the 30 so the  $m$  will be by itself. Notice that 30 is being subtracted from  $m$ . Do the inverse operation: Add 30. Do this to both sides of the equation.

$$m - 30 + 30 = 67 + 30$$

$$m = 97$$

### TIP



When you solve for a variable, you can check to see if your answer is correct. Just put your answer in place of the variable in the original equation. Then see if the equation still works. Look at the example below.

$$x + 2 = 7$$

$$x + 2 - 2 = 7 - 2$$

$$x = 5$$

Now check your answer.

$$x + 2 = 7$$

$$5 + 2 = 7$$

$$7 = 7$$

Yes, your answer is correct!

## ■ PRACTICE 17: Solving Equations by Subtracting and Adding

Solve each equation below. Write your answer on the line after each equation.

1.  $x + 3 = 24$   $x =$  \_\_\_\_\_

2.  $z + 450 = 2467$   $z =$  \_\_\_\_\_

3.  $h - .5 = 4$   $h =$  \_\_\_\_\_

4.  $z - 36 = 683$   $z =$  \_\_\_\_\_

5.  $q - 70 = 120$   $q =$  \_\_\_\_\_

6.  $m - 12 = 45$   $m =$  \_\_\_\_\_

## Solving Equations by Dividing and Multiplying

Equations can also be solved by using division and multiplication.

### Example 1

Look at the following equation.

$$9x = 27$$

In the equation above, you must get rid of the 9 to get the  $x$  by itself.

Notice that 9 is being multiplied by  $x$ . To get rid of 9, do the inverse operation: Divide by 9. Do this to both sides of the equation.

$$\frac{9x}{9} = \frac{27}{9}$$

$$x = 3$$

You now know that you must get a variable by itself to find its value and solve an equation. You have learned that when a number is added to a variable in an equation, you must subtract that number from both sides of the equation. When a number is subtracted from a variable, you must add that number to both sides of the equation. When a variable is multiplied by a number in an equation, you must divide both sides by that number. Lastly, when a variable is divided by a number in an equation, you must multiply both sides by that number.

Look at the example below.

### Example 2

$$\frac{x}{3} = 9$$

To get the  $x$  by itself, you must multiply both sides of the equation by 3.

$$3 \left( \frac{x}{3} \right) = 3(9)$$

$$\frac{3x}{3} = 27$$

$$x = 27$$

## ■ PRACTICE 18: Solving Equations by Dividing and Multiplying

Solve each equation on the next page. Write your answer on the line after each equation.

**Example:**  $6z = 24$

$$\frac{6z}{6} = \frac{24}{6}$$

$$z = 4$$

1.  $10x = 150$   $x =$  \_\_\_\_\_

2.  $84 = 3m$   $m =$  \_\_\_\_\_

3.  $\frac{n}{4} = 12$   $n =$  \_\_\_\_\_

4.  $\frac{f}{7} = 3$   $f =$  \_\_\_\_\_

5.  $\frac{s}{18} = 5$   $s =$  \_\_\_\_\_

6.  $\frac{y}{9} = 3$   $y =$  \_\_\_\_\_

**IN REAL LIFE**



Suppose it is your friend's birthday. You are in charge of collecting money for the birthday cake. You know that the cake costs \$12.00. You also know that there are four people (including yourself) who want to help pay. How much should each person pay? If you think of this problem as an algebraic equation, it might look like this:  $4x = 12$ .  $x$  is the amount of money each person must pay. It is the unknown number. Now solve the equation. Divide both sides by 4 to get the  $x$  by itself.  $\frac{4x}{4} = \frac{12}{4}$ .  $x = 3$ . Now you know that each person should pay \$3.00!

### Solving Two-Step Equations

In some equations, the variable is part of two or more different operations.

Look at the example below.

#### Example 1

$$4x - 8 = 12$$

In this equation, 4 is multiplied by  $x$ . Then 8 is subtracted from the product of 4 and  $x$ . You still need to get the variable by itself. What do you do first?

### Rule for Solving Two-Step Equations

If there are parentheses—( )—in an equation, always do the operation in parentheses first. When there is more than one operation and there are no parentheses, do the steps below:

1. Take care of any addition or subtraction operations.
2. Take care of any multiplication or division operations.

### Example 2

Let's work through the following equation.

$$4x - 8 = 12$$

**Step 1.** First, take care of any addition or subtraction operations. Add 8 to both sides.

$$4x - 8 + 8 = 12 + 8$$

$$4x = 20$$

**Step 2.** Take care of any multiplication or division operations.

$$\frac{4x}{4} = \frac{20}{4}$$

$$x = 5$$

Now let's look at another example.

### Example 3

$$\frac{x}{3} + 65 = 120$$



**Step 1.** Take care of any addition or subtraction operations.

Subtract 65 from both sides of the equation.

$$\frac{x}{3} + 65 - 65 = 120 - 65$$

$$\frac{x}{3} = 55$$

**Step 2.** Take care of any multiplication or division operations.

Multiply both sides by 3 to solve for  $x$ .

$$\frac{x}{3}(3) = 55(3)$$

$$x = 165$$

### ■ PRACTICE 19: Solving Two-Step Equations

Solve each equation below. Write your answer on the line.

**Example:**

$$2z - 5 = 11$$

$$2z - 5 + 5 = 11 + 5$$

$$2z = 16$$

$$\frac{2z}{2} = \frac{16}{2}$$

1.  $\frac{w}{7} + 12 = 33$   $w =$  \_\_\_\_\_

2.  $\frac{m}{6} - 8 = 14$   $m =$  \_\_\_\_\_

3.  $2p + 11 = 47$   $p =$  \_\_\_\_\_

4.  $7 + \frac{t}{6} = 15$   $t =$  \_\_\_\_\_



# Algebra

Teacher's Guide

# Table of Contents

<i>To the Teacher</i> .....	<i>vi</i>
<i>Classroom Management</i> .....	<i>vii</i>

## Unit 1: Algebra Basics

Unit Overview .....	1
Additional Activity Suggestions .....	3

## Unit 2: Solving Equations and Inequalities

Unit Overview .....	4
Additional Activity Suggestions .....	5

## Unit 3: Graphing Linear Equations

Unit Overview .....	7
Additional Activity Suggestions .....	9

## Unit 4: Polynomial Operations

Unit Overview .....	10
Additional Activity Suggestions .....	12

## Unit 5: Quadratic Equations

Unit Overview .....	13
Additional Activity Suggestions .....	14

<i>Answer Key</i> .....	15
<i>Graphic Organizers</i> .....	23
<i>Student Book Appendixes</i> .....	28
<i>Student Book Glossary</i> .....	47

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# Unit 3: Graphing Linear Equations

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This unit introduces students to graphing linear equations on the coordinate plane. Lesson 7 presents graphing points and lines on the coordinate plane. Lesson 8 introduces linear equations and presents two approaches to graphing them on the coordinate plane: the table method and the intercept method. Lesson 9 introduces the students to linear slope, including the formula for finding slope, positive and negative slope, and how to graph a line using slope and one point.

## Lesson 7—The Coordinate Plane

**Goal:** To graph ordered pairs on the coordinate plane

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### WORDS TO KNOW

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<b>axes</b>	the horizontal number line ( $x$ -axis) and vertical number line ( $y$ -axis) on a coordinate plane; the singular is “axis.”
<b>axis</b>	either of the number lines (horizontal and vertical) used to form a coordinate plane; the plural is “axes.”
<b>coordinates</b>	a pair of numbers used to locate a point on a coordinate plane
<b>coordinate plane</b>	a flat surface divided into four parts by a horizontal line ( $x$ -axis) and a vertical line ( $y$ -axis) that meet in the center of the plane
<b>horizontal</b>	going from side to side
<b>intersect</b>	to cross at exactly one point
<b>line</b>	a straight path that goes on forever in two different directions
<b>ordered pair</b>	a pair of numbers used to locate a point on a coordinate plane, usually written inside parentheses; the first number tells how far to move horizontally and the second number tells how far to move vertically.
<b>origin</b>	the point at which the $x$ -axis and the $y$ -axis in the coordinate plane intersect
<b>vertical</b>	going up and down
<b><math>x</math>-axis</b>	the horizontal number line on a coordinate plane
<b><math>x</math>-coordinate</b>	the first number in an ordered pair that tells how far to move left or right from the origin
<b><math>y</math>-axis</b>	the vertical (up-and-down) number line on a coordinate plane
<b><math>y</math>-coordinate</b>	the second number in an ordered pair that tells how far to move up or down from the origin

## Lesson 8—Graphing Linear Equations

Goal: To graph linear equations using the table method and the intercept method

### WORDS TO KNOW

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intercept method	graphing a linear equation by connecting the two points where the line meets the axes of the coordinate plane
linear equations	equations that have to do with lines

## Lesson 9—Slope

Goal: To learn to find the slope of a line and to use a slope to graph lines

### WORDS TO KNOW

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ratio	the relationship between two numbers showing how they compare to each other
slope	the steepness of the slant of a line

### Notes on Application Activity in Student Text

Activity	Skills Applied	Product
Coordinates and Maps	solving problems reading a map	list of coordinates optional activity: map and list of coordinates

### Additional Activity Suggestions

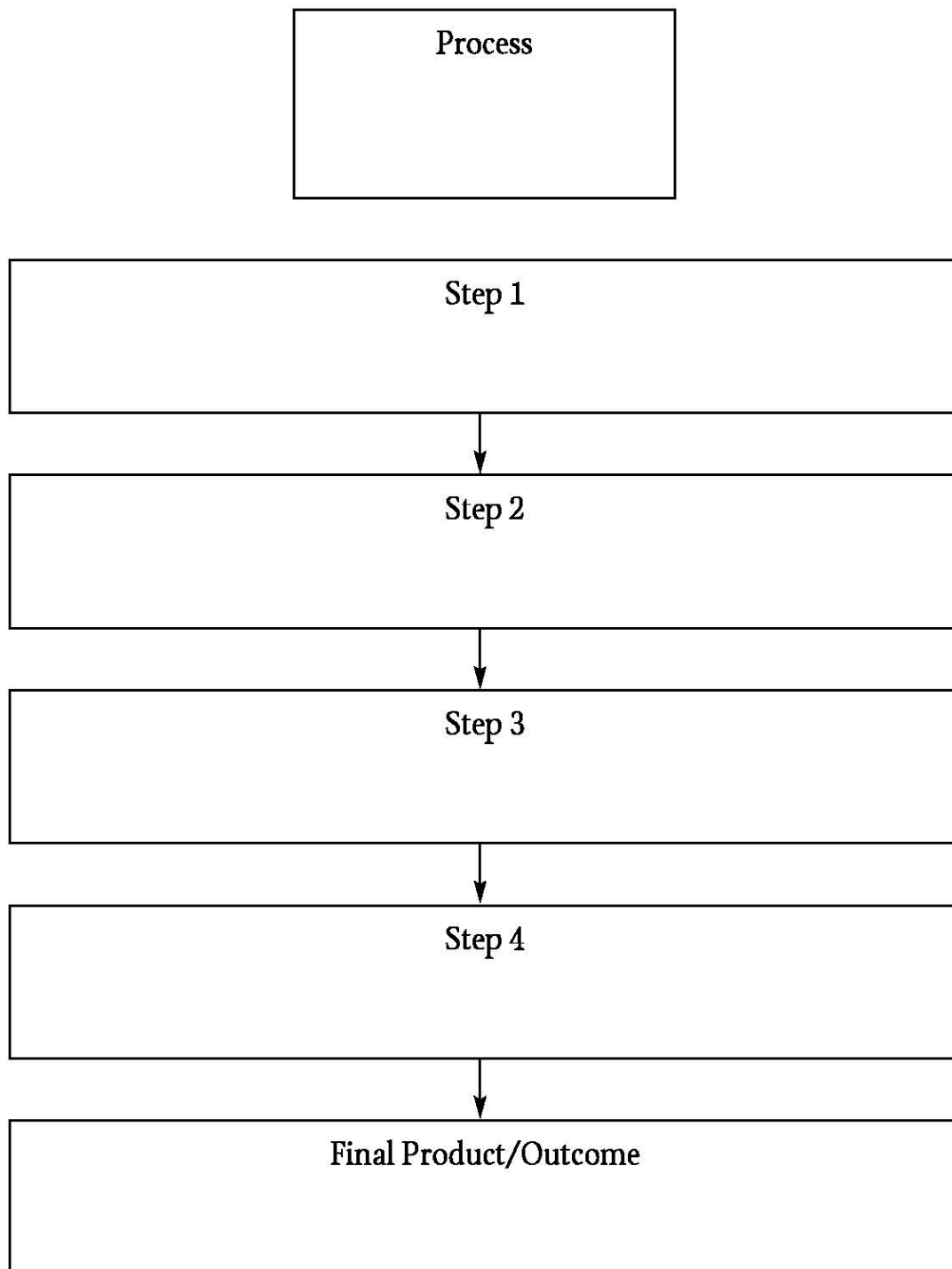
- Have learners build a number line in the form of a time line. Ask them to research a historical figure of their choice, or, if they prefer, interview a living person, and plot the major events of that person's life on a time line. The time line should have standard increments with events interspersed. You might have students include world events in order to give their subject's actions some context.
- With a large globe or an atlas handy, give learners the latitude and longitude of several locations and have them identify those locations. For example, ask learners "What city is located at latitude  $38^{\circ} 0'$  north and longitude  $23^{\circ} 44'$  east?" The answer is "Athens, Greece." In this activity learners could take turns posing questions to one another.



## Differentiation

- Give students practice using coordinates to name points with this game, played in pairs. Each student marks one point in each quadrant of a coordinate grid, labeling the point in quadrant I A, in quadrant II B, in quadrant III C, and in quadrant IV D. Students should write the coordinates for each point below the grid. Holding their grids so that their opponents cannot see them, players take turns using coordinates to name one point in each quadrant. The first player to correctly guess the coordinates of all four of the other player's points wins.
- Ask students (working in small groups or as a whole class) to brainstorm a list of situations in which slope is found. If students have difficulty getting started, suggest roads, hills, ski resorts, and so forth. Have them say whether the slope is positive or negative in relation to sea level. Once the lists are completed, ask students to suggest ways that changing the slope would affect the situation. For example, how would reducing the slope of a ski run affect the difficulty of the run?

## Steps in a Process Chart





# Algebra

Workbook



# Table of Contents

## Unit 1: Algebra Basics

<b>Activity 1</b>	What Are Negative and Positive Numbers? I . . .	1
<b>Activity 2</b>	What Are Negative and Positive Numbers? II . .	2
<b>Activity 3</b>	Larger and Smaller Numbers . . . . .	3
<b>Activity 4</b>	Actual Values and Absolute Values . . . . .	4
<b>Activity 5</b>	Adding Positive and Negative Numbers I . . . .	5
<b>Activity 6</b>	Adding Positive and Negative Numbers II . . . .	6
<b>Activity 7</b>	Adding Positive and Negative Numbers III . . .	7
<b>Activity 8</b>	The First Rule for Addition I . . . . .	8
<b>Activity 9</b>	The First Rule for Addition II . . . . .	9
<b>Activity 10</b>	The Second Rule for Addition . . . . .	10
<b>Activity 11</b>	Subtracting Positive and Negative Numbers I . . . . .	11
<b>Activity 12</b>	Subtracting Positive and Negative Numbers II . . . . .	12
<b>Activity 13</b>	Multiplying and Dividing Signed Numbers . .	13
<b>Activity 14</b>	Solving Terms . . . . .	14
<b>Activity 15</b>	Solving Expressions . . . . .	15
<b>Activity 16</b>	Combining Terms . . . . .	16
<b>Activity 17</b>	Combining Like Terms . . . . .	17

<b>Activity 18</b>	Algebraic Equations I . . . . .	18
<b>Activity 19</b>	Algebraic Equations II . . . . .	19
<b>Activity 20</b>	Checking Your Work . . . . .	20
<b>Activity 21</b>	Solving for Variables I . . . . .	21
<b>Activity 22</b>	Solving for Variables II . . . . .	22

## Unit 2: Solving Equations and Inequalities

<b>Activity 23</b>	Solving Equations by Subtracting and Adding I . . . . .	23
<b>Activity 24</b>	Solving Equations by Subtracting and Adding II . . . . .	24
<b>Activity 25</b>	Solving Equations by Dividing and Multiplying I . . . . .	25
<b>Activity 26</b>	Solving Equations by Dividing and Multiplying II . . . . .	26
<b>Activity 27</b>	Solving Two-Step Equations I . . . . .	27
<b>Activity 28</b>	Solving Two-Step Equations II . . . . .	28
<b>Activity 29</b>	Solving Equations with Fractional Coefficients I . . . . .	29
<b>Activity 30</b>	Solving Equations with Fractional Coefficients II . . . . .	30
<b>Activity 31</b>	Solving Equations with Squared Variables I . .	31
<b>Activity 32</b>	Solving Equations with Squared Variables II .	32
<b>Activity 33</b>	Solving Equations with Parentheses I . . . . .	33

# Table of Contents, *continued*

<b>Activity 34</b>	Solving Equations with Parentheses II . . . . .	34
<b>Activity 35</b>	The Distance/Rate/Time Formula I . . . . .	35
<b>Activity 36</b>	The Distance/Rate/Time Formula II . . . . .	36
<b>Activity 37</b>	Setting Up Algebraic Equations I . . . . .	37
<b>Activity 38</b>	Setting Up Algebraic Equations II . . . . .	38
<b>Activity 39</b>	Inequality Symbols . . . . .	39
<b>Activity 40</b>	Inequalities with Variables . . . . .	40
<b>Activity 41</b>	Solving Inequalities I . . . . .	41
<b>Activity 42</b>	Solving Inequalities II . . . . .	42
<b>Activity 43</b>	Solving Inequalities III . . . . .	43
<b>Activity 44</b>	Solving Inequalities in Two Steps I . . . . .	44
<b>Activity 45</b>	Solving Inequalities in Two Steps II . . . . .	45
<b>Activity 46</b>	Simplifying Inequalities . . . . .	46
<b>Unit 3: Graphing Linear Equations</b>		
<b>Activity 47</b>	Vertical Number Lines . . . . .	47
<b>Activity 48</b>	Graphing Points on the Coordinate Plane I . . . . .	48
<b>Activity 49</b>	Graphing Points on the Coordinate Plane II . . . . .	49
<b>Activity 50</b>	Graphing a Line on the Coordinate Plane III . . . . .	50
<b>Activity 51</b>	The Table Method of Graphing Linear Equations I . . . . .	51

<b>Activity 52</b>	The Table Method of Graphing Linear Equations II . . . . .	52
<b>Activity 53</b>	The Intercept Method of Graphing Linear Equations . . . . .	53
<b>Activity 54</b>	Finding Linear Slope I . . . . .	54
<b>Activity 55</b>	Finding Linear Slope II . . . . .	55
<b>Activity 56</b>	The Formula for Finding Slope I . . . . .	56
<b>Activity 57</b>	The Formula for Finding Slope II . . . . .	57
<b>Activity 58</b>	Positive and Negative Slope . . . . .	58
<b>Activity 59</b>	Graphing a Line When You Know the Slope and One Point . . . . .	59

## Unit 4: Polynomial Operations

<b>Activity 60</b>	Adding and Subtracting Terms . . . . .	60
<b>Activity 61</b>	Ordering Polynomials I . . . . .	61
<b>Activity 62</b>	Ordering Polynomials II . . . . .	62
<b>Activity 63</b>	Adding and Subtracting Polynomials . . . . .	63
<b>Activity 64</b>	Multiplying Variables with Exponents . . . . .	64
<b>Activity 65</b>	Multiplying Monomials I . . . . .	65
<b>Activity 66</b>	Multiplying Monomials II . . . . .	66
<b>Activity 67</b>	Dividing Variables with Exponents . . . . .	67
<b>Activity 68</b>	Dividing Monomials . . . . .	68

# Table of Contents, *continued*

<b>Activity 69</b>	Multiplying a Polynomial by a Monomial I . . .69	<b>Activity 87</b>	Making Quadratic Equations Equal Zero . . . .87
<b>Activity 70</b>	Multiplying a Polynomial by a Monomial II . .70	<b>Activity 88</b>	Solving Special Binomial Quadratic Equations I . . . . .88
<b>Activity 71</b>	Multiplying Binomials I . . . . .71	<b>Activity 89</b>	Solving Special Binomial Quadratic Equations II . . . . .89
<b>Activity 72</b>	Multiplying Binomials II . . . . .72	<b>Activity 90</b>	Solving Special Binomial Quadratic Equations III . . . . .90
<b>Activity 73</b>	Multiplying Binomials III . . . . .73	<b>Activity 91</b>	Solving Perfect Square Quadratic Equations . .91
<b>Activity 74</b>	Multiplying Special Binomials . . . . .74	<b>Activity 92</b>	Types of Quadratic Equations Solved by Factoring . . . . .92
<b>Activity 75</b>	Finding Factors . . . . .75	<b>Activity 93</b>	Solving the Four Types of Quadratic Equations I . . . . .93
<b>Activity 76</b>	Finding the Greatest Common Factor I . . . . .76	<b>Activity 94</b>	Solving the Four Types of Quadratic Equations II . . . . .94
<b>Activity 77</b>	Finding the Greatest Common Factor II . . . . .77	<b>Activity 95</b>	Solving the Four Types of Quadratic Equations III . . . . .95
<b>Activity 78</b>	The Differences Between Two Squares I . . . . .78	<b>Activity 96</b>	The Quadratic Formula I . . . . .96
<b>Activity 79</b>	The Difference Between Two Squares II . . . . .79	<b>Activity 97</b>	The Quadratic Formula II . . . . .97
<b>Activity 80</b>	Factoring Trinomials I . . . . .80	<b>Activity 98</b>	The Quadratic Formula with Negative Coefficients I . . . . .98
<b>Activity 81</b>	Factoring Trinomials II . . . . .81	<b>Activity 99</b>	The Quadratic Formula with Negative Coefficients II . . . . .99
<b>Activity 82</b>	Factoring Other Negative Trinomials I . . . . .82	<b>Activity 100</b>	Using the Quadratic Formula to Solve Word Problems . . . . .100
<b>Activity 83</b>	Factoring Other Negative Trinomials II . . . . .83		
<b>Activity 84</b>	Factoring Other Negative Trinomials III . . . . .84		
<b>Activity 85</b>	Combining Factoring Skills . . . . .85		
<b>Unit 5: Quadratic Equations</b>			
<b>Activity 86</b>	What Is a Quadratic Equation? . . . . .86		

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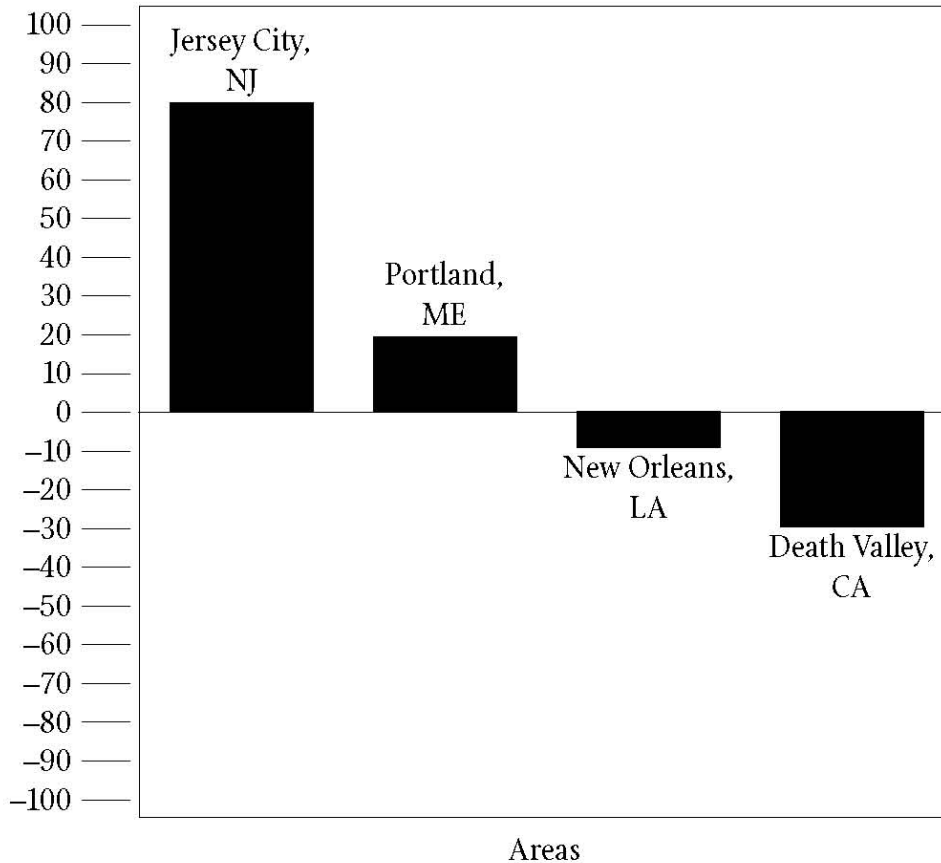


## UNIT 1 • ACTIVITY 1

### What Are Negative and Positive Numbers? I

Look at the graph below. Then answer the questions that follow.

Elevations of Some Areas in United States



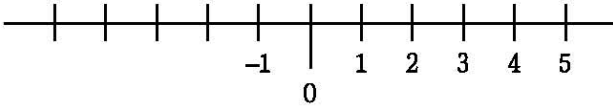
1. What elevation in feet represents sea level? \_\_\_\_\_
2. What areas have elevations that are given in positive numbers? \_\_\_\_\_  
\_\_\_\_\_
3. In relation to sea level, what do positive numbers represent? \_\_\_\_\_
4. What areas have elevations that are given in negative numbers? \_\_\_\_\_  
\_\_\_\_\_
5. In relation to sea level, what do negative numbers represent? \_\_\_\_\_  
\_\_\_\_\_



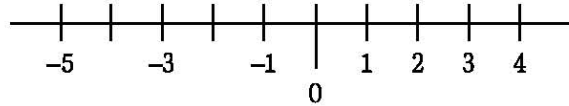

**UNIT 1 • ACTIVITY 2**
**What Are Negative and Positive Numbers? II**

Complete each number line by writing the missing negative numbers.

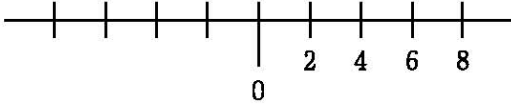
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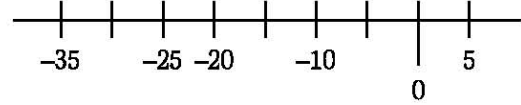
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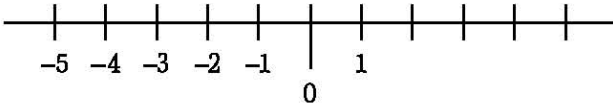


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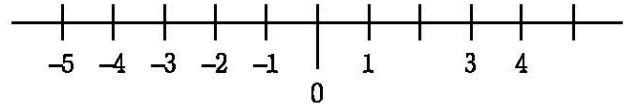


Complete each number line by writing the missing positive numbers.

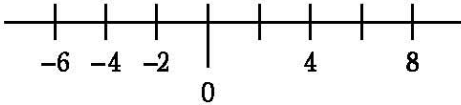
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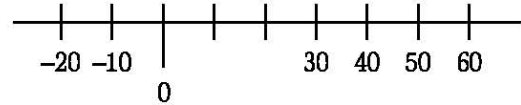
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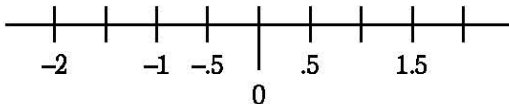


8.

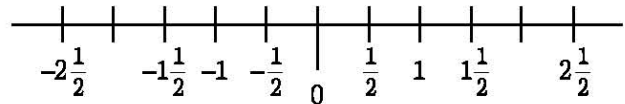


Complete each number line by writing the missing negative and positive numbers.

9.



10.



NAME: \_\_\_\_\_



## UNIT 2 • ACTIVITY 35

### The Distance/Rate/Time Formula I

Use the distance/rate formula,  $D = r(t)$ , to solve each problem below.

1. A bus travels 60 mph for 6 hours on the highway. How far did the bus travel?  
\_\_\_\_\_
2. A space shuttle travels at 500 mph for 10 hours. How many miles has the shuttle traveled?  
\_\_\_\_\_
3. Tami can rollerblade at a rate of 15 mph. If she rollerblades for 180 miles, how many hours has she rollerbladed? \_\_\_\_\_
4. A free-flying balloon travels at a rate of 20 mph. If it travels 460 miles before running into the side of a mountain, how many hours has the balloon been free flying? \_\_\_\_\_
5. Bianca flies in her glider for 4 hours and travels 256 miles. What is the average rate of speed of the glider? \_\_\_\_\_
6. A train traveled 1800 miles in 9 hours. How fast was the train going? \_\_\_\_\_
7. A sailboat travels 70 kilometers in 4 hours. What is its average rate of speed?  
\_\_\_\_\_
8. A truck driver drives at a speed of 65 mph for 6 hours on highway 95. How far has the driver traveled? \_\_\_\_\_





## UNIT 2 • ACTIVITY 36

### The Distance/Rate/Time Formula II

Suppose you ride your bike to the library 8 miles away at rate of 4 mph on a calm day. However, when you ride your bike to the library on a windy day, you lose a mile an hour. Your rate is now  $4 - 1 = 3$  mph. You might think that the wind would have no effect on a round-trip time because the wind would speed up your bike ride from the library at a rate of  $4 + 1 = 5$  mph. However, the tables below show that the time it takes to make a round-trip does increase.

Using  $\text{Distance} \div \text{Rate} = \text{Time}$

#### No wind

	Rate	Time	Distance
One way	4 mph	2	8
Way back	4 mph	2	8

Total time =  $2 + 2 = 4$  hours

#### With wind

	Rate	Time	Distance
One way	$4 - 1 = 3$ mph	$\frac{8}{3}$	8
Way back	$4 + 1 = 5$ mph	$\frac{8}{5}$	8

Total time =  $\frac{8}{3} + \frac{8}{5} = 4\frac{4}{15}$  hours

Imagine you can paddle a canoe at 3 mph in still water. If there is a current, the canoe can travel at 4 mph going downstream but only 2 mph against the current on the way back. Fill in the tables to show how the time for a 6-mile round-trip changes from still water to water with a current.

#### 1. Still water

	Rate	Time	Distance
One way			
Way back			

Total time = \_\_\_\_\_

#### 2. Current

	Rate	Time	Distance
One way			
Way back			

Total time = \_\_\_\_\_



**UNIT 5 • ACTIVITY 100****Using the Quadratic Formula to Solve Word Problems**

Use the quadratic formula to solve each word problem. Check your work by substituting your solutions into the variable of your original equation. Write your answer on the line.

1. The length of a rectangle is 6 more than its width. If the area is 16 square centimeters, what is the length and width of the rectangle?

Length = \_\_\_\_\_

Width = \_\_\_\_\_

Check work:

2. The radius of a circle is 5 less than  $x$ . If the area of the circle is  $36\pi$  square feet, what is the radius? (Use  $A = \pi r^2$ .)

Radius = \_\_\_\_\_

Check work:







# Algebra

Test Pack

# Table of Contents

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To the Teacher .....	v
Testing Students Who Do Not Test Well .....	vi
Test-Taking Strategies for <i>Power Basics</i> .....	vii
<b>Pretest .....</b>	<b>1</b>
<b>Unit 1 Test: Algebra Basics .....</b>	<b>8</b>
<b>Unit 2 Test: Solving Equations and Inequalities .....</b>	<b>13</b>
<b>Unit 3 Test: Graphing Linear Equations .....</b>	<b>20</b>
<b>Unit 4 Test: Polynomial Operations .....</b>	<b>26</b>
<b>Unit 5 Test: Quadratic Equations .....</b>	<b>30</b>
<b>Posttest .....</b>	<b>35</b>
Answer Key .....	43
Student Record-Keeping Form .....	44
Strategies for Standardized Testing .....	45

**UNIT 2 TEST • SOLVING EQUATIONS AND INEQUALITIES**

---

Circle the correct answer for each of the following questions. Show your work, if necessary.

1. Solve the following equation.

$$\frac{r}{12} + 7 = 73$$

$$r = ?$$

a.  $5\frac{1}{2}$

b.  $6\frac{2}{3}$

c. 792

d. 960

---

2. Solve the following equation.

$$12r + 17 = 113$$

$$r = ?$$

a. 2

b. 8

c. 1152

d. 1560

---

3. Solve the following equation.

$$\frac{2}{3}n + 2\frac{2}{3}n + 4 = 25 + \frac{1}{3}n$$

$$n = ?$$

a. 5.7

b. 7

c. 63

d. 87

4. Solve the following equation.

$$\frac{3}{4}w + 4\frac{3}{16}w + 9 = 24 - \frac{1}{16}w$$

$$w = ?$$

- a. 3
  - b. 6.6
  - c. 75
  - d. 165
- 

5.  $s = 5$  is the solution to which of the following equations?

a.  $3\frac{3}{4}s + 3 = 5 - \frac{1}{4}s$

b.  $\frac{2}{3}s - 3 = 5 - \frac{1}{3}s$

c.  $7\frac{1}{2}s - 9 = 36 - \frac{1}{2}s$

d.  $7\frac{1}{2}s + 9 = 36 + \frac{1}{2}s$

---

6.  $s = 12$  is the solution to which of the following equations?

a.  $3\frac{3}{4}s + 3 = 15 - \frac{1}{4}s$

b.  $\frac{2}{3}s - 3 = 15 - \frac{1}{3}s$

c.  $1\frac{1}{2}s - 9 = 45 + 1\frac{1}{2}s$

d.  $2\frac{1}{2}s + 9 = 45 - \frac{1}{2}s$

---

7. Circle the letter of the inequality symbol that would make the following statement true.

$$28 - 6 \quad \underline{\hspace{1cm}} \quad 2(6 + 4)$$

- a. >
- b. ≤
- c. =
- d. <

8. Circle the letter of the inequality symbol that would make the following statement true.

$$\frac{13}{14} \text{ ————— } \frac{6}{7}$$

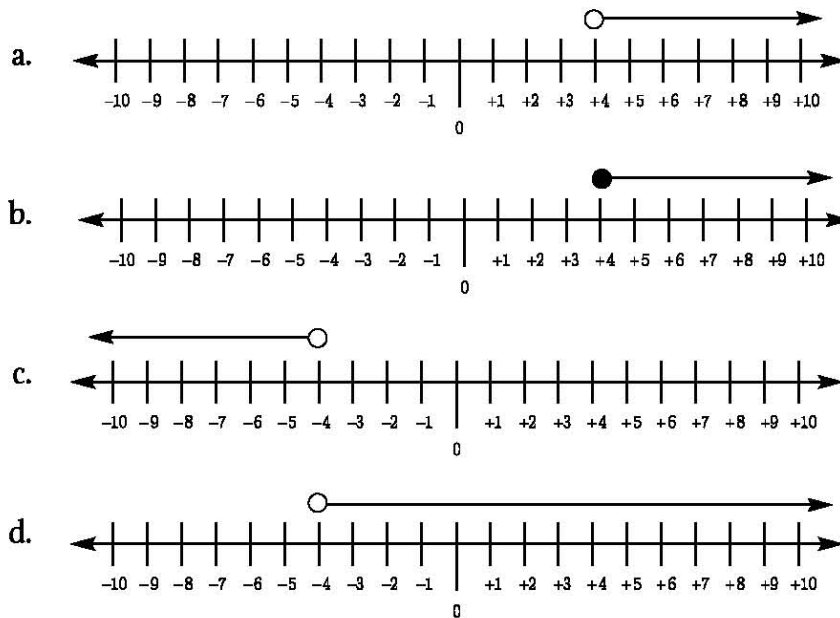
- a. <  
b. >  
c. =  
d. ≤

9. Beth is 7 years older than Darnell. Darnell is 2 times as old as Juan. Which formula represents Beth's age in relation to Juan?

- a.  $B = 2J - 7$   
b.  $B = 2J + 7$   
c.  $B = 2J + 14$   
d.  $B = J - 2$

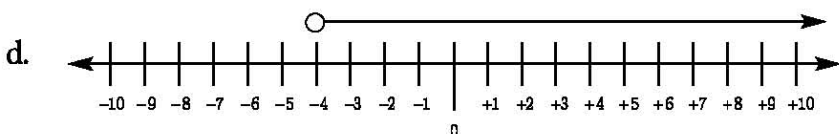
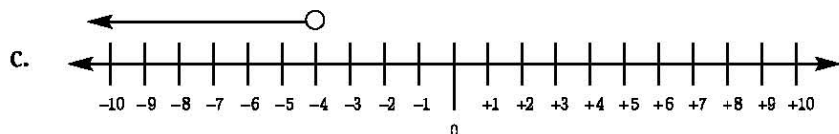
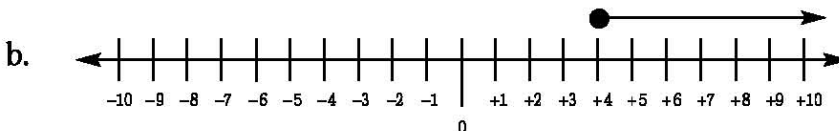
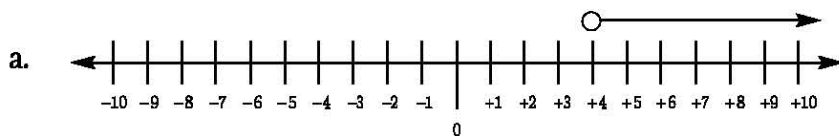
10. Which number line below shows the solution to the following inequality?

$$-\frac{1}{2}x + 12 > 28 + 3\frac{1}{2}x$$



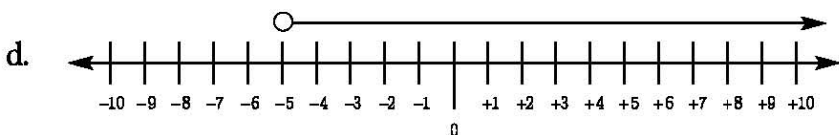
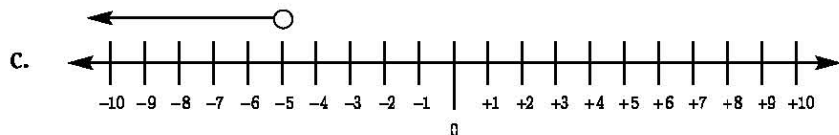
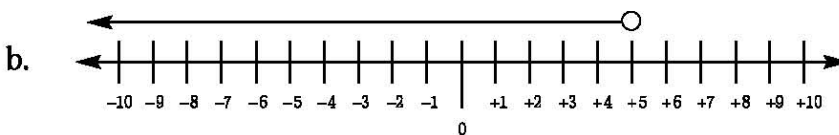
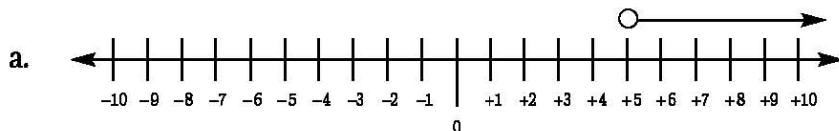
11. Which number line below shows the solution to the following inequality?

$$x - 16 < 8 + 7x$$



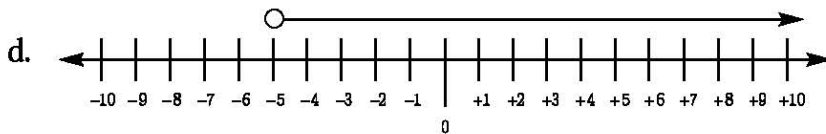
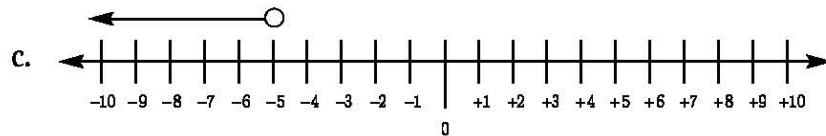
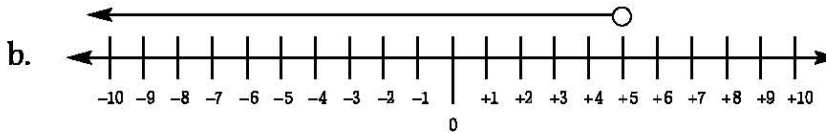
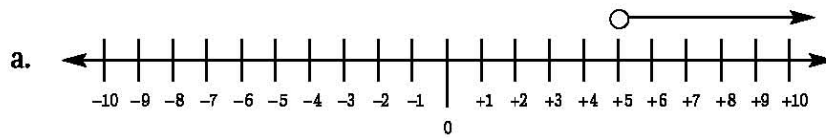
12. Which number line below shows the solution to the following inequality?

$$-2y - 3 < 22 + 3y$$



13. Which number line below shows the solution to the following inequality?

$$-2y - 6 + y < 24 - 7y$$



14. What is the solution to the following inequality?

$$-3x + 5 > -1$$

a.  $x < 2$

b.  $x > 2$

c.  $x > 5\frac{1}{3}$

d.  $x < 5\frac{1}{3}$

15. What is the solution to the following inequality?

$$-3x + 5 < 11$$

a.  $x < -2$

b.  $x > -2$

c.  $x > 5\frac{1}{3}$

d.  $x < 5\frac{1}{3}$

---

16. Which number below would NOT be a possible solution to the following inequality?

$$8t - 12 > 16t + 4$$

$$t = ?$$

a.  $-3$

b.  $-4$

c.  $-2$

d.  $-12$

---

17. Which number would NOT be a possible solution to the following inequality?

$$7t - 12 > 16$$

$$t = ?$$

a.  $4$

b.  $12$

c.  $28$

d.  $36$



18. Which number below would be a possible solution to the following inequality?

$$-10m - 8 \geq -12m - 10$$

$$m = ?$$

- a.  $-\frac{1}{2}$
- b.  $-1\frac{1}{2}$
- c.  $-2$
- d.  $-12$

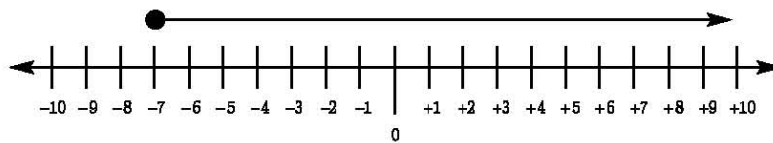
19. Which number would NOT be a possible solution to the following inequality?

$$4m - 8 \geq 12m - 10$$

$$m = ?$$

- a.  $-20$
- b.  $-\frac{1}{2}$
- c.  $0$
- d.  $2$

20. Look at the number line below. Which of the following inequalities correctly describes the number line?



- a.  $d > 7$
- b.  $d \geq -7$
- c.  $d \geq 7$
- d.  $d < -7$