Study Guide

Key Concepts

Order of Operations (Lesson 1-2)
- Evaluate expressions inside grouping symbols.
- Evaluate all powers.
- Multiply and/or divide in order from left to right.
- Add or subtract in order from left to right.

Properties of Equality (Lessons 1-3 and 1-4)
- For any numbers a, b, and c:
  - Reflexive: \( a = a \)
  - Symmetric: If \( a = b \), then \( b = a \).
  - Transitive: If \( a = b \) and \( b = c \), then \( a = c \).
  - Substitution: If \( a = b \), then a may be replaced by \( b \) in any expression.
- Distributive: \( ab + ac = a(b + c) \) and \( ab - ac = a(b - c) \)
- Commutative: \( a + b = b + a \) and \( ab = ba \)
- Associative: \((a + b) + c = a + (b + c)\) and \((ab)c = abc\)

Solving Equations (Lesson 1-5)
- Apply order of operations and the properties of real numbers to solve equations.

Relations, Functions, and Interpreting Graphs of Functions (Lessons 1-6 through 1-9)
- Relations and functions can be represented by ordered pairs, a table, a mapping, or a graph.
- Use the vertical line test to determine if a relation is a function.
- End behavior describes the long-term behavior of a function on either end of its graph.
- Points where the graph of a function crosses an axis are called intercepts.
- A function is positive on a portion of its domain where its graph lies above the x-axis, and negative on a portion where its graph lies below the x-axis.

Key Vocabulary

<table>
<thead>
<tr>
<th>Term</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>algebraic expression</td>
<td>p. 5</td>
</tr>
<tr>
<td>base</td>
<td>p. 5</td>
</tr>
<tr>
<td>coefficient</td>
<td>p. 5</td>
</tr>
<tr>
<td>coordinate system</td>
<td>p. 46</td>
</tr>
<tr>
<td>dependent variable</td>
<td>p. 46</td>
</tr>
<tr>
<td>domain</td>
<td>p. 46</td>
</tr>
<tr>
<td>equation</td>
<td>p. 33</td>
</tr>
<tr>
<td>exponent</td>
<td>p. 33</td>
</tr>
<tr>
<td>function</td>
<td>p. 42</td>
</tr>
<tr>
<td>independent variable</td>
<td>p. 40</td>
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<tr>
<td>intercept</td>
<td>p. 27</td>
</tr>
<tr>
<td>like terms</td>
<td>p. 27</td>
</tr>
<tr>
<td>line symmetry</td>
<td>p. 37</td>
</tr>
<tr>
<td>mapping</td>
<td>p. 40</td>
</tr>
</tbody>
</table>

Lesson-by-Lesson Review

1-7 Variables and Expressions

Write a verbal expression for each algebraic expression.
1. \( 8 - 7 \)
2. \( 9 \cdot 5 \)
3. \( 10 \cdot 5 + 3 \cdot 6 \)

Write an algebraic expression for each verbal expression.
4. A number increased by 9
5. Two thirds of a number d to the third power
6. 3 less than four times a number

Evaluate each expression.
7. \( 2^5 \)
8. \( 5^2 \)
9. \( 16 - 4^2 \)

10. BOWLING: Fantastic Pins Bowling Alley charges $2.50 for shoe rental plus $3.25 for each game. Write an expression representing the cost to rent shoes and bowl 1 game.

11. The base is 3 and the exponent is 4. \( 3^4 = 3 \cdot 3 \cdot 3 \cdot 3 \)

12. Evaluate \( 3^3 \). Use 3 as a factor 3 times.

13. Evaluate \( 5^3 \).

14. Evaluate \( 3(9 - 5)^2 + 8 \).

15. Evaluate \( (6m - 2n) \cdot r^2 \) if \( m = 6, n = 4, p = 2 \).

16. Evaluate \( \sqrt{5 + 8 - 4} \). Replace \( m \) with 8, \( n \) with 4, and \( p \) with 2.

17. ICE CREAM: The cost of a one-scoop sundae is $2.75, and the cost of a two-scoop sundae is $4.25. Write and evaluate an expression to find the total cost of 3 one-scoop sundaes and 2 two-scoop sundaes.
1-3 Properties of Numbers
Evaluate each expression using properties of numbers. Name the property used in each step.

28. $18 \cdot (3 + 3) = 29. [5 + (8 - 6)]$ = $30. (16 - 47) + 9 = 31. 2 \cdot 5 + 4 \cdot 2 - 7 = 32. 18 + 41 + 32 + 9 = 33. \frac{7}{6} + 5 + \frac{2}{6} = 34. 5.8 + 0.5 - 5 = 35. 5.3 + 2.6 - 3 + 5.2 = 36. SCHOOL SUPPLIES Monica needs to purchase a binder, a textbook, a calculator, and a workbook for her algebra class. The binder costs $9.25, the textbook $32.50, the calculator $18.75, and the workbook $15.00. Find the total cost for Monica’s algebra supplies.

Example 6: Evaluate $6(4 \cdot 2 - 7) + 5 \cdot \frac{1}{5}$. Name the property used in each step.

$6(4 \cdot 2 - 7) + 5 \cdot \frac{1}{5}
= 6(8 - 7) + 5 \cdot \frac{1}{5}
= 6 \cdot 1 + 5 \cdot \frac{1}{5}
= 6 + 1
= 7
$
Substitution
Multiplicative Identity
Multiplicative inverse
Addition

1-4 The Distributive Property
Use the Distributive Property to rewrite each expression. Then evaluate.

37. $(2 + 3)6 = 38. 5(18 + 12)$ = $39. (6 - 2)4 = 40. (11 - 4)3 = 41. -2(5 - 3) = 42. (8 - 3)4
Rewrite each expression using the Distributive Property. Then simplify.

43. $3(x + 2) = 44. (m + 8)4$ = $45. 6(6 - 3) = 46. -4(5 - 2) = 47. (3y - 6)(-3) = 48. -6(4x + 3)$

Example 8: Rewrite the expression $6(x + 4)$ using the Distributive Property. Then simplify.

$6(x + 4) = 6 \cdot x + 6 \cdot 4
= 6x + 24
$
Distributive Property
Addition
Simplification

Example 9: Rewrite the expression $(3x - 2k) - 5$ using the Distributive Property. Then simplify.

$(3x - 2k - 5) = (3x - 5) - 2k$ Distributive Property

1-5 Equations
Find the solution of each equation if the replacement set are $x = \{1, 3, 5, 7, 9\}$ and $y = \{6, 8, 10, 12, 14\}$.

50. $y - 9 = 3 = 51. 14 + x = 21 = 52. 4y = 32 = 53. 3x - 11 = 16 = 54. \frac{2}{y} = 7 = 55. 2(x - 1) = 8$

Solve each equation.

56. $a = 24 - 7(3)$ = $57. x = 63 + (3^2 - 2)$

58. AGE Shandra’s age is four more than three times Sherita’s age. Write an equation for Shandra’s age. Solve if Sherita is 3 years old.

Example 10: Solve the equation $5w - 19 = 11$ if the replacement set is $w = \{2, 4, 6, 8, 10\}$. Replace $w$ in $5w - 19 = 11$ with each value in the replacement set.

$w$ | $5w - 19 = 11$ | True or False?
--- | --- | ---
2 | $5(2) - 19 = 11$ | false
4 | $5(4) - 19 = 11$ | true
6 | $5(6) - 19 = 11$ | true
8 | $5(8) - 19 = 11$ | false
10 | $5(10) - 19 = 11$ | false

Since the equation is true when $w = 6$, the solution of $5w - 19 = 11$ is $w = 6$.

1-6 Relations
Express each relation as a table, a graph, and a mapping. Then determine the domain and range.

59. $(1, 3), (2, 4), (3, 5), (4, 6)$
60. $(0, -1), (0, -3), (1, 1), (4, -1)$
61. $(0, -2), (1, 3), (0, 2), (0, -1)$

Express the relation shown in each table, mapping, or graph as a set of ordered pairs.

Example 11: Express the relation $(-3, 4), (1, -2), (0, 1), (3, -1)$ as a table, a graph, and a mapping.

Table

$X$ | $Y$
--- | ---
-3 | 4
1 | -2
0 | 1
3 | -1

Graph
Graph each ordered pair on a coordinate plane.

Mapping
List the $x$-values in the domain and the $y$-values in the range. Draw arrows from the $x$-values in set $X$ to the corresponding $y$-values in set $Y$.
**1-7 Functions**

Determine whether each relation is a function.

65. \( f(x) = 2x + 4 \) and \( g(x) = x^2 - 3 \), find each value.

66. \( f(x) = 2x - 3 \) and \( g(x) = 3x - 2 \), find each value.

67. \( f(2, 3), (4, 2), (2, 1), (6, 0) \)

68. \( f(1) \) and \( g(2) \)

70. \( f(0) \)

71. \( g(-4) \)

72. \( f(m - 2) \)

73. \( g(3p) \)

74. **GRADES** A teacher claims that the relationship between number of hours studied for a test and test score can be described by \( g(x) = 45 + 5x \), where \( x \) represents the number of hours studied. Graph this function.

**Example 12**

Determine whether \( 2x - y = 1 \) represents a function.

First make a table of values. Then graph the equation.

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

Using the vertical line test, it can be shown that \( 2x - y = 1 \) does represent a function.

1-8 Interpreting Graphs of Functions

75. **Identify the function graphed as linear or nonlinear.** Then estimate and interpret the intercepts of the graph, any symmetry, where the function is positive, negative, increasing, and decreasing, the \( x \)-coordinate of any relative extrema, and the end behavior of the graph.

76. **Example 13**

**POPULATION** The population of Haiti from 1994 to 2010 can be modeled by the function graphed below. Estimate and interpret where the function is increasing, and decreasing, the \( x \)-coordinates of any relative extrema, and the end behavior of the graph.

77. **U.S. Patents Granted**

80. **Population of Haiti**

The population increased from 1994 to 2009 and decreased from 2009 to 2010. The relative maximum of the graph indicates that the population peaked in 2009.

As \( x \) increases or decreases, \( y \) decreases. The end behavior indicates a decline in population from 2009 to 2010.

**Practice Test**

Write an algebraic expression for each verbal expression.

1. six more than a number
2. twelve less than the product of three and a number
3. four divided by the difference between a number and seven

Evaluate each expression.

4. \( 32 + 4 + 2^3 - 3 \)
5. \( \frac{(2 + 4)^2}{7 + 3^2} \)

**MULTIPLE CHOICE** Find the value of the expression \( a^2 + 2ab + b^2 \) if \( a = 6 \) and \( b = 4 \).

4. A 68
   B 92
   C 100
   D 121

Evaluate each expression. Name the property used in each step.

7. \( 13 + (16 - 4) \)
8. \( \frac{2}{3} [9 + (7 - 5)] \)

Rewrite each expression using the Distributive Property. Then simplify.

10. \( 4(x + 3) \)
11. \( (5p - 2)(-3) \)

12. **MOVIE TICKETS** A company operates three movie theaters. The chart shows the typical number of tickets sold each week at the three locations. Write and evaluate an expression for the total number of tickets sold by all three locations in four weeks.

<table>
<thead>
<tr>
<th>Location</th>
<th>Tickets Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>238</td>
</tr>
<tr>
<td>B</td>
<td>374</td>
</tr>
<tr>
<td>C</td>
<td>512</td>
</tr>
</tbody>
</table>

Find the solution of each equation if the replacement sets are \( x \in \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\} \). Find each value.

13. \( 3x - 9 = 12 \)
14. \( y^2 - 5y - 11 = 13 \)

15. **CELL PHONES** The ABC Cell Phone Company offers a plan that includes a flat fee of $25 per month plus a $0.12 charge per minute. Write an equation to find \( C \), the total monthly cost for \( m \) minutes. Then solve the equation for \( m = 50 \).

Express the relation shown in each table, mapping, or graph as a set of ordered pairs.

16. **Domain** Range

17. **Domain** Range

18. **MULTIPLE CHOICE** Determine the domain and range for the relation \( \{(2, 5), (-1, 3), (0, -1), (3, 3), (-4, -2)\} \).

19. Determine whether the relation \( \{(2, 3), (-1, 3), (0, 4), (3, 2), (-2, 3)\} \) is a function.

20. \( g(3) \)
21. \( f(-6) \)

22. Identify the function graphed as linear or nonlinear. Then estimate and interpret the intercepts of the graph, any symmetry, where the function is positive, negative, increasing, and decreasing, the \( x \)-coordinate of any relative extrema, and the end behavior of the graph.
Eliminate Unreasonable Answers

You can eliminate unreasonable answers to help you find the correct one when solving multiple choice test items. Doing so will save you time by narrowing down the list of possible correct answers.

Strategies for Eliminating Unreasonable Answers

**Step 1**
Read the problem statement carefully to determine exactly what you are being asked to find.

Ask yourself:
- What am I being asked to solve?
- What format (i.e., fraction, number, decimal, percent, type of graph) will the correct answer be?
- What units (if any) will the correct answer have?

**Step 2**
Carefully look over each possible answer choice and evaluate for reasonableness.

- Identify any answer choices that are clearly incorrect and eliminate them.
- Eliminate any answer choices that are not in the proper format.
- Eliminate any answer choices that do not have the correct units.

**Step 3**
Solve the problem and choose the correct answer from those remaining. Check your answer.

Exercises

Read each problem. Eliminate any unreasonable answers. Then use the information in the problem to solve.

1. Coach Roberts expects 35% of the student body to turn out for a pep rally. If there are 360 students, how many does Coach Roberts expect to attend the pep rally?
   - A 184
   - B 196
   - C 214
   - D 390

2. Jorge and Sally leave school at the same time. Jorge walks 300 yards north and then 400 yards east. Sally rides her bike 600 yards south and then 800 yards west. What is the distance between the two students?
   - F 500 yd
   - G 750 yd
   - H 1,200 yd
   - J 1,500 yd

3. What is the range of the relation below?
   \{(1, 2), (3, 4), (5, 6), (7, 8)\}
   - A all real numbers
   - B all even numbers
   - C \{2, 4, 6, 8\}
   - D \{1, 3, 5, 7\}

4. The expression \(3n + 1\) gives the total number of squares needed to make each figure of the pattern where \(n\) is the figure number. How many squares will be needed to make Figure 9?
   - F 28 squares
   - G 32.5 squares
   - H 56 squares
   - J 88.5 squares

5. The expression \(3x - (2x + 4x - 6)\) is equivalent to
   - A \(-3x - 6\)
   - B \(-3x + 6\)
   - C \(3x + 6\)
   - D \(3x - 6\)
Multiple Choice

Read each question. Then fill in the correct answer on the answer document provided by your teacher or on a sheet of paper.

1. Evaluate the expression $2^5$.
   A 12
   B 32
   C 64
   D 128

2. Which sentence best describes the end behavior of the function shown?

   ![Graph](image)
   A $y = -x$
   B $y = x$
   C $y = -x$
   D $y = x$

3. Let $y$ represent the number of yards. Which algebraic expression represents the number of feet in $y$?
   A $y - 3$
   B $y + 3$
   C $3y$
   D $\frac{y}{3}$

4. What is the domain of the following relation? $\{(1,3), (-6, 4), (8, 5)\}$
   F $\{3, 4, 5\}$
   G $\{-6, 1, 8\}$
   H $\{-6, 1, 3, 4, 5, 8\}$
   J $\{1, 3, 4, 5, 8\}$

5. The table shows the number of some of the items sold at the concession stand at the first day of a soccer tournament. Estimate how many items were sold from the concession stand throughout the four days of the tournament.

<table>
<thead>
<tr>
<th>Item</th>
<th>Number Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Popcorn</td>
<td>78</td>
</tr>
<tr>
<td>Hot Dogs</td>
<td>90</td>
</tr>
<tr>
<td>Chips</td>
<td>48</td>
</tr>
<tr>
<td>Sodas</td>
<td>51</td>
</tr>
<tr>
<td>Bottled Water</td>
<td>82</td>
</tr>
</tbody>
</table>

   A 1350 items
   B 1400 items
   C 1450 items
   D 1500 items

6. There are 24 more cars than twice the number of trucks for sale at a dealership. If there are 100 cars for sale, how many trucks are there for sale at the dealership?
   F 28
   H 34
   G 32
   J 38

7. Refer to the relation in the table below. Which of the following values would result in the relation not being a function?

<table>
<thead>
<tr>
<th>$x$</th>
<th>$-6$</th>
<th>$-2$</th>
<th>$6$</th>
<th>$3$</th>
<th>$5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>$-1$</td>
<td>$3$</td>
<td>$-3$</td>
<td>$4$</td>
<td>$0$</td>
</tr>
</tbody>
</table>

   A $-1$
   B $3$
   C $7$
   D $8$

Short Response/Grided Response

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

8. The edge of each box below is 1 unit long.

   [Diagram]

9. The table shows the costs of certain items at a corner hardware store.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>box of nails</td>
<td>$3.90</td>
</tr>
<tr>
<td>box of screws</td>
<td>$5.25</td>
</tr>
<tr>
<td>claw hammer</td>
<td>$12.95</td>
</tr>
<tr>
<td>electric drill</td>
<td>$42.50</td>
</tr>
</tbody>
</table>

   a. Write two expressions to represent the total cost of 3 boxes of nails, 2 boxes of screws, 2 hammers, and 1 electric drill.
   b. What is the total cost of the items purchased?

10. GRIDDED RESPONSE

    Evaluate the expression below.

    \[ \frac{x^2 + 2x + 4}{x^2 + 4x + 4} \]

    a. Complete the table for each value of $x$.
    | $x$ | $y$ |
    |-----|-----|
    | 1   | 1   |
    | 2   | 2   |
    | 3   | 3   |
    | 4   | 4   |
    | 5   | 5   |
    | 6   | 6   |
    | 7   | 7   |
    | 8   | 8   |
    | 9   | 9   |
    | 10  | 10  |
    | 11  | 11  |
    | 12  | 12  |

    b. Plot the points from the table on a coordinate grid. What does you notice about the points?

    c. Make a conjecture about the relationship between the change in $x$ and the change in $y$.

Extended Response

Record your answers on a sheet of paper. Show your work.

12. The volume of a sphere is four-thirds the product of $x$ and the radius cubed.

   a. Write an expression for the volume of a sphere with radius $r$.
   b. Find the volume of a sphere with a radius of 6 centimeters. Describe how you found your answer.

Need Extra Help?

If you missed Question...

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>1-8</td>
<td>1-1</td>
<td>1-6</td>
<td>1-4</td>
<td>1-5</td>
<td>1-7</td>
<td>1-5</td>
<td>1-3</td>
<td>1-2</td>
<td>1-4</td>
<td>1-1</td>
</tr>
</tbody>
</table>