7TH GRADE MATHEMATICS

UNIT 2

EXPRESSIONS AND EQUATIONS

WORTH COUNTY MIDDLE SCHOOL

2015-2016
## Unit 2: Expressions and Equations

**Unit Essential Question:** How do I use variables to represent real-world situations and use the properties of operations to generate equivalent expressions for these situations?

<table>
<thead>
<tr>
<th>Properties &amp; Orders of Operations</th>
<th>Expressions</th>
<th>Equations</th>
<th>Inequalities</th>
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<tbody>
<tr>
<td><strong>Lesson EQ:</strong></td>
<td><strong>Lesson EQ:</strong></td>
<td><strong>Lesson EQ:</strong></td>
<td><strong>Lesson EQ:</strong></td>
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<tr>
<td>How do the properties of integers help me navigate the coordinate plane?</td>
<td>How can we represent values using variables?</td>
<td>How can we use variables to solve equations?</td>
<td>How do I solve and graph inequalities?</td>
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<tr>
<td>How do I use the properties of numbers to solve problems containing rational numbers?</td>
<td>What properties do I need to understand in order to simplify and evaluate algebraic expressions and solve equations?</td>
<td>How are expressions and equations similar? How are they different?</td>
<td>How are solutions to inequalities represented?</td>
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<tr>
<td>How does the order of operations help us simplify numerical expressions?</td>
<td>How do we evaluate expressions?</td>
<td>What basic operations help us maintain equality on both sides of an equation?</td>
<td>How can we translate mathematical relationships into inequalities?</td>
</tr>
<tr>
<td>How do we solve word problems using variables?</td>
<td>How do we solve real world problems using equations?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Vocabulary:**
- Commutative, associative, distributive, identity properties
- Variables, expressions, constant, coefficient, term, numerical expression, algebraic expression
- Equation, solution
- Inequality, solution set

| MGSE7.EE.1 | MGSE7.EE.2 | MGSE7.EE.1, 2, 3, and 4 | MGSE7.EE.4b |
UNIT 2: EXPRESSIONS AND EQUATIONS

Use properties of operations to generate equivalent expressions.

MGSE7.EE.1 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

MGSE7.EE.2 Understand that rewriting an expression in different forms in a problem context can clarify the problem and how the quantities in it are related. For example, a + 0.05a = 1.05a means that adding a 5% tax to a total is the same as multiplying the total by 1.05. Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

MGSE7.EE.3 Solve multistep real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals) by applying properties of operations as strategies to calculate with numbers, converting between forms as appropriate, and assessing the reasonableness of answers using mental computation and estimation strategies. For example: • If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. • If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide,
you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.

**MGSE7.EE.4** Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

**MGSE7.EE.4a** Solve word problems leading to equations of the form \( px + q = r \) and \( p(x + q) = r \), where \( p, q, \) and \( r \) are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?

**MGSE7.EE.4b** Solve word problems leading to inequalities of the form \( px + q > r \) or \( px + q < r \), where \( p, q, \) and \( r \) are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. For example, as a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions.

**MGSE7.EE.4c** Solve real-world and mathematical problems by writing and solving equations of the form \( x+p = q \) and \( px = q \) in which \( p \) and \( q \) are rational numbers.
LESSON 1: Properties & Orders of Operations

Order Of Operations: (PEMDAS)

- Parentheses
- Exponents
- Multiplication (Done from left to right)
- Division (Done from left to right)
- Addition
- Subtraction

Tutorials:  
http://www.regentsprep.org/Regents/Math/orderop/Lorder.htm  
http://www.math.com/school/subject2/lessons/S2U1L2GL.html

Simplify using order of operations.

1) \[ 24 \div 4 + 3^2 \]

2) \[ 13 + (3 \times 2)^2 - 8 \]

3) \[ 14 \div 7 \times 5 - 3 \]

4) \[ [8 \times 2 - (3 + 9)] + [8 \div 2 \times 3] \]

<table>
<thead>
<tr>
<th>Property</th>
<th>Addition</th>
<th>Multiplication</th>
</tr>
</thead>
<tbody>
<tr>
<td>associative</td>
<td>( a + (b + c) = (a + b) + c )</td>
<td>( a \cdot (b \cdot c) = (a \cdot b) \cdot c )</td>
</tr>
<tr>
<td>commutative</td>
<td>( a + b = b + a )</td>
<td>( a \cdot b = b \cdot c )</td>
</tr>
<tr>
<td>identity</td>
<td>( a + 0 = a )</td>
<td>( a \cdot 1 = a )</td>
</tr>
<tr>
<td>inverse</td>
<td>( a + (-a) = 0 )</td>
<td>( a \cdot \left(\frac{1}{a}\right) = 1 )</td>
</tr>
<tr>
<td>distributive</td>
<td></td>
<td>( a \cdot (b + c) = a \cdot b + a \cdot c )</td>
</tr>
</tbody>
</table>
Definitions for Properties of Mathematics

**Associative Property of Addition**
When three or more numbers are added, the sum is the same regardless of the grouping of the addends. For example \((a + b) + c = a + (b + c)\)

**Associative Property of Multiplication**
When three or more numbers are multiplied, the product is the same regardless of the order of the multiplicands. For example \((a \times b) \times c = a \times (b \times c)\)

**Commutative Property of Addition**
When two numbers are added, the sum is the same regardless of the order of the addends. For example \(a + b = b + a\)

**Commutative Property of Multiplication**
When two numbers are multiplied together, the product is the same regardless of the order of the multiplicands. For example \(a \times b = b \times a\)

**Distributive Property**
The sum of two numbers times a third number is equal to the sum of each addend times the third number. For example \(a \times (b + c) = a \times b + a \times c\)

**Identity Property of Addition**
The sum of any number and zero is the original number. For example \(a + 0 = a\).

**Identity Property of Multiplication**
The product of any number and one is that number. For example \(a \times 1 = a\).

**Additive Inverse of a Number**
The additive inverse of a number, \(a\) is \(-a\) so that \(a + -a = 0\).

**Multiplicative Inverse of a Number**
The multiplicative inverse of a number, \(a\) is \(\frac{1}{a}\) so that \(a \times \frac{1}{a} = 1\).
Identify the Properties of Mathematics

1) The multiplicative inverse of a number, a is $\frac{1}{a}$ so that $a \times \frac{1}{a} = 1$. 

2) When two numbers are multiplied together, the product is the same regardless of the order of the multiplicands. For example $a \times b = b \times a$. 

3) The sum of any number and zero is the original number. For example $a + 0 = a$. 

4) Multiplying any number by 0 yields 0. For example $a \times 0 = 0$. 

5) Adding 0 to any number leaves it unchanged. For example $a + 0 = a$. 

6) When three or more numbers are multiplied, the product is the same regardless of the order of the multiplicands. For example $(a \times b) \times c = a \times (b \times c)$. 

7) When three or more numbers are added, the sum is the same regardless of the grouping of the addends. For example $(a + b) + c = a + (b + c)$. 

8) The additive inverse of a number, a is $-a$ so that $a + (-a) = 0$. 

9) When two numbers are added, the sum is the same regardless of the order of the addends. For example $a + b = b + a$. 

10) The sum of two numbers times a third number is equal to the sum of each addend times the third number. For example $a \times (b + c) = a \times b + a \times c$. 

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Order of Operations

Solve.

1) \(5 + 8 \div 2 - 7\)  
   Ans = 

2) \(12 \times 3 - 42 + 20\)  
   Ans = 

3) \(4 \div 1 + 8 \times 2\)  
   Ans = 

4) \(17 \times 3 + 15 \div 3\)  
   Ans = 

5) \(29 - 6 \times 5 + 14\)  
   Ans = 

6) \(31 \times 2 - 54 - 3\)  
   Ans = 

7) \(16 \div 8 + 5 + 17\)  
   Ans = 

8) \(28 + 4 \times 5 \div 5\)  
   Ans = 

9) \(32 + 9 \times 6 - 84\)  
   Ans = 

10) \(62 - 33 \div 3 + 14\)  
    Ans =
Order of Operations

Solve.

1) \(6 + 42 ÷ 2 - 15\)
   Ans = 

2) \(36 - 10 \times 2 ÷ 5 - 11\)
   Ans = 

3) \(25 \times 2 - 42 ÷ 6 + 18\)
   Ans = 

4) \(3 + 32 ÷ 8 - 9\)
   Ans = 

5) \(8 ÷ 9 - 2 \times 3\)
   Ans = 

6) \(4 - 6 \times 2 ÷ 2 + 2\)
   Ans = 

7) \(12 ÷ 2 \times 6 + 4 - 3\)
   Ans = 

8) \(63 ÷ 7 \times 3 - 4\)
   Ans = 

9) \(4 ÷ 8 - 5 \times 6\)
   Ans = 

10) \(5 + 36 ÷ 2 \times 3 - 4\)
    Ans = 
# Comparing Quantities

## A) Fill in the box with an appropriate symbol (= or ≠).

1) \(6 - 32 ÷ 8 + 7\) \[\text{□} \ 10 + 30 ÷ 6 - 3 \times 2\]  
2) \(9 + 42 ÷ 6 + 3\) \[\text{□} \ 5 + 4 ÷ 2 \times 6\]

3) \(14 \times 2 + 4 - 3\) \[\text{□} \ 28 ÷ 14 + 2\]  
4) \(9 ÷ 3 + 4\) \[\text{□} \ 17 - 9 \times 2 + 8\]

5) \(7 + 2 - 6 ÷ 2\) \[\text{□} \ 9 + 4 - 16 ÷ 8\]  
6) \(5 \times 6 + 2\) \[\text{□} \ 2 \times 19 - 24 ÷ 4\]

## B) Fill in the box with an appropriate symbol (<, > or =).

7) \(1 + 6 ÷ 3\) \[\text{□} \ 4 \times 5 - 17\]  
8) \(6 ÷ 3 + 7 \times 2\) \[\text{□} \ 2 \times 4 + 10 - 3\]

9) \(3 - 8 \times 2 + 3\) \[\text{□} \ 5 - 18 ÷ 3 \times 2\]  
10) \(8 - 2 \times 4 + 9\) \[\text{□} \ 12 ÷ 4 \times 2 - 2 + 5\]

11) \(7 \times 12 ÷ 4 + 6\) \[\text{□} \ 4 + 8 ÷ 2\]  
12) \(10 \times 12 ÷ 3\) \[\text{□} \ 11 + 3 - 7 \times 3\]

## C) Match the equal quantities.

13) \(4 + 7 \times 3 - 1\) \[\circ \ 8 \times 2 - 3 + 7\]

14) \(10 + 4 ÷ 2\) \[\circ \ 11 + 4 \times 2 + 5\]

15) \(14 + 24 ÷ 6 + 2\) \[\circ \ 25 ÷ 5 - 3 \times 3\]

16) \(5 - 4 \times 3 + 9 ÷ 3\) \[\circ \ 2 \times 3 + 60 ÷ 10\]
Distributing And Factoring Area

Write the expression that represents the area of each rectangle.

1. \[ \frac{5}{4} \]
2. \[ \frac{7}{m} \]
3. \[ \frac{a}{3} \]
4. \[ \frac{4}{x} \]

Find the area of each box in the pair.

5. \[ \frac{x}{4} \]
6. \[ \frac{a}{7} \]
7. \[ \frac{x}{3} \]

Write the expression that represents the total length of each segment.

8. \[ x \]
9. \[ x \]
10. \[ a \]

Write the area of each rectangle as the product of length \times width and also as a sum of the areas of each box.

11. \[ \frac{x}{5} \]
12. \[ \frac{x}{3} \]
13. \[ \frac{a}{5} \]

<table>
<thead>
<tr>
<th>AREA AS PRODUCT</th>
<th>AREA AS SUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>( S(x+7) )</td>
<td>( Sx+35 )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AREA AS PRODUCT</th>
<th>AREA AS SUM</th>
</tr>
</thead>
</table>

Use the distributive property to find sums that are equivalent to the following expressions. (You may want to use a rectangle to help you)

14. \( 4(x + 7) = \) __________
15. \( 7(x - 3) = \) __________
16. \( -2(x + 4) = \) __________
17. \( 3(x + 9) = \) __________
18. \( 4(a - 1) = \) __________
19. \( 3(m + 2) = \) __________
20. \( -4(a - 4) = \) __________
21. \( \frac{1}{2}(a - 12) = \) __________
Factoring Using Area Models

Fill in the missing information for each: dimensions, area as product, and area as sum

1. \[ \begin{array}{c|c}
    x & 6 \\
    \hline
    2 & \Box \\
\end{array} \]

2. \[ \begin{array}{c|c|c}
    \Box & \Box & \Box \\
    \hline
    \Box & \Box & \Box \\
\end{array} \]

3. \[ \begin{array}{c|c}
    \Box & \Box \\
    \hline
    \Box & \Box \\
\end{array} \]

4. \[ \begin{array}{c|c|c}
    \Box & \Box & \Box \\
    \hline
    \Box & \Box & \Box \\
\end{array} \]

\[ 2(x+6) \]

\[ 2x+12 \]

Fill in the missing dimensions from the expression given.

5. \[ 5x+35 = 5(\quad) \]

6. \[ 2x+12 = 2(\quad) \]

7. \[ 3x-21 = (\quad) \]

8. \[ 7x-21 = (\quad) \]

9. \[ -3x-15 = -3(\quad) \]

10. \[ -5x+45 = \quad \]

Use rectangles to factor the following problems:

Factor these:

11. \[ 4x-16 = \quad \]

12. \[ -7x-35 = \quad \]

13. \[ 9x-81 = \quad \]

14. \[ 4x+18 = \quad \]
LESSON 2: EXPRESSIONS

ALGEBRA EXPRESSIONS WORD PROBLEMS

Word Problems need to be turned into Algebra Expressions so that we can do mathematics on them, and work out number answers. (Or write a Computer App that gets the answer).

Little Red Riding Hood has to walk 5 miles.

If she hops on 1 leg at 1 mile per hour, it will take her 5 hours.

If she walks at 5 miles per hour, it will take her 1 hour.

If she runs at 10 miles per hour, it will take her half an hour.

The Algebra Expression that gets the time for any speed she travels at is: 5 divided by Speed or the “expression” $\frac{5}{S}$.

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### Algebraic Expressions

An algebraic expression is a collection of real numbers, variables, grouping symbols and operation symbols.

Here are some examples of algebraic expressions.

$$5x^2 + x - 7, \ 4, \ \frac{1}{3}xy - \frac{5}{7}, \ -7(x - 2)$$
Lesson 3.1 Mathematical Properties & Equivalent Expressions

**Commutative Property:** The order in which numbers are added does not change the sum. The order in which numbers are multiplied does not change the product.

\[ a + b = b + a \]
\[ a \times b = b \times a \]

**Associative Property:** The grouping of addends does not change the sum. The grouping of factors does not change the product.

\[ a + (b + c) = (a + b) + c \]
\[ a \times (b \times c) = (a \times b) \times c \]

**Identity Property:** The sum of an addend and 0 is the addend. The product of a factor and 1 is the factor.

\[ a + 0 = a \]
\[ a \times 1 = a \]

**Properties of Zero:** The product of a factor and 0 is 0. The quotient of the dividend 0 and any divisor is 0.

\[ a \times 0 = 0 \]
\[ 0 \div a = 0 \]

**Distributive Property:** If two addends or the minuend and subtrahend in an equation are being multiplied by the same factor, the equation can be rewritten by factoring out the common factor.

\[ a \times (b + c) = (a \times b) + (a \times c) \]
\[ a \times (b - c) = (a \times b) - (a \times c) \]

Rewrite each expression using the property indicated.

\( \text{a} \)

1. associative: \((7 + 6) + y = \)

2. commutative: \(z \times 8 = \)

3. distributive: \(6 \times (a + b) = \)

4. commutative: \(7 + y = \)

5. identity: \(45 \times 1 = \)

\( \text{b} \)

identity: \(724 + 0 = \)

zero: \(61 \times 0 = \)

zero: \(0 \div 5 = \)

associative: \(5 \times (6 \times 3) = \)

distributive: \((7 \times 3) + (7 \times 7) = \)

Spectrum Math
Grade 7

Chapter 3, Lesson 1
Expressions, Equations, and Inequalities
Lesson 3.1  Mathematical Properties & Equivalent Expressions

Use phrases to help you understand which operations to use in word problems.

<table>
<thead>
<tr>
<th>Addition Phrases</th>
<th>Subtraction Phrases</th>
<th>Multiplication Phrases</th>
<th>Division Phrases</th>
</tr>
</thead>
<tbody>
<tr>
<td>more than</td>
<td>less than</td>
<td>the product of</td>
<td>the quotient of</td>
</tr>
<tr>
<td>the sum of</td>
<td>decreased by</td>
<td>times</td>
<td>divided by</td>
</tr>
</tbody>
</table>

Write each phrase as an expression or equation.

1. three increased by \( d \) \[ a \]

2. seven less than 12 \[ b \]

3. a number divided by 6 is 8 \[ \text{two more than a number is nine} \]

4. the sum of five and six is eleven \[ \text{nine more than 15} \]

5. three less than \( t \) is five \[ \text{the quotient of twelve and } s \text{ is } 4 \]

6. the product of five and three is \( y \) \[ \text{the product of two and } b \text{ is } 4 \]

7. 12 more than 20 \[ \text{twenty divided by a number is five} \]

8. the quotient of 30 and \( f \) is 3 \[ \text{the sum of } 4 \text{ and } 11 \text{ is } 15 \]

7 times \( b \) is 63
Lesson 6.1 Equivalent Expressions

Equivalent expressions are created by simplifying values and combining terms.

4(6x - 5) = 24x - 20    Multiply each value by 4 to create an equivalent expression.

3(4^3 + 7x) = 3(64 + 7x)  First, calculate the value of the exponents.
3(64 + 7x) = 192 + 21x    Then, use the distributive property to create the equivalent expression.

\[ t + t + t = 3t \]  Use multiplication in place of repeated addition.

Create expressions equivalent to the ones below.

1. 7(4z + 8b)
2. 8(2x + 3^2)
3. 4(r + r + r + r)
4. 9(3 + 8x)
5. 4^2(3 + 6t)
6. \( \frac{1 + 1 + 1}{4} \)
7. 2(4s^3 + 2)
8. 30(3x + 4)
9. 6(5a + 9b)
10. 9(3x + 54)
11. 7(c + c + c)
12. 9(2 + 7t)
Lesson 3.2 Solving Problems with Equivalent Expressions

Sometimes, it is easier to solve equations by writing them in different ways.

A number increased by 10% can be written as:
- \( n + (0.10 \times n) \)
- \( 1.10 \times n \)

A number divided by 7 equals 3 can be written as:
- \( n \div 7 = 3 \)
- \( 3 \times 7 = n \)

Write two equivalent expressions for each statement.

a

1. a number decreased by 7%

2. $25 plus a 5% tip

3. a number divided by 5 equals 9

4. 12 times the difference of 15 and a number

5. the sum of 7 and a number times 10

b

9 times the sum of 7 and a number

the sum of a number and 4 times the number

a number increased by \( \frac{1}{5} \)

$44 plus a 20% tip

a number decreased by \( 3\frac{1}{4} \)
Lesson 3.3  Creating Expressions to Solve Problems

Write expressions to solve problems by putting the unknown number, or variable, on one side of the equation and the known values on the other side of the equation. Then, solve for the value of the variable.

Francine is making earrings and necklaces for six friends. Each pair of earrings uses 6 centimeters of wire and each necklace uses 30 centimeters. How much wire will Francine use?

Let $w$ represent the amount of wire used.

Equation: $w = 6 \times (6 + 30)$

Another way of writing this expression is: $w = (6 \times 6) + (6 \times 30)$

How much wire did Francine use? $w = 216$ centimeters

---

Solve each problem.

1. A jaguar can run 40 miles per hour while a giraffe can run 32 miles per hour. If they both run for 4 hours, how much farther will the jaguar run?

   Let $d$ represent the distance.

   Equation: __________________________

   Another way of writing this is: __________________________

   The jaguar will run _______________ miles farther.

2. Charlene sold 15 magazine subscriptions for the school fundraiser. Mark sold 17 subscriptions and Paul sold 12. How many magazine subscriptions did they sell in all?

   Let $s$ represent subscriptions.

   Equation: __________________________

   Another way of writing this is: __________________________

   They sold _______________ subscriptions in all.

3. Shara bought 3 bags of chocolate candies for $1.25 each and 3 bags of gummy bears for $2.00 each. How much did she spend in all?

   Let $m$ represent the money spent.

   Equation: __________________________

   Another way of writing this is: __________________________

   Shara spent _______________ on candy.
Lesson 6.2 Factoring Expressions

Factoring expressions involves the use of the distributive property. You’ve learned how to use the distributive property to expand expressions:

$$3(4x + 5) = (3 \times 4x) + (3 \times 5) = 12x + 15$$

Because 3 is a factor of both numbers, a factored form of $12x + 15$ is $3(4x + 5)$. By factoring, you are “pulling out” a common factor of both terms in an expression.

Many times, you are looking to find the greatest common factor (GCF) of both terms.

To factor $6a + 4b$, first look for the greatest common factor of the terms. The coefficients 6 and 4 are both divisible by 2. So, the GCF is 2.

First, determine what to multiply 2 by to get $6a$; $2 \times 3a = 6a$.

$$2(3 + \_\_)$$

Then, determine what to multiply 2 by to get $4b$; $2 \times 2b = 4b$.

$$2(3a + 2b) = 6a + 4b$$

Use the distributive property and greatest common factor to factor each expression. If the expression cannot be factored, write OK.

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>$4m + 12$</td>
<td>$2x + 8y$</td>
</tr>
<tr>
<td>2.</td>
<td>$9t + 18$</td>
<td>$10v - 15w$</td>
</tr>
<tr>
<td>3.</td>
<td>$6b - 18a$</td>
<td>$42 + 70$</td>
</tr>
<tr>
<td>4.</td>
<td>$14y + 35x$</td>
<td>$m + 3n$</td>
</tr>
<tr>
<td>5.</td>
<td>$39 + 91$</td>
<td>$2f + 48$</td>
</tr>
<tr>
<td>6.</td>
<td>$x - 51x$</td>
<td>$-4s + 56$</td>
</tr>
<tr>
<td>7.</td>
<td>$7y + 56z$</td>
<td>$5p + 30q$</td>
</tr>
</tbody>
</table>
Add or subtract.

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5 + 3 = _____</td>
<td>-5 + (-3) = _____</td>
<td>5 + (-3) = _____</td>
<td>-5 + 3 = _____</td>
</tr>
<tr>
<td>2</td>
<td>5 - 3 = _____</td>
<td>-5 - 3 = _____</td>
<td>5 - (-3) = _____</td>
<td>-5 - (-3) = _____</td>
</tr>
<tr>
<td>3</td>
<td>-3 + (-3) = _____</td>
<td>3 + (-3) = _____</td>
<td>-3 + 3 = _____</td>
<td>3 + 3 = _____</td>
</tr>
<tr>
<td>4</td>
<td>8 + (-8) = _____</td>
<td>-8 + (-8) = _____</td>
<td>8 + 8 = _____</td>
<td>-8 + 8 = _____</td>
</tr>
</tbody>
</table>

Multiply or divide.

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>6 ÷ 2 = _____</td>
<td>6 ÷ (-2) = _____</td>
<td>-6 ÷ 2 = _____</td>
<td>-6 ÷ -2 = _____</td>
</tr>
<tr>
<td>6</td>
<td>5 ÷ (-1) = _____</td>
<td>-5 × (-1) = _____</td>
<td>5 ÷ (-5) = _____</td>
<td>-5 ÷ (-5) = _____</td>
</tr>
</tbody>
</table>

Rewrite each expression using the distributive property.

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>4 × (6 + 7) = _______________</td>
<td>(2 × 3) + (2 × 5) = _______________</td>
</tr>
<tr>
<td>8</td>
<td>6 × (4 - 3) = _______________</td>
<td>(4 × 8) - (4 × 9) = _______________</td>
</tr>
</tbody>
</table>
**Check What You Know**

**CHAPTER 2 PRETEST**

**Integers and Equations**

Solve each equation.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>4 + s = 11</td>
<td>b</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>27 - z = 4</td>
<td>x - 13 = 42</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>c - 19 = 0</td>
<td>r + 5 = 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>3 x s = 27</td>
<td>t x 9 = 81</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>z ÷ 5 = 4</td>
<td>72 ÷ c = 18</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>20 / t = 4</td>
<td>9 = x / 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>5b + 3 = 13</td>
<td>7p - 5 = 16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Write an equation for each problem. Then, solve the equation.

16. In Chase’s art class, there are 21 students. Nine of them are girls. How many are boys?

   There are ______ boys in the class.

17. Garrett earns $8.00 an hour in his summer job. Each week, he earns $160. How many hours per week does he work?

   He works ______ hours per week.

18. The outside temperature changed -14°F over 4 hours. If the temperature changed the same amount each hour, what was the change in temperature each hour?

   The temperature change each hour was ______°F.
Study Guide and Notes: Variables and Expressions

A variable is a symbol, usually a letter, used to represent an unspecified number. It is used in to “translate” verbal expressions into algebraic expressions or formulae. Math symbols are used to indicate what type of computation to do. Here are some examples of expressions using mathematical operations and variables:

<table>
<thead>
<tr>
<th>Addition:</th>
<th>Subtraction:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 plus a number</td>
<td>4 + x</td>
</tr>
<tr>
<td>5 more than a number</td>
<td>x + 5</td>
</tr>
<tr>
<td>A number increased by 3</td>
<td>x + 3</td>
</tr>
<tr>
<td>The sum of a number and 2</td>
<td>x + 2</td>
</tr>
<tr>
<td></td>
<td>a - b</td>
</tr>
<tr>
<td></td>
<td>3 less than a number</td>
</tr>
<tr>
<td></td>
<td>x - 3</td>
</tr>
<tr>
<td></td>
<td>A number decreased by 8</td>
</tr>
<tr>
<td></td>
<td>x - 8</td>
</tr>
<tr>
<td></td>
<td>A number less 6</td>
</tr>
<tr>
<td></td>
<td>x - 6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multiplication:</th>
<th>Division:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The product of a and b</td>
<td>The quotient of a and b</td>
</tr>
<tr>
<td>5 times a number</td>
<td>a ÷ b</td>
</tr>
<tr>
<td>Twice a number</td>
<td>A number divided by 8</td>
</tr>
<tr>
<td></td>
<td>x ÷ 8</td>
</tr>
<tr>
<td></td>
<td>The ratio of x and y</td>
</tr>
<tr>
<td></td>
<td>x ÷ y</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exponents:</td>
</tr>
<tr>
<td></td>
<td>The square of a number</td>
</tr>
<tr>
<td></td>
<td>x²</td>
</tr>
<tr>
<td></td>
<td>The cube of a number</td>
</tr>
<tr>
<td></td>
<td>x³</td>
</tr>
<tr>
<td></td>
<td>A number raised to the 5th power</td>
</tr>
<tr>
<td></td>
<td>x⁵</td>
</tr>
</tbody>
</table>

Write a variable expression the the algebraic expression.

1. 3x + 7  
2. x - 9  
3. x² - 2x  
4. \( \frac{a}{2b} \)

Write an algebraic expression for the variable expression.

5. twice a number increased by 5  
6. the sum of a number and 6

7. the quotient of 8 and x  
8. 9 less than a number

9. the square of a number decreased by 3  
10. the difference of x and x squared

Note the similarities and the differences in the following expressions

11. the sum of twice x and y  
12. twice the sum of x and y

13. 4 times the difference of a and b  
14. the difference of 4 times a and b

Write the expression using exponents.

15. 9 to the third power  
16. 8 \cdot 8 \cdot 8  
17. 5 \cdot b \cdot b \cdot c \cdot c \cdot c

Evaluate the expression. Use the calculator keystrokes shown to check your work after you work the problem.

18. 3⁴  
19. 5³  
20. 10⁷
Area And Algebra

I. Perimeter and Area of Figures

Find the perimeter and area of the following figures. Explain in words how you found the perimeter and area of each figure. (unit: inches)

1.

Perimeter: _______________

Area: _______________

Explanation:

2.

Perimeter: _______________

Area: _______________

Explanation:
II. **Perimeter of Algebraic Figures**

*Find the perimeter of each of the following figures.*

1. What is the perimeter of this figure?

2. What is the perimeter of the figure if \(x=3\) in.? Show your calculations step-by-step.

3. What is the perimeter of this figure?

4. What is the perimeter of the figure if \(a=1/2\) in.? Show your calculations step-by-step.
III. Perimeter and Area of Algebraic Figures

A corner has been removed from this rectangle. Answer the following questions related to figure below.

1. Find an expression for the perimeter of the rectangle.

2. What is the perimeter of the rectangle if \( a = \frac{3}{4} \) inch? Show your calculations step-by-step.

3. Find an expression for the area of the rectangle.

4. What is the area of the rectangle if \( a = 1.8 \) feet? Show your calculations step-by-step.
**LESSON 3: EQUATIONS**

Coefficient \[ \text{Variable} \]

\[ 4x - 7 = 5 \]

Operator \[ \text{Constants} \]

\[ 2y - 5x = 18 \]

\[ +5x \quad +5x \]

\[ \frac{2y}{2} = \frac{18 + 5x}{2} \]

\[ y = 9 + \frac{5}{2}x \]

*In other words, isolate the variable "y" by itself*

*Undo the subtracting 5x by adding 5x to both sides.*

*Undo the multiplying by 2, by dividing both sides by 2*

*Remember, all numbers on the other side get divided by 2.*

*Since you have "y = ", you have now solved for y*

**Example: Solve the following for y**
Expressions and Equations

Create expressions equivalent to the ones below.

1. $4(a + b)$

2. $3(9a + 8b)$

3. $9(x + 2y)$

Solve. Write your answer in simplest form.

4. The standard size of a bin holds $2 \frac{3}{4}$ gallons. The large size of that bin is $1 \frac{1}{4}$ times larger. How many gallons does the large bin hold?

   The large bin holds ___________ gallons.

5. Diana has $3 \frac{1}{4}$ bags of nuts. Each bag holds $4 \frac{1}{2}$ pounds. How many pounds of nuts does Diana have?

   Diana has ___________ pounds of nuts.

6. Each month, Kelsey donates $\frac{1}{2}$ of her allowance to her school for supplies. Of that amount, $\frac{1}{2}$ goes to the chorus class. How much of her allowance goes to supplies for the chorus class?

   ___________ of her allowance goes to help the chorus classes.

Use the Distributive Property to factor each expression.

7. $32a + 56b$

8. $15y + 18x$
Lesson 7.2  Equations with Grouping Symbols

To solve equations with grouping symbols, such as parentheses, first use the distributive property to remove the parentheses. Then, solve.

Solve:  \[ 3(2 + n) = 10 + 2n \]
\[ (3 \times 2) + (3 \times n) = 10 + 2n \]
Distributive Property
\[ 6 + 3n = 10 + 2n \]
Simplify
\[ 6 + 3n - 2n = 10 + 2n - 2n \]
Subtraction Property
\[ n = 4 \]
Solution

Some equations have no solutions. The symbol \( \emptyset \) means null, or no solution. Some equations have an infinite number of solutions, or true for all solutions.

\[ 2 + a = 4 + a \]
\[ 2 + a - a = 4 + a - a \]
\[ 2 = 4 \]
This equation is never true. Therefore, the solution is \( \emptyset \) (null).

\[ 10b - 5 = 2(5b - 2) - 1 \]
\[ 10b - 5 = 10b - 4 - 1 \]
\[ 10b - 5 = 10b - 5 \]
\[ 10b = 10b \text{ after adding 5 to each side} \]
\[ b = b \text{ after dividing each side by 10} \]
This equation is always true. Therefore, the solution is true for all numbers.

Solve the equations. Write null or all where appropriate. Show fractions in simplest form.

<table>
<thead>
<tr>
<th></th>
<th>( a )</th>
<th>( b )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>( 5(y + 2) = 20 )</td>
<td>( 16 = 4(n - 5) + 4 )</td>
</tr>
<tr>
<td>2.</td>
<td>( 2(x - 4) = 2x - 8 )</td>
<td>( 7p + 9 = 4(p - 3) )</td>
</tr>
<tr>
<td>3.</td>
<td>( 6(k + 3) = 2(4k + 5) )</td>
<td>( 3(2m + 4) = 6m + 15 )</td>
</tr>
<tr>
<td>4.</td>
<td>( 30 - 2x = 2(3x + 3) )</td>
<td>( 2(4w + 7) = 3(6 + 2w) )</td>
</tr>
<tr>
<td>5.</td>
<td>( 6(2 + 3z) = 3(4 + 6z) )</td>
<td>( 25 = 6(c + 7) - 14 )</td>
</tr>
<tr>
<td>6.</td>
<td>( 4g + 9 = 2(g - 6) + 2g )</td>
<td>( 3(3h + h) = 2(h + 5) )</td>
</tr>
</tbody>
</table>
Writing Equations from Word Problems

1. You can buy 5 small pizzas for the same price as 3 small pizzas and 10 one dollar drinks. How much does each pizza cost?

2. Old McDonald’s 3 hens each lay the same number of eggs one week. This gives Old McDonald’s wife enough eggs to make two recipes. One recipe requires 10 eggs and the other recipe requires 2 eggs. How many eggs did each hen lay?

3. The vet put 2 litters of kittens in a cage with 5 other kittens. She also put 3 litters of puppies in the next cage with 1 other puppy. If all of the litters have the same number of animals and the cages now contain the same number of animals, how many animals are in each litter?

4. Brian buys 1 pack of baseball cards to add to the 2 cards a friend gave him. Then his mother gives him 2 more packs as a special treat. Now he has as many cards as Marcus who owns 1 pack plus 12 loose cards. How many cards are in each pack?

5. Paul owns a set of model cars. His brother gives him 3 more sets for his birthday. Then Paul gives 1 set to a friend who really likes model cars but doesn’t have any. Now Paul has 30 model cars left. How many model cars are in each set?

6. Tanner likes to collect comic books. He has 3 sets of the same title comics and 5 other comic books. His friend, Scott, has 1 set (the same as Tanner’s) and 19 other comic books. The total number of comic books owned by Tanner and Scott is the same. How many books are in each set?

7. Erin can buy 5 Putt-putt tickets and 2 one-dollar boxes of popcorn for the same price as 3 putt-putt tickets and 12 one-dollar boxes of popcorn. How much does each putt-putt ticket cost?

8. Allison has 2 aquariums. In each aquarium she has 2 families of guppies and 3 tetras. Leigh has 1 aquarium with 10 tetras and 3 families of guppies. Allison and Leigh have the same number of fish and their guppy families each have the same number of members. How many guppies are in each family?
LESSON 4: INEQUALITIES

Check It Out: Example 3

Rylan’s March profit of $172 was at least $12 less than his February profit. What was February’s profit?

Let \( p \) represent the profit decrease from February to March.

March profit was at least $12 less than February’s profit.

\[
172 \geq -12 + p
\]

\[
\begin{align*}
172 & \geq -12 + p \\
+12 & \quad +12 \\
184 & \geq p
\end{align*}
\]

\( p \leq 184 \)

February’s profit was at most $184.

---

12.5 Solving Inequalities by Adding or Subtracting

Additional Example 1B: Using the Addition Property of Inequality

Solve. Then graph the solution set on a number line.

\[
a - 10 \geq -3
\]

\[
\begin{align*}
a - 10 & \geq -3 \\
+10 & \quad +10 \\
a & \geq 7
\end{align*}
\]

Add 10 to both sides.

Draw a closed circle at 7. Then shade the line to the right.
## Example 1: Write equations and inequalities

<table>
<thead>
<tr>
<th>Verbal Sentence</th>
<th>Equation or Inequality</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. The difference of twice a number $k$ and 8 is 12.</td>
<td>$2k - 8 = 12$</td>
</tr>
<tr>
<td>b. The product of 6 and a number $n$ is at least 24.</td>
<td>$6n \geq 24$</td>
</tr>
<tr>
<td>c. A number $y$ is no less than 5 and no more than 13.</td>
<td>$5 \leq y \leq 13$</td>
</tr>
</tbody>
</table>

![Number line diagrams for inequalities]

---

**Diagram Notes:**
- **$a \geq 4$** (closed circle, arrow to the right)
- **$a > 4$** (open circle, arrow to the right)
- **$a < 4$** (open circle, arrow to the left)
- **$a \leq 4$** (closed circle, arrow to the left)
Lesson 7.3  Inequalities

Recall that the = symbol means equal to. This symbol indicates an equation, or equality. An inequality states that values are not equal. The symbols > and < indicate inequality. Sometimes the values in an inequality might also be equal. For example, a tank holds 15 gallons of gas. How much gas is in the tank? You don’t know without measuring. However, you do know that the amount must be less than or equal to 15 gallons: Gas in tank \( \leq \) 15 gallons.

Sometimes you can use the text in an item to determine when to use the less than or equal to or greater than or equal to symbols. Terms such as “no more than” or “at most” indicate that \( \leq \) should be used. Terms such as “at least” indicate that \( \geq \) should be used.

Tim wants to run no more than 5 miles can be represented by \( x \leq 5 \) miles.

Shauna wants to work at least 4 hours can be represented by \( x \geq 4 \) hours.

Write \( \geq \) or \( \leq \) on the line to complete the inequality.

1. In 1 year, Lana wants to save at least $500. Lana wants her savings to be ________ $500.

2. Jordan takes $20 to the mall. Using cash only, Jordan will spend ________ $20.

3. Luis wants to bike at least 20 miles today. Luis wants to bike ________ 20 miles.

4. Maria wants her plant to grow to at most 12 inches tall. Maria wants her plant to grow ________ 12 inches tall.

Write an inequality that describes the situation.

5. Trudi plans to study no more than 2 hours. ________________

6. There are at least 32 students that want to go to the museum. ________________
Lesson 7.4  Solving Inequalities by Adding or Subtracting

The addition and subtraction properties also apply to inequalities. You can add or subtract the same number from both sides of an inequality without affecting the inequality.

Solve: \( n + 4 < 9 \quad n + 4 - 4 < 9 - 4 \quad n < 5 \)

The solution is that \( n \) can be any value less than 5.

If you swap the left side and right side of an inequality, you must reverse the direction of the inequality. The direction is the way the arrow points.

\[
\begin{array}{ccc|ccc}
  n < 5 & x - 6 > 3 & p \leq 9 & k - 7 \geq 6 \\
  5 > n & 3 < x - 6 & 9 \geq p & 6 \leq k - 7 \\
  < \text{ becomes } > & > \text{ becomes } < & \leq \text{ becomes } \geq & \geq \text{ becomes } \leq
\end{array}
\]

When the solution includes an arrow pointing in the positive or negative direction, the solution includes all of the numbers in that direction. So, there are an infinite number of values for the solution.

Solve the inequalities and represent the possible values of the variable on a number line.

1. \( x + 2 < 4 \)

2. \( t - 3 > 2 \)

3. \( 1 < 2 + k \)

4. \( 3 > 2 + k \)

Write an inequality for each problem. Use \( n \) as the variable. Then, solve the inequality. Include the proper inequality symbol in the solution.

5. Jermaine has $25. He wants to buy a pair of gloves that costs $16.50. He also wants to buy a sandwich. How much can Jermaine spend on the sandwich?

   Inequality: ___________________________ Solution: ___________________________

6. Sharon has jogged 1.25 miles. Her goal is to jog more than 3.5 miles. How much more must she jog to accomplish her goal?

   Inequality: ___________________________ Solution: ___________________________
Lesson 7.5 Solving Inequalities by Multiplying or Dividing

Multiplication and division properties also apply to inequalities. You can multiply or divide both sides of an inequality by the same positive number without affecting the inequality. But if you multiply or divide both sides by a negative number, you must reverse the direction of the inequality.

Solve: \(4x > 12\)  
\[
\frac{4x}{4} > \frac{12}{4} \\
x > 3
\]

Solve: \(\frac{n}{2} \leq 8\)  
\[
\frac{n}{2} \times 2 \leq 8 \times 2 \\
n \leq 16
\]

Solve: \(-3p < 6\)  
\[
-\frac{3p}{3} > -\frac{6}{3} \text{ reverse the inequality} \\
p > -2
\]

Remember to reverse the direction of the inequality if you swap the left and the right sides.

Solve each inequality. Show the solution on a number line.

1. \(12 \leq 4n\) 

2. \(-7h < 28\) 

3. \(9 \leq \frac{n}{3}\) 

4. \(4 > -4n\) 

Write an inequality for each problem. Use \(n\) as the variable. Then, solve the inequality. Include the proper inequality symbol in the solution.

5. Kevin has $26 and wants to rent a bicycle. The bicycle rents for $6.25 per hour. How many hours can Kevin ride without owing more money than he has?

Inequality: _______________________________ Solution: _______________________________

6. Shia wants to save the same amount each month. In 4 months, she wants savings of at least $200. How much money must Shia save each month to achieve her goal?

Inequality: _______________________________ Solution: _______________________________
Check What You Know

Equations and Inequalities

Write an inequality for each problem. Use $n$ as the variable. Then, solve the inequality. Include the proper inequality symbol in the solution.

10. An auto mechanic estimates that the cost to repair Brett's car will be no more than $200. The parts will cost $49.23. What is the estimated cost for the labor?

   Inequality: ___________________ Solution: ________________

11. Tawana has $325.54 in her checking account. She must keep a balance of at least $300 to avoid a fee. She plans to write a check to pay her credit card bill of $125.43. How much money must Tawana deposit in her account to maintain at least the minimum balance?

   Inequality: ___________________ Solution: ________________

Solve the inequalities and represent the possible values of the variable on a number line.

12. $6 > z - 2$

13. $g + 7 < -12$

14. $d - 5 < 7$

15. $15 > k + 2$

16. $1 + x > -16$

17. $y + 8 < -9$

18. $8 \leq 8 + r$

19. $w + 8 \geq 11$
Check What You Know

Equations and Inequalities

Solve each equation. Write \textit{null} if the equation has no solution. Write \textit{all} if all numbers solve the equation. Write fractions in simplest form.

1. \(15 + n = 2n\) \hspace{1cm} \(7 - p = 3p + 5\)

2. \(6y + 2 = 4y\) \hspace{1cm} \(0.6x = 2.2x - 4\)

3. \(\frac{2c}{3} = 10 - r\) \hspace{1cm} \(3(m + 2) = 21\)

4. \(14 = 2(n - 3) + 6\) \hspace{1cm} \(5(b + 4) = 5(b + 6) - 10\)

5. \(4(z - 1) = 3(z + 2)\) \hspace{1cm} \(7(a + 3) = 7a + 11\)

Write \(\leq\) or \(\geq\) on the line to complete the inequality.

6. Carmen will make at least $30 doing chores. Carmen’s earnings will be \(\underline{\hspace{2cm}}\) $30.

7. To lose weight, Brad wants to consume no more than 2,000 calories a day. Brad wants his daily consumption to be \(\underline{\hspace{2cm}}\) 2,000 calories.

Solve each inequality and graph its solution.

8. \(h + 6 < -12\)

9. \(-10a, -70\)
Lesson 7.6 Solving Multi-Step Inequalities

Some problems with inequalities require more than one step to solve. Use the properties of equality to solve the inequality. Remember to reverse the direction of the inequality if you multiply or divide by a negative number or if you swap the sides of the inequality.

\[
\begin{align*}
4n + 6 &< 18 \\
4n + 6 - 6 &< 18 - 6 & \text{Subtraction Property} \\
4n &< 12 & \text{Simplify} \\
\frac{4n}{4} &< \frac{12}{4} & \text{Division Property} \\
n &< 3 & \text{Solution}
\end{align*}
\]

\[
\begin{align*}
6 - 2n &\geq 24 \\
6 - 2n - 6 &\geq 24 - 6 & \text{Subtraction Property} \\
-2n &\geq 18 & \text{Simplify} \\
\frac{-2n}{-2} &\leq \frac{18}{-2} & \text{Reverse direction} \\
n &\leq -9 & \text{Solution}
\end{align*}
\]

Solve each inequality. Show the solution on a number line.

1. \(-6x + 4 > 40\) 

2. \(\frac{3x}{5} \geq 9\) 

3. \(\frac{4m}{3} \geq 12\) 

4. \(5y - 0.25 < 6\) 

Write an inequality for each problem. Use \(n\) as the variable. Then, solve the inequality.

5. Josh wants to download music online. He must buy a membership for $14. Then, he can download songs for 99 cents each. Josh has $20. How many songs can Josh buy without spending more money than he has?

Inequality: ___________________________ Solution: ________________

6. Kendra makes $8 per hour mowing lawns in the summer. Gas for the mower costs $16 and will last all summer. How many hours must Kendra mow to earn at least $200?

Inequality: ___________________________ Solution: ________________
Check What You Learned

Equations and Inequalities

Solve each equation. Write \textit{null} if the equation has no solution. Write \textit{all} if all numbers solve the equation. Write fractions in simplest form.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) &amp; (b)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. &amp; (33 + a = 12a) &amp; (-6n + 2 = 4n - 5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. &amp; (2.4b - 7 = b + 15.4) &amp; (\frac{4m}{6} = m + 3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. &amp; (4p + \frac{1}{4} = 6p) &amp; (24 - c = 2(3 + 4c))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. &amp; (3(5 - 2y) = 4(y + 2)) &amp; (5(2x + 3) = 3(x + 2) + 7x + 9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. &amp; (4(3k + 6) = 12(5 + k)) &amp; (3(2n + 4) = 2n + 56)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Write \(\leq\) or \(\geq\) on the line to complete the inequality.

6. A polling company needs at least 250 responses for its survey to be valid. The number of responses must be \(\text{________} 250\).

7. If Rima can sign up 10 people or more to attend a concert, everyone will get a discount on the ticket price. Rima needs a group that is \(\text{________} 10\).

Solve the inequality and represent the possible values of the variable on a number line.

8. \(8 > z - 2\)

9. Explain how many solutions there are to \(3x + 2 \geq 17\).
Lesson 3.5 Using Variables to Express Inequalities

An inequality is a mathematical sentence that states that two expressions are not equal.

\[ 2 \times 5 \geq 6 \]

Inequalities can be solved the same way as you solve equations.

\[-4 \times x \geq -4 \]
\[-4 \times x \div (-4) \geq -4 \div (-4) \]
\[ x \geq 1 \]

Solve each inequality and graph its solution.

1. \[ -4 \times m > 20 \]
2. \[ 15 \times x \leq 15 \]
3. \[ -10a < -70 \]

\[ \frac{x}{5} \leq -\frac{3}{5} \]
\[ h \div 6 < -12 \]
\[ n \div 2 \geq 2 \]
Lesson 3.5 Using Variables to Express Inequalities

Word problems can be solved by creating inequality statements.

Aria has $55 to spend on flowers. She wants to buy two rose bushes, which will cost $20, and spend the rest of her money on lilies. Each lily costs $10. Write an inequality to show how many lilies Aria can buy.

Let \( l \) represent the number of lilies she can buy.
Inequality: \( 10 \times l + 20 \leq 55 \)
\( 10 \times l + 20 - 20 \leq 55 - 20 \)
\( 10 \times l \leq 35 \div 10 \)
\( l \leq 3.5 \)
Aria can buy 3 lilies.

Solve each problem by creating an inequality.

1. Andrew had $20 to spend at the fair. If he paid $5 to get into the fair, and rides cost $2 each, what is the maximum number of rides he could go on?

   Let \( r \) represent the number of rides.

   Inequality: _____________________________

   Andrew could go on ___________________________ rides.

2. Sandra has $75 to spend on a new outfit. She finds a sweater that costs twice as much as the skirt. What is the most the skirt can cost?

   Let \( s \) represent the cost of the skirt.

   Inequality: _____________________________

   The most the skirt can cost is ____________________________.

3. Alan earns $7.50 per hour at his after-school jobs. He is saving money to buy a skateboard that costs $120. How many hours will he have to work to earn enough money for the skateboard?

   Let \( h \) represent the number of hours Alan will have to work.

   Inequality: _____________________________

   Alan will have to work ___________________________ hours.
Lesson 3.5 Problem Solving

Solve each problem by creating an inequality.

1. Blue Bird Taxi charges a $2.00 flat rate in addition to $0.55 per mile. Marcy only has $10 to spend on a taxi ride. What is the farthest she can ride without going over her limit?
   Let \( d \) equal the distance Marcy can travel.
   Inequality: ________________________________
   Marcy can travel ______________________ miles without going over her limit.

2. The school store is selling notebooks for $1.50 and T-shirts for $10.00 to raise money for the school. They have a goal of raising $250 to buy supplies for the science lab. If they have sold 60 notebooks, how many T-shirts will they need to sell to reach their goal?
   Let \( t \) equal the number of T-shirts.
   Inequality: ________________________________
   They need to sell ______________________ T-shirts.

3. There are 178 7th grade students and 20 chaperones going on the field trip to the aquarium. Each bus holds 42 people. How many buses will the group have to take?
   Let \( b \) represent the number of buses.
   Inequality: ________________________________
   They will need to take ______________________ buses.

4. Sofia’s parents gave her an allowance for summer camp of $125. If she is going to be at camp for 6 weeks, what is the most she can spend each week while she is at camp?
   Let \( m \) represent the amount Sofia can spend each week.
   Inequality: ________________________________
   The most Sofia can spend each week is ______________________.

5. The cell phone company allows all users 450 text messages a month. Any text messages over the allowed amount are charged $0.25 per message. Craig only has $26 extra to spend on his cell phone bill. How many messages can he go over the allowed amount for the month without breaking his budget of $26?
   Let \( p \) represent the amount of text messages Craig can go over.
   Inequality: ________________________________
   Craig can send and receive ______________________ extra text messages without breaking his budget of $26.
Expressions, Equations, and Inequalities

Solve each problem by creating an equation or inequality.

11. Yael bought two magazines for $5 and some erasers that cost $1.00 each. He could only spend $25. How many erasers could he buy?
   Let e represent the number of erasers he was able to buy.
   Equation or Inequality: __________________________
   Yael can buy __________________________ erasers.

12. The sum of three consecutive numbers is 75. What is the smallest of these numbers?
   Let n represent the smallest number.
   Equation or Inequality: __________________________
   __________________________ is the smallest number in the set.

13. Summer won 40 super bouncy balls playing Skee Ball at her school’s fall festival. Later, she gave 3 to each of her friends. She only has 7 remaining. How many friends does she have?
   Let f represent the number of friends.
   Equation or Inequality: __________________________
   Summer shared with __________________________ friends.

14. Mrs. Watson had some candy to give to her students. She first took ten pieces for herself and then evenly divided the rest among her students. Each student received two pieces. If she started with 50 pieces of candy, how many students does she teach?
   Let s represent the number of students.
   Equation or Inequality: __________________________
   Mrs. Watson teaches __________________________ students.

15. The Cooking Club made some cakes to sell at a baseball game to raise money for the school library. The cafeteria contributed 5 cakes to the sale. Each cake was then cut into 10 pieces and sold. There were a total of 80 pieces to sell. How many cakes did the club make?
   Let c represent the number of cakes.
   Equation or Inequality: __________________________
   The club made __________________________ cakes.
SE LEARNING TASK: T.V. Time and Video Games

An inequality is a math sentence that compares two quantities. Often one of the quantities is a variable. Use the following symbols and descriptions to represent each type of inequality.

< means “is less than.”
\( \leq \) means “is less than or equal to.”
> means “is greater than.”
\( \geq \) means “is greater than or equal to.”
\( \neq \) means “is not equal to.”

How could you represent each inequality below?

1. Nima will spend less than $25

2. Derrick ran at least 30 miles last week

3. Kia needs at least $200 to buy the TV she wants

Kia volunteers with some friends at a community center. While shopping online for a new television she decides she wants one with at least a 26 in. screen. Using the chart below, write an inequality to show how much money the center will have to spend.

<table>
<thead>
<tr>
<th>Screen Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 in.</td>
<td>$300</td>
</tr>
<tr>
<td>26 in.</td>
<td>$330</td>
</tr>
<tr>
<td>32 in.</td>
<td>$370</td>
</tr>
<tr>
<td>40 in.</td>
<td>$420</td>
</tr>
</tbody>
</table>

Inequality

4. Graph the inequality on the number line.

5. Kia wants to have money left over. How can the graph be changed to show they need to have more than $330?

6. The center has a stand for the television that will hold up to 30 lb of weight. Draw a graph to show how much the television she buys can weigh.
Kia plans to use money from the community center's savings account to buy a gaming system. There must be $129 left in the savings account after she withdraws what she needs.

7. Write and solve an inequality to represent the situation, where $x$ represents the amount of money the center has in its savings account.

8. Graph the possible values from the solution found in number seven.

The community center rents rooms for an hourly rate, plus a set-up fee.

<table>
<thead>
<tr>
<th>Room Rentals</th>
<th>Rental Rate per Hour</th>
<th>Set-up Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Hall</td>
<td>$15</td>
<td>$40</td>
</tr>
<tr>
<td>Dining Room</td>
<td>$12</td>
<td>$30</td>
</tr>
</tbody>
</table>

9. A school group has $140 to spend. Write and solve an inequality that represents the cost to rent the main hall, where $h$ represents the number of hours the group can rent the room.

10. The same group is also considering renting the dining room. Write and solve an inequality to represent this situation.

11. Use your solutions from 9 and 10 to justify your selection of which room the group should rent.
The community center has $175 to spend on video games for its new gaming system. Games are on sale for $35 each.

12. Write and solve an inequality to represent the number of games the center could buy. Explain your solution in reference to the problem.

13. Graph the solution on a number line.

The center is considering signing up for an online game-rental service rather than buying the games. The table shows equipment cost and monthly fees for two services.

<table>
<thead>
<tr>
<th>Service</th>
<th>Equipment Cost</th>
<th>Monthly Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>NetGames</td>
<td>$99</td>
<td>$8</td>
</tr>
<tr>
<td>Anytime Games</td>
<td>$19</td>
<td>$19</td>
</tr>
</tbody>
</table>

14. Write and solve an inequality that represents the number of months the center could rent games from NetGames with its $175. Explain the solution in terms of the problem.

15. Write and solve an inequality to represent the number of months the center could rent games from Anytime Games. Explain the solution in terms of the problem.

16. Use your answers from 14 and 15 to justify which service the community center should purchase.