(1) Evaluate \( 8g - f \) if \( f = 4 \), and \( g = -1 \)

\[
\begin{align*}
5(-1) & - 4 \\
-5 & - 4 \\
-5 + (-4) & = -9 \\
\end{align*}
\]

(2) Evaluate \( \frac{w}{30} \), where \( w \) is a person’s weight in pounds, is used to find the approximate number of quarts of blood in a person’s body. How many quarts of blood does a 120-pound person have?

\[
\frac{120}{30} = 4 \text{ quarts}
\]

(3) Write an expression to find the total cost of buying \( b \) paperback books and \( m \) magazines if magazines cost $4.95 each and paperback books cost $7.95 each.

What would the total cost be for 3 paperback books and 4 magazines?

\[
\begin{align*}
4.95m & + 7.95b \\
4.95(4) & + 7.95(3) \\
19.80 & + 23.85 \\
\hline
43.65
\end{align*}
\]
Properties of Operations

**Key Concept**

**Properties of Operations**

**Words** The **Commutative Property** states that the order in which numbers are added or multiplied does not change the sum or product.

**Addition**

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a + b = b + a$</td>
<td>$6 + 1 = 1 + 6$</td>
</tr>
</tbody>
</table>

**Multiplication**

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a \cdot b = b \cdot a$</td>
<td>$7 \cdot 3 = 3 \cdot 7$</td>
</tr>
</tbody>
</table>

**Words** The **Associative Property** states that the way in which numbers are grouped when they are added or multiplied does not change the sum or product.

**Addition**

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a + (b + c) = (a + b) + c$</td>
<td>$2 + (3 + 8) = (2 + 3) + 8$</td>
</tr>
</tbody>
</table>

**Multiplication**

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a \cdot (b \cdot c) = (a \cdot b) \cdot c$</td>
<td>$3 \cdot (4 \cdot 5) = (3 \cdot 4) \cdot 5$</td>
</tr>
</tbody>
</table>
A property is a statement that is true for any number. The following properties are also true for any numbers.

<table>
<thead>
<tr>
<th>Property</th>
<th>Words</th>
<th>Symbols</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Additive Identity</strong></td>
<td>When 0 is added to any number, the sum is the number.</td>
<td>$a + 0 = a$</td>
<td>$9 + 0 = 9$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$0 + a = a$</td>
<td>$0 + 9 = 9$</td>
</tr>
<tr>
<td><strong>Multiplicative Identity</strong></td>
<td>When any number is multiplied by 1, the product is the number.</td>
<td>$a \cdot 1 = a$</td>
<td>$5 \cdot 1 = 5$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$1 \cdot a = a$</td>
<td>$1 \cdot 5 = 5$</td>
</tr>
<tr>
<td><strong>Multiplicative Property of Zero</strong></td>
<td>When any number is multiplied by 0, the product is 0.</td>
<td>$a \cdot 0 = 0$</td>
<td>$8 \cdot 0 = 0$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$0 \cdot a = 0$</td>
<td>$0 \cdot 8 = 0$</td>
</tr>
</tbody>
</table>

**Example**

1. Name the property shown by the statement
   \[2 \cdot (5 \cdot n) = (2 \cdot 5) \cdot n.\]
   
   Assoc. Prop. of multiplication

   \[a. \quad b. \quad \]

   **Got It?** Do these problems to find out.

   a. $42 + x + y = 42 + y + x$
   b. $3x + 0 = 3x$

   Commutative
   Prop. of Addition
   Additive Identity

You may wonder if any of the properties apply to subtraction or division. If you can find a counterexample, an example that shows that a conjecture is false, the property does not apply.

**Example**

2. State whether the following conjecture is true or false. If false, provide a counterexample.

   Division of whole numbers is commutative.

   \[\text{False} \quad 6 \div 3 \neq \frac{3}{6}\]
   \[\text{False} \quad \frac{6}{2} \neq \frac{1}{2}\]

   \[\text{False} \quad 18 \div -3 \neq -3 \div 18\]
   \[-6 \neq -\frac{1}{6}\]
c. The difference of two different whole numbers is always less than both of the two numbers.

\[ 5 - 2 = 3 \]

**False**, 3 is less than 5 but not 2.

---

**Example**

3. Alana wants to buy a sweater that costs $38, sunglasses that costs $14, a pair of jeans that costs $22, and a T-shirt that costs $16. Use mental math to find the total cost before tax.

Write an expression for the total cost. You can rearrange the numbers using the properties of math. Look for sums that are multiples of ten.

\[ \text{Commulative Prop. of Addition} \]

\[ \underbrace{38 + 14 + 22 + 16}_{60} + \underbrace{160} = \$90 \]

---

**Got It?** Do this problem to find out.

d. Lance made four phone calls from his cell phone today. The calls lasted 4.7, 9.4, 2.3, and 10.6 minutes. Use mental math to find the total amount of time he spent on the phone.

\[ \text{Commulative Prop. of Addition} \]

\[ 4.7 + 2.3 + 9.4 + 10.6 = 27.0 \text{ or } 27 \text{ min} \]

---

**Examples**

Simplify each expression. Justify each step.

4. \((7 + 9) + 5\)

\[(7 + 9) + 5 = (9 + 7) + 5 \quad \text{Commulative Prop. (4)}\]

\[= 9 + (7 + 5) \quad \text{Associative Prop. (4)}\]

\[= 9 + 12\]
5. \((m \cdot 11) \cdot m = (11 \cdot m) m\)  
   \[= 11 \cdot (m \cdot m)\]  
   \[= 11 \cdot m^2\]

Guided Practice

Name the property shown by each statement. (Example 1)

1. \(3m \cdot 0 \cdot 5m = 0\)  
   Multiplication Prop. of Zero

2. \(7c + 0 = 7c\)  
   Add. Identity Prop. of Zero

3. State whether the following conjecture is true or false. If false, provide a counterexample. (Example 2)
   
   Subtraction of whole numbers is associative.
   
   \[\frac{8 - (6 - 2)}{2} = \frac{8 - 4}{2}\]

4. Simplify \(9c + (8 + 3c)\). Justify each step. (Examples 3-5)
   
   \[9c + (8 + 3c)\]
   \[= (9c + 3c) + 8\]  
   \[= (4c + 3c) + 8\]
   \[= 4c + 8\]

5. Building on the Essential Question: Explain the difference between the Commutative and Associative Properties.  
   Commutative order
   
   \[\text{Associative - Grouping/Not order sensitive}\]

Homework p. 281 - 282 (1 - 6, 7, 8, 13, 14, 15)