Warm Up
Evaluate each expression.
1. $(-7)(2.8)$ $-19.6$
2. $0.96 \div 6$ $0.16$
3. $(-9)(-9)$ $81$
4. $\left(\frac{5}{6}\right)\left(\frac{6}{5}\right)$ $1$
5. $\left(\frac{8}{15}\right)\left(\frac{5}{4}\right)$ $\frac{2}{3}$
6. $\left(\frac{3}{4}\right)(2.4)$ $1.8$
Objective

Solve one-step equations in one variable by using multiplication or division.
Solving an equation that contains multiplication or division is similar to solving an equation that contains addition or subtraction. Use inverse operations to undo the operations on the variable.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Inverse Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiplication</td>
<td>Division</td>
</tr>
<tr>
<td>Division</td>
<td>Multiplication</td>
</tr>
</tbody>
</table>
Example 1A: Solving Equations by Using Multiplication

Solve the equation.

\[-8 = \frac{j}{3}\]

\[(3)(-8) = (3)\left(\frac{j}{3}\right)\] Since j is divided by 3, multiply both sides by 3 to undo the division.

\[-24 = j\]

Check

\[-8 = \frac{j}{3}\]

To check your solution, substitute \(-24\) for j in the original equation.

\[
\begin{array}{c|c|c}
-8 & -24 & \checkmark \\
\hline
-8 & 3 & \\
\hline
-8 & -8 & \checkmark \\
\end{array}
\]
Example 1B: Solving Equations by Using Multiplication

Solve the equation.

\[ \frac{n}{6} = 2.8 \]

\[
(6) \left( \frac{n}{6} \right) = (6)(2.8) \quad \text{Since } n \text{ is divided by } 6,
\text{ multiply both sides by } 6 \\
\text{to undo the division.}
\]

\[ n = 16.8 \]

Check

\[ \frac{n}{6} = 2.8 \]

<table>
<thead>
<tr>
<th>16.8</th>
<th>2.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>2.8</td>
</tr>
</tbody>
</table>
| 2.8  | 2.8 | ✓

To check your solution, substitute 16.8 for \( n \) in the original equation.
Solve the equation. Check your answer.

\[
\frac{p}{5} = 10
\]

\[
(5)\left(\frac{p}{5}\right) = (5)(10) \quad \text{Since } p \text{ is divided by } 5, \text{ multiply both sides by } 5 \text{ to undo the division.}
\]

\[
p = 50
\]

**Check**

\[
\frac{p}{5} = 10
\]

\[
\frac{50}{5} = 10
\]

To check your solution, substitute 50 for p in the original equation.
Check It Out! Example 1b

Solve the equation. Check your answer.

\[-13 = \frac{y}{3}\]

\[(3)(-13) = (3)\left(\frac{y}{3}\right)\quad \text{Since } y \text{ is divided by } 3, \text{ multiply both sides by } 3 \text{ to undo the division.}\]

\[-39 = y\]

**Check** \[-13 = \frac{y}{3}\]

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-13</td>
<td>-39</td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>-13</td>
<td>-13 ✓</td>
</tr>
</tbody>
</table>

To check your solution, substitute \(-39\) for \(y\) in the original equation.
Solve the equation. Check your answer.

\[ \frac{c}{8} = 7 \]

Since \( c \) is divided by 8, multiply both sides by 8 to undo the division.

\[ (8) \left( \frac{c}{8} \right) = (8)(7) \]

\[ c = 56 \]

**Check**

\[ \frac{c}{8} = 7 \]

<table>
<thead>
<tr>
<th>56</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>7</td>
</tr>
</tbody>
</table>

To check your solution, substitute 56 for \( c \) in the original equation.
Example 2A: Solving Equations by Using Division

Solve the equation. Check your answer.

\[ 9y = 108 \]

\[
\begin{array}{c}
9y \\
9
\end{array} = \frac{108}{9} \quad \text{Since } y \text{ is multiplied by 9, divide both sides by 9 to undo the multiplication.}
\]

\[ y = 12 \]

**Check**

\[
\begin{array}{c|c}
9y & 108 \\
9(12) & 108 \\
108 & 108 \checkmark
\end{array}
\]

To check your solution, substitute 12 for \( y \) in the original equation.
Example 2B: Solving Equations by Using Division

Solve the equation. Check your answer.

\[-4.8 = -6v\]

\[
\begin{align*}
\frac{-4.8}{-6} &= \frac{-6v}{-6} \\
0.8 &= v
\end{align*}
\]

**Check**

\[
\begin{array}{c|c}
-4.8 & -6(0.8) \\
\hline
-4.8 & -4.8 \checkmark
\end{array}
\]

To check your solution, substitute 0.8 for v in the original equation.
Check It Out! Example 2a

Solve the equation. Check your answer.

\[ 16 = 4c \]

Since \( c \) is multiplied by 4, divide both sides by 4 to undo the multiplication.

\[
\begin{align*}
\frac{16}{4} &= \frac{4c}{4} \\
4 &= c
\end{align*}
\]

Check

\[
\begin{array}{c|c}
16 & 4(4) \\
16 & 16 \checkmark
\end{array}
\]

To check your solution, substitute 4 for \( c \) in the original equation.
Solve the equation. Check your answer.

\[ 0.5y = -10 \]

\[
\frac{0.5y}{0.5} = \frac{-10}{0.5} \\
0.5 \quad 0.5
\]

\[ y = -20 \]

**Check**

\[ 0.5y = -10 \]

\[
\frac{0.5(-20)}{0.5} \quad -10 \\
-10 \quad -10 \checkmark
\]

To check your solution, substitute \(-20\) for \(y\) in the original equation.
Solve the equation. Check your answer.

\[ 15k = 75 \]

\[
\begin{array}{c c}
15k & 75 \\
15 & 15 \\
\end{array}
\]

Since \( k \) is multiplied by 15, divide both sides by 15 to undo the multiplication.

\[ k = 5 \]

\[
\begin{array}{c | c}
15(5) & 75 \\
75 & 75 \\
\end{array}
\]

To check your solution, substitute 5 for \( k \) in the original equation.

\[ 15(5) = 75 \]
Remember that dividing is the same as multiplying by the reciprocal. When solving equations, you will sometimes find it easier to multiply by a reciprocal instead of dividing. This is often true when an equation contains fractions.
Example 3A: Solving Equations That Contain Fractions

Solve the equation.
\[ \frac{5}{6} w = -20 \]

\[ \left( \frac{6}{5} \right) \frac{5}{6} w = \left( \frac{6}{5} \right) (-20) \]

\[ w = -24 \]

The reciprocal of \( \frac{5}{6} \) is \( \frac{6}{5} \). Since \( w \) is multiplied by \( \frac{5}{6} \), multiply both sides by \( \frac{6}{5} \).

Check
\[ \frac{5}{6} w = -20 \]

\[ \left( \frac{5}{6} \right) (-24) = -20 \]

\[ -20 = -20 \checkmark \]

To check your solution, substitute \(-24\) for \( w \) in the original equation.
Example 3B: Solving Equations That Contain Fractions

Solve the equation.

\[ \frac{3}{16} = \frac{1}{8}z \]

To check your solution, substitute \( \frac{3}{2} \) for \( z \) in the original equation.
Check It Out! Example 3a

Solve the equation. Check your answer.

\[- \frac{1}{4} = \frac{1}{5}b\]

(5)\(-\frac{1}{4}\) = (5)\(\frac{1}{5}b\)

\[-\frac{5}{4} = b\]

The reciprocal of \(\frac{1}{5}\) is 5. Since \(b\) is multiplied by \(\frac{1}{5}\), multiply both sides by 5.

Check

\[- \frac{1}{4} = \frac{1}{5}b\]

\[-\frac{5}{4} = \frac{1}{5}(\frac{1}{5})\left(-\frac{5}{4}\right)\]

To check your solution, substitute \(-\frac{5}{4}\) for \(b\) in the original equation.
Solve the equation.

\[
\frac{4j}{6} = \frac{2}{3}
\]

\[
\frac{4}{6} j = \frac{2}{3}
\]

\[
\left(\frac{6}{4}\right) \frac{4}{6} j = \left(\frac{6}{4}\right) \frac{2}{3}
\]

\[
j = 1
\]

\[
\frac{4j}{6} \text{ is the same as } \frac{4}{6} j.
\]

The reciprocal of \(\frac{4}{6}\) is \(\frac{6}{4}\). Since \(j\) is multiplied by \(\frac{4}{6}\), multiply both sides by \(\frac{6}{4}\).
Check It Out! Example 3b Continued

Solve the equation.

\[
\frac{4j}{6} = \frac{2}{3}
\]

**Check**

\[
\begin{array}{c|c|c}
4(1) & 2 & \text{To check your solution, substitute 1 for } j \text{ in the original equation.} \\
6 & 3 & \\
4 & 2 & \\
6 & 3 & \\
2 & 2 & \\
3 & 3 & \checkmark \\
\end{array}
\]
Solve the equation.

\[ \frac{1}{6}w = 102 \]

\[ (6)\left(\frac{1}{6}w\right) = (6)(102) \]

\[ w = 712 \]

**Check**

\[ \frac{1}{6}w = 102 \]

\[ \frac{1}{6}(712) \quad 102 \]

\[ 102 \quad 102 \checkmark \]

The reciprocal of \( \frac{1}{6} \) is 6. Since \( w \) is multiplied by \( \frac{1}{6} \), multiply both sides by 6.

To check your solution, substitute 712 for \( w \) in the original equation.
Example 4: Application

Ciro puts $\frac{1}{4}$ of the money he earns from mowing lawns into a college education fund. This year Ciro added $285$ to his college education fund. Write and solve an equation to find how much money Ciro earned mowing lawns this year.

Write an equation to represent the relationship.

\[ \frac{1}{4} m = c \]

Substitute 285 for $c$. Since $m$ is divided by 4, multiply both sides by 4 to undo the division.

\[ (4) \frac{m}{4} = (4)285 \]

\[ m = $1140 \]

Ciro earned $1140$ mowing lawns.
Check it Out! Example 4

The distance in miles from the airport that a plane should begin descending, divided by 3, equals the plane's height above the ground in thousands of feet. A plane began descending 45 miles from the airport. Use the equation to find how high the plane was flying when the descent began.

Distance divided by 3 equals height in thousands of feet
\[
\frac{d}{3} = h
\]
Write an equation to represent the relationship.

\[
\frac{45}{3} = h
\]
Substitute 45 for d.

15 = h

The plane was flying at 15,000 ft when the descent began.
## Properties of Equality

<table>
<thead>
<tr>
<th>Words</th>
<th>Addition Property of Equality</th>
</tr>
</thead>
<tbody>
<tr>
<td>You can add the same number to both sides of an equation, and the statement will still be true.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Numbers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$3 = 3$</td>
<td></td>
</tr>
<tr>
<td>$3 + 2 = 3 + 2$</td>
<td></td>
</tr>
<tr>
<td>$5 = 5$</td>
<td></td>
</tr>
</tbody>
</table>

<p>| Algebra                  |                                |
|--------------------------|                                |
| $a = b$                  |                                |
| $a + c = b + c$          |                                |</p>
<table>
<thead>
<tr>
<th>WORDS</th>
<th>Subtraction Property of Equality</th>
</tr>
</thead>
<tbody>
<tr>
<td>You can subtract the same number from both sides of an equation, and the statement will still be true.</td>
<td></td>
</tr>
<tr>
<td>NUMBERS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ 7 = 7 ]</td>
</tr>
<tr>
<td></td>
<td>[ 7 - 5 = 7 - 5 ]</td>
</tr>
<tr>
<td></td>
<td>[ 2 = 2 ]</td>
</tr>
<tr>
<td>ALGEBRA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ a = b ]</td>
</tr>
<tr>
<td></td>
<td>[ a - c = b - c ]</td>
</tr>
</tbody>
</table>
## Properties of Equality

<table>
<thead>
<tr>
<th>WORDS</th>
<th>Multiplication Property of Equality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>You can multiply both sides of an equation by the same number, and the statement will still be true.</td>
</tr>
<tr>
<td>NUMBERS</td>
<td>6 = 6</td>
</tr>
<tr>
<td></td>
<td>6(3) = 6(3)</td>
</tr>
<tr>
<td></td>
<td>18 = 18</td>
</tr>
<tr>
<td>ALGEBRA</td>
<td>$a = b$</td>
</tr>
<tr>
<td></td>
<td>$ac = bc$</td>
</tr>
</tbody>
</table>
## Properties of Equality

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WORDS</strong></td>
<td>Division Property of Equality</td>
</tr>
<tr>
<td></td>
<td>You can divide both sides of an equation by the same nonzero number, and the</td>
</tr>
<tr>
<td></td>
<td>statement will still be true.</td>
</tr>
<tr>
<td><strong>NUMBERS</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$8 = 8$</td>
</tr>
<tr>
<td></td>
<td>$\frac{8}{4} = \frac{8}{4}$</td>
</tr>
<tr>
<td></td>
<td>$2 = 2$</td>
</tr>
<tr>
<td><strong>ALGEBRA</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$a = b$</td>
</tr>
<tr>
<td></td>
<td>$(c \neq 0)$</td>
</tr>
<tr>
<td></td>
<td>$\frac{a}{c} = \frac{a}{c}$</td>
</tr>
</tbody>
</table>
Lesson Quiz: Part 1

Solve each equation.

1. \(-3 = \frac{m}{-7}\)  \(m = 21\)
2. \(\frac{x}{100} = 0.028\)  \(x = 2.8\)
3. \(8y = 4\)  \(y = \frac{1}{2}\)
4. \(126 = -9q\)  \(q = -14\)
5. \(\frac{2}{5}m = 16\)  \(m = 40\)
6. \(\frac{15}{16}c = \frac{25}{48}\)  \(c = \frac{5}{9}\)
Lesson Quiz: Part 2

7. A person's weight on Venus is about \( \frac{9}{10} \) his or her weight on Earth. Write and solve an equation to find how much a person weighs on Earth if he or she weighs 108 pounds on Venus.

\[
108 = \frac{9}{10}w; \quad 120 \text{ lb}
\]