AN INTRODUCTION TO EQUATIONS

**Students will be able to:**

solve equations and check solutions and
solve equations using tables and mental math.

**Key Vocabulary:**

- Defining a variable
- Four-step problem solving plan
- Formula
AN INTRODUCTION TO EQUATIONS

**EQUATION** is a mathematical sentence that uses an equal sign (=). It can be used to represent the relationship between two quantities that have the same value.

**TYPES**

**True equation**

If the expressions on either side of the equal sign are equal.

\[ 1 + 9 = 10 \quad 10 + 2 = 8 + 4 \]
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TYPES

False equation

If the expressions on either side of the equal sign are not equal.

\[ 2 + 8 = 11 \quad 11 + 2 = 9 + 5 \]

Open Sentence

If the equation contains one or more variables, and maybe a true or a false depending on the values of its variables.

\[ x + 5 = 14 \quad 8 + x = 13 \]
Sample Problem 1: Tell whether each equation is true, false, or open. Explain.

A. $12 + 18 = 15 + 15$

B. $5 \cdot 7 = 34$

C. $3x + 12 = 48$
Sample Problem 1: Tell whether each equation is true, false, or open. Explain.

A. $12 + 18 = 15 + 15$  
   True  $30 = 30$

B. $5 \cdot 7 = 34$  
   False  $35 \neq 34$

C. $3x + 12 = 48$  
   Open  variable $x$
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SOLUTION OF AN EQUATION containing a variable is a value of the variable that makes the equation true.
Sample Problem 2: Tell whether the given number is a solution of each equation.

A. Is $x = 6$ a solution of the equation $x - 14 = 5$?

B. Is $y = \frac{1}{2}$ a solution of the equation $4y + 2 = 10$?

C. Is $z = 5$ a solution of the equation $8z - 6 = 50$?
Sample Problem 2: Tell whether the given number is a solution of each equation.

A. Is \(x = 6\) a solution of the equation \(x - 14 = 5\)?
   
   \[
   \begin{align*}
   x &= 14 + 5 \\
   x &= 19 \\
   x \neq 6
   \end{align*}
   \]

B. Is \(y = \frac{1}{2}\) a solution of the equation \(4y + 2 = 10\)?
   
   \[
   \begin{align*}
   4y &= 10 - 2 \\
   4y &= 8 \\
   y &= 2 \\
   y \neq \frac{1}{2}
   \end{align*}
   \]

C. Is \(z = 5\) a solution of the equation \(8z - 6 = 50\)?
   
   \[
   \begin{align*}
   8z &= 50 + 6 \\
   8z &= 56 \\
   z &= 7 \\
   z \neq 5
   \end{align*}
   \]
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Sample Problem 3: Find the solution of each equation.

A. \( 8b - 3 = 13 \)

B. \(-16 = 26 - 21x \)

C. \(-8z - 12 = -4 \)
Sample Problem 3: Find the solution of each equation.

A. \(8b - 3 = 13\)

\[
\begin{align*}
8b &= 13 + 3 \\
8b &= 16
\end{align*}
\]

\(b = 2\)

B. \(-16 = 26 - 21x\)

\[
\begin{align*}
-16 - 26 &= -21x \\
-42 &= -21x
\end{align*}
\]

\(2 = x\)

C. \(-8z - 12 = -4\)

\[
\begin{align*}
-8z &= -4 + 12 \\
-8z &= 8
\end{align*}
\]

\(z = 1\)
Sample Problem 4: Use a table to find the solution of each equation.

A. $7x + 10 = 45$

B. $7x + 14 = 21$

C. $12 = 4x + 8$
Sample Problem 4: Use a table to find the solution of each equation.

A. $7x + 10 = 45$

<table>
<thead>
<tr>
<th>$x$</th>
<th>$7x + 10 = 45$</th>
<th>$21 + 10 = 45$</th>
<th>$31 \neq 45$</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>$7(3) + 10 = 45$</td>
<td>$21 + 10 = 45$</td>
<td>$31 \neq 45$</td>
</tr>
<tr>
<td>4</td>
<td>$7(4) + 10 = 45$</td>
<td>$28 + 10 = 45$</td>
<td>$38 \neq 45$</td>
</tr>
<tr>
<td>5</td>
<td>$7(5) + 10 = 45$</td>
<td>$35 + 10 = 45$</td>
<td>$45 = 45$</td>
</tr>
<tr>
<td>6</td>
<td>$7(6) + 10 = 45$</td>
<td>$42 + 10 = 45$</td>
<td>$52 \neq 45$</td>
</tr>
</tbody>
</table>
### Sample Problem 4: Use a table to find the solution of each equation.

**B. 7x + 14 = 21**

<table>
<thead>
<tr>
<th>x</th>
<th>7x + 14 = 21</th>
<th>7 + 14 = 21</th>
<th>21 = 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7(1) + 14 = 21</td>
<td>7 + 14 = 21</td>
<td>21 = 21</td>
</tr>
<tr>
<td>2</td>
<td>7(2) + 14 = 21</td>
<td>14 + 14 = 21</td>
<td>28 ≠ 21</td>
</tr>
<tr>
<td>3</td>
<td>7(3) + 14 = 21</td>
<td>21 + 14 = 21</td>
<td>35 ≠ 21</td>
</tr>
</tbody>
</table>
Sample Problem 4: Use a table to find the solution of each equation.

C. $12 = 4x + 8$

\[
\begin{array}{c|c|c|c}
\text{x} & 12 = 4x + 8 & 12 = 4 + 8 & 12 = 12 \\
1 & 12 = 4(1) + 8 & 12 = 4 + 8 & 12 = 12 \\
2 & 12 = 4(2) + 8 & 12 = 8 + 8 & 12 \neq 16 \\
3 & 12 = 4(3) + 8 & 12 = 12 + 8 & 12 \neq 20 \\
\end{array}
\]
Sample Problem 5: Use a table to find two consecutive integers between which the solution lies.

A. $8x - 20 = 37$

B. $3x + 4 = 36$

C. $8 = 3 - 2x$
Sample Problem 5: Use a table to find two consecutive integers between which the solution lies.

A. $8x - 20 = 37$

<table>
<thead>
<tr>
<th>$x$</th>
<th>$8x - 20$</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>$8(6) - 20$</td>
<td>48 - 20</td>
<td></td>
<td>28</td>
</tr>
<tr>
<td>7</td>
<td>$8(7) - 20$</td>
<td>56 - 20</td>
<td></td>
<td>36</td>
</tr>
<tr>
<td>8</td>
<td>$8(8) - 20$</td>
<td>64 - 20</td>
<td></td>
<td>44</td>
</tr>
</tbody>
</table>
Sample Problem 5: Use a table to find two consecutive integers between which the solution lies.

B. $3x + 4 = 36$

10 $< x < 11$

<table>
<thead>
<tr>
<th>$x$</th>
<th>$3x + 4$</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>$3(10) + 4$</td>
<td>$30 + 4$</td>
</tr>
<tr>
<td>11</td>
<td>$3(11) + 4$</td>
<td>$33 + 4$</td>
</tr>
<tr>
<td>12</td>
<td>$3(12) + 4$</td>
<td>$36 + 4$</td>
</tr>
</tbody>
</table>
Sample Problem 5: Use a table to find two consecutive integers between which the solution lies.

C. \(8 = 3 - 2x\)

\[-2 < x < -3\]

<table>
<thead>
<tr>
<th>(x)</th>
<th>(3 - 2x)</th>
<th>(3 + 2)</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>3 - 2(-1)</td>
<td>3 + 2</td>
<td>5</td>
</tr>
<tr>
<td>-2</td>
<td>3 - 2(-2)</td>
<td>3 + 4</td>
<td>7</td>
</tr>
<tr>
<td>-3</td>
<td>3 - 2(-3)</td>
<td>3 + 6</td>
<td>9</td>
</tr>
</tbody>
</table>
Sample Problem 6: Find the solution of each equation using mental math or table. If the solution lies between two consecutive integers, identify those integers.

A. \(3x - 9 = 14\)

B. \(17 = 9 + (-x)\)

C. \(8 = 21 - 7x\)
Sample Problem 6: Find the solution of each equation using mental math or table. If the solution lies between two consecutive integers, identify those integers.

A. $3x - 9 = 14$

<table>
<thead>
<tr>
<th>$x$</th>
<th>$3x - 9$</th>
<th>$21 - 9$</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>3(7) - 9</td>
<td>12</td>
</tr>
<tr>
<td>8</td>
<td>3(8) - 9</td>
<td>15</td>
</tr>
<tr>
<td>9</td>
<td>3(9) - 9</td>
<td>18</td>
</tr>
</tbody>
</table>

$7 < x < 8$
Sample Problem 6: Find the solution of each equation using mental math or table. If the solution lies between two consecutive integers, identify those integers.

B. $17 = 9 + (-x)$

<table>
<thead>
<tr>
<th>$x$</th>
<th>$9 + (-x)$</th>
<th>$9 + 8$</th>
<th>17</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-8$</td>
<td>$9 + (-(-8))$</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>$-9$</td>
<td>$9 + (-(-9))$</td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>
Sample Problem 6: Find the solution of each equation using mental math or table. If the solution lies between two consecutive integers, identify those integers.

C. \(8 = 21 - 7x\)

<table>
<thead>
<tr>
<th>(x)</th>
<th>(21 - 7x)</th>
<th>(21 - 7)</th>
<th>(21 - 14)</th>
<th>(21 - 21)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21 - 7(1)</td>
<td>21 - 7</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>21 - 7(2)</td>
<td>21 - 14</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>21 - 7(3)</td>
<td>21 - 21</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
AN INTRODUCTION TO EQUATIONS

TRANSLATING SENTENCES TO EQUATIONS:

1. Use variables to represent the unspecified numbers or measures referred to in the sentence or problem.

2. Write the verbal expressions as algebraic expressions.

Verbal Expressions that suggest the equals sign:

- is equal to
- equals
- is
- is the same as
- is as much as
- is identical to
Sample Problem 7: Write an equation for each sentence.

A. Fifteen times the number $a$ is equal to four times the sum of $b$ and $c$.

B. Three times $x$ subtracted from 57 equals 29.

C. The difference of 10 and a number is 5.
Sample Problem 7: Write an equation for each sentence.

A. Fifteen times the number $a$ is equal to four times the sum of $b$ and $c$.

$$15 \cdot a = 4(b + c)$$

B. Three times $x$ subtracted from 57 equals 29.

$$57 - 3x = 29$$

C. The difference of 10 and a number is 5.

$$10 - x = 5$$