Ex. 1) \(2x - 3 = -7\)

The variable “x” is first being multiplied by 2 and then that product is being subtracted by 3. To solve this equation, we must not only reverse operations used to create the equation, but also the order of these operations. Since subtracting 3 was the last step in creating the equation, the first step in solving would be to add 3. Then we would undo the multiplying by 2 by dividing by 2. Following the arrows will help students solve the equation.

First step, add 3 to both sides.

Minus three plus three combine to give zero.

Second step, divide both sides by 2,

Any number divided by itself equals one.

Solution

\[
\begin{align*}
2x - 3 &= -7 \\
+ 3 &\quad + 3 \\
2x &= -4 \\
\frac{2x}{2} &= \frac{-4}{2} \\
\frac{1}{2} &= \frac{-4}{2} \\
x &= -2
\end{align*}
\]
Ex. 2) \[ \frac{x + 5}{4} = 6 \]

<table>
<thead>
<tr>
<th>Do</th>
<th>Undo</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\div 4)</td>
<td>(\cdot 4)</td>
</tr>
<tr>
<td>(+ 5)</td>
<td>(- 5)</td>
</tr>
</tbody>
</table>

The variable “x” is first being divided by 4 and then that quotient is being added to 5. Since adding 5 was the last step in creating the equation, the first step in solving would be to subtract 5. Then we would undo the dividing by 4 by multiplying by 4.

First step, subtract 5 from both sides.

Add five subtract five combine to give zero.

\[ \frac{x}{4} = 1 \]

The 4’s simplify to 1 on the diagonal. Even if 4x is divided by 4, 1x will result on the left of the equals sign.

\[ \frac{1}{4} \cdot x = 1 \cdot 4 \]

\[ x = 4 \]

Solution
Ex. 3.A) \( \frac{3x}{5} - 2 = -8 \)

- **Do**
  - \( \cdot 3 \)
  - \( \div 5 \)
  - \(- 2 \)

- **Undo**
  - \( \div 3 \)
  - \( \cdot 5 \)
  - \(+ 2 \)

The variable “\( x \)” is first being multiplied by 3, and then the product is being divided by 5. Finally, the quotient is being subtracted by 2. Since subtracting 2 was the last step in creating the equation, the first step in solving would be to add 2. Then we would undo the dividing by 5 by multiplying by 5. Finally, to undo the multiplication by 3, we would divide by 3.

\[
\begin{align*}
\frac{3x}{5} - 2 &= -8 \\
+ 2 &= \frac{3x}{5} + 2
\end{align*}
\]

Add 2 to both sides of the equation.

\[
\begin{align*}
\frac{3x}{5} - 2 &= -8 \\
+ 2 &= \frac{3x}{5} + 2
\end{align*}
\]

Subtract two add two combine to give zero.

\[
\begin{align*}
\frac{3x}{5} &= -6 \\
1 \cdot \frac{3x}{5} &= -6 \cdot 1
\end{align*}
\]

The 5’s simplify to 1 on the diagonal. Even if 15x is divided by 5, 3x will result on the left of the equals sign.

\[
\begin{align*}
3x &= -30 \\
\frac{3x}{3} &= \frac{-30}{3}
\end{align*}
\]

Divide by 3 on both sides.

\[
\begin{align*}
3x &= -30 \\
\frac{3x}{3} &= \frac{-30}{3}
\end{align*}
\]

Solution

\[x = -10\]
The last example could be illustrated using only two operations instead of three. This would be essential to show students in order to emphasize the flexibility in solving. Here is the last example worked with a fractional coefficient to the variable.

**Ex. 3.B) \( \frac{3}{5} x - 2 = -8 \)**

<table>
<thead>
<tr>
<th>Do</th>
<th>Undo</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{3}{5} )</td>
<td>( \div \frac{3}{5} ) or ( \cdot \frac{5}{3} )</td>
</tr>
<tr>
<td>- 2</td>
<td>+ 2</td>
</tr>
</tbody>
</table>

The variable “x” is first being multiplied by \( \frac{3}{5} \), and then product is being subtracted by 2. Since subtracting 2 was the last step in creating the equation, the first step in solving would be to add 2. Then we would undo the multiplication by \( \frac{3}{5} \) by dividing by \( \frac{3}{5} \), or rather multiplying by its reciprocal.

Add 2 to both sides of the equation.

Subtract two add two combine to give zero.

\[ \frac{3}{5} x = -6 \]

Multiply both sides by the reciprocal and simplify.

\[ \frac{5}{3} \cdot \frac{3}{5} x = -2 \]

\[ x = -10 \]

Solution