Solving Equations in the Form ax = b

In equations of the form $ax = b$ (a times x equals b), x is a variable which represents an unknown number and a and b are constants.

EXAMPLES:

$$ax = b$$
$$3x = 12$$
$$-4y = -16$$
$$x = 9$$

To solve an equation we must find the value of the variable so that the original equation is true when the variable is replaced with that value.

EXAMPLE: $3x = 12$

If x is replaced with 4, the equation is true.

$$3x = 12$$
$$3(4) = 12$$
$$12 = 12$$

TRUE

To solve these equations we must use the Multiplication Property of Equations. **NOTE** that the final goal in solving the equation is to have a statement where the variable is equal to the constant. The solution is the constant.

SOLVE: $5x = 75$

To get x by itself on one side of the equation we must change the coefficient of x from 5 to 1. We will do this by multiplying **both sides** of the equation by the **reciprocal** of 5.

$$5x = 75$$
$$\frac{1}{5}\times 5x = 75\times\frac{1}{5}$$
$$\frac{5}{5}x = \frac{75}{5}$$

Reduce the fractions and we have:

$$1x = 15$$

Multiplying a number by one does not change the number.

$1x = 15$ is the same as $x = 15$

CHECK:

$$5x = 75$$
$$5(15) = 75$$
$$75 = 75$$
TRUE

EXAMPLE: Solve: $\frac{4x}{5} = 16$

4 times x, divided by 5 is the same as $\frac{4}{5}$ times x.

The first thing we will do is rewrite $\frac{4x}{5}$ as $\frac{4}{5} \cdot x$

Multiply both sides by the reciprocal of $\frac{4}{5}$

$$\frac{5}{4} \times \frac{4}{5} x = \frac{16}{1} \times \frac{5}{4}$$

$$\frac{20}{20} x = \frac{80}{4}$$

$$1x = 20$$
$$x = 20$$

CHECK:

$$\frac{4}{5} x = 16$$

$$\frac{4(20)}{5} = 16$$

$$\frac{80}{5} = 16$$

$$16 = 16$$
TRUE

In some problems it is necessary to combine like terms before solving the equation.

EXAMPLE: $8y - 6y = 14$

$8y$ and $6y$ are like terms on the same side of the equals sign. We must combine variable terms so that there is only one variable term before we begin to solve.

$$
\begin{aligned}
8y - 6y &= 14 && \text{Combine like terms} \\
2y &= 14 \\
\frac{1}{2} \times 2y &= 14 \times \frac{1}{2} && \text{Multiply both sides by the reciprocal of 2} \\
1y &= \frac{14}{2} \\
y &= 7 && \text{Simplify}
\end{aligned}
$$

NOTE: Be very careful when the coefficient is negative and remember that the reciprocal of a negative number is also negative.

Negative coefficient

$$
\begin{aligned}
-4x &= 12 \\
-\frac{1}{4}(-4x) &= 12\left(-\frac{1}{4}\right) \\
x &= -3
\end{aligned}
$$

EXERCISES: Solve and check.

1. $-3x = 18$
2. $\frac{4}{9}x = 12$
3. $7y = 21$
4. $-32 = 8n$
5. $-12x = -144$
6. $\frac{x}{3} = 15$
7. $\frac{2n}{3} = 2$
8. $5x + 3x = 24$
9. $2n - 6n = 28$
10. $-\frac{2}{5}x = -\frac{5}{8}$

KEY:

1.	$x = -6$	6.	$x = 45$
2.	$x = 27$	7.	$n = 3$
3.	$y = 3$	8.	$x = 3$
4.	$n = -4$	9.	$n = -7$
5.	$x = 12$	10.	$x = \frac{25}{16}$

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