

Solving Multi-Step Equations

How do we solve multi-step equations?

Example



1. Solve $15(20 + d) = 420$.

$$\begin{array}{r} \cancel{300} + 15d = 420 \\ -\cancel{300} \qquad -300 \\ \hline \end{array}$$

$$\begin{array}{r} 15d = 120 \\ \hline 15 \quad 15 \end{array}$$

$$\boxed{d = 8}$$

2. $8(3a + 6) = 9(2a - 4) \rightarrow 9(2a + (-4))$

$$\begin{array}{r} 24a + 48 = 18a + \cancel{(-36)} \\ -18a \qquad -18a \\ \hline \end{array}$$

$$\begin{array}{r} 6a + 48 = -36 \\ -48 \qquad -48 \\ \hline \end{array}$$

$$\begin{array}{r} 6a = -84 \\ \hline 6 \end{array}$$

$$\boxed{a = -14}$$

Got It? Do these problems to find out.

a. $-3(9 + x) = 33$

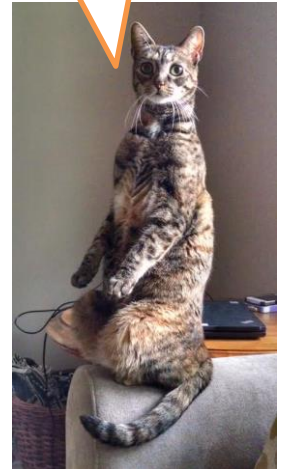
b. $5(a - 7) = 25$

3. $\frac{1}{3}h - 4\left(\frac{2}{3}h - 3\right) = \frac{2}{3}h - 6$

Number of Solutions

	Null Set	One Solution	Identity
Words	no solution	one solution	infinitely many solutions
Symbols	$a = b$	$x = a$	$a = a$
Example	$3x + 4 = 3x$ $4 = 0$ Since $4 \neq 0$, there is no solution.	$2x = 20$ $x = 10$	$4x + 2 = 4x + 2$ $2 = 2$ Since $2 = 2$, the solution is all numbers .

Wait a second... equations can have more or less than one solution?! My kitty mind is blown!



Some equations have **no solution**. When this occurs, the solution is the **null set** or empty set and is shown by the symbol \emptyset or $\{\}$. Other equations may have **every number** as their solution. An equation that is **true for every value** of the variable is called an **identity**.

Examples

2. Solve $6(x - 3) + 10 = 2(3x - 4)$.

$$\begin{aligned}
 &6(x + (-3)) + 10 = 2(3x + (-4)) \\
 &6x + (-18) + 10 = 6x + (-8) \\
 &6x + (-8) = 6x + (-8) \quad \text{identity!} \\
 &\begin{array}{r}
 6x + (-8) \\
 -6x \\
 \hline
 -8 = -8
 \end{array}
 \end{aligned}$$

all real #'s

3. Solve $8(4 - 2x) = 4(3 - 5x) + 4x$.

$$\begin{aligned}
 &8(4 + (-2x)) = 4(3 + (-5x)) + 4x \\
 &32 + (-16x) = 12 + (-20x) + 4x \\
 &32 + (-16x) = 12 + (-16x) \\
 &\begin{array}{r}
 32 + (-16x) \\
 +16x \\
 \hline
 32 \neq 12
 \end{array}
 \end{aligned}$$

Null set \emptyset

Got It? Do these problems to find out.

c. $3(6 - 4x) = -2(6x - 9)$

d. $2(3x + 5) = 5(2x - 4) - 4x$

How do we write multi-step equations given a word problem?



Example



4. At the fair, Hunter bought 3 snacks and 10 ride tickets. Each ride ticket costs \$1.50 less than a snack. If he spent a total of \$24.00, what was the cost of each snack?

$S =$ cost of each snack

$$24 = 3s + 10(s - 1.5)$$

$$24 = 3s + 10(s + (-1.5))$$

$$24 = 3s + 10s + (-15)$$

$$24 = 13s + (-15)$$

$$\begin{array}{r} +15 \\ 24 = 13s + (-15) \\ \hline = 13s \end{array}$$

$$\frac{24}{13} = \frac{13s}{13}$$

$$\text{snacks} = 3s$$

$$\text{ride tickets} = 10(s - 1.5)$$

$$s = \$3$$

3. Mr. Richards's class is holding a canned food drive for charity. Juliet collected 10 more cans than Rosana. Santiago collected twice as many cans as Juliet. If they collected 130 cans altogether, how many cans did

Juliet collect? (Example 4) 35 cans

$$r = \text{Rosana}$$

$$J = 10 + r$$

$$S = 2(10 + r)$$

$$10 + r + 20 + 2r$$

$$4r + 30 = 130$$

$$\underline{-30 \quad -30}$$

$$4r = 100 \quad r = 25$$

$$\underline{4 \quad 4}$$

Guided Practice

Solve each equation. Check your solution. (Examples 1–3)

1. $-8(w - 6) = 32$

2. $8z - 22 = 3(3z + 11) - z$

Show your work. →

- 9 The school has budgeted \$2,000 for an end-of-year party at the local park. The cost to rent the park shelter is \$150. How much can the student council spend per student on food if each of the 225 students receives a \$3.50 gift? (Example 4) _____