

Day 2 – Solving Multi-Step Equations – Notes

Multi-step equations mean you might have to add, subtract, multiply, or divide all in one problem to isolate the variable. When solving multi-step equations, you are still using inverse operations, which is like doing PEMDAS in reverse order. However, your left and right sides should be completely simplified (combined like terms and distributed) BEFORE using inverse operations. Make it your goal to have a simplified equation that looks like the equations below before using inverse operations.

Variable + constant = variable + constant	$2x + 4 = x - 3$
Variable + constant = constant	$2x + 4 = -3$
Variable + constant = variable	$2x + 4 = x$

Multi - Step Equations with Combining Like Terms

Practice: Solve each equation, showing all steps, for each variable.

a. $-5n + 6n + 15 - 3n = -3$

$$\begin{array}{r} -2n + 15 = -3 \\ -15 \quad -15 \\ \hline \end{array}$$

$$\begin{array}{r} -2n = -18 \\ -2 \quad -2 \\ \hline \end{array}$$

$$\boxed{n=9}$$

d. $14 = -3 + 7n - 4$

$$\begin{array}{r} 14 = -7 + 7n \\ +7 \quad +7 \\ \hline \end{array}$$

$$\frac{21}{7} = \frac{7n}{7}$$

$$\boxed{3 = n}$$

g. $7x - 3 + 8 + 2x = 14$

$$\begin{array}{r} 9x + 5 = 14 \\ -5 \quad -5 \\ \hline \end{array}$$

$$\frac{9x}{9} = \frac{9}{9}$$

$$\boxed{x=1}$$

b. $3x + 12x - 20 = 25$

$$\begin{array}{r} 15x - 20 = 25 \\ +20 \quad +20 \\ \hline \end{array}$$

$$\frac{15x}{15} = \frac{45}{15}$$

$$\boxed{x=3}$$

e. $6 + 5x + 6x = 17$

$$\begin{array}{r} 11x + 6 = 17 \\ -6 \quad -6 \\ \hline \end{array}$$

$$\frac{11x}{11} = \frac{11}{11}$$

$$\boxed{x=1}$$

h. $-4 - 6x - 4x = 6$

$$\begin{array}{r} -4 - 10x = 6 \\ +4 \quad +4 \\ \hline \end{array}$$

$$\frac{-10x}{-10} = \frac{10}{-10}$$

$$\boxed{x=-1}$$

c. $-2x + 4x - 12 = 40$

$$\begin{array}{r} 2x - 12 = 40 \\ +12 \quad +12 \\ \hline \end{array}$$

$$\frac{2x}{2} = \frac{52}{2}$$

$$\boxed{x=26}$$

f. $12 = 2x - 8x$

$$\begin{array}{r} 12 = -6x \\ -6 \quad -6 \\ \hline \end{array}$$

$$\boxed{-2 = x}$$

i. $7x - 4 - 1 - 2x = 15 + 5$

$$\begin{array}{r} 5x - 5 = 20 \\ +5 \quad +5 \\ \hline \end{array}$$

$$\frac{5x}{5} = \frac{25}{5}$$

$$\boxed{x=5}$$

Multi - Step Equations with the Distributive Property

Practice: Solve each equation, showing all steps, for each variable.

a. $2(n + 5) = -2$

$$\begin{array}{r} 2n + 10 = -2 \\ -10 \quad -10 \\ \hline \end{array}$$

$$\frac{2n}{2} = \frac{-12}{2}$$

$$\boxed{n = -6}$$

b. $4(2x - 7) + 5 = -39$

$$8x - 28 + 5 = -39$$

$$\begin{array}{r} 8x - 23 = -39 \\ +23 \quad +23 \\ \hline \end{array}$$

$$\frac{8x}{8} = \frac{-16}{8}$$

$$\boxed{x = -2}$$

c. $6x - (3x + 8) = 16$

$$6x - 3x - 8 = 16$$

$$\begin{array}{r} 3x - 8 = 16 \\ +8 \quad +8 \\ \hline \end{array}$$

$$\frac{3x}{3} = \frac{24}{3}$$

$$\boxed{x = 8}$$

d. $6 + 4(4 + 2x) = 86$

$$6 + 16 + 8x = 86$$

$$\begin{array}{r} 22 + 8x = 86 \\ -22 \quad -22 \\ \hline \end{array}$$

$$\frac{8x}{8} = \frac{64}{8}$$

$$\boxed{x = 8}$$

e. $-8(x - 7) = 120$

$$\begin{array}{r} -8x + 56 = 120 \\ -56 \quad -56 \\ \hline \end{array}$$

$$\frac{-8x}{-8} = \frac{64}{-8}$$

$$\boxed{x = -8}$$

f. $-6(x - 7) - 8x = 98$

$$-6x + 42 - 8x = 98$$

$$\begin{array}{r} -14x + 42 = 98 \\ -42 \quad -42 \\ \hline \end{array}$$

$$\frac{-14x}{-14} = \frac{56}{-14}$$

$$\boxed{x = -4}$$

g. $8(6x + 7) - 8(5 + 4x) = -32$

$$48x + 56 - 40 - 32x = -32$$

$$\begin{array}{r} 16x + 16 = -32 \\ -16 \quad -16 \\ \hline \end{array}$$

$$\frac{16x}{16} = \frac{-48}{16}$$

$$\boxed{x = -3}$$

h. $-4(4 + 5x) - 5(-5x + 1) = -31$

$$-16 - 20x + 25x - 5 = -31$$

$$\begin{array}{r} -21 + 5x = -31 \\ +21 \quad +21 \\ \hline \end{array}$$

$$\frac{5x}{5} = \frac{-10}{5}$$

$$\boxed{x = -2}$$

i. $-3(-2x + 6) + 8(3x - 4) = -20$

$$6x - 18 + 24x - 32 = -20$$

$$\begin{array}{r} 30x - 50 = -20 \\ +50 \quad +50 \\ \hline \end{array}$$

$$\frac{30x}{30} = \frac{30}{30}$$

$$\boxed{x = 1}$$

Multi-Step Equations with Variables on Both Sides

Practice: Solve each equation, showing all steps, for each variable

a. $5p - 14 = 8p + 4$

$$\begin{array}{r} -5p \quad -5p \\ -14 = 3p + 4 \\ -4 \quad -4 \end{array}$$

$$\frac{-18}{3} = \frac{8p}{3}$$

$$\boxed{-6 = p}$$

b. $8x - 1 = 23 - 4x$

$$\begin{array}{r} +4x \quad +4x \\ 12x - 1 = 23 \\ +1 \quad +1 \end{array}$$

$$\frac{12x}{12} = \frac{24}{12}$$

$$\boxed{x = 2}$$

c. $5x + 34 = -2(1 - 7x)$

$$\begin{array}{r} 5x + 34 = -2 + 14x \\ -5x \quad -5x \end{array}$$

$$\frac{34}{+2} = \frac{-2 + 9x}{+2}$$

$$\frac{36}{9} = \frac{9x}{9}$$

$$\boxed{4 = x}$$

d. $-7(1 + 6x) = -7 + 8x$

$$\begin{array}{r} -7 - 42x = -7 + 8x \\ +42x \quad +42x \end{array}$$

$$\begin{array}{r} -7 = -7 + 50x \\ +7 \quad +7 \end{array}$$

$$\frac{0}{50} = \frac{50x}{50}$$

$$\boxed{0 = x}$$

e. $-39 - 6x = -5(x + 7) - 5$

$$\begin{array}{r} -39 - 6x = -5x - 35 - 5 \\ -39 - 6x = -5x - 40 \end{array}$$

$$\begin{array}{r} -39 - 6x = -5x - 40 \\ +40 \quad +40 \end{array}$$

$$\begin{array}{r} 1 - 6x = -5x \\ +6x \quad +6x \end{array}$$

$$\boxed{1 = x}$$

f. $-5(2x - 1) + 5 = -4 - 8x$

$$\begin{array}{r} -10x + 5 + 5 = -4 - 8x \end{array}$$

$$\begin{array}{r} -10x + 10 = -4 - 8x \\ +10x \quad +10x \end{array}$$

$$\begin{array}{r} 10 = -4 + 2x \\ +4 \quad +4 \end{array}$$

$$\frac{14}{2} = \frac{2x}{2}$$

$$\boxed{7 = x}$$

g. $-6(5 + 2x) = 5(1 - x)$

$$\begin{array}{r} -30 - 12x = 5 - 5x \\ +12x \quad +12x \end{array}$$

$$\begin{array}{r} -30 = 5 + 7x \\ -5 \quad -5 \end{array}$$

$$\frac{-35}{7} = \frac{7x}{7}$$

$$\boxed{-5 = x}$$

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

$$\begin{array}{r} 12 - 6x = 2 - 8x - 16 \end{array}$$

$$\begin{array}{r} 12 - 6x = -14 - 8x \\ +8x \quad +8x \end{array}$$

$$\begin{array}{r} 12 + 2x = -14 \\ -12 \quad -12 \end{array}$$

$$\frac{2x}{2} = \frac{-26}{2}$$

$$\boxed{x = -13}$$

i. $-2 + 5(1 + 3x) = 2x - 5(2x + 4)$

$$\begin{array}{r} -2 + 5 + 15x = 2x - 10x - 20 \end{array}$$

$$\begin{array}{r} 3 + 15x = -8x - 20 \\ 8x \quad +8x \end{array}$$

$$\begin{array}{r} 3 + 23x = -20 \\ -3 \quad -3 \end{array}$$

$$\frac{23x}{23} = \frac{-23}{23}$$

$$\boxed{x = -1}$$