2.4 Solving Multi-step Equations with Variables on Both Sides

To solve equations with variables on both sides:

Follow the same steps as Multi-step Equations

Hints:

- Remember when there are parentheses and the operation is multiplication, you need to use the Distributive Property before combing like terms. (Remove grouping symbols)
- When combing like terms, it is always easier to cancel out the negative term (smaller number) by adding

Examples:

$2h - 8 = h + 17$

$2h-8=h+17$
$+8 \quad +8$
$2h=h+25$
$-h \quad -h$
$h=25$

Check: $2h-8=h+17$
$2(25)-8=25+17$
$50-8=42$
$42=42$ ✓

$-9 + 8k = 7 + 4k$

$-9+8K=7+4K$
$+9 \quad +9$
$8K=16+4K$
$-4K \quad -4K$
$4K=16$
$\frac{4K}{4}=\frac{16}{4}$
$K=4$

Check:
$-9+8K=7+4K$
$-9+8(4)=7+4(4)$
$-9+32=7+16$
$23=23$ ✓

$3(5j + 2) = 2(3j - 6)$

$3(5j+2)=2(3j-6)$
$15j+6=6j-12$
$+12 \quad +12$
$15j+18=6j$
$-15j \quad -15j$
$18=-9j$
$\frac{18}{9}$
$j=-2$

Check:
$3(5j+2)=2(3j-6)$
$3(5\cdot-2+2)=2(3\cdot-2-6)$
$3(-10+2)=2(-6-6)$
$3(-8)=2(-12)$
$-24=-24$ ✓

$5(-6 - 3d) = 3(8 + 7d)$

$5(-6-3d)=3(8+7d)$
$-30+-15d=24+21d$
$+30 \quad +30$
$-15d=54+21d$
$-21d \quad -21d$
$\frac{1}{-36}\left(-36d=54\right)$
$d=\frac{54}{1}\cdot\frac{1}{-36}$
$d=-\frac{3}{2}$ or $-1\frac{1}{2}$

Check:
$5(-6-3(-\frac{3}{2}))=3(8+7(-\frac{3}{2}))$
$5(-6+\frac{9}{2})=3(8+-\frac{21}{2})$
$5(-1\frac{1}{2})=3(-2\frac{1}{2})$
$-7\frac{1}{2}=-7\frac{1}{2}$ ✓

Equation Notes: No, One, & Infinite Solutions

Solutions to Equations/Linear Equations

An equation is either True or False.

Example: $2x + 3 = 7$ could be true or false depending on the value of x. If $x = 3$, then it's false because $2(3) + 3 = 9$, not 7. It is only true if $x =$ 2, because $2(2) + 3 = 7$.
We say $x = 2$ is the Solution of this equation.

Solution: the values of the variable that makes an equation a true statement

One Solution

- Normally the case
- Equation only has 1 solution to make it true

Example: $4(2x + 8) = 72$

$8x+32=72$

$8x=40$

$x=5$

No Solution

- There is no possible value for x that could make the equation true
- No solution exists for the equation
- Symbol = $\varnothing$

Example: $10 + 4x = 8 + 7x - 3x$

$10+4x=8+\underline{7x-3x}$

$10+4x=8+4x$

Infinite Solution:

- After simplifying, one side of the equation is identical to the other
- Any value will work for the variable, so the equation has an infinite number of solutions
- Symbols = ∞
- An equation that is true for every possible value of the variable is an identity

Example: $5(x - 9) + 3 = 5x - 42$

$5x-45+3=5x-42$

$5x-42=5x-42$

Try It:

Solve for x and state if the equation has one solution, no solution, or infinite solutions.

1. $10 + 6x = 15 + 9x - 3x$

$\varnothing$

2. $3(5 + 2x) = 7 + 8 + 6x$

∞

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

∞

4. $12(x + 3) + 2 = 10(x + 4) + 2$

$x = 2$

5. $4(x - 4) = 2(2x + 10)$

$\varnothing$

Process It?

* Write a linear equation in one variable that has no solution.
* Write a linear equation in one variable that has infinitely many solutions.

2.4 pg. 106 #27-39 all

27) $2(a-4)=4a-(2a+4)$

$2a-8=4a-2a-4$

$2a-8=2a-4$

$\varnothing$

28) $5y+2=\frac{1}{2}(10y+4)$

$5y+2=5y+2$

∞

29) $K-3K=6K+5-8K$

$K-3K=-2K+5$

$\varnothing$

30) $2(2K-1)=4(K-2)$

$4K-2=4K-8$

$\varnothing$

31) $-6a+3=-3(2a-1)$

$-6a+3=-6a+3$

∞

32) $4-d=-(d-4)$

$4-d=-d+4$

∞

33) $3.2 - 4d = 2.3d + 3$
$+4d \quad +4d$
$3.2 = 6.3d + 3$
$-3 \qquad -3$
$\dfrac{0.2 = 6.3d}{6.3}$
$\dfrac{2}{10} \div 6\dfrac{3}{10} = d$
$\dfrac{2}{10} \cdot \dfrac{10}{63} = d$
$\dfrac{2}{63} = d$

34) $3d + 4 = 2 + 3d - \frac{1}{2}$
$3d + 4 = 1\frac{1}{2} + 3d$
$-3d \qquad -3d$
$4 \neq 1\frac{1}{2}$
$\emptyset$

36) $3a + 1 = -3.6(a-1)$
$3a + 1 = -3.6a + 3.6$
$+3.6a \qquad +3.6a$
$6.6a + 1 = 3.6$
$-1 \quad -1$
$6.6a = 2.6$
$6\frac{6}{10}a = 2\frac{6}{10}$
$\frac{10}{66}\left(\frac{66}{10}a = \frac{26}{10}\right)$
$a = \frac{26}{10} \cdot \frac{10}{66}$
$a = \frac{13}{33}$

35) $2.25(4x - 4) = -2 + 10x + 12$
$9x - 9 = 10 + 10x$
$+9 \quad +9$
$9x = 19 + 10x$
$-10x \quad -10x$
$-1(-x = 19)$
$x = -19$

37) $\frac{1}{2}h + \frac{1}{3}(h-6) = \frac{5}{6}h+2$

$\frac{1}{2}h + \frac{1}{3}h - 2 = \frac{5}{6}h + 2$

$\frac{3}{6}h + \frac{2}{6}h - 2 = \frac{5}{6}h + 2$

$\frac{5}{6}h - 2 = \frac{5}{6}h + 2$

$-\frac{5}{6}h \quad -\frac{5}{6}h$

$-2 \neq 2$

$\varnothing$

38) $0.5b + 4 = 2(b+2)$

$0.5b + 4 = 2b + 4$

$-4 \quad -4$

$0.5b = 2b$

$\frac{1}{2}b = 2b$

$-\frac{1}{2}b \quad -\frac{1}{2}b$

$0 = 1\frac{1}{2}b$

$\left(0 = \frac{3}{2}b\right)\frac{2}{3}$

$0 = b$

$b = 0$

39) $-2(-c-12) = -2c-12$

$2c + 24 = -2c - 12$

$+12 \quad +12$

$2c + 36 = -2c$

$-2c \quad -2c$

$\frac{36}{-4} = \frac{-4c}{-4}$

$c = -9$