

- 1) Bell Ringer: integers sprint  
*Hand in  
P.S. 12*
- 2) Go over homework page 31
- 3) Lesson 5: Solving Equations by Moving Variables
- 4) Homework: page 36  
*Do not forget  
Name/#*

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## Solving Multi-Step Equations

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### MORE NOTES (variables on both sides)

To solve an equation with variables on both sides:

1. Perform any distributive property shown in the equation.
2. Combine any like terms in the equation (do not cross the =).  $2x + 3x =$
3. Move variable terms to one side of the equation, and constants to the other side of the equation.
  - x a. It doesn't matter to which side you choose to move things.
  - x b. Continue using inverse operations to move things properly.

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**EXAMPLES**

9)  $3x + 20 = x - 8$  .....original problem

$$\begin{array}{r} 3x + 20 = x - 8 \\ -x \quad -x \\ \hline 2x + 20 = -8 \\ -20 \quad -20 \\ \hline 2x = -28 \\ 2 \quad 2 \end{array}$$

Show alternate steps that lead to same answer.

- ..... pick something to move!
- ..... subtract "x" from both sides
- ..... simplify the equation
- ..... subtract 20 from both sides
- ..... simplify the equation
- ..... divide both sides by 2

$$x = -14$$

.....final answer!

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10)  $-13 + 7x = -3x - 33$  .....original problem

$$\begin{array}{r} -13 + 7x = -3x - 33 \\ +3x \quad +3x \\ \hline -13 + 10x = -33 \\ +13 \quad +13 \\ \hline 10x = -20 \\ 10 \quad 10 \end{array}$$

Show alternate steps that lead to same answer.

- ..... pick something to move!
- ..... add "3x" to both sides
- ..... simplify the equation
- ..... add 13 to both sides
- ..... simplify the equation
- ..... divide both sides by 10

$$x = -2$$

.....final answer!

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# Solving Multi-Step Equations

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## MORE EXAMPLES

11)

$$\begin{array}{r}
 \cancel{-7x} + 11 = 19 - \cancel{x} \\
 \hline
 11 = 19 + 6x \\
 \underline{-19} \quad \underline{-19} \\
 -8 = 6x \\
 \frac{6}{6} \quad | \\
 -\frac{4}{3} = x \\
 \frac{8}{6} = \frac{4}{3} \\
 6 \div 2 = 3 \\
 \text{or } -1\frac{1}{3}
 \end{array}$$

12)

$$\begin{array}{l}
 \cancel{18 - 12y} = \cancel{-22 - 7y} \\
 \text{check} \\
 -7x + 11 = 19 - x \\
 -7(-\frac{4}{3}) + 11 = 19 - (-\frac{4}{3}) \\
 \frac{28}{3} + 11 = 19 - (-\frac{4}{3}) \\
 = 19 + 1\frac{1}{3} \\
 9\frac{1}{3} + 11 = 20\frac{1}{3} \\
 20\frac{1}{3} \quad \checkmark
 \end{array}$$

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12)

$$\begin{array}{r}
 \cancel{18 - 12y} = \cancel{-22 - 7y} \\
 \hline
 18 = -22 + 5y \\
 \underline{+22} \quad \underline{+22} \\
 \frac{40}{5} = \frac{5y}{5} \\
 8 = y
 \end{array}$$

check

$$\begin{array}{l}
 18 - 12y = -22 - 7y \\
 18 - 12(8) = -22 - 7(8) \\
 18 - 96 = -22 - 56 \\
 -78 = -78
 \end{array}$$

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Directions: Solve each equation for the variable. SHOW YOUR WORK FOR CREDIT!

13.  $-5 = 6d - 7d + 4$

$$\begin{aligned} -5 &= -1d + 4 \\ \underline{-4} &\quad \underline{-4} \\ -9 &= -1d \\ \underline{-1} &\quad \underline{-1} \\ 9 &= d \end{aligned}$$

14.  $4e - 4 = e - 4$

15.  $-7f + 6 = 116 + 3f$

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16.  $4 + 2g + 5g = -66$

17.  $5h + 3 = 3h + 11$

18.  $5i + 4 = 14 + 4i$

check #13

$$-5 = 6d - 7d + 4$$

$$-5 = 6(9) - 7(9) + 4$$

$$-5 = -54 - 63 + 4$$

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19.  $4j + 26 = 50 + 6j$

20.  $2k + 36 = 6k - 12$

21.  $L + 21 = -L + 87$

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22.  $3q + 7 = 7q - 13$

23.  $21 - r = -87 + 2r$

24.  $2s - 54 = -s + 21$

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Ex:  $4(x + 11) - x = 8$

$$\begin{array}{rcl} 4x + 44 - x & = & 8 \\ \hline 3x + 44 & = & 8 \\ -44 & & -44 \\ \hline 3x & = & -36 \\ \frac{3x}{3} & = & \frac{-36}{3} \\ x & = & -12 \end{array}$$

Use the distributive property.  
Combine like terms.  
Subtract 44 from both sides.  
Simplify.  
Divide both sides by 4.  
Simplify.

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P.24b

There may also be times where we have to use the distributive property and then combine like terms. In that case, we follow the order of operations and do our multiplication before combining like terms with addition. Consider the following example which we should verify has a solution of  $x = 3$ :

- 1) distribute
- 2) combine like terms
- 3) add / subtract
- 4) multiply / divide
- 5) check

$$\begin{aligned} 3(x+2) - 7 + 2x &= 14 \\ 3x + 6 - 7 + 2x &= 14 \\ 5x - 1 &= 14 \\ +1 &+1 \\ 5x &= 15 \\ \frac{5x}{5} &= \frac{15}{5} \\ x &= 3 \end{aligned}$$

check

$$\begin{aligned} 3(x+2) - 7 + 2x &= 14 \\ 3(3+2) - 7 + 2(3) &= 14 \\ 3(5) - 7 + 6 &= 14 \\ 15 - 7 + 6 &= 14 \\ 8 + 6 &= 14 \\ 14 &= 14 \quad \checkmark \end{aligned}$$

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Solve each equation by using the distributive property and combining like terms.

$$1. 2(x+7) + x = 20$$

$$\begin{aligned} 2x + 14 + x &= 20 \\ 3x + 14 &= 20 \\ -14 &-14 \\ 3x &= 6 \\ \frac{3x}{3} &= \frac{6}{3} \\ x &= 2 \end{aligned}$$

$$3. 3(m+1) - 2m = 0$$

$$2. 2(x-1) + 3x = 3$$

$$\begin{aligned} x + 8x + 12 &= 15 \\ 9x + 12 &= 15 \\ -12 &-12 \\ 9x &= 3 \\ \frac{9x}{9} &= \frac{3}{9} \\ x &= \frac{3}{9} = \frac{1}{3} \end{aligned}$$

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1)  $2(x+7) + x = 20$

$$\begin{aligned} 2(2+7) + 2 &= 20 \\ 2(9) + 2 &= 20 \\ 18 + 2 &= 20 \\ 20 &= 20 \checkmark \end{aligned}$$

$$\begin{aligned} 4 + 14 + 2 &= 20 \\ 18 + 2 &= 20 \\ 20 &= 20 \checkmark \end{aligned}$$

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4)  $x + 4(2x+3) = 15$

$$\begin{aligned} \frac{1}{3} + 4\left(2 \cdot \frac{1}{3} + 3\right) &= 15 \\ \frac{1}{3} + 4\left(\frac{2}{3} + 3\right) &= 15 \\ \frac{1}{3} + 4\left(\frac{12}{3}\right) &= 15 \\ \frac{1}{3} + 14\frac{2}{3} &= 15 \\ 15 &= 15 \checkmark \end{aligned}$$

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5.  $-\frac{1}{2}(b+2) + 3b = -1$

6.  $4(n+2) - 2n = 0$

7.  $4 + 2(1+x) = 12$

$$8. \overbrace{-1(x+3)}^{\textcircled{1}} + \frac{3}{4}x + 5 = 0$$

$$\underline{-1x-3 + \frac{3}{4}x + 5} = 0$$

$$-\frac{1}{4}x \cancel{-2} = -2$$

$$\left(-\frac{4}{1}\right) \cancel{-\frac{1}{4}x} = -2 \left(-\frac{4}{1}\right)$$

$$x = 8$$

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$$\textcircled{8} \quad -(x+3) + \frac{3}{4}x + 5 = 0$$

$$-(8+3) + \frac{3}{4}(8) + 5 = 0$$

$$-11 + \cancel{\frac{6}{1}} + 5 = 0$$

$$-11 + 11 = 0$$

$$0 = 0 \checkmark$$

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1)  $2(x + 5) = 16$

2)  $3(t + 1) = 18$

3)  $2(3x - 5) = 14$

4)  $4(3t - 2) = 88$

5)  $2(3x + 1) = 11$

6)  $6(3k + 5) = 39$

7)  $9(3x - 5) = 9$

8)  $3(t + 7) = 15$

$$\begin{aligned} 1) \quad & 2(x+5) = 16 \\ & 2x + 10 = 16 \\ & \underline{-10} \quad \underline{-10} \\ & 2x = 6 \\ & \underline{2} \quad \underline{2} \\ & x = 3 \end{aligned}$$

$$\begin{aligned} \text{check } & 2(x+5) = 16 \\ & 2(3+5) = 16 \\ & 2(8) = 16 \\ & 16 = 16 \checkmark \end{aligned}$$

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$$\begin{aligned} ② \quad & 3(t+1) = 18 \\ & 3t + 3 = 18 \\ & \underline{-3} \quad \underline{-3} \\ & 3t = 15 \\ & \underline{3} \quad \underline{3} \\ & t = 5 \end{aligned}$$

$$\begin{aligned} \text{check } & 3(t+1) = 18 \\ & 3(5+1) = 18 \quad 3(5+1) = 18 \\ & 15+3 = 18 \quad 3(6) = 18 \\ & 18 = 18 \quad 18 = 18 \checkmark \end{aligned}$$

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$$2(3y - 5) = 14$$

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(b)  $6(3k + 5) = 39$

$$\begin{array}{r} 18k + 30 = 39 \\ -30 \quad -30 \\ \hline 18k = 9 \end{array}$$

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

check

$$\begin{aligned} 6(3k + 5) &= 39 \\ 6\left(3 \cdot \frac{1}{2} + 5\right) &= 39 \\ 6\left(\frac{1}{2} + 5\right) &= 39 \\ 6\left(6 \cdot \frac{1}{2}\right) &= 39 \\ 39 &= 39 \checkmark \end{aligned}$$

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$$\textcircled{1} \quad -2x - 7(-5x + 12) = 114$$

$$-2x + 35x - 84 = 114$$

$$33x - 84 = 114$$

$$\underline{+84} \quad \underline{+84}$$

$$\frac{33x}{33} = \frac{198}{33}$$

$$x = 6$$

check

$$-2x - 7(-5x + 12) = 114$$

$$-2(6) - 7(-30 + 12) = 114$$

$$-12 - 7(-30 + 12) = 114$$

$$-12 - \underline{7(-18)} = 114$$

$$-12 + 126 = 114$$

$$114 = 114 \checkmark$$

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