

Get out your homework from yesterday and have it ready to check. Check your answers with those below.

### Classwork - Solving Equations with Variables on Both Sides

Solve the following inequalities. SHOW WORK

**Remember** → Flip the inequality sign when multiplying or dividing both sides by a negative!

A)  $4.25x + 6 < 40$

$$\begin{array}{r} -6 \quad -6 \\ \hline 4.25x < 34 \\ \hline 4.25 \quad 4.25 \\ \hline x < 8 \end{array}$$



B)  $-2n + 10 < 16$

$$\begin{array}{r} -10 \quad -10 \\ \hline -2n < 6 \\ \hline -2 \quad -2 \\ \hline n > -3 \end{array}$$



C)  $4 \leq \frac{2}{3}x - 12$

$$\begin{array}{r} +12 \quad +12 \\ \hline 3 \cdot 16 \leq \frac{2x}{3} - 3 \\ \hline 48 \leq \frac{2x}{3} \\ \hline 24 \leq x \\ \text{OR} \\ x \geq 24 \end{array}$$



D)  $-\frac{x}{3} + 11 > 7$

$$\begin{array}{r} -11 \quad -11 \\ \hline -\frac{x}{3} > -4 \\ \hline -3 \cdot -3 \quad -3 \cdot -3 \\ \hline x < 12 \end{array}$$



$$E) 3(x-2) > -27$$

$$3x - 6 > -27$$

$$\begin{array}{r} +6 \quad +6 \\ \hline \end{array}$$

$$3x > -21$$

$$\frac{3x}{3} > \frac{-21}{3}$$

$$x > -7$$



$$G) (6x) + 2(+6x) < 14$$

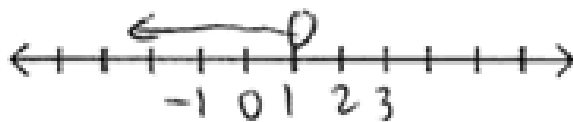
$$12x + 2 < 14$$

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

$$12x < 12$$

$$\frac{12x}{12} < \frac{12}{12}$$

$$x < 1$$



$$F) -2(5x-4) \leq -12$$

$$-10x + 8 \leq -12$$

$$\begin{array}{r} -8 \quad -8 \\ \hline \end{array}$$

$$-10x \leq -20$$

$$\frac{-10x}{-10} \leq \frac{-20}{-10}$$

$$x \geq 2$$



$$H) -318 \geq -6(6n-7)$$

$$-318 \geq -36n + 42$$

$$\begin{array}{r} -42 \quad -42 \\ \hline \end{array}$$

$$-360 \geq -36n$$

$$\frac{-360}{-36} \geq \frac{-36n}{-36}$$

$$10 \leq n \text{ OR } n \geq 10$$



$$I) 6 - 4(6n + 7) \geq 122$$

$$\textcircled{6} - 24n - 28 \geq 122$$

$$\begin{array}{r} -24n - 28 \geq 122 \\ +22 \quad +22 \end{array}$$

$$\frac{-24n \geq 144}{-24 \quad -24} \quad \textcircled{n \leq -6}$$

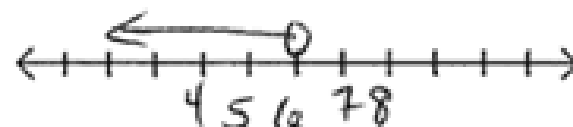


$$J) 5(3x + 6) + 7 < 127$$

$$15x + 30 + 7 < 127$$

$$15x + 37 < 127$$

$$\frac{-37 \quad -37}{15x < 90} \quad \textcircled{x < 6}$$



$$I) 167 > 7(-7n + 2) + 6$$

$$167 > -49n + 14 + 6$$

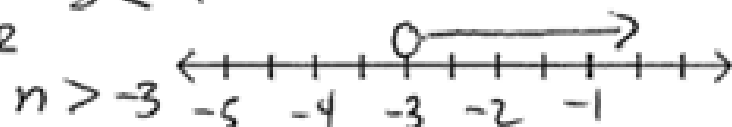
$$167 > -49n + 20$$

$$\begin{array}{r} -20 \quad -20 \end{array}$$

$$\frac{147 > -49n}{-49 \quad -49}$$

$$-3 < n \quad \text{OR}$$

OR

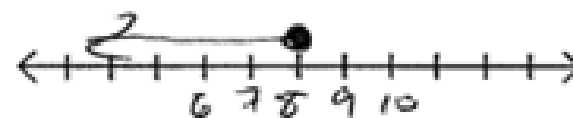


$$J) 6(3x - 1) + 4(2x + 3) \leq 214$$

$$18x - 6 + 8x + 12 \leq 214$$

$$\begin{array}{r} 26x + 6 \leq 214 \\ -6 \quad -6 \end{array}$$

$$\frac{26x \leq 208}{26 \quad 26} \quad \textcircled{x \leq 8}$$



Write an inequality to represent the situation. Then solve and graph the inequality. Interpret your solution.

A) Kevin went to the mall and bought a pair of shorts for \$18. He also found a sale on his favorite shirts for \$10.50 each. If he only brought \$60 to spend, what is the greatest number of shirts he could buy?

Define variable:  $s = \# \text{ of shirts}$



Inequality

$$10.50s + 18 \leq 60$$
$$\quad -18 \quad -18$$

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$$10.50s \leq 42$$
$$\frac{10.50}{10.50} \quad \frac{42}{10.50}$$

$$s \leq 4$$

B) Susan has a savings account with \$325 in it. Each month she plans to add \$175 to her account. How many months will it take for the account to have over \$2,425 in it?

Define variable:  $m = \# \text{ of months}$



Inequality

$$175m + 325 > 2425$$
$$\quad -325 \quad -325$$

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$$175m > 2100$$
$$\frac{175}{175} \quad \frac{2100}{175}$$

$$m > 12$$



## Real-World Link



Turn to p. 145 in the book

**Cell Phones** A wireless company offers two cell phone plans. Plan A charges \$24.95 per month plus \$0.10 per minute for calls. Plan B charges \$19.95 per month plus \$0.20 per minute. Use the questions to find when the two plans cost the same.

1. Complete the table.

Minutes ( $m$ )	Plan A $24.95 + 0.10m$	Plan B $19.95 + 0.20m$
10	25.95	21.95
20	26.95	23.95
30	27.95	25.95
40	28.95	27.95
50	29.95	29.95
60	30.95	31.95
70	31.95	33.95

4. For what value(s) do both Plans cost the same?

50 minutes

2. For what value(s) does Plan A cost less?

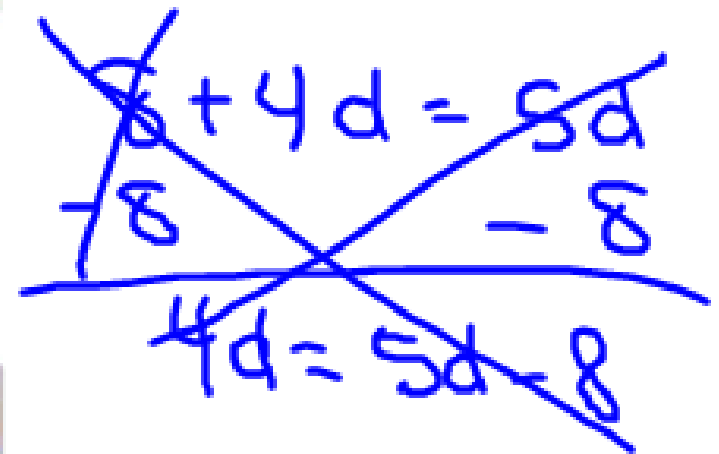
After 50 minutes

3. For what value(s) does Plan B cost less?

Less than 50 minutes

## Equations with Variables on Each Side

Some equations, like  $8 + 4d = 5d$ , have variables on each side of the equals sign. To solve, use the properties of equality to write an equivalent equation with the variables on one side of the equals sign. Then solve the equation.



### Examples



1. Solve  $8 + 4d = 5d$ . Check your solution.

$$8 + 4d = 5d$$

Write the equation.

$$\underline{-4d = -4d}$$

Subtraction Property of Equality

$$8 = d$$

Simplify by combining like terms.

Subtract  $4d$  from the left side of the equation to isolate the variable.

Subtract  $4d$  from the right side of the equation to keep it balanced.

To check your solution, replace  $d$  with 8 in the original equation.

**Check**  $8 + 4d = 5d$

Write the original equation.

$$8 + 4(8) \stackrel{?}{=} 5(8)$$

Replace  $d$  with 8.

$$40 = 40 \checkmark$$

The sentence is true.

2. Solve  $6n - 1 = 4n - 5$ .

$$6n - 1 = 4n - 5$$

Write the equation.

$$\underline{-4n \quad = \quad -4n}$$

Subtraction Property of Equality

$$2n - 1 = -5$$

Simplify.

$$\underline{+1 = +1}$$

Addition Property of Equality

$$2n = -4$$

Simplify.

$$n = -2$$

Mentally divide each side by 2.

**Check**  $6n - 1 = 4n - 5$

Write the original equation.

$$6(-2) - 1 \stackrel{?}{=} 4(-2) - 5$$

Replace  $n$  with  $-2$ .

$$-13 = -13 \quad \checkmark$$

The sentence is true.

$$\begin{array}{r} 6n - 1 = 4n - 5 \\ +1 \qquad \qquad +1 \\ \hline 6n = 4n - 4 \\ -4n \quad +4n \\ \hline 2n = -4 \\ \frac{2n}{2} = \frac{-4}{2} \\ n = -2 \end{array}$$

**Got it?** Do these problems to find out.

Solve each equation. Check your solution.

a.  $8a = 5a + 21$

$$\underline{5a - 5a}$$

$$\frac{3a}{3} = \frac{21}{3}$$

$$a = 7$$

b.  $3x - 7 = 8x + 23$

$$\underline{-3x \quad -3x}$$

$$\begin{array}{r} -7 = 8x + 23 \\ -23 \qquad -23 \\ \hline -30 = 5x \end{array}$$

$$\frac{-30}{5} = \frac{5x}{5}$$

$$x = -6$$



# Example



3. Green's Gym charges a one time fee of \$50 plus \$30 per session for a personal trainer. A new fitness center charges a yearly fee of \$250 plus \$10 for each session with a trainer. For how many sessions is the cost of the two plans the same?

Words	fee of \$50 plus \$30 per session	is the same as	a fee of \$250 plus \$10 per session.
Variable	Let $s$ represent the number of sessions.		
Equation	$50 + 30s = 250 + 10s$		

Green's                  New

$$50 + 30s = 250 + 10s$$

$$\underline{- 10s = - 10s}$$

$$50 + 20s = 250$$

$$\underline{- 50 = - 50}$$

$$20s = 200$$

$$20s = 200$$

$$\underline{20 = 20}$$

$$s = 10$$

Write the equation.

Subtraction Property of Equality

Simplify.

Addition Property of Equality

Simplify.

Division Property of Equality

Simplify.

So, the cost is the same for 10 personal trainer sessions.

Check

Green's Gym: \$50 plus 10 sessions at \$30 per session

$$50 + 10 \cdot 30 = 50 + 300$$

$$= \$350$$

new fitness center: \$250 plus 10 sessions at \$10 per session

$$250 + 10 \cdot 10 = 250 + 100$$

$$= \$350 \checkmark$$



**Got it?** Do this problem to find out.

- c. The length of a flag is 0.3 foot less than twice its width. If the perimeter is 14.4 feet longer than the width, find the dimensions of the flag.

$$2w + 2(2w - 0.3) = 14.4 + w$$

## Guided Practice #4

4. EZ Car Rental charges \$40 a day plus \$0.25 per mile.  
Ace Rent-A-Car charges \$25 a day plus \$0.45 per mile.  
What number of miles results in the same cost for

one day? (Example 3)

$x = \# \text{ of miles}$

$EZ$	$Rent-A-Car$
$40 + 0.25x$	$25 + 0.45x$
$- 0.25x$	$- 0.25x$
<hr/>	
$40 = 25 + 0.2x$	
$- 25$	$- 25$
<hr/>	
$15 = 0.2x$	
$\frac{15}{0.2}$	$\frac{0.2x}{0.2}$

$x = 75 \text{ miles}$

## Equations with Rational Coefficients

In some equations, the coefficients of the variables are rational numbers. Remember when working with fractions, you need to have a common denominator before you add or subtract.

### Example

4. Solve  $\frac{2}{3}x - 1 = 9 - \frac{1}{6}x$ .

$$\frac{4}{6}x - 1 = 9 - \frac{1}{6}x$$

The common denominator of the coefficients is 6.  
Rewrite the equation.

$$\frac{4}{6}x - 1 = 9 - \frac{1}{6}x$$

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Addition Property of Equality

$$\frac{5}{6}x - 1 = 9$$

Simplify.

$$\frac{5}{6}x - 1 = 9$$

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Addition Property of Equality

$$\frac{5}{6}x = 10$$

Simplify.

$$\left(\frac{6}{5}\right)\frac{5}{6}x = 10\left(\frac{6}{5}\right)$$

Multiplication Property of Equality

$$x = 12$$

Simplify.

**Got it?** Do these problems to find out.

e.  $\frac{1}{2}p + 7 = \frac{3}{4}p + 9$

f.  $-\frac{5}{4}c - \frac{1}{2} = -\frac{3}{4} + \frac{5}{8}c$

Handwritten solution for problem e:

$$\begin{array}{r} \frac{1}{2}p + 7 = \frac{3}{4}p + 9 \\ -\frac{3}{4}p \quad -\frac{3}{4}p \\ \hline \frac{1}{4}p + 7 = 9 \\ -7 \quad -7 \\ \hline \frac{1}{4}p = 2 \\ \cdot \frac{4}{1} \quad \cdot \frac{4}{1} \\ \hline p = 8 \end{array}$$

The final answer  $p = 8$  is circled in blue.

## Guided Practice

Solve each equation. Check your solution. (Examples 1, 2, 4)

1.  $5n + 9 = 2n$

2.  $7y - 8 = 6y + 1$

3.  $\frac{3}{5}x - 15 = \frac{6}{5}x + 12$