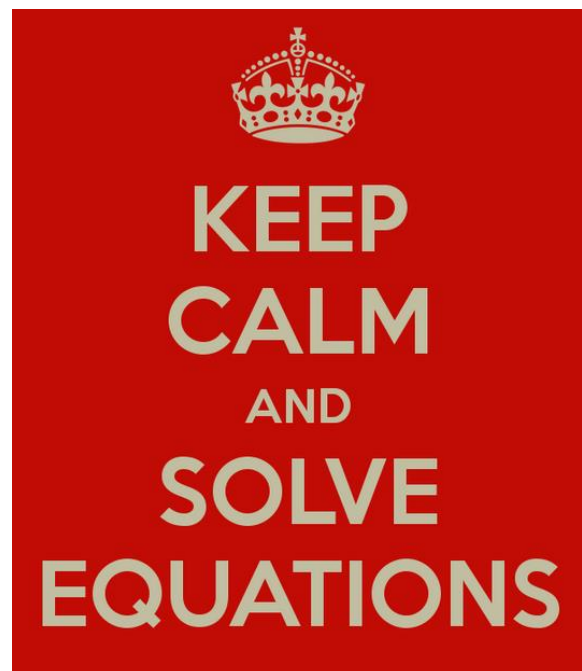Name: _____

Solving Equations and Inequalities

- I can solve one step equations using addition and subtraction
- I can solve one step equations using multiplication and division
- I can solve one step equations with fractional coefficients
- I can solve two step equations
- I can solve multi-step equations by combining like terms
- I can solve multi-step equations by using the distributive property
- I can solve multi-step equations with variables on both sides
- I can solve and graphing inequalities in one-step and two-steps

KEEP CALM AND SOLVE EQUATIONS

Objectives: I can solve one-step equations using addition and subtraction.

SOLVING EQUATIONS BY ADDING OR SUBTRACTING

When you solve an equation, the goal is to get the variable alone. The value on the other side of the variable tells you the solution of the original equation. You use **inverse operations**, which undo each other, to get the variable alone. (Remember that, in previous math classes, you used related equations like $3 + 5 = 8$ and $8 - 3 = 5$. These equations show that addition and subtraction undo each other.)

SUBTRACTION PROPERTY OF EQUALITY:

    You can subtract the same number from each side of an equation.

Arithmetic	Algebra
$10 = 2(5)$	If $a = b$,
$10 - 5 = 2(5) - 5$	then $a - c = b - c$

ADDITION PROPERTY OF EQUALITY:

    You can add the same number to each side of an equation.

Arithmetic	Algebra
$10 = 2(5)$	If $a = b$
$10 + 3 = 2(5) + 3$	then $a + c = b + c$

EXAMPLES:

1) $y + 5 = 13$

    $\underline{-5 \quad -5}$

    $y \quad = 8$

2) $c - (-12) = 24$

    $c + 12 = 24$ (ADD THE OPPOSITE!)

    $\underline{-12 \quad -12}$

    $c \quad = 12$

3) $x - 10 = 12$

    $x + -10 = 12$

    $\underline{+10 \quad +10}$

    $x \quad = 22$

Check:

1) $8 + 5 = 13$ ☑

2) $12 - (-12) = 24$ ☑

3) $22 - 10 = 12$ ☑

PRACTICE.

a) $a + 8 = 3$

b) $5 = d + 1$

c) $c + (-4) = -5$

d) $y - 5 = 8$

e) $p - 40 = 42$

d) $98 = x - 14$

Applying Solving Equations

When translating words in sentences, you can write equations to be solved. This skill will enable you to solve more complex word problems. Let's review some words and their corresponding math symbols.   Make a list of words that correspond with the given symbol.

+	—	*	÷	=

PRACTICE

Write an equation for each sentence. You may have to choose your own variable.

1. The sum of 63 and some number, x, is -82. Find the number.

_____

2. Sixty-eight is ninety-seven less than a number. Find the number.

_____

3. Fifty-seven is 19 more than some number. Find the number.

_____

4. A number decreased by 16 is -26. Find the number.

_____

5. After buying has 24 more bracelets, Tasha now has 137. How many did Tasha use to have?

_____

6. Sarah spent $28.50 of her savings. She now has $42. Previously how much did Sarah have in savings?

_____

HOMEWORK:

Solve each equation:

1. $m - 17 = -8$

2. $k - \frac{1}{2} = 1\frac{1}{4}$

3. $-44 + n = 36$

4. $-36 = p - 91$

5. $m - 21.1 = -36.6$

6. $19 = c - (-12)$

7. $x + 14 = 21$

8. $31 = p + 17$

9. $-19 = k + 9$

10. $n + 4.7 = -4.7$

11. $36 + n = 75$

12. $-176 = h + (-129)$

13. $-88 + z = 0$

Hint for #14: simplify left side first
14. $-33 + (-7) = 29 + m$

15. $t + (-2) = -66$

Write an equation for each sentence. **Solve the equation.**

16. The sum of -25 and a number is -73. Find the number.

17. A number increased by 46 is 22. Find the number.

18. Twenty-two less than a number is -85. Find the number

Equation: _____

(show work)

Solution: _____

Equation: _____

(show work)

Solution: _____

Equation: _____

(show work)

Solution: _____

Objectives: I can solve one-step equations using multiplication and division.

SOLVING EQUATIONS BY MULTIPLYING OR DIVIDING

DIVISION PROPERTY OF EQUALITY:

You can divide the same non-zero number from each side of an equation.

<u>Arithmetic</u>

$6 = 3(2)$

$$\frac{6}{3} = \frac{3(2)}{3}$$

<u>Algebra</u>

If $a = b$ and $c \neq 0$, then

$$\frac{a}{c} = \frac{b}{c}$$

MULTIPLICATION PROPERTY OF EQUALITY:

You can multiply the same number to each side of an equation.

<u>Arithmetic</u>

$12 = 3(4)$

$12*2 = 3(4)*2$

<u>Algebra</u>

If $a = b$, then

$a * c = b * c$

EXAMPLES:

a) Dividing to solve an equation: $-2v = -24$ Check your solution.

b) Multiplying to solve an equation: Check your solution.

$$\frac{x}{8} = -5$$

c) 288 is the product of 12 and a number.

Write an equation.   Check your answer.
Solve.

PRACTICE:

Solve each equation. Check each solution for reasonableness.

a. $4x = 84$

b. $91 = 7y$

c. $\dfrac{r}{-5} = 10$

d. $-3d = 24$

e. $\dfrac{x}{6} = -30$

f. $-4d = -56$

g. $-30 = \dfrac{f}{-20}$

h. $\dfrac{u}{10} = 50$

i. $-8n = 96$

Write an equation, then solve.

j. The product of a number and -4 is 240. What is the number?

k. The quotient of a number and 20 is 40. What is the number?

Homework:

Solve each equation. Check each solution for reasonableness.

1. $2p = -68$

2. $-48 = 4y$

3. $\dfrac{g}{-9} = 30$

4. $-160 = 20t$

5. $\dfrac{x}{-5} = -5$

6. $-6y = -24$

7. $-6 = \dfrac{m}{-2}$

8. $\dfrac{u}{-4} = -12$

9. $-8z = -80$

10. $-4m = -32$

11. $56 = -7j$

12. $\dfrac{r}{30} = 6$

13. $-3r = -48$

14. $\dfrac{x}{6.1} = -3$

15. $-8u = 56$

Write an equation, then solve.

16. Twice a number is -346. What is the number?

17. The quotient of a number and -7 is 210. What is the number?

Objectives: I can solve one step equations with fractional coefficients and solutions.

FRACTIONAL COEFFICIENTS AND SOLUTIONS

Sometimes you will have a fractional coefficient. (A coefficient is the number multiplied by the variable.) Sometimes your answers will be a fraction as well. Leave your answers as fractions.
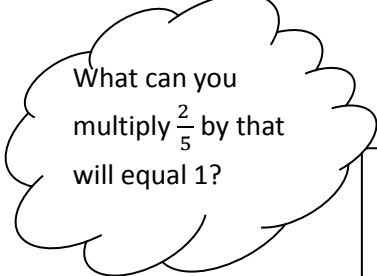
Examples...

1. $\frac{2}{5}x = 20$

What can you multiply $\frac{2}{5}$ by that will equal 1?

Instead of dividing by the coefficient...multiply by the reciprocal.

$$\frac{5}{2} * \frac{2}{5}x = 20 * \frac{5}{2}$$

$$\frac{5}{2} * \frac{2}{5}x = \overset{10}{\cancel{20}} * \frac{5}{\cancel{2}_{1}}$$

Cross-cancel if possible.

$$x = 50$$

2.   5x = 52

Divide both sides by 5.

$$\frac{5x}{5} = \frac{52}{5}$$

Reduce if possible. Improper fractions do NOT HAVE to be changed to mixed numbers.

$$x = \frac{52}{5} = 10\frac{2}{5}$$

Practice.

a.   2p = −5

b.   −46 = 4y

c. $\frac{5}{8}d = 30$

d.   −65 = 20t

e. $-\frac{9}{10}k = -15$

f. $-\frac{2}{3}y = -11$

g.   −8 + d = 13

h.   e − 4 = −32

i. $44 = \frac{2}{3}f$

Homework:

Solve each equation.

1. $\frac{2}{3}p = -8$

2. $-42 = 4y$

3. $\frac{5}{6}u = 30$

4. $-160 = 30w$

5. $\frac{4}{-7}d = -14$

6. $-6y = -22$

7. $-16 = \frac{r}{-2}$

8. $\frac{1}{-4}h = -12$

9. $-8 + v = -80$

10. $m - 4 = -13$

11. $48 = -5j$

12. $\frac{4}{5}w = -6$

13. $-3 + r = -48$

14. $\frac{2}{9}v = -5$

15. $-8e = 52$

Write an equation, then solve.

16. Two-thirds of a number is -36. What is the number?

17. The product of a number and -3 is -20. What is the number?

Objectives: I can solve two step equations.

SOLVING TWO STEP EQUATIONS

Now we'll solve some more complicated equations and inequalities - ones that have two-step solutions, because they involve two operations. Solving equations is like solving a puzzle. Just keep working through the steps until you get the variable you're looking for alone on one side of the equation. This is called **isolating** the variable.

Here's a two-step equation. Let's start with the variable x, and describe, step by step, what is being done to x in an equation.

3x - 10 = 14	Equation
3x	First, x is _____ by three.
3x - 10	Next, ten is _____ from the term _____.
3x - 10 = 14	We get a result of 14.
Start with x --> Multiply by 3 --> Subtract 10 --> Result is 14.	

Solving an equation is like working the equation backwards to discover what number will work in the equation. Now let's work backwards and use **inverse operations** to undo all the steps. We can start with the result of 14.

14	**Start with result.**
14 + 10	Next, working backwards, we can _____ 10, which is the inverse of _____ 10.
$\dfrac{14 + 10}{3}$	Now we _____ by 3, since that's the inverse of _____ by 3.
$\dfrac{24}{3} = 8$	We get an answer of 8.
Start with result of 14 —> Add 10 —> Divide by 3 Answer is 8.	

Do you see how it's important when solving an equation to "undo" all the steps in the correct order? No matter how many steps are in the original equation, you can work backwards and apply the inverse operations, in order, to arrive at the solution!

Solving a two-step equation requires the same procedure(s) as a one-step equation. However, the order in which the procedures are done makes a difference.	
Do the inverse operation for addition or subtraction first.	**Do the inverse operation of multiplication or division last.**

Step 1: change subtraction to adding the opposite, then **add** 9 to both sides **Step 2**: Then **divide** both sides by 5	**5x – 9 = 31**	Check your answer.
	Perform the **inverse** operations when solving equations.	When checking your solution, use the correct order of operations. [P E MD AS]

You can use two-step equations to solve many problems. Write an equation for each and solve.

1. Five more than 2 times a number is -7.

Equation: _____

Solve   {   Check   {

2. Two diminished by -7 times a number is 51.

Equation: _____

Solve   {   Check   {

3. Six meters less than twice length *x* is 18.

Equation: _____

Solve   {   Check   {

Practice:

Solve and check each solution.

1. $\dfrac{r}{10} + 4 = 5$ check ✓

2. $4n - 9 = -9$ check ✓

3. $\dfrac{m}{16} - 9 = -8$ check ✓

4. $-4x + 38 = -122$ check ✓

Homework:

Solve and check each solution.

1. $4x - 17 = 31$ check ✓

2. $15 = 2m + 3$ check ✓

3. $\dfrac{k}{3} + 4 = 8$ check ✓

4. $7 = 3 + \dfrac{h}{6}$ check ✓

5. $9n + 18 = 81$ check ✓

6. $5 = \dfrac{y}{3} - 9$ check ✓
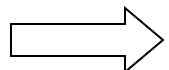
7. $14 = 5k - 31$ check ✓   **8.** $\frac{t}{9} - 7 = -5$ check ✓

9. $\frac{v}{8} - 9 = -13$ check ✓   **10.** $-2 + \frac{p}{3} = 9$ check ✓

11. Five times a number, decreased by 2 is -37.

Equation: _____

Solve   Check

12. Six years older than twice age x is 38.

Equation: _____

Solve   Check

13. Multiple choice: Choose the correct equation for the situation.

50mph slower than twice the speed x is 100mph.

A. 50 + 2x = 100   **B.** 2x − 50 = 100   **C.** 50 = 2x + 100   **D.** 50 − 2x = 100

Review Solving One and Two Step Equations

Objectives: I can solve one and two step equations.

Solve and <u>CHECK</u> each problem. SHOW ALL STEPS!!!!!!!

Solve	Check
#1 $x - (-4) = -13$	Solution: Equation: $x - (-4) = -13$ Substitution:
#2 $-4 = x + 5$	Solution: Equation: $-4 = x + 5$ Substitution:
#3 $-6 + x = -5$	Solution: Equation: $-6 + x = -5$ Substitution:
#4 $-3x - (-9) = -9$	Solution: Equation: $-3x - (-9) = -9$ Substitution:
#5 $7 + 2x = -7$	Solution: Equation: $7 + 2x = -7$ Substitution:
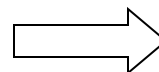
Solve	Check
#6 $\quad 7 - 3x = 43$	Solution: Equation: $7 - 3x = 43$ Substitution:
#7 $\quad -27 = 9 - 4x$	Solution: Equation: $-27 = 9 - 4x$ Substitution:
#8 $\quad -2x + 6 = 26$	Solution: Equation: $-2x + 6 = 26$ Substitution:
#9 $\quad 17 = 7 + 2x$	Solution: Equation: $17 = 7 + 2x$ Substitution:
#10 $\quad \frac{3}{5}x - (-10) = 16$	Solution: Equation: $\frac{3}{5}x - (-10) = 16$ Substitution:

Solve	Check
#11 $122 = 11x - 10$	Solution: Equation: $122 = 11x - 10$ Substitution:
#12 $\frac{w}{6} - 8 = -10$	Solution: Equation: $\frac{w}{6} - 8 = -10$ Substitution:
#13 $3 - 2x = -3$	Solution: Equation: $3 - 2x = -3$ Substitution:
#14 $5 = -5x + 5$	Solution: Equation: $5 = -5x + 5$ Substitution:
#15 $-\frac{4}{5}x + 7 = 55$	Solution: Equation: $-\frac{4}{5}x + 7 = 55$ Substitution:
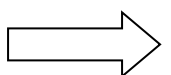
Solve	Check
#16 $\quad\quad -8 = 4x$	**Solution:** **Equation:** $-8 = 4x$ **Substitution:**
#17 $\quad\quad x - (-10) = -3$	**Solution:** **Equation:** $x - (-10) = -3$ **Substitution:**
#18 $\quad\quad \dfrac{n}{-3} = 6$	**Solution:** **Equation:** $\dfrac{n}{-3} = 6$ **Substitution:**
#19 $\quad\quad \dfrac{n}{-3} + 2 = 6$	**Solution:** **Equation:** $\dfrac{n}{-3} + 2 = 6$ **Substitution:**
#20 $\quad\quad -3 = \dfrac{m}{7} - 2$	**Solution:** **Equation:** $-3 = \dfrac{m}{7} - 2$ **Substitution:**

Objectives: I can solve one and two step equations.

SOLVING EQUATIONS

Substitute the given value of <u>x</u> to find the value of <u>y</u>.

a) Example:
Solve for y: $3x + 8 = y$ if $x=5$

$3(5) + 8 = y$

$15 + 8 = y$

y is already isolated, just simplify the expression

$23 = y$

$y = 23$

Find the value of <u>x</u> when given the value of <u>y</u>.

b) Example:
Solve for x: $3x + 8 = y$ if y=-10

x is not isolated, you must solve the equation

$3x + 8 = -10$

$\underline{-8 \quad -8}$

$3x = -18$

$\dfrac{3x}{3} = \dfrac{-18}{3}$

$x = -6$

1. a) **$2x - 4 = y$** if $x = 14$

    b) **$2x - 4 = y$** if y=10

2. a) **$5m + 12 = n$** if $m = 2$

    b) **$5m + 12 = n$** if n=27

3. a) **$3j - 5 = k$** if $j = 6$

    b) **$3j - 5 = k$** if k=25

4. a) **$6u - 3 = t$** if $u=4$

    b) **$6u - 3 = t$** if t = 27
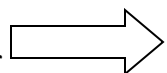
Ski Club Trip

Read all parts of the extended-response question before you begin. Write your answers to the extended-response question on the answer page. For each extended-response question, use the grid provided to create any required charts or graphs. If a question does not require a chart or graph, write your written response over the grid lines.

The ski club is planning a trip for winter break. They wrote the equation $C = 200 + 10n$ to estimate the cost in dollars of the trip if n students attended. Duncan and Seth both used the equation to estimate the cost for 50 students. Duncan said the cost would be $10,500 and Seth said it would be $700.

a) Determine which estimate is correct. Show the calculations needed to find the estimate.

b) What mathematical operations do you need to perform to calculate the cost of the trip? In what order must you perform the operations?

c) How do you think Duncan and Seth found such different estimates if they both used the same equation?

d) The president of the ski club sent in a check for $950. How many students signed up to go if this is the total cost? Show all calculations.

BE SURE TO LABEL YOUR RESPONSES (a), (b), (c) AND (d).

++

Rubric Scoring Guide
a) ½ point: Determining the correct estimate for 50 students
   ½ point: Accurately and completely showing the calculations

b) ½ point: Stating the correct operations needed
   ½ point: Stating the correct order of these operations

c) ½ point: Clearly stating how Duncan and Seth arrived at different estimates
d) ½ point: Determining the correct number of students
   1 point: Accurately and completely showing the calculations (½ point for a minor error)

This problem is worth 10 points.
Score of 4: You will have a 10/10.
Score of 3: You will have a 9/10.
Score of 2: You will have a 7.5/10.
Score of 1: You will have a 5/10.
Score of 0: You will have a 1/10.
No attempt: You will have a 0/10

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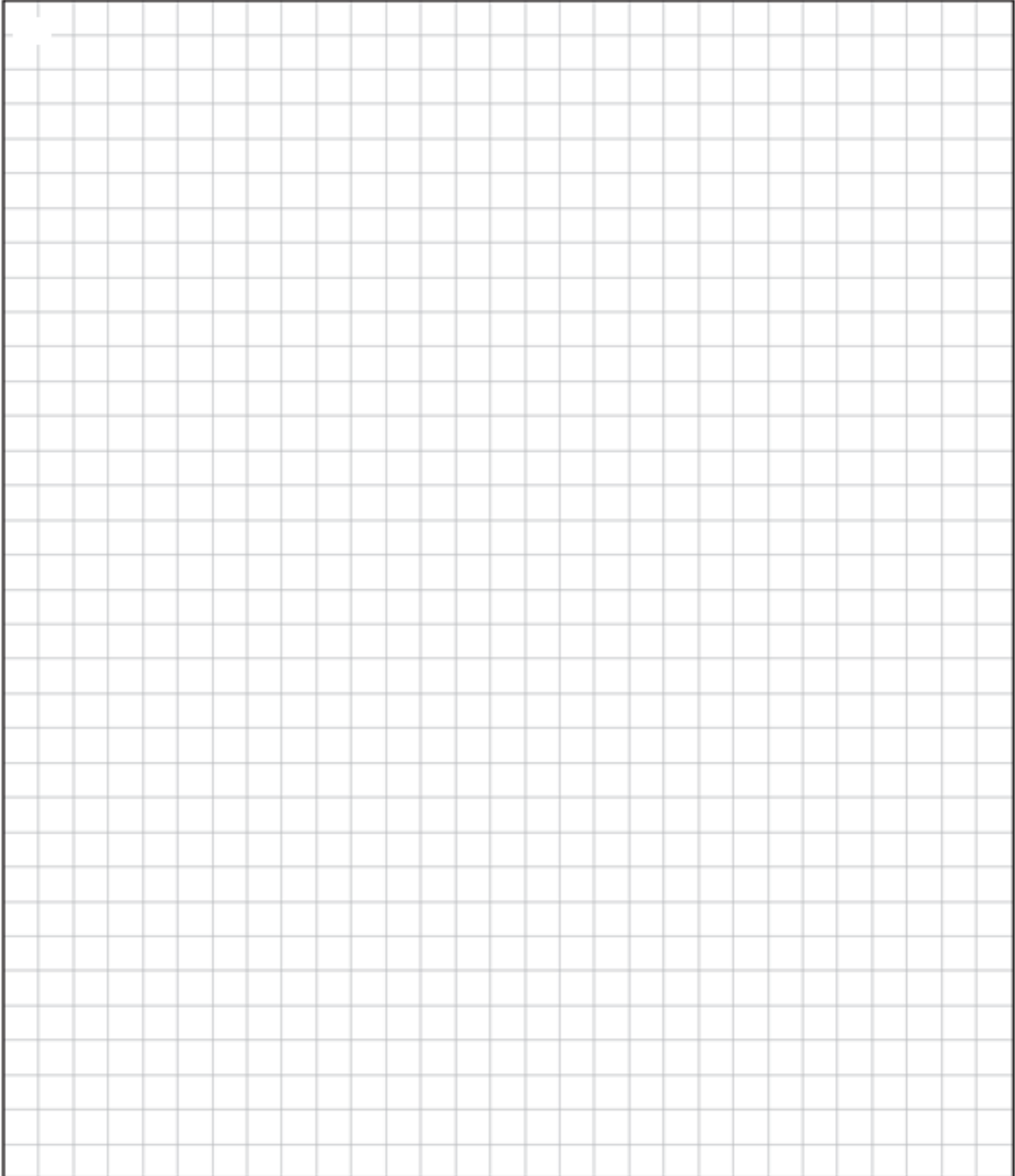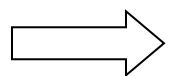
Solve. You must show your work as demonstrated in class!

1. $x - 28 = -35$ **2.** $-7 + x = -61$ **3.** $x + 9 = -80$

4. $\frac{x}{3} = -15$ **5.** $x = 12 + (-18)$ **6.** $-54 = 3x$

7. $\frac{x}{-4} - 2 = 14$ **8.** $-3(4) + (-52) = x$ **9.** $-7x + 5 = -16$

10. $28 = -4x$ **11.** $-\frac{2}{5}x - 20 = 80$ **12.** $2x - 73 = -21$

13. $x + 72 = 15$ **14.** $42 = -3 + 5c$ **15.** $7 = \frac{p}{2} + 5$

16. $-3a - 2 = 10$ **17.** $\frac{x}{5} + 4 = 19$ **18.** $1 = 4 + \frac{u}{-3}$

MORE WITH FRACTIONS, FRACTIONAL COEFFICIENTS, AND SOLUTIONS

You may have to solve an equation with a big fraction bar that we encountered when we were simplifying expressions. Remember that when solving equations, you are UNDOING the order of operations to isolate the variable.

For Example:

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

First, multiply each side by 5...you can think of the x+4 as being grouped together in parentheses.

$$5 * \frac{(x+4)}{5} = -3 * 5$$

The 5's on the left side cancel out, leaving a one-step equation.

$$x + 4 = -15$$

Add (-4) to both side to isolate the variable.

$$\underline{-4 \quad -4}$$
$$x = -19$$

Remember, if you have a fractional coefficient, multiply by the reciprocal. You can expect some problems in the section to have rational (fractional) answers.

Practice:

1) $\frac{w-6}{3} = 8$

2) $\frac{2}{3}r + 16 = 8$

3) $-2n + 5 = 20$

4) $\frac{g+7}{4} = -2$

5) $-\frac{5}{8}u - 8 = 12$

6) $6p + 9 = -5$

HOMEWORK: Solve each equation showing steps as demonstrated in class.

1) $\frac{m-15}{7} = 3$

2) $8y - 3 = -13$

3) $12 - 5b = 14$

4) $\frac{1}{4}m + 9 = -16$

5) $2 - \frac{x}{15} = -3$

6) $\frac{5}{8}a - 27 = -7$

7) $3x - 11 = 6$

8) $32 = -8 - 12y$

9) $36 = 30 - \frac{k}{16}$

10) $-10 = -12 + \frac{4}{7}n$

11) $\frac{d+8}{3} = -14$

12) $\frac{8}{5}p + 6 = 30$

13) $10 + \frac{2}{3}x = 0$

14) $37 = \frac{2}{3}x - 1$

15) $\frac{4m-7}{2} = 18$

Objectives: I can write equations to model real world problems.

SOLVING WORD PROBLEMS USING EQUATIONS

When a rate and a starting amount are given in a word problem, a similar equation can usually be written and solved.

$$Total = Start\ Amount + Rate * How\ Many$$

Starting Amount A flat fee or starting value. This value is a constant. It never changes.

A Rate The following are examples of a rate
- $3 per day
- $2 an hour
- 60 mph

Per is a key word that is often associated with rate.

Examples: Write an equation for each situation. Do NOT solve yet!

Sometimes the total is unknown and therefore it will be assigned the variable.

1) A plumber charges $25 for a service call plus $50 per hour of service. Write an equation for the cost, *C,* for 2 hours and 30 minutes.

_____

2) Nick collected 100 pounds of aluminum cans to recycle. He plans to collect an additional 25 pounds each week for 2 months. (assume four weeks for each month) Write the equation for the total pounds, *P,* of aluminum cans.

_____

Sometimes there is an amount to be determined and therefore it will be assigned the variable.

3) For babysitting, Nicole charges a flat fee of $10, plus $5 per hour. Write an equation if Nicole wants to make a total of $50 after *h* hours of babysitting.

_____

4) Suppose that the water level of a river is 34 feet and that it is **receding** at a rate of 0.5 foot per day. Write an equation for the water level after *d* days to determine how many days will the water level be 26 feet.

_____

HOMEWORK:

Write an equation for each of the following.

1) A canoe rental service charges a $10 transportation fee and $20 dollars an hour to rent a canoe. Write an equation representing the cost, C, if you are renting the canoe for 6 hours.

_____

2) A video rental store charges a $20 membership fee and $2.50 for each video rented. Write an equation to model this situation if a new member paid the store $67.50 in the last 3 months, to find how many videos, v, were rented.

_____

3) An attorney charges a fixed fee on $250 for an initial meeting and $150 per hour for all hours worked after that. Write an equation to find the charge, C, for 26 hours of work.

_____

4) A water tank already contains 55 gallons of water when Baxter begins to fill it. Water flows into the tank at a rate of 8 gallons per minute. Write an equation to model this situation to find the volume of water in the tank, V, 25 minutes after Baxter begins filling the tank.

_____

5) Casey has a small business making dessert baskets. She estimates that her fixed weekly costs for rent and electricity are $200. The ingredients for one dessert basket cost $2.50. Write an equation if her total costs were $562.50 to find how many dessert baskets, d, she made.

_____

6) Tim buys a new computer for his office for $1200. For tax purposes, he declares depreciation (**loss** of value) of $200 per year. Let d be the declared value of the computer after 5 years. Write an equation to model the value of the computer over time.

_____

7) Brenna works as waitress. She earns an hourly wage of $6 plus tips. Today she worked h hours and was paid a total of $ 108.00. She received $48 in tips. Write an equation to determine how many hours Brenna worked in today's shift.

_____

8) The cost of a school banquet is $95 plus $15 for each person attending. Write an equation that determines the total cost, c, for 77 people.

_____

9) A sunflower in Julia's garden was 12 centimeters tall when it was first planted. Since then, it has grown approximately 0.6 centimeters per day. Write an equation if the sunflower's height is now 102 cm to determine the number of days, d, since it was planted.

_____
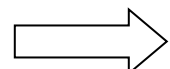
10) Jeanette paid $150 to join a handball club. She pays an additional $15 every time she uses one of the club's handball courts. Write an equation to find the number of times she has played, p, if Jeanette's total cost for playing handball is $225.

_____

REVIEW: Solve **each** equation showing steps as demonstrated in class.

Directions: Use your solutions to navigate through the puzzle. **SHOW ALL STEPS!!!!**

Start!
$4x + 10 = -26$

$\dfrac{x}{3} + 10 = 15$

$9 - 2x = 35$

$\dfrac{2}{3}x + 15 = 17$

-4   15   -13

9   -9   -8   -2   48   -22   3

$\dfrac{x}{7} - 4 = -2$

$\dfrac{1}{2}x + 13 = 9$

$\dfrac{3}{4}x - 9 = 27$

$-5x - 10 = 10$

14   8   4

-14   24   44   11   -4   -4   0

$8 - \dfrac{1}{3}x = 16$

$-12x - 17 = -89$

$18 - 4x = -2$

$19 - \dfrac{5}{2}x = 34$

6   5   -5

-72   -24   -6   17   4   48   -6

$28 - 32x = 92$

$5 - x = 12$

$13 - \dfrac{3}{2}x = 37$

END!

☺

7   -7   -16

Objectives: I can write and solve equations to model real world problems.

SOLVING WORD PROBLEMS USING EQUATIONS Part 2

Now that you have practiced writing equations to model situations, you will also find the solution to the problems by solving the equations.

Write an equation to model each situation and then solve to find the solution.

1) Billy plans to paint baskets. The paint costs $14. The baskets cost $7each. Write an equation that finds the total cost, C, if 6 baskets were made. Determine the cost of six baskets.

2) Felicia paid $125 to join a tennis club. She pays an additional $5 every time she uses one of the club's tennis courts. Write an equation to model this situation to determine n number of times Felicia played tennis if her total cost for playing tennis is $300. How many times did she play?

Equation: _____

Work

Solution _____
(Include units)

Equation: _____

Work

Solution _____
(Include units)

Homework

Write an equation to model each situation and then solve to find the solution.

1) A water tank already contains 70 gallons of water when Ryan begins to fill it. Water flows into the tank at a rate of 6 gallons per minute. Write an equation to model this situation to find the volume of water in the tank, V, 30 minutes after Ryan begins filling the tank. Determine the final volume.

2) Jose works as server in a restaurant. He earns an hourly wage of $4 plus tips. Today he worked h hours and was paid a total of $108. He received $62 in tips. Write an equation to determine how many hours, h, Jose worked in today's shift.

Equation: _____

Work

Solution _____
(Include units)

Equation: _____

Work

Solution _____
(Include units)

3) Shakira buys a new printer for her office for $800. For tax purposes, she declares depreciation (**loss** of value) of $100 per year. Let *d* be the declared value of the printer. Write and solve an equation to model the value of the computer after 5 years.

Equation: _____

Work

Solution _____
(Include units)

4) Rebekah has a small business making dessert baskets. She estimates that her fixed weekly costs for rent and electricity are $250. The ingredients for one dessert basket cost $3.00. Write and solve an equation if her total costs were $325 to find how many dessert baskets, *d*, she made.

Equation: _____

Work

Solution _____
(Include units)

5) A kayak rental service charges a $12 transportation fee and $25 dollars an hour to rent a canoe. Write and solve an equation representing the cost, *C*, if you are renting the kayak for 4 hours.

Equation: _____

Work

Solution _____
(Include units)

6) A tree in Abram's garden was 22 cm tall when it was first planted. Since then, it has grown approximately 7 cm per year. Write an equation and solve if the tree's height is now 78 cm to determine the number of years, *y*, since it was planted.

Equation: _____

Work

Solution _____
(Include units)

7) Members of the soccer team are walking to raise money for a local shelter. Hanna asked her mom for a $20 donation then each of her friends donated $2.50 each. Write and solve an equation to determine how many of her friends, *f*, donated if she raised a total of $40.

Equation: _____

Work

Solution _____
(Include units)

8) Beaumont Bowling Lanes charges a flat fee of $15 plus $2 per game. Write and solve an equation to calculate the total bill, T, if Jonea and Casey played 4 games.

Equation: _____

Work

Solution _____
(Include units)

9) A day camp charges a $35 fee for activities plus $150 per week. Write and solve an equation to model this situation to find the number of weeks Lane attended camp if the total owed is $935.

Equation: _____

Work

Solution _____
(Include units)

10) The roller rink charges an admittance fee of $6 plus $3 per hour. Write and solve an equation to calculate how many hours, h, Shareef skated if he paid a total of $21.

Equation: _____

Work

Solution _____
(Include units)

11) A car rental charges a flat fee of $40 plus $12 per day. What is your total charge, C, if you needed the car for five days? Write an equation and solve.

Equation: _____

Work

Solution _____
(Include units)

12) Pi Pizza charges a $5 delivery charge and $8 per large pizza. If the total cost is $37, write and solve an equation to determine how many pizzas were ordered, p.

Equation: _____

Work

Solution _____
(Include units)

13) Tristan is pouring sand into a cylinder at a rate of 1.5 pounds/minute. The cylinder started with 8 Lbs of sand before he started. How much sand did the cylinder hold if it took Tristan 10 minutes to fill it? Write and solve an equation using s for the volume of the cylinder.

Equation: _____

Work

Solution _____
(Include units)

14) A new candle is 15 inches tall. If it burns at a rate of 1/2 inch per hour, how long will it take for the candle to burn out? (Height would be zero.) Write and solve an equation using t for the number of hours.

Equation: _____

Work

Solution _____
(Include units)

Objective: I can solve multi- step equations with the distributive property and combining like terms.

Solving Multi-Step Equations

Sometimes one side of an equation will need to be simplified before you can solve. You may have to combine like terms or use the distributive property.

Practice using the distributive property and combining like terms with these expressions:

1. $2(x + 14) = $ _____

2. $-5(3c + 6) = $ _____

3. $3v + -5v + 7 = $ _____

4. $-(-5e + 4) = $ _____

5. $2(9f - 4) - 5f = $ _____ = _____

6. $9 - (4x + 8) = $ _____ = _____

7. $2(5n - 6) + 5(-4n + 3) = $ _____ = _____

Now we'll simplify one side of the equation before we solve.

First...Distribute if possible
Second...Combine like terms if possible
Third...isolate the variable by UNDOING the order of operations.

8. $5(x + 4) = 40$

9. $-2(3y - 7) = 56$

10. $15 - (4m - 5) = 32$

11. $-5y - 5(-6 - 2y) = 0$

12. $5(4 + 2x) - (8x - 12) = 68$

Practice

13. $-2(-7k + 4) = -22$

14. $4(2x + 5) - 8 = 36$

Homework

1. $6(1 - 4w) = -18$

2. $2(5 - 3v) = 28$

3. $7 - 3(5t - 10) = 67$

4. $2(5 - 3v) + 9v = 28$

5. $5(2x - 3) = 1$

6. $4(9 + 3t) - 12 = 6$

7. $7y - 2(8y + 1) = 4$

8. $3(1 + 4n) - 2(5n - 3) = 25$

9. $3(6v + 12) - (10v - 6) = 0$

10. $-8x + 6(3x + 5) = -25$

Objective:I can solve multi- step equations with variables on both sides.

VARIABLE TERMS ON BOTH SIDES

To solve when you have variables on both sides, eliminate one of these terms by adding the opposite of it to both sides.

Add -2x to both sides first
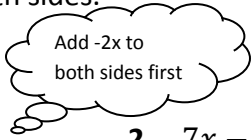
Make sure that you only combine LIKE terms. Line them up accordingly.

Examples

1. 5x + 6 = 2x +15

2. $7x - 4 = 20 + 3x$

3. $2x + 15 = -5x$

Practice.

1. $3 + 4v = 9v + 13$

2. $2c - 50 = 8c$

3. $-7m - 20 = 5m + 4$

4. $27 - 11x = x$

5. $21z + 6 = 17z - 26$

6. $11x = 8x - 6$

Write an equation and solve. Let "x" = the number.

7. Twenty decreased by 2 times a number is the same as 10 less than 3 times the number. Find the number.

Equation: _____

Solve

Homework.

1. $-x - 29 = 13 + 2x$ **2.** $-18 + 5f = -12f - 1$ **3.** $36 + 15x = 17x$

4. $-15 - 4h = 6 - 3h$ **5.** $12n - 9 = 8n - 37$ **6.** $-5x + 40 = 6x - 70$

Review.

7. $2(5 - 3c) + 9c = 28$ **8.** $-9(6 + y) - 2y = -10$ **9.** $13x + 7(-3x - 1) = -63$

10. $\dfrac{4-h}{3} = 8$ **11.** $\dfrac{-5}{7}u + 13 = -12$ **12.** $-8k + 12 = -32$
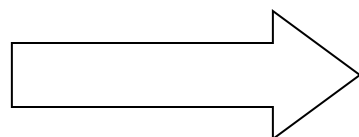
Write an equation and solve. Let "x" = the number.

13. Eight less than 7 times a number is the same as 4 more than 3 times the number. Find the number.

Equation: _____

Solve {

14. Four more than 6 times a number is the same as 9 times the number increased by 10. Find the number.

Equation: _____

Solve {

15. A number plus 5 more than 3 times the number is 37. Find the number.

Equation: _____

Solve {

Objectives: I can solve multi- step equations with variables on both sides with the distributive property and Identify equations with no solution or all real numbers.

NO SOLUTION AND ALL REAL NUMBERS

Examples:

1. $4(2n - 5) = 3n + 10$

2. $2(4x + 7) - 10 = 3x + 5x$

3. $2(4x + 7) + 2x = 8x + 14$

| If you get a **FALSE** statement...like 5=2, then no solution would satisfy the equation...write **NO SOLUTION** | If you get a **TRUE** statement...like 5=5, then all real numbers would satisfy the equation...write **ALL REAL #'s** |

Practice:

1. $8(k + 3) = 12k - 4$

2. $-3(5 - 9c) = 25 + 27c$

3. $6x + 5 = 5(3x + 1) - 9x$

4. $5 - 11t = 7(5 - 2t)$

5. $-2(18 - 3y) = 7y + 2y$

6. $2(4a - 12) = 6a + 1$

<u>Homework</u>.

1. $10p + 16 = 8(2p - 4)$

2. $9(2 + w) - 4w = 3w - 10$

3. $3(4k + 1) + 2k = 3 + 14k$

4. $6(1 + 3m) = -8(-2m + 5) - 4$

5. $-2 + 3(x + 10) = 7(2x + 4) - 11x$

6. $6p - (5p + 5) = -8 - 2(p + 12)$

Write an equation and solve. Let "x" = the number.

7. Four times a number is the same as 14 less than twice the number. Find the number

Equation: _____

Solve

8. One more than 8 times a number is the same as 12 times the number decreased by 3. Find the number.

Equation: _____

Solve

INEQUALITIES AND THEIR GRAPHS

Equations

We have been studying equations and how to solve them. Let's review. What is an equation?

An equation is: _____

_____

To find a value for the variable that makes the equations true, we SOLVE the equation. Any value for the variable that makes an equation true is called the _____ of the equation.

Inequalities

An inequality is a mathematical sentence that shows the relationship between quantities that *are not equal*, using inequality symbols.

Inequality Symbols				
Symbol	$<$	$>$	$\leq$	$\geq$
Key Phrases	• is less than • is fewer than	• is greater than • is more than	• is less than or equal to • is at most • is no more than	• is greater than or equal to • is at least • is no less than

Some students have trouble remembering which symbol is greater than and which one is less than. *Do you have a trick to help them remember?*

Examples of Inequalities

$$5 \; < \; 10 \qquad 15 \; > \; -8 \qquad y \; < \; 3$$

To find a value for the variable that makes the inequalities true, we SOLVE the inequality. Any value for the variable that makes an inequality true is called the _____ of the inequality.

Graphing Solutions of Inequalities

Example #1 $y \; < \; 3$

What values for **y** would make this inequality true? _____

Is 3 a solution for this inequality? Explain. _____
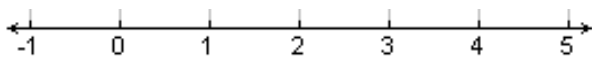
An _____ dot shows that 3 is NOT a solution. Shade all the points to the left of 3 since **y** is *less than* 3.

Example #2 $-2 > n$

How can we rewrite this inequality so that it is still true but the variable is first? _____

What values for **n** would make this inequality true? _____

Is –2 a solution for this inequality?   Explain. _____
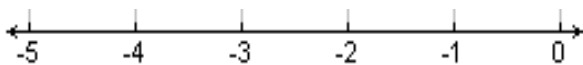
An _____ dot shows that –2 is NOT a solution. Shade all the points to the right of –2 since **n**
is **greater than** –2.

Example #3 $w \geq -3$

What values for **w** would make this inequality true? _____

Is –3 a solution for this inequality? Explain. _____

A _____ dot shows that –3 is a solution. Shade all the points to the right of –3 since **w** is
greater than –3.

Example #4 $9 \leq k$

How can we rewrite this inequality so that it is still true but the variable is first? _____

What values for **k** would make this inequality true? _____

Is 9 a solution for this inequality?   Explain. _____
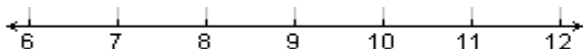
A _____ dot shows that 9 is a solution. Shade all the points to the rightt of 9 since **k** is
greater than 9.

Writing Inequalities to Describe Graphs

Write the inequality shown in each graph.

a.

b.

_____   _____

Writing Inequalities to Describe Real-World Situations

You can write inequalities to describe real-world situations. What inequality symbols do you think you will use when you see the following phrases:

at most	
no more than	
at least	
no less than	

Write inequalities to represent these real-life situations.

1) Amusement Parks make rules for safety. The sign the amusement park (in the picture at the right) tells you how tall you have to be to ride. Write an inequality for this situation. Let *h* be height in feet.

Words ⟶

Inequality ⟶

2) You must be at least 17 years old to get into an R-rated movie. _____

3) The room can hold at most 210 people. _____

4) No more than 7 people can fit into the SUV. _____

5) You must be at least 16 years old to get your driver's license. _____

6) There can be no less than 30 chairs in the classroom. _____

7) We need no less than 550 hot dogs for the food competition. _____

Homework

Write an inequality for each sentence.

1. The total t is less than sixteen. _____

2. A number h is not less than 7. _____

3. The price p is less than or equal to $25. _____

4. A number n is negative. _____

Write an inequality for each graph. Name your own variable.

5.

$$-8\ -7\ -6\ -5\ -4\ -3\ -2\ -1\ \ 0\ \ 1\ \ 2$$

_____

6.

$$-16\quad -12\quad -8\quad -4\quad 0\quad 4$$

_____

7.

$$-5\ -4\ -3\ -2\ -1\ \ 0\ \ 1\ \ 2\ \ 3\ \ 4\ \ 5$$

_____

8.

$$-5\ -4\ -3\ -2\ -1\ \ 0\ \ 1\ \ 2\ \ 3\ \ 4\ \ 5$$

_____
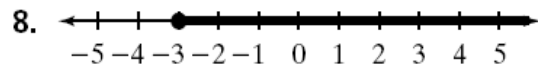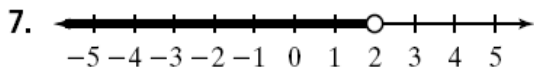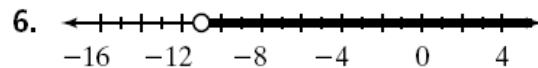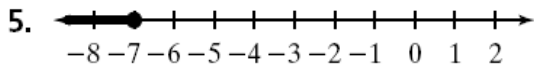
Graph the solutions of each inequality on a number line.

9. $x < -2$

$$-5\ -4\ -3\ -2\ -1\ \ 0\ \ 1\ \ 2\ \ 3\ \ 4\ \ 5$$

10. $y \geq -1$

$$-5\ -4\ -3\ -2\ -1\ \ 0\ \ 1\ \ 2\ \ 3\ \ 4\ \ 5$$

11. $k > 1$

$$-5\ -4\ -3\ -2\ -1\ \ 0\ \ 1\ \ 2\ \ 3\ \ 4\ \ 5$$

12. $p \leq 4$

$$-5\ -4\ -3\ -2\ -1\ \ 0\ \ 1\ \ 2\ \ 3\ \ 4\ \ 5$$
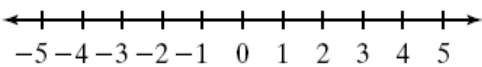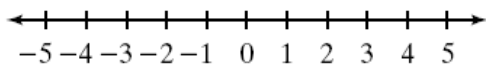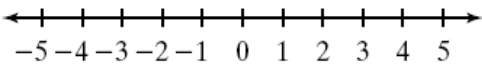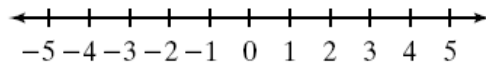
Write an inequality for each situation.

13. Everyone in the class is under 13 years old. Let x be the age of a person in the class.

   _____

14. The speed limit is 60 miles per hour. Let s be the speed of a car driving within the limit.

   _____

15. You have $4.50 to spend on lunch. Let c be the cost of your lunch.

   _____
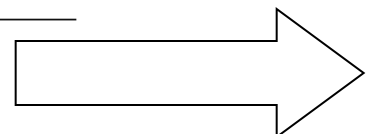
Review

Simplify.

21. $18m - 9 + 12m$ _____

22. $6(k + 2)$ _____

23. $-2(b + 3)$ _____

24. $-5k + (-7k)$ _____

Solve.

25. $\dfrac{p+7}{5} = -8$

26. $9d + 7 = 19$

27. $-\dfrac{3}{4}k + 8 = 29$

28. $6x - (3x + 8) = 16$

29. $11 + 3x - 7 = 6x + 5 - 3x$

30. $6x + 5 - 2x = 5 + 4x$

Objectives: I can solve and graph one-step linear inequalities including real-world situations.

SOLVING ONE-STEP INQUALITIES

$>$

$\geq$
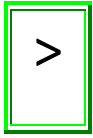
Solving linear inequalities is pretty much the same as solving equations. Don't panic!

$<$

$\leq$
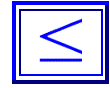
Note: Inequalities have more than one solution!

Example #1 --

Solve and graph the inequality.

$$n - 3 > -4.5$$

Example #3 --

Solve and graph the inequality.

$$\frac{n}{4} < -2$$

Example #4 --

Solve and graph the inequality.

$$-9 < 3n$$

Example #2 --

Solve and graph the inequality.

$$n + 5 \leq -3$$
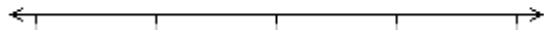
Remember we said, solving linear inequalities is pretty much the same as solving equations? There is a VERY IMPORTANT exception!

Addition

Look at this true statement: $6 > 3$

Suppose we add 3 to each side**.** $6 + 3 \; ? \; 3 + 3$

What is the relationship between these two numbers? $9 \underline{} 6$

Is the relationship the same as before you added 3 to each side? _____

Subtraction

Look at this true statement: $8 < 9$

Suppose we subtract 7 from each side**.** $8 - 7 \; ? \; 9 - 7$

What is the relationship between these two numbers? $1 \underline{} 2$

Is the relationship the same as before you subtracted 7 from each side? _____

Multiplication

Look at this true statement: $5 > 3$

Suppose we multiply both sides by -2**.** $(-2)(5) \; ? \; (3)(-2)$

What is the relationship between these two numbers? $-10 \underline{} -6$

Is the relationship the same as before you multiplied by -2? _____ If not, how do we "fix" the inequality?

Explain. _____

Division

Look at this true statement: $-6 < 12$

Suppose we divide both sides by -2**.** $\dfrac{-6}{-2} \; ? \; \dfrac{12}{-2}$

What is the relationship between these two numbers? $3 \underline{} -6$

Is the relationship the same as before you divided by -2? _____If not, how do we "fix" the inequality?

 Explain. _____

Make a conjecture as to the VERY IMPORTANT difference between solving equations and

inequalities:_____

_____

When you <u>multiply</u> or <u>divide</u> an inequality by a <u>negative</u> number, it changes the direction of the inequality symbol!

Let's try these together...

1) $3n > -21$

2) $\frac{k}{5} \leq 85$
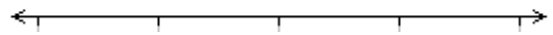
3) $\frac{k}{-10} \geq -0.5$

4) $-76 < -2n$
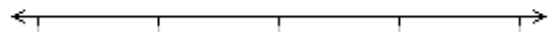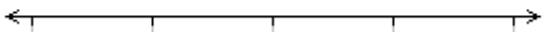
5) Write an inequality for the situation. Then solve and graph the inequality.

> You must be at least 48 inches tall to ride an amusement park ride, and your little sister is 39 inches tall. How many inches (*i*) must she grow before she can ride the

YOU MUST BE AT LEAST THIS TALL TO RIDE THIS RIDE.

I'VE HAD IT UP TO HERE WITH HEIGHT RESTRICTIONS
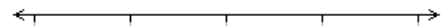
Homework

Solve and graph.

1) $n - 7 > -65$
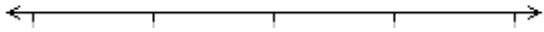
2) $-8 + d < 55$
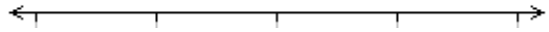
3) $-2g < 30$
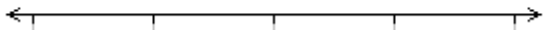
4) $350 > 5h$
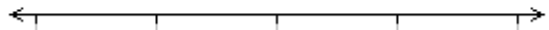
5) $42 \geq \frac{p}{-7}$

6) $n + \frac{1}{2} \geq -4$
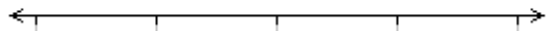
7) $-14 \geq \frac{p}{2}$
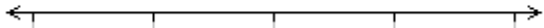
8) $-\frac{2}{3} \geq 4 + n$

9) $n - (-8) > -65$

10) $-8.26 + d < 15.25$
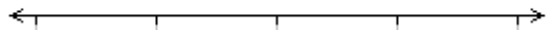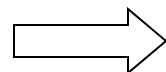
11) $-2g < -28$

12) $-350.55 > 5h$
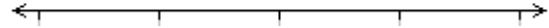
Write an inequality for the situation. Then solve the inequality.

13) You need no more than 3000 calories in a day. You consumed 840 calories at breakfast and 1150 calories at lunch. How many calories (**c**) can you eat for dinner?

14) I can spend $65 at the most at the mall today. I spent $23 at The Gap and $30 at Rue 21. How much more (**d**) can I spend today?

Review: Solve each equation.

15) $\frac{r}{10} + 4 = -5$

16) $\frac{n}{-2} + 5 = 3$

17) $3p - 2 = -29$

18) $\frac{k-10}{2} = -7$

19) $1 - r = -5$

20) $\frac{n-5}{2} = -5$

SOLVING TWO STEP INEQUALITIES

Solving two-step inequalities is pretty much the same as solving two-step equations with a very important exception---when you **multiply** or **divide** an inequality by a **negative** number, it changes the direction of the inequality symbol!

Examples:

Solve and graph:

#1 $2x + 9 > 5$

#2 $\frac{k}{-6} + 3 > 11$

#3 Write an inequality and solve.

 You divide a number x by -3. Then you subtract 1 from the quotient. The result is at most 5. Write and solve an inequality to find all possible solutions.

Inequality: _____

Check Understanding

#1 Solve and graph each inequality.

a. $-2m + 4 \leq 34$ b. $6 - x > 3$ c. $24 < \frac{x}{3} + 30$

#2) Write and inequality for the situation. Then solve the inequality.

You multiply a number, x, by -5. Then you add 16 to the product. The result is at most -19.
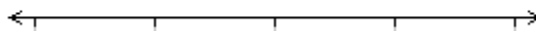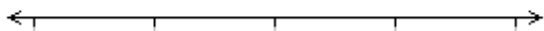
Inequality: _____

Solve
& graph.

←—————————————————————→
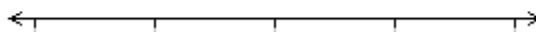
Homework:
Solve and graph.

1) $5x + 2 \le 17$

2) $50 < 8 - 6n$

←—————————————————————→   ←—————————————————————→

3) $\dfrac{k}{-4} > 0$

4) $12 > -6m$

←—————————————————————→   ←—————————————————————→

5) $19 + 8 \le 6 + 7p$

6) $15 - 5k \ge 0$

←—————————————————————→   ←—————————————————————→
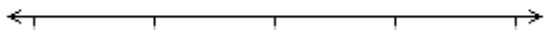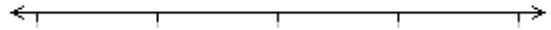
7) $\frac{y}{2} + 12 > 10$

8) $9 + 2r < 7$
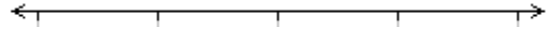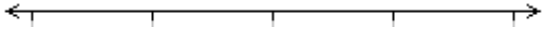
9) $-12 > -6g + 4$

10) $\frac{c}{-3} - 4 \leq -90$

Write an inequality for the following two situations. Then solve.

11) On a trip from Kentucky to Florida, your family wants to travel at least 420 miles in 6 hours of driving. Write and solve an equation as to what your average speed must be.

12) You want to spend at most $20 for a taxi ride. Before you go anywhere, the driver sets the meter at the initial charge of $5. The meter then adds $2 for every mile you drive. What is the farthest you can go?

13) **Error Analysis** A student solved and graphed the inequality $-12x + 40 > 4$

What error did the student make? (Justify your answer.)

<u>**Review: Solving Equations and Inequalities**</u>

<u>**Solve**</u> each of the following. **Show all steps. Leave all answers as integers or fractions in simplest form. Do not round. Put a** rectangle **around your answers.**

1) $-12x = 288$　　　　　　**2)** $-\frac{x}{3} = -14$　　**3)** $x + 15 = 245$　　**4)** $x - 6 = -46$

5) $-4 + x = 36$　　　　**6)** $\frac{2}{3}x = -8$　　　　**7)** $-2x = 15$　　　　**8)** $-6 + x = -93$

9) $4x + (-7) = 17$　　　　**10)** $\frac{x}{3} - 9 = 8$　　　**11)** $-x + 7 = -40$

12) $\frac{3}{5}x - 4 = 29$　　　　　　**13)** $\frac{x-4}{8} = -3$

<u>**Simplify**</u> **by combining like terms.**

14) $-8x - 3x$　　　　**15)** $2 + 6x - 3$　　　　　　**16)** $4x + 2 - 7x + 15$

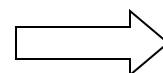**Use the distributive property to multiply.** <u>**Simplify**</u> **if possible.**

17) $2(6x + 1)$　　　**18)** $-4(-3x + 10)$　　**19)** $3(-5x - 3)$　　　　**20)** $5(7x + 8) + 3$

Solve each of the following. Show all steps. Leave all answers as integers or fractions in simplest form. Do not round. If your solution is "all real numbers" or "no solution," state that. Put a rectangle around your answers.

21) $4x + 3 = 2x + 15$

22) $2(3x + 7) = -4$

23) $8(x + 3) = 12x - 4$

24) $2(4x - 12) - 1 = 6x + 2x$

25) $6(1 + 3x) = -8(-2x + 5) - 4$

26) Dan went to a craft fair where he spent a total of $16.00. He spent $6.00 on admission and went to 8 tables. He spent the same amount of money (m) at each table. The following number sentence can be used to find how much money he spent at each table.

$$16 = 6 + 8m$$

How much money did Dan spend at each table?

A. $0.50   B. $0.80   C. $1.25   D. $2.00

27) Ms. Cook's class bought 2 bags of concrete and some bricks to build a border for their class garden. The bricks cost $51. The total cost of the bricks and the concrete was $57. Which equations can be used to find the cost, b, of 1 bag of concrete?

A. $b + 51 = 57$ B. $2 + 51b = 57$ C. $2b + 51 = 57$ D. $2(51) + b = 57$

28) Which of the following represents a correct procedure for solving each given equation?

A. $-2(x - 5) = -12$
     $-2x - 10 = -12$
          $-2x = -2$
            $x = 1$

B. $8(x - 5) = 24$
     $8x - 40 = 24$
          $8x = -16$
            $x = -2$

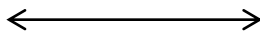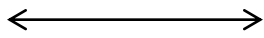C. $5 - 2x = 8x + 25$
     $5 = -10x + 25$
     $30 = 10x$
      $3 = x$

D. $7x - 12 = -2x + 15$
     $9x - 12 = 15$
          $9x = 27$
            $x = 3$

Solve and graph. Work must be shown.
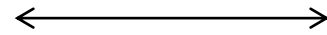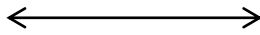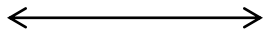
29) $45 < u - 61$

30) $3r > 90$

31) $-\dfrac{u}{8} \geq 6$

$\longleftrightarrow$

$\longleftrightarrow$

$\longleftrightarrow$

32) $-45 > x - 67$

33) $-2c - (-8) \leq 90$

34) $\dfrac{p}{4} - 5 \leq -6$

$\longleftrightarrow$

$\longleftrightarrow$

$\longleftrightarrow$

35) Choose the best inequality to describe the situation. You must be at least 18 years old to vote.

A. $v \leq 18$ 　　　　B. $v < 18$ 　　　　C. $v > 18$ 　　　　D. $v \geq 18$

36) Choose the correct inequality to describe the situation. The concert tickets are less than $50.00 each.

A. $c \leq \$50.00$ 　　　B. $c < \$50.00$ 　　　C. $c > \$50.00$ 　　　D. $c \geq \$50.00$

37) A go-cart has a maximum weight limit of 240 pounds. Which inequality correctly represents this weight limit, w?

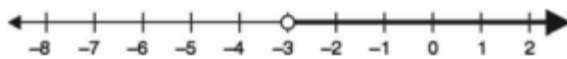A. $w \leq 240$ pounds 　　B. $w < 240$ pounds 　　C. $w \geq 240$ pounds 　　D. $w > 240$ pounds

38) Use the line graph below to answer the question that follows.

What is the solution set of the graph above?

A. $x < -3$ 　　　　B. $x \leq -3$ 　　　　C. $x > -3$ 　　　　D. $x^3 - 3$