Math Virtual Learning

Grade 8
Solving Equations: Variables on Both Sides
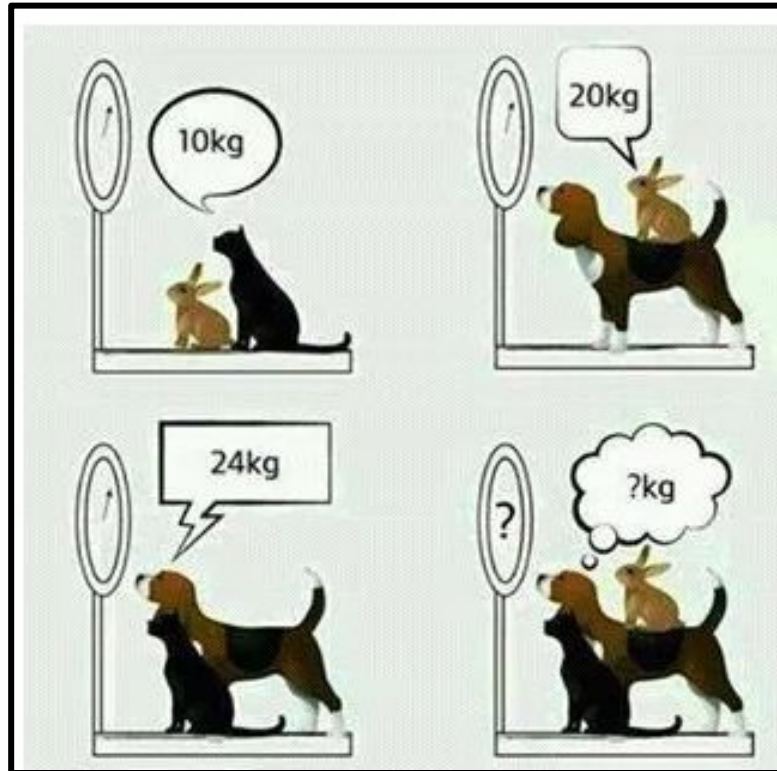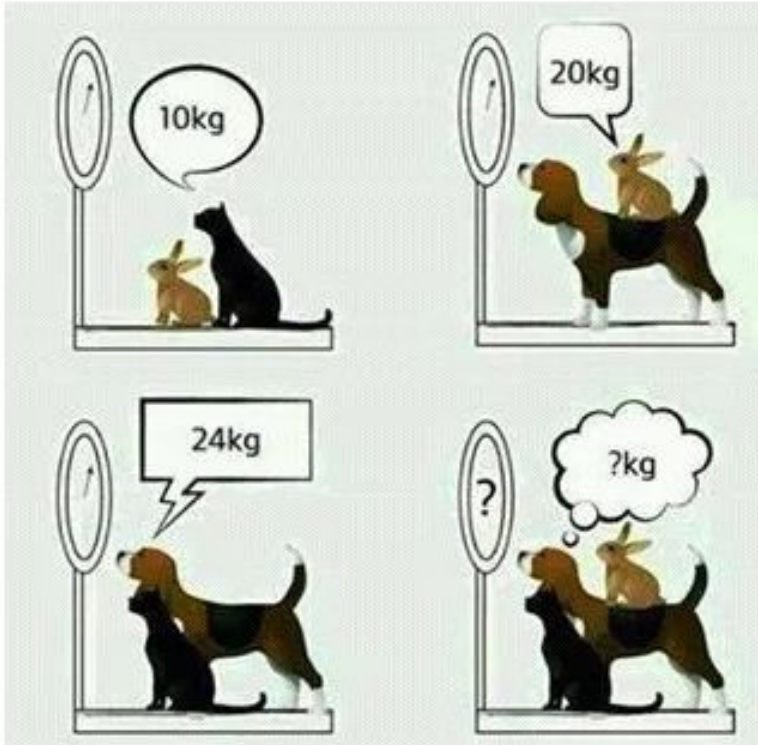## May 8, 2020

Math 8
Lesson: May 8, 2020

Objective/Learning Target:
I can solve equations with variables on both sides (and identify number of solutions).

Warm-Up: Can you find the weight of the rabbit, cat, and dog using the clues below?

Answers on next slide

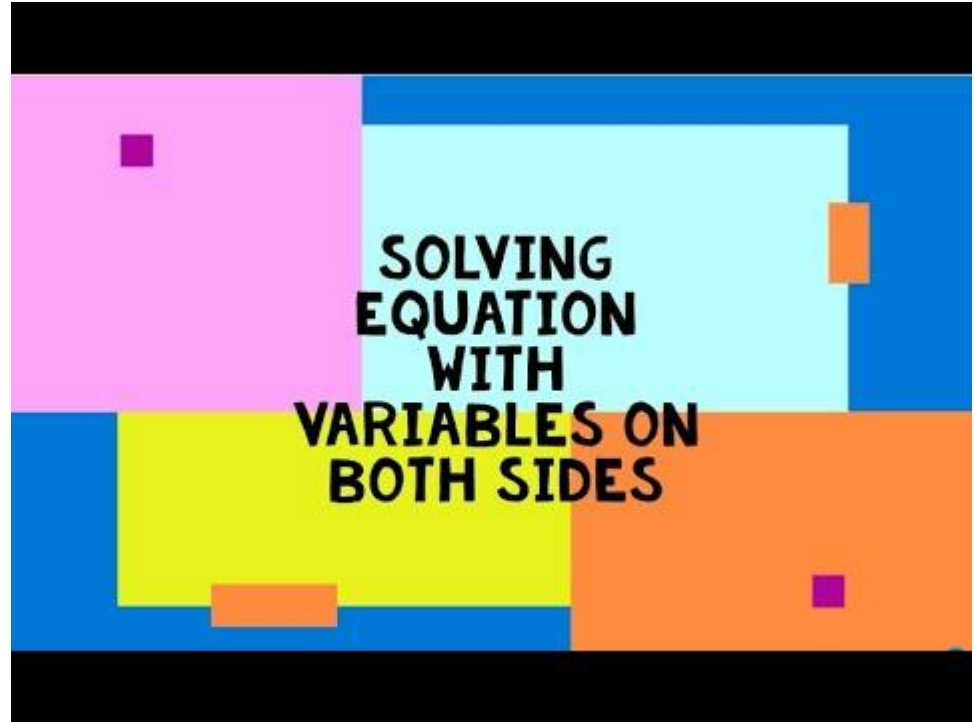# Warm-Up: *Answer Key*

Dog = 17kg

Cat = 7kg

Rabbit = 3kg

Dog + Cat + Rabbit = 27kg

Video:

Take notes on a piece of paper as you watch this video.

Review: Multi-Step Equations

$$5(p - 4) + 5p = -100$$

5p − 20 + 5p = − 100

10p − 20 = − 100
+20   + 20
―――――――――――――
10p = − 80
10   10
―――――――――――――
p = − 8

① **Distribute**. (Multiply the outside term to each term inside the parentheses.)
5 multiplied by p   and   5 multiplied by − 4

② **Combine Like Terms**. (Number terms can be combined with other number terms on the <u>same side of the equal sign</u>. Variable terms can be combined with other variable terms on the <u>same side of the equal sign</u>.)
5p can be combined with 5p on the left side

③ **Add or Subtract** on <u>both sides</u> of the equal sign. (Use the correct <u>inverse</u> <u>operation</u> to isolate the variable.)
The inverse of − 20 is + 20, so add 20 to both sides

④ **Multiply or Divide** on <u>both sides</u> of the equal sign. (Use the correct <u>inverse operation</u> to solve.)
10p means 10 x p,   so divide by 10 on both sides

⑤ Plug your answer back in to **check**.   *(See next slide)*

Review: Check Step

$$5(p - 4) + 5p = -100$$

5(−8 −4) + 5(−8) = −100

5(−12)   + 5(−8) = −100

− 60   + −40 = −100

      −100   = −100

① **Plug in your answer** for each variable.
   Where there is a p, we will instead put − 8

② **Solve using Order of Operations**. (PEMDAS)
   Parentheses: combine − 8 and − 4.

   Multiply: 5 times − 12   and   5 times − 8

   Add/Subtract: − 60 + − 40   is equal to − 100

③ **If your answers match at the end, your solution is correct. If your answers do not match at the end, you have made a mistake somewhere.**
   − 100   is equal to − 100

How To: Variables on Both Sides

Use basically the same steps, and always make sure to <u>keep</u> <u>the</u> <u>equation</u> <u>balanced</u>!

$$3x + 16 = 1 + 8x$$

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

$$16 = 1 \;\; + 5x$$

① **Distribute**. (Multiply the outside term to each inside term.)
  No distribution necessary on this problem.

② **Combine Like Terms**. (Number terms can be combined with other number terms on the <u>same side of the equal sign</u>. Variable terms can be combined with other variable terms on the <u>same side of the equal sign</u>.)
No terms to combine on this problem.

③ **Isolate the Variable**. (Use the correct <u>inverse</u> <u>operation</u> to isolate the variable to only <u>one</u> side of the equal sign. You will need to add or subtract a variable term.)
(You can subtract 3x or 8x from each side. Suggestion: subtract the smaller variable term.)

Subtract 3x from <u>both sides</u>

How To: Variables on Both Sides *cont'd*

$$3x + 16 = 1 + 8x$$

$-3x \qquad\qquad -3x$

$$16 = 1 + 5x$$

$-1 \quad -1$

$$\frac{15}{5} = \frac{5x}{5}$$

$$3 = x$$

④ **Add or Subtract** on <u>both sides</u> of the equal sign. (Use the correct <u>inverse</u> <u>operation</u> to isolate the variable. You will need to add or subtract a number term.)
(Because the variable term is on the right side, we want to eliminate the number term from the right side.)

Subtract 1 from both sides.

⑤ **Multiply or Divide** on <u>both sides</u> of the equal sign. (Use the correct <u>inverse operation</u> to solve.)
5x means 5 times x,   so divide by 5 on both sides

⑥ Plug your answer back in to **check**.
3(3) + 16 = 1 + 8(3)
9 + 16 = 1 + 24
25   =   25

Example 1: **Equations with <u>One</u> Solution**

5x = 2x + 21

-2x = -2x
_____

3x = 21

3   3

x = 7

Notice that the only solution that works in this problem is 7. This means there is 1 solution!

Step 1: Move variables to one side (subtract 2x)

Step 2: Divide by 3

Example 2: Equations with <u>Infinite</u> Solutions

3x + 5 = 2x + 5 + x

3x + 5 = 3x + 5

-3x   -3x
_____

    5 = 5

When you get a true statement, it means every value of x will work in the problem. There are INFINITE SOLUTIONS.

1) Combine terms (2x + x = 3x)

2) Subtract 3x from both sides

3) Notice you get a statement that is true.

5 = 5

Example 3: Equations with <u>No</u> Solution

5x + 15 = 5x + 8
-5x   = -5x
_____
       15 =   8

When you get an untrue statement, there is no value of x that will work in the problem. There is NO SOLUTION

1)   Move the variables to the same side of equation (subtract 5x from both sides)

2)   Notice that you get an equation that is not true...

15 ≠ 8

Practice 1:

Solve each equation, then identify the number of solutions.

$-b + 7 = 11 - b$

$v + 4 - 5 = v - 1$

$12 + 2m = m + 12$

$-5 + 3x = 3 + 7x$

-b + 7 = 11 - b

7 ≠ 11
No Solution

v + 4 - 5 = v - 1

-1 = -1
Infinite Solutions

12 + 2m = m + 12

One Solution
m = 0

-5 + 3x = 3 + 7x

One Solution
x = −2

Exit Ticket:

A student has completed the problem below.
Do you agree or disagree with their answer? Explain.

Charlotte's ice skates cost $30.45 less than her skateboard. Her ice skates cost $95.28. How much did her skateboard cost? Write and solve an equation.

b = the cost of the skateboard

$$b - 30.45 = 95.28$$
$$- 30.45 \quad - 30.45$$
$$b = 64.83$$

The skateboard cost $64.83.

This student's work is not correct.
The error is in the first step. Notice that 30.45 was <u>subtracted</u> from both sides of the equation. The inverse operation for the given equation is addition.
The correct work is given below.

$$b - 30.45 = 95.28$$
$$+30.45 \quad +30.45$$
$$b \qquad = 125.73$$

The skateboard cost: $125.73

Additional Resources:

Khan Academy Practice

IXL

Khan Academy fractions and decimals