

Solving Equations Task

Name _____

In elementary school, students often draw pictures of the arithmetic they do. For instance, they might draw the following picture for the problem $2 + 3$:

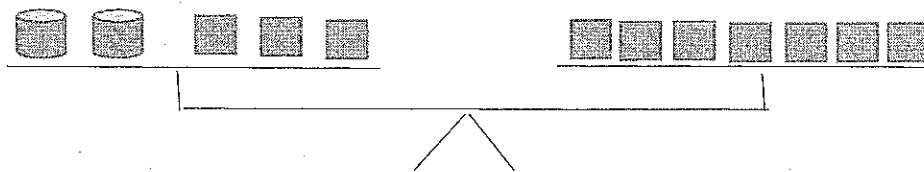


In this picture, each square represents a tile.

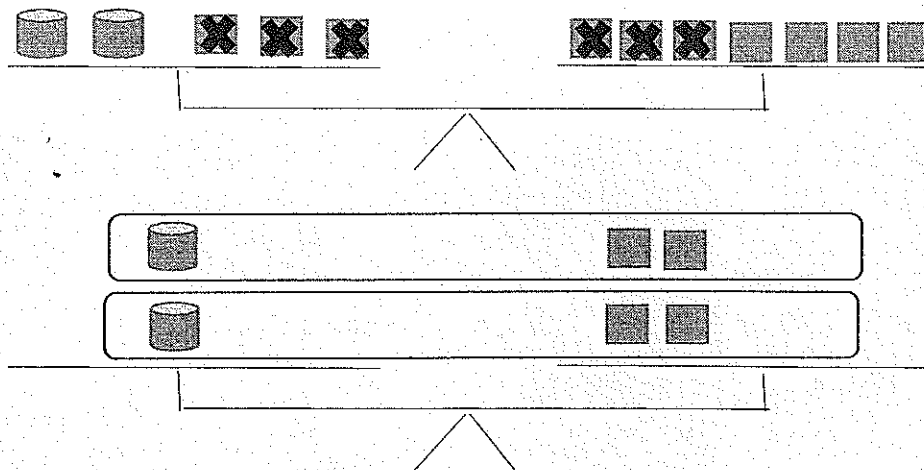
We can do the same thing for algebraic expressions, but we need to be careful about how we represent the unknown. If we assume that an unknown number of tiles are contained in a container, we could draw the following picture for $2x + 3$:



When we have an equation to solve, we assume that the two sides of the equation are equal. We can represent this by showing them level on a balance. For example, the equation $2x + 3 = 7$ could be shown as:



When we solve equations, we can add, subtract, multiply or divide both sides of the equation by the same thing in order to maintain the equality. This can be shown in pictures by keeping the balance level. For example, we could solve the equation using pictures by first removing (subtracting) 3 from each side, and then splitting (dividing) the remaining blocks into two equal groups:



From this picture, we can see that, in order to keep the balance level, each container must contain 2 tiles, which means that $x = 2$.

a. Solve $3x + 1 = 7$ in two ways: symbolically, the way you usually do with equations, and also with pictures of a balance. Show how each step you take symbolically is shown in the pictures.

b. Solve the equation $9 = 5x + 4$ using pictures and symbols. Discuss any issues that arise.

c. What issues arise when you try to solve the equation $2 = 2x - 4$ using pictures? Do the same issues arise when you solve this equation symbolically?

d. Use pictures to show why the following solution to the equation is incorrect.

$$\begin{aligned}2x + 4 &= 10 \\ \frac{2x}{2} + 4 &= \frac{10}{2} \\ x + 4 &= 5 \\ x + 4 - 4 &= 5 - 4 \\ x &= 1\end{aligned}$$

Solving 2 step equations

Date _____ Hour _____

Solve each equation symbolically or visually.

1) $-6 + \frac{x}{7} = -8$

2) $3 = \frac{b}{8} + 1$

3) $-6 + 9r = -42$

4) $-3 + \frac{x}{8} = -1$

5) $-4 + 5v = 51$

6) $-8 = -9 + \frac{x}{9}$

7) $-12 = -6 + \frac{n}{2}$

8) $-7 + \frac{x}{6} = -6$

9) $33 = 8n - 7$

10) $10 + \frac{k}{6} = 8$

$$11) -x + \frac{1}{2} = 4\frac{1}{3}$$

$$12) \frac{1}{4} - 2\frac{1}{2}n = -3\frac{1}{2}$$

$$13) -1 = 1\frac{3}{4}v + 1$$

$$14) -3\frac{2}{3} = -3\frac{2}{3} - 1\frac{3}{4}a$$

$$15) -2\frac{4}{5}n + \frac{1}{2} = 4\frac{7}{10}$$

$$16) -1\frac{2}{9} = \frac{2}{3}x - \frac{5}{3}$$

$$17) \frac{1}{6} = 1\frac{2}{3} + \frac{3}{2}k$$

$$18) 2\frac{3}{5} + 3x = 1\frac{1}{10}$$

$$19) -1 + \frac{1}{2}p = -\frac{1}{2}$$

$$20) -5\frac{2}{25} = \frac{4}{5}x - 3\frac{4}{5}$$

Combining Like Terms and Distributive Property

Name _____

A. Represent the following expressions using the shapes below. (Remember the container stands for x .)



1. $6 + 5x + 4$

2. $2x + 7 + 3x$

3. $4x + 9 + x + 2$

B. Write equivalent expressions for the three expressions above.

1.

2.

3.

What mathematical term(s) describe what you did in part B?

C. Represent the following expressions using the shapes below.



1. $2(x + 4)$

2. $5(2x + 3)$

D. Write equivalent expressions for the two expressions above.

1.

2.

What mathematical term(s) describe what you did in part D?

E. Solve the following equation using a balanced scale. $2(2x + 5) = 22$



Solve $2(2x + 5) = 22$ symbolically.

What issue(s) may arise if you always want to choose the balanced scale approach? Does this happen when you use the symbolic approach? Explain.

F. Bethany solved a math problem below. Did she do it correctly or not? Explain thoroughly. Use math terms.

$$-3(4x + 2) - 6 = -156$$

$$-12x - 2 - 6 = -156$$

$$-12x - 8 = -156$$

$$-12x - 8 + 8 = -156 + 8$$

$$-12x = -164$$

$$-12x + 12 = -164 + 12$$

$$x = -176$$

Combining Like Terms and Distributive Property

Name Kelly

A. Represent the following expressions using the shapes below. (Remember the container stands for x.)



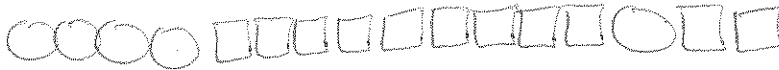
1. $6 + 5x + 4$



2. $2x + 7 + 3x$



3. $4x + 9 + x + 2$



B. Write equivalent expressions for the three expressions above.

1. $5x + 10$

2. $5x + 7$

3. $5x + 11$

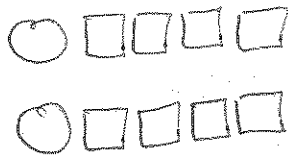
What mathematical term(s) describe what you did in part B?

Combining Like Terms

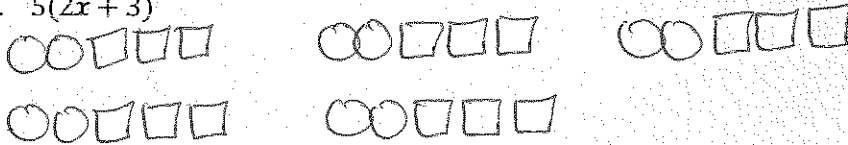
C. Represent the following expressions using the shapes below.



1. $2(x + 4)$



2. $5(2x + 3)$



D. Write equivalent expressions for the two expressions above.

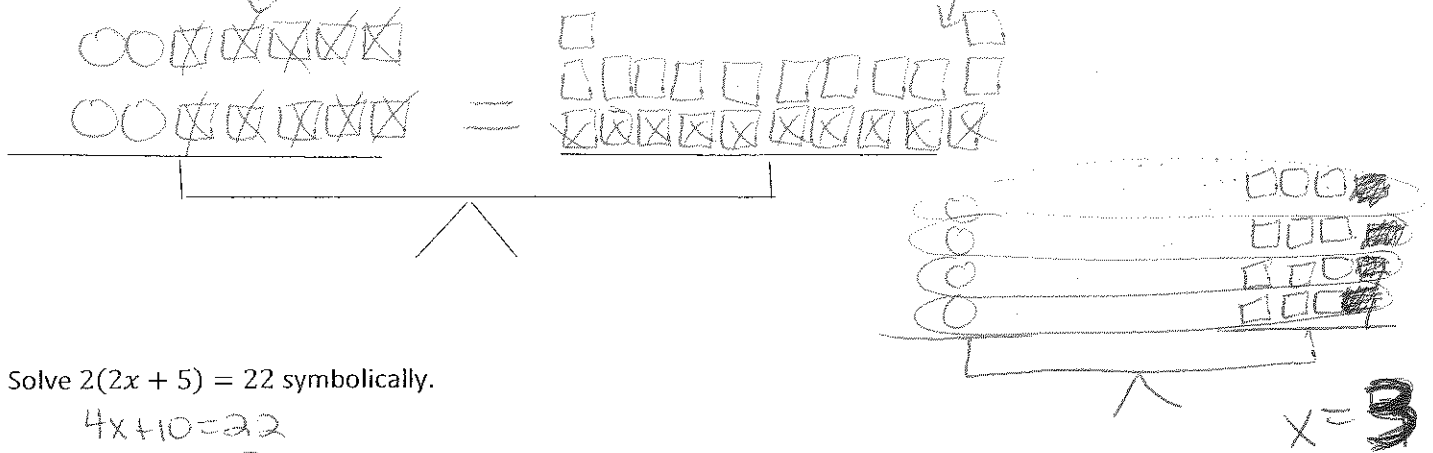
1. $2x + 8$

2. $10x + 15$

What mathematical term(s) describe what you did in part D?

Distributive Property

E. Solve the following equation using a balanced scale. $2(2x + 5) = 22$



Solve $2(2x + 5) = 22$ symbolically.

$$\begin{aligned}
 4x + 10 &= 22 \\
 -10 &-10 \\
 \hline
 4x &= 12 \\
 \frac{4}{4} &\quad \frac{4}{4} \\
 x &= 3
 \end{aligned}$$

What issue(s) may arise if you always want to choose the balanced scale approach? Does this happen when you use the symbolic approach? Explain.

It is difficult to represent all numbers (negatives, fractions, very big numbers). Different types of numbers do not make a difference when using the symbolic approach. The problem may be difficult to do symbolically but almost impossible to do visually.

F. Bethany solved a math problem below. Did she do it correctly or not? Explain thoroughly. Use math terms.

$$-3(4x + 2) - 6 = -156$$

$$-12x - 2 - 6 = -156$$

$$-12x - 8 = -156$$

$$-12x - 8 + 8 = -156 + 8$$

$$-12x = -164$$

$$-12x + 12 = -164 + 12$$

$$x = -176$$

Remember
 Topic Sentence
 Details - as many as needed
 Conclusion Sentence

Solving Equations using Like Terms and Distributive Property

Hour _____

Solve each equation.

1) $4 - 7a - 4 = 7$

2) $8 = r - 1 + 3$

3) $1 - 3x + 4 = 23$

4) $3n - 3 + 8n = 19$

5) $-16 = v - 3v$

6) $-13 = -7x - 6x$

7) $-7(6 + 6n) = 126$

8) $-131 = -8 - 3(6 + 5x)$

$$9) -7p + 7(7 - 6p) = 98$$

$$10) -8(1 + 3k) - 6k = 142$$

$$11) 6(1 + 7n) = -162$$

$$12) -112 = -7(8 - x)$$

$$13) -39 = 3(-1 - 8x) - 2(4x + 2)$$

$$14) 8 = -4(a + 1) - 7(a + 3)$$

$$15) -27 = 2(6k + 6) - 5(4k + 3)$$

$$16) 22 = -2(7 - p) - 4(3 + 2p)$$

$$17) -58 = 6(5x - 7) + 7(-8 - 5x)$$

$$18) -80 = 3(-7 - 4n) - 5(n + 5)$$

Sammy's Chipmunk and Squirrel Observations

Name _____

For a science project, Sammy observed a chipmunk and a squirrel stashing acorns in holes. The chipmunk hid 3 acorns in each of the holes it dug. The squirrel hid 4 acorns in each of the holes it dug. They each hid the same number of acorns, although the squirrel needed 4 fewer holes.

Create a visual representation of the situation to find how many acorns the chipmunk and squirrel hid.

Make a table of values for the chipmunk and the squirrel.

Define a variable and write expressions for the number of acorns the chipmunk and the squirrel each hid.

Variable:

Chipmunk:

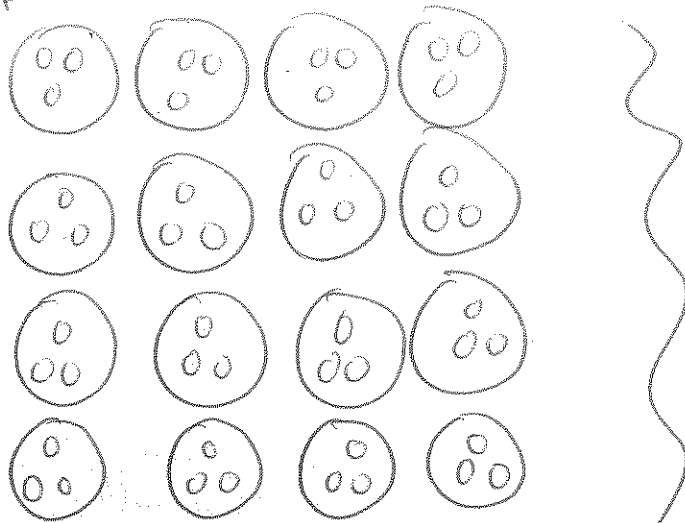
Squirrel:

Sammy's Chipmunk and Squirrel Observations

Name Key

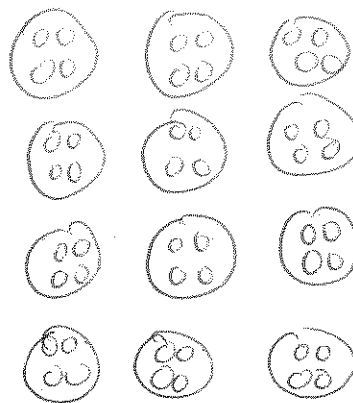
For a science project, Sammy observed a chipmunk and a squirrel stashing acorns in holes. The chipmunk hid 3 acorns in each of the holes it dug. The squirrel hid 4 acorns in each of the holes it dug. They each hid the same number of acorns, although the squirrel needed 4 fewer holes.

chipmunk Create a visual representation of the situation to find how many acorns the chipmunk and squirrel hid.



16 holes

48 acorns



squirrel

12 holes

48 acorns

Make a table of values for the chipmunk and the squirrel.

chipmunk

holes	acorns
1	3
2	6
3	9
4	12
5	15
6	18
7	21
8	24
9	27
10	30
11	33
12	36
13	39

holes	acorns
14	42
15	45
16	48

squirrel

holes	acorns
1	4
2	8
3	12
4	16
5	20
6	24
7	28
8	32
9	36
10	40
11	44
12	48

Define a variable and write expressions for the number of acorns the chipmunk and the squirrel hid.

Variable: ~~acorns~~ $h = \text{holes made by squirrel}$

Chipmunk:

$$3(h+4)$$

Squirrel:

$$4h$$

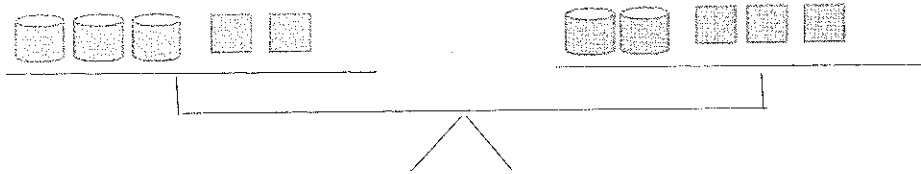
$$3(h+4) = 4h$$

$$\begin{array}{r} 3h + 12 = 4h \\ -3h \quad -3h \\ \hline 12 = h \end{array}$$

$12 = h$
12 holes for squirrel
48 acorns

Solving Equations with variables on both sides

1. Write the equation symbolically for the problem represented visually below. Solve the problem.



2. Solve $4x + 3 = 2x + 6$ in two ways: symbolically, the way you usually do with equations, and also with pictures of a balance. Show how each step you take symbolically is shown in the pictures.

3. Use pictures to show why the following solution to the equation is incorrect.

$$3x + 2 = 2x + 8$$

$$5x = 10$$

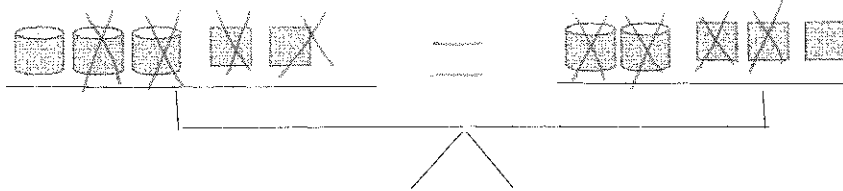
$$\frac{5x}{5} = \frac{10}{5}$$

$$x = 2$$

Solving Equations with variables on both sides

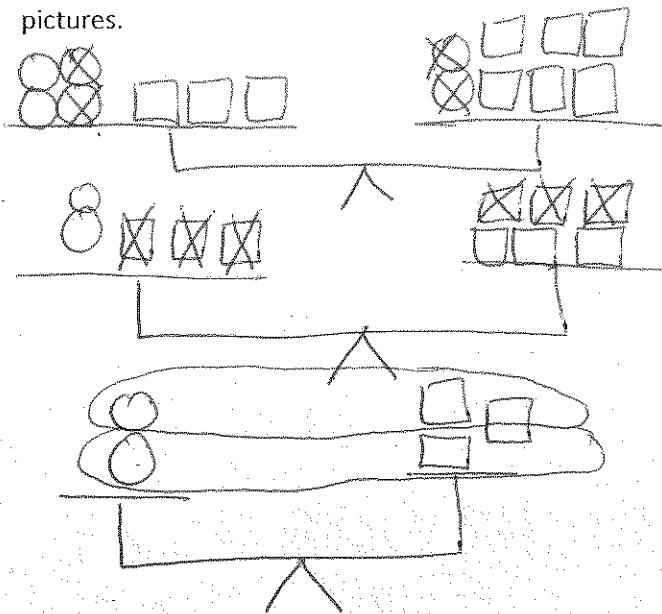


1. Write the equation symbolically for the problem represented visually below. Solve the problem.



$$\begin{array}{r}
 3x + 2 = 2x + 3 \\
 -2x \quad -2x \\
 \hline
 x + 2 = 3 \\
 -2 \quad -2 \\
 \hline
 x = 1
 \end{array}$$

2. Solve $4x + 3 = 2x + 6$ in two ways: symbolically, the way you usually do with equations, and also with pictures of a balance. Show how each step you take symbolically is shown in the pictures.



$$\begin{array}{r}
 4x + 3 = 2x + 6 \\
 -2x \quad -2x \\
 \hline
 2x + 3 = 6 \\
 -3 \quad -3 \\
 \hline
 2x = 3 \\
 \frac{2x}{2} = \frac{3}{2} \\
 x = 1.5
 \end{array}$$

3. Use pictures to show why the following solution to the equation is incorrect.

$$\begin{array}{l}
 3x + 2 = 2x + 8 \\
 5x = 10 \\
 \frac{5x}{5} = \frac{10}{5} \\
 x = 2
 \end{array}$$

8th grade

Name _____

Solving Equations with variables on both sides

Date _____ Hour _____

Solve each equation.

1) $-7n - 2 = -7 - 8n$

2) $7m - 6m = -2m - 5m + 8$

3) $7 + 4r + 6 - 2r = 7r - 7$

4) $7x + 7 + 3x = -13 + 5x$

5) $8 - b = 3b - 2 + 2$

6) $n + 2 = -6 - 7n$

7) $-32 + 7n = 2(1 + 8n) - 7$

8) $4(3v + 5) - 6 = 24 + 2v$

$$9) 38 - 6x = -2(7x - 3)$$

$$10) 8a - 28 = -2(3 + 7a)$$

$$11) -(r + 8) = -8 + 8r$$

$$12) 6x - 6 = -3(x + 8)$$

$$13) -5(-5 + p) - 6 = -8(p - 2)$$

$$14) -8(1 - x) = -8(x - 7)$$

$$15) 2(k - 3) - 6(3k + 8) = -2 - 6k + 5k + 8$$

$$16) -(n - 6) = -n - (5n - 6)$$

The Sign of Solutions

Name _____

Without solving them, say whether these equations have a positive solution, a negative solution, a zero solution, or no solution. Explain.

1. $3x = 5$

2. $5z + 7 = 3$

3. $7 - 5w = 3$

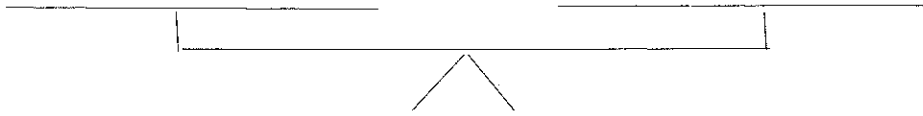
4. $4a = 9a$

5. $y = y + 1$

Solving Equations with variables on both sides part 2

Name _____

1. Represent the following equation visually, $7 + 5x = 7 + 5x$. Solve the equation, visually or symbolically.



2. Represent the following equation visually, $1 + 6r = 8 + 6r$. Solve the equation, visually or symbolically.



3. When looking for equations with no solution or with multiple solutions, what do you look for? Explain in detail.

8th grade

Name _____

Solving Equations-variables both sides #2

Date _____ Hour _____

Solve each equation.

1) $2 - 8r = 2 - 7r$

2) $-5n + 6 = -2n - 3n$

3) $15 + 6m = 8m + 7$

4) $10 + 6x = -4 + 4x$

5) $-8 + 2b = 2(b - 7)$

6) $-38 + 7x = -3 - 7(1 - 5x)$

7) $-2 + 8v = 5(v + 2)$

8) $-12 - 4x = -2(2x + 7) + 2$

$$9) -5(n+3) = -33 - 8n$$

$$10) 2b + 28 = 4(b+3)$$

$$11) -1\frac{1}{4}\left(1\frac{1}{3}m + 1\frac{1}{4}\right) = \frac{5}{12} - 3\frac{1}{4}m$$

$$12) -1\frac{1}{4}a + \frac{3}{4} = -1\frac{1}{2}\left(-\frac{1}{2}a + \frac{1}{2}\right)$$

$$13) -(4m+4) + 3 = -2(2m+1) + 1$$

$$14) 2(-p-1) = -3(1+p)$$

$$15) 1\frac{1}{2}n + 1\frac{1}{4}\left(n - 2\frac{1}{3}\right) = \frac{7}{4}\left(n - \frac{7}{2}\right)$$

$$16) -\frac{5}{3}m - \frac{2}{3}\left(-1\frac{3}{4}m + 1\right) = 1\frac{1}{2}m - 1\frac{1}{4}\left(2m + 1\frac{2}{3}\right)$$