Lesson SE - 3

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Objective: Solving Equations (*the most important lesson ever*)

Homework SE-3 – 1-Step: NYA p.118 #1 – 12
2-Step: NYA p.122 #1, 3, 5, 8, 14, 15, 21, 23, 44, 47, 52
Simplification: NYA p.129 #1, 2, 12, 16, 23, p.136 #1, 8, 13, p.162 #3 – 6

Do Now: Solve. 1. $\frac{x}{4} = 12$ 2. $-3x + 8 = 20$ 3. $2(x + 10) = 6x - 12$

Exam Prep: Which of the following equations has no solution?

A) $5x = 0$ B) $3x + 2 = 3x - 2$ C) $2(5x + 1) = 10x + 2$ D) $x = -1$

Your friend The Cat wants you to know that vast majority of this lesson is contains things you should already know… but because it is vital information, it is here again for your help.

So grab your helmet and lets go. My associate, The Doctor, will be watching you.

ONE STEP EQUATIONS: FOUNDATION MATERIAL

Algebraic Manipulation Procedures

When you are solving an equation, you are looking for the missing values (variables). You are trying to isolate the variable (with a constant on the other side).

Think of an equation as a scale that must always be balanced. In order to keep it balanced, whatever you do to one side, you must also do to the other side.

Adding or Subtracting on Both Sides: You may add to or subtract from both sides of an equation in order to isolate the variable. These are **inverse operations**, they undo each other.

$x + 14 = 21$ ← subtract 14 (both sides)	$y - 5 = 9$	$-13 = -4 + h$
$-14 \quad -14$ ← $14 - 14 = 0$, $21 - 14 = 7$	$+5 \quad +5$	$+4 \quad +4$
$x = 7$ ← solved for x	$y = 14$	$-9 = h$

TO CHECK, SUBSTITUTE YOUR VALUE INTO THE ORIGINAL EQUATION

Practice

1. $x - 3 = 19$	2. $8 + x = 10$	3. $y - 5 = 43$
4. $29 = k - 10$	5. $p + 6 = 36$	6. $-5 + x = 20$
7. $h - 4 = 18$	8. $-7 + x = 63$	9. $z = 54$

<u>Multiplying or Dividing on Both Sides</u>: You may multiply or divide both sides of an equation by a value in order to isolate the variable (inverse operations).

$5y = 30$ ← Original	$\frac{x}{4} = 12$	$8k = 20$
$\frac{5y}{5} = \frac{30}{5}$ ← Divide both sides by 5	$\frac{x}{4} \cdot 4 = 12 \cdot 4$	$\frac{8k}{8} = \frac{20}{8}$
$y = 6$ ← solved for y	$x = 48$	$k = 2.5$

TO CHECK, SUBSTITUTE YOUR VALUE INTO THE ORIGINAL EQUATION

Practice

1. $12s = 60$	2. $7y = 42$	3. $\frac{x}{9} = 72$
4. $-5j = 30$	5. $\frac{n}{20} = 1$	6. $15 = \frac{n}{5}$
7. $100 = 25u$	8. $-36 = -6p$	9. $-10 = \frac{t}{13}$

Challenging! Follow the Same Idea of Balance

10. 4a + 10 = 5a	**11. 50 – 7x = –5x**	**12. 100y = 50y – 500**

TWO STEP EQUATIONS: FOUNDATION MATERIAL

Algebraic Manipulation Procedures (Two Step)

When isolating the variable in a two-step equation, use inverse operations to:

1. **Undo addition and subtraction**
2. **Undo multiplication and division**

Remember: Operate on both sides to preserve the balance of the equation.

Solve			Check it!
	$4x + 5 = -27$	Undo addition first.	
	$4x + 5 = -27$ $-5 \quad -5$	Subtract 5 from both sides.	$4(-8) + 5 \stackrel{?}{=} -27$
	$4x = -32$	Then undo multiplication.	$-32 + 5 \stackrel{?}{=} -27$
	$\frac{4x}{4} = \frac{-32}{4}$	Divide both sides by 4.	$-27 = -27$
	$x = -8$		Both Equal. Good!

Solve			Check it!
	$\frac{x}{5} - 20 = 35$	Undo subtraction first.	
	$\frac{x}{5} - 20 = 35$ $+20 \quad +20$	Add 20 to both sides.	$\frac{275}{5} - 20 \stackrel{?}{=} 35$
	$\frac{x}{5} = 55$	Then undo division.	$55 - 20 \stackrel{?}{=} 35$
	$\frac{x}{5}(5) = 55(5)$	Multiply both sides by 5.	$35 = 35$
	$x = 275$		Both Equal. Good!

Practice: SHOW ALL WORK

1. $3x - 10 = 20$	2. $\frac{x}{5} + 3 = 12$	3. $16 = 2x + 6$
4. $2x - 7 = 35$	5. $28 = 3x + 1$	6. $9 = \frac{x}{8} - 2$
7. $3x - 17 = 43$	8. $\frac{x}{6} + 3 = -15$	9. $\frac{1}{5}x - 9 = 16$
10. $8 = \frac{n}{4} + 1$	11. $2x - 0.75 = 3.25$	12. $7.8 = 2x + 3.2$

Word Problems

1) A health club charges $60 for joining plus dues of $20 a month. Another club charges a one-time fee of $1000. Which equation could you solve to find the number of months you would need to spend at the first club until you reach a cost of $1000? Let x equal the number of months.

a) $20x - 60 = 1000$ b) $20x + 60 = 1000$ c) $60x + 20 = 1000$ d) $20x + 60x = 1000$

2) Mrs. Hill paid an electric bill of $23 that included a $5 late fee. If electricity costs $0.10 per kWh, how many kilowatt hours did she use?

3) A scuba diver at a depth of 200 ft. rises at 6 ft. per second to avoid over-pressurization. How long does it take for the diver to reach a depth of 40 ft?

4) A recipe calls for 1 tsp of baking powder per 3 servings, plus 1 additional teaspoon. Cal used 6 tsp of baking powder. How many servings did he make?

SIMPLIFICATION AND SOLVING: MOSTLY FOUNDATION MATERIAL

Algebraic Simplification

Term – the addends of an algebraic expression; i.e. x, ax^2, $2x^4y^2$, or –4ab
Coefficient – the numerical factor of a term that has a variable
Like terms contain the same variable and exponent, or do not have exponents.
Combining like terms is a way of simplifying expressions or equations.

Part I

$2x + 3x - 4 = 11$	Original equation: Combine like terms $2x + 3x = 5x$
$5x - 4 = 11$ $+4 \quad +4$	Add 4 to each side
$\frac{5x}{5} = \frac{15}{5}$	Divide each side by 5
$x = 3$	Solution: x by itself

Try It	1. $-13 = 3n + 3 + n$	2. $5x - 3x + 12 = 8$	3. $(-2a) + (7a) - (-5a) = 25$

Representing consecutive integers or consecutive even (odd) integers is a common task in algebra.

n = 1st Integer n + 1 = 2nd Integer n + 2 = 3rd Integer	n = 1st Even (or Odd) Integer n + 2 = 2nd Even (or Odd) Integer n + 4 = 3rd Even (or Odd) Integer

Practice: Solve these problems using "combining like terms"

1. The sum of three consecutive unknown integers is 147.
2. The sum of three consecutive unknown odd integers is 51.

Sometimes variables appear on <u>both sides of an equation</u>. You will still <u>combine like terms</u>, now using inverse operations. Collect variables on one side; it is best to pick the side with the <u>largest coefficient</u>.

$2x + 3 = 3x + 5$	Original equation
$2x + 3 = 3x + 5$ $-2x \quad -2x$	Subtract 2x from each side
$3 = x + 5$ $-5 \quad -5$	Subtract 5 from each side
$-2 = x$	Solution: x by itself

Try It	1. $7x + 12 = 13x$	2. $7y - 3 = 45 - 5y$	3. $-2a + 8 = 4a + 2$

Use the <u>distributive property</u> to simplify an equation, whenever possible. You may have to combine like terms afterwards.

Part II

$5y + 2(y - 3) = 92$	Original equation: Use the distributive property
$5y + 2y - 6 = 92$	Combine like terms
$7y - 6 = 92$ $+6 \quad +6$	Add 6 to both sides
$7y = 98$	
$\frac{7y}{7} = \frac{98}{7}$	Divide each side by 7
$y = 14$	Solution: y by itself

Try It	1. $24 = \frac{1}{4}(x - 8)$	2. $1 = y + 3(y - 9)$	3. $8n - 4 = 3(2n - 8)$

Problem Solving: State Test Verbal Questions

1. **The cost of seeing x movies at the theater is 7x dollars. Buying a VCR and renting x movies costs 350 + 3x dollars. Set the expressions equal and solve for x. What does your answer represent?**
2. **One less than three times a number is equal to the same number plus 19. What is the number?**
3. **Four times a number plus seventeen is equal to the sum of seven times the same number and two. What is the number?**

<u>Rational numbers</u> can be used to solve equations also. You may use multiplication by a <u>reciprocal</u> or multiplication by a <u>common denominator</u>.

Part III

$\frac{3}{4}x + 12 = 72$ $-12 \quad -12$	**Original equation: Undo addition**
$\frac{3}{4}x = 60$	**New equation (rational)**
$\frac{4}{3} \cdot \frac{3}{4}x = 60 \cdot \frac{4}{3}$	**Multiply reciprocals**
$x = \frac{240}{3}$	**Simplify**
$x = 80$	**Solution**

Practice

1. $\frac{2}{3}z = 10$	2. $\frac{4x}{5} + 1 = 16$	3. $\frac{2}{9}x - 15 = -7$
4. $\frac{3}{2}x - \frac{7}{2}x - 10 = 55$	5. $\frac{2}{3}g = 112 - \frac{5}{3}g$	6. $\frac{2x+1}{3} = 15$