Day 1 – Solving One & Two Step Equations - Notes

Remember, an **expression** is a mathematical "phrase" composed of terms, coefficients, and variables that stands for a single number, such as $3x + 1$ or $x^2 - 1$. We use Properties of Operations to *simplify* algebraic expressions. Expressions do NOT contain equal signs.

An **equation** is a mathematical "sentence" that says two expressions are equal to each other such as $3x + 1 = 5$. We use Properties of Equality (inverse operations) to solve algebraic equations. Equations contain equal signs.

An Algebra Expression does NOT have an = sign.

$4n^2 + 7$

An "Equation" does have an Equals sign.

$4n^2 + 7 = 11$

When solving equations, you must perform **inverse operations**, which means you have to perform the operation opposite of what you see. You must also remember the operation you perform on one side of the equation must be performed to the other side.

Informal		Formal		
Operation	**Inverse**	**Property**	**General Example**	**Example 1**
Addition	Subtraction	Addition Property of Equality	If $a = b$, then $a + c = b + c$	If $x - 4 = 8$, then $x = 12$
Subtraction	Addition	Subtraction Property of Equality	If $a = b$, then $a - c = b - c$	If $x + 5 = 7$, then $x = 2$
Multiplication	Division	Multiplication Property of Equality	If $a = b$, then $ac = bc$	If $\frac{x}{2} = 9$, then $x = 18$
Division	Multiplication	Division Property of Equality	If $a = b$, then $\frac{a}{c} = \frac{b}{c}$	If $2x = 10$, then $x = 5$

No More "Cancelling"

When you first learned to solve equations in middle school, you might have used the words "cancel". We are no longer going to use the word "cancel". Take a look at the following examples:

$x - 120 = 80$
$+120 \quad +120$
$x = 200$

← **Adding the opposite**
Additive Inverse
Adding to zero

$\frac{k}{2} = 16$

$\frac{k}{2} \times 2 = 16 \times 2$

$k = 32$ ✓

← **Multiplying by the Reciprocal**
Multiplicative Inverse
Divides/Multiplies to one

Additive Inverse	A number plus its inverse equals 0.	$a + -a = 0$	$7 + -7 = 0$
Multiplicative Inverse (Reciprocal)	A number times its reciprocal equals 1.	$a \cdot \frac{1}{a} = 1$	$3 \cdot \frac{1}{3} = 1$

↳ $\frac{2}{3} \rightarrow \frac{3}{2}$

Solving One Step Equations

Practice: Solve each equation.

1. $x - 4 = 3$
$+4 \quad +4$
$x = 7$
Operation You See: Sub Inverse Operation: add

2. $y + 4 = 3$
$-4 \quad -4$
$y = -1$
Operation You See: add Inverse Operation: Sub

3. $\frac{s}{3} = 9 \cdot 3$
$s = 27$
Operation You See: division Inverse Operation: multi

4. $\frac{6p}{6} = \frac{12}{6}$
$p = 2$
Operation You See: multi Inverse Operation: division

Rewrite: • $y - -7 \rightarrow y + 7$ • $y + -8 \rightarrow y - 8$

Practice: Solve each equation on your own.

a. $x - 6 = 10$
$+6 \quad +6$
$x = 16$

b. $-5d = 25$
$\frac{-5d}{-5} = \frac{25}{-5}$
$d = -5$

c. $8 + m = -4$
$-8 \quad -8$
$m = -12$

d. $7 \cdot \frac{x}{7} = 1 \cdot 7$
$x = 7$

e. $y - (-9) = 2$
$y + 9 = 2$
$-9 \quad -9$
$y = -7$

f. $3 \cdot \frac{1}{3}x = 6 \cdot 3$
$x = 18$

Solving Two Step Equations

When solving equations with more than one step, you still want to think about how you can "undo" the operations you see. For the following equations, describe the operations being performed on each variable (go in PEMDAS order). Then describe the inverses using a table.

a. $3x + 5 = 14$
$-5 \quad -5$
$\frac{3x}{3} = \frac{9}{3}$
$x = 3$

b. $2n - 6 = 4$
$+6 \quad +6$
$\frac{2n}{2} = \frac{10}{2}$
$n = 5$

c. $4 \cdot \frac{x-2}{4} = 1 \cdot 4$
$x - 2 = 4$
$+2 \quad +2$
$x = 6$

Practice: Solve each equation, showing all steps, for each variable.

1. $3x - 4 = 14$
$+4 \quad +4$
$\frac{3x}{3} = \frac{18}{3}$
$x = 6$

2. $2x + 4 = 10$
$-4 \quad -4$
$\frac{2x}{2} = \frac{6}{2}$
$x = 3$

3. $7 - 3y = 22$
$-7 \quad -7$
$\frac{-3y}{-3} = \frac{15}{-3}$
$y = -5$

4. $0.5m - 1 = 8$
$+1 \quad +1$
$\frac{0.5m}{0.5} = \frac{9}{0.5}$
$m = 18$

5. $-6 + \frac{x}{4} = -5$
$+6 \quad +6$
$4 \cdot \frac{x}{4} = 1 \cdot 4$
$x = 4$

6. $\frac{x-8}{4} = -5 \cdot 4$
$x - 8 = -20$
$+8 \quad +8$
$x = -12$

Error Analysis with Solving Equations

1. William solved the following equation on his homework last night. However, he solved it incorrectly. Describe the mistake William made and what he should have done instead. Then re-solve the equation to find the correct answer.

✗
$4 = \frac{y}{8} + 1$
$32 = y + 1$
$31 = y$

Mistake: They multiplied by 8 first instead of subtracting 1.

Corrected Solution:
$4 = \frac{y}{8} + 1$
$-1 \quad -1$
$8 \cdot 3 = \frac{y}{8} \cdot 8$
$24 = y$

2. Tyler solved the following equation on his homework last night. However, he solved it incorrectly. Describe the mistake Tyler made and what he should have done instead. Then re-solve the equation to find the correct answer.

✗
$28y + 7 = 21$
$28y = 28$
$y = 1$

Mistake: They add 7 to the 21 instead of subtracting it.

Corrected Solution:
$28y + 7 = 21$
$-7 \quad -7$
$\frac{28y}{28} = \frac{14}{28}$
$y = \frac{1}{2}$