Name: _____ Date: _____

SEEING STRUCTURE TO SOLVE EQUATIONS
COMMON CORE ALGEBRA I

You spent a lot of time in 8th grade Common Core Math solving linear equations (ones where the variable is raised to the first power only). In fact, the expectation is that you mastered solving linear equations. These types of equations are so essential in mathematics, though, that it pays to work with them more. In today's lesson, we will be solving linear equations where the variable only occurs once. We will solve these equations by seeing the structure of the expression involving *x* and using this structure to "undo" what has been done to it.

***Exercise* #1:** Consider the equation $5x+3=23$.

(a) List the operations that have been done to the variable *x* on the left hand side of the equation in the order in which they occurred.

(b) Solve the equation by reversing what has been done to *x*. Verify that your value of *x* is a solution by seeing if it makes the equation true.

This is the most basic of all equation solving techniques. It is the most important solving technique in all of mathematics. Be clear on this:

SOLVING EQUATIONS BY INVERSE OPERATIONS

If the **variable** you are solving for shows up only once, identify the operations that have been done on it and reverse them in the opposite order in which they occur.

***Exercise* #2:** Find the value of *x* that solves each equation. In each case, first identify the operations that have occurred to *x* and reverse them. Show each step.

(a) $\frac{x-3}{2}+7=23$

What happened to *x*?

Now reverse.

(b) $4(x+1)-2=-6$

What happened to *x*?

Now reverse.

Often equations can be solved in multiple ways. Let's take a look at the next problem to see an example.

***Exercise* #3:** Solve the following equation two different ways. In (a) reverse the operations that have been done to x. In (b), apply the distributive property first.

(a) $-2(x-4)+8=2$ [Reverse the operations]

(b) $-2(x-4)+8=2$ [Use the Distributive Prop First]

We should also be prepared to use this technique to solve problems where we must translate between English and mathematics.

***Exercise* #4:** Set up equations that translate the following verbal phrases into mathematics and then solve the equations.

(a) Ten less than five times a number results in thirty five. What is the number? Carefully set up an equation, solve it, and check your answer for reasonableness. Watch out! Subtraction is involved.

(b) When three times the sum of a number and seven is increased by ten, the result is four. What is the number? Carefully set up an equation and solve it. Check for reasonableness.

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SEEING STRUCTURE TO SOLVE EQUATIONS
COMMON CORE ALGEBRA I HOMEWORK

FLUENCY

1. In the expression $\frac{x}{5}-3$ which is the correct order in which operations have been done to x?

   (1) x was divided by 5 and the result was subtracted from 3
   (2) x had 3 subtracted from it and the result was then divided by 5.
   (3) x was divided by 5 and 3 was subtracted from the result
   (4) 5 was divided by x and then 3 was subtracted from the result.

2. Which of the following is the solution to $6x+1=4$? Show the steps or explain how you found the solution.

   (1) $x=\frac{7}{6}$ (3) $x=\frac{4}{3}$

   (2) $x=\frac{1}{2}$ (4) $x=\frac{5}{6}$

3. The solution to $5(x-2)-6=24$ is which of the following? Show the steps in your solution process.

   (1) $x=7$ (3) $x=-3$

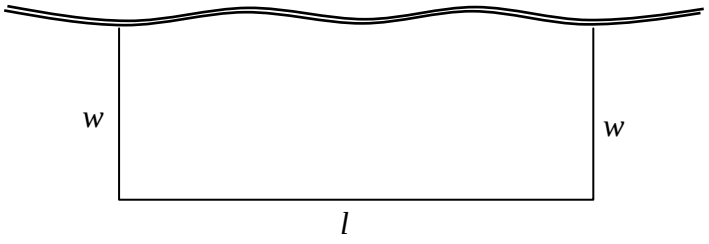
   (2) $x=-12$ (4) $x=8$

APPLICATIONS

4. If a number is increased by five and the result is then divided by three, the result is seven. Write an equation that models this verbal description and solve the equation for the number described.

5. Max and his friend Zeke are comparing their ages. They figure out that if they double Max's age from 3 years ago and add it to Zeke's current age, the sum is 26. If Zeke is currently 8 years old, determine how old Max currently is.

6. A rectangular area is being fenced in along a river that serves as one side of the rectangle.



(a) Write an equation that relates the amount of fencing, F, needed as a function of the width w and the length l.

(b) If $w = 12$ feet and $l = 20$ feet, what is the value of F ?

(c) If we know that the amount of fencing we have available is 120 feet and we want to devote 30 feet to the length, l, then set up an equation to solve for w and find the width.

REASONING

7. Consider the equation $\frac{5(2x-1)}{3}-4=11$. This equation looks complicated, but we can unravel all of the operations that have been done to x to produce the output of 11.

(a) List the operations that have been done to x and the order in which they have been done.

(b) Reverse the operations from (a) to solve for x.

8. Think about the equation $4(3x+2)=-16$.

(a) Solve this equation by reversing what has been done to x.

(b) Solve this equation by first distributing the multiplication by 4.