

**Title: Secret Agent Man****Brief Overview:**

In this lesson students will be able to understand and use the inverse relationships of addition and subtraction, multiplication and division to simplify computations and solve problems. Secret Agent Man is on a mission to hide his true identity and it is up to the students to uncover his secret. The “secret agent” is the answer to the variable in a two–step equation, when the students are taught the steps to solving two–step equations and applying those steps, they are able to uncover the identity of the variable or “Secret Agent Man”

**NCTM Content Standard:**

- Understand meanings of operations and how they relate to one another by understanding and using the inverse relationships of addition and subtraction, and multiplication and division to simplify computations and solve problems.

**Grade/Level:**

Grades 7 – 8

**Duration/Length:**

Four 60 – minute class periods

**Student Outcomes:**

Students will:

- Follow multi–step directions to create a three–dimensional figure
- Use the inverse operations to complete 2 step equations
- Analyze word problems to solve 2 step equations
- Add, subtract, multiply, and divide
- Give a clear definitions of vocabulary after the lesson

**Materials and Resources:**

- Whiteboards
- Dry Erase Markers
- Whiteboard Erasers
- Envelopes
- 8in x 8in paper squares
- Paper clips
- Copies of worksheets
  - Solving Equations Pre-assessment
  - Creating a Fortune Teller
  - Uncover the Secret Agent In Each Tile

- Secret Agent Man: Who Am I?
- Final Mission
- Chain Reaction
- I Have... Who Has...?
- Find the Spy
- Two-Step Equations Summative Assessment

**Development/ Procedures:**

Day 1

- Pre-Assessment  
Distribute the “Solving Equations” pre-assessment activity to assess the students’ prior knowledge of solving one and two-step equations. Emphasize that the students should show all work to solve for the variables.
- Exploration:  
Provide each student with an 8in by 8in paper square and the directions to create a Fortune Teller origami. Have the students follow the directions to create a fortune teller.

Instruct the students to unfold the origami fortune teller by following the directions in the opposite direction. Explain to the students how they used inverse operations to unfold the Fortune Teller.

**Say:** When you created your Fortune Teller, you were “adding” folds to create it. In order to go back to your original 8in by 8in piece of paper, you must do the inverse, or the opposite, of each direction. By unfolding your Fortune Teller, you are actually subtracting each fold. From this, we can see how the inverse, or the opposite, movement cancels what action was previously performed.

- Explanation:  
Discuss the opposite operation (inverse): Multiplication/Division and Addition/Subtraction

$$X + 5 = 12$$

**Say:** *Through what operation are the variable and the constant attached?*

**Answer:** *Addition.*

**Say:** *What is the inverse or opposite operation of addition?*

**Answer:** *Subtraction.*

**Say:** *Equations are like balances, we want to keep both sides of the equal sign the same. However we change the left side, we must change the right side in the same way. We will have to subtract the constant, 5, from both sides of the equation. What is 5 minus 5?*

**Answer:** *Zero.*

**Say:** *Now that the variable is all alone, we need to work on the right side of the equation. The operation we used on the left side of the equation, we will use on the right side. Subtract 5 from 12. What is your difference?*

**Answer:** *Seven.*

**Say:** *What does x equal?*

**Answer:**  $X$  equals 7.

**Say:** How can we check that our answer of 7 is correct? We can substitute, or replace, the variable with our answer of 7. What is 7 plus 5?

**Answer:** Twelve.

**Say:** Does our value of  $x$  equals seven make our equation a true statement?

**Answer:** Yes.

**Say:** Then our final answer of  $x$  equals seven is correct.

$$Y - 8 = 14$$

**Say:** Through what operation are the variable and the constant attached?

**Answer:** Subtraction.

**Say:** What is the inverse or opposite operation of subtraction?

**Answer:** Addition.

**Say:** We will use the inverse operation to unattach the constant from the variable. Instead of having eight subtracted from  $y$ , we will now have to add eight to both sides of the equation. Minus eight and plus eight equal zero, but then what must also happen to the right side of the equation?

**Answer:** We have to add eight to that side too. 14 plus eight equals 22.

**Say:** Then what is the value of  $y$ ?

**Answer:**  $Y$  equals 22.

**Say:** How can we check that the answer is correct?

**Answer:** Substitute 22 for  $y$ , and then subtract eight from 22. This is 14. Our answer is correct.

Have students complete one step equations to demonstrate understanding of inverse operations:

$$a + 5 = 7$$

**Answer:**  $a = 2$

$$9r = 81$$

**Answer:**  $r = 9$

$$\frac{m}{7} = 6$$

**Answer:**  $m = 42$

$$10n = 120$$

**Answer:**  $n = 12$

o Application

Divide the class into groups of four. Give each group two cards with equations on them. Have the students work together to answer each problem. Invite representatives from each group to the board to show their equations and explain their solutions.

o Reteach: Pull students who are struggling into a small group. Give each student a number line (attached) and a paper clip. Tell the students to put their paper clip on "0" or the "starting line." The constant on each problem below will identify to the

student how many spaces they need to move their paper clip and in which direction.

For example,  $x + 8 = 12$  shows that the student should move their paper clip 8 spaces in a positive direction. Then ask the students what they need to do to get their paper clip back to “0” or the “starting line.” The answer should be “go back 8 spaces,” or “subtract 8 spaces.” This shows that the opposite of +8 is -8 and will cause the two to equal “0” or “cancel out,” leaving the variable by itself. The same action, subtracting 8, should be taken on the other side of the equation to solve the problem. 12 minus 8 equals for. The correct answer should be  $x = 4$ .

$$B + 6 = 20$$

$$B = 14$$

$$n - 9 = 15$$

$$n = 24$$

$$h - 3 = -6$$

$$h = -3$$

$$s + 2 = 8$$

$$s = 6$$

Although multiplication and division problems are not shown in this section, the purpose is to extend the concept of inverse operation.

- o Enrichment – One Step Equations Answers

Solve and check for each question.

$$1) 5x + 7x = 144$$

$$x = 12$$

$$3) 0.75w + 0.5w = 15$$

$$w = 10$$

$$2) b - 13 + 5 = 2 - 18$$

$$b = -8$$

$$4) \frac{4}{3}y + \frac{8}{12}y = 22$$

$$y = 11$$

Day 2

- o Exploration

Read the following two situations. Describe how you would find the solutions.

- 1) Angie spent \$45 to on two CDs and one DVD that cost \$19. How much did each CD cost?  
\$13; Answers will vary.

- 2) How old am I if 258 reduced by four times my age is 108?  
27; Answers will vary.

- o Explanation

Set the stage for solving two-step equations by creating a scenario around a secret agent who wants to keep his identity hidden. Explain that the variable in an equation is a secret agent and he does not want any one to know who he is. Present to the class that their mission is to find out the identity of the ‘secret agent’, the variable, by using the inverse operations.

Continue with the secret agent scenario by explaining that the secret agent, the variable, wants to reveal his identity to the equal sign, but no one can be around when he does this. Explain that, as a result of this, all the numbers have to be moved to the other side of the equal sign by using the inverse operations.

Demonstrate how to use the inverse operations to isolate the variable. Create a sequence chain of the steps for the students to follow:

Step 1: Use the inverse of addition/subtraction

- Make sure to keep each side balanced, by doing the same thing on each side of the equal sign.

Step 2: Use the inverse of multiplication/division

- The secret agent is now along side the equal sign and will tell who he truly is. His identity is the answer to the equation.

Teacher will demonstrate two problems by prompting the class to identify the inverse operations and how they will be used to complete a multi- step equation.

$$2c + 8 = 120$$

**Say:** *Who is the secret agent in this situation?*

**Answer:** *c*

**Say:** *The coefficient is the secret agent's best friend so we want to move him last. Through what operation are the variable and the constant attached?*

**Answer:** *Addition.*

**Say:** *What is the inverse or opposite operation of addition?*

**Answer:** *Subtraction.*

**Say:** *Equations are like balances, we want to keep both sides of the equal sign the same. However we change the left side, we must change the right side in the same way. We will have to subtract the constant, 8, from both sides of the equation. What is 8 minus 8?*

**Answer:** *Zero.*

**Say:** *Now that the variable is all alone with his best friend, we need to work on the right side of the equation. The operation we used on the left side of the equation, we will use on the right side. Subtract 8 from 120. What is your difference?*

**Answer:** *One hundred twelve.*

**Say:** *What is our resulting equation?*

**Answer:**  *$2c = 112$*

**Say:** *Through what operation are the secret agent and his best friend attached?*

**Answer:** *Multiplication*

**Say:** *What is the inverse operation of multiplication?*

**Answer:** *Division*

**Say:** *What number would we divide by?*

**Answer:** *Two*

**Say:** *So, let's divide both sides of the equation by two. What does c equal?*

**Answer:** *C equals 56.*

**Say:** *To check our answer we can substitute, or replace, the variable with our answer of 56.*

**Say:** *Does our value of c equals 56 make our equation a true statement?*

**Answer:** *Yes.*

**Say:** *Then our final answer of c equals 56 is correct.*

$$\frac{x}{2} - 6 = -4$$

**Say:** Who is the secret agent in this situation?

**Answer:**  $x$

**Say:** The coefficient is the secret agent's best friend so we want to move him last. Through what operation are the variable and the constant attached?

**Answer:** Subtraction.

**Say:** What is the inverse or opposite operation of addition?

**Answer:** Addition.

**Say:** Equations are like balances, we want to keep both sides of the equal sign the same. However we change the left side, we must change the right side in the same way. We will have to add the constant, 6, from both sides of the equation. What is -6 plus 6?

**Answer:** Zero.

**Say:** Now that the variable is all alone with his best friend, we need to work on the right side of the equation. The operation we used on the left side of the equation, we will use on the right side. Add 6 to -4. What is your sum?

**Answer:** Two.

**Say:** What is our resulting equation?

**Answer:**  $\frac{x}{2} = 2$

**Say:** Through what operation are the secret agent and his best friend attached?

**Answer:** Division.

**Say:** What is the inverse operation of division?

**Answer:** Multiplication.

**Say:** What number would we multiply by?

**Answer:** Two

**Say:** So, let's multiply both sides of the equation by two. What does  $x$  equal?

**Answer:**  $x$  equals 4.

**Say:** To check our answer we can substitute, or replace, the variable with our answer of 4.

**Say:** Does our value of  $x$  equals 4 make our equation a true statement?

**Answer:** Yes.

**Say:** Then our final answer of  $x$  equals 4 is correct.

Next, the students will complete two problems on their own

- $5x - 15 = 145$

**Answer:**  $x = 32$

- $\frac{h}{2} - 18 = -5$

**Answer:**  $h = 26$

o Application

Distribute "Secret Agent Man: Who Am I?" for the students to solve independently. Pair up the students, and have them compare and correct each

other's work. Invite students to the board to demonstrate their work and solutions to the problems at the end of the activity.

- o Assessment:  
Have the students complete the "Final Mission" exit ticket.

### Day 3

- o Exploration  
Use the worksheet entitled Exploration of Reciprocals to ensure the students understand the relationship between  $\frac{1}{4}$  and  $\frac{4}{1}$ .
  - $\frac{1}{4}$  and  $\frac{4}{1}$  are the reciprocals of each other because the product of the two is equal to 1.
- o Explanation  
Demonstrate how to solve two - step equations which include fractions, emphasizing to the students that the steps will remain the same as the previous day.

The teacher will have the following four problems on the board for the students to copy:

- $\frac{2}{3}m + 9 = 25$
- $\frac{1}{8}x - 15 = -9$
- $\frac{5}{4}y - 7 = 13$
- $16 = \frac{1}{2}k + 6$

Using the steps from the previous day, with the concept of reciprocals, the teacher will follow the directions below to evaluate the first two equations while the students copy each problem in their notebook. The second two equations the students will copy and complete on their own.

- $\frac{2}{3}m + 9 = 25$

**Say:** *Who is the secret agent in this situation?*

**Answer:** *m*

**Say:** *The coefficient is the secret agent's best friend so we want to move him last. Through what operation are the variable and the constant attached?*

**Answer:** *Addition.*

**Say:** *What is the inverse or opposite operation of addition?*

**Answer:** Subtraction.

**Say:** Equations are like balances, we want to keep both sides of the equal sign the same. However we change the left side, we must change the right side in the same way. We will have to subtract the constant, 9, from both sides of the equation. What is 9 minus 9?

**Answer:** Zero.

**Say:** Now that the variable is all alone with his best friend, we need to work on the right side of the equation. The operation we used on the left side of the equation, we will use on the right side. Subtract 9 from 25. What is your difference?

**Answer:** 16.

**Say:** What is our resulting equation?

**Answer:**  $\frac{2}{3}m = 16$

**Say:** Through what operation are the secret agent and his best friend attached?

**Answer:** Multiplication

**Say:** What is the inverse operation of multiplication?

**Answer:** Division

**Say:** When dividing fractions, gain a more accurate result we need to multiply by the reciprocal. What is the reciprocal of  $\frac{2}{3}$ ?

**Answer:**  $\frac{3}{2}$

**Say:** So, let's multiply both sides of the equation by the reciprocal. What does  $x$  equal?

**Answer:**  $x$  equals 24.

**Say:** To check our answer we can substitute, or replace, the variable with our answer of 24.

**Say:** Does our value of  $x$  equals 24 make our equation a true statement?

**Answer:** Yes.

**Say:** Then our final answer of  $x = 24$  is correct.

▪  $\frac{1}{8}x - 15 = -9$

**Say:** Who is the secret agent in this situation?

**Answer:**  $x$

**Say:** The coefficient is the secret agent's best friend so we want to move him last. Through what operation are the variable and the constant attached?

**Answer:** Subtraction.

**Say:** What is the inverse or opposite operation of subtraction?

**Answer:** Addition.

**Say:** Equations are like balances, we want to keep both sides of the equal sign the same. However we change the left side, we must change the right

side in the same way. We will have to add the constant, 15, from both sides of the equation. What is -15 plus 15?

**Answer:** Zero.

**Say:** Now that the variable is all alone with his best friend, we need to work on the right side of the equation. The operation we used on the left side of the equation, we will use on the right side. Add 15 to -9. What is your sum?

**Answer:** 6.

**Say:** What is our resulting equation?

**Answer:**  $\frac{1}{8}x = 6$

**Say:** Through what operation are the secret agent and his best friend attached?

**Answer:** Multiplication

**Say:** What is the inverse operation of multiplication?

**Answer:** Division

**Say:** When dividing fractions, gain a more accurate result we need to multiply by the reciprocal. What is the reciprocal of  $\frac{1}{8}$ ?

**Answer:**  $\frac{8}{1}$

**Say:** So, let's multiply both sides of the equation by the reciprocal. What does  $x$  equal?

**Answer:**  $x$  equals 48.

**Say:** To check our answer we can substitute, or replace, the variable with our answer of 48.

**Say:** Does our value of  $x$  equals 48 make our equation a true statement?

**Answer:** Yes.

**Say:** Then our final answer of  $x = 48$  is correct.

▪  $\frac{5}{4}y - 7 = 13$

**Answer:**  $y = 16$

▪  $16 = \frac{1}{2}k + 6$

**Answer:**  $k = 20$

o Application

Cut out the cards from “Chain Reaction” and place them in envelopes prior to the start of class. Make enough envelopes for each student to work individually. Instruct the students to solve each problem on a separate sheet of paper, and arrange the cards in order to form the chain reaction.

o Differentiate:

- Reteach/Enrich  
Cut up the cards for the “I Have...Who Has...?” game prior to the start of class. Give each student a card, and instruct the student that they are to work out each equation on a separate piece of paper. Select a student to state the ‘who has’ part of their card, and allow the other students to solve this equation. Have the students look at the ‘I have’ part of their cards, and ask the student with the answer to read their entire card. Repeat the process until all cards have been read, and, if done correctly, the cycle returns to the student who read their card first.

#### Day 4

- o Students will be broken into groups of 5, depending on class size  
They will review 2 step equations by playing the game Jeopardy  
Jeopardy will have various categories from the weeks lessons  
See attached Jeopardy answer sheet for teacher copy of all questions and answers.

### **Summative Assessment**

Students will complete the Two-Step Equations assessment included at the end of this unit.

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**Solving Equations**  
**Pre-Assessment**

Name: \_\_\_\_\_

**Directions:** Choose the letter of the answer that makes the given statement true.

1.  $6f + 13 = 136$

- a. 11.5
- b. 12.5
- c. 20.5
- d. 20.6

2.  $5a = 45$

- a. 6
- b. 7
- c. 8
- d. 9

3.  $12b - 124 = 432$

- a. 4633
- b. 4.633
- c. 46.33
- d. 463.3

4.  $\frac{m}{4} + 12 = 144$

- a. 5.28
- b. 285
- c. 528
- d. 825

5.  $100 + \frac{m}{25} = 125$

- a. 632
- b. 626
- c. 625
- d. 526

6.  $10z - 36 = 244$

- a. 20
- b. 28
- c. 80
- d. 82

7.  $\frac{m}{3} - 63 = 92$

- a. 456
- b. 465
- c. 546
- d. 654

8.  $\frac{m}{14} + 21 = 365$

- a. 1648
- b. 4816
- c. 6814
- d. 8164

9. 82 is added to 4 times a number, and the answer is 169

- a.  $169 - 4n = 82$
- b.  $82 + 4n = 169$
- c.  $4n - 82 = 169$
- d.  $4(n + 82) = 169$

10. The sum of 25 and a number divided by 14 is 480.

- a.  $25 + \frac{n}{14} = 480$
- b.  $480 = 14 + \frac{25}{n}$
- c.  $25 - \frac{n}{14} = 480$
- d.  $25 \times \frac{n}{14} = 480$

**Solving Equations**  
**Pre-Assessment**

Name: \_\_ANSWER KEY\_\_

**Directions:** Choose the letter of the answer that makes the given statement true.

1.  $6f + 13 = 136$

- a. 11.5
- b. 12.5
- c. 20.5
- d. 20.6

2.  $5a = 45$

- a. 6
- b. 7
- c. 8
- d. 9

3.  $12b - 124 = 432$

- a. 4633
- b. 4.633
- c. 46.33
- d. 463.3

4.  $\frac{m}{4} + 12 = 144$

- a. 5.28
- b. 285
- c. 528
- d. 825

5.  $100 + \frac{m}{25} = 125$

- a. 632
- b. 626
- c. 625
- d. 526

6.  $10z - 36 = 244$

- a. 20
- b. 28
- c. 80
- d. 82

7.  $\frac{m}{3} - 63 = 92$

- a. 456
- b. 465
- c. 546
- d. 654

8.  $\frac{m}{14} + 21 = 365$

- a. 1648
- b. 4816
- c. 6814
- d. 8164

9. 82 is added to 4 times a number, and the answer is 169

- a.  $169 - 4n = 82$
- b.  $82 + 4n = 169$
- c.  $4n - 82 = 169$
- d.  $4(n + 82) = 169$

10. The sum of 25 and a number divided by 14 is 480.

- a.  $25 + \frac{n}{14} = 480$
- b.  $480 = 14 + \frac{25}{n}$
- c.  $25 - \frac{n}{14} = 480$
- d.  $25 \times \frac{n}{14} = 480$

## Creating a Fortune Teller

You will need one 8in x 8in paper square per fortune teller.

1. Fold the square along the diagonal to form a triangle. Unfold.
2. Fold the square along the opposite diagonal. Unfold.
3. Fold each corner so that they meet at the center of the square. You will now have four triangles forming a small square.
4. Flip the square so that the flaps are on the bottom.
5. Fold each corner of the square again so that the corners meet in the center.
6. Flip the square one more time.
7. Fold the square lengthwise along the center. Unfold and fold widthwise along the center. You will now have two creases in the figure.
8. Insert your thumbs and forefingers under each flap and bring fingers together toward middle.



**Uncover the Secret Agent In Each Tile**

Name: \_\_\_\_\_

**Directions:** Solve for each variable. Show all work.

|                      |                            |
|----------------------|----------------------------|
| $24f = 48$           | $2f - 162 = 634$           |
| $4m = 240$           | $\frac{m}{4} + 24 = 264$   |
| $\frac{q}{8} = 64$   | $\frac{q}{8} - 64 = 567$   |
| $12p = 144$          | $12p + 144 = 144$          |
| $\frac{w}{10} = 130$ | $\frac{w}{10} - 110 = 130$ |
| $9s = 81$            | $9s + 209 = 281$           |

**Uncover the Secret Agent In Each Tile**

Name: \_\_\_ANSWER KEY\_\_\_\_\_

**Directions:** Solve for each variable. Show all work.

|                                 |                                       |
|---------------------------------|---------------------------------------|
| $24f = 48$ $f = 2$              | $2f - 162 = 634$ $f = 398$            |
| $4m = 240$ $m = 60$             | $\frac{m}{4} + 24 = 264$ $m = 960$    |
| $\frac{q}{8} = 64$ $q = 512$    | $\frac{q}{8} - 64 = 567$ $q = 5048$   |
| $12p = 144$ $p = 12$            | $12p + 144 = 144$ $p = 0$             |
| $\frac{w}{10} = 130$ $w = 1300$ | $\frac{w}{10} - 110 = 130$ $w = 2400$ |
| $9s = 81$ $s = 9$               | $9s + 209 = 281$ $s = 8$              |

# Secret Agent Man: Who am I?

**Directions:** Uncover the Secret Agent Man's true identity by solving each equation.

1.  $5d - 7 = 33$

2.  $9 + \frac{z}{4} = 5$

3.  $\frac{w}{-2} + 17 = 23$

4.  $-9y + 4 = -32$

5.  $-3 = 6a - 21$

6.  $\frac{b}{12} - 5 = -11$

7.  $12 = \frac{h}{5} + 9$

8.  $12 - 4r = -36$

9.  $\frac{n}{3} + 13 = 1$

10. Rachel and her two sisters went shopping. They each bought 2 equally priced shirts from their favorite store. They also spent \$20 on lunch. If they spent \$128 altogether, how much did each shirt cost?



**Secret Agent Man: Who Am I?**Name: ANSWER KEY**Directions:** Uncover the Secret Agent Man's true identity by solving each equation.

1.  $5d - 7 = 33$   
 $d = 8$

2.  $9 + \frac{z}{4} = 5$   
 $z = -16$

3.  $\frac{w}{-2} + 17 = 23$   
 $w = -12$

4.  $-9y + 4 = -32$   
 $y = 4$

5.  $-3 = 6a - 21$   
 $a = 3$

6.  $\frac{b}{12} - 5 = -11$   
 $b = -72$

7.  $12 = \frac{h}{5} + 9$   
 $h = 15$

8.  $12 - 4r = -36$   
 $r = 12$

9.  $\frac{n}{3} + 13 = 1$   
 $n = -36$

10. Rachel and her two sisters went shopping. They each bought 2 equally priced shirts from their favorite store. They also spent \$20 on lunch. If they spent \$128 altogether, how much did each shirt cost?

$$6x + 20 = 128$$
$$x = 18$$



Reteach: Number Line

|    |    |    |    |    |    |    |    |    |                    |   |   |   |   |   |   |   |   |   |
|----|----|----|----|----|----|----|----|----|--------------------|---|---|---|---|---|---|---|---|---|
| -9 | -8 | -7 | -6 | -5 | -4 | -3 | -2 | -1 | Start<br>Line<br>0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|----|----|----|----|----|----|----|----|--------------------|---|---|---|---|---|---|---|---|---|

**Final Mission**  
**BCR**

Name: \_\_\_\_\_

**Step A:** Evaluate the expression:  $-8x + 12 = 68$

**Step B:** Use words, numbers, and/or symbols to explain your answer to Step A.

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**Final Mission**  
**BCR**

Name: ANSWER KEY

**Step A:** Evaluate the expression:  $-8x + 12 = 68$

$$x = -7$$

**Step B:** Use words, numbers, and/or symbols to explain your answer to Step A.

$$\begin{aligned} -8x + 12 &= 68 \\ -8x + 12 - 12 &= 68 - 12 \\ \frac{-8x}{-8} &= \frac{56}{-8} \\ x &= -7 \end{aligned}$$

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### Exploration Day 3

The following are all examples of pairs of reciprocals. Use the examples below to develop a definition of reciprocals.

Reciprocals are \_\_\_\_\_

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$$\frac{2}{3} \text{ and } \frac{3}{2}$$

$$\frac{5}{4} \text{ and } \frac{4}{5}$$

$$\frac{1}{5} \text{ and } \frac{5}{1}$$

$$\frac{6}{11} \text{ and } \frac{11}{6}$$

What happens if you multiply each pair of reciprocals?

\_\_\_\_\_

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## Chain Reaction Cards

**Directions** Cut out the cards. Mix them up. Choose a card to begin with. Solve the problem on the bottom of the card and match it with the card that has that answer on top. The last problem should match the answer at the top.

$$x = -9$$

$$2\frac{2}{3}x - 4 = 6$$

$$x = 3.75$$

$$-\frac{1}{8}x + 14 = 21$$

$$x = -56$$

$$-16 = -31 - 5x$$

$$x = -3$$

$$17 - \frac{4}{9}x = -3$$

$$x = 45$$

$$10 = \frac{3}{5}x - 8$$

$$x = 30$$

$$-12 + \frac{7}{3}x = -33$$

I Have...Who Has...? Cards

|  |   |
|--|---|
| I have ..... 50<br>Who has the solution to<br>$7x - 4 = -11$       | I have ..... -81<br>Who has the solution to<br>$-12x + -60 = 144$ |
| I have ..... -1<br>Who has the solution to<br>$4x + 3 = 19$        | I have ..... -17<br>Who has the solution to<br>$(x/3) + 3 = 8$    |
| I have ..... 4<br>Who has the solution to<br>$-9x + 5 = 23$        | I have ..... 15<br>Who has the solution to<br>$-6x + 10 = -104$   |
| I have ..... -2<br>Who has the solution to<br>$(-5/6)x + 30 = 120$ | I have ..... 19<br>Who has the solution to<br>$(x/-4) + 8 = 5$    |
| I have ..... -108<br>Who has the solution to<br>$6x + 42 = 126$    | I have ..... 12<br>Who has the solution to<br>$-9x + -90 = -243$  |
| (blank)  | (blank)   |

|   |   |
|---|---|
| <p>I have ..... 14</p> <p>Who has the solution to<br/> <math>-2x + 9 = 15</math></p>    | <p>I have ..... 17</p> <p>Who has the solution to<br/> <math>2x + 11 = 199</math></p>     |
| <p>I have ..... -3</p> <p>Who has the solution to<br/> <math>(3/2)x - 8 = 7</math></p>  | <p>I have ..... 94</p> <p>Who has the solution to<br/> <math>(3/4)x + 22 = 16</math></p>  |
| <p>I have ..... 10</p> <p>Who has the solution to<br/> <math>2x + 15 = 7</math></p>     | <p>I have ..... -8</p> <p>Who has the solution to<br/> <math>(1/2)x + 17 = 4</math></p>   |
| <p>I have ..... -4</p> <p>Who has the solution to<br/> <math>(2/3)x + 14 = 4</math></p> | <p>I have ..... -26</p> <p>Who has the solution to<br/> <math>(x/8) + 20 = 0</math></p>   |
| <p>I have ..... -15</p> <p>Who has the solution to<br/> <math>-6x + -4 = -16</math></p> | <p>I have ..... -160</p> <p>Who has the solution to<br/> <math>12x - 13 = -169</math></p> |
| <p>(blank)</p>  | <p>(blank)</p>  |

|   |  |
|---|--|
| <p>I have ..... 2</p> <p>Who has the solution to<br/> <math>(-3/2)x - 53 = 7</math></p> | <p>I have ..... -13</p> <p>Who has the solution to<br/> <math>(x/7) + 13 = 5</math></p>    |
| <p>I have ..... -40</p> <p>Who has the solution to<br/> <math>-4x + 8 = 52</math></p>   | <p>I have ..... -56</p> <p>Who has the solution to<br/> <math>(x/4) + 22 = 0</math></p>    |
| <p>I have ..... -11</p> <p>Who has the solution to<br/> <math>(x/4) + 2 = -2</math></p> | <p>I have ..... -88</p> <p>Who has the solution to<br/> <math>(x/7) + 15 = 4</math></p>    |
| <p>I have ..... -16</p> <p>Who has the solution to<br/> <math>2x - 10 = -20</math></p>  | <p>I have ..... -77</p> <p>Who has the solution to<br/> <math>(x/5) + 19 = 0</math></p>    |
| <p>I have ..... -5</p> <p>Who has the solution to<br/> <math>(x/20) - 5 = -4</math></p> | <p>I have ..... -95</p> <p>Who has the solution to<br/> <math>(-3/4)x + 3 = -15</math></p> |

|   |  |
|---|--|
| <p>I have .... 20</p> <p>Who has the solution to<br/> <math>(1/2)x + 7 = 21</math></p>  | <p>I have..... 24</p> <p>Who has the solution to<br/> <math>(-2/3)x + 12 = 50</math></p> |
| <p>I have .... 28</p> <p>Who has the solution to<br/> <math>(-4/7)x + 1 = -3</math></p> | <p>I have..... -57</p> <p>Who has the solution to<br/> <math>(x/3) - 15 = 62</math></p>  |
| <p>I have .... 7</p> <p>Who has the solution to<br/> <math>(3/5)x + 7 = -5</math></p>   | <p>I have..... 231</p> <p>Who has the solution to<br/> <math>7x + 40 = 166</math></p>    |
| <p>I have .... -20</p> <p>Who has the solution to<br/> <math>(x/2) - 10 = -6</math></p> | <p>I have..... 18</p> <p>Who has the solution to<br/> <math>(x/9) + 13 = 25</math></p>   |
| <p>I have .... 8</p> <p>Who has the solution to<br/> <math>-9x + 1 = -80</math></p>     | <p>I have .... 108</p> <p>Who has the solution to<br/> <math>-3x + 101 = 200</math></p>  |
| <p>(blank)</p>  | <p>(blank)</p>   |

|  |   |
|--|---|
| <p>I have ..... 9</p> <p>Who has the solution to<br/> <math>(-7/2)x + 4 = 200</math></p> | <p>I have ..... -33</p> <p>Who has the solution to<br/> <math>5x + 15 = 15</math></p> |
| <p>I have ..... -56</p> <p>Who has the solution to<br/> <math>(x/5) - 8 = -2</math></p>  | <p>I have ..... 0</p> <p>Who has the solution to<br/> <math>-7x + 4 = 46</math></p>   |
| <p>I have ..... 30</p> <p>Who has the solution to<br/> <math>(x/2) + 16 = 2</math></p>   | <p>I have ..... -6</p> <p>Who has the solution to<br/> <math>8x + 10 = 50</math></p>  |
| <p>I have ..... -28</p> <p>Who has the solution to<br/> <math>(x/9) + 2 = -7</math></p>  | <p>I have ..... 5</p> <p>Who has the solution to<br/> <math>4x - 100 = 100</math></p> |

**Two-Step Equations  
Summative Assessment**

Name: \_\_\_\_\_

**Multi- Step Equations Jeopardy**

**Multi-Step Must Knows**

100 - What is the goal of multi-step equations? *Isolate the variable*

200 - How would you move a number from one side of the problem to the other in order to isolate the variable? *use the opposite operation*

300 - Name the operations you would use in the first step and second step of any multi-step equation?

*First step – addition or subtraction, second step – multiplication or division*

400 - After you have solved the equation, how would you know you got the correct answer? Be specific. *Substitute the answer into the problem. If the answers are equal you are correct.*

500 - How many steps would it take to solve this problem:  $2x + 7 = 29$ ? AND solve it.

*Two steps  $x = 11$*

**One-Step Equations**

100 – Solve the equation:  $P - 13 = 34$

$p = 47$

200 – Determine the value of the variable:  $43 = g + 12$

$g = 31$

300 – Evaluate:  $7m = 56$

$m = 8$

400 – Simplify:  $W + 56 = 112$

$w = 56$

500 – Solve for the unknown:  $12 = \frac{R}{6}$

$R = 72$

**Multiplication Equations**

100 – Evaluate:  $-6c + 15 = 33$

$c = -3$

200 – Solve the equation:  $112 = -32 + 12h$

$12 = h$

300 – Simplify for a:  $4a + 73 = 25$

$a = 12$

400 – Solve:  $84 - 5m = 49$

$m = 7$

500 – Determine the value of p:  $-7 = -8p + 57$

$-8 = p$

**Division Equations**

100 – Simplify for G:  $\frac{G}{12} - 5 = 31$

$G = 3$

200 – Evaluate your answer:  $73 = \frac{Y}{6} + 13$   $Y = 10$

300 – Solve:  $\frac{K}{9} + 11 = 20$   $K = 1$

400 – Determine your answer:  $\frac{B}{5} + 7 = 32$   $B = 5$

500 – Simplify for F:  $54 = \frac{F}{8} - 8$   $F = 6$

### **Interpreting Multi-Step Equations**

100 – Write this equation as a verbal expression:  $27 = 2x - 17$   
*Answers will vary. Ex: Twenty seven is eighteen less than twice a number*

200 – Write this equation as a verbal expression:  $10 - 3x = 46$   
*Answers will vary. Ex: Ten decreased by three times a number is forty-six*

300 – Write the equation as a verbal expression:  $\frac{2}{3}x + 13 = 19$   
*Answers will vary. Ex: two thirds multiplied by a number increased by 13 is 19*

400 - Write an equation for this situation: Wanda and her husband are assessing the money they took on their 5-day cruise to Jamaica. The couple took \$1200 to spend and have already spent \$628. If they split the rest of the money evenly how much money would each person get?  
 $2x + 628 = 1200$

500 - Write a variable expression for this situation: Jonathon has six weeks to prepare for a three-mile endurance run for lacrosse camp. He can now run 1.2 miles and plans to increase his distance by an equal amount each week. How many miles should he add to the distance he runs each week?  
 $6x + 1.2 = 3$

### **Solving verbal expressions**

100 – Write a variable expression AND solve for the given situation: Max has 3 sons who love to play video games. For Christmas each boy received the same number of games for themselves and 2 games to share. If the boys received 14 games total, how many video games did each boy receive?  
 $3x + 2 = 14; x = 4$

200 – Write an equation and simplify: Jennifer drove to work 3 days a week and carpooled for the other 2 days. She also drives around 72 miles on the weekend. In a normal week Jennifer drives 141 miles. How many miles is Jennifer's commute to work each day?

$$\underline{3x + 72 = 141; x = 23}$$

300 - Create and evaluate an expression for this situation: Travis, his wife and 3 kids go out to dinner. Each person orders a meal with the same cost. The 3 children also get \$2 ice creams. If the family spent \$41 altogether, how much did each meal cost?

$$\underline{5x + 6 = 41; x = 7}$$

400 – Write a variable expression and determine the value of the variable: Kathy and 3 friends went to the movies. In addition to the tickets, Kathy and her friends spent \$21. As a group they spent \$45. How much did each movie ticket cost?

$$\underline{4x + 21 = 45; x = 6}$$

500 – Write and solve an equation for this situation: Tim is training for a marathon in 2 weeks. He runs a total of 75 miles each week. So far this week Tim has run 51 miles. He has 2 days left to run. How many miles should Tim run today if he splits the rest of the miles evenly between the 2 days?

$$\underline{2x + 51 = 75; x = 12}$$

## Summative Assessment: Two-Step Equations

**Directions:** For exercises 1 – 2, fill in the blank.

- 1) \_\_\_\_\_ is the inverse operation of division.
- 2) \_\_\_\_\_ is the inverse operation of addition.

**Directions:** For exercises 3 – 5, select the best solution.

- 3) Which of the following is the first step in solving for  $x$  in the equation  $5x + 3 = -15$  ?
  - a. Divide both sides of the equation by five
  - b. Add three to each side of the equation
  - c. Subtract three from each side of the equation
  - d. Multiply each side of the equation by five
  
- 4) When solving for  $x$  in the equation  $\frac{5x}{8} - 12 = 36$ , what value will be multiplied to both sides of the equation?
  - a.  $-\frac{5}{8}$
  - b.  $-\frac{8}{5}$
  - c.  $\frac{8}{5}$
  - d.  $\frac{1}{36}$
  
- 5) Which of the following order of operations would be used to solve for  $x$  in the equation  $4x - 16 = 30$  ?
  - a. Add, divide
  - b. Add, multiply
  - c. Divide, add
  - d. Subtract, divide

**Directions:** For exercises 6 – 17, solve for the variable. Show all work and check steps.

6)  $-7x - 7 = -42$

7)  $-2y + 29 = 13$

8)  $\frac{d}{5} - 8 = 2$

9)  $12w - 15 = 129$

10)  $\frac{x}{9} + 2 = -7$

11)  $-\frac{5}{6}y + 30 = 120$

12)  $9y + 4 = -14$

13)  $5d - 7 = 33$

14)  $\frac{m}{4} + 24 = 264$

15)  $-6x + 12 = 24$

16)  $\frac{2f}{3} + 14 = 4$

17)  $12x - 13 = -169$

**Directions:** For exercises 18 – 20, write and solve an equation for each of the situation.

18) An amusement park charges \$8 for admission and \$1.50 for each ride. Katie spends \$32 total at the amusement park. How many rides did she go on?

19) John bought a CD for \$12 and two equally priced DVDs. He spent a total of \$52. What was the cost of each DVD?

20) Ninety-eight people attended the opening night of the school play. They filled eight rows and there were 10 people sitting in the last row. How many seats were in each row?

21) **BCR**

**Step A:** Evaluate the equation:  $-12x - 60 = 144$

\_\_\_\_\_

**Step B:** Use words, numbers, and/or symbols to explain how you determined your answer in Step A.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

22) **ECR**

**Step A:** Evaluate the equation:  $\frac{x}{4} + 8 = 5$

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**Step B:**

- Use words, numbers, and/or symbols to explain how you determined your answer in Step A.

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- How might the solution in Step A change if the addition sign in the original equation were changed to a subtraction sign?

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**Two-Step Equations  
Summative Assessment**

Name: ANSWER KEY

**Directions:** For exercises 1 – 2, fill in the blank.

- 1) Multiplication is the inverse operation of division.
- 2) Subtraction is the inverse operation of addition.

**Directions:** For exercises 3 – 5, select the best solution.

- 3) Which of the following is the first step in solving for  $x$  in the equation  $5x + 3 = -15$ ?
  - a. Divide both sides of the equation by five
  - b. Add three to each side of the equation
  - c. Subtract three from each side of the equation
  - d. Multiply each side of the equation by five

- 4) When solving for  $x$  in the equation  $\frac{5x}{8} - 12 = 36$ , what value will be multiplied to both sides of the equation?

- |  |                   |
|--|-------------------|
| a. $-\frac{5}{8}$                                    | b. $-\frac{8}{5}$ |
| <input checked="" type="checkbox"/> c. $\frac{8}{5}$ | d. $\frac{1}{36}$ |

- 5) Which of the following order of operations would be used to solve for  $x$  in the equation  $4x - 16 = 30$ ?

- |  |                     |
|--|---------------------|
| <input checked="" type="checkbox"/> a. Add, divide | b. Add, multiply    |
| c. Divide, add                                     | d. Subtract, divide |

**Directions:** For exercises 6 – 17, solve for the variable. Show all work and check steps.

$$\begin{aligned} 6) \quad -7x - 7 &= -42 \\ x &= 5 \end{aligned}$$

$$\begin{aligned} 7) \quad -2y + 29 &= 13 \\ y &= 8 \end{aligned}$$

$$\begin{aligned} 8) \quad \frac{d}{5} - 8 &= 2 \\ d &= 30 \end{aligned}$$

$$\begin{aligned} 9) \quad 12w - 15 &= 129 \\ w &= 12 \end{aligned}$$

$$\begin{aligned} 10) \quad \frac{x}{9} + 2 &= -7 \\ x &= -81 \end{aligned}$$

$$\begin{aligned} 11) \quad -\frac{5}{6}y + 30 &= 120 \\ y &= -108 \end{aligned}$$

$$\begin{aligned} 12) \quad 9y + 4 &= -14 \\ y &= -2 \end{aligned}$$

$$\begin{aligned} 13) \quad 5d - 7 &= 33 \\ d &= 8 \end{aligned}$$

$$\begin{aligned} 14) \quad \frac{m}{4} + 24 &= 264 \\ m &= 960 \end{aligned}$$

$$\begin{aligned} 15) \quad -6x + 12 &= 24 \\ x &= -2 \end{aligned}$$

$$\begin{aligned} 16) \quad \frac{2f}{3} + 14 &= 4 \\ f &= -15 \end{aligned}$$

$$\begin{aligned} 17) \quad 12x - 13 &= -169 \\ x &= -13 \end{aligned}$$

**Directions:** For exercises 18 – 20, write and solve an equation for each of the situation.

18) An amusement park charges \$8 for admission and \$1.50 for each ride. Katie spends \$32 total at the amusement park. How many rides did she go on?

$x$ : Number of rides

$$1.50x + 8 = 32$$

$$x = 16 \text{ rides}$$

19) John bought a CD for \$12 and two equally priced DVDs. He spent a total of \$52. What was the cost of each DVD?

$x$ : Cost per DVD

$$2x + 12 = 52$$

$$x = \$20$$

20) Ninety-eight people attended the opening night of the school play. They filled eight rows and there were 10 people sitting in the last row. How many seats were in each row?

$x$ : Number of seats

$$8x + 10 = 98$$

$$x = 11 \text{ seats}$$

21) **BCR**

**Step A:** Evaluate the equation:  $-12x - 60 = 144$

$$\underline{\hspace{2cm}} x = -17 \underline{\hspace{2cm}}$$

**Step B:** Use words, numbers, and/or symbols to explain how you determined your answer in Step A.

$$-12x - 60 = 144$$

$$-12x - 60 + 60 = 144 + 60$$

$$\frac{-12x}{-12} = \frac{204}{-12}$$

$$x = -17$$

22) **ECR**

**Step A:** Evaluate the equation:  $\frac{x}{4} + 8 = 5$

$$\underline{\hspace{2cm}} x = -12 \underline{\hspace{2cm}}$$

**Step B:**

- Use words, numbers, and/or symbols to explain how you determined your answer in Step A.

$$\frac{x}{4} + 8 = 5$$

$$\frac{x}{4} + 8 - 8 = 5 - 8$$

$$4 \cdot \frac{x}{4} = -3 \cdot 4$$

$$x = -12$$

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- How might the solution in Step A change if the addition sign in the original equation were changed to a subtraction sign?

$$\frac{x}{4} - 8 = 5$$

$$\frac{x}{4} - 8 + 8 = 5 + 8$$

$$4 \cdot \frac{x}{4} = 13 \cdot 4$$

$$x = 52$$

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