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Lesson 10: True and False Equations

WARM-UP

Exercise 1 (4 minutes)

a. Consider the statement: "The President of the United States is a United States citizen."

Is the statement a grammatically correct sentence?

What is the subject of the sentence? What is the verb in the sentence? And what is the object of the sentence?

And finally, is the sentence true?

b. Consider the statement: "2 + 3 = 1 + 4."

This is a sentence. What is the verb of the sentence? What is the subject of the sentence and what is the object?

Is the sentence true?

c. Consider the statement: "2 + 3 = 9 + 4."

Is this statement a sentence? And if so, is the sentence true or false?

A *number sentence* is a statement of equality between two numerical expressions.

A number sentence is said to be *true* if both numerical expressions are equivalent (that is, both evaluate to the same number). It is said to be *false* otherwise. True and false are called *truth values*.

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Classwork

Exercise 1 (7 minutes)

Determine whether the following number sentences are TRUE or FALSE.

d. $4 + 8 = 10 + 5$

e. $\frac{1}{2} + \frac{5}{8} = 1.2 - 0.075$ **(HINT: Use the calculator)**

f. $(71 \cdot 603) \cdot 5876 = 603 \cdot (5876 \cdot 71)$

(What properties did we recently study that could help us answer for this number sentence?)

g. $13 \times 175 = 13 \times 90 + 85 \times 13$ **(What property is hidden in this number sentence?)**

h. $(7 + 9)^2 = 7^2 + 9^2$

i. $\frac{1}{2} + \frac{1}{3} = \frac{2}{5}$

j. $\frac{1}{2} + \frac{1}{3} = \frac{5}{6}$

k. $3^2 \times 4^2 = 12^2$

l. $3^2 \times 3^3 = 3^5$ **(What do we do with the exponents when the bases are the same?)**

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Exercise 2 (3 minutes)

a. Could a number sentence be both TRUE and FALSE?

b. Could a number sentence be neither TRUE nor FALSE?

An *ALGEBRAIC EQUATION* is _____.

Exercises 3 - ALWAYS TRUE, SOMETIMES TRUE, NEVER TRUE

When algebraic equations contain a symbol whose value has not yet been determined, we use analysis to determine whether:

1. The equation is true for all the possible values of the variable(s), or
2. The equation is true for a certain set of the possible value(s) of the variable(s), or
3. The equation is never true for any of the possible values of the variable(s).

For each of the three cases, write an algebraic equation that would be correctly described by that case. Use only the variable, x, where x represents a real number.

Example 1

Consider the following scenario.

Julie is 300 feet away from her friend's front porch and observes, "Someone is sitting on the porch."

Given that she didn't specify otherwise, we would assume that the "someone" Julie thinks she sees is a human. We can't guarantee that Julie's observatory statement is true. It could be that Julie's friend has something on the porch that merely looks like a human from far away. Julie assumes she is correct and moves closer to see if she can figure out who it is. As she nears the porch she declares, "Ah, it is our friend, John Berry."

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Exercise 5 (6 MINUTES)

Name a value of the variable that would make each equation a true number sentence.

Here are several examples of how we can name the value of the variable:

Let $w = -2$, then $w^2 = 4$ is true.

Or:

$w^2 = 4$ is true when $w = -2$

Or:

$w^2 = 4$ is true if $w = -2$

Or:

$w^2 = 4$ is true for $w = -2$ and $w = 2$.

There might be more than one option for what numerical values to write. (And feel free to write more than one possibility.)

Warning: Some of these are tricky. Keep your wits about you!

a. Let _____, then $7 + x = 12$ is true.

b. $m^3 = -125$ is true for _____.

c. A number x and its square, x^2 have the same value when _____.

d. The average of 7 and n is -8 if _____.

e. Let _____, then $2a = a + a$ is true.

f. $q + 67 = q + 68$ is true for _____.

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Classwork/Homework

Determine whether the following number sentences are true or false.

1. $18 + 7 = \frac{50}{2}$
2. $3.123 = 9.369 \cdot \frac{1}{3}$
3. $(123 + 54) \cdot 4 = 123 + (54 \cdot 4)$

In the following equations, let $x = -3$ and $y = 2/3$. Determine whether the following equations are true, false, or neither true nor false.

4. $xy = -2$
5. $x + 3y = -1$
6. $x + z = 4$

For each of the following, assign a value to the variable, x, to make the equation a true statement.

7. $(d + 5)^2 = 36$ for _____.

8. $\frac{1}{x} = \frac{x}{1}$ if _____.

9. $x + 2 = 9$
10. $x + 2^2 = -9$
11. $-12t = 12$
12. $12t = 24$
13. $\frac{1}{b-2} = \frac{1}{4}$
14. $\frac{1}{2b-2} = -\frac{1}{4}$
15. $\frac{2}{3} + \frac{1}{5} = \frac{3}{x}$

Generate the following:

16. An equation that is always true
17. An equation that is true when $x = 0$
18. An equation that is never true
19. An equation that is true when $t = 1$ or $t = -1$
20. An equation that is true when $y = -0.5$
21. An equation that is true when $z = \pi$

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Exit Ticket

1. Consider the following equation, where a represents a real number: $\sqrt{a+1} = \sqrt{a} + 1$.

Is this statement a number sentence? If so, is the sentence TRUE or FALSE?

2. Suppose we are told that *b* has the value 4. Can we determine whether the equation below is TRUE or FALSE? If so, say which it is, if not, state that it cannot be determined. Justify your answer.

$$\sqrt{b+1} = \sqrt{b} + 1$$

3. For what value of c is the following equation TRUE?

$$\sqrt{c+1} = \sqrt{c} + 1$$