

T101 SECTION 3-1 ADDITION AND SUBTRACTION OF WHOLE NUMBERS

I. INTRODUCTION

We have already discussed the NATURAL NUMBERS and now we will begin discussion of the WHOLE NUMBERS. What is the difference between these two sets of numbers?

Natural Numbers or $\mathbf{N} = \{ \quad \quad \quad \}$

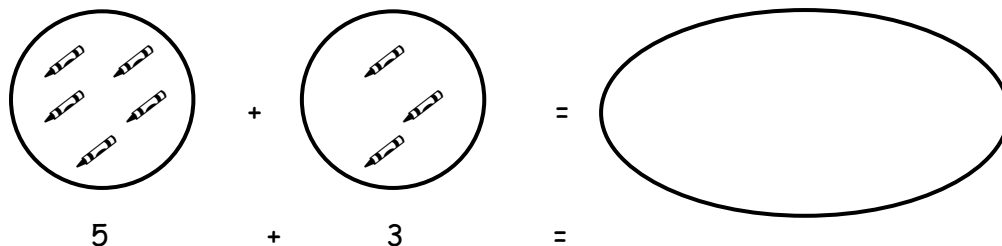
Whole Numbers or $\mathbf{W} = \{ \quad \quad \quad \}$

For the remainder of this chapter, we will be examining a variety of models that can be used to teach basic computational skills (+, -, \times , \div).

II. ADDITION OF WHOLE NUMBERS

A. SET MODEL: Combining Sets

Example: If Jessica has 5 s and Andrew has 3 s, how many do they have together?



DEFINITION OF ADDITION OF WHOLE NUMBERS

Let A and B be two *disjoint* sets. If $n(A) = a$ and $n(B) = b$, then

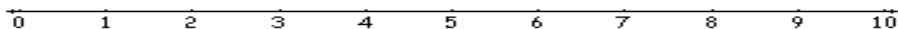
$$a + b = n(A \cup B)$$

The numbers a and b are called the _____

and $(a+b)$ is called the _____.

B. NUMBER LINE MODEL

Example: Josh has 4 feet of red ribbon and 3 feet of blue ribbon. How many feet of ribbon does Josh have altogether?

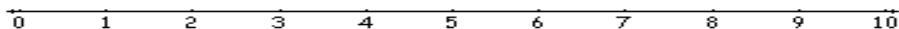


Note the direction of the arrows. Using these arrow helps to distinguish addition and subtraction on the number line.

When showing the number line model on an exam, you will be graded on the following:

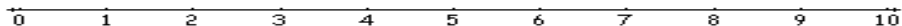
- A separate arrow for each of the Addends
- A separate arrow for the Sum
- Be sure to indicate the final answer (write the addition sentence).

Example: Model $8 - 6$, using the number line.



GREATER THAN AND LESS THAN

We can also use the number line to introduce the concepts of greater than and less than.



Since 4 is to the left of 7, we could say

"4 is _____ 7" and we would write _____.

Or we could also say that

"7 is _____ 4" and we would write _____.

DEFINITION OF LESS THAN

For any whole numbers a and b , we can say that a is *less than* b if and only if there exists a natural number k such that when a is added with k , you get b .

$$a < b \quad \text{if and only if} \quad a + k = b$$

$a > b$ means _____ $a < b$ means _____

$a \geq b$ means _____ $a \leq b$ means _____

C. PROPERTIES OF ADDITION OF WHOLE NUMBERS

1. Closure Property of Addition of Whole Numbers

For any whole numbers a and b , _____

This simply means that given any set, the set is closed under addition if the sum of any two or more elements is also a member of the set.

Which of the following are closed under addition?

$\{2, 4, 6, 8, \dots\}$

$\{1, 2, 3, 4\}$

$\{1, 3, 5, 7, \dots\}$

$\{0\}$

$\{0, 1\}$

2. Commutative Property of Addition of Whole Numbers

For any whole numbers a and b , _____

3. Associative Property of Addition of Whole Numbers

For any whole numbers a , b , and c , _____

4. Identity Property of Addition of Whole Numbers

There is a unique whole number _____, called the *additive identity* such that for any

whole number a , _____

Name the demonstrated property.

BE SURE TO WRITE COMPLETE NAME, SPELLED CORRECTLY.

$$4 + 9 = 9 + 4$$

$$(3 + 8) + 5 = 3 + (8 + 5)$$

$23 + 54$ is a whole number

$$0 + k = k + 0 = 0$$

$$(a + b) + c = (b + a) + c$$

$$(x + 3) + 4 = 4 + (x + 3)$$

D. MASTERING ADDITION FACTS

The following is a list of strategies used to help children master their basic addition facts. Basic addition facts are those that involve a single digit plus a single digit.

1. **Counting On** - Starting with the greater addend, count on. However, this strategy works best when one of the addends is a 1, 2, or 3. Otherwise it can become quite inefficient.

$$7 + 3 = (\text{think } 7, \dots 8, 9, 10)$$

$$2 + 9 = (\text{think } 9, \dots 10, 11)$$

$$4 + 8 = (\text{think } 8, \dots 9, 10, 11, 12)$$

2. **Doubles** - Learning doubles ($1+1=2$, $2+2=4$, etc.) receives special attention in the classroom. We can extend the knowledge of these fact to *doubles + 1* and *doubles + 2*.

$$\begin{array}{l} \text{Since } 5 + 5 = 10 \text{ then} \quad 5 + 6 = (5 + 5) + 1 = 11 \\ \quad \quad \quad \quad \quad \quad \quad 5 + 7 = \underline{\hspace{2cm}} \end{array}$$

3. **Making 10** - Students quickly learn that it is easy to add onto 10.

$$7 + 6 = (\text{think } 7 + 3 \text{ plus } 3 \text{ more}) \quad (7 + 3) + 3 = 10 + 3 = 13$$

$$9 + 8 = (\text{think } 9 + 1 \text{ plus } 7 \text{ more}) \underline{\hspace{2cm}}$$

[Or they might use the doubles $(8 + 8) + 1 = 17$]

4. **Counting Back** - Used when one number is 1 or 2 less than 10

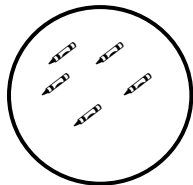
$$9 + 6 = (\text{think } 10 + 6 \text{ then count back } 1) \quad 10 + 6 = 16 \text{ then } 16 - 1 \text{ is } 15$$

$$4 + 8 = (\text{think } 4 + 10 \text{ then count back } 2) \quad \underline{\hspace{2cm}}$$

III. SUBTRACTION OF WHOLE NUMBERS

A. TAKE-AWAY MODEL

Example: If Jessica has 5 s and Andrew steals 3 s, how many does she have left?



B. MISSING-ADDEND MODEL

This model relates subtraction back to the basic addition facts that the student has already mastered. This will then lead us to the Definition of Subtraction.

$9 - 4 = \square$ this leads us to think $\square + 4 = 9$ (*Find the missing-addend*)

The Missing-Addend model gives elementary school students their first opportunity to think *algebraically* - find the "unknown" amount.

It also introduces the concept of "fact families".

$$4 + 5 = 9$$

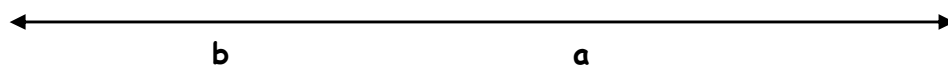
$$5 + 4 = 9$$

$$9 - 5 = 4$$

$$9 - 4 = 5$$

DEFINITION OF SUBTRACTION

For any whole numbers a and b such that $a \geq b$, the difference $(a - b)$ is the unique whole number c such that $a = b + c$.



Given the subtraction problem $m - s = d$

Hint: "*My - Subtraction = Definitions*"

m is called the _____

s is called the _____

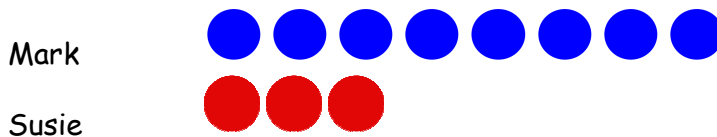
d is called the _____

C. COMPARISON MODEL

This model brings in the idea of "*how much more than?*" and how this concept is a subtraction problem.

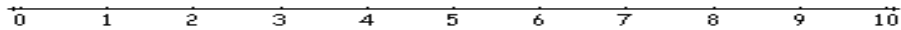
Example: Suppose Mark has 8 blue marbles and Susie has red 3.
How many more marbles does Mark have?

By pairing Susie's marbles up with Mark's marbles, the child can discover that Mark has 5 more marbles than Susie. Thus, $8 - 3 = 5$



D. NUMBER LINE MODEL

Example: Model $9 - 3$, using the number line.

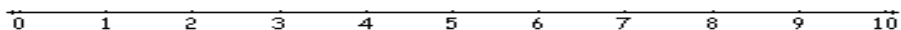


Note the direction of the arrows. Using these arrow helps to distinguish addition and subtraction on the number line.

When showing the number line model on an exam, you will be graded on the following:

- An arrow for the Minuend
- An arrow for the Subtrahend
- Shade the Difference
- Be sure to indicate the final answer (write the subtraction sentence).

Example: Model $8 - 6$, using the number line.



REVIEW

List the Models of Addition:

1. _____

2. _____

List the Models of Subtraction:

1. _____

2. _____

3. _____

4. _____