

Part One:

Definitions: For each operation you should carefully define the operation. If appropriate, you should give multiple definitions for the operations and explain why they are appropriate.

Standard Algorithms: For each operation you should include a careful description of the standard algorithm for computing the result of that operation. In addition, you should explain why the standard algorithm yields the correct answer.

Important Properties: For each of the basic operations you should include a discussion of important properties of the operation, e.g. commutativity, associativity, etc. Each property should be justified in terms of the definition of the operation.

- **Subtraction:** Taking objects away from a group to make a new group; regrouping objects. When you subtract; start with the far right and if the number on top is smaller than the number on bottom then you need to pull (barrow) from the column on the left if the integer greater than zero. If it does not have an integer greater than zero move to the next column on the left and pull (barrow) from the number on the top. (That will be a continuation with any too number that is smaller than the bottom number.) When you pull from the left hand column to make the right hand column bigger than the bottom number it increases the number by 10. Now that we have made the top number bigger than the bottom you proceed subtracting the bottom number from the top.
- **Addition:** Taking one collections of objects and combining them to another collection of objects to make one new singular group of objects. In our one handed notation system you are not allowed more than 4 in a place value. When you reach a total of 5 you must regroup them and move them to the next place value spot. This is what we refer to as carrying. When we add we add right to left and use one place value at a time. Start by adding the right hand column and then putting your answer in the answer place. If the number is greater than 4 you need to move it to the next place value spot to the left. Addition is communicative meaning the order doesn't matter.
- **Multiplication:** Multiplication is communicative meaning that $(a \times b) = (b \times a)$. $3 \times 2 = 6$ just as $2 \times 3 = 6$. Order doesn't matter. Multiplication is distributed over addition.
- **Division:** The standard algorithm is long division! When dividing using the standard algorithm you start with your outside number and see how many times that number fits into the first number and that number goes on top. Then you take the top number times the outside number and put that under your first number. You then subtract and whatever is left you bring down the next number under the division line and repeat the process.

Part Two:

Story problems:

- Robert has two Cardinal birds on the tree in his front yard. Two more Cardinal birds, three blue jays and a hawk join them. How many total birds are there? Use the standard algorithm of **ADDITION** to find the sum of the birds in Roberts tree.
- If Stacy has 12 pieces of gum and she has three friend, could she give out equal number of pieces to them including herself? Use the standard algorithm of **DIVISION** to solve this.

- There are 14 calories in a granola bar. How many calories are there in a 42 granola bars? Use the standard algorithm of **MULTIPLICATION** to find your answer.
- Sam was playing with her classmates. She and her group of 9 friends were playing hopscotch. It was close to parent pick up time and Jill, Sally, Sue and Josie were picked up by their parents. If Sam was playing with 9 friends at the beginning, how many friends is she playing with now? Use the standard algorithm of **SUBTRACTION** to find your answer.

Part Three:

1.) 25×12

Solve using standard multiplication but with using our base five finger notation we have been up till this point in the semester. Show how you got this using manipulatives.

2.) Solve the following problem using manipulatives and explaining the exchanges you make throughout the process. $25 - 12$

3.) 434 divided by 4. Solve using standard division and show all exchanges.

4.) $432 + 443 = ?$ Solve using the standard algorithm for addition.

5.) Jill has 9 pennies, 7 nickels, and 5 quarters. What dollar amounts can she make?

6.) Give a single picture that illustrates 4 groups of 6 and 6 groups of 4. Explain this picture's relationship to properties of multiplication.

7.) Explain how 6×7 is the same as 7×6 .

8.) Explain how $2 + (7+9) =$ the same thing as $(2+7) + 9$

9.) 223×4 solve and explain what definition of multiplication you used and why it works.

10.) A. $\{x \mid x \text{ is all even numbers}\}$

B. $\{1,2,3,4,5,6,7,8,9\}$

C. $\{1,3,5,7,9\}$

D. $\{2,4,6,8,0\}$

What is DUC?