Lab Experiment 0

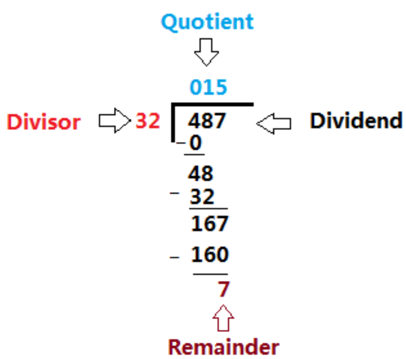
Math Review

INTRODUCTION

Laboratory 0 is based on a review of the basic mathematics used for digital computing technicians. The topics include how to find the remainder of a division, the basic rules of mathematical order of operation, and basic algebra laws.

PART 1 – DIVISION

One of the basic math that student should remember for the digital electronics class is to find the remainder of a division. A brief review of it starts with identifying the part of a division: dividend, divisor, quotient, and remainder.



The ***dividend*** is the number that is being divided. The ***divisor*** is the number divide the dividend. The ***quotient*** is the number of times the *divisor* is into the *dividend*. The ***remainder*** is the number left out the *quotient* count because it is less than the *divisor* and it cannot form a whole *divisor* number.

1.1 How to find the remainder using a calculator

Divide the dividend with the divisor: $487 \div 32 = 15.21875$

From the result, 15.21875, 15 is the quotient and 0.21875 is the fraction part of the division. The remainder is found by multiplying the fraction or decimal part of the result with the divisor: $0.21875 \times 32 = 7$
In this case, the remainder is 7, and the quotient is 15

Other method to find the quotient using a calculator is to divide the dividend and the divisor first: $487 \div 32 = 15.21875$

Then, multiply the quotient and the divisor,
$15 \times 32 = 480$

Now subtract the dividend with the product of the quotient and the divisor

$487 - 480 = 7$

The difference, which is 7, is the remainder.

Example) Find each remainder of a chain division of $175 \div 8$

To find each remainder of a chain division of $175 \div 8$, we can:

Step 1) Solve for the division and identify each part of the division.

Step 2) The quotient of the division becomes the new dividend of the next division

Step 3) Keep dividing until the dividend is less than the divisor.

Exercise #	Dividend	Divisor	Quotient	Remainder
$175 \div 8$	175	8	21	7
	21	8	2	5
	2	8	-	**2**

Stop the division because the dividend, which is **2**, is less than the divisor which is 8. In this case, **2** is the last remainder of this chain division.

Exercises 1.1 – Find each remainder of a chain division

For the following division, find each remainder of the chain division:

1. 352 ÷ 16
   ____
   ____
   ____
   ____
   ____

2. 215 ÷ 8
   ____
   ____
   ____
   ____
   ____

3. 59 ÷ 2
   ____
   ____
   ____
   ____
   ____

PART 2 – ORDER OF OPERATIONS

Order of operation in math, including the use in a calculator and computer programming, is a set of rules where indicates which procedures to perform first in order to solve for a mathematical expression. Indeed, the order of operation in math is **P**arentheses, **E**xponents, **M**ultiplication and **D**ivision, and **A**ddition and **S**ubtraction or simply **PEMDAS**

For example, evaluate - 9+3× (2 - 8) ÷ 6 + 2 using the order of operations:

Parenthesis	➔	- 9+3× (- 6) ÷ 6 + 2
Exponent	➔	None
Multiplication	➔	- 9 -18 ÷ 6 + 2
Division	➔	- 9 – 3 + 2
Addition	➔	- 9 – 1
Subtraction	➔	- 10

When you have an expression where the division comes before a multiplication, then you perform the division operation first and then the multiplication

For example, evaluate (3 + 8) + 112 ÷ 7 × 2^3

Parenthesis	➔	(11) + 112 ÷ 7 × 2^3
Exponent	➔	11 + 112 ÷ 7 × 8
Division	➔	11 + 16 × 8
Multiplication	➔	11 + 128
Addition	➔	139
Subtraction	➔	None

To solve an operation using a calculator or computer programming, it is always important to set the parenthesis in the right location. For example, if we want to perform the following operation:

$$x = \frac{1}{\frac{1}{120} + \frac{1}{360}}$$

Solving *x* by hand, first we need to simplify the denominator by adding $\frac{1}{120}$ and $\frac{1}{360}$

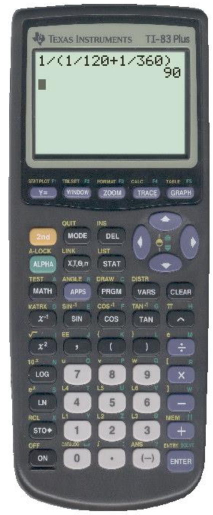
$\frac{3\times1}{3\times120} + \frac{1}{360} = \frac{3}{360} + \frac{1}{360} = \frac{4}{360}$ ➔ $x = \frac{1}{\frac{4}{360}}$

After it, we perform the division of fraction ➔ $1 \div \frac{4}{360} = \frac{360}{4}$

$x = \frac{360}{4}$

The last step is to simplify 360 with 4, which is 90 ➔ *x = 90*

Now, to solve for *x* using a calculator, since we need to simplify the denominator first, then we need to place parenthesis to the denominator expression. As the calculator follows the order of operation, it will solve the expression within the parenthesis and then 1 divide to the simplified denominator:



Exercises 1.2 – Order of Operation

Evaluate the following mathematical expression using order of operation

1. $(2 + 76 \div 1 + 9) + 4 – 3 \times 9$

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   ____

   ____

2. $5 - (49 \div 1 - 5) \times 2 + 9 – 3$

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   ____

   ____

   ____

   ____

3. $5 + (9 + 6^3 – 3) – 3$

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   ____

   ____

   ____

   ____

4. $10 + (6 \times 5) + 9^3 \times 8$

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PART 3 – BASIC ALGEBRA LAWS

3.1 Commutative Laws of addition and multiplication

Commutative law states that the reordering the terms or factors in an equation does not alter its sum or product

Addition ➔ $3+5+7 = 5+7+3 = 7+3+5 = 3+7+5 = 5+3+7$

$A + B + C = B + A + C = C + B + A = A + C + B$

Multiplication ➔ $2\times4\times6 = 4\times6\times2 = 6\times2\times4 = 2\times6\times4 = 4\times2\times6$

$A\times B\times C = B\times C\times A = B\times A\times C = C\times A\times B = C\times B\times A$

3.2 Associative Laws of addition and multiplication

Associative laws states that the terms or factors in an equation may be associated or grouped in any way desired and it will not alter the sum or product

Addition ➔ $(3+5)+7 = 3+(5+7) = (3+7)+5$

$A + (B + C) = (A + B) + C = (A + C) + B$

Multiplication ➔ $(2\times4)\times6 = 2\times(4\times6) = (2\times6)\times4$

$A\times(B\times C) = (A\times B)\times C = (A\times C)\times B$

3.3 Distributive Law

The distributive law states that a multiplication factor is distributed with each of the terms inside the parenthesis. Basically, multiplying a term with a group of terms added together is the same as the addition of their product separately

$A\times(B+C) + B = AB + AC + B$

$2\times(4+6) + 10 = (2\times4) + (2\times6) + 10$

Combination of commutative, distribute, and associative laws

$AB \times (C+D) + AC = ABC + ABD + AC$	➔ Distribute law
$ABC + ABD + AC = ABD + ABC + AC$	➔ Commutative law
$ABD + ABC + AC = ABD + (ABC + AC)$	➔ Associative law
$ABD + (ABC + AC) = ABD + AC(B + 1)$	➔ Factor the expression within the parenthesis

Exercises 1.3 - Basic Algebra Laws

Apply the community laws to the following equations

1. $AB \times BC \times CD$ ________________________
2. $XYZ + XY + ZX + YZ$ ___________________

Apply associate law to find the missing elements for the following equations

3. $(3A + $ ____ $) + 5C = (3A + 5C) + 7B =$ _____ $+ ($ ____ $+$ _____ $)$
4. $2X \times (35YZ) =$ ____ $\times (14X$___$) = (10X$____$) \times$_____

Apply the distributive law to the following equations

5. $15Y(Z + 7)$
6. $-6A(2B - 8C)$

Apply different algebra laws and factor, if it is necessary, for the following equations. Show all steps and mention in each step what was the algebra law that was applied:

7. $X \times (Y+1) + Y \times (XZ + X)$

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8. $(-3A + 5B) \times 2A + 3B[2 \times (4 + 7A) - 10A]$

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PART 4 – BASE AND EXPONENTS

A number that is multiply by itself different times can be expressed with a base number and an exponent. The number that is being multiplied is known as the base number, and the number that the number is being multiplied is known as the exponent.

Base number

$$\underbrace{2 \times 2 \times 2}_{\text{3 factors of 2}} = 2^{3} \rightarrow \text{exponent}$$

Exercises 1.4 – Base and Exponent

Represent the following factors with a base number and exponent

1. 8×8×8×8×8 = ________________________________
2. 10×10×10 = _________________________________
3. 2×2×2×2×2×2 = ______________________________

Solve the following operation:

4. $2^5 + 10^6 - 8^4$ = _____________________________
5. $10^0 - 2 \times 8^3 + 16^5$ = ___________________________
6. $5^3 \times 2^0 - 6^1 + 9^2 \div (2^5 \times 1^{20}) + 3^2$ = _______________

Student's Name: _________________ Lab instructor's signature ______________________

------ **LAB EXPERIMENT 0 ENDS HERE** -------