<u>Chapter 1 Introduction to Logic</u>

<u>Section 1.1</u>

<u>Statement</u>: is a declarative sentence, which has a truth value; that is, it is either true or false, but not both true and false.

The following symbols will be used in logic: p , q, r, **and sometimes** s **where:**

$p \vee q$ **: read it as** p **<u>or</u>** q **or both** ***(Disjunction)***

$p \wedge q$ **: read it as** p **<u>and</u>** q ***(Conjunction)***

$\sim p$ **: read it as <u>not</u> p** ***(Negation)***

Example 1: p **= Mike likes coffee ;** q **= Mike likes tea**

a) Mike likes coffee and he likes tea too.

b) Mike likes coffee and he does not like tea

c) Mike does not like coffee and he does not like tea.

There will be 4 rules regarding Chapter 1:

Rules 1 & 2: v ***or*** **;** $\wedge$ ***And*** **(section 1.1)**

Rules 3 & 4: $\rightarrow$ ***If*** **;** $\leftrightarrow$ ***If and only if*** **(section 1.2)**

Rule 1: Using the v symbol (**<u>or</u>**), it is true when either one or both are true.

T v T = T
T v F = T
F v T = T
F v F = F

Rule 2: Using the $\wedge$ symbol (**<u>and</u>**), it is true only when both are true.

T $\wedge$ T = T
T $\wedge$ F = F
F $\wedge$ T = F
F $\wedge$ F = F

In creating the truth table:

The number of rows in the truth table depends on the number of variables n:

For *p* and *q* (*n* = 2 variables), number of rows = 4

For *p, q* and *r* (*n* = 3 variables), number of rows = 8

For *p, q, r* and *s* (*n* = 4 variables), number of rows = 16

The above numbers were found using the formula of 2^n which will be used in chapter 2 in finding the number of subsets.

For *p* and *q* with 4 rows: The first column 2 T and 2 F, the second column 1 T and 1 F.

p	q
T	T
T	F
F	T
F	F

For *p, q* and *r* with 8 rows: The first column 4 T and 4 F, the second column 2 T and 2 F and the third column 1 T and 1 F

p	q	r
T	T	T
T	T	F
T	F	T
T	F	F
F	T	T
F	T	F
F	F	T
F	F	F

- **Example 2**: Construct the truth table for:

a) $\sim(p \wedge \sim q) \vee p$

p	q				
T	T				
T	F				
F	T				
F	F				

b) $(p \vee q) \wedge (p \vee \sim r)$

p	q	r				
T	T	T				
T	T	F				
T	F	T				
T	F	F				
F	T	T				
F	T	F				
F	F	T				
F	F	F				

Tautology = **valid argument**: is a statement that is true for all possible combinations of truth conditions for the component statement (*the elements of the last column are **all** T).* See example 2a.

Contradiction: is a statement that is false for all possible combinations of truth conditions for the component statement (*The elements of the last column are **all** F*).

Logical Equivalence: When they have identical truth values under identical truth conditions of the simple statement (*When two statements have identical last column in the truth tables*). See example 3.

- **Example 3**: Construct the truth table for:

a) $\sim(p \wedge q)$

p	q		
T	T		
T	F		
F	T		
F	F		

b) $\sim p \vee \sim q$

p	q			
T	T			
T	F			
F	T			
F	F			