LONDON metropolitan university

First - SIT 12 HOURS ASSESSMENT QUESTION PAPER:

Module Code:	**MA4001NI**
Module Title:	**Logic and Problem Solving**
Module Leader:	**Ashok Dhungana** (Islington College)

Date:	
Day / Evening:	**Day**
Start Time:	
Duration:	**12 HOURS**

Test Type:	*12 HOURS ASSESSMENT*
Materials permitted:	
Warning:	Candidates are warned that possession of unauthorised materials in a test is a serious assessment offence.

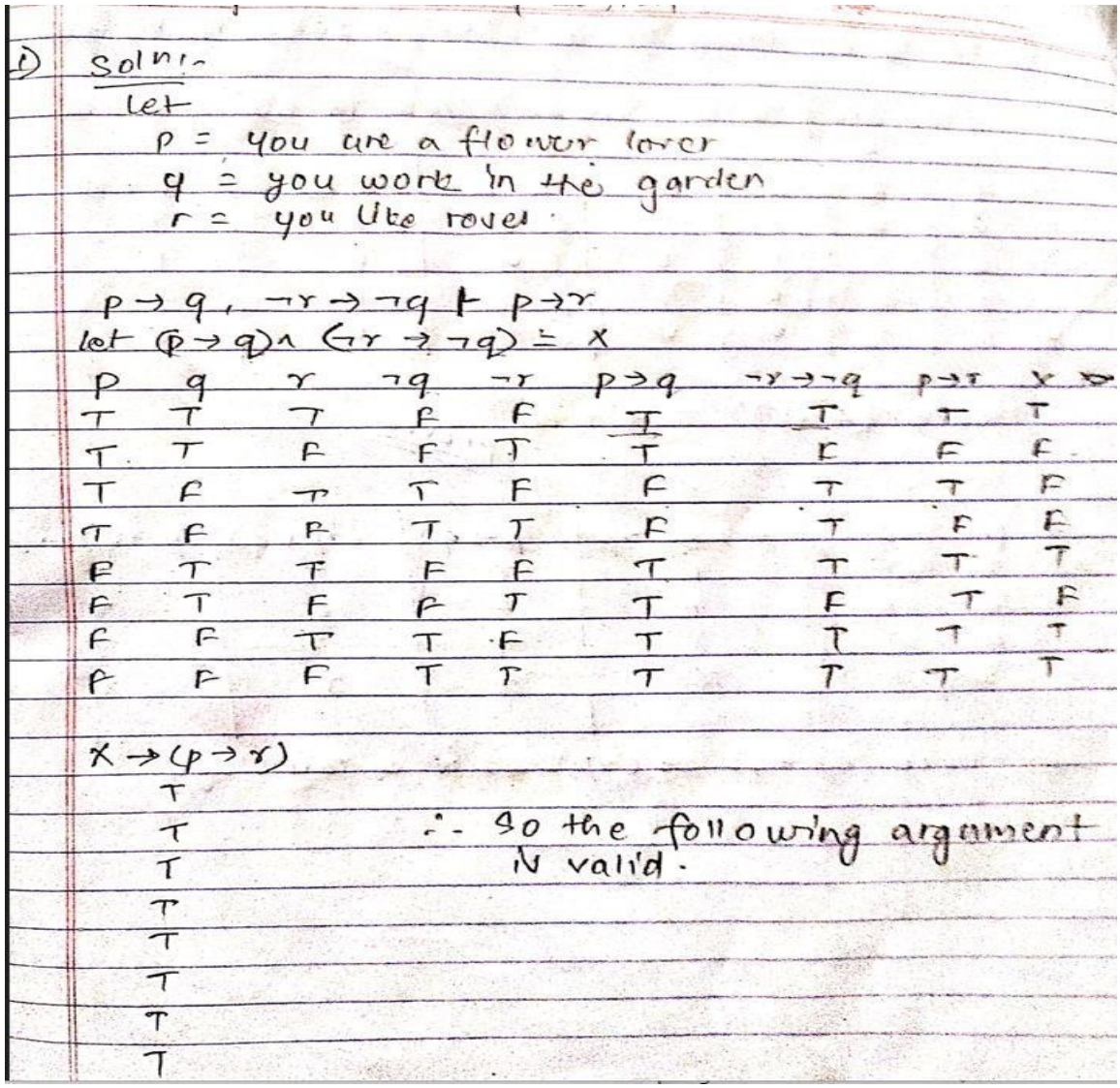
Instructions to candidates:	**Please Note:** Inclusive of this cover page, this test paper consists of 3 pages **and 10 Questions.** The student must complete all Questions. This test accounts for 25% of your total module marks.

Marks will be awarded for correctness and appropriate presentation of the answers.

Attempt all the questions.

1. Check the validity of the following argument:

If you are a flower lover, then you work in the garden. If you don't like roses, then you don't work in the garden. Therefore, if you are flower lover, then you like roses.



1) Soln:-

let

p = you are a flower lover

q = you work in the garden

r = you like roses.

$p \to q, \neg r \to \neg q \vdash p \to r$

let $(p \to q) \wedge (\neg r \to \neg q) = X$

p	q	r	¬q	¬r	p→q	¬r→¬q	p→r	X
T	T	T	F	F	T	T	T	T
T	T	F	F	T	T	F	F	F
T	F	T	T	F	F	T	T	F
T	F	F	T	T	F	T	F	F
F	T	T	F	F	T	T	T	T
F	T	F	F	T	T	F	T	F
F	F	T	T	F	T	T	T	T
F	F	F	T	T	T	T	T	T

$X \to (p \to r)$

T
T
T
T
T
T
T
T

∴ So the following argument is valid.

[10 marks]

2. Verify De Morgan's laws using truth table .

2) Verify De Morgan's laws using table Truth table

→ According to De Morgan's law $(A \cdot B)' = A' + B'$

A	B	A'	B'	A · B	(A · B)'	A' + B'
0	0	1	1	0	1	1
0	1	1	0	0	1	1
1	0	0	1	0	1	1
1	1	0	0	1	0	0

Hence $(A \cdot B)' = A' + B'$ proved

[10 marks]

3.

a) Construct a truth table to show that $(p \rightarrow q) \leftrightarrow (\neg p \vee q)$ is a tautology.

3) a)

p	q	p → q	¬p	(p → q)	(¬p ∨ q)	(p → q) ↔ (¬p ∨ q)
T	T	T	F	T	T	T
T	F	F	F	F	F	T
F	T	T	T	T	T	T
F	F	T	T	T	T	T

Hence $(p \rightarrow q) \leftrightarrow (\neg p \vee q)$ is a tautology.

[5 marks]

b) Show that $\neg (p \vee (\neg p \wedge q))$ and $(\neg p \wedge \neg q)$ are logically equivalent by using laws.

Soln–

To show;

$\neg (p \vee (\neg p \wedge q)) \equiv (\neg p \wedge \neg q)$

L·H·S = $\neg (p \vee (\neg p \wedge q))$

= $\neg ((p \vee \neg p) \wedge (p \vee q))$ (Distributive law)

= $\neg (\text{True} \wedge (p \vee q))$ (Complement law)

= $\neg (p \vee q)$ (Identity law)

= $\neg p \wedge \neg q$ (De Morgan law)

= R·H·S

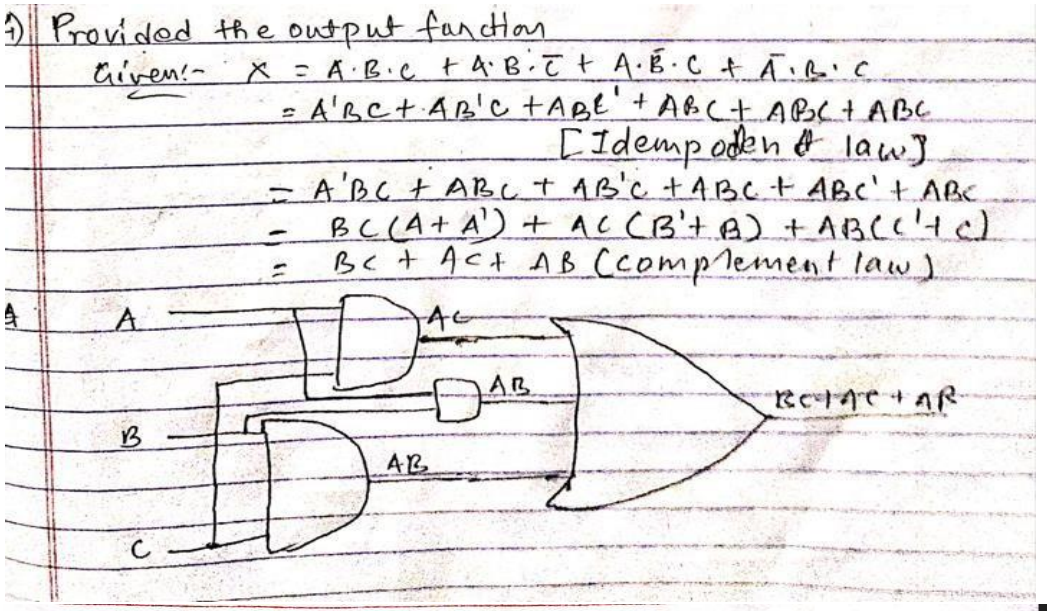
proved

[5 marks]

4. Provided the output function:

$$X = A.B.C + A.B.\bar{C} + A.\bar{B}.C + \bar{A}.B.C$$

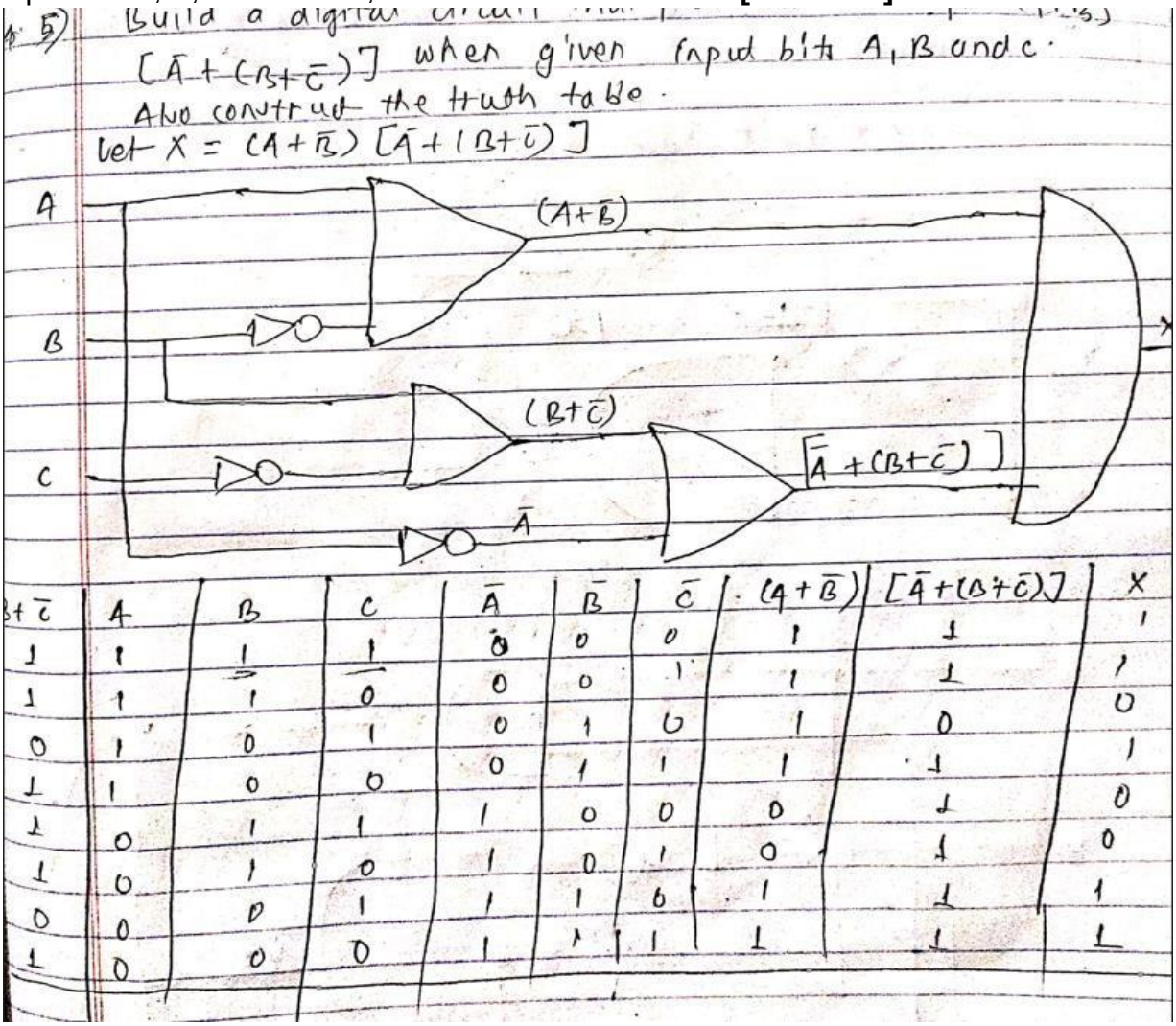
a) Using the laws, simplify the expression as much as possible. **[6 marks]**
b) Construct the logic circuit of the simplified expression. **[2 marks]**
c) Construct the truth table of the simplified expression. **[2 marks]**



A	B	C	AB	AC	BC	BC+
1	1	1	1	1	1	1
1	1	0	1	0	0	0
1	0	1	0	1	0	1
1	0	0	0	0	0	0
0	1	1	0	0	1	1
0	1	0	0	0	0	0
0	0	1	0	0	0	0
0	0	0	0	0	0	0

BC+AC+AB
1
1
1
0
1
0
0
0

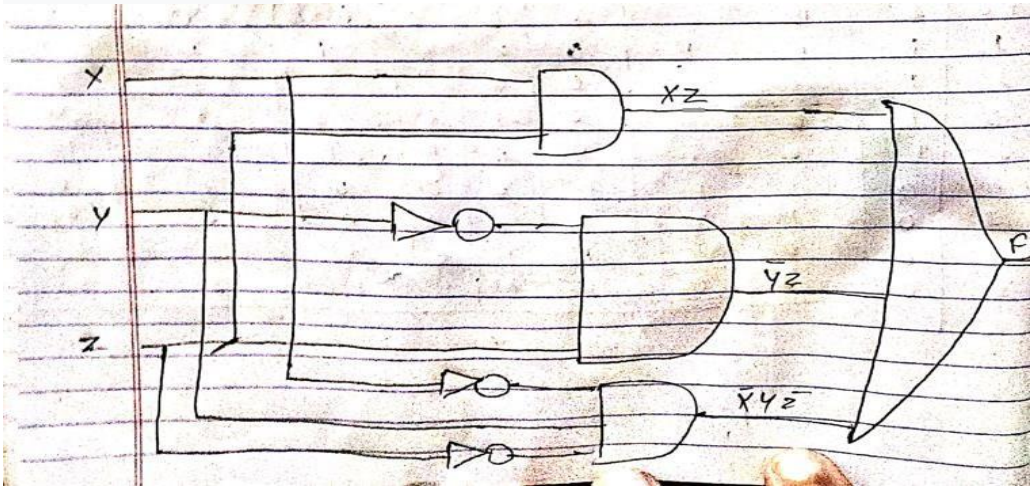
5. Build a digital circuit that produces the output $(A + \bar{B})\ [\bar{A} + (B + \bar{C})]$ when given input bits A, B, and C. Also, construct the truth table. **[10 marks]**



B+C̄	A	B	C	Ā	B̄	C̄	(A+B̄)	[Ā+(B+C̄)]	X
1	1	1	1	0	0	0	1	1	1
1	1	1	0	0	0	1	1	1	1
0	1	0	1	0	1	0	1	0	0
1	1	0	0	0	1	1	1	1	1
1	0	1	1	1	0	0	0	1	0
1	0	1	0	1	0	1	0	1	0
0	0	0	1	1	1	0	1	1	1
1	0	0	0	1	1	1	1	1	1

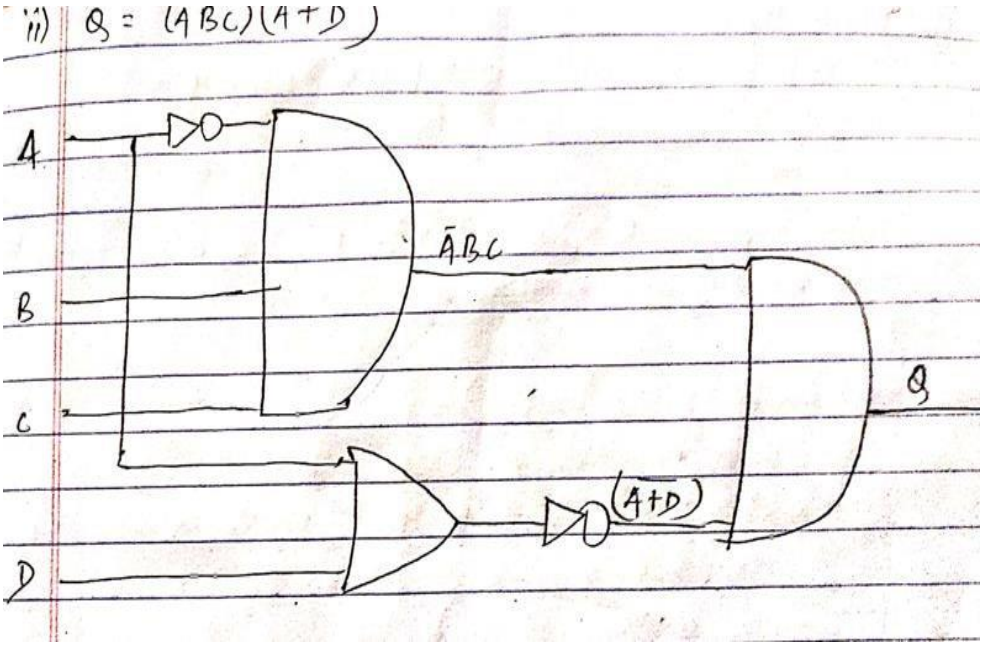
6. Draw the logic circuit for the following output functions.

i) $F = XZ + YZ + \bar{X}YZ$



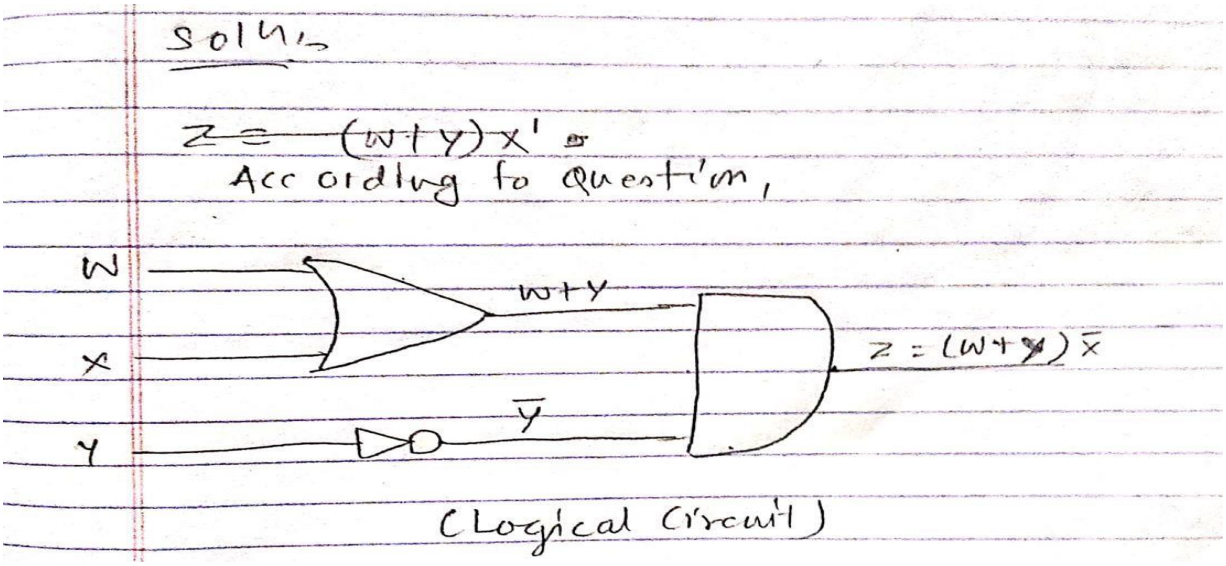
[5 marks]

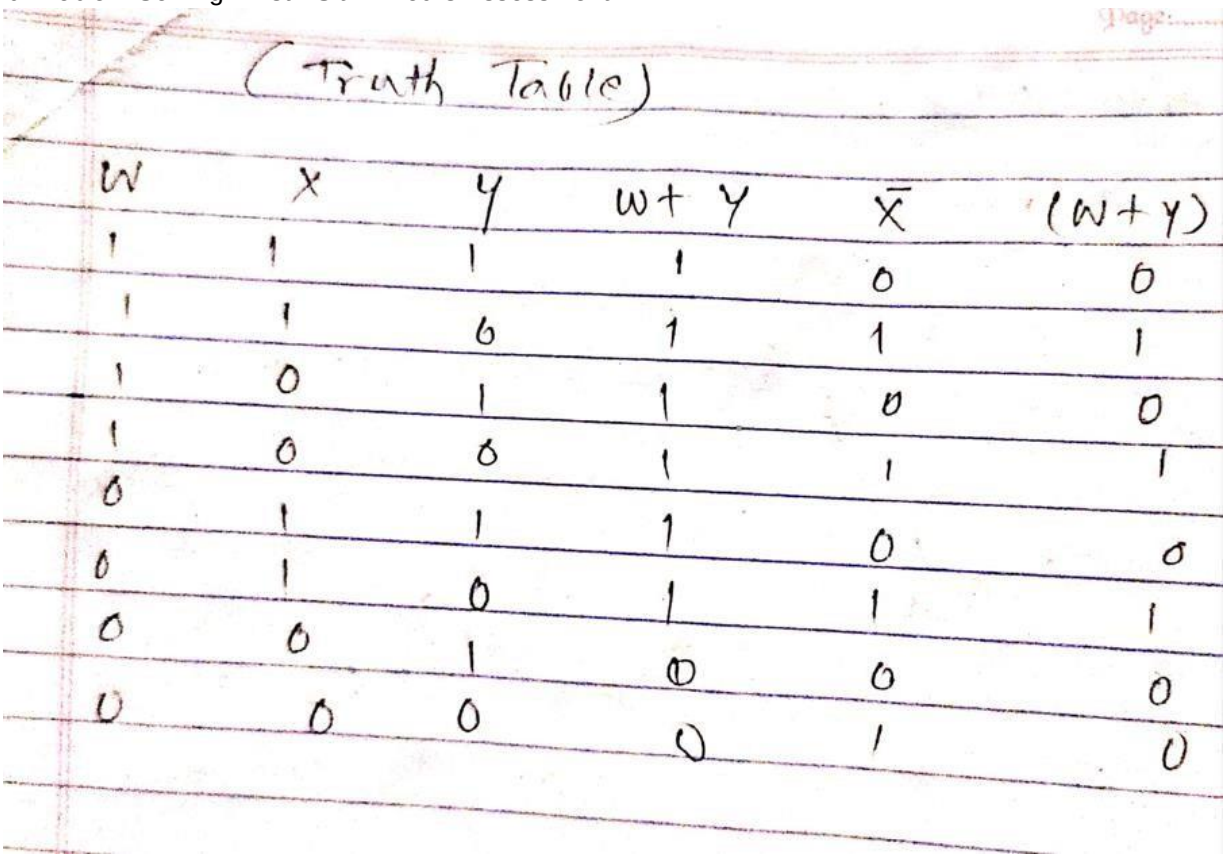
ii) $Q = (\bar{A}BC)(\bar{\bar{A}}+\bar{\bar{D}})$



[5 marks]

7. A system uses 3 switches W, X and Y ; a combination of switches determines whether an alarm, Z, sounds. If switch W or switch Y are in the ON position and switch X is in the OFF position then a signal to sound an alarm, Z, is produced. Design the logic of the circuit using the appropriate logic gates and construct the truth table to show all possible output.





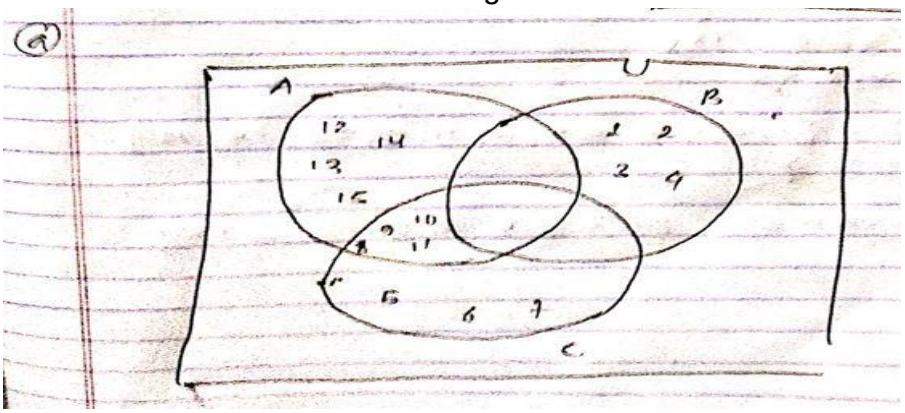
(Truth Table)

W	X	Y	W + Y	$\bar{X}$	(W + Y)
1	1	1	1	0	0
1	1	0	1	1	1
1	0	1	1	0	0
1	0	0	1	1	1
0	1	1	1	0	0
0	1	0	1	1	1
0	0	1	0	0	0
0	0	0	0	1	0

[10 marks]

8. Given U= {1, 2, 3, ..., 15}. A= {x: x ∈ U, x ≥ 8}, B= {x: x ∈ U, x ≤4} and C= {x : x ∈ U, 4< x < 12}.

a) Put all the information on Venn Diagram



[2 marks]

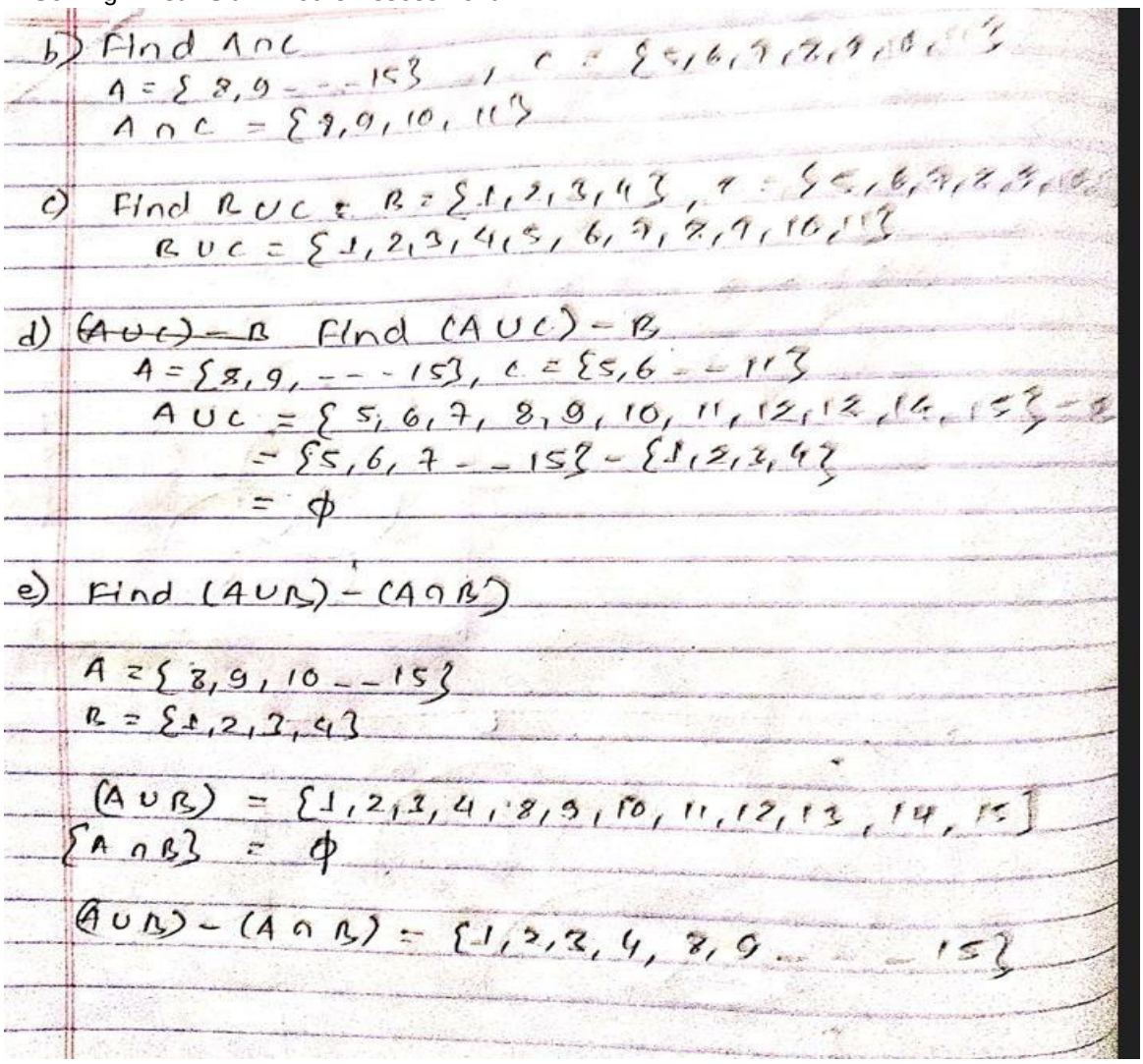
b) Find A ∩ C

[2 marks]

c) Find B U C **[2 marks]**

d) Find (A U C) - B **[2 marks]**

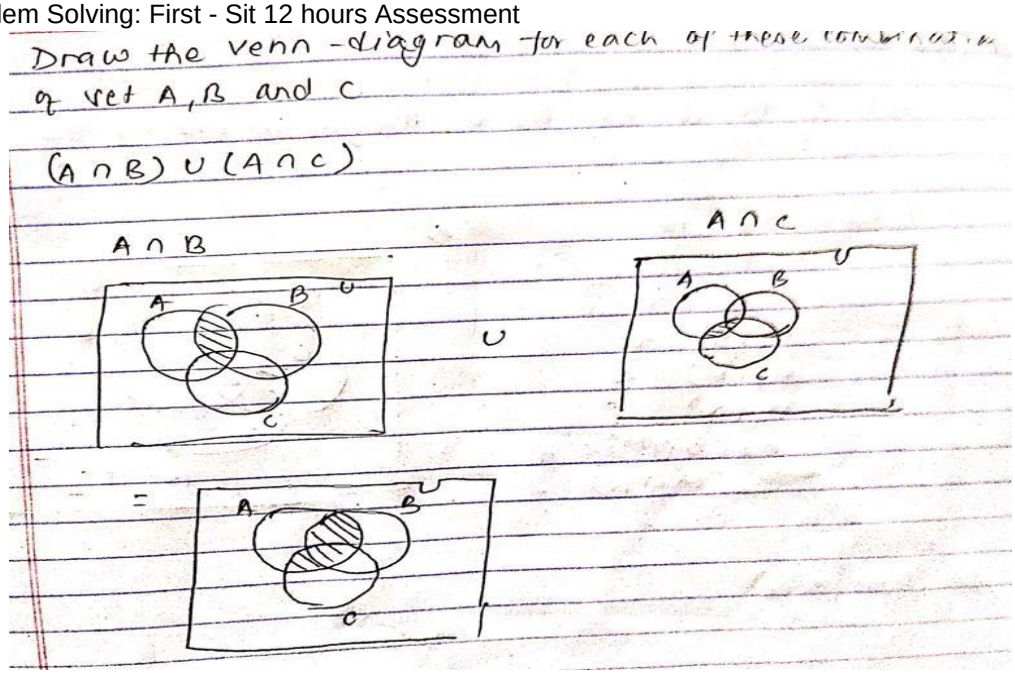
e) Find (AU B) - (A∩ B)



[2 marks]

9. Draw the Venn diagrams for each of these combinations of the sets A,B and C.

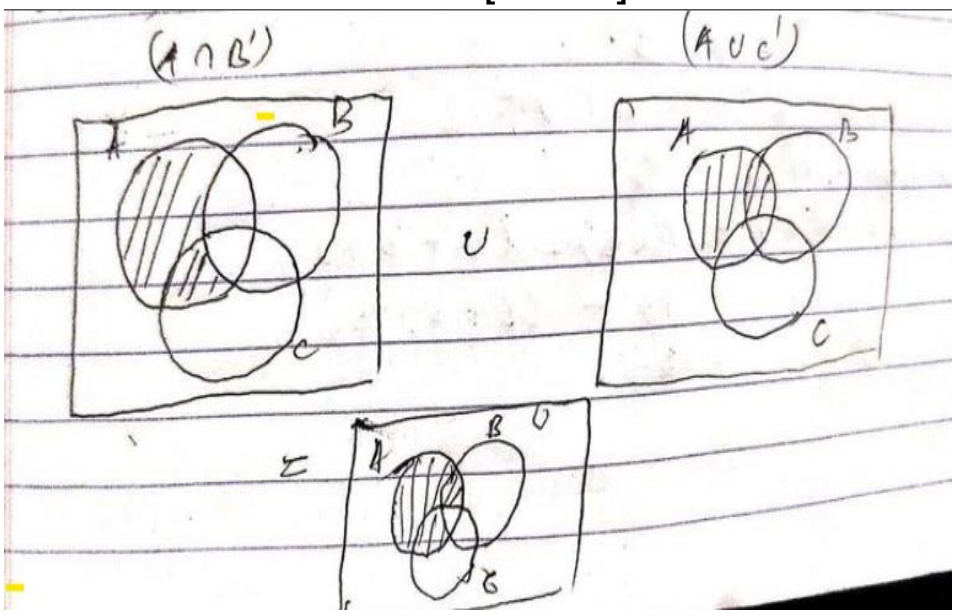
a) (A ∩ B) ∪ (A ∩ C)



[5 marks]

b) (A ∩ B') ∪ (A ∩ C')

[5 marks]



10. In a group of students 18 read Books, 19 read Magazines and 16 read Novels. 6 read Books only, 9 read Magazines only, 5 read Books and Magazines only and 2 read Magazines and Novels only.

a) Put all the information in Venn- Diagram. **[2 marks]**
b) How many students read all three ? **[2 marks]**
c) How many read Books and Novels only? **[2 marks]**
d) How many read Novels only? **[2 marks]**
e) How many students are there all together? **[2 marks]**

10) Soln:-

Let B, M, N be book, magazines and Novels respectively.

$n(B) = n(B) = 18$

$n(M) = 19$

$n(N) = 16$

$n_0(B) = 6$

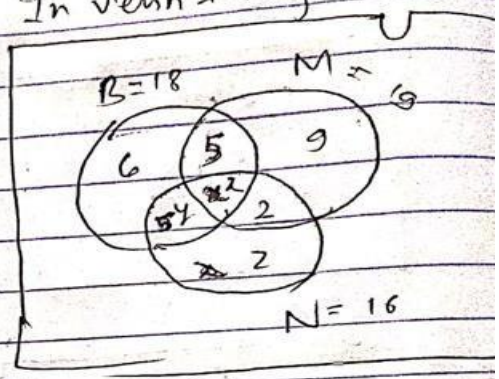
$n_0(M) = 9$

$n_0(N) = ?$

$n_0(B \cap M) = 5$

$n_0(M \cap N) = 2$

a) In venn Diagram



b) $(B \cap M \cap N) = ?$

As, $n(M) = 19$

then, $2 + x + 5 + 9 = 19$

or, $x = 19 - 16$

$\therefore x = 3$

i.e $(B \cap M \cap N) = 3$

b) $(B \cap M \cap N) = 3$

c) $n_0(B \cap M) = n(B) - (6 + 5 + x)$

$= 18 - (6 + 5 + 3)$

$= 4$

d) $n_0(M) = n(M) - (4 + x + 2)$

$= 16 - (4 + 3 + 2)$

$= 7$

e) $n(U) = 6 + 5 + 9 + 4 + 3 + 2 + 7$

$= 36$

The End