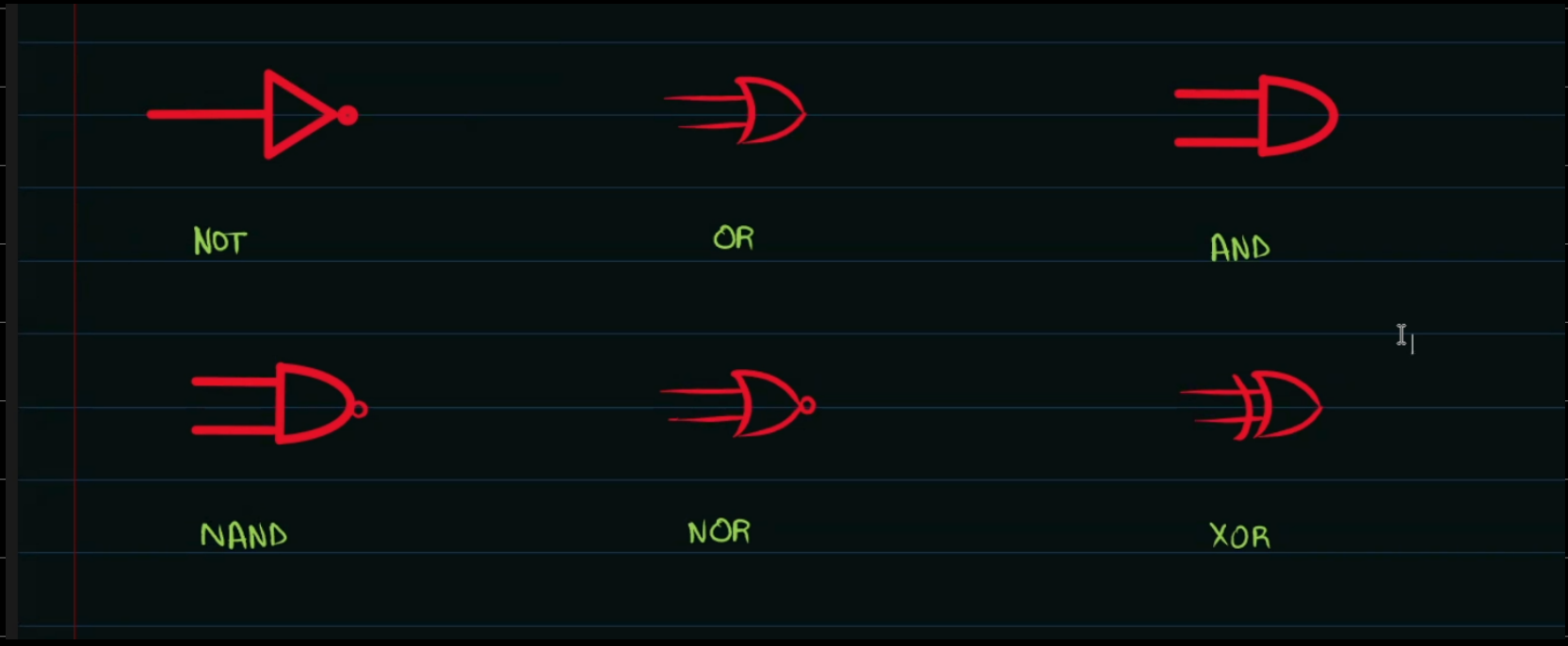
Logic Gates

- Logic Gates are used in Digital electronics and are used to create electronic circuits.
- Not a physical device.

Symbols For Logic Gates



Truth Table

- Truth tables are used to trace the output from a logic gate or logic circuit
- The "NOT" Gate is the only logic gate with one input.
- When constructing truth tables, all possible combinations "1s" and "0s" are considered.

$2^2 = 4$

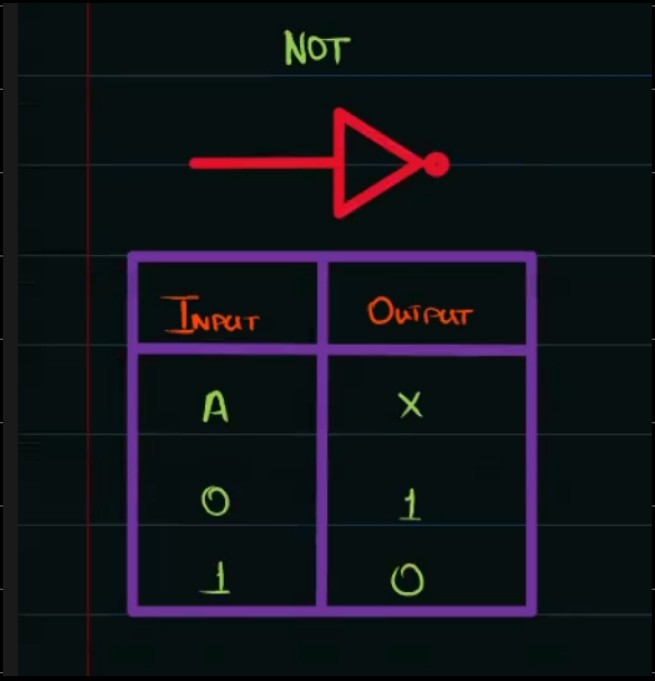
Inputs	
A	B
0	0
0	1
1	0
1	1

$2^3 = 8$

Inputs		
A	B	C
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

- Divide kartay chalay jaana hai

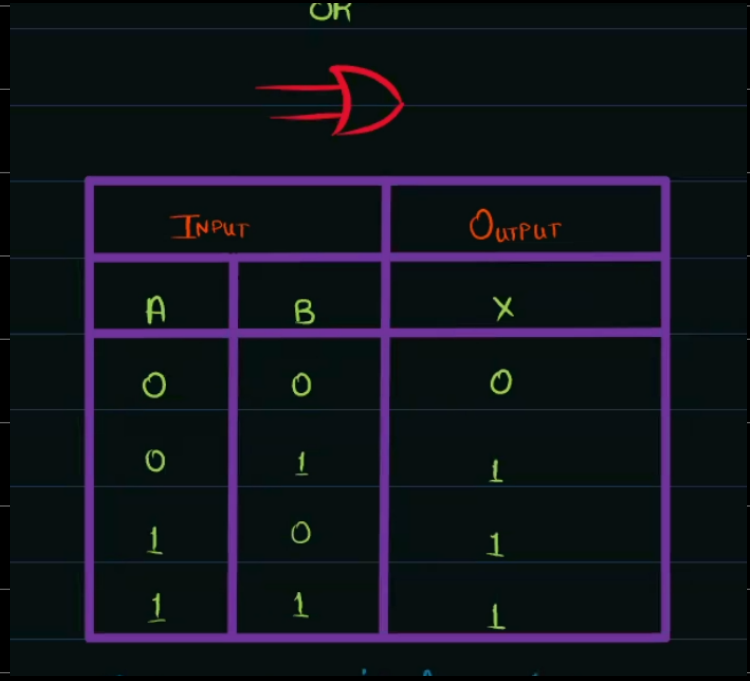
NOT Gate



Input	Output
A	X
0	1
1	0

- X = NOT A → logic Notation
- X = $\bar{A}$ → Boolean Algebra
- Inverses inputs

OR Gate



Input		Output
A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

* Not Binary addition

- If even one input is "1" then output is "1".
- X = A OR B → logic Notation
- X = A + B → Boolean Algebra

AND Gate

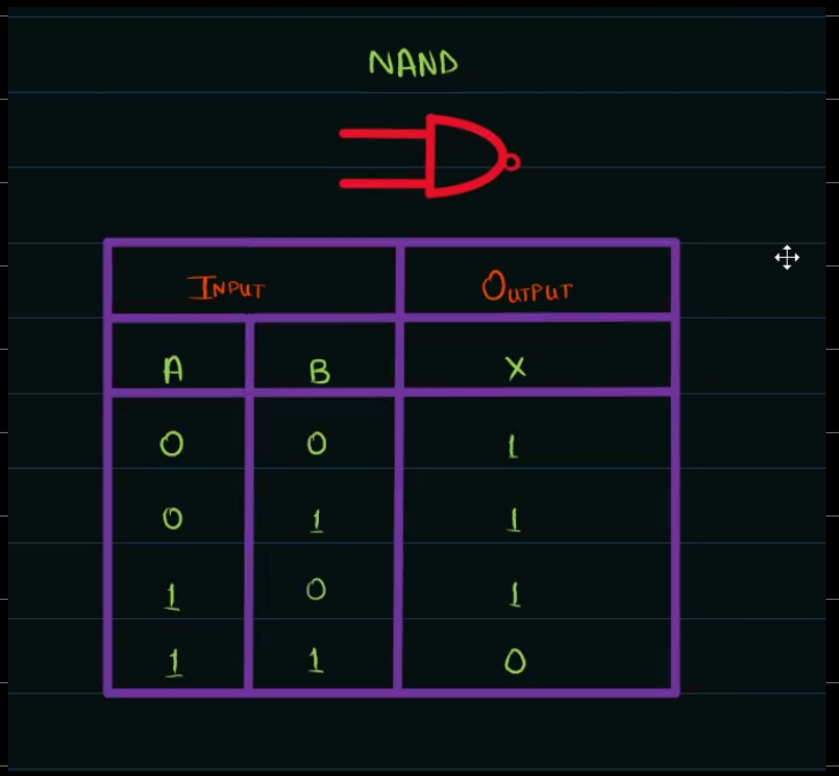
Input		Output
A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

- If even one input is "0" then the output is 0.

X = A AND B → logic Notation

X = A.B → Boolean Algebra

NAND Gate



Input		Output
A	B	X
0	0	1
0	1	1
1	0	1
1	1	0

- Inverses output of AND
- X = A NAND B → logic Notation
- $X = \overline{A.B}$ → Boolean Algebra

NOR Gate

Input		Output
A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

- Inverse the output of "OR"
- $X = A \text{ NOR } B$ → Logic Notation
- $X = \overline{A + B}$ → Boolean Algebra

XOR Gate

Input		Output
A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

- Same input, the output would be "0". Different input, the output would be "1".

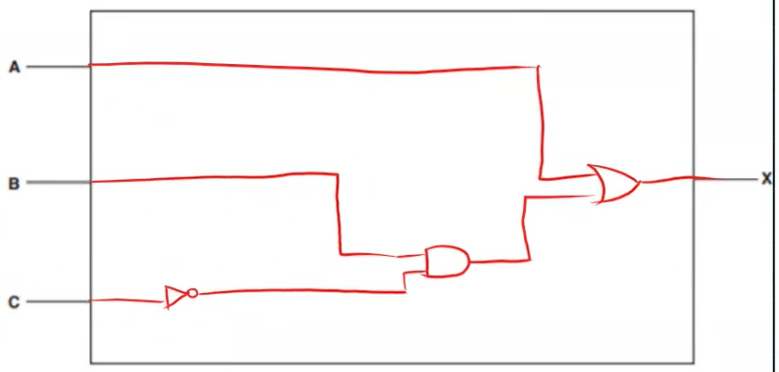
- $X = A \text{ XOR } B$ → Logic Notation
- $X = A \oplus B$ → Boolean Algebra

CASE 1: Construct logic Circuit by Logic Expression.

- Solve values of Bracket first.

6 (a) Draw a logic circuit to represent the logic expression:

X = A OR (B AND NOT C)

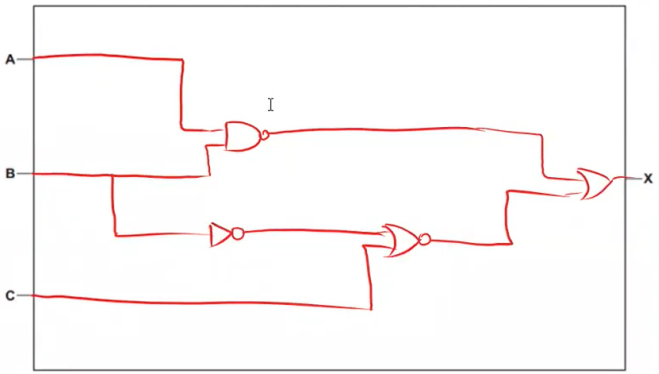


[5]

A NAND B NOT B NOR C

X = NOT (A AND B) OR NOT (NOT B OR C)

Draw the logic circuit for the given expression using a maximum of **four** gates.

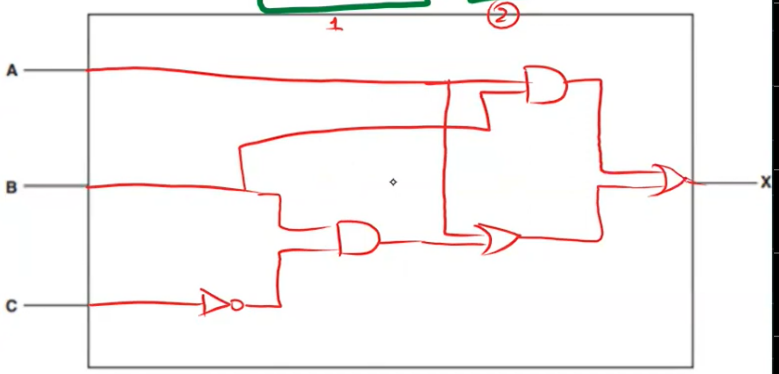


[4]

6 (a) Draw a logic circuit to represent the logic expression:

X = A OR (B AND NOT C) OR (A AND B)

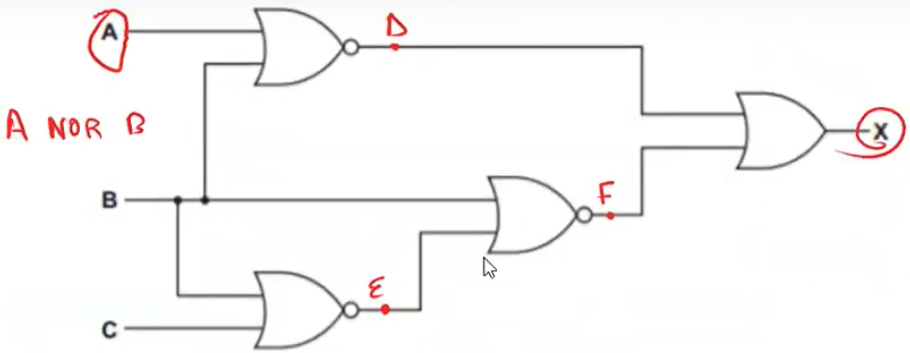
1 2



[5]

CASE 2: Construct a Truth Table by Logic Circuit

8 (a) Complete the truth table for the following logic circuit:



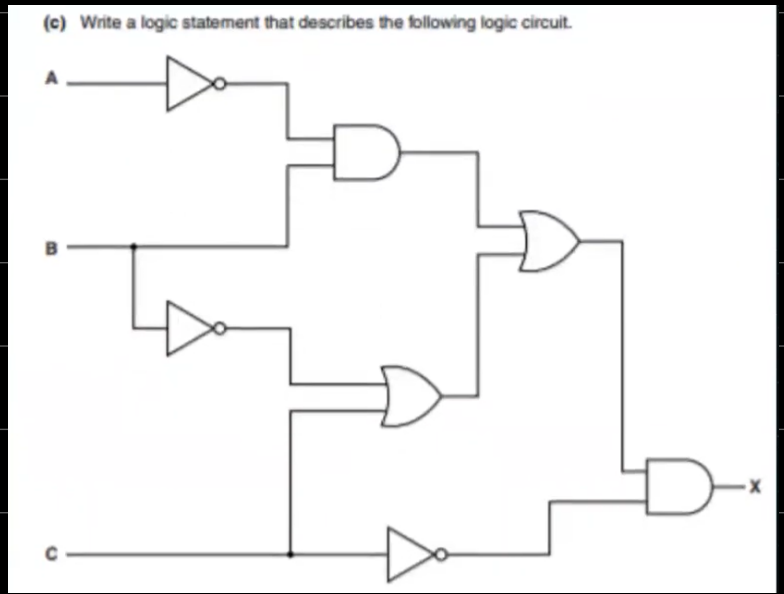
A	B	C	D	E	B working	F	D	X
0	0	0	1	1	0	0	1	1
0	0	1	1	0	0	1	1	1
0	1	0	0	0	1	0	0	0
0	1	1	0	0	1	0	0	0
1	0	0	0	1	0	0	0	0
1	0	1	0	0	0	1	0	1
1	1	0	0	0	1	0	0	0
1	1	1	0	0	1	0	0	0

[4]

CASE 3: Construct a Logic Expression From a Logic Circuit

- No steps, only use logic

(c) Write a logic statement that describes the following logic circuit.



((NOT A AND B) OR (NOT B OR C)) AND NOT C

CASE 4: Construct a logic Expression From Truth Table

- $A = 1$
- $\bar{A} = 0$

- Row multiply
- Column add

3 (a) A Boolean algebraic expression produces the following truth table.

INPUT			OUTPUT
A	B	C	X
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

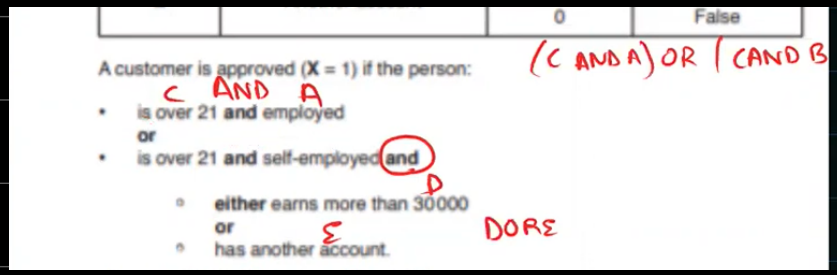
$\bar{A}\cdot\bar{B}\cdot\bar{C} + \bar{A}\cdot\bar{B}\cdot C + \bar{A}\cdot B\cdot\bar{C} + \bar{A}\cdot B\cdot C + A\cdot\bar{B}\cdot\bar{C} + A\cdot B\cdot\bar{C}$

Step 1 : Mark rows with output 1

Step 2 : Now write A or $\bar{A}$ / B or $\bar{B}$ / C or $\bar{C}$

CASE 5 : Construct Logic Circuit from Problem statement

Note: Always write the expression first.

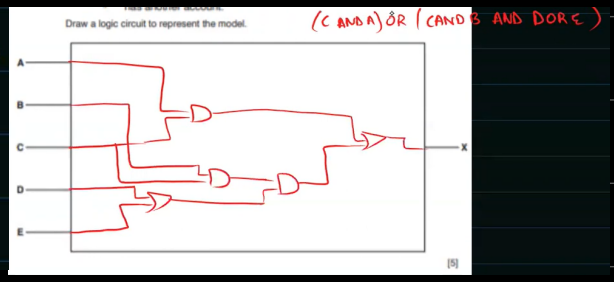


		0	False

A customer is approved (X = 1) if the person:

- is over 21 **and** employed
  or
- is over 21 **and** self-employed **and**
  - **either** earns more than 30000
    or
  - has another account.

C AND A
D
E
DORE
(C AND A) OR (C AND B AND DORE)



- Use the parameters from the table