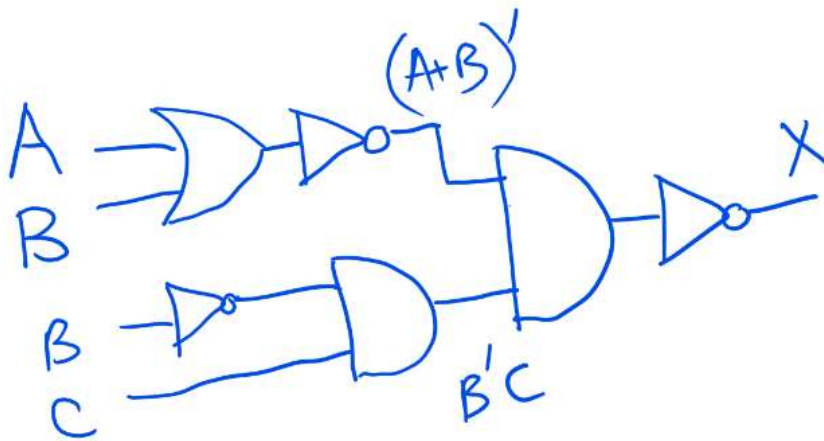


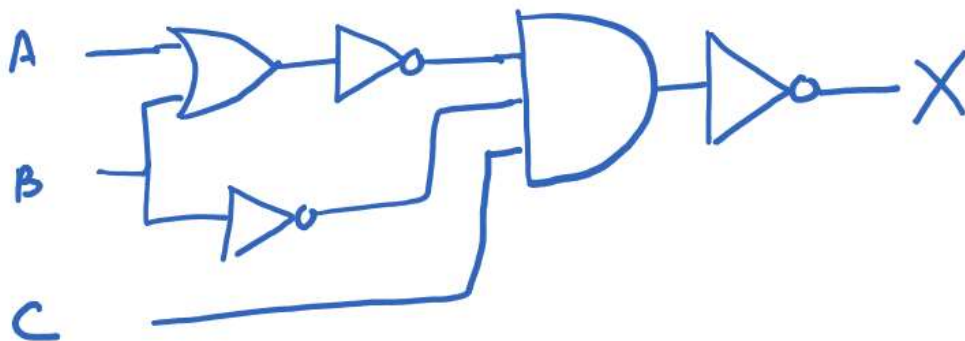
**L1 practice****Answers:**

1 (a)  $X = [(A+B)' (B'C)]'$

Logic circuit diagram (there is usually more than one way to draw):



Or



Truth table:

Inputs			Output
A	B	C	X
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Logical reasoning (good mental exercise):

$$X = [ (A+B)' (B'C) ]'$$

In order to make output  $X=0$ , the inputs must be such that  $(A+B)'=1$  and  $(B'C)=1$ .

This implies  $A=B=0$ , and  $B=0$  and  $C=1$ ,

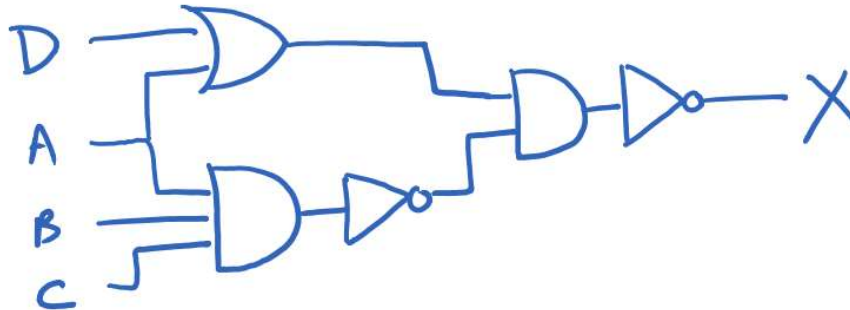
i.e.  $A,B,C = 0,0,1$  (highlighted in truth table)

A circuit cannot control whether its inputs are 0 or 1. But the circuit must produce the required outputs (0 or 1) when the inputs have certain specified logic values.

A circuit input-output behavior may be fully described by its truth table, logic circuit diagram or Boolean expression.

(b)  $X = [ (ABC)' (A+D) ]'$

Logic circuit diagram (there is usually more than one way to draw):



Truth table:

Inputs				Output
A	B	C	D	X
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	1
1	1	1	1	1

Logical reasoning (good mental exercise):

$$X = [ (ABC)' (A+D) ]'$$

In order to make output  $X=1$ , the inputs must be such that either  $(ABC)'=0$  or  $(A+D)=0$ .

This implies  $ABC=1$ , or  $A=D=0$  (highlighted in truth table)

2. Compare the truth tables of AND and OR:

a	b	a OR b	a AND b
0	0	0	0
0	1	1	0
1	0	1	0
1	1	1	1

Set one input to logic 1, the other to logic 0.

If output = 1, then it is an OR gate. Otherwise, it is an AND gate.

3.  $X = [(A+B)' (B+C')']'$

Logical reasoning:

X is 0 only if

$$(A+B)' = 1, \text{ and } (B+C')' = 1$$

$$\text{i.e. } (A+B) = 0, \text{ and } (B+C') = 0$$

$$\text{i.e. } A = B = 0 \text{ and } C = 1$$

Alternatively, simplify the Boolean Expression, (you will learn this in L2)

$$X = [(A+B)'(B+C')']'$$

using DeMorgan's theorem, we get

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

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

Thus there is only one way to make  $X = 0$ , i.e.  $A=B=C'=0$

Truth table:

Inputs			Output
A	B	C	X
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Output waveform:

