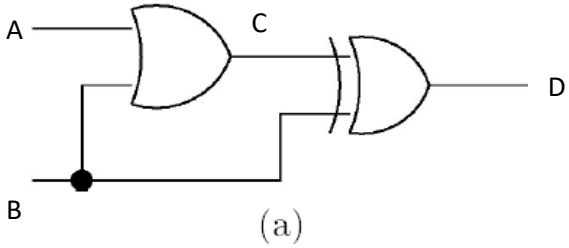
Foundations of Computer Science – Exercise 1

2. a)

C = A OR B
D = B XOR C = B XOR (A OR B)

A	B	C	D
0	0	0	0
0	1	1	0
1	0	1	1
1	1	1	0

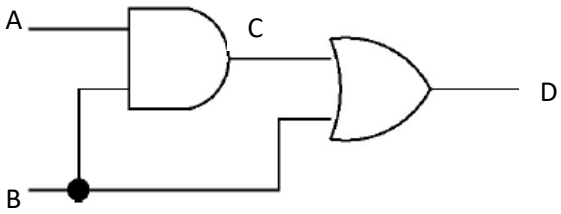


(a)

b)

C = A AND B
D = B OR C = B OR (A AND B)

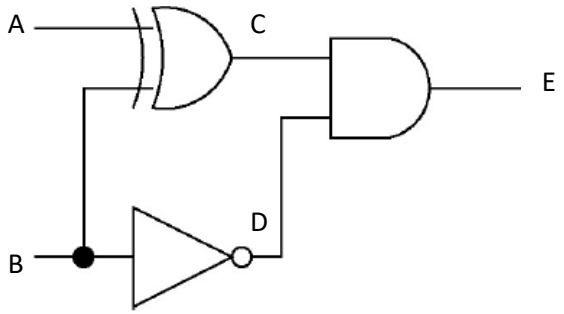
A	B	C	D
0	0	0	0
0	1	0	1
1	0	0	0
1	1	1	1



c)

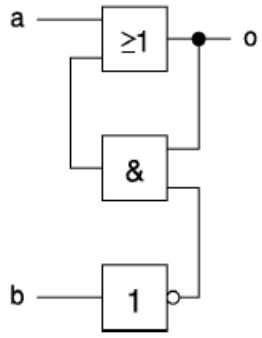
C = A XOR B
D = NOT B
E = C AND D
= (A XOR B) AND (NOT B)

A	B	C	D	E
0	0	0	1	0
0	1	1	0	0
1	0	1	1	1
1	1	0	0	0



(c)

3.



a	b	o
0	0	0
0	1	0
1	0	1
1	1	1

⇨ Value of output must be compromised as it not only depends on but also affects the whole operation of the circuit.

4.

a) (P ∨ Q) ∧ P ∧ (Q ∨ R) ∧ (P ∨ ¬ P ∨ ¬ R) ∧ (¬ Q ∨ R)
= (P ∨ Q) ∧ P ∧ (Q ∨ R) ∧ (1 ∨ ¬ R) ∧ (¬ Q ∨ R) (Complementation law)
= (P ∨ Q) ∧ P ∧ (Q ∨ R) ∧ 1 ∧ (¬ Q ∨ R) (Identity law)
= (P ∨ Q) ∧ P ∧ (Q ∨ R) ∧ (¬ Q ∨ R) (Identity law)
= (P ∨ Q) ∧ P ∧ (R ∨ (Q ∧ ¬ Q)) (Distribution law)
= (P ∨ Q) ∧ P ∧ R (Complementation law + Identity law)
= ((P ∧ R) ∧ P) ∨ ((P ∧ R) ∧ Q) (Distribution law)
= (P ∧ R) ∨ ((P ∧ R) ∧ Q) (Idempotence law)
= P ∧ R (Absorption law)

b) ¬ ((P ∨ Q) ∧ ¬ R) (Distribution law)
= ¬ ((P ∧ ¬ R) ∨ (Q ∧ ¬ R)) (De Morgan law)
=¬ (P ∧ ¬ R) ∨ ¬ (Q ∧ ¬ R) (De Morgan law)
= (¬ P ∧ R) ∨ (¬Q ∧ R) (De Morgan law)

5.

x	y	z	((x ∧ (y ∨ z)) ∨ (¬y ∧ z))
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

DNF:

O = x'y'z + xy'z + xyz'+ xyz

= y'z(x' + x) + xy'z + xyz' + xyz

= y'z + xy'z + xyz'+ xyz

= y'z + xy(z'+ z)

= y'z + xy