DIGITAL LOGIC

SOLUTIONS

1. In the following truth table, V = 1 if and only if the input is valid.

Inputs				Outputs		
D_0	D_1	D_2	D_3	X_0	X_1	V
0	0	0	0	x	x	0
1	0	0	0	0	0	1
x	1	0	0	0	1	1
x	x	1	0	1	0	1
x	x	x	1	1	1	1

What function does the truth table represent?

(a) Priority encoder
(b) Decoder
(c) Multiplexer
(d) Demultiplexer

Solution: Option (a)

Explanation:
Since there are more than one outputs and number of outputs are less than inputs, it is a Priority encoder.

2. Which one of the following expressions does NOT represent exclusive NOR of x and y?

(a) xy + x' y'
(b) x ^ y' where ^ is XOR
(c) x' ^ y where ^ is XOR
(d) x' ^ y' where ^ is XOR

Solution: Option (d)

Explanation:
It is a simple De Morgan's laws question.

3. The truth table

X	Y	f (X, Y)
0	0	0
0	1	0
1	0	1
1	1	1

represents the Boolean function:

(a) X
(b) X + Y
(c) X xor Y
(d) Y

Solution: Option (a)

Explanation:
The value of f(X, Y) is same as X for all input pairs.

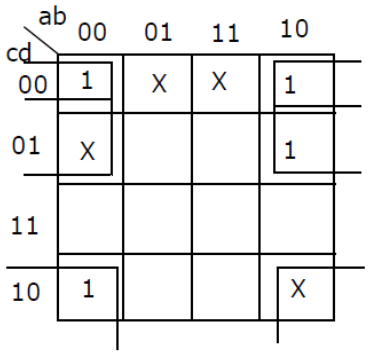
4. What is the minimal form of the Karnaugh map shown below? Assume that X denotes a don't care term.

ab / cd	00	01	11	10
00	**1**	**X**	**X**	**1**
01	**X**			**1**
11				
10	**1**			**X**

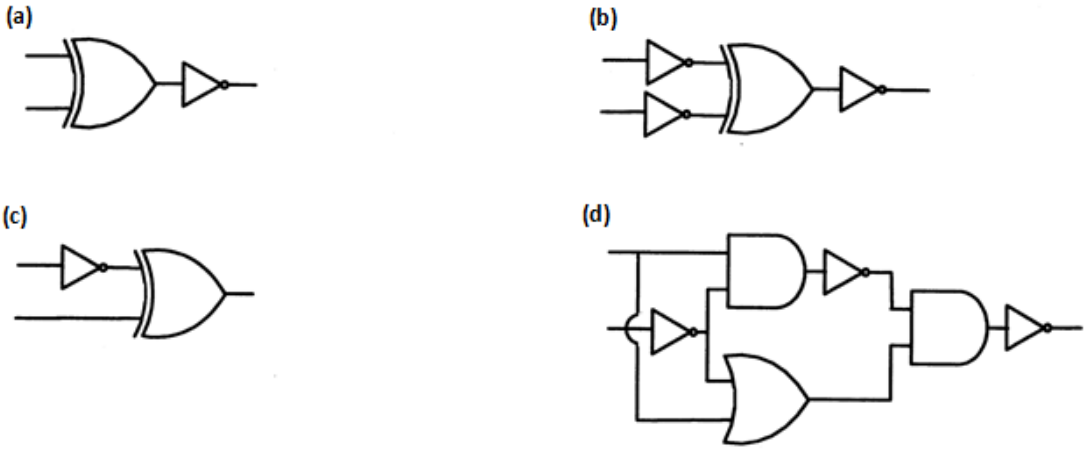
(a) b'd'
(b) b'd' + b'c'
(c) b'd' + a'b'c'd'
(d) b'd' + b'c' + c'd'

Solution: Option (b)

Explanation:



5. Which one of the following circuits is NOT equivalent to a 2-input XNOR (exclusive NOR) gate?



Solution: Option (d)

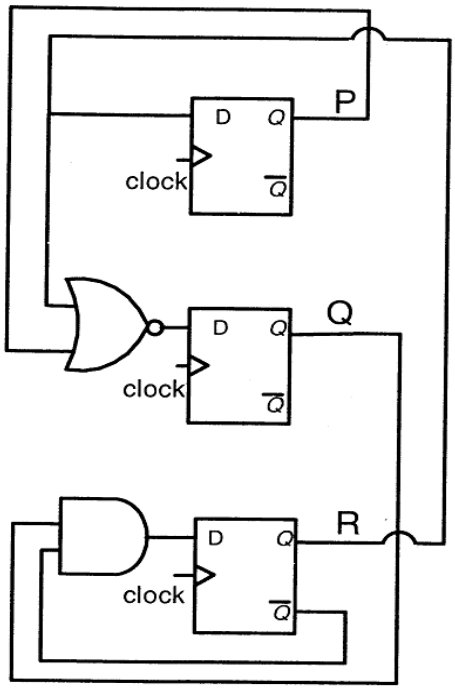
Explanation:
All options except D produce XOR.

6. The simplified SOP (Sum Of Product) form of the boolean expression
(P + Q' + R') . (P + Q' + R) . (P + Q + R') is

(a) (P'.Q + R')
(b) (P + Q'.R')
(c) (P'.Q + R)
(d) (P.Q + R)

Solution: Option (b)

7. Consider the following circuit involving three D-type flip-flops used in a certain type of counter configuration.



If at some instance prior to the occurrence of the clock edge, P, Q and R have a value 0, 1 and 0 respectively, what shall be the value of PQR after the clock edge?

(a) 000 (b) 001
(c) 010 (d) 011

Solution: Option (d)

Explanation:
P' = R
Q' = (P + R)'
R' = QR'

Given that (P, Q, R) = (0, 1, 0), next state P', Q', R' = 0, 1, 1

8. Consider the data given in previous question. If all the flip-flops were reset to 0 at power on, what is the total number of distinct outputs (states) represented by PQR generated by the counter?

(a) 3 (b) 4

(c) 5 (d) 6

Solution: Option (b)

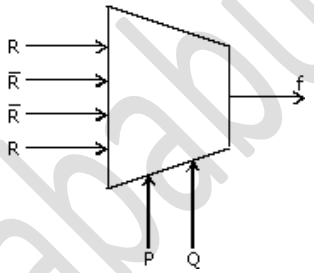
Explanation:
There are four distinct states, 000 → 010 → 011 → 100 (→ 000)

9. The minterm expansion of f(P, Q, R) = PQ + QR' + PR' is

(a) $m_2 + m_4 + m_6 + m_7$ (b) $m_0 + m_1 + m_3 + m_5$
(c) $m_0 + m_1 + m_6 + m_7$ (d) $m_2 + m_3 + m_4 + m_5$

Solution: Option (a)

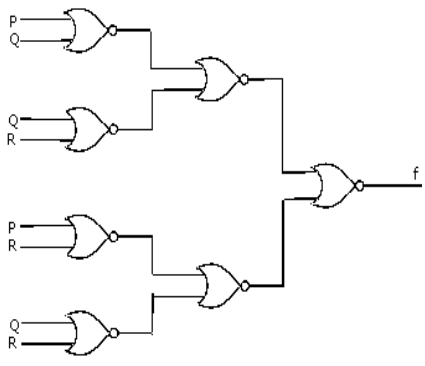
10. The Boolean expression for the output 'f' of the multiplexer shown below is



(a) (P(XOR) Q(XOR) R)' (b) P(XOR) Q(XOR) R
(c) (P+Q+R)' (d) P+Q+R

Solution: Option (b)

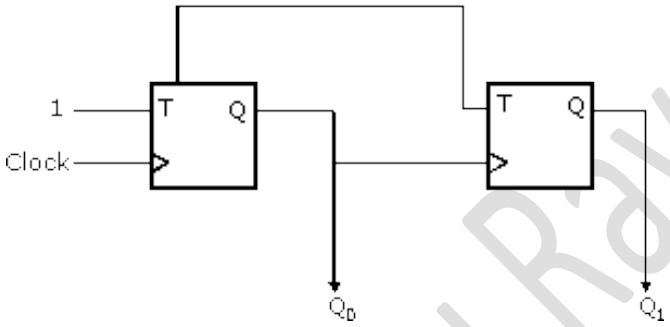
11. What is the Boolean expression for the output f of the combinational logic circuit of NOR gates given below?



(a) (Q+R)’ (b) (P+Q)’
(c) (P+R) (d) (P+Q+R)’

Solution: Option (a)

12. In the sequential circuit shown below, if the initial value of the output Q_1Q_0 is 00, what are the next four values of Q_1Q_0?



(a) 11, 10, 01, 00 (b) 10, 11, 01, 00
(c) 10, 00, 01, 11 (d) 11, 10, 00, 01

Solution: Option (d)

13. In the Karnaugh map shown below, X denotes a don’t care term. What is the minimal form of the function represented by the Karnaugh map?

cd \ ab	00	01	11	10
00	1	1		1
01	X			
11	X			
10	1	1		X

(a) $\bar{b}.\bar{d} + \bar{a}.\bar{d}$ (b) a’b’+ b’d’+ a’bd’
(c) b’d’+ a’bd’ (d) a’b’+ b’d’+a’d’

Solution: Option (a)

14. What is the minimum number of gates required to implement the Boolean function (AB+C) if we have to use only 2-input NOR gates?

(a) 2 (b) 3
(c) 4 (d) 5

Solution: Option (b)

Explanation:
AB + C = (A+C) (B+C) = ((A+C)' + (B+C)')'

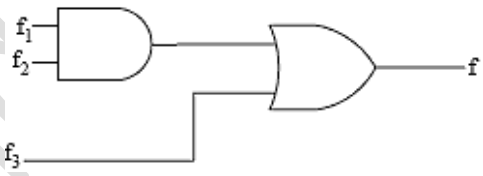
So, '3' 2-input NOR gates are required.

15. Let r denote number system radix. The only value(s) of r that satisfy the equation $\sqrt{121_r} = 11_r$ is/are

(a) decimal 10 (b) decimal 11
(c) decimal 10 and 11 (d) any value > 2

Solution: Option (d)

16. Given f_1, f_3 and f in canonical sum of products form (in decimal) for the circuit



$f_1 = \Sigma m(4,5,6,7,8)$
$f_3 = \Sigma m(1,6,15)$
$f = \Sigma m(1,6,8,15)$

then f_2 is

(a) $\Sigma m(4,6)$ (b) $\Sigma m(4,8)$
(c) $\Sigma m(6,8)$ (d) $\Sigma m(4,6,8)$

Solution: Option (c)

17. If P, Q, R are Boolean variables, then (P + Q')(PQ' + PR)(P'R' + Q') simplifies

(a) PQ’ (b) PR’
(c) PQ’ + R (d) PR” + Q

Solution: Option (a)

18. How many 3-to-8 line decoders with an enable input are needed to construct a 6-to-64 line decoder without using any other logic gates?

(a) 7 (b) 8
(c) 9 (d) 10

Solution: Option (c)

19. Consider the following Boolean function of four variables:
f(w,x,y,z) = ∑(1,3,4,6,9,11,12,14)

The function is:

(a) independent of one variables. (b) independent of two variables.
(c) independent of three variables. (d) dependent on all the variables.

Solution: Option (b)

20. Let f(w, x, y, z) = ∑(0, 4, 5, 7, 8, 9, 13, 15). Which of the following expressions are NOT equivalent to f?

(a) x’y’z’ + w’xy’ + wy’z + xz (b) w’y’z’ + wx’y’ + xz
(c) w’y’z’ + wx’y’ + xyz + xy’z (d) x’y’z’ + wx’y’ + w’y

Solution: Option (d)