PROBLEM SET - 1 CS230

Q1) Consider the following boolean expression

$F = (P + Q + R)(\overline{P} + Q)(\overline{Q} + R)$

What boolean expression(s) below is/are equivalent to complement of F $(\overline{F})$

A. $(\overline{P} + \overline{Q} + \overline{R})(P + \overline{Q})(Q + \overline{Z})$

B. $P\overline{Q} + \overline{R}$

C. $(P + \overline{R})(\overline{Q} + \overline{R})$

D. $P\overline{Q} + Q\overline{R} + \overline{P}\,\overline{Q}\,\overline{R}$

Q2) To implement the following binary equation, a minimum number of **NAND** gates used are

$(\overline{P} + \overline{Q})(R + S)$

A. 3

B. 4

C. 5

D. 6

Q3) Which of the following is not correct if $\oplus$ be ex-OR and $\odot$ be ex-NOR gates. Which of the following is false?

A. $\overline{X \oplus Y} = X \odot Y$

B. $\overline{X} \oplus Y = X \odot Y$

C. $\overline{X} \oplus \overline{Y} = X \oplus Y$

D. $X \oplus \overline{X} \oplus Y = \overline{(X \odot \overline{X} \odot Y)}$

Q4) Let $X_7 .... X_0$ and $Y_7 ...... Y_0$ be two 8 bit numbers represented in 2's complement form (X0 and Y0 as LSBs). When these two numbers are added using ripple carry combinational circuit , the sum obtained is $S_7 .... S_0$ and carry $C_7 .... C_0$. In which of the following cases overflow will occur?
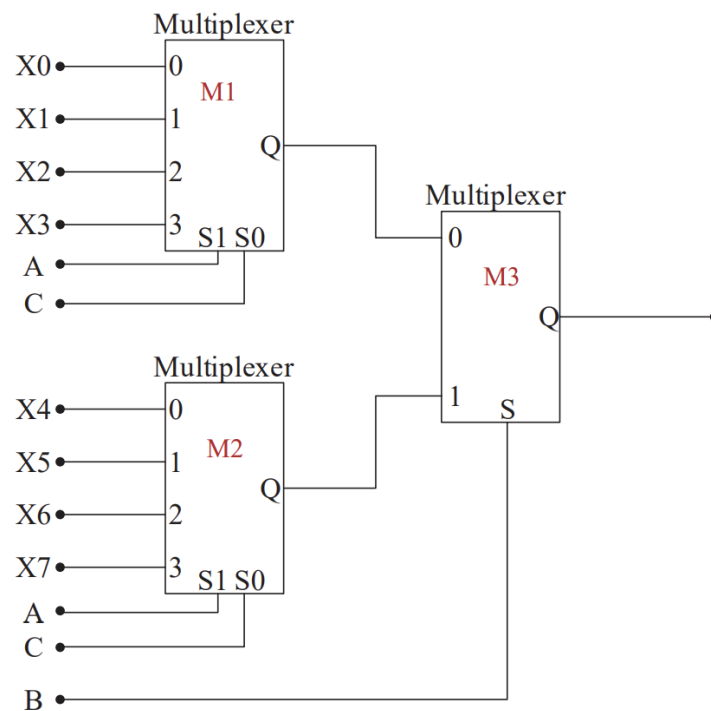
A. $(X_0 Y_0 \overline{S_0} + \overline{X_0}\,\overline{Y_0} S_0)$ is 1

B. The carry bit C_7 is 1

C. $(X_7 Y_7 \overline{S_7} + \overline{X_7}\,\overline{Y_7} S_7)$ is 1

Q5) A boolean digital circuit is composed using two 4-input multiplexers (M1 and M2) and one two input multiplexer (M3) as shown in the figure. (X0-X7) are the inputs of the multiplexers M1 and M2 and could be connected to either 0 or 1. The select lines of the multiplexer are connected to boolean variables A,B,C as shown in the figure.
What values of the set (X0, X1, X2,X3, X4, X5,X6, X7) will realise the boolean function
$\overline{A} + \overline{A}\,\overline{C} + A\overline{B}\,C$?

Multiplexer
X0 —— 0
        M1
X1 —— 1
                Q
X2 —— 2
                    Multiplexer
X3 —— 3 S1 S0
A —   0
C —   M3
                                Q
Multiplexer
X4 —— 0
                            1 S
X5 —— 1 M2
                Q
X6 —— 2
X7 —— 3 S1 S0
A —
C —
B —

Q6) Consider the minterm list form of a Boolean function

$$F(A, B, C, D) = \sum m(0, 2, 5, 7, 9, 11) + d(3, 8, 10, 12, 14)$$

Here, **m** denotes a minterm and **d** denotes a don't care term. The number of essential prime implicants of the function is ___

Q7)   Consider the Karnaugh map given below, where X, represents *"don't care"* and blank represents 0. Assume for all inputs (a, b, c, d) and their respective complements $(\bar{a}, \bar{b}, \bar{c}, \bar{d})$ are also available. The above logic is implemented using 2-input NOR gates only. The minimum number of gates required is _____

dc \ ba	00	01	11	10
00		X	X	
01	1			X
11	1			1
10		X	X	