

TEST 2 SOLUTIONS

CMPE 2020A Test 2

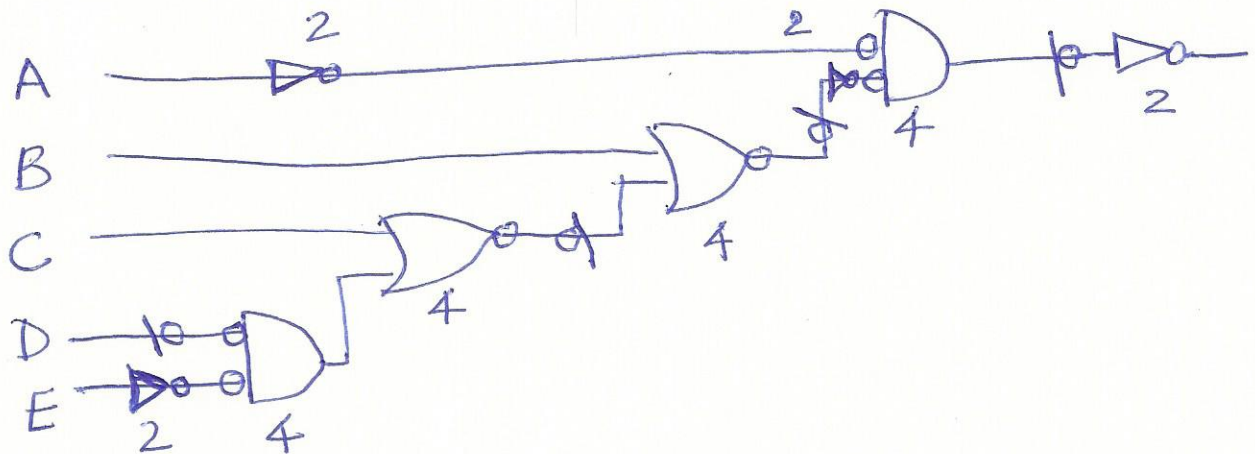
NAME:

GT ID NO:

Problem 1 (10 points):

You are to implement the function $F = A \cdot (B + (C + (\overline{D \cdot E})))$ using inverters and 2-input NOR gates. Draw the circuit below that realizes the function F using mixed-logic notation (i.e. use the slash "/" notation to represent inversion in the original function F above and cancel bubbles, etc.). How many transistors are needed to implement your circuit ?

No of transistors:



$$\text{No of transistors} = 16 + 8 = 24$$

(a) : The numbers X and Y are in 8 bit signed 2's complement format.

Is there overflow or not ? Say yes or no.

(b):

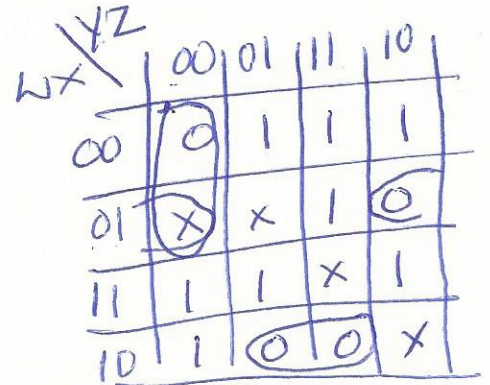
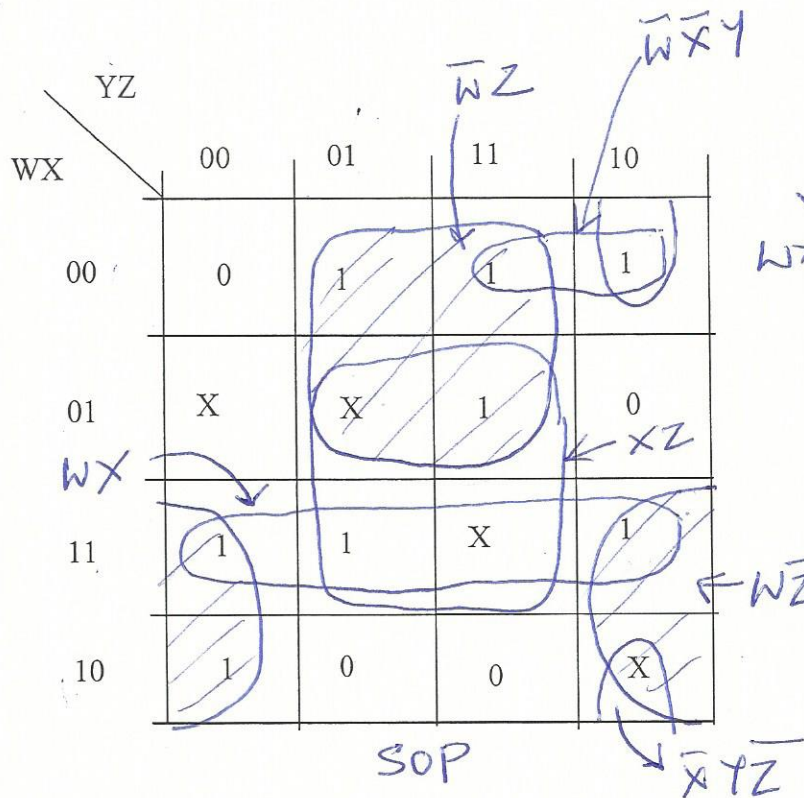
Is there overflow or not. Say yes or no:

(c):

Decimal value of X =

$$\begin{array}{r} - \quad 010010 \\ \quad \quad \quad +1 \\ \hline 010011 \end{array} = -19$$

Problem 3 (10 points):



The above K-map has don't care entries X.

(a) What is the minimal sum of products expression for $F(W,X,Y,Z)$?

$$\begin{aligned}
 F &= \bar{W}\bar{Z} + \bar{W}Z + WX + \bar{W}\bar{X}Y \\
 &= \bar{W}\bar{Z} + \bar{W}Z + XZ + \bar{W}\bar{X}Y \\
 &= \bar{W}\bar{Z} + \bar{W}Z + WX + \bar{X}Y\bar{Z} \\
 &= \bar{W}\bar{Z} + \bar{W}Z + XZ + \bar{X}Y\bar{Z}
 \end{aligned}$$

(b) What is the minimal product of sums expression for $F(W,X,Y,Z)$?

$$F = (W + Y + Z) \cdot (W + \bar{X} + Z) \cdot (\bar{W} + X + \bar{Z})$$

Problem 4 (10 points):

| | | | | | |
|----|----|----|----|----|----|
| | | YZ | | | |
| | | 00 | 01 | 11 | 10 |
| WX | 00 | 1 | 1 | 1 | 1 |
| | 01 | 0 | 1 | 1 | 0 |
| | 11 | 1 | 0 | 0 | 1 |
| | 10 | 1 | 0 | 0 | 1 |

- (a) Find all prime implicants of the K-map above and write the product terms corresponding to each prime implicant.

$$\overline{W}X, \overline{X}Z, \overline{W}Z, WZ$$

- (b) Which of the above prime implicants are essential (write the product terms corresponding to the essential prime implicants above) ?

$$(shaded) \quad W\overline{Z}, \overline{W}Z$$

- (c) Write a minimal sum of products expression for $F(W,X,Y,Z)$

$$F = W\overline{Z} + \overline{W}Z + \begin{cases} \overline{W}X \\ \overline{X}Z \end{cases}$$