$\bar{A}\cdot B = 0$ $\bar{A}+\bar{B}=0$ $\bar{A}\cdot B$ $\bar{A}+\bar{B}$

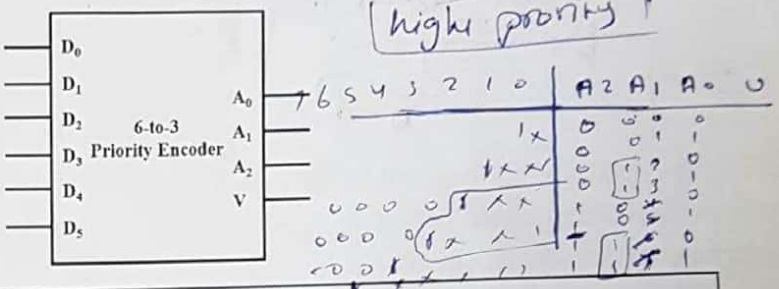
0907231 Digital Logic	Second Exam	University of Jordan
11 Problems	75 Minutes	Summer 2017
الرقم الجامعي:		الاسم :

Problem 1: Answer the following short questions: **(9 points)**

a. If $\overline{A+B} = 0$ and $\overline{AB} = 0$ then $A \odot B =$ ..... 1 .....

$\bar{A}\cdot\bar{B}$ $\bar{A}+\bar{B}=0$ $\bar{A}+\bar{B}$ $\overline{AB}$ AB $\bar{A}+\bar{B}$

b. Given the 6-to-3 priority encoder below, write the boolean expression of output A_1 assuming **high** priority and the Boolean expression of A_2 assuming **low** priority.



high priority

6 5 4 3 2 1 0 | A2 A1 A0 V

A_1 (assuming High priority) = $\bar{D}_5\bar{D}_4D_3 + \bar{D}_5\bar{D}_4\bar{D}_3D_2$

A_2 (assuming Low priority) = $\bar{D}_0\bar{D}_1\bar{D}_2\bar{D}_3D_4 + \bar{D}_0\bar{D}_1\bar{D}_2\bar{D}_3\bar{D}_4D_5$

c. Variables **A** and **B** are 8-bit unsigned numbers with the following values: $\mathbf{A} = (1000\ 1001)_2$ and $\mathbf{B} = (1001\ 1010)_2$. An 8-bit adder/subtractor is used to perform the operation: **A – B**. Determine the 8-bit result of the adder/subtractor and Borrow bit.

$A - B =$ 1110 1111 **Borrow bit =** 1

1000 1001 + 0110 0110 = 1110 1111

d. The 2's complement for $(0010111)_2$ is ..... (1101001) .....

e. The 7's complement for $(735)_8$ is ..... = 6's complement = (042) .....

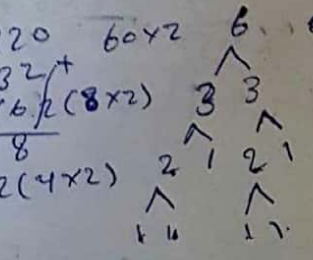
777 − 735 = 042

f. How many 1-to-2 decoders and 2-input AND gates are needed to implement 6 to 60 decoder.

Number of 1 to 2 decoders: 6

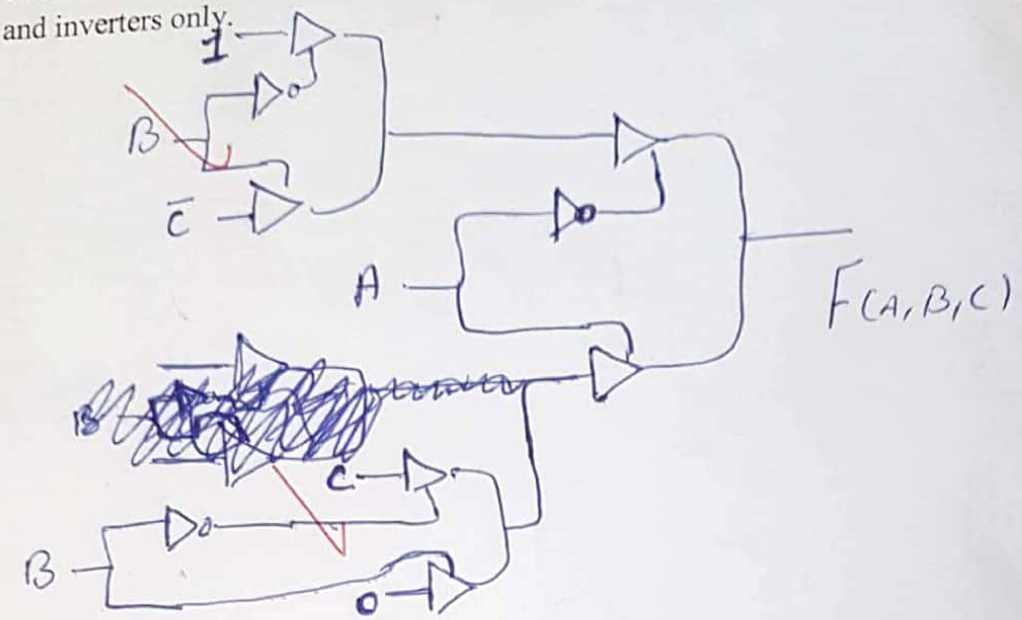
Number of 2-input AND gates = 168

120 60×2 32 (16×2) (8×2) 2(4×2)



8×4

Problem 2: Given the truth table of function $f(A, B, C)$, implement the function using tri-state buffers and inverters only. **(2 Points)**

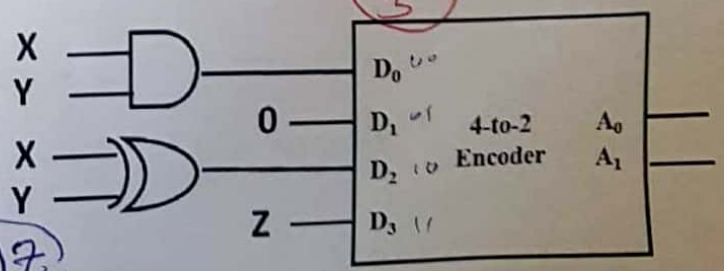


A	B	C	$f(A,B,C)$
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

Problem 3: Write the truth table for a combinational circuit that takes a **three inputs A,B and C**. The circuit has **1-bit output called F**, such that F = 1 when the odd parity of ABC equal 0 **OR** when the carry out of **A + B + C** equals 1 **(2 points)**

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

Problem 4: Based on the following logic diagram, write the Boolean expression for A_1 and A_0 outputs in term of X, Y and Z. Assume the Encoder is a **low** priority encoder. **(2 Points)**



$A_0 =$ $(\overline{x \cdot y})(x \oplus y)\bar{z}$

$A_1 =$ $(\overline{x \cdot y})(x \oplus y)\bar{z} + (\overline{x \cdot y})(x \oplus y)z$

$A_0 = \bar{D}_0 D_1 + D_0 D_1 D_2 D_3$

$\bar{D}_0 \bar{D}_2 D_3$

$(\overline{x \cdot y})(x \oplus y)z$

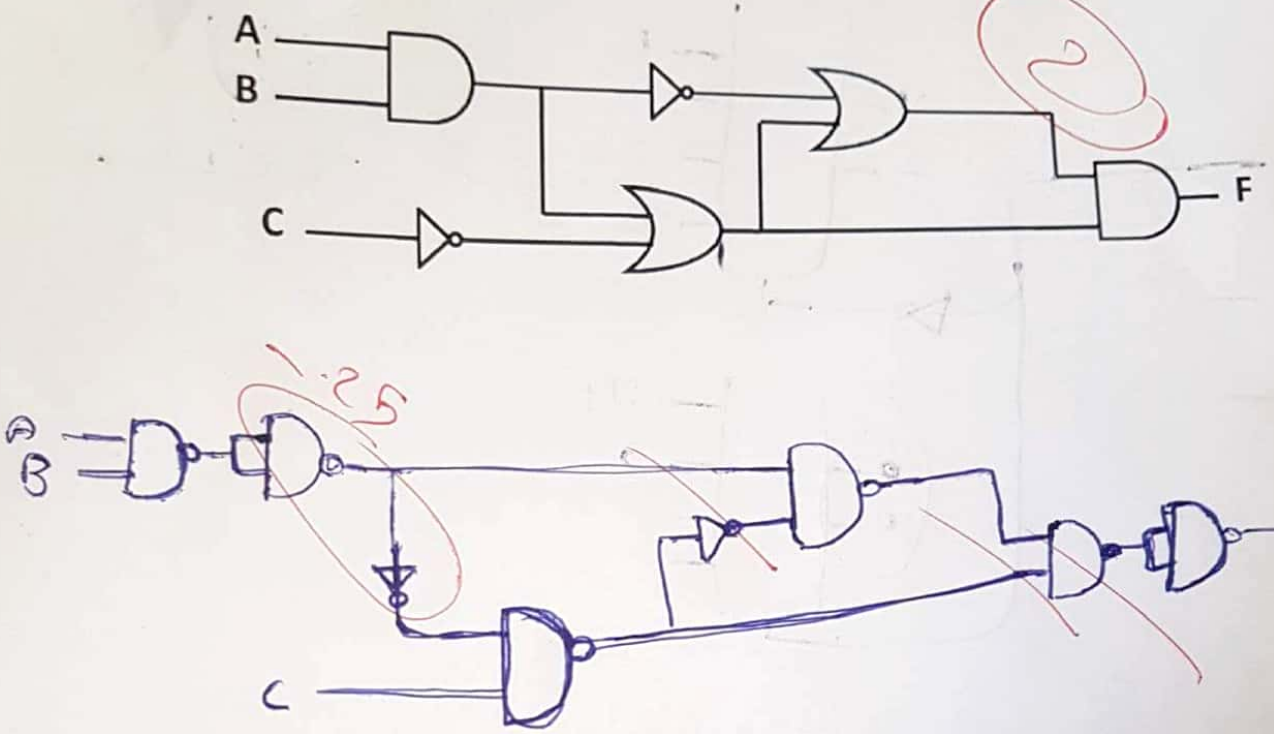
$A_1 = \bar{D}_0 D_1 D_2 + D_0 \bar{D}_1 D_2 D_3$

D_0	D_1	D_2	D_3	A_1	A_0
1	X	X	X	0	0
0	1	X	X	0	1
0	0	1	X	1	0
0	0	0	1	1	1

$D_1 + D_2$

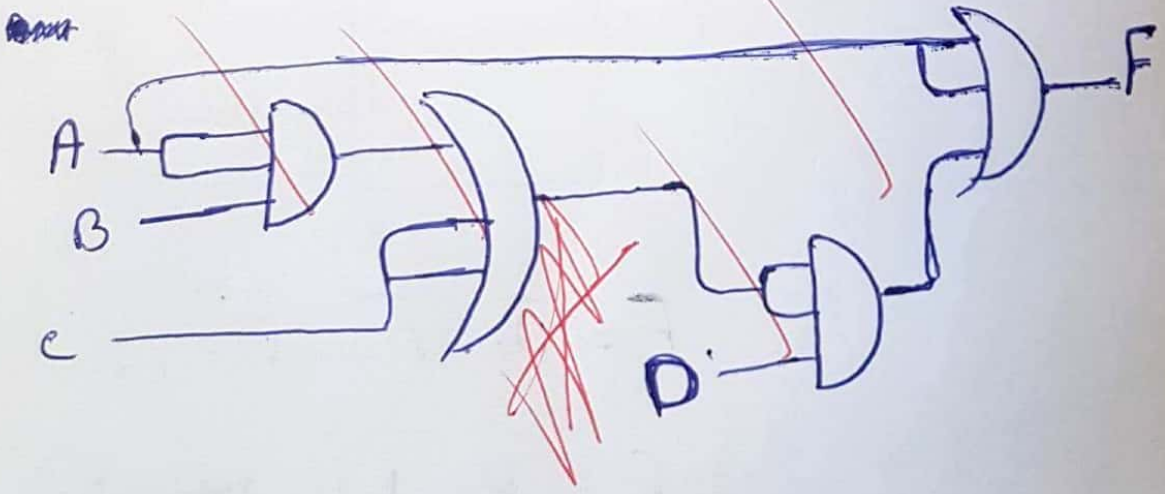
$D_2 + D_3$

Problem 5: Re-design the following logic function using NAND gates only and using the **minimum** number of inverters. **(2 Points)**

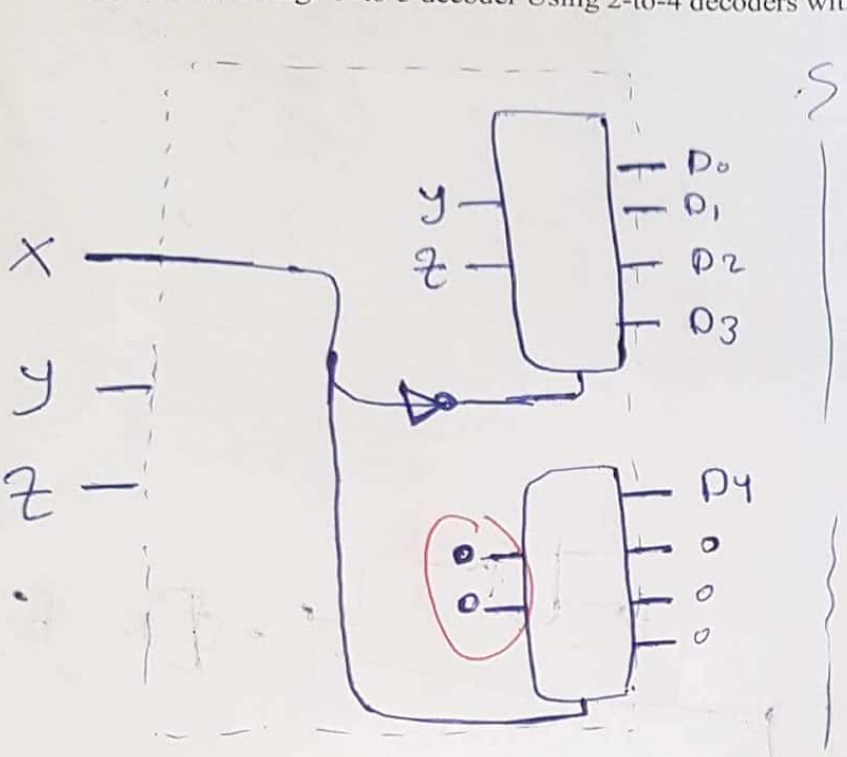


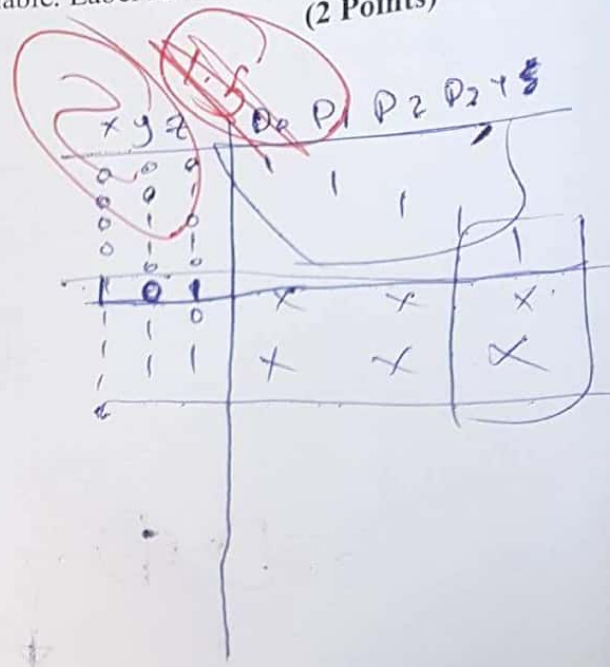
Problem 6: Implement the following function using 3-input OR gates and 3- input AND gates **only** **(2 Points)**

$$F = (A.B + C).D + A$$



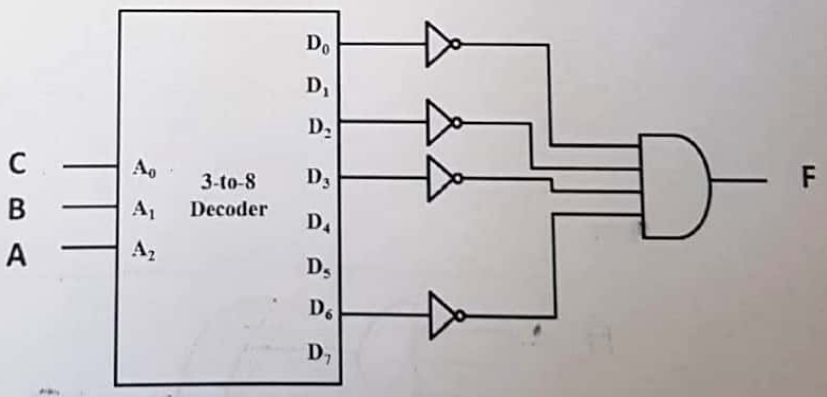
Problem 7: Design 3-to-5 decoder Using 2-to-4 decoders with enable. Label All the inputs and outputs **(2 Points)**





Problem 8: Given the following implementation of function (A, B, C) . Find the Boolean expression of F as SOM. **(1 point)**

$$F(A,B,C) = \sum_m (1, 4, 5, 7)$$



$$F = \bar{D_0} \cdot \bar{D_2} \cdot \bar{D_3} \cdot \bar{D_6}$$

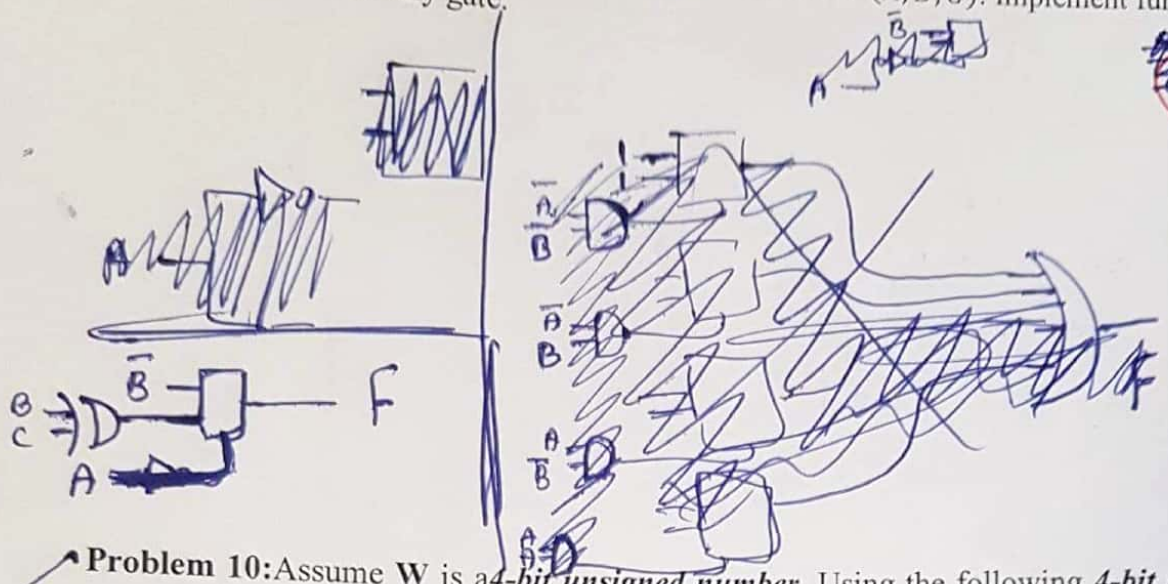
$$f = \overline{D_0 + D_2 + D_3 + D_6}$$

$$\bar{f} = D_0 + D_2 + D_3 + D_6$$

$$\bar{F} \rightarrow SOM \rightarrow (0, 2, 3, 6)$$

$$F \Rightarrow POS \rightarrow SOM(1, 4, 5, 7)$$

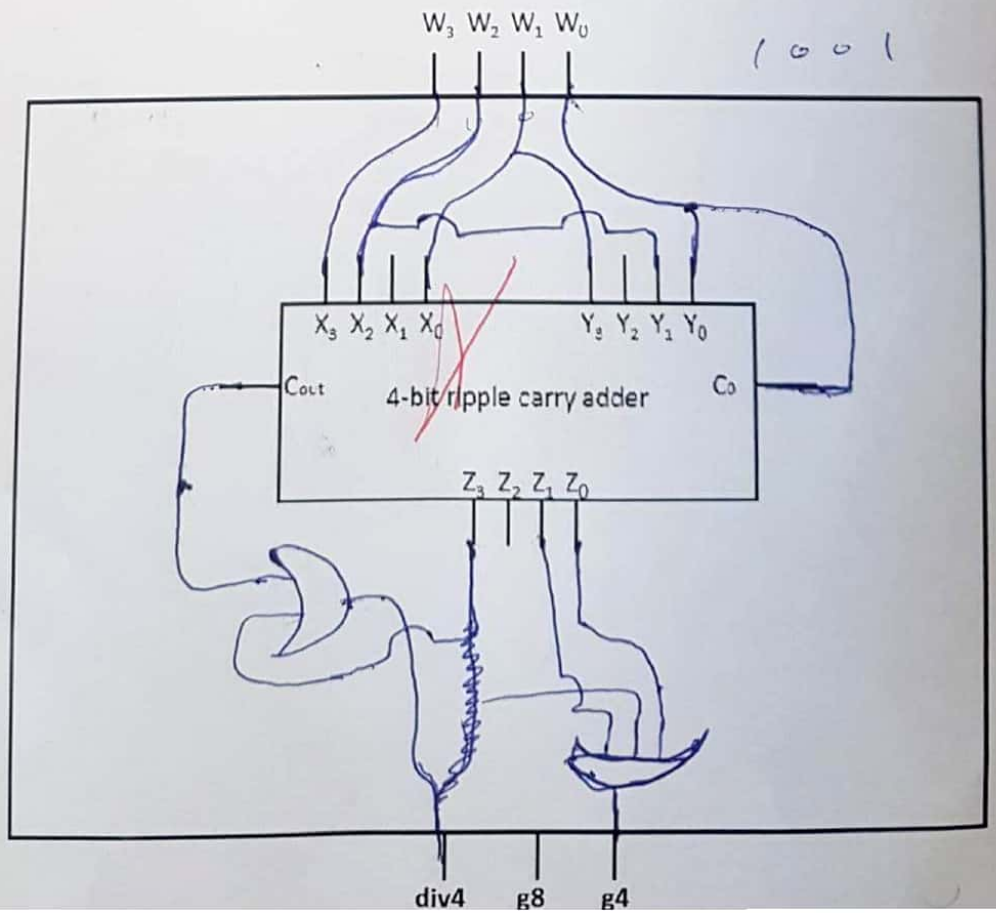
Problem 9: Given the following truth table for function $F(A, B, C)$. Implement function F using **ONE** 2-to-1 multiplexer and any gate. **(2 points)**



A	B	C	F
0	0	0	1
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	0

Problem 10: Assume **W** is a ***4-bit unsigned number***. Using the following ***4-bit ripple carry adder and any logic gates*** to design that the logic block that outputs three bits div4, g8 and g4 according to the following table: **(3 points)**

Output	Outputs
div4	=1 if W is divisible by 4 without a remainder =0 if W is Not divisible by 4 without a remainder
g8	=1 if W> 8 =0 if W<= 8
g4	=1 if W> 4 =0 if W<= 4



Problem 11: Implement the following function using **only one 2-to4 decoder, one 4-to-1 MUX, and two OR gates**. The decoder and the MUX are drawn below for your convenience.

(3.5 points)

$$F(W,X,Y,Z) = \sum_m (1,4,7,8,13,14)$$