0907231 Digital Logic	Second Exam	University of Jordan
5 Problems		
المدرس:		

Problem 1. Answer the following short questions. **(14 points)**

a. What is the decimal value of the binary number $(10111)_2$ if it represents:

1. Sign-Magnitude number: $(10111) = -7$
2. 2's complement signed number: $(10111) = -9$

b. Does the following operation $(110001)_2 + (110111)_2$ result in an overflow or not when the number are: ***(You must Justify your answer)***

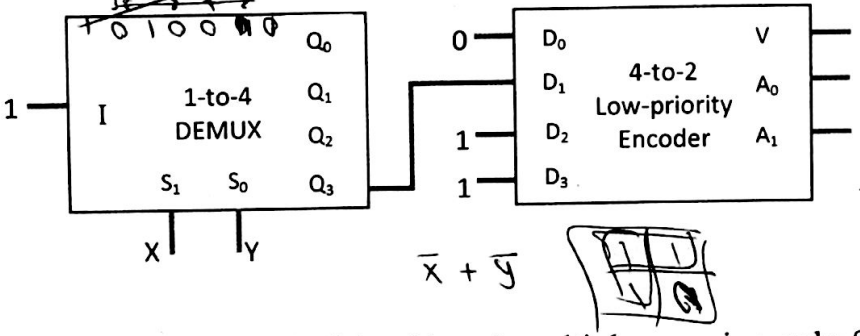
1. Unsigned numbers:
$$\begin{array}{r} 1\ 1\ 1\ 1 \\ 1\ 1\ 0\ 0\ 0\ 1 \\ +\ 1\ 1\ 0\ 1\ 1\ 1 \\ \hline 1\ 1\ 0\ 1\ 0\ 0\ 0 \end{array}$$
overflow because the curry is 1 and larger than the result the allowed bit

2. 2's complement signed numbers:
$$\begin{array}{r} 1\ 1\ 1 \\ 1\ 1\ 0\ 0\ 0\ 1 \\ +\ 1\ 1\ 0\ 1\ 1\ 1 \\ \hline 1\ 1\ 0\ 1\ 0\ 0\ 0 \end{array}$$
$C_{n-1} \oplus C_n = 0$ No over flow

c. Given two ***2's complement signed numbers*** $A = (1010)_2$ and $B = (01011100)_2$. In the given blank write the result of $A - B$ using an ***8-bit adder/subtractor***?

$A - B =$ 10101110

d. Given the following combinational logic circuit, write the Boolean equations of A_0 and A_1 as functions of variables X and Y:



$A_0(X,Y) = \bar{X} + \bar{Y}$

$A_1(X,Y) = 1$

Y	X	V	A_0	A_1
0	0	x	ϕ	ϕ
0	ϕ	x	1	ϕ
ϕ	0	x	1	1
1	1	x	0	1

$\bar{X} + \bar{Y}$

e. We want to build a 64-to-1 multiplexer using only 8-to1 multiplexers. How many 8-to-1 multiplexers are needed?

Answer = $8 + 1 = 9$

$\frac{64}{8} = \frac{8}{8} = 1$

f. Fill in the blanks:

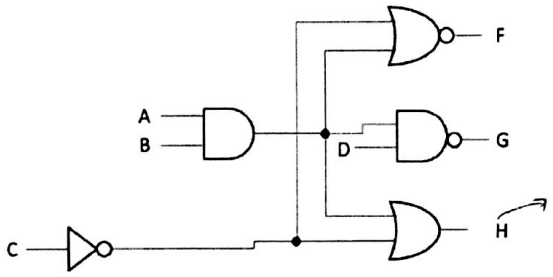
$(765)_8 + (303)_8 = ($ 3777 $)_8$

A=10
B=11
C=12
D=13
E=14

$(6PA8)_{16} - (4ED9)_{16} = ($ 20BF $)_{16}$

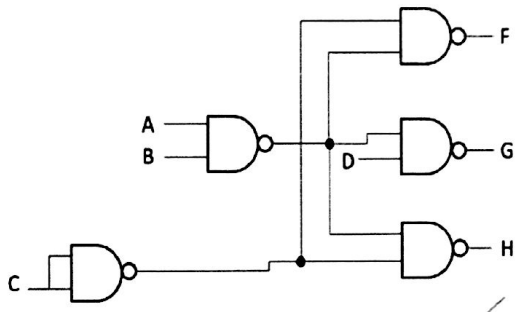
$(1000\ 0111\ 0011)_{BCD} + (0000\ 1001\ 1001)_{BCD} = ($ (1001 0001 0010) $)_{BCD}$

g. We want to implement the following logic diagram using only NAND gates:

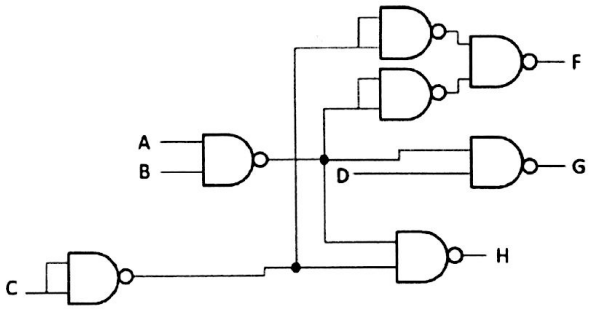


Choose the ***correct answer*** that uses ***minimum number*** of NAND gates:

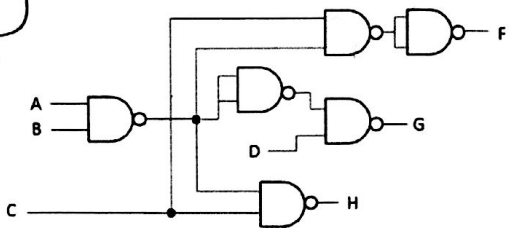
a.



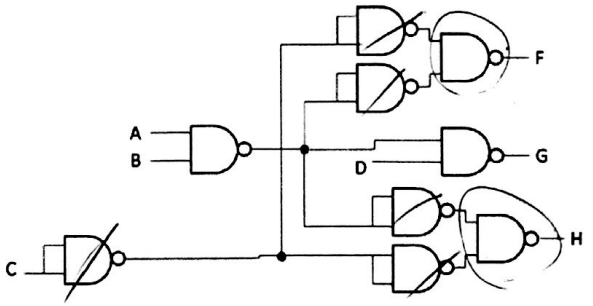
b.



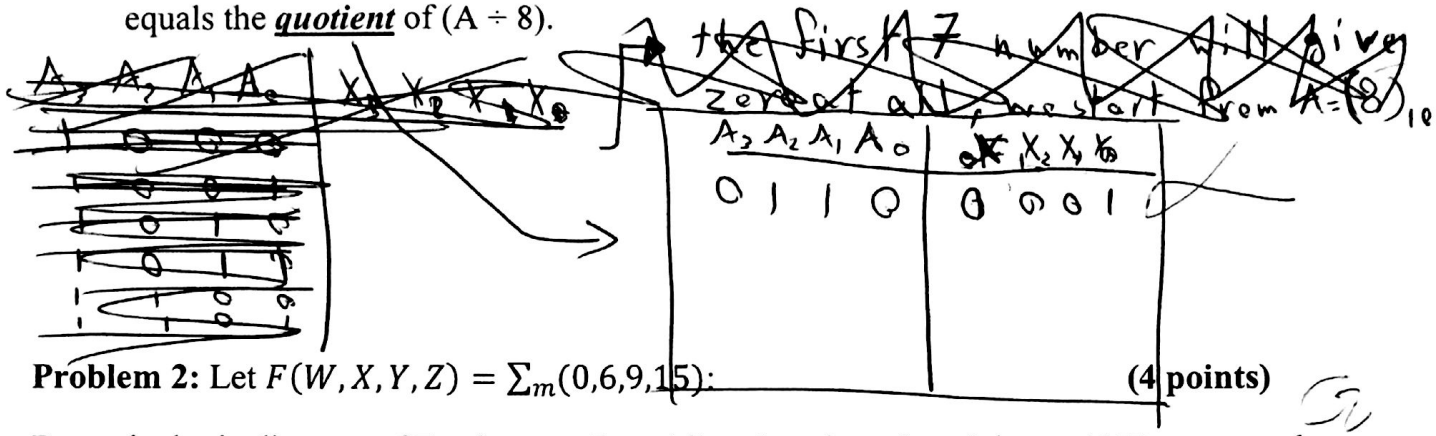
c.



d.

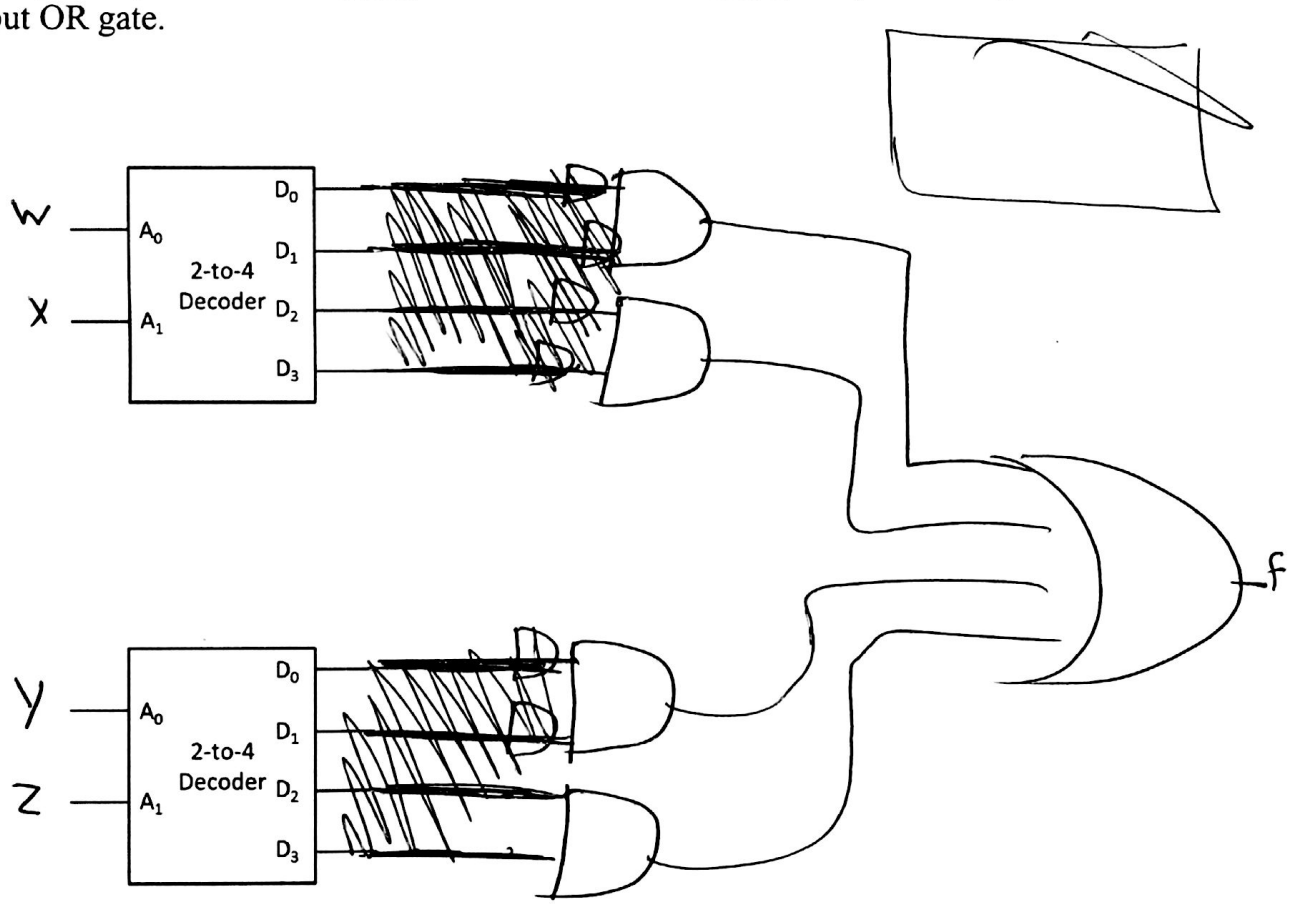


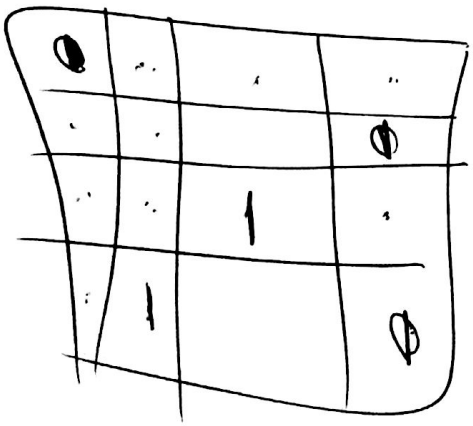
h. Draw the logic diagram of a combinational circuit that has a ***4-bit unsigned*** number (A) as an input and produces a ***4-bit unsigned*** number (B) as an output such that B equals the ***quotient*** of (A ÷ 8).



Problem 2: Let $F(W,X,Y,Z) = \sum_m(0,6,9,15)$: **(4 points)**

Draw the logic diagram of F using ***two*** 2-to-4 line decoders, ***four*** 2-input AND gates, and ***one*** 4-input OR gate.

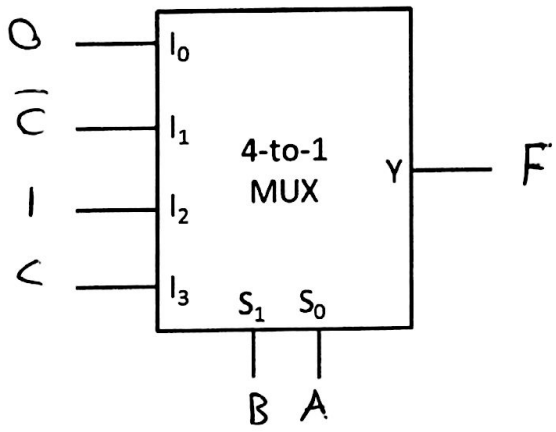


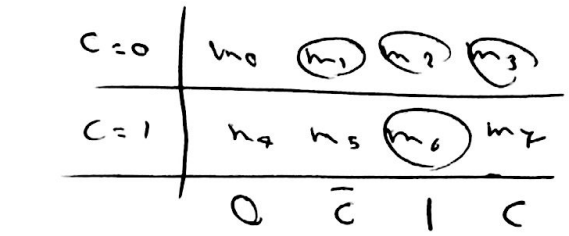


Problem 3: Let $F(A, B, C)$ be given by the below truth table. **(3 points)**

Draw the logic diagram of F using a single 4-to-1 Multiplexer and a single inverter.

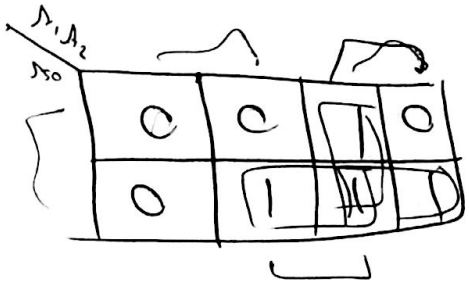
A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0





Problem 4: Write the truth table for a combinational circuit that takes a 3-bit input and produces 1-bit output. The output is 1 if there is ***at least*** two consecutive 1's in the input. **(4 points)**

A_2	A_1	A_0	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1



$$F = A_2\bar{A}_0 + A_1\bar{A}_0 + A_1A_2$$

Problem 5: Assume **m** and **n** are 4-bit ***unsigned*** numbers. Using ***only*** the following three 4-bit ripple carry adders and ***any logic gates*** you need, design a circuit that outputs an 8-bit ***unsigned*** number **k** such that: **(5 points)**

$$k = (6 \times m) - n$$