Name *Answers*

CE-1901-11 – Dr. Durant – Quiz 6
Fall 2016, Week 7 Quiz

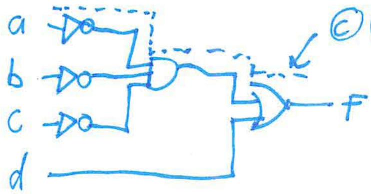
1. (4 points) Simplification and implementation: $F(abcd) = \Sigma_m(0, 1, 3, 5, 7, 9, 11, 13, 15) + d(12, 14)$

   a. (2 points) ***Draw*** the K-map and use it to ***derive*** a simplified SOP expression taking advantage of these don't cares.

F: ab \ cd	00	01	11	10
00	* 1	1	1	
01		1	1	
11		1	1	
10	X	1	1 *	X

$$F = \underbrace{\bar{a}\bar{b}\bar{c} + d}_{\text{answer}} = \overline{a+b+c} + d$$

   b. (1 point) ***Draw*** the SOP schematic using NOT-AND-OR gates.



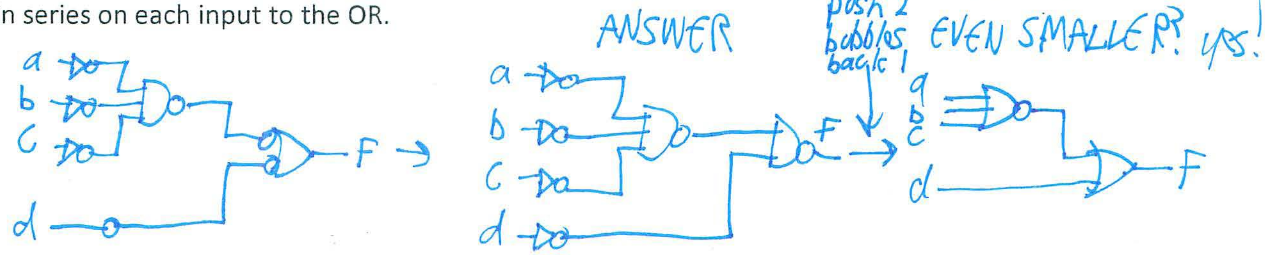
© (equivalently, from b or c)

   c. (1 point) ***What*** path of gates is involved in the propagation delay (critical path) of this circuit? (illustrate in part b)

   d. (0.5 point) ***How*** many CMOS transistors does this require? Show your calculations.

3 NOT	6
1 AND3	8
1 OR2	6
	20

   e. (1 point) ***Draw*** the NOT-NAND-NAND form of the SOP circuit. Hint: Begin by placing 2 NOTs in series on each input to the OR.



   f. (0.5 point) ***How*** many CMOS transistors does this require? Show your calculations.

4 NOT	8
1 NAND3	6
1 NAND2	4
	16

NOR-OR option →

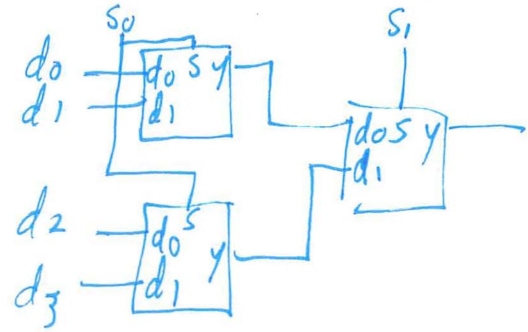
1 NOR3	6
1 OR2	6
	12

2. (3 points) MUXes

a. (1 point) ***Write*** the logic equation for the 4:1 MUX, $y = f(s_{1..0}, d_{0..3})$. Remember that there is a product term for each of the data terms; this product term checks all values of s to make sure they match the term's corresponding s-minterm.

$$y = \bar{s}_1\bar{s}_0 d_0 + \bar{s}_1 s_0 d_1 + s_1 \bar{s}_0 d_2 + s_1 s_0 d_3$$

b. (2 points) Using a block diagram ***show*** how a 4:1 MUX can be made from 3, 2:1 MUXes.

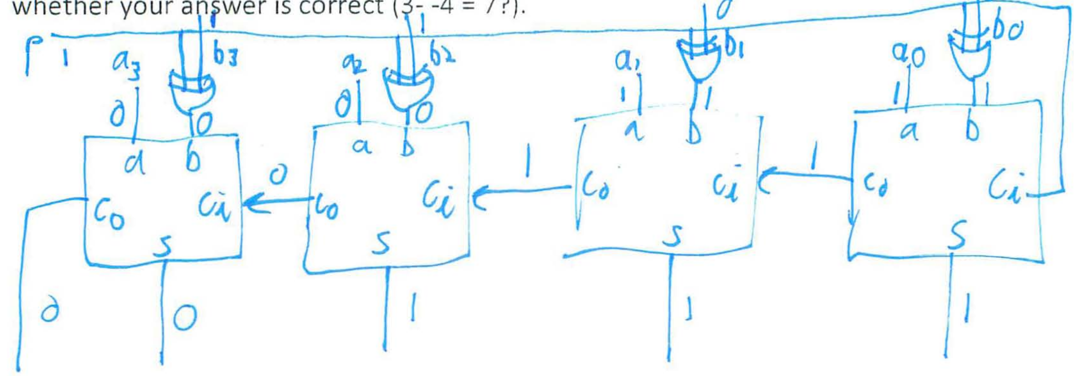


3. (3 points) Subtraction

a. (2 points) ***Draw*** the block diagram for the 4-bit ripple-carry adder-subtractor (RCAS4). ***Use*** full adder (FA) blocks. ***Hint***: You need a "sub"tract input and 4 XOR2 gates.

b. (1 point) ***Label*** the inputs to your RCAS3 so that it is subtracting B=-4 from A=3. ***Show the logic value*** of every node in the circuit (but not the internal details of the FAs). Comment on whether your answer is correct (3 - -4 = 7?).

5



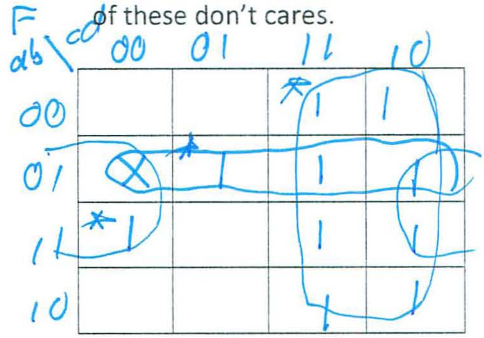
answer = $0111_2 = 7_{10}$ ✓

-4: 0100 ← 4
1011 ← n
1100 ← +1
-4

Name Answers

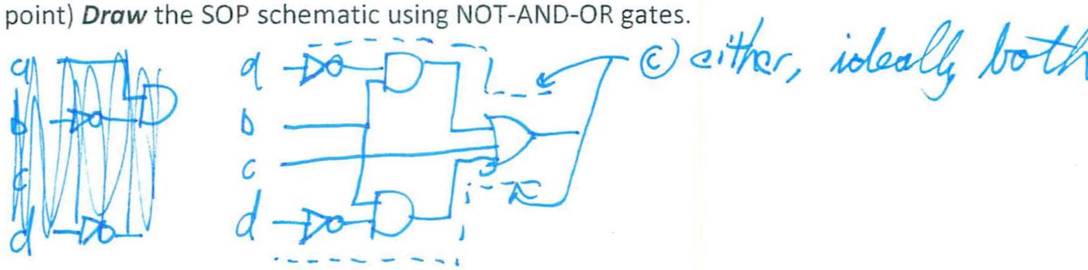
CE-1901-12 – Dr. Durant – Quiz 6
Fall 2016, Week 7 Quiz

1. (4 points) Simplification and implementation: $F(abcd) = \Sigma_m(2, 3, 5, 6, 7, 10, 11, 12, 14, 15) + d(4)$
   a. (2 points) ***Draw*** the K-map and use it to ***derive*** a simplified SOP expression taking advantage of these don't cares.



$F = c + \bar{a}b + b\bar{d}$

   b. (1 point) ***Draw*** the SOP schematic using NOT-AND-OR gates.

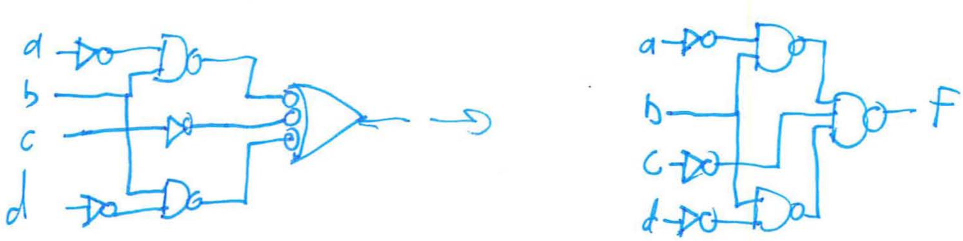


   c. (1 point) ***What*** path of gates is involved in the propagation delay (critical path) of this circuit? (illustrate in part b)

   d. (0.5 point) ***How*** many CMOS transistors does this require? Show your calculations.

2 NOT	4
2 AND2	12
1 OR3	8
	24

   e. (1 point) ***Draw*** the NOT-NAND-NAND form of the SOP circuit. Hint: Begin by placing 2 NOTs in series on each input to the OR.



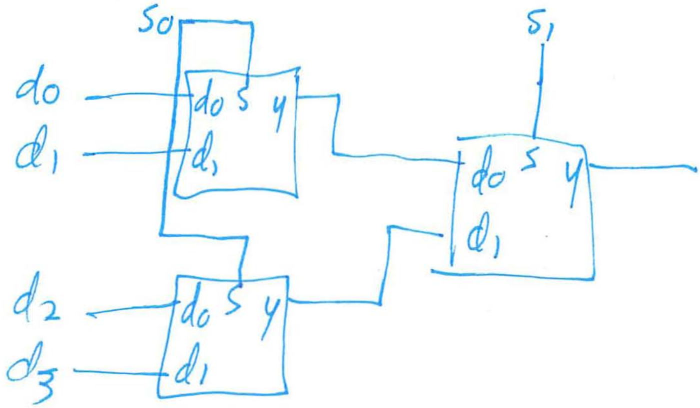
   f. (0.5 point) ***How*** many CMOS transistors does this require? Show your calculations.

3 NOT	6
2 NAND2	8
1 NAND3	6
	20

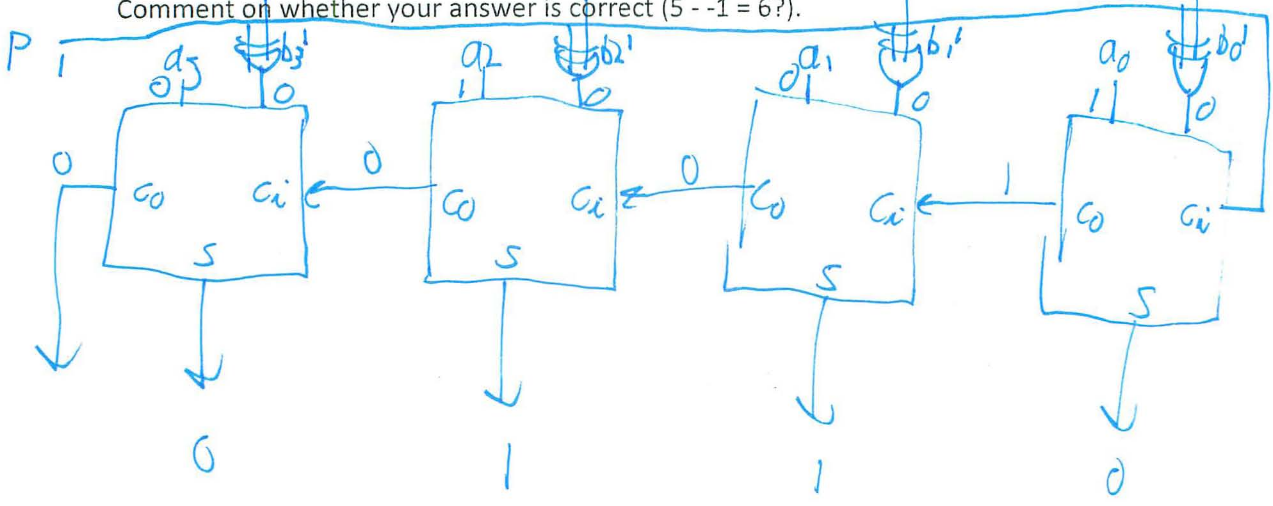
2. (3 points) MUXes
   a. (1 point) ***Write*** the logic equation for the 4:1 MUX, $y = f(s_{1..0}, d_{0..3})$. Remember that there is a product term for each of the data terms; this product term checks all values of s to make sure they match the term's corresponding s-minterm.

$$y = \bar{s}_1\bar{s}_0 d_0 + \bar{s}_1 s_0 d_1 + s_1\bar{s}_0 d_2 + s_1 s_0 d_3$$

   b. (2 points) Using a block diagram ***show*** how a 4:1 MUX can be made from 3, 2:1 MUXes.



3. (3 points) Subtraction
   a. (2 points) ***Draw*** the block diagram for the 4-bit ripple-carry adder-subtractor (RCAS4). ***Use*** full adder (FA) blocks. ***Hint***: You need a "sub"tract input and 4 XOR2 gates.
   b. (1 point) ***Label*** the inputs to your RCAS3 so that it is subtracting B=-1 (1111) from A=5. ***Show the logic value*** of every node in the circuit (but not the internal details of the FAs). Comment on whether your answer is correct (5 - -1 = 6?).



$$S = 0110_2 = 6_{10} \checkmark$$