Questions 1-3 (6 points): For each of the following scenarios,

- build the truth table (1 point);

- derive the corresponding boolean expression, and simplify it to the extent possible (1 point).

A company's board consists of 4 people: Abigail (the CEO), Benoit, Charlie, and Debra.
When they take a vote, if there is a majority (either up or down), that vote prevails.
If, however, there is a tie, then Abigail's vote is the tie-breaker (e.g. if A&B vote up, and C&D vote down, the outcome is "up", because A's vote breaks the tie).
The truth table will show all possible combinations of the 4 votes, and the final decision for each.

Abigail	Benoit	Charlie	Debra	Final Decision
Up	Up	Up	Up	Up
Up	Up	Up	Down	Up
Up	Up	Down	Up	Up
Up	Up	Down	Down	Up
Up	Down	Up	Up	Up
Up	Down	Up	Down	Up
Up	Down	Down	Up	Up
Up	Down	Down	Down	Down
Down	Up	Up	Up	Up
Down	Up	Up	Down	Down
Down	Up	Down	Up	Down
Down	Up	Down	Down	Down
Down	Down	Up	Up	Down
Down	Down	Up	Down	Down
Down	Down	Down	Up	Down
Down	Down	Down	Down	Down

Abigail	Benoit	Charlie	Debra	Final Decision
1	1	1	1	1
1	1	1	0	1
1	1	0	1	1
1	1	0	0	1
1	0	1	1	1
1	0	1	0	1
1	0	0	1	1
1	0	0	0	0
0	1	1	1	1
0	1	1	0	0
0	1	0	1	0
0	1	0	0	0
0	0	1	1	0
0	0	1	0	0
0	0	0	1	0
0	0	0	0	0

Abigail	Benoit	Charlie	Debra	Final Decision
1	1	1	1	1
1	1	1	0	1
1	1	0	1	1
1	1	0	0	1
1	0	1	1	1
1	0	1	0	1
1	0	0	1	1
1	0	0	0	0
0	1	1	1	1
0	1	1	0	0
0	1	0	1	0
0	1	0	0	0
0	0	1	1	0
0	0	1	0	0
0	0	0	1	0
0	0	0	0	0

ab \ cd	00	01	11	10
00	0	0	0	0
01	0	0	1	0
11	1	1	1	1
10	0	1	1	1

$ac + cdb$
$+ c'ab + ac'd$

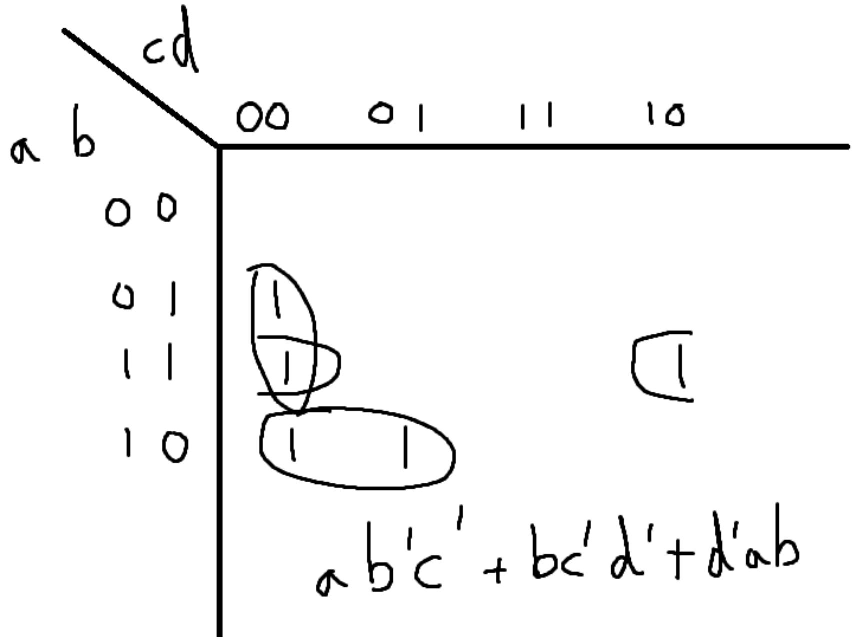
Given four inputs: a, b, c & d, where (a, b) represents a 2-bit unsigned binary number X; and (c, d) represents a 2-bit unsigned binary number Y (i.e. both X and Y are in the range #0 to #3). The output is z, which is 1 whenever X > Y, and 0 otherwise (this circuit is part of a "2-bit comparator").

For instance, if a = 1, b = 0 (i.e. X = b10 => #2); c = 0, d = 1 (i.e. Y = b01 => #1); then z = 1, since b10 > b0Z

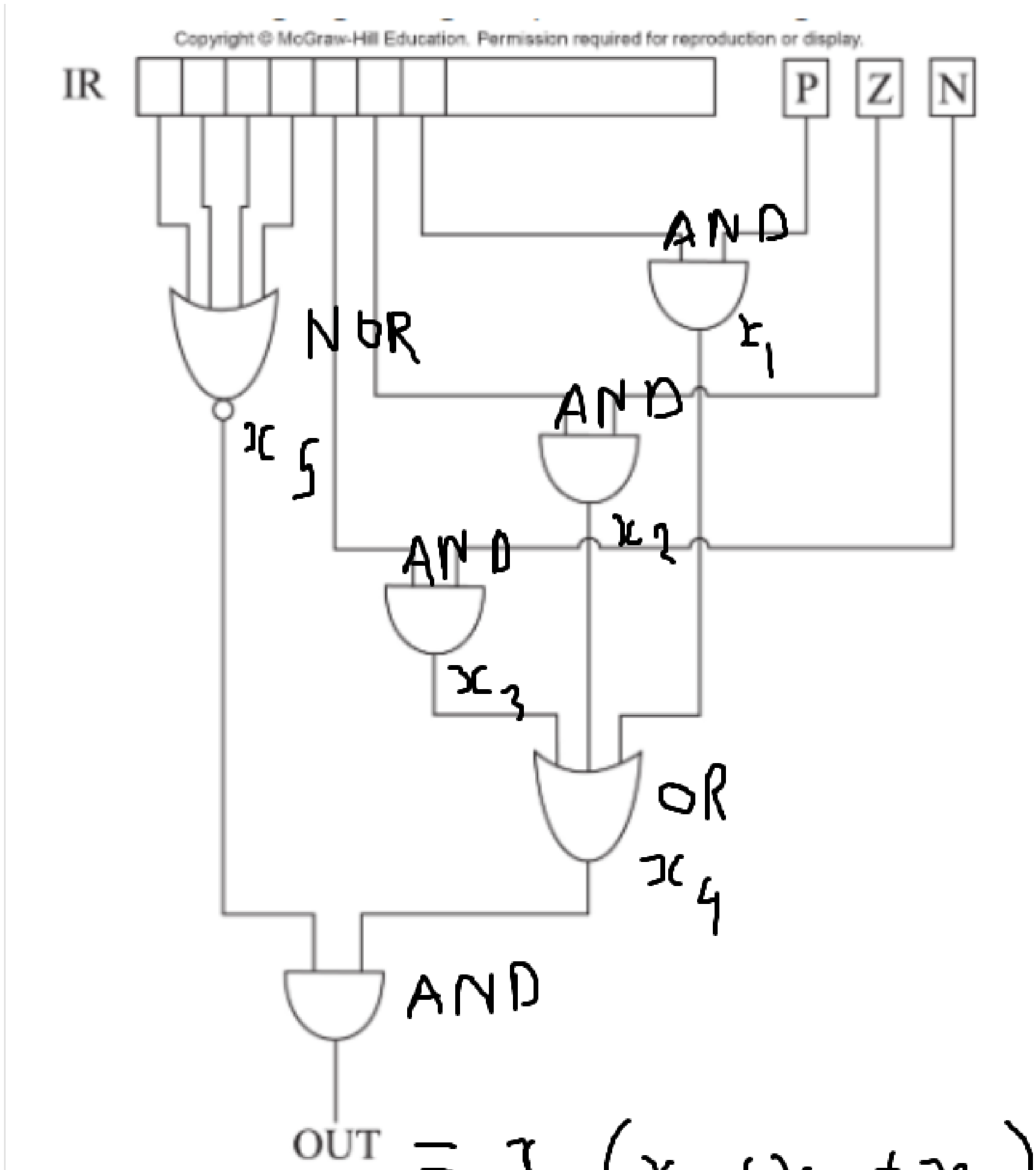
a	**b**	**c**	**d**	**X**	**Y**	**X > Y?**
0	0	0	0	0	0	0
0	0	0	1	0	1	0
0	0	1	0	0	2	0
0	0	1	1	0	3	0
0	1	0	0	1	0	1
0	1	0	1	1	1	0
0	1	1	0	1	2	0
0	1	1	1	1	3	0
1	0	0	0	2	0	1
1	0	0	1	2	1	1
1	0	1	0	2	2	0
1	0	1	1	2	3	0
1	1	0	0	3	0	1
1	1	0	1	3	1	1
1	1	1	0	3	2	1
1	1	1	1	3	3	0

a	**b**	**c**	**d**	**X > Y?**
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

a	b	c	d	X > Y?
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0



The following logic diagram produces the logical value OUT.



$$= x_5(x_1 + x_2 + x_3)$$

Show your attempt at creating a truth table and deriving the boolean expression. What does the value 0 or 1 for OUT signify?

OUT being 0 means that x4 or x5 or both x4 and x5 and 0. And 1 is the inverse

Questions 4-5 (1 point each): Chapter 3, exercises 3.21 (3.15 in 2nd edition) and 3.27 (3.21 in 2nd edition)

Q4

If A and B are four-bit unsigned binary numbers, 0111 and 1011, complete the table obtained when using a two-bit full adder from Figure 3.15 to calculate each bit of the sum, S, of A and B. Check your answer by adding the decimal value of A and B and comparing the sum with S. Are the answers the same? Why or why not?

So S gives us 2 while the decimal answer is 19. This is because of overflow and there not being enough bits to store the answer which is 5 bits since we are only using 4 bits.

C_{in}				0
A	0^1	1^1	1^1	1
B	1	0	1	1
S	0	0	1	0
C_{out}				

Q5

You know a byte is eight bits. We call a four-bit quantity a nibble. If a byte-addressable memory has a 14-bit address, how many nibbles of storage are in this memory?

7 x 2 = 14 nibbles of storage