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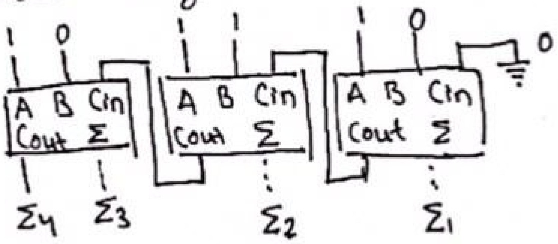
EIE2050 Assignment 5

1.



$\Sigma_1 = (A \oplus B) \oplus C_{in} = (1 \oplus 0) \oplus 0 = 1$

$\Rightarrow C_{out} = AB + BC + AC = 1 \cdot 0 + 0 \cdot 0 + 1 \cdot 0 = 0$

$\Sigma_2 = (A \oplus B) \oplus$ ~~[illegible]~~ $C_{in} = (1 \oplus 1) \oplus 0 = 0$

$\Rightarrow C_{out} = AB + BC + AC = 1 \cdot 1 + 1 \cdot 0 + 1 \cdot 0 = 1$

$\Sigma_3 = (A \oplus B) \oplus C_{in} = (1 \oplus 0) \oplus 1 = 0$

$\Rightarrow \Sigma_4 = AB + BC + AC = 1 \cdot 0 + 0 \cdot 1 + 1 \cdot 1 = 1$

$\Sigma_4 \Sigma_3 \Sigma_2 \Sigma_1 = 1001$

2. When $\overline{add}$/sub is high, the XOR gate produces complements of their inputs, so full adder addition function is as shown below:

Cin ←	Cin ←	Cin ←	
A_3	A_2	A_1	A_0
$\overline{B_3}$	$\overline{B_2}$	$\overline{B_1}$	$\overline{B_0}$
			1
Cout Σ_3	Σ_2	Σ_1	Σ_0

2's complement of B: $\overline{B_3}\ \overline{B_2}\ \overline{B_1}\ \overline{B_0}$ + 1

$\underbrace{C_{out}\ \Sigma_3\ \Sigma_2\ \Sigma_1\ \Sigma_0}_{A-B}$

the operation performs substraction

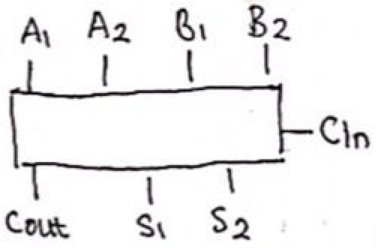
When $\overline{add}$/sub is low, the XOR gate produces the outputs whereas similar with the inputs, so full adder function is as show below:

A_3	A_2	A_1	A_0
B_3	B_2	B_1	B_0
			0
Cout Σ_3	Σ_2	Σ_1	Σ_0

$\underbrace{C_{out}\ \Sigma_3\ \Sigma_2\ \Sigma_1\ \Sigma_0}_{A+B}$

the operation performs addition

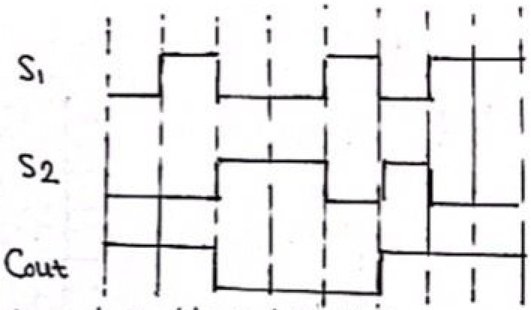
3.



	A_1	A_2
	B_1	B_2
Cout	S_1	S_2

Cin

as assumed A_1 & B_1 are MSB



derived truth table is:

A_1	A_2	B_1	B_2	Cin	S_1	S_2	Cout
1	0	1	0	0	0	0	1
1	1	1	1	0	1	0	1
0	1	0	0	0	0	1	0
0	0	0	1	0	0	1	0
0	1	0	0	1	1	0	0
1	1	0	1	1	0	1	1
1	1	1	0	1	1	0	1
1	0	1	1	1	1	0	1

4. first clock pulse:

$A = A_3A_2A_1A_0 = 1001$

$B = B_3B_2B_1B_0 = 0100$

since the binary sequence of A is larger than B, $A>B$ is high

second clock pulse:

$A = A_3A_2A_1A_0 = 1111$

$B = B_3B_2B_1B_0 = 1111$

since the binary sequence of A is equal to B, $A=B$ is high

third clock pulse:

$A = A_3A_2A_1A_0 = 1110$

$B = B_3B_2B_1B_0 = 0010$

since the binary sequence of A is larger than B, $A>B$ is high

fourth clock pulse:

$A = A_3A_2A_1A_0 = 1100$

$B = B_3B_2B_1B_0 = 0011$

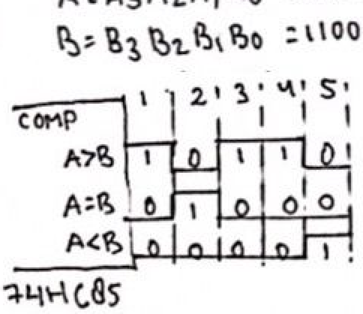
since the binary sequence of A is larger than B, $A>B$ is high

fifth clock pulse:

$A = A_3A_2A_1A_0 = 0101$

$B = B_3B_2B_1B_0 = 1100$

since the binary sequence of A is smaler than B, $A<B$ is high



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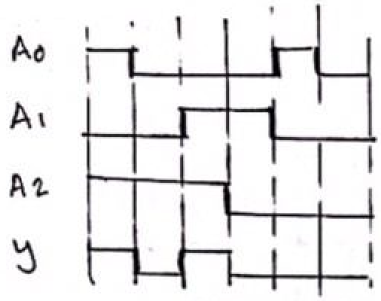
5. $y = \overline{A_0} A_1 A_2 + A_0 \overline{A_1} A_2 + \overline{A_0} A_1 \overline{A_2}$

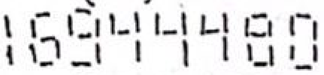
$= A_0 \overline{A_1} A_2 + \overline{A_0} A_1$



6.

	A_3	A_2	A_1	A_0	waveform sequence
0	0	0	0	0	8
1	0	0	0	1	1
2	0	0	1	0	
3	0	0	1	1	
4	0	1	0	0	4,5,6
5	0	1	0	1	
6	0	1	1	0	2
7	0	1	1	1	
8	1	0	0	0	7
9	1	0	0	1	3

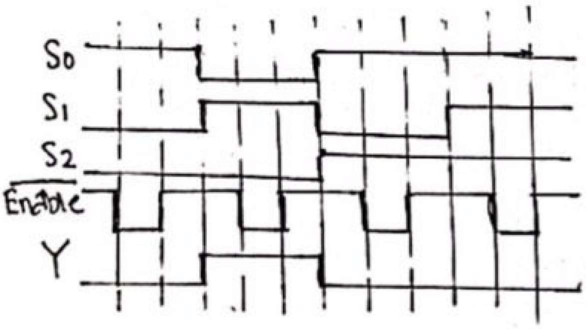
waveform sequence is read from timing diagram, reading taken from bottom to top. therefore, it will display:



16 9 4 4 4 8 0

7.

S_2	S_1	S_0	Y
0	0	0	D_0
0	0	1	D_1
0	1	0	D_2
0	1	1	D_3
1	0	0	D_4
1	0	1	D_5
1	1	0	D_6
1	1	1	D_7



$\overline{\text{Enable}} = 0$ implies the output depends on the inputs

$\overline{\text{Enable}} = 1$ implies the output doesn't depend on the imput

8. (a) The A_1 input is open (top adder)

$\Sigma = 1 \quad C_{out} = 1$

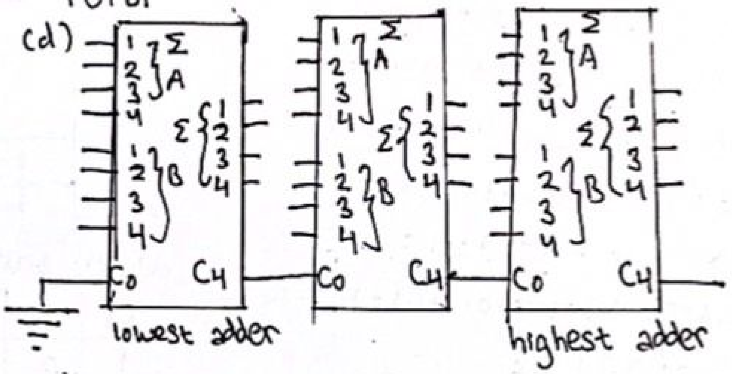
(b) The C_{out} is open (top adder)

$\Sigma_1 = 0 \quad \Sigma_2 = 0 \quad \Sigma_3 = 1 \quad \Sigma_4 = 1$

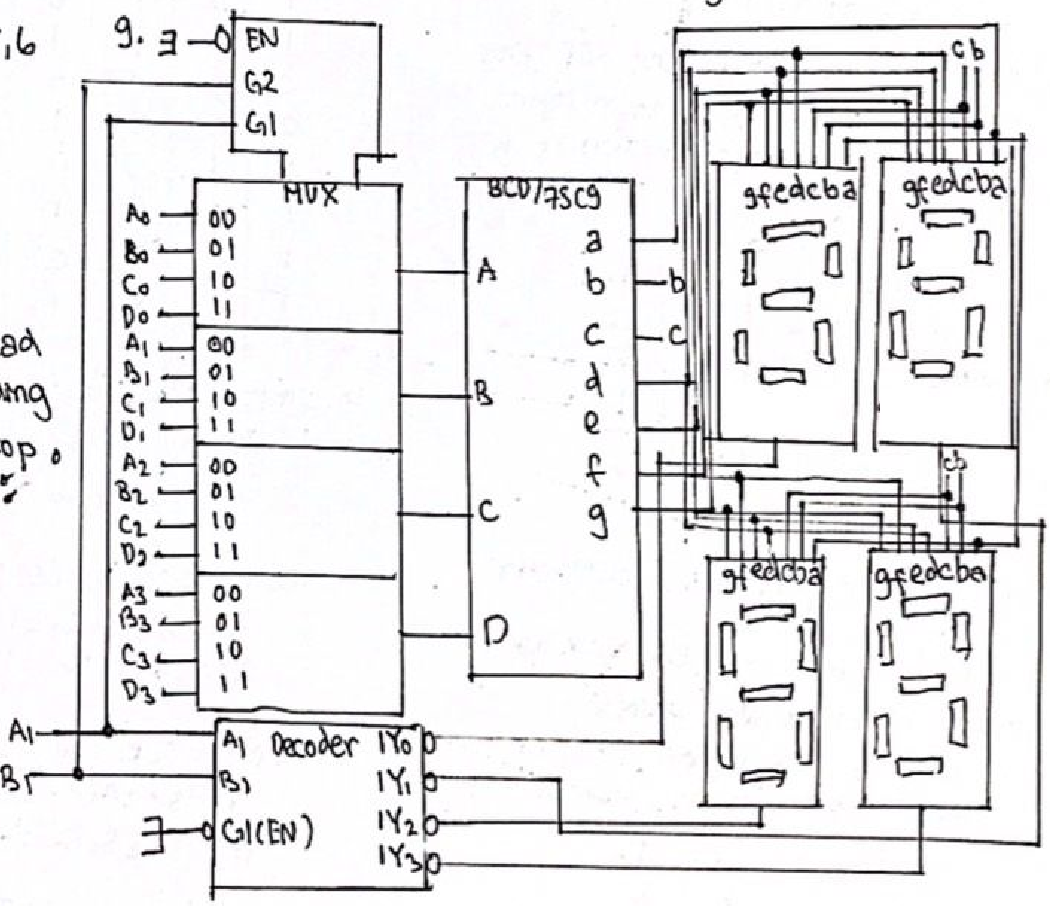
(c) The Σ_4 output is shorted to ground (top adder)

$$\begin{array}{r} 1011 \\ 1010 \\ \hline 10101 \end{array}$$

(d)



9.



10.

A_3	A_2	A_1	A_0	output (Y)
0	0	0	0	0
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

the circuit coin looks like,