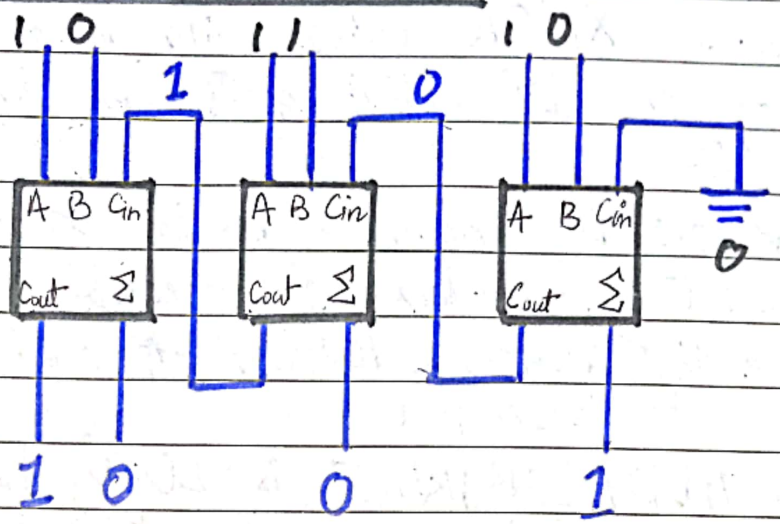
Assignment # 5

Question # 01

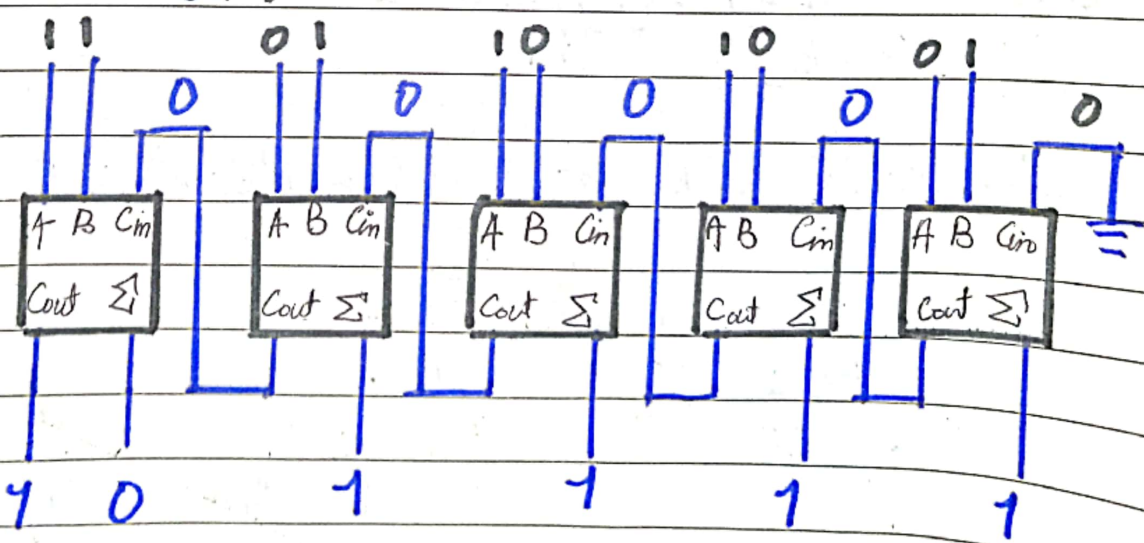
a)



Long Hand Addition:

A :	1	1	1	
B :	0	1	0	
Sum :	1	0	0	1

b)



A :	1	0	1	1	0
B :	1	1	0	0	1
Sum :	1	0	1	1	1	1

Sandal

Question # 2

a) When the ADD/SUBTRACT input is HIGH, the bits of number B gets inversed due to the attached XNOR gates with them. Moreover, the Cin of the 1st adder gets an input of 1 rather than 0.

Therefore, the number B is changed into its 2's complement and added with number A, which will yield the difference between A and B. The last carry is also discarded.

b) When ADD/SUBTRACT is LOW, the circuit will behave like a normal adder without changing the bits of B and the input carry. Last carry is also discarded

c) Assuming: ADD/SUBTRACT = 1,
A = 1010,
and B = 1101

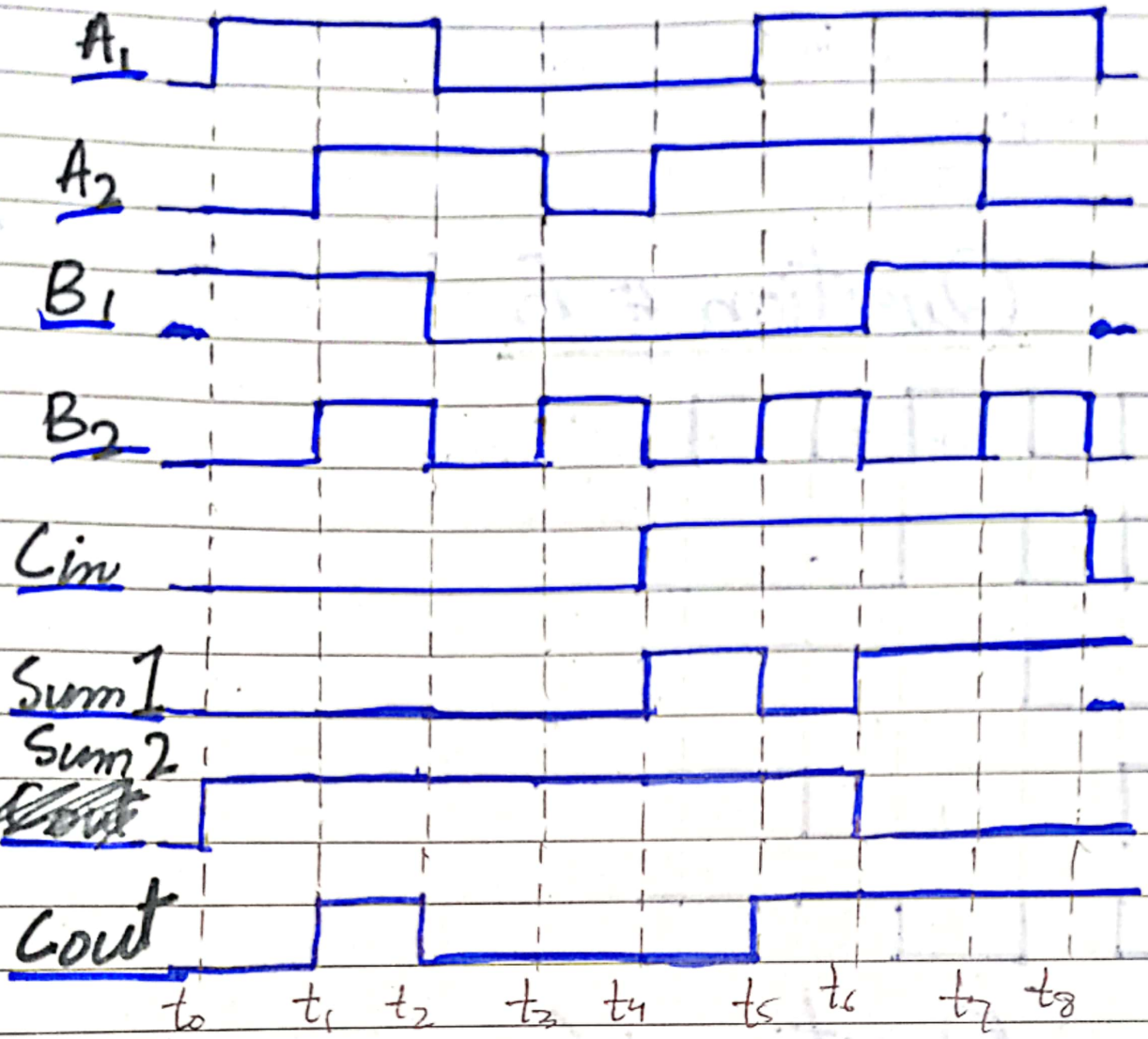
* The circuit will change B into its 2's complement because ADD/SUBTRACT is high:
$\Rightarrow B_{2's} = 0011$

* The circuit will now add B2's and A:

```
    1
A : 1 0 1 0
B : 0 0 1 1
---------
Sum : 1 1 0 1
```

is the output

Question # 3



Question # 4

Cin: 0 0 0 0

A_1	1	0	1	0
B_1	1	0	0	1
Σ_1	0	0	1	1
carries	1	0	0	0
A_2	1	1	0	0
B_2	1	0	1	1
Σ_2	1	1	1	1
carries	1	1	0	0
A_3	0	1	0	1
B_3	0	0	0	0
Σ_3	1	1	0	1
carries	0	0	0	0
A_4	1	1	0	1
B_4	0	0	0	1
Σ_4	1	1	0	0
Cout:	0	0	0	1

Hence:

Σ_0: 0 0 1 1

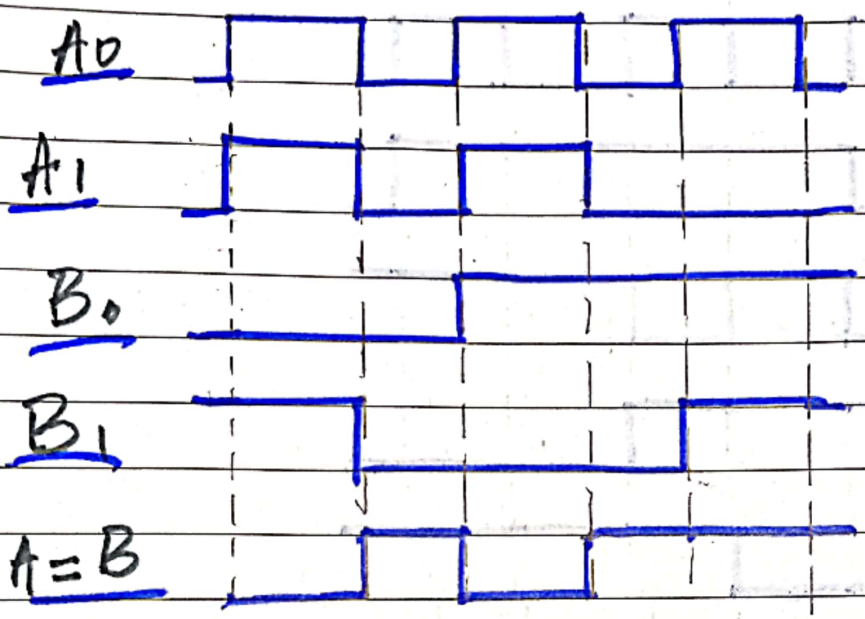
Σ_1: 1 1 1 1

Σ_2: 1 1 0 1

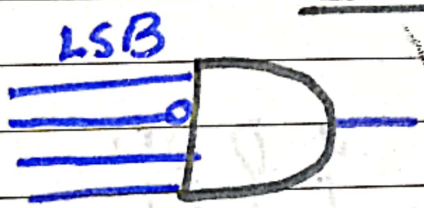
Σ_3: 1 1 0 0

Cout: 0 0 0 1

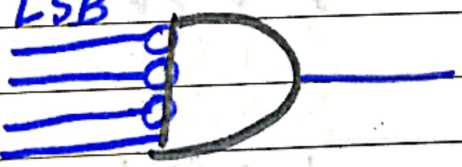
Question # 5



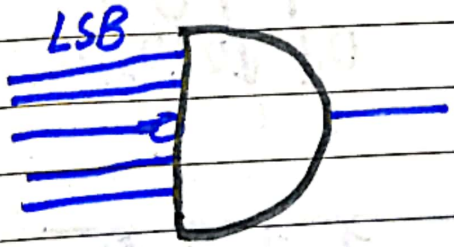
Question # 6

a) 

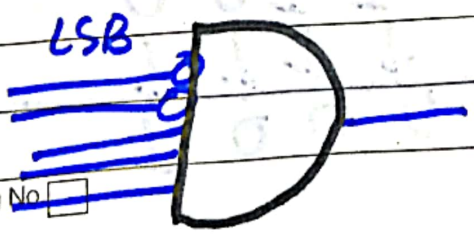
For 1101

b) 

For 1000

c) 

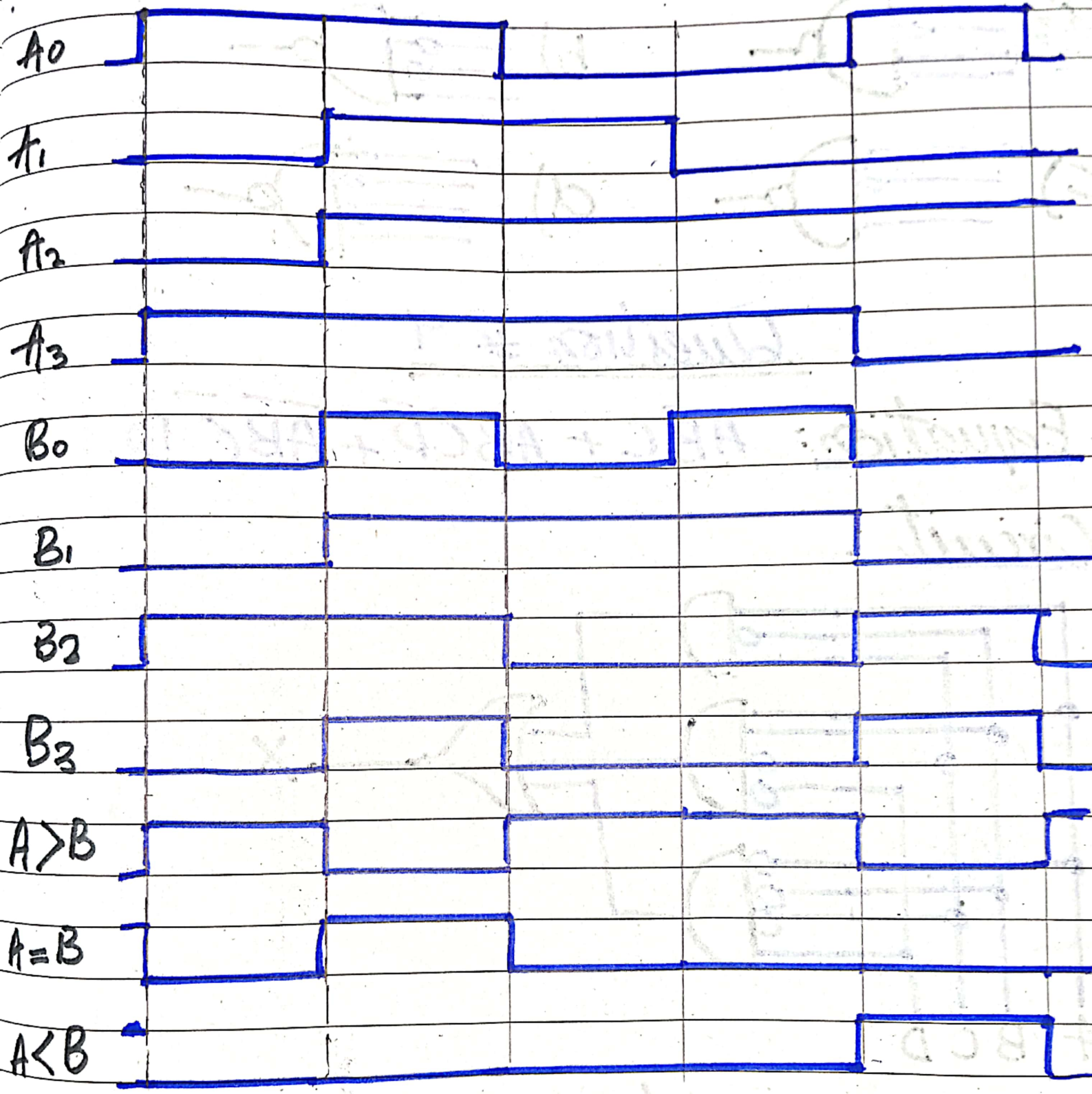
For 11011

d) 

For 11100

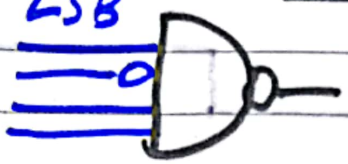
Sandal

Question # 6

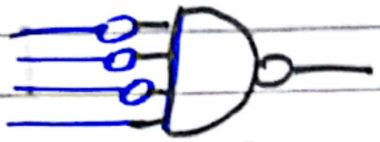


Question # 8

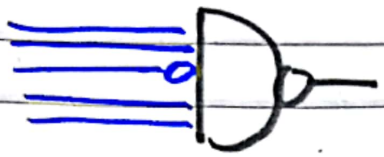
a) LSB



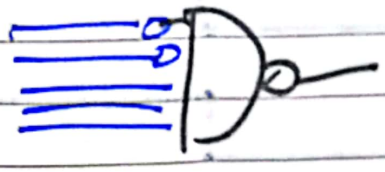
b)



c)



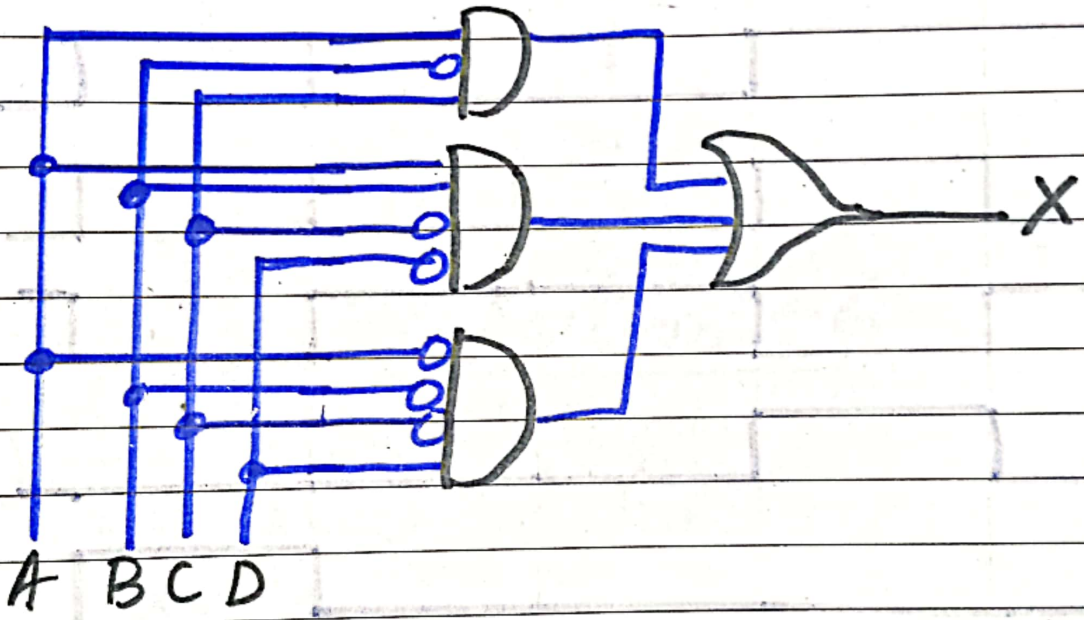
d)



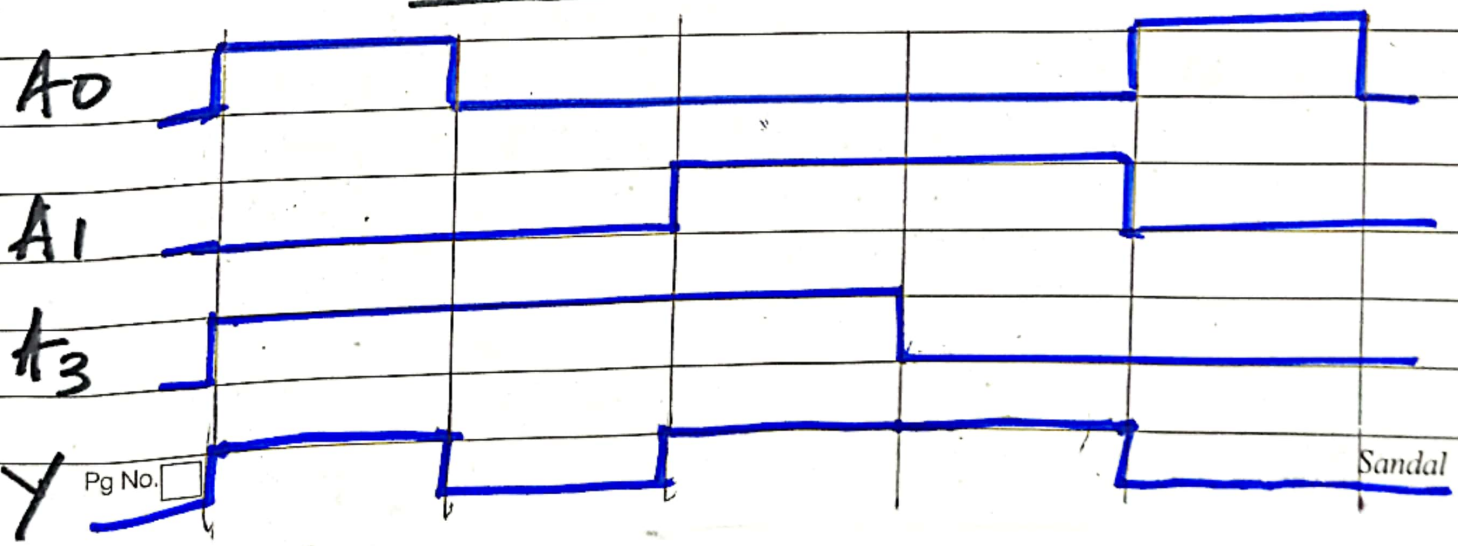
Question # 9

Equation: $A\bar{B}C + AB\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D}$

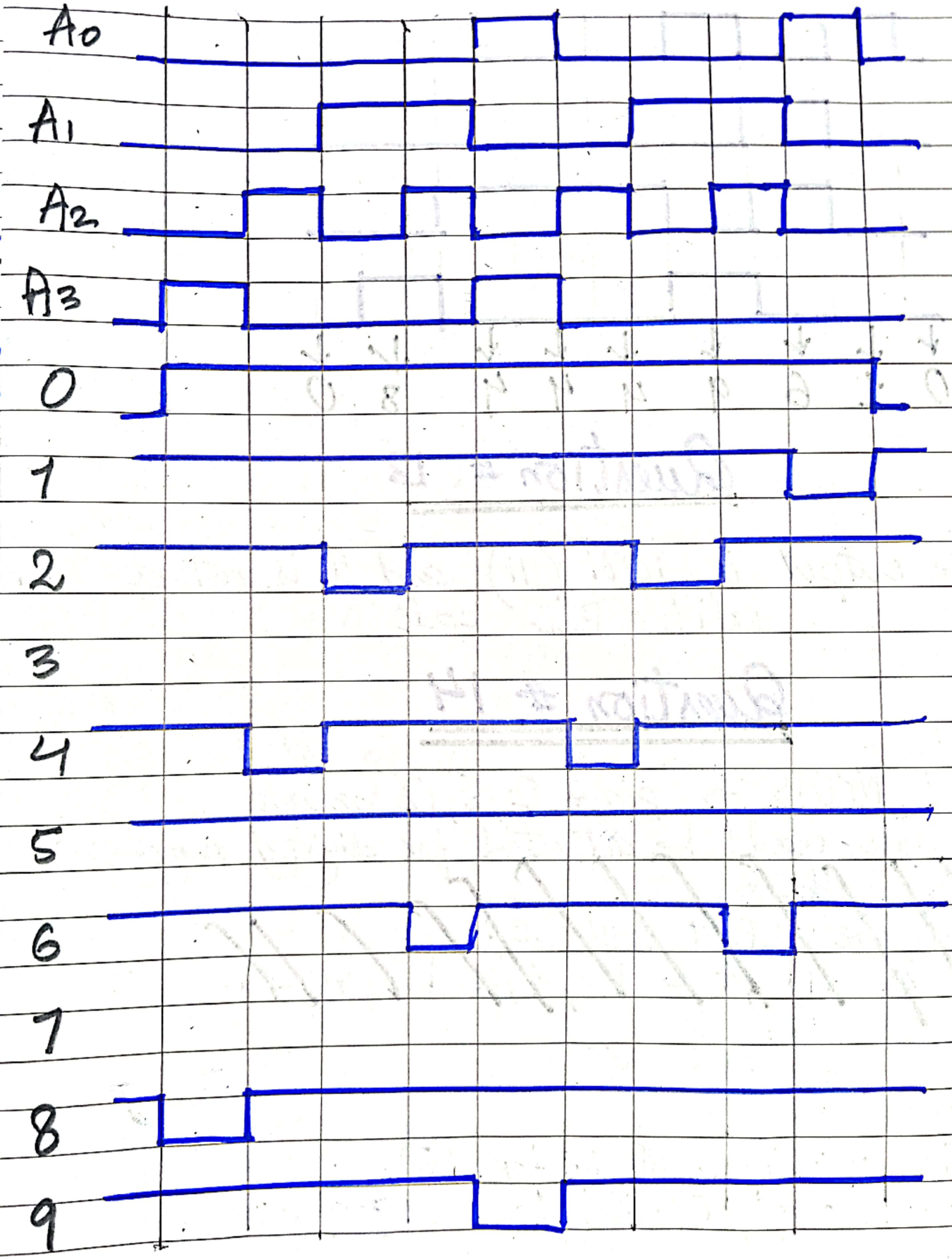
Circuit:



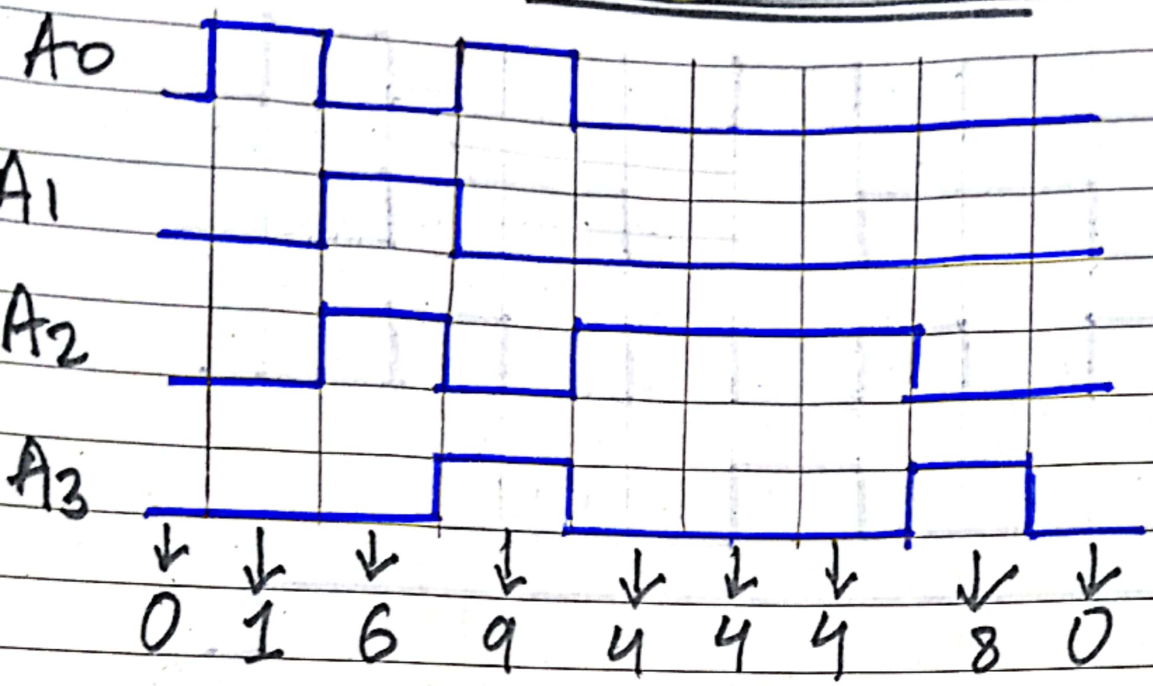
Question #10



Question # 11



Question #12



Question # 13

The output is 1011 (11) and it is not a valid BCD code

Question # 14

* LOW INPUTS on pin # 2, 5, 12 means the logic should be activated for digital numbers: 2, 5, and 8.
Hence, the output will be:
$A_0 = 1$, $A_1 = 1$, $A_2 = 1$, $A_3 = 1$

2 and $\bar{5}$

⇒ The priority will be for '5'
i.e. the output will be as 0101

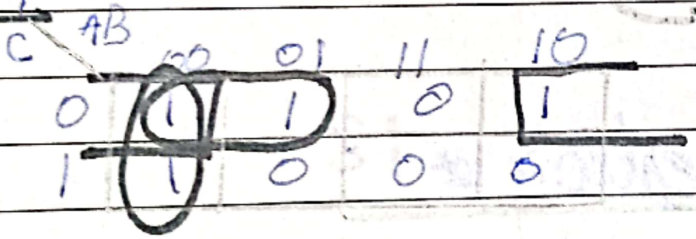
Question # 15

Truth Table:

A	B	C	X
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0

SOP: $\bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + A\bar{B}\bar{C} + A\bar{B}C$

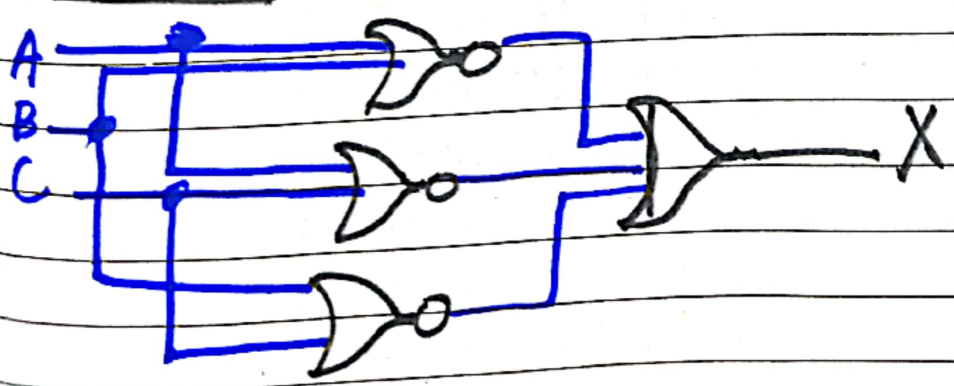
K-Map:



$\Rightarrow \bar{A}\bar{B} + \bar{A}\bar{C} + \bar{B}\bar{C}$

$\Rightarrow \overline{(A+B)} + \overline{(A+C)} + \overline{(B+C)}$

Circuit:



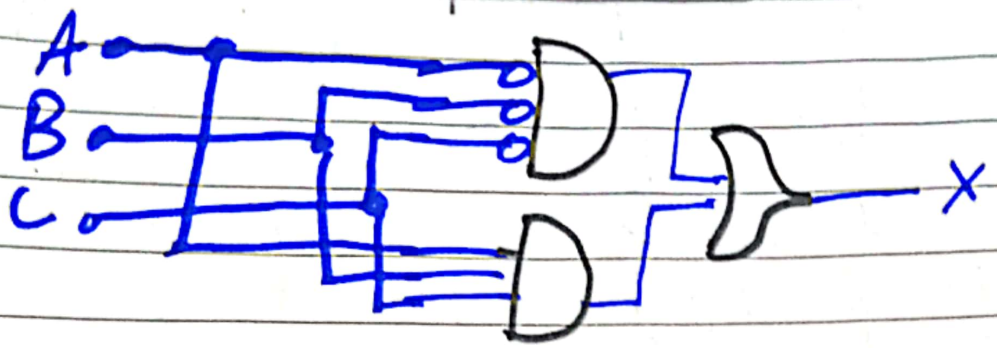
Sandal

Question # 16

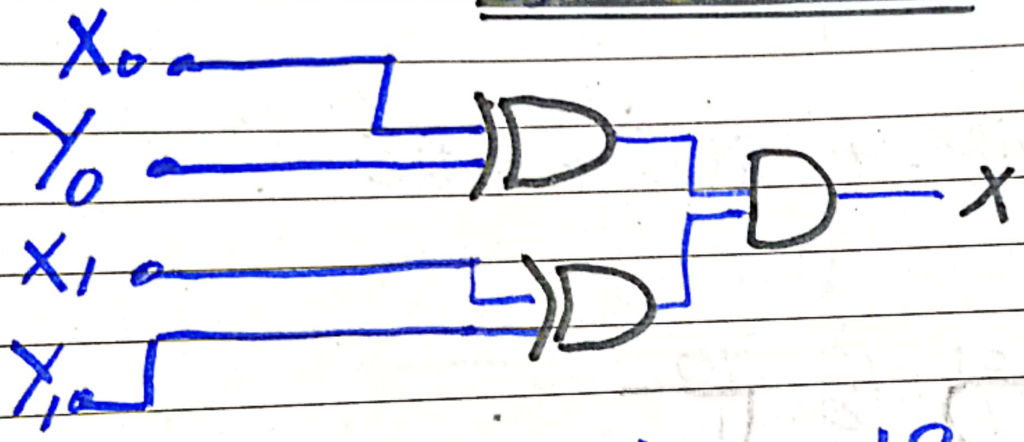
* K-Map:

C \ AB	00	01	11	10
0	1	0	0	0
1	0	0	1	0

$\Rightarrow \bar{A}\bar{B}\bar{C} + AB\bar{C}$



Question #17



Question # 18

A_3	A_2	A_1	A_0	X
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1

A_3	A_2	A_1	A_0	X
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

Sandal

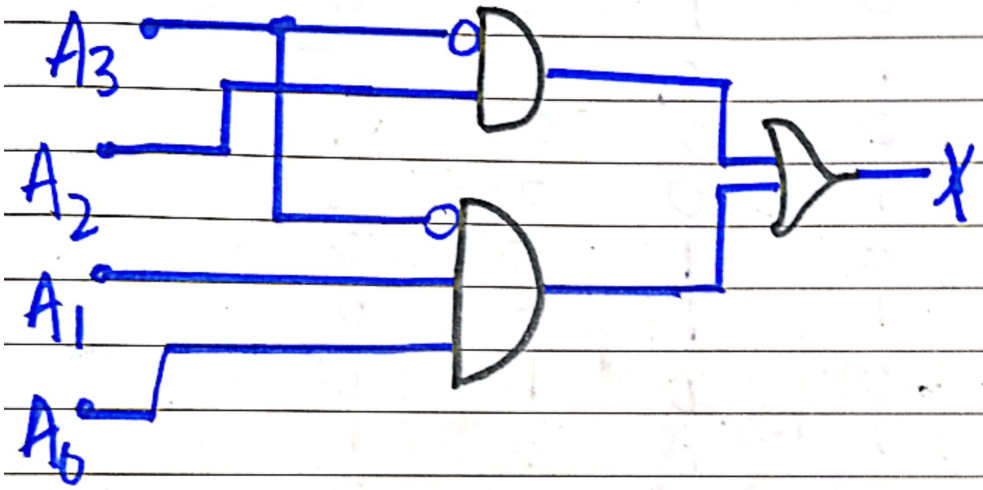
K-Map:

Date:

A_3A_2 \ A_1A_0	00	01	11	10
00	0	0	1	0
01	1	1	1	1
11	0	0	0	0
10	0	0	0	0

$\Rightarrow \bar{A_3}A_2 + \bar{A_3}A_1A_0$

Circuit:

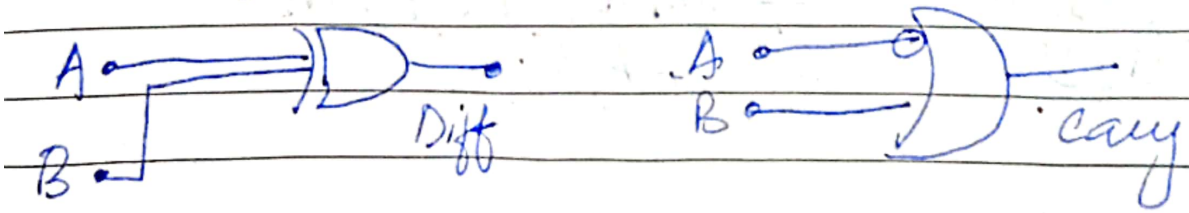


Question # 19

A	B	Diff	Carry	Functions
0	0	0	0	$\bar{A}\bar{B}$
0	1	1	1	$\bar{A}B$
1	0	1	0	$A\bar{B}$
1	1	0	0	AB

$Diff. = \bar{A}B + A\bar{B} = A \oplus B$

$Carry = AB$



Question # 20

A_2	A_1	B_2	B_1	A>B	A=B	A<B
0	0	0	0	0	1	0
0	0	0	1	0	0	1
0	0	1	0	0	0	1
0	0	1	1	0	0	1
0	1	0	0	1	0	0
0	1	0	1	0	1	0
0	1	1	0	0	0	1
0	1	1	1	0	0	1
1	0	0	0	1	0	0
1	0	0	1	1	0	0
1	0	1	0	0	1	0
1	0	1	1	0	0	1
1	1	0	0	1	0	0
1	1	0	1	1	0	0
1	1	1	0	1	0	0
1	1	1	1	0	1	0

$A = \bar{A}_2 \bar{A}_1 \bar{B}_2 B_1 + \bar{A}_2 A_1 \bar{B}_2 \bar{B}_1 + \bar{A}_2 A_1 B_2 B_1 + A_2 \bar{A}_1 B_2 \bar{B}_1 + A_2 A_1 B_2 B_1 + A_2 A_1 \bar{B}_2 \bar{B}_1$

A>B:

A_2A_1 \ B_2B_1	00	01	11	10
00	0	0	0	0
01	1	0	0	0
11	1	1	0	1
10	1	1	0	0

$\Rightarrow A_2 A_1 \cdot \bar{B}_1 + \bar{B}_2 \bar{B}_1 \cdot A_1 + A_2 \cdot \bar{B}_2$

Date:

A = B:

A_2A_1 \ B_2B_1	00	01	11	10
00	1	0	0	0
01	0	1	0	0
11	0	0	1	0
10	0	0	0	1

$$\Rightarrow \bar{A}_2\bar{A}_1\bar{B}_2\bar{B}_1 + \bar{A}_2A_1\cdot\bar{B}_2B_1 + A_2A_1B_2B_1 + A_2\bar{A}_1\cdot B_2\bar{B}_1$$

$$\Rightarrow (\overline{A_1 \oplus B_1})(\overline{A_2 \oplus B_2})$$

A < B:

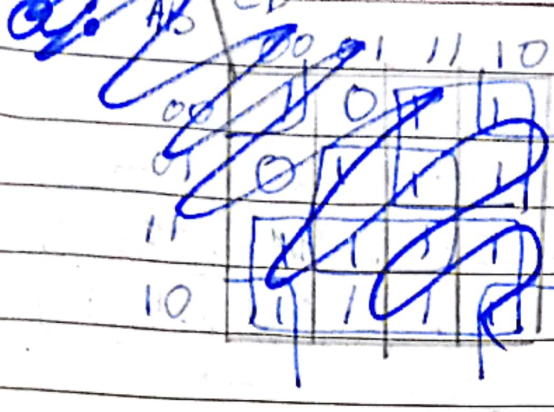
A_2A_1 \ B_2B_1	00	01	11	10
00	0	1	1	1
01	0	0	1	1
11	0	0	0	0
10	0	0	0	0

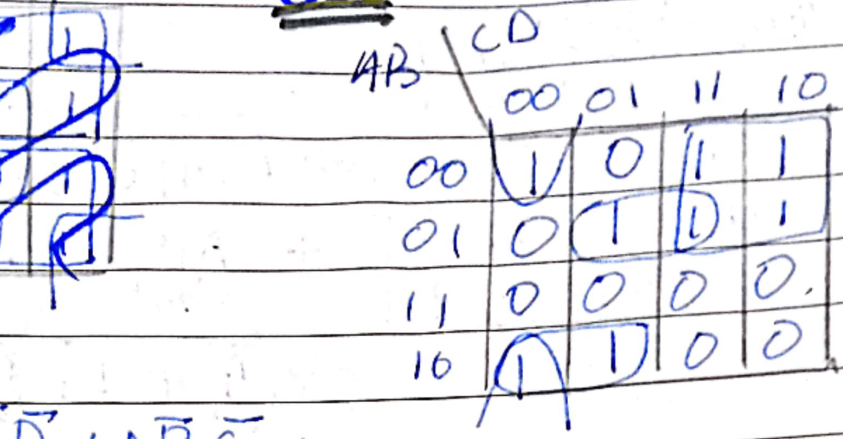
$$\Rightarrow \bar{A}_2\bar{A}_1B_1 + \bar{A}_1B_1B_2 + \bar{A}_2B_2$$

Question # 21

A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	1	1	1	1	1	1	0
0	0	0	1	0	1	1	0	0	0	0
0	0	1	0	1	1	0	1	1	0	1
0	0	1	1	1	1	1	1	0	0	1
0	1	0	0	0	1	1	0	0	1	1
0	1	0	1	1	0	1	1	0	1	1
0	1	1	0	1	0	1	1	1	1	1
0	1	1	1	1	1	1	0	0	0	0
1	0	0	0	1	1	1	1	1	1	1
1	0	0	1	1	1	1	1	0	1	1
1	0	1	0	0	0	0	0	0	0	0
1	0	1	1	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0	0
1	1	0	1	0	0	0	0	0	0	0
1	1	1	0	0	0	0	0	0	0	0
1	1	1	1	0	0	0	0	0	0	0

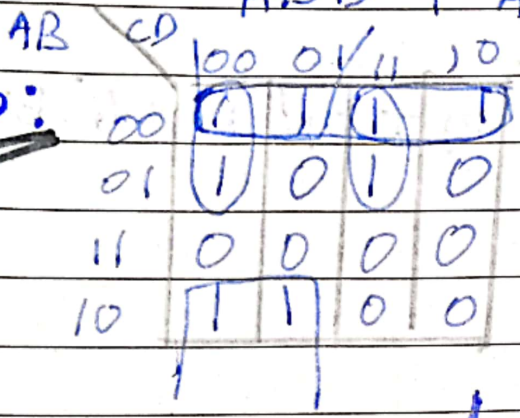
a:





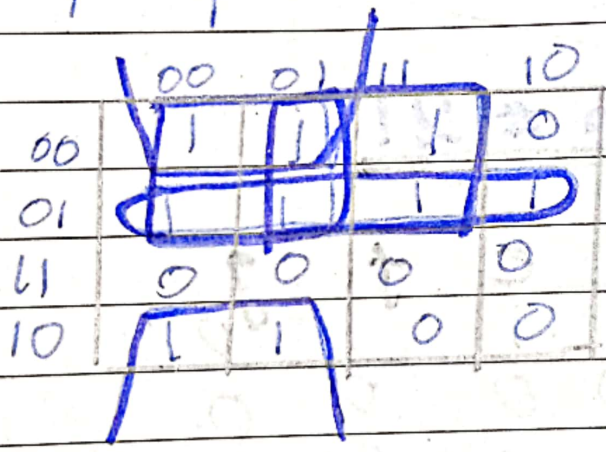
$\Rightarrow a = \bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C} + \bar{A}BD + \bar{A}C$

b:



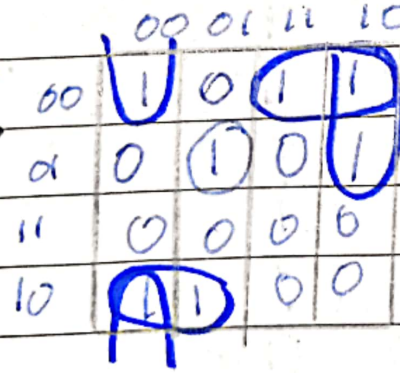
$\Rightarrow \bar{A}\bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}CD + \bar{B}\bar{C}$

c:



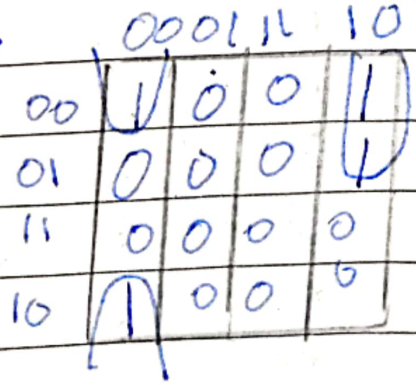
$\Rightarrow \bar{B}\bar{C} + \bar{A}\bar{C} + \bar{A}\bar{D} + \bar{A}\bar{B}$

d:



$\Rightarrow \bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}CD + \bar{A}B\bar{C}D$

e:



$\Rightarrow \bar{B}\bar{C}\bar{D} + \bar{A}CD$

Date:

f:

	00	01	11	10
00	1	0	0	0
01	1	1	0	1
11	0	0	0	0
10	1	1	0	0

$\Rightarrow \bar{B}\bar{C}\bar{D} + \bar{C}A\bar{B} + \bar{A}B\bar{C} + \bar{A}\bar{B}\bar{D}$

g:

	00	01	11	10
00	0	0	1	1
01	1	1	0	1
11	0	0	0	0
10	1	1	0	0

$\Rightarrow \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + \bar{A}CD$

Hence:

$a = A\bar{B}\bar{C} + \bar{A}\bar{B}D + \bar{A}C + \bar{B}CD$

$b = \bar{A}\bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}CD + \bar{B}\bar{C}$

$c = \bar{A}\bar{C} + \bar{A}D + \bar{A}B + \bar{B}\bar{C}$

$d = A\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}BC\bar{D} + \bar{A}C\bar{D} + \bar{B}C\bar{D}$

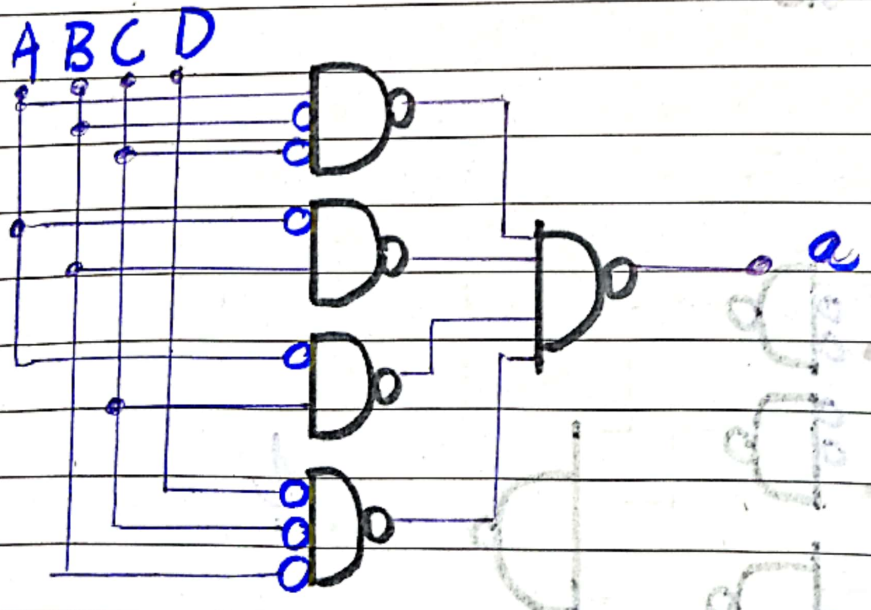
$e = \bar{A}C\bar{D} + \bar{B}C\bar{D}$

$f = A\bar{B}\bar{C} + \bar{A}B\bar{C} + \bar{A}B\bar{D} + \bar{B}C\bar{D}$

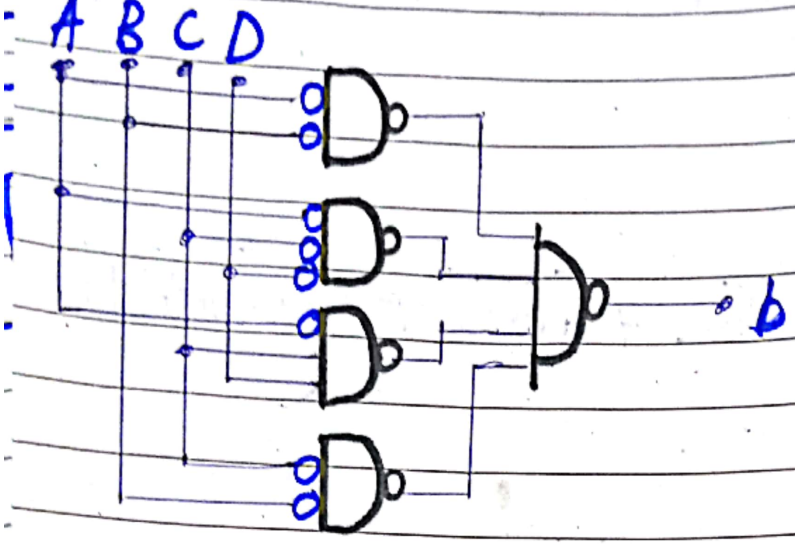
$g = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + \bar{A}CD$

Circuit Diagrams:

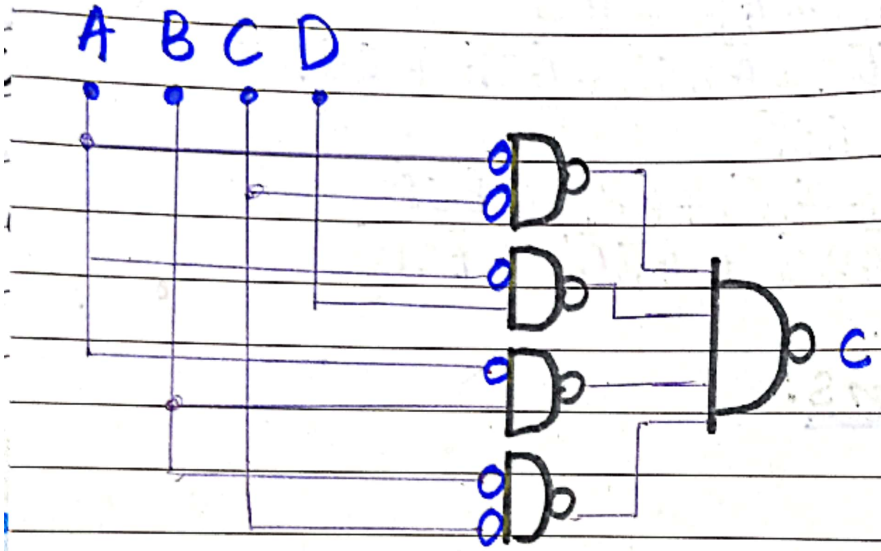
a:



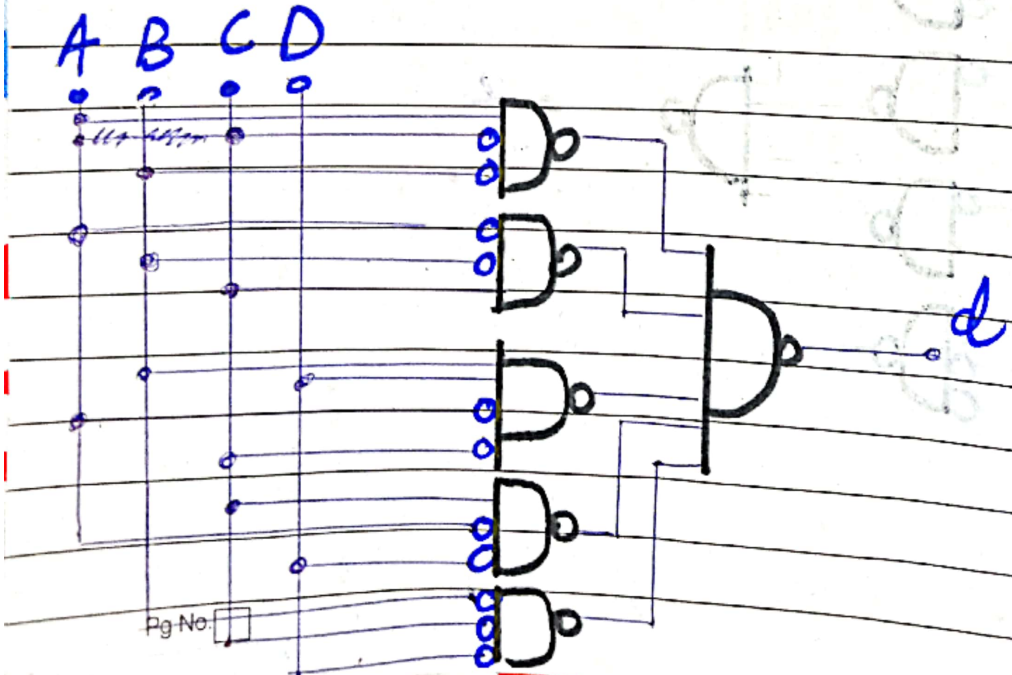
b:



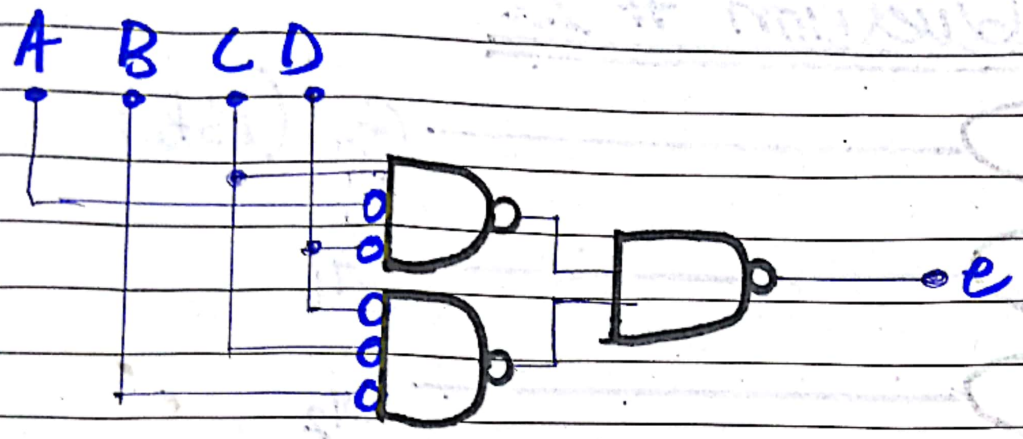
c:



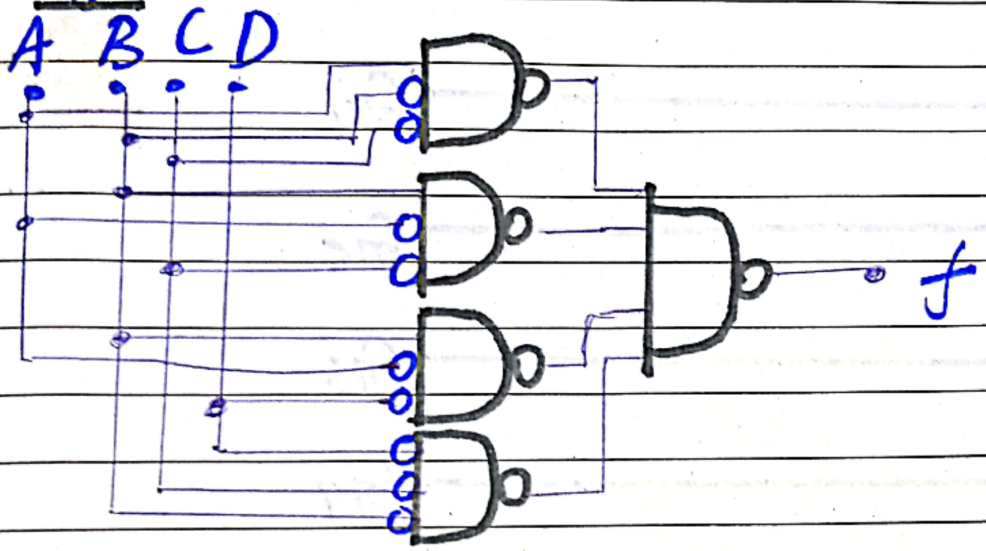
d:



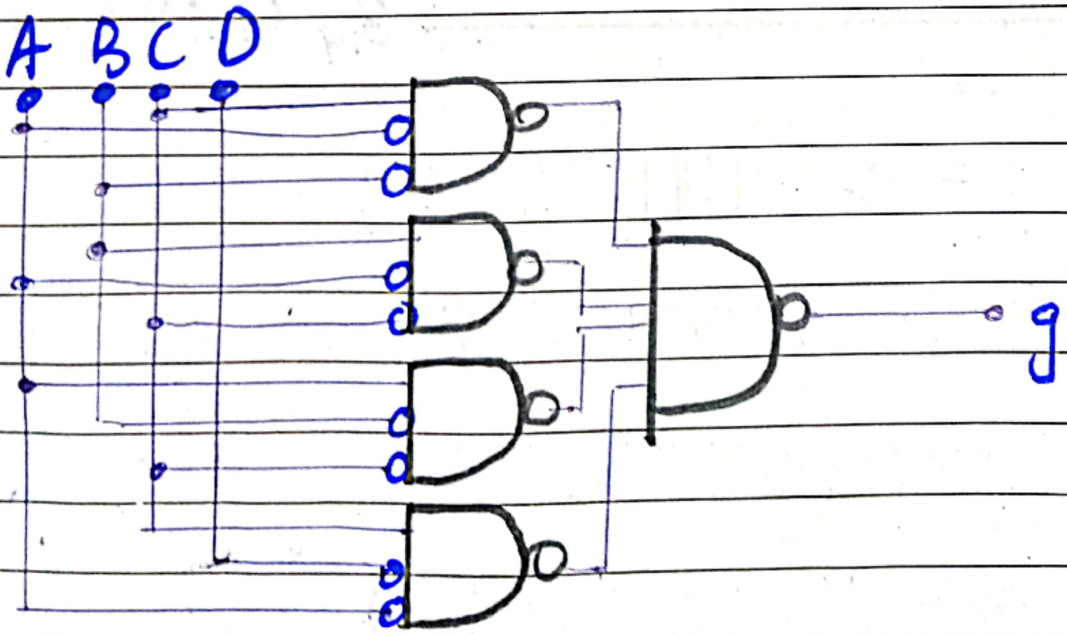
e:



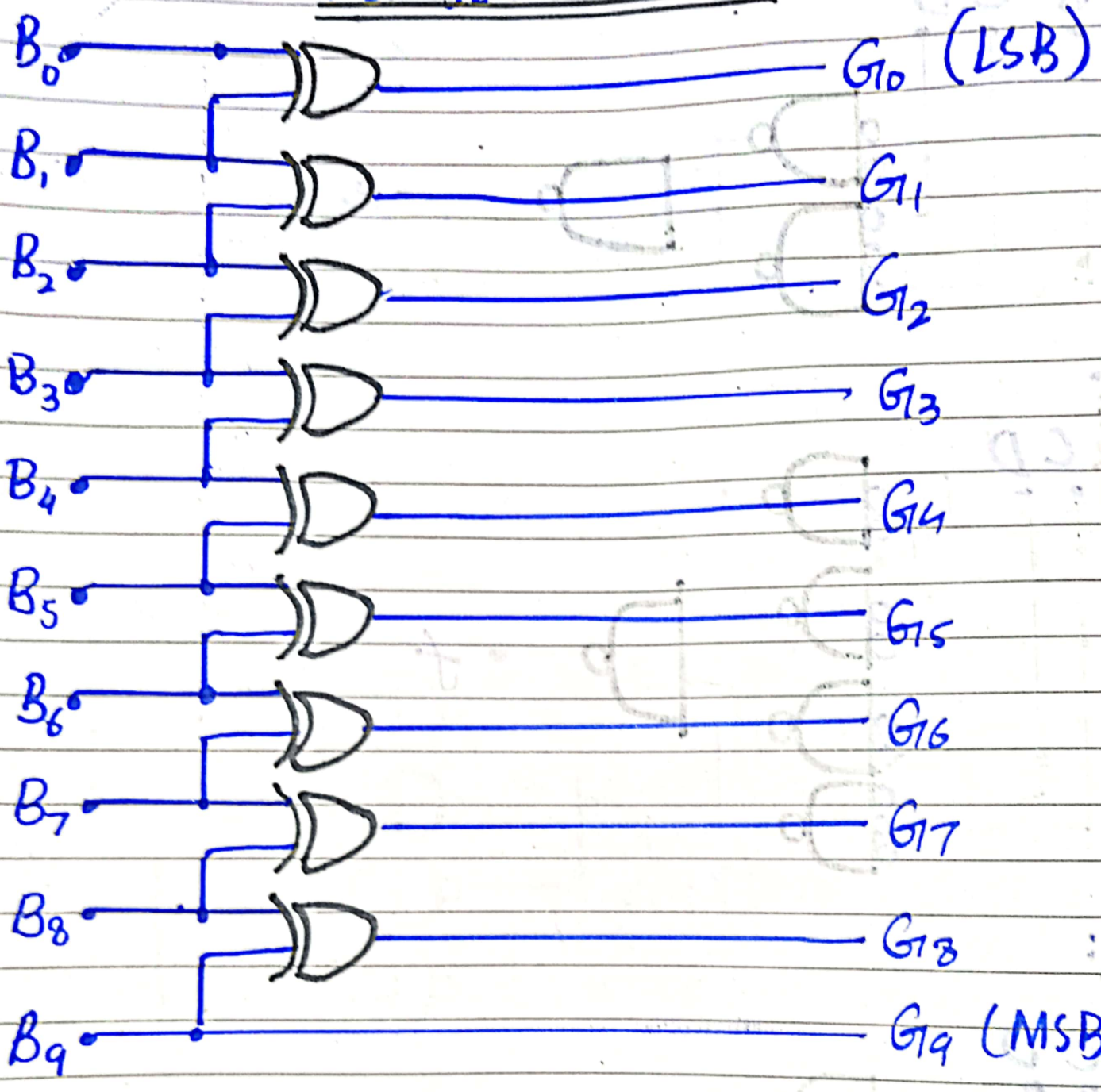
f:



g:



Question # 22



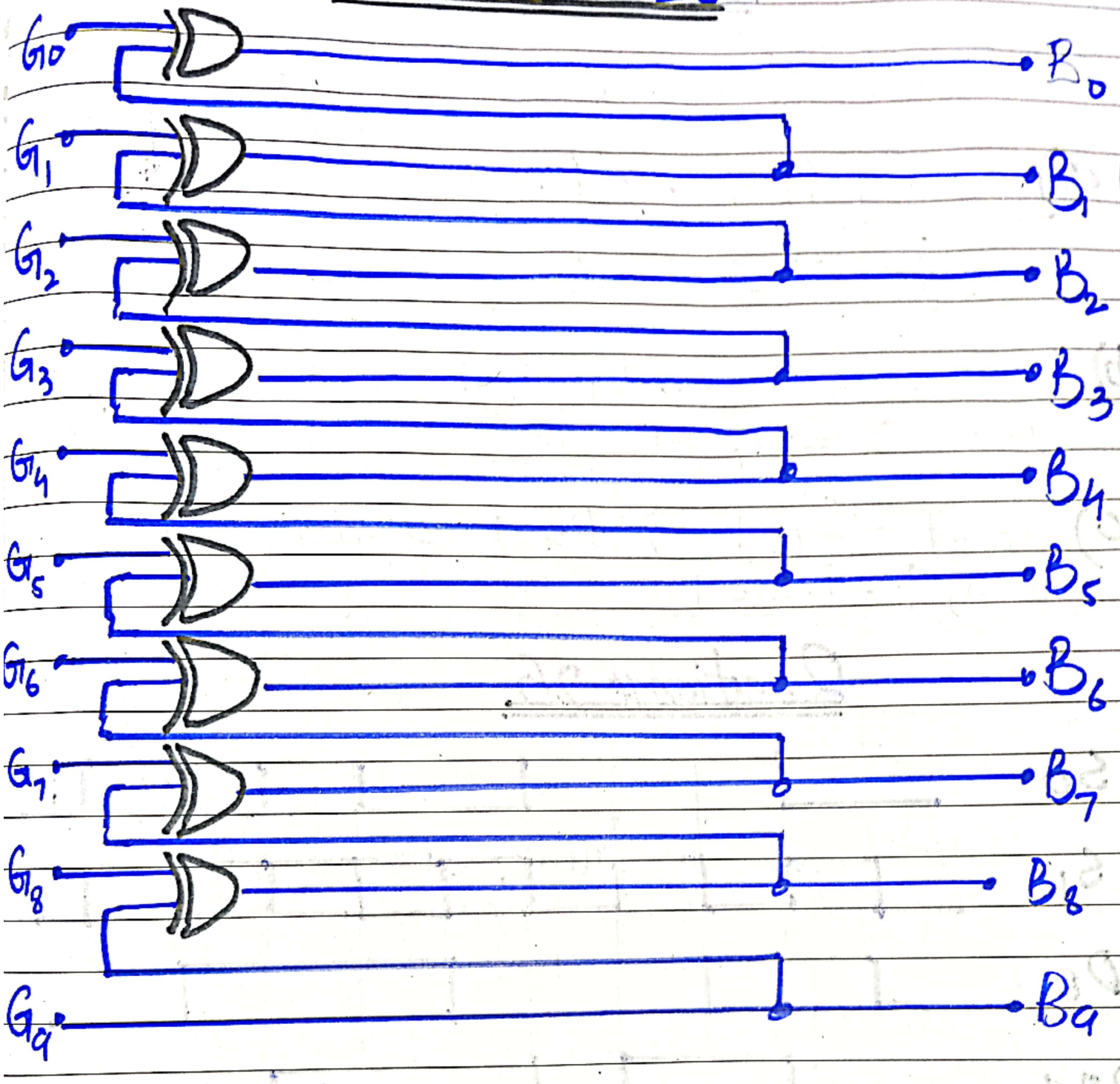
a) 1010111100 → 1111100010

b) 1111000011 → 1000100010

c) 1011110011 → 1100010010

d) 1000000001 → 1000000001

Question # 23



a) 1010 1111 00 → 1100 1010 00

b) 1111 0000 11 → 1010 0000 10

c) 1011 1100 11 → 1101 0 1101

d) 1000000001 → 1111 1111 10

Question # 24

$D_0 = 1, D_1 = 0, D_2 = 0, D_3 = 1$

a) $S_0 = 0, S_1 = 1 \Rightarrow D_2$ is enabled

Therefore, $Y = D_2 = 0$

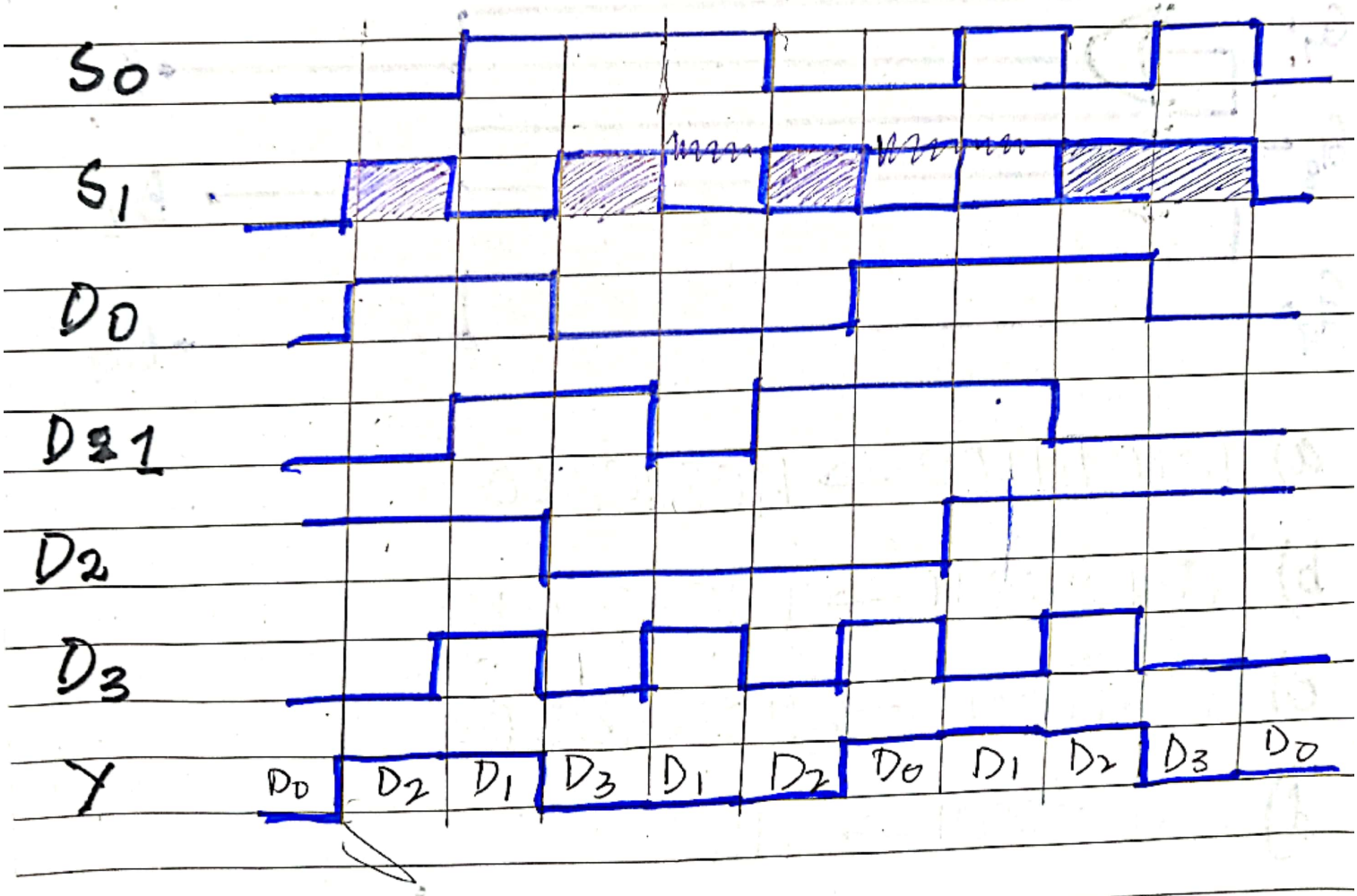
b) $S_0 = 1, S_1 = 0 \Rightarrow D_1$ is enabled

Thus, $Y = D_1 = 0$

c) $S_0 = 1, S_1 = 1 \Rightarrow D_3$ is enabled

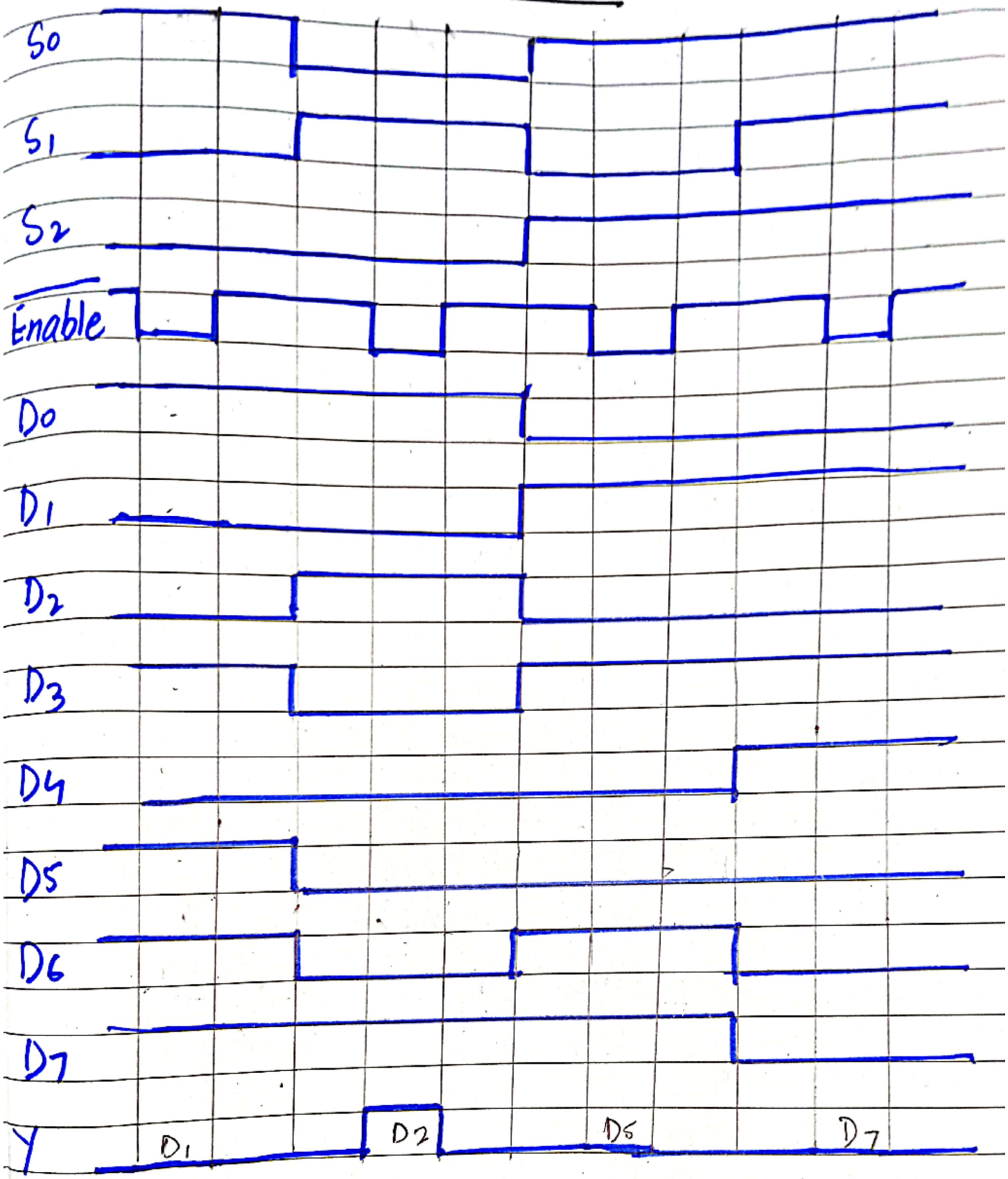
Thus, $Y = D_3 = 1$

Question # 25



Sandal

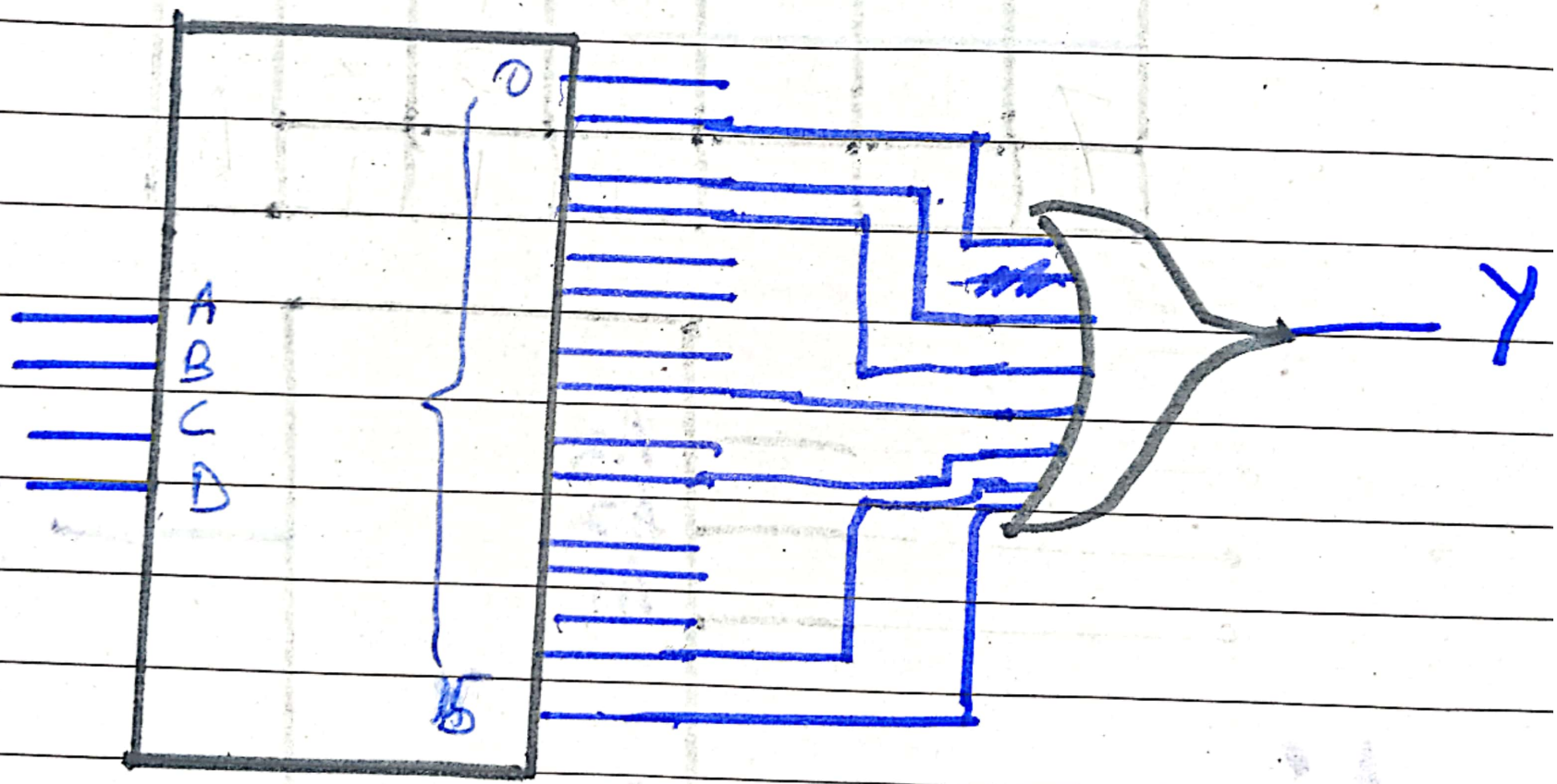
Question # 26



Sandal

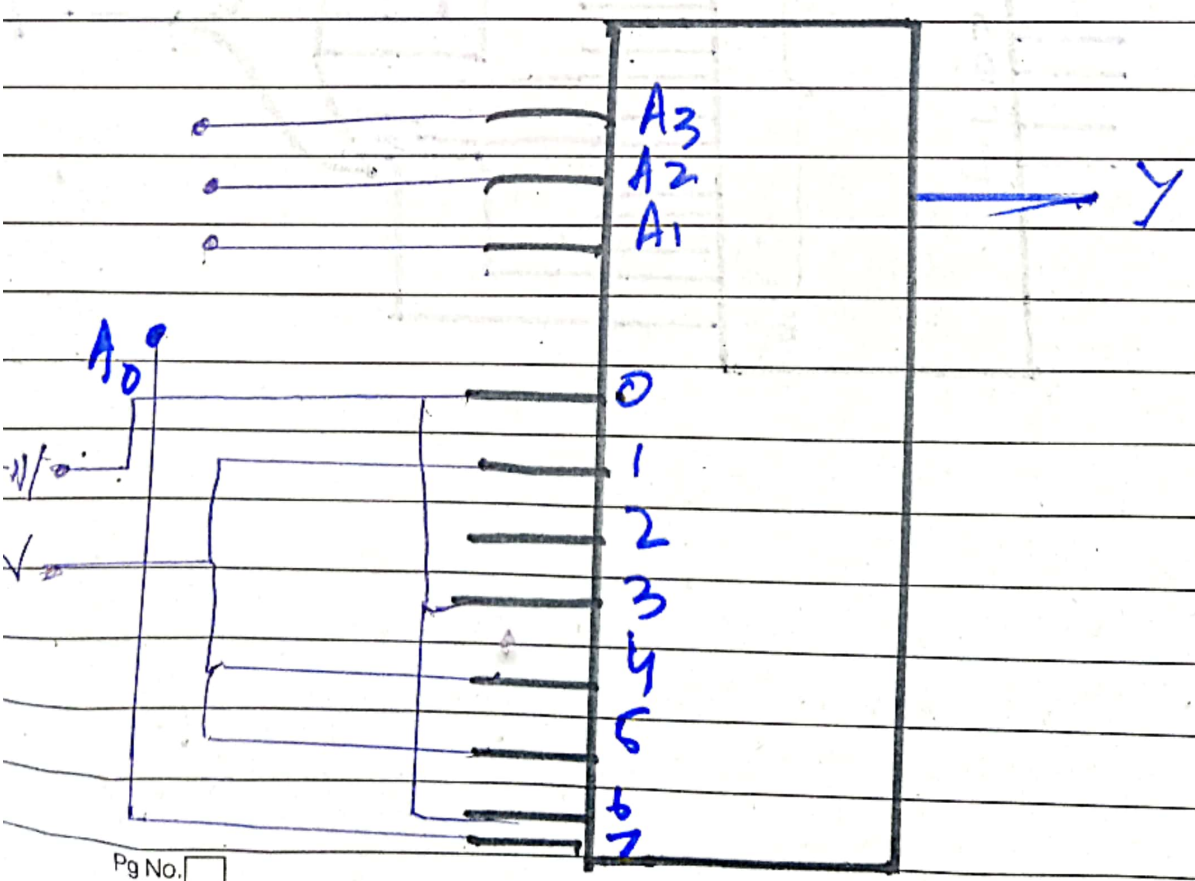
Question # 28

$F(A,B,C,D) = \Sigma(1,2,3,7,9,13,15)$



Question # 29

	A_3	A_2	A_1	A_0	Y	
0	0	0	0	0	0	0
	0	0	0	1	0	
1	0	0	1	0	1	1
	0	0	1	1	1	
2	0	1	0	0	1	$\bar{A}_0$
	0	1	0	1	0	
3	0	1	1	0	0	0
	0	1	1	1	0	
4	1	0	0	0	1	1
	1	0	0	1	1	
5	1	0	1	0	1	1
	1	0	1	1	1	
6	1	1	0	0	0	0
	1	1	0	1	0	
7	1	1	1	0	0	A_0
	1	1	1	1	1	



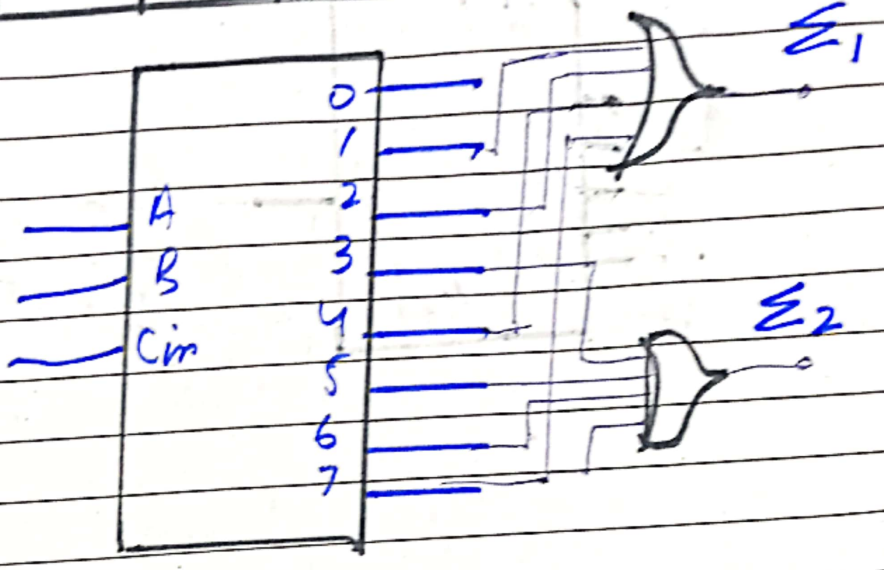
Sand

Date:

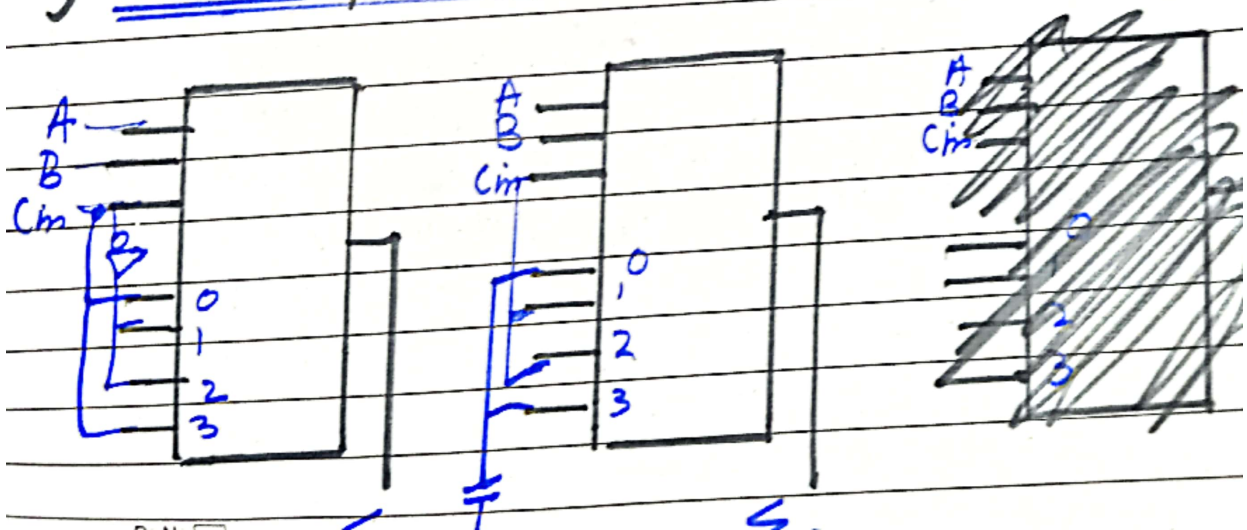
Question # 30

a) 3-to 8 Line Decoder:

A	B	Cin	Σ_1	Σ_2	Cout
0	0	0	0	0	0
0	0	1	1	0	0
0	1	0	1	0	0
0	1	1	0	1	1
1	0	0	1	0	0
1	0	1	0	1	1
1	1	0	0	1	1
1	1	1	1	1	1



b) 4x1 Multiplexer:



Date: _____

Question # 31