Problem1

Y = (-7) · (x-1)

↳ 4-bit signed

Min → -21 → x = 4

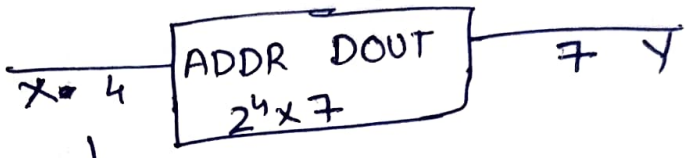
Max → 63 → x = -8

32168 4 2 1

-64 | 32 | 16 | 8 | 4 | 2 | 1

x-min = -8

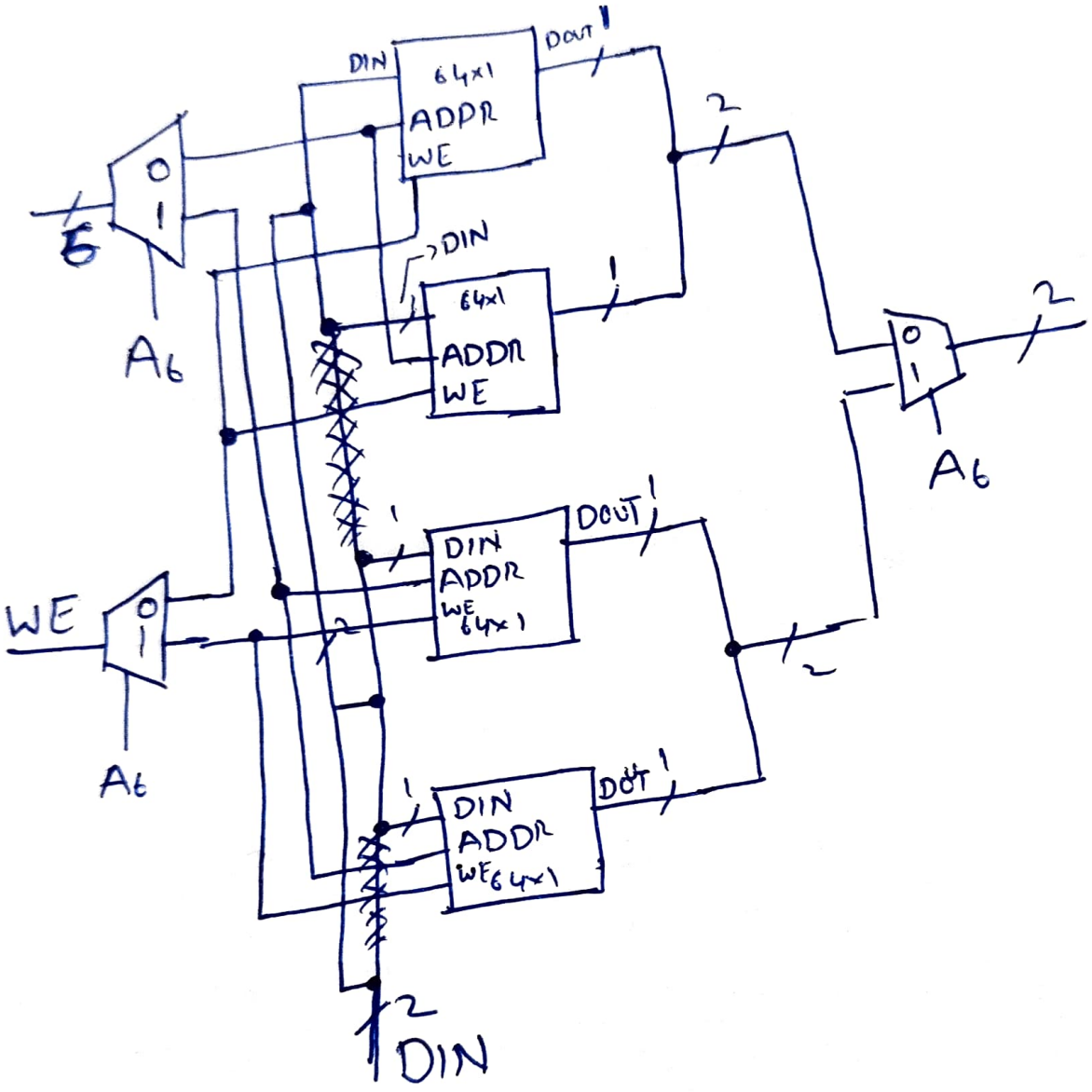
Max → 4



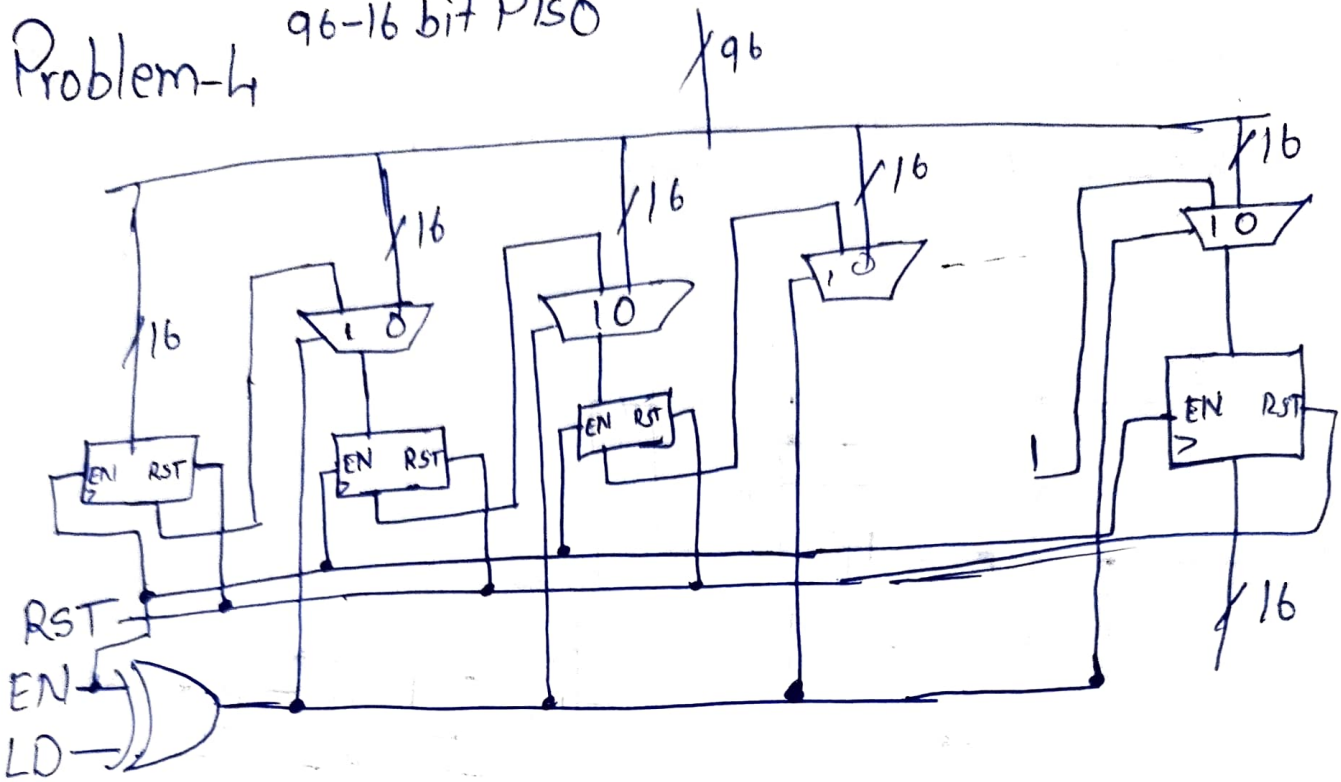
X	Y binary Signed	Y
-8	0111111	63
-7	0111000	56
-6	0110001	49
-5	0101010	42
-4	0100011	35
-3	0011100	28
-2	0010101	21
-1	0001110	14
0	0000111	7
1	0000000	0
2	1111001	-7
3	1110100	-14
4	1101011	-21

Problem-2

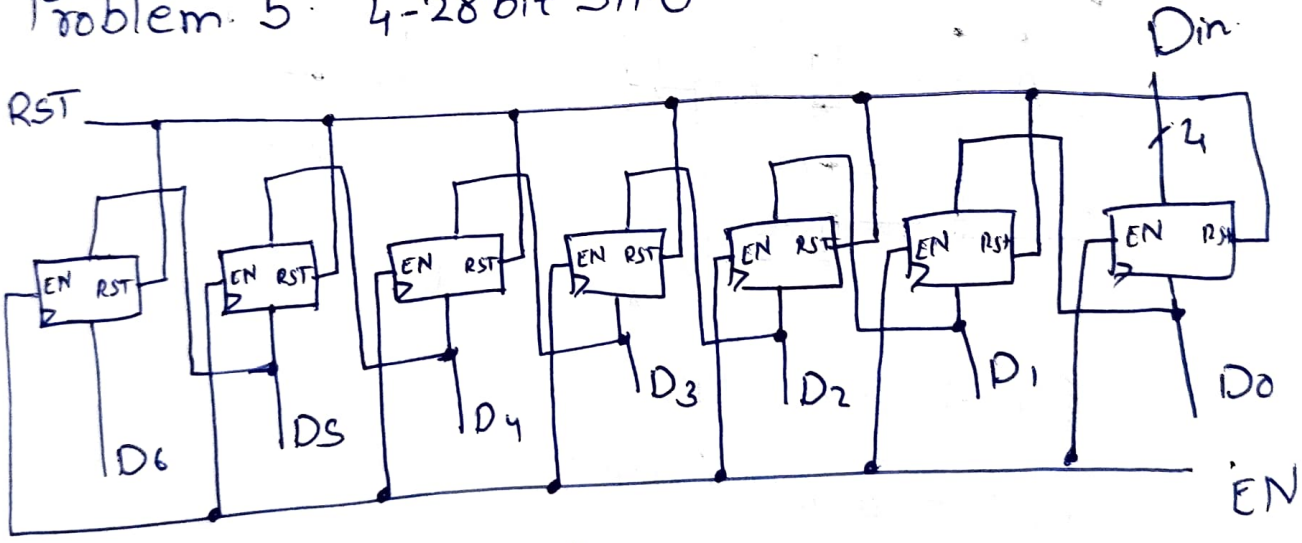
A_6 A_5 A_4 A_3 A_2 A_1 A_0
64 32 16 8 4 2 1



Problem-4 96-16 bit PISO



Problem 5 4-28 bit SIPO

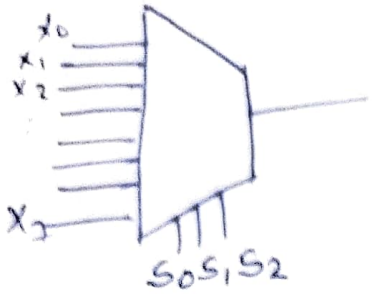


Cycle: 1 → RST: 1 → Q = ~~0000000000~~ 0

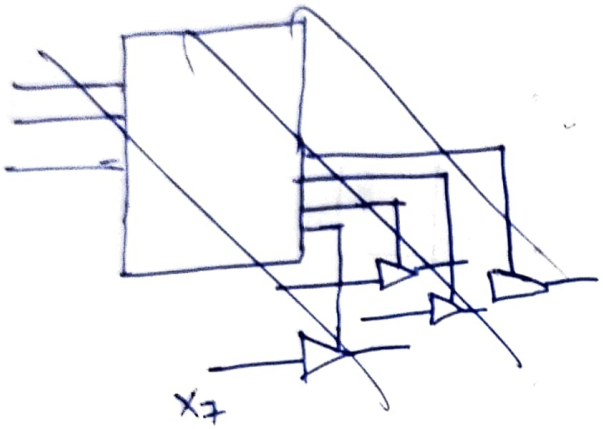
Cycle 2 → RST 0 → EN 1 → Q = D0 → 1101

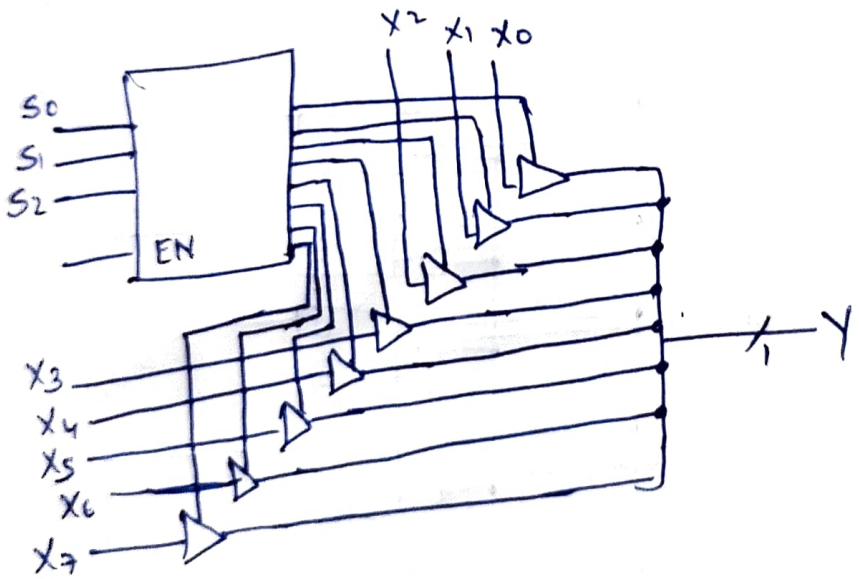
Cycle 3 → RST 0 → EN 1 → Q = D0 → 1110
D1 → 1101

Problem 6

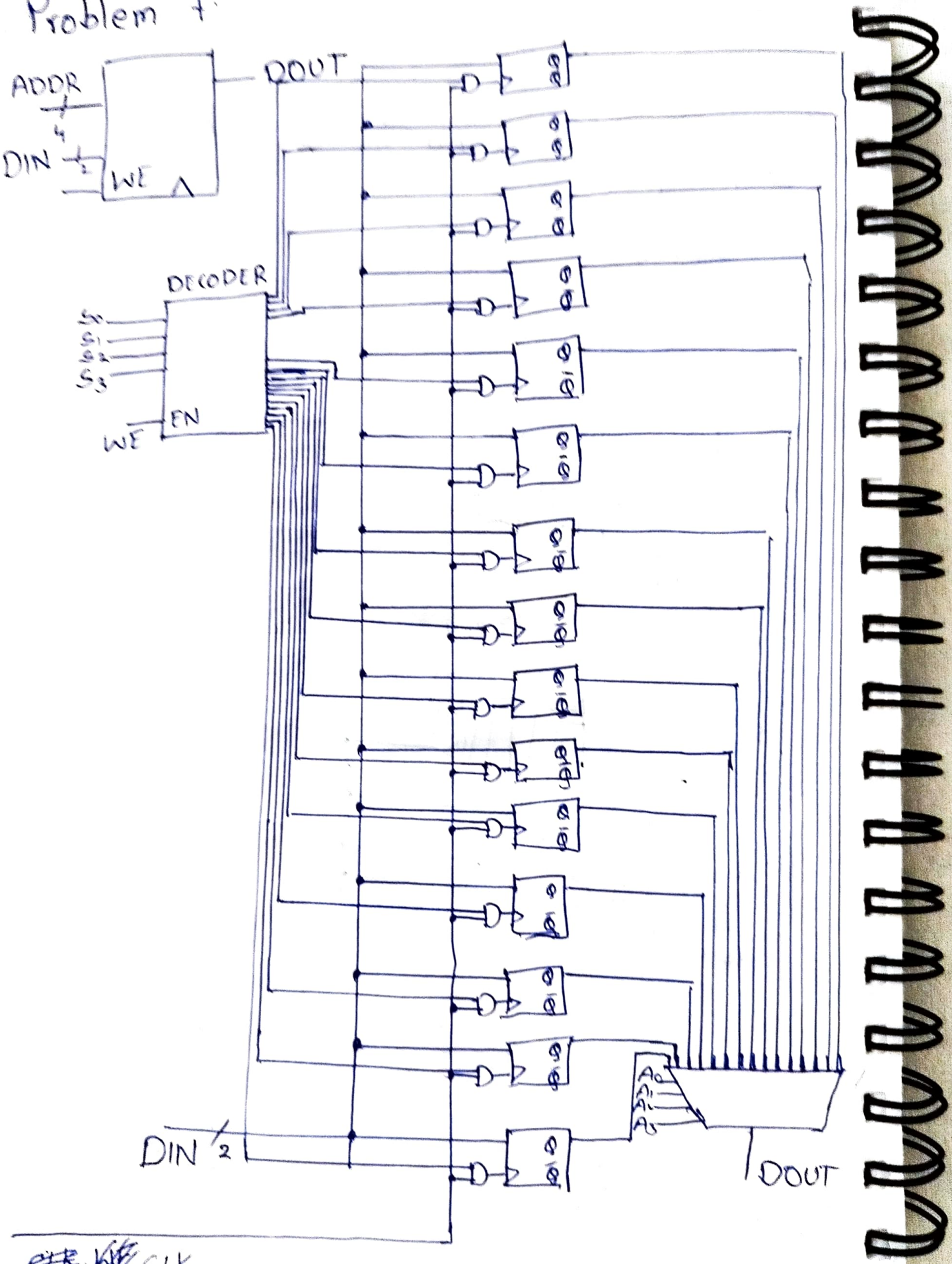


y using tri-state buffer





Problem 7.



Problem 8

(a)

0F	1F	DC	10	10	DC	DC	00	76	10	54	54
00	00	00	00	76	76	76					
0F	0F	0F	0F	0F	0F	0F					
10	10	10	10	10	54	54					
1F	DC	DC	DC	DC	DC	DC					

DOUT
MEM[0]
MEM[1]
MEM[2]
MEM[3]

0ns 100ns 200ns 300ns 400ns 500ns 600ns

(b)

0F	1F	10	DC	00	10
00	00	00	00	76	76
0F	0F	0F	0F	0F	0F
10	10	10	10	10	54
1F	DC	DC	DC	DC	DC

DOUT
MEM[0]
MEM[1]
MEM[2]
MEM[3]

0ns 100ns 200ns 300ns 400ns 500ns 600ns

(c)

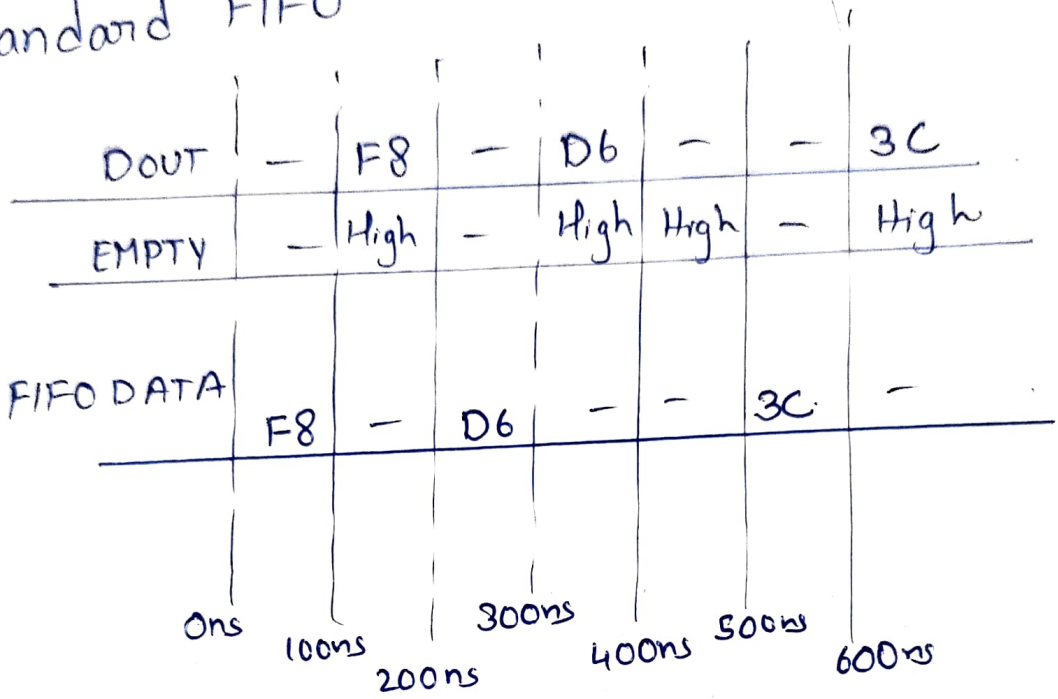
	0ns	100ns	200ns	300ns	400ns	500ns	600ns
DOUT	0F	DC	10	DC	76	54	
MEM[0]	00	00	00	00	76	76	
MEM[1]	0F	0F	0F	0F	0F	0F	
MEM[2]	10	10	10	10	10	54	
MEM[3]	1F	DC	DC	DC	DC	DC	

(d)

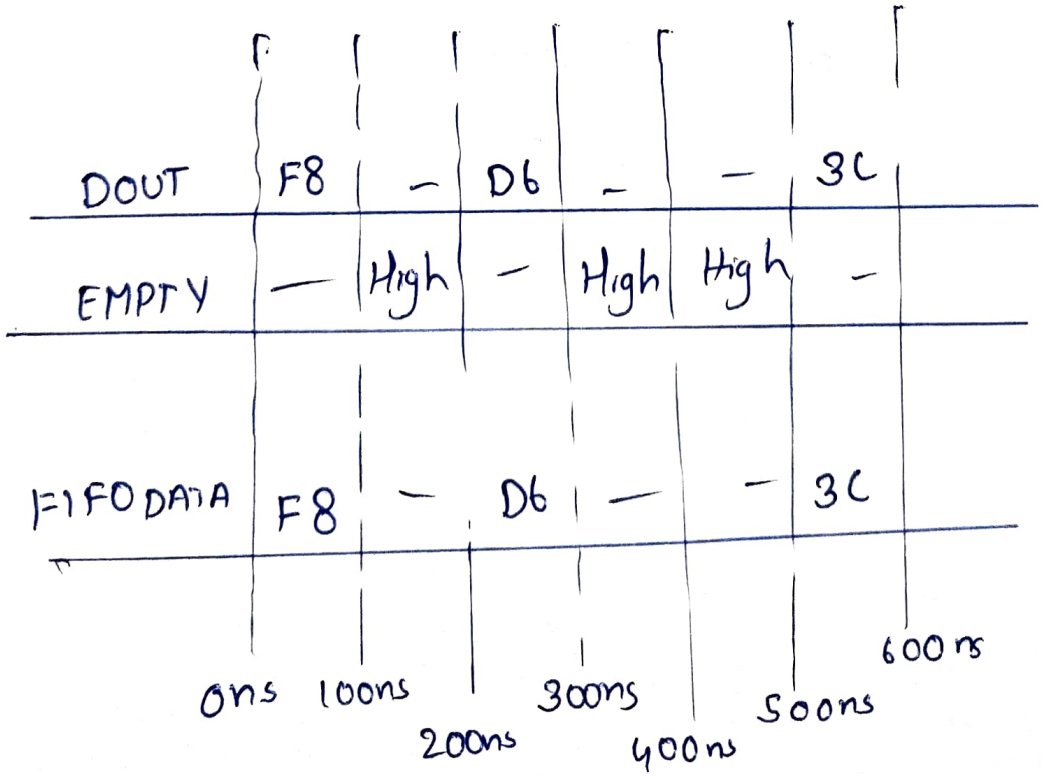
	0ns	100ns	200ns	300ns	400ns	500ns	600ns
DOUT	0F	0F	0F	0F	0F	0F	
MEM[0]	00	00	00	00	76	76	
MEM[1]	0F	0F	0F	0F	0F	0F	
MEM[2]	10	10	10	10	10	54	
MEM[3]	1F	DC	DC	DC	DC	DC	

Problem 9

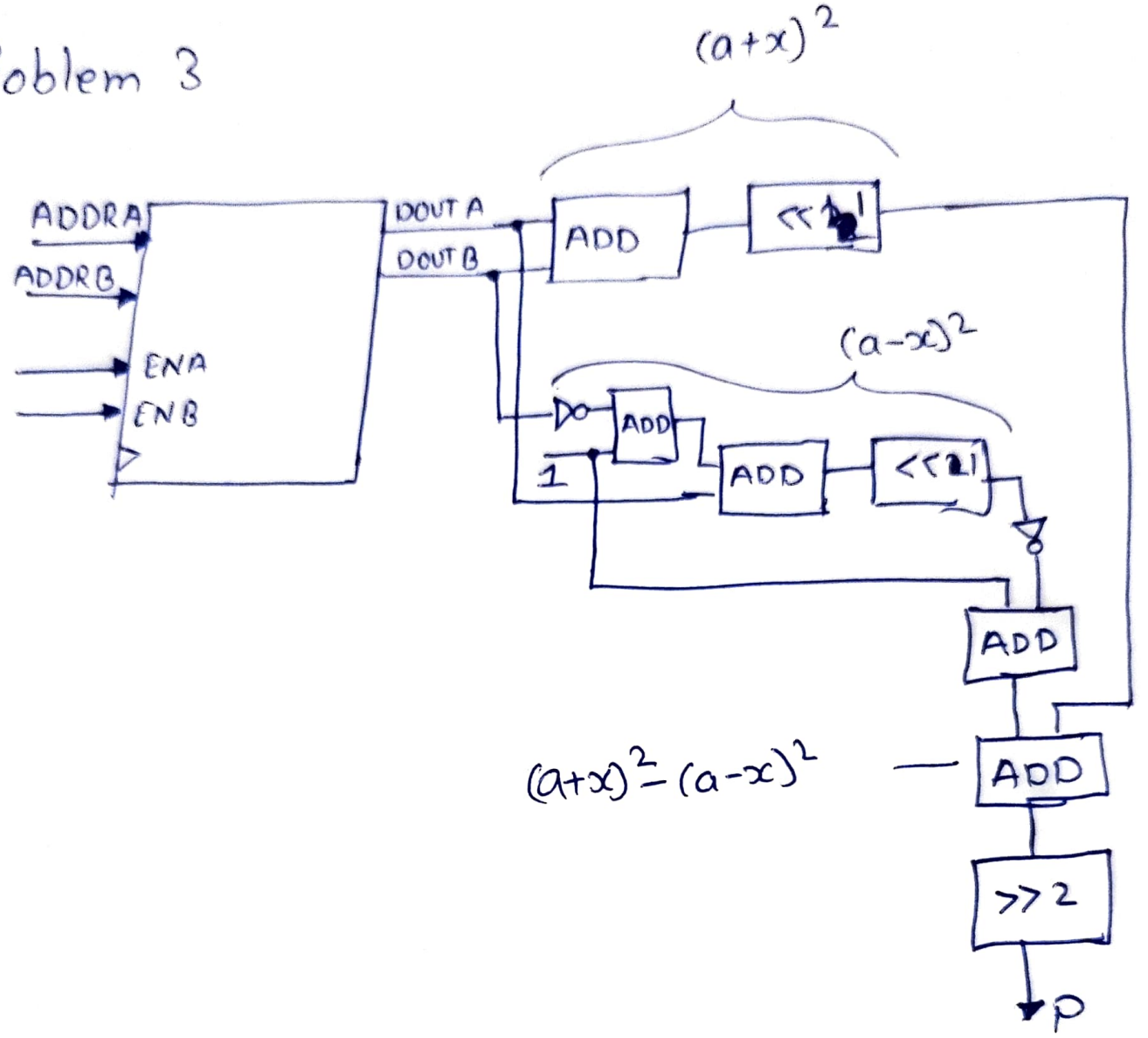
(a) standard FIFO



(d) First-Word-Fall through FIFO



Problem 3


$(a+x)^2$
ADDRA
ADDRB
ENA
ENB
DOUT A
DOUT B
ADD
<<1
$(a-x)^2$
D0
1
ADD
ADD
<<2
ADD
$(a+x)^2-(a-x)^2$
ADD
>>2
P