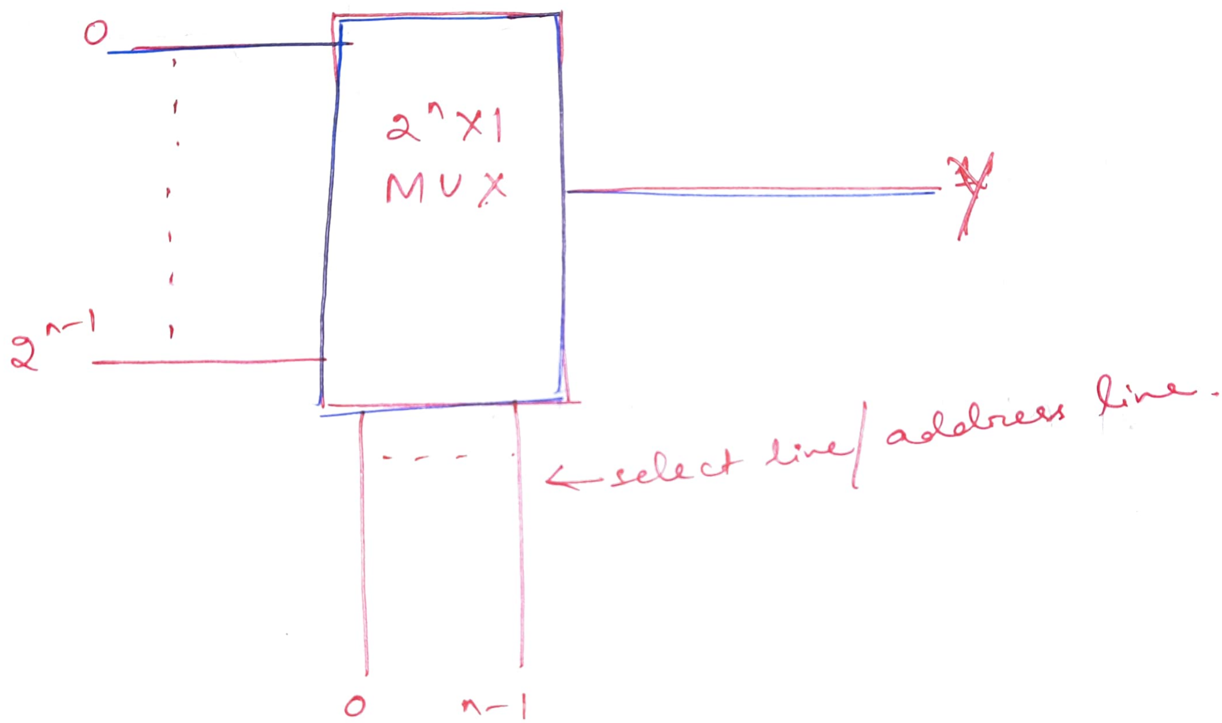
MULTIPLEXER:

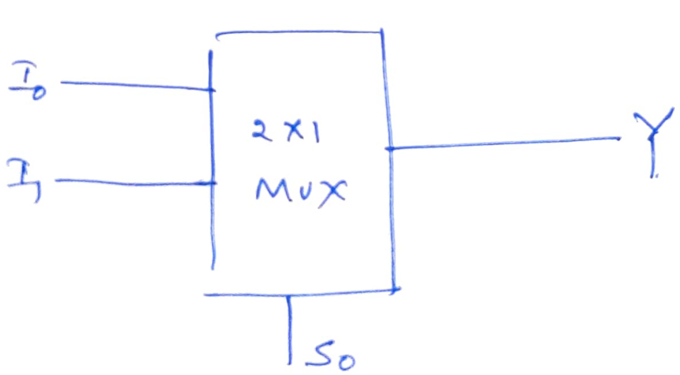
(Many inputs ; one output)

No. of input lines = 2^n
No. of output line = 1.
n = no. of select lines.

- The bit combination of selection lines ~~with~~ at any point will determine the input lines.

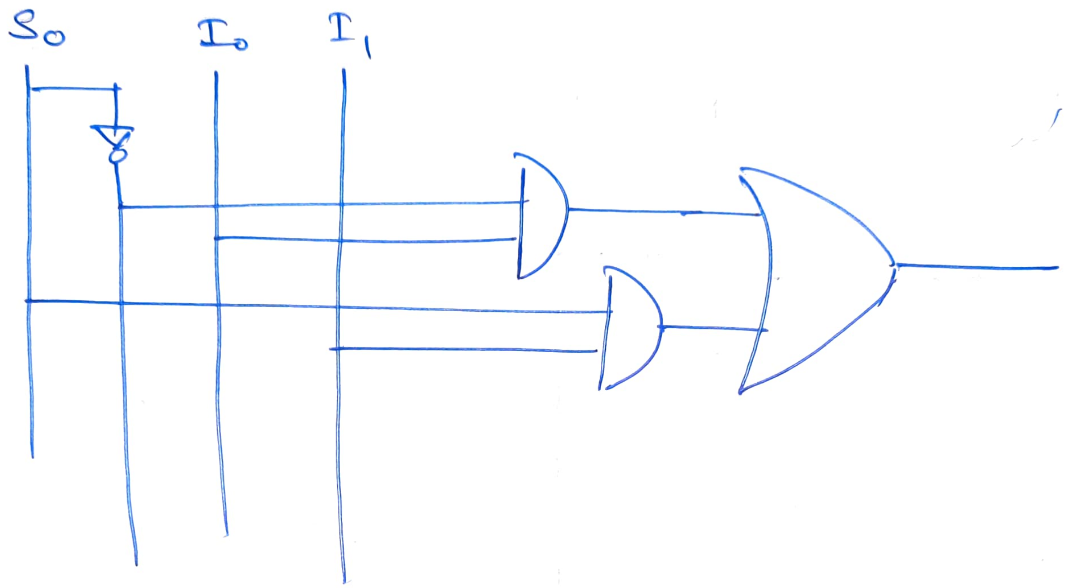


* **2×1 MUX:** No. of input = 2
No. of select lines = 1
No. of o/p = 1



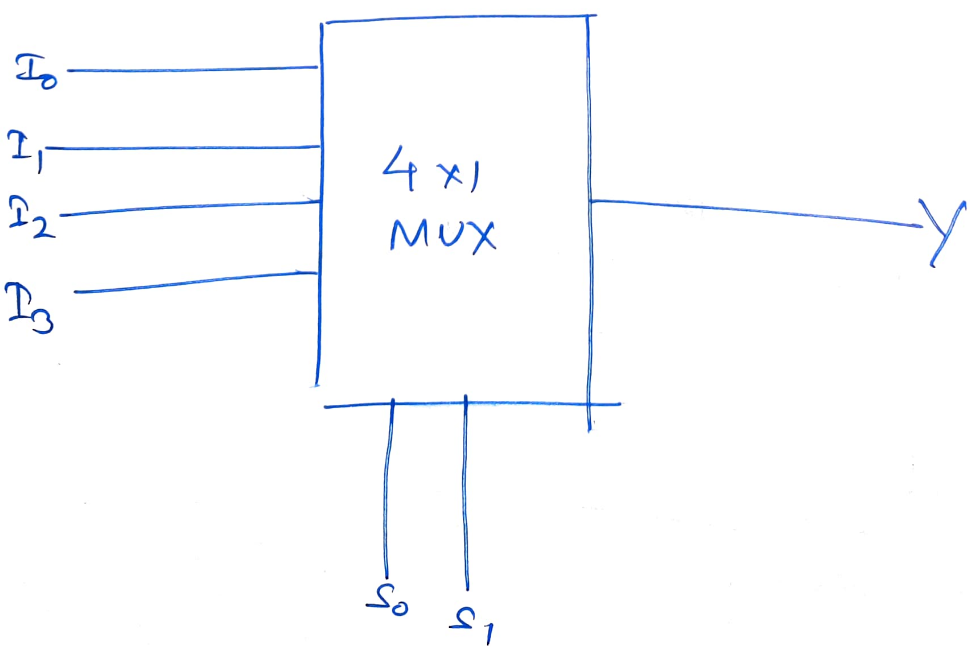
S_0	Y
0	I_0
1	I_1

$$Y = \bar{S}_0 I_0 + S_0 I_1$$



* <u>4 x 1 MUX</u> :

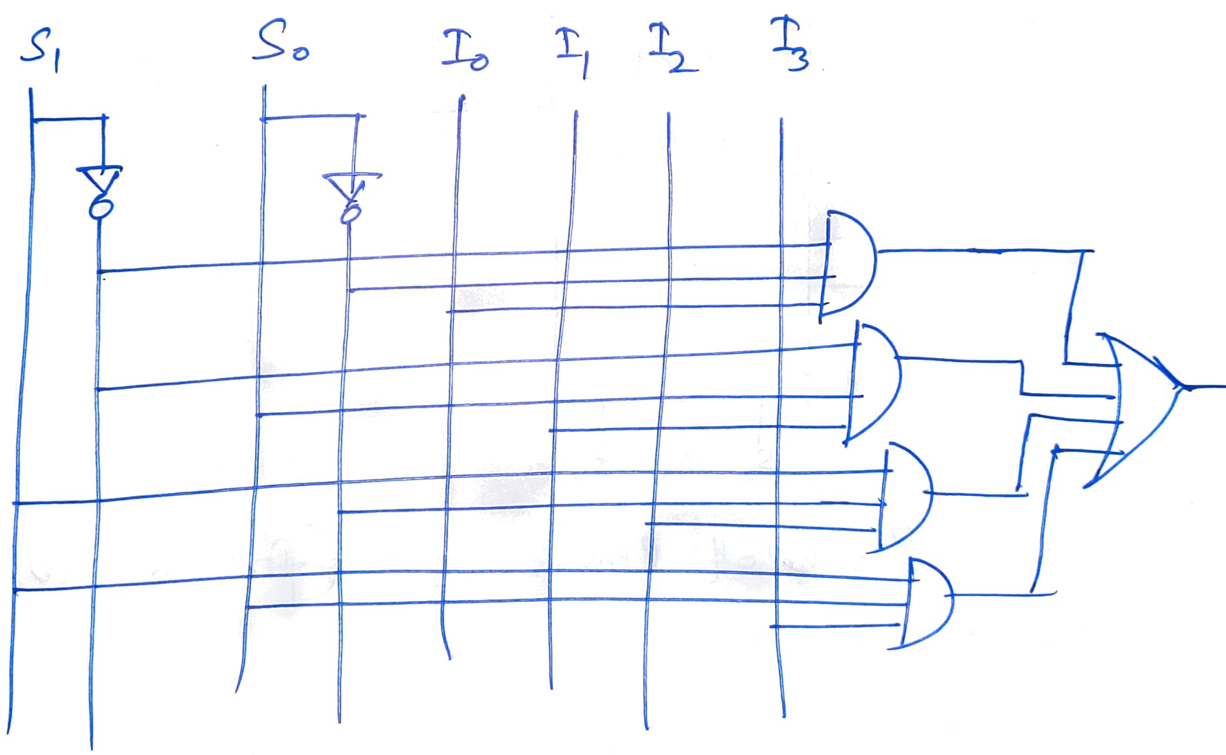
No. of I/P = 4
No. of select lines = 2



$$Y = \underset{0\ \ 0}{\bar{S}_1 \bar{S}_0} I_0 + \underset{0\ \ 1}{\bar{S}_1 S_0} I_1 + \underset{1\ \ 0}{S_1 \bar{S}_0} I_2 + \underset{1\ \ 1}{S_1 S_0} I_3$$

$\cancel{S_1 \quad S_0}$

S_1	S_0	Y
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3



Q. Implement the following Boolean function using MUX.

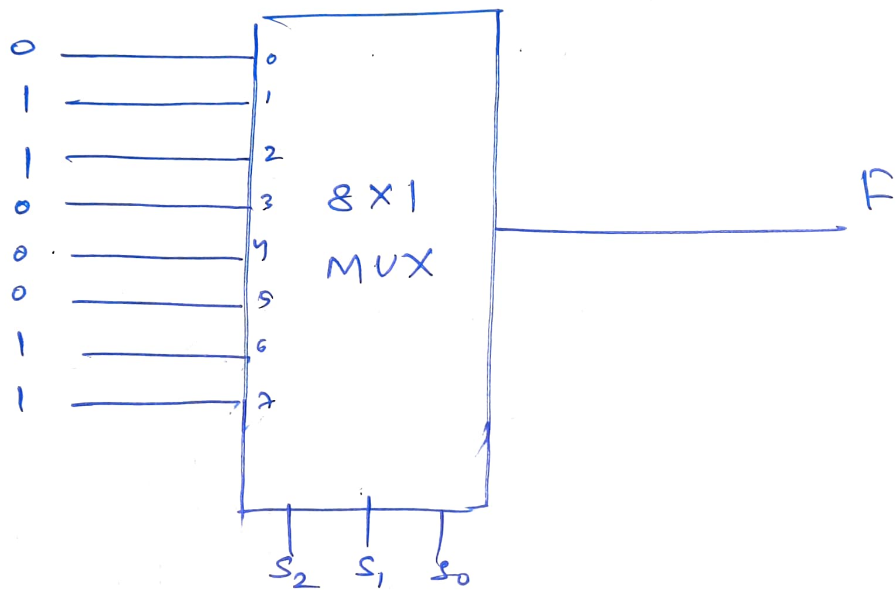
$F = \sum m(1, 2, 6, 7)$

i) Use 8×1 MUX

ii) Use 4×1 MUX *

Ans.

i) 8×1 MUX:

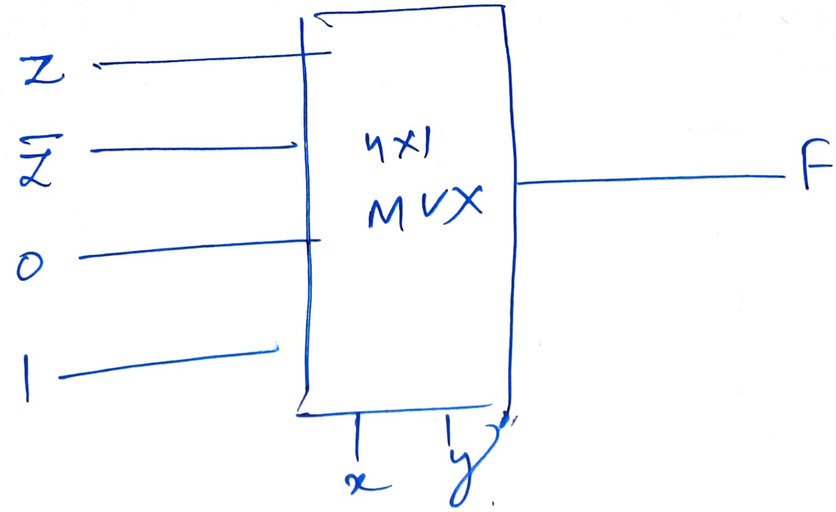


ii) No. of select lines = 3. (for 8×1 MUX).

For 4×1 MUX:

Let x & y be select lines.

	I_0	I_1	I_2	I_3
$\bar{z}$	0	2	4	6
z	1	3	5	7
	z	$\bar{z}$		$\bar{z} + z = 1$



Q. Implement the function $AB + \bar{B}C$ using

i) 8 x 1 MUX

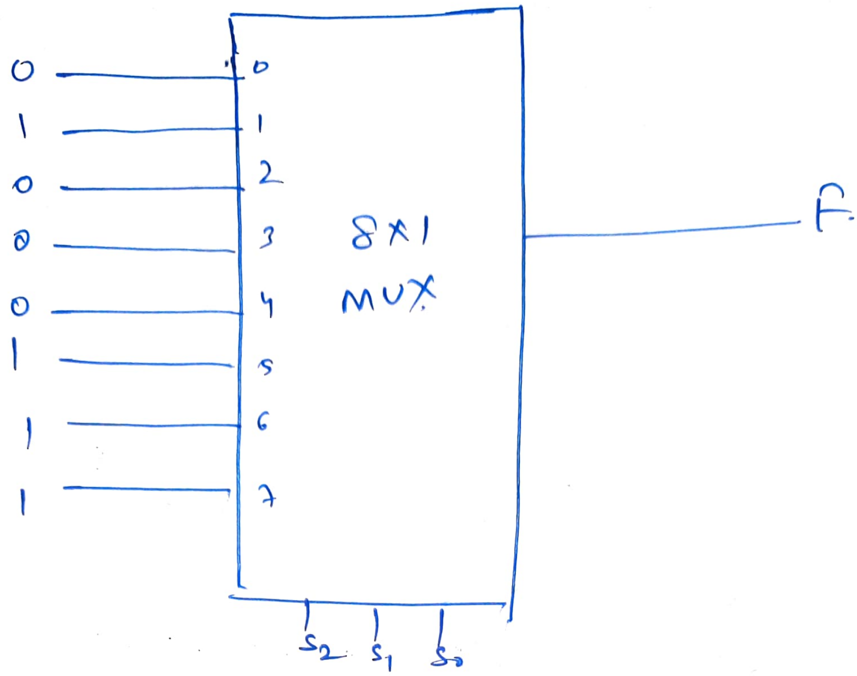
ii) 4 x 1 MUX

Ans.

A	B	C	AB	$\bar{B}$	$\bar{B}C$	$AB+\bar{B}C$
0	0	0	0	1	0	0
0	0	1	0	1	1	1
0	1	0	0	0	0	0
0	1	1	0	0	0	0
1	0	0	0	1	0	0
1	0	1	0	1	1	1
1	1	0	1	0	0	1
1	1	1	1	0	0	1

$F = \sum m(1, 5, 6, 7)$

i) 8x1 MUX :



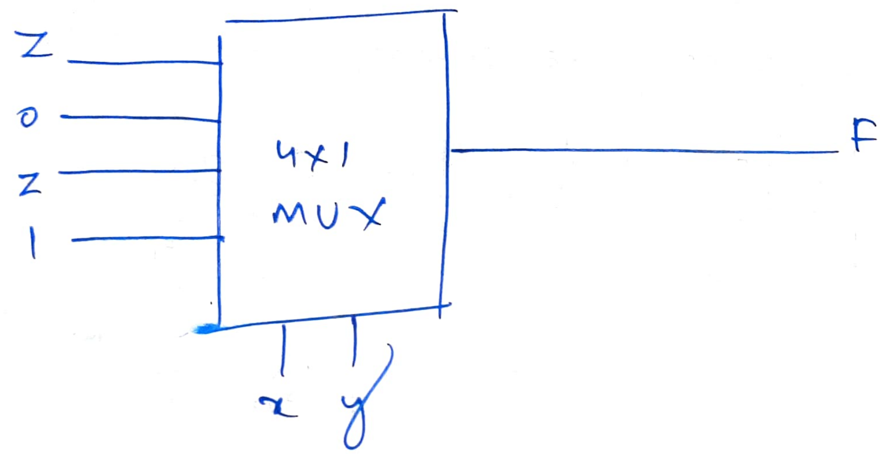
ii) 4x1 MUX :

~~Let~~ No. of select lines ~~for~~ for 8x1 MUX = 3

" " " " " 4x1 MUX = 2

Let x and y be select lines

	I_0	I_1	I_2	I_3
$\bar{z}$	0	2	4	6
z	1	3	5	7
	$\Downarrow$	$\Downarrow$	$\Downarrow$	$\Downarrow$
	z	0	z	$\bar{z}+z=1$

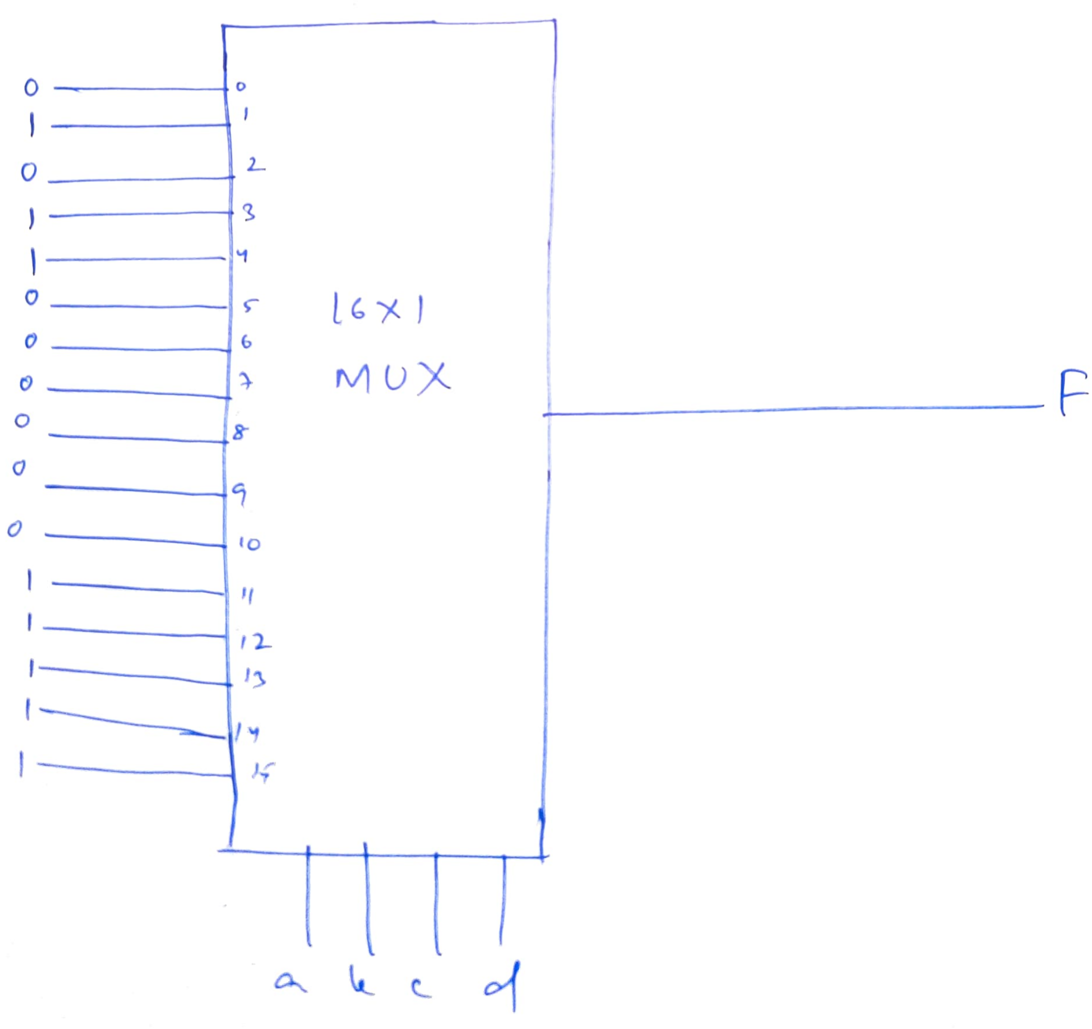


Q. Solve using suitable MUX ~~as~~ implementing following function:

$$f(a,b,c,d) = \sum m(1,3,4,11,12,13,14,15)$$

Ans.

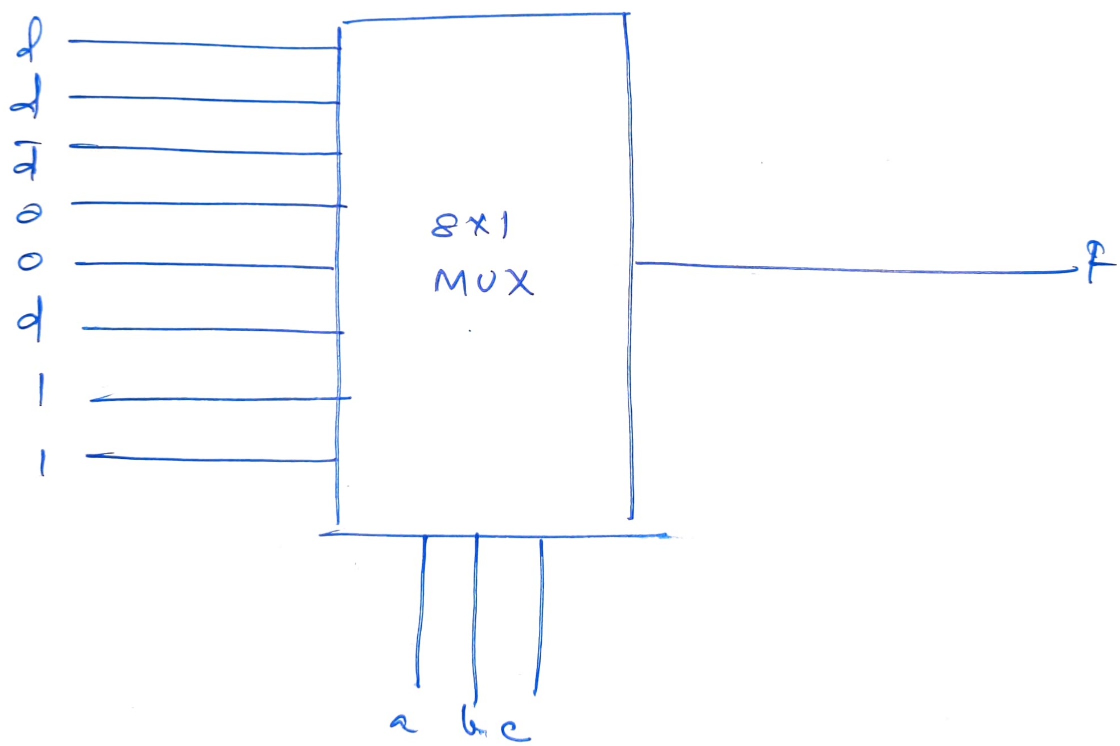
Method-1 (Using 16x1 MUX)



Method-2 : (Using 8×1 MUX)

Let a, b, c be select lines;

	I_0	I_1	I_2	I_3	I_4	I_5	I_6	I_7
$\bar{d}$	0	2	4	6	8	10	12	14
d	1	3	5	7	9	11	13	15
	$\Downarrow$	$\Downarrow$	$\Downarrow$	$\Downarrow$	$\Downarrow$	$\Downarrow$	$\Downarrow$	$\Downarrow$
	d	d	$\bar{d}$	0	0	d	$\bar{d}+d=1$	$\bar{d}+d=1$



Q. Design Full adder using suitable MUX.

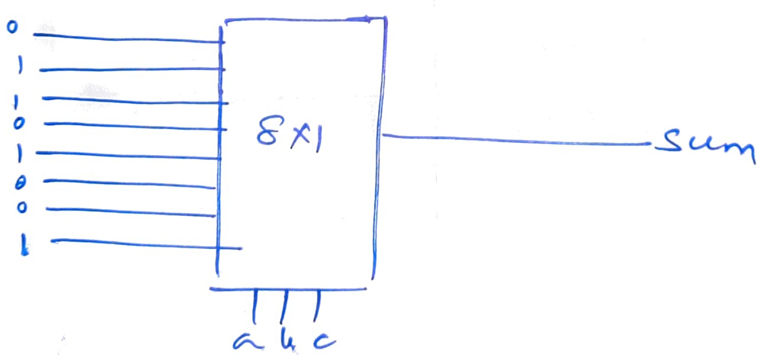
Ans.

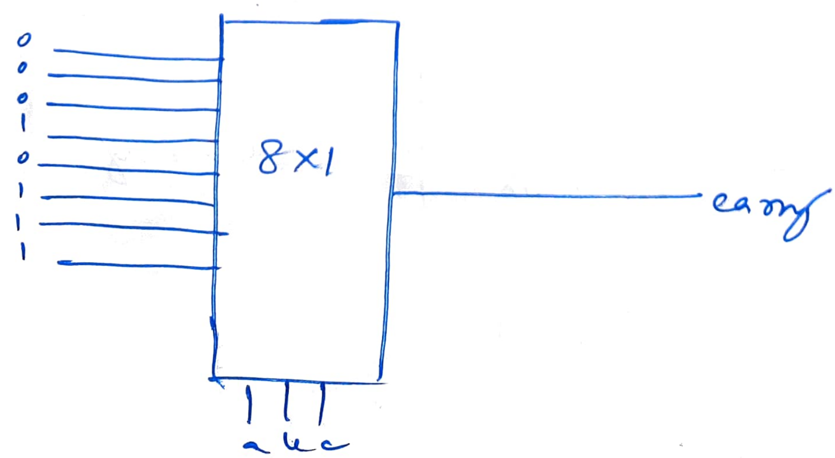
A	B	C	Sum	Carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

$$Sum = \sum m(1, 2, 4, 7)$$

$$Carry = \sum m(3, 5, 6, 7)$$

i) Using two 8×1 MUX :





ii) two 4×1 MUX :

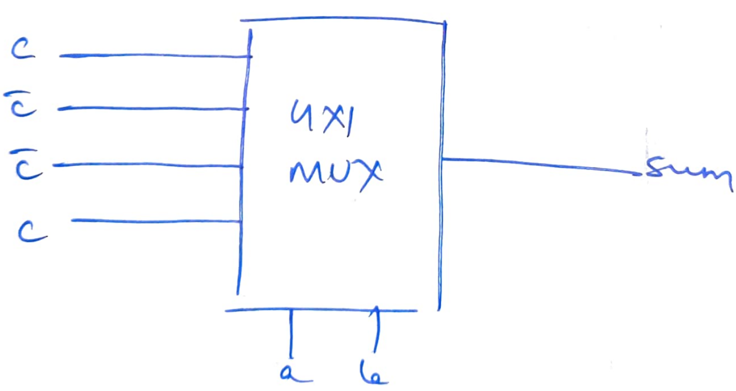
Let a & b be input lines.

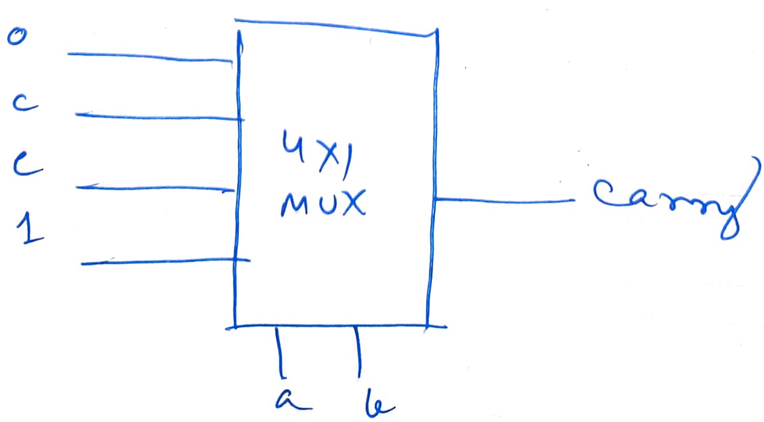
Sum :

	I_0	I_1	I_2	I_3
$\bar{c}$	0	2	4	6
c	1	3	5	7
	c	$\bar{c}$	$\bar{c}$	c

Carry :

	I_0	I_1	I_2	I_3
$\bar{c}$	0	2	4	6
c	1	3	5	7
	0	c	c	$c+\bar{c}=1$





Q. Design XOR gate using

i) 4x1 MUX

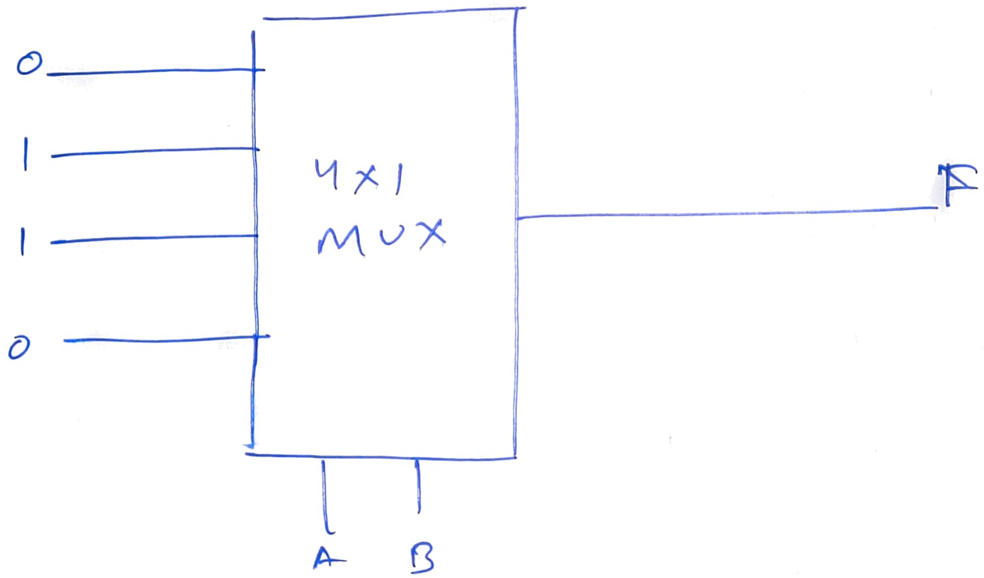
ii) 2x1 MUX

Ans.

A	B	F
0	0	0
0	1	1
1	0	1
1	1	0

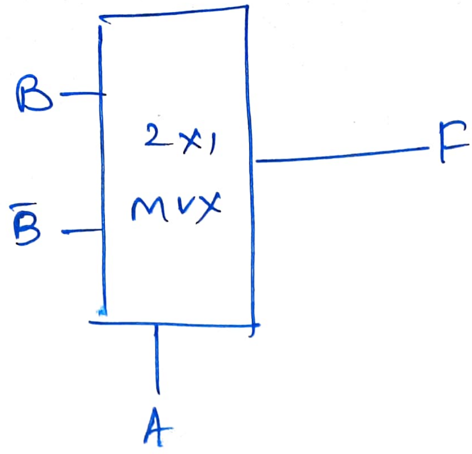
$F = \sum m(1, 2)$.

i) 4x1 MUX :



ii) 2x1 MUX : Let A be input line.

	I_0	I_1
$\bar{B}$	0	2
B	1	3
	B	$\bar{B}$



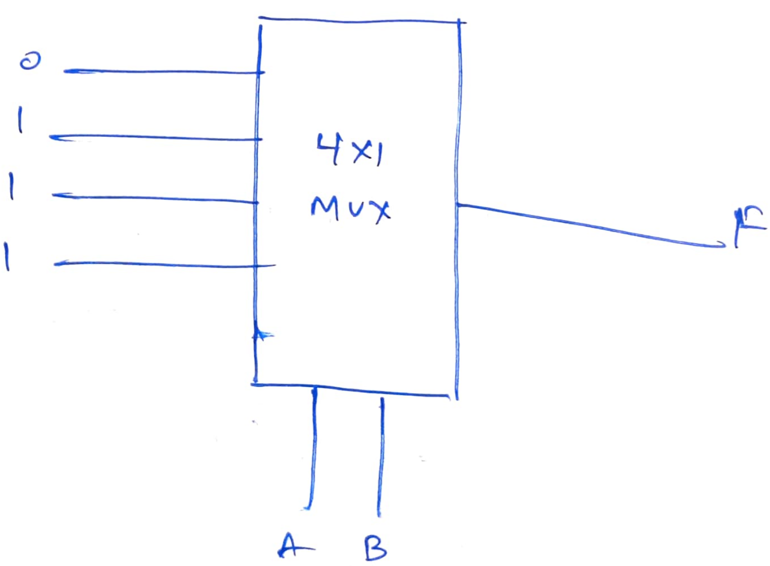
Q. Design OR gate using i) 4x1 MUX
ii) 2x1 MUX.

Ans.

A	B	F
0	0	0
0	1	1
1	0	1
1	1	1

$f = \sum m(1, 2, 3)$

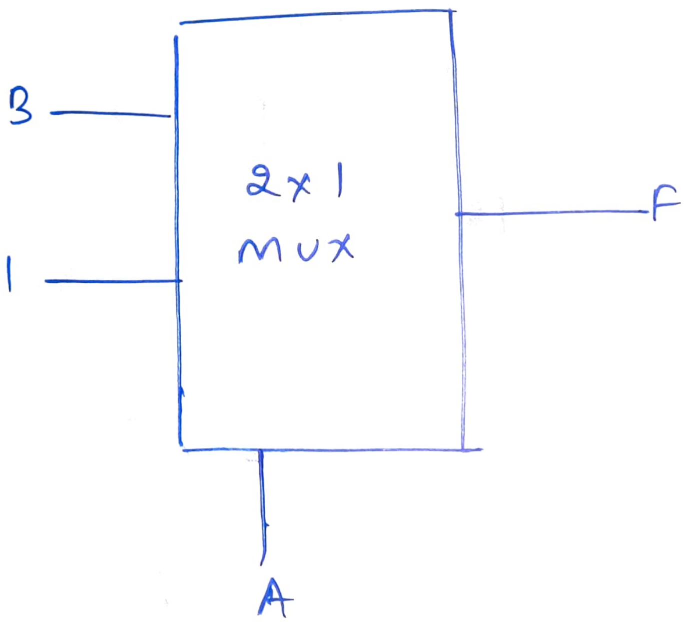
i) Using 4x1 MUX:



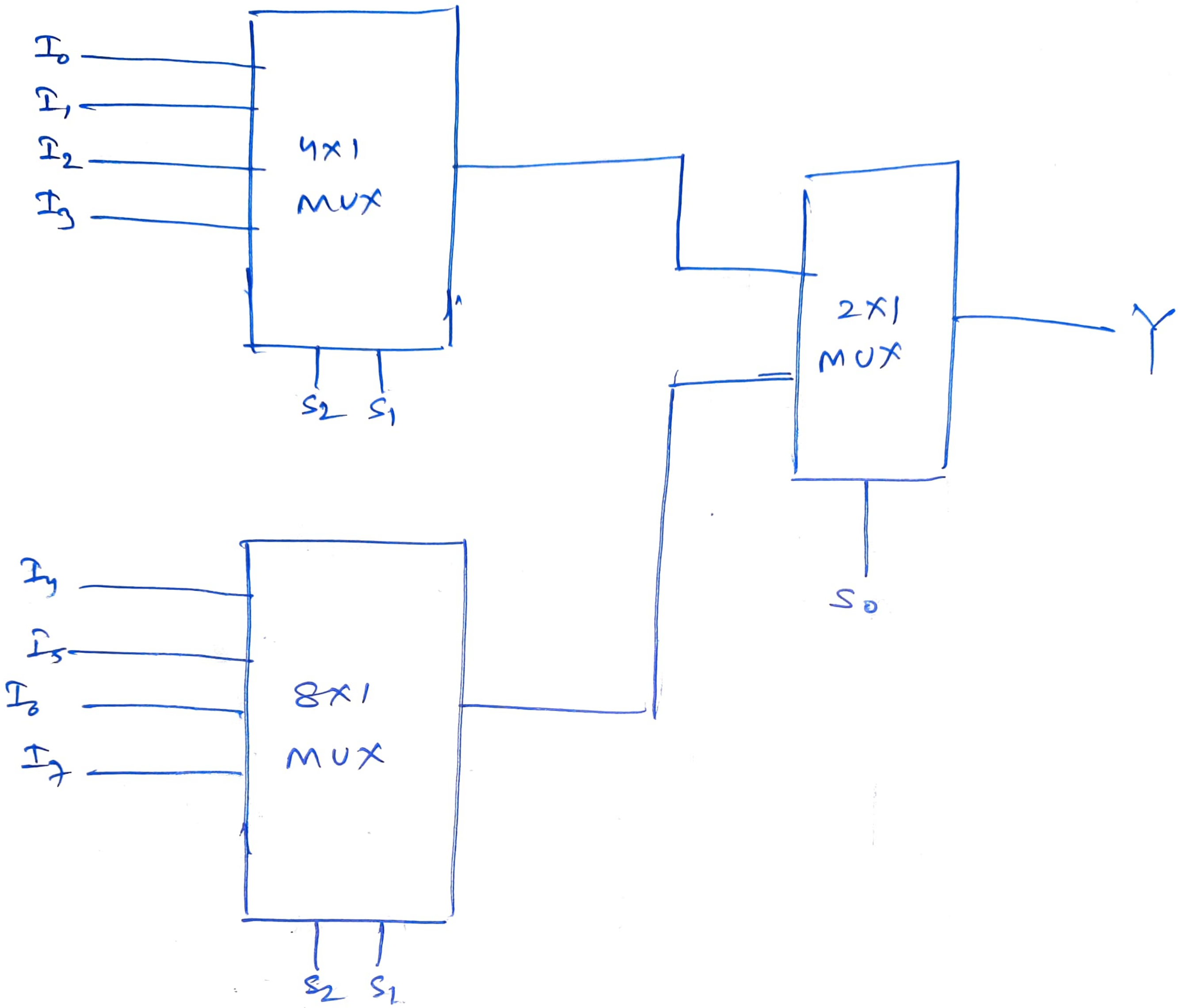
ii) using 2x1 MUX :

Let A be the input line.

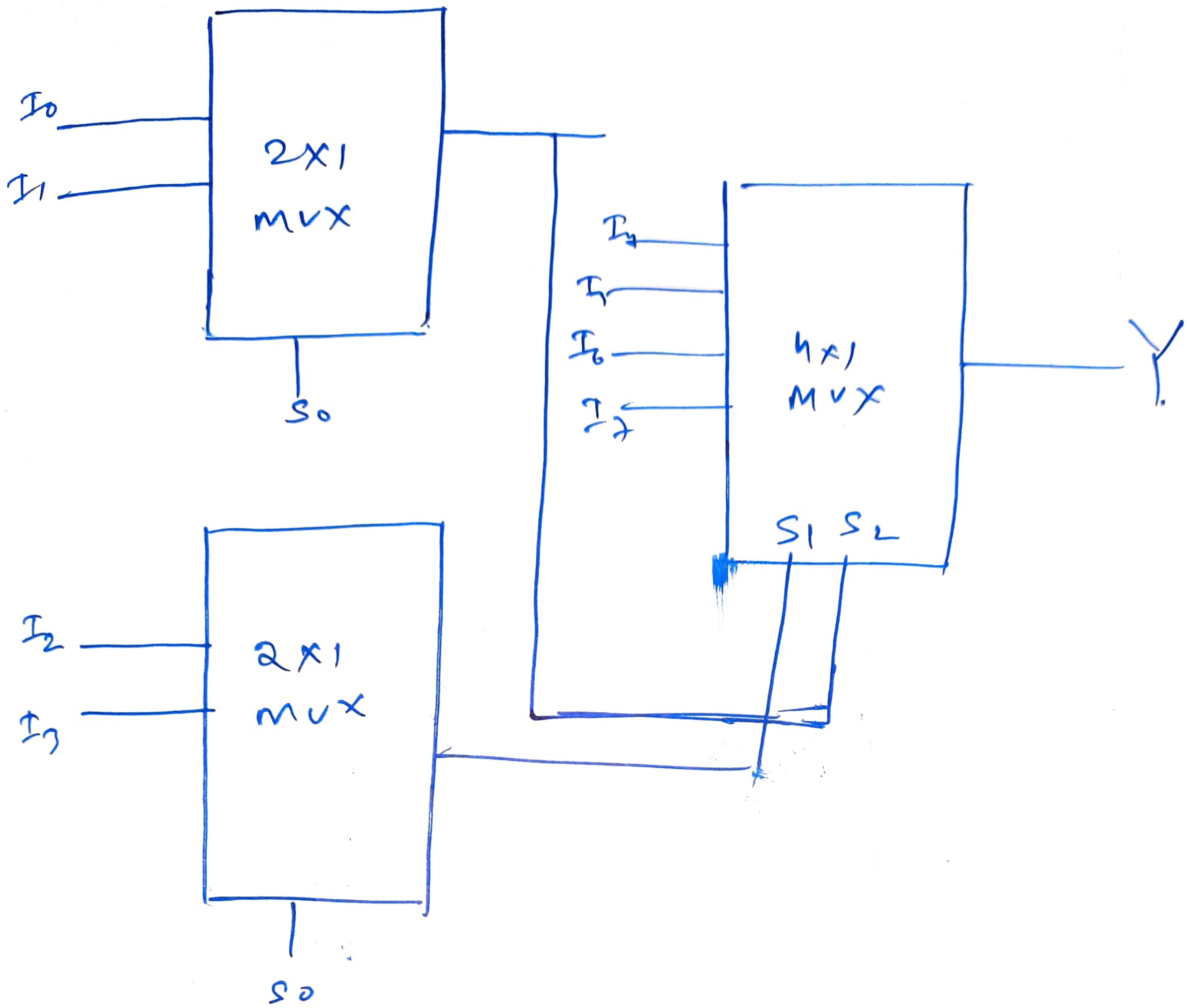
	I_0	I_1
$\bar{B}$	0	2
B	1	3
	B	$\bar{B}+B = 1$



Q. Design 8x1 MUX using two 4x1 MUX and one 2x1 MUX.



Q. Use 8x1 MUX using two 2x1 MUX and one 4x1 MUX.

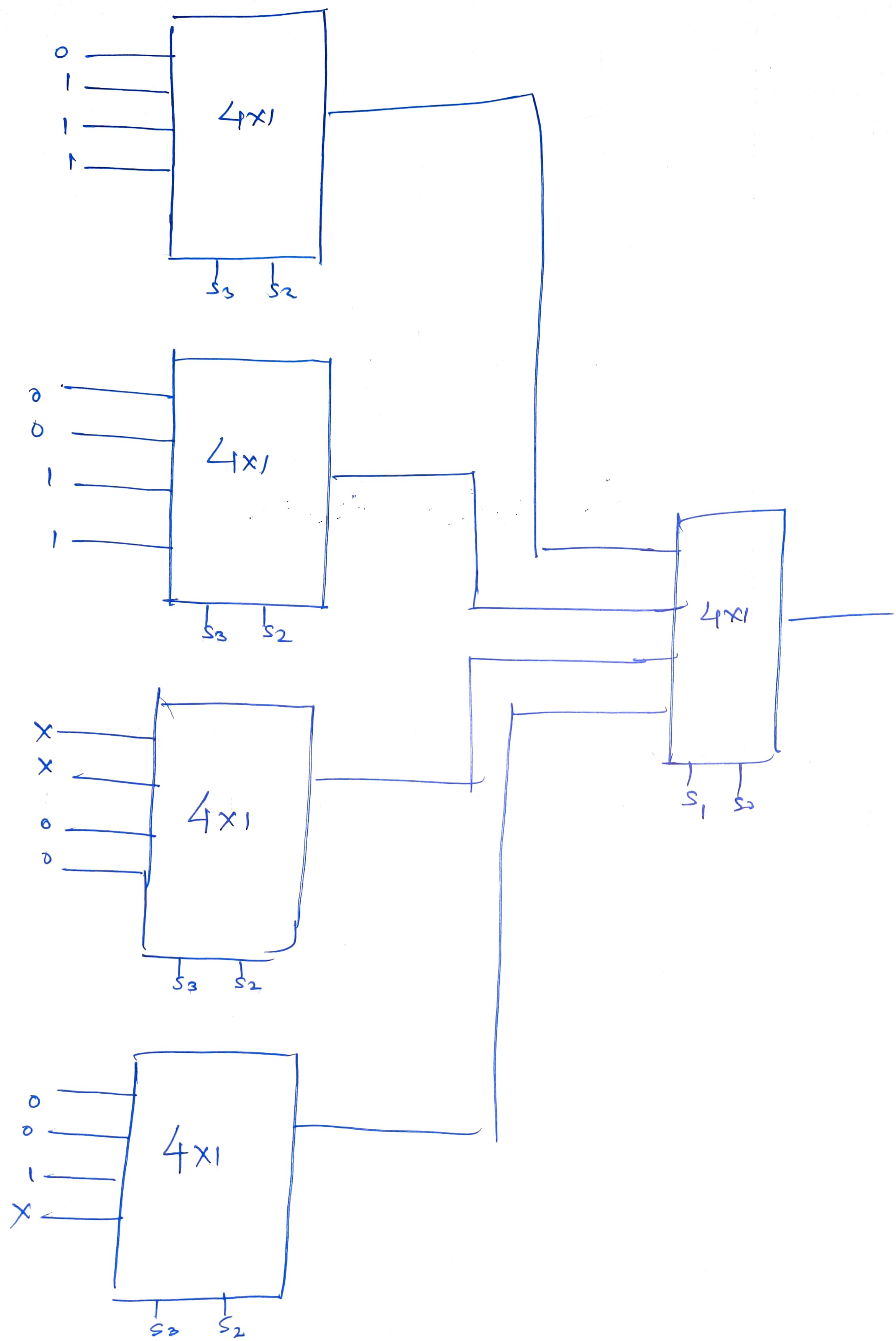


Q. Use 4X1 MUX to implement the functn.

$F(w, x, y, z) = \sum m(1, 2, 3, 6, 7, 14) + d(8, 9, 15)$

Ans.

(P.T.O)


0
1
1
1
4x1
S3 S2
0
0
1
1
4x1
S3 S2
X
X
0
0
4x1
S3 S2
0
0
1
X
4x1
S3 S2
4x1
S1 S0

* Using single 4X1 MUX:

Let ~~w~~ & ~~x~~ be input lines;

y & z be select lines.

	I_0	I_1	I_2	I_3
$\bar{w}\bar{x}$	0	1	2	3
$\bar{w}x$	4	5	6	7
$w\bar{x}$	8	9	10	11
wx	12	13	14	15
	0	$\bar{w}\bar{x}$	$\bar{w}\bar{x}+\bar{w}x+wx$	$\bar{w}\bar{x}+\bar{w}x$

w	x	y	z	F
0	0	0	0	0
0	0	0	1	1
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	0
1	0	0	0	X
1	0	0	1	X
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	1
1	1	1	1	X

$I_0 = 0$

$I_1 = \bar{w}\bar{x}$

$I_2 = \bar{w}\bar{x} + \bar{w}x + wx$

$= \bar{w}(\bar{x}+x) + wx$

$= \bar{w} + wx$

$= (\bar{w}+w)(\bar{w}+x)$

$= \bar{w} + x$

$I_3 = \bar{w}\bar{x} + \bar{w}x$

$= \bar{w}(\bar{x}+x)$

$= \bar{w}$