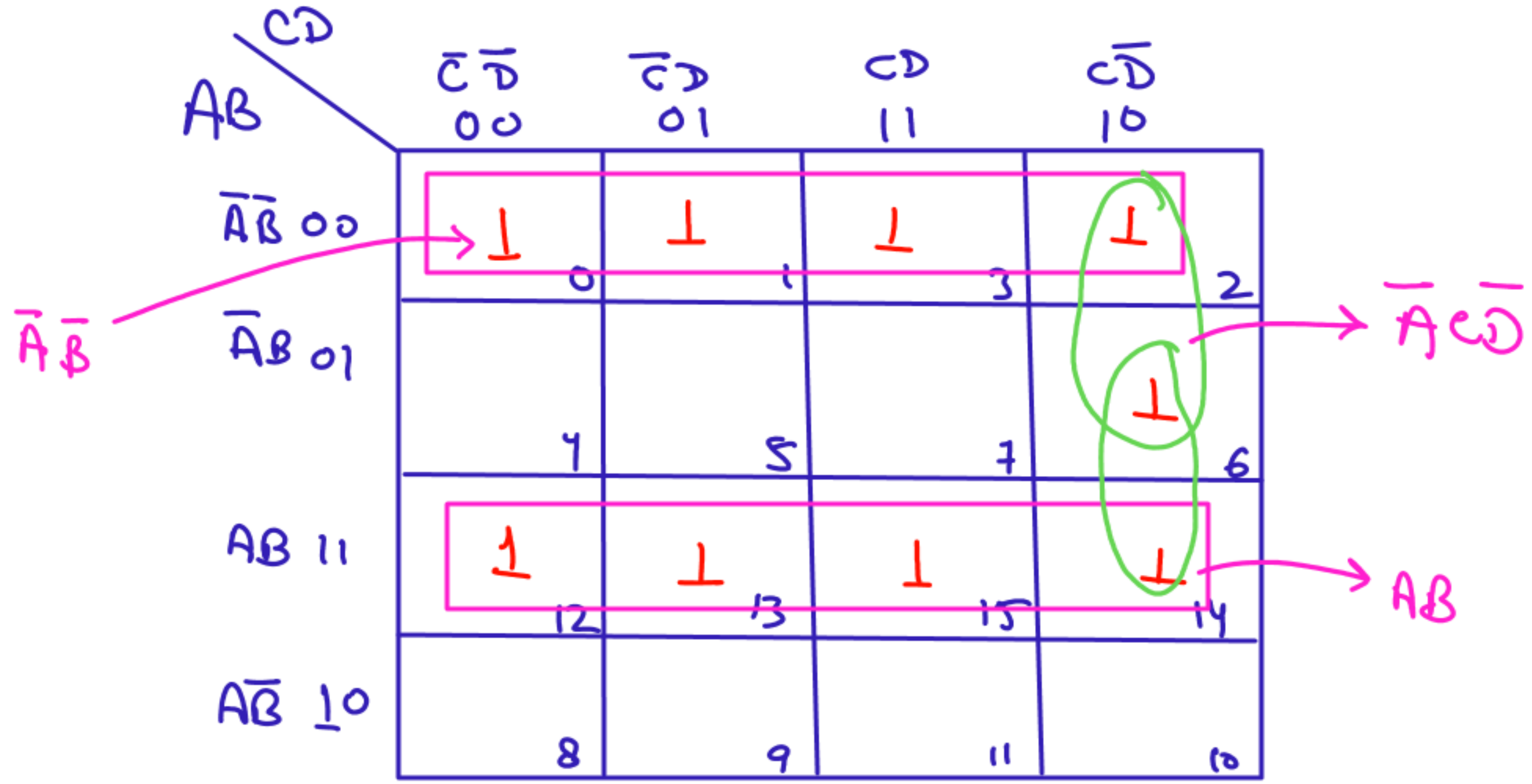
DPP on Boolean Algebra

The simplified expression/s of the following boolean function: F(A,B,C,D) = $\sum(0,1,2,3,6,12,13,14,15)$ is/are:

A) A'B' + AB + A'C'D'
B) A'B' + AB + A'CD'
C) A'B' + AB + BC'D'
D) A'B' + AB + BCD'



The boolean expression: AB + AB' + A'C + AC is unaffected by the value of the boolean variable __________ .

A) A

B) B

C) C

D) A,B,C

$A(\cancel{B+\bar{B}}) + C(\cancel{A+\bar{A}})$

$\boxed{A+C}$

The Boolean expression A'B + AB'+AB is equivalent to:

A) (A+B)'
B) A+B
C) AB
D) A'B

$\bar{A}B + A(\cancel{B+\bar{B}})$

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

$x + \bar{x}y = x+y$

The Binary operator ≠ is defined by the following truth table. Which one of the following is true about ≠ operator?

A) Both Commutative and Associative
B) Commutative but not Associative
C) Not Commutative but Associative
D) Neither Commutative Nor Associative

p	q	p≠q
0	0	0
0	1	1
1	0	1
1	1	0

XoR

Consider the following boolean function with four variables:

$F(w,x,y,z) = \sum(1,3,4,6,9,11,12,14)$ the function is:

A) Independent of one variable

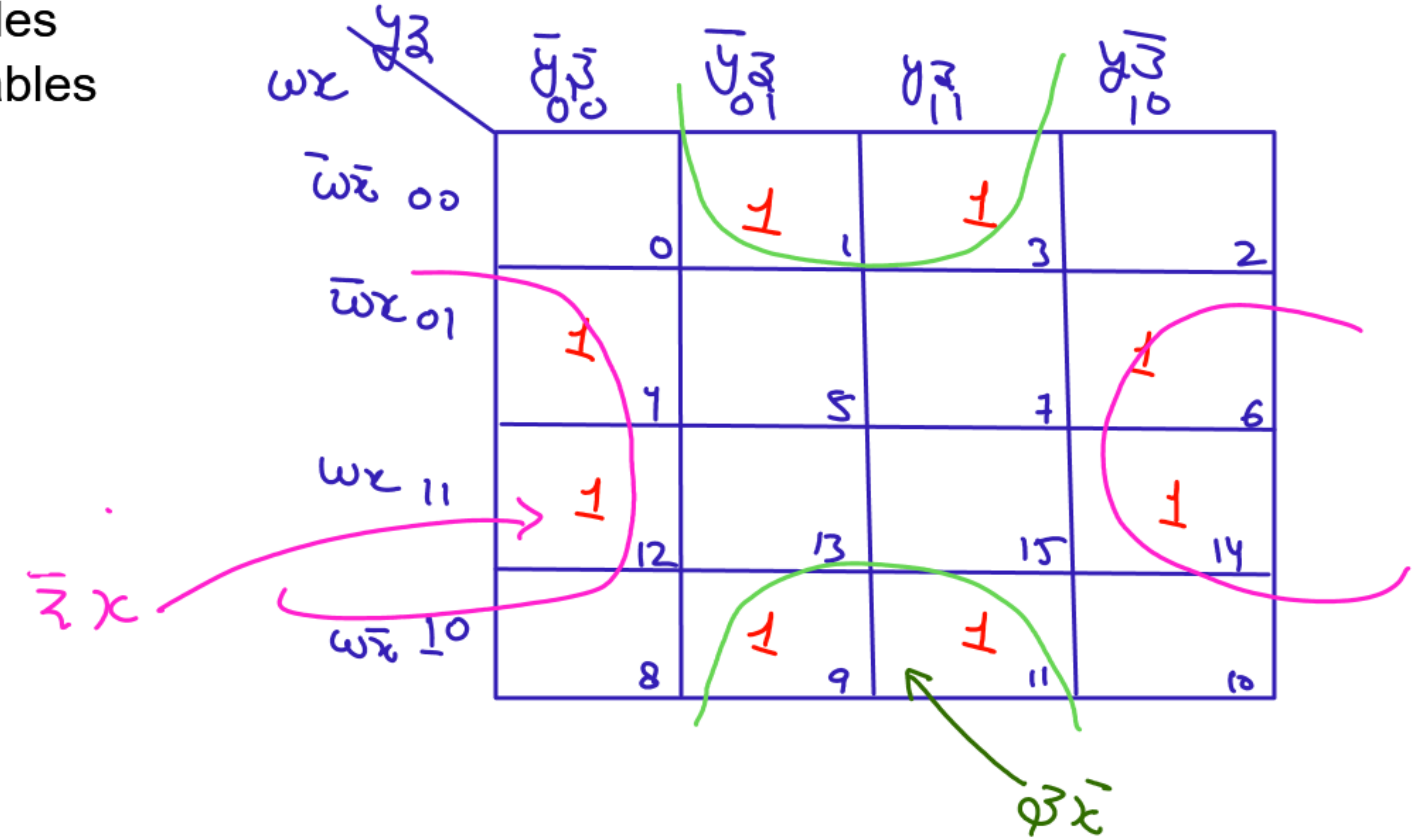
B) Independent of two variables

C) Independent of three variables

D) Depends on all variables

$$f = x\bar{z} + \bar{x}z$$

$$= x \oplus z$$

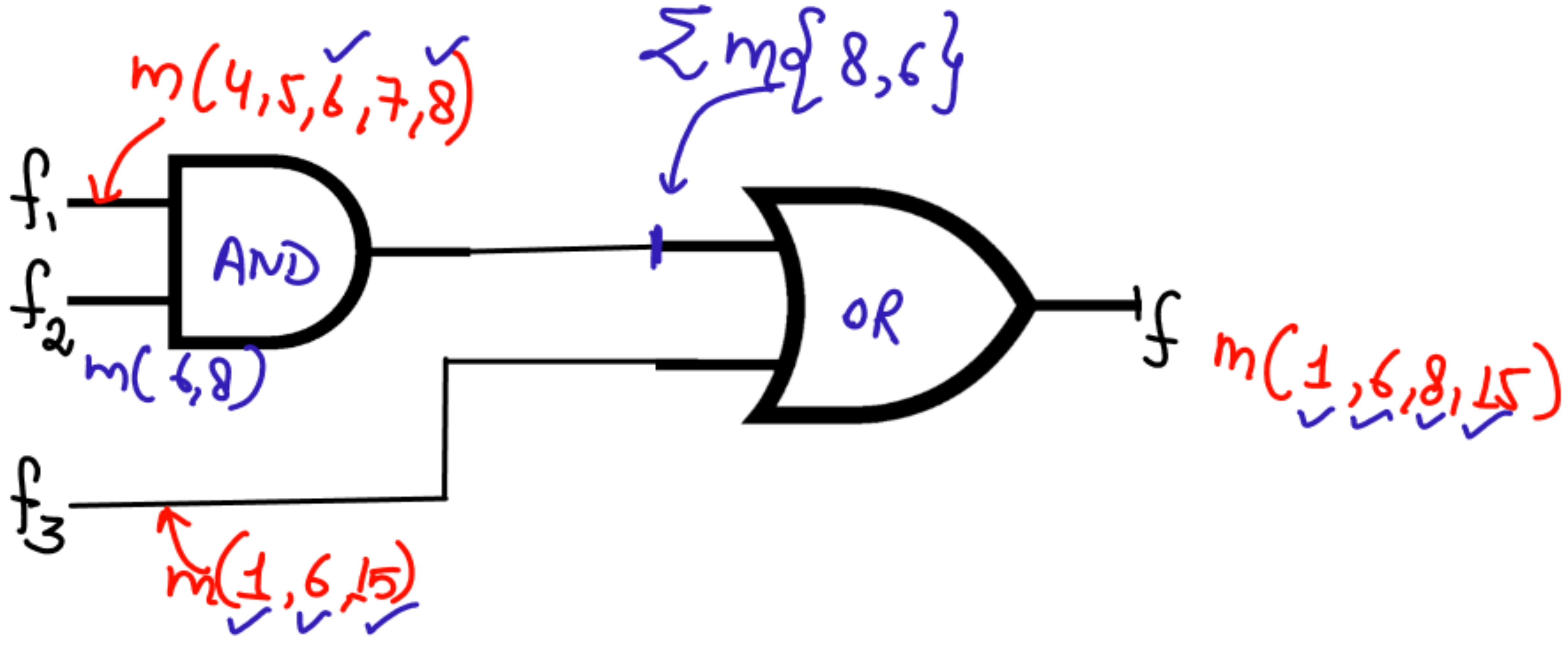


Given f1, f3 and f in canonical SOP form (in decimal) for the circuit.

$f1 = \sum m(4,5,6,7,8)$

$f3 = \sum m(1,6,15)$

$f = \sum m(1,6,8,15)$



a) $\sum m(4,6)$
b) $\sum m(4,8)$
c) $\sum m(6,8)$
d) $\sum m(4,6,8)$

AND: Intersection of minterms
↓
Common minterms are selected for output

OR : Union of minterms
↓
All minterms for function A & B are selected for output

The simplified SOP form of the Boolean Expression is:

$$\left(P+\overline{Q}+\overline{R}\right).\left(P+\overline{Q}+R\right).\left(P+Q+\overline{R}\right)$$

A. (P'Q+R')
~~B.~~ (P+Q'R')
C. (P'Q+R)
D. (PQ+R)

$$(\underline{P+\overline{Q}}+\overline{R})\cdot(\underline{P+\overline{Q}}+R)\cdot(P+Q+\overline{R})$$

$$\left((P+\overline{Q}\cdot P+\overline{Q})+R(P+\overline{Q})+\overline{R}(P+\overline{Q})+\cancel{\overline{R}R}\right)(P+Q+\overline{R})$$

$$(P+\overline{Q}+PR+R\overline{Q}+\overline{R}P+\overline{R}\overline{Q})(P+Q+\overline{R})$$

$$\Rightarrow(P+\overline{Q}+PR+P\overline{R}+\overline{Q}R+\overline{Q}\overline{R})(P+Q+\overline{R})$$

$$\left((P+\overline{Q}+\cancel{P(R+\overline{R})}+\overline{Q}\,\cancel{(R+\overline{R})}\right)(P+Q+\overline{R})$$

$$(P+\overline{Q}+\overline{Q})(P+Q+\overline{R})\Rightarrow(P+\overline{Q})(P+Q+\overline{R})$$

$$PP+PQ+P\overline{R}+P\overline{Q}+\cancel{Q\overline{Q}}+\overline{Q}\overline{R}$$

$$P+PQ+P\overline{R}+P\overline{Q}+\overline{Q}\overline{R}$$

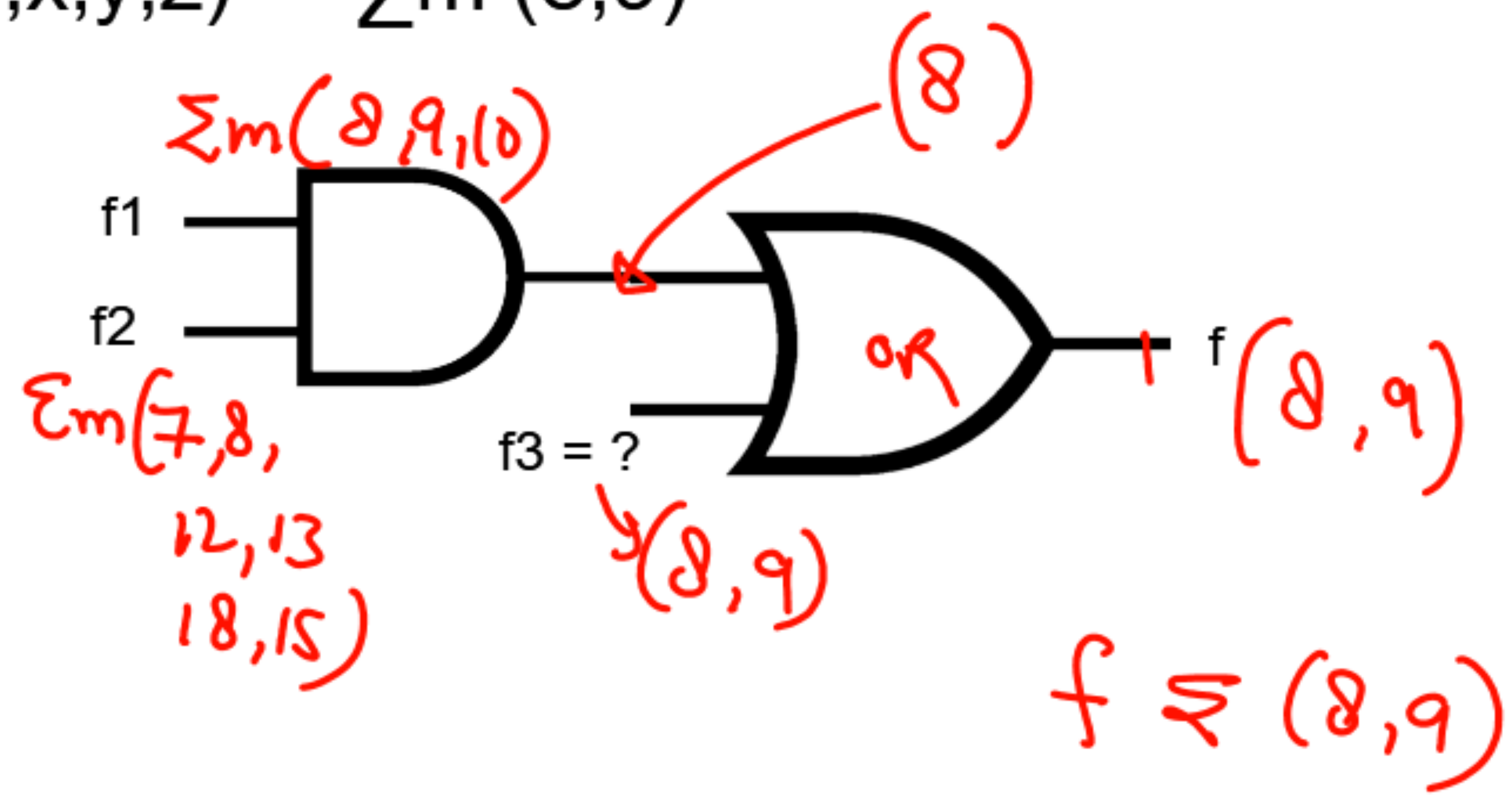
$$\Rightarrow P+\overline{Q}\overline{R}$$

Consider the logic circuit shown in the figure below. The functions f1, f2 and f (in canonical SOP form) are:

$f1(w,x,y,z) = \sum m\ (8,9,10)$

$f2\ (w,x,y,z) = \sum m\ (7,8,12,13,18,15)$

$f3\ (w,x,y,z) = \sum m\ (8,9)$



The function f3 is:

A. $\sum 9,10$

B. $\sum 9,8$

C. $\sum 1,8,9$

D. $\sum 8,10,15$

What happens when a bit string is XORed with itself n-times as shown:

[B⊕ (B⊕(B⊕ B………n times))]

(a) Complements when n is even

(b) Complements when n is odd

(c) Divides by 2^n always

(d) Remains unchanged when n is even

$$\boxed{\begin{array}{l} B \oplus B = 0 \\ B \oplus 0 = B \end{array}}$$

n = 2 (even)

$B \oplus (B \oplus B) = \underline{B}$

If no. of XOR gates are even

n = 3 (odd)

$B \oplus (B \oplus (\underbrace{B \oplus B}))$

$B \oplus (B \oplus 0)$

$B \oplus B$

$= 0$

* If the number of XOR gate is odd then o/p stuck at 0

The function represented by the map given below is:

A \ BC	00 ($\bar{B}\bar{C}$)	01	11 (BC)	10
0 ($\bar{A}$)	1		1	
1 (A)	1		1	

$\bar{B}\bar{C}$ $\quad$ BC

(a) A.B

(b) AB + BC + CA

(c) (B⊕C)'

(d) A.BC

$f = BC + \bar{B}\bar{C}$

$\Rightarrow B \odot C \leftarrow \overline{B \oplus C}$

f(A, B)=A’+ B. Simplified expression for function f(f(x+y,y),z) is

(a) x’ + z

(b) xyz

(c) xy’ + z

(d) None of these

$f(A,B) = \bar{A} + B$

$\underbrace{f(x+y,y)}_{\bar{x}+y}$

$f(x+y,y)$

$= \overline{x+y} + y$

$\bar{x}\cdot\bar{y} + y \leftarrow$ RLR $(A + \bar{A}B = A + B)$

$\boxed{\bar{x} + y}$

$f(\bar{x}+y, z) \Rightarrow \overline{\bar{x}+y} + z$

$= \bar{\bar{x}} + \bar{y} + z$

$z + x\bar{y}$

Which are the essential prime implicants of the following Boolean function?

f(a, b, c) = a’c + ac’ + b’c

(a) a’c and ac’
(b) a’c and b’c
(c) a’c only
(d) ac’ and bc’

$$\Rightarrow \bar{a}c\cdot(B+\bar{B}) + a\bar{c}(b+\bar{B}) + \bar{b}c(a+\bar{a})$$

$$\Rightarrow \underset{\substack{011\\\downarrow\\3}}{\bar{a}bc} + \underset{\substack{001\\\downarrow\\1}}{\bar{a}\bar{b}c} + \underset{\substack{110\\\downarrow\\6}}{ab\bar{c}} + \underset{\substack{100\\\downarrow\\4}}{a\bar{b}\bar{c}} + \underset{\substack{101\\\downarrow\\5}}{a\bar{b}c} + \underset{\substack{001\\\downarrow\\1}}{\bar{a}\bar{b}c}$$

$$f = \Sigma m(1, 3, 4, 5, 6)$$

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

A \ BC	$\bar{B}\bar{C}$ 00	$\bar{B}C$ 01	BC 11	$B\bar{C}$ 10
$\bar{A}$ 0	0	1 (1)	1 (3)	2
A 1	1 (4)	1 (5)	7	1 (6)

$\bar{A}C$

$A\bar{B}$

$\bar{C}A$

Which of the following expressions is equivalent to A ⊕ B ⊕C?

(a) (A+B+C) (A'+ B'+ C') ← 2 Max

(b) (A+B+C) (A'+ B'+C) ← 2 Max

~~(c)~~ ABC + A' (B⊕C) + B' (A⊕C)

(d) None of these

$\Pi M(1,3,5,6)$

$\Sigma m(1,2,4,7)$

	A	B	C	A⊕B⊕C
0	0	0	0	0 (M)
1	0	0	1	1
2	0	1	0	1
3	0	1	1	0 (M)
4	1	0	0	1
5	1	0	1	0 (M)
6	1	1	0	0 (M)
7	1	1	1	1

$ABC + \bar{A}(B\bar{C} + \bar{B}C) + \bar{B}(A\bar{C} + \bar{A}C)$

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

111 010 001 100 001

$\Rightarrow$

XOR → If there are 3 input
XOR Searches for odd number
of 1's OR
Even no of Zeroes

The switching expression corresponding to f A,B,C,D = ∑m(1,4,5,9,11,12) is

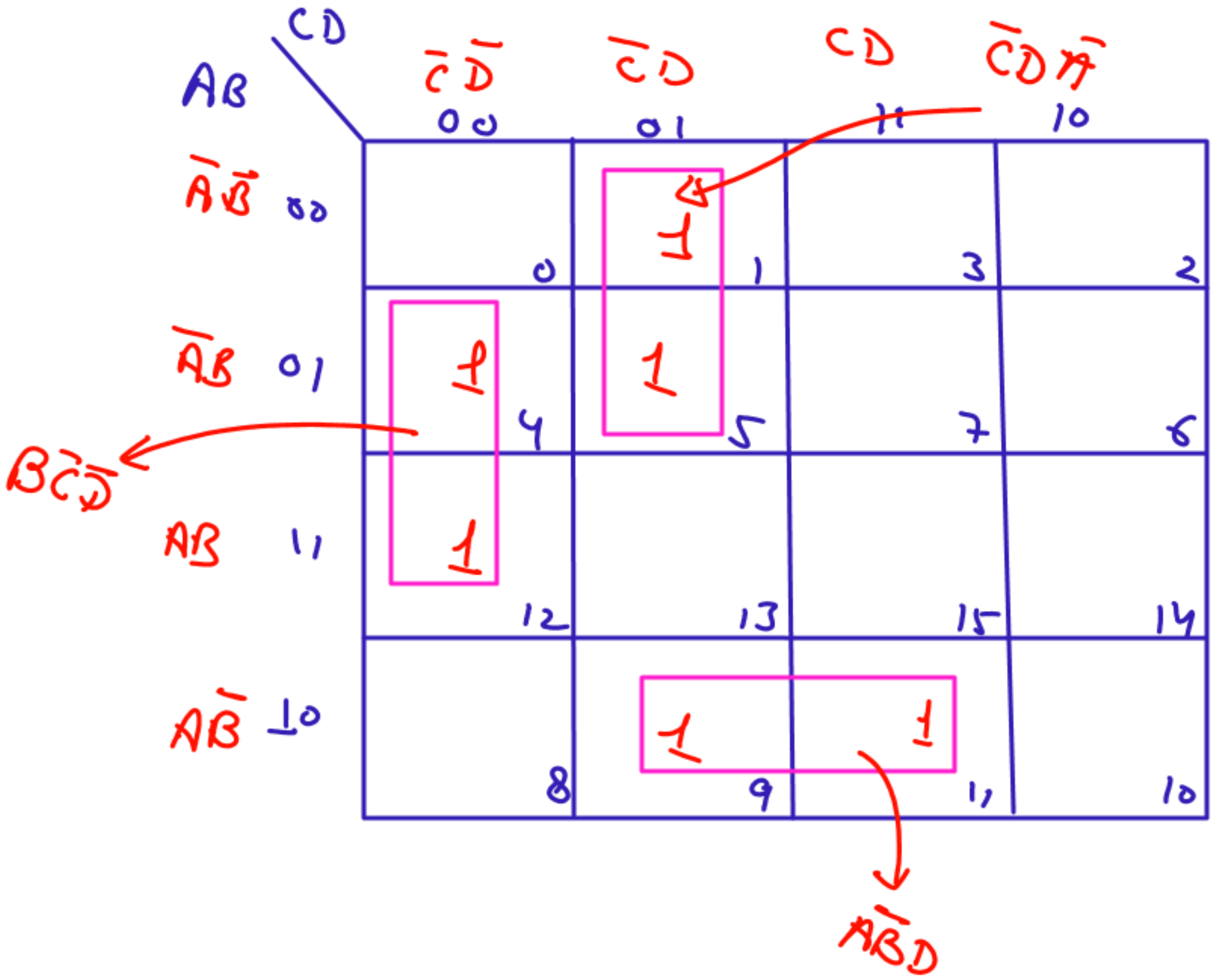
(a) BC’D’ + A’C’D + AB’D

(b) ABC’ + ACD + B’C’D

(c) ACD’ + A’BC’ + AC’D’

(d) A’BD + ACD’ + BCD’

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



What is maximum number of different Boolean functions involving in ‘n’ Boolean variables?

(a) n^2

(b) 2^n

(c) 2^2^n

(d) 2^n^2

for n variables there are 2^n Combinations

for n Combinations we can define 2^n functions

$\Rightarrow$ for 'n' variables = 2^{2^n} Combinations (REMEMBER)

Consider the following Boolean function of four variables f w,x,y,z = $\sum m(1,3,4,6,9,11,12,14)$

The function is

(a) independent of one variable

(b) independent of two variables

(c) independent of three variables

(d) dependent on all the variables

"do Yourself"

The following expression was to be realized using 2-input AND and OR gates. However, during the fabrication all 2-input AND gates were mistakenly substituted by 2-input NAND gates.

$f =$ (a.b).c + (a'.c).d + (b.c).d + a.d

What is the function finally realized?

(a) 1

(b) a' + b' + c' + d'

(c) a' + b + c' + d'

(d) a' + b' + c + d'

$$f = \overline{\overline{ab}\cdot c} + \overline{\overline{ac}\cdot d} + \overline{\overline{bc}\cdot d} + \overline{ad}$$

$$\Rightarrow \overline{\overline{AB}} + \bar{c} + \overline{\overline{ac}} + \bar{d} + \overline{\overline{bc}} + \bar{d} + \bar{a} + \bar{d}$$

$$\Rightarrow ab + \bar{c} + ac + \bar{d} + bc + \cancel{\bar{d}} + \bar{a} + \cancel{\bar{d}}$$

$$\Rightarrow ab + \bar{c} + ac + \bar{d} + bc + \bar{a}$$

$$ab + \bar{c} + \cancel{a} + \bar{d} + \cancel{a} + bc + \bar{a}$$

$$ab + \underbrace{\bar{c} + \bar{d} + bc}_{} + \bar{a}$$

$$ab + \bar{d} + \bar{c} + b + \bar{a}$$

$$b(a+1) + \bar{c} + \bar{d} + \bar{a}$$

$$= b + \bar{c} + \bar{d} + \bar{a}$$

$\overline{ab} = \bar{a} + \bar{b}$

$A + \bar{A}B$

$\bar{c} + ca$

$\bar{c} + a$

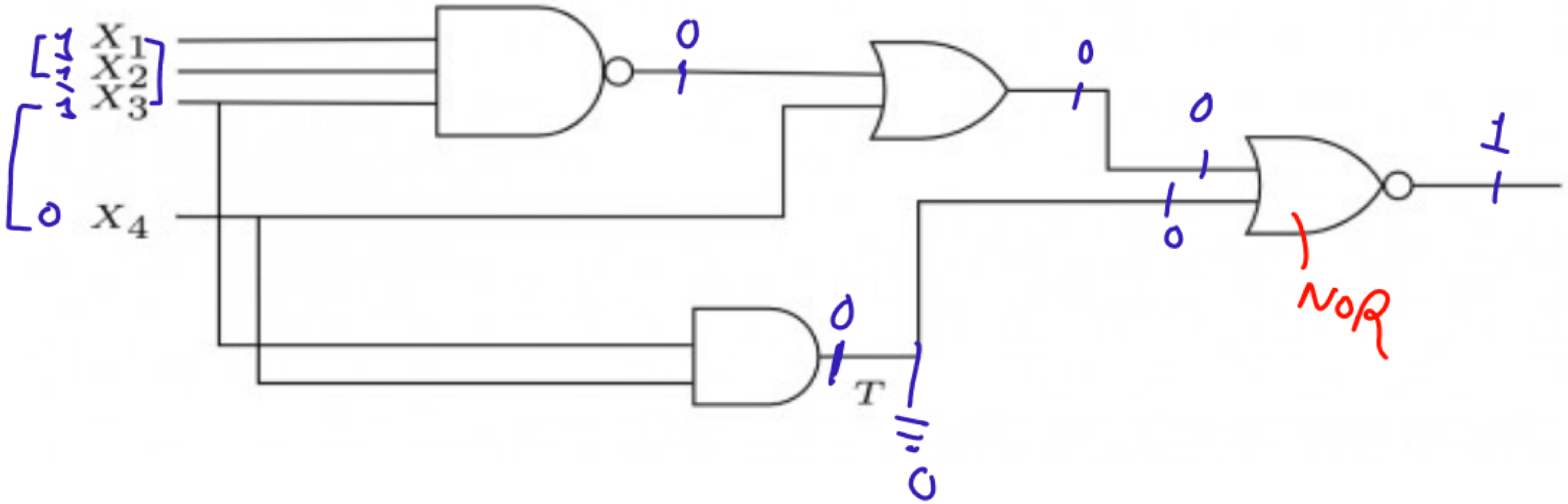
$\bar{c} + cb$

$\bar{c} + b$

The line T in the following figure is permanently connected to the ground.

Which of the following inputs (X1,X2,X3,X4) will detect the fault?

(a) 0000
(b) 0111
(c) 1111
(d) None of these



A	B	$\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

* It is not possible to detect the fault.

The total number of prime implicants of the function f (w,x,y,z) = $\sum m(0,2,4,5,6,10)$ is ____________.

Do yourself (H.W)