☆ Karnaugh Maps (Veitch Diagram).

* 3 - Variable K - Map:

F(A, B, C)

A \ BC	00	01	11	10
0	0	1	3	2
1	4	5	7	6

Octet (group of 8 adj minterms).

↓ x

Quad (group of 4 adj. minterms).

↓ x

pair (group of 2 adj minterms.

Q: How many possible ways to get Quad of minterms?

Ans: 6.

* 4 - Variable K-map

AB \ CD	00	01	11	10
00	0	1	3	2
01	4	5	7	6
11	12	13	15	14
10	8	9	11	10

Possible Quads ⇒ 24

Possible octets ⇒ 8.

Possible pair ⇒ 32

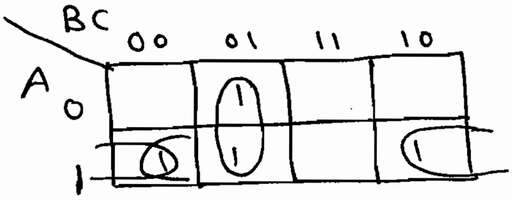
(0, 2, 8, 10) ⇒ Quad.

Colums	Rows
✓ 1, 2	1, 2
✓ 2, 3	2, 3
✓ 3, 4	3, 4
✓ 4, 1	4, 1

Ex-1 Simplify the following expression using maping.

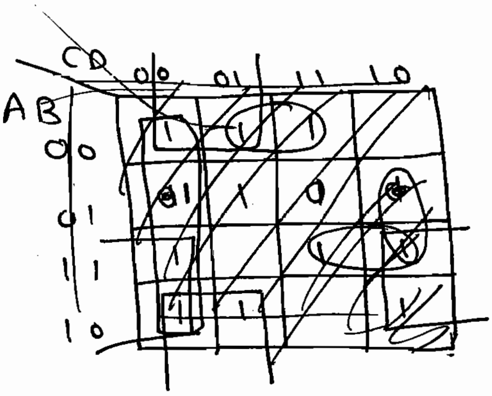
ⓐ $F(A,B,C) = \Sigma m(1,4,5,6)$

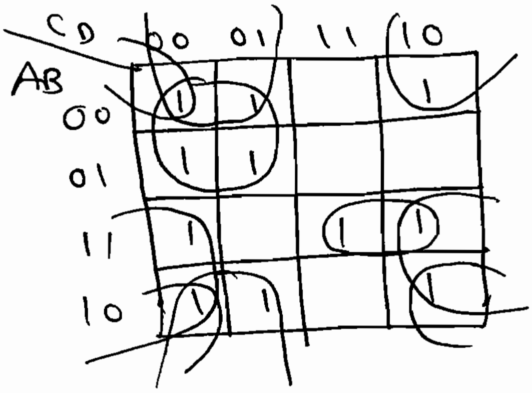
→



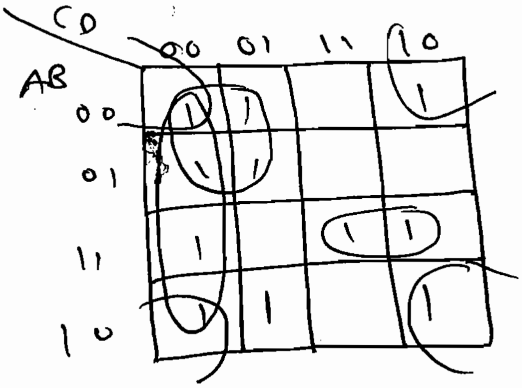
$\therefore F = A\bar{C} + \bar{B}C.$

ⓑ $F(A,B,C,D) = \Sigma m(0,1,2,4,5,8,9,10,12,14,15).$





(OR)



NOTE The simplified expression obtained using k-map is $\boxed{\text{minimal}}$ but $\boxed{\text{not unique.}}$

Ex-1 a) F (A, B, C) = Σm (1, 2, 4, 7).

b) F_1 (A, B, C) = Σm (0, 3, 5, 6).

Ans: ⓐ

A \ BC	00	01	11	10
0		1		1
1	1		1	

	A	B	C
m_1	0	0	1
m_2	0	1	0
m_4	1	0	0
m_7	1	1	1

$F = A\bar{B}\bar{C} + \bar{A}\bar{B}C + A\bar{B}\bar{C} + ABC.$

$F = \bar{B}(A\bar{C} + \bar{A}C) + A(\bar{B}\bar{C} + BC).$

$\therefore \boxed{F = A \oplus B \oplus C.}$

→ All minterms have odd no. of 1's.

→ All minterms have even no. of 0's.

b) F_1

A \ BC	00	01	11	10
0	1		1	
1		1		1

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

$+\ \bar{F} = +\Sigma m(0,3,5,6)$

$1 \; \bar{F} \; 1$

$\therefore F = A \odot B \oplus C.$ $F_1 = \bar{F}$

$F_1 = \overline{A \oplus B \oplus C} = \bar{A} \odot \overline{B \oplus C}$

le, t, $\bar{z} = \overline{A \oplus B}$
$= A \odot B$

$\therefore F_1 = \overline{z \oplus c}$

$\boxed{F_1 = A \odot B \oplus C}$. (or)

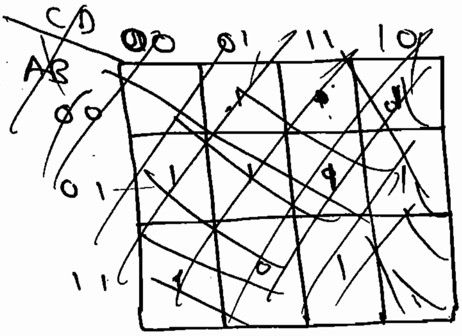
$\boxed{F_1 = A \oplus B \odot C.}$

→ Minterms doesn't have odd no. zeros and even no. of 1's.

Ex-2 Represent F = A ⊕ B ⊕ C ⊕ D in Sum of minterms (Canonical SOP form).

Ans:

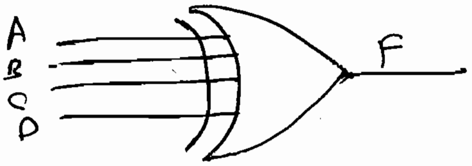
F = A ⊕ B ~~⊕D~~ ⊕ C ⊕ D.



CD / AB	00	01	11	10
00		1	.	1
01	1		1	
11		1		1
10	1		1	

Ans: 8

A	B	C	D	F
0	0	0	0	0
0	0	0	1	1 0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	0	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

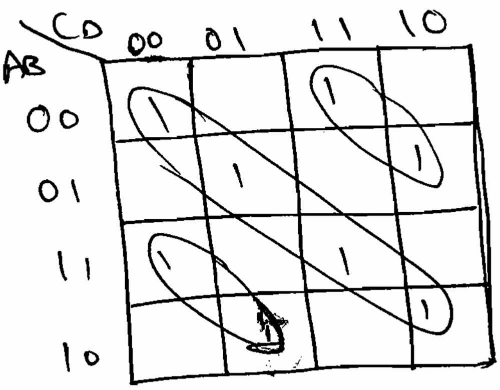


F = Σm(1, 2, 4, 7, 8, 11, 13, 14).

Hint : All above minterms have odd no. of ones.

Ex-3 simplify the following ~~terms~~: map:

$F = \Sigma m(0, 3, 5, 6, 9, 10, 12, 15)$.



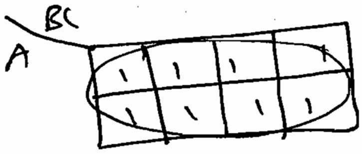
* All minterms contain even no. zeros

So, X-NOR gate.

∴ $\boxed{F = A \odot B \odot C \odot D.}$

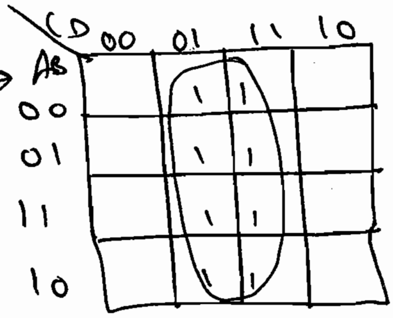
Ex-4 In n-variable k-map a group of 8^m is form. How many literals the resulting minterms.

Ans: → 3- var k-map ⟶



F = 1
so, 0 literal

→ 4 - Var k-map ⟶



F = D
so, 1 literal.

⋮

→ n - Var k-mp → there are n-3 literals. require for 8 minterms.

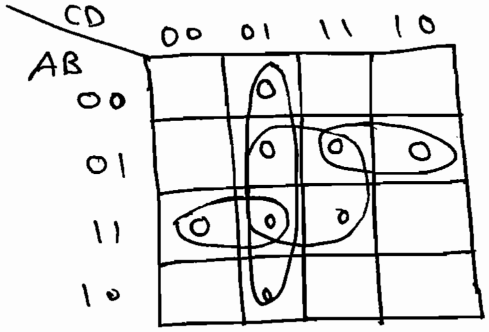
for pair → n-1 literals.
→ for Quad → n-2 literals.
for ~~8 min~~ octet → n-3 literals.

Ex-5 Determine the Simplified pos expression of F where, $F = \sum m(0, 2, 3, 4, [illegible], 8, 10, 11, 14)$.

Ans: for pos.

$\therefore F = \prod M(1, 5, 6, 7, 9, 12, 13, 15)$.

for max term
0 → var
$\overline{\text{var}}$



$F = (\bar{B}+\bar{D})\cdot(C+\bar{D})\cdot(\dot{A}+\bar{B}+\dot{C})(A+\bar{B}+\bar{C})$.

* Impiicant:

→ (i) Prime impiicant &

(ii) ~~A~~Essential impiicant

→ **Impiicant:**

→ it is the set of all adjecent minterms.

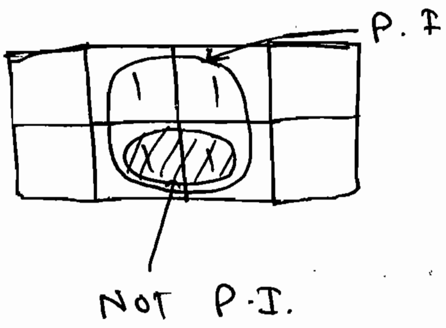
E.g. octents, pairs.

* Prime impiicant:

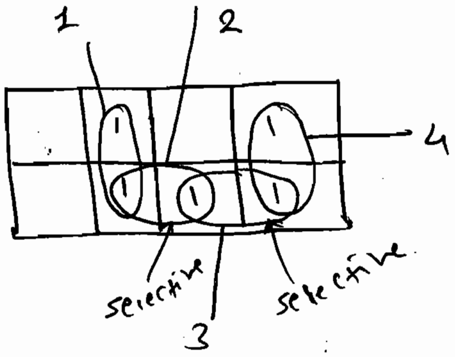
→ It is an impiicant which is not a subset of another impiicant.

e.g.

(a)

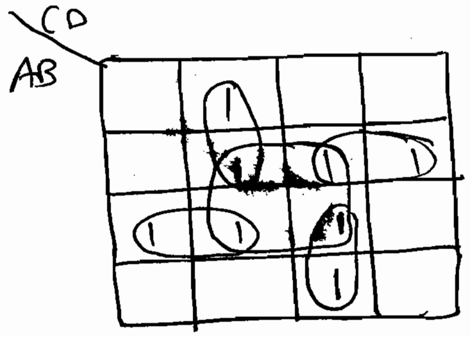


(b)



All 4 are prime impiicants.

(c)

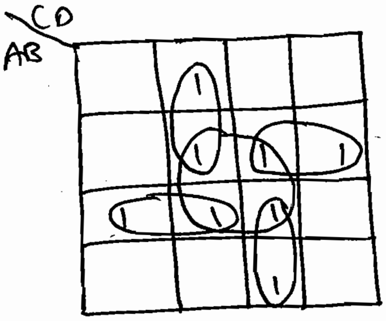


All are prime impiicants.

* Essential Prime implicants:

→ It is a prime implicant which contains atleast 1 minterms which is not covered by another prime implicant.

e.g.



← is non-essential prime implicant and remaining are essential prime implicant.

* Non-Essential Prime Implicants:

1) Redundant P.I (RPI).

→ It is a non-essential prime implicant whose minterms are covered by all essential P.I.

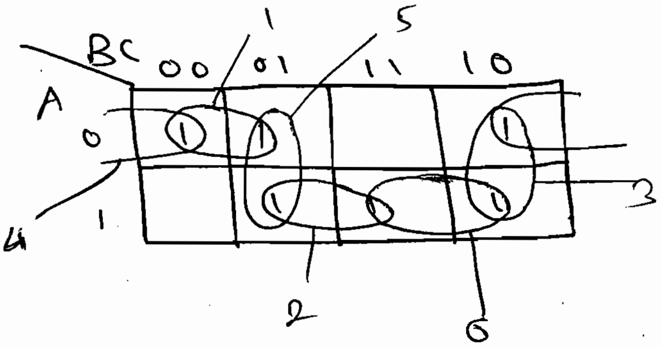
2) Selective Prime implicant:

→ It is a non-essential prime implicant whose minterms are covered by atleast one non-essential P.I.

* Minimal Expression = EPI's + (optional) SPI

Ex-1 Determine the essential P.I. and minimal expression for the following f^ns.

Ans: ① $F(A,B,C) = \Sigma m(0,1,2,5,6,7)$.



EPI's → Null

RPI's → Null

SPI's → ①, ②, ③, ④, ⑤, ⑥, 7

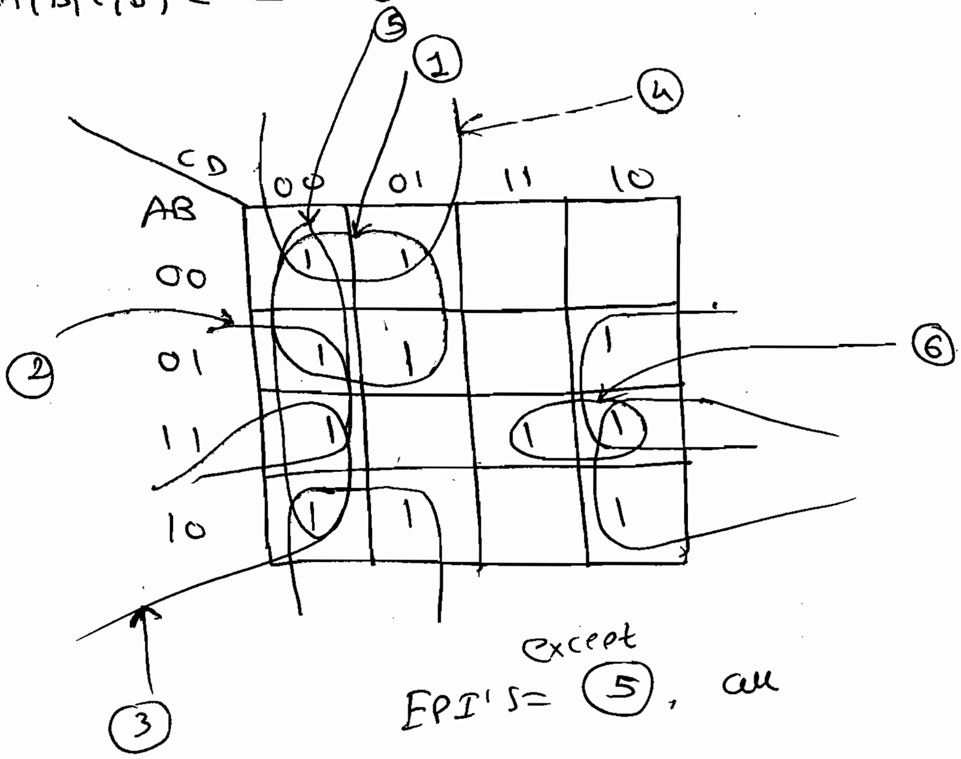
(

minimal expression = ① ~~or~~ + ② + ③

(or)

= ④ + ⑤ + ⑥.

ⓑ $F(A,B,C,D) = \Sigma m(0,1,4,5,6,8,9,10,12,14,15)$.



EPI's = ⑤, all except

∴ F = ① + ② + ③ + ④ + ⑥. ~~+~~

$F = \bar{A}\bar{C} + B\bar{D} + A\bar{D} + \bar{C}\bar{B} + ABC$