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① a. $F_1 = \sum(m_i)$, $F_2 = \sum(m_j)$

$E = F_1 + F_2 = \sum(m_i) + \sum(m_j)$ contains the sum of minterms of F_1 and F_2

b. $G = F_1 \cdot F_2 = (\sum(m_i)) \cdot (\sum(m_j)) = \sum(m_i \cdot \sum(m_j))$

$m_i \cdot m_j = m_i$ if $i = j$

∴ G contains only the minterms that are common to F_1 and F_2

2. a. $F(x,y,z) = \sum(3,5,7) = \prod(0,1,2,4,6)$

b. $F(A,B,C,D) = \prod(3,5,8,11,12,15) = \sum(0,1,2,4,6,7,9,10,13,14)$

3. a. $F = (b'+d)(a'+b'+c)(a'+c)$

$= (b'a' + b' + b'c + a'd + b'd + cd)(a'+c)$

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

$= a'b' + a'd + cb' + cd \longrightarrow$ SOP

$= a'b'c(c+c')(d+d') + a'd(b'+b)(c'+c) + cb'(a+a')(d+d') + cd(b+b')(a+a')$

$= m_0 + m_1 + m_2 + m_3 + m_5 + m_7 + m_{10} + m_{11} + m_{15}$

$= \sum(0,1,2,3,5,7,10,11,15) \rightarrow$ canonical form

b. $F = xy + x'z' + x'yz$

$= (xy + x'z' + x'y)(xy + x'z' + z)$

$= (y + x'z')(xy + z + x') \cdot xy$

$= xy(xy + z + x')$

$= (xy + xyz)$

$= xy + zz'$

$= (x'y + z)(xy + z')$

$= (z+y)(x+z)(x+z')(z'+y) \rightarrow$ POS

$= (z+y+xx')(x+z+yy')(x+z'+yy')(z'+y+xx')$

$= M_0 M_1 M_2 M_3 M_4 M_5$

$= \prod(0,1,2,3,4,5) \rightarrow$ canonical form

4. a. ① $y'z' + yz' + x'z$

$= z' + x'z$

$= (z'+z)(z'+x)$
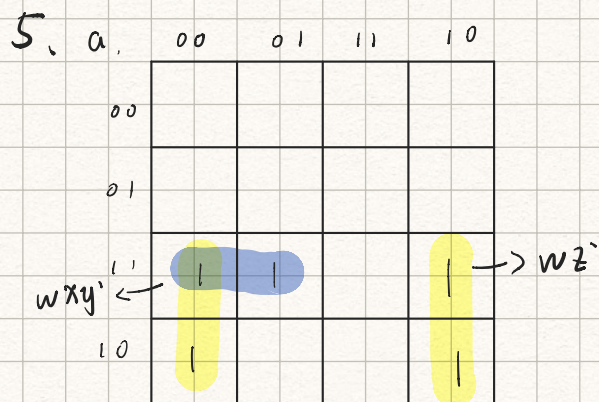
$= z' + x'$

② $x' + xz'$

$= (x'+x)(x'+z')$

$= x' + z'$

a is true

b. ① $x'y + xz + y'z'$
  $= x'y(z+z') + xz(y+y') + y'z'(x+x')$
  $= \Sigma(0,2,3,4,5,7)$

  ② $xy' + x'z' + yz$
  $= xy'(z+z') + x'z'(y+y') + yz(x+x')$
  $= \Sigma(0,2,3,4,5,7)$

  b is true

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

5. a.

$F(w,x,y,z) = wz' + wxy'$

b.

$F(A,B,C,D) = BD + B'D'$

c.

$F(A,B,C,D) = AC' + AD + BCD$

d.
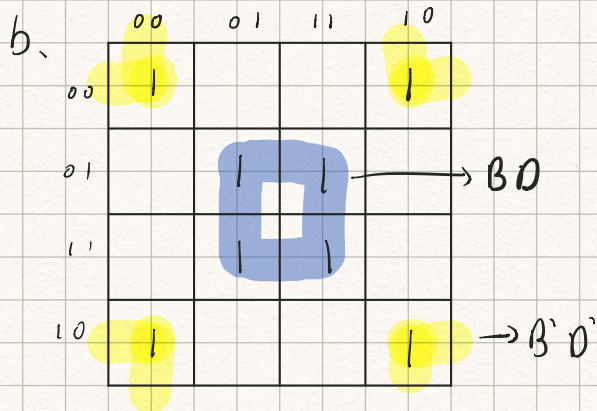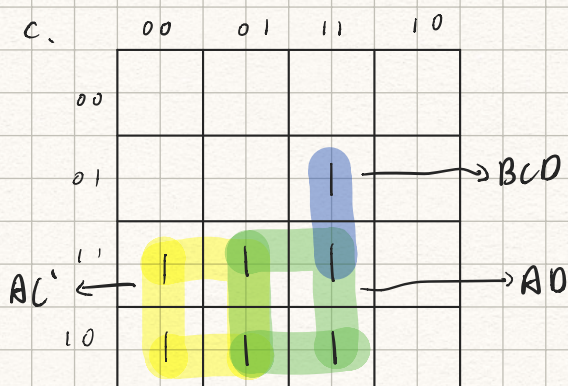
CD\AB	00	01	11	10
00		1		
01	1	1		
11			1	
10		1	1	1

A'BC' ←
→ ACD
→ AB'C
→ B'C'D

$$F(A,B,C,D) = AB'C + ACD + B'C'D + A'BC'$$

6.

a.

CD →

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

A'BC' ←
C'D' ←

$$F(A,B,C,D) = (C+D)(C'+D')(A+B'+C)$$

b.
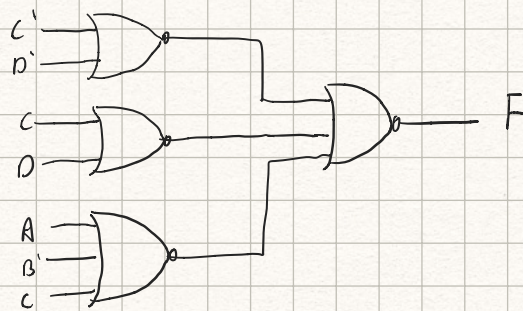
CD\AB	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11	1	1	1	1
10	0	0	1	1

AB'C' ←
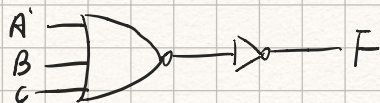
$$F(A,B,C,D) = (A'+B+C)$$

7. a.

	00	01	11	10
00	X			1
01	1		1	X
11	1			
10	X			1

$C'D' \leftarrow$ (left column)
$\rightarrow A'BC$
$\rightarrow B'CD'$

$$F(A,B,C,D) = C'D' + B'CD' + A'BC$$

$$= \Sigma(0,2,4,6,7,8,10,12)$$

b.

	00	01	11	10
00	X	X		1
01	1	X		
11	1			1
10	X			1

$A'C' \leftarrow$
$\rightarrow B'CD'$
$\rightarrow AD'$

$$F(A,B,C,D) = AD' + A'C' + B'CD' = \Sigma(0,1,2,4,5,8,10,12,14)$$

8.

$$F = A'BC'D + AB'CD' + ABC'D' + A'B'CD$$
$$= A'D(BC' + B'C) + AD'(B'C + BC')$$
$$= (BC' + B'C)(A'D + AD')$$
$$= (B \oplus C)(A \oplus D)$$