K-Map of 2 variables

A B	A'	A
B'	0	2
B	1	3

K-Map of 3 variables

AB C	A'B'	A'B	AB	AB'
C'	0	2	6	4
C	1	3	7	5

K-Map of 4 variables for SOP function

ab cd	a+b	a+b'	a'+b'	a'+b
c+d	0	4	12	8
c+d'	1	5	13	9
c'+d'	3	7	15	11
c+d'	2	6	14	10

K-Map of 4 variables for POS function

ab cd	a+b	a+b'	a'+b'	a'+b
c+d	0	4	12	8
c+d'	1	5	13	9
c'+d'	3	7	15	11
c+d'	2	6	14	10

1. Minimize using K-Map `F(A,B,C)=∑(1,2,3,6,7)`

AB C	A'B'	A'B	AB	AB'
C'		1	1	
C	1	1	1	

An overlapping pair and a quad. So the minimal solution is
`F(A,B,C)=A'C + B`

2. Minimize using K-Map F(A,B,C,D)=∑(4,5,6,7,12,13,14)

CD \ AB	A'B'	A'B	AB	AB'
C'D'		1	1	
C'D		1	1	
CD		1		
CD'		1	1	

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

3. Minimize using K-Map F(A,B,C,D)=∏(0,1,2,3,4,5,8,9,10,11,14)

CD \ AB	A+B	A+B'	A'+B'	A'+B
C+D	0	0		0
C+D'	0	0		0
C'+D'	0			0
C'+D	0		0	0

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

1. Minimise the following SOP functions using K-Map:

a) F(A,B,C,D)=∑(0,1,2,3,4,5,8,9,12,13)
b) F(A,B,C,D)=∑(0,1,2,3,5,7,8,9,12,13,14,15)
c) F(A,B,C,D)=∑(0,1,2,3,5,7,8,9,10,11,13,15)
d) F(A,B,C,D)=∑(0,2,4,6,7,8,9,10,11,12,13,14,15)
e) F(A,B,C,D)=∑(0,1,2,3,4,8,9,10,11,12)
f) F(A,B,C,D)=∑(1,3,4,5,7,9,11,12,13,14)

2. Minimise the following POS functions using K-Map:

a) F(A,B,C,D)=∏(0,2,6,7,8,9,10,11,13,15)
b) F(A,B,C,D)=∏(0,4,5,9,11,12,13,15)
c) F(A,B,C,D)=∏(0,4,5,7,8,9,12,13,15)
d) F(A,B,C,D)=∏(0,2,4,6,7,8,9,10,12,13,14,15)
e) F(A,B,C,D)=∏(0,2,4,5,6,7,10,14)

3. Algebraically prove the identities:

a) A'B'C'+A'BC'+ABC'+AB'C'+A'B'C+A'BC=A'+C'

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LHS  =  A'B'C'+A'BC'+ABC'+AB'C'+A'B'C+A'BC
        Pairing 1st & 2nd term, 3rd & 4th term and 5th & 6th term
=  A'C'(B'+B)+AC'(B+B')+A'C(B'+B)
=  A'C'+AC'+A'C     Since B+B'=1
=  C'(A'+A)+A'C
=  C'+A'C           Since A+A'=1
=  (C'+A')(C'+C)    Applying Distributive Law: (X+Y)(X+Z)=X+YZ
=  A'+C'            Since C+C'=1
=  RHS
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b) A'BC'+ABC'+AB'C'+A'BC+ABC+A'B'C'=B+C'

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LHS  =  A'BC'+ABC'+AB'C'+A'B'C'+A'BC+ABC
        Pairing 1st & 2nd term, 3rd & 6th term and 4th & 5th term
     =  BC'(A'+A)+B'C'(A+A')+BC(A'+A)
     =  BC'+B'C'+BC      Since A+A'=1
     =  C'(B+B')+BC
     =  C'+BC            Since B+B'=1
     =  (C'+B)(C'+C)     Applying Distributive Law (X+Y)(X+Z)=X+YZ
     =  B+C'             Since C+C'=1
     =  RHS
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c) A'B'C+A'B'C'+ABC+A'BC+A'BC'+ABC'=A'+B

d) A'B'C'+A'B'C+ABC'+ABC+AB'C'+AB'C=A+B'

e) A'B'C'+A'B'C+A'BC+ABC+AB'C'+AB'C=B'+C

f) ABC'+A'B'C+A'BC+ABC+AB'C'+AB'C=A+C

4. Algebraically prove the identities:

a) (A+B+C)(A+B+C')(A+B'+C')(A'+B'+C')(A'+B+C')(A'+B+C)=BC'

```
LHS  =  (A+B+C)(A+B+C')(A+B'+C')(A'+B'+C')(A'+B+C')(A'+B+C)
        Pairing 1st & 2nd term, 3rd & 4th term and 5th & 6th term
     =  (A+B+CC')(AA'+B'+C')(A'+B+C'C)
        Applying Distributive Law (X+Y)(X+Z)=X+YZ
     =  (A+B)(B'+C')(A'+B)  Since A'A=0 and CC'=0
     =  (AA'+B)(B'+C')
     Pairing 1st & 3rd terms, applying Distributive Law (X+Y)(X+Z)=X+YZ
     =  B(B'+C')            Since AA'=0
     =  BB'+BC'
     =  BC'                 Since BB'=0
     =  RHS
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b) (A+B+C)(A+B+C')(A+B'+C')(A'+B'+C')(A'+B+C')(A+B'+C)=AC'

```
LHS  =  (A+B+C)(A+B+C')(A+B'+C')(A'+B+C')(A+B'+C)(A'+B'+C')
        Pairing 1st & 2nd term, 3rd & 6th term and 4th & 5th term
     =  (A+B+CC')(A+B'B+C')(A+B'+CC')
        Applying Distributive Law (X+Y)(X+Z)=X+YZ
     =  (A+B)(A+C')(A+B')   Since B'B=0 and CC'=0
     =  (A+BB')(A+C')
     Pairing 1st & 3rd terms, applying Distributive Law (X+Y)(X+Z)=X+YZ
     =  A(A+C')             Since BB'=0
     =  AA'+AC'
     =  AC'                 Since AA'=0
     =  RHS
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c) (A'+B'+C)(A+B+C')(A+B'+C')(A'+B'+C')(A'+B+C')(A+B'+C)=B'C'

d) (A+B+C)(A+B'+C)(A'+B'+C)(A'+B+C)(A+B+C')(A+B'+C')=AC

e) (A+B+C)(A+B'+C)(A'+B'+C)(A'+B+C)(A'+B'+C')(A+B'+C')=B'C

f) (A+B+C)(A+B'+C)(A'+B'+C)(A'+B+C)(A'+B'+C')(A'+B+C')=A'C