

**Tutorial (Boolean, DeMorgan's Theorem and K-Map)**

Apply DeMorgan's Theorem to each expression:

1.  $\overline{\overline{AB}(C + D)}$

2.  $\overline{AB(CD + EF)}$

3.  $\overline{(A + \overline{B} + C + \overline{D}) + ABC\overline{D}}$

4.  $\overline{\overline{(A + B + C + D)}(\overline{ABCD})}$

5.  $\overline{\overline{AB(CD + \overline{EF})}(\overline{AB + CD})}$

6.  $\overline{\overline{\overline{(ABC)}(\overline{EFG})} + \overline{\overline{HIJ}}(\overline{KLM})}$

7.  $\overline{(A + \overline{BC} + CD) + \overline{BC}}$

8.  $\overline{\overline{\overline{(A + B)}(\overline{C + D})}(\overline{E + F})}(\overline{G + H})$

Using Boolean algebra techniques, simplify the following expression:

1.  $BD + B(D + E) + \overline{D}(D + F)$

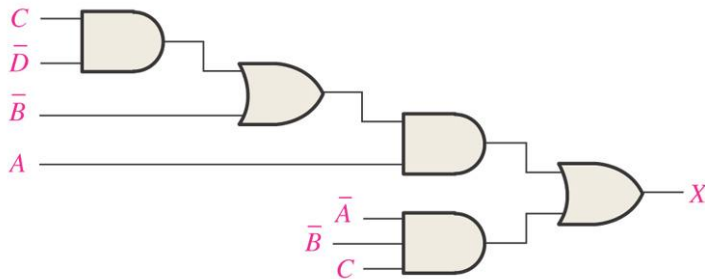
2.  $\overline{\overline{ABC}} + \overline{\overline{(A + B + C)}} + \overline{ABCD}$

3.  $(B + BC)(B + \overline{BC})(B + D)$

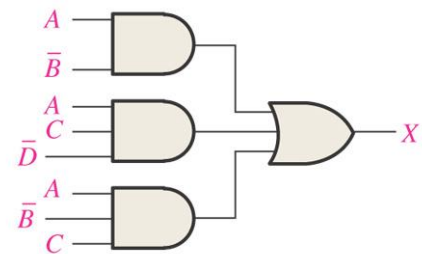
4.  $ABCD + AB(\overline{CD}) + (\overline{AB})CD$

5.  $ABC[AB + \overline{C}(BC + AC)]$

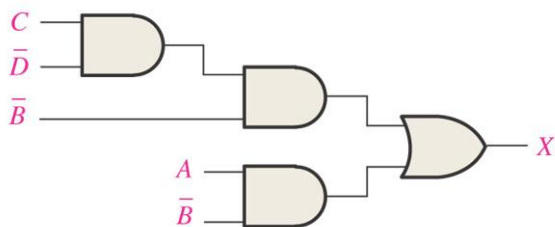
From the Figure (a-d) below, find their Boolean expression and simplify it:



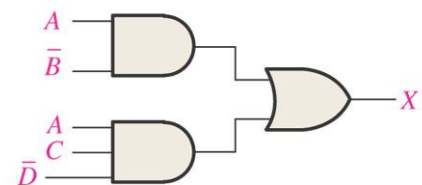
(a)



(b)



(c)



(d)

Use Karnaugh Map to find the minimum SOP form for each expression:

1.  $X = \overline{A} \overline{B} \overline{C} + \overline{A} \overline{B} C + A \overline{B} C$

2.  $X = AC(\overline{B} + C) = AC + A\overline{B}C$

3.  $X = \overline{A}(BC + \overline{B}C) + A(BC + \overline{B}C)$

4.  $X = \overline{A} \overline{B} \overline{C} + A \overline{B} \overline{C} + \overline{A} B \overline{C} + A B \overline{C}$

Use the Karnaugh Map method; find the minimum SOP expression in the truth table below:

<i>ABC</i>	<i>X</i>
000	0
001	1
010	0
011	0
100	1
101	1
110	0
111	1

<i>ABC</i>	<i>X</i>
000	0
001	0
010	0
011	0
100	0
101	1
110	1
111	1

<i>ABCD</i>	<i>X</i>
0000	1
0001	1
0010	0
0011	1
0100	0
0101	1
0110	1
0111	0
1000	0
1001	1
1010	0
1011	0
1100	1
1101	0
1110	0
1111	0

<i>ABCD</i>	<i>X</i>
0000	0
0001	0
0010	1
0011	0
0100	1
0101	1
0110	0
0111	1
1000	0
1001	0
1010	0
1011	1
1100	1
1101	0
1110	0
1111	1

Inputs			Output
<i>A</i>	<i>B</i>	<i>C</i>	<i>X</i>
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

Inputs				Output
<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>X</i>
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

Use K-Map to find the minimum SOP from

	$\bar{C}\bar{D}$	$\bar{C}D$	$CD$	$C\bar{D}$
$\bar{A}\bar{B}$	1	1	0	1
$\bar{A}B$	1	1	0	1
$AB$	1	1	0	1
$A\bar{B}$	1	1	1	1

	$\bar{C}\bar{D}$	$\bar{C}D$	$CD$	$C\bar{D}$
$\bar{A}\bar{B}$	1			1
$\bar{A}B$				
$AB$				
$A\bar{B}$	1			1

	$\bar{C}\bar{D}$	$\bar{C}D$	$CD$	$C\bar{D}$
$\bar{A}\bar{B}$	1			1
$\bar{A}B$				
$AB$	x			x
$A\bar{B}$	1			1

	$\bar{C}\bar{D}$	$\bar{C}D$	$CD$	$C\bar{D}$
$\bar{A}\bar{B}$	1			1
$\bar{A}B$	x			x
$AB$	x			x
$A\bar{B}$	1			1

	$\bar{C}\bar{D}$	$\bar{C}D$	$CD$	$C\bar{D}$
$\bar{A}\bar{B}$	x			1
$\bar{A}B$	x	x	x	x
$AB$	x	1	1	x
$A\bar{B}$	1			x

	$\bar{C}\bar{D}$	$\bar{C}D$	$CD$	$C\bar{D}$
$\bar{A}\bar{B}$	1		x	1
$\bar{A}B$	x	x	1	
$AB$		1	x	x
$A\bar{B}$	1	x		1

	$\bar{C}\bar{D}$	$\bar{C}D$	$CD$	$C\bar{D}$
$\bar{A}\bar{B}$		x	x	
$\bar{A}B$	x	1	1	x
$AB$	1			1
$A\bar{B}$		x	x	