第二章布置习题参考解

2-1

a) 用真值表验证 $\overline{XYZ}=\overline{X}+\overline{Y}+\overline{Z}$ 三变量 **DeMorgan** 定律

X	Y	Z	XYZ	$\overline{XYZ}$	$\overline{X}+\overline{Y}+\overline{Z}$
0	**0**	**0**	**0**	**1**	**1**
0	**0**	**1**	**0**	**1**	**1**
0	**1**	**0**	**0**	**1**	**1**
0	**1**	**1**	**0**	**1**	**1**
1	**0**	**0**	**0**	**1**	**1**
1	**0**	**1**	**0**	**1**	**1**
1	**1**	**0**	**0**	**1**	**1**
1	**1**	**1**	**1**	**0**	**0**

2-2 用代数化简来证明下列布尔函数的性质

a) $\overline{X}\overline{Y}+\overline{X}Y+XY=\overline{X}+Y$

$$\overline{X}\overline{Y}+\overline{X}Y+XY=(\overline{X}\overline{Y}+\overline{X}Y)+(\overline{X}Y+XY)$$
$$=\overline{X}(\overline{Y}+Y)+Y(\overline{X}+X)$$
$$=\overline{X}+Y$$

c) $Y+\overline{X}Z+X\overline{Y}=X+Y+Z$

$$Y+\overline{X}Z+X\overline{Y}=Y+X\overline{Y}+\overline{X}Z$$
$$=(Y+X)(Y+\overline{Y})+\overline{X}Z$$
$$=Y+X+\overline{X}Z$$
$$=Y+(X+\overline{X})(X+Z)$$
$$=X+Y+Z$$

2-3 用代数化简来证明下列布尔函数的性质

a) $AB\overline{C} + B\overline{C}\,\overline{D} + BC + \overline{C}D = B + \overline{C}D$

ABC’ + BC’D’ + BC + C’D

= (ABC’ + BC) + (BC’D’ + C’D)

= B(AC’ + C) + C’(BD’ + D)

= B(A + C) + C’(B + D)

= AB + BC + BC’ + C’D

= B + C’D

c) $A\overline{D} + \overline{A}B + \overline{C}D + \overline{B}C = (\overline{A} + \overline{B} + \overline{C} + \overline{D})(A + B + C + D)$

$$
\begin{aligned}
& A\overline{D} + \overline{A}B + \overline{C}D + \overline{B}C \\
&= \overline{\overline{A\overline{D} + \overline{A}B + \overline{C}D + \overline{B}C}} \\
&= \overline{(\overline{A} + D)(C + \overline{D})(A + \overline{B})\overline{B}C} \\
&= \overline{(\overline{A}C + \overline{A}\,\overline{D} + CD)(B + \overline{C})(A + \overline{B})} \\
&= \overline{(\overline{A}BC + \overline{A}B\overline{D} + BCD + \overline{A}\,\overline{C}\,\overline{D})(A + \overline{B})} \\
&= \overline{ABCD + \overline{A}B\overline{C}\,\overline{D}} \\
&= (\overline{A} + \overline{B} + \overline{C} + \overline{D})(A + B + C + D)
\end{aligned}
$$

2-6 化简下列布尔表达式，使表达式中包含的变量最少

b) $(\overline{A + B + C}) \bullet \overline{ABC}$

$$
\begin{aligned}
&= \overline{A}\,\overline{B}\,\overline{C} \bullet \overline{ABC} \\
&= \overline{A}\,\overline{B}\,\overline{C} \bullet (\overline{A} + \overline{B} + \overline{C}) \\
&= \overline{A}\,\overline{B}\,\overline{C}
\end{aligned}
$$

d) $\overline{A}\overline{B}D + \overline{A}\overline{C}D + BD = D(\overline{A}\overline{B} + B) + \overline{A}\overline{C}D$

$= \overline{A}D + DB + \overline{A}\overline{C}D = \overline{A}D(1 + \overline{C}) + DB$

$= \overline{A}D + DB = D(\overline{A} + B)$

2-10

a) $(XY + Z)(Y + XZ)$

XYZ	F
000	0
001	0
010	0
011	1
100	0
101	1
110	1
111	1

$F = (XY + Z)(Y + XZ)$

$= (X + Z)(Y + Z)(Y + X)(Y + Z)$

$= (X + Z) + Y\overline{Y})(Y + Z + X\overline{X})(Y + X + Z\overline{Z})$

$= (X + Y + Z)(X + Z + \overline{Y})(Y + Z + X)$

$(Y + Z + \overline{X})(Y + X + Z)(Y + X + \overline{Z})$

$= (X + Y + Z)(X + \overline{Y} + Z)(\overline{X} + Y + Z)(X + Y + \overline{Z})$

$= \overline{X}YZ + X\overline{Y}Z + XY\overline{Z} + XYZ$

c)

WXYZ	F
0000	0
0001	0
0010	1
0011	0
0100	0
0101	0
0110	1
0111	0
1000	0
1001	0
1010	1
1011	0
1100	1
1101	1
1110	1
1111	1

$\overline{W}\overline{X}Y\overline{Z} + \overline{W}XY\overline{Z} + W\overline{X}Y\overline{Z} + WX\overline{Y}\overline{Z} + WX\overline{Y}Z + WXY\overline{Z}$

$+ WXYZ$

$(W + X + Y + Z)(W + X + Y + \overline{Z})(W + X + \overline{Y} + \overline{Z})$

$(W + \overline{X} + Y + Z)(W + \overline{X} + Y + \overline{Z})(W + \overline{X} + \overline{Y} + \overline{Z})$

$(\overline{W} + X + Y + Z)(\overline{W} + X + Y + \overline{Z})(\overline{W} + X + \overline{Y} + \overline{Z})$

2-11

a) $E = \sum m(1,2,4,6) = \prod M(0,3,5,7)$ $F = \sum m(0,2,4,7) = \prod M(1,3,5,6)$

c) $E + F = \sum m(0,1,2,4,6,7)$ $\qquad E \bullet F = \sum m(2,4)$

e) $E = \overline{X}\overline{Y}Z + \overline{X}Y\overline{Z} + X\overline{Y}\overline{Z} + XY\overline{Z}$ $\qquad F = \overline{X}\overline{Y}\overline{Z} + \overline{X}Y\overline{Z} + X\overline{Y}\overline{Z} + XYZ$

$= \overline{X}\overline{Y}Z + X\overline{Z} + Y\overline{Z}$ $\qquad = \overline{Y}\overline{Z} + \overline{X}\overline{Z} + XYZ$

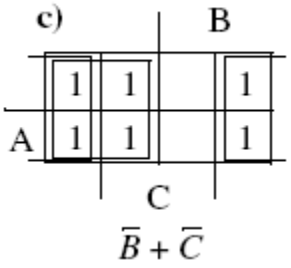
2-12

b) $\overline{X} + X(X + \overline{Y})(Y + \overline{Z}) = (\overline{X} + X)(\overline{X} + (X + \overline{Y})(Y + \overline{Z}))$

$= (\overline{X} + X + \overline{Y})(\overline{X} + Y + \overline{Z})$

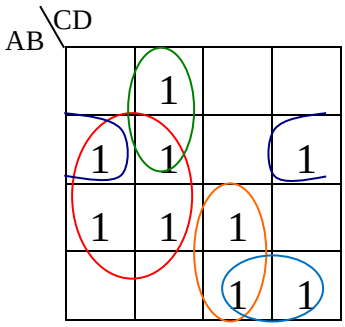
$= (1 + \overline{Y})(\overline{X} + Y + \overline{Z}) = \overline{X} + Y + \overline{Z}$ s.o.p. p.o.s.

2-15



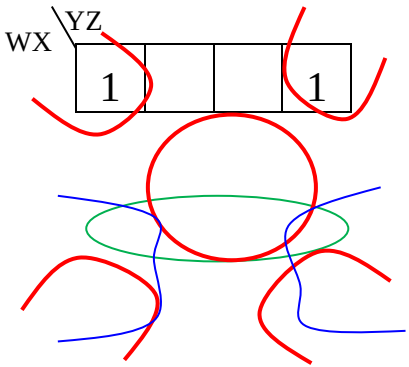
$\overline{B} + \overline{C}$

2-17



b) $F = B\overline{C} + \overline{A}\,\overline{C}D + \overline{A}B\overline{D} + ACD + A\overline{B}C$

2-19



	1	1	
1	1	1	1
1			1

a) Pr *ime* = WX, XZ, $\overline{X}\overline{Z}$, $W\overline{Z}$

Essential = XZ, $\overline{X}\overline{Z}$

2-22 (a)

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

$A\bar{C} + CD + \bar{B}D$ (s.o.p.)

$(\bar{C} + D)(A + D)(A + \bar{B} + C)$ (p.o.s.)

Or

$A\bar{C} + \bar{B}D + \bar{A}CD + ABCD$

$=A(\bar{C} + BCD) + \bar{B}D + \bar{A}CD$

$=A\bar{C} + ABD + \bar{B}D + \bar{A}CD$

$=A\bar{C} + AD + \bar{B}D + \bar{A}CD$

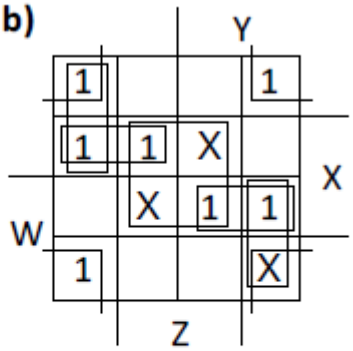
$=A\bar{C} + AD + \bar{B}D + CD$

$=A\bar{C} + AD + CD + \bar{B}D$

$=A\bar{C} + CD + \bar{B}D$ (s.o.p.)

2-25

b)



$Primes = \overline{XZ},\ XZ,\ \bar{W}X\bar{Y},\ WXY,\ \bar{W}\bar{Y}\bar{Z},\ WY\bar{Z}$

$Essential = \overline{XZ}$

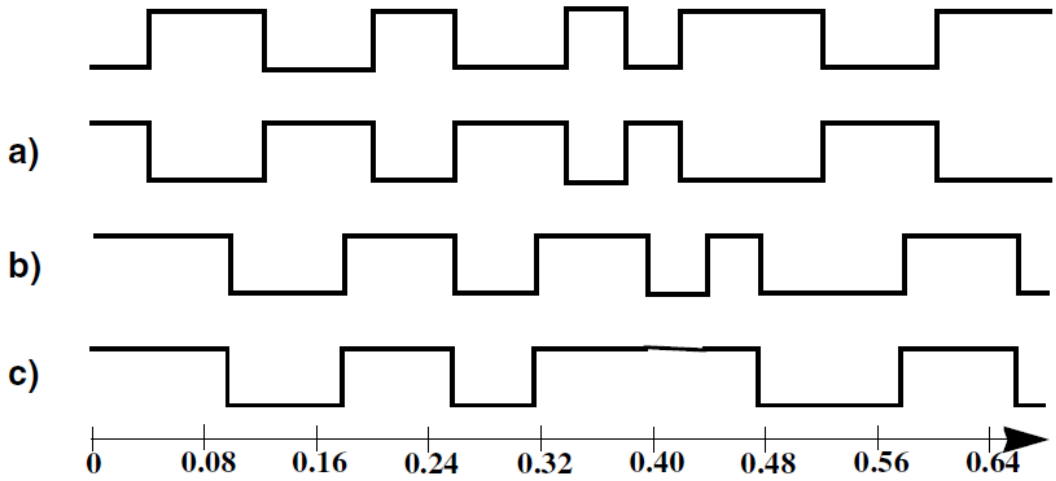
$F = \overline{XZ} + \bar{W}X\bar{Y} + WXY$

2-29

The longest path is from input C or $\overline{D}$.

0.073 ns + 0.073 ns + 0.048 ns + 0.073 ns = 0.267 ns

2-30



2-31

	a)	b)
Input	Delay t_{pd}	Delay t_{pd}
C	1.12ns	1.12ns
D	1.12ns	1.12ns

$\overline{B}$	0.84ns	0.84ns
A	0.56ns	0.56ns
B	0.56ns	0.56ns
$\overline{C}$	0.56ns	0.56ns

c) They are the same.