2-1. (a)

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

2-2. (a) $\bar{X}\bar{Y}+\bar{X}Y+XY = \bar{X}(\bar{Y}+Y)+XY = \bar{X}+XY = \bar{X}+Y.$

(c) $Y+\bar{X}Z+X\bar{Y} = (Y+X)(Y+\bar{Y})+\bar{X}Z = Y+X+\bar{X}Z$

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

2-3. (a) $AB\bar{C}+B\bar{C}D+BC+\bar{C}D$

$= AB+BC+B\bar{C}+\bar{C}D$

$= B+AB+\bar{C}D = B+\bar{C}D.$

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

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

2-6. (b) $\overline{(A\bar{B}+C)}\cdot\overline{AB\bar{C}} = A\bar{B}\bar{C}\cdot(\bar{A}+\bar{B}+\bar{C}) = \bar{A}A\bar{B}\bar{C}+\bar{A}\bar{B}B\bar{C}+\bar{A}\bar{B}\bar{C}\bar{C}$

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

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

2-10. (a)

X	0	0	0	0	1	1	1	1
Y	0	0	1	1	0	0	1	1
Z	0	1	0	1	0	1	0	1
a	0	0	0	1	0	1	1	1

SOM: $\bar{X}YZ+X\bar{Y}Z+XY\bar{Z}+XYZ$.

POM: $(X+Y+\bar{Z})(X+\bar{Y}+Z)(\bar{X}+Y+Z)$

(b)

X	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Y	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
Z	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
W	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
C	0	0	1	0	0	0	1	0	0	0	1	0	1	1	1	1

SOM: $\bar{W}\bar{X}YZ+\bar{W}X\bar{Y}Z+W\bar{X}\bar{Y}Z+$
$WX\bar{Y}\bar{Z}+WX\bar{Y}Z+WXY\bar{Z}+WXYZ$

POM: $(W+X+Y+Z)(W+\bar{X}+Y+\bar{Z})(W+\bar{X}+\bar{Y}+Z)$
$(W+\bar{X}+\bar{Y}+\bar{Z})(\bar{W}+X+Y+Z)(\bar{W}+X+\bar{Y}+\bar{Z})(\bar{W}+\bar{X}+Y+\bar{Z})(\bar{W}+\bar{X}+\bar{Y}+\bar{Z})$

2-11 (a). $E = \Sigma_m(1,2,4,6) = \Pi_M(0,3,5,7)$

$F = \Sigma_m(0,2,4,7) = \Pi_M(1,3,5,6)$

(c) $E+F = \Sigma_m(0,1,2,4,6,7)$

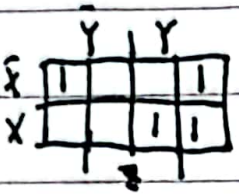
$E\cdot F = \Sigma_m(2,4)$

(d) $E = \bar{X}\bar{Y}Z+\bar{X}Y\bar{Z}+X\bar{Y}\bar{Z}+XYZ$

$F = \bar{X}\bar{Y}\bar{Z}+X\bar{Y}\bar{Z}+\bar{X}Y\bar{Z}+XYZ$.

2-12. (b) ~~$X(Y\bar{Z}+\bar{Y}Z)$~~ $\bar{X}+X(X+\bar{Y})(Y+\bar{Z}) = \bar{X}+(X+X\bar{Y})(Y+\bar{Z})$

$= \bar{X}+XY+X\bar{Z}+XY\bar{Z} = \bar{X}+Y+\bar{Z}$ (SOP) $= (\bar{X}+X)(\bar{X}+Y+\bar{Z})$ (POS)

2-15. (a) 

$\bar{X}\bar{Z} + XY$

(b) 
$\bar{A} + \bar{B}C$

(c) 
$\bar{B} + \bar{C}$

2-17. (a) 
$F = \bar{Y}\bar{Z} + \bar{Y}Z + \bar{W}\bar{X}\bar{Y} + \bar{W}XYZ$

(b) 

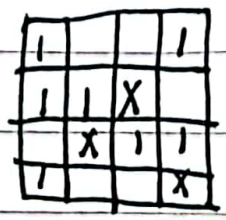
$F = B\bar{C} + \bar{A}\bar{C}D + \bar{A}B\bar{D} + A\bar{B}C + ACD$

2-19. (a) prime: XZ, WX, $W\bar{Z}$, $\bar{X}\bar{Z}$.

essential: XZ, $\bar{X}\bar{Z}$.

2-22. (a) $A\bar{C} + \bar{B}D + \bar{A}CD + ABCD = A\bar{C} + \bar{B}D + CD$ (SOP)

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

2-25. (b) 

prime: XZ、$\bar{X}\bar{Z}$、$\bar{W}X\bar{Y}$、WXY、$WY\bar{Z}$、$\bar{W}\bar{Y}\bar{Z}$

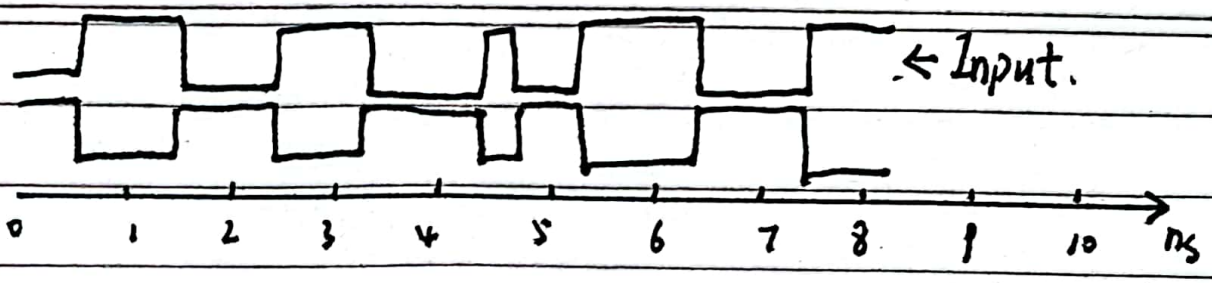
essential: XZ

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

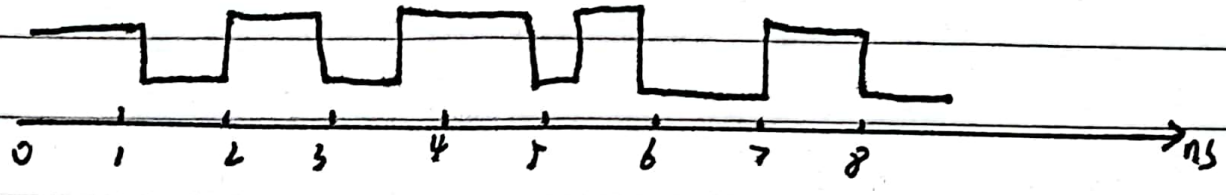
2-29. start $C\bar{D}$: $0.073 \times 3 + 0.048 = 0.267$ ns.

2-30. (a)

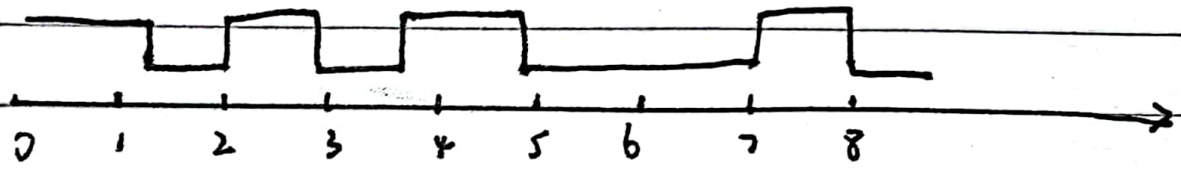
(a)



(b)



(c)



2-31 (a) $t_{PHL(CD)} = 2t_{PLH} + 2t_{PHL} = 1.12ns$

$t_{PLH(CD)} = 2t_{PLH} + 2t_{PHL} = 1.12ns$

$t_{pd(CD)} = 1.12ns$

$t_{PHL(\bar{B})} = 2t_{PHL} + t_{PLH} = 0.76ns$

$t_{PLH(\bar{B})} = 2t_{PLH} + t_{PHL} = 0.92ns$

$t_{pd(\bar{B})} = 0.84ns$

$t_{PHL(AB\bar{C})} = t_{PLH} + t_{PHL} = 0.56ns$

$t_{PLH(A,B,\bar{C})} = t_{PHL} + t_{PLH} = 0.56ns$

$t_{pd(A,B,\bar{C})} = 0.56ns$

(b). $t_{pd(CD)} = 4t_{pd} = 1.12ns$

$t_{pd(\bar{B})} = 3t_{pd} = 0.78ns$

$t_{pd(A,B,\bar{C})} = 2t_{pd} = 0.56ns.$

(c) If the gates of not are odd number, t_{PHL}, t_{PLH}, t_{pd} are different. If it's even, they are same.