Q1 Q1

a) 112 → 0
56 → 0
28 → 0
14 → 0
7 → 1
3 → 1
1 → 1
0

112_{10} = 1110000 Binary

= 0111 0000 = 70 Hexadecimal
(7 0)

b) $12_{10} - 18_{10}$ = A = 01100 B = 010010

−B = 101101 + 1

= 101110 2's Complet of B

A − B = 01100 + 101110 = 110110

A −ve number = $000110_2 = -6$

Q2 Q2

a) $F(a,b,c,d) = (\bar{a}b + ac + bc) + ab(\bar{a}\bar{c}\bar{d} + c\bar{b}\bar{d})$

$= [\bar{a}b + ac + bc(a+\bar{a})] + (0 + 0)$

$= \bar{a}b + ac + abc + \bar{a}bc = \bar{a}b + ac$

b) $F(a,b,c,d) = (\overline{ab} \oplus c\bar{d}) + a$ from diagram

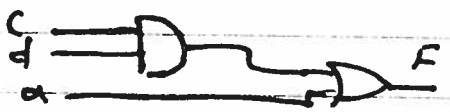
$= (\overline{\overline{ab} \cdot c\bar{d}} + \overline{ab} \cdot \overline{c\bar{d}}) + a$

$= [ab(\bar{c}+\bar{d}) + (\bar{a}+\bar{b})cd] + a$

$= ab\bar{c} + ab\bar{d} + \bar{a}cd + \bar{b}cd + a$

$= \bar{a}cd + \bar{b}cd + a$

$= cd + \bar{b}cd + a = cd + a$



After minimization

Before minimization Delay = $Delay_{NAND} + Delay_{NOR} + Delay_{OR}$

$= 15 + 20 + 15 = 50\,ns$

After minimization Delay = $Delay_{NAND} + Delay_{OR}$

$= 10 + 15 = 25\,ns$

Q3 Q3

d)

0: 1	4: X	12: X	8: 1
1	5: 1	13: X	9
3: 1	7	15: 1	11: X
2: X	6: X	14: X	10: X

$PI1 = \Sigma m(0,2,4,6,8,10,12,14) = \bar{d}$ Essential

$PI2 = \Sigma m(2,3,10,11) = \bar{b}c$ Essential

$PI3 = \Sigma m(4,5,12,13) = b\bar{c}$ Essential

$PI4 = \Sigma m(12,13,14,15) = ab$

$PI5 = \Sigma m(10,11,14,15) = ac$

$F(a,b,c,d) = PI1 + PI2 + PI3 + \begin{cases} PI4 \\ PI5 \end{cases}$ either can be selected

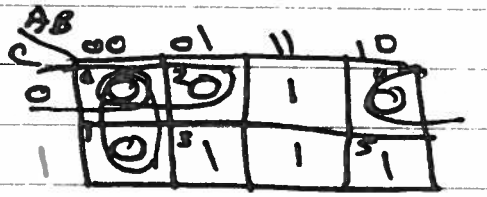
$= \bar{d} + \bar{b}c + b\bar{c} + \begin{cases} ab \\ ac \end{cases}$

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

$= (A+C)(A+D)B$

c) $F(A,B,C) = BC + A(B+C)$

$= BC + AB + AC$

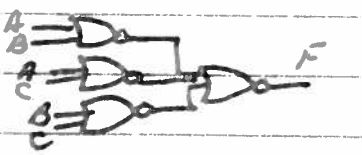


$PI1 = \Pi M(0,1) = (A+B)$

$PI2 = \Pi M(0,2) = (A+C)$

$PI3 = \Pi M(0,4) = (B+C)$

$F = (A+B)(A+C)(B+C)$



Q4 Q4