Q1

a)

129/2	64	1
64/2	32	0
32/2	16	0
16/2	8	0
8/2	4	0
4/2	2	0
2/2	1	0
1/2	0	1

Answer $129_{10} = 10000001_2$

$8 \quad 1 = 81_{16}$

b)

$$\begin{array}{r} 1001 \quad 0111 \\ 1001 \quad 1000 \\ \hline 10010 \quad 1111 \\ 0110 \quad 0110 \\ \hline 0001 \quad 1001 \quad 0101 \end{array}$$

← Not BCD number, add 0110 to both numbers

Answer 0001 1001 0101

Q2

a) $[\overline{xy}\cdot(x+\bar{y}) + xy\cdot\overline{(x+\bar{y})}]\cdot[w(w+y)+\bar{w}\cdot\overline{(w+y)}]$

$[(\overline{x}+\overline{y})\cdot(x+\bar{y}) + xy\,\overline{(x+\bar{y})}]\cdot[w+\bar{w}\,\overline{(w+y)}]$

$[(\bar{x}+\bar{y})(x+\bar{y}) + xy\,(\bar{x}\cdot y)]\cdot[w+\bar{w}\cdot\bar{y}]$

$[\bar{x}x+\bar{x}\bar{y}+x\bar{y}+\bar{y}+x\bar{x}y]\cdot[w+\bar{y}]$

$[0+\bar{y}]\cdot[w+\bar{y}] = \bar{y}$

b) There are 3, paths to the output. The longest path is 8ns → XNOR, 4ns → NAND, 10ns → OR

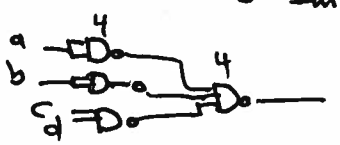
Delay is equal to $d = 8+4+10 = 22$ ns $\quad f = \frac{109}{22} = 45.45$ MHz

c) $(\overline{a \oplus b})\cdot\overline{cd} + a = \overline{a \oplus b + \overline{cd}} + a = a\bar{b} + \bar{a}b + a + cd$

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

$= a + b + cd$

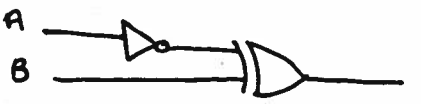
Maximum frequency is obtained by a NAND-NAND Implementation

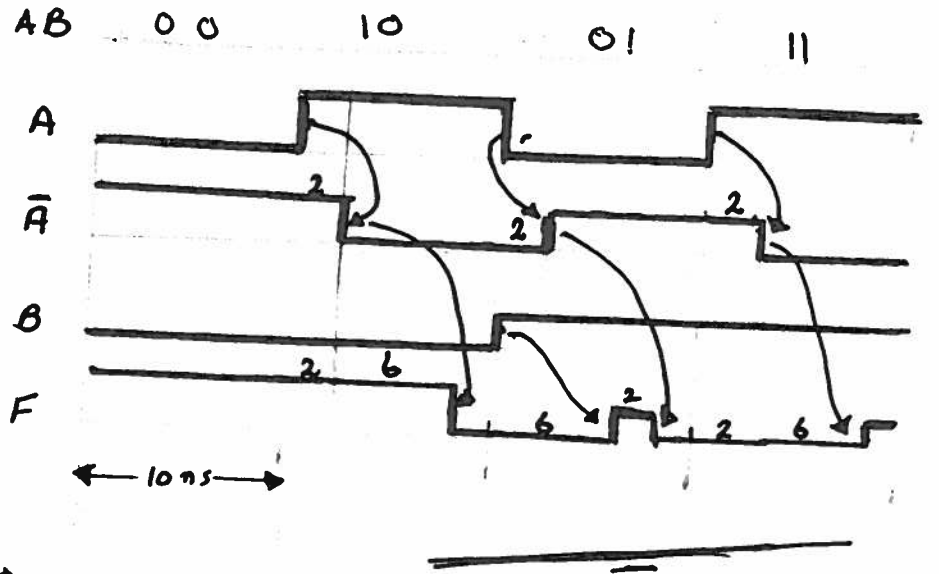


total delay $= 4 + 4 = 8$ ns

Maximum frequency $= \frac{109}{8} = 125$ MHz

Q3





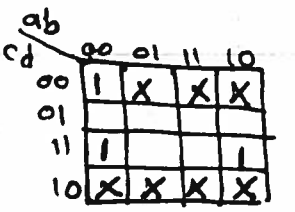
Q4

4.a) $EPI_1 = \sum m(0,2,4,6,8,10,12,14) = \bar{d}$

$EPI_2 = \sum m(2,3,10,11) = \bar{b}c$

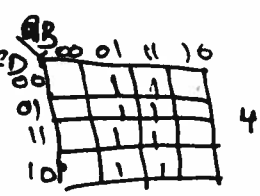
$EPI_3 = \sum m(4,5,12,13) = b\bar{c}$

Minimum $F = EPI_1 + EPI_2 + EPI_3 = \bar{d} + \bar{b}c + b\bar{c}$



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

4.c) $F(A,B,C,D) = B = \sum m(4,5,6,7,12,13,14,15)$



4.d) From Kmap 4.d

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

$= \overline{\overline{A \cdot (C+D)(B+D)}}$ Double Negate

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