1. The *ten-bit* Gray code for 353_{10} is **0111010001**. Explain briefly but precisely why it cannot be true that **0111010100** is the ten-bit Gray code for 354_{10} **also** calculate gray code for (354)10. **(2+1)**

Reason:

- **0111010001 represents 353 in decimal.**
- **0111010100 is not a valid Gray code for 354 in decimal because it does not satisfy the property of Gray codes, where adjacent numbers differ by only one bit.**

Gray code for 353_{10} = 0111010011

2. Using 10's complement. subtract 72532 - 3250. **3**

Solution:

M =		72532
10's complement of N =	+	96750
Sum =		169282
Discard end carry 10^5 =	−	100000
Answer =		69282

3. Given the two binary numbers **X = 1010100** and **Y = 1000011** perform the subtraction X - Y and Y - X by using 2's complements **(2+2)**

Solution:

(a)

$$\begin{array}{rr} X = & 1010100 \\ \text{2's complement of } Y = & +\ \underline{0111101} \\ \text{Sum} = & 10010001 \\ \text{Discard end carry } 2^7 = & -\underline{10000000} \\ \textit{Answer: } X - Y = & 0010001 \end{array}$$

(b)

$$\begin{array}{rr} Y = & 1000011 \\ \text{2's complement of } X = & +\ \underline{0101100} \\ \text{Sum} = & 1101111 \end{array}$$

There is no end carry. Therefore, the answer is $Y - X = -(\text{2's complement of } 1101111) = -0010001$.

4. Simplify the following Boolean Functions to minimum possible number of literals. **(5+5=10)**

a) AC'D' + A'C + ABC + AB'C + A'C'D'

F = AC'D' + A'C + ABC + AB'C + A'C'D'
F = (A + A')C'D' + A'C + AC(B + B')
F = C'D' + A'C + AC
F = C'D' + C(A' + A)
F = C'D' + C = (C + C')(C + D')
F = C + D'

b) $(A' + B)'\ (A' + C')'\ (AB'C)'$

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

$(\bar{\bar{A}} \cdot \bar{B}) \cdot \overline{\bar{A}+\bar{C}} \cdot \overline{A\bar{B}C}$ ∴ demorgan $\overline{\bar{A}+B} = \bar{\bar{A}} \cdot \bar{B}$

$A\bar{B} \cdot \overline{\bar{A}+\bar{C}} \cdot \overline{A\bar{B}C}$ ∴ double negation $\bar{\bar{A}} = A$

$A\bar{B} \cdot (\bar{A}\,\cancel{+}\cdot\bar{C}) \cdot \overline{A\bar{B}C}$ ∴ demorgan $X = \bar{A}$, $Y = \bar{C}$

$\overline{\bar{A}+\bar{C}} = \bar{\bar{A}} \cdot \bar{\bar{C}}$

$A\bar{B} \cdot AC \cdot \overline{A\bar{B}C}$ ∴ double negation $\bar{\bar{A}} = A$, $\bar{\bar{C}} = C$

∴ commulative law

$AA \cdot \bar{B}C \cdot \overline{A\bar{B}C}$

$A\bar{B}C \cdot \overline{A\bar{B}C}$ ∴ $A \cdot A = A$ idempotent law

$A\bar{B}C \cdot \bar{A}+\bar{\bar{B}}+\bar{C}$ ∴ demorgan $\overline{A\bar{B}C} = \bar{A}+\bar{\bar{B}}+\bar{C}$

∴ double negation

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

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

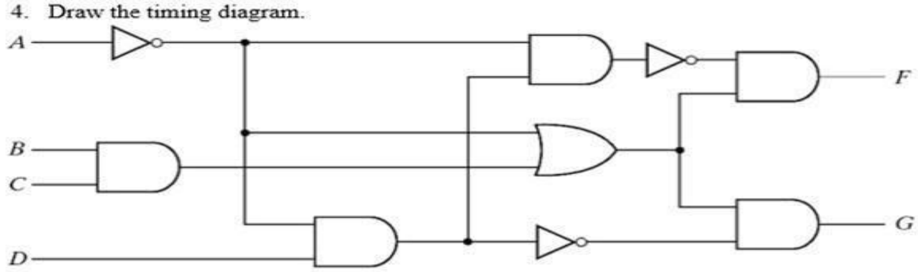
$= [(0)\bar{B}C] + [AC(0)] + (A\bar{B}0)$

$= 0+0+0$

$= 0$

5. For the digital circuit shown below.

1. Identify the Number of input(s) and output(s).
2. Write the Expression(s) of output(s) in terms of input(s).
3. Calculate the truth table.
4. Draw the timing diagram.



(2+2+3+3 = 10)

Number of inputs = 4
Number of outputs = 2

F = (BC + A')(A'DA')' = (BC + A')(A'D)'
G = (BC + A')(A'D)'

A	B	C	D	A'	BC	BC+A'	A'D	(A'D)'	F	G
0	0	0	0	1	0	1	0	1	1	1
0	0	0	1	1	0	1	1	0	0	0
0	0	1	0	1	0	1	0	1	1	1
0	0	1	1	1	0	1	1	0	0	0
0	1	0	0	1	0	1	0	1	1	1
0	1	0	1	1	0	1	1	0	0	0
0	1	1	0	1	1	1	0	1	1	1
0	1	1	1	1	1	1	1	0	0	0
1	0	0	0	0	0	0	0	1	0	0
1	0	0	1	0	0	0	0	1	0	0
1	0	1	0	0	0	0	0	1	0	0
1	0	1	1	0	0	0	0	1	0	0
1	1	0	0	0	0	0	0	1	0	0
1	1	0	1	0	0	0	0	1	0	0
1	1	1	0	0	1	1	0	1	1	1
1	1	1	1	0	1	1	0	1	1	1

6. **Use 2's complement to find A + B in the following cases and verify that your answer is correct. All the numbers given are signed numbers.** **(5+5 = 10)**

   a) A = $(-57)_{10}$ and B = $(35)_8$

Updated Solution:

35 is in octal which is (29) in decimal. Hence this solution is correct as -57 + 29 = -28 which is what we obtained in the below solution.

Converting the numbers to binary, we get
$|A| = 57 = (0111001)_2$
$B = (35)_8 = (011101)_2 = (3 \times 8) + (5 \times 1) = (29)_{10}$
After computing the 2's complement of |A| we get:
$A = -57 = (1000111)_2$

Addition

Carry			1	1	1	1	1	
A	=	1	0	0	0	1	1	1
B	=	0	0	1	1	1	0	1
A + B	=	1	1	0	0	1	0	0

$A + B = (1100100)_2$

Verification
As the MSB of the answer is 1, so it is a negative number
Computing 2's complement we get
$A + B = (0011100)_2$
Dec = 16 + 8 + 4 = 28
A + B = -28
And (-57) + (29) = -28
Hence our answer is correct

OR

Those students who have taken out $-(011100)_2$ as their answer is also correct provided they have shown proper working before that.

b) A = $(41)_{10}$ and B = $(33)_{16}$
Updated Solution:

$(41)_{10}$ **=** $(101001)_2$
$(33)_{16} = (110011)_2$

A + B =

$$
\begin{array}{rr}
 & 0101001 \\
+ & 0110011 \\
\hline
 & 1011100
\end{array}
\quad = 92 \text{ in decimal}
$$

Verification:
$(33)_{16} = (51)\ in\ decimal$

(51) + (41) = **(92)** all base 10 (in decimal)