Q - Draw the logic Diagram for the following. Also make the truthtable [Simplify the expression if needed]

(a) $Q = (X+Y).Z + (ZX + ZY)$

(b) $Q = \overline{XYZ} + \overline{(\overline{XY} + \overline{XZ} + \overline{YZ})}$ (hint: use Demorgan's law to simplify)

(c) $Q = (X \oplus Y)(X \oplus Z) + Y \oplus Z$

$\Leftarrow$ I have solved this as an example, but first try yourself.

(d) $Q = \begin{cases} (X+Y).(\bar{X}Z) + \bar{Y}Z & ;\ \text{when } X=0 \\ (\bar{X}+Y)(XZ) + Y\bar{Z} & ;\ \text{when } X=1 \end{cases}$

(e) $Q = (X+Y)\bar{Z} + \bar{X}.\bar{Y}.\bar{Z} + XYZ$

(f) $Q = \begin{cases} X\bar{Y}Z + (X+Y)(X+Z) & ;\ Y=1 \\ XYZ + XY + \bar{Z}X & ;\ Y=0 \end{cases}$

solve for (d)

$$Q = \begin{cases} (X+Y).\bar{X}Z + \bar{Y}Z & \text{, when } X=0 \\ (\bar{X}+Y)(XZ) + Y\bar{Z} & \text{, when } X=1 \end{cases}$$

Solution

First solving when $X=0$:

$\Rightarrow X=0$; so expression $(X+Y).\bar{X}Z + \bar{Y}Z$ can be simplified as;

$\Rightarrow (X+Y)\bar{X}Z + \bar{Y}Z \Rightarrow Y.Z + \bar{Y}Z$ $\left(\because X=0 \;\&\; \bar{X}=1\right)$

$\Rightarrow YZ + \bar{Y}Z$

$\Rightarrow Z(Y+\bar{Y})$; we know that $Y+Y=1$

$$\boxed{Q = Z}$$

Now Solving, when $X=1$:

$\Rightarrow (\bar{X}+Y)(XZ) + Y\bar{Z})$

$\Rightarrow YZ + Y\bar{Z}$ $(\because X=1, \;\&\; \bar{X}=0)$

$\Rightarrow Y(Z+\bar{Z})$ $(\because Z+\bar{Z}=1$, so we have$)$

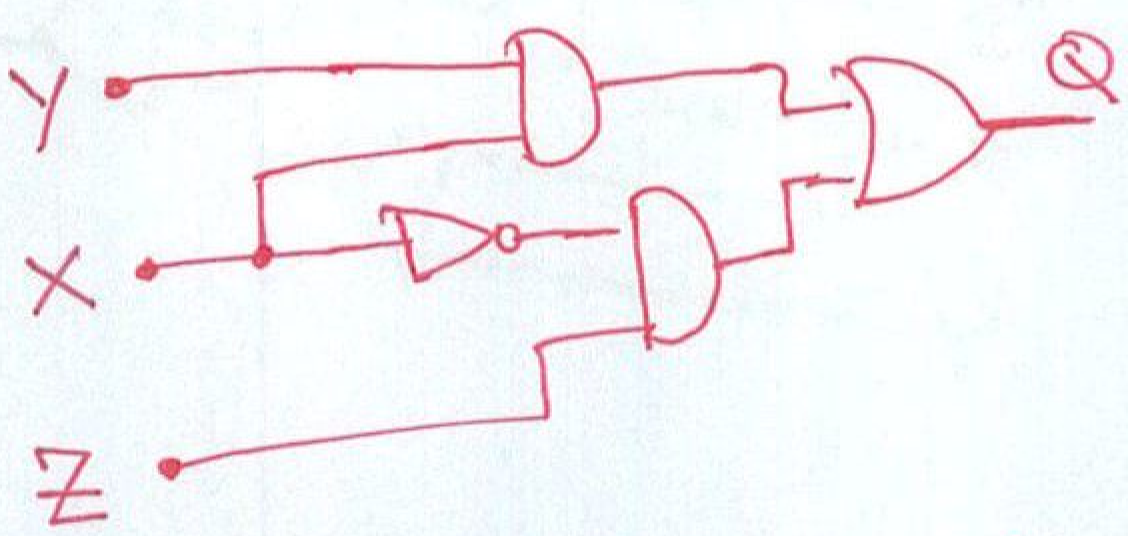
$$\boxed{Q = Y}$$

$\Rightarrow$ Hence final ~~logical~~ expression is,

$$Q = \begin{cases} Z & \text{when } X=0 \\ Y & \text{when } X=1 \end{cases}$$

$\Rightarrow$ logically, we can write it as-

$$\boxed{Q = \bar{X}Z + XY}$$



(Logic Diagram)

Solve ⓔ for the following Q

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

<u>Solution</u>

$$Q = \bar{Z}\left[(X+Y) + \bar{X}.\bar{Y}\right] + XYZ \quad \text{— eq ①}$$

⇒ (from Demorgan's law we know that:

$$\overline{a+b} = \bar{a}.\bar{b}\ )$$

(we also know that $a = \bar{\bar{a}}$; i.e. if we twice inverse a variable it is equal to itself.)

Using the above two properties, we will solve eq ①

lets take $\underline{(X+Y) + \bar{X}.\bar{Y}}$ from eq. ①

$$= \overline{\overline{(X+Y)}} + \bar{X}.\bar{Y} \qquad (\because \bar{\bar{a}} = a)$$

$$= \overline{\bar{X}.\bar{Y}} + \bar{X}.\bar{Y} \qquad (\because \overline{a+b} = \bar{a}.\bar{b})$$

Now, let consider $A = \bar{X}.\bar{Y}$, so we can write above expression as

$$= \bar{A} + A = 1 \quad (\text{because of the property } \bar{a} + a = 1)$$

Hence we can put this value to eq ① now

$$Q = \bar{Z}[\underbrace{(X+Y)+\bar{X}.\bar{Y}}_{1}] + XYZ$$

$$\boxed{Q = \bar{Z} + XYZ}$$