Answer to the question no-01

(a)

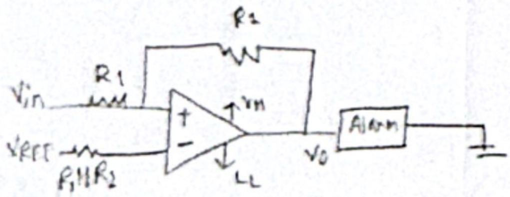
For 100% opacity, we get 10 V

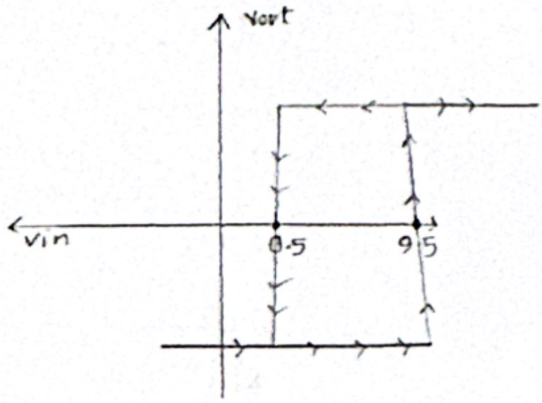
$\therefore$ 5% " " " " $\frac{10}{100} \times 5 = 0.5\,V$

Again,

For 95% opacity, we get $95 \times \frac{10}{100} = 9.5\,V$

This is a non-inverting schmitt trigger circuit





(b)

Our hysteresis width
$= V_{UT} - V_{LT}$
$= 9V$

Now,

$$V_{UT} - V_{LT} = 9V$$

$$\Rightarrow -\frac{R_1}{R_2} \cancel{V_L}^{0} + \cancel{\frac{R_1+R_2}{R_2} V_{REF}} + \frac{R_1}{R_2} \cdot V_H - \cancel{\frac{R_1+R_2}{R_2} \cdot V_{REF}} = 9V$$

$$\Rightarrow \frac{R_1}{R_2} = \frac{9}{10}$$

$\therefore$ $R_1 = 9\,k\Omega$ and $R_2 = 10\,k\Omega$

putting R_1 and R_2 to get V_{REF},

$$V_{UT} = -\frac{R_1}{\cancel{R_2}} \cancel{V_L}^{\,0} + \frac{R_1 + R_2}{R_2} \times V_{REF}$$

$$\Rightarrow 9.5 = \left(1 + \frac{9}{10}\right) \times V_{REF}$$

$$\therefore V_{REF} = 5V$$

(c)

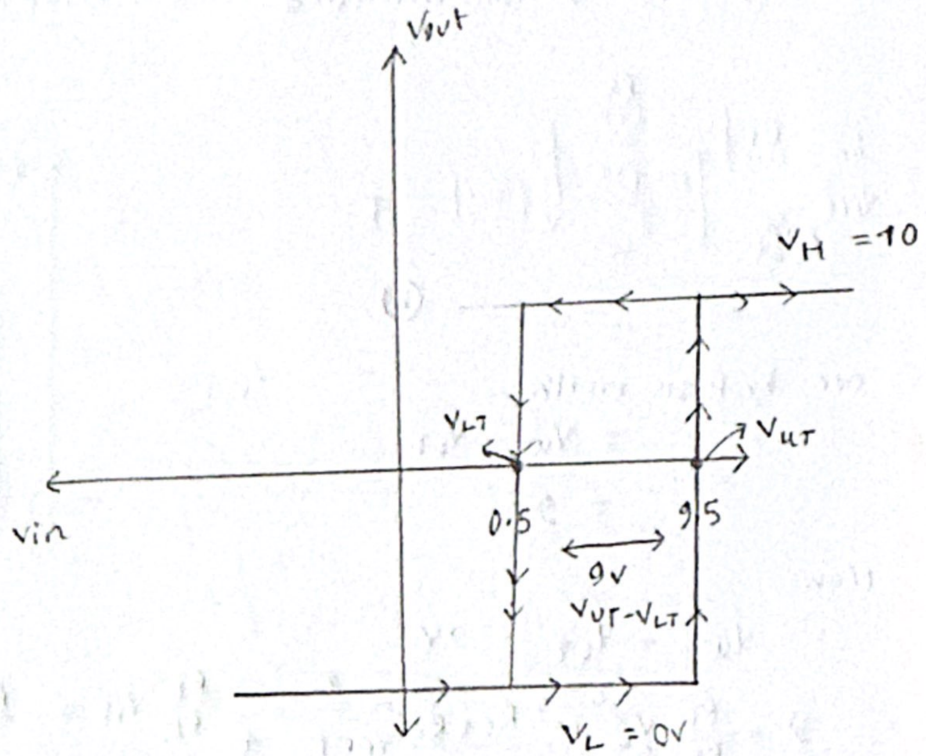
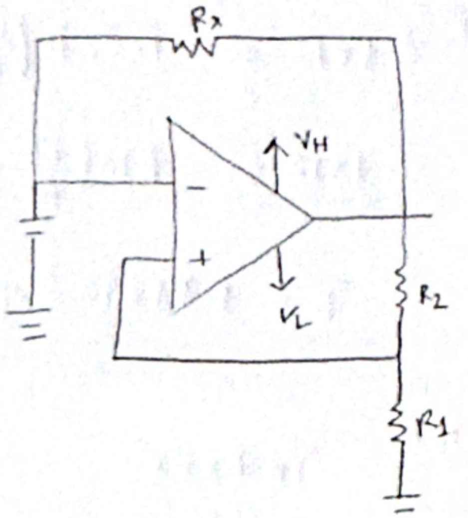


Fig: VTC curve of above circuit.

Answer to the question no-02

(a)



(b)

Given,

Duty cycle = 0.5 = 50%

$V_H = 12V$

$V_L = 0V$

Let $f = 500 Hz$

$f^{-1} = T = 2 \times 10^{-3} sec = 2ms$

Now, $D = \frac{T_1}{T} \Rightarrow 0.5 = \frac{T_1}{2}$

$T_1 = 1ms$

$T_2 = 1ms$

Let, $R_1 = R_2$

Now, $V_{UT} = \left(\frac{R_1}{R_1+R_2}\right) \times V_H = 6V$

$V_{LT} = \left(\frac{R_1}{R_1+R_2}\right) \times V_L = 0V$

Now,

$$T_1 = R_x C_x \ln\left(\frac{V_H - V_{LT}}{V_H - V_{UT}}\right)$$

$$\Rightarrow 1\times10^{-3}s = R_x C_x \ln\left(\frac{12-0}{12-6}\right)$$

$$\Rightarrow 1\times10^{-3}s = \tau \ln\left(\frac{12}{6}\right) \qquad [R_x C_x = \tau] \text{ assuming}$$

$$\tau = 1.44\times10^{-3} \text{ approx}$$

Now,

$$\tau = R_x C_x$$

choosing $R_x = 1.44\ k\Omega$

$C_x = 1\mu F$

ⓒ

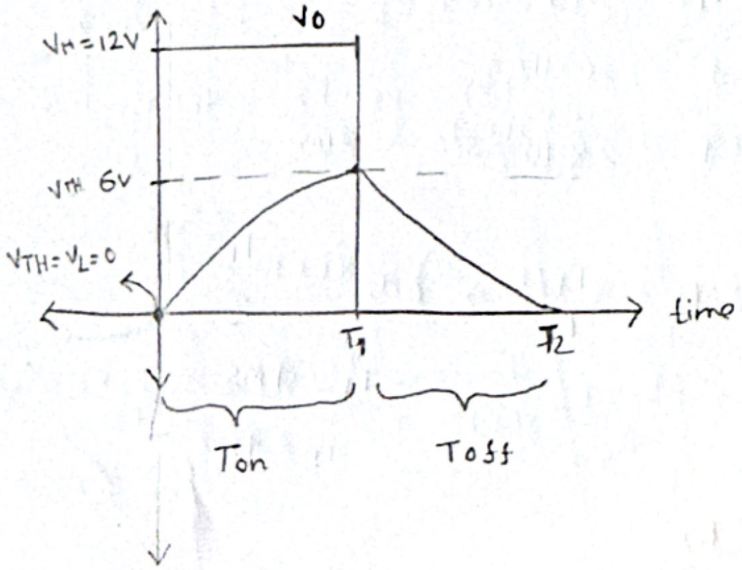


Fig: voltage curve (time vs Vin/Vo plot)