Solve

BRAC UNIVERSITY
CSE 350
Quiz-4, Section 8
Fall 2024
Marks: 20

Name: **ID:**

1. Design an inverting Schmitt trigger circuit having a center voltage of 4V and Hysteresis width of 1 V. Assume VH = +10V and VL = -10V. Draw the circuit and transfer curve with proper labeling. **[10]**

Here, $V_H = +10V$, $V_L = -10V$,

$V_S = 4V$, $V_{HW} = 1V$

$V_{TH} = V_S + \frac{V_{HW}}{2} = 4 + \frac{1}{2} = 4.5\,V$

$V_{TL} = V_S - \frac{V_{HW}}{2} = 4 - \frac{1}{2} = 3.5\,V$

We know,

$$V_S = V_{REF}\frac{R_2}{R_1+R_2} \rightarrow (1), \quad V_{HW} = 2V_H\frac{R_1}{R_1+R_2} \rightarrow (11)$$

From (11),

$$1 = 2\times 10\times\frac{R_1}{R_1+R_2}$$

$$\Rightarrow \frac{R_1}{R_1+R_2} = \frac{1}{20}$$

$$\Rightarrow \frac{R_1}{R_2} = \frac{1}{19}$$

If, $R_2 = 38k\Omega$,

$$\frac{R_1}{38k} = \frac{1}{19} \Rightarrow R_1 = 2k\Omega$$

From (1),

$$4 = V_{REF}\times\frac{38}{38+1}$$

$$\therefore V_{REF} = 4.1V$$

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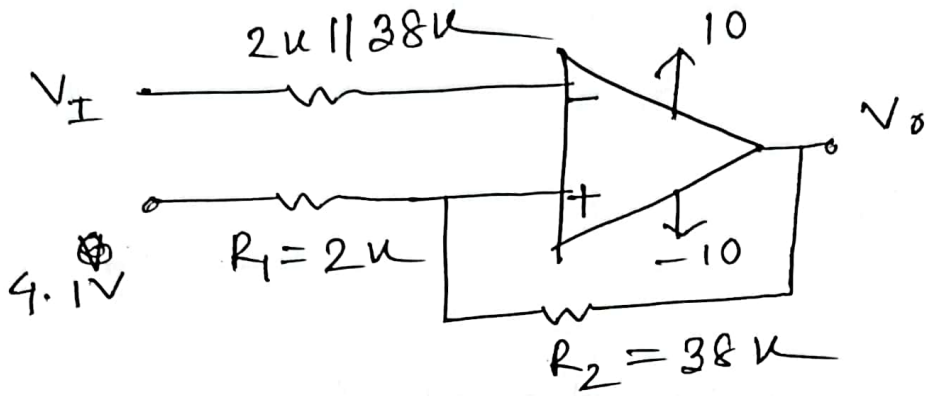
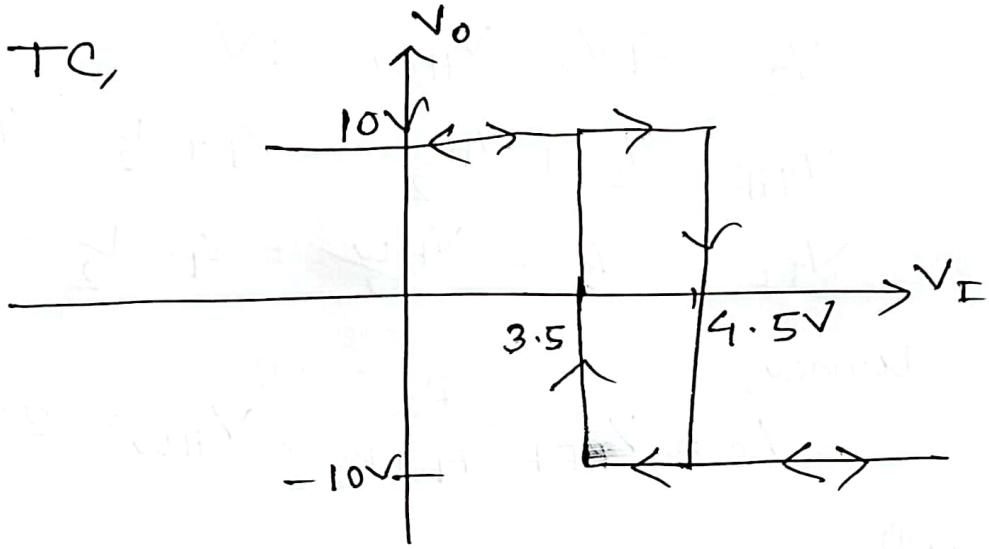


VTC,



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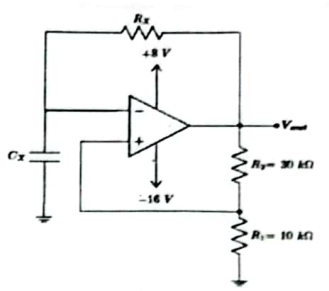
2.a) For the given circuit, determine the duty cycle. [4]

b) Plot the voltage of capacitor (Vx) and output voltage with respect to time on the same graph with proper labeling. [6]

(*Given:* $R_x = 1\,k\Omega$ *and* $C_x = 10\,\mu F$)



2.a) $R_1 = 10k$, $R_2 = 30k$,

$V_H = 8V$, $V_L = -16V$,

$$V_{TH} = 8 \times \frac{10}{10+30} = 2V,$$

$$V_{TL} = -16 \times \frac{10}{10+30} = -4V$$

$$T_1 = R_x C_x \ln \frac{V_H - V_{TL}}{V_H - V_{TH}}$$

$$= R_x C_x \ln \frac{8+4}{8-2} = R_x C_x \ln 2$$

$$T_2 = R_x C_x \ln \frac{V_L - V_{TH}}{V_L - V_{TL}}$$

$$= R_x C_x \ln \frac{-16-2}{-16+4} = R_x C_x \ln 1.5$$

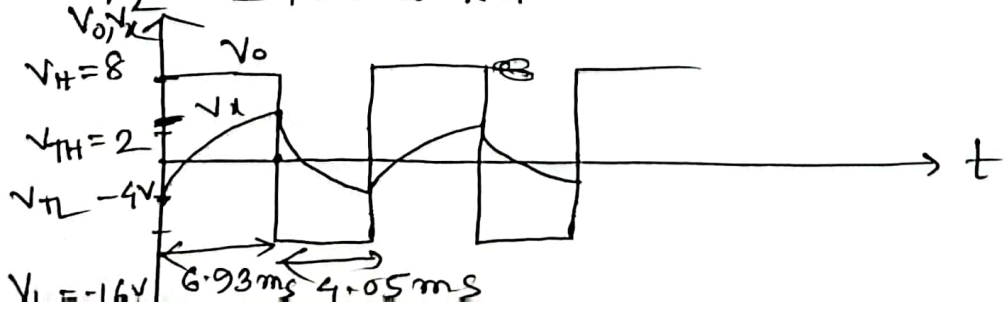
$$DC = \frac{T_1}{T_1+T_2} \times 100\% = \frac{R_x C_x \ln 2}{R_x C_x \ln 2 + R_x C_x \ln 1.5} \times 100$$

$$= 0.63 \times 100\% = 63.09\%$$

2.b) $R_x C_x = 1k \times 10\mu = 10\,ms$

$T_1 = 10\,ms \ln 2 = 6.93\,ms$

$T_2 = 10\,ms \ln 1.5 = 4.05\,ms$



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