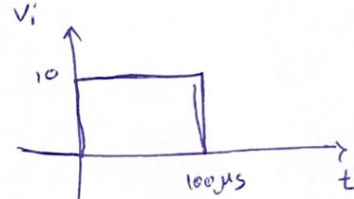
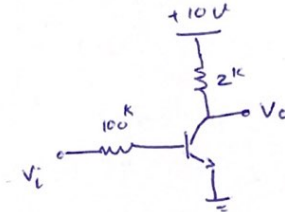
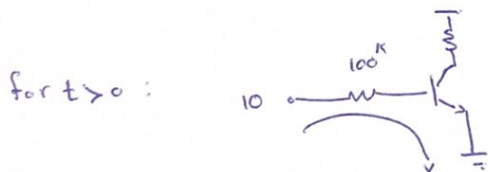


#3

$$\begin{cases} \tau_s = 10 \text{ ns} \\ \tau_{BF} = 50 \text{ ns} \\ \tau_F = 0.5 \text{ ns} \\ V_{CE,sat} = 0.2 \\ V_{BE,on} = 0.7 \end{cases}$$



for $t < 0 \rightarrow V_o = V_{CC} - R_C I_C = 10V$



KVL: $I_{B1} = \frac{10 - 0.7}{100k} = 0.093 \text{ mA} = 93 \mu A$

$$Q_F(t) = Q_F(\infty) + [Q_F(0) - Q_F(\infty)] e^{-\frac{t}{\tau_{BF}}} \quad Q_F(0) = 0 \quad Q_F(\infty) = \tau_{BF} I_{B1} = 0.5 \times 93 \mu A = 0.0465 \text{ PC}$$

$$Q_F(t) = 0.0465 \left(1 - e^{-\frac{t}{50 \text{ ns}}} \right) \text{ PC}$$

$$I_{C,sat} = \frac{V_{CC} - V_{CE,sat}}{R_C} = \frac{10 - 0.2}{2k} = 2.4 \text{ mA}$$

$$Q_A = \tau_F I_{C,sat} = 0.5 \times 2.4 \text{ mA} = 1.2 \text{ PC} \Rightarrow 1.2 \text{ PC} = 0.0465 \left(1 - e^{-\frac{t}{50 \text{ ns}}} \right)$$

$$\Rightarrow t_f = 0$$