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Assignment-2

1) a) $V_T = \frac{KT}{q}$ $T = 20 + 273 \Rightarrow 293\,K$

OR $\boxed{V_T = \frac{T}{11600}}$

$\Rightarrow \frac{1.38 \times 10^{-23} \times 293}{1.6 \times 10^{-19}}$

$\Rightarrow \frac{404.34 \times 10^{-23+19}}{1.6}$

$\Rightarrow 252.71 \times 10^{-4}\,V$ Ans

$\Rightarrow 25.27\,mV$ Ans

b) $I_s = 40nA$, $n = ?$, $V_D = 0.5\,V$, $V_T = 25.27\,mV$

$I_D = I_s e^{V_D/nV_T} - I_s$

$= 40 \times 10^{-9} e^{0.5/2 \times 25.27 \times 10^{-3}} - 40 \times 10^{-9}$

$\Rightarrow 40 \times 10^{-9} (e^{0.5/2 \times 10^{3}/50.54} - 1)$

$\Rightarrow 40 \times 10^{-9} (e^{500/50.54} - 1)$

$\Rightarrow 40 \times 10^{-9} (e^{9.89} - 1)$

$\Rightarrow 40 \times 10^{-9} (19732.05 - 1)$

$\Rightarrow 40 \times 10^{-9} \times 19731.05$

$\Rightarrow 789242 \times 10^{-9}$

$\Rightarrow 0.7 \times 10^{-3} \approx \boxed{0.87\,mA}$ Ans

Assignment-3

② $I_D = 8mA \Rightarrow 8 \times 10^{-3} A$

$n = 1$

$V_D = 0.5 V$

$T = 25^\circ C \Rightarrow 25 + 273 = 298 K$

$I_S = ?$

$$V_T = \frac{KT}{q} = \frac{1.38 \times 10^{-23} \times 298}{1.6 \times 10^{-19}} \Rightarrow 257.02 \times 10^{-4} V$$

$$I_D = I_S (e^{V_D/nV_T} - 1)$$

$$I_S = \frac{8 \times 10^{-3}}{e^{0.5/257.02 \times 10^{-4}} - 1} \Rightarrow \frac{8 \times 10^{-3}}{e^{5000/257.02} - 1}$$

$$\Rightarrow \frac{8 \times 10^{-3}}{e^{19.45} - 1}$$

$$\Rightarrow \frac{8 \times 10^{-3}}{2.7 \times 10^{8}}$$

$$\Rightarrow 2.96 \times 10^{-11}$$

$$\Rightarrow 29.6 \times 10^{-12} A$$

$\Rightarrow 30 pA.$

③ $I_D = 6 \times 10^{-3} A$, $V_T = 26 \times 10^{-3} V$, $n = 1$, $I_S = 10^{-9} A$

$V_D = ?$

$$I_D = I_S (e^{V_D/nV_T} - 1)$$

$$6 \times 10^{-3} = 10^{-9} (e^{V_D/26 \times 10^{-3}} - 1)$$

$$6 \times 10^{6} + 1 = e^{V_D/0.026}$$

$$V_D = (0.026) \ln (6 \times 10^{6} + 1)$$

$$= 0.026 \times 15.60$$

$\Rightarrow 0.4056 V$ Ans

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$I_S = 0.1mA$

$T = 293K$

$I_S' = ?$

$T = 273 + 40 \Rightarrow 313K$

$I_D = I_S (e^{V_D/nV_T} - 1)$

$\frac{I}{I_S} = \ln V_D$

⑥ $V_D = 0.6V$

$V_T = \frac{KT}{q}$

$\Rightarrow \frac{1.38 \times 10^{-23} \times 293}{1.6 \times 10^{-19}}$

$\Rightarrow 252.71 \times 10^{-4} V$

$V_D = 0.6V \rightarrow I_S = 50nA$

$I_D = I_S (e^{V_D/nV_T} - 1)$

$\Rightarrow 50 \times 10^{-9} (e^{0.6/2 \times 252.71 \times 10^{-4}} - 1)$

$\Rightarrow 50 \times 10^{-9} (e^{0.6/505.42 \times 10^{-4}} - 1)$

$\Rightarrow 50 \times 10^{-9} (e^{142914.23} - 1)$

$\Rightarrow 50 \times 10^{-9} (142913.23)$

$\Rightarrow 7145661.5 \times 10^{-9}$

$\Rightarrow 7.1 mA$ Ans

③ $I_S = 0.1mA$

$T = 293K$

$I_S' = ?$

$T = 273 + 40 \Rightarrow 313K$

$I_D = I_S (e^{V_D/nV_T} - 1)$

$\frac{I}{I_S} = \ln V_D$

⑥ $V_D = 0.6V$

$V_T = \frac{KT}{q}$

$\Rightarrow \frac{1.38 \times 10^{-23} \times 293}{1.6 \times 10^{-19}}$

$\Rightarrow 252.71 \times 10^{-4} V$

$V_D = 0.6V \rightarrow I_S = 50nA$

$I_D = I_S (e^{V_D/nV_T} - 1)$

$\Rightarrow 50 \times 10^{-9} (e^{0.6/2 \times 252.71 \times 10^{-4}} - 1)$

$\Rightarrow 50 \times 10^{-9} (e^{0.6/505.42 \times 10^{-4}} - 1)$

$\Rightarrow 50 \times 10^{-9} (142914.23 - 1)$

$\Rightarrow 50 \times 10^{-9} \times (142913.23)$

$\Rightarrow 7145661.5 \times 10^{-9}$

$\Rightarrow 7.1 mA$ Ans

④ $I_{SO} = 0.1mA$

$T_1 = 293K$

$T_2 = 273 + 40 = 313K$

$I_S = I_{SO} (2^{T_2 - T_1/10})$

$= 0.1 \times 10^{-3} (2^{313 - 293/10})$

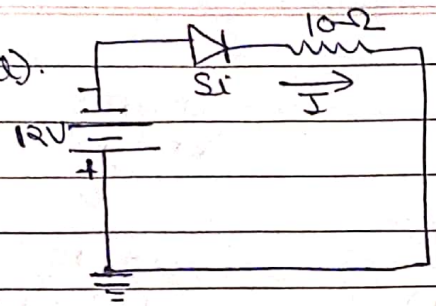
$\Rightarrow 0.1 \times 10^{-3} \times 4$

$\Rightarrow 0.4 \times 10^{-3}$

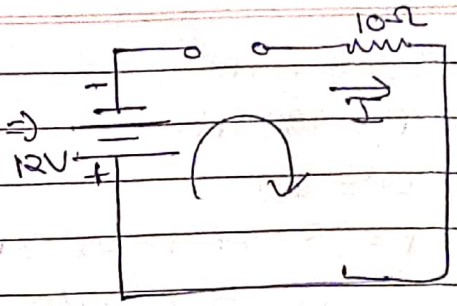
$\Rightarrow 0.4mA$ Ans

⑦

(11) a).

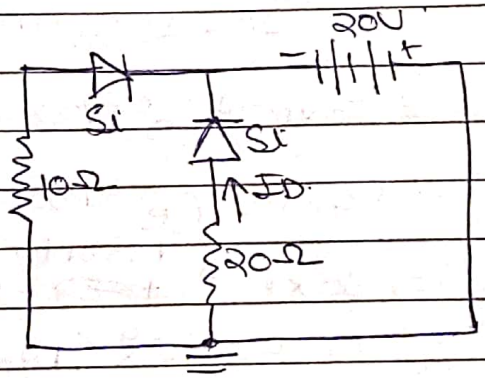


⇒

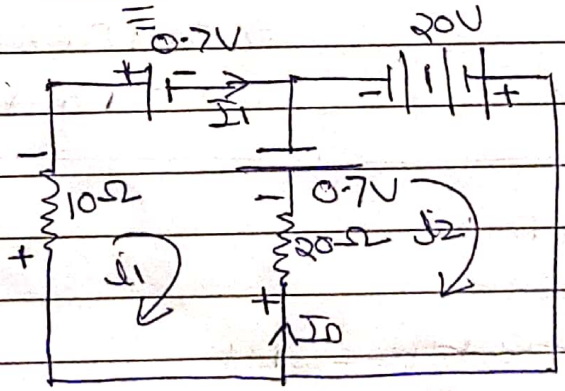


$-12 + 10I = 0$ ckt become open, so no current will flow from it. So, $\boxed{I = 0A}$

b).



⇒



$-10I - 0.7 + 0.7 + 20I_D = 0$

$-10I + 20I_D = 0 \quad \text{---} (1)$

$20 - 20I_D - 0.7 = 0$

$19.3 = 20I_D$

$\boxed{I_D = 0.965A}$

$J(I_{dc})$

Assignment-3

⑤. $T = 27°C = 300K$.

$V_D = 0.2V$.

$V_T = 25.8 \times 10^{-3} V$.

$V_T = \frac{KT}{q}$

$\Rightarrow \frac{1.38 \times 10^{-23} \times 300}{1.6 \times 10^{-19}}$.

$\Rightarrow 25.8 mV$.

$\frac{V_D}{\eta V_T} = \frac{0.2}{1 \times 25.8 \times 10^{-3}}$

$\Rightarrow 0.00775 \times 10^3$

$\Rightarrow 7.75$

$I_D = I_S [e^{V_D/\eta V_T} - 1]$

$= 10^{-6} [e^{7.75} - 1]$ A

$\Rightarrow 2.27 mA$.

$R_{AC} = \frac{\eta V_T}{I_D} \Rightarrow \frac{25.8 \times 10^{-3}}{2.27 \times 10^{-3}} \Rightarrow 11.39 \Omega$

$R_{DC} = \frac{V_D}{I_D} \Rightarrow \frac{0.2}{2.27 \times 10^{-3}} \Rightarrow 88.10 \Omega$

(7) $n = 1.2$

~~$I_D = 10\,mA$~~

~~$I_{SO} = 0.1\,mA$~~

~~$\log\left(\frac{I_D}{I_{SO}}\right) = \frac{V_D}{nV_T}$~~ $\Rightarrow 1.92 \log\left(\frac{100}{0.1}\right)$

$\Rightarrow 1.2$

(8) $n = 1,\ T = 300\,K$

$I = I_O\left[e^{V_D/nV_T} - \right]$

$V_T = \frac{T}{11600} = \frac{300}{11600} \Rightarrow 0.0258\,V$

$\Rightarrow 25.8\,mV$

$I = -0.75 I_O$

$-0.75 I_O = I_O\left[e^{V_D/nV_T} - 1\right]$

$\Rightarrow 1 - 0.75 = e^{V_D/nV_T}$

$\Rightarrow 0.25 = e^{V_D/V_T}$

$V_D = V_T \ln(0.25)$

$V_D = 25.8 \times 10^{-3} \times -1.38$

$V_D = -35.60 \times 10^{-3}$

$\boxed{V_D = 0.0356\,V}$ Ans