Tut Sheet -4
Solution

Ans. 1.

1. (a) $I_{B_Q} = \dfrac{V_{CC} - V_{BE}}{R_B} = \dfrac{16\text{ V} - 0.7\text{ V}}{470\text{ k}\Omega} = \dfrac{15.3\text{ V}}{470\text{ k}\Omega} = \mathbf{32.55\ \mu A}$

(b) $I_{C_Q} = \beta I_{B_Q} = (90)(32.55\ \mu\text{A}) = \mathbf{2.93\ mA}$

(c) $V_{CE_Q} = V_{CC} - I_{C_Q}R_C = 16\text{ V} - (2.93\text{ mA})(2.7\text{ k}\Omega) = \mathbf{8.09\ V}$

(d) $V_C = V_{CE_Q} = \mathbf{8.09\ V}$

(e) $V_B = V_{BE} = \mathbf{0.7\ V}$

(f) $V_E = \mathbf{0\ V}$

Ans. 2.

(a) Load line intersects vertical axis at $I_C = \dfrac{21\text{ V}}{3\text{ k}\Omega} = 7\text{ mA}$ and horizontal axis at $V_{CE} = 21\text{ V}$.

(b) $I_B = 25\ \mu\text{A}$: $R_B = \dfrac{V_{CC} - V_{BE}}{I_B} = \dfrac{21\text{ V} - 0.7\text{ V}}{25\ \mu\text{A}} = \mathbf{812\ k\Omega}$

(c) $I_{C_Q} \cong \mathbf{3.4\ mA}$, $V_{CE_Q} \cong \mathbf{10.75\ V}$

(d) $\beta = \dfrac{I_C}{I_B} = \dfrac{3.4\text{ mA}}{25\ \mu\text{A}} = \mathbf{136}$

(e) $\alpha = \dfrac{\beta}{\beta + 1} = \dfrac{136}{136 + 1} = \dfrac{136}{137} = \mathbf{0.992}$

(f) $I_{C_{sat}} = \dfrac{V_{CC}}{R_C} = \dfrac{21\text{ V}}{3\text{ k}\Omega} = \mathbf{7\ mA}$

(g) –

(h) $P_D = V_{CE_Q}I_{C_Q} = (10.75\text{ V})(3.4\text{ mA}) = \mathbf{36.55\ mW}$

(i) $P_s = V_{CC}(I_C + I_B) = 21\text{ V}(3.4\text{ mA} + 25\ \mu\text{A}) = \mathbf{71.92\ mW}$

(j) $P_R = P_s - P_D = 71.92\text{ mW} - 36.55\text{ mW} = \mathbf{35.37\ mW}$

Ans. 3

$$I_{B_Q} = \frac{16\text{ V} - 0.7\text{ V}}{910\text{ k}\Omega} = 16.81\ \mu\text{A}$$

$$I_{C_Q} = \beta I_{B_Q} = (120)(16.81\ \mu\text{A}) = \mathbf{2.017\ mA}$$

(from characteristics) $V_{E_Q} = \mathbf{11.5\ V}$, $I_{C_Q} = \mathbf{2.4\ mA}$

Ans.4

(a) $R_C = \dfrac{V_{CC} - V_C}{I_C} = \dfrac{12\text{ V} - 7.6\text{ V}}{2\text{ mA}} = \dfrac{4.4\text{ V}}{2\text{ mA}} = \mathbf{2.2\ k\Omega}$

(b) $I_E \cong I_C$: $R_E = \dfrac{V_E}{I_E} = \dfrac{2.4\text{ V}}{2\text{ mA}} = \mathbf{1.2\ k\Omega}$

(c) $R_B = \dfrac{V_{R_B}}{I_B} = \dfrac{V_{CC} - V_{BE} - V_E}{I_B} = \dfrac{12\text{ V} - 0.7\text{ V} - 2.4\text{ V}}{2\text{ mA}/80} = \dfrac{8.9\text{ V}}{25\ \mu\text{A}} = \mathbf{356\ k\Omega}$

(d) $V_{CE} = V_C - V_E = 7.6\text{ V} - 2.4\text{ V} = \mathbf{5.2\ V}$

(e) $V_B = V_{BE} + V_E = 0.7\text{ V} + 2.4\text{ V} = \mathbf{3.1\ V}$