

Q1 (a)

$$Q = CV \quad (1)$$

$$= 10 \times 10^{-6} \times 820$$

$$= 8.2 \times 10^{-3} \text{ C}$$

$$Q = It \quad (1)$$

$$\therefore t = \frac{Q}{I} = \frac{8.2 \times 10^{-3} \text{ C}}{2 \times 10^{-3} \text{ A}} \quad (1)$$

$$= 4.1 \text{ seconds.} \quad (1)$$

4.1 seconds

Q1 (b)

$$R = \frac{\rho l}{a} \quad (1)$$

$$= \frac{(3 \times 10^{-8})(1500)}{(78.54 \times 10^{-6})} \quad (1)$$

$$= 0.57 \, \Omega \quad (1)$$

0.57 Ω

Q1 (c)

$$\text{RESISTANCE } R_{\theta} = R_0 (1 + \alpha_0 \theta) \quad (1)$$

$$= 120 [1 + (0.0043)(28)]$$

$$= 120 [1 + 0.1204] \quad (1)$$

$$= 134.5 \, \Omega \quad (1)$$

134.5

Q₂ (a)

$$Q = mc(t_2 - t_1) \quad (1)$$

$$= 15 \times 4200 \times (85 - 0) \quad (1)$$

$$= 5,355,000 \text{ J} \quad (1)$$

$$= \underline{\underline{5.36 \text{ MJ}}}$$

Q₂ (b)

$$Q - W = U_2 - U_1 \quad (1)$$

$$Q - 60 = 65 - 5 \quad (1)$$

$$Q = 65 - 5 + 60$$

$$\therefore \underline{\underline{Q = 120 \text{ kJ}}} \quad (1)$$

Q is positive $\therefore$ Heat supplied to the system. (1)

Q2
(c)

CLOSED CYLINDER - CONSTANT VOLUME.
NO WORK.

$$Q - W = M C_V (t_2 - t_1)$$

$$\therefore Q = M C_V (t_2 - t_1) \quad (1)$$

$$\Delta t = \frac{Q}{M C_V} = \frac{87 \times 10^3 \text{ J}}{(10)(718)} \quad (1)$$

kg. J/kg K

$$= \underline{\underline{12.12 \text{ K}}} \quad (1)$$

Q3 (a)

$$R_6 + R_7 = 4.8 + 4.3 = 9.1 \text{ k}\Omega \quad (1)$$

$$R_5 + (R_6 + R_7) = \frac{(12 \times 9.1)}{(12 + 9.1)} = 5.17 \text{ k}\Omega. \quad (1)$$

$$R_4 + 5.17 = 25 + 5.17 = 30.17 \text{ k}\Omega. \quad (1)$$

$$R_2 = 12 \text{ k}\Omega.$$

$$R_3 = 10 \text{ k}\Omega. \quad \therefore \frac{1}{R} = \frac{1}{12} + \frac{1}{10} + \frac{1}{30.17}$$

$$\therefore R = 4.62 \text{ k}\Omega. \quad (1)$$

$$R_T = 50 \text{ k}\Omega + 4.62 \text{ k}\Omega$$

$$\underline{\underline{R_T = 54.62 \text{ k}\Omega.}} \quad (1)$$

Q3 / (b)

$$(i) \quad 510 \times 10^{-12} + 22 \times 10^{-9} = 22.51 \times 10^{-9} \text{ F.}$$

$$\frac{1}{C_T} = \frac{1}{47 \times 10^{-6}} + \frac{1}{220 \times 10^{-9}} + \frac{1}{22.51 \times 10^{-9}}$$

$$\therefore C_T = \underline{\underline{20.41 \text{ nF}}} \quad (1)$$

$$(ii) \quad Q = CV \quad (1)$$

$$= 20.41 \text{ nF} \times 24$$

$$= \underline{\underline{489.9 \text{ nC.}}} \quad (1)$$

$$(iii) \quad E = \frac{CV^2}{2} \quad (1)$$

$$= \frac{489.9 \times 10^{-9} \times 24^2}{2}$$

$$= \underline{\underline{141.09 \mu\text{J.}}} \quad (1)$$

Q4

(a)

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$\frac{1}{17.2} = \frac{1}{50.8} + \frac{1}{d_i}$$

$$\therefore \frac{1}{d_i} = \frac{1}{17.2} - \frac{1}{50.8}$$

$$\therefore d_i = (17.2^{-1} - 50.8^{-1})^{-1}$$

$$= \underline{\underline{26 \text{ cm.}}}$$

(1)

$$\frac{h_i}{h_o} = - \frac{d_i}{d_o}$$

$$\therefore h_i = 7 \times \left(- \frac{26}{(50.8)} \right) = - 3.58 \text{ cm (INVERTED)} \quad (1)$$

Q4 (b)

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$\frac{1}{40} = \frac{1}{20} + \frac{1}{d_i}$$

$$\frac{1}{d_i} = \frac{1}{40} - \frac{1}{20} \quad (1)$$

$$\therefore d_i = (40^{-1} - 20^{-1})^{-1}$$

$$= \underline{\underline{-40 \text{ cm}}} \quad (\text{VIRTUAL}) \quad (1)$$

$$\underline{Q_4} \quad (c) \quad n_i \sin \theta_i = n_r \sin \theta_r \quad (1)$$

$$1.5 \sin 57^\circ = 1.33 \sin \theta_r \quad (1)$$

$$\therefore \theta_r = \sin^{-1} \left(\frac{1.5 \sin 57^\circ}{1.33} \right)$$

$$= 71.06^\circ \approx 71^\circ 3' 42'' \quad (1)$$

$$Q_4 \quad (d) \quad \frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$\frac{1}{53} = \frac{1}{48} + \frac{1}{d_i} \quad (1)$$

$$d_i = (53^{-1} - 48^{-1})^{-1}$$

$$\therefore d_i = -508.8$$

$$\frac{h_i}{h_o} = -\frac{d_i}{d_o}$$

$$h_i = 9.6 \left(-\left(\frac{-508.8}{48} \right) \right) \quad (1)$$

$$= 9.6 + 10.6$$

$$\therefore h_i = \underline{\underline{20.2 \text{ cm}}} \quad (1)$$

Q5

(a)

(i) TRUE (2)

(ii) FALSE (1)

(iii) TRUE (2)

(b) (i) HOT BODY COLD BODY (2)

(ii) METAL INSULATOR DIELECTRIC (3)