

Modern ResonanceEngineering Science

$$\begin{aligned} 1a) \quad C &= 10 \mu\text{F} (10^{-6}) \\ V &= 820 \text{V} \\ I &= 2 \text{mA} (10^{-3}) \end{aligned}$$

$$Q = C \times V$$
$$(10 \times 10^{-6}) \times 820 = 8.2 \times 10^{-3}$$

$$Q = I t$$

$$t = \frac{Q}{I} = \frac{8.2 \times 10^{-3}}{2 \times 10^{-3}} = \underline{4.1 \text{ seconds}}$$

$$1b) \quad R = \frac{\rho \times L}{A}$$
$$\frac{9 \times 10^{-8} \times 1500}{78.54 \times 10^{-6}} = \underline{0.57 \Omega}$$

$$1c) \quad R_A = R_0 (1 + \alpha \Delta t)$$

$$120 (1 + (0.0043 \times 28))$$

$$= \underline{134.45 \Omega}$$

$$2a) \quad Q = M C \Delta T$$

$$Q = 15 \times 4200 \times 85$$

$$= \underline{5.26 \text{ MJ}}$$

$$2b) Q = \Delta u + w$$

$$u_2 = 65 \text{ kJ}$$

$$u_1 = 5 \text{ kJ}$$

$$w_d = 60 \text{ kJ} \text{ (Positive)}$$

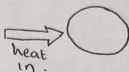
$$u_1 + Q = u_2 + w$$

$$Q = u_2 + w - u_1$$

$$Q = 65 + 60 - 5$$

$$Q = 120 \text{ kJ}$$

* Since Q is Positive, heat is supplied into the system.*



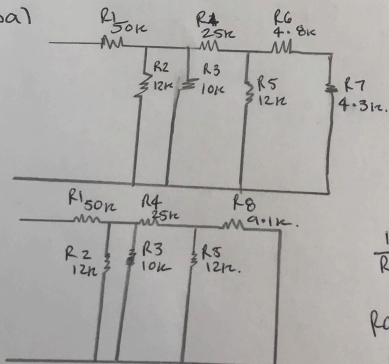
$$2c) P_v = mRT$$

$$Q = mC_v(T_2 - T_1)$$

$$\Delta T = \frac{Q}{mC_v}$$

$$\frac{87 \times 10^3}{10 \times 718 \times 10^3} = 12.12^\circ \text{C or } 285.3 \text{ K}$$

3a)



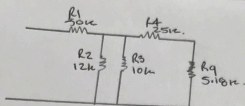
$$R_7 + R_6 = 4.8 + 4.3 = 9.1 \text{ k}$$

$$R_8 = 9.1 \text{ k}$$

$$\frac{1}{R_9} = \frac{1}{R_8} + \frac{1}{R_5}$$

$$R_9 = \frac{1}{\frac{1}{9.1} + \frac{1}{12}} = 0.193$$

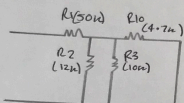
$$R_9 = 5.18 \text{ k}$$



$$\frac{1}{R_{10}} = \frac{1}{R_9} + \frac{1}{R_4}$$

$$\frac{1}{R_{10}} = \frac{1}{5.18} + \frac{1}{25} = 0.2124$$

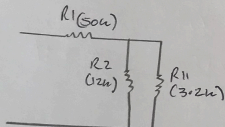
$$\underline{R_{10} = 4.7k}$$



$$\frac{1}{R_{11}} = \frac{1}{R_{10}} + \frac{1}{R_3}$$

$$R_{11} = \frac{1}{4.7k} + \frac{1}{10} = 0.313$$

$$\underline{R_{11} = 3.2k}$$



$$\frac{1}{R_{12}} = \frac{1}{R_2} + \frac{1}{R_{11}}$$

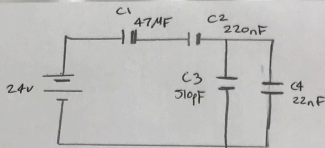
$$R_{12} = \frac{1}{12} + \frac{1}{3.2} = 0.396$$

$$\underline{R_{12} = 2.53k}$$

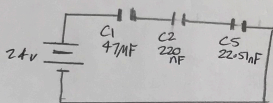
$$R_T = R_1 + R_{12} = 50 + 2.53 = \underline{52.53k}$$

3b)

i)



$$C5 = C4 + C3 = 510 \times 10^{-12} + 22 \times 10^{-9} = \underline{22.51 \times 10^{-9}}$$



$$\frac{1}{C6} = \frac{1}{C2} + \frac{1}{C5}$$

$$\frac{1}{C6} = \frac{1}{220 \times 10^{-9}} + \frac{1}{22.51 \times 10^{-9}}$$

$$\underline{C6 = 20.42 \text{ nF}}$$

$$CT = \frac{1}{20.42 \times 10^{-9}} + \frac{1}{47 \times 10^{-9}} = \underline{20.41 \text{ nF}}$$

$$\begin{aligned} \text{ii) } Q &= CV \quad Q = 20.41 \times 10^{-9} \times 24 \\ &= \underline{489.84 \text{ nC}} \end{aligned}$$

$$\text{iii) } W = \frac{1}{2} CV^2$$

$$W = \frac{1}{2} \times 20.41 \times 10^{-9} \times 24^2$$

$$= \underline{5.88 \text{ mJ}}$$

$$4a) \quad \frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

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

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

$$\frac{1}{d_i} = 0.0581 - 0.0197$$

$$d_i = (0.0581 - 0.0197)^{-1}$$

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

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

$$h_i = 7 \times \left(-\frac{26}{50.8} \right) = \underline{\underline{-3.58 \text{ cm}}} \text{ (Inverted)}$$

* The negative value indicates that the image is an inverted image *

$$4b) \quad \frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

* d_o is the distance of the object from the lens.

* d_i is the distance of the image from the lens.

*

* f is the focal length.

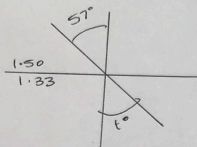
$$\frac{1}{40} = \frac{1}{20} + \frac{1}{d_i}$$

$$\frac{1}{d_i} = \frac{1}{40} - \frac{1}{20} = \underline{\underline{-0.025}}$$

$$d_i = (-0.025)^{-1}$$

$$\underline{\underline{d_i = -40\text{cm}}} \quad (\underline{\underline{\text{Virtual Image}}})$$

$$4c) \theta = \sin^{-1} \frac{1.50 \sin 57^\circ}{1.33} = \underline{71.06^\circ}$$



$$4d) \frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$\frac{1}{53} = \frac{1}{48} + \frac{1}{d_i}$$

$$\frac{1}{53} - \frac{1}{48} = \frac{1}{d_i}$$

$$= \underline{-526.32 \text{ cm}} \quad \underline{\text{Virtual}}$$

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

$$\frac{h_i}{9.6} = \frac{-526.32}{48}$$

$$h_i = 9.6 \left(\frac{-526.32}{48} \right) = \underline{105.26 \text{ cm}} \quad \underline{\text{Upright}}$$

5a) i) True

ii) False

iii) True.

i) Heat is transferred ~~is~~ from a high temperature to a low temperature.

ii) A capacitor is two conducting plates separated by an insulator called dielectric.