Solutions

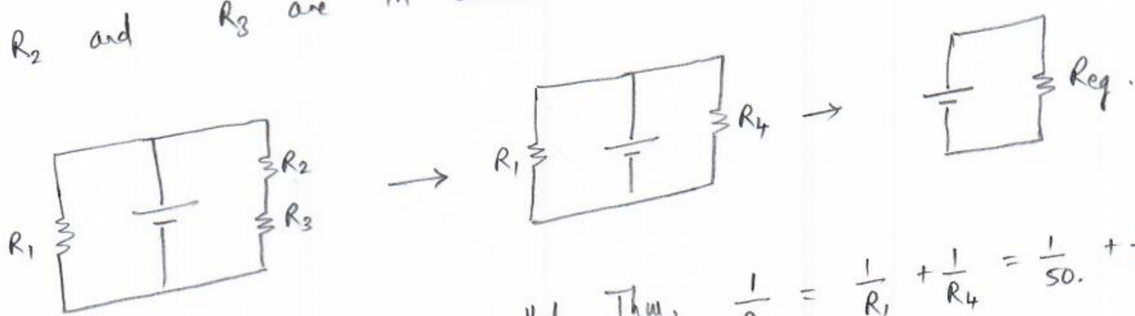
PHYS-203B-001 (Midterm Exam 02) Spring 2022

Problem 1

$$\Delta V = -\vec{E}\cdot\vec{d} = 0$$ (since $\vec{d}$ connecting '2' & '3' is perpendicular to $\vec{E}$.)

Problem 2

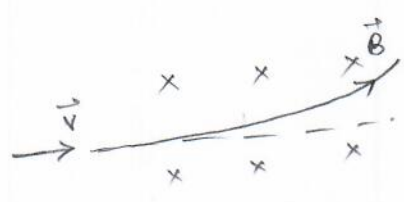
R_2 and R_3 are in series. Thus, $R_4 = R_2 + R_3 = 25 + 25 = 50\Omega$.



R_1 and R_4 are in parallel. Thus, $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_4} = \frac{1}{50} + \frac{1}{50} = \frac{2}{50}$.

$$\Rightarrow R_{eq} = \frac{50}{2} = 25\Omega.$$

Problem 3



$\vec{F}$ is upward.

Trajectory is circular

Problem 4

Magnetic dipole moment tends to orient along the direction of $\vec{B}$. Since the magnetic field of Earth points North, the magnetic dipole moment will point North.

Problem 5

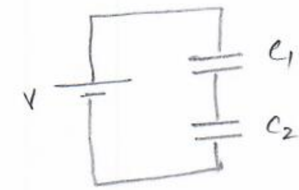
$$U = \frac{k q_1 q_2}{L} + \frac{k q_2 q_3}{L} + \frac{k q_1 q_3}{L}$$

$$= 3 \frac{kQ^2}{L}$$

$q_1 = q_2 = q_3 = Q$

Problem 6

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{10.0} + \frac{1}{20.0} = \frac{3}{20.0}$$



$$\Rightarrow \quad C_{eq} = \frac{20.0}{3} = 6.67\,\mu F$$

$$Q_1 = Q_2 = Q = C_{eq} V$$
$$= (6.67\,\mu F)(10.0\,V) = 66.7\,\mu C$$

$$U_1 = \frac{Q_1^2}{2C_1} = \frac{(66.7 \times 10^{-6})^2}{2(10.0 \times 10^{-6})} = 0.222 \text{ mJ}$$

$$U_2 = \frac{Q_2^2}{2C_2} = \frac{(66.7 \times 10^{-6})^2}{2(20.0 \times 10^{-6})} = 0.111 \text{ mJ}$$

Problem 7

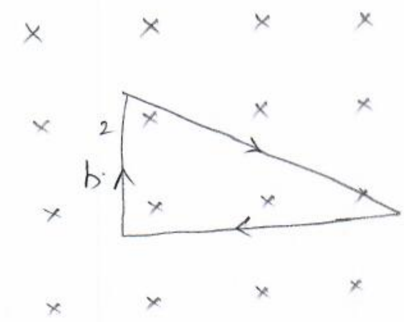
$$P = IV = (0.17 \times 10^{-3})(3.0) = 0.51 \times 10^{-3}\text{ W}$$

Energy = Power × time

$$= (0.51 \times 10^{-3})(60 \times 60\text{ s})$$

$$= 1.8\text{ J.}$$

Problem 8



$$\vec{F} = I \vec{L}_b \times \vec{B}$$

$$|\vec{F}| = I L_b B \sin(90)$$

$$= (2.0)(2.0 \times 10^{-2})(0.30)(1)$$

$$= 12 \text{ mN}$$

direction: along $-x$.