Solutions — Midterm Exam 02, PHYS-203B-001, 2017 Spring

Prob. 1

$Ws = J$

$$50.00\ \text{USD} = 50.00\ \text{USD} \frac{1\ \text{kWh}}{0.12\ \text{USD}}$$

$$= \frac{50.00}{0.12} 10^3\ \text{W}\ 60\times 60\ \text{s}$$

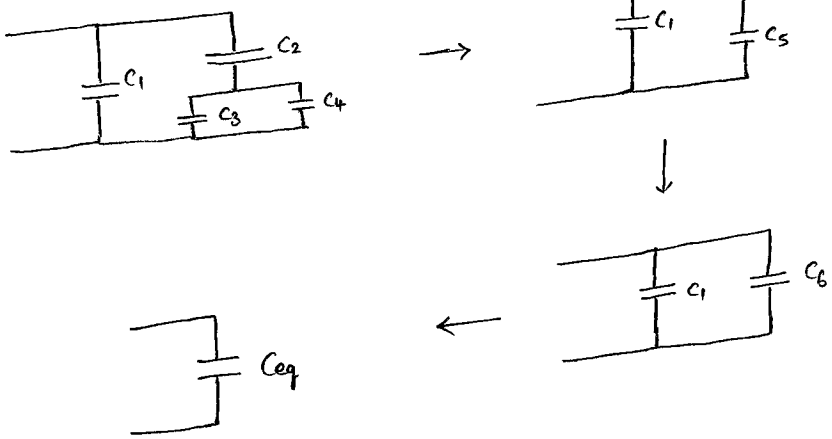
$$= 1.5\times 10^9\ \text{J}$$

Prob. 2

$$R = \frac{\rho l}{A} = \frac{\rho l}{\pi r^2} = \frac{(1.50\times 10^{-6}\ \Omega\,\text{m})\ (15\,\text{m})}{\pi\ (6.50\times 10^{-4}\,\text{m})^2} = 17.0\ \Omega$$

$$P = \frac{V^2}{R} = \frac{(120\,\text{V})^2}{17.0\,\Omega} = 850\ \text{W}$$

Prob. 3



$$C_5 = C_3 + C_4 = (3.0 + 4.0)\,\mu\text{F} = 7.0\,\mu\text{F}$$

$$\frac{1}{C_6} = \frac{1}{C_2} + \frac{1}{C_5} = \frac{1}{2.0} + \frac{1}{7.0} = \frac{9.0}{14}$$

$$C_6 = \frac{14}{9.0} = 1.6\,\mu\text{F}$$

$$C_{eq} = C_1 + C_6 = (1.0 + 1.6)\,\mu\text{F} = 2.6\,\mu\text{F}.$$

Prob. 4

(a) $\frac{P_1}{P_2} = \frac{I_1^2 R_1}{I_2^2 R_2} = \frac{R_1}{R_2} = \frac{1}{2}$ $\quad I_1 = I_2$ (in series).

$P_2 = 2 P_1$

(b) Bulb 2 would glow brighter, because power is a measure of the intensity of light emitted by a bulb.

Prob. 5

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

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

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

(c) $V_1 = \frac{Q_1}{C_1} = \frac{66.7\ \mu C}{10.0\ \mu F} = 6.67\ V$

$V_2 = \frac{Q_2}{C_2} = \frac{66.7\ \mu C}{20.0\ \mu F} = 3.33\ V$

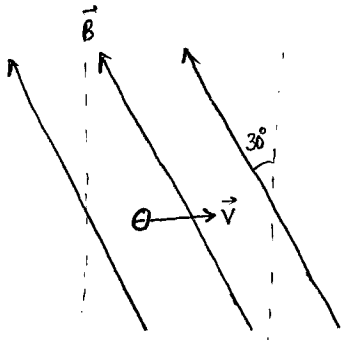
(d) $U_1 = \frac{Q_1^2}{2C_1} = \frac{(66.7\ \mu C)^2}{2(10.0\ \mu F)} = 0.222\ mJ$

$U_2 = \frac{Q_2^2}{2C_2} = \frac{(66.7\ \mu C)^2}{2(20.0\ \mu F)} = 0.111\ mJ$

Prob. 6

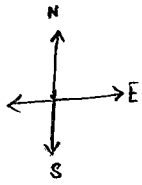
Positive (using Right-Hand-Rule)

Prob. 7

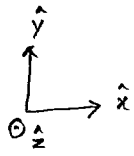


(a) $|\vec{F}_B| = |q|\,|\vec{v}|\,|\vec{B}|\sin\theta$

$= (1.6\times10^{-19}\,C)\left(5.1\times10^{6}\,\frac{m}{s}\right)(0.107)\sin(90+30)^{W}$



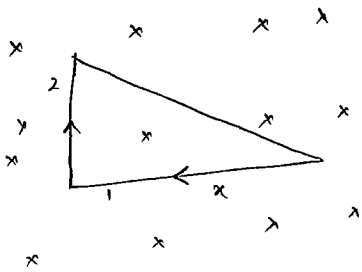
$= 7.1\times10^{-14}\ N$

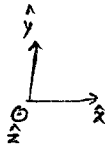


(b) $-\hat{z}$ (vertically down)

Note it is a negative charge.

Prob. 8





(a) $\vec{F}_1 = I\,\vec{L}_1 \times \vec{B}$

$= -\hat{y}\,(2.0\,A)\,(3.0\times10^{-2}\,m)\,(2.0\,T)\sin 90$

$= -\hat{y}\ 0.12\ N$

(b) $\vec{F}_2 = I\,\vec{L}_2 \times \vec{B}$

$= -\hat{x}\,(2.0\,A)\,(2.0\times10^{-2}\,m)\,(2.0\,T)\sin 90$

$= -\hat{x}\ 0.080\ N$