Solution to Midterm Exam 02 (Summer 2015, 203B)

MT02, prob. 1

$$I = \frac{\Delta Q}{\Delta t} \qquad \Delta Q = I\,\Delta t$$

$$= (0.17\times10^{-3}\,A)\times(60\times60\ sec)$$

$$= 0.612\ C$$

MT02, prob. 2

$$Energy = 50.00\ USD\ \frac{kWh}{0.10\ USD}$$

$$= 500\ kWh$$

$$= 500\times10^{3}\times60\times60\ J = 1.80\times10^{9}\ J$$

MT02, prob. 3

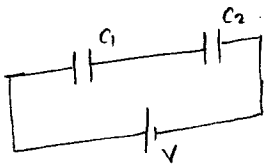
(a) $\frac{1}{R_{eq}} = \frac{1}{R}+\frac{1}{R}+\frac{1}{R} \Rightarrow R_{eq} = \frac{R}{3} = \frac{300\,\Omega}{3} = 100\,\Omega$

(b) 10.0 V across each resistor

(c) $V = IR \qquad I = \frac{V}{R} = \frac{10.0}{300} = 0.033\ A$ through each resistor

(d) $P = \frac{V^2}{R} = \frac{(10.0)^2}{300} = 0.33\ W$ consumed by each resistor.

MT02, prob. 4



(a) $\frac{1}{C_{eq}} = \frac{1}{C_1}+\frac{1}{C_2} = \frac{1}{100\mu F}+\frac{1}{20.0\mu F}$

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

(b) $Q_{eq} = V\,C_{eq} = 10.0\times6.67\times10^{-6} = 66.7\,\mu C$

$Q_1 = Q_2 = Q_{eq} = 66.7\,\mu C$

(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) $U_1 = \frac{Q_1^2}{2C_1} = \frac{(66.7\,\mu C)^2}{2\times10.0\,\mu F}$

$= 0.22\ mJ$

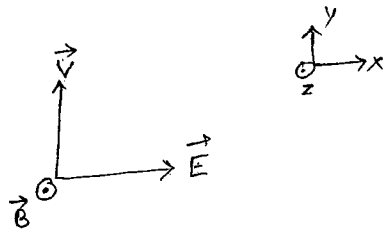
$U_2 = \frac{Q_2^2}{2C_2} = 0.11\ mJ$

MT02, prob. 5

(a) positive

(b) Circle.

MT02, prob. 6



$\vec{F}_E = qE\,\hat{i}$

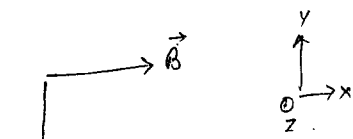
$= 1.8\,\mu C \times 4.50\times10^{3}\,\frac{N}{C}\,\hat{i} = 8.1\,mN\,\hat{i}$

$\vec{F}_B = qvB\,\hat{i}$

$= 1.8\,\mu C \times 3.00\times10^{6}\,\frac{m}{s} \times 1.50\times10^{-3}\,T\,\hat{i} = 8.1\,mN\,\hat{i}$

$\vec{F}_{tot} = \vec{F}_E + \vec{F}_B = 16.2\times10^{-3}\,N\,\hat{i}$

MT02, prob. 7



(a) $F = ILB\sin 90$

$= 2.00\,mA \times 0.325\,m \times 0.35\,T \times 1$

$= 0.228\,mN$

(b) Along positive z-axis.

MT02, prob. 8

$N_s = 1$

$N_c = 1$

$A_{square} = \frac{L}{4} \times \frac{L}{4} = \frac{L^2}{16}$

$2\pi R = L$

$A_{circle} = \pi R^2$

$= \pi\left(\frac{L}{2\pi}\right)^2$

$= \frac{L^2}{4\pi}$

$\frac{\tau_{square}}{\tau_{circle}} = \frac{N_s \not{I} A_s B}{N_c \not{I} A_c B}$

$= \frac{A_s}{A_c} = \frac{L^2/16}{L^2/4\pi}$

$= \frac{4\pi}{16}$

$= \frac{\pi}{4}$.