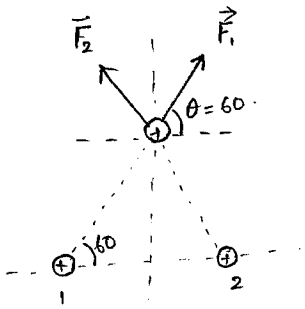
Final Exam PHYS-205B Spring 2016

Prob. 1



$$|\vec{F}_1| = |\vec{F}_2| = \frac{kq^2}{L^2}$$

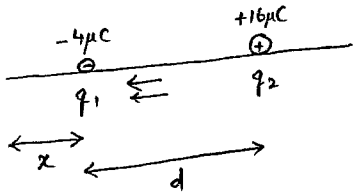
$$\vec{F}_{tot} = \vec{F}_1 + \vec{F}_2 = \hat{j}\, 2\,|\vec{F}_1| \sin 60$$

$$= \hat{j}\, 2\, \frac{kq^2}{L^2}\, \frac{\sqrt{3}}{2}$$

$$= \hat{j}\, \sqrt{3}\, \frac{kq^2}{L^2}$$

magnitude $= \sqrt{3}\, \frac{kq^2}{L^2}$ direction : along the bisecta.

Prob. 2



Argue that it will on the left of q_1.

$$|\vec{E}_1| = |\vec{E}_2|$$

$$\frac{k|q_1|}{|x|^2} = \frac{k|q_2|}{|d+x|^2}$$

$$d + x = \pm\sqrt{\frac{|q_2|}{|q_1|}}\, x$$

$$\sqrt{\frac{|q_2|}{|q_1|}} = \sqrt{\frac{16}{4}} = \pm 2$$

$$x = \frac{d}{\left(-1 \pm \sqrt{\frac{|q_2|}{|q_1|}}\right)} = \frac{10.0\,cm}{-1 \pm 2}$$

$$= 10\,cm \text{ or } -3.33\,cm$$

$x = 10.0\,cm$ (to the left of q_1) is the correct solution.

Prob. 3

$$U = \frac{kq^2}{L} + \frac{kq^2}{L} + \frac{kq^2}{L} = 3\frac{kq^2}{L}$$

Prob. 4

$$\frac{1}{2} m_2 v_{2i}^2 + \frac{k q_1 q_2}{r_i} = \frac{1}{2} m_2 v_{2f}^2 + \frac{k q_1 q_2}{r_f}$$

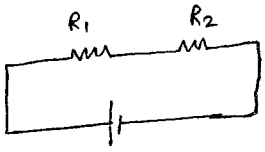
($v_{2f} = 0$)

$$\frac{1}{2} 10\times10^{-3} (10.0)^2 + \frac{8.99\times10^9 \times 10\times10^{-6} \times 1.0\times10^{-6}}{30.0\times10^{-2}} = 0 + \frac{8.99\times10^9 \times 10\times10^{-6} \times 1.0\times10^{-6}}{r_f}$$

$$0.5 + 0.3 = \frac{0.0899}{r_f}$$

$$r_f = 0.112 \text{ m} = 11.2 \text{ cm}.$$

Prob. 5



(a) $R_{eq} = R_1 + R_2 = 300.0\ \Omega$

(b) $I_1 = I_2 = I_{eq} = \frac{V}{R_{eq}} = \frac{10.0}{300.0} = 0.0333\text{ A} = 33.3\text{ mA}$

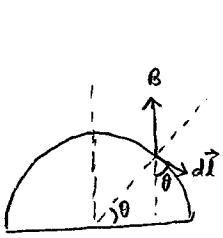
(c) $V_1 = I_1 R_1 = \frac{10.0}{300.0} \times 100.0 = 3.33\text{ V}$

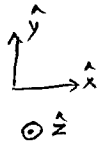
$V_2 = I_2 R_2 = \frac{10.0}{300.0} \times 200.0 = 6.67\text{ V}$

(d) $P_1 = I_1^2 R_1 = \left(\frac{10.0}{300.0}\right)^2 100.0 = 0.111\text{ W}$

$P_2 = I_2^2 R_2 = \left(\frac{10.0}{300.0}\right)^2 200.0 = 0.222\text{ W}$

Prob. 6





$dl = R\,d\theta$

$$\vec{F}_2 = \hat{z} \int_0^{\pi} I\,dl\,B\,\sin(180-\theta)$$

$$= \hat{z}\, IBR \int_0^{\pi} d\theta \sin\theta = \hat{z}\, 2IBR = \hat{z}\ 1.0\times10^{-2}\text{ N}$$

$$\vec{F}_1 = -\hat{z}\, 2IBR = -\hat{z}\ 1.0\times10^{-2}\text{ N}$$

$$\vec{F}_{tot} = \vec{F}_1 + \vec{F}_2 = 0$$

$2IBR = 2\times1.0\times0.10\times5.0\times$
$= 1.0\times10^{-2}\text{ N}$

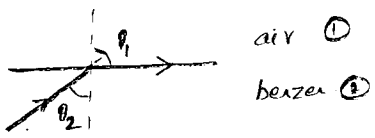
Prob. 7

(a) increasing

(b) anticlockwise

(c) $I = \frac{Blv}{R} = \frac{1.2 \times 10.0 \times 10^{-2} \times 5.0}{0.40} = 1.5\ A$

Prob. 8



$n_1 \sin\theta_1 = n_2 \sin\theta_2$

$1.0 \sin 90 = 1.80 \sin\theta_2$

$\theta_2 = \sin^{-1}\left(\frac{1.0}{1.80}\right) = 33.8°$

Prob. 9

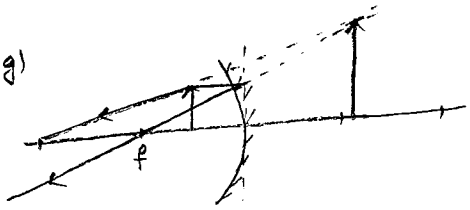
(a) $R = 2f = 20.0\ cm$

(b) $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$ $\quad \frac{1}{5.0} + \frac{1}{d_i} = \frac{1}{10.0} \Rightarrow d_i = -10.0\ cm$

(c) $m = -\frac{d_i}{d_o} = -\frac{(-10.0cm)}{5.0cm} = 2.0$

(d) virtual (e) upright (f) $m = \frac{h_i}{h_o} \Rightarrow h_i = 2.0cm$

(g)



Prob. 10

(a) $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$ $\quad \frac{1}{15} + \frac{1}{d_i} = \frac{1}{10} \Rightarrow d_i = 30.0cm$

(b) $m = -\frac{d_i}{d_o} = -\frac{30.0cm}{15.0cm} = -2$

(c) real

(d) inverted

(e)