Solution

Final Exam, PHYS-205B-001, Spring 2017

Prob. 1

$$a = \frac{q}{m} E$$

$$v = v_i + at = \frac{q}{m} Et \qquad (v_i = 0)$$

$$\frac{v_e}{v_p} = \frac{\frac{e}{m_e} Et}{\frac{e}{m_p} Et} = \frac{m_p}{m_e} = 1835$$

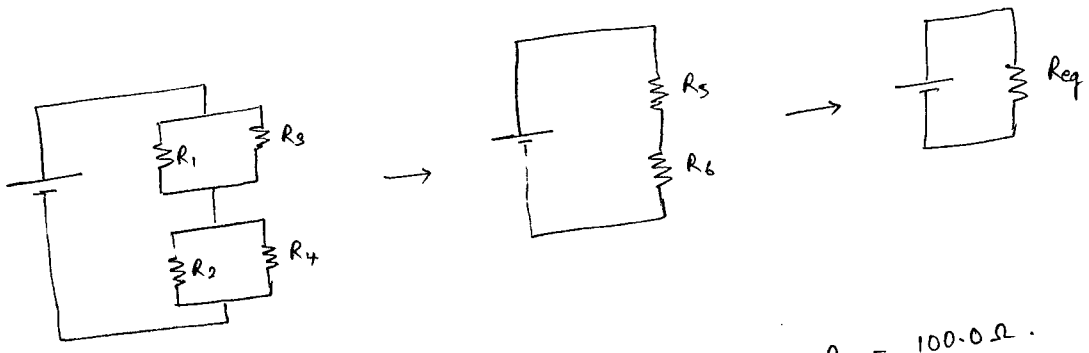
$$\frac{1}{1835} = 5.45 \times 10^{-4}$$

Prob. 2

$$\frac{1}{2} m v^2 = qV$$

$$v = \sqrt{\frac{2qV}{m}} = \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 146}{1.67 \times 10^{-27}}} = 1.7 \times 10^5 \ \frac{m}{s}$$

Prob. 3



$$\frac{1}{R_5} = \frac{1}{R_1} + \frac{1}{R_3} = \frac{2}{100} \Rightarrow R_5 = 50.0\,\Omega$$

$$\frac{1}{R_6} = \frac{1}{R_2} + \frac{1}{R_4} = \frac{2}{100} \Rightarrow R_6 = 50.0\,\Omega.$$

$$R_{eq} = R_5 + R_6 = 100.0\,\Omega.$$

Prob. 4

$$\frac{2\pi}{T} = \omega = \frac{q}{m} B$$

$$T = \frac{2\pi m}{qB} = \frac{2\pi \times 9.1 \times 10^{-31}}{1.60 \times 10^{-19} \times (2.21 \times 10^{-3})} = 1.6 \times 10^{-8}\ s$$

Prob. 5

$$I = \frac{V}{R} = \frac{1}{R}\left(\frac{\Delta\Phi}{\Delta t}\right) A$$

$$= \frac{1}{2.50}\left(\frac{2.50 - 0.500}{1.00}\right)\left(5.00 \times 10^{-4}\ m^2\right)$$

$$= 4.00 \times 10^{-4}\ A = 0.400\ mA.$$

Prob. 6

$$d = 8.0 \text{ light-minutes}$$

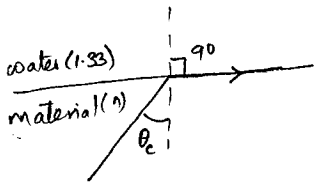
$$= 8.0 \text{ light-minutes} \frac{1 \text{ light-years}}{365 \times 24 \times 60 \text{ light-minutes}}$$

$$= 1.5 \times 10^{-5} \text{ light-years}$$

Prob. 7

(b) bends toward the normal and slows down.

Prob. 8



$$n \sin\theta_c = 1.33 \underbrace{\sin 90}_{=1}$$

$$\frac{c}{v} \sin\theta_c = 1.33$$

$$v = c \frac{\sin\theta_c}{1.33}$$

$$= 3.00 \times 10^{8} \frac{m}{s} \frac{\sin 60}{1.33}$$

$$= 1.95 \times 10^{8} \frac{m}{s}$$

Prob. 9

(a) $R = 2f = 2 \times (-10.0\,\text{cm}) = -20.0\,\text{cm}$

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

$\frac{1}{+10} + \frac{1}{d_i} = \frac{1}{-10} \Rightarrow d_i = -5.0\,\text{cm}$

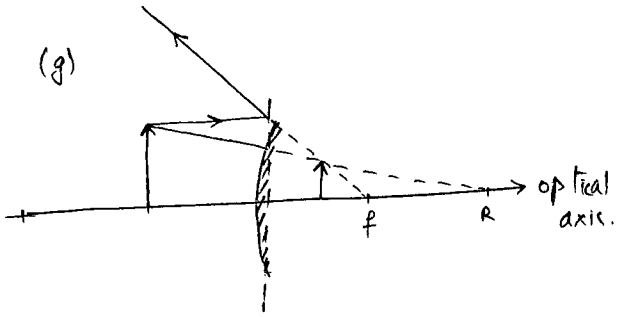
(c) $m = -\frac{d_i}{d_o} = -\frac{(-5.0\,\text{cm})}{(+10.0\,\text{cm})} = +0.5$

(d) virtual

(e) upright

(f) $h_i = m h_o = +0.5 \times 1.0\,\text{cm} = +0.50\,\text{cm}$

(g)



Prob. 10

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

$\frac{1}{+10} + \frac{1}{d_i} = \frac{1}{+10} \Rightarrow d_i \to \infty$

(b) $m = -\frac{d_i}{d_o} \to \infty$

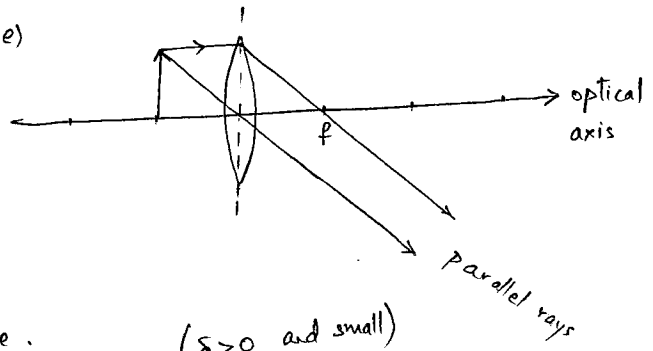
(c) For $d_o = +10.0\,\text{cm} + \delta$, real image.

$d_o = +10.0\,\text{cm} - \delta$, virtual image.

(d) For $d_o = +10.0\,\text{cm} + \delta$, inverted image.

$d_o = +10.0\,\text{cm} - \delta$, upright image.

(e)



($\delta > 0$ and small)