

PHY 232: PRACTICE EXAM #2 SOLUTIONS

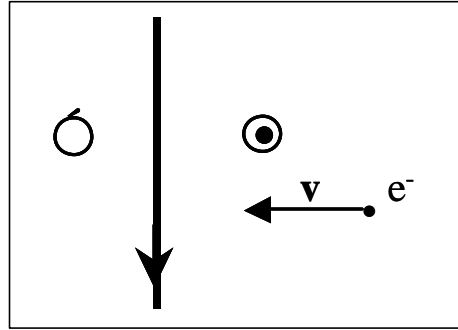
Some Useful Information:

$$e = 1.60 \times 10^{-19} \text{ C}$$

$$m_e = 9.1 \times 10^{-31} \text{ kg}$$

$$c = 3 \times 10^8 \text{ m/s}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ T}\cdot\text{m/A}$$



1. A wire lying in the plane of the page carries a current toward the bottom of the page, as shown. What is the direction of the magnetic force it produces on an electron that is moving perpendicularly toward the wire, also in the plane of the page, from your right?

At e^- , B is out of paper. Thus, by right-hand rule, F is up the page if charge is positive. Then F on e^- must be down the page.

- a) **toward the bottom of the page**

2. A solenoid 20 cm long is wound with 5000 turns of wire. What magnetic field is produced at the center of the solenoid when a current of 10 A flows?

- a) 1.6 T
 b) 0.84 T
 c) 0.67 T
 d) **0.31 T**
 e) 1.0 T

$$B = \mu_0 n I = \mu_0 \left(\frac{5000}{0.2 \text{ m}} \right) 10 = 0.31 \text{ T}$$

3. A charged particle moves and experiences no magnetic force. From this we can conclude that

- a) no magnetic field exists in that region of space
 b) the particle is moving parallel to the magnetic field
 c) the particle is moving at right angles to the magnetic field
 d) **either no magnetic field exists or the particle is moving parallel to the field**
 e) the particle is moving in a circle

4. An RL circuit with $L = 3 \text{ H}$ and an RC circuit with $C = 3 \mu\text{F}$ have the same value of time constant. If the two circuits have the same value of R , what is the value of the time constant?

- a) **3 ms**
 b) $50 \mu\text{s}$
 c) $7 \mu\text{s}$
 d) 6.7 s
 e) $.0043 \text{ s}$

$$t = L/R = RC \Rightarrow L/C = R^2$$

$$R = \sqrt{L/C} = 1000 \Omega$$

$$t = L/R = 3 \text{ H} / 1000 \Omega = 3 \text{ ms}$$

5. As the frequency of the AC voltage across a capacitor approaches zero, the capacitive reactance of that capacitor

- a) approaches zero
- b) **approaches infinity**
- c) approaches unity
- d) none of the above
- e) not enough information

$$X_L = \frac{1}{2\pi f C}$$

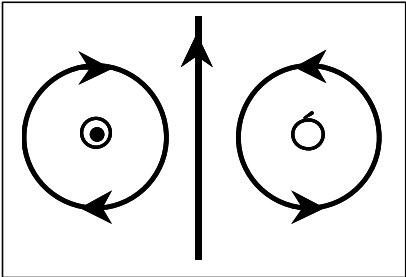
As $f \rightarrow 0$, then $X_L \rightarrow \infty$

6. A series RLC circuit has resistance of 150Ω , a capacitance of $40 \mu\text{F}$ and an inductance of 50 mH . It is driven by a 120 V (rms) , 60 Hz source. How much power is dissipated in the inductor?

- a) **0 W**
- b) 88 W
- c) 67 W
- d) 31 W
- e) 99 W

Inductor does not dissipate power.

7. A long straight wire lies flat on a horizontal table and carries an ever-increasing current in a northward direction. Two coils of wire lie flat on the table, one on either side of the wire. When viewed from above, the induced current circles



- a) clockwise in both coils
- b) counterclockwise in both coils
- c) clockwise in the east coil and counterclockwise in the west coil
- d) counterclockwise in the east coil and clockwise in the west coil

Directions of increasing applied field are shown on above diagram. The induced currents produce fields inside rings that oppose the change in applied field.

8. What resistance is needed in series with a $10 \mu\text{F}$ capacitor at 1 kHz for a total impedance of 45Ω ?

- a) 29.1 Ω
- b) **42.0 W**
- c) 60.9 Ω
- d) 1772 Ω
- e) 19.7 Ω

$$Z = 45 \Omega = \sqrt{R^2 + X_c^2} \text{ and}$$

$$X_c = \frac{1}{2\pi f C} = 15.9 \Omega$$

$$R = \sqrt{45^2 - X_c^2} = 41.7 \Omega$$

9. Light enters a substance from air at 30° to the normal. It continues through the substance at an angle of 23° to the normal. What would be the critical angle for this substance?

- a) 53°
- b) 51.4°**
- c) 36.7°
- d) 12.6°
- e) 6.7°

$$n_1 \sin q_1 = n_2 \sin q_2 \text{ where } n_1 = 1.00.$$

$$n_2 = \frac{\sin q_2}{\sin q_1} = 1.28$$

$$\sin q_c = 1.00/1.28 \Rightarrow q_c = 51.4^\circ$$

10. An object is 15.2 mm from a converging lens. The image is 4 mm tall, and 9 cm from the lens. How tall is the object?

- a) 6.8 mm
- b) 5.4 mm
- c) 1.7 mm
- d) 0.68 mm**
- e) 0.11 mm

$$|M| = \frac{h'}{h} = \frac{q}{p} = \frac{9 \text{ cm}}{1.52 \text{ cm}} = \frac{4 \text{ mm}}{h}$$

Thus $h = 0.68 \text{ mm}$.

11. An electron is accelerated through $\Delta V = 2400 \text{ V}$ from rest and then enters a region in which there is a uniform $B = 1.70 \text{ T}$ magnetic field. What is the magnitude of the maximum magnetic force this charge can experience?

- a) $7.9 \times 10^{-12} \text{ N}$**
- b) 0 N
- c) $1.6 \times 10^{-3} \text{ N}$
- d) 57 N
- e) 4.3 N

$$\frac{1}{2}mv^2 = \Delta V \cdot e \Rightarrow v = 2.9 \times 10^7 \text{ m/s}$$

$$F = evB = 7.9 \times 10^{-12} \text{ N.}$$

12. If a man's face is $p = 30.0 \text{ cm}$ in front of a concave shaving mirror creating an upright image 1.50 times as large as the object ($M = 1.50$), what is the mirror's focal length?

- (a) 12.0 cm
- (b) 20.0 cm
- (c) 70.0 cm
- (d) 90.0 cm**
- (e) 110.0 cm

$$M = \frac{-q}{p} = +1.5 = \frac{-q}{30 \text{ cm}} \Rightarrow q = -45 \text{ cm}$$

$$\frac{1}{f} = \frac{1}{30 \text{ cm}} - \frac{1}{45 \text{ cm}} \Rightarrow f = 90 \text{ cm}$$