

PHY2054 Final Exam

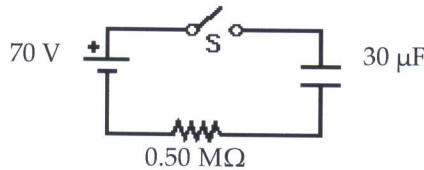
Name _____ Panther ID _____

MULTIPLE CHOICE (8 points each). Choose the one alternative that best completes the statement or answers the question.

- 1) The square plates of a 9000 pF capacitor measure 60 mm by 60 mm and are separated by a dielectric which is 0.18 mm thick. The voltage rating of the capacitor is 300 V. The dielectric constant of the dielectric is closest to: 1) _____
- A) 42 B) 46 C) 55 D) 37 **E) 51**

- 2) 2) _____

Figure 1



Initially, for the circuit shown, the switch S is open and the capacitor is uncharged. The switch S is closed at time $t = 0$. In Figure 1, when the time t is equal to 20.0 s, the potential difference across the resistor is closest to:

- A) 22 V B) 26 V **C) 18 V** D) 30 V E) 33 V

- 3) An 42 mH solenoid inductor is wound on a form 0.80 m in length and 0.10 m in diameter. A coil is tightly wound around the solenoid at its center. The coil resistance is 2.4 ohms. The mutual inductance of the coil and solenoid is 28 μ H. At a given instant, the current in the solenoid is 940 mA, and is decreasing at the rate of 2.5 A/s. At the given instant, the induced emf in the solenoid is closest to: 3) _____
- A) 95 mV B) 84 mV C) 74 mV **D) 110 mV** E) 120 mV

- 4) A series RLC circuit has a peak current of 2.0 A with a frequency of 36 kHz. If the resistance of the circuit is 53 k Ω , the capacitance of the circuit is 14 μ F, and the inductance of the circuit is 24 H, determine the average power of the circuit over one cycle. 4) _____
- A) 17,000 W B) 320,000 W **C) 110,000 W** D) 32,000 W

- 5) A 3.0 A current passes through an inductor. If the inductor stores 11 J of energy, what is the inductance? 5) _____
- A) 2.44 H** B) 49.5 H C) 2.7 H D) 33 H

- 6) In a series R-L-C circuit suppose V_C , V_L , V_R are the potential differences across the three elements. Then for such a circuit 6) _____
- A) the current in the inductor will not necessarily be in phase with the current in the other two elements.
 B) equal amounts of power will be dissipated in the resistor, the inductor, and the capacitor only when the circuit is at resonance.
 C) equal amounts of power will be dissipated in the inductor, the capacitor, and the resistor.
 D) the voltage across the resistor will always be in phase with the applied emf.
E) None of these is true.

- 7) When an electromagnetic wave falls on a white, perfectly reflecting surface, it exerts a force F on that surface. If the surface is now painted a perfectly absorbing black, the force that the same wave would exert on the surface is: 7) _____
- A) $2F$ B) $4F$ C) F **D) $F/2$** E) $F/4$

- 8) A double-concave lens has equal radii of curvature of magnitude 15.1 cm. An object placed 14.2 cm from the lens forms a virtual image 4.20 cm from the lens. What is the index of refraction of the lens material? 8) _____
 A) 2.11 B) 2.36 C) 2.27 D) 2.18
- 9) A double convex thin lens has equal magnitude of radii of curvature. The focal length of the lens is +42.0 cm and the index of refraction of the lens is 1.52. The magnitude of the radius of curvature of each convex surface, in cm, is closest to: 9) _____
 A) 35 B) 39 C) 44 D) 48 E) 52
- 10) Two identical large parallel metal sheets carry equal but opposite charges. When they are 2.00 cm apart, the potential difference between them is 20.0 V. If they are now moved closer until they are 1.00 cm apart, the potential difference between them will be closest to: 10) _____
 A) 5.00 V B) 10.0 V C) 20.0 V D) 80.0 V E) 40.0 V

Regular problems (10 points each)

11. As part of a piece of optical apparatus to be used in air, you need to design a thin glass lens with radii of curvature of same magnitude. The index of refraction for the glass is 1.5. When an object is placed 30.0 cm from this lens, the image magnification should be $m = -3$. Find the radii of the curvature of the lens.

$$m = -3, \quad s = 30 \text{ cm} = 0.3 \text{ m} \quad \therefore m = -\frac{s'}{s} \Rightarrow s' = -ms = 0.9 \text{ m}$$

$$\frac{1}{f} = \frac{1}{s} + \frac{1}{s'} \quad \text{solve for } f = 22.5 \text{ cm} = 0.225 \text{ m}$$

$$\frac{1}{f} = (n-1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right); \quad n = 1.5, \quad f > 0, \quad \therefore R_1 > 0, \quad R_2 < 0$$

$$R_1 = -R_2$$

$$\frac{1}{f} = (n-1) \frac{2}{R_1} \quad \rightarrow \quad R_1 = 0.225 \text{ m}, \quad R_2 = -0.225 \text{ m}$$

12) What is the current through resistor R_1 in the circuit in Figure 3? 12) _____

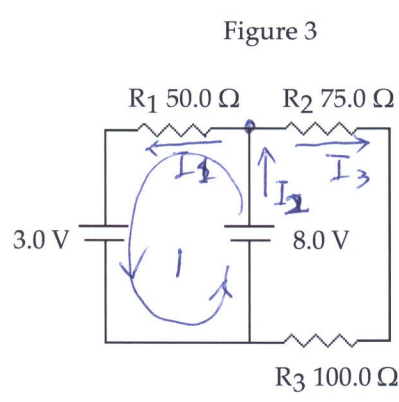
Loop 1.

$$\mathcal{E}_2 - \mathcal{E}_1 = I_1 R_1$$

$$R_1 = 50 \, \Omega$$

$$\therefore I_1 = \frac{\mathcal{E}_2 - \mathcal{E}_1}{R_1}$$

$$= \frac{8 - 3}{50} = 0.1 \text{ (A)}$$



$$\mathcal{E}_1 = 3 \text{ (V)}$$

$$\mathcal{E}_2 = 8 \text{ (V)}$$