PHY2054 TEST II

Name_____ Panther ID _____

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

1) A circular coil of wire of 200 turns and diameter 4 cm carries a current of 5 A. It is placed in a magnetic field of 0.50 T with the plane of the coil making an angle of 30° with the magnetic field. What is the torque on the coil? 1) _____

A) 0.54 N • m B) 0.31 N • m C) 1.4 N • m D) 0.27 N • m E) 1.0 N • m

2) A charged particle of mass 0.0040 kg is subjected to a 4.0 T magnetic field which acts at a right angle to its motion. If the particle moves in a circle of radius 0.10 m at a speed of 2.0 m/s, what is the magnitude of the charge on the particle? 2) _____

A) 2500 C B) 0.020 C C) 0.00040 C D) 50 C

3) Alpha particles (charge = +2e, mass = 6.68×10^{-27} kg) are accelerated in a cyclotron to a final orbit radius of 0.50 m. The magnetic field in the cyclotron is 0.50 T. The kinetic energy of an alpha particle in the final orbit is closest to: 3) _____

A) 2.6 MeV B) 3.4 MeV C) 3.9 MeV D) 4.3 MeV E) 3.0 MeV

4) A charged particle moving within a static magnetic field 4) _____

A) will always experience a magnetic force, regardless of its direction of motion.
B) may experience a magnetic force, but its speed will not change.
C) may experience a magnetic force which will cause its speed to change.
D) None of the above statements are true.

5) A very long straight current-carrying wire produces a magnetic field of 20 mT at a distance d from the wire. To measure a field of 5 mT due to this wire, you would have to go to a distance of 5) _____

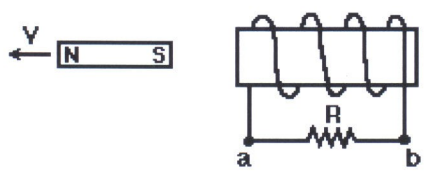
A) $2d$ B) $8d$ C) $d\sqrt{2}$ D) $4d$ E) $16d$

6) A 1.0 μF capacitor is charged until it acquires a potential difference of 900.0 V across its plates, then the emf source is removed. If the capacitor is then discharged through a 500.0 kΩ resistance of a circuit, what is the voltage drop across the capacitor 9.0 ms later? 6) _____

A) 16 V B) -16 V C) 880 V D) 920 V

7) In Figure 1, a bar magnet moves away from the solenoid. The induced current through the resistor R is: 7) _____

Figure 1



A) from a to b B) from b to a C) zero

8) A circular coil of 20 turns and radius 5 cms is placed with its plane oriented at 90° to a magnetic field of 0.1 T. The field is now increased at a steady rate, reaching a value of 0.5 T after 4 seconds. What EMF is induced in the coil? 8) _____

A) 0.021 V B) 0.031 V C) 0.016 V D) 0.026 V E) 0.036 V

9) What is the radius of a tightly wound solenoid of circular cross-section that has 180 turns if a change in its internal magnetic field of 3.0 T/s causes a 6.0 A current to flow? The resistance of the circuit that contains the solenoid is 17 Ω. The only emf source for the circuit is the induced emf. 9) _____

A) 0.25 m B) 0.043 m C) 0.014 m D) 0.54 m

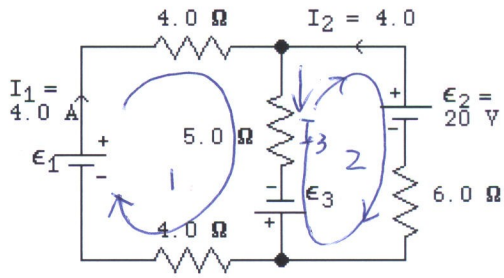
10) A 2.0 m conductor is formed into a square and placed in the horizontal *xy*-plane. A magnetic field is oriented 30.0° above the horizontal xy-plane with a strength of 1.0 T. What is the magnetic flux through the conductor? 10) _____

A) 0.25 T • m^2 B) 0.12 T • m^2 C) 0.22 T • m^2 D) 2.0 T • m^2

Regular Problems (10 points each)

11. In Figure 2, consider the circuit sketched. Note that two currents are shown. Calculate the emf's ε_1 and ε_3.

Figure 2



From the Junction rule $I_1 + I_2 = I_3$

$I_3 = I_1 + I_2 = 8$ (A)

From the loop rule:

① $\varepsilon_1 + \varepsilon_3 = 4I_1 + 4I_1 + 5I_3$ — <1>

$= 72$

② $-\varepsilon_2 - \varepsilon_3 = -5I_3 - 6I_2$ — <2>

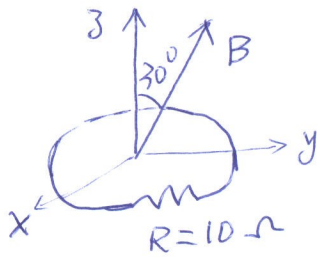
$= -64$

Solve <1> & <2>. from <2> $\varepsilon_3 = 64 - \varepsilon_2 = 44$ (V)

Then $\varepsilon_1 = 28$ (V).

11) _____

12) A circular conducting loop with a radius of 0.50 m and a small gap filled with a 10.0 Ω resistor is oriented in the *xy*-plane. If a magnetic field of 1.0 T, making an angle of 30° with the *z*-axis, increases to 10.0 T, in 4.0 s, Find (a) the magnitude of the induced emf and (b) the induced current that will be caused to flow in the conductor? 12) _____



$r = 0.5$ m. $R = 10\ \Omega$.

B from 1 T to 10 T in 4 s.

so $\frac{\Delta B}{\Delta t} = \frac{10-1}{4} = 2.25$ T/s

$\Phi_B = AB\cos(30°)$, $A = \pi r^2$

a> $\mathcal{E}mf = \mathcal{E} = \left|\frac{\Delta \Phi_B}{\Delta t}\right| = A\cos(30°)\left|\frac{\Delta B}{\Delta t}\right|$

$= 1.53$ (V)

b> $I_{in} = \frac{\mathcal{E}}{R} = 0.153$ (A)