Multiple choice questions. Circle the correct answer. No work needs to be shown and no partial credit will be given.

(6 pts) 1. Consider the circuit shown in the sketch. Initially, the switch is open and the capacitor is uncharged. What is the voltage across the resistor just after the switch is closed?

\( E = 12.0 \) V

(a) zero  
(b) 2.0 V  
(c) 4.0 V  
(d) 6.0 V  
(e) 12.0 V  
(f) 36.0 V  
(g) none of the above answers

(6 pts) 2. Consider the circuit shown in the sketch. Initially, the switch is open. What is the voltage across the resistor just after the switch is closed?

(a) zero  
(b) 2.0 V  
(c) 4.0 V  
(d) 6.0 V  
(e) 12.0 V  
(f) 36.0 V  
(g) none of the above answers

(6 pts) 3. A capacitor with capacitance \( 5.0 \times 10^{-9} \) F initially has charge of magnitude \( 2.0 \times 10^{-4} \) C on each plate. The charged capacitor is then connected to an inductor with inductance 4.0 H. During the current oscillations that occur after the circuit is completed, what is the maximum current in the inductor?

\( b = 1.41 \) A

(a) zero  
(b) 1.41 A  
(c) 2.00 A  
(d) 4.00 A  
(e) 8.00 A  
(f) none of the above answers
(6 pts) 4. A rectangular wire loop is being pulled out of a region of uniform magnetic field that is directed into the page. While the loop is being pulled out of the field (that is, part of the loop is still in the field and part is already out of the field, as shown in the sketch), what is the direction of the current induced in the loop?

(a) clockwise (b) counterclockwise (c) the induced current is zero

(6 pts) 5. A rectangular loop of wire has area $A$ and carries current $I$ as shown in the sketch. The loop is in a uniform magnetic field $B$ that is directed into the page. For the axis shown, what is the magnitude of the torque on the loop?

(a) $\frac{1}{2} IAB$ (b) $IAB$ (c) zero (d) $BA$ (e) none of the above answers

(6 pts) 6. A circular loop of wire is in a magnetic field that is directed into the page. If the magnitude of the magnetic field is increasing at a constant rate, the current induced in the loop of wire is

(a) zero (b) clockwise (c) counterclockwise

(6 pts) 7. A small particle with negative charge enters a region of uniform magnetic field and travels along the path shown in the sketch. The magnetic field in the region has direction

(a) into the page (b) out of the page (c) toward the top of the page (d) toward the bottom of the page (e) to the left (f) to the right
(6 pts) 8. Three long, straight parallel wires carry currents of the same magnitude and in the directions shown. Adjacent wires are separated by distance $a$. The net force that wires 1 and 2 exert on wire 3

(a) is zero
(b) has direction toward the top of the page
(c) has direction toward the bottom of the page

(6 pts) 9. A particle with negative charge $q$ is moving to the right and enters a region where the magnetic field is uniform and directed into the page. If the particle moves through the region with constant velocity, the electric field in the region has direction

(a) into the page
(b) out of the page
(c) to the left
(d) to the right
(e) toward the top of the page
(f) toward the bottom of the page

On the following problems show all your work. Partial credit will be given, if earned. Write your answers in the blanks provided. All answers must include the correct plus or minus sign and the correct units.

(14 pts) 10. A long straight solenoid has 800 turns. When the current in the solenoid is increasing at a constant rate of +0.20 A/s, the emf induced in the coil is 0.060 V.

a) What is the self-inductance of the solenoid?

Ans. $0.3 \text{ H}$

b) When the current in the solenoid is 15.0 A, what is the average magnetic flux through each turn of the solenoid?

Ans. $0.00562 \text{ Wb}$
11. A long straight wire carries current $I = 5.0\, \text{A}$ in the direction shown in the sketch. A small sphere with negative charge $q = -8.0 \times 10^{-6}\, \text{C}$ is 0.20 m from the wire and is moving parallel to the wire in the direction opposite to the current direction. The speed of the sphere is $v = 40.0\, \text{m/s}$.

a) What are the magnitude and direction of the magnetic field of the wire at the location of the sphere? (The direction is one of the following: into the page, out of the page, toward the top of the page, toward the bottom of the page, to the left or to the right.)

Ans. $B = 5.0 \times 10^{-6}\, \text{T}$

direction out of page

b) What are the magnitude and direction of the force that the wire exerts on the sphere? (The direction is one of the following: into the page, out of the page, toward the top of the page, toward the bottom of the page, to the left or to the right.)

Ans. $F = 1.6 \times 10^{-9}\, \text{N}$

direction toward bottom of page
12. Consider the circuit shown in the sketch. The current in the 8.0 Ω resistor is 2.0 A, in the direction shown.

\[ R_1 = 4.0 \Omega \]

\[ R_3 \]

(a) What is \( I_1 \), the current through the 4.0 Ω resistor?

\[
\text{Ans. } 5.0 \text{A}
\]

(b) What is the resistance of the resistor \( R_3 \)?

\[
\text{Ans. } 9 \Omega
\]