The purpose of this review is to refresh your memory. Physics is a cumulative subject, so make sure that you understand basic concepts and typical problem solving techniques in previous chapters before moving on to a new chapter.

A. Magnetic Field due to Currents
In the figure, current $i = 50$ mA is set up in a loop having two radial lengths and two semicircles of radii $a = 4$ cm and $b = 8$ cm with a common center $P$. Find the magnetic field at $P$ and the loop’s magnetic dipole moment.

B. Magnetic Force between Two Parallel Currents
Three long wires are parallel to a $z$ axis, and each carries a current of 2 A in the positive $z$ direction. There points of intersection with the $xy$ plane form an equilateral triangle with sides of 30 cm as shown in the figure. A fourth wire (wire $b$) passes through the midpoint of the base of the triangle and is parallel to the other three wires. If the net magnetic force on wire $a$ is zero, what are the magnitude and direction of the current in wire $b$?

C. Electromagnetic Induction
In the wire arrangement in the figure below right, $a = 20$ cm and $b = 30$ cm. The current in the wire is given by $I = 4t$, where $I$ is in amperes and $t$ is in seconds. Find the induced emf in the square loop at $t = 5$ s.

D. RL Circuits
The current in an $RL$ circuit drops from 10 A to 0.1 A in the first 5 seconds following removal of the battery from the circuit. If $L$ is 15 H, find the resistance $R$ in the circuit.
Working on this problem set is optional, but it is strongly recommended. It is quite possible that some of these problems will appear in exams. Do it on a weekly basis. Cramming is tiring and sometimes it ends up in a disaster.

1. In the figure, the current element \( \text{idl} \), the point \( P \), and the three vectors (1, 2, 3) are all in the plane of the page. The direction of \( dB \), due to this current element, at the point \( P \) is: (Biot-Savart Law) a. in the direction marked “1” b. in the direction marked “2” c. in the direction marked “3” d. out of the page e. into the page

2. In Ampere’s law, \( |B|ds = \mu_0i \), the integration must be over any: (Ampere’s Law) a. surface b. closed surface c. path d. closed path e. closed path that surrounds all the currents producing \( B \)

3. The diagram show three circuits consisting of concentric circular arcs (either half or quarter circles of radii \( r \), \( 2r \) and \( 3r \)) and radial lengths. The circuits carry the same current. Rank them according to the magnitudes of the magnetic fields they produce at \( C \), least to greatest. (Magnetic Field due to Current Loops) a. 1, 2, 3 b. 3, 2, 1 c. 1, 3, 2 d. 2, 3, 1 e. 2, 1, 3

4. Two parallel long wires carry the same current and repel each other with a force \( F \) per unit length. If both these currents are doubled and the wire separation tripled, the force per unit length becomes: (Force between Parallel Currents) a. \( 2F/9 \) b. \( 4F/9 \) c. \( 2F/3 \) d. \( 4F/3 \) e. \( 6F \)

5. A rectangular loop of wire is placed midway between two long straight parallel conductors as shown. The conductors carry current \( i_1 \) and \( i_2 \), as indicated. If \( i_1 \) is increasing and \( i_2 \) is constant, then the induced current in the loop is: (Lenz’s Law) a. zero b. clockwise c. counterclockwise d. depends on \( i_1 - i_2 \) e. depends on \( i_1 + i_2 \)

6. A cylindrical region of radius \( R = 3.0 \) cm contains a uniform magnetic field parallel to its axis. If the electric field induced at a point \( R/2 \) from the cylinder axis is \( 4.5 \times 10^{-3} \) V/m, the magnitude of the magnetic field must be changing at the rate: (Faraday’s Law) a. 0 b. 0.30 T/s c. 0.60 T/s d. 1.2 T/s e. 2.4 T/s

7. A 10-turn ideal solenoid has an inductance of 3.5 mH. When the solenoid carries a current of 2.0 A, the magnetic flux through each turn is: (Inductors) a. 0 b. \( 3.5 \times 10^{-4} \) wb c. \( 7.0 \times 10^{-4} \) wb d. \( 7.0 \times 10^{-2} \) wb e. \( 7.0 \times 10^{-3} \) wb

8. An 8.0-mH inductor and a 2.0-\( \Omega \) resistor are wired in series to an ideal battery. A switch in the circuit is closed at time 0, at which time the current is zero. The current reaches half its final value at a time of (RL circuit) a. 2.8 ms b. 4.0 ms c. 3 s d. 170 s e. 250 s

Answers: 1-e 2-d 3-b 4-d 5-c 6-c 7-c 8-a