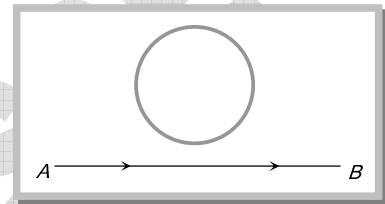


**Electromagnetic Induction**

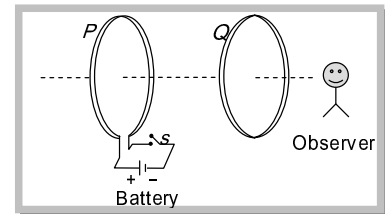
1. A solenoid is 1.5 m long and its inner diameter is 4.0 cm. It has three layers of windings of 1000 turns each and carries a current of 2.0 amperes. The magnetic flux for a cross section of the solenoid is nearly
- (a)  $2.5 \times 10^{-7}$  weber (b)  $6.31 \times 10^{-6}$  weber (c)  $5.2 \times 10^{-5}$  weber (d)  $4.1 \times 10^{-5}$  weber
2. A small coil is introduced between the poles of an electromagnet so that its axis coincides with the magnetic field direction. The number of turns is  $n$  and the cross sectional area of the coil is  $A$ . When the coil turns through  $180^\circ$  about its diameter, the charge flowing through the coil is  $Q$ . The total resistance of the circuit is  $R$ . What is the magnitude of the magnetic induction
- (a)  $\frac{QR}{nA}$  (b)  $\frac{2QR}{nA}$  (c)  $\frac{Qn}{2RA}$  (d)  $\frac{QR}{2nA}$
3. An electron moves along the line  $AB$ , which lies in the same plane as a circular loop of conducting wires as shown in the diagram. What will be the direction of current induced if any, in the loop

- (a) No current will be induced  
 (b) The current will be clockwise  
 (c) The current will be anticlockwise  
 (d) The current will change direction as the electron passes by



4. As shown in the figure,  $P$  and  $Q$  are two coaxial conducting loops separated by some distance. When the switch  $S$  is closed, a clockwise current  $i_P$  flows in  $P$  (as seen by observer) and an induced current  $i_{Q_1}$  flows in  $Q$ . The switch remain closed for a long time. When  $S$  is opened, a current  $i_{Q_2}$  flows in  $Q$ . Then the directions of  $i_{Q_1}$  and  $i_{Q_2}$  (as seen by observer) are

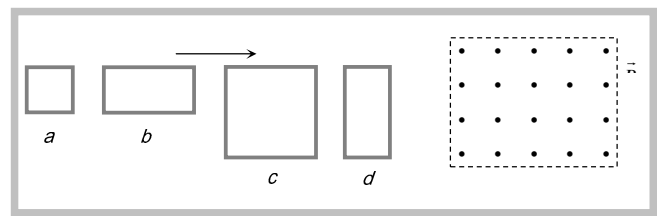
- (a) Respectively clockwise and anticlockwise  
 (b) Both clockwise  
 (c) Both anticlockwise  
 (d) Respectively anticlockwise and clockwise



5. Two identical circular loops of metal wire are lying on a table without touching each other. Loop  $A$  carries a current which increases with time. In response the loop  $B$
- (a) Remain stationary (b) Is attracted by the loop  $A$   
 (c) Is repelled by the loop  $A$  (d) Rotates about its CM with CM fixed
6. In a uniform magnetic field of induction  $B$  a wire in the form of a semicircle of radius  $r$  rotates about the diameter of the circle with an angular frequency  $\omega$ . The axis of rotation is perpendicular to the field. If the total resistance of the circuit is  $R$  the mean power generated per period of rotation is
- (a)  $\frac{(B\pi r\omega)^2}{2R}$  (b)  $\frac{(B\pi r^2\omega)^2}{8R}$  (c)  $\frac{B\pi^2\omega}{2R}$  (d)  $\frac{(B\pi r\omega^2)^2}{8R}$

7. The figure shows four wire loops, with edge lengths of either  $L$  or  $2L$ . All four loops will move through a region of uniform magnetic field  $\vec{B}$  (directed out of the page) at the same constant velocity. Rank the four loops according to the maximum magnitude of the e.m.f. induced as they move through the field, greatest first

- (a)  $(e_c = e_d) < (e_a = e_b)$   
 (b)  $(e_c = e_d) > (e_a = e_b)$   
 (c)  $e_c > e_d > e_b > e_a$   
 (d)  $e_c < e_d < e_b < e_a$



8. The resistance and inductance of series circuit are  $5 \Omega$  and  $20 H$  respectively. At the instant of closing the switch, the current is increasing at the rate  $4 A\cdot s$ . The supply voltage is
- (a) 20 V (b) 80 V (c) 120 V (d) 100 V
9. Two circular coils have their centres at the same point. The mutual inductance between them will be maximum when their axes

## GRAVITY CLASSES

- (a) Are parallel to each other  
(b) Are at  $60^\circ$  to each other  
(c) Are at  $45^\circ$  to each other  
(d) Are perpendicular to each other
10. Two conducting circular loops of radii  $R_1$  and  $R_2$  are placed in the same plane with their centres coinciding. If  $R_1 \gg R_2$ , the mutual inductance  $M$  between them will be directly proportional to
- (a)  $R_1, R_2$                       (b)  $\frac{1}{(R_1 R_2)}$                       (c)  $\frac{R_1^2}{R_2}$                       (d)  $\frac{R_2^2}{R_1}$
11. An inductor of  $2\text{ H}$  and a resistance of  $10\text{ ohm}$  are connected to a battery of  $5\text{ V}$  in series. The initial rate of change of current is
- (a)  $0.5\text{ A/sec}$                       (b)  $2.0\text{ A/sec}$                       (c)  $2.5\text{ A/sec}$                       (d)  $0.25\text{ A/sec}$
12. A solenoid has an inductance of  $60\text{ henry}$  and a resistance of  $30\ \Omega$ . If it is connected to a  $100\text{ volt}$  battery, how long will it take for the current to reach  $\frac{e-1}{e} = 63.2\%$  of its final value
- (a)  $1\text{ second}$                       (b)  $2\text{ seconds}$                       (c)  $e\text{ seconds}$                       (d)  $2e\text{ seconds}$
13. In series with  $20\text{ ohm}$  resistor a  $5\text{ henry}$  inductor is placed. To the combination an e.m.f. of  $5\text{ volt}$  is applied. What will be the rate of increase of current at  $t = 0.25\text{ second}$
- (a)  $2.01\text{ A/s}$                       (b)  $3\text{ A/s}$                       (c)  $0.368\text{ A/s}$                       (d) Zero
14. Self inductances of two coils connected in series are  $0.01$  and  $0.03\text{ H}$ . If the windings in the coils are in opposite sense and  $M = 0.01\text{ H}$ , then the resultant self-inductance will be
- (a)  $2\text{ H}$                       (b)  $0.2\text{ H}$                       (c)  $0.02\text{ H}$                       (d) Zero
15. A conducting loop of area  $5.0\text{ cm}^2$  is placed in a magnetic field which varies sinusoidally with time as  $B = B_0 \sin \omega t$  where  $B_0 = 0.20\text{ T}$  and  $\omega = 300\text{ s}^{-1}$ . The normal of the coil makes an angle of  $60^\circ$  with the field. Find the maximum  $emf$  induced in the coil and  $emf$  induced at  $t = (\pi/900\text{ sec.})$
- (a)  $0.15\text{ V}, 7.5 \times 10^{-3}\text{ V}$                       (b)  $0.15\text{ V}, \text{zero}$                       (c)  $0.015\text{ V}, \text{zero}$                       (d)  $0.015\text{ V}, 7.5 \times 10^{-3}\text{ V}$