Vidyamandir Classes
Gurukul for IITJEE Preparation

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Exercise	Electromagnetic Induction & AC	Physics

Electromagnetic Induction

2002

1. A conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnetic induction B constant in time and space, pointing perpendicular and into the plane at the loop exists everywhere with half the loop outside thefield, as shown in figure. The induced emf is

Fig 2?

(1) zero (2) RvB (3) VBL/R (4) VBL

2. The inductance between A and D is **Fig 3?**

(1) 3.66 H (2) 9 H (3) 0.66 H (4) 1 H

3. In a transformer , number of turns in the primary coil are 140 and that in the secondary coil are 280. If current in primary coil is 4A, then that in the secondary coil is

(1) 4 A (2) 2 A (3) 6 A (4) 10 A

2003

4. Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon

(1) the rates at which currents are changing in the two coils
(2) relative position and orientation of the two coils
(3) the materials of the wires of the coils.
(4) the currents in the two coils

5. When the current changes from +2A to -2A in 0.05 second, an e.m.f. of 8V is induced in a coil. The coefficient of self-induction of the coil is

(1) 0.2 H (2) 0.4 H (3) 0.8 H (4) 0.1 H

6. In an oscillating LC circuit the maximum charge on the capacitor is Q. The charge on the capacitor when the energy is stored equally between the electric and magnetic field is

(1) $\frac{Q}{2}$ (2) $\frac{Q}{\sqrt{3}}$ (3) $\frac{Q}{\sqrt{2}}$ (4) Q

7. The core of any transformer is laminated so as to
(1) reduce the energy loss due to eddy currents (2) make it light weight
(3) make it robust and strong (4) increase the secondary voltage

2004

8. A coil having n turns and resistance 4R Ω This combination is moved in time t seconds from a magnetic field W_1 weber to W_2 weber. The induced current in the circuit is

(1) $-\frac{W_2 - W_1}{5Rnt}$ (2) $-\frac{W_2 - W_1}{5Rt}$ (3) $-\frac{W_2 - W_1}{Rnt}$ (4) $-\frac{W_2 - W_1}{Rnt}$

9. In a uniform magnetic field of induction B a wire in the form of semicircle of radius r rotates about the diameter of the circle with angular frequency ω. 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

(1) $\frac{B\pi r^2\omega}{2R}$ (2) $\frac{(B\pi r^2\omega)^2}{2R}$

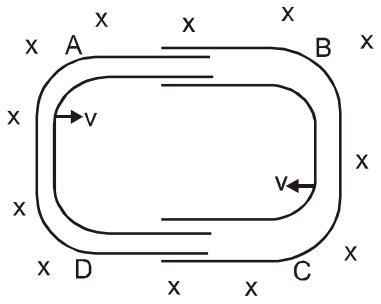
(3) $\frac{(B\pi r\omega)^2}{2R}$ (4) $\frac{(B\pi r\omega)^2}{8R}$

10. A metal conductor of length 1 m rotates vertically about one of its ends at angular velocity 5 radians per second. If the horizontal component of earth's magnetic field is 0.3×10^{-4} T, then the e.m.f. developed between the two ends of the conductor is
(1) depends on the nature of the metal used
(2) depends on the intensity of the radiation
(3) depends both on the intensity of the radiation and the metal used
(4) is the same for all metals and independent of the intensity of the radiation.

2005

11. One conducing U tube can slide inside another as shown in figure, maintaining electrical contacts between the tubes. The magnetic field B is perpendicular to the

plane of the figure. If each tube moves towards the other at a constant speed v, then the emf induced in the circuit in terms of B, l and v, where l is the width of each tube will be.



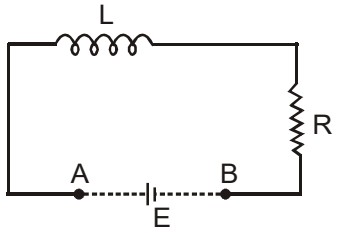
(1) Blv (2) –Blv
(3) zero (4) 2 Blv

12. A coil of inductance 300 mH and resistance 2 Ω is connected to a source of voltage 2V. The current reaches half of its steady state value in:
(1) 0.05 s (2) 0.1 s (3) 0.15 s (4) 0.3 s

2006

13. The flux linked with a coil at nay instant 't' is given by $\phi = 10t^2 - 50t + 250$.
The induced emf at. t = 3 s is
(1) 190 V (2) 10 V (3) 10 V (4) 190 V

14. An inductor (L = 100 mH) , a resistor (R = 100 Ω) and a battery (E = 100 V) are initially connected in series as shown in the figure. After a long time the battery is disconnected after short circuiting the points A and B. The current in the circuit 1 ms after the short circuit is



(1) 1/e A (2) e A (3) 0.1 A (4) 1 A

2007

15. An ideal coil of 10 H is connected in series with a resistance of 5 Ω and a battery of

5 V. 2 seconds after the connection is made, the current flowing in amperes in the circuit is

(1) $(1 - e^{-1})$ (2) $(1 - e)$ (3) e (4) e^{-1}

2008

16. Two coaxial solenoids are made by winding thin insulated wire over a pipe of cross-sectional area A = 10 cm^2 and length = 20 cm. If one of the solenoids has 300 turns and the other 400 turns, their mutual inductance is

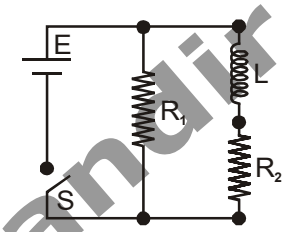
$\left(\mu_0 = 4\pi \times 10^{-7}\ T\ m\ A^{-1}\right)$

(1) $2.4\pi \times 10^{-4}$ H (2) $2.4\pi \times 10^{-5}$ H

(3) $4.8\pi \times 10^{-4}$ H (4) $4.8\pi \times 10^{-5}$ H

2009

17.

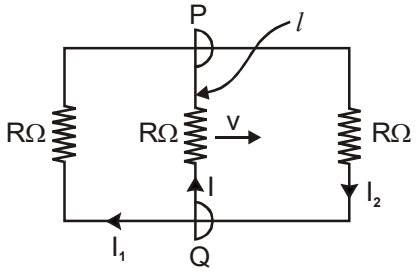


An inductor of inductance L = 400 mH and resistors of resistances $R_1 = 2\Omega$ and $R_2 = 2\Omega$ are connected to a battery of emf 12V as shown in the figure. The internal resistance of the battery is negligible. The switch S is closed at t = 0. The potential drop across L as a function of time is :

(1) $6e^{-5t}V$ (2) $\frac{12}{t}e^{-3t}V$ (3) $6\left(1 - e^{-t/0.2}\right)V$ (4) $12e^{-5t}V$

2010

18. A rectangular loop has a sliding connector PQ of length l and resistance $R\Omega$ and it is moving with a speed v as shown. The set-up is placed in a uniform magnetic field going into the plane of the paper. The three currents I_1, I_2 and I are



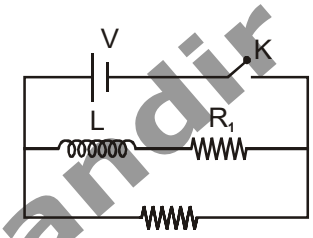
(1) $I_1 = I_2 = I = \frac{Blv}{R}$

(2) $I_1 = I_2 = \frac{Blv}{6R}, I = \frac{Blv}{3R}$

(3) $I_1 = -I_2 = \frac{Blv}{R}, I = \frac{2Blv}{R}$

(4) $I_1 = I_2 = \frac{Blv}{3r}, I = \frac{2Blv}{3R}$

19. In the circuit shown below, the key K is closed at t = 0. The current through the battery is



(1) $\frac{V}{R_2}$ at t = 0 and $\frac{VR_1R_2}{\sqrt{R_1^2+R_2^2}}$ at $t = \infty$

(2) $\frac{V(R_1+R_2)}{R_1R_2}$ at t = 0 and $\frac{V}{R_2}$ at $t = \infty$

(3) $\frac{VR_1R_2}{\sqrt{R_1^2+R_2^2}}$ at t = 0 and $\frac{V}{R_2}$ at $t = \infty$

(4) $\frac{V}{R_2}$ at t = 0 and $\frac{V(R_1+R_2)}{R_1R_2}$ at $t = \infty$

2011(I)

20. A boat is moving due east in a region where the earth's magnetic field is 5.0×10^{-5} $NA^{-1}m^{-1}$ due north and horizontal. The boat carries a vertical aerial pole 2m long. If the speed of the boat is 1.50 ms^{-1}, the magnitude of the induced emf in the wire of aerial is

(1) 0.75 mV (2) 0.50 mV (3) 0.15 mV (4) 1 mV

21. A fully charged capacitor C with initial charge q_0 is connected to a coil of self inductance L at t = 0. The time at which the energy is stored equally between the electric and the magnetic fields is

(1) $\frac{\pi}{4}\sqrt{LC}$ (2) $2\pi\sqrt{LC}$ (3) $\sqrt{LC}$ (4) $\pi\sqrt{LC}$

2011(II)

22. A horizontal straight wire 20 m long extending from east to west is falling with a speed of 5.0 m/s, at right angled to the horizontal component of the earth's magnetic field 0.30×10^{-4} Wb/m^2. The instantaneous value of the e.m.f. induced in the wire will be

(1) 6.0 mV (2) 3 mV (3) 4.5 mV (4) 1.5 mV

2012

23. A coil is suspended in a uniform magnetic field, with the plane of the coil parallel to magnetic lines of forces. When a current is passed through the coil, it starts oscillating; it is very difficult to stop.But if Alumunium plate is placed near to the coil, it stops. This is due to :

(1) development of air current when plate is placed.

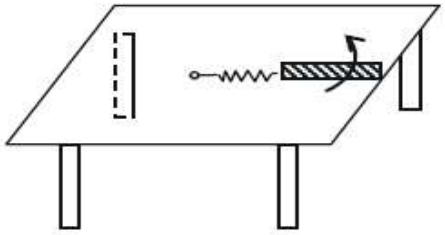
(2) induction od electric charge on the plate.

(3) shielding of magnetic lines of forces as alumunium is paramagnetic material.

(4) electromagnetic induction in the alumunium plate giving rise to electromagnetic damping.

2013

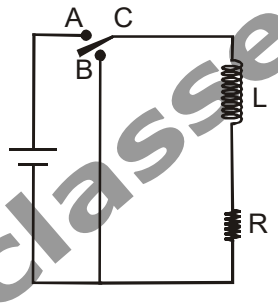
24. A metallic rod of length 'l' is tied to a string oflength 2l and made to rotate with angular speed ω on a horizontal table with one end of the string fixed. If there is a vertical magnetic field 'B' in the region, the e.m.f. induced across the ends of the rod is:



(1) $\frac{3B\omega l^2}{2}$ (2) $\frac{4B\omega l^2}{2}$ (3) $\frac{5B\omega l^2}{2}$ (4) $\frac{2B\omega l^2}{2}$

2014(Offline)

25. In the circuit shown here,the point C is kept connected to a point 'A' till the curent flowing through the circuit becomes constant . Afterward, suddenly, point 'C' is disconnected from point 'A' and connected to point 'B' at time t=0. Ratio of the voltage across resistance and inductor at t = L/R will be equal to :

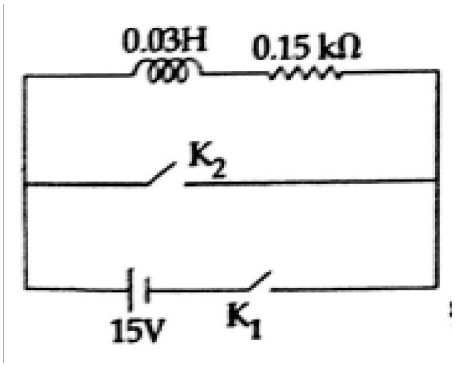


(1) –1 (2) $\frac{1-e}{e}$

(3) $\frac{e}{1-e}$ (4) 1

2015(Offline)

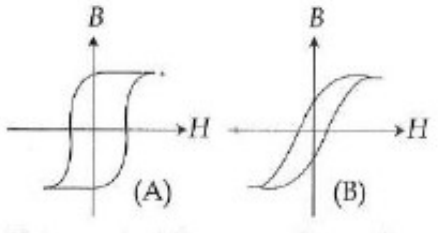
26. An inductor (L =0.03 H)and a resistor (R = 0.15 kΩ) are connected in series to a battery of 15 V EMF in a circuit shown below. The key K_1 has been kept closed for a long time. Then at t = 0 K_1 is opened and key K_2 is closed simultaneously. At t = 1 ms, the current in the circuit will be : ($e^5 \cong 150$)



(1) 67 mA (2) 6.7 mA (3) 0.67mA (4) 100 mA

2016(Offline)

27. Hysteresis loops for two magnetic materials A and B are given below :



These materials are used to make magnets for electric generators, transformer core and electromagnet core. then it is proper to use
(1) A for electric generators and transformer
(2) A for electromagnets and B for electric generators
(3) A for transformer and B for electric generators
(4) B for electromagnets and transformer

Alternating Current

2002

28. The power factor of an AC circuit having resistance (R) and inductance (L) connected in series and an angular velocity ω is

(1) $\frac{R}{\omega L}$

(2) $\frac{R}{\left(R^2+\omega^2L^2\right)^{1/2}}$

(3) $\frac{\omega L}{R}$

(4) $\frac{R}{\left(R^2-\omega^2L^2\right)^{1/2}}$

2004

29. In a LCR circuit capacitance is changed from C to 2C. For the resonant frequency to remain unchanged, the inductance should be changed from L to
(1) 4L (2) 2L (3) L/2 (4) L/4

30. In an LCR series a.c. circuit, the voltage across each of the components, L, C and R is 50 V. The voltage across the LC combination will be
(1) 50 V (2) $50\sqrt{2}$ V
(3) 100 V (4) 0 V

2005

31. The self inductance of the motor of an electric fan is 10 H. In order to impart maximum power at 50 Hz, it should be connected to a capacitance of:

(1) $4\ \mu F$ (2) $8\ \mu F$ (3) $1\ \mu F$ (4) $2\ \mu F$

32. A circuit has a resistance of 12 ohm and an impedance of 15 ohm. The power factor of the circuit will be:

(1) 0.8 (2) 0.4

(3) 1.25 (4) 0.125

33. The phase difference between the alternating current and emf is $\frac{\pi}{2}$. Which of the following cannot be the constituent of the circuit?

(1) C alone (2) R, L

(3) L, C (4) L alone

2006

34. In a series resonant LCR circuit, the voltage across R is 100 volts and R = 1 KΩ with $C = 2\mu F$. The resonant frequency ω is 200 rad/s. At resonance the voltage across L is

(1) $2 \cdot 5 \times 10^2 J$ (2) 40 V

(3) 250 v (4) $4 \times 10^3 v$

35. In a AC generator, a coil with N turns, all of the same area A and total resistance R, rotates with frequency ω in a magnetic field B. The maximum value of emf generated in the coil is

(1) N.A. B. R. ω (2) N.A. B

(3) N.A.B.R (4) N.A.B. ω

2007

36. In an a.c. circuit the voltage applied is $E = E_0 \sin \omega t$. The resulting current in the circuit is $I = I_0 \sin(\omega - \frac{\pi}{2})$. The power consumption in the circuit is given by

(1) $P = \sqrt{2}\, E_0\, I_0$ (2) $P = \frac{E_0\, I_0}{\sqrt{2}}$ (3) P = zero (4) $P = \frac{E_0\, I_0}{2}$

2010

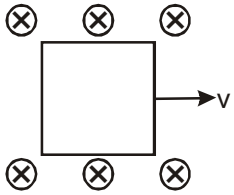
37. In series LCR circuit $R = 200\Omega$ and the voltage and the frequency of the main supply

is 220 V and 50 Hz respectively. On taking out the capacitance from the circuit the current lags behind the voltage by 30°. On taking out the inductor from the circuit the current leads the voltage by 30°. The power dissipated in the LCR circuit is
(1) Zero W (2) 242 W (3) 305 W (4) 210 W

2016(Offline)

38. An arc lamp requires a direct current of 10 A at 80 V to function. If it is connected to 220 V (rms), 50 Hz AC supply, the series inductor needed for it to work is close to :
(1) 80 H (2) 0.08 H (3) 0.044 H (4) 0.065 H

1. A conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnetic induction B, constant in time and space, pointing perpendicular to and into the plane of the loop exists everywhere.

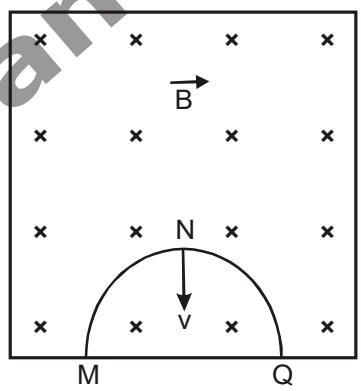


The current induced in the loop is **(IIT JEE 1989; 2M)**

(a) BLv/R clockwise (b) BLv/R anticlockwise

(c) 2BLv/R anticlockwise (d) zero

2. A thin semicircular conducting ring of radius R is falling with its plane vertical in a horizontal magnetic induction $\vec{B}$. At the position MNQ the speed of the ring is v and the potential difference developed across the ring is **(IIT JEE 1996; 2M)**



(a) zero (b) $Bv\pi R^2/2$ and M is at higher potential

(c) πBRv and Q is at higher potential (d) 2RBv and Q is at higher potential

3. A metal rod moves at a constant velocity in a direction perpendicular to its length. A constant uniform magnetic field exists in space in a direction perpendicular to the rod as well as its velocity. Select the correct statement (s) from the following. **(IIT JEE 1998; 2M)**

(a) The entire rod is at the same electric potential

(b) There is an electric field in the rod

(c) The electric potential is highest at the centre of the rod and decrease towards its

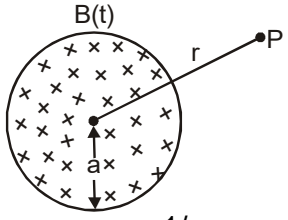
ends
(d) The electric potential is lowest at the centre of the rod and increases towards its ends

4. A small square loop of wire of side l is placed inside a large square loop of wire of side L<L> > l). The loops are coplanar and their centres coincide. The mutual inductance of the system is proportional to **(IIT JEE 1998; 2M)**
(a) l/L (b) l^2/L (c) L/l (d) L^2/l

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 **(IIT JEE 1999; 2M)**
(a) remains stationary (b) is attracted by the loop A
(c) is repelled by the loop A (d) rotates about its CM, with CM fixed

6. A coil of inductance 8.4 mH and resistance Ω is connected to a 12 V battery. The current in the coil is 1A at approximately the time **(IIT JEE 1999; 2M)**
(a) 500 s (b) 20 s (c) 35 ms (d) 1 ms

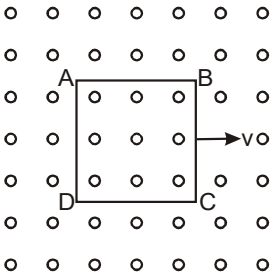
7. A uniform but time-varying magnetic field B(t) exists in a circular region of radius a and is directed into the plane of the paper as shown. The magnitude of the induced electric field at point P at a distance r from the centre of the circular region **(IIT JEE 2000; 2M)**



(a) is zero (b) decreases as 1/r
(c) increases as r (d) decreases as $1/r^2$

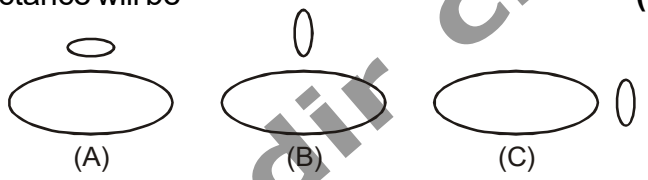
8. A coil of wire having finite inductance and resistance has a conducting ring placed co-axially within it. The coil is connected to a battery at time t = 0, so that a time dependent current $I_1(t)$ starts flowing through the coil. If $I_2(t)$ is the current induced in the ring and B(t) is the magnetic field at the axis of the coil due to $I_1(t)$ then as a function of time (t > 0), the product $I_2(t)$ B (t) **(IIT JEE 2000; 2M)**
(a) increases with time (b) decreases with time
(c) does not vary with time (d) passes through a maximum

9. A metallic square loop ABCD is moving in its own plane with velocity v in a uniform magnetic field perpendicular to its plane as shown in the figure. Electric field is induced **(IIT JEE 2001; 2M)**



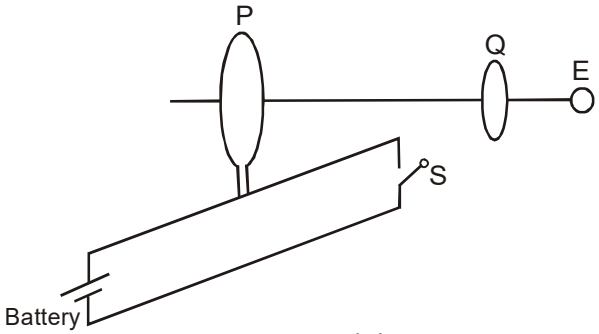
(a) in AD, but not in BC (b) in BC, but not in AC
(c) neither in AD nor in BC (d) in both AD and BC

10. Two circular coils can be arranged in any of the three stuations shown in the figure. Their mutual inductance will be **(IIT JEE 2001; S)**



(a) maximum in situation (A) (b) maximum in situation (B)
(c) maximum in situation (B) (d) the same in all situations

11. As shown in the figure, P and Q are two coaxil conducting loops separated by some distance. When the switch S is closed, a clockwise current I_p flows in P (as seen by E) and an induced current I_{Q_1} flows in Q. The switch remains closed for a long time. When S is opened, a current IQ2 flows in Q. Then the direction I_{Q_1} and I_{Q_2} (as seen by E) are **(IIT JEE 2002; 2M)**

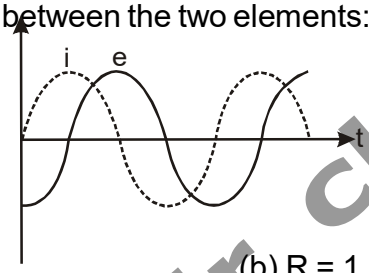


(a) respectively clockwise and anticlockwise (b) both clockwise
(c) both anticlockwise (d) respectively anticlockwise and clockwise

12. A short-circuited coil is placed in a time varying magnetic field. Electrical power is dissipated due to the current induced in the coil. If the number of turns were to be quadrupled (four times) and the wire radius halved, the electrical power dissipated would be **(IIT JEE 2002; 2M)**

(a) halved (b) the same (c) doubled (d) quadrupled

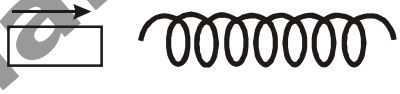
13. When an AC source of emf $e = E_0 \sin(100t)$ is connected across a circuit, the phase difference between the emf e and the current i in the circuit is observed to be $\frac{\pi}{4}$ ahead, as shown in the diagram. If the circuit consists possibly only of R-C or R-L or L-C in series, find the relationship between the two elements: **(IIT JEE 2003; 2M)**



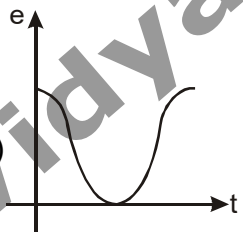
(a) R = 1 k Ω, C = 10 μ F (b) R = 1 k Ω, C = 1 μ F

(c) R = 1 k Ω, L = 10 H (d) R = 1 k Ω, L = 1H

14. The variation of induced emf (e) with time (t) in a coil if a short bar magnet is moved along its axis



with a constant velocity is best represented as **(IIT JEE 2004; 2M)**

(a)


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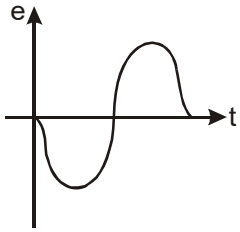

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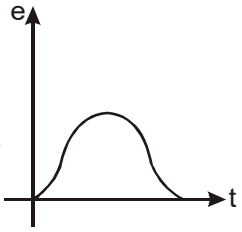
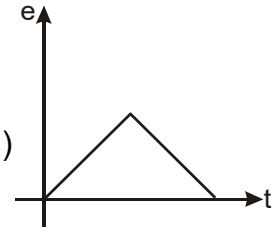
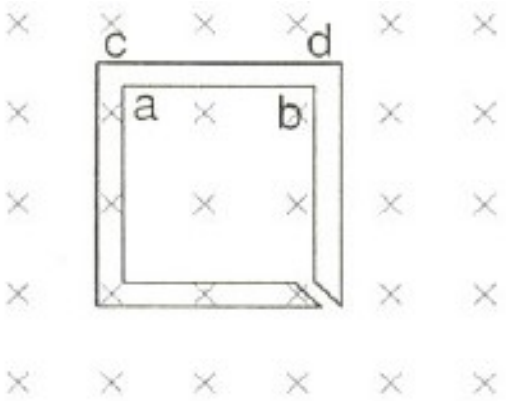


(d)


15. An infinitely long cylinder is kept parallel to an uniform magnetic field B directed along positive z-axis. The direction of induced current as seen from the z-axis will be **(IIT JEE 2005; 2M)**

(a) clockwise of the +ve z-axis
(b) anticlockwise of the +ve z-axis
(c) zero
(b) along the magnetic field

16. The figure shows certain wire segments joined together to form a coplanar loop. The loop is placed in a pependicular magnetic field in the direction going into the plane of the figure. Themagnitude of the field increase with time. I1 and I2 are the currents in the segments ab and cd. Then **(IIT JEE 2009; 3M)**



(a) $I_1 > I_2$
(b) $I_1 < I_2$
(c) I_1 is in the direction **ba** and I_2 is in the direction **cd**
(d) I_1 is in the direction **ab** and I_2 is in the direction **dc**

Practice Exercise Questions:

JEE Main / AIEEE Questions :

1.(4)	2.(4)	3.(2)	4.(2)	5.(4)	6.(3)
7.(1)	8.None	9.(4)	10.(4)	11.(4)	12.(2)
13.(2)	14.(1)	15.(1)	16.(1)	17.(1)	18.(4)
19.(4)	20.(3)	21.(1)	22.(3)	23.(4)	24.(3)
25.(4)	26.(3)	27.(4)	28.(2)	29.(3)	30.(4)
31.(3)	32.(1)	33.(2)	34.(3)	35.(4)	36.(3)
37.(2)	38.(4)				

Previous year IIT-JEE Questions(One Option correct).

1.(d)	2.(d)	3.(b)	4.(b)	5.(c)	6.(d)
7.(b)	8.(d)	9.(d)	10.(a)	11.(d)	12.(d)
13.(a)	14.(b)	15.(c)	16.(d)		