DPP – 1 (EMI)

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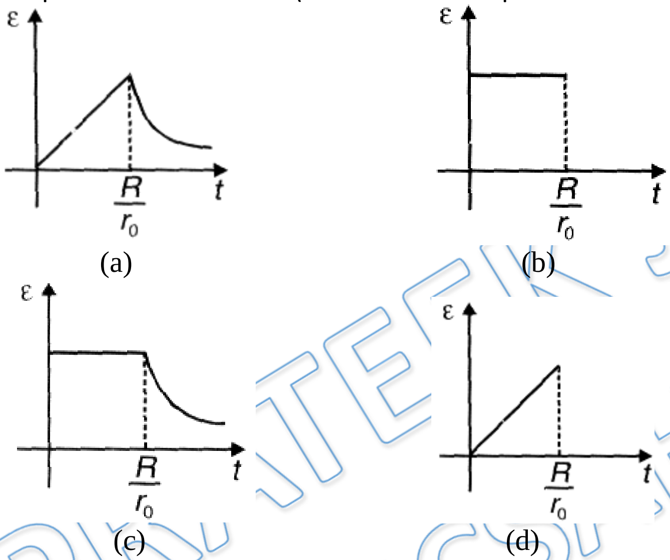
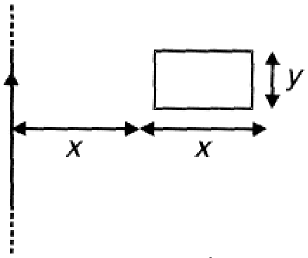
Q 1. A conducting loop of radius R is placed in a uniform cylindrical, transverse magnetic field region of strength B. Radius of the region is increasing with time as r= r_0t. Induced emf in the loop varies with time as (centre of the loop coincides with axis of magnetic field region)



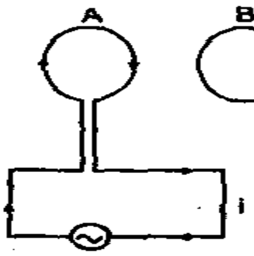
Q 2. Consider a system of coplanar infinite straight wire and a rectangular loop of resistance 1ohm as shown in the figure. If current in the wire changes from i to 2i, charge flowing through the rectangular loop is



(a) $\frac{\mu_0 y i \ln 2}{4\pi}$ (b) $\frac{\mu_0 y i \ln 4}{4\pi}$

(c) $\frac{\mu_0 y i \ln 8}{4\pi}$ (d) $\frac{\mu_0 y i \ln 10}{4\pi}$

Q 3. Two coaxial circular coils A and B are facing each other as shown in figure. The current i through A can be altered:

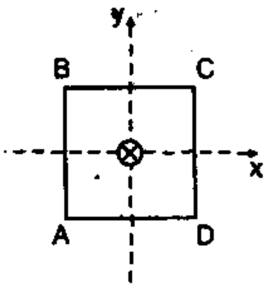


(a) there will be repulsion between A and B if i is increased
(b) there will be attraction between A and B if i is increased
(c) there will be neither attraction nor repulsion when ifs changed
(d) attraction or repulsion between A and B depends on the direction of current. It does not depend whether the current is increased or decreased

Q 4. A conducting circular loop of radius a and resistance R is kept on a horizontal plane. A vertical time varying magnetic field B = 2t is switched on at time t = 0. Then:
(a) power generated in the coil at any timer is constant
(b) flow of charge per unit time from any section of the coil is constant
(c) total charge passed through any section between time t = 0 to t = 2 is $\frac{4\pi a^2}{R}$
(d) all of the above

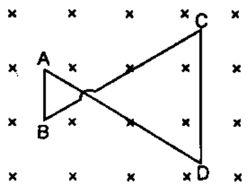
Q 5. Two identical coaxial circular loops carry a current I each circulating in the same direction. If the loops approach each other:
(a) the current in each loop will decrease
(b) the current in each loop will increase
(c) the current in each loop will remain the same
(d) the current in one loop will increase and in the other loop will decrease

Q 6. A square coil ABCD is lying in xy plane with its centre at origin. A long straight wire passing through origin carries a current i =2t in negative z-direction. The induced current in the coil is:



(a) clockwise (b) anticlockwise (c) alternating (d) zero

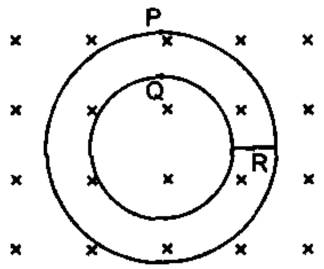
Q 7. A conducting wire frame is placed in a magnetic field which is directed into the paper. The magnetic field is increasing at a constant rate. The directions of induced currents in wires AB and CD are:



(a) B to A and D to C
(b) A to B and C to D
(c) A to B and D to C
(d) B to A and C to D

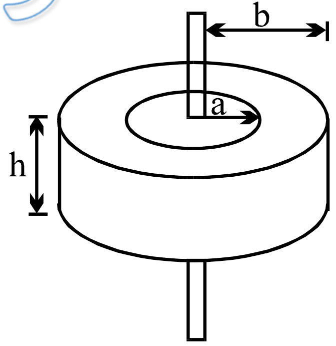
Q 8. Two identical circular loops of metal wire are lying on a table without touching each other. Loop A. carries a current which increases with time. In response, the loop B:
(a) remains stationary
(b) is attracted by the loop A
(c) is repelled by the loop A
(d) rotates about its CM, with CM fixed

Q 9. Figure shows plane figure made of a conductor located in a magnetic field along the inward normal to the plane of the figure. The magnetic field starts diminishing. Then the induced current:



(a) at point P is clockwise
(b) at point Q is anticlockwise
(c) at point Q is clockwise
(d) at point R is zero

Q 10. A long straight wire is arranged along the symmetry axis of a toroidal coil of rectangular cross-section, whose dimensions are given in the figure. The number of turns on the coil is N, and relative permeability of the surrounding medium is unity. Find the amplitude of the emf induced in this coil, if the current $i = i_m$ Cosωt flows along the straight wire.

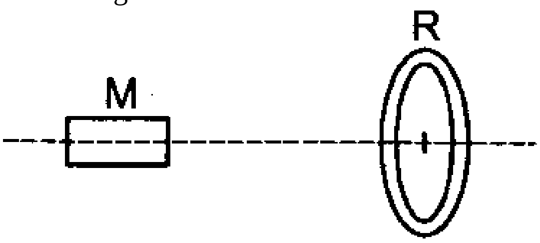


(a) $\frac{\mu_0 h\omega i_m N}{2\pi} ln\frac{b}{a}$
(b) $\frac{\mu_0 h\omega i_m N}{4\pi} ln\frac{b}{a}$
(c) $\frac{\mu_0 h\omega i_m N}{2\pi}$
(d) $\frac{\mu_0 h\omega i_m Nb}{2\pi a}$

Q 11. A bar magnet is moved along the axis of copper ring placed far away from the magnet. Looking from the side of the magnet, an anticlockwise current is found to be induced in the ring. Which of the following may be true?

(a) The south pole faces the ring and the magnet moves towards it.
(b) The north pole faces the ring and the magnet moves towards it.
(c) The south pole faces the ring and the magnet moves away from it.
(d) The north pole faces the ring and the magnet moves away from it.

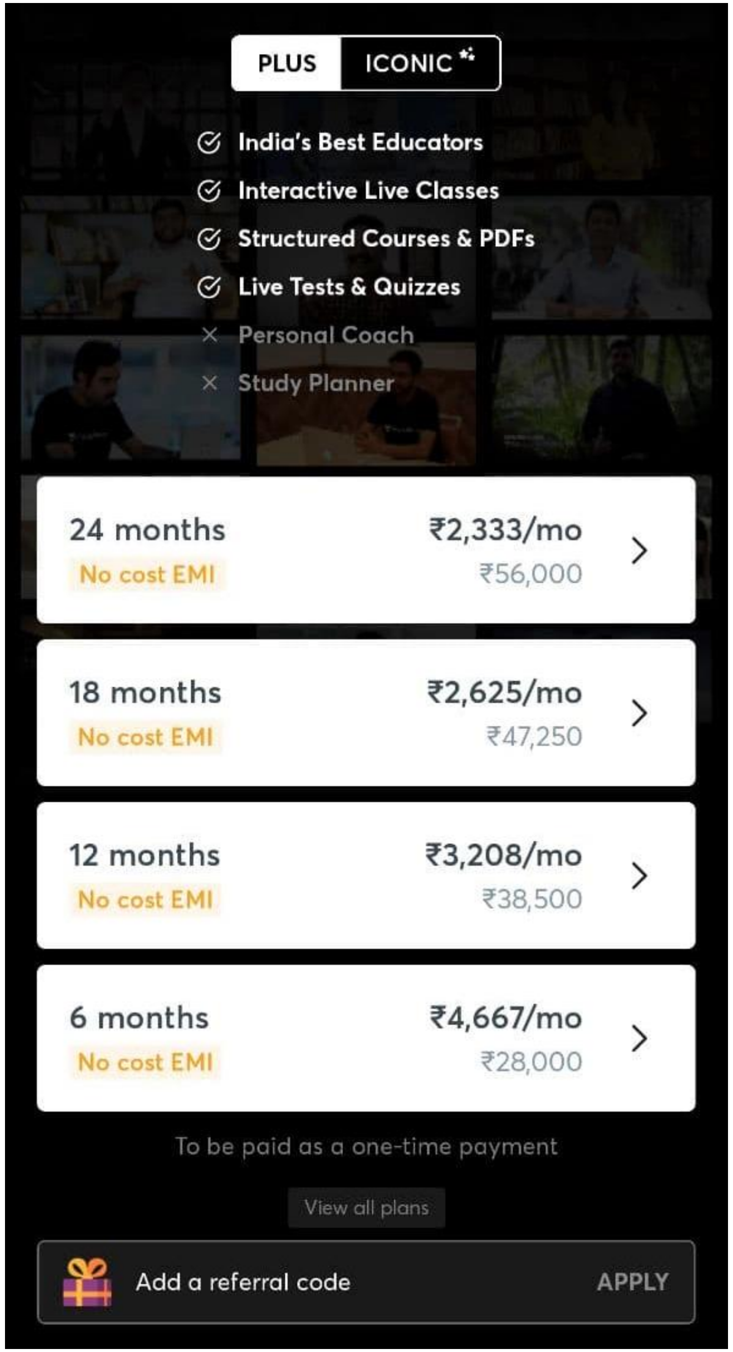
Q 12. A conducting ring R is placed on the axis of a bar magnet M. The plane of R is perpendicular to this axis. M can move along this axis.



(a) M will repel R when it is moving towards R.
(b) M will attract R when it is moving towards R.
(c) M will repel R when moving towards as well as away from R.
(d) M will attract R when moving towards as well as away from R.

Answer Key

Q.1 d	Q.2 b	Q.3 a	Q.4 d	Q.5 a
Q.6 d	Q.7 a	Q.8 c	Q.9 a, c, d	Q.10 a
Q.11 b, c	Q.12 a			



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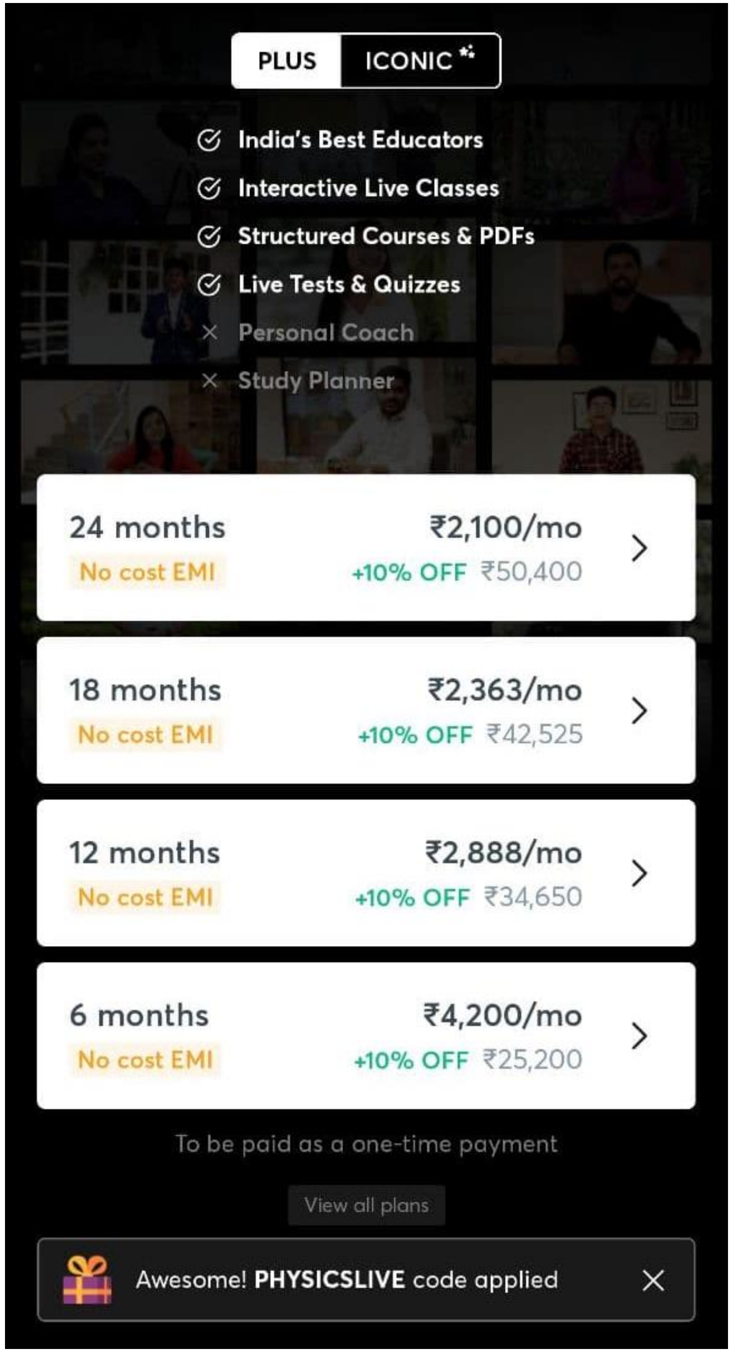

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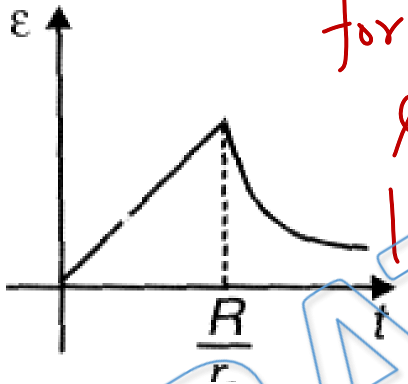
Written Solution

DPP- 1 EMI- Magnetic flux, Faraday’s first and second law, Lenz law

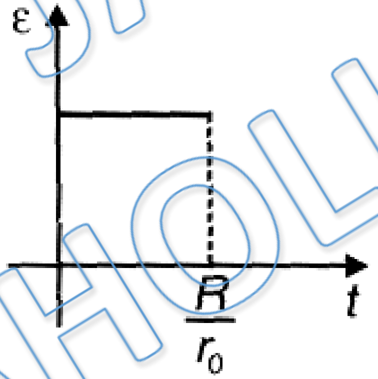
By Physicsaholics Team

Q.1) A conducting loop of radius R is placed in a uniform cylindrical, transverse magnetic field region of strength B. Radius of the region is increasing with time as $r = r_0 t$. Induced emf in the loop varies with time as (centre of the loop coincides with axis of magnetic field region)

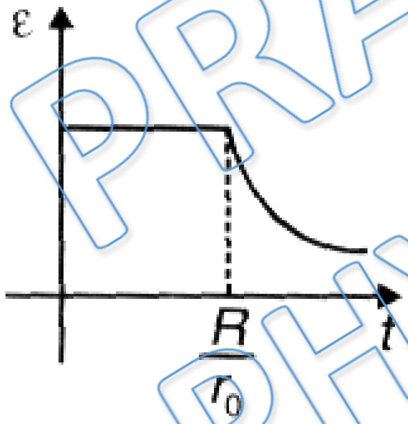
(a)



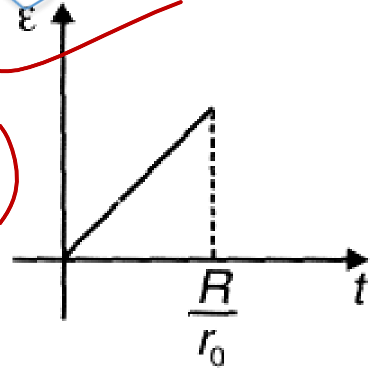
(b)



(c)



(d)



$r = r_0 t$

for $r < R$ $(t < R/r_0)$

$\phi = B_0 \pi r^2$

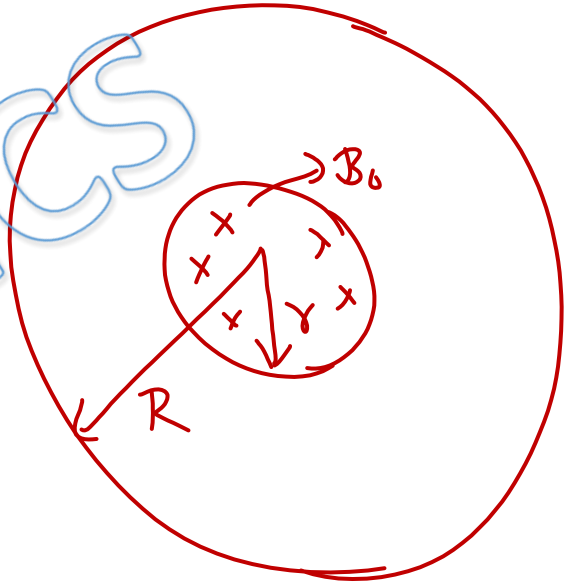
$|\varepsilon| = \left|\frac{d\phi}{dt}\right| = 2\pi B_0 r \frac{dr}{dt}$

$= 2\pi B_0 r_0^2 t$

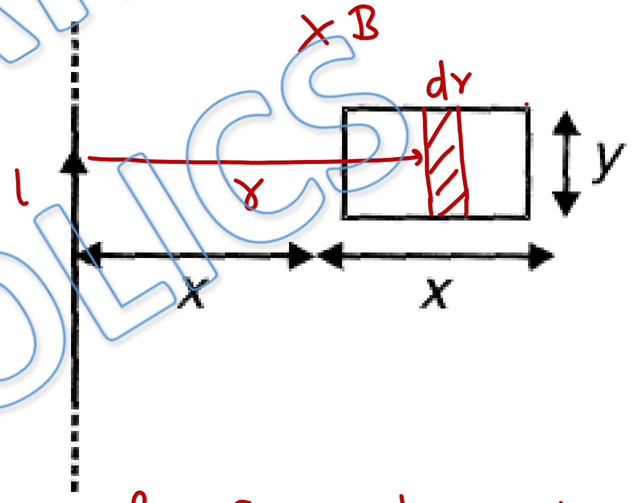
for $r \geq R$ $(t \geq R/r_0)$

$\phi = B_0 \pi R^2$

$\varepsilon = 0$



Q.2) Consider a system of coplanar infinite straight wire and a rectangular loop of resistance 1ohm as shown in the figure. If current in the wire changes from i to 2i, charge flowing through the rectangular loop is



$$q = -\frac{\Delta\phi}{R}$$

when Current is i

at $r = r$ $\quad B = \frac{\mu_0 i}{2\pi r}$

$$d\phi = B\,y\,dr = \frac{\mu_0 y i}{2\pi r}\,dr$$

$$\phi = \frac{\mu_0 y i}{2\pi}\int_x^{2x}\frac{dr}{r}$$

$$\phi_1 = \frac{\mu_0 y i \ln 2}{2\pi}$$

(a) $\frac{\mu_0 y i\, ln2}{4\pi}$ (b) $\frac{\mu_0 y i\, ln4}{4\pi}$

(c) $\frac{\mu_0 y i\, ln8}{4\pi}$ (d) $\frac{\mu_0 y i\, ln10}{4\pi}$

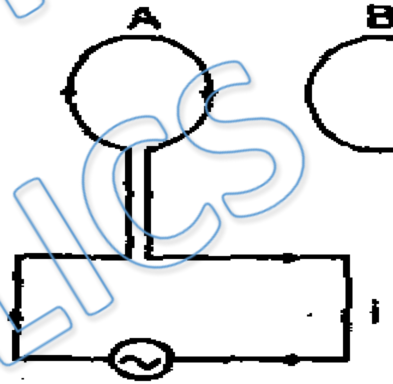
when Current is 2i

$$\phi_f = \frac{2\mu_0 y i \ln 2}{2\pi}$$

$$\Delta\phi = \frac{\mu_0 y i \ln 2}{2\pi}$$

$$|q| = \left|\frac{\Delta\phi}{R}\right| = |\Delta\phi| = \frac{\mu_0 y i \ln 2}{2\pi}$$

Q.3) Two coaxial circular coils A and B are facing each other as shown in figure. The current i through A can be altered:



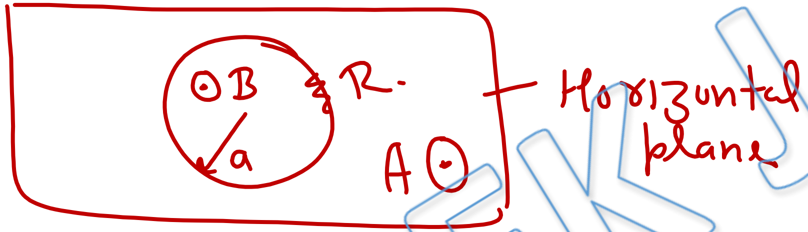
(a) there will be repulsion between A and B if i is increased

(b) there will be attraction between A and B if i is increased

(c) there will be neither attraction nor repulsion when its changed

(d) attraction or repulsion between A and B depends on the direction of current. It does not depend whether the current is increased or decreased

Q.4) A conducting circular loop of radius a and resistance R is kept on a horizontal plane. A vertical time varying magnetic field B = 2t is switched on at time t = 0. Then:



$$\phi = B\pi a^2$$

$$-\frac{d\phi}{dt} = -\pi a^2 \times 2 = -2\pi a^2$$

$$\varepsilon = -2\pi a^2 = \text{Constant}$$

(a) power generated in the coil at any timer is constant

(b) flow of charge per unit time from any section of the coil is constant

(c) total charge passed through any section between time t = 0 to t = 2 is $\frac{4\pi a^2}{R}$

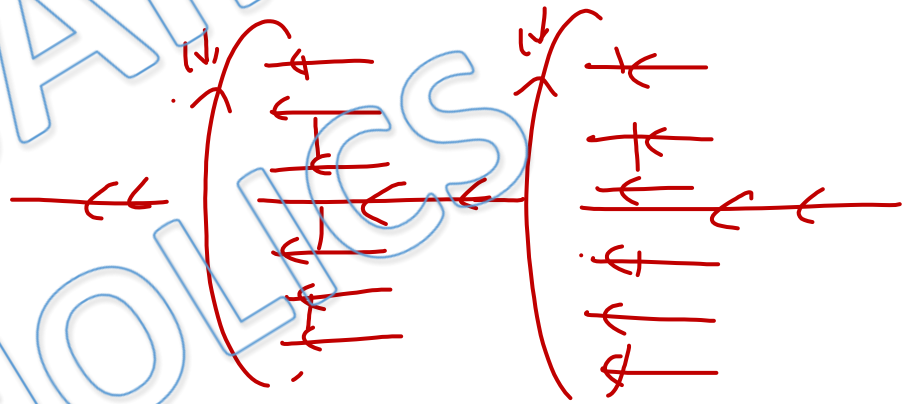
(d) all of the above

$$P = \frac{\varepsilon^2}{R} = \frac{4\pi a^4}{R} = \text{Constant.}$$

$$i = \varepsilon/R = \frac{-2\pi a^2}{R} = \text{Constant}$$

$$q = it = \frac{-4\pi a^2}{R}$$

Q.5) Two identical coaxial circular loops carry a current I each circulating in the same direction. If the loops approach each other:



(a) the current in each loop will decrease

(b) the current in each loop will increase

(c) the current in each loop will remain the same

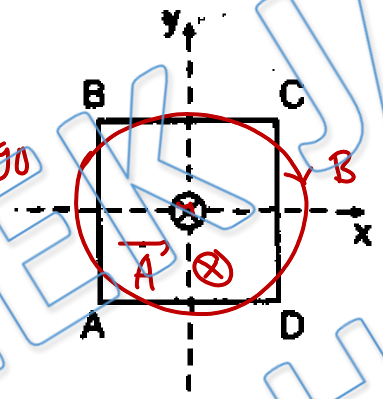
(d) the current in one loop will increase and in the other loop will decrease

Q.6) A square coil ABCD is lying in xy plane with its centre at origin. A long straight wire passing through origin carries a current i =2t in negative z-direction. The induced current in the coil is:

angle b/w $\vec{B}$ & $d\vec{A}$ = 90

$\phi = 0$

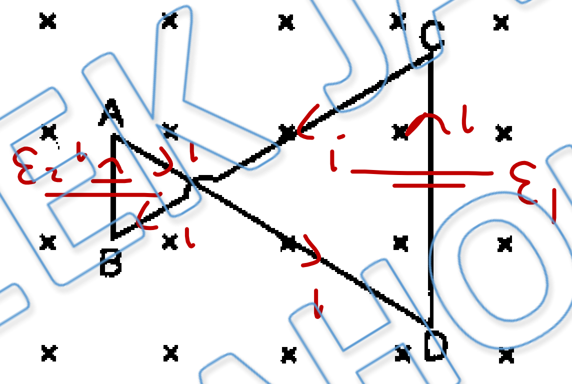
$\mathcal{E}_{ind} = 0$



(a) clockwise (b) anticlockwise (c) alternating (d) zero

Q.7) A conducting wire frame is placed in a magnetic field which is directed into the paper. The magnetic field is increasing at a constant rate. The directions of induced currents in wires AB and CD are:

$\varepsilon_1 > \varepsilon_2$



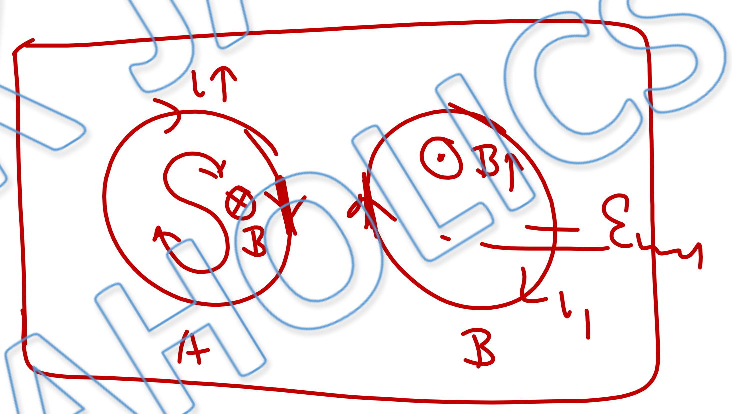
(a) B to A and D to C

(b) A to B and C to D

(c) A to B and D to C

(d) B to A and C to D

Q.8) 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:



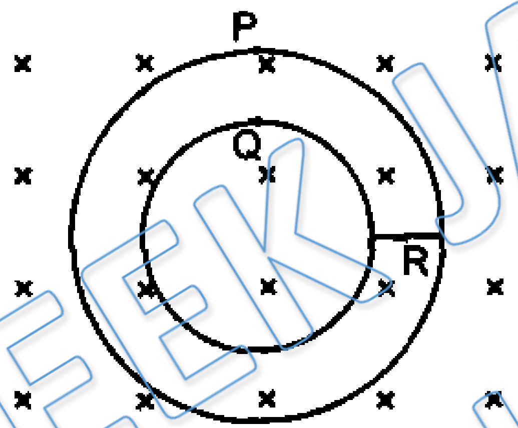
(a) remains stationary

(b) is attracted by the loop A

(c) is repelled by the loop A

(d) rotates about its CM, with CM fixed

Q.9) Figure shows plane figure made of a conductor located in a magnetic field along the inward normal to the plane of the figure. The magnetic field starts diminishing. Then the induced current:



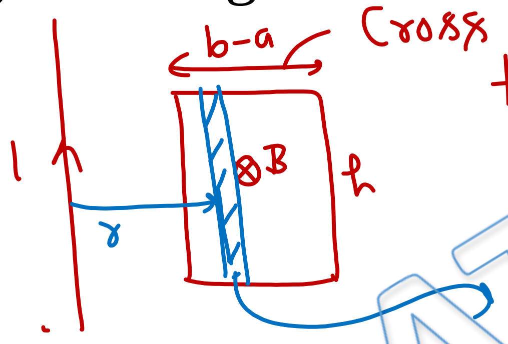
(a) at point P is clockwise

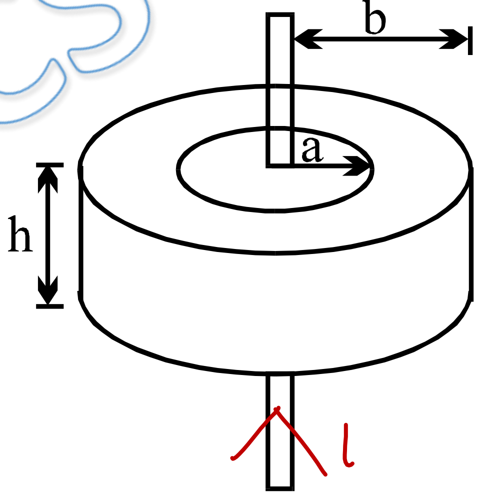
(b) at point Q is anticlockwise

(c) at point Q is clockwise

(d) at point R is zero

Q.10) A long straight wire is arranged along the symmetry axis of a toroidal coil of rectangular cross-section, whose dimensions are given in the figure. The number of turns on the coil is N, and relative permeability of the surrounding medium is unity. Find the amplitude of the emf induced in this coil, if the current $i = i_m \cos\omega t$ flows along the straight wire.





$$|\varepsilon| = N\left|\frac{d\phi}{dt}\right|$$

$$= \frac{N\mu_0 h}{2\pi}\ln(b/a)\frac{di}{dt}$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$d\phi = \frac{\mu_0 I}{2\pi r} h\,dr$$

$$\phi = \frac{\mu_0 I h}{2\pi}\int_a^b \frac{dr}{r}$$

$$\phi = \frac{\mu_0 I h \ln b/a}{2\pi}$$

$$|\varepsilon| = \frac{N\mu_0 h I_m \omega \sin\omega t}{2\pi}\ln(b/a)$$

$$|\varepsilon_{max}| = \frac{N\mu_0 h I_m \omega \ln(b/a)}{2\pi}$$

(a) $\frac{\mu_0 h\omega i_m N}{2\pi}\ln\frac{b}{a}$

(b) $\frac{\mu_0 h\omega i_m N}{4\pi}\ln\frac{b}{a}$

(c) $\frac{\mu_0 h\omega i_m N}{2\pi}$

(d) $\frac{\mu_0 h\omega i_m N b}{2\pi a}$

Q.11) A bar magnet is moved along the axis of copper ring placed far away from the magnet. Looking from the side of the magnet, an anticlockwise current is found to be induced in the ring. Which of the following may be true?

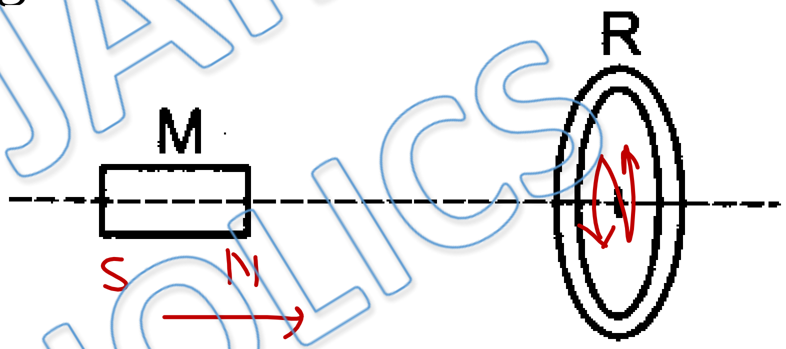
(a) The south pole faces the ring and the magnet moves towards it.

(b) The north pole faces the ring and the magnet moves towards it.

(c) The south pole faces the ring and the magnet moves away from it.

(d) The north pole faces the ring and the magnet moves away from it.

Q.12) A conducting ring R is placed on the axis of a bar magnet M. The plane of R is perpendicular to this axis. M can move along this axis.



(a) M will repel R when it is moving towards R.

(b) M will attract R when it is moving towards R.

(c) M will repel R when moving towards as well as away from R.

(d) M will attract R when moving towards as well as away from R.

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Chalo Niklo