ELECTROMAGNETIC INDUCTION & ALTERNATING CURRENT

Revise Most Important Questions to Crack NEET 2020

Q-1 - 9728831

A bar magnet is moved along the axis of a 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 form it.

(D) The north pole faces the ring and the magnet moves away form it.

CORRECT ANSWER: B::C

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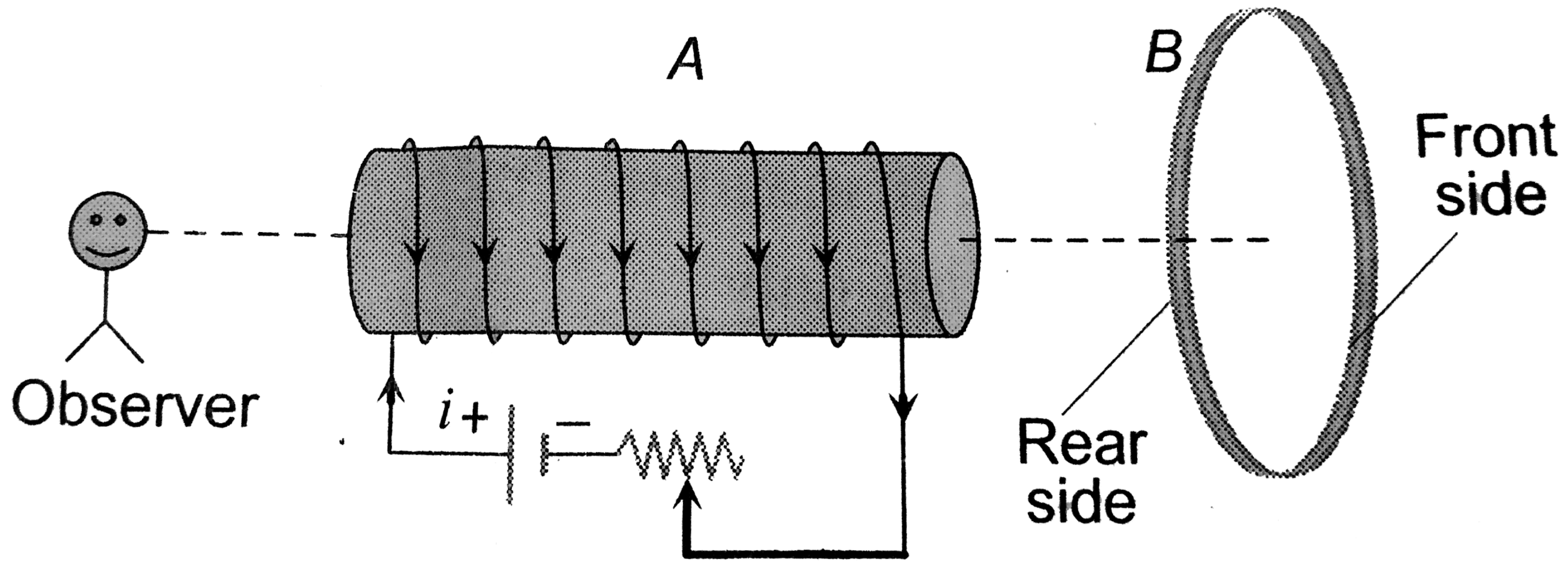
Q-2 - 11967864

An aluminium ring B faces an electromagnet A. The current I through A can be altered



(A) wheter I increases or decreases, B will not experience any force

(B) If I decreases, A will repel B

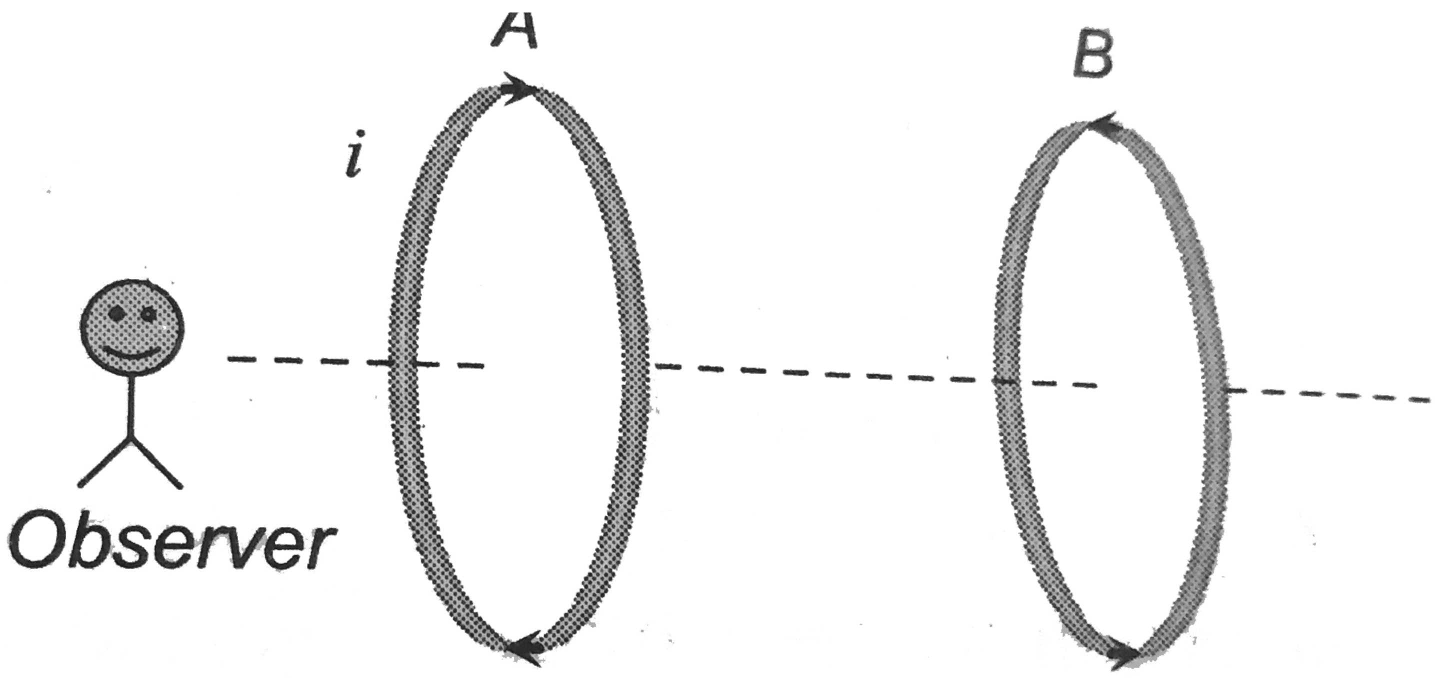
(C) If I increasing , A will attract B

(D) If I increasing , A will repel B

CORRECT ANSWER: D

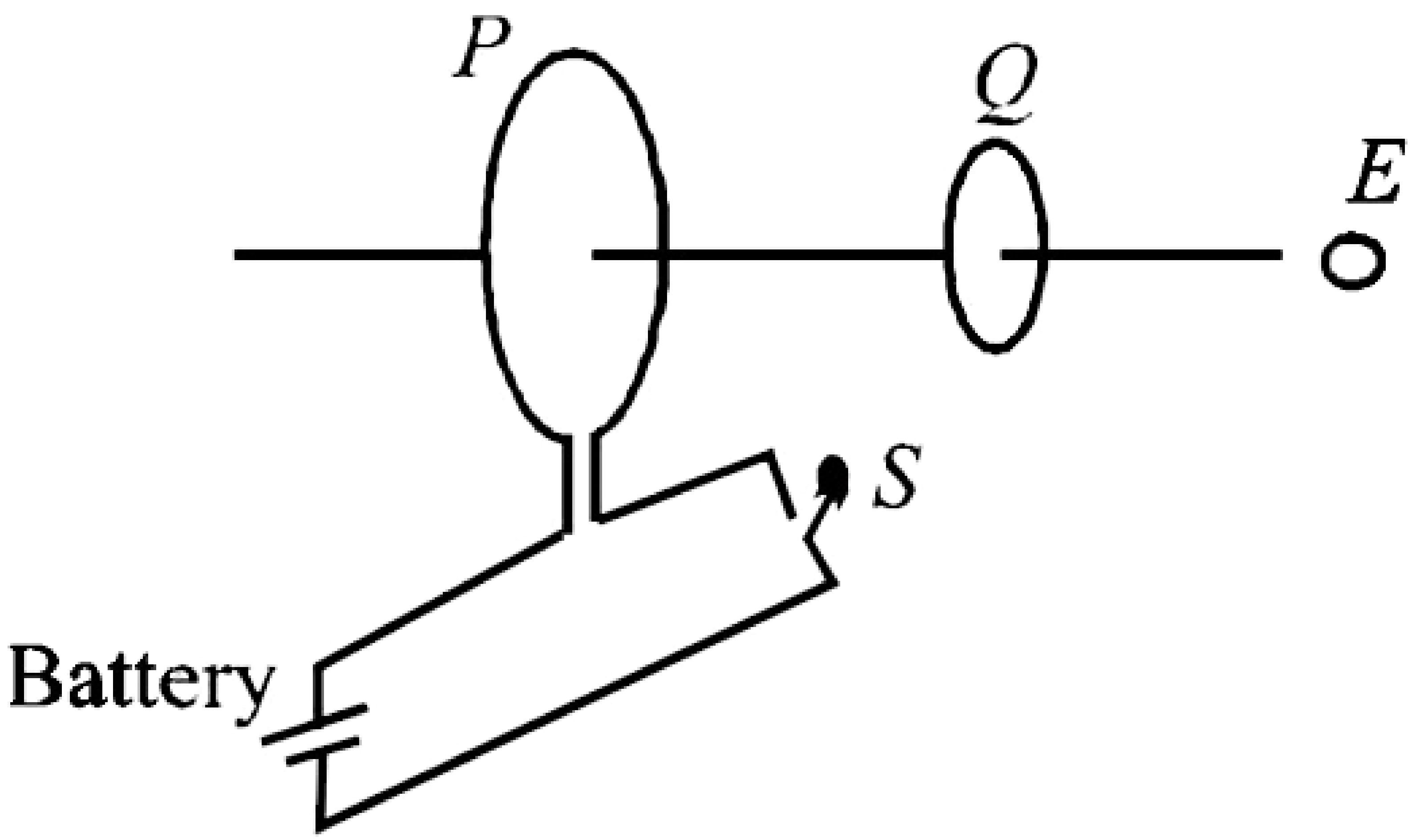
SOLUTION:

If current through A increase, crosses (XX) linked with coil B increase, hence anticlockwise current induces in coil B. As shown in figure both the current produces repulsive effect.



Q-3 - 10060007

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 (as seen by E) and an induced current I_{Q1} flows in Q. The switch remains closed for a long time. when S is opened, a current I_{Q2} flows in Q. Then the direction IQ_1 and IQ_2 (as seen by E) are



(A) respectively clockwise and anti-clockwise

(B) both clockwise

(C) both anti-clockwise

(D) respectively anti-clockwise and clockwise

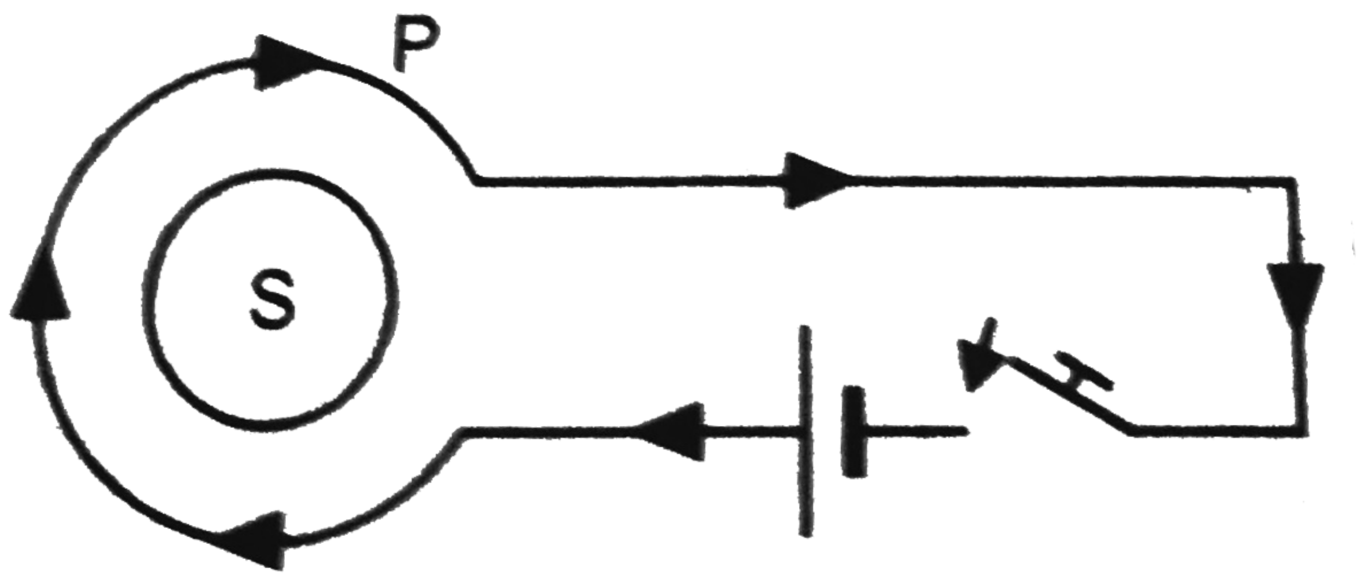
CORRECT ANSWER: D

SOLUTION:

When switch S is closed, a magnetic field is set-up in the space around P. The field lines threading Q increases in the direction from right to left. According to Lenz's law. $\left(I_{Q_1}\right)$ will flow so as to oppose the cause and flow in anticlockwise direction as seen by E. Reverse is the case wheb S is opened. $\left(I_{Q_2}\right)$ will be clockwise.

Q-4 - 12012700

In fig. P and S are two coils. What shall be the direction of induced momentary current in S immediately after the switch is closed, (ii) if the switch is opened, after it the been closed for some time,



SOLUTION:

When switch is closed, current in P grows. Induced current is S will oppos the growth. Hence the current in S must be anticlockwise. When switch is opened, current in P dacays from maximum to zero. Induced current in S will oppose the decay. Hence current in S must be clockwise.

Q-5 - 14156482

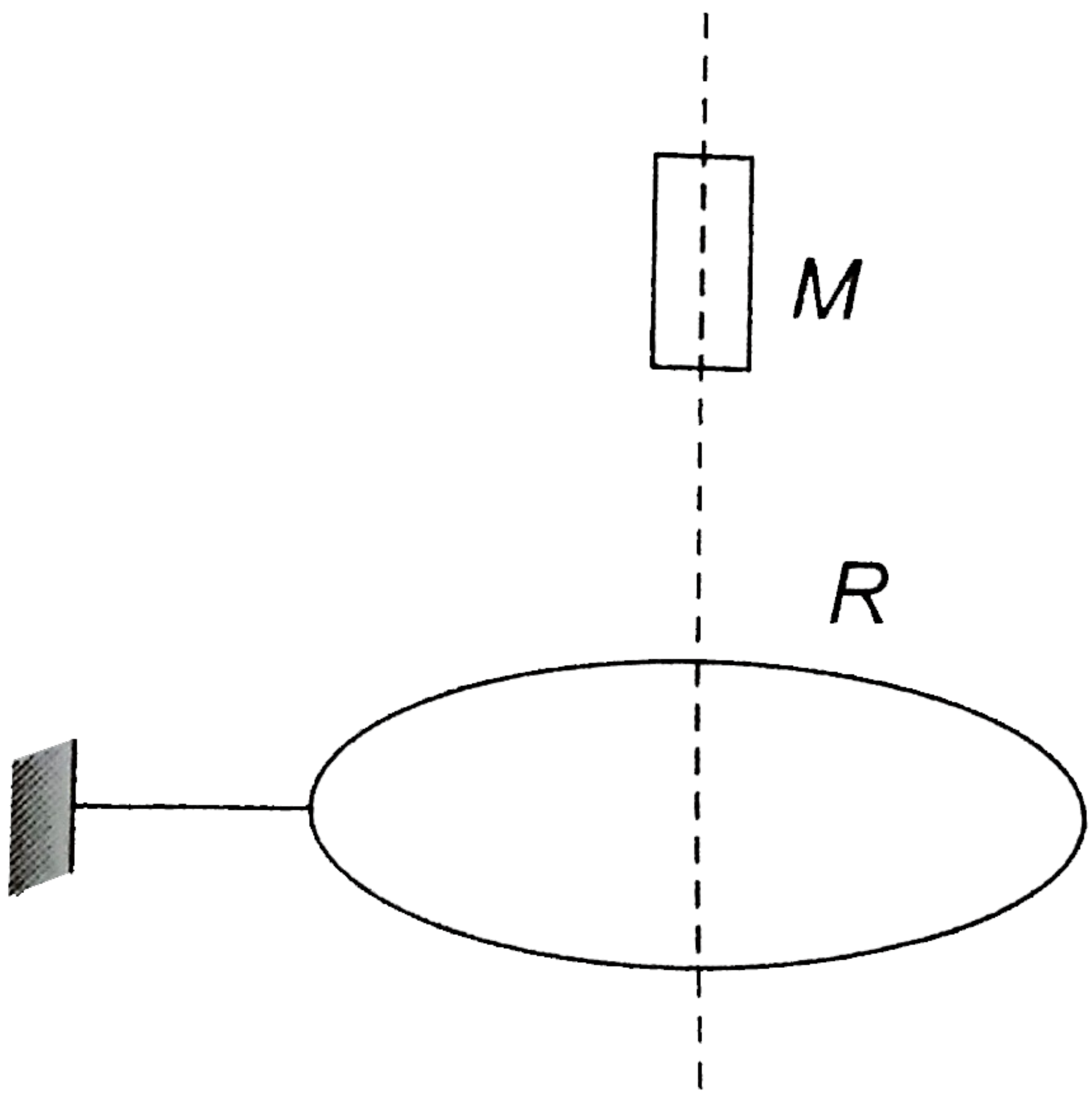
A small magnet M is allowed to fall through a fixed horizontal conducting ring R . Let g be the acceleration of M will be

(i) $< g$ when it is above R and moving towards R

(ii) $> g$ when it is above R and moving towards R

(iii) $< g$ when it is below R and moving away from R

(iv) $> g$ when it is below R and moving away from R



(A) (i), (iii)

(B) (ii), (iv)

(C) (i), (ii)

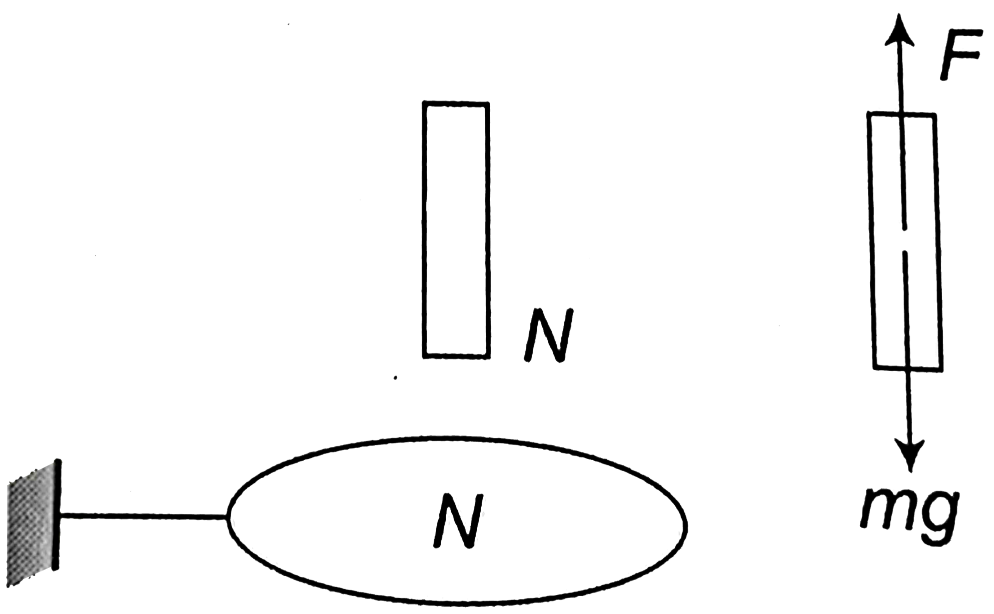
(D) (ii), (iii)

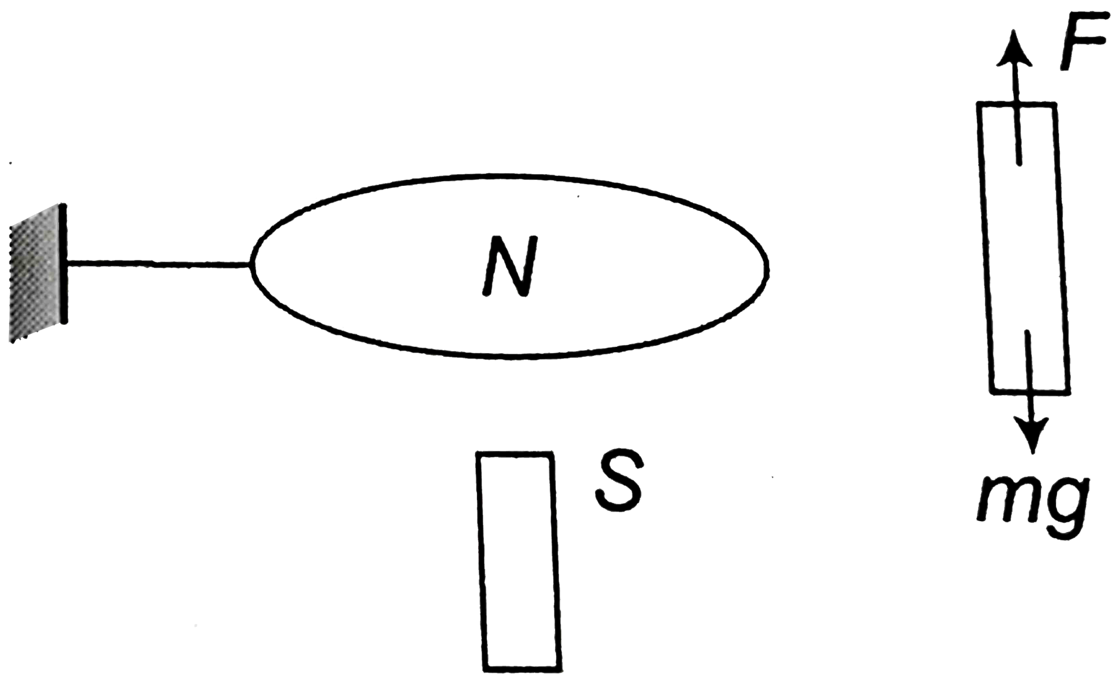
CORRECT ANSWER: A

SOLUTION:

Net forceltmg

Net forceltmg





Q-6 - 14156499

A conducting circular loop is placed in a uniform magnetic field $0.04T$ with its plane perpendicular to the magnetic field. The radius of the loop starts shrinking at $2mm / \sec$. The induced emf in the loop when the radius is $2cm$ is

(A) $3.2\pi\mu V$

(B) $4.8\pi\mu V$

(C) $0.8\pi\mu V$

(D) $1.6\pi\mu V$

CORRECT ANSWER: A

SOLUTION:

$$\phi = BA = B\pi r^2$$

$$e = \frac{d\phi}{dt} = B\pi.2r\frac{dr}{dt}$$

$$= 0.04\pi \times 2 \times 2$$
$$\times 10^{-2} \times 2 \times 10^{-3}$$

$$= 3.2\pi\mu V$$

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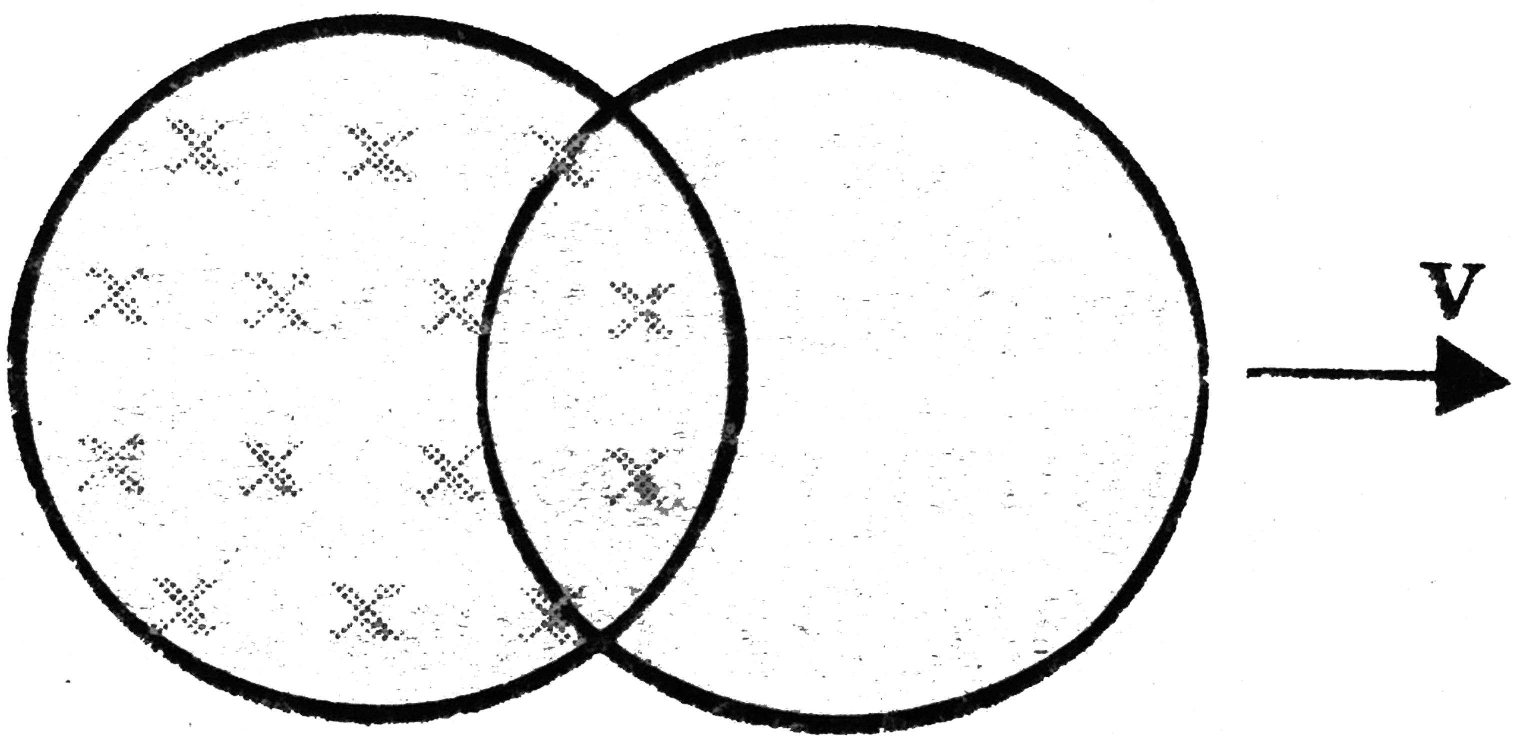
Q-7 - 11314561

A uniform magnetic field $B = 0.5T$ exists in a circular region of radius $R = 5m$. A loop of radius $R = 5m$ encloses the magnetic field at $t = 0$ and then pulled at uniform speed $v = 2ms^{-1}$ In the plane of the paper. Find the induced emf $(\text{in}V)$ in the loop at time

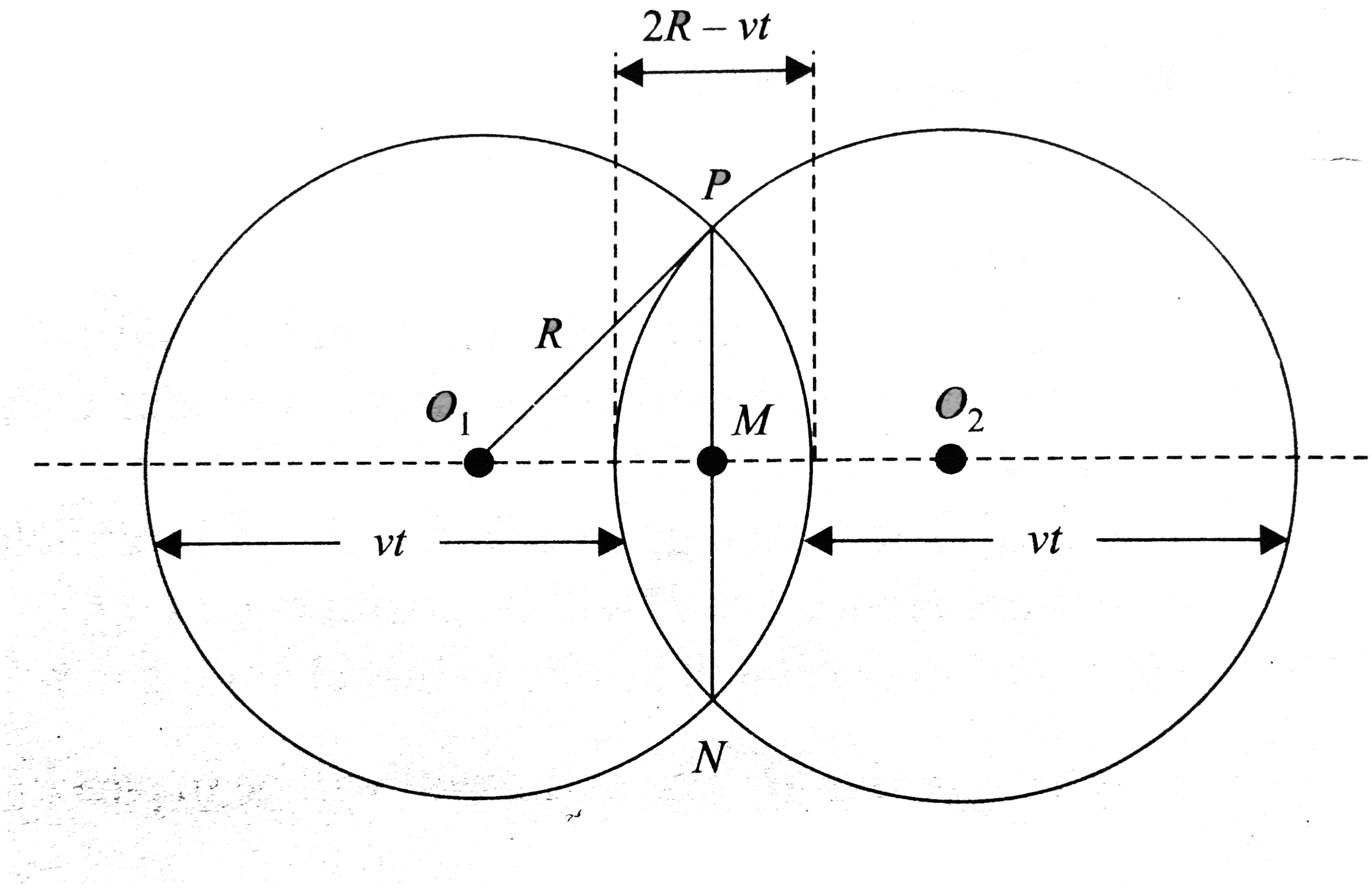
$t = 3s.$



CORRECT ANSWER: 8

SOLUTION:

$$O_1M = (vt - R) + \left(\frac{2R - vt}{2}\right) = \frac{vt}{2}$$



$$l = 2\sqrt{r^2 - (O_1M)^2}$$

$$= 2\sqrt{R^2 - \left(\frac{vt}{2}\right)^2}$$

$$= \sqrt{4R^2 - v^2t^2}$$

so

$$E = Bvl$$

$$= Bx\sqrt{4R^2 - v^2t^2}$$

given

$$R = 5m, v = 2m/s, t$$

$$= 3s$$

$$E = 0.5 \times 2\sqrt{4 \times 25 - 4 \times 9} = 8V$$

Q-8 - 9728847

A square- shaped copper coil has edges of length 50cm and contains 50 turns. It is placed perpendicular to 1.0 T magnetic field. It is removed form the magnetic field in 0.25 s and restored in its joriginal place in the next 0.25 s. Find the magnitude of the average emf induced in the loop during (a) its removal, (b) its restoration and (c) its motion.

SOLUTION:

(a) during removal,

$$\phi_1 = BA$$

$$= 1 \times 50 \times 0.5 \times 0.5$$

$$25 \times 0.5 = 12.5T$$

$$- m^2$$

$$\phi_2 = 0, t = 0.25s$$

$$e = \frac{-d\phi}{dt}$$

$$= \frac{\phi_1 - \phi - 2}{dt}$$

$$= \frac{12.5}{0.25}$$

$$= \frac{125 \times 10^{-1}}{25 \times 10^{-2}}$$

$$= 50V.$$

$$(b) Dur \in gitsres$$

$$\rightarrow ration$$

$$\phi_1 = 0,$$

$$\phi_2 = 12.5 Tesla - m^2$$

$$t = 0.25s$$

$$e = \frac{12.5 - 0}{0.25} = 50V.$$

$(c) Dur \in gthemotion$phi_1=0,phi_2=0e=(d

phi)/(dt)=0`.

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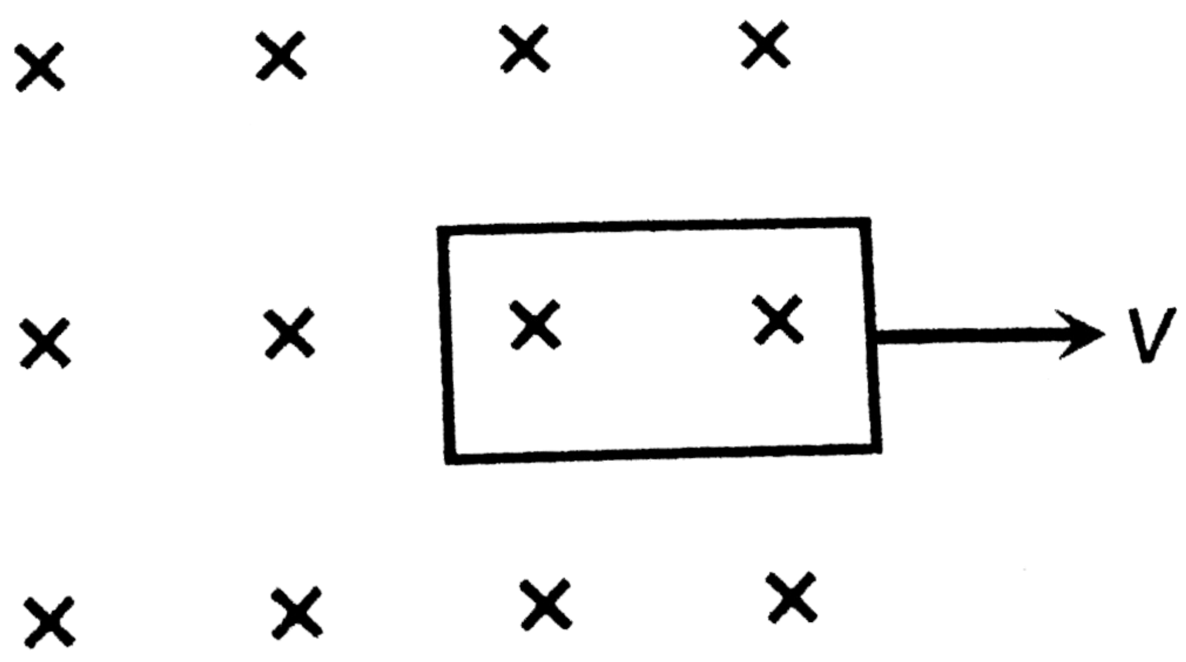
Q-9 - 11968157

Figure show a square loop of side $0.5m$ and resistance 10Ω. The magnetic field has a magnitude $B = 1.0T$. The work done in pulling the loop out of the field slowly and uniformly in $2.0s$ is



(A) $3.125 \times 10^{-3} J$

(B) $6.25 \times 10^{-4} J$

(C) $1.25 \times 10^{-2} J$

(D) $5.0x10^{-4} J$

CORRECT ANSWER: A

SOLUTION:

Speed of the loop should be

$$v = \frac{l}{t} = \frac{0.5}{2}$$

$$= 0.25 m/s$$

Induced emf,

$$eBvl$$

$$= (1.0)(1.0)(0.25)(0.5$$

$$)$$

$$= 0.125 V$$

$$\therefore \text{ Current in the loop } i = \frac{e}{R} = \frac{0.125}{10}$$

$= 1.25 \times 10^{-2} A$ The magnetic force on the left arm due to the magnetic field is

$F_m = ilB$

$= (1.25$

$\times 10^{-2}(0.5)(1.0)$

$= 6.25 \times 10^{-3} N$

to pull the loop uniform an external force of

$6.25 \times 10^{-3} N$ towards right must be applied.

$\therefore W$

$= (6.25$

$\times 10^{-3N}(0.5m)$

$= 3.125 \times 10^{-3} J$

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Q-10 - 14156508

A rectangular, a square , a circular and an elliptical loop, all in the $(x - y)$ plane, are moving out of a uniform magnetic field with a contant velocity $\vec{v} = v\hat{i}$. The magnetic field is directed along the negative z-axis direction. The induced emf, during the passege of these loops , out of the field region, will not remain constant for

(A) the rectangular, circular and elliptical loops

(B) the circular and the elliptical loops

(C) only the elliptical loop

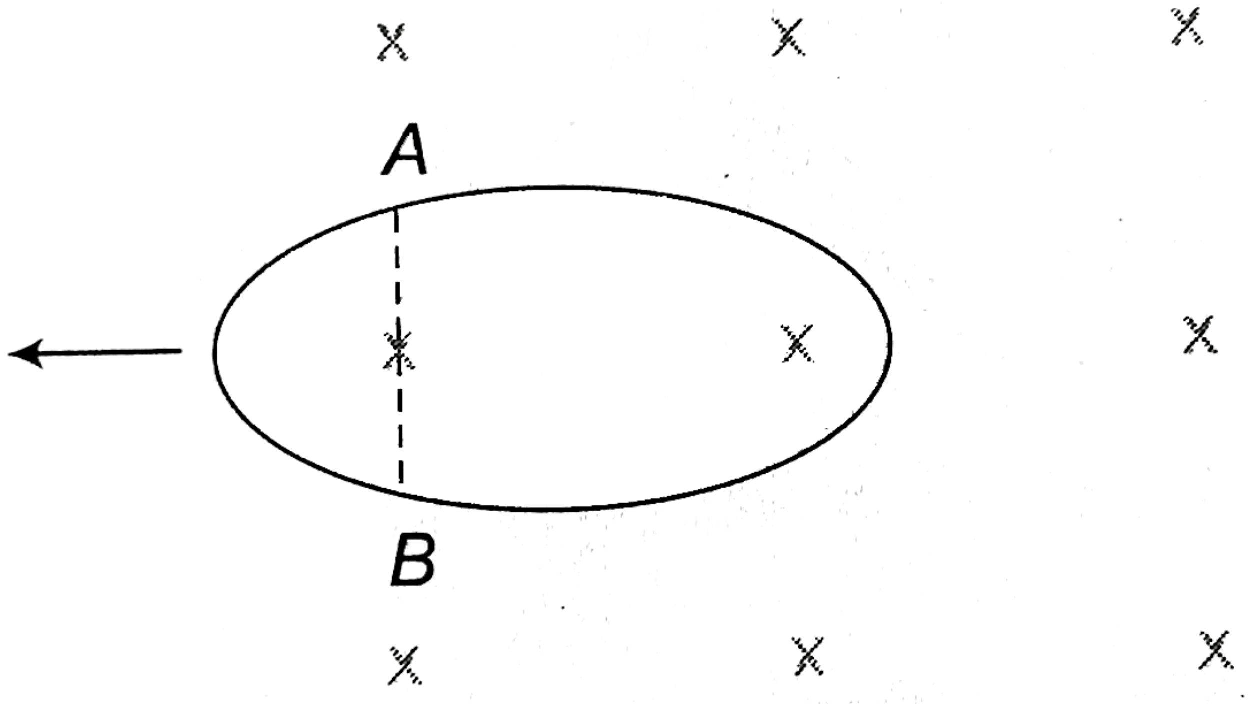
(D) any of the four loops

CORRECT ANSWER: B

SOLUTION:

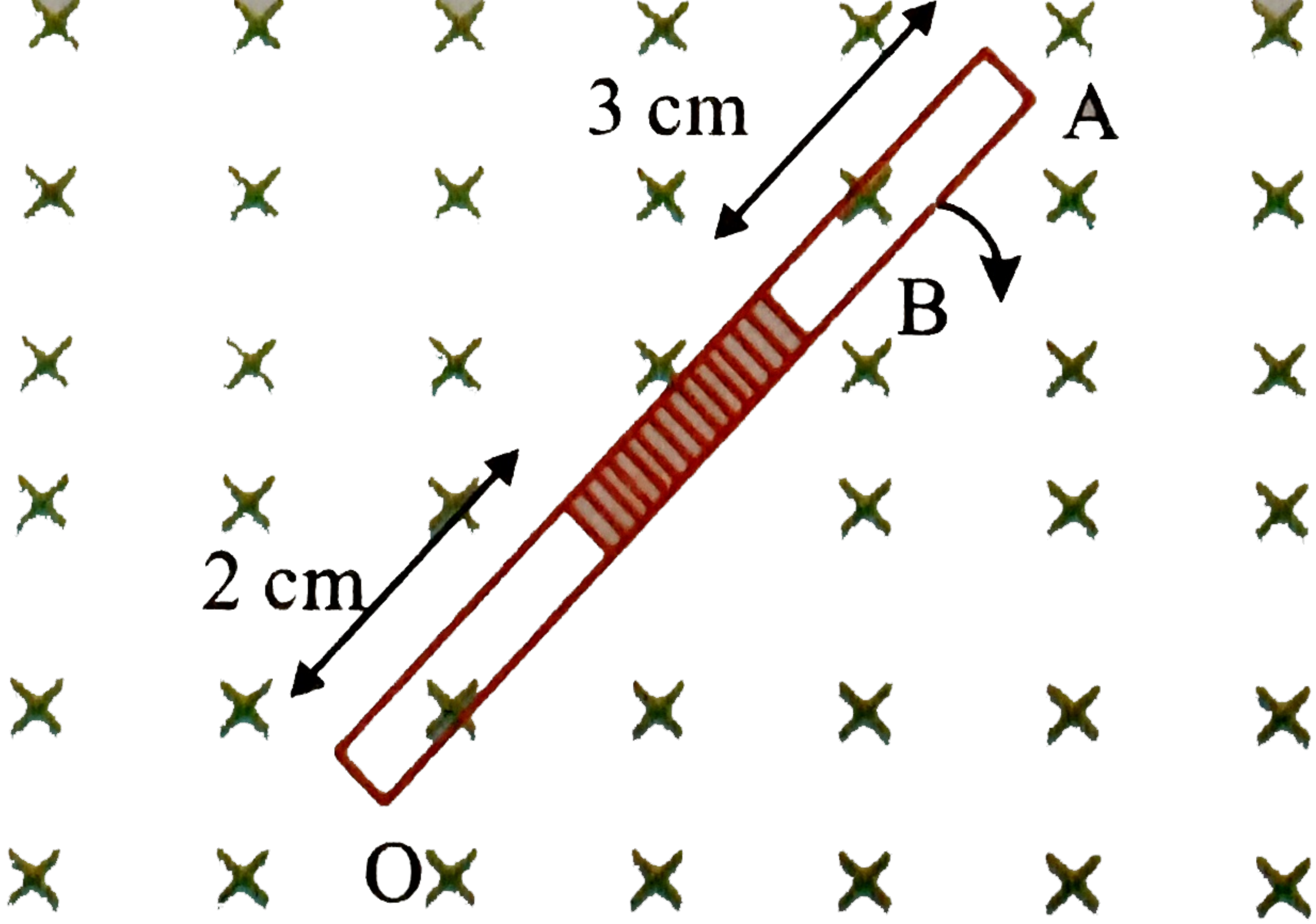
For elliptical loop

AB changes



Q-11 - 13657707

A rod of length $10cm$ made up of conducting and non-conducting material (shaded part is non-conducting). The rod is rotated with constant angular velocity $10rad/s$ about point O, in constant magnetic field of $2T$ as shown in the figure. The induced emf between the point A and B of rod will be:



(A) $0.029V$

(B) $0.1V$

(C) 0.051

(D) $0.064V$

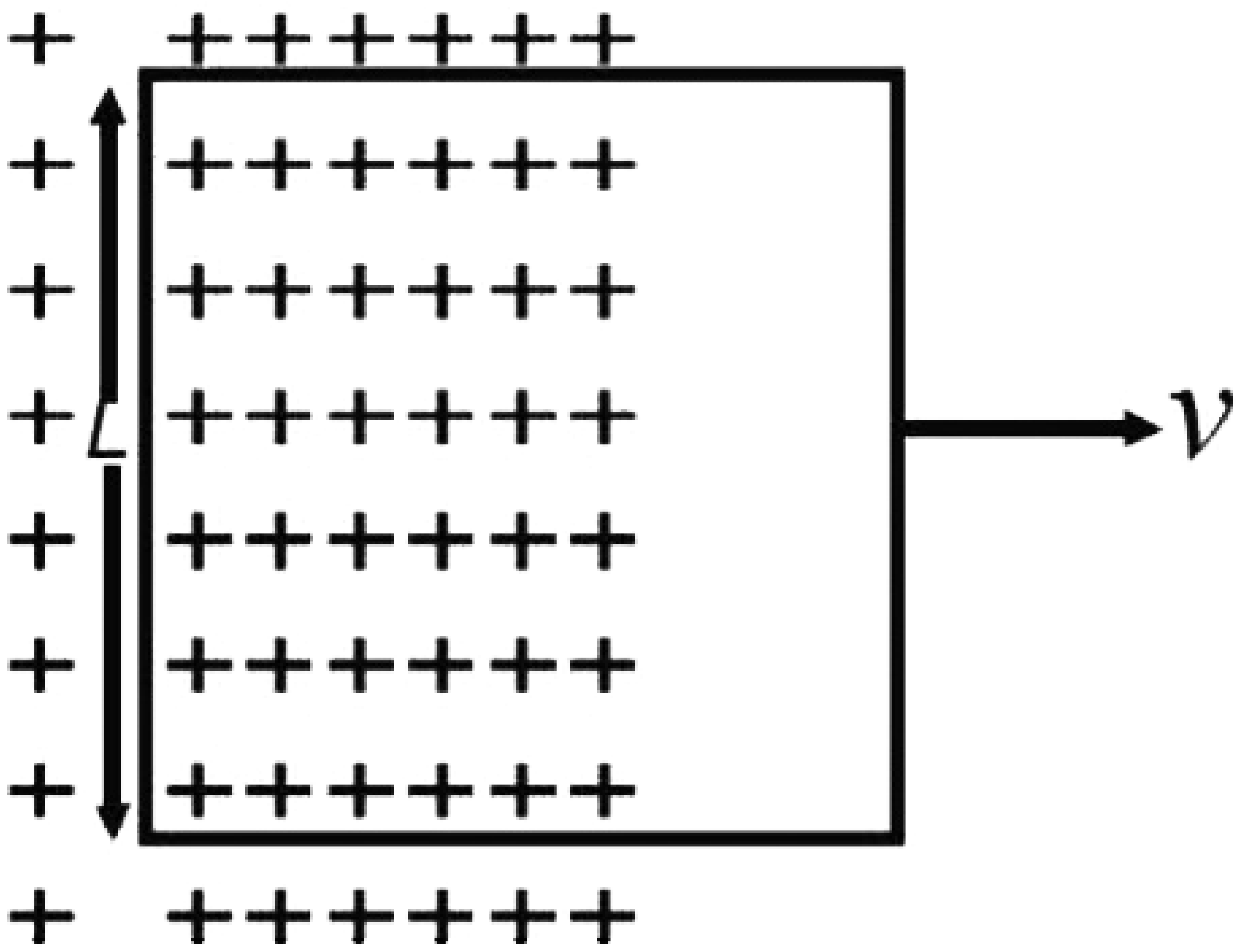
CORRECT ANSWER: C

SOLUTION:

$$e = B\omega\int_{7}^{10} x dx$$
$$= 0.051V$$

Q-12 - 10060064

A conduting square loop of side L and resistnce R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnitude induction B constant in time and space, pointing perpendicular and into to plane at the loop exists every with half the loop outside the field, as shown in figure. The induced emf is



(A) zero

(B) RvB

(C) vBL / R

(D) vBL

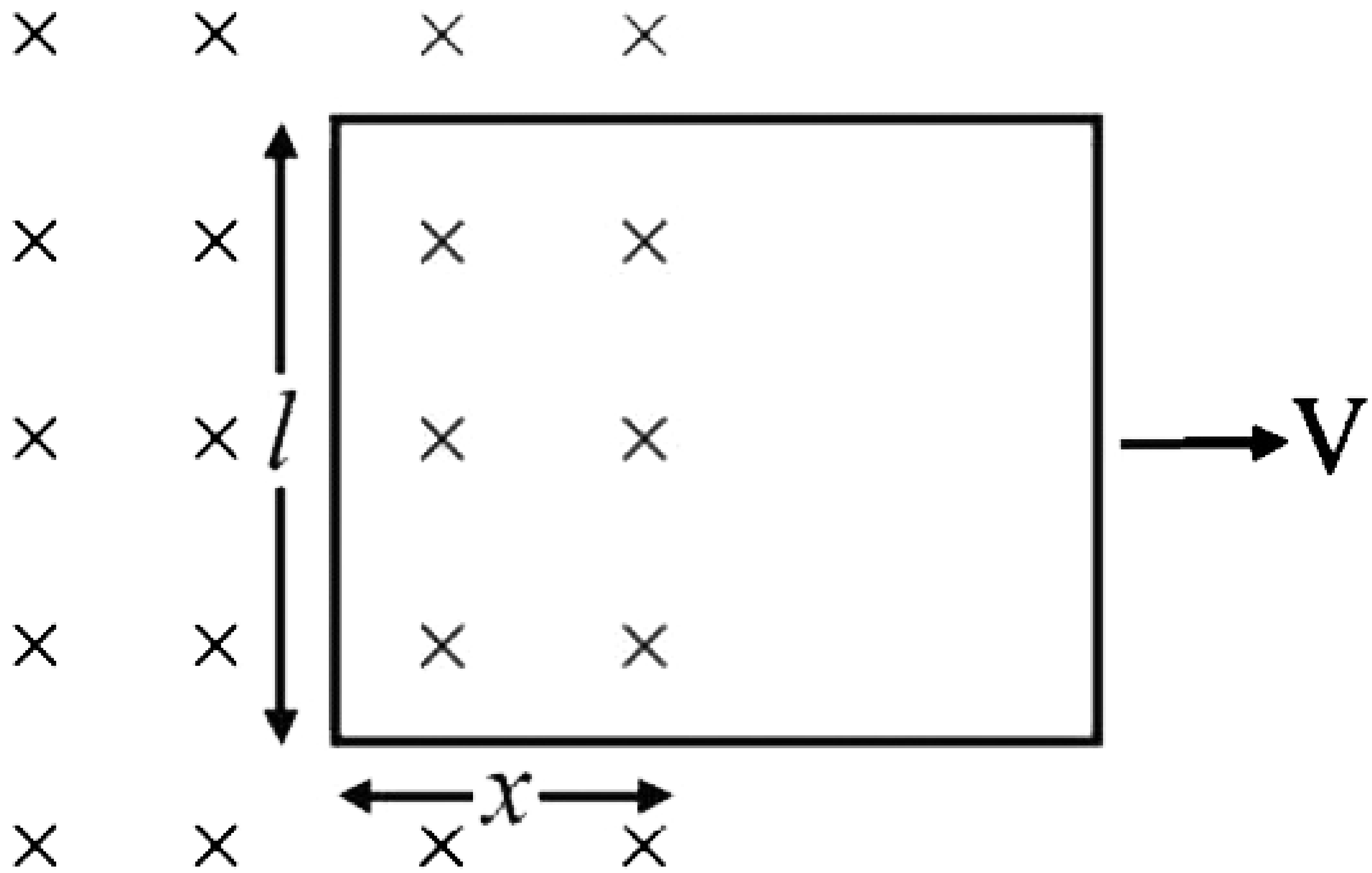
CORRECT ANSWER: D

SOLUTION:

(d) The induced emf is

$$e = \frac{-d\phi}{dt} =$$

$$-\left(d\frac{\vec{B}\,.\,\vec{A}}{dt = \frac{-d\,(BA\cos 0)}{dt}}\right.$$



$$\therefore E = -B\frac{dA}{dt} =$$

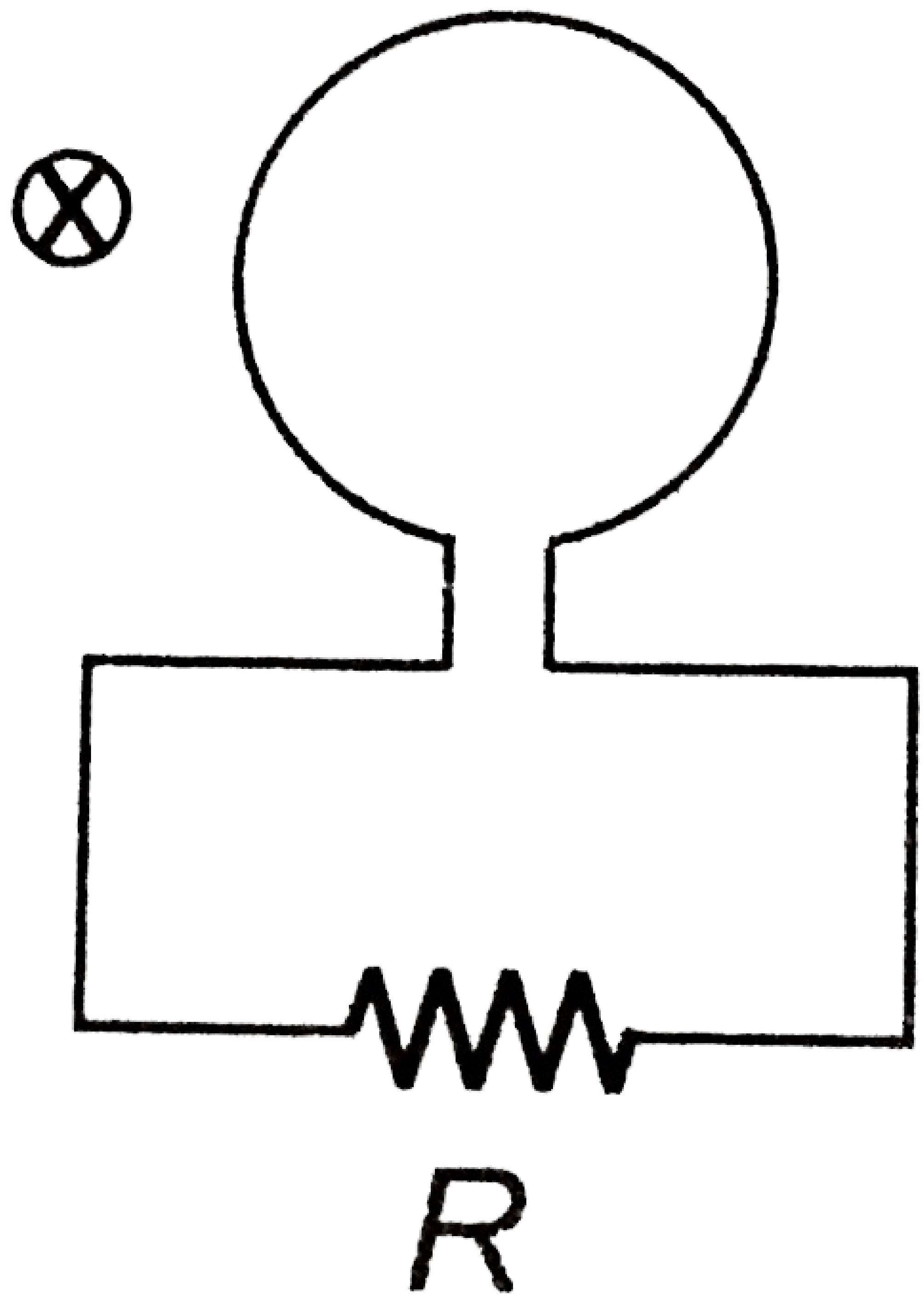
$$-B\frac{d(l \times x)}{dt} =$$

$$-Bl\frac{dx}{dt} = -Blv$$

.

Q-13 - 14156516

In the figure the flux through the loop perpendicular to the plane of the coil and direciton into the paper varying according to the relation $\phi = 6t^2 + 7t + I$ where ϕ is in milliweber and t is in loop at $t = 2s$ and direction of induced current through R are



(A) $39mV$, right to left

(B) $39mV$, left to right

(C) $31mV$ right to left

(D) $31mV$, left to right

CORRECT ANSWER: D

SOLUTION:

$$\phi = \left(6t^2 + 7t + 1\right) \times 10^{-3}$$

$$|e| = \frac{d\phi}{dt} = (12t + 7) \times 10^{-3}$$

At $t = 2 \text{ sec}$, $|e| = 31 \times 10^{-3} V$

ϕ is increasing with time, current will be anticlockwise.

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Q-14 - 14156519

A conducing rod of length l is falling with a velocity v perpendicular to a unifrorm horizontal magnetic field B . The potential difference between its two ends will be

(A) $2Blv$

(B) Blv

(C) $0.5Blv$

(D) $B^2l^2v^2$

CORRECT ANSWER: B

SOLUTION:

NA

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Q-15 - 9728879

A wire of length 10cm translates in a direction making an angle of 60 with its length. The plane of motion is perpendicular ot a uniform magnetic field of 1.0 T that exists in the space. Find the emf induced between the ends of the rod if the speed of translation of`20 cm s^(-1).

SOLUTION:

Here1 $= 10cm = 0.1m$

$\theta = 60, B = 1T,$

$v = 20cm/s = 0.2m$

$/s$

$e = Bvl\sin 60$

$\Big[Aswehave$

$\rightarrow taket\hat{c}ompo$

$\neq ntof \leq n > h$

$\overrightarrow{\overrightarrow{}} rwhichisperpendic\underline{a}r$

$\rightarrow thevelocity \overrightarrow{\overrightarrow{}} r\Big]$

$= 1.732 \times 10^{-2}$

$= 17.32 \times 10^{-3} V.$

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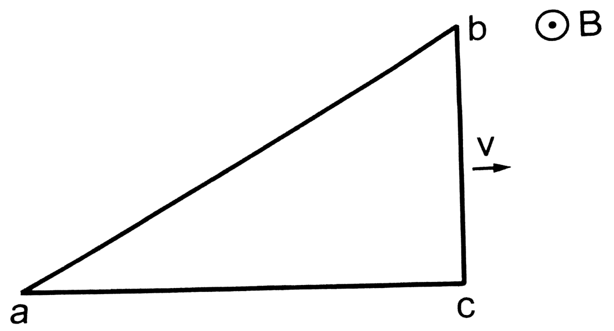
Q-16 - 9728877

A right angled triangle abc, made from a metallic wire, moves at a uniform speed v in its plane as shown in . A uniform magnetic field B exists in the perpendicular direction. Find the emf induced (a) in the loop abc, (b) in the segment bc, (c) in the segment or and (d) in the segment ab.



SOLUTION:

(a) Zero as the comonents of ab are exactly oppsite to that of bc.They cancel each other, because velocity should be perpendicular to the length.

$$(b)e = D\theta \times l$$

$$= Dv(bc) + veatC.$$

$$(c)e = 0asvelocityis$$

$$\neg perpendic\underline{a}r \to the$$

$$\leq n > hpositiveat'a'$$

.

$(d)e = Bv(bc)$

$i.e. thecompo \neq ntof$

$'ab' alongthedirection$

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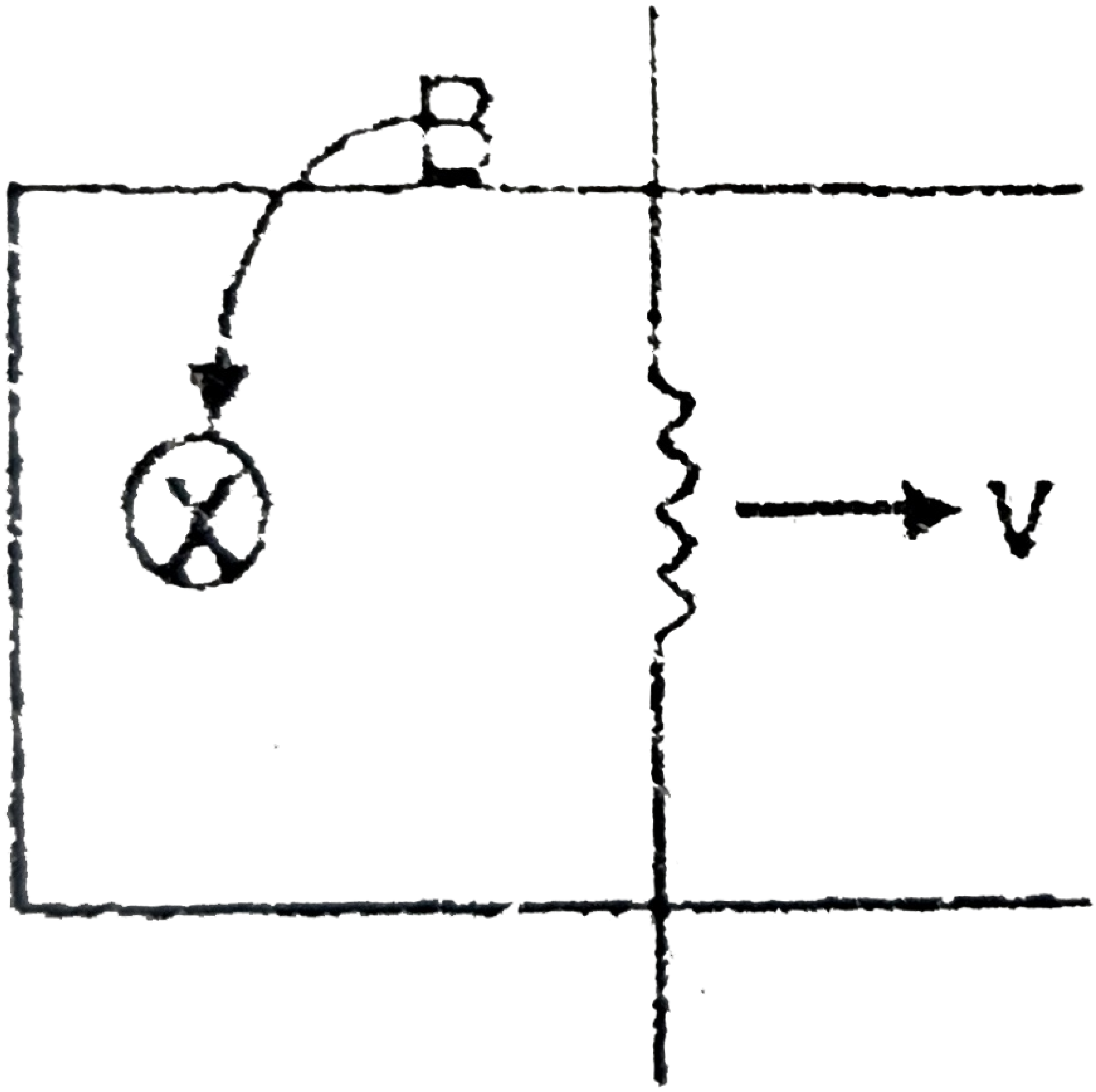
Q-17 - 15524519

A conducting bar is pulled with a constant speed v on a smooth conducting rail. The region has a steady magnetic field of induction B as shown in the figure. If the speed of the bar is doubled then the rate of heat dissipation will



(A) remain constant

(B) become quarter of the initial value

(C) become four fold

(D) get doubled

SOLUTION:

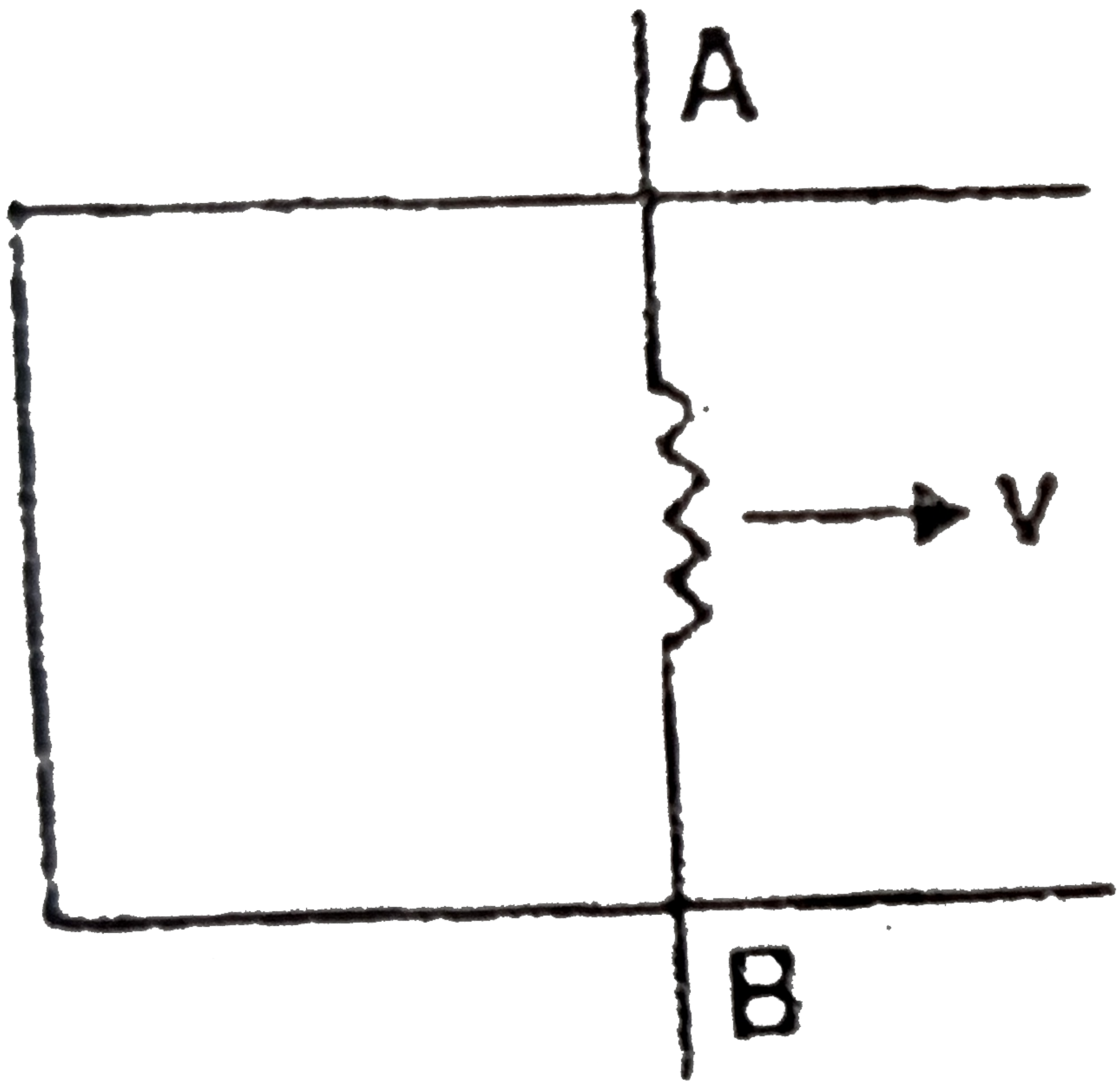
The induced emf between A and $B = E = Blv$

$\Rightarrow$ The induced current $= i = \frac{E}{R}$

$\Rightarrow i = \frac{Blv}{R}$

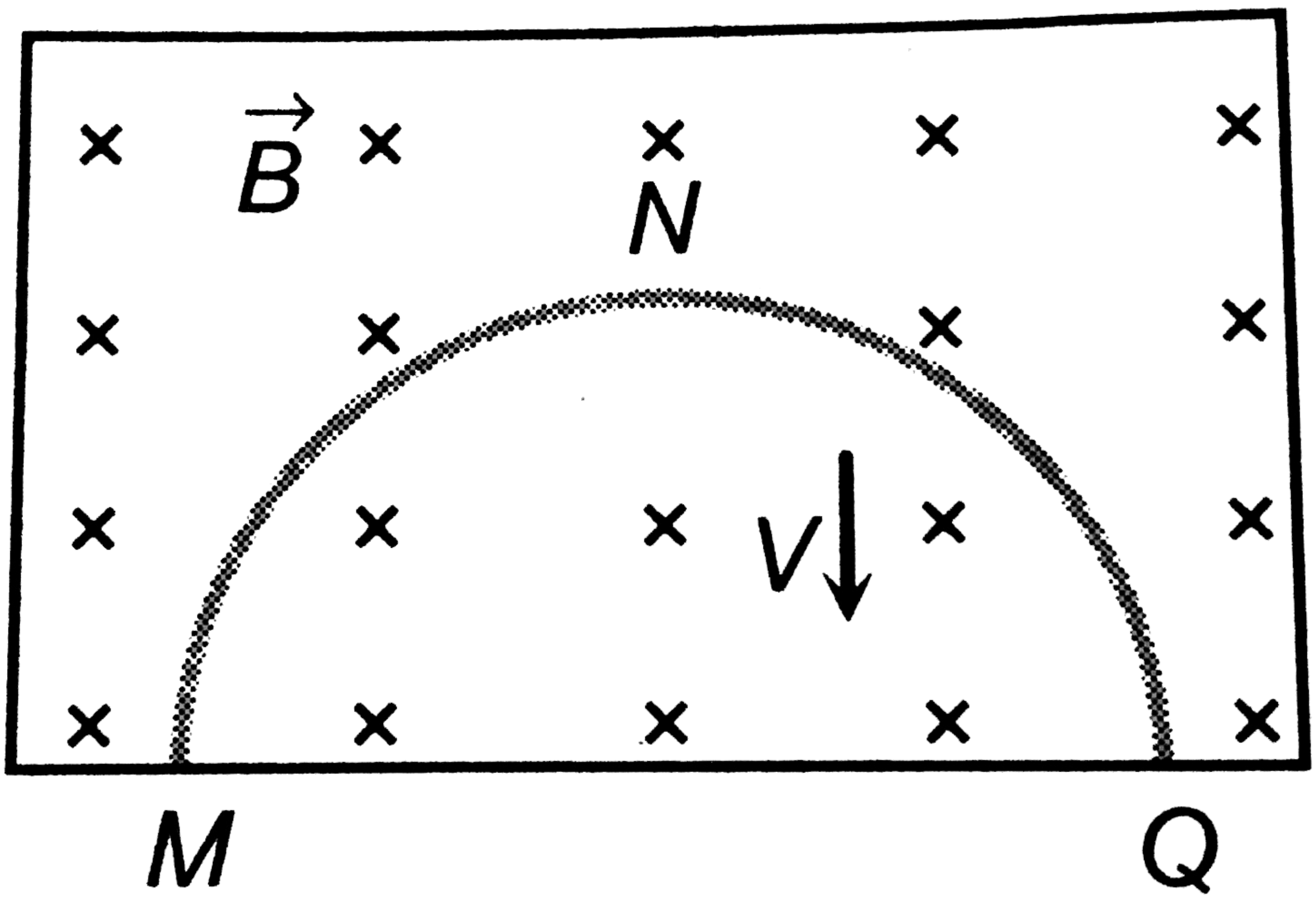
The electrical power $= P = i^2 R = \frac{B^2 l^2 v^2}{R}$

Since v is doubled, the electrical power, becomes four times. Since heat dissipation per second is proportional to electrical power, it becomes four fold.



Q-18 - 11967937

A thin semicircular conducting ring of radius R is falling with its plane verticle in a horizontal magnetic inducting B. At the position MNQ, the speed of the ring is V and the potential difference developed across the ring is



(A) Zero

(B) $Bv\pi R^2 / 2$ and M is at higer potential

(C) πRBV and Q is at higer potential

(D) $2RBV$ and Q is at higer potential

CORRECT ANSWER: D

SOLUTION:

Rate of decrease of area of the semicircular ring

$$\frac{dA}{dt} = (2R)V$$

According to Faraday's law of induction induced emf

$$e = -\frac{d\varphi}{dt} =$$

$$-B\frac{dA}{dt} =$$

$$-B(2RV)$$

The induced current in the must generate magnetic field in the upward direction. thus Q is at higer potential

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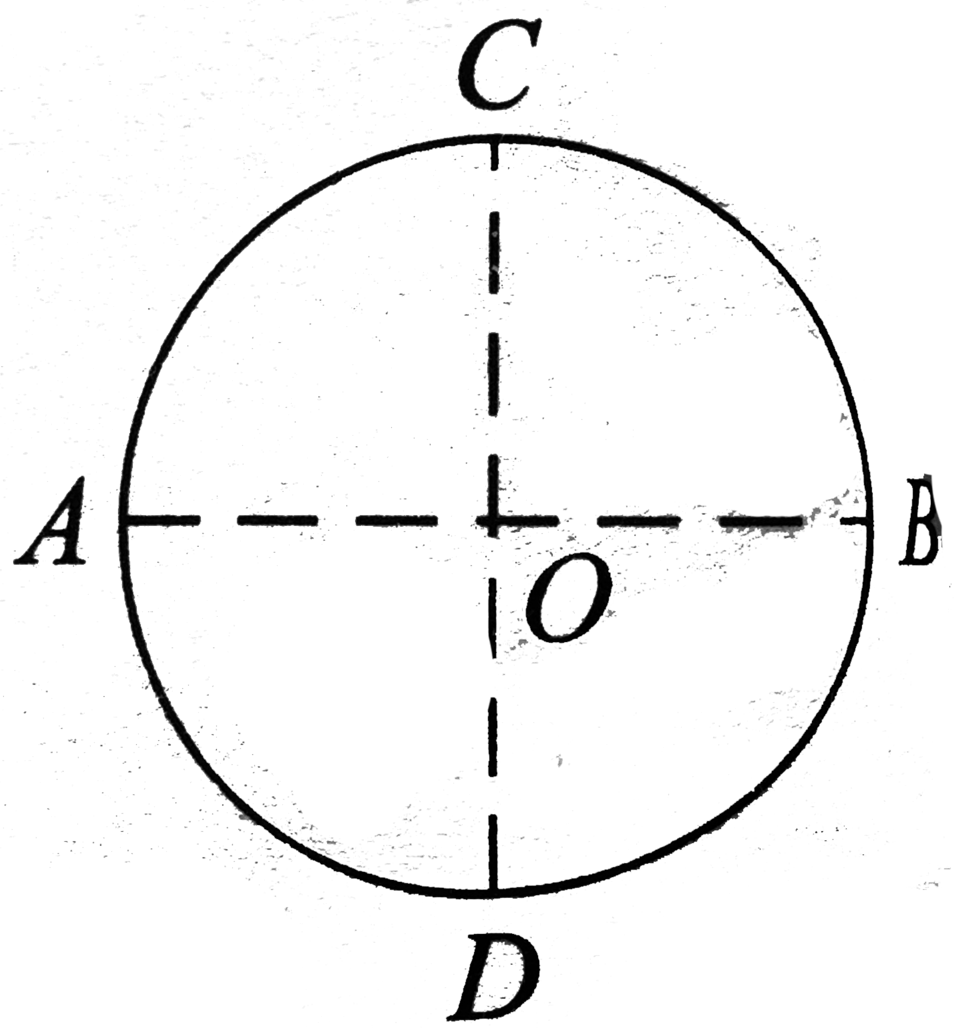
Q-19 - 11314464

A vertical conducting ring of radius R falls vertically with a speed V in a horizontal uniform magnetic field B which is perpendicular to the plane of the ring. Which of the following statements is correct?



(A) (a) A and B are at the same potential

(B) (b) C and D are at the same potential

(C) (c) current flows in clockwise direction

(D) (d) current flows in anticlockwise direction

CORRECT ANSWER: B

SOLUTION:

(b) When the ring falls vertically, there will be an induced emf across $A \text{ and } B(e=Bv(2r)$.

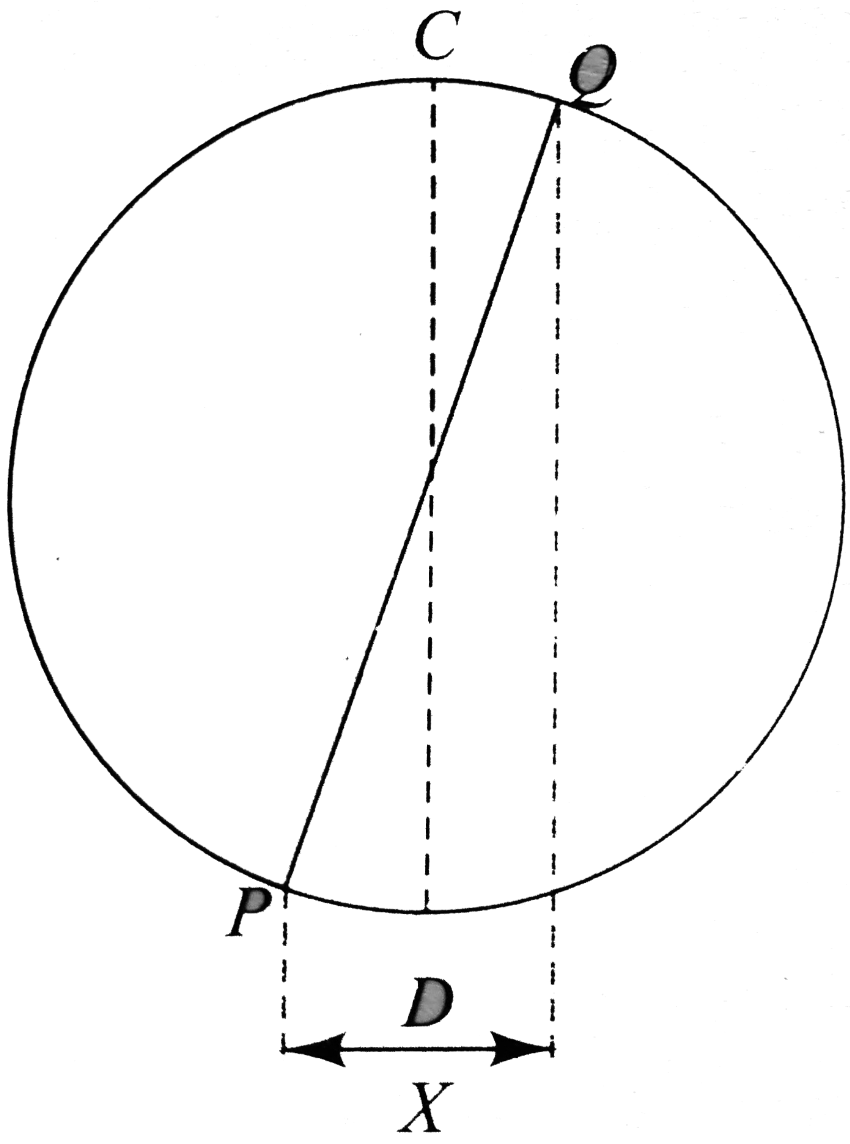
Note that there will be a potential difference across any two points on the ring, and the line joining these has a projected length in the horizontal plane. For example, between points $P \text{ and } Q$ there is a projected length x in the horizontal plane.

$\therefore$ P. D. across P and Q is

$V=Bvx$

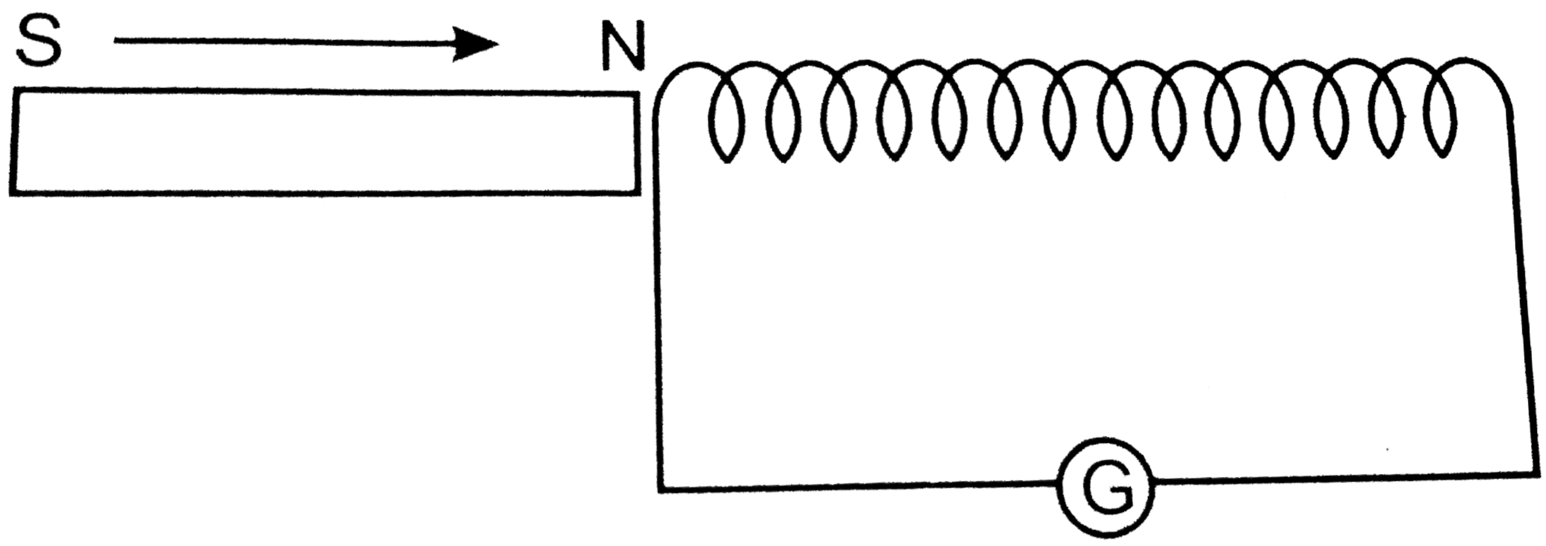
But for points C and D, $x=0$ Therefore, $P.D.=0$

Hence (b)



Q-20 - 11967874

As shown in the figure, a magnetic is moved with a a fast speed towards a coil at rest. Due to this, induced electromotive force, induced charge in the coil are E, I and Q respectively. If the speed of magnetic is doubled, the incorrect statement is



(A) E increases

(B) I increases

(C) Q remains same

(D) Q increases

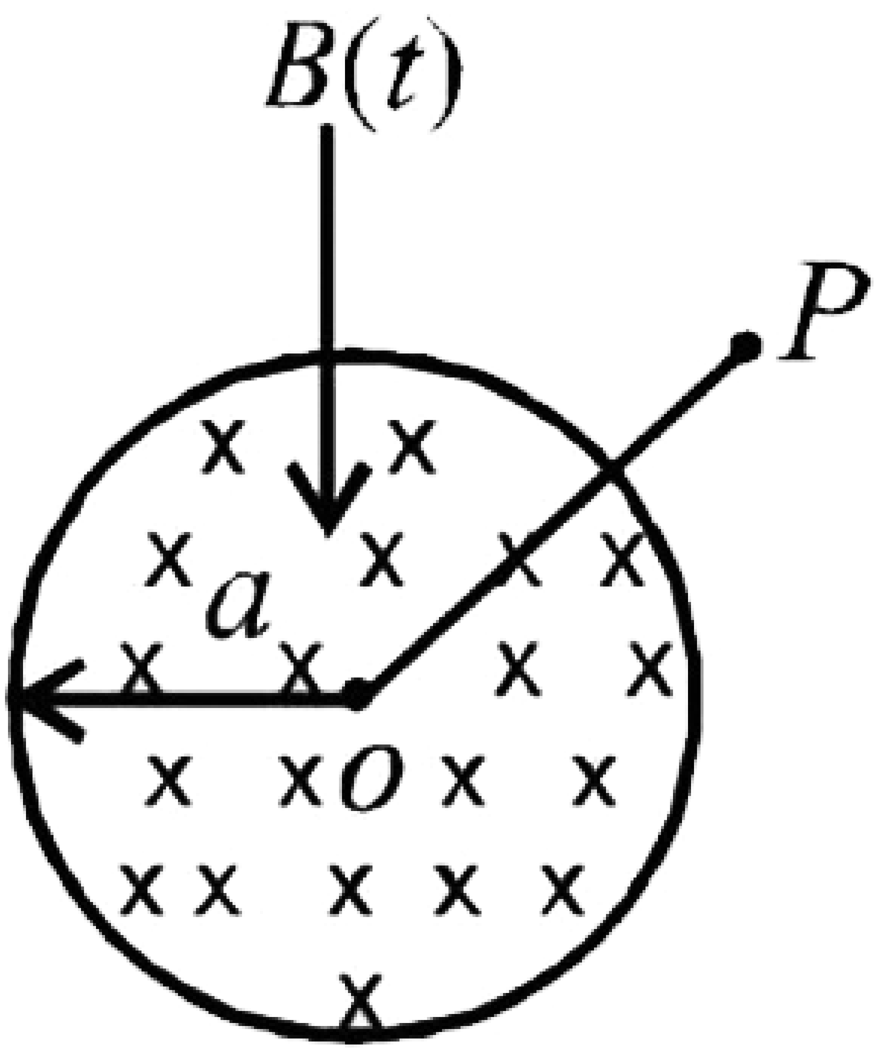
CORRECT ANSWER: D

SOLUTION:

with the increasing in the time rate of change flux, both induced emf and current increase. But the induced charge does not depend upon time. So, it would remain the same.

Q-21 - 10060002

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



(A) is zero

(B) decreases as $1/r$

(C) Increases as r

(D) decreases as $1 / r^2$

CORRECT ANSWER: B

SOLUTION:

$$\oint\left(\vec{E}\right).\left(\vec{d}\,l\right)$$

$$=\frac{d\phi}{dt}\left(\left(\vec{B}\right)\left(\vec{A}\right)\right)$$

$$=\frac{d}{dt}\left(BA\cos\left(0^{\square}\right)\right)$$

$$=A\frac{dB}{dt}$$

$$\Rightarrow E(2\pi r)$$

$$=(\pi)\left(a^2\right)\frac{dB}{dt}f \text{ or } r$$

$$\geq a$$

$$\Rightarrow E = \frac{a^2}{2r}\frac{dB}{dt}$$

$$\Rightarrow E(\propto)\frac{1}{r}$$

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Q-22 - 19037208

An alternating voltage V=140 sin 50 t is applied to a resistor of resistance 10 Ω. This voltage produces $\triangle H$ heat in the resistor in time $\triangle t$. To produce the same heat in the same time, rquired DC current is

(A) 14 A

(B) about 20 A

(C) about 10 A

(D) None of these

SOLUTION:

(c)

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Q-23 - 13156798

An alternating voltage $V = 200\sqrt{2}\sin 100t$ where V is in volt and t in sec is connected to a series combination of $i\mu F$ capacitor and 10Ω resistor throught an ac ammeter The reading of the ammeter will be .

(A) $\sqrt{2}mA$

(B) $10\sqrt{2}mA$

(C) $2mA$

(D) $20mA$

CORRECT ANSWER: B

SOLUTION:

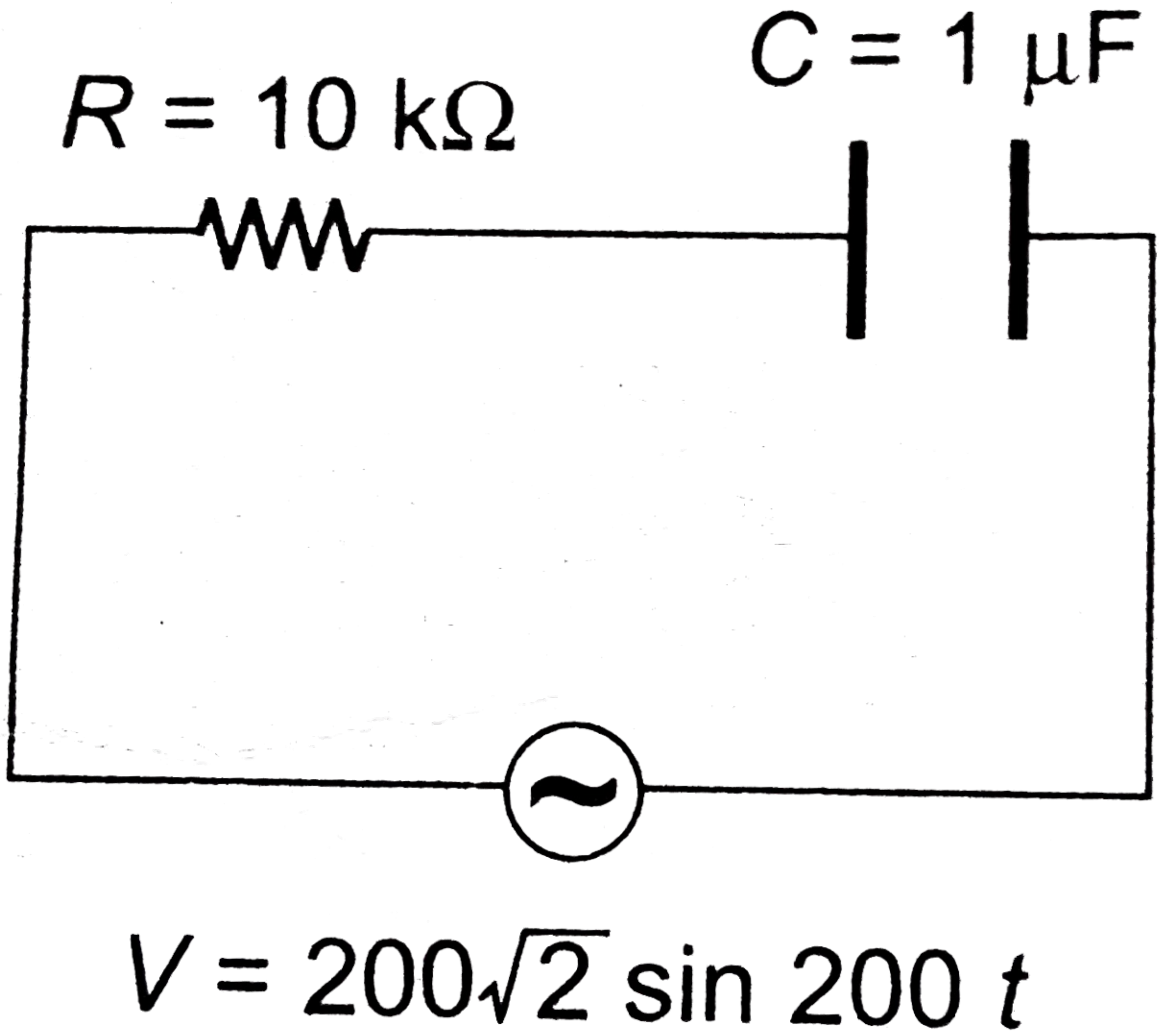
$$\omega = 100 rad / \sec, V_0 = 200\sqrt{2} V, V_{rms} = \frac{V_0}{\sqrt{2}} = 200 V$$

$$X_C = \frac{1}{\omega C} = \frac{1}{100 \times 10^{-6}} = 10^4 \Omega$$

$$Z = \sqrt{R^2 + X_C^2} = \sqrt{\left(10^4\right)^2 + \left(10^4\right)^2} = 10^4\sqrt{2}\Omega$$

$$I_{rms} = \frac{V_{rms}}{Z} = \frac{200}{10^4\sqrt{2}} = \frac{100\sqrt{2}}{10^4} = 10\sqrt{2} \times 10^{-3} A$$

$= 10\sqrt{2} mA$



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Q-24 - 19037212

An AC voltage $e = e_0 \sin 50t - e_0 \cos 100\pi t$ is connected in series with a resistor and capacitor. The steady state current through circuit is found to be

$I = I_0 \sin g(50\pi t + \phi) + I_0$
$' \cos(100\pi t + \phi_2)$

$$\text{Then, the ratio of } \frac{I_0}{I_0'} \text{ is}$$

(A) greater than 1

(B) equal to 1

(C) less than 1

(D) None of these

SOLUTION:

(C)

$$l_0 = \frac{E_0}{\sqrt{R^2 + X_C =^2}}$$

$$= \frac{E_0}{\sqrt{R^2 + \left(\frac{1}{50C}\right)^2}}$$

Similarly ,

$$l'_0 = \frac{E_0}{\sqrt{R^2 + \left(\frac{1}{100C}\right)^2}}$$ Hence ,I_(0)ltI_(0)`

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Q-25 - 10060089

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

(A) $P = \sqrt{2}E_0 I_0$

(B) $P = \frac{E_0 I_0}{\sqrt{2}}$

(C) P=zero

(D) $P = \frac{E_0 I_0}{2}$

CORRECT ANSWER: C

SOLUTION:

(c) We know that power consumed i a.c. Circuit is given

by $P = E_{rms} I_{rms} \cos \phi$

Here, $E = (E_0) \sin \omega t$

I

$= (i_0) \sin \left(\omega t \right.$

$\left. - \frac{\pi}{2} \right) Which$

$\Rightarrow t\hat{t} hephased \Leftrightarrow e$

$\neq nce,$

(phi)=(pi)/(2):. P=E_(rms).I_(rms).cos(pi)/(2)=0 {:. cos

(pi)/(2)=0)`.

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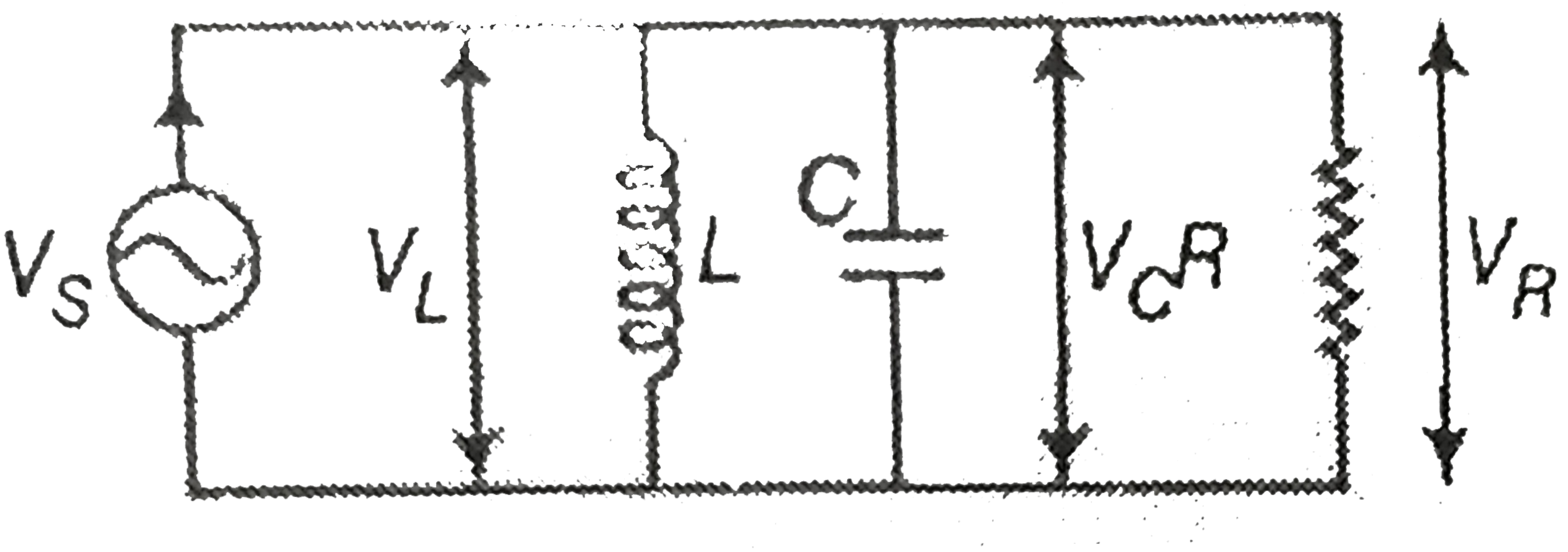
Q-26 - 19037242

An AC source is connected in parallel with an L-C-R circuit as

shown.Let l_s, l_L, l_C and l_R denote the currents through and

V_s, V_L, V_C and $V_R$the voltage across the corresponding

componts.Then,



(A) $l_S = l_L + L_C + l_R$

(B) $V_S = V_L + V_C + V_R$

(C) $(l_L, l_C, l_R) < l_S$

(D) l_L, l_C may be greater than l_S

SOLUTION:

(d) In parallel resonant circuit, current through L and C may be greater than the source current , i.e. I_L, I_C may be greater than L_s

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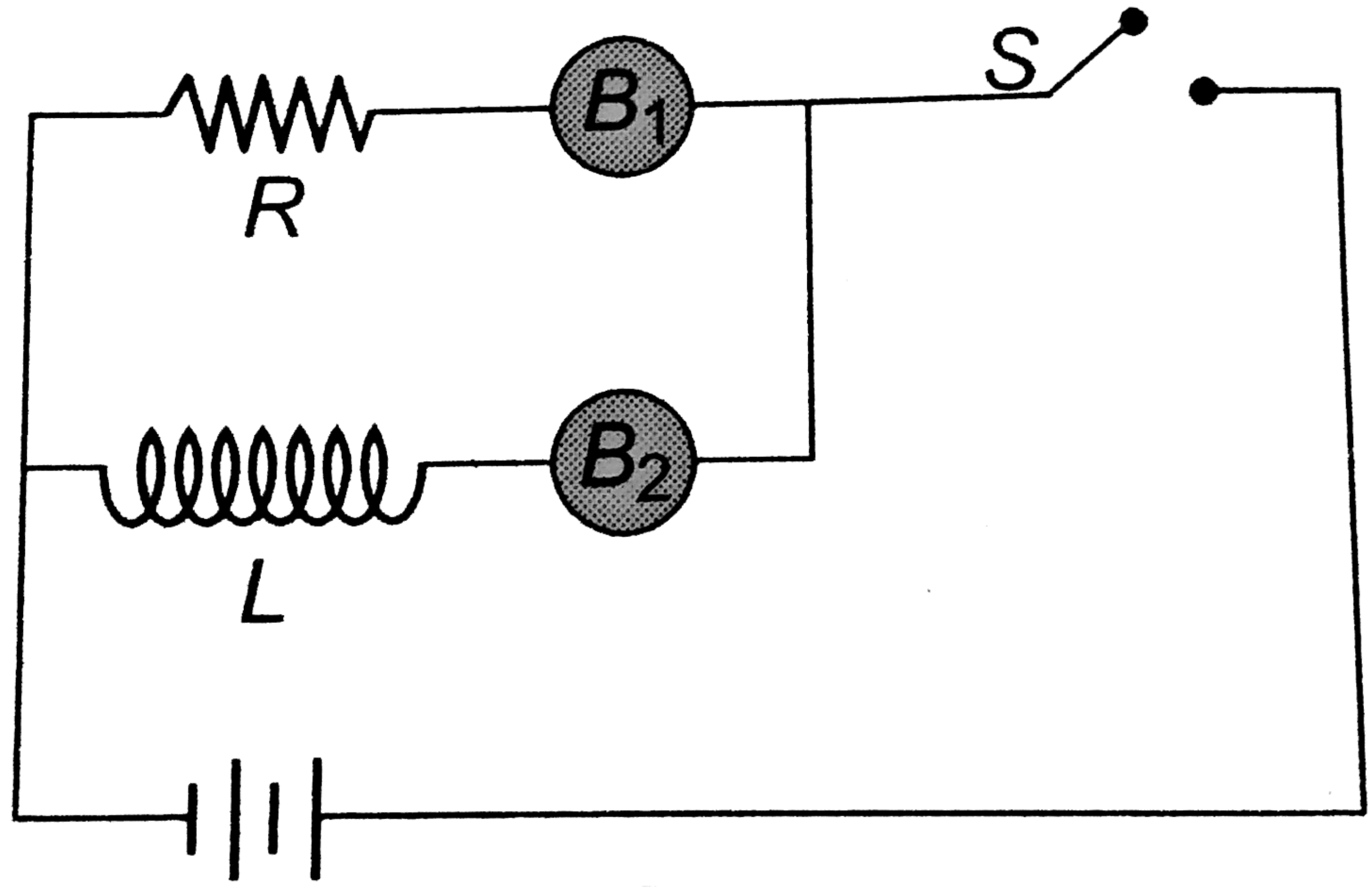
The adjoining figure shows two bulbs $B-(1)$ and B_{20} resistor R and an inductor and L. When the switch S is turned off



(A) Both B_1 and B_2 die out promptly

(B) Both B_1 and B_2 die out with some delay

(C) B_1 dies out promptly but B_2 with some delay

(D) B_2 dies out promptly but B_1 with some delay

CORRECT ANSWER: C

SOLUTION:

Current in B_1 will promptly become zero while current in B_2 will slowly tend to zero.

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Q-28 - 14156552

A conducting loop is placed in a uniform magnetic field with its plane perpendicular to the field with its plane perpendicular to the field. An emf is induced in the loop if

(i) it is traslated

(ii) it is rotated about its axis

(iii) it is rotated about a diameter

it is deformed

(A) $(i), (ii)$

(B) $(ii), (iii)$

(C) $(iii), (iv)$

(D) $(i), , (v)$

CORRECT ANSWER: C

SOLUTION:

NA

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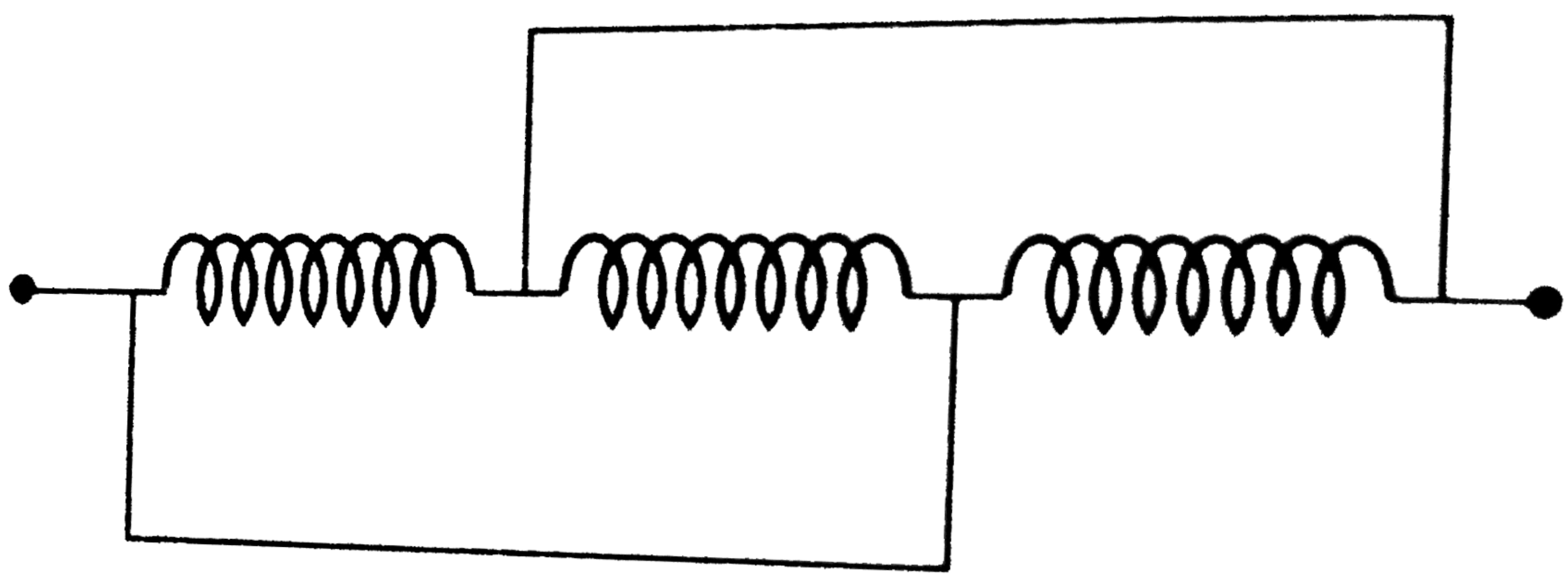
Q-29 - 11968023

Pure inductance of $3.0H$ is connected as shown below. The equivalent inductance of the circuit is



(A) $1H$

(B) $2H$

(C) $3H$

(D) $9H$

CORRECT ANSWER: A

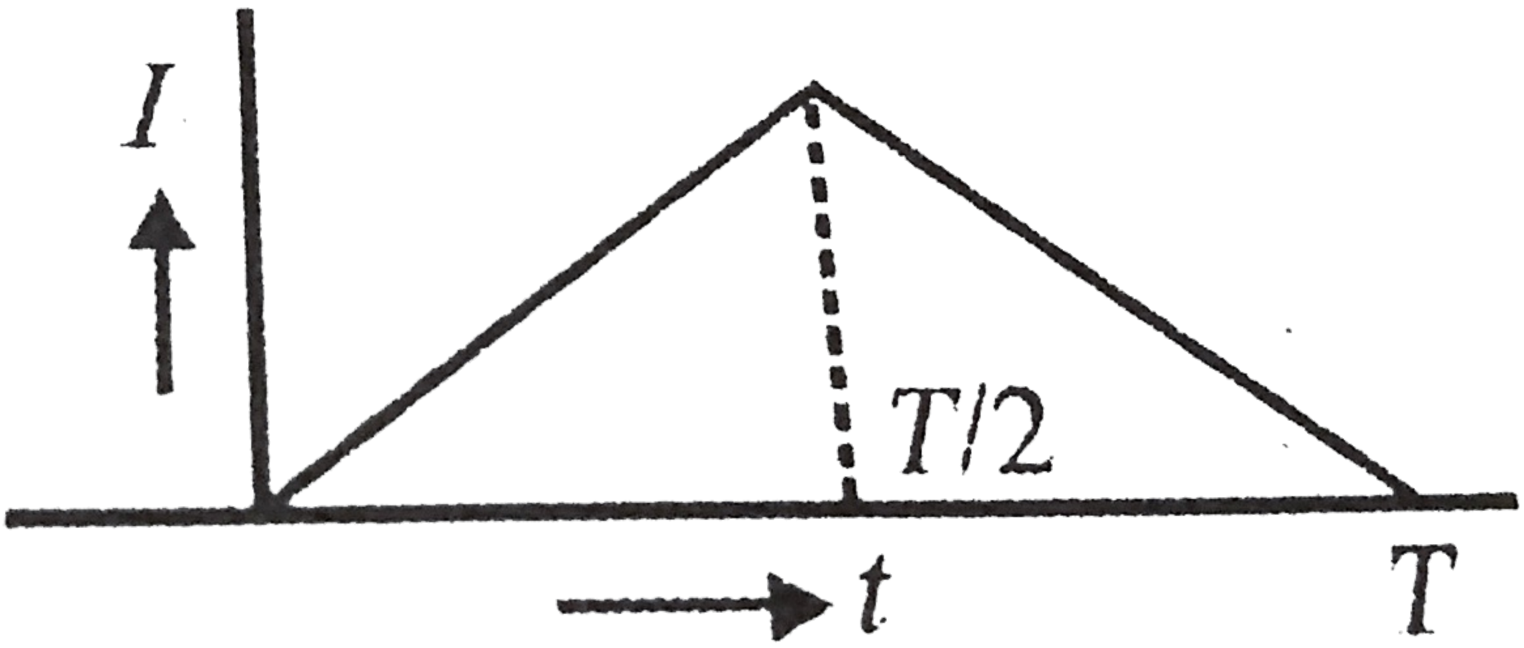
SOLUTION:

The inductance are in parallel

$$\Rightarrow L_{eq} = \frac{L}{3} = \frac{3}{3}$$
$$= 1H$$

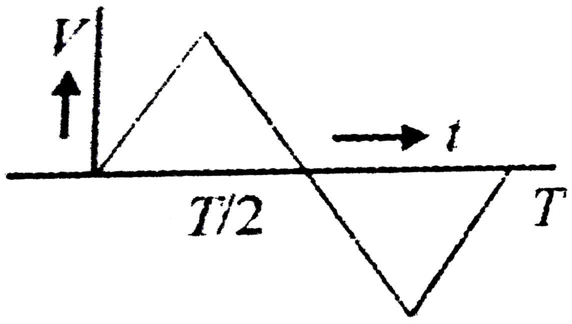
Q-30 - 14928587

The current (I) in the inductance is varying with time according to the plot shown in figure.

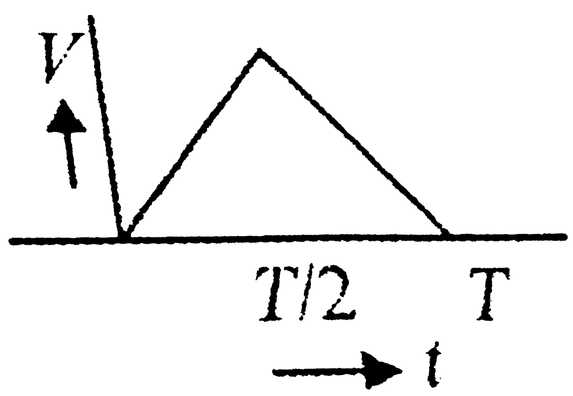


Which one of the following is the correct variation of voltage with time in the coil?

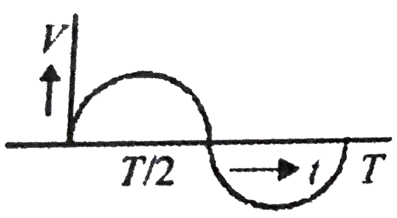
(A)



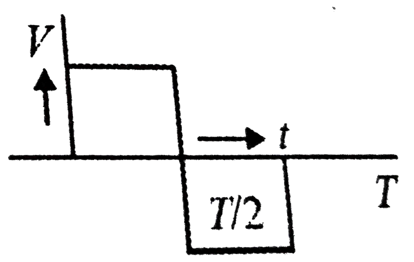
(B)



(C) (c)



(D) (d)



Q-31 - 10060069

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

(A) $\frac{Q}{2}$

(B) $\frac{Q}{\sqrt{3}}$

(C) $\frac{Q}{\sqrt{2}}$

(D) Q

CORRECT ANSWER: C

SOLUTION:

(c) When the capicitor is completely charged, the total energy in the L.C circuit is with the capacitor and that

energy is

$$E = \frac{1}{2}\frac{Q^2}{C}$$

When half energy is with the capacitor in the form of

electric field between the plates of he capacitor we get

(E)/(2)=1/2(Q'^(2))/(C)

$$whereQ'isthechar$$

$$\geq ono \neq plateofthe$$

$$\cap aci \rightarrow r$$

:. 1/2xx1/2(Q^2)/(C)=1/2(Q'^(2))/(C) implies Q' =

(Q)/(sqrt(2))`.

Q-32 - 17654340

In an LR-circuit the current attains one-third of its final steady value

in 5s. What is the time-constant of the circuit ? $(\log_2 = 0.405)$

CORRECT ANSWER: 12.3S

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Q-33 - 11968143

Two coils have a mutual inductance $0.005H$. The current changes in the first coil according to equation $I = I_0 \sin \omega t$, where $I_0 = 10A$ and $\omega = 100\pi$radian//sec`. The maximum value of e.m.f. in the second coil is

(A) 2π

(B) 5π

(C) π

(D) 4π

CORRECT ANSWER: B

SOLUTION:

$$e = M\frac{di}{dt} = 0.005$$

$$\times \frac{d}{dt}(i_0 \sin \omega t)$$

$$= 0.005 \times i_0 \omega \cos \omega t$$

$$\therefore e_{\max} = 0.005 \times 10$$

$$\times 100\pi = 5\pi)$$

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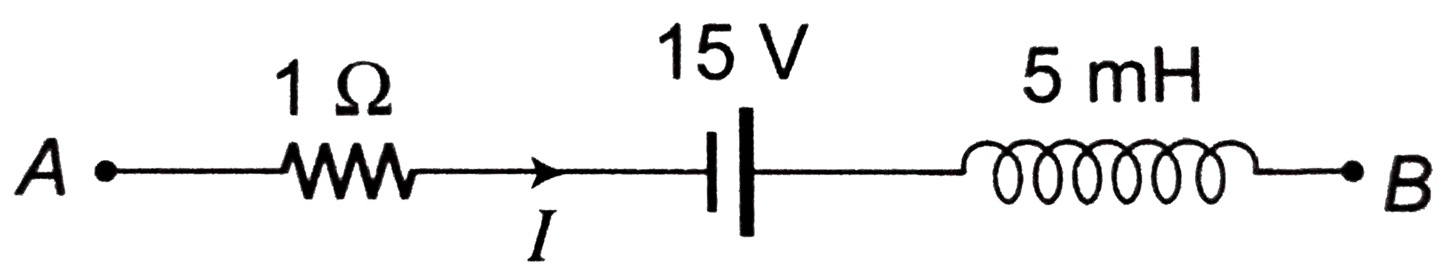
Q-34 - 14156575

If $I = 5A$ and decreasing at a rate of $10^2 (A/\sec)$, then $V_B - V_A$



(A) $5V$

(B) $10V$

(C) $15V$

(D) $20V$

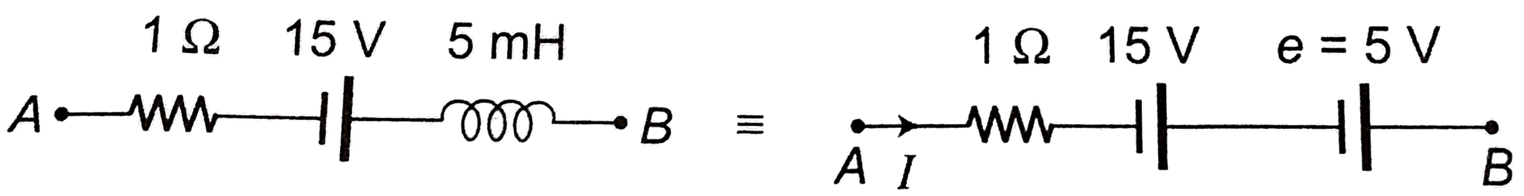
CORRECT ANSWER: C

SOLUTION:

An inductor can be replaced by battery of

$$emf Ldi / dt$$
$$e = Ldi / dt = 5$$
$$\times 10^{-3} \times 10^{30} = 5V$$

$$V_A - 5 \times 1 + 15 + 5$$
$$= V_B \Rightarrow V_B - V_A$$
$$= 15V$$



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Q-35 - 9728836

Two solenoids have identical geometrical construction but one is made of thick wire and the other of thin wire. Which of the following quantities are different for the two solenoids?

(A) self inductance

(B) rate of Joule heating if the same current goes through them

(C) magnetic field energy if the same current goes throgh them

(D) time constant if one solenoid is conneted to one battery and the other is connected to another battery.

CORRECT ANSWER: B::D

Q-36 - 11968121

In a step up transformer, if ratio of turns of primary to secondary is $1:10$ and primary voltage si $230V$. If the load current is $2A$. Then the current in primary is

(A) $20A$

(B) $10A$

(C) $2A$

(D) $1A$

CORRECT ANSWER: A

SOLUTION:

$$\frac{N_p}{N_s} = \frac{I_s}{I_p} \Rightarrow I_p$$

$$= \frac{N_s}{N_p} I_s = \frac{10}{1} \times 2$$

$$= 20A$$

.

Q-37 - 19037215

In a circuit consisting of inductor (L), capacitor (C) and resistor (R) are in series, if $\omega L < \frac{1}{\omega C}$, then the emf

(A) leads the current

(B) lags behind the current

(C) is in phase with current

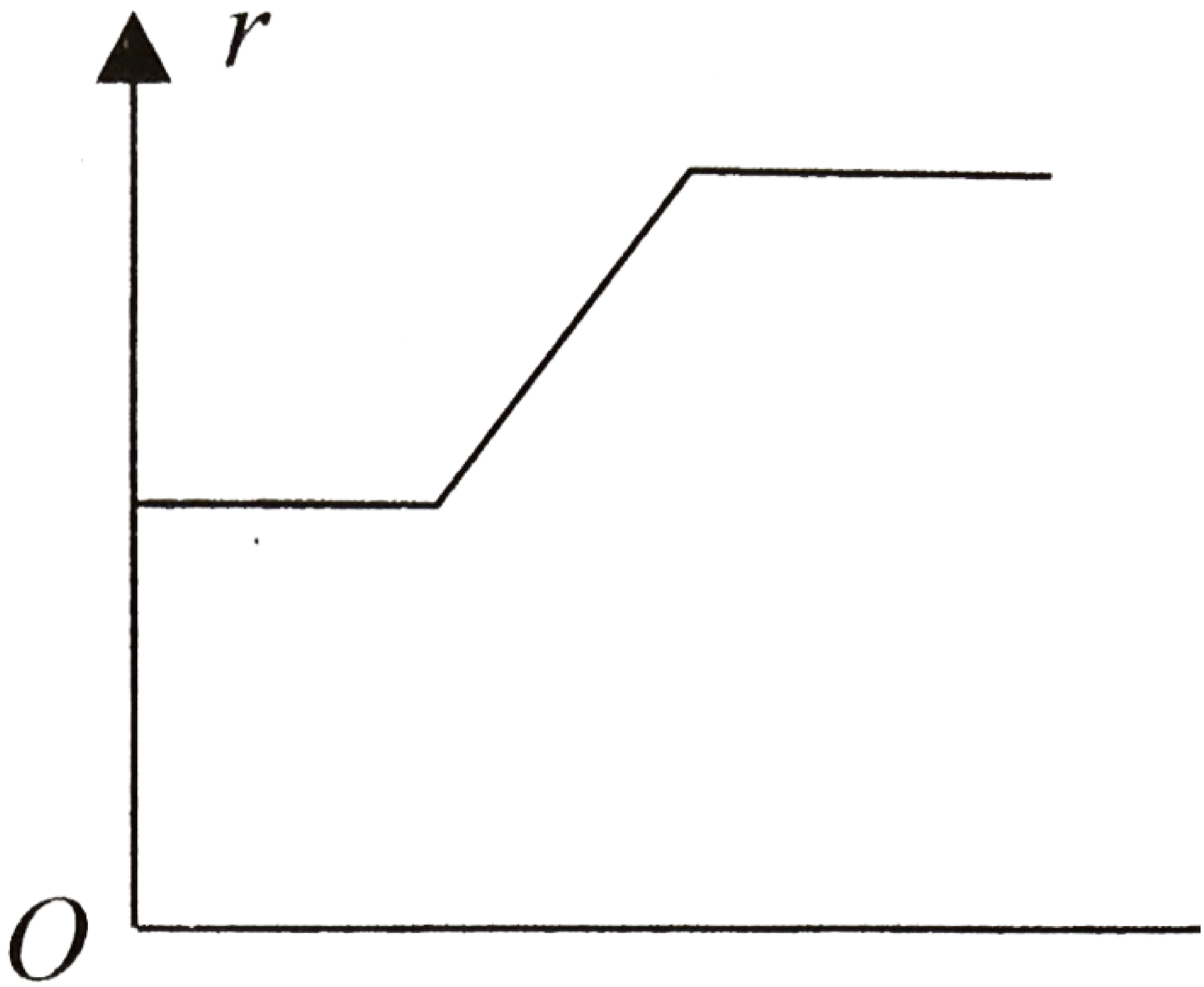
(D) is zero

SOLUTION:

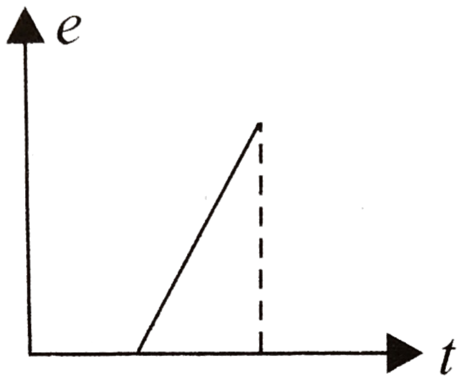
(a) When $\omega L < \frac{1}{\omega C}$, emf leads the current by $\frac{\pi}{2}$.

Q-38 - 11314969

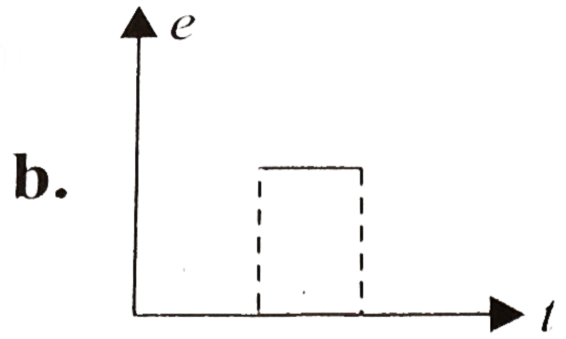
Radius of a circular ring is changing with time and the coil is placed in uniform magnetic field perpendicular to its plane. The variation of 'r' with time 't' is shown in Fig. Then induced emf e with time t will be best represented by



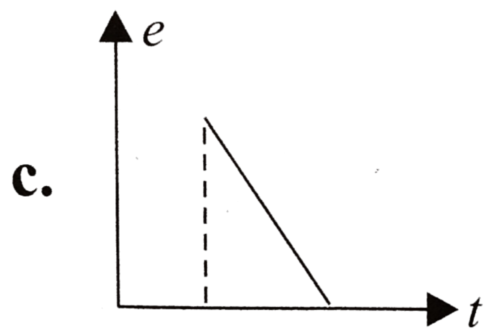
(A) **a.**



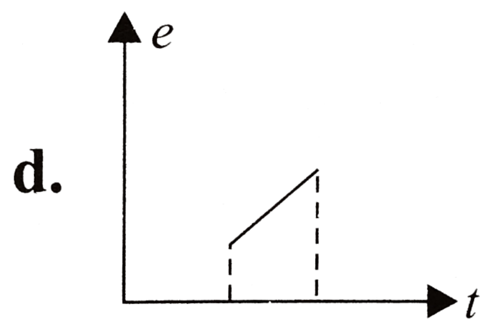
(B)



(C)



(D)



CORRECT ANSWER: D

SOLUTION:

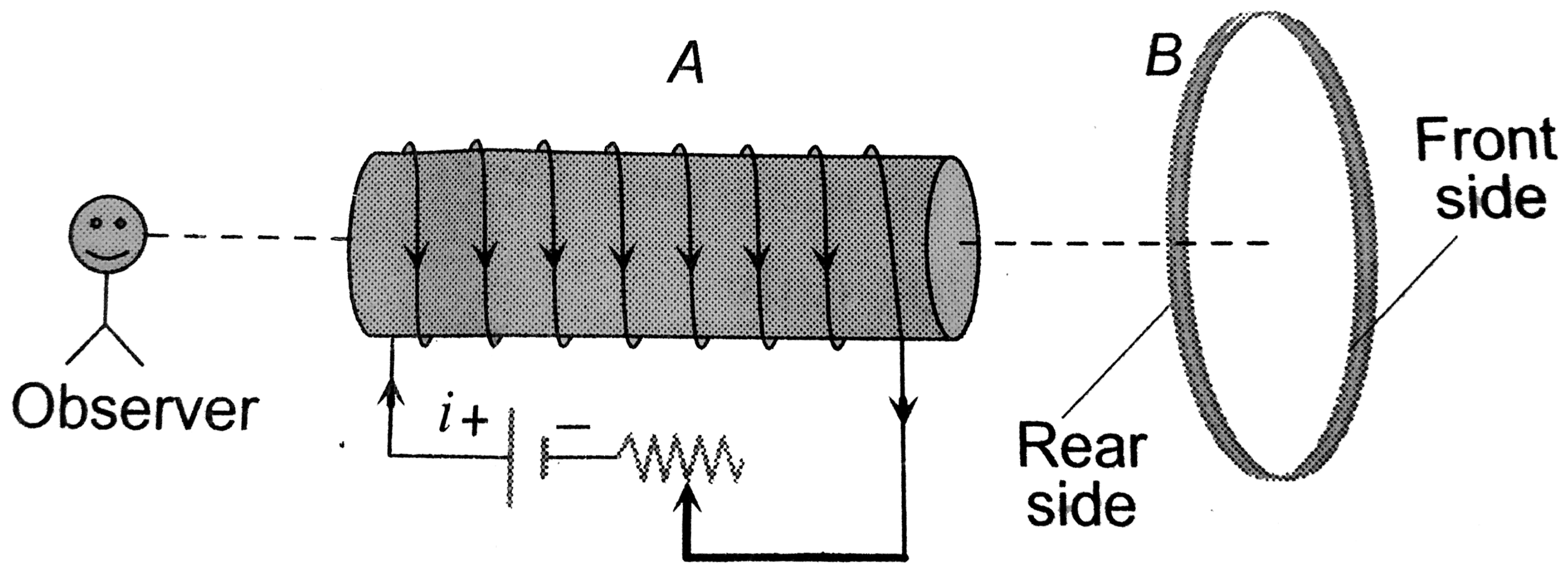
In first and third part, radius remains same, so there is no change in flux hence, no emf is induced. For second part:

$$e = B\frac{dA}{dt}$$
$$= B\left(d\frac{\pi r^2}{dt}\right)$$
$$= B2\pi r\frac{dr}{dt}$$

dr/dt is constant, but r increase linearly, hence induced emf also increases linearly.

Q-39 - 11967864

An aluminium ring B faces an electromagnet A. The current I through A can be altered



(A) wheter I increases or decreases, B will not experience any force

(B) If I decreases, A will repel B

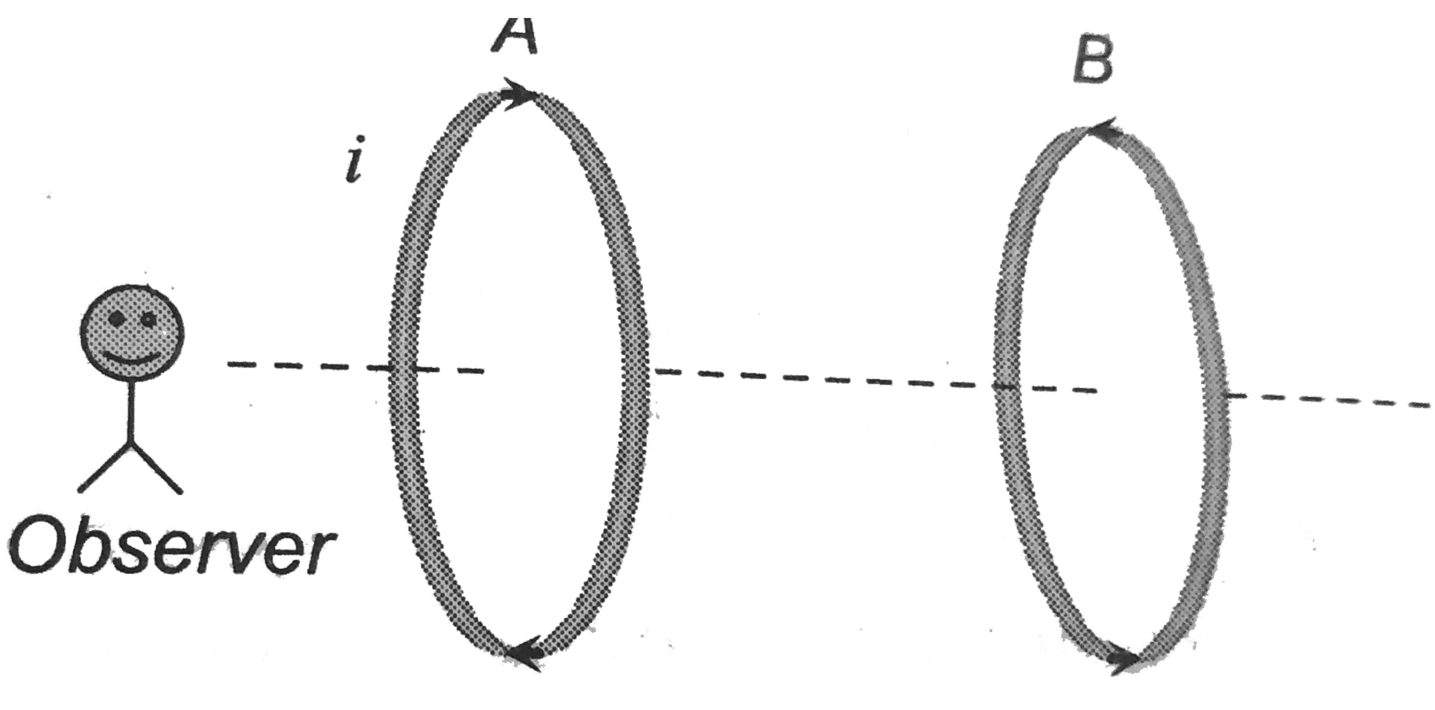
(C) If I increasing , A will attract B

(D) If I increasing , A will repel B

CORRECT ANSWER: D

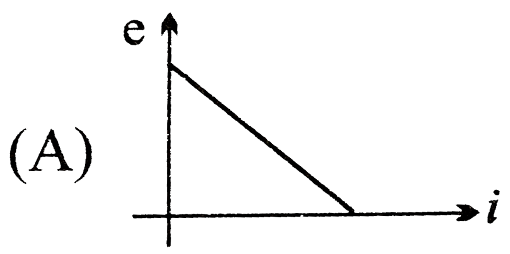
SOLUTION:

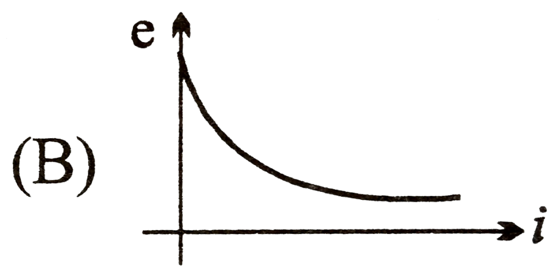
If current through A increase, crosses (XX) linked with coil B increase, hence anticlockwise current induces in coil B. As shown in figure both the current produces repulsive effect.

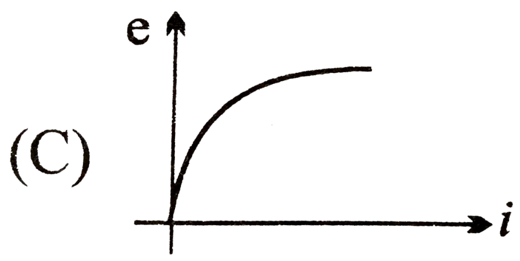


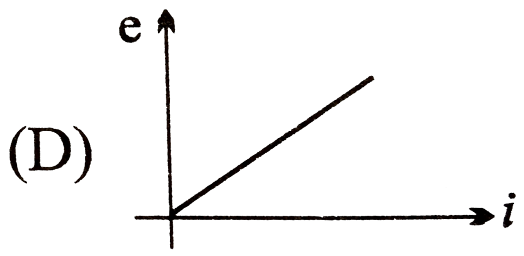
Q-40 - 12229280

In an L-R circuit connected to a battery of constant e.m.f. E switch S is closed at time t=0. If e denotes the magnitude of induced e.m.f. across inductor and i the current in the circuite at any time t. Then which of the following graphs shows the variation of e with i?

(A) 

(B) 

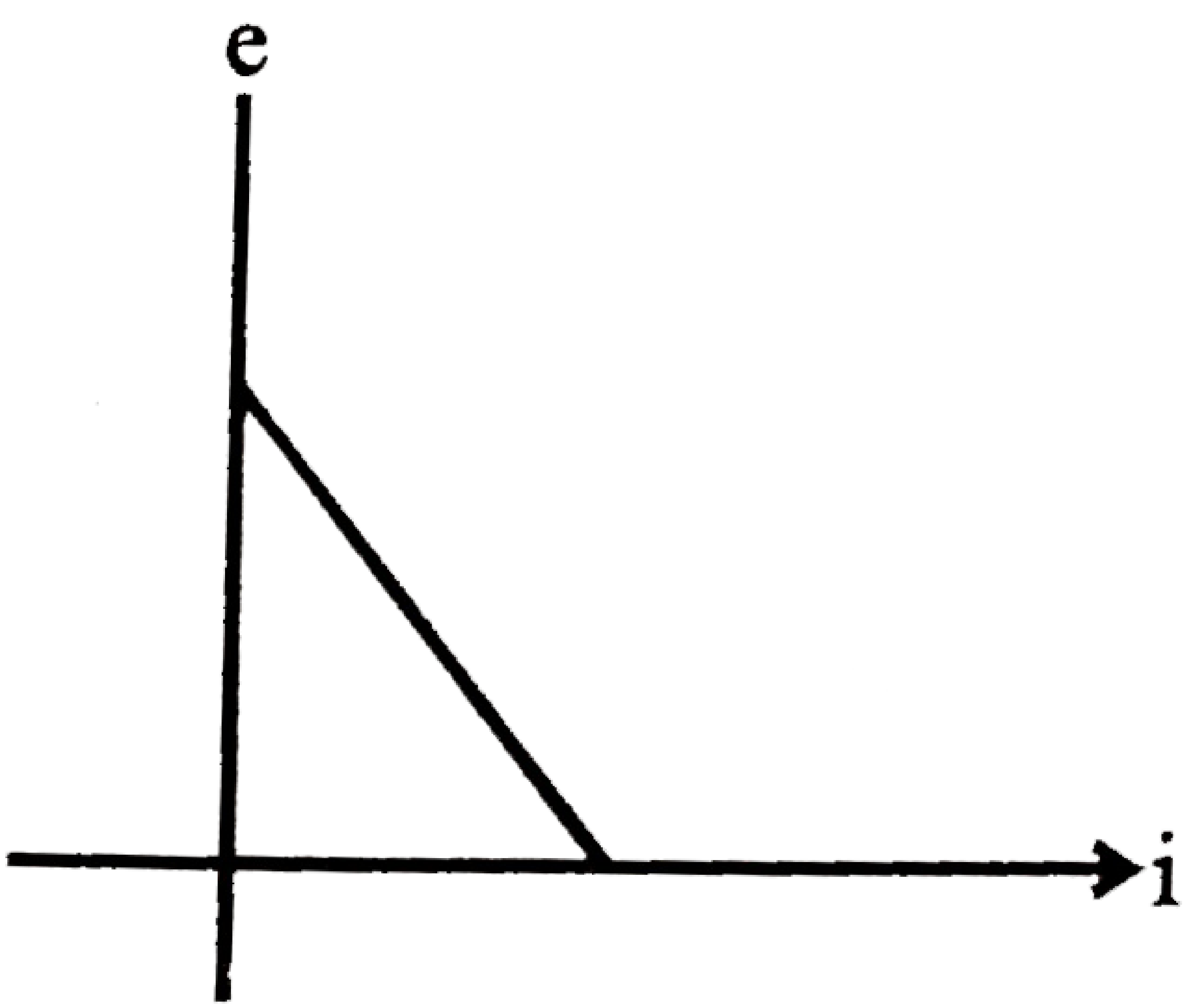
(C) 

(D) 

CORRECT ANSWER: A

SOLUTION:

$E = e + IR \Rightarrow e = - IR + E$



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Q-41 - 14928507

In an inductor of self-inductance L=2 mH, current changes with time according to relation $i = t^2 e^{-t}$. At what time emf is zero ?

(A) 4s

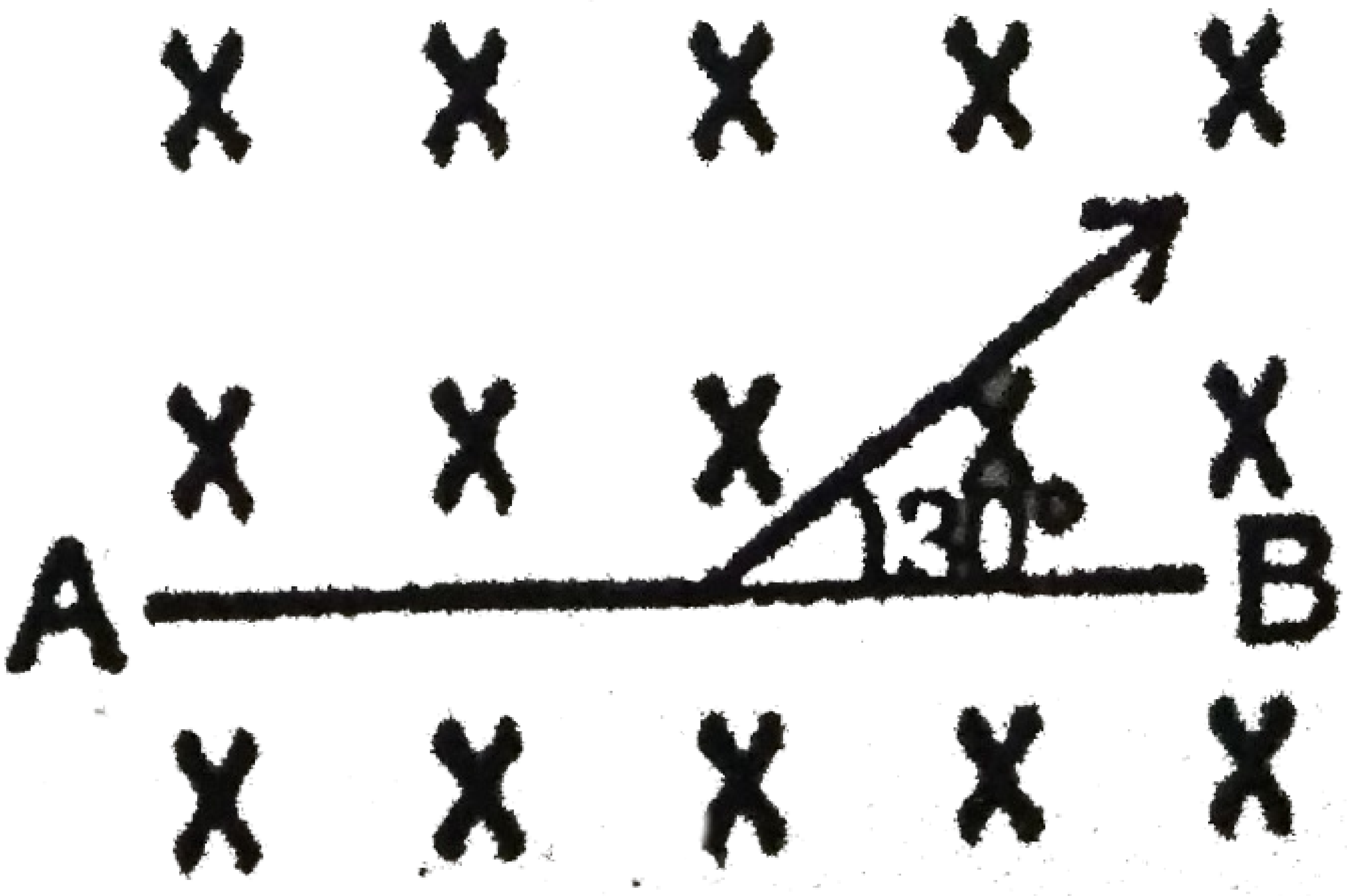
(B) 3s

(C) 2s

(D) 1s

Q-42 - 14528251

A conducting rod AB of length $l = 1m$ is moving at a velocity $v_A = 4m/s$ making an angle 30 with its length. A uniform magnetic field $B = 2T$ exists in a direction perpendicular to the plane of motion. Then



(A) $V_A - V_B = 8V$

(B) $V_A - V_B = 4V$

(C) $V_B - V_A = 8V$

(D) $V_B - V_A = 4V$

CORRECT ANSWER: B

Q-43 - 10967699

A magnet is taken towards a conducting ring in such a way that a constant current of $10mA$ is induced in it. The total resistance of the ring is 0.5Ω. In $5s$, the magnetic flux through the ring changes by

(A) $0.25mWb$

(B) $25mWb$

(C) $50mWb$

(D) $15mWb$

CORRECT ANSWER: B

SOLUTION:

$$\triangle q = \frac{\triangle \phi}{R}$$

$$\text{or } i \triangle t = \frac{\triangle \phi}{R}$$

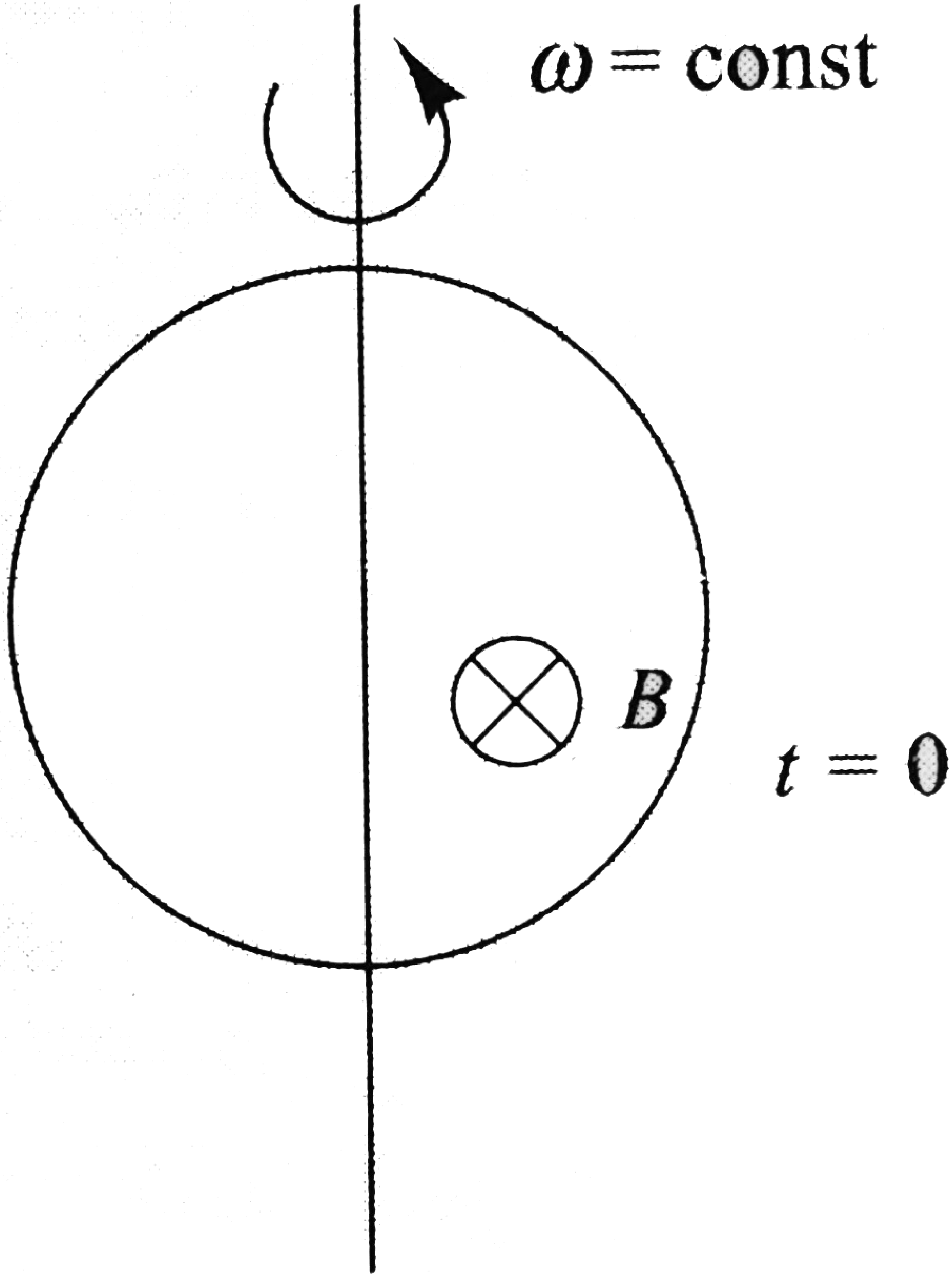
$$\therefore \triangle \phi = i(\triangle t)R$$

$$= (10 \times 10^{-3})(5)(0.5)$$

$$= 25 \times 10^{-3} Wb$$

Q-44 - 11314386

A ring rotates with angular velocity ω about an axis in the plane of the ring which passes through the center of the ring. A constant magnetic field B exists perpendicualr to the plane of the ring . Find the emf induced in the ring as a function of time.



CORRECT ANSWER: N/A

SOLUTION:

At any time t,

$$\phi = BA\cos\theta$$
$$= BA\cos\omega t$$

Now, induced emf in the loop

$$e = -\frac{d\phi}{dt} = BA \text{ omega sin omegat}$$

If there are n turns,

$$emf = BA\omega N \sin \omega t$$

$BA\omega N$ is the amplitude of the emf $e = e_m$ sin omegat,

where $e_m = BA\omega N$

$$i = \frac{e}{R} = \frac{e_m}{R} \sin \omega t$$
$$= i_m \sin \omega t$$

where $i_m = \frac{e_m}{R}$.

the rotating coil thus produces a sinusoidally varying current or alternating current. This is also the principle used in generator.

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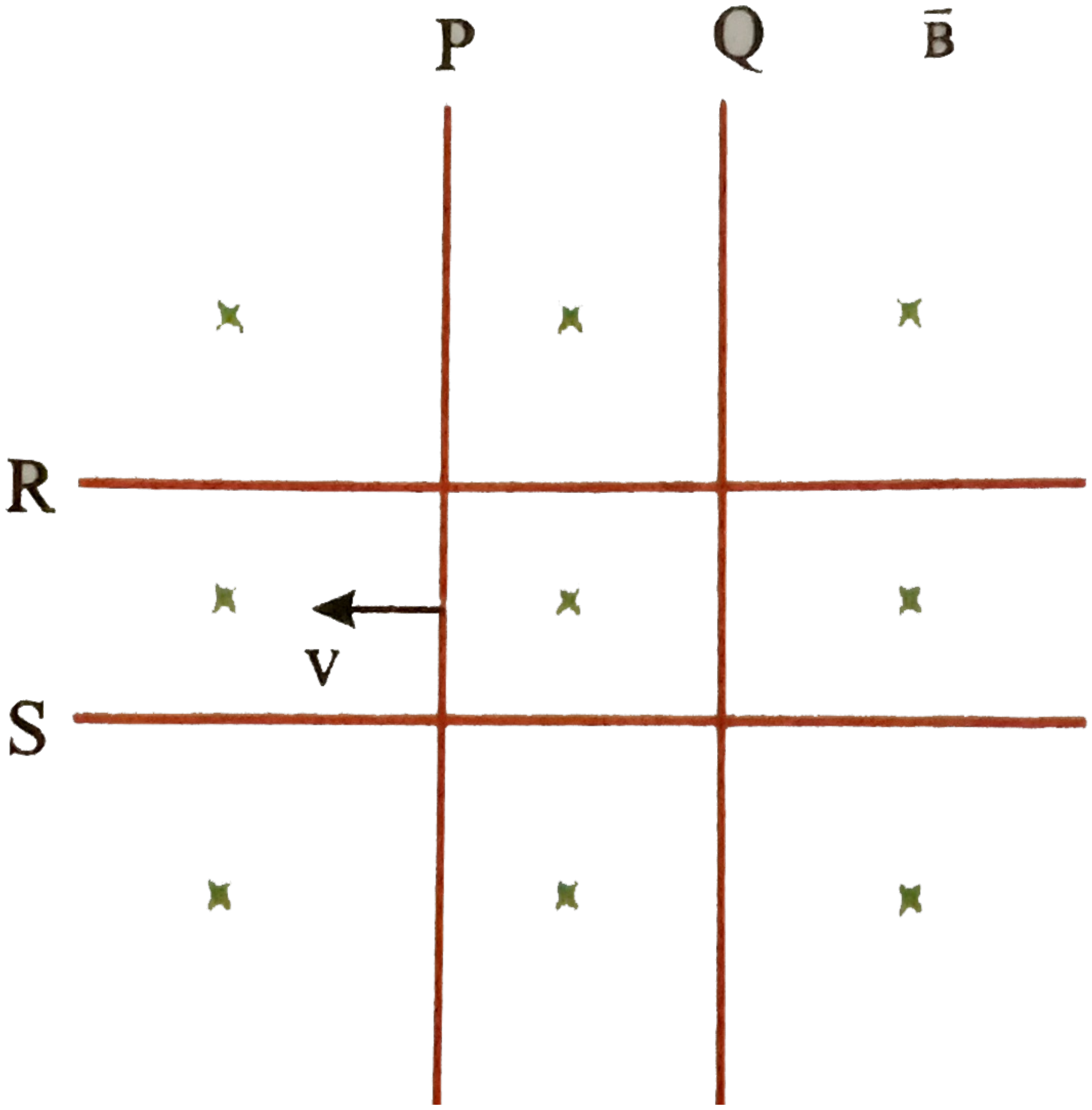
Q-45 - 13657442

Two idential conductors P and Q are placed on two frictionless rails R and S in a uniform magnetic field directed into the plane. If P is moved in the direction shown in figure with a constant speed, then rod Q



(A) will be attracted towards P

(B) will be repelled away from P

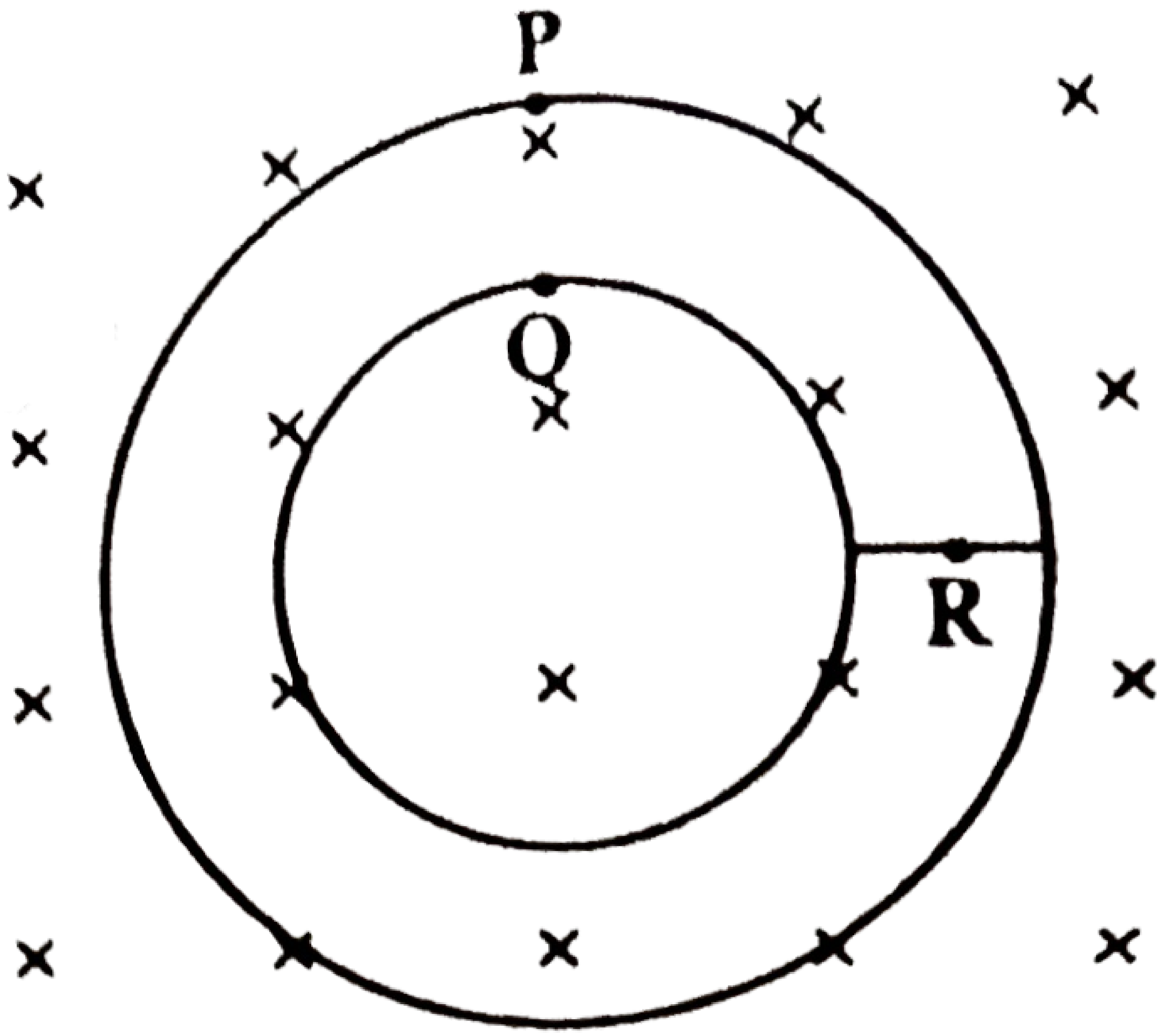
(C) will remain stationary

(D) may be repelled away orattracted towards P

CORRECT ANSWER: A

Q-46 - 12229325

Figure shown 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

CORRECT ANSWER: A, C, D

SOLUTION:

Induce field will be in the form of concentrice circle having orientation clockwise since at P and Q there in a close path so induce current will be clockwise.

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Q-47 - 13156816

In an LCR series ac circuit the voltage across L, C and R are V_1, V_2 and V_3 respectively The voltage of the source is .

(A) $\sqrt{(V_1 - V_2)^2 + V_3^2}$

(B) $\sqrt{V_1^2 + (V_2 - V_3^2}$

(C) $\sqrt{V_2^2 + (V_1 - V_3)^2}$

(D) $V_1 + V_2 + V_3$

CORRECT ANSWER: A

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Q-48 - 12229346

Two coil A and B have coefficient of mutual inductance M=2H. The magnetic flux passing through coil A charges by 4 Weber in 10 seconds due to the change in current in B. Then

(A) change in current in B in this time interval is $0.5A$

(B) change in current in B in this time interval is $2A$

(C) change in current in B in this time interval is $8A$

(D) a change in current of $1A$ in coil A will produce a change in flux passing through by 4 Weber.

CORRECT ANSWER: B

SOLUTION:

$\phi = MI \Rightarrow \Delta\phi = M$
ΔI

$4 = 2 \times \Delta I \Rightarrow \Delta I$
$= 2 Amp$

.

Q-49 - 17689230

Two coils X and Y are placed in a circuit such that a current change of 3A in coil X causes the change in magnetic flux by 1.2Wb in coil Y. The value of mutual inductance of the coil is:

(A) 0.2H

(B) 0.4H

(C) 0.6H

(D) 3.6H

CORRECT ANSWER: A

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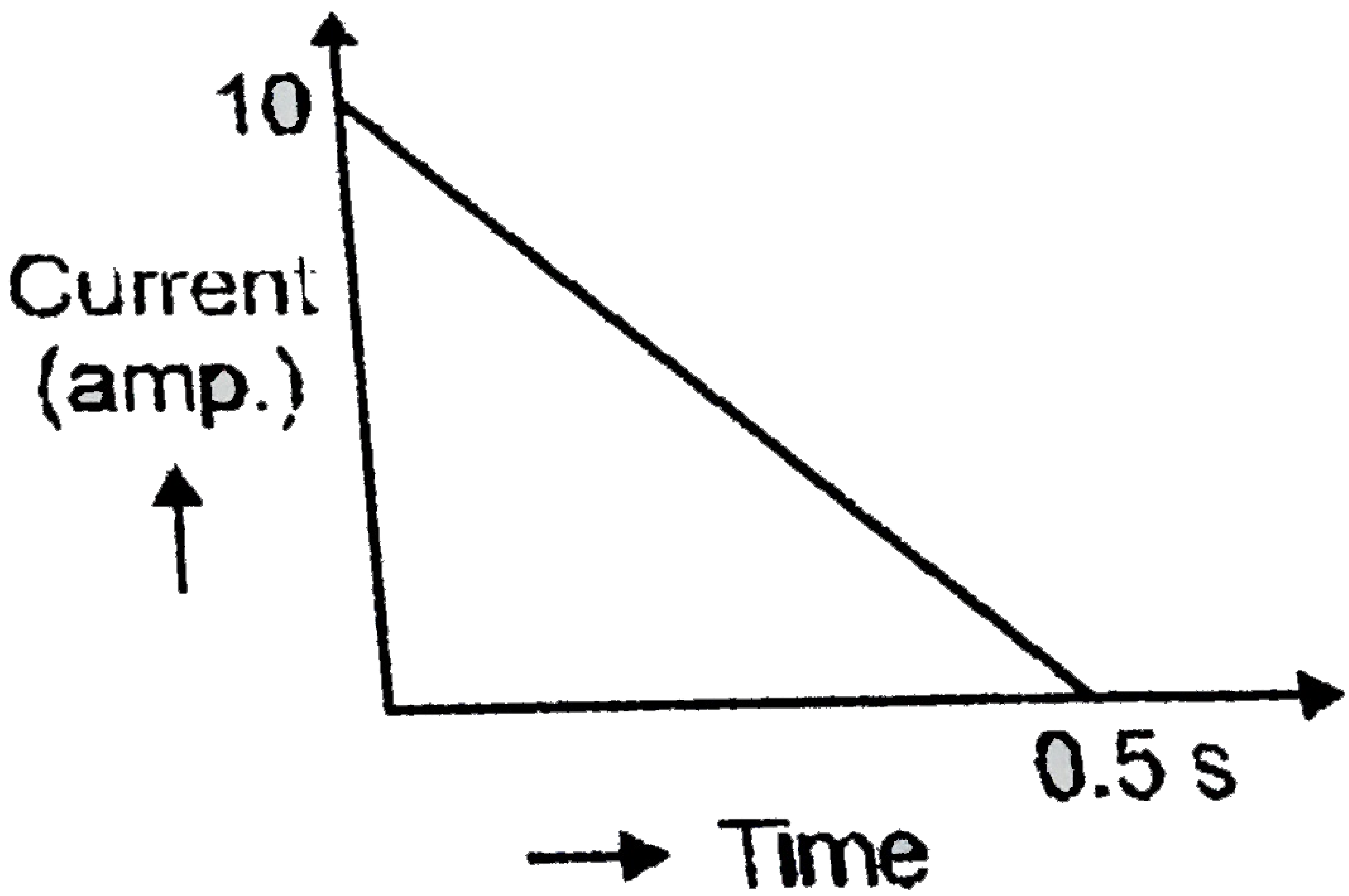
Q-50 - 14928489

In a coil of resistance 100Ω , a current is induced by changing the magnetic flux through it as shown in the figure. The magnitude of change in flux through the coil is



(A) 250 Wb

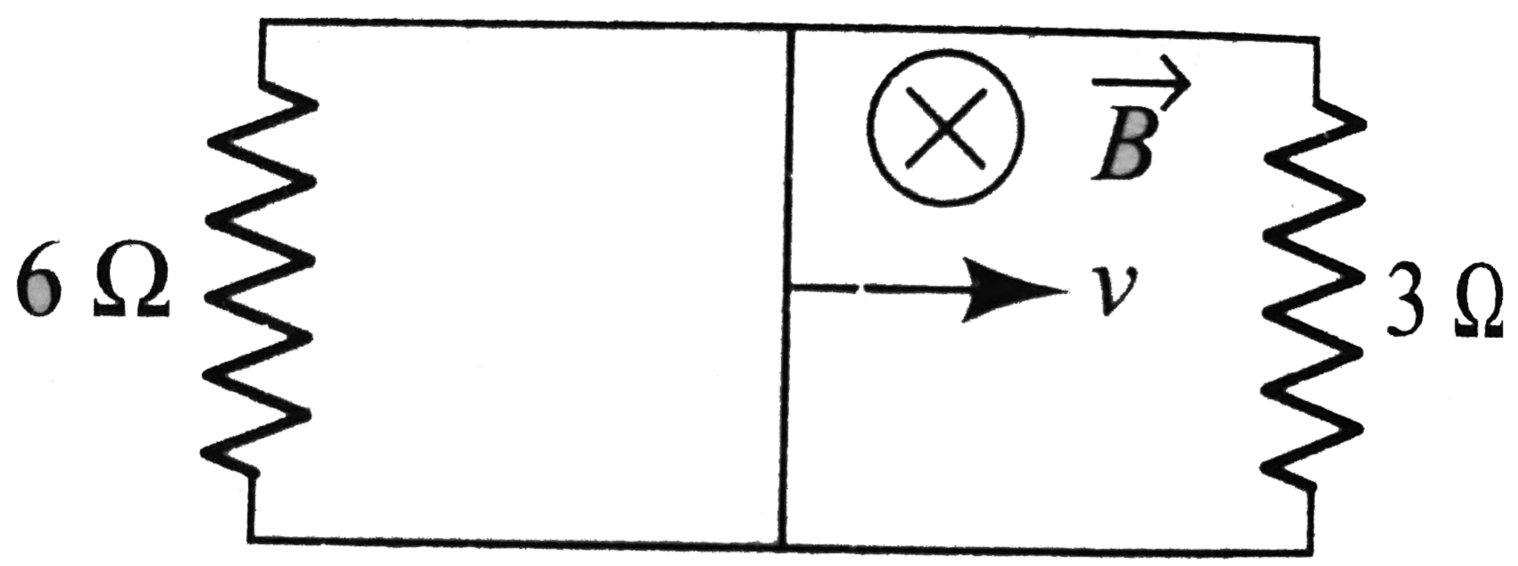
(B) 275 Wb

(C) 200 Wb

(D) 225 Wb

Q-51 - 11314433

A rectangular loop with a sliding connector of length $l = 1.0m$ is situated in a uniform magnetic field $B = 2T$ perpendicular to the plane of loop. Resistance of connector is $r = 2\Omega$. Two resistances of 6Ω and 3Ω are connected as shown in . The external force required to keep the connetor moving with a constant velocity $v = 2ms^{-1}$ is



(A) (a) $6n$

(B) (b) $4n$

(C) (c) $2n$

(D) (d) $1n$

CORRECT ANSWER: C

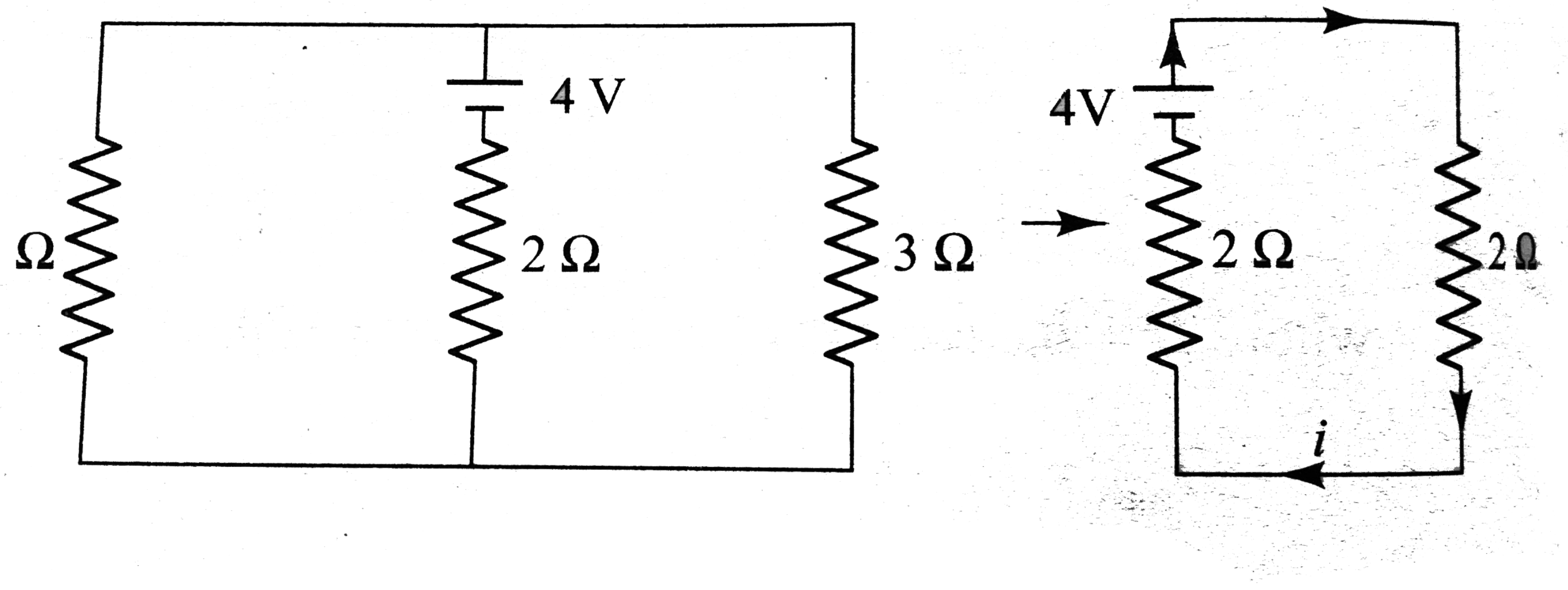
SOLUTION:

(c) Motion emf

$e = Bvl$

$e = (2)(2)(1) = 4V$

This acts as a cell of emf $E = 4V$ and internal resistance $r = 2\Omega$. The simple circuit can be drawn as follows:



Therefore, current through the connector

$$i = \frac{4}{2+2} = 1A$$

Magnetic force on connector

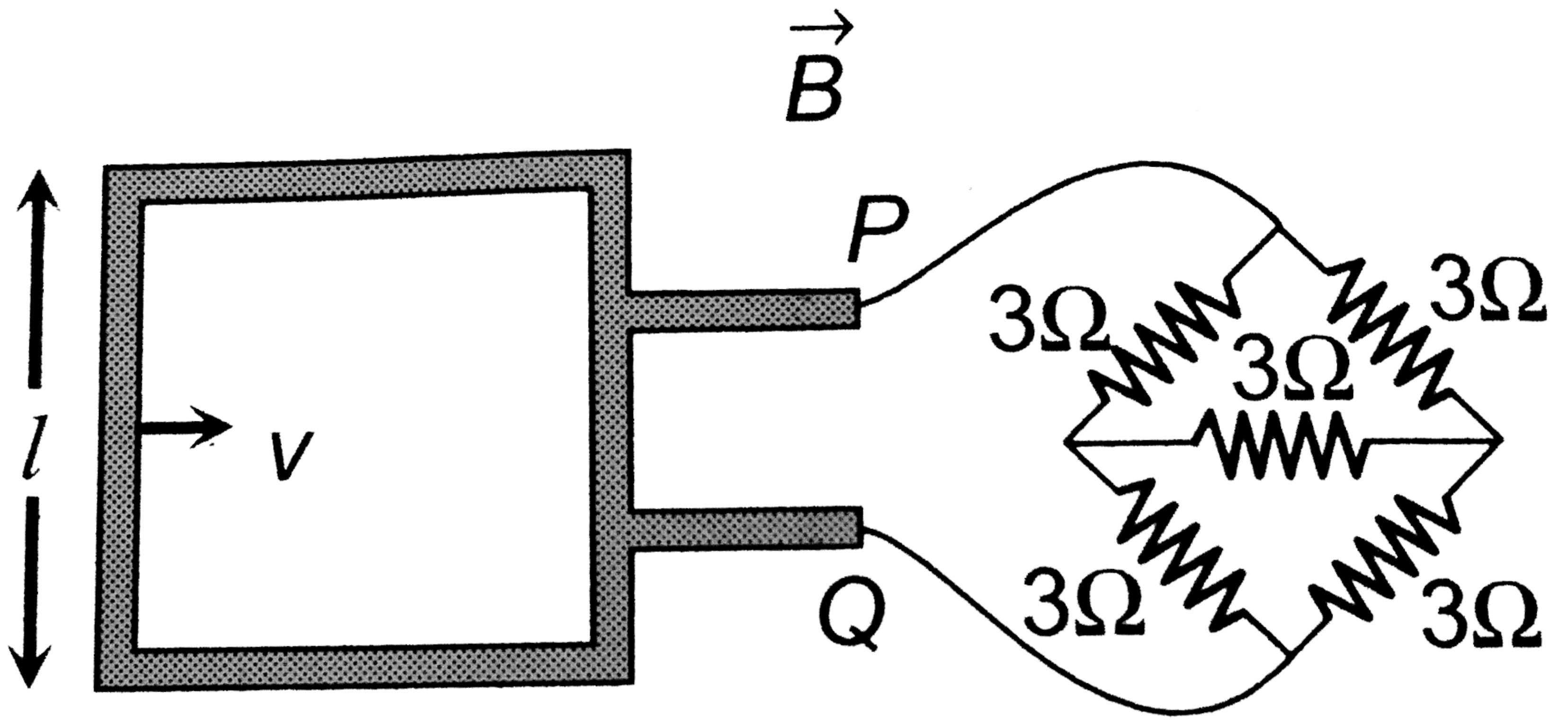
$$F_m = ilB = (1)(1)(2)$$
$$= 2N$$

(towards left)

Therefore, to leep the connector moving with a constant velocity, a force of $2n$ will have to be appiled towards right.

Q-52 - 11967941

A square metallic wire loop of side $0.1m$ and resistance of $1W$ is moved with a constant velocity in a magnetic field of $2wb / m^2$ as shown in figure. The magnetic field field is perpendicular to the plane of the loop, loop is coonected to a network of resistances. what should be the velocity of loop so as to have a steady current of $1mA$ in loop?



(A) $1cm$ / sec

(B) $2cm$ / sec

(C) $3cm$ / sec

(D) $4cm$ / sec

CORRECT ANSWER: B

SOLUTION:

Equivalent resistance of the given wheatstone bridge circuit (balanced) is $3W$ so total resistance in circuit is $R = 3 + 1 = 4\Omega$. The emf induced in the loop $e = Bvl$.

so induced current $i = \frac{e}{R} = \frac{Bvl}{R}$

$$\Rightarrow 10^{-3} = \frac{2 \times v \times (10 \times 10^{-2})}{4}$$

$$= v = 2cm/\sec$$

.

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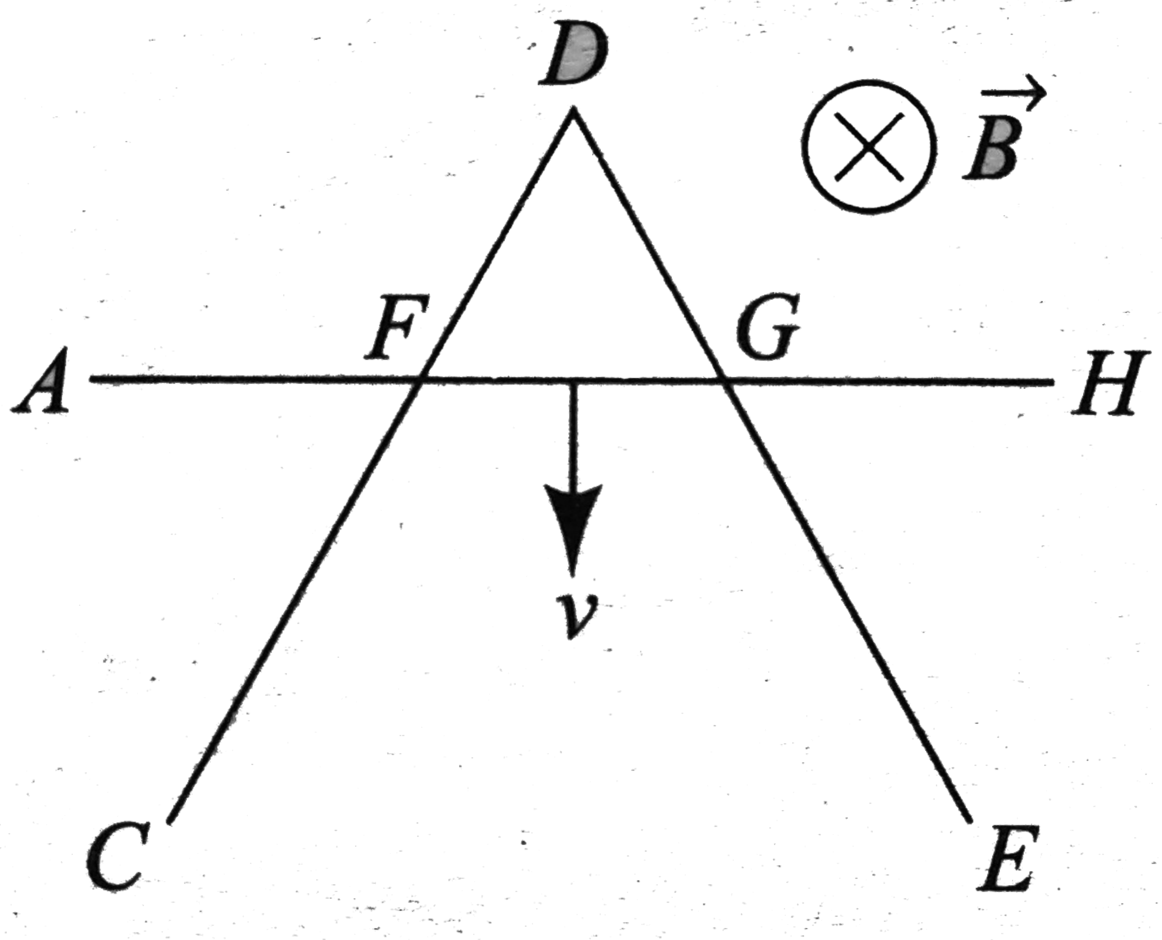
Q-53 - 11314438

A long conducting wire AH is moved over a conducting triangular wire CDE with a constant velocity v in a uniform magnetic field

$\vec{B}$ directed into the plane of the paper. Resistance per unit length of each wire is ρ. Then



(A) (a) a constant clockwise induced will flow in the closed loop

(B) (b) an increasing anticlockwise induced current will flow in the closed loop

(C) (c) a decreasing anticlockwise induced current will flow in the closed loop

(D) (d) an constant anticlockwise induced current will flow in the closed loop

CORRECT ANSWER: D

SOLUTION:

(d) Magnetic flux in $\otimes$ direction through the coil is increasing. Therefore, induced current will produce magnetic field in $\odot$ direction. Thus, the current in the loop is anticlockwise. Magnitude of induced current at any instant of time is

$$I = \frac{e}{R}$$

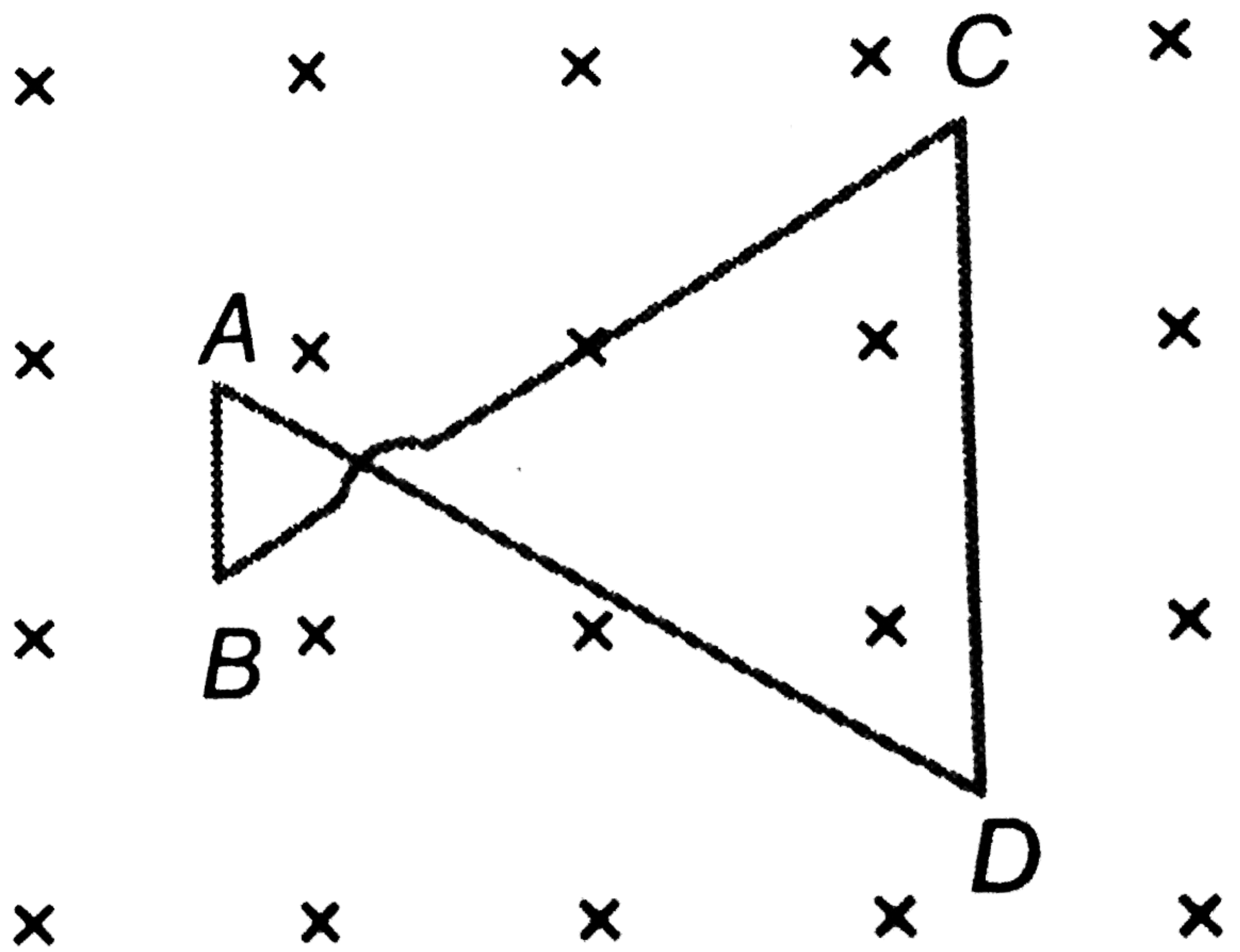
$$= \frac{Bv(FG)}{\rho(FG + GD + DF)}$$

When the wire AH moves downwards FG, GD and DF all increasing in the same ratio.

Therfore, i is constant.

Q-54 - 11967891

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 direction of induced current in wire 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

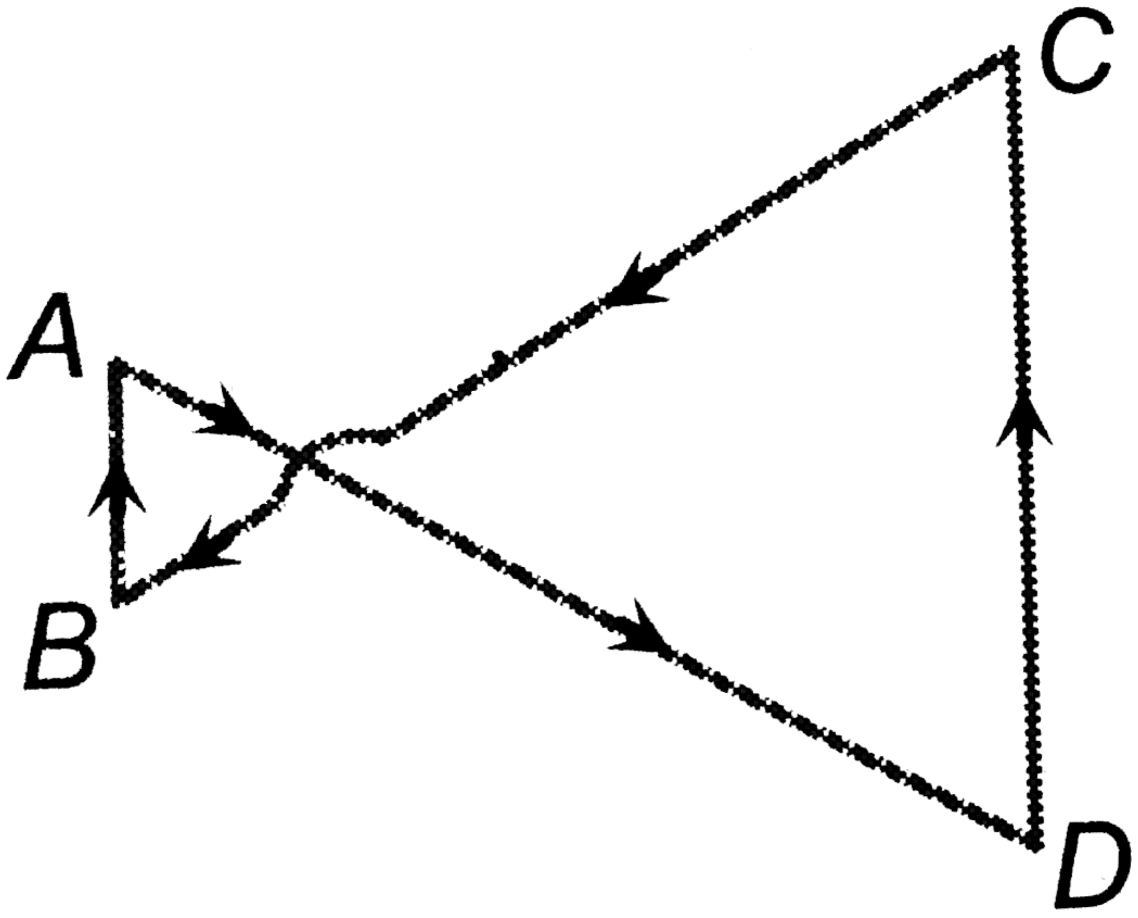
CORRECT ANSWER: A

SOLUTION:

Inward magnetic field $(\times)$ increasing. Therefore, induced current in both the loops should be anticlockwise.But as the area of loop on right side is more, induced emf in this will be more compared to the left side loop

$$\left(e = -\frac{d\phi}{dt} = -A \cdot \frac{dB}{dt}\right)$$

therefore net current in the complete loop will be in a direction shown below. hence only option (a) is correct.



Q-55 - 11314877

A dc ammeter and a hot wire ammeter are connected to a circuit in series. When a direct current is passed through circuit, the dc ammeter shows 6 A. When ac current flows through circuit, the ac ammeter shows 8A. What will be reading of each ammeter if dc and ac current flow simulataneously through the circuit?

(A) dc=6 A, ac=10A

(B) dc=3 A, ac=5A

(C) dc=5 A, ac=8A

(D) dc=2 A, ac=3A

CORRECT ANSWER: A

SOLUTION:

Resultant current is superposition of tow currents, i.e.

I(instantaneous total current) $= 6 + (I_0)\sin\omega t$

dc ammeter will read average value

$$= \overline{6 + (I_0)\sin\omega t} = 6 \langle Bar((I_0)\sin\omega t = 0))$$

ac ammeter will read

$$= \sqrt{\left(\overline{6 + (I_0)\sin\omega t^2}\right)}$$

$$= \sqrt{\overline{36 + 12 I_0 \sin\omega t} \,(\because \overline{I_0 si\omega t} = 0) + I_0^2 \sin^2\omega t}$$

since

$$\overline{\sin^2 om\eta t} = \frac{1}{2} \text{ and}$$

$$(I_{rms}) = 8$$

$$= \frac{I_0}{\sqrt{2} \Rightarrow (I_0) = 8\sqrt{2}A}$$

Therefore ac reading

$$= \sqrt{36 + \frac{I_0^2}{2}}$$

$$= \sqrt{36 + 64} = 10A$$

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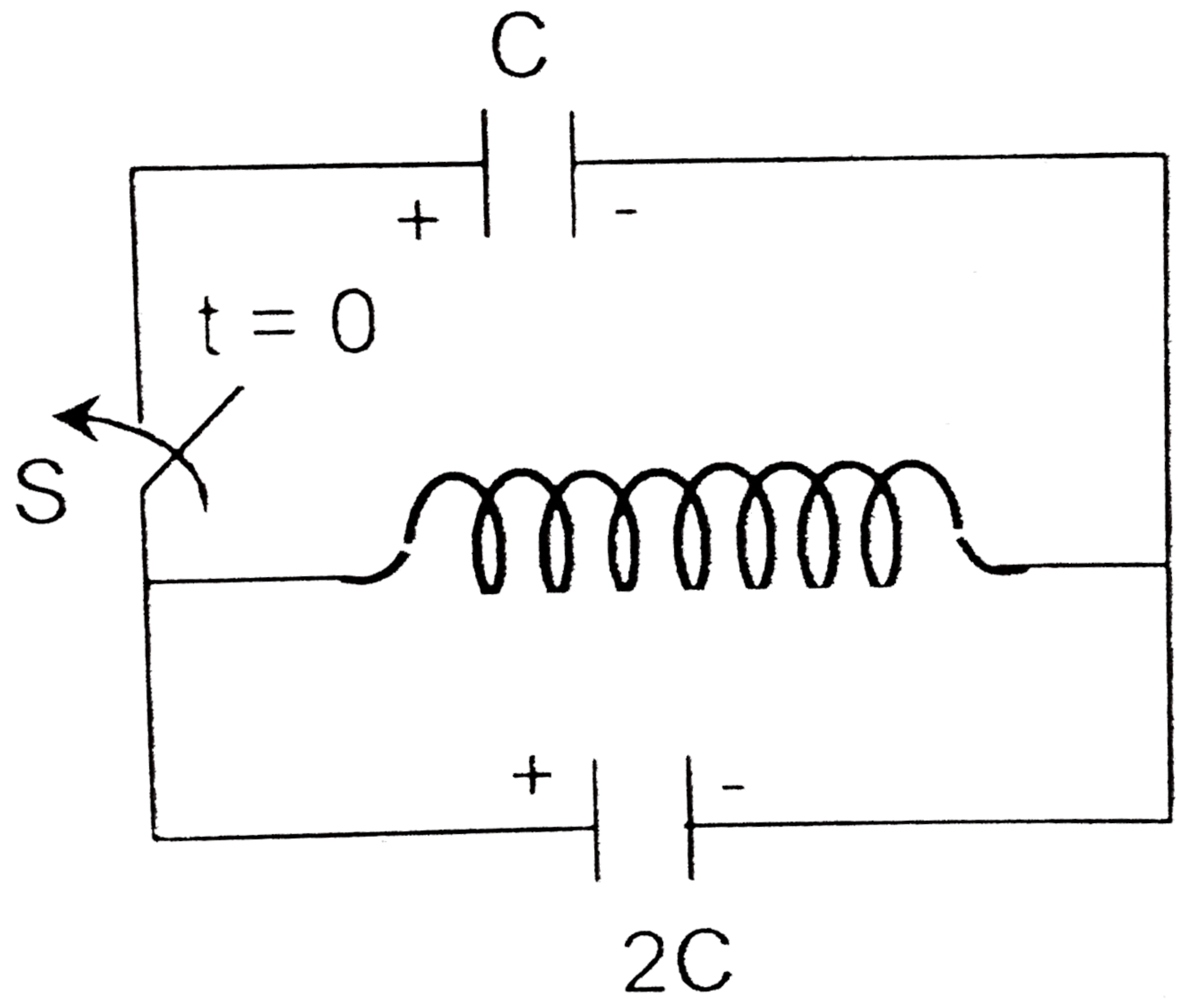
Watch Video Solution On Doubtnut App

Q-56 - 14278068

In the given LC circuit if initially capacitor C has change Q on it and $2C$ has charge $2Q$. The polarities are as shown in the figure. Then after closing the switch s at $t = 0$



(A) energy will get equally distributed in both the

capacitor just after closing the switch

(B) Initial rate of growth of current in inductor will be $2Q/3CL$

(C) Maximum energy in the inductor will be $3Q^2/2C$

(D) None of these

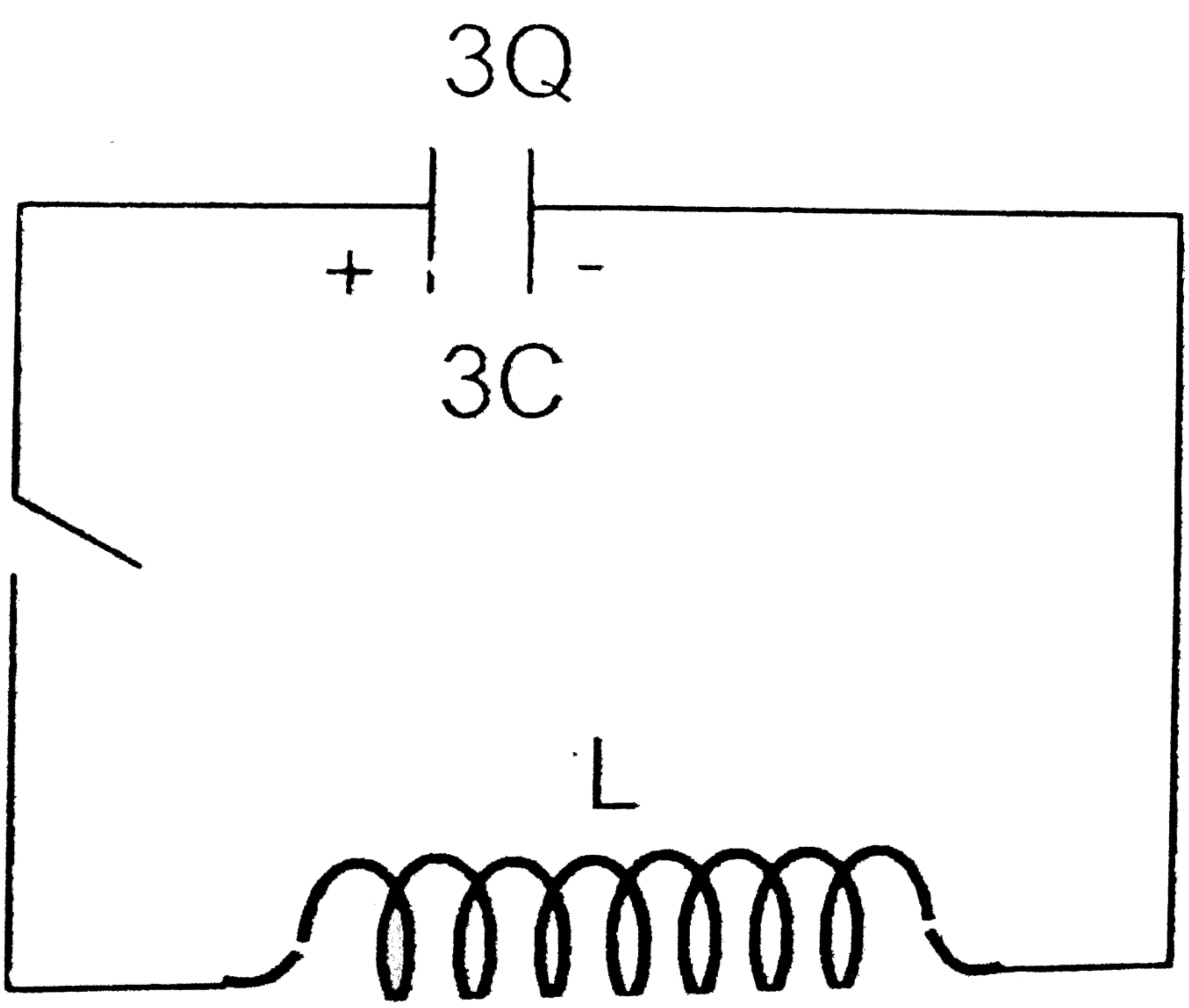
CORRECT ANSWER: C

SOLUTION:

The equivalent circuit is as shown in fig.

$$U_{L(\max)} = U_{C(\max)}$$

$$= \frac{1}{2}\frac{(3Q)^2}{3C} = \frac{3Q^2}{2C}$$



Power factor of an L-R series circuit is 0.6 and that of a C-R series circuit is 0.5. If the element (L. C, and R) of the two circuits are joined in series the power factor of this circuit is found to be 1. The ratio of the resistance in the L-R circuit to the resistance in the C-R circuit is

(A) $6/5$

(B) $5/6$

(C) $\frac{4}{3\sqrt{3}}$

(D) $\frac{3\sqrt{3}}{4}$

CORRECT ANSWER: D

SOLUTION:

$$\cos\phi_1 = 0.6 = \frac{3}{5}$$

$$\tan\phi_1 = \frac{4}{3} = \frac{X_C}{R_2}(1)$$

$$\cos\phi_1 = 0.5 = \frac{1}{2}$$

$$\tan\phi_2 = \sqrt{3}$$

$$= \frac{X_C}{R_2} (2)$$

From (1) and (2) $\frac{3\sqrt{3}}{4} = \frac{R_1}{R_2}$

Q-58 - 14928507

In an inductor of self-inductance L=2 mH, current changes with time according to relation $i = t^2 e^{-t}$. At what time emf is zero ?

(A) 4s

(B) 3s

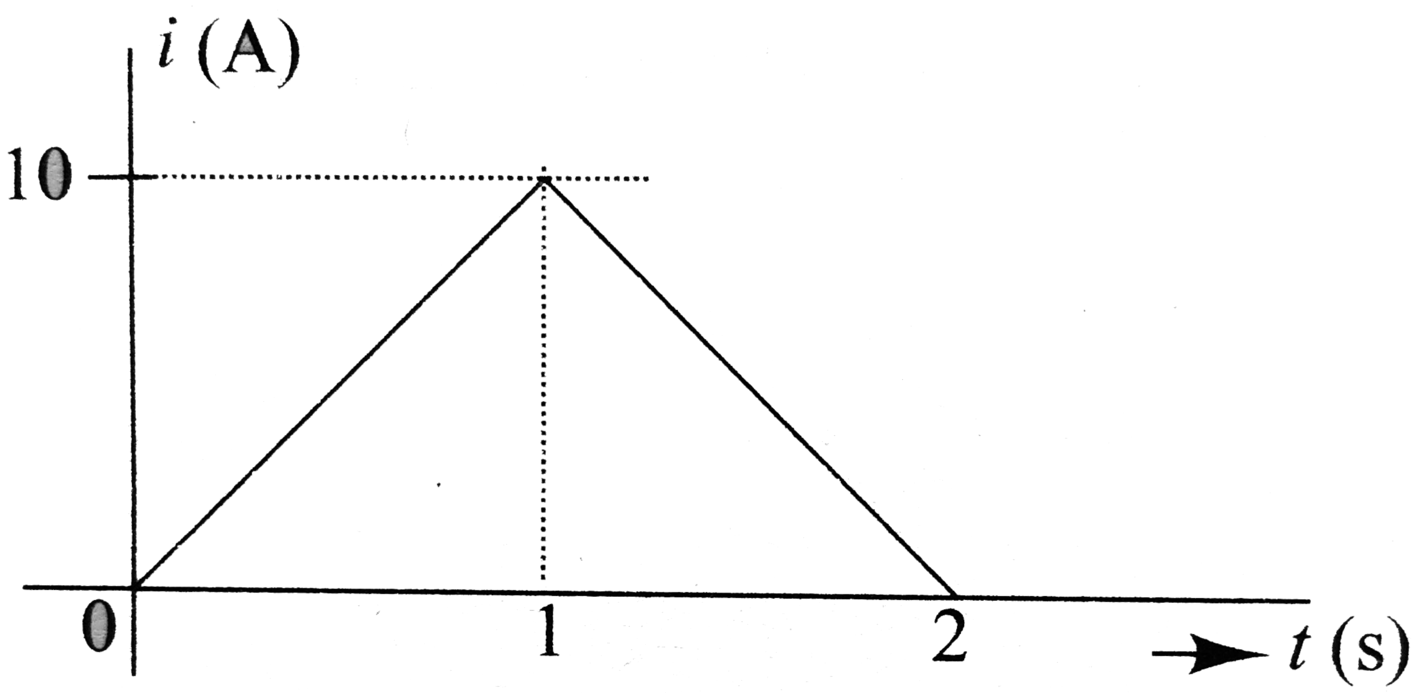
(C) 2s

(D) 1s

Q-59 - 11314941

Find the avarage value of current (in A) shown graphically in fig.

From $t = 0 \rightarrow t = 2s$.



CORRECT ANSWER: 5

SOLUTION:

From the i-t graph, area from t=0 to t=2 s

$$\frac{1}{2} \times 2 \times 10 = 10As$$

$\therefore$ Average current $\frac{10}{2} = 5A$.

Q-60 - 10967868

Assertion : In series $L - C - R$, AC circuit, current and voltage are in same phase at resonance.

Reason : In series $L - C - R$, AC circuit, resonant frequency does not depend on the value of resistance. Hence, current at resonance does not depend on resistance.

(A) If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

(B) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion

(C) If Assertion is true, but the Reason is false.

(D) If Assertion is false but the Reason is true.

CORRECT ANSWER: C

SOLUTION:

At resonasnce $X_L = X_C$

$\Rightarrow Z = R$

Hence, $I = \frac{V}{Z} = \frac{V}{R}$

So, current at resonance depends on R.