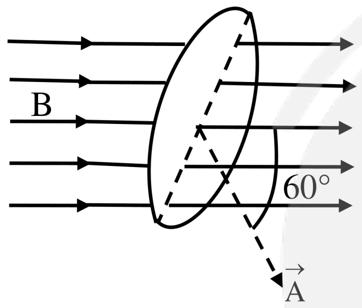
Prachand NEET 2025

Physics

Electromagnetic Induction

DPP : 01

Q1 Fig. represents an area $A=0.5\ m^2$ situated in a uniform magnetic field $B=2.0$ weber $/m^2$ and making an angle of 60° with respect to magnetic field. The value of the magnetic flux through the area would be equal to -

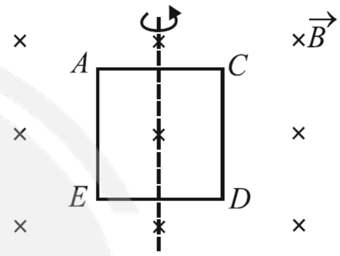


(A) 2.0 weber
(B) $\sqrt{3}$ weber
(C) $\sqrt{3}/2$ weber
(D) 0.5 weber

Q2 According to Faraday's laws of electromagnetic induction, magnitude of induced emf in a coil is directly proportional to
(A) Rate of change of voltage
(B) Rate of change of resistance
(C) Rate of change of electric flux linked with the coil
(D) Rate of change of magnetic flux linked with the coil

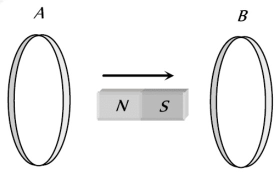
Q3 The magnetic flux across a loop of resistance 10Ω is given by $\phi=5t^2-4t+1$ weber. How much current is induced in the loop at 0.2 sec ?
(A) 0.4 A
(B) 0.2 A
(C) 0.04 A
(D) 0.02 A

Q4 A square loop $ACDE$ of area $10\ cm^2$ and resistance $10\ \Omega$ is rotated in a magnetic field $B=2\ T$ through 180°. The magnitude of average value of induced emf in 0.01 s is:



(A) 0.2 V
(B) 0.4 V
(C) 0.8 V
(D) 1.0 V

Q5 In the diagram shown, if a bar magnet is moved along the common axis of two single turn coils A and B in the direction of arrow;



(A) current is induced only in A & not in B.
(B) induced currents in A & B are in the same direction.
(C) current is induced only in B and not in A.
(D) induced currents in A & B are in opposite directions.

Q6 To induce an e.m.f. in a coil, the linking magnetic flux:
(A) Must decrease
(B) Can either increase or decrease
(C) Must remain constant
(D) Must increase

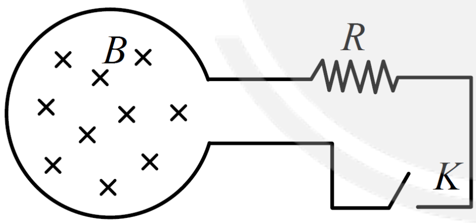
Q7 A rectangular coil of 20 turns and area of cross-section 25 cm^2 has a resistance of 100 ohm. If a magnetic field which is perpendicular to the plane of the coil changes at the rate of 1000 tesla per second, the current in the coil is

(A) 1.0 A
(B) 0.5 A
(C) 50 A
(D) 5.0 A

Q8 The magnetic flux linked with a circuit of resistance 100 ohm increases from 10 to 60 webers. The amount of induced charge that flows in the circuit is (in coulomb)

(A) 0.5 (B) 5
(C) 50 (D) 100

Q9 Shown in the figure is a circular loop of radius *r* and resistance *R*. A variable magnetic field of induction $B = B_0 e^{-t}$ is established inside the coil. If the key (K) is closed, the electrical power developed right after closing the switch is equal to:

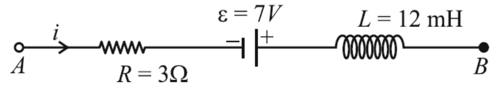


(A) $\frac{B_0^2 \pi r^2}{R}$ (B) $\frac{B_0 10 r^3}{R}$
(C) $\frac{B_0^2 \pi^2 r^4 R}{5}$ (D) $\frac{B_0^2 \pi^2 r^4}{R}$

Q10 Electric current flowing in a coil of self inductance 2 mH is increased from 1 A to 2 A in 2 ms. Induced emf in the coil is

(A) 1 V
(B) 3 V
(C) 2 V
(D) 4 V

Q11 The electric network shown in figure is part of a complete circuit. If at any instant, current $i = 2 \text{ A}$ and potential difference across A and B is zero, then value of $\left|\frac{di}{dt}\right|$ is;



(A) $\frac{26}{3} \text{ A/s}$
(B) $\frac{25}{3} \text{ A/s}$
(C) $\frac{250}{3} \text{ A/s}$
(D) $\frac{290}{3} \text{ A/s}$

Q12 Energy stored in a coil of self inductance 40 mH carrying a steady current of 2 A is:

(A) 80 J
(B) 0.8 J
(C) 0.08 J
(D) 8.0 J

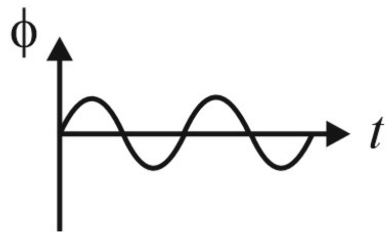
Q13 A current carrying infinitely long wire is kept along the diameter of a circular wire loop, without touching it. The correct statement(s) is (are):-

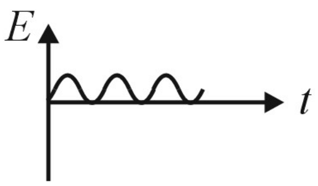
(A) the emf induced in the loop has undefined value if the current is constant
(B) the emf induced in the loop is zero if the current is constant
(C) the emf induced in the loop is zero if the current decreases at a steady state
(D) both (B) and (C).

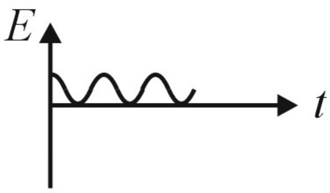
Q14 Eddy currents are induced when;

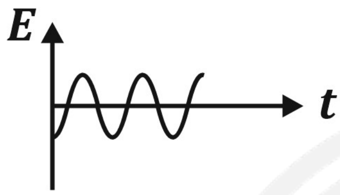
(A) A metal block is kept in a changing magnetic field
(B) A metal block is kept in a uniform magnetic field
(C) A coil is kept in a uniform magnetic field
(D) Current is passed in a coil

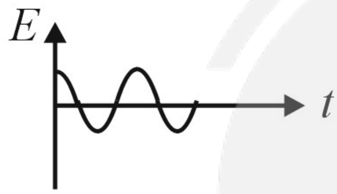
Q15 The magnetic flux ϕ through a coil varies with time t as shown in the diagram. Which graph best represents the variation of the e.m.f. E induced in the coil with time t?



(A) 

(B) 

(C) 

(D) 

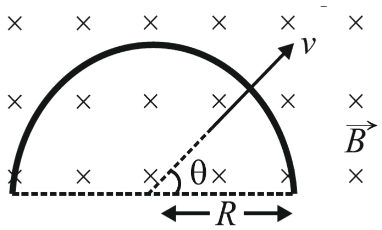
Q16 A wire of length $1\ \mathrm{m}$ is moving with a velocity of $8\ \mathrm{m/s}$ at right angles to a magnetic field of 2 T. The magnitude of induced emf, between the ends of wire the will be

(A) $20\ \mathrm{V}$ (B) $8\ \mathrm{V}$
(C) $12\ \mathrm{V}$ (D) $16\ \mathrm{V}$

Q17 Two solenoids of same cross-sectional area have their lengths and number of turns in ratio of $1:2$ both. The ratio of self-inductance of two solenoid is:

(A) $1:2$ (B) $2:1$
(C) $1:4$ (D) $1:1$

Q18 A semicircular loop of radius R is placed in a uniform magnetic field B as shown. If it is pulled with a constant velocity v. The magnitude of induced emf about ends of the loop is;

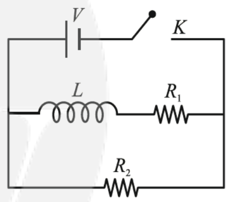


(A) $Bv(\pi R)\cos\theta$
(B) $Bv(2R)\cos\theta$
(C) $Bv(2R)$
(D) $Bv(2R)\sin\theta$

Q19 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) $\frac{R_1}{R_2}$
(B) $\frac{R_2}{R_1}$
(C) $\frac{R_1^2}{R_2}$
(D) $\frac{R_2^2}{R_1}$

Q20 In the circuit shown below, the key K is closed at $t=0$. The current through the battery is;



(A) $\frac{VR_1R_2}{\sqrt{R_1^2+R_2^2}}$ at $t=0$ and $\frac{V}{R_2}$ at $t=\infty$
(B) $\frac{V}{R_2}$ at $t=0$ and $\frac{V(R_1+R_2)}{R_1R_2}$ at $t=\infty$
(C) $\frac{V}{R_2}$ at $t=0$ and $\frac{VR_1R_2}{\sqrt{R_1^2+R_2^2}}$ at $t=\infty$
(D) $\frac{V(R_1+R_2)}{R_1R_2}$ at $t=0$ and $\frac{V}{R_2}$ at $t=\infty$

Q21 Self inductances of two uncoupled coils are $40\ \mathrm{mH}$ and $90\ \mathrm{mH}$. Their mutual inductance is

(A) $60\ \mathrm{mH}$
(B) $130\ \mathrm{mH}$
(C) $50\ \mathrm{mH}$
(D) Zero

Q22 A copper disc of radius $0.1\ \mathrm{m}$ is rotated about its centre with $10\ \mathrm{rev/s}$ in a uniform magnetic field of $0.1\ \mathrm{T}$ with its plane perpendicular to field. The emf induced across the radius of disc is;

(A) $\frac{\pi}{10}$ volt
(B) $\frac{\pi}{100}$ volt
(C) $\frac{\pi}{1000}$ volt

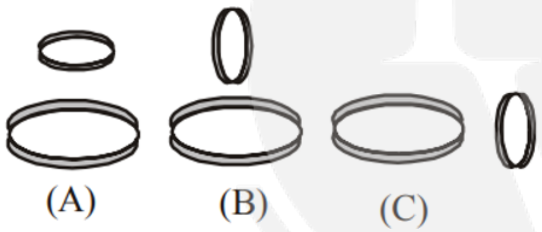
(D) zero

Q23 **Assertion** : The induced emf in a conducting loop of wire will be non zero when it rotates in a uniform magnetic field about its diameter.

Reason : The emf is induced due to change in magnetic flux.

(A) If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.
(B) If both Assertion and Reason are true but Reason is not the correct explanation of the Assertion.
(C) If Assertion is true but Reason is false.
(D) If the Assertion and Reason both are false.

Q24 Two circular coils can be arranged in any of the three situations shown in the figure. Their mutual inductance will be



(A) Maximum in situation (A)
(B) Maximum in situation (B)
(C) Maximum in situation (C)
(D) The same in all situations

Q25 **Statement-1:** The induced e.m.f. and current will be same in two identical loops of copper and aluminium, when rotated with same speed in the same magnetic field.

Statement-2 : Induced e.m.f. is proportional to rate of change of magnetic flux while induced current depends on resistance of wire.

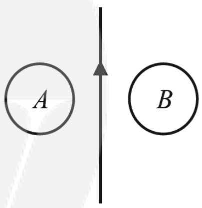
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is not a correct explanation for Statement-1.
(C) Statement -1 is False, Statement-2 is True.
(D) Statement -1 is True, Statement-2 is False

Q26 **Statement-1:** Lenz's law violates the principle of conservation of energy.

Statement-2: Induced e.m.f. opposes the change in magnetic flux responsible for its production.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement -1 is False, Statement-2 is True.
(D) Statement -1 is True, Statement-2 is False.

Q27 A and B are two metallic rings placed on opposite sides of an infinitely long straight conducting wire as shown. If current in the wire is slowly decreased, the direction of induced current will be:



(A) clockwise in A and anticlockwise in B
(B) anticlockwise in A and clockwise in B
(C) clockwise in both A and B
(D) anticlockwise in both A and B

Q28 A coil of inductance 2 H and resistance $10\ \Omega$ is connected across a battery of 100 V along with a key. At time $t = 0$, the key is closed. Based on this information, match the List I with List II.
(Use $e^{-5} = 0.0067$)

	List I		List II
(a)	Time constant of the circuit (in sec)	(I)	9.93
(b)	Steady current in the circuit (in A)	(II)	100
(c)	Current in the circuit at t = 1 s (in A)	(III)	0.2
(d)	Magnetic energy stored in the coil in steady state (in J)	(IV)	10

(A) a-II, b-I, c-III, d-IV
(B) a-III, b-IV, c-II, d-I
(C) a-III, b-IV, c-I, d-II
(D) a-III, b-II, c-I, d-IV

Q29 For a coil having $L = 2\mathrm{mH}$, current flowing through it is $I = t^2\mathrm{e}^{-t}$ then at which time emf become zero:
(A) $2\ \mathrm{s}$
(B) $1\ \mathrm{s}$
(C) $4\ \mathrm{s}$
(D) $3\ \mathrm{s}$

Q30 A square of side L metre lies in the XY-plane in a region, where the magnetic field is given by $\vec{B} = B_0\left(2\hat{i} + 3\hat{j} + 4\hat{k}\right)$ T, where B_0 is constant. The magnitude of flux passing through the square is
(A) $2B_0L^2\ \mathrm{Wb}$
(B) $3B_0L^2\ \mathrm{Wb}$
(C) $4B_0L^2\ \mathrm{Wb}$
(D) $\sqrt{29}B_0L^2\ \mathrm{Wb}$

Answer Key

Q1	(D)
Q2	(D)
Q3	(B)
Q4	(B)
Q5	(D)
Q6	(B)
Q7	(B)
Q8	(A)
Q9	(D)
Q10	(A)
Q11	(C)
Q12	(C)
Q13	(D)
Q14	(A)
Q15	(C)
Q16	(D)
Q17	(A)
Q18	(D)
Q19	(D)
Q20	(B)
Q21	(D)
Q22	(B)
Q23	(A)
Q24	(A)
Q25	(C)
Q26	(C)
Q27	(B)
Q28	(C)
Q29	(A)
Q30	(C)

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

(D)

$$\begin{aligned}\phi &= \vec{B} \cdot \vec{A} \\ &= \mathrm{BA}\cos\theta \\ &= (2)(0.5)\cos(60^{\circ}) \\ &= 2 \times 0.5 \times \frac{1}{2} = 0.5 \text{ weber}\end{aligned}$$

Video Solution:

Q2 Text Solution:

(D)

$$e_{\text{ind}} = -N\frac{d\phi_B}{dt}$$

Video Solution:

Q3 Text Solution:

(B)

$$e = -\frac{d\phi}{dt} = -10t + 4$$

at t=0.2 s

e = 2 V

and $i = \frac{e}{R} = \frac{2}{10} = 0.2\ \mathrm{A}$

Video Solution:

Q4 Text Solution:

(B)

Let us take the area vector $\vec{S}$ perpendicular to plane of loop inwards. So initially, $\vec{S} \uparrow\uparrow \vec{B}$ and when it is

rotated by 180°, $\vec{S} \uparrow\downarrow \vec{B}$.

Hence, initial flux passing through the loop,

$$\begin{aligned}\phi_i &= BS\cos 0^{\circ} = (2)\left(10 \times 10^{-4}\right)(1) \\ &= 2.0 \times 10^{-3}\ \mathrm{Wb}\end{aligned}$$

Flux passing through the loop when it is rotated by 180°

$$\begin{aligned}\phi_f &= BS\cos 180^{\circ} = (2)\left(10 \times 10^{-4}\right)(-1) \\ &= -2.0 \times 10^{-3}\ \mathrm{Wb}\end{aligned}$$

Therefore, change in flux,

$$\Delta\phi_B = \phi_f - \phi_i = -4.0 \times 10^{-3}\ \mathrm{Wb}$$

Given, $\Delta t = 0.01\ \mathrm{s}, R = 10\Omega$

$$|e| = \left|-\frac{\Delta\phi_B}{\Delta t}\right| = \frac{4.0 \times 10^{-3}}{0.01} = 0.4\ \mathrm{V}$$

Video Solution:

Q5 Text Solution:

(D)

When bar is moving along common axis of two coils then current is included in both coils.

Because when magnet is moving, there will be change of magnetic flux linked with both the coils.
And change of flux will result into emf and finally current is induced in both the coils and direction in one coil will be clockwise and in other coil it will be anticlockwise.

Video Solution:

Q6 Text Solution:

(B)

According to Faraday's, the induced EMF in a coil is directly proportional to the rate of change in magnetic flux link with the coil. So, to induce an e.m.f. in a coil, the linking magnetic flux can either increase or decrease.

Video Solution:

Q7 Text Solution:

(B)

$N = 20, \qquad A = 25 \times 10^{-4} m^2$

$R = 100\ \Omega, \frac{dB}{dt} = 1000$ T/sec

$i = \frac{e}{R} = \frac{NA}{R}\frac{dB}{dt}$

$= \frac{20 \times 25 \times 10^{-4} \times 1000}{100} \Rightarrow i = 0.5A$

Video Solution:

Q8 Text Solution:

(A)

Induced charge, $Q = \frac{\Delta\phi}{R} = \frac{60-10}{100} = 0.5\ C$

Video Solution:

Q9 Text Solution:

(D)

$P = \frac{e^2}{R}; e = -\frac{d}{dt}\left(B.A\right) = -A\frac{d}{dt}\left(B_0 e^{-t}\right)$

$= AB_0 e^{-t}$

$\Rightarrow P = \frac{1}{R}(AB_0 e^{-t})^2 = \frac{A^2 B_0^2 e^{-2t}}{R}$

At the time of starting $t = 0$ so $P = \frac{A^2 B_0^2}{R}$

$\Rightarrow P = \frac{(\pi r^2)^2 B_0^2}{R} = \frac{B_0^2 \pi^2 r^4}{R}$

Video Solution:

Q10 Text Solution:

(A)

$$|e| = L\frac{di}{dt} = 2 \times 10^{-3} \times \frac{1}{2 \times 10^{-3}} = 1\ \text{V}$$

Video Solution:

Q11 Text Solution:

(C)

$$V_A - iR + \varepsilon - L\frac{di}{dt} = V_B$$

$$V_A - (2 \times 3) + 7 - \left(12 \times 10^{-3}\right)\frac{di}{dt} = V_B$$

$$V_A - V_B = -1 + \left(12 \times 10^{-3}\right)\frac{di}{dt}$$

$$1 = 12 \times 10^{-3}\frac{di}{dt}$$

$$\frac{di}{dt} = \frac{1000}{12} = \frac{250}{3}\ \text{A/s}$$

Video Solution:

Q12 Text Solution:

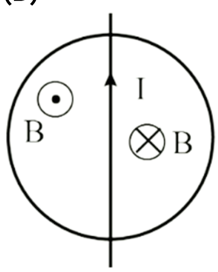
(C)

$$U = \frac{1}{2}LI^2 = \frac{1}{2} \times 40 \times 10^{-3} \times 4 = 0.08\ \text{J}$$

Video Solution:

Q13 Text Solution:

(D)



When the current is constant, the flux changing through it will be zero.
So, no emf will be induced.
When the current is decreasing at a steady rate, then the change in the flux (decreasing inwards) on the right half of the wire is equal to the change in flux (decreasing outwards) on the left half of the wire such that $\Delta\phi$ through the circular loop is zero.
$\therefore$ The change in current will not cause any change in magnetic flux in the loop.
$\therefore$ Induced emf is zero whether the currect is constant or the current is varying.

Q14 Text Solution:

(A)

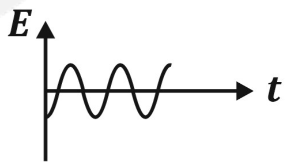
Eddy currents are induced when a metal block is kept in a changing magnetic field

Video Solution:

Q15 Text Solution:

(C)

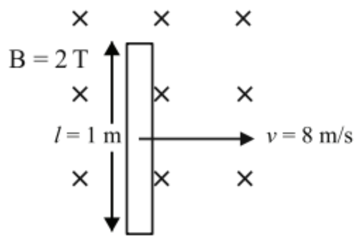
According to the figure
magnetic flux, $\phi = k\ \sin\ \omega t$
Induced Emf will be
$\in = -\frac{d\phi}{dt} = -k\omega\ \cos\ \omega t$
So the graph of induced emf will be (–)ve cosine.



Video Solution:

Q16 Text Solution:

(D)



Induced emf across the ends of the rod
$= B\ell v = 2 \times 8 \times 1 = 16 \text{ V}$

Video Solution:

Q17 Text Solution:

(A)

Given, $\frac{N_1}{N_2} = \frac{1}{2}$, $\frac{l_1}{l_2} = \frac{1}{2}$

From $L = \frac{\mu_0 N^2 A}{l}$, $L \propto \frac{N^2}{l}$

we get, $\frac{L_1}{L_2} = \frac{(1/2)^2}{1/2} = \frac{1}{2}$

Video Solution:

Q18 Text Solution:

(D)

$$e = B \times l_{eff} \times v \times \sin\theta$$
$$l_{\text{eff}} = 2R$$
$$e = Bv(2R)\sin\theta$$

Video Solution:

Q19 Text Solution:

(D)

Magnetic field at the centre of primary coil (bigger coil)

$$B = \frac{\mu_0 i_1}{2R_1}.$$

Considering it to be uniform, magnetic flux passing through secondary coil(smaller coil) is

$$\phi_2 = BA = \frac{\mu_0 i_1}{2R_1}(\pi R_2^2)$$

Now, $M = \frac{\phi_2}{i_1} = \frac{\mu_0 \pi R_2^2}{2R_1}$

$$\therefore M \propto \frac{R_2^2}{R_1}$$

Video Solution:

Q20 Text Solution:

(B)

At $t = 0$, inductor behaves like an infinite resistance,

So at $t = 0, i = \frac{V}{R_2}$ and

at $t = \infty$, inductor behaves like a conducting wire, $i = \frac{V}{R_{eq}} = \frac{V(R_1+R_2)}{R_1 R_2}$

Video Solution:

Q21 Text Solution:

(D)

Mutual inductance between two coils is a measure of the voltage induced in one coil due to the change in current in the other coil. For two uncoupled coils, there is no magnetic linkage between them, hence the mutual inductance is zero.

Video Solution:

Q22 Text Solution:

(B)

$$\varepsilon=\frac{1}{2}B\omega R^2, R=0.1m, B=0.1T, \omega = 20\pi s^{-1}$$

$$\varepsilon=\frac{1}{2}(0.1)(0.1)^2(20\pi)=\frac{\pi}{100}\text{volt}$$

Video Solution:

Q23 Text Solution:

(A)

As the coil rotates, the magnetic flux linked with the coil will change and emf will be induced in the loop.

Video Solution:

Q24 Text Solution:

(A)

The mutual inductance between two coils depends on their degree of flux linkage, i.e., the fraction of flux linked with one coil which is also linked to the other coil. Here, the two coils in arrangement (A) are placed with their planed parallel. This will allow maximum flux linkage.

Video Solution:

Q25 Text Solution:

(C)

Given both the loops are identical (same area and no. of turns) and rotated with same speed in same magnetic field.

The induced e.m.f is given as

$\varepsilon=-\frac{d\phi}{dt}$, where $\phi=BA\cos\theta$ is magnetic flux

Since all the parameters of two loops are same, the induced e.m.f will be same.

However,the current in both loops will be different as it depends upon resistance $\left(\frac{\varepsilon}{R}\right)$.

Statement -1 is False, Statement-2 is True.

Video Solution:

Q26 Text Solution:

(C)

According to Lenz's law, Induced e.m.f. opposes the change in magnetic flux responsible for its production.

Lenz's law is based on principle of conservation of energy. It does not violate the principle of conservation of energy

Statement -1 is False, Statement-2 is True.

Video Solution:

Q27 Text Solution:

(B)

According to Lenz law, the induced current in A will be anticlockwise and in B it will be clockwise.

Video Solution:

Q28 Text Solution:

(C)

Time constant :

$\tau = \frac{\mathrm{L}}{\mathrm{R}} = \frac{2\ \mathrm{H}}{10\ \Omega} = 0.2\ \mathrm{s}$

Steady current in the circuit

$I_0 = \frac{V}{R} = \frac{100\ \mathrm{V}}{10\ \Omega} = 10\ A$

The current in the circuit at t = 1s :

Equation of growth of current in the circuit can be given by

$I = I_0\left(1 - e^{-t/\tau}\right)$

At t = 1s

= 10 (1 - $e^{-1/0.2}$) = 10 (1 - e^{-5}) = 9.93 A

Magnetic energy stored in coil in steady state:

$\mathrm{U} = \frac{1}{2}LI_0^2 = \frac{1}{2} \times 2 \times (10)^2 = 100\ J$

Hence,

a-III, b-IV, c-I, d-II

Video Solution:

Q29 Text Solution:

(A)

$$\varepsilon = \frac{Ldi}{dt}$$

When $\frac{di}{dt}$ becomes zero, ε will become zero.

$$\frac{di}{dt} = -t^2\left(e^{-t}\right) + e^{-t}(2t) = 0 \Rightarrow t = 2\ \mathrm{s}$$

Video Solution:

Q30 Text Solution:

(C)

Given, $B = B_0(2\hat{i} + 3\hat{j} + 4\hat{k})\ \mathrm{T}$

Area of square, $A = L^2$

Since, square lies in *XY*-plane, hence

$A = L^2\ \hat{k}$

Magnetic flux passing through the square,

$\phi = \vec{B}\ .\ \vec{A}$

$= B_0\left(2\hat{i} + 3\hat{j} + 4\hat{k}\right) \cdot L^2\ \hat{k}$

$= 4B_0L^2\ \mathrm{Wb}$

Video Solution: