



Chapter 6 : Electromagnetic Induction (50 Important MCQs)

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Notes

50 important MCQs from GSEB, CBSE, NEET and JEE exams · Answer key at the end

Section A — Multiple Choice Questions

Each question carries 1 mark. Choose the correct option.

Q.1 Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon

- (A) the rates at which currents are changing in the two coils
- (B) the relative position and orientation of the two coils
- (C) the materials of the wires of the coils
- (D) the currents in the two coils

Q.2 A conducting rod of length 1 m rotates in a vertical plane normal to a uniform magnetic field with angular speed 5 rad/s, one end being at the centre of the circular path. If the horizontal component of the earth's magnetic field is 0.2×10^{-4} T, the emf induced between the two ends of the rod is

- (A) 5 μ V
- (B) 5 mV
- (C) 50 μ V
- (D) 50 mV

Q.3 A coil of n turns and resistance $R \Omega$ is connected to a galvanometer of resistance $4R \Omega$. The combination is moved in time t seconds from a magnetic field of W_1 weber to W_2 weber (flux per turn). The induced current in the circuit is

- (A) $\frac{W_2 - W_1}{5Rnt}$
- (B) $-\frac{n(W_2 - W_1)}{5Rt}$
- (C) $-\frac{W_2 - W_1}{Rnt}$
- (D) $-\frac{n(W_2 - W_1)}{Rt}$

Q.4 Which of the following units has the dimensions $[M^1 L^2 Q^{-2}]$? (Q denotes electric charge)

- (A) H/m²
- (B) Wb
- (C) Wb/m²
- (D) H (henry)

Q.5 The flux linked with a coil at any instant t is $\Phi = 10t^2 - 50t + 250$ (SI units). The induced emf at $t = 3$ s is

- (A) 10 V
- (B) 190 V
- (C) -190 V
- (D) -10 V

Q.6 Two coaxial solenoids are made by winding thin insulated wire over a pipe of cross-sectional area $A = 10 \text{ cm}^2$ and length $l = 20 \text{ cm}$. If one solenoid has 300 turns and the other 400 turns, their mutual inductance is ($\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$)

- (A) $2.4\pi \times 10^{-4} \text{ H}$
- (B) $2.4\pi \times 10^{-5} \text{ H}$
- (C) $4.8\pi \times 10^{-4} \text{ H}$
- (D) $4.8\pi \times 10^{-5} \text{ H}$

Q.7 A boat carrying a vertical aerial (antenna) of length 2 m moves east with velocity 1.5 m/s. If the horizontal component of the earth's magnetic field is $5 \times 10^{-5} \text{ N A}^{-1} \text{ m}^{-1}$, the emf induced between the two ends of the aerial is

- (A) 1 mV
- (B) 0.75 mV
- (C) 0.5 mV
- (D) 0.15 mV

Q.8 A horizontal metallic wire 20 m long, lying in the east–west direction, is perpendicular to the horizontal component of the earth's magnetic field ($0.3 \times 10^{-4} \text{ Wb/m}^2$). The wire falls freely; at an instant its velocity is 5 m/s. The magnitude of the instantaneous emf is

- (A) 6.0 mV (B) 3 mV (C) 4.5 mV (D) 1.5 mV

Q.9 A small square loop of wire of side l is placed inside a large square loop of side L ($L > l$). The loops are coplanar and their centres coincide. The mutual inductance of the system is proportional to

- (A) $\frac{l}{L}$ (B) $\frac{l^2}{L}$ (C) $\frac{L}{l}$ (D) $\frac{L^2}{l}$

Q.10 In a coil of resistance 100Ω , a current is induced by changing the magnetic flux through it. The induced current falls linearly from 10 A to zero in 0.5 s. The magnitude of the change in flux through the coil is

- (A) 250 Wb (B) 275 Wb (C) 200 Wb (D) 225 Wb

Q.11 The self-induced emf of a coil is 25 V when the current in it changes at a uniform rate from 10 A to 25 A in 1 s. The change in the energy of the inductance is

- (A) 740 J (B) 437.5 J (C) 540 J (D) 637.5 J

Q.12 A square loop of side d moves with velocity $\hat{v}_i$ in a non-uniform magnetic field $\vec{B} = \frac{B_0}{a}x\hat{k}$ (the loop lies in the x - y plane with two sides parallel to the y -axis). The emf induced in the loop is

- (A) $\frac{B_0 dv}{a}$ (B) $\frac{B_0 a^2 v}{d}$ (C) $\frac{2B_0 d^2 v}{a}$ (D) $\frac{B_0 d^2 v}{a}$

Q.13 A small square loop of side l is placed inside a large square loop of side L ($L \gg l$). Both loops are coplanar and their centres coincide. The mutual inductance of the system is

- (A) $\frac{2\sqrt{2}\mu_0 L^2}{\pi l}$ (B) $\frac{\mu_0 l^2}{2\sqrt{2}\pi L}$ (C) $\frac{2\sqrt{2}\mu_0 l^2}{\pi L}$ (D) $\frac{\mu_0 L^2}{2\sqrt{2}\pi l}$

Q.14 A small circular loop of radius r is placed at the centre of a square loop of side L ($r \ll L$), in the same plane. The mutual inductance is

- (A) $\frac{\mu_0 r^2}{\sqrt{2}L}$ (B) $\frac{\pi\mu_0 r^2}{2L}$ (C) $\frac{2\sqrt{2}\mu_0 r^2}{L}$ (D) $\frac{4\mu_0 r^2}{L}$

Q.15 A square loop of area 25 cm^2 has a resistance of 10Ω . It is placed in a uniform magnetic field of 40.0 T with its plane perpendicular to the field. The work done in pulling the loop out of the field slowly and uniformly in 1.0 s is

- (A) $2.5 \times 10^{-3} \text{ J}$ (B) $1.0 \times 10^{-3} \text{ J}$ (C) $1.0 \times 10^{-4} \text{ J}$ (D) $5 \times 10^{-3} \text{ J}$

Q.16 A metallic frame of size $2 \text{ m} \times 2.5 \text{ m}$ has its area vector at 60° to an external magnetic field of 4 T . The frame is taken out of the field in 10 seconds. The average emf induced in the frame is

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

Q.17 A rod of length 5 m moves with velocity 10 m/s perpendicular to its length in a uniform magnetic field of $60 \mu\text{T}$, which is perpendicular to both the rod and its velocity. The induced emf across the ends of the rod is [JEE Jan 2024]

- (A) 3 mV (B) 6 mV (C) 0 V (D) 1 mV

Q.18 A square loop of side 15 cm moves to the right at a constant speed of 2 cm/s. Its front edge enters a 50 cm wide region of uniform magnetic field $B = 1.0 \text{ T}$ (normal to the loop) at $t = 0$. The induced emf in the loop at $t = 10 \text{ s}$ is

- (A) 0.3 mV (B) 4.5 mV (C) 0 (D) 3 mV

Q.19 Two conducting circular loops A (radius a) and B (radius b) lie in the same plane with their centres coinciding ($b \gg a$). The mutual inductance between them is

- (A) $\frac{\mu_0 \pi a^2}{2b}$ (B) $\frac{\mu_0 b^2}{2\pi a}$ (C) $\frac{\mu_0 \pi b^2}{2a}$ (D) $\frac{\mu_0 a^2}{2\pi b}$

Q.20 In a region of magnetic induction $B = 10^{-2}$ T, a circular coil of radius 30 cm and resistance $\pi^2 \Omega$ is rotated about a diameter perpendicular to B . If the coil rotates at 200 rpm, the amplitude of the induced alternating current is

- (A) $4\pi^2$ mA (B) 30 mA (C) 6 mA (D) 200 mA

Q.21 The current in a self-inductance $L = 40$ mH is increased uniformly from 1 A to 11 A in 4 milliseconds. The emf induced in the inductor during the process is

- (A) 100 V (B) 0.4 V (C) 4.0 V (D) 440 V

Q.22 A rectangular coil of 20 turns and area 25 cm^2 has a resistance of 100Ω . If a magnetic field perpendicular to the plane of the coil changes at a rate of 1000 T/s , the current in the coil is

- (A) 1 A (B) 50 A (C) 0.5 A (D) 5 A

Q.23 An electron moves along a straight line XY that passes just below a circular coil abcd lying in the same plane. What will be the direction of the current, if any, induced in the coil?

- (A) No current induced
(B) In abcd direction
(C) In adcb direction
(D) The current will reverse its direction as the electron goes past the coil

Q.24 A long solenoid has 1000 turns. When a current of 4 A flows through it, the magnetic flux linked with each turn is 4×10^{-3} Wb. The self-inductance of the solenoid is

- (A) 3 H (B) 2 H (C) 1 H (D) 4 H

Q.25 A bulb connected in series with an air-cored solenoid is lit by an a.c. source. If a soft iron core is introduced into the solenoid,

- (A) the bulb stops glowing (B) the bulb glows brighter
(C) there is no change in the glow (D) the bulb becomes dimmer

Q.26 Inside a parallel plate capacitor, the electric field E varies with time as t^2 . The induced magnetic field varies with time as

- (A) t^2 (B) no variation (C) t^3 (D) t

Q.27 The magnetic potential energy stored in an inductor is 25 mJ when the current in it is 60 mA. The inductance is

- (A) 13.89 H (B) 0.138 H (C) 1.389 H (D) 138.88 H

Q.28 An 800-turn coil of effective area 0.05 m^2 is kept perpendicular to a magnetic field of 5×10^{-5} T. When the plane of the coil is rotated by 90° about any of its coplanar axes in 0.1 s, the emf induced in the coil is

- (A) 0.02 V (B) 2 V (C) 0.2 V (D) 2×10^{-3} V

Q.29 Two conducting circular loops of radii R_1 and R_2 lie in the same plane with their centres coinciding. If $R_1 \gg R_2$, the mutual inductance M between them is directly proportional to

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

Q.30 A step-down transformer connected to a 220 V a.c. mains supply operates an 11 V, 44 W lamp. Ignoring power losses, the current in the primary circuit is

- (A) 4 A (B) 0.2 A (C) 0.4 A (D) 2 A

Q.31 A big circular coil of 1000 turns and average radius 10 m rotates about its horizontal diameter at 2 rad s^{-1} . If the vertical component of the earth's magnetic field there is $2 \times 10^{-5} \text{ T}$ and the resistance of the coil is 12.56Ω , the maximum induced current is

- (A) 1 A (B) 2 A (C) 0.25 A (D) 1.5 A

Q.32 The magnetic energy stored in an inductor of inductance $4 \mu\text{H}$ carrying a current of 2 A is

- (A) 8 μJ (B) 4 μJ (C) 4 mJ (D) 8 mJ

Q.33 When the current in the primary coil falls from 2 A to zero in 0.01 s, the emf induced in the secondary coil is 1000 V. The mutual inductance of the coils is

- (A) 1.25 H (B) 2.50 H (C) 5.00 H (D) 10.00 H

Q.34 A coil of wire of a certain radius has 100 turns and a self-inductance of 15 mH. The self-inductance of a second similar coil of 500 turns will be

- (A) 75 mH (B) 375 mH (C) 175 mH (D) None of these

Q.35 A circular coil of area 4 cm^2 and 10 turns is placed inside a solenoid having 15 turns/cm, with the axis of the coil along the axis of the solenoid. The mutual inductance of the system is

- (A) 7.54 μH (B) 8.54 μH (C) 9.54 μH (D) 10.54 μH

Q.36 The radii of two concentric coplanar circular rings are 1 m and 2 m. Current is passed in the outer ring. The mutual inductance of the system will be

- (A) $\frac{\mu_0 \pi}{2}$ (B) $\frac{\mu_0 \pi}{4}$ (C) $\frac{\mu_0 \pi}{8}$ (D) $\frac{\mu_0 \pi}{10}$

Q.37 A conducting ring of radius r is placed perpendicular to a time-varying magnetic field $B = B_0 + \alpha t$, where B_0 and α are positive constants. The emf produced in the ring is

- (A) $-\pi\alpha r^2$ (B) $-\pi\alpha r$ (C) $-\pi\alpha^2 r^2$ (D) $-\pi\alpha^2 r$

Q.38 A rod of length 10 cm moves perpendicular to a uniform magnetic field of $5 \times 10^{-4} \text{ Wb/m}^2$. If the acceleration of the rod is 5 m/s^2 , the rate of increase of the induced emf is

- (A) $2.5 \times 10^{-4} \text{ V s}^{-1}$ (B) $25 \times 10^{-4} \text{ V s}$ (C) $20 \times 10^{-4} \text{ V s}$ (D) $20 \times 10^{-4} \text{ V s}^{-1}$

Q.39 Select the **incorrect** unit of self-inductance:

- (A) mho-second (B) Weber/Amp (C) Volt-second/Ampere (D) Ohm-second

Q.40 The coil of an a.c. generator has 100 turns and cross-sectional area 2.5 m^2 . It revolves in a uniform magnetic field of 0.3 T with angular velocity 60 rad s^{-1} . The maximum voltage produced is ____ kV.

- (A) 4.50 (B) 2.25 (C) 6.75 (D) 1.25

Q.41 Two inductors, each of inductance L , are connected in parallel. Another inductor of 5 mH is connected in series with this combination; the effective inductance is 15 mH. The value of L is ____ mH.

- (A) 10 (B) 5.0 (C) 2.5 (D) 20

Q.42 A coil of 200 turns has an area of 0.15 m^2 . A magnetic field perpendicular to it changes from 0.2 T to 0.6 T in 0.4 s. The induced emf in the coil is ____ V.

- (A) 45 (B) 30 (C) 15 (D) 60

Q.43 A wheel of radius 2 m having 8 conducting concentric spokes rotates about its geometrical axis with an angular velocity of 10 rad/s in a uniform magnetic field of 0.2 T perpendicular to its plane. The induced emf between the rim and the centre is ____ V.

- (A) 2 (B) 6 (C) 4 (D) 8

Q.44 A coil of area 200 cm^2 with 25 turns is held perpendicular to a magnetic field of 0.02 Wb/m^2 . The resistance of the coil is 1Ω . If it is removed from the field in 1 s, the induced charge in the coil is ____ C.

- (A) 1 (B) 0.01 (C) 0.1 (D) 0.001

Q.45 A coil of 1000 turns and area 0.10 m^2 rotates at half a revolution per second in a uniform magnetic field of 0.01 T perpendicular to its axis of rotation. The maximum emf generated is ____ V.

- (A) 0.5 (B) 5.0 (C) 3.14 (D) 0.314

Q.46 For a long current-carrying solenoid with magnetic field 0.6 T inside, the magnetic energy per unit volume is

- (A) $1.43 \times 10^5 \text{ J/m}^3$ (B) $2.86 \times 10^4 \text{ J/m}^3$ (C) $5.23 \times 10^4 \text{ J/m}^3$ (D) zero

Q.47 A pair of adjacent coils has a mutual inductance of 1.5 H. If the current in one coil changes from 0 to 20 A in 0.5 s, the change of flux linkage with the other coil is

- (A) 15 Wb (B) 30 Wb (C) 45 Wb (D) 60 Wb

Q.48 An air-cored solenoid of length 30 cm, area of cross-section 25 cm^2 and 500 turns carries a current of 2.5 A. The current is suddenly switched off in 10^{-3} s . The average back emf induced across the ends of the open switch is (ignore end effects)

- (A) 654 V (B) 65.4 V (C) 6.54 V (D) 0.654 V

Q.49 Current in a circuit falls from 5.0 A to 0.0 A in 0.1 s. If an average emf of 100 V is induced, the self-inductance of the circuit is

- (A) 0.5 H (B) 1 H (C) 2 H (D) 4 H

Q.50 The flux associated with a closed loop is $\phi(t) = 3t^2 + 2t + 5$ weber. If the resistance of the loop is 14Ω , the current induced in it at $t = 2 \text{ s}$ is

- (A) 1 A (B) 2 A (C) 1.5 A (D) 2.5 A

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	11	B	21	A	31	A	41	D
2	C	12	D	22	C	32	A	42	B
3	B	13	C	23	D	33	C	43	C
4	D	14	C	24	C	34	B	44	B
5	D	15	B	25	D	35	A	45	C
6	A	16	A	26	D	36	B	46	A
7	D	17	A	27	A	37	A	47	B
8	B	18	C	28	A	38	A	48	C
9	B	19	A	29	A	39	A	49	C
10	A	20	C	30	B	40	A	50	A

