	INDIAN SCHOOL AL WADI AL KABIR	
Class: XII	DEPARTMENT OF SCIENCE -2026-27 SUBJECT: PHYSICS	DATE: 09-08-26
WORKSHEET NO:6 WITH ANSWERS	TOPIC: ELECTROMAGNETIC INDUCTION	A4 FILE FORMAT
CLASS & SEC:	NAME OF THE STUDENT:	ROLL NO.

MULTIPLE CHOICE QUESTIONS,

1. A conducting loop is moved parallel to a uniform magnetic field. The induced emf in the loop is:
(a) Maximum
(b) Zero
(c) Depends on resistance
(d) Infinite

2. 1 henry is equal to:
(a) weber/ampere
(b) weber/Volt
(c) weber ampere
(d) None of these

3. The role of inductance is equivalent to:
(a) inertia
(b) force
(c) energy
(d) momentum

4. According to Faraday's experiments, a galvanometer connected to a closed coil shows a deflection only when:
(a) A bar magnet is held stationary inside the coil.
(b) There is relative motion between the magnet and the coil.
(c) A steady current flows through a neighbouring stationary coil.
(d) The magnetic flux through the coil remains constant.

5. In the relation $\phi = B\ A \cos\theta$, θ is angle
(a) which normal to the surface area makes with the direction of the magnetic field.
(b) which magnetic field makes with the surface.
(c) is always a constant.
(d) None of the above.

6. SI unit of magnetic flux is
(a) Henry (b) weber (c) coulomb (d) volt

7. An induced e.m.f. is produced when a magnet is plunged into a coil. The strength of the induced e.m.f. is independent of
(a) the strength of the magnet
(b) number of turns of coil
(c) the resistivity of the wire of the coil
(d) speed with which the magnet is moved

8. According to Faraday's law of electromagnetic induction
(a) electric field is produced by time-varying magnetic flux.
(b) magnetic field is produced by time varying electric flux.
(c) magnetic field is associated with a moving charge.
(d) None of these

9. A moving conductor coil produces an induced e.m.f. This is in accordance with
(a) Lenz's law
(b) Faraday's law
(c) Coulomb's law
(d) Ampere's law

10. The polarity of induced emf is given by
(a) Ampere's circuital law
(b) Biot -Savart law
(c) Lenz's law
(d) Fleming's right-hand rule

11. The coils in resistance boxes are made from double-insulated wire to nullify the effect of
(a) heating
(b) magnetism
(c) pressure
(d) self-induced e.m.f.

12. Two pure inductors each of self-inductance L are connected in series; the net inductance is
(a) L
(b) 2 L
(c) L/2
(d) L/4

13. Lenz's law is a consequence of the law of conservation of
(a) charge
(b) mass
(c) energy
(d) momentum

Q.14. Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon
(a) the rate at which currents are changing in the two coils.
(b) relative position and orientation of two coils.

(c) the material of the wires of the coils.
(d) the currents in the two coils.

15. The current flows from A to B is as shown in the figure. The direction of the induced current in the loop is

(a) clockwise.
(b) anticlockwise.
(c) straight line.
(d) no induced e.m.f produced.

Q.16. In a coil of self-induction 5 H, the rate of change of current is 2 As^{-1}. Then emf induced in the coil is
(a) 10 V
(b) -10 V
(c) 5 V
(d) -5 V

Q.17. A coil of 200 turns experiences a change in magnetic flux from 0.04 Wb to 0.01 Wb in 0.02 s. The magnitude of the induced emf is:

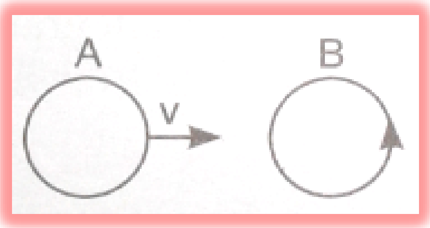
(a) 150 V

(b) 300 V

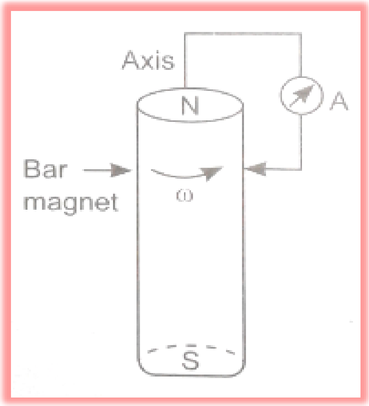
(c) 200 V

(d) 100 V

Q.18. There are two coils A and B as shown in the figure. A current starts flowing in B as shown when A is moved towards B and stops. B is kept stationary when A moves. We can infer that
(a) there is a constant current in the clockwise direction in A.
(b) there is a varying current in A.
(c) there is no current in A.
(d) there is a constant current in the counterclockwise direction in A.



Q.19. A cylindrical bar magnet is rotated about its axis. A wire is connected from the axis and is made to touch the cylindrical surface through a contact. Then
(a) a direct current flows in the ammeter A.
(b) no current flows through ammeter A.
(c) an alternating sinusoidal current flows through the ammeter A with a time period $T = 2\pi/\omega$.
(d) a time-varying non-sinusoidal current flows through the ammeter A.



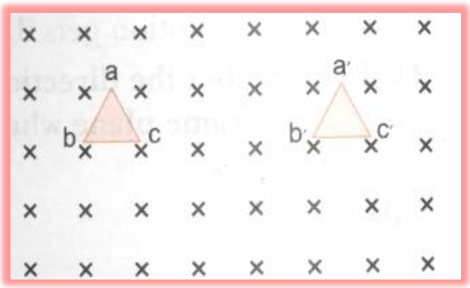
Q.20. The self-inductance L of a solenoid of length l and of cross-section A, with a fixed number of turns N increases as,
(a) l and A increase.
(b) l decreases and A increases.
(c) l increases and A decreases.
(d) both l and A increase.

SHORT ANSWER TYPE QUESTIONS;(2 MARKS)

21. Name and state the law that gives the polarity of induced emf.

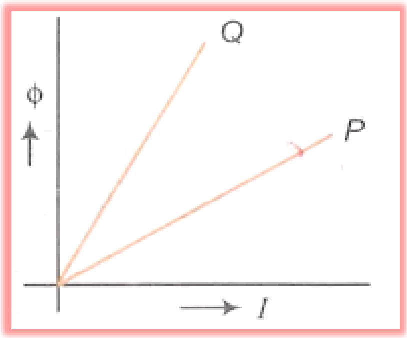
22. On what factors does the magnitude of the emf induced in the circuit due to magnetic flux depend?

23. A triangular loop of wire placed at *abc* is moved completely inside a magnetic field which is directed normal to the plane of the loop away from the reader to a new position *a'b'c'*. What is the direction of the current induced in the loop? Give reason.



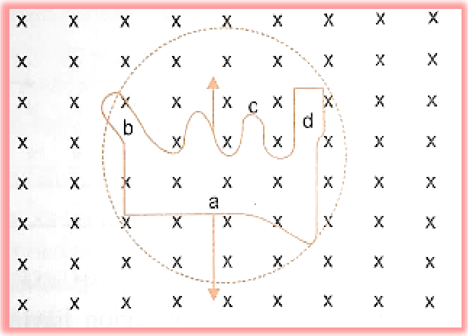
24. Current in a circuit falls from 3.0 to 0.0 A in 300 ms. If an average emf of 200 V is induced. Calculate the self-inductance of the circuit.

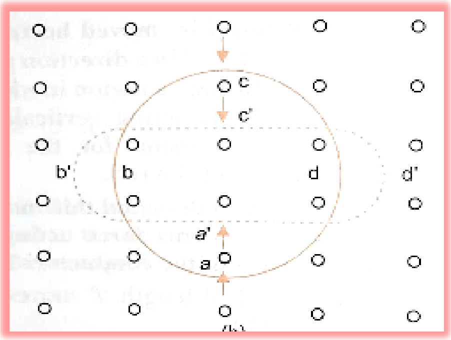
25.(i)If the rate of change of current 2 As^{-1} induces an emf of 40 mV in the solenoid, what is the self-inductance of the solenoid?
(ii) The given graph shows a plot of magnetic flux(φ) and the electric current(I) flowing through two inductors P and Q. Which of the two inductors has a smaller value of self-inductance?



3 MARKS QUESTIONS
26. A circular coil of radius 10 cm, 500 turns and resistance 200 Ω is placed with its plane perpendicular to the horizontal component of the Earth's magnetic field. It is rotated about its vertical diameter through 180° in 0.25 second. Estimate the magnitudes of the emf and current induced in the coil. (Horizontal component of the earth magnetic field at the place is 3×10^{-5} T)

27. Use Lenz's law to determine the direction of induced current in the situation described by following figures.
(i) A wire of irregular shape turning into a circular shape.
(ii) A circular loop being deformed into a narrow straight wire.

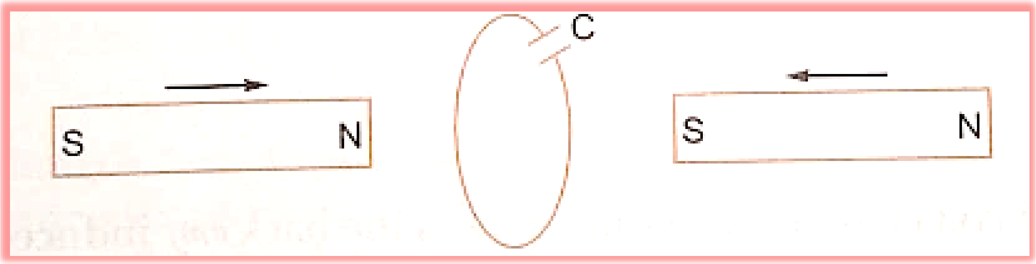




28. (i)State Lenz's law. Illustrate, by giving an example, how this law helps in predicting the direction of the current in a loop in the presence of a changing magnetic flux.
(ii)In a given coil of self-inductance of 5.0 mH, current changes from 4 A to 1 A in 30 ms. Calculate the emf induced in the coil.

LONG ANSWER TYPE QUESTIONS (5 MARKS)

29. (i) Show that Lenz's law is in accordance with the law of conservation of energy.
(ii) Two bar magnets are quickly moved towards a metallic loop connected across a capacitor 'C' as shown in the figure. Predict the polarity of the capacitor.



30. (i) Define motional e.m.f. Obtain an expression for it.
(ii) A jet plane is travelling west at 450 ms^{-1}. If the horizontal component of Earth's magnetic field at that place is 4×10^{-4} T and the angle of dip is 30°, find the emf induced between the ends of wings having a span of 30 m.

ASSERTION REASONING QUESTIONS

Directions: These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses.
(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

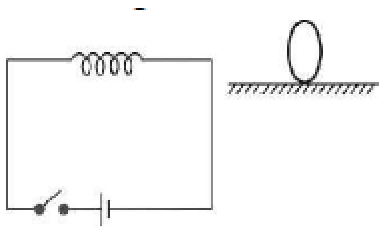
1. Assertion: Induced emf will always occur whenever there is a change in magnetic flux.
Reason: Current always induces whenever there is a change in magnetic flux.

2. **Assertion:** Lenz's law does not violate the principle of conservation of energy.
Reason: Induced emf always opposes the change in magnetic flux responsible for its production

3. Assertion: An induced current has a direction such that the magnetic field due to the current opposes the change in the magnetic flux that induces the current.
Reason: The above statement is in accordance with conservation of energy.

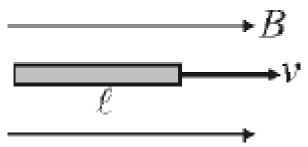
4. Assertion: Acceleration of a magnet falling through a long solenoid decreases.
Reason: The induced current produced in a circuit always flows in such a direction that it opposes the change to the cause that produced it.

5. Assertion : Figure shows a horizontal solenoid connected to a battery and a switch. A copper ring is placed on a smooth surface, the axis of the ring being horizontal. As the switch is closed, the ring will move away from the solenoid.



Reason: Induced emf in the ring, $e=-d\Phi/dt$

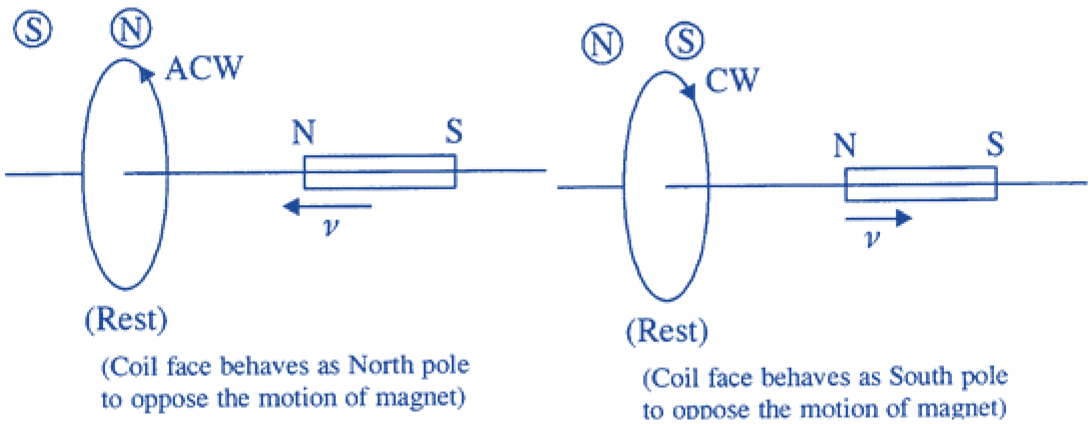
6. Assertion: Figure shows a metallic conductor moving in magnetic field. The induced emf across its ends is zero.



Reason: The induced emf across the ends of a conductor is given by $e = Bv\ell \sin\theta$.

CASE STUDY BASED QUESTIONS: -

1. Lenz's law states that the direction of induced current in a circuit is such that it opposes the change which produces it. Thus, if the magnetic flux linked with a closed circuit increases, the induced current flows in such a direction that magnetic flux is created in the opposite direction of the original magnetic flux. If the magnetic flux linked with the closed circuit decreases, the induced current flows in such a direction so as to create magnetic flux in the direction of the original flux.

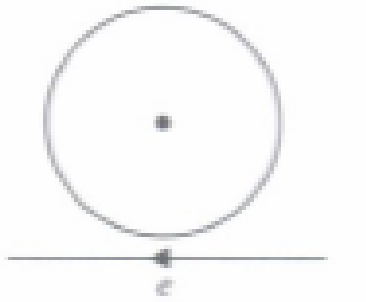


(i) Which of the following statements is correct?
(a) The induced e.m.f. is not in the direction opposing the change in magnetic flux so as to oppose the cause which produces it.
(b) The relative motion between the coil and magnet produces a change in magnetic flux.
(c) Emf is induced only if the magnet is moved towards the coil.
(d) Emf is induced only if the coil is moved towards the magnet.

(ii) The polarity of induced emf is given by
(a) Ampere's circuital law (b) Biot-Savart law
(c) Lenz's law (d) Fleming's right-hand rule

(iii) Lenz's law is a consequence of the law of conservation of
(a) charge (b) mass (c) momentum (d) energy

(iv) Near a circular loop of conducting wire as shown in the figure, an electron moves along a straight line.



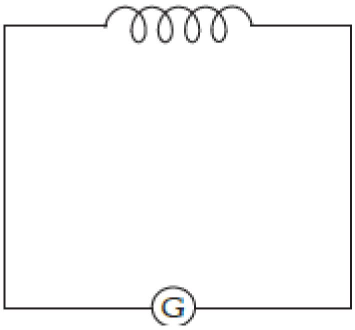
The direction of the induced current if any in the loop is
(a) variable (b) clockwise (c) anticlockwise (d) zero

OR

(iv)Two identical circular coils A and B are kept in a horizontal tube side by side without touching each other. If the current in coil A increases with time, in response, coil B

a) is attracted b) neither repelled nor attracted
c) repelled d) rotates

2. Self-Induction. When a current I flow through a coil, flux linked with it is $\varphi = LI$, where L is a constant known as self-inductance of the coil.



Any change in current sets up an induced emf in the coil. Thus, self-inductance of a coil is the induced emf set up in it when the current passing through it changes at the unit rate. It is a measure of the opposition to the growth or the decay of current flowing through the coil. Also, the value of self-inductance depends on the number of turns in the solenoid, its area of cross-section and the permeability of its core material.

(i) The inductance in a coil plays the same role as
(a) inertia in mechanics
(b) energy in mechanics
(c) momentum in mechanics
(d) force in mechanics

(ii) A current of 2.5 A flows through a coil of inductance 5 H. The magnetic flux linked with the coil is
(a) 0.5 Wb
(b) 12.5 Wb
(c) zero
(d) 2 Wb

(iii) The inductance L of a solenoid depends upon its radius R as
(a) $L \propto R$
(b) $L \propto 1/R$
(c) $L \propto R^2$
(d) $L \propto R^3$

(iv) The unit of self-inductance is
(a) Weber-ampere
(b) Weber^{-1} ampere
(c) Ohm second
(d) Farad

OR

(iv) The induced emf in a coil of 10 henry inductance in which current varies from 9 A to 4 A in 0.2 second is
(a) 200 V
(b) 250 V
(c) 300 V
(d) 350 V

CBSE BOARD QUESTIONS-

1) A coil of wire of radius r has 600 turns and a self-inductance of 108 mH. The self-inductance of a coil with same radius and 500 turns is:
a) 80 mH b) 75 mH c) 108 mH d) 90 mH

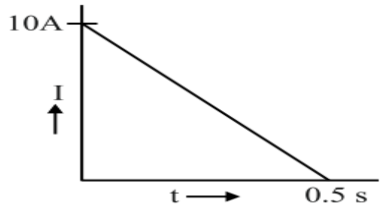
2) The current in the primary coil of a pair of coils changes from 7A to 3A in 0.04s. The mutual inductance between the two coils is 0.5 H. The induced emf in the secondary coil is
a) 50 V b) 75 V c) 100 V d) 220 V

3) If a wire of length 2 m is moving with a velocity of 1 $m\text{-}s^{-1}$ perpendicular to a magnetic field of 0.5 T, then the E.M.F. induced in the wire will be

(a) 0.2 V (b) 0.5 V

(c) 1 V (d) 2 V

4) In a coil of resistance 100 Ω a current is induced by changing the magnetic flux through it. The variation of current with time is as shown in the figure. The magnitude of change in flux through the coil is **(1 MARK)**



(a) 200 Wb (b) 275 Wb (c) 225 Wb (d) 500 Wb

5)a. Define mutual inductance and write its SI unit. **(3 MARKS)**
b. Two circular loops, one of small radius *r* and other of larger radius R, such that R >> *r*, are placed co-axially with centres coinciding. Obtain the mutual inductance of the arrangement.

6)Two long straight parallel current-carrying conductors are kept 'a' distant apart in air. The direction of current in both the conductors is the same. Find the magnitude of force per unit length and direction of the force between them. Hence define one ampere. **(3 MARKS)**

7) You are required to design an air-filled solenoid of inductance 0.016 H having a length 0.81m and radius 0.02 m. The number of turns in the solenoid should be
(a) 2592 (b) 2866 (c) 2976 (d) 3140

8) Assertion: It is difficult to move a magnet into a coil of large number of turns when the circuit of the coil is closed.
Reason: The direction of the induced current in a coil with its circuit closed due to motion of a magnet, is such that it opposes the cause.

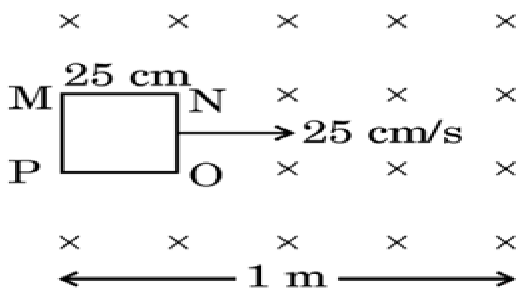
9) (i) State Faraday's law of electromagnetic induction.
(ii) Explain, with the help of a suitable example, how we can show that Lenz's law is consequences of the principle of conservation of energy.
(iii) Use the expression for Lorentz force acting on the charge carriers of a conductor to obtain the expression for the induced EMF across the conductor of length '*l*' moving with velocity '*v*' through a magnetic field 'B' acting perpendicular to its length.

10) A rectangular loop of area A is placed in a uniform magnetic field B. If the loop is rotated with an angular velocity ω about an axis perpendicular to the field, show that the maximum flux linked with the loop is BA and the induced emf is BAωsinωt. **(CBSE 2024)**

11) A bar magnet is moved towards a metallic ring. Use Lenz's Law to predict the direction of the induced current in the ring as viewed from the side of the magnet. Does the ring experience a force of attraction or repulsion? Justify. **(CBSE 2023)**

12) The figure given below shows a square-shaped loop MNOP of side 25 cm placed horizontally in a uniform magnetic field $\vec{B}$ directed vertically downward. The position of the loop at **t=0 s** is as shown in the figure. The loop is pulled with a constant velocity of 25 cm/s until it goes out of the field.

(CBSE-2025) (3marks)



(a) What will be the direction of the induced current in the loop as it goes out of the field? For how long would the current in the loop persist?

(b) Plot graphs showing the variation of magnetic flux and magnitude of induced emf as functions of time.

Q.NO.	ANSWERS
1.	(b) Zero
2.	(a) weber/ampere
3.	(a) -inertia
4.	(b)There is relative motion between the magnet and the coil.
5.	(a) which normal to the surface area makes with the direction of magnetic field.
6.	(b) weber
7.	(c) the resistivity of the wire of the coil
8.	(a) electric field is produced by time varying magnetic flux.
9.	(b) Faraday's law
10.	(c) Lenz's law
11.	(d) self-induced e.m.f.
12	(b) 2 L
13.	(c) energy
14.	(b) relative position and orientation of two coils.
15.	a) By Lenz's law, the induced current must produce inward flux to counter magnetic flux of AB. So induced current is clockwise in the loop.
16.	(b) Induced e.m.f. ε = -L dI/dt = – 5 × 2 = -10 V
17.	(b) $E = N\frac{\Delta\Phi}{\Delta t} = 200 \times \frac{0.03}{0.02} = 300\ \mathrm{V}$
18.	(d) there is a constant current in the counter clockwise direction in A.
19.	(b) no current flows through ammeter A.
20.	(b) l decreases and A increases.
	SHORT ANSWER TYPE QUESTIONS;(2 MARKS)
21.	Lenz's law - statement

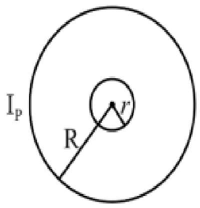
22.	Ans: - flux density, length of the coil, velocity with which the coil is moved and the angle between the velocity and flux.
23.	Ans: - change in magnetic flux through wire loop is zero, hence no current.
24.	Ans: - L = $\frac{-e}{dI/dt}$ = 20 H.
25.	Ans: -(i) L = 20mH. (ii) L = slope, p is having smaller resistance,
26.	Hints; - Initial magnetic flux through the coil, $\phi_i = B_H A\cos\theta = 3.0\times10^{-5}\times(\pi\times10^{-2})\times\cos0^\circ$ $=3\pi\times10^{-7}$Wb Final magnetic flux after the rotation $\phi_f = 3.0\times10^{-5}\times(\pi\times10^{-2})\times\cos180^\circ$ $=-3\pi\times10^{-7}$Wb. Induced emf, $\epsilon = -N\frac{d\phi}{dt} = -\frac{N(\phi f-\phi i)}{t}$. $= -\frac{500(-3\pi\times10-7-3\pi\times10-7)}{0.25}$ $= \frac{500\times(6\pi\times10-7)}{0.25} = 3.8\times10^{-3}$V I= ϵ/R $=3.8\times10^{-3}$V/2Ω $= 1.9\times10^{-3}$A.
27.	Hints: -(a)The wire is expanding to form a circle, which means that force is acting outwards on each part of wire because of magnetic field (acting in the downwards direction). The direction of induced current should be such that it will produce magnetic field in upward direction (towards the reader). Hence force on wire will be towards inward direction, i.e. induced current is flowing in anticlockwise direction in the loop from cbad. (b)When the shape of a circular loop is deformed into a narrow straight wire, the flux piercing the surface decreases. Hence, the induced current flows along abcd.
28.	Ans: -(i) refer note book. (ii) e = 500 V.
29.	(i) Refer notes (ii)Current induced in coil will oppose the approach of magnet; therefore, left face of coil will act as N-pole and right face as S-pole. For this the current in coil will be anticlockwise as seen from left therefore the plate A of capacitor will be positive and plate B will be negative. The upper plate is positive and lower plate is negative.
30.	(i) Refer notes (ii) $B_V = B_H \cdot \tan(\delta)$ Since $\tan(30^\circ) = \frac{1}{\sqrt{3}}$: $B_V = B_H \cdot \tan(30^\circ) = 4\times10^{-4}\cdot\frac{1}{\sqrt{3}} = \frac{4\times10^{-4}}{\sqrt{3}}$ T

	$\epsilon = B_V \cdot v \cdot L$ Substituting the values: $\epsilon = \left(\frac{4 \times 10^{-4}}{\sqrt{3}}\right) \cdot (450) \cdot (30)$ First, calculate $\frac{4 \times 10^{-4}}{\sqrt{3}}$: $\frac{4 \times 10^{-4}}{\sqrt{3}} \approx 2.309 \times 10^{-4}\,\mathrm{T}$ Now substitute this back into the e.m.f. equation: $\epsilon = (2.309 \times 10^{-4}) \cdot (450) \cdot (30)$ $\epsilon \approx 2.309 \times 10^{-4} \cdot 13500 \approx 3.12\,\mathrm{V}$
	ASSERTION REASONING
1.	Answer(c) Emf will always induces whenever, there is change in magnetic flux. The current will be induced only in closed loop.
2.	Answer(a) Lenz's law (that the direction of induced emf is always such as to oppose the change that cause it) is direct consequence of the law of conservation of energy.
3.	Answer-(b)
4.	Answer(a) The induced current in the ring opposes the motion of falling magnet. Therefore, the acceleration of the falling magnet. Therefore, the acceleration of the falling magnet will be less than that due to gravity.
5.	Answer - (a)When switch is closed, the magnetic flux through the ring will increase and so ring will move away from the solenoid so as to compensate this flux. This is according to Lenz's law.
6.	Answer - (a)
	CASE BASED STUDY QUESTIONS
1.	(i) b) The relative motion between the coil and magnet produces change in magnetic flux. (ii) (c) Lenz's law (iii) (d) energy (iv) (a) variable OR

	(iv) (c) repelled Two identical circular coils A and B are kept on a horizontal tube side by side without touching each other. If the current in the coil A increases with time, in response, the coil B is repelled. It is so because when the current in coil A is changed, the magnetic field associated with it also changes. As a result, the magnetic field around coil B also changes. This change in magnetic field lines around coil B induces an electric current in it. Now as the same current is flowing in both the coils and in same direction, hence they both will repel each other.
2.	(i) (a) inertia in mechanics (ii) (b) 12.5 Wb (iii) (c) $L \propto R^2$ (iv) (c) Ohm second OR (iv) (b) 250 V
	CBSE BOARD QUESTIONS-
1.	Correct option is B) Given : $N = 600$ $L = 108\ mH$ $N' = 500$ Self inductance of the coil $L = \frac{\mu_0 N^2 A}{l}$ where $A = \pi r^2$ $\Rightarrow L \propto N^2$ $(\because A = \text{constant})$ $\Rightarrow \frac{L'}{L} = \frac{N'^2}{N^2}$ $\therefore \frac{L'}{108} = \frac{(500)^2}{(600)^2}$ OR $L' = 108 \times \frac{25}{36}$ $\Longrightarrow L' = 75\ mH$
2.	a) 50 V

	$E_s = -M\frac{\Delta I}{\Delta t}$ Substituting the known values: $E_s = -0.5\,\mathrm{H} \cdot \frac{-4\,\mathrm{A}}{0.04\,\mathrm{s}}$ **Calculate the induced emf** Now, calculate the fraction: $\frac{-4\,\mathrm{A}}{0.04\,\mathrm{s}} = -100\,\mathrm{A/s}$ Now substitute this back into the equation: $E_s = -0.5\,\mathrm{H} \cdot (-100\,\mathrm{A/s}) = 50\,\mathrm{V}$
3.	(c) $l = 2m, v = 1m/s, B = 0.5wb/m^2$ $v = Bvl = 2 \times 1 \times 0.5$ $= 1.0\,\text{volt}$
4.	**Step 1: Calculate the induced emf** $\varepsilon = IR = 10 \times 100 = 1000\ \mathrm{V}$ **Step 2: Use Faraday's law** $\varepsilon = \frac{\Delta\Phi}{\Delta t}$ $\Delta\Phi = \varepsilon\Delta t = 1000 \times 0.5 = 500\ \mathrm{Wb}$ Since the current decreases linearly, the emf remains constant during the inte **Answer:** $\boxed{\Delta\Phi = 500\ \mathrm{Wb}}$

5.	**(a)** : Definition and S.I. Unit. **½ + ½ M**
	(b)



Let a current I_P flow through the circular loop of radius R. The magnetic induction at the centre of the loop is

$$B_P = \frac{\mu_0 I_P}{2R}$$ **½ M**

As, $r << R$, the magnetic induction B_P may be considered to be constant over the entire cross sectional area of inner loop of radius r. Hence magnetic flux linked with the smaller loop will be

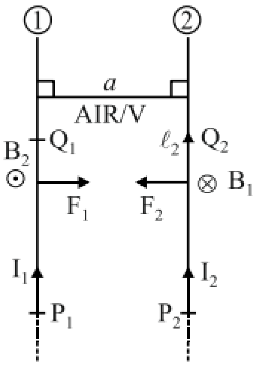
$$\phi_S = B_P A_S = \frac{\mu_0 I_P}{2R}\pi r^2$$ **½ M**

Also, $\phi_S = M I_P$ **½ M**

$$\therefore \quad M = \frac{\phi_S}{I_P} = \frac{\mu_0 \pi r^2}{2R}$$

6. The magnetic induction B_1 set up by the current I_1 flowing in first conductor at a point somewhere in th middle of second conductor is

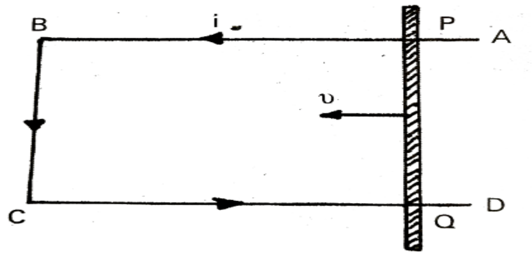
$$B_1 = \frac{\mu_0 I_1}{2\pi a} \quad ...(1)$$ **½ M**



The magnetic force acting on the portion P_2Q_2 of length ℓ_2 of second conductor is

$$F_2 = I_2 \ell_2 B_1 \sin 90° \quad ...(2)$$

	From equation (1) and (2), $F_2 = \frac{\mu_0 I_1 I_2 \ell_2}{2\pi a}$, towards first conductor ½ M $\frac{F_2}{\ell_2} = \frac{\mu_0 I_1 I_2}{2\pi a}$ ...(3) The magnetic induction B_2 set up by the current I_2 flowing in second conductor at a point somev the middle of first conductor is $B_2 = \frac{\mu_0 I_2}{2\pi a}$ ...(4) ½ M The magnetic force acting on the portion P_1Q_1 of length ℓ_1 of first conductor is $F_1 = I_1 \ell_1 B_2 \sin 90°$ ...(5) From equation (3) and (5) $F_1 = \frac{\mu_0 I_1 I_2 \ell_1}{2\pi a}$, towards second conductor ½ M $\frac{F_1}{\ell_1} = \frac{\mu_0 I_1 I_2}{2\pi a}$ ...(6) The standard definition of 1A If $I_1 = I_2 = 1A$ $\ell_1 = \ell_2 = 1m$ $a = 1m$ in V/A then $\frac{F_1}{\ell_1} = \frac{F_2}{\ell_2} = \frac{\mu_0 \times 1 \times 1}{2\pi \times 1} = 2 \times 10^{-7}$ N/m ∴ One ampere is that electric current which when flows in each one of the two infinitely long straight parallel conductors placed 1m apart in vacuum causes each one of them to experience a force of 2×10^{-7} N/m. **1**M
7.	$L = (\mu_0 * N^2 * A) / l$, $N = \sqrt{(L * l / (\mu_0 * A))}$. $N = \sqrt{(0.016\ H * 0.81\ m / (4\pi \times 10^{-7}\ T\cdot m/A}$ $0.0012566\ m^2)) \approx 2866$ turns.
8.	Ans. (a) (a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

9.	(ii) According to Lenz's law the direction of the induced current caused by induced emf is always such as to oppose the change causing it. The negative sign expresses Lenz's law. It means that the induced emf is such that the induced current opposes the change in flux if the circuit is closed. Consider a bar magnet and a loop. The bar magnet experiences a repulsive force due to the current induced. Hence some amount of work is done to move the magnet. The energy which is spent by the person in moving the magnet is dissipated by Joules heating produced by the induced current. Therefore, the law of conservation of energy is validated.  Consider a conductor PQ of length l moving freely in a uniform magnetic field $\vec{B}$ with uniform velocity v on a rectangular conductor ABCD. Let any arbitrary charge q in the conductor also move in the field with same velocity. Magnitude of Lorentz force on this charge (F) $= Bqv....(1)$ Workdone in moving the charge from P to Q is given by $W = \text{Force} \times \text{displacement}$ $W = Bqv \times l$ $-(2)(\therefore$ Direction of force on the charge as per Fleming's left hand rule) Electromotive force $(\varepsilon) = \dfrac{W}{q}$ $\varepsilon = \dfrac{Bqvl}{q} \Rightarrow \varepsilon = Blv - (3)$
10.	**Magnetic Flux** • **Area vector ($\vec{A}$)** points perpendicular to the surface of the rectangular loop. • **Magnetic field ($\vec{B}$)** is uniform across the region. • **Angle (θ)** between $\vec{B}$ and $\vec{A}$ changes with time t as the loop rotates at angular velocity ω, so $\theta = \omega t$. • **Magnetic flux (Φ_B)** equals $BA\cos(\theta) = BA\cos(\omega t)$. • **Maximum flux ($\Phi_{max}$)** occurs when $\cos(\omega t) = 1$, giving $\Phi_{max} = BA$.

	### Induced Electromotive Force (EMF) • **Faraday's law** states that induced emf (ε) equals the negative rate of change of magnetic flux: $\varepsilon = -\frac{d\Phi_B}{dt}$. • **Derivative calculation** of $\Phi_B = BA\cos(\omega t)$ with respect to time t yields $-\frac{d}{dt}(BA\cos(\omega t)) = -BA(-\omega\sin(\omega t))$. • **Final expression** simplifies to $\varepsilon = BA\omega\sin(\omega t)$.
11.	When a bar magnet moves towards a metallic ring, the induced current flows in a counterclockwise direction (as viewed from the magnet), and the ring experiences a force of repulsion. ### Lenz's Law and Induced Current • **Approaching Magnet**: The north pole of the bar magnet moves closer to the ring, increasing the magnetic flux pointing towards the ring. • **Opposing the Change**: By Lenz's Law, the induced current creates its own magnetic field to oppose this increase in flux. • **Current Direction**: To oppose the approaching north pole, the ring faces the magnet with a north magnetic polarity. Viewed from the magnet's side, this requires a counterclockwise current. ### Force of Interaction • **Magnetic Repulsion**: The induced north pole on the ring faces the north pole of the approaching bar magnet. • **Justification**: Like magnetic poles repel each other, so the ring and the magnet push away from one another.

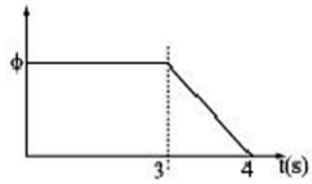
12.

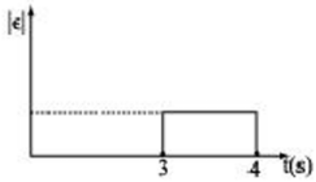
(a) Finding:
Direction of induced current 1
Time for which current persists in the loop. 1
(b) Plotting graphs showing variation of magnetic flux, magnitude of induced emf as a function of time. 1

(a) As the magnetic flux linked with the loop is decreasing, hence in accordance with Lenz's Law, the induced current will be in the clockwise direction. 1

$$t = \frac{25\,\text{cm}}{25\,\text{cm/s}} = 1\,\text{s}$$ 1

(b) ½+½





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