INDIAN SCHOOL AL WADI AL KABIR

Class: XII	**Department: SCIENCE -2020 -2021** **Subject : Physics**	**Date of completion** **02.07.2020**
Worksheet No:02 with Answers	**Topic: Electromagnetic Induction (EMI)**	**Note:** **A4 FILE FORMAT**
NAME OF THE STUDENT	**CLASS / SECTION**	**ROLL NO.**

MULTIPLE CHOICE QUESTIONS,

1. In the relation $\phi = BA \cos\theta$, θ is angle

(*a*) which normal to surface area makes with the direction of magnetic field

(*b*) which magnetic field makes with the surface

(*c*) which is never constant (*d*) none of the above

2. SI unit of magnetic flux is

(*a*) henry (*b*) weber (*c*) coulomb (*d*) volt

3. The cause of induced e.m.f. is

(*a*) magnetic flux (*b*) magnetic field

(*c*) area (*d*) change in magnetic flux

4. Choose the wrong statement :

(*a*) Whenever the amount of magnetic flux linked with a circuit changes, an e.m.f. is induced in the circuit.

(*b*) The induced e.m.f. lasts so long as the change in magnetic flux continues.

(*c*) Larger the amount of magnetic flux linked with a circuit, greater is the e.m.f. induced in it.

(*d*) The direction of induced e.m.f. is given by Lenz's Law.

5. Amount of charge induced in a circuit of resistance R is given by

(*a*) $dQ = (d\phi) \times R$ (*b*) $dQ = \frac{d\phi}{R}$ (*c*) $dQ = R^2\, d\phi$ (*d*) $dQ = \frac{d\phi}{R^2}$

6. Which one is not an application of eddy currents ?

(*a*) Magnetic brakes (*b*) speedometers (*c*) Induction furnace (*d*) Transformers

7. Out of the following, choose the correct relation

(*a*) $1\,\text{henry} = \frac{1\,\text{volt}}{1\,\text{ampere}}$ (*b*) $1\,\text{henry} = \frac{1\,\text{amp}}{1\,\text{volt}}$

(*c*) $1\,\text{henry} = \frac{1\,\text{volt}}{1\,\text{amp/sec}}$ (*d*) $1\,\text{henry} = \frac{1\,\text{volt}}{1\,\text{amp.sec}}$

8. When number of turns of a solenoid is doubled, its self inductance becomes k times, where k =

(*a*) 2 (*b*) 1 (*c*) 8 (*d*) 4

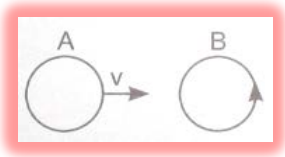
9. The magnetic flux linked with a coil is $\phi = (3t^2 - 2t + 1)$ milliweber. The e.m.f. induced in the coil at $t = 1$ sec is

(*a*) 4 V (*b*) 4×10^{-3} V (*c*) 6 V (*d*) 4×10^3 V

10. A wire of length 2 m moves with a speed of 5 m/s perpendicular to a magnetic field of induction 0·1 Wb/m^2. The e.m.f. induced in the wire is

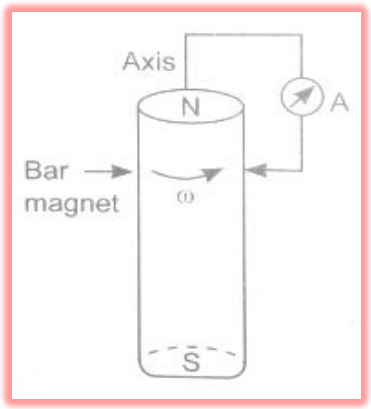
(*a*) 1 V (*b*) 10 V (*c*) 5 V (*d*) 2 V

11. There are two coils A and B as shown in figure. A current start 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 counter clockwise direction in A.

12. 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 flow in the ammeter A.
(b) no current flows through ammeter A.
(c) an alternating sinusoidal current flow through the ammeter A with a time period $T = 2\pi/\omega$.
(d) a time varying non-sinusoidal current flows through the ammeter A.

13. In a coil of self-induction 5H, 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

14. An emf is produced in a coil, which is not connected to an external voltage source. This is not due to
(a) the coil being in a time varying magnetic field.
(b) the coil moving in a time varying magnetic field.
(c) the coil moving in a constant magnetic field.
(d) the coil stationary in external spatially varying magnetic field, which does not change with time.

15. 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 increases.
(b) l decreases and A increases.
(c) l increases and A decreases.
(d) both l and A increases.

FILL IN THE BLANKS;

SHORT ANSWER TYPE QUESTIONS;

1. One weber is the amount of.....over an area of.....held normal to a uniform..... .
2. An e.m.f. is induced in a coil when.....linked with the coil.....with..... .
3. The magnitude of.....in a circuit is.....to the.....linked with the circuit.
4. According to.....law, the polarity of.....is such that it.....responsible for..... .
5. Lenz's law is.....with the law..... .
6. Eddy currents are the currents.....when.....changes.
7. If ω is angular frequency of a.c., then the reactance offered by inductance L and capacitance C are X_L = ... and X_C = ...
8. Self induction of a coil is said to be.....when a current change.....through the coil induces.....in the coil.
9. Self inductance of a solenoid varies.....as the.....of total number of turns in the solenoid.
10. Coefficient of mutual inductance of two coils is numerically.....linked with one coil when.....flows through..... .

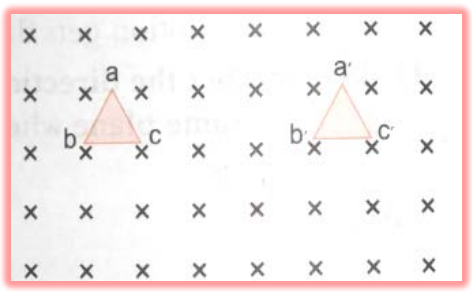
1. state the law that gives the polarity of induced emf.

Ans: - Lenz's law

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

Ans: - flux density, length of the coil, velocity with which the coil is moved and the angle between the velocity and flux.

3. 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.



Ans: - change in magnetic flux through wire loop is zero, hence no current.

5. 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.

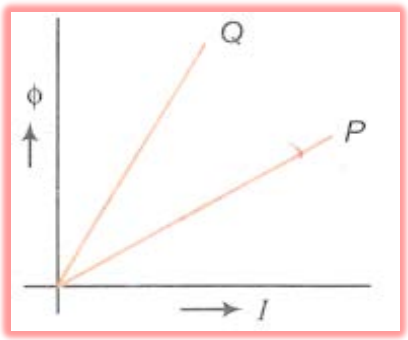
Ans: - L = $\frac{-e}{dI/dt}$ = 20 H.

6. (i) How are Eddy Currents reduced in a metallic core?
(ii) Give two uses of eddy current.

Ans: - see eddy current in notebook.

7.(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) following through two inductors P and Q. Which of the two inductors has smaller value of self-inductance.



Ans: -(i) L = 20mH.

(ii) L = slope, p is having smaller resistance,

LONG ANSWER TYPE QUESTION;

1. 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 x 10^{-5} T)

Hints; - Initial magnetic flux through the coil,

$\varphi_i = B_H A\cos\theta = 3.0\times10^{-5}\times(\pi\times10^{-2})\times\cos0^\circ$

$= 3\pi\times10^{-7}$ Wb

Final magnetic flux after the rotation

$\varphi_f = 3.0\times10^{-5}\times(\pi\times10^{-2})\times\cos180^\circ$

$= -3\pi\times10^{-7}$ Wb.

Induced emf,

$\epsilon = -N\frac{d\phi}{dt} = -\frac{N(\phi f-\phi i)}{t}$.

$= -\frac{500(-3\pi\times10-7-3\pi\times10-7)}{0.25}$

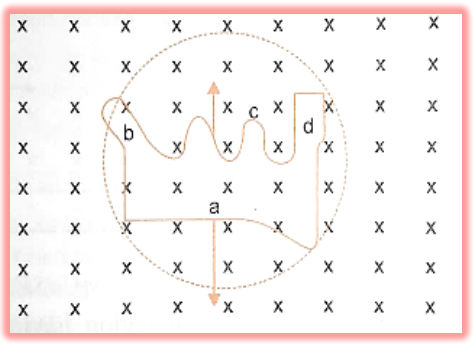
$= \frac{500\times(6\pi\times10-7)}{0.25} = 3.8\times10^{-3}$ V

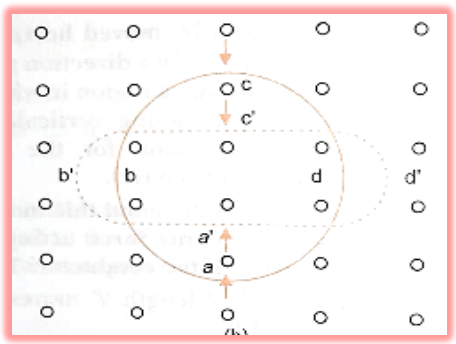
$I = \epsilon/R = 3.8\times10^{-3}\text{V}/2\Omega = 1.9\times10^{-3}$ A.

2.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.





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.

3. (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.

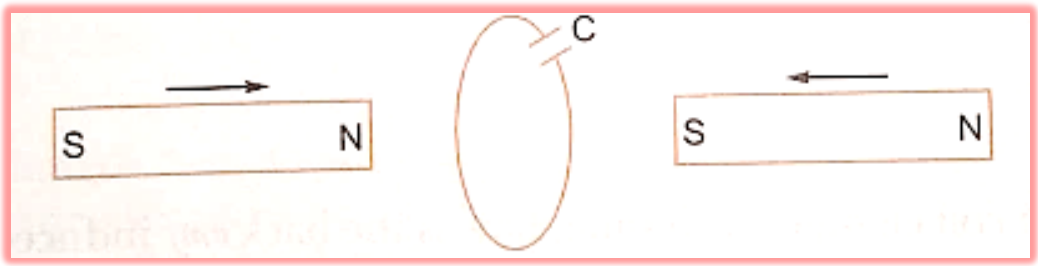
(ii)In a given coil of self-inductance of 5.0 mH, current changes from 4 A to 1 A in 30 ms. Calculate the emf induced in the coil.

Ans: -(i) prefer note book.

(ii) e = 500 V.

4. (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.



Ans: - (i) prefer note book.

(ii) apply Lenz's law.

5. A jet plane is travelling west at 450 ms^{-1}. If the horizontal component of earth's magnetic field at that place is 4 x 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.

Hints: - apply e = Blvsinθ.

6. (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.

Hints: - prefer note book.

7.Describe briefly with the help of a labelled diagram the basic elements of an ac generator.
State its underlying principle.
Show diagrammatically how an alternating emf is generated by a loop of wire rotating in a magnetic field.
Write the expression for the instantaneous value of the emf induced in the rotating loop.

Hints: - prefer note book.

8. What are Eddy currents?
How are they produced?
In what sense eddy currents are considered undesirable in a transformer? How can they be minimized?
Give two applications of eddy currents.

Hints: - prefer note book.

ANSWERS OF MCQs; **-1. (a),2. (b), 3. (d), 4. (c), 5. (b), 6. (d), 7. (c), 8. (d), 9. (b), 10. (a), 11. (d), 12. (b), 13. (b), 14. (a, b, c), 15. (b),**

ANSWERS OF fill in the blanks: -

1.magnetic flux; 1 m^2; magnetic field of 1 Wb/m^2.

2.amount of magnetic flux; change; time.

3.e.m.f. induced; equal; rate of change in magnetic flux; its production.

4.Lenz's; emf induced; opposes the change in magnetic flux; its production.

5.in accordance; of conservation of energy.

6.induced in the body of a conductor; amount of magnetic flux linked with the conductor.

7.$X_L = \omega L$; $X_C = 1/\omega C$

8.one henry; at the rate of 1A/s; an emf of 1 volt.

9.directly; square.

10.equal to amount of magnetic flux; unit current; the other coil.

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