Electromagnetic Induction

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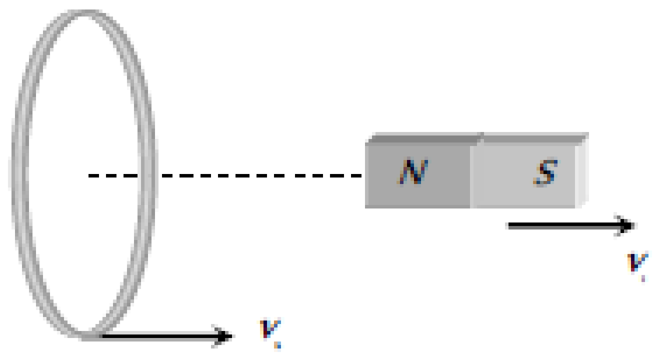
1. A circular coil and a bar magnet placed near by are made to move in the same direction. The coil covers a distance of 1 m in 0.5 sec and the magnet a distance of 2 m in 1 sec. The induced emf produced in the coil

(a) Zero (b) 1 V (c) 0.5 V

(d) Cannot be determined from the given information



Speed of bar magnet

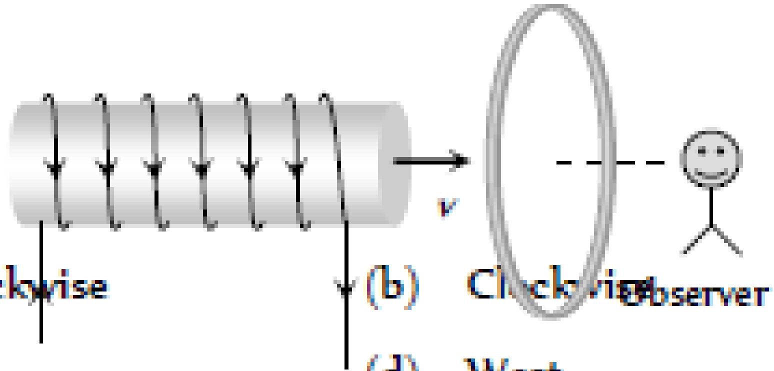
$V = \frac{s}{t} = \frac{2}{1} = 2$ m/s

Speed of coil

$v = \frac{1}{0.5} = 2$ m/s

Relative speed between coil and magnet is zero, so there is no induced emf in the coil.

A current carrying solenoid is approaching a conducting loop as shown in the figure. The direction of induced current as observed by an observer on the other side of the loop will be



(a) Anticlockwise (b) Clockwise

(c) East (d) West

as

A piece of metal and a piece of non-metal are dropped
from the same height near the surface of the earth. The non-metallic piece will reach the ground first because there will be no induced current in it.

A transformer is used to:
(a) Change the alternating potential
(b) Change the alternating current
(c) To prevent the power loss in alternating current flow
(d) To increase the power of current source

Transformers are used to change AC voltage levels, such transformers being termed step-up or step-down type to increase or decrease voltage level, respectively.

The efficiency of transformer is very high because:

(a) There is no moving part in a transformer

(b) It produces very high voltage

(c) It produces very low voltage

(d) None of the above

There is no moving part so no mechanical loss in transformer.

Which of the following is constructed on the principle of electromagnetic induction:

(a) Galvanometer (b) Electric motor

(c) Generator (d) Voltmeter

An electric generator is a device which works on the principle of electromagnetic induction.

Choke coil works on the principle of:
(a) Transient current (b) Self induction
(c) Mutual induction (d) Wattless current

The choke coil works because it acts as an inductor. When the current passing through changes, as AC currents do, it typically creates a magnetic field in the coil that works against that current. This property, known as inductance.
Hence option B is correct.

When the speed of a DC motor increases the armature current.

(a) Increases

(b) Decreases

(c) Does not change

(d) Increases and decreases continuously

Armature current, $i = \frac{V - E}{R}$ or $E = V - iR$

Where V is terminal voltage and E is back emf developed due to induction.

Back emf is directly proportional so speed

$$E \propto speed$$

As speed increases E increases

As E increase, it means i decrease.

Armature current decreases as speed increases

Work of electric motor is:
(a) To convert ac into dc
(b) To convert dc into ac
(c) Both (a) and (b)
(d) To convert ac into mechanical work

Correct option is D. To convert ac into mechanical work
Electrical motor convert electrical energy into mechanical energy.
Option D.

What is increased in step-down transformer:

(a) Voltage (b) Current

(c) Power (d) Current density

The step-down transformer transforms high voltage to low voltage, but the power provided remains constant, hence the current increases according to the $P = V \times I$ relationship.

In transformer, core is made of soft iron to reduce:

(a) Hysteresis losses

(b) Eddy current losses

(c) Force opposing electric current

(d) None of the above

Transformer cores are made up of soft iron because soft iron has less losses due to hysteresis.

The transformation ratio in the step-up transformer is

(a) 1

(b) Greater than one

(c) Less than one

(d) The ratio greater or less than one depends on the other factors

$\frac{N_s}{N_p}$ = transformer Ratio

$N_s > N_p$

$\frac{N_s}{N_p} > 1$

Voltage in the secondary coil of a transformer does not depend upon.

(a) Voltage in the primary coil

(b) Ratio of number of turns in the two coils

(c) Frequency of the source

(d) Both (a) and (b)

The voltage in primary and secondary coil is related as:$\Rightarrow \frac{V_s}{V_p} = \frac{N_s}{N_p}$

Clearly, voltage in secondary coil depends on voltage in primary coil and number of turns in primary and secondary coil. It is independent of frequency of the source.

Hence, option A is correct.

Quantity that remains unchanged in a transformer is:

(a) Voltage (b) Current

(c) Frequency (d) None of the above

Frequency remains unchanged in a transformer.

Frequency at input = Frequency at output.

In a transformer, number of turns in the primary are 140 and that in the secondary are 280. If current in primary is 4A then that in the secondary is:

(a) 4 A (b) 2 A

(c) 6 A (d) 10 A

The correct option is **B** 2 A

Given: Number of turns in primary coil (N_p) = 140

Number of turns in secondary coil (N_s) = 280

Current in primary coil (i_p) = 4 A

Let, current in secondary coil = (i_s)

Voltage in primary coil = (V_p)

Voltage in secondary coil = (V_s)

We know that, in a transformer

$$\frac{N_p}{N_s} = \frac{V_p}{V_s} = \frac{i_s}{i_p}$$

$$\therefore \frac{N_p}{N_s} = \frac{i_s}{i_p} \Rightarrow i_s = 4 \times \frac{140}{280} = 2 \text{ A}$$

Two identical circular loops of metal wire are lying on a table without touching each other. Loop-A carries a current which increases with time. In response, the loop-B:

(a) Remains stationary

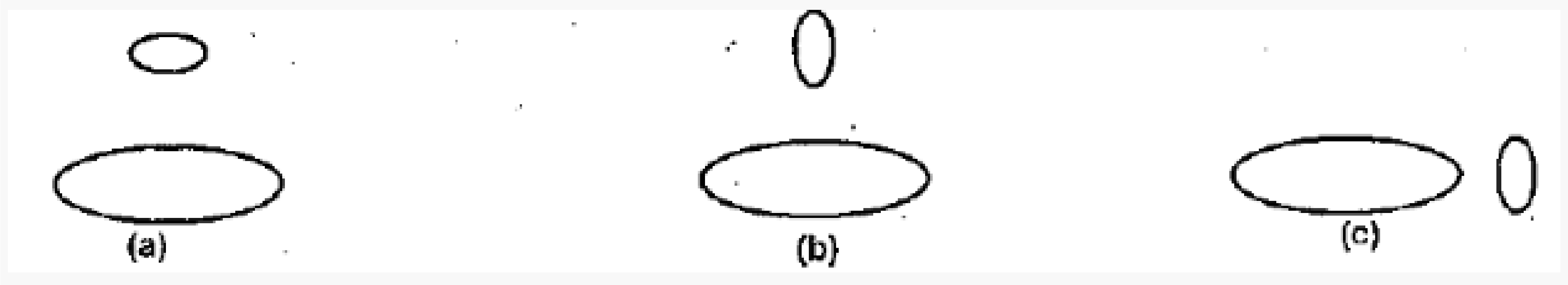
(b) Is attracted by the loop-A

(c) Is repelled by the loop-A

(d) Rotates about its CM, with CM fixed

If the current increase with time in loop. A, then magnetic flux in B will increase. According to Lenz's law, loop-B is repelled by loop-A.

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

Mutual induction ∝ flux linkage between coils

1) flux linkage in coil (a) is maximum because both coils have same axis.

2) Flux linkage between coils is 0 because thus axis are perpendicular to each other.

3) Flux linkage between coils is 0 because their axis are perpendicular to each other .

So, mutual inductance between coils is maximum in case (a).

Two identical coaxial circular loops carry current i each circulating in the clockwise direction. If the loops are approaching each other, Then:

(a) Current in each loop increases

(b) Current in each loop remains the same

(c) Current in each loop decreases

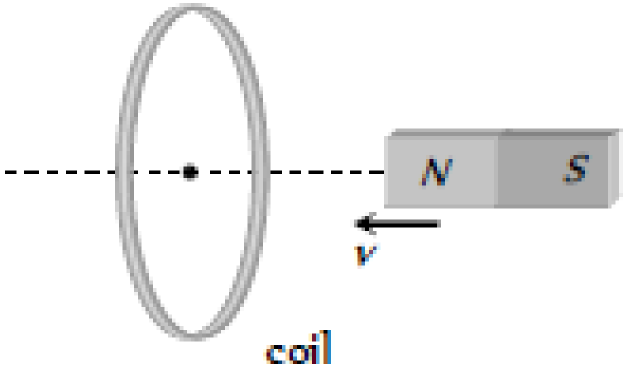
(d) Current in one-loop increases and in the other it decreases

As the two identical coaxial circular loops carry a current i each circulating in the same direction, their flux add each other. When the two are brought closer, the total flux linkage increase.

By Lenz's a law a current will be induced in both the loops such that it opposes this change in flux. As the flux increases, the current in each loop will decreases so as to decrease the increasing flux.

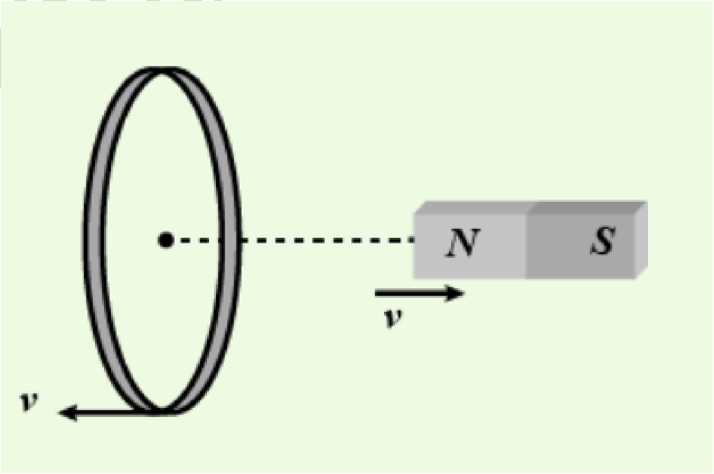
In the following figure, the magnet is moved towards the coil with a speed v and induced emf is e. If magnet and coil recede away from one another each moving with speed v, the induced emf in the coil will be

(a) e (b) 2e (c) e/2 (d) 4e



$$\frac{\Delta\phi}{\Delta t} = \varepsilon$$

$$\left(\frac{\Delta\phi}{\Delta t}\right)_{relative\ veloity\ 2v} = 2\left(\frac{\Delta\phi}{\Delta t}\right) = 2\varepsilon$$



Lenz's law gives:

(a) The magnitude of the induced e.m.f.

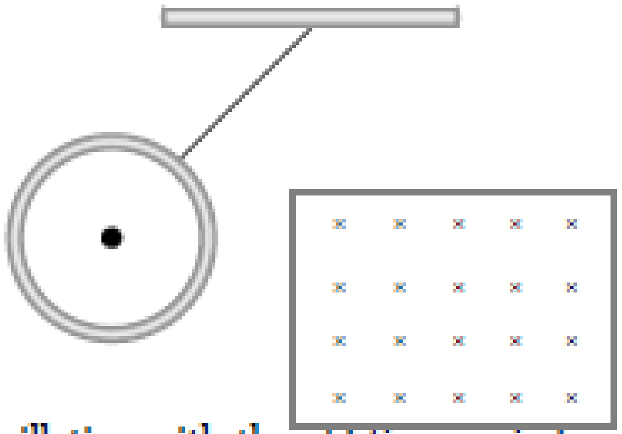
(b) The direction of the induced current

(c) Both the magnitude and direction of the induced current

(d) The magnitude of the induced current

Induced Current

A metallic ring connected to a rod oscillates freely like a pendulum. If now a magnetic field is applied in horizontal direction so that the pendulum now swings through the field, the pendulum will



(a) Keep oscillating with the old time period

(b) Keep oscillating with a smaller time period

(c) Keep oscillating with a larger time period

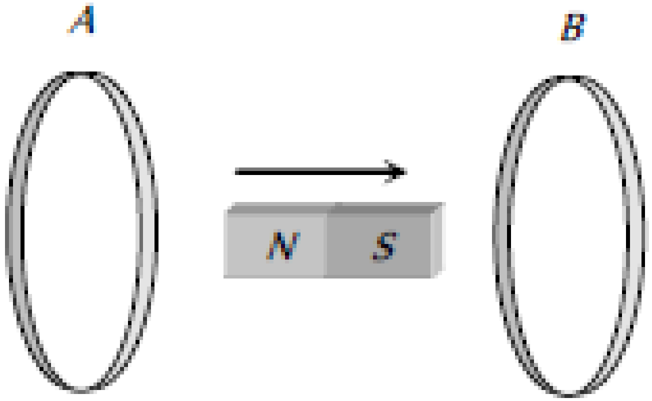
(d) Come to rest very soon

Emf Induces in ring and it will opposes the motion. Hence due to the resistance of the ring all energy dissipates.

Faraday's laws are consequence of conservation of:
(a) Energy
(b) Energy and magnetic field
(c) Charge
(d) Magnetic field

Faraday’s laws involve conversion of mechanical energy into electrical energy. This is in accordance with the law of conservation of energy.

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

Option d is the right answer.

A coil and a bulb are connected in series with a dc source, a soft iron core is then inserted in the coil. Then

(a) Intensity of the bulb remains the same

(b) Intensity of the bulb decreases

(c) Intensity of the bulb increases

(d) The bulb ceases to glow

There will be self induction effect when soft iron core is inserted. So Option b is correct.

Mutual inductance of two coils can be increased by:
(a) Decreasing the number of turns in the coils
(b) Increasing the number of turns in the coils
(c) Winding the coils on wooden core
(d) None of the above

To increase flux linkage we have to increase the number of turns. So option b is the right answer.

When the number of turns and the length of the solenoid are doubled keeping the area of cross-section same, the inductance:

(a) Remains the same (b) Is halved

(c) Is doubled (d) Becomes four times

L = $\mu_0 \frac{N^2}{L}$ A so c is the right answer.

The self inductance of a straight conductor is:

(a) Zero (b) Very large

(c) Infinity (d) Very small

$L \propto n$ for straight conductor $n = 0$ so $L = 0$