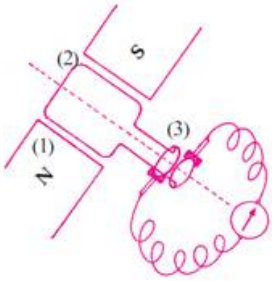
3. Electromagnetic induction

Let us Assess

1. Question



(a) Write down the name of parts numbered in the diagram.

(b) State the working principle of this device.

Answer

(a) 1) Magnetic north pole of field magnet.

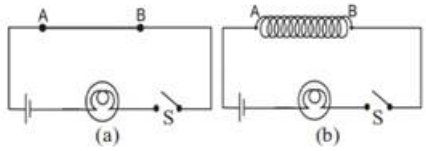
2)Armature

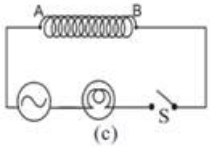
3)Slip Rings

(b) It converts mechanical energy to electrical energy, and operates on the principle of electromagnetic induction, i.e. changing magnetic field induces an electric field.

2. Question

Copper wires of the same length and thickness are connected to points A and B in all the three circuits. In circuit (a) copper wire is not coiled. In circuits (b) and (c), the copper wire is coiled. Observe the circuits and answer the following questions.





(a) When circuit (a) is switched on, what do you observe?

(b) When circuit (b) is switched on, what change do you observe in the intensity of light? Justify your answer.

(c) When circuit (c) is switched on, what change do you observe in the intensity of light? Justify your answer.

Answer

(a)The bulb in (a) glows brightly.

(b) The bulb in (b) glows brightly. There is no change in intensity as the power supply is DC. So, inductance has no role to play.

(c) The intensity of light reduces. The coiled wire behaves as an inductor and a back emf is generated. This reduces the effective voltage of the circuit.

3 A. Question

The current in the secondary coil of a transformer is 1A and that in the primary is 0.5 A.

What type of a transformer is this?

Answer

The equation used to work out the power for the primary coil and the secondary coil of a transformer is:

$P = V \times I$

where:

P is the power in watts, W

V is the potential difference in volts, V

I is the current in amperes (amps), A

Because the current is larger in the secondary coil of the transformer is larger as compared to that in primary coil.

This means the voltage in the secondary coil must be smaller in order to maintain constant power. Hence, the transformer which results in low voltage is called a step-down transformer.

3 B. Question

The current in the secondary coil of a transformer is 1A and that in the primary is 0.5 A.

If 200 V is available in the secondary coil of this transformer, what is the voltage in the primary?

Answer

Transformer ratio $= \frac{\text{Voltage in primary coil}}{\text{Voltage in secondary coil}} = \frac{\text{Current in secondary coil}}{\text{Current in primary coil}}$

$= \left(\frac{1}{0.5}\right) = 2$

Now,

$$\frac{\text{Voltage in primary coil}}{\text{Voltage in secondary coil}} = \frac{?\ V}{200} = 2$$

⇒ Voltage is primary coil, V = 400 V.

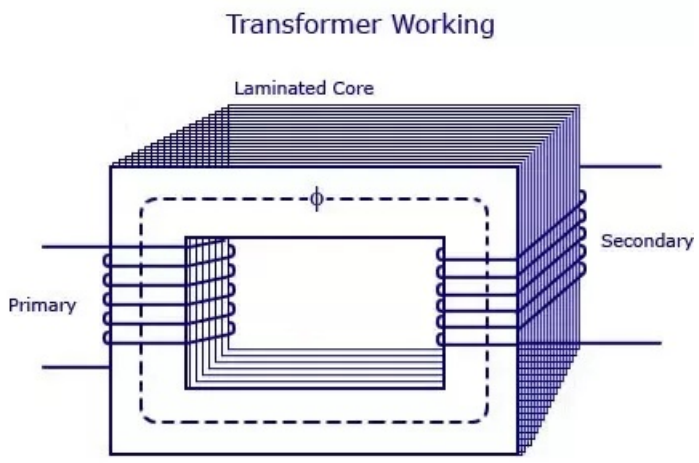
3 C. Question

The current in the secondary coil of a transformer is 1A and that in the primary is 0.5 A.

Explain the working principle of a transformer.

Answer

The diagram is shown below:



i. In a transformer, the AC voltage applied to the primary coil produces a varying magnetic field.

ii. By electromagnetic induction, an emf is induced in the primary. The change of flux in the primary coil is linked with the secondary.

iii. Hence an emf is induced in the secondary coil as well.

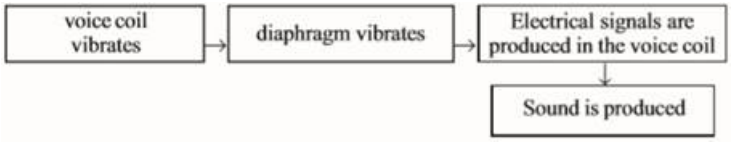
iv. Thus the emf induced in each turn of the primary coil and secondary coil will be same.

v. In this way, the voltage across the primary coil is stepped up or stepped down depending on the turns ratio of the primary and secondary coils.

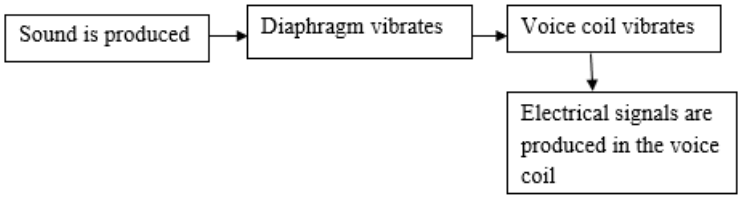
4. Question

In connection with the working of a microphone, a few statements are given in boxes.

Arrange them in the proper order.

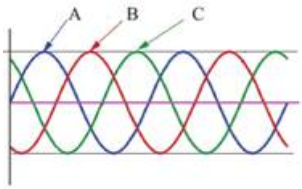


Answer



5. Question

Given below is a graph of the output from the secondary coil of a transformer. Observe the graph and answer the following questions.



(a) The electricity produced from which type of generator does the given graph represent?

(b) The maximum and minimum voltages in A, B, C are the same Give the reason.

Answer

(a) Electricity has been produced by a three-phase generator.

(b) The maximum and minimum voltages in A, B, C are the same because there are 3 identical windings that are placed 120 electrical degrees apart from each other. The loads are balanced.

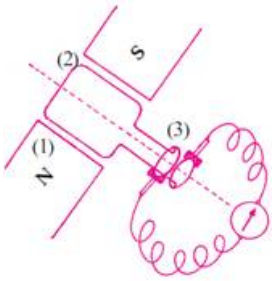
6. Question

Thick insulated copper wires are used in the primary coil of a step up transformer and in the secondary of a step-down transformer. What is the necessity of doing this? Why is it so?

Answer

The thicker the wire, the greater is its cross-section(A), the lesser is its resistance(because of $\mathrm{R} = \frac{\rho l}{A}$). So, the power dissipated is reduced. This is important because one of the main purposes of a transformer is power transfer at required voltages.

1. Question



(a) Write down the name of parts numbered in the diagram.

(b) State the working principle of this device.

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2)Armature

3)Slip Rings

(b) It converts mechanical energy to electrical energy, and operates on the principle of electromagnetic induction, i.e. changing magnetic field induces an electric field.

Extended Activities

1. Question

Make coils of a different number of turns using insulated copper wire. Use magnets of different strengths to produce induced emf. Present this activity in the science club.

Answer

The greater the number of coils and greater the strength of the magnets used, greater will be the magnitude of induced emf.

2. Question

Michael Faraday, the father of electricity, did not even get elementary education. Are you not inspired by the achievements of Faraday in the field of science?

Conduct a seminar on “Contributions of Faraday and the hard work behind it.”

Answer

Talk about the early life of Michael Faraday, how he worked as a bookbinder’s apprentice and how he read and learned so much. Then proceed to his encounter with Humphrey Davy and how he was influenced by his lectures, Faraday’s beginning in the world of physics as Davy’s apprentice. Finally describe his Christmas lectures for the free public, and how he revolutionized the world of science with his limited resources.

3. Question

Energy is invaluable, especially electrical energy. Society must be convinced of the necessity of reducing the consumption of electrical energy. Prepare and propagate posters for this purpose.

Answer

4. Question

Collect information regarding microphones which work under different physical principles.

Answer

Several different types of microphone are in use, which employ different methods to convert the air pressure variations of a sound wave to an electrical signal. The most common are the dynamic microphone, which uses a coil of wire suspended in a magnetic field; the condenser microphone, which uses the vibrating diaphragm as a capacitor plate, and the piezoelectric microphone, which uses a crystal of piezoelectric material. Some even operate on the principles of fiber optics.

5. Question

Compare the induced current obtained when the armature coil rotates once in between the poles of a magnet, and the induced current obtained when the experiment using a magnet and coil was performed.

Answer

If the magnet strength and the no. of coils are equivalent in both cases, then the induced currents will be equal. This is because electromagnetic induction occurs due to relative motion between the magnet and the coil.