Unit 18 · Electromagnetic Induction

WORKSHEET

Full marks 34

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 34

1 Key words [4]

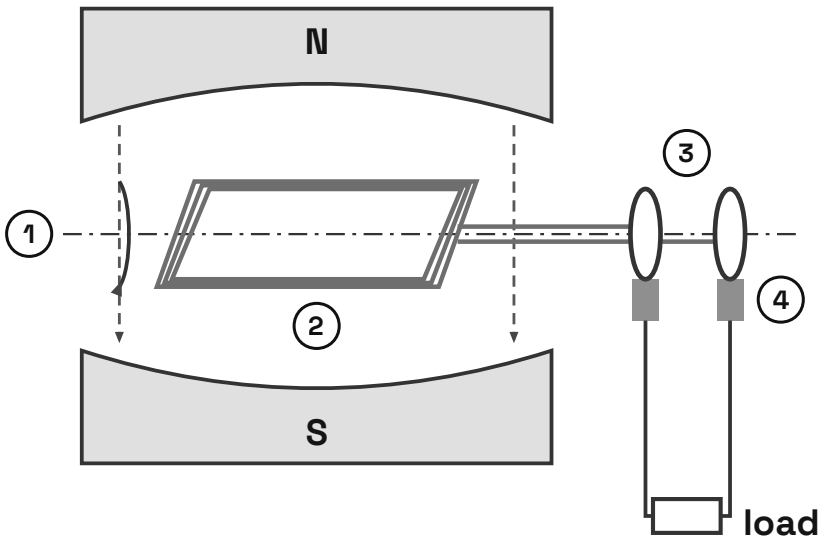
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

coercivity	**eddy currents**	**electromagnetic induction**	**henrys**	**laminated**	**Lenz's law**
motional	**mutual induction**	**Seebeck effect**	**self-induction**		

An e.m.f. set up in a circuit by a change of the magnetic flux linked with it is called _____. By _____, the induced current always opposes the change that produces it. The e.m.f. Blv across a rod moving through a field is a _____ e.m.f. Currents that swirl inside a solid piece of metal in a changing field are _____, and a transformer's core is _____ to reduce them. The e.m.f. a coil sets up in itself when its own current changes is due to _____, and the coefficient L is measured in _____. An e.m.f. set up in one coil by a change of current in a nearby coil is due to _____.

2 Label the diagram [2]

The diagram shows a simple a.c. generator. Write the label that belongs in place of 1 to 4. Each carries 0.5 mark.



1. _____ **2.** _____

3. _____ **4.** _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. A coil of 150 turns, each of area 40 cm^2, lies at right angles to a field that rises steadily from 0.05 T to 0.35 T in 0.05 s. The e.m.f. induced in it is: [1]

a. 0.024 V **b.** 2.4 V
c. 3.6 V **d.** 4.2 V

ii. A rod 0.8 m long moves at 3 m/s at right angles to a field of 0.25 T. The e.m.f. between its ends is: [1]

a. 0.6 V **b.** 0.2 V
c. 6 V **d.** 9.6 V

iii. A solenoid is rewound with half as many turns, keeping its length and area. Its self-inductance becomes: [1]

a. half as large **b.** a quarter as large
c. twice as large **d.** unchanged

iv. A coil of self-inductance 40 mH carries 3 A. The energy stored in its magnetic field is: [1]

a. 0.06 J **b.** 0.12 J
c. 0.18 J **d.** 0.36 J

v. A galvanometer's coil is wound on an aluminium frame so that: [1]

a. the coil is lighter
b. eddy currents in the frame stop the pointer swinging to and fro
c. the field in the gap is radial
d. the coil's resistance is smaller

4 Short answers [6]

Write short answers to the following questions.

a. Explain how Lenz's law follows from the conservation of energy. [2]

b. Why is electric power sent over long lines at a high voltage? [2]

c. How is a simple a.c. generator changed to give d.c.? Why does this work? [2]

5 Long answer [4]

Write a long answer to the following question.

A coil of N turns, each of area A, turns with a steady angular velocity ω in a uniform magnetic field B, about an axis at right angles to the field. Show that the e.m.f. induced in it is $\varepsilon = NBA\omega \sin \omega t$. When is it greatest, and what is its greatest value?

6 Numerical problems [10]

Solve the following problems. Show your working. Take $\mu_0 = 4\pi \times 10^{-7}$ H/m.

a. A generator's coil has 100 turns, each 8 cm × 5 cm, and turns at 50 revolutions per second in a field of 0.4 T. Find i. its greatest e.m.f., ii. its e.m.f. at the moment its plane makes 30° with the field. [3]

Answer:

b. A solenoid 50 cm long has 1000 turns, each of area 6.0 cm^2. Find i. its self-inductance, ii. the e.m.f. induced in it when a current of 2.0 A in it falls steadily to zero in 5.0 ms, and iii. the energy stored in it while it carries 2.0 A. [4]

Answer:

c. A phone charger's transformer steps 230 V down to 12 V. Its primary has 1150 turns. Taking it as ideal, find the number of turns on the secondary, and the primary current when it gives 6.0 W. **[3]**

Answer: _____

7 Think **[3]**

A metal rod rests on two smooth horizontal rails joined at one end by a resistor, in a vertical magnetic field. Saurav gives the rod a push and lets go. What happens to its speed? Where does its kinetic energy go?

8 Activity: Demonstrating Lenz's law (Activity 18.3) (not marked)

Join a coil to a galvanometer. Move a bar magnet as in the table, and note which way the needle moves.

The magnet	Which way the needle moves
N pole brought towards the coil	
N pole pulled away	
S pole brought towards the coil	
S pole pulled away	

Which pole did the coil's near end become each time?