INDUCED EMF

1 OBJECTIVE

To study the emf induced in a circular coil as a function of the amplitude and time period of the magnet.

2 REQUIREMENTS

Circular coil, resistor, diode, capacitor, voltmeter, milliammeter, key

3 INTRODUCTION

Whenever the magnetic flux ϕ around a conductor changes, an emf is induced inside the conductor. This is known as *Faraday's first law of electromagnetic induction.*

This experiment works on the principle of electromagnetic induction.

$$\varepsilon = -\frac{d\theta}{dt}$$

4 PROCEDURE

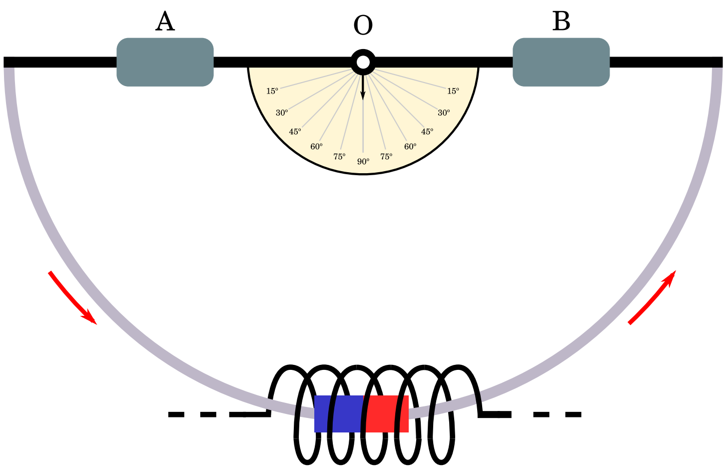

Figure 1: Experimental setup

4.1 Potential difference versus amplitude

1. The apparatus is set up as shown in figure 1. The magnet is placed on the circular arc and is allowed to oscillate through the coil by releasing it through different angles.

2. Connect the coil in the above apparatus as shown in the circuit diagram in figure 2.

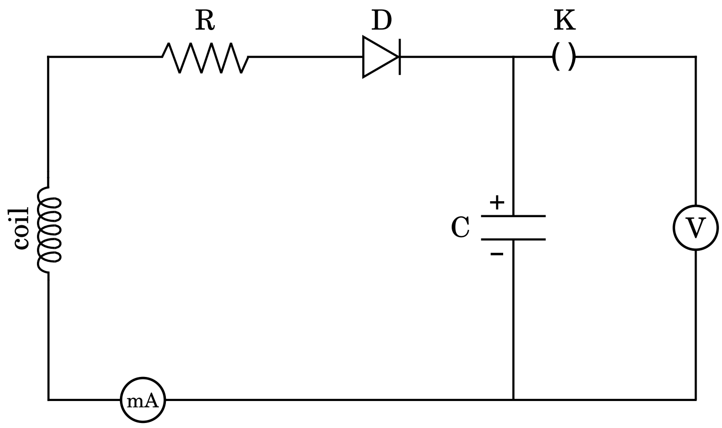

Figure 2: Circuit diagram

3. Short the terminals of the capacitor in order to discharge it completely.
4. Keep the masses at equal distances from the pivot.
5. Set the semicircular arc into oscillations by releasing it from a known amplitude of, say, 15°.
6. When the induced emf charges the capacitor to its maximum, the galvanometer deflection becomes zero and steady. Note down the potential difference across the capacitor at this stage. This gives a measure of the induced emf.
7. The terminals of the capacitor is again shorted, bringing its potential difference to zero.
8. Repeat this process for different amplitudes of oscillations (say 20°, 25°, 30°, 35°, etc.)
9. Plot a graph of potential difference (ε) against amplitude of oscillation (θ).

4.2 Emf versus time period

1. Measure the separation of the masses OA and OB from the pivot.
2. Oscillate the arc by a constant amplitude of, say, 20°.
3. Measure the time taken for 10 oscillations and hence find the time period T of the oscillating arc.
4. Again, the potential difference is measured when the galvanometer attains steady state.
5. Now change the length of separation OA and OB by equal amounts so that the balance is maintained.
6. Repeat the experiment for different lengths of separations, keeping the amplitude constant, i.e., 20°.
7. Plot a curve of emf (ε) versus time period (T).

5 OBSERVATIONS

5.1 *Potential difference versus amplitude*

No.	Amplitude of oscillations $\theta(^\circ)$	Potential difference across capacitor (V)			Mean ε (V)
		ε_1	ε_2	ε_3	
1	20				
2	25				
3	30				
4	35				
5	40				

5.2 *Emf versus time period*

Amplitude of oscillations = ________
No. of oscillations = ________

Distance (cm)		Time taken for 5 oscillations (s)		Mean t (s)	Time period T (s)	Potential difference across capacitor (V)		Mean ε (V)	$\frac{1}{T}$ (s^{-1})
OA	OB	t_1	t_2			ε_1	ε_2		

6 CALCULATIONS

From the table in section 5.1, plot a curve of potential difference against the amplitude of oscillations, to get a straight line (figure 3).

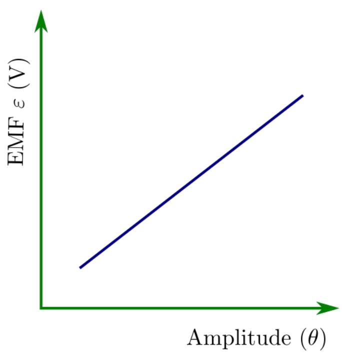

Figure 3

From the table in 5.2, plot a curve of the EMF versus the time period of oscillations (T) to get a straight line with a negative slope:

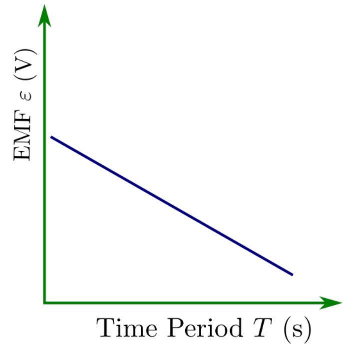

Figure 4

7 RESULT

The emf induced was studied as a function of the amplitude and time period of oscillations of the magnet.