12 Electromagnetic induction – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English	**Write it 3 times** (English)		
electromagnetic induction			
magnetic flux			
Faraday's law			
Lenz's law			

Recall

In Part A you saw that a current makes a magnetic field. The reverse is just as important:

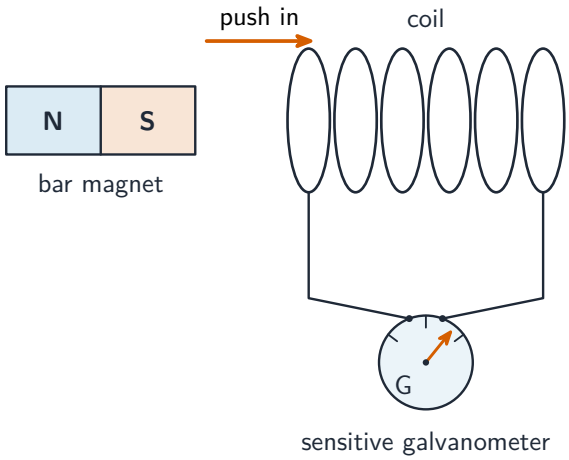
- Move a magnet near a coil of wire and a current appears – with no battery at all.
- This is how every generator and power station makes electricity.

Each idea has a worked example before the Practice.

New ideas

■ 1 Electromagnetic induction

A **changing** magnetic field through a coil drives a current – **electromagnetic induction** . Move a magnet into a coil, or out of it, and a current flows while the magnet is moving.



2 Magnetic flux

The **magnetic flux** $\Phi = BA$ measures how much field passes through a loop of area A. The flux changes if the field strength, the area, or the loop's angle changes.

3 Faraday's law

Faraday's law says the induced voltage equals how fast the flux changes:

$$\varepsilon = \frac{\Delta\Phi}{\Delta t}.$$

A coil of N turns gives N times as much.

Worked example. If the flux through a single loop drops from 0.020 Wb to 0.008 Wb in 0.030 s: $\varepsilon = \dfrac{\Delta\Phi}{\Delta t} = \dfrac{0.020 - 0.008}{0.030} = 0.40$ V.

4 Lenz's law

Lenz's law says the induced current flows in the direction that **opposes** the change that caused it. This is really energy conservation – you must do work to push the magnet, and that work becomes the electrical energy.

Watch out: it is the **change** in flux that induces a current, not the flux itself. A magnet sitting still inside a coil induces **nothing** – the magnet has to be moving.

Practice

Try these in order. The methods are all above.

2.1 State what must happen for a coil to have a current induced in it. [1]

2.2 The flux through a single loop rises from 0.010 Wb to 0.030 Wb in 0.040 s. Find the induced voltage. [3]

2.3 A coil has 50 turns. If one turn would give 0.40 V, what voltage does the whole coil give? [2]

2.4 State what Lenz's law tells you about the direction of an induced current. [1]

2.5 A student holds a magnet still inside a coil and expects a current. Explain why none flows. [2]