# 6.2 Induction and transformers

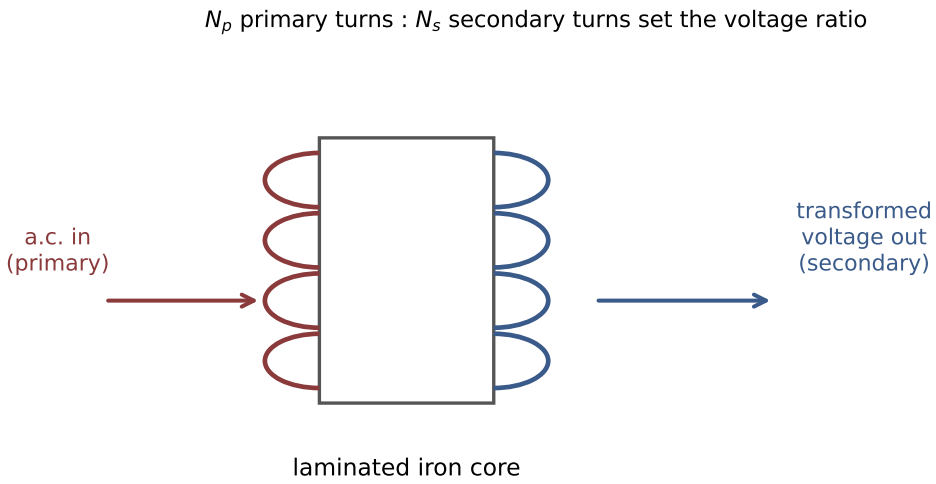
Name: _____ Class: _____ Date: _____ **Total: 22 marks**

## Objective

Cover induction and transformers (6.15–6.20P): induced voltage and its factors, generators, (P) transformer structure and the turns-ratio and power equations, and transmission at high voltage. Original IGCSE-level practice.

## 1 Key knowledge and worked examples

### ■ Induction to transmission




$$\frac{V_p}{V_s} = \frac{N_p}{N_s} \qquad V_p I_p = V_s I_s$$

**Worked check.** Step-up from 25 kV to 400 kV for transmission at 500 MW: $I = P/V = 500 \times 10^6 / 400 \times 10^3 = 1250$ A – without the step-up, at 25 kV, the current would be 20 000 A and the cable heating ($I^2R$) enormous.

## 2 Practice

**2.1** State two ways to induce a voltage in a coil. [2]

**2.2** Name two factors that increase the size of an induced voltage. [2]

**2.3** A magnet is pushed into a coil. State what happens to the induced voltage if it is pushed in twice as fast. [1]

**2.4** (P) A transformer has 500 primary and 2500 secondary turns; primary 12 V. Calculate the secondary voltage. [2]

**2.5** (P) State the power relationship for a 100 % efficient transformer. [1]

## 3 Exam-style questions

**3.1** Describe how a generator produces electricity, naming two factors that raise the output voltage. [3]

**3.2** (P) A power station generates at 25 kV. Explain, with a calculation of current at 400 kV for a 200 MW flow, why transmission uses step-up transformers. [4]

**3.3** (P) A transformer steps 230 V down to 11.5 V; the secondary supplies 4.0 A. Calculate the primary current and the turns ratio. [4]

**3.4** A coil of 200 turns sits in a field that grows steadily from zero to full strength in 0.5 s, inducing 6 V. State the induced voltage if the same change happens in 0.1 s, and explain why. [3]

## Solutions

**2.1** Move the coil (or magnet) so the coil cuts field lines; change the magnetic field through a stationary coil.

**2.2** Faster movement/rotation; stronger field; more turns (any two).

**2.3** It doubles – the rate of cutting field lines doubles.

**2.4** $V_s = 12 \times 2500/500 = 60$ V.

**2.5** Input power = output power: $V_p I_p = V_s I_s$.

**3.1** A coil (or magnet) rotates in a magnetic field; the coil continuously cuts field lines, inducing an alternating voltage; output raised by rotating faster and using a stronger field (or more turns).

**3.2** Step-up to 400 kV so the current is $I = P/V = 200 \times 10^6/400 \times 10^3 = 500$ A; cable heat loss is $I^2R$, so lower current means far less energy lost; at 25 kV the current would be 8000 A – 16× larger and 256× the heating.

**3.3** $V_p/V_s = 230/11.5 = 20$, so turns ratio $N_p : N_s = 20 : 1$; power out $= 11.5 \times 4.0 = 46$ W; $I_p = 46/230 = 0.20$ A.

**3.4** Five times faster change: $V = 6 \times 0.5/0.1 = 30$ V; the induced voltage is proportional to the rate of change of the field through the coil.