

6.1 Generators transformers and the home (P)

Name: _____ Class: _____ Date: _____

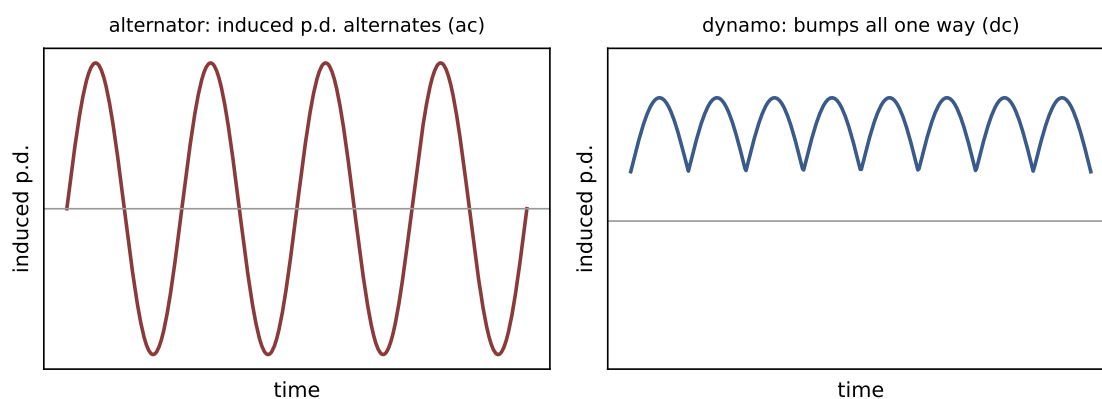
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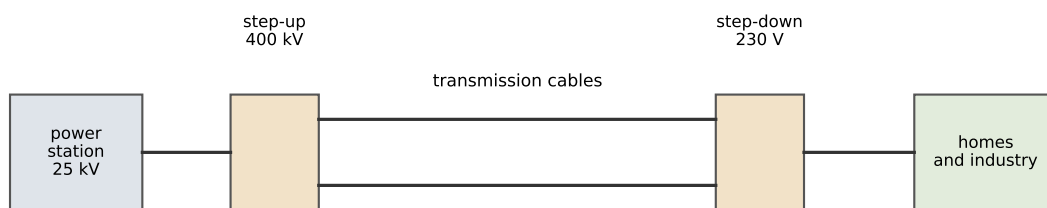
Objective

Cover generating, transmitting and transforming electricity (3.6.1–3.6.3): the generator effect and its factors, alternator and dynamo traces, the grid with step-up/step-down transformers, the turns-ratio and power equations, switch-mode transformers, and home a.c./d.c. with fuses and earthing. All (P) Paper-2 content. Original OxfordAQA practice.

1 Key knowledge and worked examples

■ Induce, transform, protect





high voltage keeps the current small, so cable heating (I^2R) losses stay low

$$\frac{V_p}{V_s} = \frac{n_p}{n_s} \quad V_p I_p = V_s I_s$$

Worked check. 500 primary turns, 50 secondary, 230 V in: $V_s = 230 \times 50/500 = 23$ V (step-down); if the secondary supplies 2 A, the primary draws $I = 23 \times 2/230 = 0.2$ A.

2 Practice

2.1 State the two situations that induce a p.d. [2]

2.2 Name three factors increasing an induced p.d. [3]

2.3 Why is electricity transmitted at high voltage? [2]

2.4 A transformer: 1000 primary turns, 250 secondary; 12 V in. Calculate the output. [2]

2.5 State one advantage of a circuit breaker over a fuse. [1]

3 Exam-style questions

3.1 Explain, step by step, how a transformer transforms voltage, naming each coil. [3]

3.2 A power station exports 200 MW at 400 kV. Calculate the line current, and the current had it been sent at 25 kV, and comment on losses. [4]

3.3 Describe how earthing plus a fuse protects someone touching a faulty metal-cased heater. [3]

Solutions

2.1 A conductor moving relative to a magnetic field; a conductor in a changing magnetic field.

2.2 Faster movement; stronger field; more turns on the coil (also larger coil area).

2.3 Smaller current for the same power; cable heating loss I^2R is much reduced.

2.4 $V_s = 12 \times 250/1000 = 3 \text{ V}$.

2.5 It trips faster and can be reset.

3.1 Alternating current in the **primary** coil makes a changing magnetic field in the iron core; the changing field passes through the **secondary** coil; inducing an alternating p.d. across it – sized by the turns ratio.

3.2 At 400 kV: $I = 2 \times 10^8 / (4 \times 10^5) = 500 \text{ A}$; at 25 kV: $I = 2 \times 10^8 / (2.5 \times 10^4) = 8000 \text{ A}$; $16\times$ the current $\rightarrow 256\times$ the I^2R heating – losses would be enormous without the step-up.

3.3 The live wire touches the metal case, making it live; the earth wire gives the fault current a low-resistance route to earth; the large current melts the fuse, disconnecting the supply before the person receives a shock.