Exercise walk-through

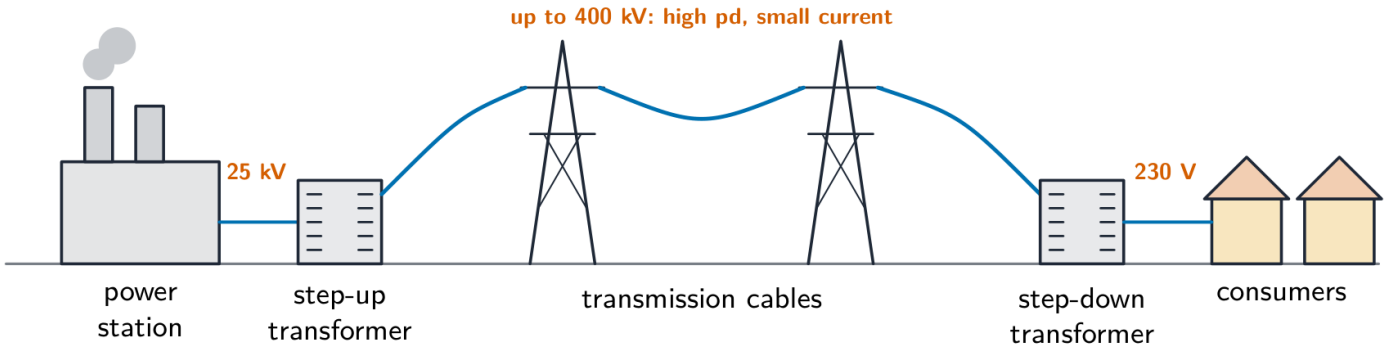
2.7
The National Grid (4.2.4.3)

AQA · GCSE · Physics

The National Grid

- A **step-up transformer** increases the potential difference from the power station to a very high value for transmission.
- For the same power, a higher potential difference means a smaller current ($P = VI$).
- A smaller current heats the cables less ($P = I^2R$), so less energy is wasted and the grid is more efficient.
- A **step-down transformer** then decreases the potential difference to about 230 V, a safer value for homes.

Figure: The National Grid



same power, higher pd: smaller current, so less energy wasted heating the cables

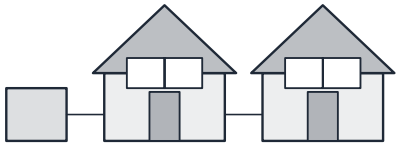
- A higher potential difference gives a smaller current for the same power, so less energy is wasted in the cables.
- Match each part of the diagram to the text.

Exercises 2.1·2.2

2.1 Name transformer A and transformer B. [2]



2.2 Explain why the potential difference is stepped down before electricity reaches homes. [



Exercises 2.1·2.2

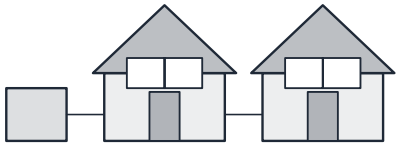
2.1 Name transformer A and transformer B. [2]



2.1

- A: step-up transformer; B: step-down transformer

2.2 Explain why the potential difference is stepped down before electricity reaches homes. [

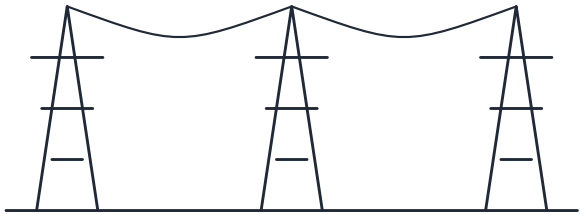


2.2

- the potential difference in the cables is far too high to be safe in homes; appliances are made to work at 230 V

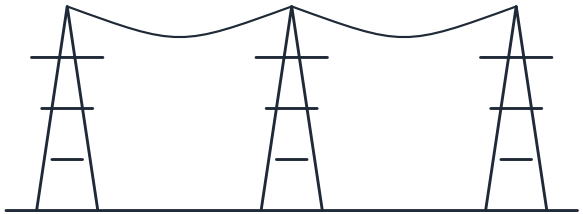
Exercise 3.1

3.1 Explain why electricity is sent through the National Grid at a very high potential difference. [3]



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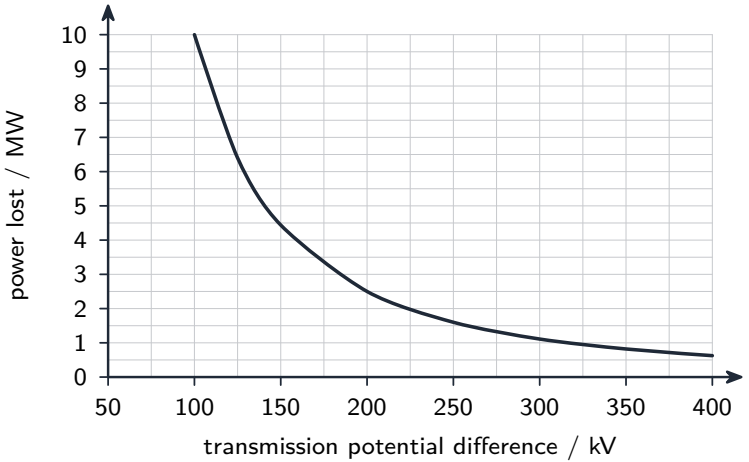
3.1

- for the same power, a higher potential difference means a smaller current
- a smaller current heats the cables less
- so less energy is wasted, because power lost $= I^2R$

Exercise 3.2 (a)

3.2 A power station sends 100 MW through cables of resistance 10 Ω. The graph shows the power lost in the cables at different transmission potential differences.

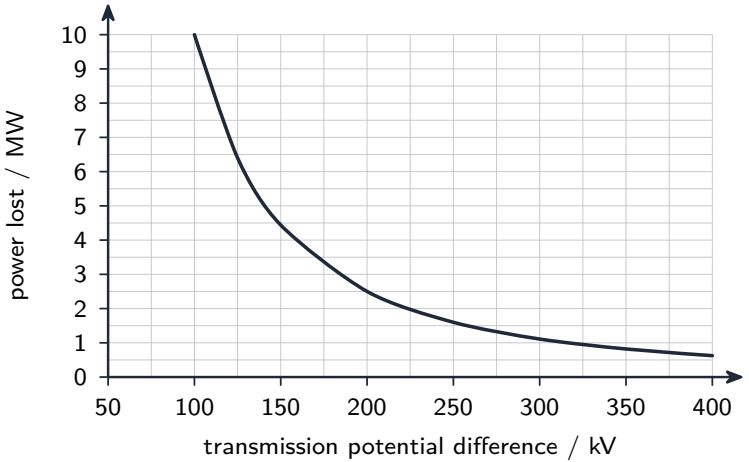
(a) Use the graph to find the power lost at 200 kV. [2]



Exercise 3.2 (a)

3.2 A power station sends 100 MW through cables of resistance 10 Ω. The graph shows the power lost in the cables at different transmission potential differences.

(a) Use the graph to find the power lost at 200 kV. [2]



(a) read at 200 kV; **2.5** MW

Exercise 3.2 (b)

3.2 A power station sends 100 MW through cables of resistance 10 Ω. The graph shows the power lost in the cables at different transmission potential differences.

(b) Calculate the current in the cables at 400 kV. [3]

Exercise 3.2 (b)

3.2 A power station sends 100 MW through cables of resistance 10 Ω. The graph shows the power lost in the cables at different transmission potential differences.

(b) Calculate the current in the cables at 400 kV. [3]

(b) 100 000 000 W and 400 000 V; $I = 100\,000\,000 \div 400\,000 = \mathbf{250}$ A

Exercise 3.2 (c)

3.2 A power station sends 100 MW through cables of resistance 10 Ω. The graph shows the power lost in the cables at different transmission potential differences.

(c) Describe the trend shown by the graph. [2]

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(c) Describe the trend shown by the graph. [2]

(c) the power lost decreases as the potential difference increases; it falls quickly at first, then more slowly: doubling the p.d. makes the loss four times smaller

Exercise 3.2 (d)

3.2 A power station sends 100 MW through cables of resistance 10 Ω. The graph shows the power lost in the cables at different transmission potential differences.

(d) Explain how the National Grid transfers energy from a power station to homes, and why it is an efficient system. [6]

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(d) Explain how the National Grid transfers energy from a power station to homes, and why it is an efficient system. [6]

(d) points to include:

- power stations generate electricity at about 25 000 V
- a step-up transformer increases the potential difference to about 400 000 V
- the high potential difference means a small current in the transmission cables
- a small current heats the cables less, so less energy is wasted
- step-down transformers reduce the potential difference to 230 V for homes
- so the grid transfers energy over long distances with little waste

Levels: **5–6** a full, logical answer with correct physics and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.