

Transformers

GCSE Physics · Written to the shared content for AQA, Edexcel and OCR

Name _____ Class _____ Date _____

1. Worked example

Describe the structure of a transformer and explain how it changes the size of an alternating potential difference. (5 marks)

Step 1 · Structure

Two coils of insulated wire, the primary and the secondary, wound on the same soft iron core.

Step 2 · Primary

An alternating p.d. across the primary coil produces an alternating current, which creates a changing magnetic field.

Step 3 · Core

The iron core is easily magnetised, so it carries this changing field through the secondary coil.

Step 4 · Secondary

The changing field through the secondary coil induces an alternating p.d. across it (generator effect).

Step 5 · Size

The ratio of the p.d.s equals the ratio of the numbers of turns: more secondary turns gives a bigger p.d.

Answer: a.c. in primary → changing field in iron core → induced a.c. p.d. in secondary

Check: No current flows through the core; energy is transferred by the changing magnetic field.

2. Now try one with the steps

A transformer has 1000 turns on its primary and 50 turns on its secondary. The primary p.d. is 230 V. Calculate the secondary p.d. (3 marks)

Step 1 · Equation (on the equation sheet)

Step 2 · Substitute

Step 3 · Calculate

Answer:

3. Practice

Show your working. The marks tell you how much is expected.

1. Describe the basic structure of a transformer. [2]

2. Explain why the core of a transformer is made of iron. [1]
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3. Explain how an alternating p.d. across the primary coil produces a p.d. across the secondary coil. [4]
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4. Explain why a transformer does not work with direct current. [2]
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5. A transformer has 1000 primary turns and 50 secondary turns. The primary p.d. is 230 V. Calculate the secondary p.d. [3]
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6. State whether the transformer in question 5 is step-up or step-down. [1]
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7. A step-up transformer increases 25 kV to 400 kV. The primary has 500 turns. Calculate the number of secondary turns. [3]
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8. A charger transformer has 2300 primary turns and steps 230 V down to 5.0 V. Calculate the number of secondary turns. [2]
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9. A transformer reduces the p.d. by a factor of 20. Its secondary coil has 60 turns. Calculate the number of primary turns. [2]
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10. A 100% efficient transformer steps 230 V down to 12 V. The primary current is 0.50 A. Calculate the secondary current in amperes to 2 significant figures. [3]

11. Explain why the secondary current of a step-down transformer is larger than its primary current. [1]

12. Explain how step-up transformers reduce energy losses in the National Grid. [2]

13. Suggest why real transformers become warm when in use. [2]

14. A transformer takes 2.0 A from a 230 V supply and is 90% efficient. Calculate its useful output power in watts. [2]

4. Before you hand it in

"Current flows through the iron core from one coil to the other."

Energy is transferred by the changing magnetic field in the core, which induces a p.d. in the secondary coil.

Turning the turns ratio upside down: $V_s = 230 \times 20$

Write $V_p \div V_s = n_p \div n_s$ and substitute carefully. Fewer secondary turns means a smaller secondary p.d.

"A step-up transformer gives you more energy."

It steps up the p.d. but steps down the current: power out $\leq$ power in.

"Transformers work on d.c. batteries."

Transformers need a changing (alternating) current to induce a p.d.