

# Transformers

## Question Paper

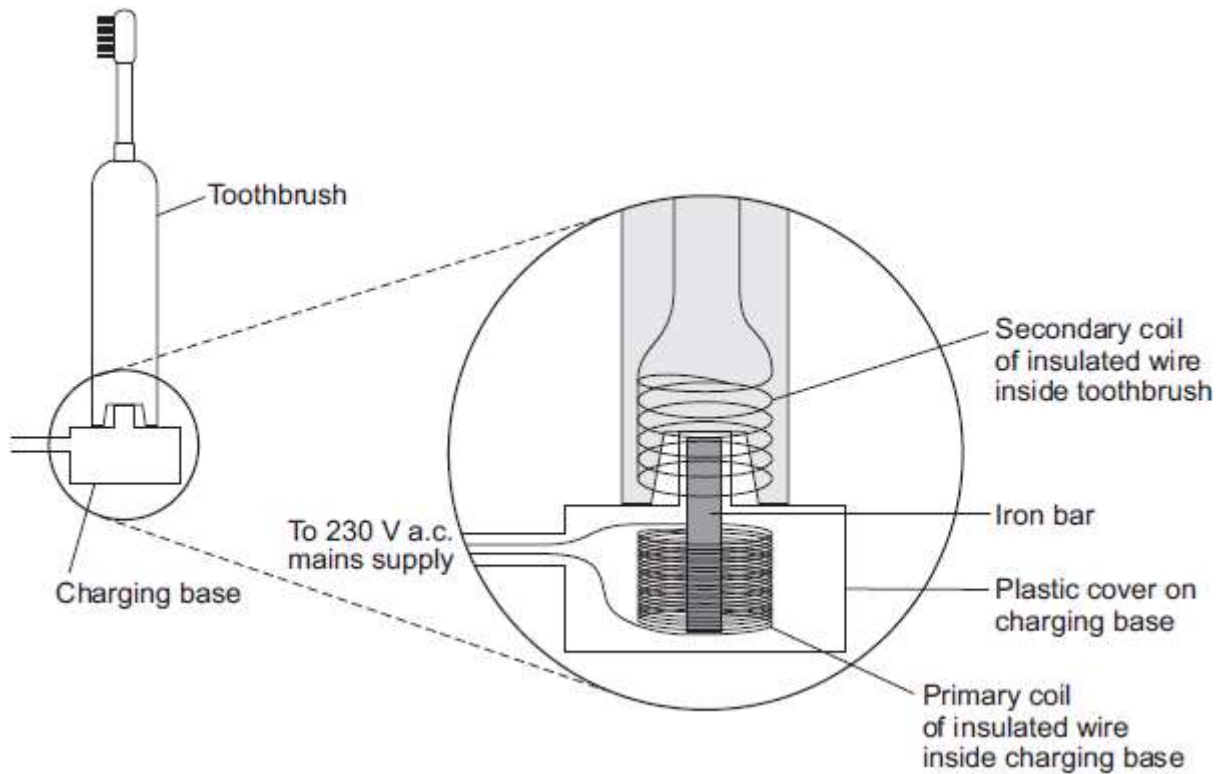
Level	GCSE
Subject	Physics
Exam Board	AQA
Unit	P3
Topic	Transformers
Difficulty Level	Gold Level
Booklet	Question Paper

**Time Allowed:** 95 minutes

**Score:** /93

**Percentage:** /100

**Q1.** An electric toothbrush is charged by standing it on a separate charging base.  
The diagram shows the inside of the electric toothbrush and the charging base.



- (a) An alternating potential difference (p.d.) across the coil in the charging base creates an alternating current in the coil inside the toothbrush.

Explain how.

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(3)

- (b) When the toothbrush is being charged, the p.d. across the primary coil in the charging base is 230 V.

The charging p.d. across the secondary coil in the toothbrush is 7.2 V.

The primary coil in the charging base has 575 turns of wire on its coil.

Calculate the number of turns on the secondary coil inside the toothbrush.

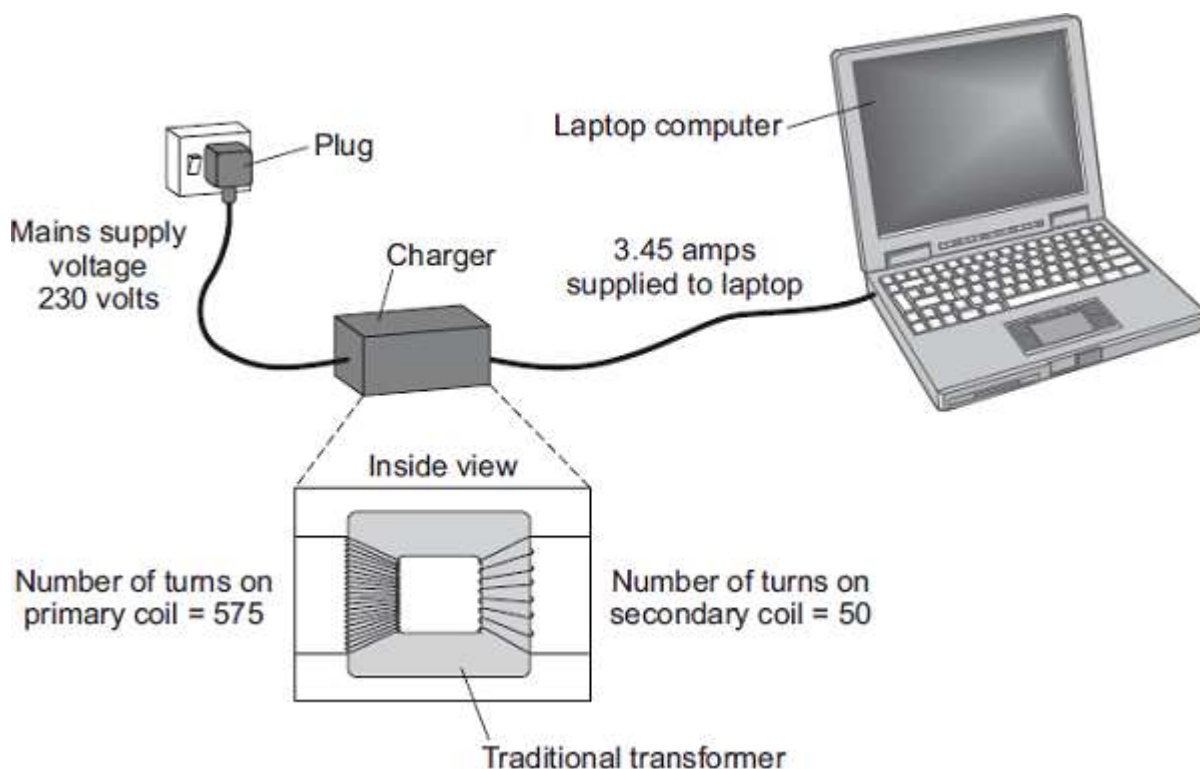
Use the correct equation from the Physics Equations Sheet.

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Number of turns on the secondary coil = .....

(2)  
(Total 5 marks)

**Q2.** Batteries inside laptop computers are charged using laptop chargers. The laptop charger contains a traditional transformer.



- (a) The alternating current flowing through the primary coil of the transformer creates an alternating current in the secondary coil.

Explain how.

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(3)

- (b) (i) Use information from the diagram to calculate the potential difference the charger supplies to the laptop.

Use the correct equation from the Physics Equations Sheet.

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Potential difference = ..... V

(2)

- (ii) Calculate the current in the primary coil of the transformer when the laptop is being charged.

Assume the transformer is 100% efficient.

Use the correct equation from the Physics Equations Sheet.

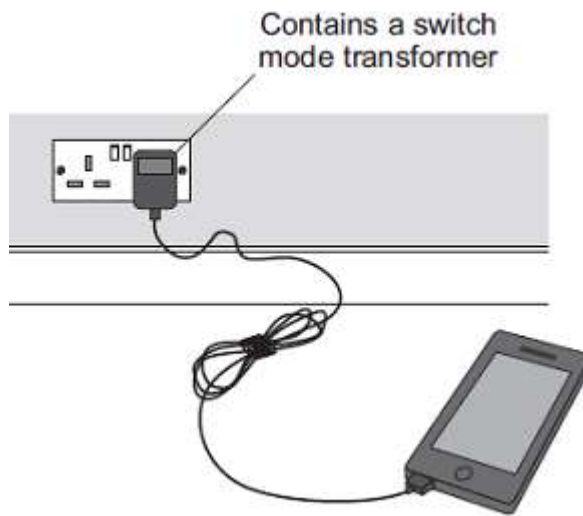
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Current = ..... A

(2)

(c) Switch mode transformers can be used in mobile phone chargers.



Switch mode transformers and traditional transformers can both use the UK mains supply.

The switch mode transformer is smaller and lighter than the traditional transformer used in the laptop charger.

Give **one** other advantage of the switch mode transformer.

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(1)

(d) Laptop batteries and mobile phone batteries can only be recharged a limited number of times. After this, the batteries cannot store enough charge to be useful. Scientists are developing new batteries that can be recharged many more times than existing batteries.

Suggest **one** other advantage of developing these new batteries.

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(1)  
(Total 9 marks)

**Q3.(a)** In the National Grid, very large step-up transformers link power stations to the transmission cables.

A transformer used for this purpose has 800 turns on its primary coil and 12 800 turns on its secondary coil. The p.d. (potential difference) across its primary coil is 25 kV.

Use the equation in the box to calculate the p.d. across its secondary coil.

$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$
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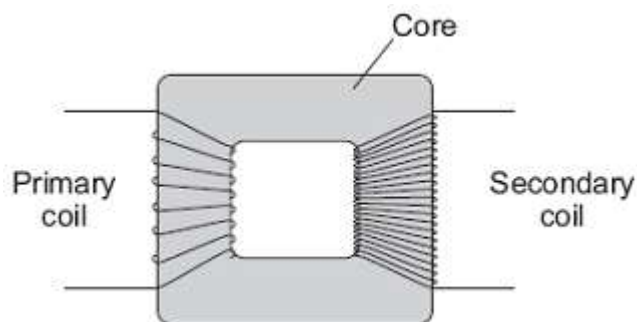
Show clearly how you work out your answer.

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p.d. across secondary coil = ..... volts

(2)

(b) The diagram shows the structure of a transformer.



(i) The primary and secondary coils of a transformer are made of insulated wire.

Why is this insulation necessary?

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(1)

(ii) Why is the core made of iron?

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(1)

(iii) Explain how the transformer works.

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(3)

(c) Before 1926, large towns had their own local power stations. After 1926, these power stations were connected to form the National Grid.

Give **two** advantages of having a National Grid system.

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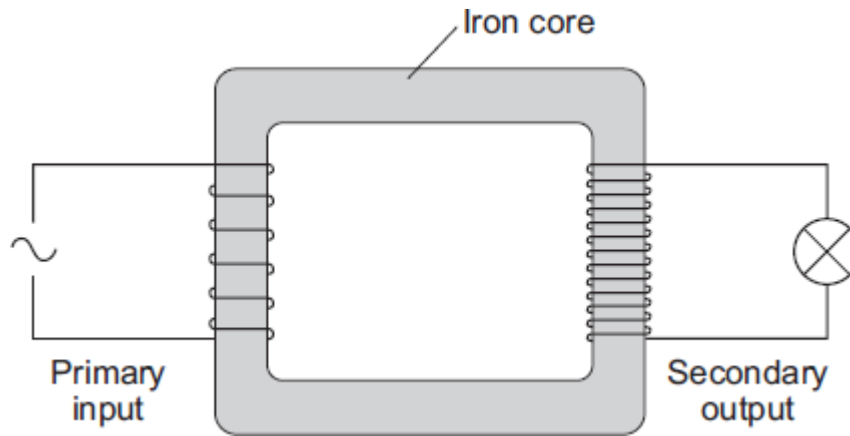
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(2)

(Total 9 marks)

**Q4.**The diagram shows a transformer.



- (a) (i) Is the transformer in the diagram being used as a step-up transformer or as a step-down transformer?

Put a tick (✓) in the box next to your answer.

a step-up transformer

a step-down transformer

Give a reason for your answer.

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(1)

- (ii) Why is the core made of iron?

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(1)

- (b) The power supply to a laptop computer contains a transformer designed to change the 230 V mains input to a 15 V output. The transformer has 920 turns on its primary coil.

Use the equation in the box to calculate the number of turns on the secondary coil.



$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$
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Show clearly how you work out your answer.

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Number of turns on the secondary coil = .....

**(2)**  
**(Total 4 marks)**

- Q5.** (a) In the National Grid, very large step-up transformers link power stations to the transmission cables.

A transformer used for this purpose has 800 turns on its primary coil and 12 800 turns on its secondary coil. The p.d. (potential difference) across its primary coil is 25 kV.

Use the equation in the box to calculate the p.d. across its secondary coil.

$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$
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Show clearly how you work out your answer **and** give the unit.

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p.d. across secondary coil = .....

**(3)**

- (b) The primary and secondary coils of a transformer are made of insulated wire.

Why is this insulation necessary?

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(1)

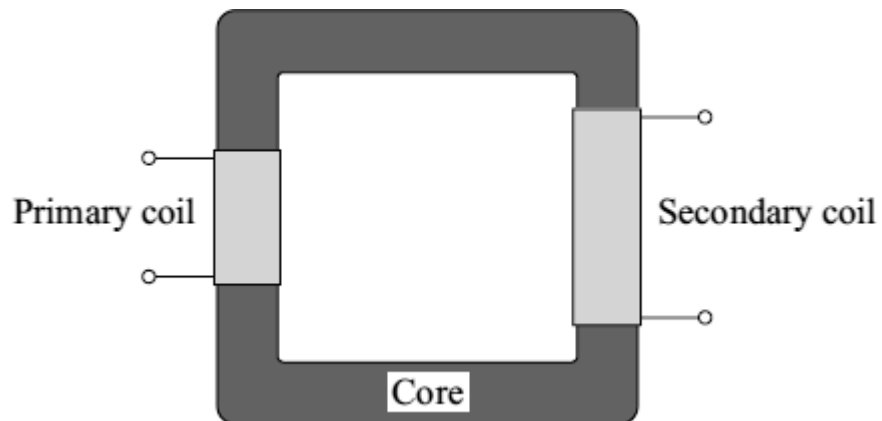
- (c) Describe what happens when an alternating potential difference is applied across the primary coil of a transformer.

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(3)

(Total 7 marks)

- Q6. (a) The diagram shows the basic structure of a step-up transformer.



- (i) What is the core made of?

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(1)

(ii) Explain how an alternating input produces an alternating output.

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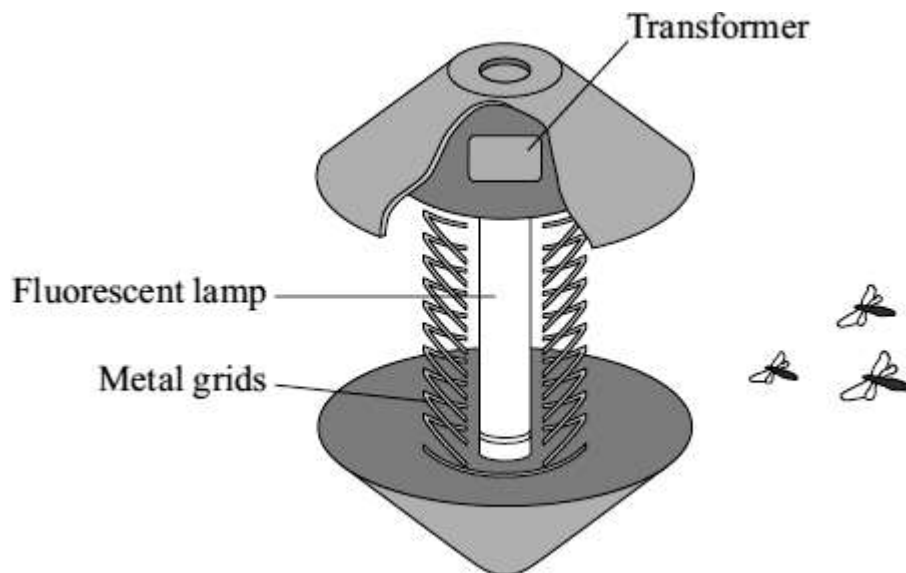
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(3)

(b) Fly killers are used in kitchens and food stores because flying insects carry diseases which cause food poisoning.

The diagram shows the inside of one design. Insects are attracted to a fluorescent lamp. The metal grids have a high potential difference (p.d.) between them. The insects are killed as they fly between the grids.



A transformer is used in the fly killer. There is a p.d. of 230 V across the primary coil. There are 300 turns of wire on the primary coil and 4000 turns on the secondary coil.

Use the equation in the box to calculate the p.d. across the secondary coil.

$$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

Show clearly how you work out your answer.

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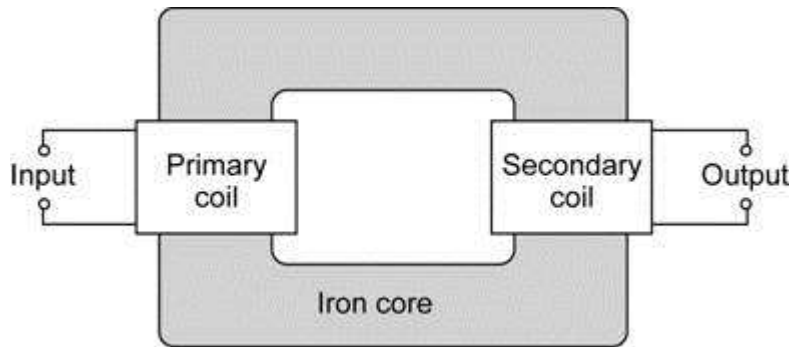
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Potential difference = .....V

(3)  
(Total 7 marks)

**Q7.** The diagram shows the basic structure of a transformer.



(a) Explain how a transformer works.

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(5)

- (b) A transformer is used to change the 230 volt mains electricity supply to the 12 volts needed to operate a low voltage halogen lamp. The current through the halogen lamp is 4 amps.

Calculate the current drawn by the transformer from the mains electricity supply.

Assume that the transformer is 100 % efficient.

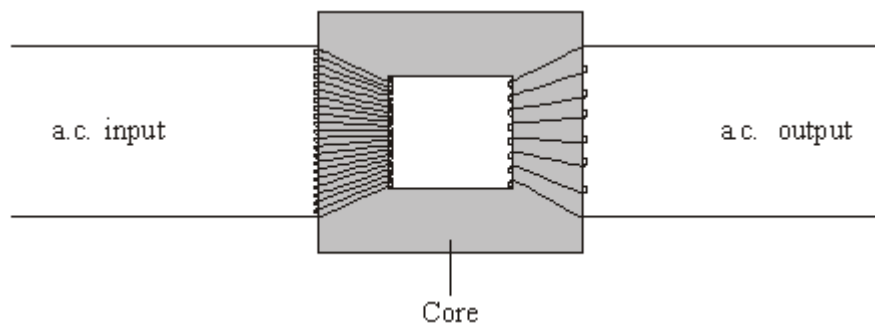
Write down the equation you use, and then show clearly how you work out your answer.

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Current = ..... amps

(2)  
(Total 7 marks)

- Q8.** (a) The diagram shows a transformer.



- (i) Is the transformer in the diagram being used as a step-up transformer or as a step-down transformer?

Put a tick (✓) in the box next to your answer.

a step-up transformer

a step-down transformer

Explain your answer.

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(1)

- (ii) Why is insulated wire, and not uninsulated wire, used to make the coils?

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(1)

- (iii) Why is the core made of iron?

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(1)

- (b) A transformer has 500 turns on its primary coil and 7500 turns on its secondary coil.  
The potential difference across the primary coil is 150 volts.

Use the equation in the box to calculate the potential difference across the secondary coil.

$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$
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Show clearly how you work out your answer.

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Potential difference across the secondary coil = ..... volts

(2)

- (c) Step-down transformers are used between power lines and people’s houses.

Explain why.

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(2)

- (d) Before 1926, large towns had their own local power stations. After 1926, these power stations were connected to form the National Grid.

Explain the advantage of having a National Grid system.

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(2)

(Total 9 marks)

Q9. (a) This notice is on the back of a television set.



The transformer used in the television set has 75 turns on its primary coil. The potential difference (p.d.) across the primary coil is 230 volts and the p.d. across the secondary coil is 32 200 volts.

Use the equation below to calculate the number of turns on the secondary coil.

$$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

Show clearly how you work out your answer.

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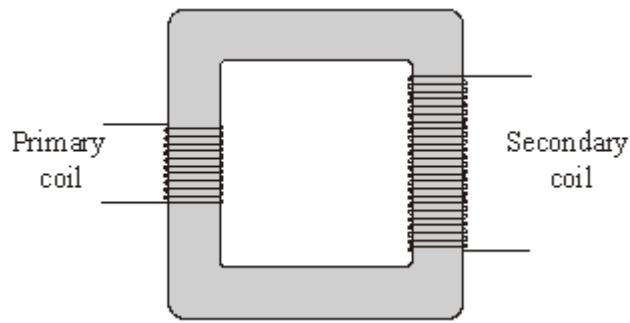
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Number of turns on the secondary coil = .....

(2)

(b) The diagram shows the structure of a transformer.





Explain how the transformer works.

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(3)  
(Total 5 marks)

**Q10.** A transformer is used to reduce the 230 V a.c. mains to the 12 V supply required for the lighting system. The transformer has 1150 turns on its primary coil.

- (i) Write down the equation which links the number of turns of each transformer coil to the voltage across each transformer coil.

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(1)

- (ii) Calculate the number of turns on the secondary coil of the transformer. Show clearly how you work out your answer.

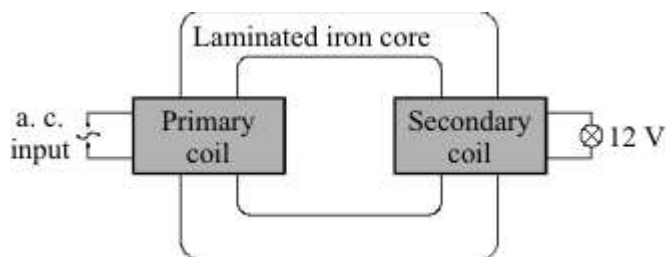
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number of turns on the secondary coil = .....

(2)  
(Total 3 marks)

- Q11. (a) The diagram represents a simple transformer used to light a 12 V lamp. When the power supply is switched on the lamp is very dim.



- (i) Give **one** way to increase the voltage at the lamp without changing the power supply.

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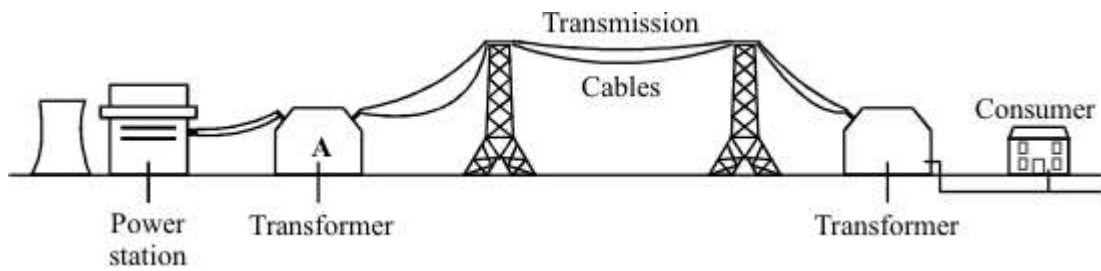
(1)

- (ii) What is meant by the iron core being *laminated*?

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(1)

- (b) Electrical energy is distributed around the country by a network of high voltage cables.



(i) For the system to work the power is generated and distributed using alternating current rather than direct current. Why?

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(1)

(ii) Transformers are an essential part of the distribution system. Explain why.

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(2)

(iii) The transmission cables are suspended high above the ground. Why?

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(1)

(c) The power station generates 100 MW of power at a voltage of 25 kV. Transformer **A**, which links the power station to the transmission cables, has 44 000 turns in its 275 kV secondary coil.

(i) Write down the equation which links the number of turns in each transformer coil to the voltage across each transformer coil.

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(1)

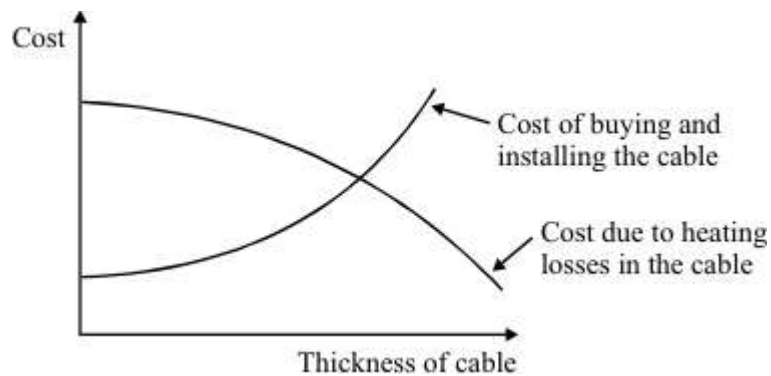
- (ii) Calculate the number of turns in the primary coil of transformer **A**. Show clearly how you work out your answer.

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Number of turns = .....

(2)

- (d) The diagram shows how the cost of transmitting the electricity along the cables depends upon the thickness of the cable.



- (i) Why does the cost due to the heating losses go down as the cable is made thicker?

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(1)

- (ii) By what process is most heat energy lost from the cables?

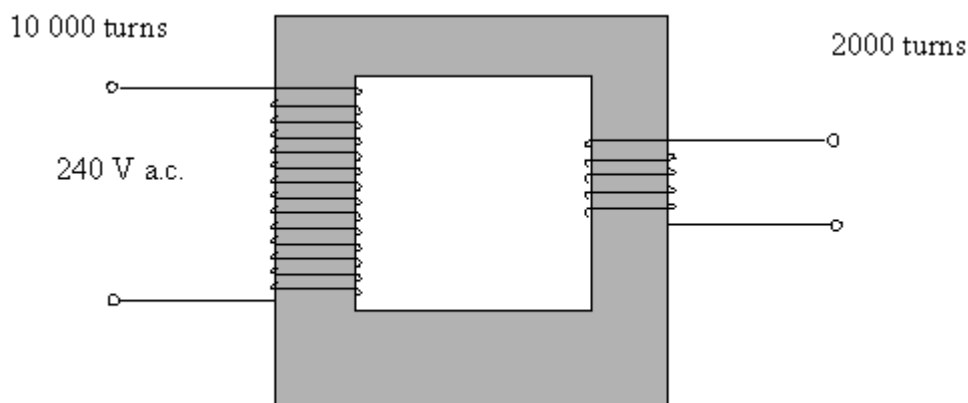
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(1)

(Total 11 marks)

- Q12.** (a) An appliance in a house has a transformer. The transformer is used to reduce the voltage to the level needed by the appliance.

The diagram shows the transformer.



- (i) Name the material used for the core of the transformer.

..... (1)

- (ii) The transformer has 10 000 turns on the input side and 2000 turns on the output side. If the mains voltage of 240 volts is applied to the input, calculate the output voltage. You may find the following information helpful:

$$\frac{\text{output voltage}}{\text{input voltage}} = \frac{\text{number of turns on output coil}}{\text{number of turns on input coil}}$$

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..... (3)

(b) Explain, in terms of magnetic fields, how a transformer works.

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(4)

(c) A 12 V car battery is connected to the input leads of the transformer. It is hoped to reduce the voltage to 2.4 V in order to run a small motor. When the output voltage is measured it is found to be zero.

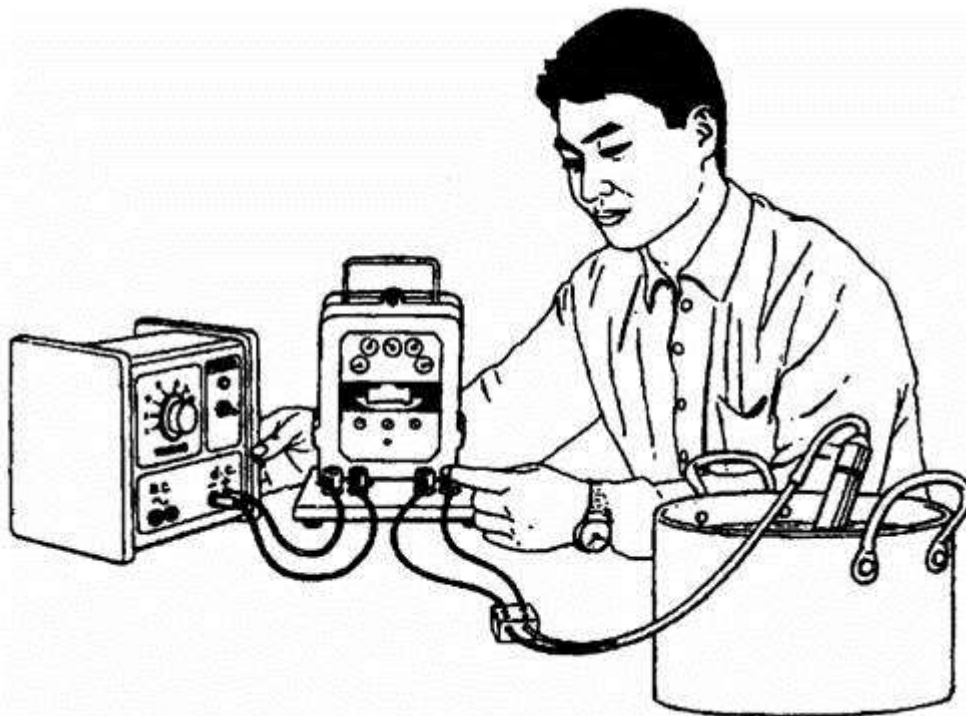
Explain why the output voltage is zero.

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(2)

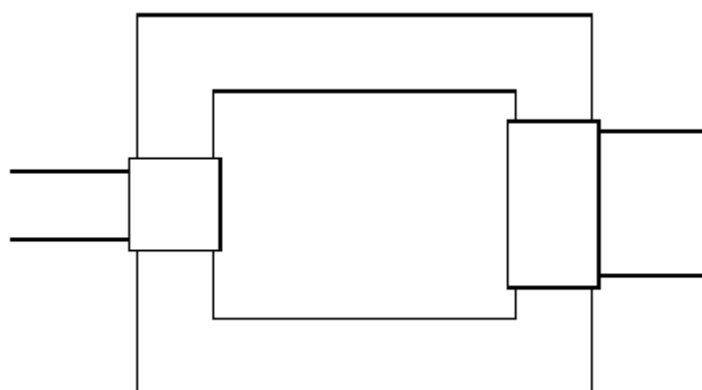
(Total 10 marks)

**Q13.** The drawing shows an experiment using a low voltage supply, a joulemeter, a small immersion heater and a container filled with water.



The immersion heater is designed for use in a tropical fish tank. It is connected to a step-down transformer supplied by 230 V a.c. mains.

The inside of a step-down transformer consists of three main parts. Name the **three** parts and briefly describe them. You may add to the diagram to help you to answer.



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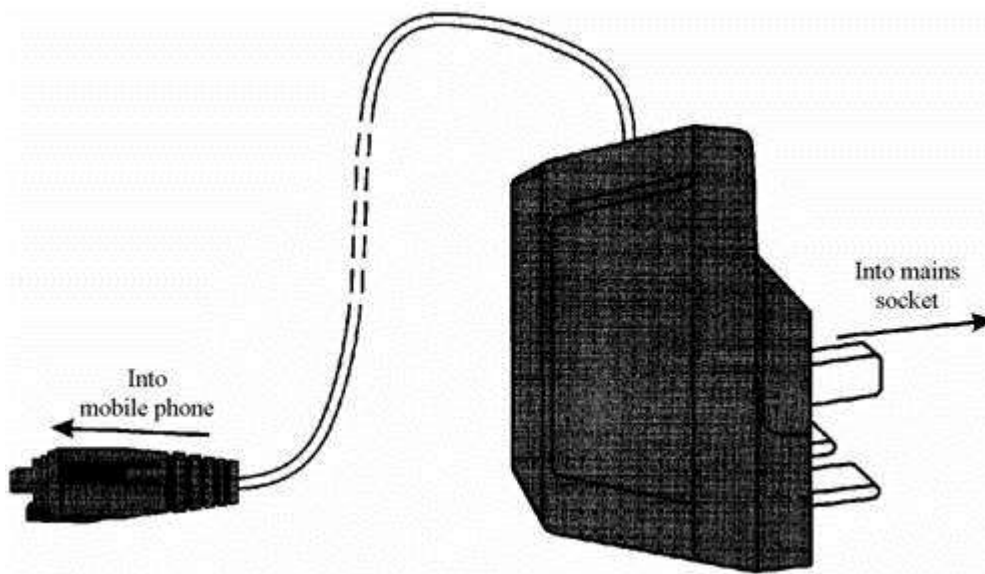
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(Total 4 marks)

- Q14.** (a) The drawing shows a small transformer used to recharge the battery in a 4.2 V mobile phone from a 230 V mains supply.



Explain how you know that this is a *step-down* transformer.

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(1)

- (b) A transformer consists of an insulated coil of wire, called the primary coil, on one side of a core. Another coil of insulated wire, called the secondary coil, is on the other side.

Give **two** features of the *core*.



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1 .....

2 .....

(2)  
(Total 3 marks)