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Student number

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Name _____

Date _____

Attempt/Time taken _____

GCSE PHYSICS

Topic Paper: 7.2 & 7.3 The motor effect, induced potential, transformers,
national grid (Higher tier physics)

Part 1

Time allowed: 45 minutes

Materials

For this paper you must have:

- the Periodic Table/Data Sheet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a calculator, which you are expected to use where appropriate.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

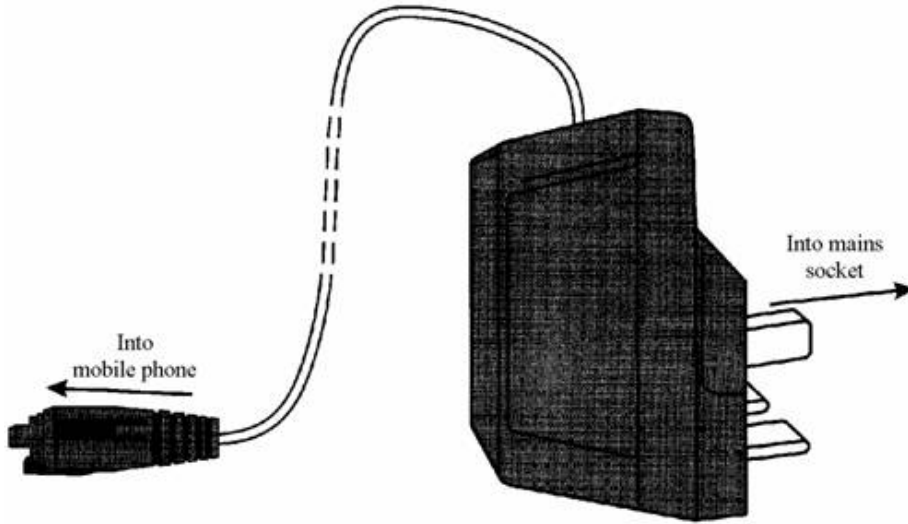
Information

- The Periodic Table/Data Sheet is provided as in insert.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions you need to make sure that your answer:
 - is clear, logical, sensibly structured
 - fully meets the requirements of the question
 - shows that each separate point or step supports the overall answer.



39 Marks

- Q1.** (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*.

1

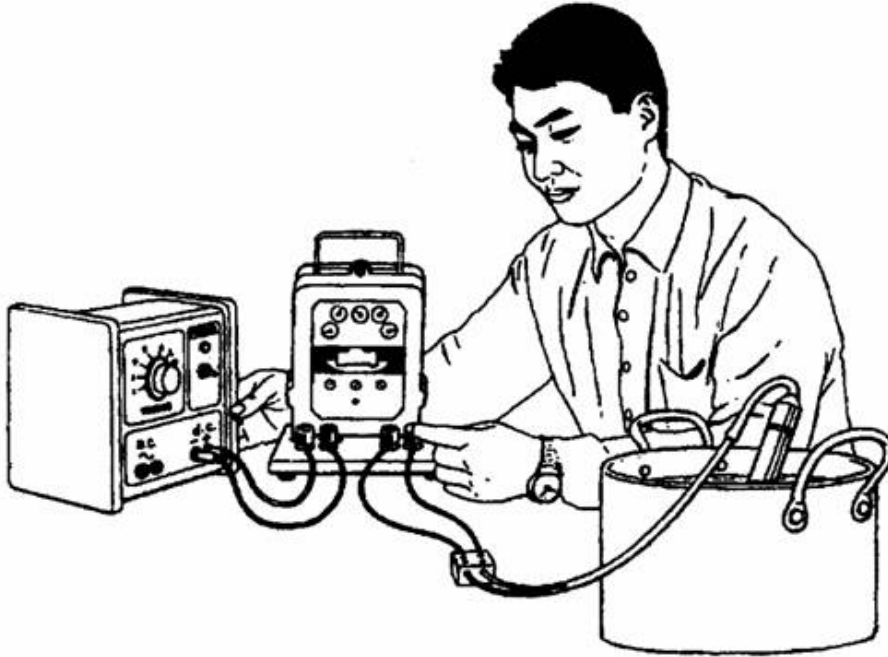
2

(2)

(Total 3 marks)



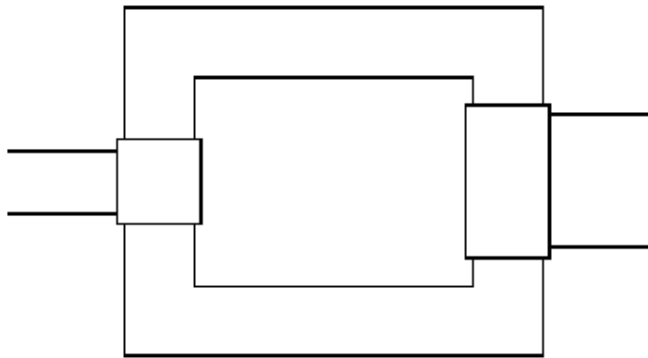
Q2. The drawing shows an experiment using a low voltage supply, a joulemeter, a small immersion heater and a container filled with water.



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.

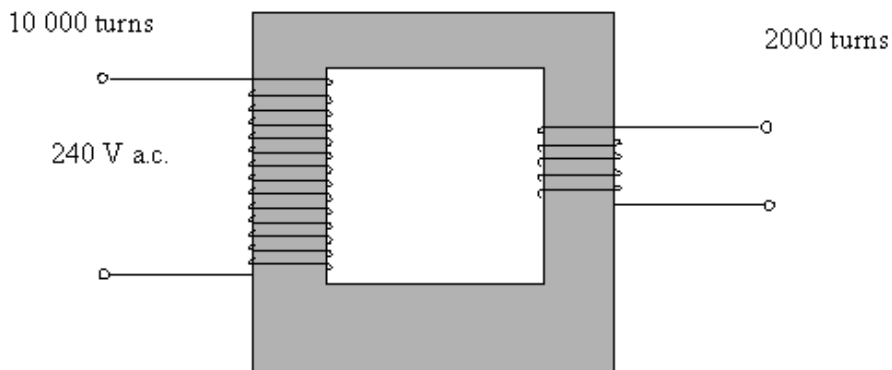


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(Total 4 marks)

Q3. (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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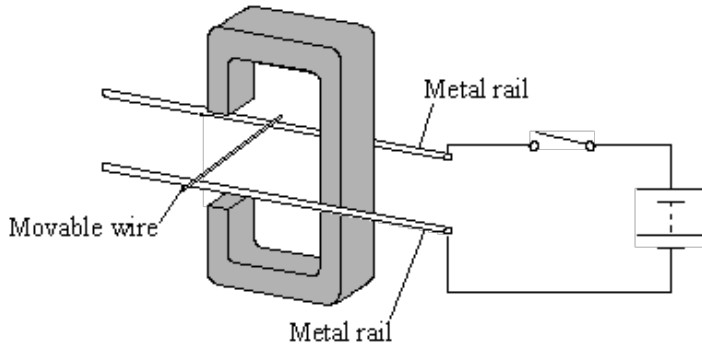
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(2)

(Total 10 marks)



Q4. The diagram shows apparatus used to demonstrate the electric motor effect. When the switch is closed the wire moves.



(i) Draw an arrow on the diagram to show the direction the wire moves.

(1)

(ii) Explain why the wire moves.

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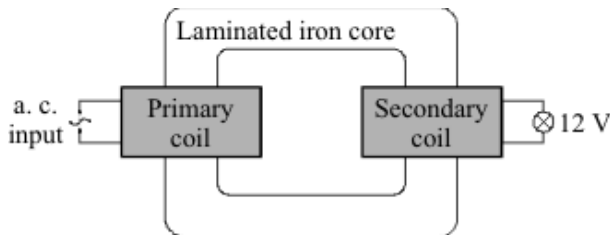
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(2)

(Total 3 marks)

Q5. (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*?

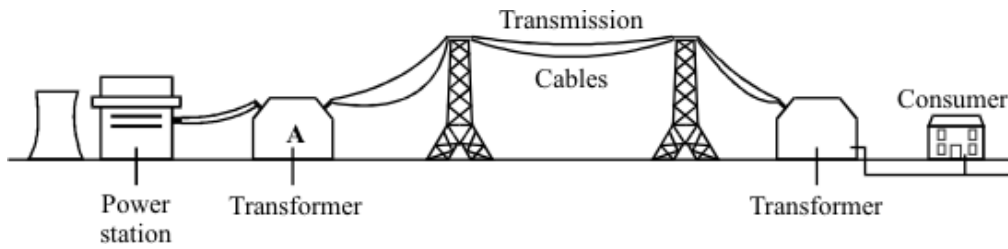
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(1)



(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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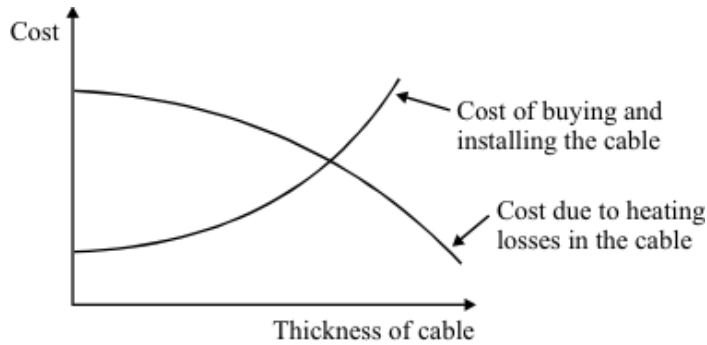
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Number of turns =

(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)

Q6. 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)



Q7. (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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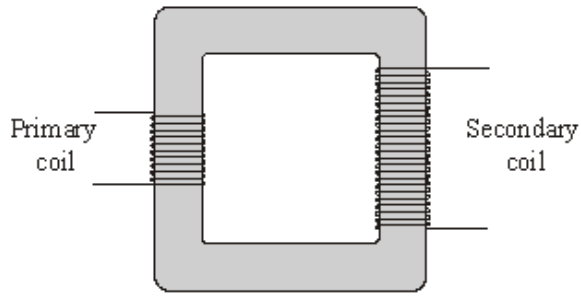
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Number of turns on the secondary coil =

(2)



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



Explain how the transformer works.

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(3)
(Total 5 marks)