

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education  
Winter 2004



**SCIENCE: SINGLE AWARD (MODULAR)**  
**Energy and Electricity (Module 17)**

**346017**

Thursday 18 November 2004 Morning Session

**In addition to this paper you will require:**

- a black ball-point pen;
- an answer sheet.

You may use a calculator.

Time allowed: 30 minutes

**Instructions**

- Fill in the boxes at the top of this page.
- Check that your name, candidate number and centre number are printed on the separate answer sheet.
- Check that the separate answer sheet has the title “Energy and Electricity” printed on it.
- Attempt **one Tier only**, **either** the Foundation Tier **or** the Higher Tier.
- Make sure that you use the correct side of the separate answer sheet; the Foundation Tier is printed on one side and the Higher Tier on the other.
- Answer **all** the questions for the Tier you are attempting.
- Record your answers on the separate answer sheet only. Rough work may be done on the question paper.

**Instructions for recording answers**

- Use a **black ball-point pen**.

- For each answer **completely fill in the circle** as shown:
 

1	2	3	4
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

- Do **not** extend beyond the circles.

- If you want to change your answer, **you must** cross out your original answer, as shown:
 

1	2	3	4
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

- If you change your mind about an answer you have crossed out and now want to choose it, draw a ring around the cross as shown:
 

1	2	3	4
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

**Information**

- The maximum mark for this paper is 36.

**Advice**

- Do **not** choose more responses than you are asked to. You will lose marks if you do.
- Make sure that you hand in both your answer sheet and this question paper at the end of the test.
- If you start to answer on the wrong side of the answer sheet by mistake, make sure that you cross out **completely** the work that is not to be marked.

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You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.  
The Higher Tier starts on page 16 of this booklet.

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**FOUNDATION TIER**

**SECTION A**

Questions **ONE** to **FIVE**.

In these questions match the words in the list with the numbers.

Use **each** answer only **once**.

Mark your choices on the answer sheet.

---

**QUESTION ONE**

Match words from the list with the numbers **1–4** in the sentences.

**black**

**increase**

**reduce**

**white**

In hot countries, houses are often painted . . . . . **1** . . . . .

This is done to . . . . . **2** . . . . . absorption of the Sun's energy.

Pipes at the back of a freezer are painted . . . . . **3** . . . . .

This is done to . . . . . **4** . . . . . radiation of energy.

**QUESTION TWO**

Each part of a plug has a job to do.

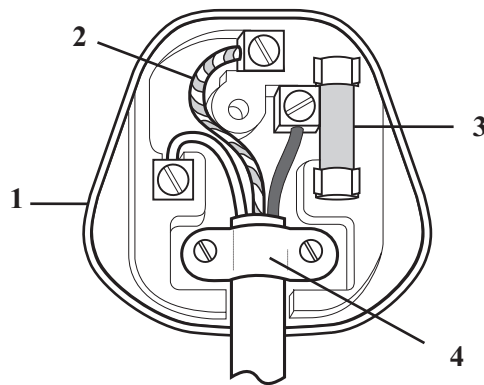
Match words from the list with the numbers 1–4 on the diagram.

**connects metal case of appliance to earth**

**holds the cable firmly**

**insulates the plug**

**wire inside melts if current is too high**

**QUESTION THREE**

A DVD player is connected to the mains supply.

Match words from the list with the numbers 1–4 in the sentences.

**current**

**frequency**

**potential difference (voltage)**

**power**

The mains supply provides a . . . . . 1 . . . . . of 230 V.

The . . . . . 2 . . . . . of the supply is 50 Hz.

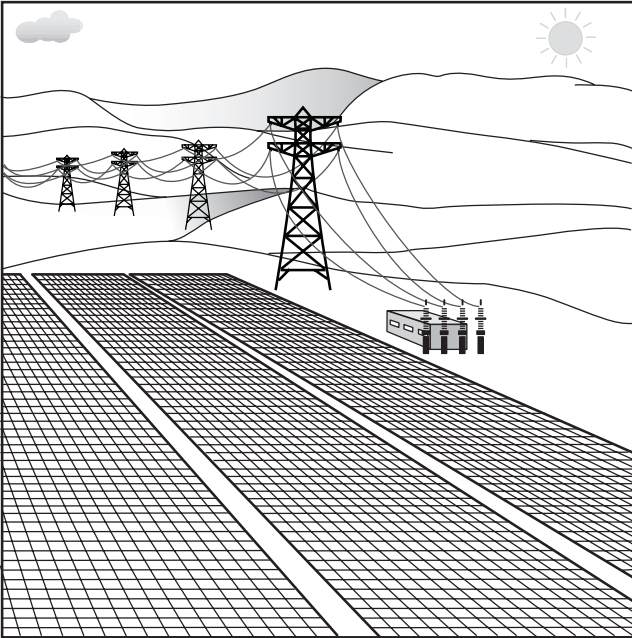
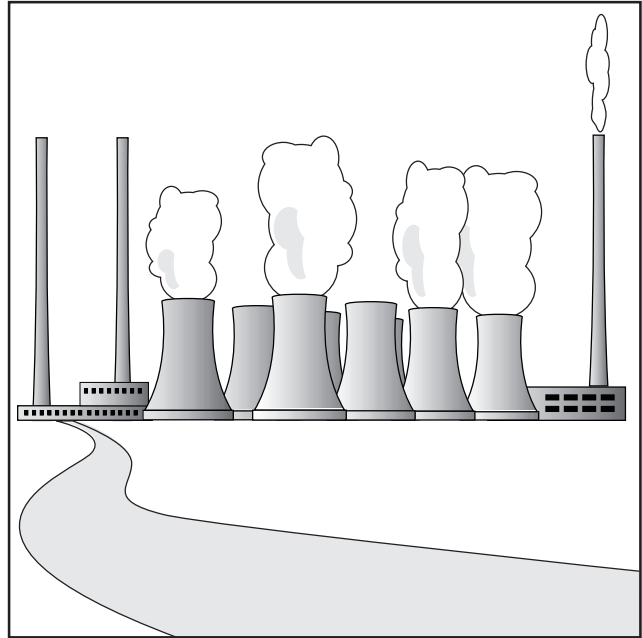
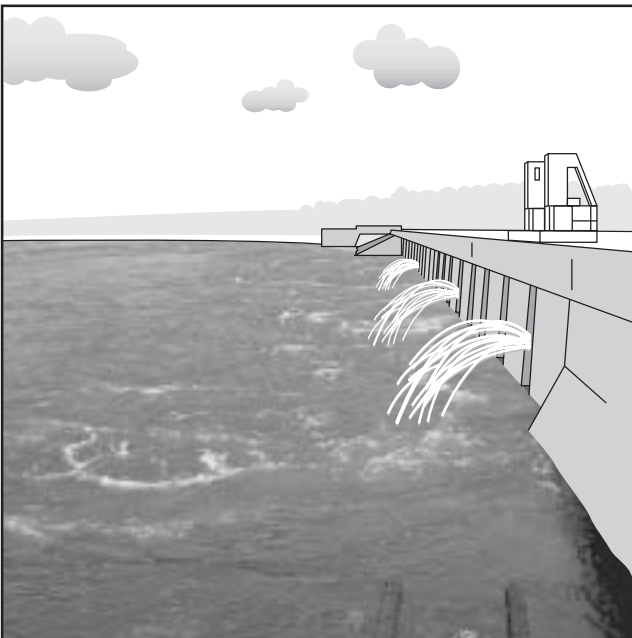
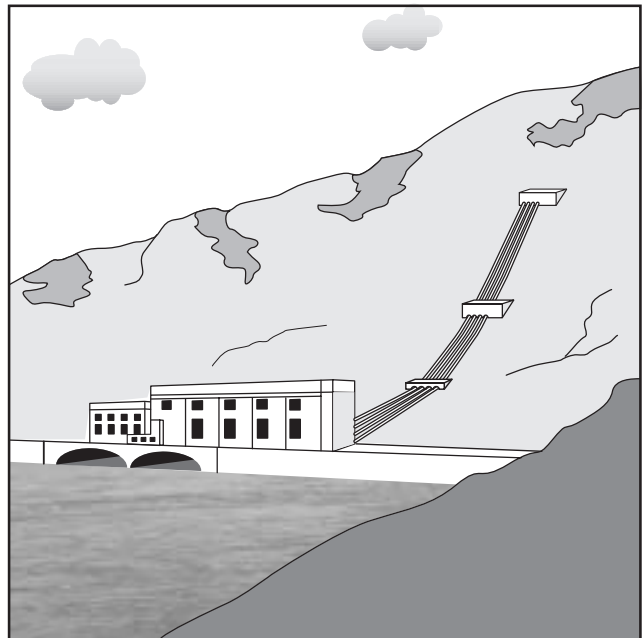
The DVD player transfers 28 W of . . . . . 3 . . . . . .

A . . . . . 4 . . . . . of 0.12 A flows through the DVD player.

**Turn over ►**

**QUESTION FOUR**

The drawings show four types of power station, **J**, **K**, **L** and **M**. Each one uses a different energy source to produce electricity.

**J****K****L****M**

---

Match words from the list of energy sources with the numbers **1–4** in the table.

**coal**

**solar energy**

**tides**

**water pumped to a high level**

<b>Energy source</b>	<b>Power station</b>
<b>1</b>	<b>J</b>
<b>2</b>	<b>K</b>
<b>3</b>	<b>L</b>
<b>4</b>	<b>M</b>

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**QUESTION FIVE**

Components in circuits have different resistances.

Match words from the list with the descriptions 1–4 in the table.

**diode**

**filament lamp**

**LDR**

**thermistor**

<b>Component</b>	<b>Description of resistance</b>
<b>1</b>	its resistance decreases when its temperature increases
<b>2</b>	its resistance decreases when the light intensity increases
<b>3</b>	its resistance increases when its temperature increases
<b>4</b>	its resistance is very high in the reverse direction

**NO QUESTIONS APPEAR ON THIS PAGE**

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**SECTION B**Questions **SIX** and **SEVEN**.In these questions choose the best **two** answers.Do **not** choose more than two.Mark your choices on the answer sheet.

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**QUESTION SIX**

When energy is transferred in devices, only part of it is transferred in a useful form. The rest of the energy is wasted.

Which **two** of the following statements are correct?

**all energy which is transferred eventually ends up as heat**

**most of the wasted energy appears as electricity**

**some of the wasted energy is destroyed**

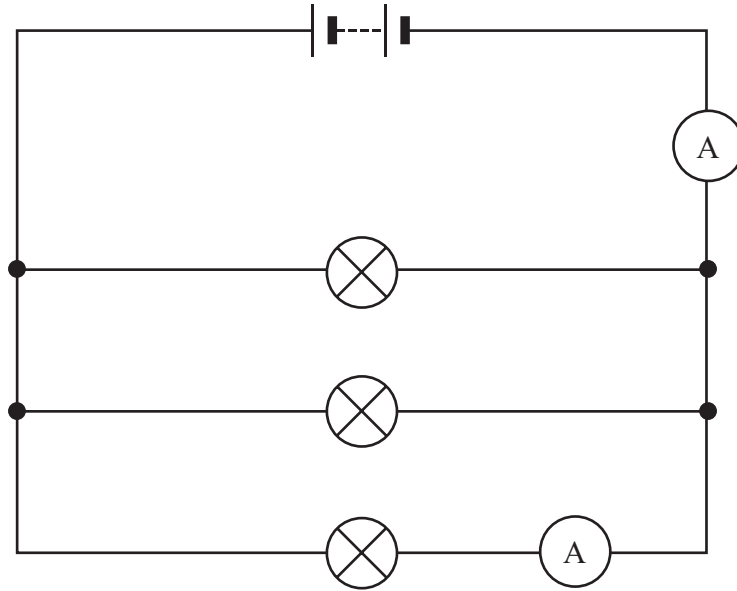
**the wasted energy becomes spread out**

**the wasted energy is always available for further useful transfers**



**QUESTION SEVEN**

The diagram shows a lighting circuit.



Which **two** of the statements **P**, **Q**, **R**, **S** and **T** are correct?

- P** the current through the battery is the sum of the currents through the lamps
- Q** the currents through both ammeters are the same
- R** the potential difference (voltage) across each lamp is the same
- S** the potential difference (voltage) of the battery is shared between the lamps
- T** the total resistance of the circuit is the sum of the resistances of each component

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**SECTION C**Questions **EIGHT** to **TEN**.

Each of these questions has four parts.

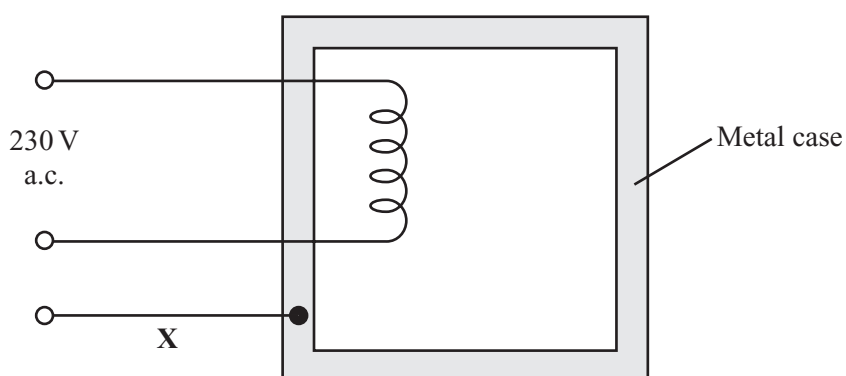
In each part choose only **one** answer.

Mark your choices on the answer sheet.

**QUESTION EIGHT**

The diagram shows an appliance with a metal case.

The three wires form the cable to the mains plug.

**8.1** What is the colour of wire **X**?

- A Blue
- B Brown
- C Green/yellow
- D Red

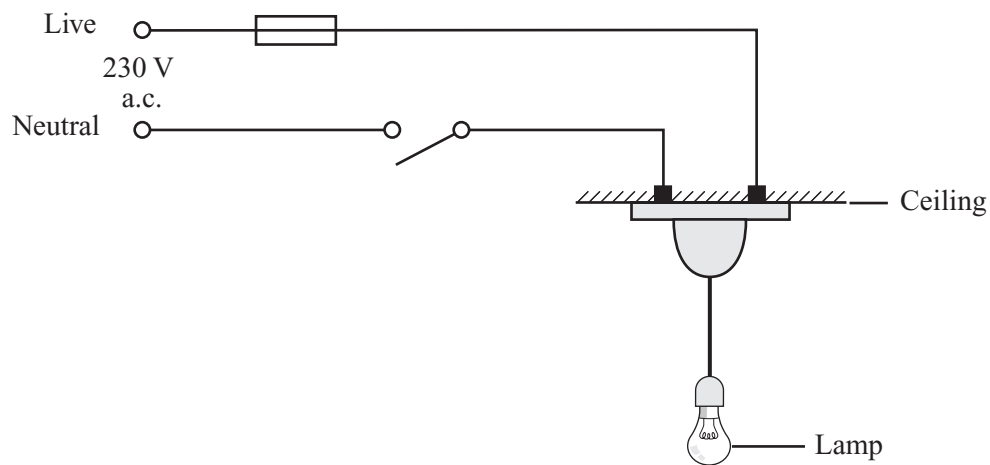
**8.2** Why is a fuse included in the mains plug?

- A To break the circuit when there is a power cut
- B To prevent too large a current flowing
- C To protect anyone touching the plug
- D To provide a path to earth

8.3 A fuse should have a value . . . . .

- A a lot less than the normal current taken by the appliance.
- B equal to the normal current taken by the appliance.
- C just greater than the normal current taken by the appliance.
- D much greater than the normal current taken by the appliance.

8.4 The lighting circuit shown in the diagram below is wired **incorrectly**.



What is wrong with the circuit?

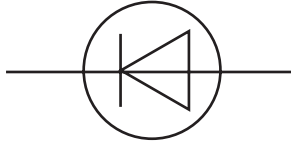
- A Both the switch and the fuse should be in the live wire
- B Both the switch and the fuse should be in the neutral wire
- C The fuse should be in a separate earth wire for safety
- D The switch should be in the live wire and the fuse should be in the neutral wire

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**QUESTION NINE**

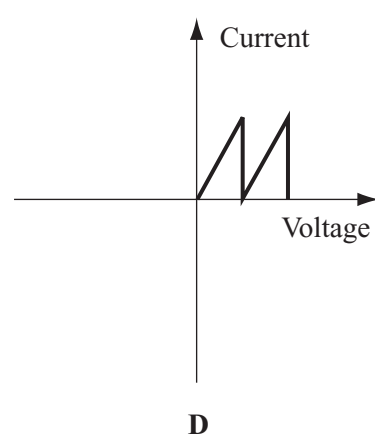
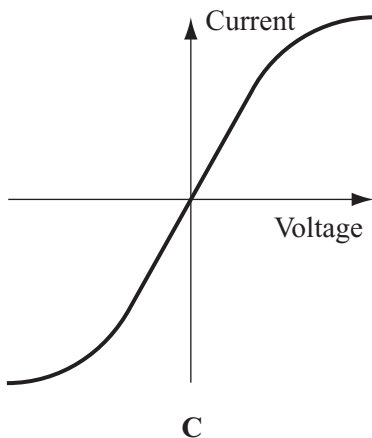
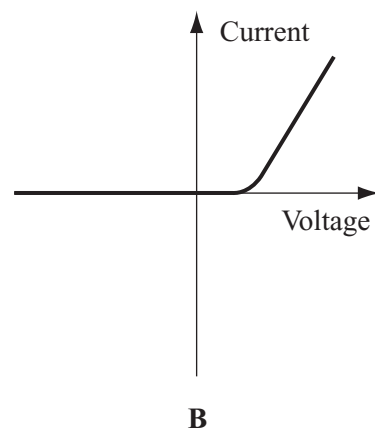
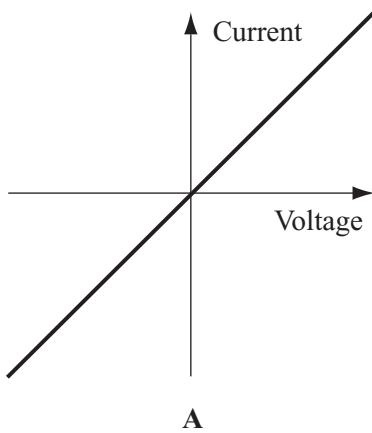
The diagram is the symbol for an electrical component.



**9.1** What is the component?

- A** A diode
- B** An LED
- C** A thermistor
- D** A variable resistor

**9.2** Which graph correctly shows how the current changes with the potential difference (voltage) across the component?

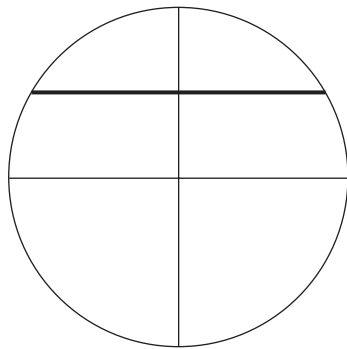


9.3 Which of these is a use of the component in circuits?

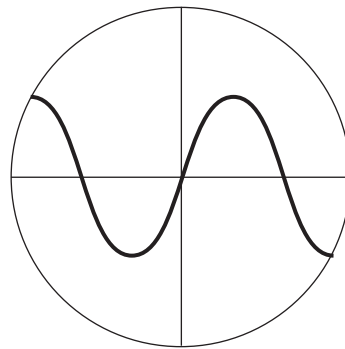
- A Measuring light intensity
- B Measuring temperature
- C Preventing current flowing in the wrong direction
- D Preventing too large a current flowing

9.4 The component is connected to an a.c. supply.

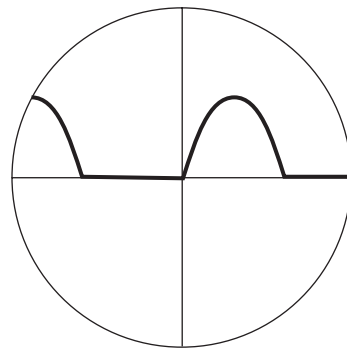
Which oscilloscope trace shows how the potential difference across the component changes?



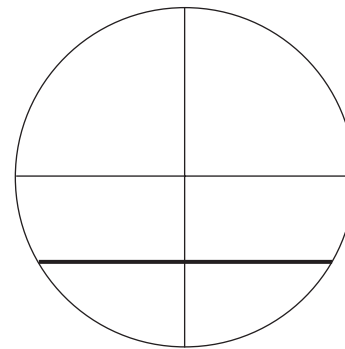
A



B



C



D

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**QUESTION TEN**

The table gives some information about burning different fuels.

<b>Fuel</b>	<b>Energy obtained by burning 1 g of fuel, in kJ</b>	<b>Mass of carbon dioxide released by burning 1 g of fuel, in grams</b>
Coal	27	3.5
Gas	55	2.8
Oil	42	3.1
Wood	20	2.6

**10.1** Which fuel produces most energy for each gram of carbon dioxide released?

- A Coal
- B Gas
- C Oil
- D Wood

**10.2** It is important to produce as little carbon dioxide as possible, because it . . . . .

- A causes increased global warming.
- B causes holes in the ozone layer.
- C kills trees in the rainforests.
- D is the main cause of acid rain.

**10.3** What is the main advantage of wood over the other fuels?

- A Cutting down trees provides land for growing food
- B It is cheap to transport
- C It is renewable
- D It produces least carbon dioxide

**10.4** Which type of power station has the longest start-up time?

- A** Coal-fired
- B** Gas-fired
- C** Nuclear
- D** Oil-fired

**END OF TEST**

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You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.  
The Foundation Tier is earlier in this booklet.

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**HIGHER TIER**

**SECTION A**

Questions **ONE** and **TWO**.

In these questions match the words in the list with the numbers.

Use **each** answer only **once**.

Mark your choices on the answer sheet.

---

**QUESTION ONE**

Components in circuits have different resistances.

Match words from the list with the descriptions **1–4** in the table.

**diode**

**filament lamp**

**LDR**

**thermistor**

<b>Component</b>	<b>Description of resistance</b>
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**QUESTION TWO**

This question is about the transfer of thermal energy.

Match words from the list with the numbers 1–4 in the sentences.

**conduction**

**convection**

**radiation**

**vibration**

Thermal . . . . . **1** . . . . . is the transfer of energy by waves.

When the hotter parts of a liquid expand and become less dense, thermal energy is transferred by . . . . . **2** . . . . .

Heating increases the kinetic energy of metal ions. This is because the . . . . . **3** . . . . . of each metal ion increases.

When electrons move through a metal and collide with metal ions, thermal energy is transferred by . . . . . **4** . . . . .

**TURN OVER FOR THE NEXT QUESTION**

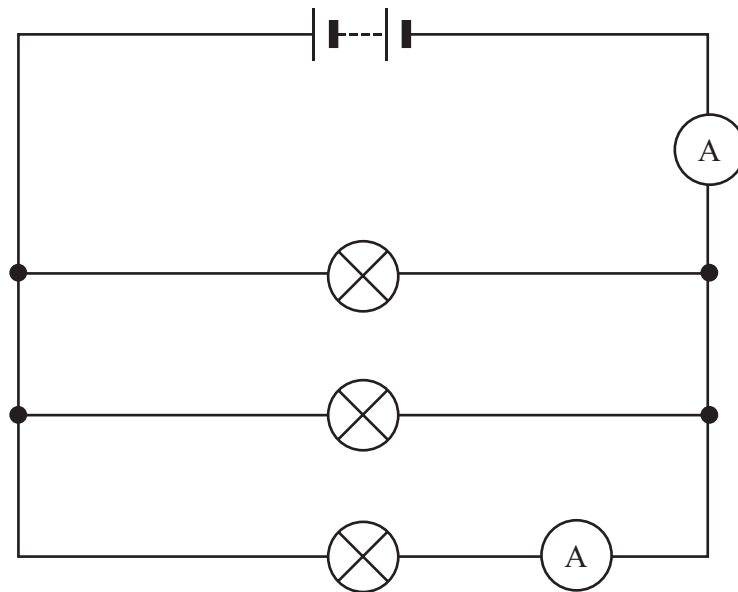
**Turn over ►**

**SECTION B**Questions **THREE** and **FOUR**.In these questions choose the best **two** answers.Do **not** choose more than two.

Mark your choices on the answer sheet.

**QUESTION THREE**

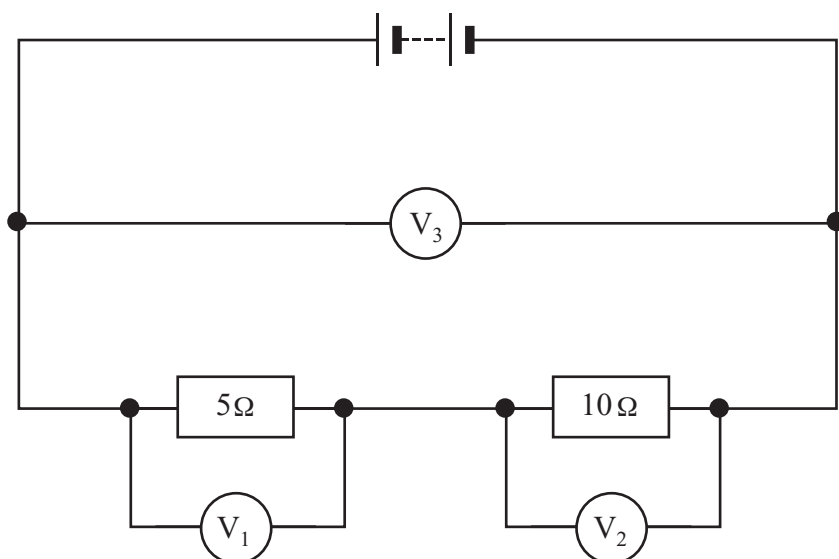
The diagram shows a lighting circuit.

Which **two** of the statements **P**, **Q**, **R**, **S** and **T** are correct?

- P** the current through the battery is the sum of the currents through the lamps
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- R** the potential difference (voltage) across each lamp is the same
- S** the potential difference (voltage) of the battery is shared between the lamps
- T** the total resistance of the circuit is the sum of the resistances of each component

**QUESTION FOUR**

Three identical voltmeters are connected in a circuit.



Which **two** statements are correct?

- the reading on  $V_2$  is twice the reading on  $V_1$**
- the reading on  $V_2$  is three times the reading on  $V_1$**
- the reading on  $V_3$  is twice the reading on  $V_1$**
- the reading on  $V_3$  is three times the reading on  $V_1$**
- the reading on  $V_3$  is twice the reading on  $V_2$**

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**SECTION C**Questions **FIVE** to **TEN**.

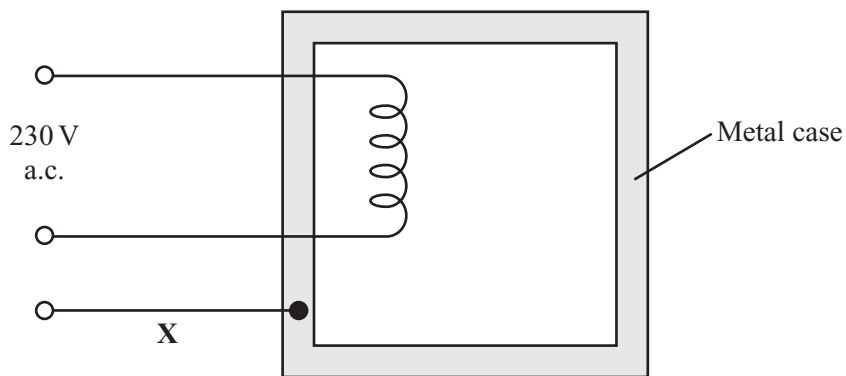
Each of these questions has four parts.

In each part choose only **one** answer.

Mark your choices on the answer sheet.

**QUESTION FIVE**

The diagram shows an appliance with a metal case.  
The three wires form the cable to the mains plug.



5.1 What is the colour of wire **X**?

- A Blue
- B Brown
- C Green/yellow
- D Red

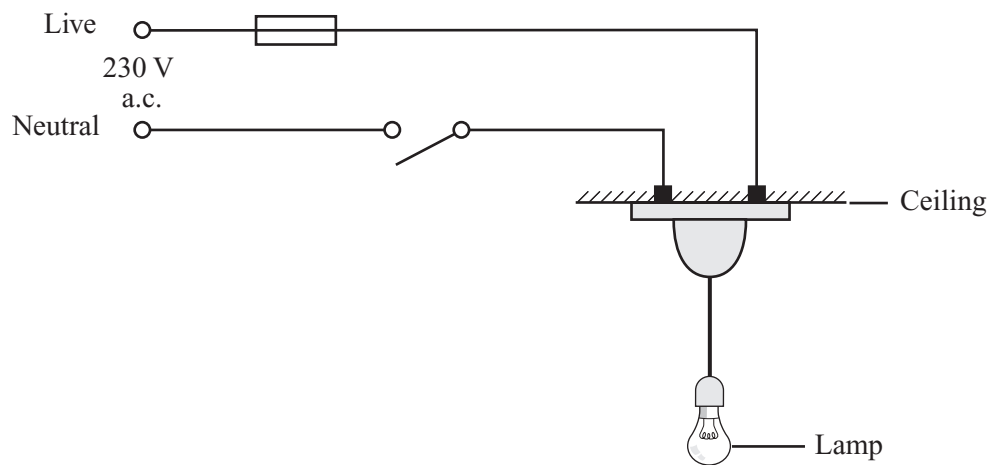
5.2 Why is a fuse included in the mains plug?

- A To break the circuit when there is a power cut
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5.3 A fuse should have a value . . . . .

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What is wrong with the circuit?

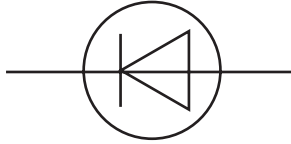
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**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**QUESTION SIX**

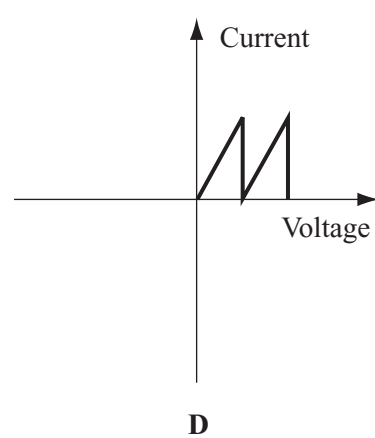
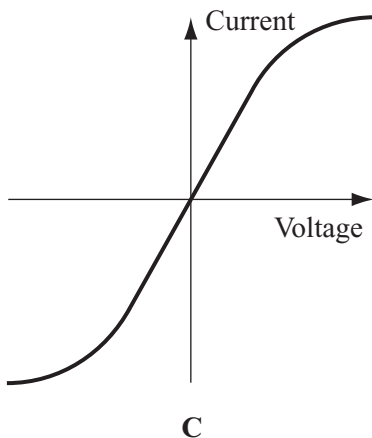
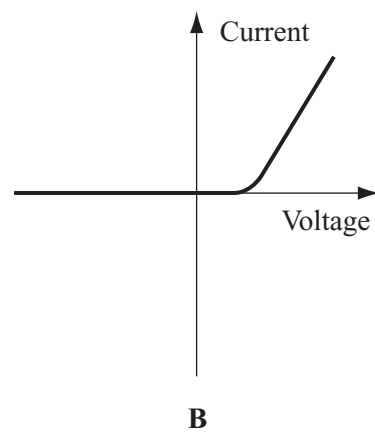
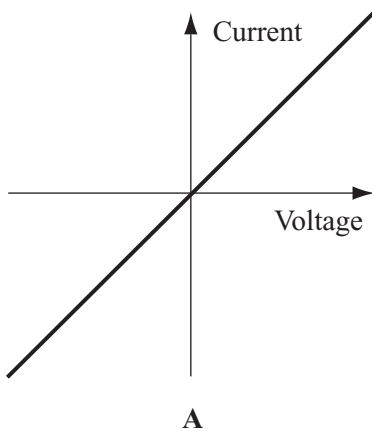
The diagram is the symbol for an electrical component.



**6.1** What is the component?

- A** A diode
- B** An LED
- C** A thermistor
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**6.2** Which graph correctly shows how the current changes with the potential difference (voltage) across the component?

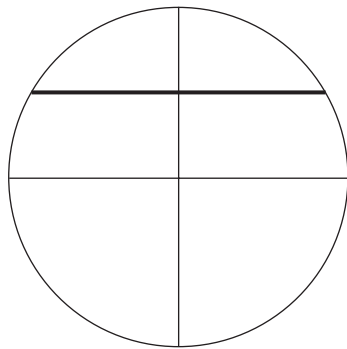


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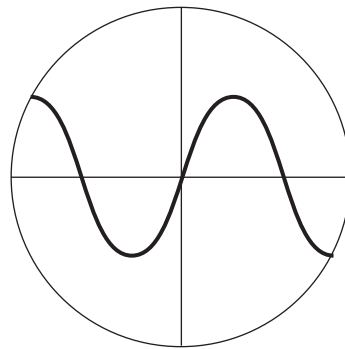
- A Measuring light intensity
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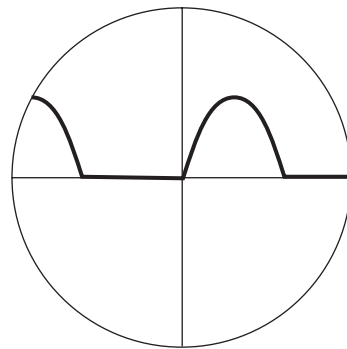
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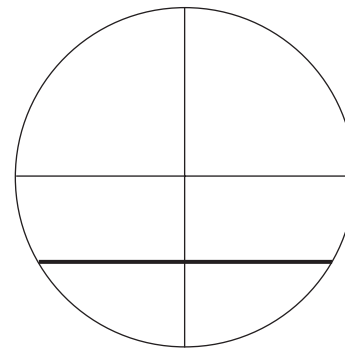
A



B



C



D

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**QUESTION SEVEN**

The table gives some information about burning different fuels.

<b>Fuel</b>	<b>Energy obtained by burning 1 g of fuel, in kJ</b>	<b>Mass of carbon dioxide released by burning 1 g of fuel, in grams</b>
Coal	27	3.5
Gas	55	2.8
Oil	42	3.1
Wood	20	2.6

**7.1** Which fuel produces most energy for each gram of carbon dioxide released?

- A Coal
- B Gas
- C Oil
- D Wood

**7.2** It is important to produce as little carbon dioxide as possible, because it . . . . .

- A causes increased global warming.
- B causes holes in the ozone layer.
- C kills trees in the rainforests.
- D is the main cause of acid rain.

**7.3** What is the main advantage of wood over the other fuels?

- A Cutting down trees provides land for growing food
- B It is cheap to transport
- C It is renewable
- D It produces least carbon dioxide



**7.4** Which type of power station has the longest start-up time?

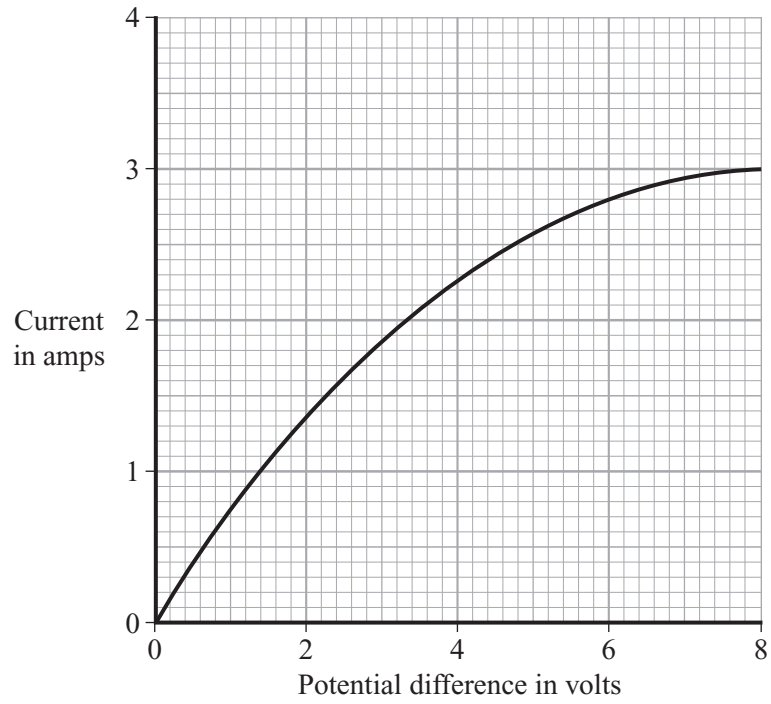
- A** Coal-fired
- B** Gas-fired
- C** Nuclear
- D** Oil-fired

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**QUESTION EIGHT**

The graph shows how the current through a filament lamp changes with the potential difference (voltage) across it.



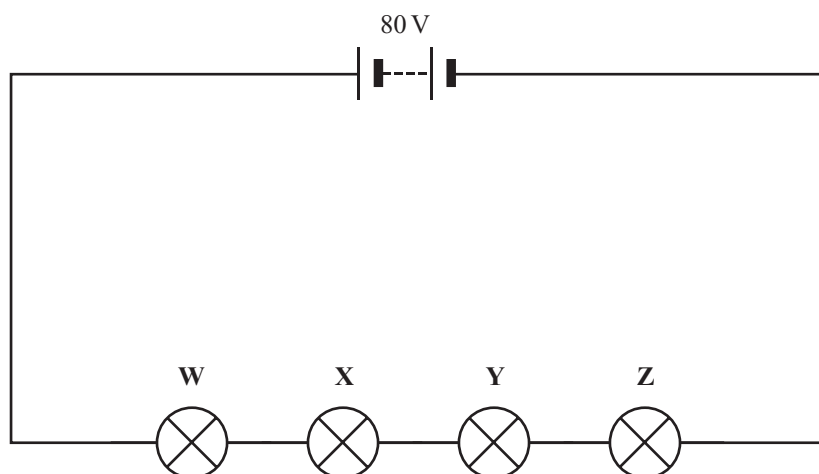
**8.1** Why does the graph have this shape?

- A As the current increases, the filament gets hotter and its resistance decreases
- B As the current increases, the filament gets hotter and its resistance increases
- C As the voltage increases, the current decreases and the resistance of the filament decreases
- D As the voltage increases, the current decreases and the resistance of the filament increases

**8.2** What is the resistance of the filament when the current through it is 2.8 A?

- A 0.47  $\Omega$
- B 2.14  $\Omega$
- C 8.80  $\Omega$
- D 16.80  $\Omega$

The diagram shows four identical lamps connected in series.  
The resistance of each lamp is  $5\ \Omega$  when it is lit normally in the circuit as shown.



**8.3** What is the current flowing through lamp **Z**?

- A 0.25 A
- B 4 A
- C 8 A
- D 16 A

**8.4** The power supply is changed for one providing 40 V.

What is the current flowing through lamp **Z** now?

- A 0.5 A
- B 2.0 A
- C 8.0 A
- D 50.0 A

Turn over ►

**QUESTION NINE**

By 2020, the UK hopes to supply 20% of its electricity using wind power.

Thousands of wind turbines will need to be erected. Very large turbines may be located out at sea.

Some people hope that the electricity from these wind turbines will allow nuclear power stations to be shut down.

This question is about arguments put forward by supporters of wind power and by supporters of nuclear power.

**9.1** Which statement describes an advantage of wind power over nuclear power?

- A Wind power causes no pollution
- B Wind power does not make any dangerous waste
- C Wind power puts less carbon dioxide into the atmosphere
- D Wind power puts less sulphur dioxide into the atmosphere

**9.2** Large wind turbines may be set up out at sea because . . . . .

- A there is less air pollution out at sea.
- B they are cheaper to set up out at sea.
- C they cause less visual pollution out at sea.
- D the wind is more reliable out at sea.

**9.3** Why does a nuclear power station take up less space than a wind farm producing the same amount of electricity?

- A It produces less electricity than a wind farm
- B The energy in the wind is more spread out than in nuclear fuels
- C Nuclear power stations are usually built near the coast
- D Nuclear power stations produce radioactive waste which must be contained

**9.4** Which statement describes an advantage of nuclear power over wind power?

- A Electricity can be produced from nuclear power at any time and in any weather
- B Fuel costs for nuclear power are very low
- C Nuclear power does not cause atmospheric pollution
- D Nuclear power does not damage river estuaries

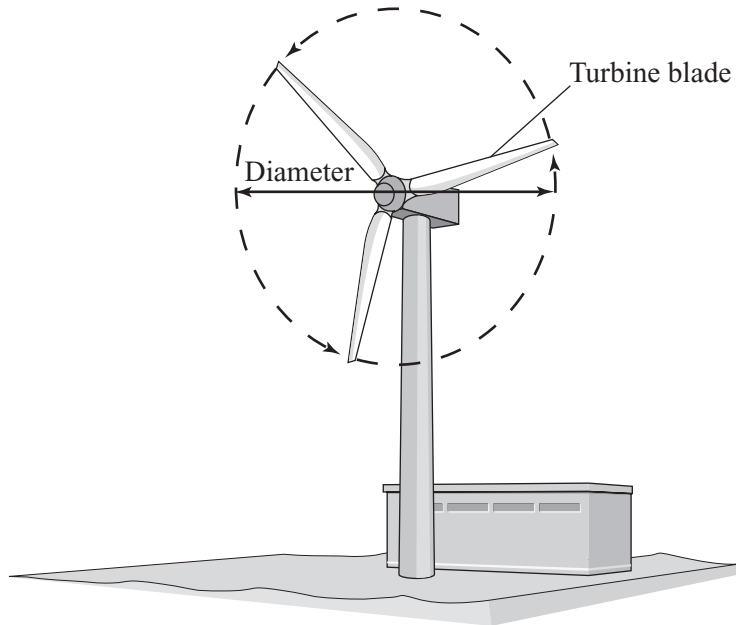
**NO QUESTIONS APPEAR ON THIS PAGE**

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**QUESTION TEN**

The diagram shows a wind turbine.



You may find the following formula useful when answering parts of this question.

The power delivered to a turbine blade by the wind is given by the formula:

$$\text{power (in watts)} = 0.5 Mv^2$$

where  $M$  is the mass of air (in kilograms) hitting a blade each second, and  $v$  is the wind speed (in metres per second).

**10.1** At a certain wind speed, a wind turbine transfers 2500 kW from the wind.

How many wind turbines would be needed to replace a 1000 MW power station?

(1 MW = 1000 kW)

- A 100
- B 200
- C 400
- D 800

**10.2** When the wind speed is 12 m/s, the mass of air hitting a blade in one second is 33 000 kg.

What is the power delivered to a blade?

- A 198 000 W
- B 396 000 W
- C 2 376 000 W
- D 4 752 000 W

**10.3** The power delivered to a different turbine blade is 49 500 W.

What is the wind speed if  $M$  is 11 000 kg/s?

- A 0.2 m/s
- B 2.1 m/s
- C 3.0 m/s
- D 4.5 m/s

**10.4** The table gives information about some wind turbines.

Turbine diameter in metres	Electrical power output in watts for a wind speed of 5 m/s
2	50
3	112.5
4	200
5	312.5
6	450

Which statement about wind turbines is correct?

- A The electrical power is proportional to the diameter
- B The electrical power is proportional to the square of the diameter
- C The electrical power is inversely proportional to the diameter
- D The electrical power is inversely proportional to the diameter squared

**END OF TEST**