

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education  
March 2006



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

**346017**

Wednesday 8 March 2006 Morning Session

**For this paper you must have:**

- a black ball-point pen
- an objective test answer sheet

You may use a calculator.

Time allowed: 30 minutes

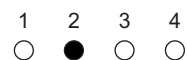
**Instructions**

- 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.
- Do all rough work in this book, **not** on your answer sheet.

**Instructions for recording answers**

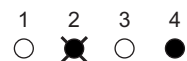
- Use a **black ball-point pen**.

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

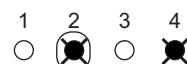


- Do **not** extend beyond the circles.

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



- 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:



**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 14 of this booklet.

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## FOUNDATION TIER

### SECTION A

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

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

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

Mark your choices on the answer sheet.

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#### QUESTION ONE

A family bought a second-hand DVD player. The current taken by the DVD player is 1 A.  
When they checked the plug, they found the faults labelled **1–4** on the diagram.

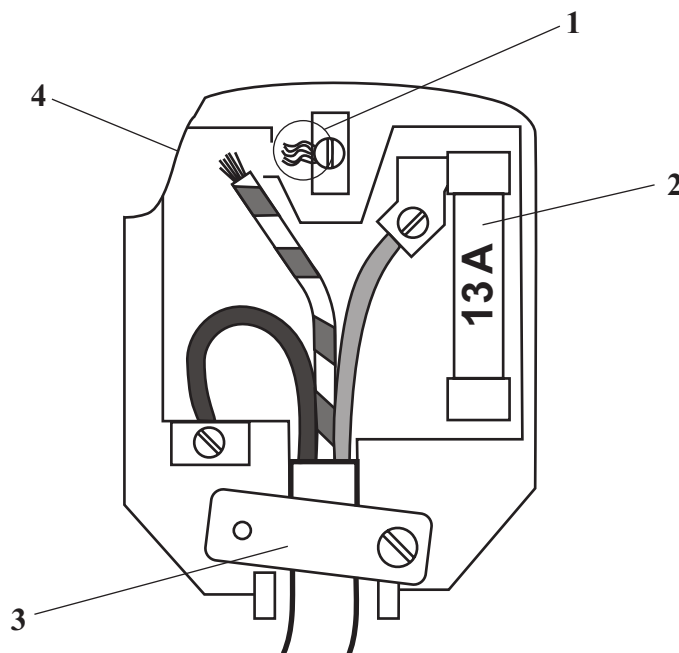
Match words from the list with the labels **1–4** on the diagram.

**cable grip is loose**

**case is broken**

**DVD player is not earthed**

**wrong fuse is used**



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**QUESTION TWO**

Electrical appliances transfer electrical energy as useful forms of energy.

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

**heat**

**light**

**movement**

**sound**

<b>Electrical appliance</b>	<b>Useful energy output</b>
Computer screen	<b>1</b>
Food mixer	<b>2</b>
Kettle	<b>3</b>
Radio	<b>4</b>

**QUESTION THREE**

Components in circuits do different jobs.

Match components from the list with the numbers **1–4** in the table.

**fuse**

**LDR (light dependent resistor)**

**variable resistor**

**voltmeter**

<b>What it does</b>	<b>Component</b>
its resistance can be adjusted	<b>1</b>
its resistance decreases when the light gets brighter	<b>2</b>
measures the potential difference across a component	<b>3</b>
prevents too high a current from flowing	<b>4</b>

**Turn over ►**

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**QUESTION FOUR**

There are different heat transfer processes.

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

**conduction**

**convection**

**evaporation**

**radiation**

Heat is transferred through the water in a pan by . . . **1** . . . .

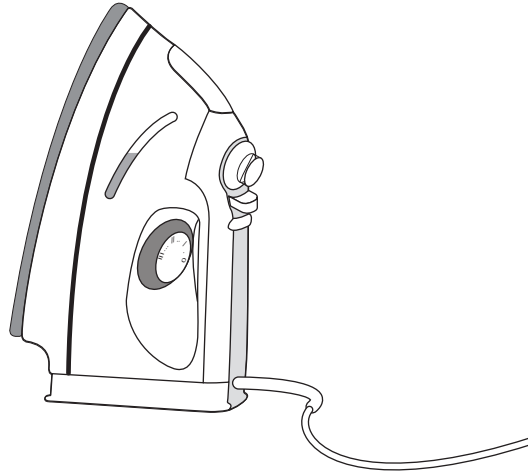
Pans often have lids. Lids reduce heat loss due to . . . **2** . . . .

Heat is transferred through copper by . . . **3** . . . .

Spaceships lose heat by . . . **4** . . . .

**QUESTION FIVE**

This question is about an electric iron.



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

**50 hertz**

**58 ohms**

**230 volts**

**920 watts**

The electric iron uses the mains supply of ... **1** ... .

The mains supply has a frequency of ... **2** ... .

The power rating of the iron is ... **3** ... .

The resistance of the iron is ... **4** ... .

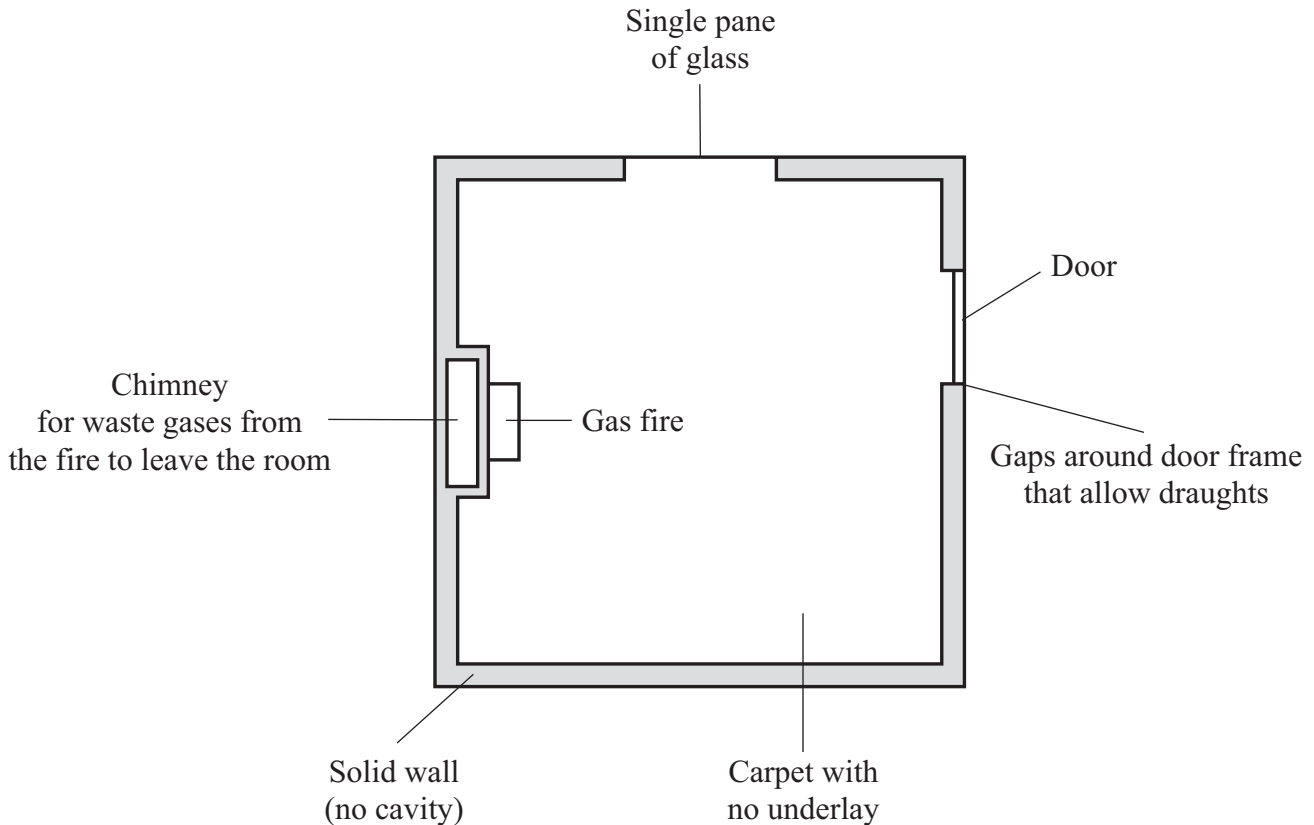
**Turn over ►**

**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.

**QUESTION SIX**

The diagram shows the plan of a room. The labels show some of the features that result in heat loss from the room.

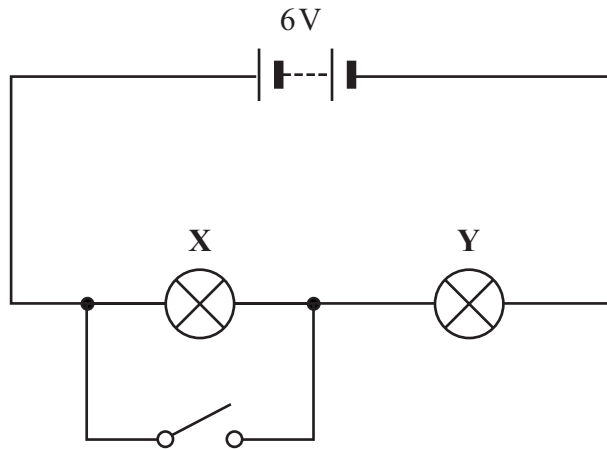


Which **two** things **J**, **K**, **L**, **M** and **N** will reduce the heat lost by conduction from the room?

- J** line the inside of the solid wall with insulation
- K** put draught proofing around the door
- L** remove the carpet, then clean and varnish the floorboards
- M** replace the single pane of glass with double glazing
- N** seal the chimney and replace the gas fire with an electric heater

**QUESTION SEVEN**

The diagram shows two 6 volt lamps connected to a 6 volt battery.



The switch is now closed.

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

- P** both lamps glow less brightly
- Q** both lamps go out
- R** lamp Y glows more brightly and lamp X goes out
- S** the potential difference (p.d.) across each lamp is now 3 V
- T** the p.d. across lamp X is now 0 V and the p.d. across lamp Y is now 6 V

**Turn over for the next question**

**Turn over ►**

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

Each of these questions has four parts.

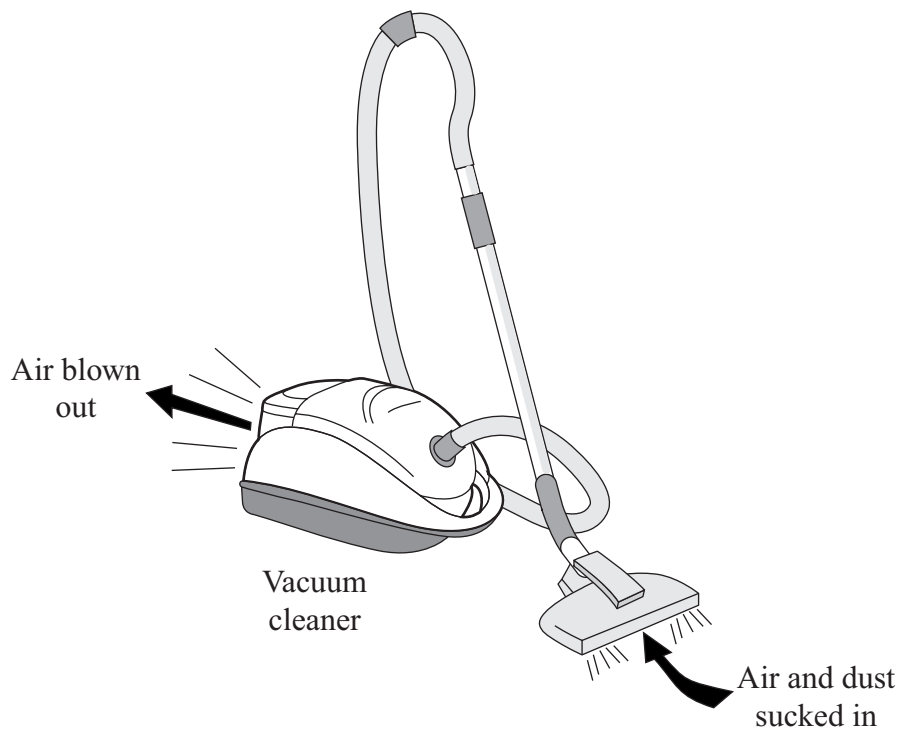
In each part choose only **one** answer.Mark your choices on the answer sheet.

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**QUESTION EIGHT**

Electrical appliances transfer, as useful energy, only part of the energy that is supplied to them. The rest of the energy is wasted.

This vacuum cleaner blows air out of one end so that it can suck air and dust into the other end.



**8.1** What is the useful energy transferred by this vacuum cleaner?

- A** Heat
- B** Light
- C** Movement
- D** Sound



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**8.2** In what form is the wasted energy transferred by this vacuum cleaner?

- A Heat and sound
- B Heat only
- C Sound and movement
- D Sound only

**8.3** A student writes the following statements about the energy transferred by the vacuum cleaner.

Which one is **false**?

- A It ends up making the surroundings a little warmer.
- B It ends up very spread out.
- C It is difficult to use for other energy transfers.
- D It no longer exists.

**8.4** A new design of vacuum cleaner transfers useful energy at the same rate as the old one, but it wastes less energy.

This means that the new design . . .

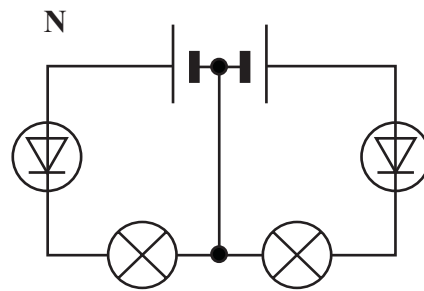
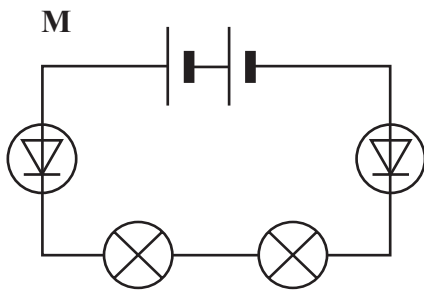
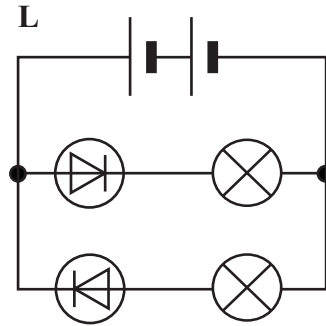
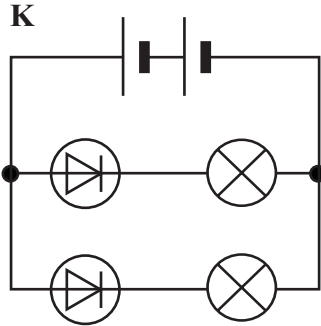
- A costs more per minute to run.
- B has a higher rate of energy input.
- C is less efficient.
- D is more efficient.

**Turn over for the next question**

**Turn over ►**

**QUESTION NINE**

All the cells, lamps and diodes in these circuits are identical. Decide which lamps light in the different arrangements before you answer the questions.



**9.1** Both lamps are off in . . .

- A** circuit **K** only.
- B** circuits **K**, **L** and **M**.
- C** circuits **M** and **N**.
- D** circuit **M** only.

**9.2** Only one lamp lights in . . .

- A** circuit **K** only.
- B** circuits **K** and **M**.
- C** circuits **L** and **N**.
- D** circuit **L** only.

**9.3** Both lamps light in . . .

- A** circuit **K** only.
- B** circuits **K** and **N**.
- C** circuits **L** and **M**.
- D** circuit **M** only.

**9.4** In which circuit do the cells run down most quickly?

- A** Circuit **K**
- B** Circuit **L**
- C** Circuit **M**
- D** Circuit **N**

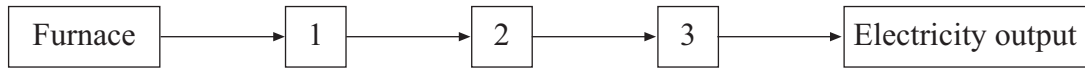
**Turn over for the next question**

**Turn over ►**

**QUESTION TEN**

A power station runs on coal. The coal used contains some sulphur.

The power station can be represented by a flow diagram.



**10.1** What is the correct order of the parts 1, 2 and 3?

- A Boiler, generator, turbine
- B Boiler, turbine, generator
- C Generator, boiler, turbine
- D Generator, turbine, boiler

**10.2** Different fossil fuels produce different quantities of carbon dioxide (CO<sub>2</sub>) when they give equal amounts of energy.

Which row of the table is correct?

	Most CO <sub>2</sub>		Least CO <sub>2</sub>
<b>A</b>	coal	oil	gas
<b>B</b>	gas	coal	oil
<b>C</b>	gas	oil	coal
<b>D</b>	oil	coal	gas

**10.3** A student writes that:

- sulphur dioxide can be removed from the coal before it is burned;
- sulphur dioxide can be removed from the waste gases;
- sulphur dioxide helps to produce acid rain.

How many of the above points are correct?

- A None of them
- B Only one of them
- C Only two of them
- D All three of them

**10.4** It is decided to replace the power station with one which:

- is very reliable;
- can be started up very quickly;
- can be used to store the energy from surplus electricity.

The replacement power station needs to be . . .

- A** gas-fired.
- B** hydroelectric.
- 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 words in the list with the numbers.

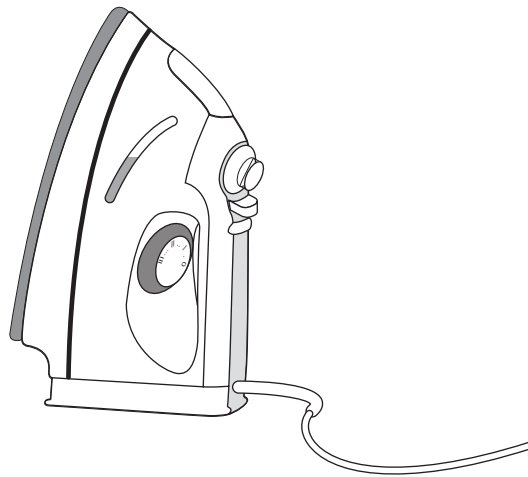
Use **each** answer only **once**.

Mark your choices on the answer sheet.

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### QUESTION ONE

This question is about an electric iron.



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

**50 hertz**

**58 ohms**

**230 volts**

**920 watts**

The electric iron uses the mains supply of . . . **1** . . . .

The mains supply has a frequency of . . . **2** . . . .

The power rating of the iron is . . . **3** . . . .

The resistance of the iron is . . . **4** . . . .

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**QUESTION TWO**

Energy is transferred by several different methods.

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

**collisions**

**electrons**

**ions**

**waves**

In metals, energy is moved to cooler regions by free . . . **1** . . . .

Energy is transferred by . . . **2** . . . between these and . . . **3** . . . .

Energy is transferred from a hot metal through space by . . . **4** . . . .

**Turn over for the next question**

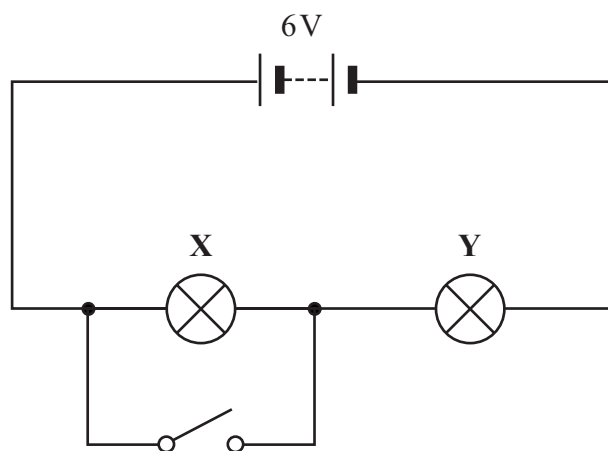
**Turn over ►**

**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 two 6 volt lamps connected to a 6 volt battery.



The switch is now closed.

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

- P** both lamps glow less brightly
- Q** both lamps go out
- R** lamp Y glows more brightly and lamp X goes out
- S** the potential difference (p.d.) across each lamp is now 3 V
- T** the p.d. across lamp X is now 0 V and the p.d. across lamp Y is now 6 V



**QUESTION FOUR**

Heat can be transferred by convection.

Which **two** statements **J**, **K**, **L**, **M** and **N** are true for convection?

- J** heat is carried by electrons moving from a higher temperature to a lower temperature
- K** heat is transferred by the movement of energy by waves
- L** materials become less dense when their particles take up more room
- M** particles which are hotter move faster and take up more room
- N** when a material expands, it is because its particles expand

**Turn over for the next question**

**Turn over ►**

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

Each of these questions has four parts.

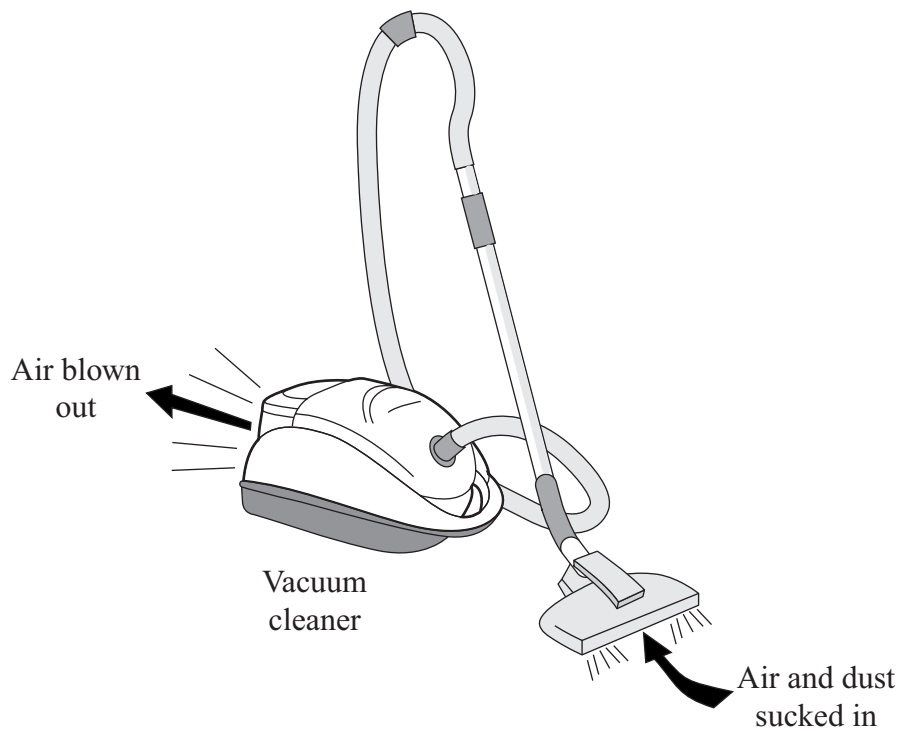
In each part choose only **one** answer.Mark your choices on the answer sheet.

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**QUESTION FIVE**

Electrical appliances transfer, as useful energy, only part of the energy that is supplied to them. The rest of the energy is wasted.

This vacuum cleaner blows air out of one end so that it can suck air and dust into the other end.



**5.1** What is the useful energy transferred by this vacuum cleaner?

- A** Heat
- B** Light
- C** Movement
- D** Sound

**5.2** In what form is the wasted energy transferred by this vacuum cleaner?

- A** Heat and sound
- B** Heat only
- C** Sound and movement
- D** Sound only

**5.3** A student writes the following statements about the energy transferred by the vacuum cleaner.

Which one is **false**?

- A** It ends up making the surroundings a little warmer.
- B** It ends up very spread out.
- C** It is difficult to use for other energy transfers.
- D** It no longer exists.

**5.4** A new design of vacuum cleaner transfers useful energy at the same rate as the old one, but it wastes less energy.

This means that the new design . . .

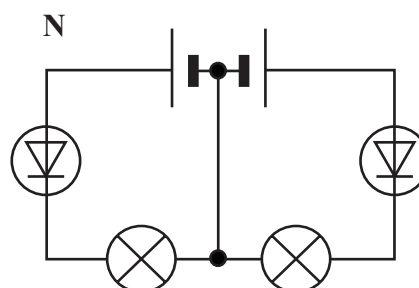
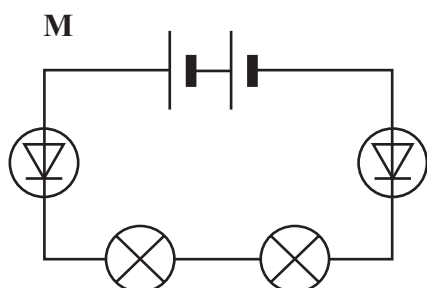
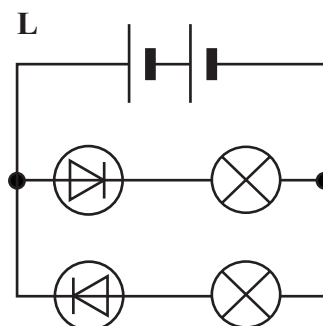
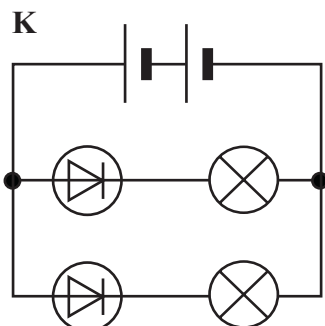
- A** costs more per minute to run.
- B** has a higher rate of energy input.
- C** is less efficient.
- D** is more efficient.

**Turn over for the next question**

**Turn over ►**

**QUESTION SIX**

All the cells, lamps and diodes in these circuits are identical. Decide which lamps light in the different arrangements before you answer the questions.



**6.1** Both lamps are off in . . .

- A** circuit **K** only.
- B** circuits **K**, **L** and **M**.
- C** circuits **M** and **N**.
- D** circuit **M** only.

**6.2** Only one lamp lights in . . .

- A** circuit **K** only.
- B** circuits **K** and **M**.
- C** circuits **L** and **N**.
- D** circuit **L** only.

**6.3** Both lamps light in . . .

- A circuit **K** only.
- B circuits **K** and **N**.
- C circuits **L** and **M**.
- D circuit **M** only.

**6.4** In which circuit do the cells run down most quickly?

- A Circuit **K**
- B Circuit **L**
- C Circuit **M**
- D Circuit **N**

**Turn over for the next question**

**Turn over ►**

**QUESTION SEVEN**

A power station runs on coal. The coal used contains some sulphur.

The power station can be represented by a flow diagram.



**7.1** What is the correct order of the parts 1, 2 and 3?

- A** Boiler, generator, turbine
- B** Boiler, turbine, generator
- C** Generator, boiler, turbine
- D** Generator, turbine, boiler

**7.2** Different fossil fuels produce different quantities of carbon dioxide (CO<sub>2</sub>) when they give equal amounts of energy.

Which row of the table is correct?

	Most CO <sub>2</sub>		Least CO <sub>2</sub>
<b>A</b>	coal	oil	gas
<b>B</b>	gas	coal	oil
<b>C</b>	gas	oil	coal
<b>D</b>	oil	coal	gas

**7.3** A student writes that:

- sulphur dioxide can be removed from the coal before it is burned;
- sulphur dioxide can be removed from the waste gases;
- sulphur dioxide helps to produce acid rain.

How many of the above points are correct?

- A** None of them
- B** Only one of them
- C** Only two of them
- D** All three of them

**7.4** It is decided to replace the power station with one which:

- is very reliable;
- can be started up very quickly;
- can be used to store the energy from surplus electricity.

The replacement power station needs to be . . .

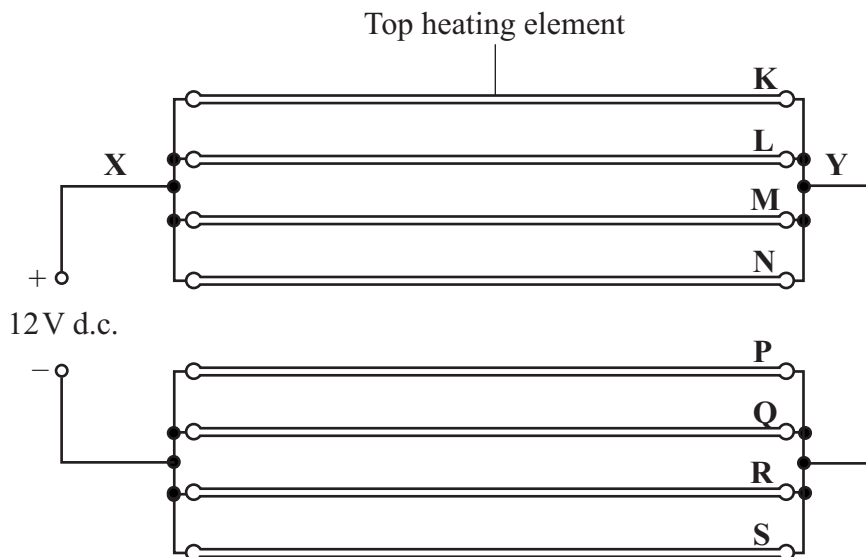
- A** gas-fired.
- B** hydroelectric.
- C** nuclear.
- D** oil-fired.

**Turn over for the next question**

**Turn over ►**

## QUESTION EIGHT

The diagram shows the way in which the eight elements of a car rear-window heater are connected. All the elements are exactly the same.



8.1 How are the elements connected?

- A K, L, M and N are in series, and P, Q, R and S are in series.
- B K, L, M and N are in series with each other but in parallel with P, Q, R and S.
- C K, L, M and N are in parallel with each other but in series with P, Q, R and S, which are in parallel with each other.
- D All eight elements are in parallel with each other.

8.2 Each heating element has a resistance of  $8.0\ \Omega$ .  
The potential difference between X and Y is 6.0 V.

The current in K is . . .

- A 0.19 A
- B 0.75 A
- C 1.33 A
- D 5.33 A



**8.3** The top heating element, **K**, becomes damaged and stops conducting.

Which statement is true?

- A** Each of the elements **L**, **M** and **N** carries the same current as before.
- B** Each of the elements **L**, **M** and **N** carries less current than each of **P**, **Q**, **R** and **S**.
- C** Each of the elements **L**, **M** and **N** carries the same current as each of **P**, **Q**, **R** and **S**.
- D** Each of the elements **L**, **M** and **N** carries more current than each of **P**, **Q**, **R** and **S**.

**8.4** In scientific terms, this type of heater is very efficient because . . .

- A** it does not get wet.
- B** it is difficult to break.
- C** nearly all the energy is transferred as useful energy.
- D** no energy is transferred as sound.

**Turn over for the next question**

**Turn over ►**

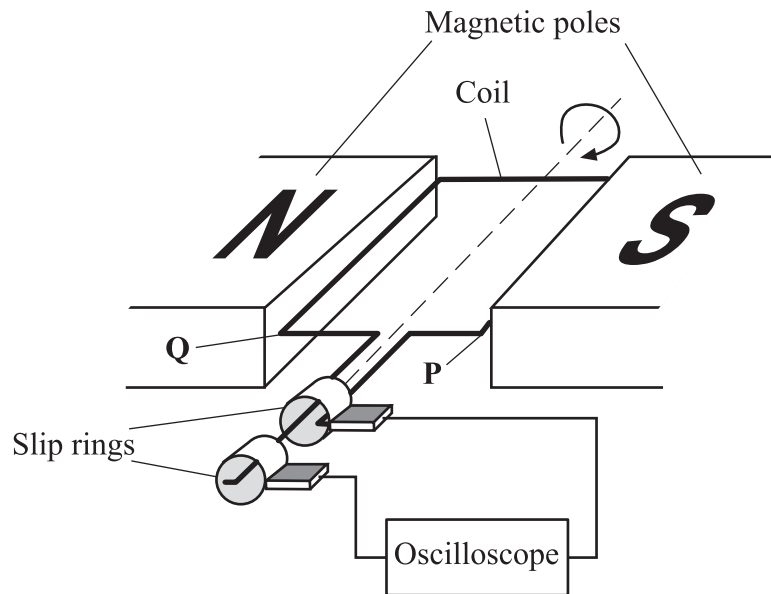
**QUESTION NINE**

The diagram shows a rectangular coil of wire between the poles of a magnet.

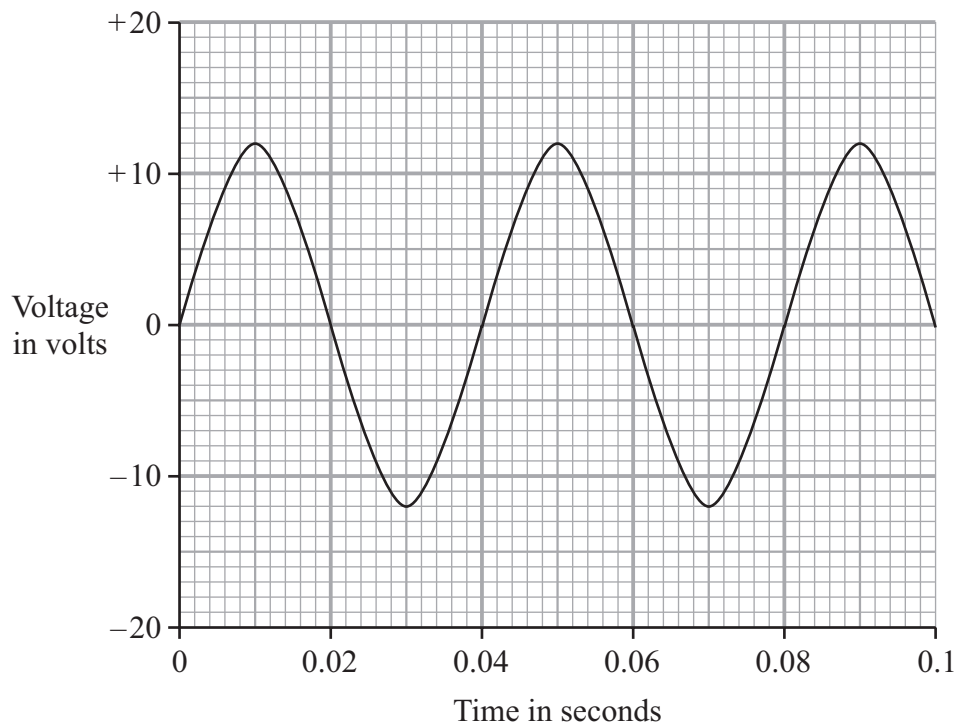
The two ends of the coil are connected to slip rings.

The slip rings make contact with brushes which are connected to an oscilloscope.

The coil is rotated at a steady speed.



**Voltage trace on the oscilloscope**



- 
- 9.1** When does the voltage trace on the oscilloscope cross the 0 volt line?
- A** When the coil is horizontal and only when **P** is to the left of **Q**
  - B** When the coil is horizontal and **P** is either to the left or to the right of **Q**
  - C** When the coil is vertical and only when **P** is above **Q**
  - D** When the coil is vertical and **P** is either above or below **Q**
- 9.2** What makes the height of the voltage trace **smaller**?
- A** Decreasing the time for one complete turn of the coil
  - B** Increasing the number of turns of wire on the coil
  - C** Rotating the coil more slowly
  - D** Using stronger magnets
- 9.3** What is the peak voltage shown by the trace on the oscilloscope?
- A** 0 V
  - B** 6 V
  - C** 12 V
  - D** 24 V
- 9.4** What is the frequency of rotation of the coil?
- A** 8 Hz
  - B** 25 Hz
  - C** 40 Hz
  - D** 50 Hz

Turn over ►

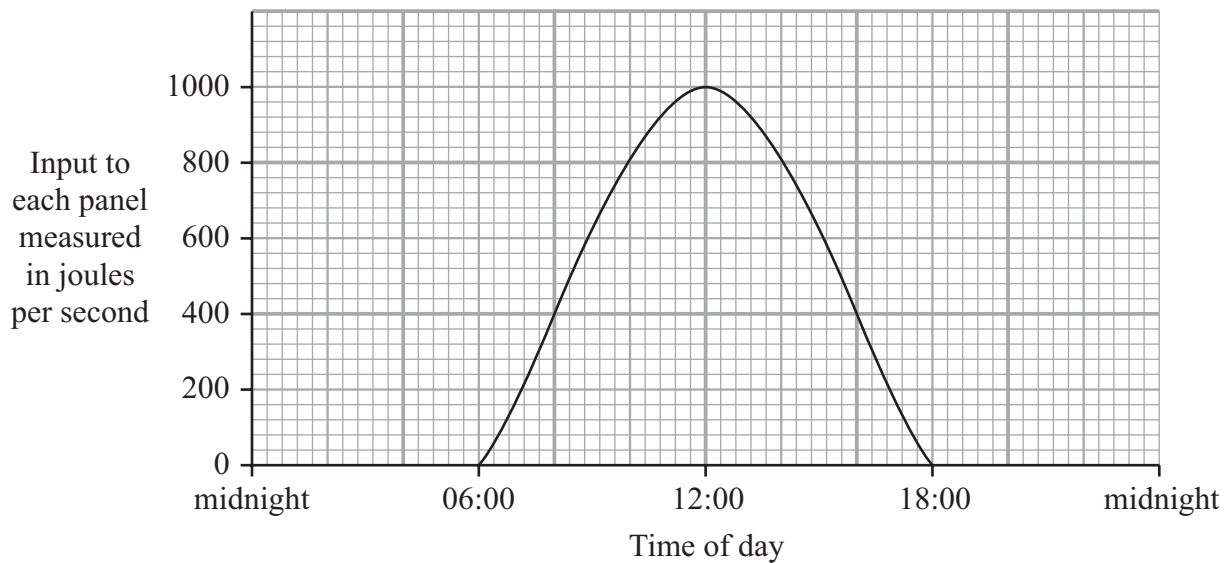
**QUESTION TEN**

A group of scientists expects to work on a remote island for several years.

The scientists have a petrol generator to provide electricity. Fuel and maintenance expenses make the electricity expensive. They are considering installing solar panels.

Each solar panel has an area of  $1\text{m}^2$ . Each costs £500 and transfers 15 % of its energy input as electricity. The scientists carry out experiments to find the average energy input per second to each panel.

The graph shows their average results.



The scientists calculate that, if they install 40 panels, they can change completely to solar power when the energy input is more than 400 joules per second to each panel.

**10.1** Why should the scientists be cautious about installing solar panels?

- A** The capital costs are high.
- B** The costs are higher than for non-renewable batteries.
- C** The longer they are used, the higher the cost of each Unit of electricity they produce.
- D** The running costs are high.

**10.2** For how long each day (on average) will the panels generate enough electricity to replace the petrol generator?

- A 6 hours
- B 8 hours
- C 12 hours
- D 24 hours

**10.3** How much electrical power is generated by each panel when the intensity of the sunlight is 400 joules per second (J/s)?

- A 40 J/s
- B 60 J/s
- C 80 J/s
- D 100 J/s

**10.4** The scientists hope to use the set of 40 panels to generate 7 200 kWh every year.

Averaging the capital costs over 10 years, how much will each Unit of electricity cost?

- A 2.8p
- B 3.6p
- C 7.2p
- D 28.0p

**END OF TEST**

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