

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education  
June 2006

**SCIENCE: DOUBLE AWARD A (MODULAR)**  
**PHYSICS A (MODULAR)**  
**Energy (Module 09)**

**346009**



Tuesday 27 June 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

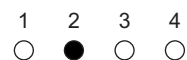
**Instructions**

- 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' 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**

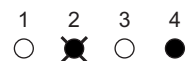
- Use a **black ball-point pen**.

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

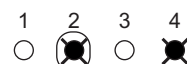


- Do **not** extend beyond the circles.

- 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 12 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.

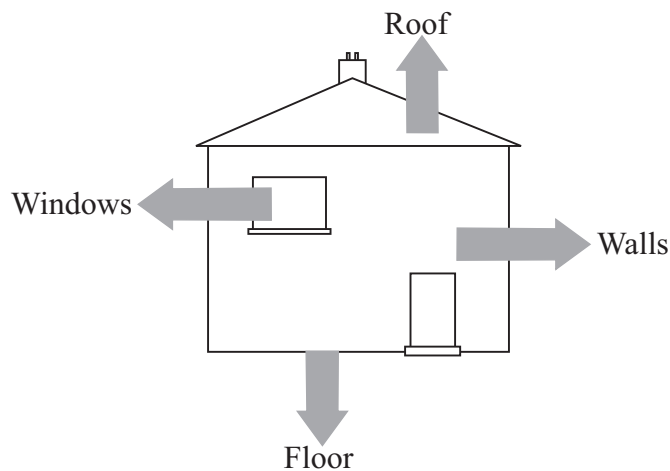
Use **each** answer only **once**.

Mark your choices on the answer sheet.

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### QUESTION ONE

The diagram shows four ways for a house to lose heat.



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

**carpets**

**cavity insulation**

**double glazing**

**loft insulation**

Heat lost through the floor can be reduced by ... **1** ... .

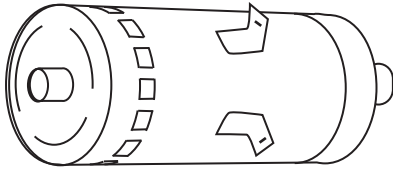
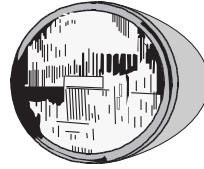
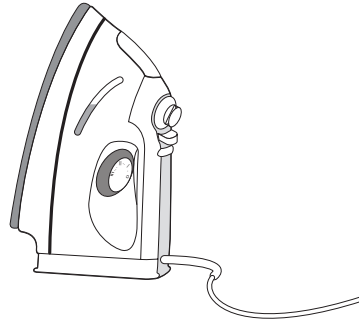
Heat lost through the roof can be reduced by ... **2** ... .

Heat lost through the walls can be reduced by ... **3** ... .

Heat lost through the windows can be reduced by ... **4** ... .

**QUESTION TWO**

The drawings show devices which are designed to transfer energy.

**Car generator****Car headlamp****Food mixer****Iron**

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

**electrical****heat****light****movement**

<b>Device</b>	<b>Output energy wanted</b>
car generator	<b>1</b>
car headlamp	<b>2</b>
food mixer	<b>3</b>
iron	<b>4</b>

**Turn over ►**

**QUESTION THREE**

Electricity can be generated from different energy resources.

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

**coal**

**geothermal**

**hydroelectric**

**uranium**

<b>How the resource is used in power stations</b>	<b>Energy resource</b>
burned in a conventional power station	<b>1</b>
used as the fuel in a nuclear power station	<b>2</b>
uses energy released in volcanic areas	<b>3</b>
uses liquid water to drive turbines	<b>4</b>

**QUESTION FOUR**

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

$$\text{total cost} = \text{number of Units} \times \text{cost per Unit}$$

A householder reads the electricity meter to find out how much the bill will be.

Match numbers from the list with the spaces **1–4** in the calculations.

**108**

**1200**

**3956**

**5156**

Meter reading in January = ... **1** ...

Meter reading in April = ... **2** ...

Units used = ... **3** ...

Total cost at 9 p per Unit = £ ... **4** ...

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**QUESTION FIVE**

The table shows the useful energy transfers produced by four devices.

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

**cordless drill**

**loudspeaker**

**microphone**

**torch**

<b>Useful energy transfer</b>	<b>Device</b>
chemical energy → electrical energy → light	<b>1</b>
chemical energy → electrical energy → kinetic energy	<b>2</b>
electrical energy → kinetic energy → sound	<b>3</b>
sound → kinetic energy → electrical energy	<b>4</b>

**Turn over for the next question**

**Turn over ►**

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**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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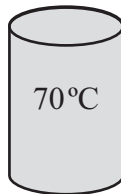
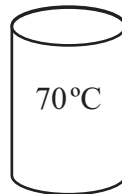
**QUESTION SIX**

The three blocks in the diagram are the same size and are made of the same material. They have different surfaces. Their temperatures are marked on the diagram.

Dull matt surface

Shiny surface

Dull matt surface

**X****Y****Z**

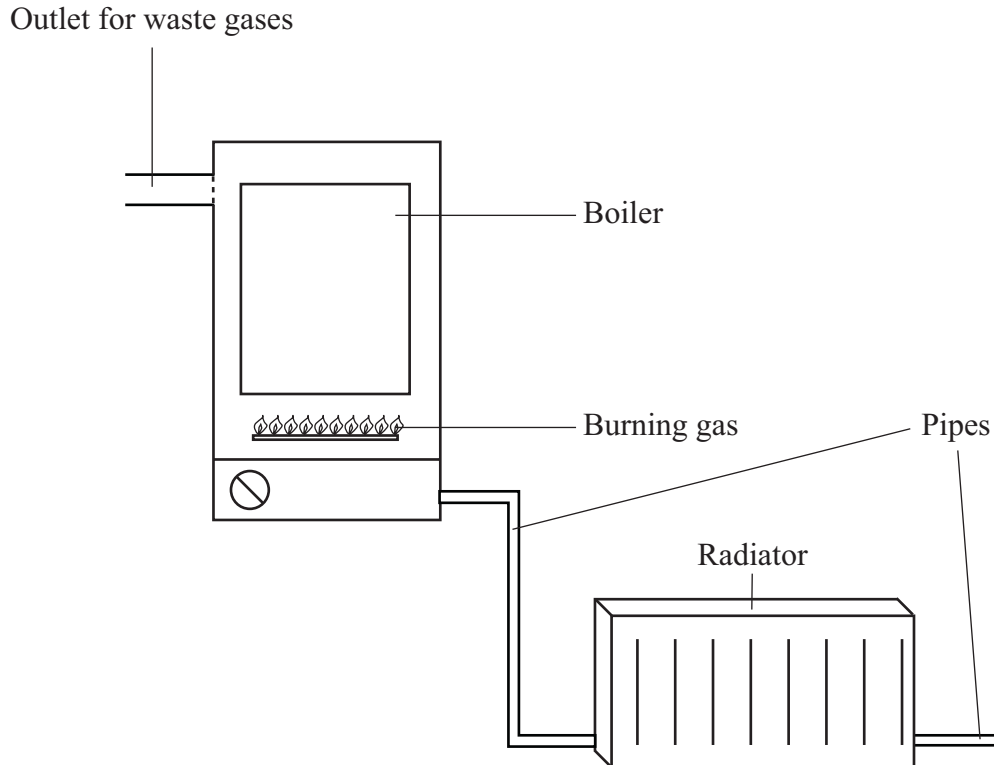
The statements are about the amounts of infra red radiation given off per second.

Which **two** statements must be correct?

**Y gives off less than X****Y gives off more than X****Y gives off more than Z****Z gives off less than X****Z gives off more than X**

**QUESTION SEVEN**

The diagram shows part of a gas central heating system. The water is heated in the boiler and pumped to a radiator in a room where the heat is needed.



Which **two** statements **J**, **K**, **L**, **M** and **N** are correct?

- J** a light-coloured shiny radiator gives out more heat than a dark-coloured dull radiator
- K** all the heat from the burning gas is absorbed by the water
- L** heat is wasted through the outlet for waste gases
- M** insulating the pipes reduces heat loss
- N** the system can be made 100 % efficient

Turn over ►

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

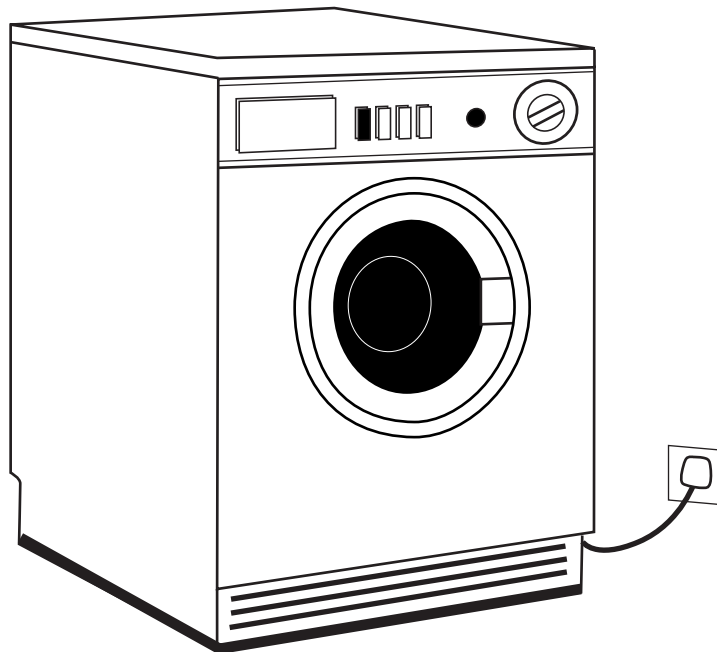
Each of these questions has four parts.

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

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**QUESTION EIGHT**

A washing machine is designed to transfer electrical energy as other useful forms of energy.  
Some of the energy is wasted.



**8.1** The washing machine is designed to transfer energy usefully as . . .

- A** kinetic and heat.
- B** kinetic and sound.
- C** kinetic, sound and heat.
- D** sound and heat.



**8.2** Which one of the following is a wasted energy transfer in the washing machine?

- A Heating the water
- B Making the machine vibrate
- C Rinsing the clothes
- D Spinning the clothes

**8.3** All the energy transferred by the washing machine eventually goes to the surroundings.

When this happens, the energy . . .

- A can easily be used for other transfers.
- B cleans clothes.
- C disappears.
- D is too spread out to be useful.

**8.4** Another washing machine is more efficient.

The scientific meaning of this is that the more efficient washing machine . . .

- A cleans clothes more quickly.
- B makes clothes cleaner.
- C transfers less energy.
- D wastes a smaller proportion of the energy supplied.

**Turn over for the next question**

**Turn over ►**

**QUESTION NINE**

A company needs to build a new power station. It considers five types: coal-fired, gas-fired, nuclear, oil-fired and wind farm. Each of these types has disadvantages.

**9.1** Which two types of power station would increase the greenhouse effect?

- A** Coal-fired and gas-fired
- B** Coal-fired and nuclear
- C** Gas-fired and nuclear
- D** Gas-fired and wind farm

**9.2** Which type of power station would produce the most gases that cause acid rain?

- A** Coal-fired
- B** Gas-fired
- C** Nuclear
- D** Wind farm

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

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

**9.4** The amount of electricity that can be generated by a wind farm . . .

- A** is constant all the year round.
- B** is greater in summer than in winter.
- C** varies in a monthly cycle.
- D** varies throughout the year.

---

**QUESTION TEN**

This question is about power stations.

**10.1** The source of energy for geothermal power stations is . . .

- A combustion.
- B decay of radioactive elements.
- C movement of air.
- D movement of water.

**10.2** The gas mainly responsible for causing acid rain is . . .

- A natural gas.
- B nitrogen.
- C oxygen.
- D sulphur dioxide.

**10.3** What is an advantage of a tidal barrage over a wind farm?

- A More power is produced at times of high demand.
- B More power is produced in winter than in summer.
- C The times and sizes of outputs for each day are more reliable.
- D There are no environmental impacts.

**10.4** When 100 tonnes of coal are burned in 1 hour, 700 000 kilowatts of power are produced.

How quickly must the coal be burned to produce 7 000 000 kilowatts?

- A 100 tonnes in 5 minutes
- B 100 tonnes in 6 minutes
- C 100 tonnes in 7 minutes
- D 100 tonnes in 8 minutes

**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

The table shows the useful energy transfers produced by four devices.

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

**cordless drill**

**loudspeaker**

**microphone**

**torch**

Useful energy transfer	Device
chemical energy → electrical energy → light	<b>1</b>
chemical energy → electrical energy → kinetic energy	<b>2</b>
electrical energy → kinetic energy → sound	<b>3</b>
sound → kinetic energy → electrical energy	<b>4</b>

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**QUESTION TWO**

Electricity can be generated by different methods.

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

**gas-fired power station**

**hydroelectric power station**

**nuclear power station**

**set of wind turbines and generators**

<b>Method</b>	<b>Description</b>
<b>1</b>	costs of construction and decommissioning are high but fuel costs are low
<b>2</b>	electricity can be generated when needed and fuel costs are zero
<b>3</b>	for each Unit of electricity produced, releases less carbon dioxide than other fossil fuel burning power stations
<b>4</b>	the supply of electricity is unreliable but fuel costs are zero

**Turn over for the next question**

**Turn over ►**

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**SECTION B**

Questions **THREE** and **FOUR**.

In these questions choose the best **two** answers.

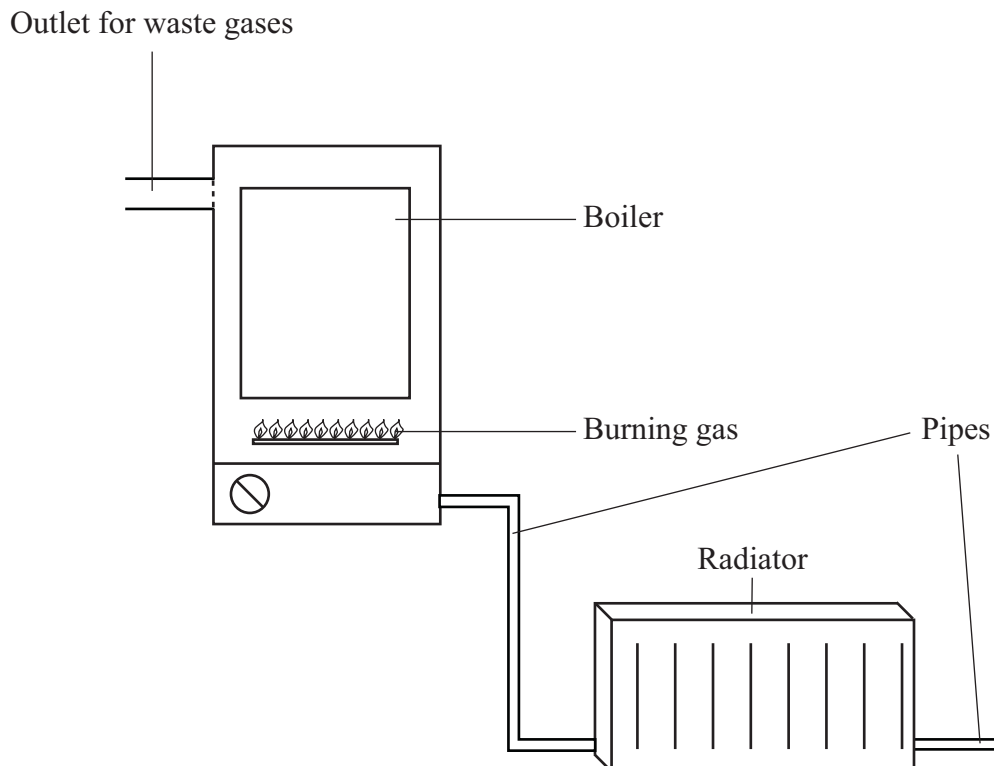
Do **not** choose more than two.

Mark your choices on the answer sheet.

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**QUESTION THREE**

The diagram shows part of a gas central heating system. The water is heated in the boiler and pumped to a radiator in a room where the heat is needed.



Which **two** statements **J**, **K**, **L**, **M** and **N** are correct?

- J** a light-coloured shiny radiator gives out more heat than a dark-coloured dull radiator
- K** all the heat from the burning gas is absorbed by the water
- L** heat is wasted through the outlet for waste gases
- M** insulating the pipes reduces heat loss
- N** the system can be made 100 % efficient

**QUESTION FOUR**

Heat energy can be transferred by conduction.

Which **two** endings could correctly complete the sentence?

Heat is conducted through metals because of . . .

**changes in density.**

**collisions between particles.**

**expansion.**

**infra red waves.**

**the movement of free electrons.**

**Turn over for the next question**

**Turn over ►**

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

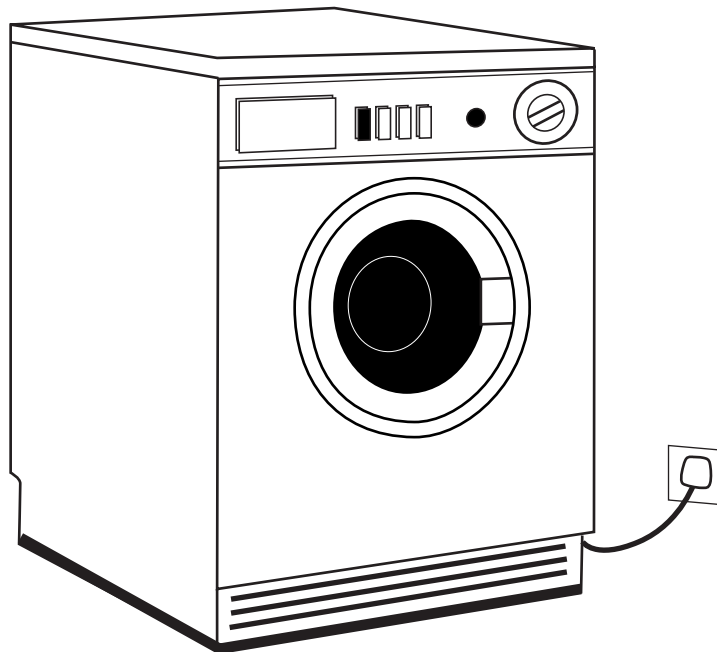
Each of these questions has four parts.

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

---

**QUESTION FIVE**

A washing machine is designed to transfer electrical energy as other useful forms of energy. Some of the energy is wasted.



**5.1** The washing machine is designed to transfer energy usefully as . . .

- A** kinetic and heat.
- B** kinetic and sound.
- C** kinetic, sound and heat.
- D** sound and heat.



**5.2** Which one of the following is a wasted energy transfer in the washing machine?

- A** Heating the water
- B** Making the machine vibrate
- C** Rinsing the clothes
- D** Spinning the clothes

**5.3** All the energy transferred by the washing machine eventually goes to the surroundings.

When this happens, the energy . . .

- A** can easily be used for other transfers.
- B** cleans clothes.
- C** disappears.
- D** is too spread out to be useful.

**5.4** Another washing machine is more efficient.

The scientific meaning of this is that the more efficient washing machine . . .

- A** cleans clothes more quickly.
- B** makes clothes cleaner.
- C** transfers less energy.
- D** wastes a smaller proportion of the energy supplied.

**Turn over for the next question**

**Turn over ►**

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**QUESTION SIX**

A company needs to build a new power station. It considers five types: coal-fired, gas-fired, nuclear, oil-fired and wind farm. Each of these types has disadvantages.

**6.1** Which two types of power station would increase the greenhouse effect?

- A Coal-fired and gas-fired
- B Coal-fired and nuclear
- C Gas-fired and nuclear
- D Gas-fired and wind farm

**6.2** Which type of power station would produce the most gases that cause acid rain?

- A Coal-fired
- B Gas-fired
- C Nuclear
- D Wind farm

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

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

**6.4** The amount of electricity that can be generated by a wind farm . . .

- A is constant all the year round.
- B is greater in summer than in winter.
- C varies in a monthly cycle.
- D varies throughout the year.

---

**QUESTION SEVEN**

This question is about power stations.

- 7.1** The source of energy for geothermal power stations is . . .
- A** combustion.
  - B** decay of radioactive elements.
  - C** movement of air.
  - D** movement of water.
- 7.2** The gas mainly responsible for causing acid rain is . . .
- A** natural gas.
  - B** nitrogen.
  - C** oxygen.
  - D** sulphur dioxide.
- 7.3** What is an advantage of a tidal barrage over a wind farm?
- A** More power is produced at times of high demand.
  - B** More power is produced in winter than in summer.
  - C** The times and sizes of outputs for each day are more reliable.
  - D** There are no environmental impacts.
- 7.4** When 100 tonnes of coal are burned in 1 hour, 700 000 kilowatts of power are produced.
- How quickly must the coal be burned to produce 7 000 000 kilowatts?
- A** 100 tonnes in 5 minutes
  - B** 100 tonnes in 6 minutes
  - C** 100 tonnes in 7 minutes
  - D** 100 tonnes in 8 minutes

**Turn over ►**

**QUESTION EIGHT**

The table gives some information about the insulation of a house.

Part of house	Area (in m <sup>2</sup> )	Type of insulation	Heat (in joules) escaping through 1 m <sup>2</sup> in 1 second for every 1 °C that it is warmer inside than it is outside	
			Without insulation	With insulation
Floors	120	Carpet with underlay	1	0.4
Roof	120	Fibreglass in loft	2	0.3
Walls	210	Foam in cavities	1	0.5
Windows	40	Double glazing	5	2.5

**8.1** How do insulators help to conserve energy?

- A By reducing heat escaping by conduction
- B By reducing heat escaping by convection
- C By reducing heat escaping by conduction and convection
- D By reducing heat escaping by conduction and convection and radiation

**8.2** Which insulator reduces the energy escaping through it by the biggest percentage?

- A Carpet with underlay
- B Fibreglass in loft
- C Foam in cavities
- D Double glazing

**8.3** It is  $10^{\circ}\text{C}$  warmer inside than outside.

The loft has not been insulated.

How much heat escapes through the roof each second?

**A** 120 J

**B** 240 J

**C** 1200 J

**D** 2400 J

**8.4** With all four types of insulation in place, where will the most heat escape?

**A** Through the floors

**B** Through the roof

**C** Through the walls

**D** Through the windows

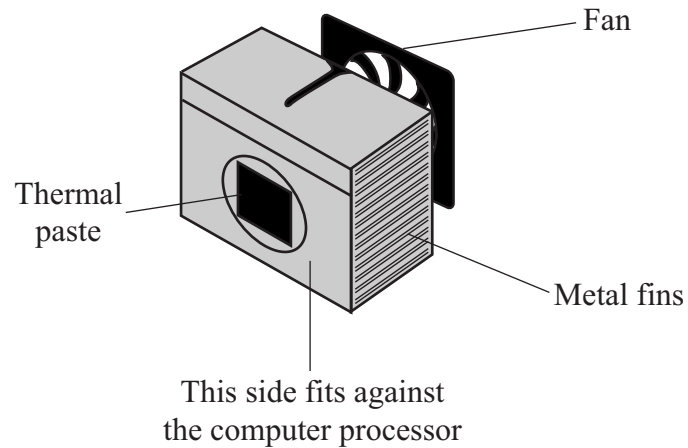
**Turn over for the next question**

**Turn over ►**

**QUESTION NINE**

The drawing shows a fan-assisted cooler designed to be fitted inside a computer.

The thermal paste ensures that heat can transfer easily from the computer's processor.



**9.1** The metal fins are painted black to . . .

- A increase heat transfer by conduction.
- B increase heat transfer by radiation.
- C reduce heat transfer by conduction.
- D reduce heat transfer by radiation.

**9.2** The thermal paste is there to . . .

- A decrease the transfer of heat by conduction.
- B decrease the transfer of heat by radiation.
- C increase the transfer of heat by conduction.
- D increase the transfer of heat by radiation.

**9.3** Which process or processes is/are aided by the fan?

- A** Conduction only
- B** Convection and conduction
- C** Radiation and conduction
- D** Radiation only

**9.4** What causes the heat transfer through the metal fins?

- A** Electrons which collide with both ions and other electrons
- B** Electrons which do not collide with either ions or other electrons
- C** Ions which collide with both electrons and other ions
- D** Ions which do not collide with either electrons or other ions

**Turn over for the next question**

**Turn over ►**

**QUESTION TEN**

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

$$\begin{array}{ccccc} \text{energy transferred} & = & \text{power} & \times & \text{time} \\ \text{(kilowatt-hour, kWh)} & & \text{(kilowatt, kW)} & & \text{(hour, h)} \end{array}$$

An African village is a long distance from a supply of mains electricity.  
The Sun shines brightly for at least a few hours nearly every day.  
The people want a supply of electricity for their radio receiver.

The table shows the costs of two different ways of providing the electricity for twenty years.

	<b>Equipment cost</b>	<b>Cost of a set of batteries</b>	<b>Number of sets of batteries needed</b>
Solar cells and rechargeable batteries	£50.00	£10.00	4
Non-rechargeable batteries	zero	£2.50	80

**10.1** What are the total costs?

	<b>Solar cells and rechargeable batteries</b>	<b>Non-rechargeable batteries</b>
<b>A</b>	£60	£160
<b>B</b>	£60	£200
<b>C</b>	£90	£180
<b>D</b>	£90	£200

**10.2** A disadvantage of using solar cells and rechargeable batteries is that . . .

- A** new batteries are needed more often.
- B** the radio could not be used at night.
- C** they are more expensive in the first place.
- D** they are more expensive in the long run.



**10.3** When they are used in the UK, solar cells produce, on average, only 10 % of their maximum output. A set of solar cells has a maximum output of 1 kW. It costs £12 000 and has an expected life of 240 000 hours. The cells need no maintenance.

Calculate the cost of each Unit (kWh) of electricity produced by the cells.

- A 20p
- B 25p
- C 40p
- D 50p

**10.4** Which of the following would make the electricity from solar cells cheaper, compared with the electricity from power stations?

- A A decrease in the cost of fuel for power stations
- B Developing other energy resources
- C Developing solar cells with a higher efficiency for the same price
- D Reducing energy losses from power stations

**END OF TEST**

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