

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education  
March 2006

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

**346009**



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

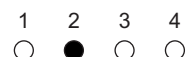
**Instructions**

- 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' 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**

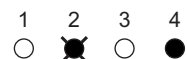
- Use a **black ball-point pen**.

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

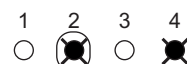


- Do **not** extend beyond the circles.

- 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

Energy is supplied to a microwave oven by mains electricity.

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

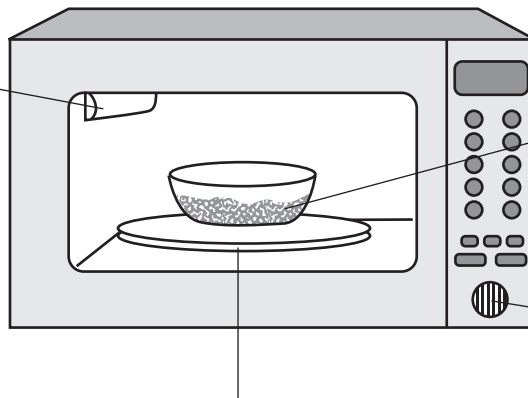
**heat**

**light**

**movement**

**sound**

The useful output  
from the lamp  
is ... **1** ...



Microwaves  
transfer energy  
as ... **4** ...

The useful output  
from the bleeper  
is ... **3** ...

The useful output from the electric motor  
for the turntable is ... **2** ...

---

**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**

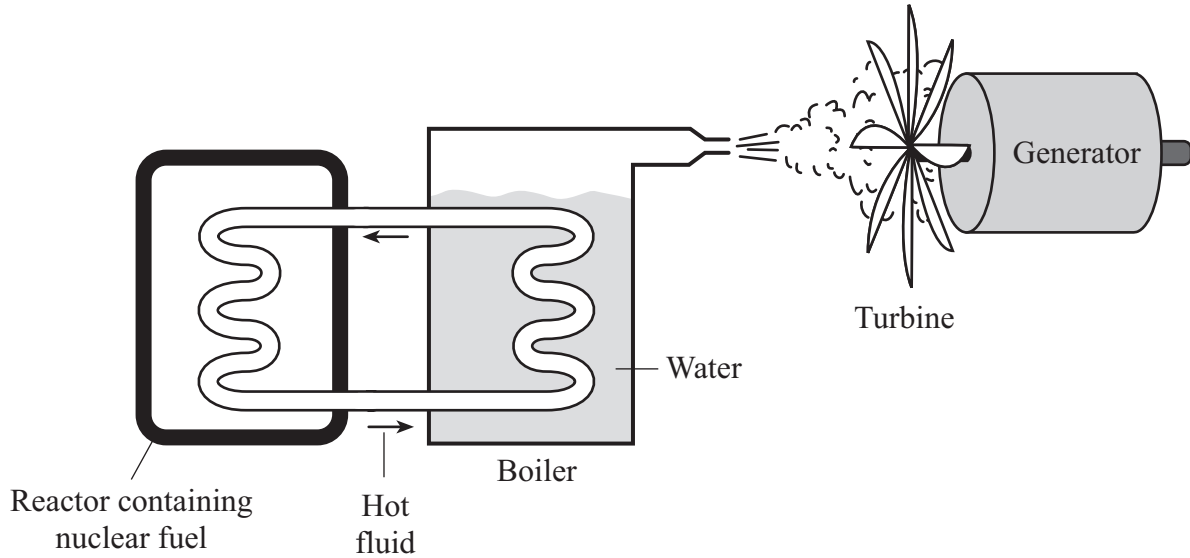
<b>Electrical appliance</b>	<b>Useful energy output</b>
Computer screen	<b>1</b>
Food mixer	<b>2</b>
Kettle	<b>3</b>
Radio	<b>4</b>

**Turn over for the next question**

**Turn over ►**

**QUESTION THREE**

The diagram shows the main parts of a nuclear power station.



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

**electricity**

**movement (kinetic)**

**steam**

**uranium**

The energy source for this power station is . . . **1** . . . .

The turbine is driven by . . . **2** . . . .

The turbine transfers . . . **3** . . . energy to the generator.

The generator transfers energy to homes and factories as . . . **4** . . . .

## 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** ... .

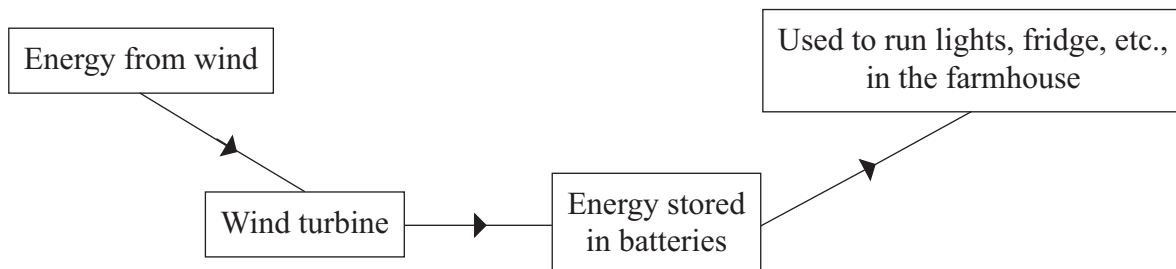
Pans often have lids. Lids reduce heat loss due to ... **2** ... .

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

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

## QUESTION FIVE

A farmhouse gets its electrical energy by using the wind.



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

**battery**

**energy**

**power**

**turbine**

The wind ... **1** ... system transfers its output to a ... **2** ... storage system.

Its average output is 4kW. This means that 4kW of ... **3** ... gives 4kWh of ... **4** ... in one hour.

**Turn over ►**

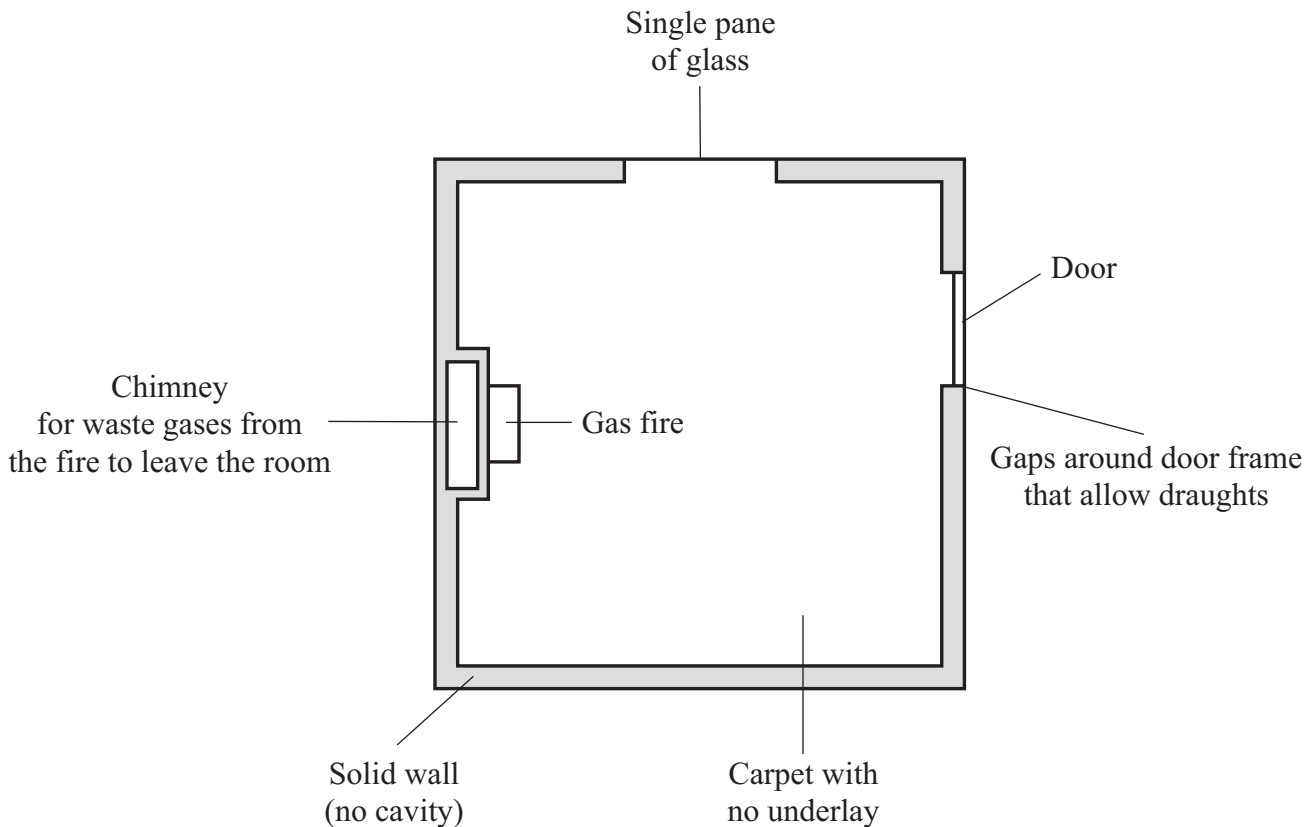
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**SECTION B**Questions **SIX** and **SEVEN**.In these questions choose the best **two** answers.Do **not** choose more than two.Mark your choices on the answer sheet.

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**QUESTION SIX**

The 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

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**QUESTION SEVEN**

The fire-fighter is dressed in a shiny, white, fire-retarding suit.



Which **two** statements **P**, **Q**, **R**, **S** and **T** explain the reasons for choosing shiny, white suits rather than matt, black suits?

- P** matt, black suits are good absorbers of radiation
- Q** matt, black suits are good reflectors of radiation
- R** shiny, white suits are good absorbers of radiation
- S** shiny, white suits are good emitters of radiation
- T** shiny, white suits are good reflectors of radiation

**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.

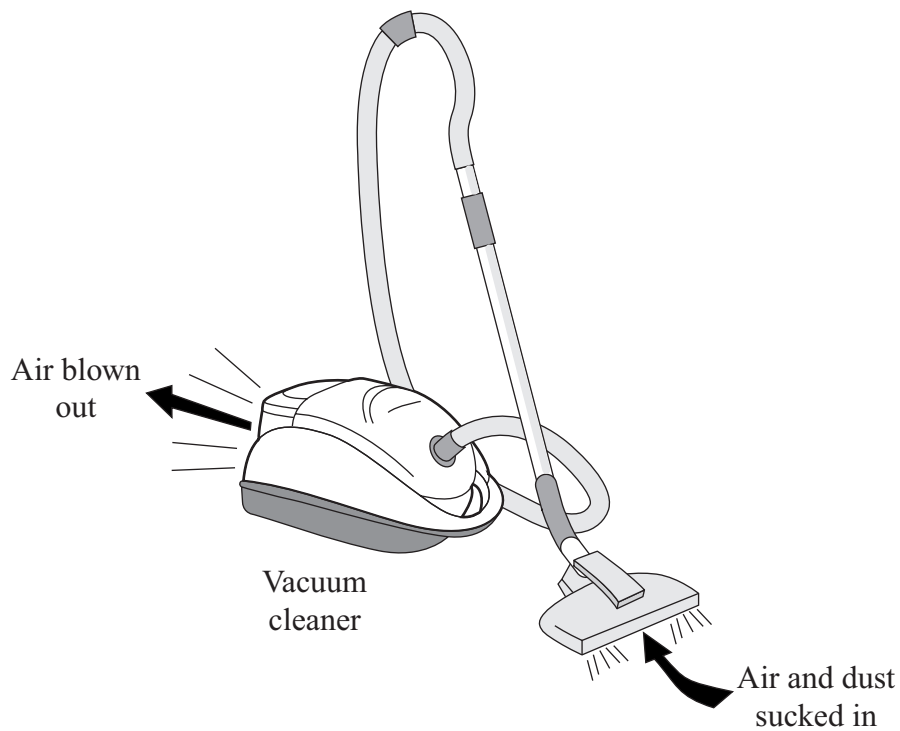
In each part choose only **one** answer.Mark your choices on the answer sheet.

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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



**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 ►**

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**QUESTION NINE**

A power station generates electricity by making use of the rise and fall of sea level.

**9.1** This power station will use . . .

- A** a tidal barrage.
- B** the Sun's radiation.
- C** uranium or plutonium.
- D** wind energy.

**9.2** The useful energy transfers in this power station are . . .

- A** gravitational potential → kinetic → electrical.
- B** heat → kinetic → electrical.
- C** kinetic → gravitational potential → electrical.
- D** kinetic → heat → electrical.

**9.3** This type of power station usually . . .

- A** destroys the habitat of wading birds.
- B** needs a dam built across an upland river valley.
- C** needs to be built on a hill.
- D** produces dangerous waste.

**9.4** What is the energy output of a 4 megawatt power station?

- A** 4 million joules per second
- B** 4 million newtons per second
- C** 4 million Units per second
- D** 4 million watts per second

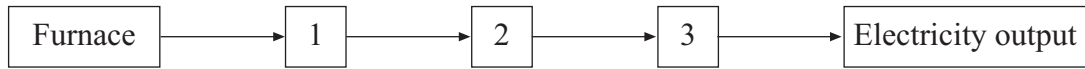
**Turn over for the next question**

**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.

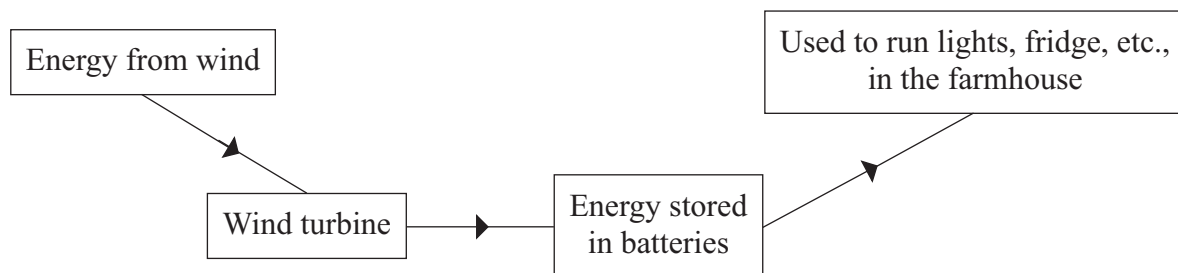
Use **each** answer only **once**.

Mark your choices on the answer sheet.

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#### QUESTION ONE

A farmhouse gets its electrical energy by using the wind.



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

**battery**

**energy**

**power**

**turbine**

The wind . . . **1** . . . system transfers its output to a . . . **2** . . . storage system.

Its average output is 4 kW. This means that 4 kW of . . . **3** . . . gives 4 kWh of . . . **4** . . . in one hour.

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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 ►**

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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.

---

**QUESTION THREE**

The fire-fighter is dressed in a shiny, white, fire-retarding suit.

Which **two** statements **P**, **Q**, **R**, **S** and **T** explain the reasons for choosing shiny, white suits rather than matt, black suits?

- P** matt, black suits are good absorbers of radiation
- Q** matt, black suits are good reflectors of radiation
- R** shiny, white suits are good absorbers of radiation
- S** shiny, white suits are good emitters of radiation
- T** shiny, white suits are good reflectors of radiation



**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.

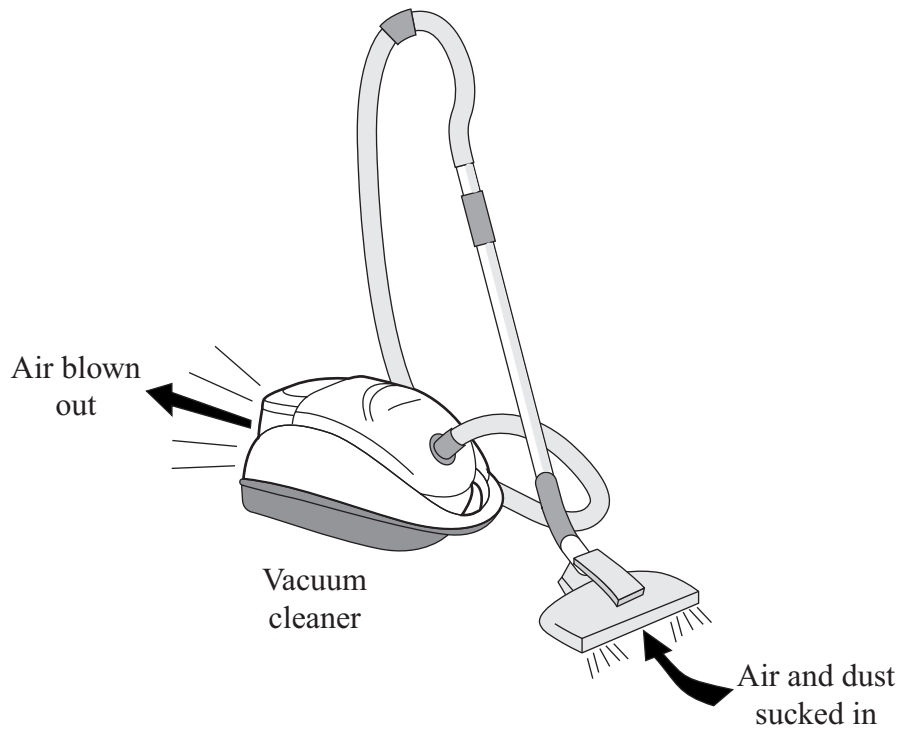
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**QUESTION FIVE**

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 ►**

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**QUESTION SIX**

A power station generates electricity by making use of the rise and fall of sea level.

**6.1** This power station will use . . .

- A** a tidal barrage.
- B** the Sun's radiation.
- C** uranium or plutonium.
- D** wind energy.

**6.2** The useful energy transfers in this power station are . . .

- A** gravitational potential → kinetic → electrical.
- B** heat → kinetic → electrical.
- C** kinetic → gravitational potential → electrical.
- D** kinetic → heat → electrical.

**6.3** This type of power station usually . . .

- A** destroys the habitat of wading birds.
- B** needs a dam built across an upland river valley.
- C** needs to be built on a hill.
- D** produces dangerous waste.

**6.4** What is the energy output of a 4 megawatt power station?

- A** 4 million joules per second
- B** 4 million newtons per second
- C** 4 million Units per second
- D** 4 million watts per second

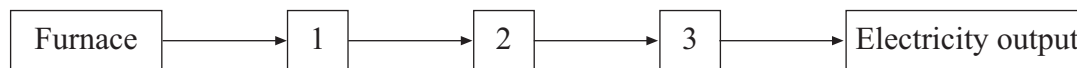
**Turn over for the next question**

**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 . . .

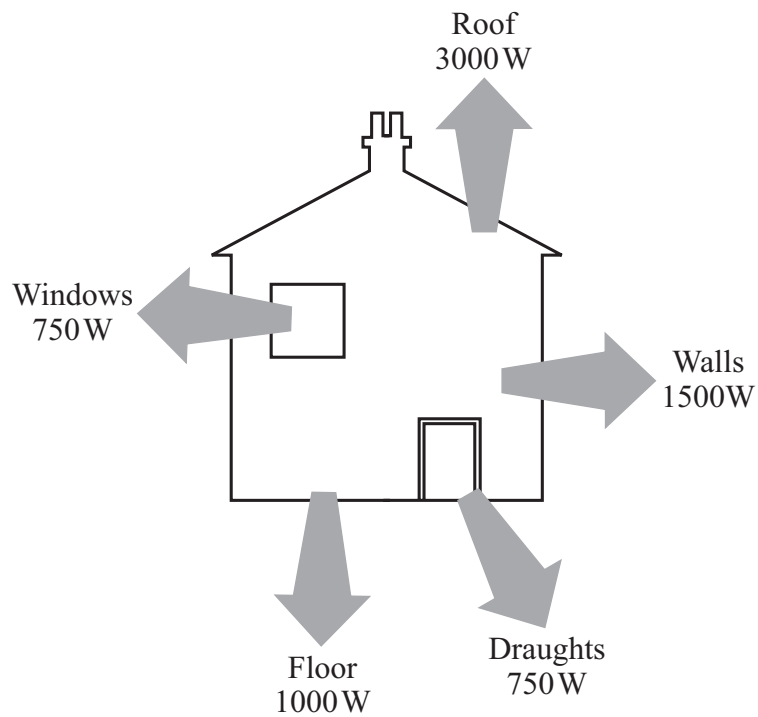
- A** gas-fired.
- B** hydroelectric.
- C** nuclear.
- D** oil-fired.

**Turn over for the next question**

**Turn over ►**

**QUESTION EIGHT**

The diagram shows how energy is lost from a house.



**8.1** Heat is lost from the house by . . .

- A** conduction only.
- B** convection only.
- C** convection and radiation only.
- D** conduction, convection and radiation.



A house owner looks for ways of reducing these energy losses.  
The table shows the costs for different types of insulation.

	Type of insulation	Insulation cost in £	Energy loss before installation	% reduction in energy loss by this route after insulation
<b>A</b>	Double glazing	4000	750 W	33
<b>B</b>	Floor insulation	300	1000 W	25
<b>C</b>	Loft insulation	200	3000 W	33
<b>D</b>	Wall insulation	600	1500 W	50

- 8.2** Which type of insulation, **A**, **B**, **C**, or **D**, saves most energy?
- 8.3** Which type of insulation, **A**, **B**, **C**, or **D**, saves the most energy for each pound (£) spent?
- 8.4** The house owner decides to insulate the walls, floor and loft only.

In the first year, the saving on the heating bill is £400.

Heating prices stay constant.

The total time taken to recover the installation costs is . . .

- A** 0.36 years.
- B** 2.75 years.
- C** 12.75 years.
- D** 13.125 years.

**Turn over for the next question**

**Turn over ►**

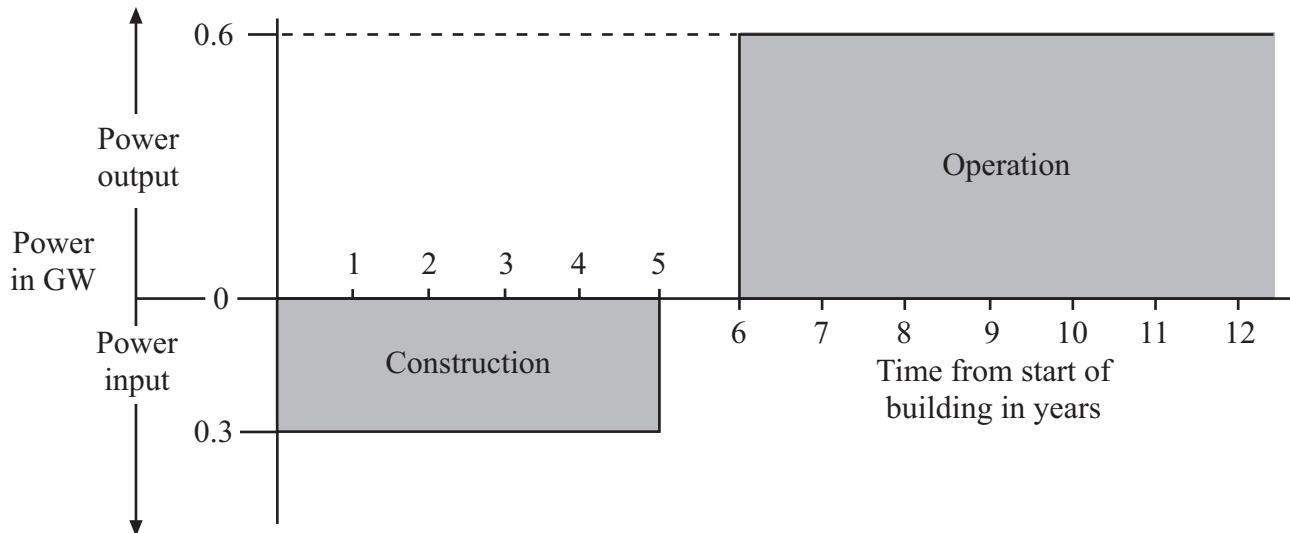
**QUESTION NINE**

Electricity can be generated in various ways. The main power stations in the UK use fossil fuels (coal, oil and gas) or nuclear fuels. Geothermal power stations are used in some other countries.

- 9.1** What is the source of energy for geothermal power stations?
- A** Combustion
  - B** Movement of air
  - C** Movement of water
  - D** Radioactive decay
- 9.2** Which one of the following is a strong argument **against** nuclear power stations?
- A** For maximum efficiency, they have to be in nearly constant use.
  - B** They have high decommissioning costs.
  - C** They have high fuel costs.
  - D** They produce gases that pollute the atmosphere.
- 9.3** We should make more use of wind power instead of nuclear or fossil fuel power stations.
- Which statement supports this view?
- A** Fossil fuel and nuclear power stations are needed when the wind drops.
  - B** Large wind farms can be unsightly and noisy.
  - C** The fuel cost of wind farms is zero.
  - D** Wind farms use large areas of land.

- 9.4** A nuclear power station takes a long time to build. Power is used in its construction. This power and the power produced by the station are shown in the graph.

The shaded areas give the energy used or produced.



After a number of years, from the start of building, the power station will start to produce more energy than was used to build it.

How long does this take?

- A** 7 years
- B** 7.5 years
- C** 8 years
- D** 8.5 years

**Turn over for the next question**

**Turn over ►**

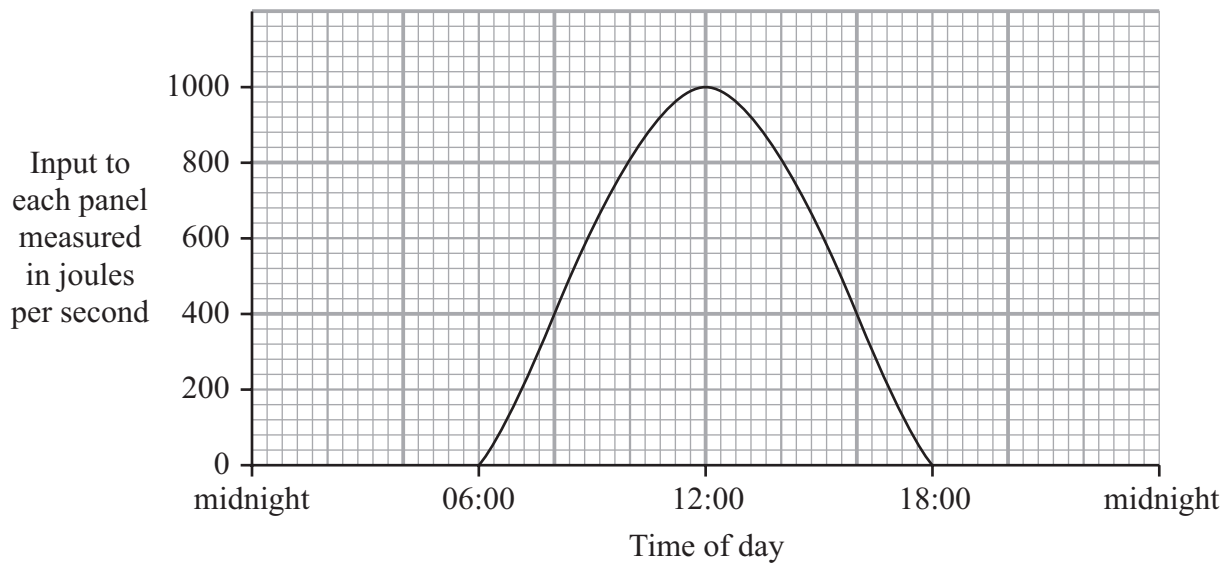
**QUESTION TEN**

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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