Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

General Certificate of Secondary Education
March 2008

SCIENCE A **PHY1AP**
Unit Physics P1a (Energy and Electricity)

PHYSICS
Unit Physics P1a (Energy and Electricity)

Wednesday 5 March 2008 Morning Session

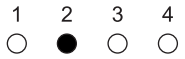
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

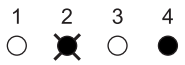
Time allowed: 30 minutes

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 'Physics Unit 1a' 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.

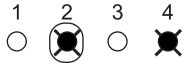
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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.

You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Higher Tier starts on page 14 of this booklet.

FOUNDATION TIER

SECTION ONE

Questions **ONE** to **SIX**.

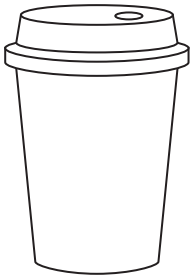
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

Polystyrene cups are designed to keep drinks hot.



Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A conduction

B convection

C insulation

D radiation

The white colour of the cup reduces heat loss by . . . **1** . . . .

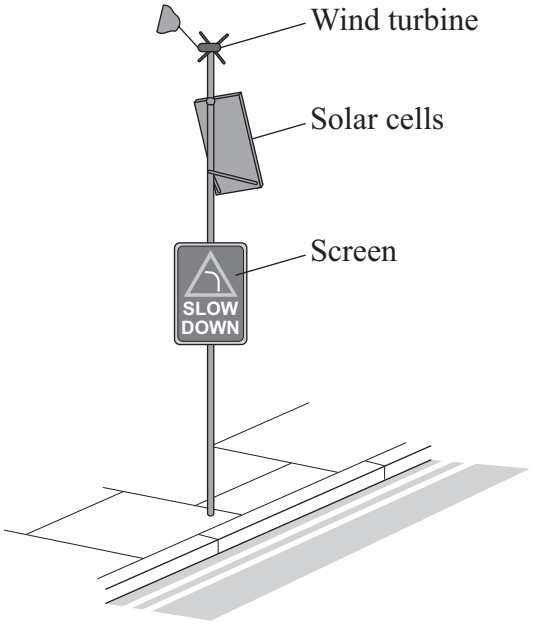
The lid reduces heat loss by . . . **2** . . . .

Polystyrene is a material that reduces heat loss by . . . **3** . . . .

Making the cup from thicker polystyrene would improve the . . . **4** . . . .

QUESTION TWO

The diagram shows an electronic road sign.



Match types of energy, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A electrical energy

B thermal energy

C light energy

D kinetic energy

The useful energy output from the screen is . . . **1** . . . .

The energy input to the wind turbine is . . . **2** . . . .

The useful energy output from the solar cells is . . . **3** . . . .

The wasted energy output from the road sign is . . . **4** . . . .

QUESTION THREE

Generating electricity causes problems for the environment.

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A acid rain

B global warming

C noise pollution

D radioactive waste

Nuclear power stations produce . . . **1** . . . .

Wind farms produce . . . **2** . . . .

Coal-fired power stations produce sulfur dioxide which causes . . . **3** . . . .

All fossil-fuel power stations produce carbon dioxide which causes . . . **4** . . . .

QUESTION FOUR

The table shows the percentage of electricity generated from some energy sources between 1960 and 2000.

	Percentage of electricity generated from each energy source			
Year	**Coal**	**Oil**	**Natural gas**	**Renewable sources**
1960	74.0	25.4	0	0
1980	36.7	37.0	21.6	0
2000	14.7	39.2	33.2	0.7

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A coal

B natural gas

C oil

D renewable sources

1	the energy source from which most electricity was produced in 1980
2	the energy source the use of which decreased between 1960 and 2000
3	the energy source that was first used between 1980 and 2000
4	the energy source the use of which increased by approximately 50% between 1980 and 2000

Turn over for the next question

QUESTION FIVE

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)
total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

The diagram shows the readings on a household electricity meter at the start and at the end of a day.

At the start of the day At the end of the day

Each kilowatt-hour of electricity costs 11 p.

Match figures, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A 10

B 44

C 56

D 2000

The total amount of electricity transferred during the day was . . . **1** . . . kWh.

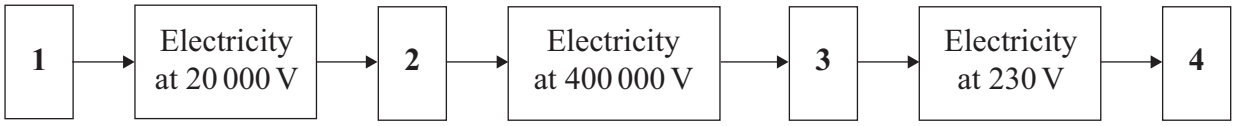
The energy transferred by a 2 kW fire is . . . **2** . . . joules per second.

The amount of energy transferred by a 2 kW fire in 5 hours is . . . **3** . . . kWh.

The total cost of using a 2 kW fire for 2 hours is . . . **4** . . . p.

QUESTION SIX

The block diagram shows how electricity is distributed in this country.



Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the diagram.

A house

B power station

C step-down transformer

D step-up transformer

Turn over for the next question

SECTION TWO

Questions **SEVEN** to **NINE**.

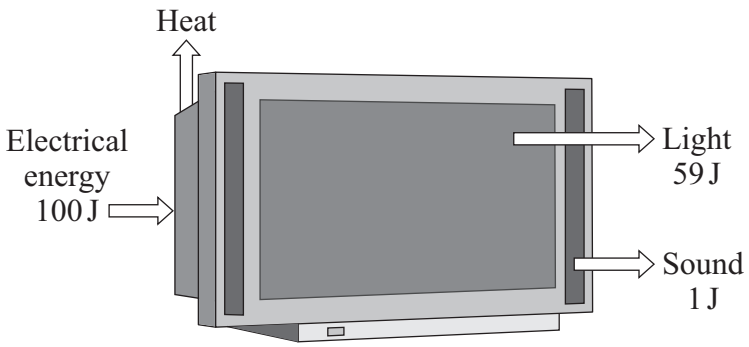
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION SEVEN

The diagram shows energy transformations in a television.



7A How much energy is usefully transferred by the television?

1 1 J

2 40 J

3 59 J

4 60 J

7B How much energy is wasted by the television?

1 0 J

2 1 J

3 40 J

4 59 J

7C

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

What is the efficiency of the television?

1 0.01

2 0.4

3 0.6

4 0.99

7D What eventually happens to the energy wasted by the television?

1 It gradually fades away.

2 It is recycled.

3 It increases the greenhouse effect.

4 It becomes increasingly spread out.

Turn over for the next question

QUESTION EIGHT

Copper pipes carry hot water around central heating systems. Different systems use pipes with different diameters. A class was asked to investigate the relationship between the diameter of a pipe and the rate at which hot water in the pipe lost heat.

8A One student said that she thought the wider the pipe, the quicker the water in it would lose heat.

She was putting forward a . . .

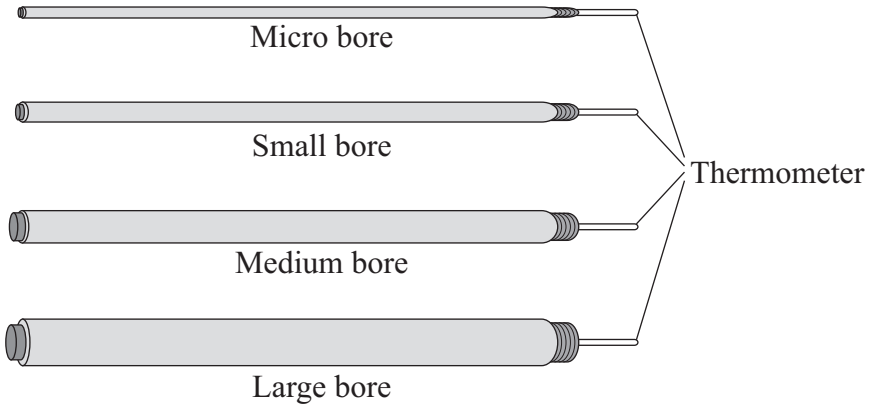
1 plan.

2 prediction.

3 conclusion.

4 theory.

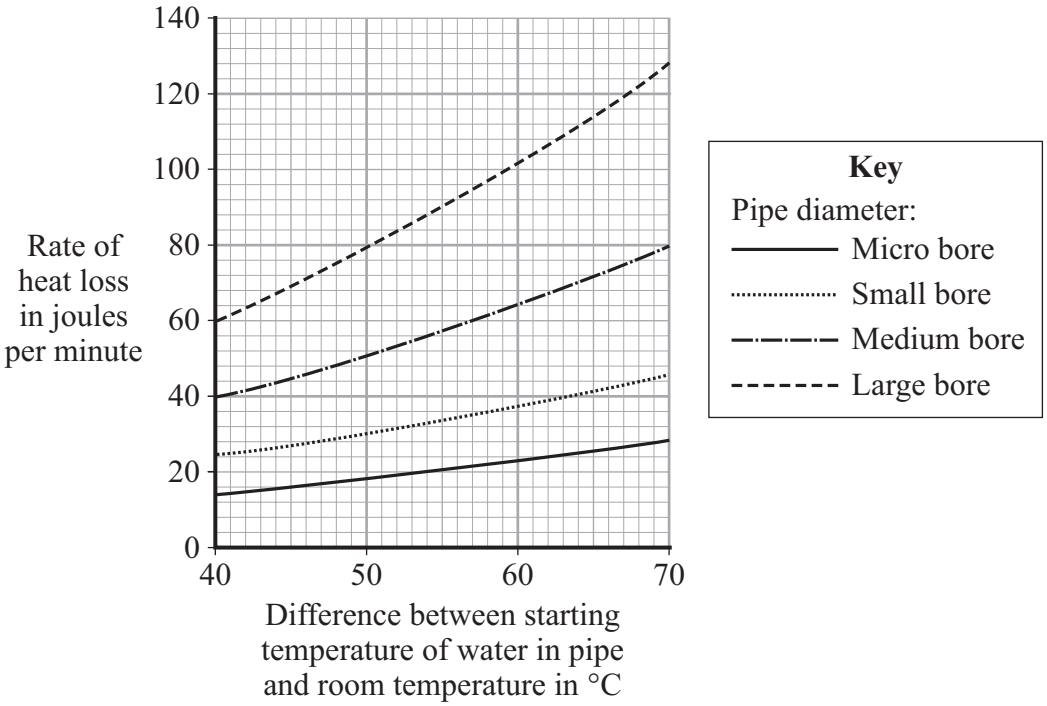
A class investigated the rate of heat loss from copper pipes with four different diameters.



All the pipes are 1 metre long.

Each group in the class used a piece of copper pipe with a different diameter; each pipe was filled with water at a measured temperature and then sealed. The temperature was read again later. Each group repeated the experiment several times with water at different temperatures. The room temperature remained constant at 20 °C.

The graph on the opposite page shows the class results.



8B What type of variable was the diameter of the copper pipes used in this investigation?

1 categoric

2 continuous

3 discrete

4 ordered

8C Which conclusion can be drawn from this investigation?

The rate of heat loss from the pipes is affected . . .

1 by the diameter of the pipe only.

2 by the difference in temperature only.

3 by the length of the pipe only.

4 by both the diameter of the pipe and the difference in temperature.

8D From these results, in terms of heat loss, which diameter of pipe would it be best to use to carry the hot water around a central heating system?

1 micro bore

2 small bore

3 medium bore

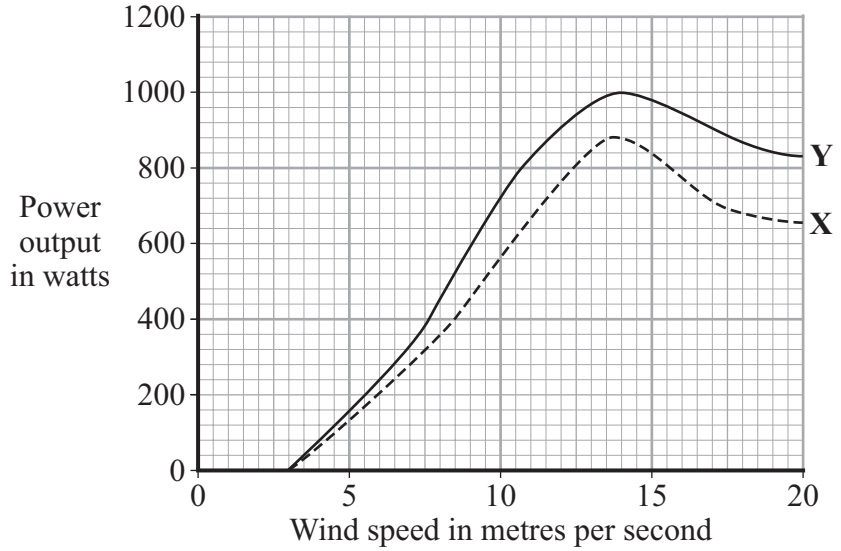
4 large bore

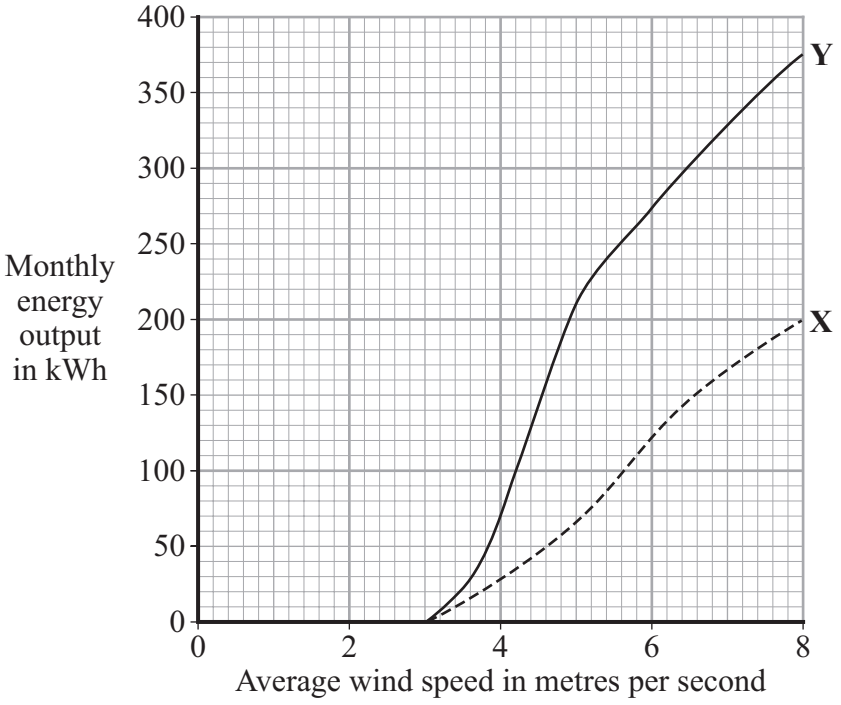
QUESTION NINE

Many people are now installing wind turbines at their homes to produce electricity.

A customer has to decide which turbine to install.

The graphs show the performance of two models of wind turbine, **X** and **Y**.





9A How much greater is the maximum power produced by turbine **Y** than that produced by turbine **X**?

1 80 W

2 120 W

3 880 W

4 1000 W

9B Which one of the following statements about the relationship between average wind speed and monthly energy output by turbine **X** is true?

1 An increase in average wind speed always causes an increase in monthly energy output.

2 As average wind speed doubles, monthly energy output doubles.

3 Above a certain average wind speed, monthly energy output falls.

4 At average wind speeds below 2 m/s, a 10 % increase in wind speed has no effect on monthly energy output.

9C Turbine **X** can be bought and installed for £750; turbine **Y** can be bought and installed for £1500.

A person lives in an area where the maximum wind speed is 10 m/s and the average annual wind speed is 3.5 m/s. A salesman advises the person to buy turbine **Y** because it produces more power.

Is the advice given by the salesman the best advice?

1 Yes, because turbine **Y** always produces more power than turbine **X**.

2 Yes, because as wind speed increases above 3 m/s, power output increases more rapidly from turbine **Y** than from turbine **X**.

3 No, because there is very little difference between the monthly energy output of the two turbines where the person lives.

4 No, because turbine **Y** will never pay for itself.

9D A neighbour objects to planning permission being given for the turbine.

The most likely reason for this objection is that the neighbour thinks that . . .

1 the turbine may cause a decrease in property prices in the area.

2 the turbine is a health risk.

3 the turbine will cause air pollution.

4 having a turbine is a status symbol.

END OF TEST

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

HIGHER TIER

SECTION ONE

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

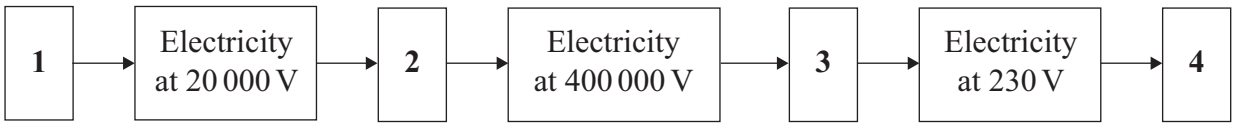
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

The block diagram shows how electricity is distributed in this country.



Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the diagram.

A house

B power station

C step-down transformer

D step-up transformer

QUESTION TWO

A geothermal power station uses the energy in hot rocks to produce electricity.

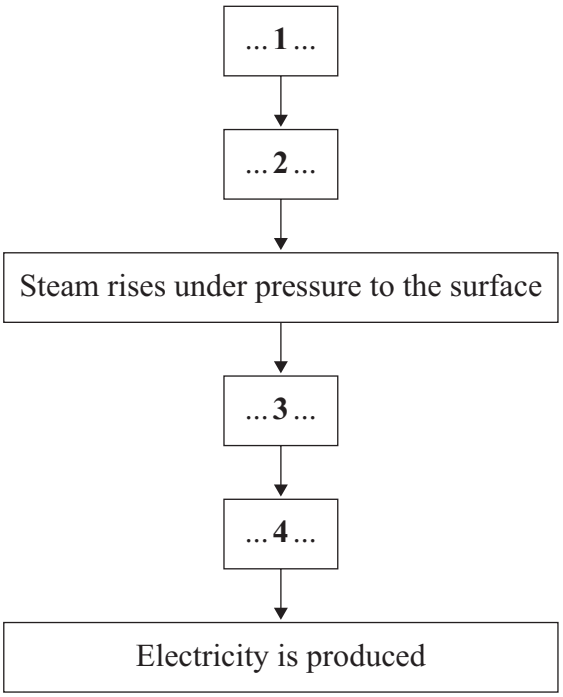
Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the flow chart to explain how the power station works.

A cold water is pumped into the rocks

B steam drives turbines

C turbines drive generators

D water is heated by radioactive decay



Turn over for the next question

SECTION TWO

Questions **THREE** to **NINE**.

Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION THREE

Copper pipes carry hot water around central heating systems. Different systems use pipes with different diameters. A class was asked to investigate the relationship between the diameter of a pipe and the rate at which hot water in the pipe lost heat.

3A One student said that she thought the wider the pipe, the quicker the water in it would lose heat.

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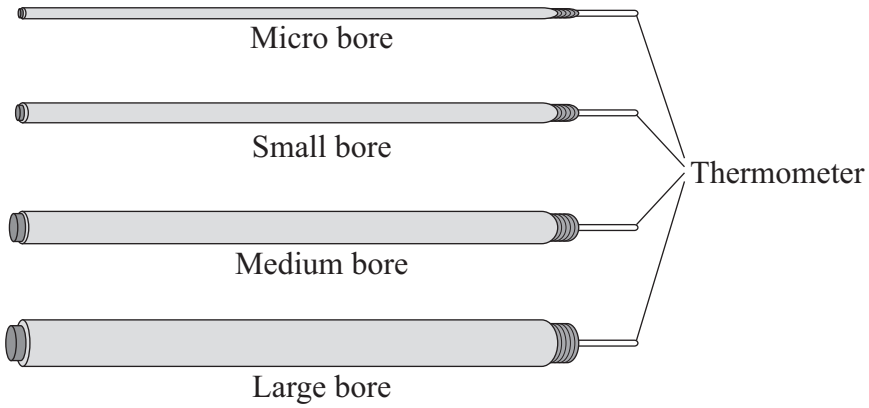

All the pipes are 1 metre long.

Each group in the class used a piece of copper pipe with a different diameter; each pipe was filled with water at a measured temperature and then sealed. The temperature was read again later. Each group repeated the experiment several times with water at different temperatures. The room temperature remained constant at 20 °C.

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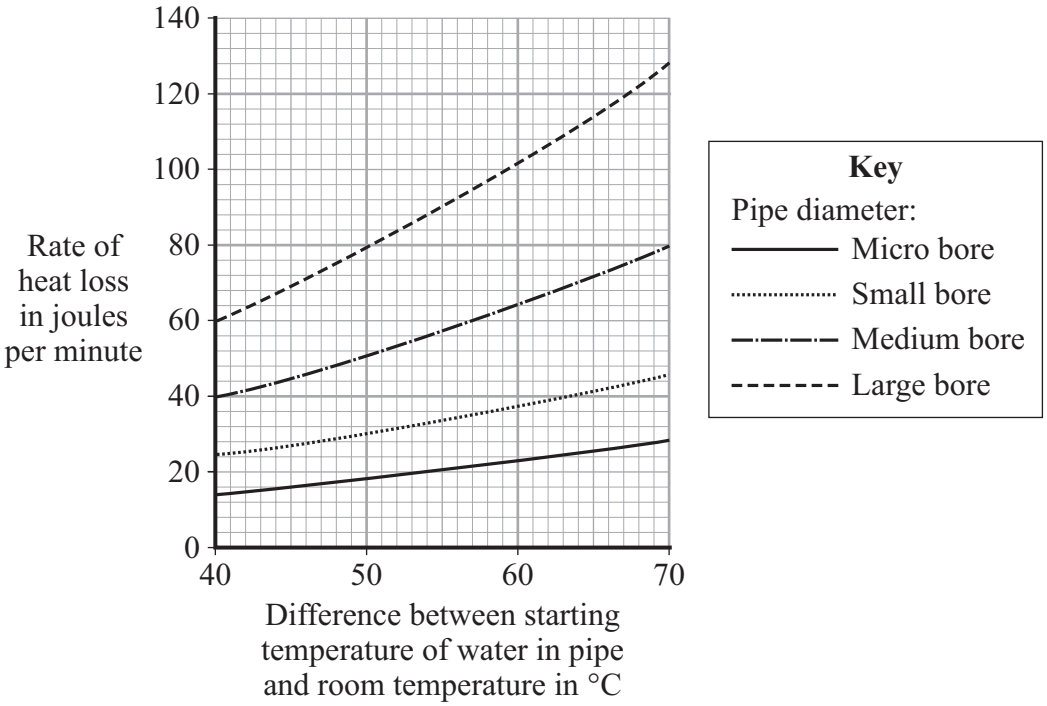

3B What type of variable was the diameter of the copper pipes used in this investigation?

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4 ordered

3C Which conclusion can be drawn from this investigation?

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3D From these results, in terms of heat loss, which diameter of pipe would it be best to use to carry the hot water around a central heating system?

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QUESTION FOUR

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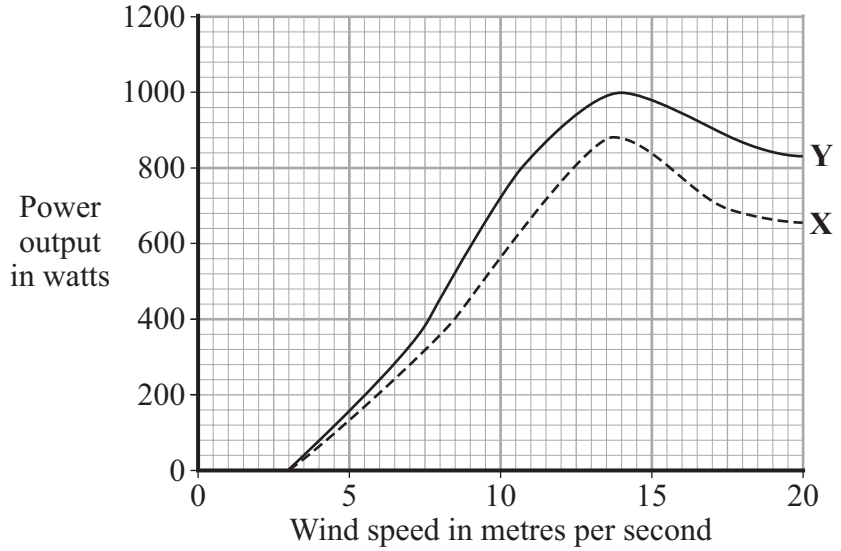
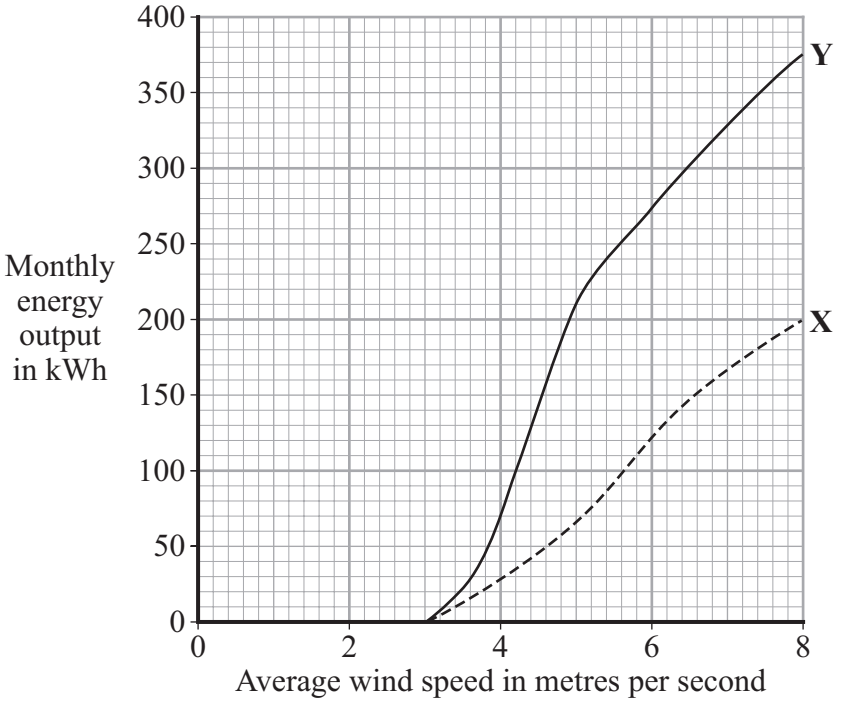
The graphs show the performance of two models of wind turbine, **X** and **Y**.





4A How much greater is the maximum power produced by turbine **Y** than that produced by turbine **X**?

1 80 W

2 120 W

3 880 W

4 1000 W

4B Which one of the following statements about the relationship between average wind speed and monthly energy output by turbine **X** is true?

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4C Turbine **X** can be bought and installed for £750; turbine **Y** can be bought and installed for £1500.

A person lives in an area where the maximum wind speed is 10 m/s and the average annual wind speed is 3.5 m/s. A salesman advises the person to buy turbine **Y** because it produces more power.

Is the advice given by the salesman the best advice?

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3 No, because there is very little difference between the monthly energy output of the two turbines where the person lives.

4 No, because turbine **Y** will never pay for itself.

4D A neighbour objects to planning permission being given for the turbine.

The most likely reason for this objection is that the neighbour thinks that . . .

1 the turbine may cause a decrease in property prices in the area.

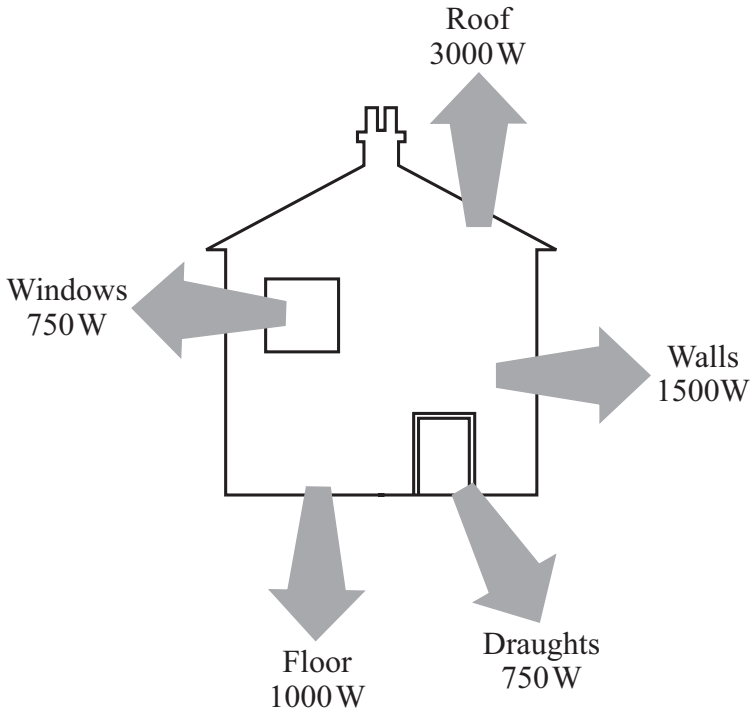
2 the turbine is a health risk.

3 the turbine will cause air pollution.

4 having a turbine is a status symbol.

QUESTION FIVE

The diagram shows how energy is lost from a house.



5A Heat is lost from the house by . . .

1 conduction only.

2 convection only.

3 convection and radiation only.

4 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	Installation cost in £	Energy loss before installation	% reduction in energy loss after installation
1	Double glazing	4000	750 W	33
2	Floor insulation	300	1000 W	25
3	Loft insulation	200	3000 W	33
4	Wall insulation	600	1500 W	50

5B Which type of insulation, **1**, **2**, **3** or **4**, saves most energy?

5C Which type of insulation, **1**, **2**, **3** or **4**, saves most energy for each pound (£) spent?

5D 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 . . .

1 0.36 years.

2 2.75 years.

3 12.75 years.

4 13.125 years.

Turn over for the next question

QUESTION SIX

An African village is in a remote location.

The Sun shines for at least a few hours nearly every day.

The villagers want a supply of electricity to pump up water from a well for a few hours each day.

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

The capital cost is the cost of buying the equipment.

	Capital cost	**Capital cost* (per kWh)**	**Fuel cost* (per kWh)**	**Maintenance cost* (per kWh)**
Solar cells	£1000	20 p	zero	zero
Petrol generator	£250	5 p	20 p	10 p

[*These costs are averaged out over the 20 years that the equipment is expected to last.]

6A Which one of the following statements is true?

1 A petrol generator has a higher initial capital cost.

2 A petrol generator has a higher capital cost per kWh.

3 A petrol generator has a higher overall cost per kWh.

4 A petrol generator needs less maintenance.

6B An advantage of the petrol generator is that . . .

1 it will cause less air pollution.

2 it is cheaper to set up the system in the first place.

3 it has no moving parts.

4 it will cost less over a 20-year period.

6C The main reason for choosing the solar cells for pumping water in the African village is that . . .

1 the low voltage from the solar cells is safer than high voltage power supplies.

2 solar cells are cheap to make.

3 solar cells provide a constant source of electricity.

4 the village is a long distance from mains electricity sources.

6D The main disadvantage of using the solar cells for pumping water in the African village is that . . .

1 they require no maintenance.

2 they will not work during the night.

3 they can work out cheaper over a 20-year period.

4 they have a high initial capital cost.

Turn over for the next question

QUESTION SEVEN

This question is about the changes in the sources of energy used to generate electricity in the UK between 1960 and 2000.

The table gives information on the percentage of electrical energy produced from various energy sources.

Year	Coal %	Oil %	Natural gas %	Nuclear %	Hydroelectric power %	Other renewables %
1960	74.0	25.4	0	0	0.6	0
1980	36.7	37.0	21.6	4.1	0.6	0
2000	17.2	37.7	33.7	10.5	0.2	0.7

7A In 2000, what was the total percentage of energy produced by sources that did **not** put carbon dioxide into the atmosphere?

1 0.8

2 10.5

3 11.2

4 11.4

7B Which statement about the percentage of energy produced from coal is correct?

1 The percentage has gone down by about 30% every 20 years.

2 The percentage has remained steady throughout that period.

3 The percentage was approximately halved every 20 years.

4 The percentage is now about half of what it was in 1960.

7C The Government may decide to increase the percentage of electricity supplied by nuclear power stations.

Which one of the following is a valid argument against the use of nuclear power stations?

1 For maximum efficiency, they have to be in almost constant use.

2 They have high decommissioning costs.

3 They have high fuel costs.

4 They produce gases that pollute the atmosphere.

7D A policy for the future that would result in the smallest contribution to possible global warming is one that made more use of . . .

1 coal, oil and natural gas.

2 oil, natural gas and nuclear energy.

3 natural gas, nuclear energy and hydroelectric power.

4 nuclear energy, hydroelectric power and other renewables.

Turn over for the next question

QUESTION EIGHT

Many scientists think that changes to the ice caps are affecting global warming.

As the ice melts, dark particles accumulate at the surface of the ice. This reduces the amount of sunlight reflected from the surface of the ice. The extra heat taken in by the ice causes the release of frozen methane. Methane is a potent greenhouse gas.

8A The reduction in the amount of sunlight reflected by the ice caps causes more heat to be transferred to the ice by . . .

1 conduction.

2 convection.

3 insulation.

4 radiation.

8B In addition to methane, the other potent greenhouse gas is . . .

1 carbon monoxide.

2 carbon dioxide.

3 ozone.

4 sulfur dioxide.

Changes to the ways in which electricity is generated could reduce global warming.

8C

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Centralised power stations are large power stations that supply electricity over a wide area.

A centralised power station wastes two-thirds of the energy supplied to it.

The efficiency of a centralised power station is . . .

1 0.23

2 0.33

3 0.50

4 0.67

8D Smaller local power stations use the heat that would normally be lost in cooling towers to warm surrounding homes and offices.

A large centralised power station and a group of four smaller local power stations both use the same mass of coal to generate electricity.

In comparison to the large centralised power station, the group of local power stations would . . .

1 produce less carbon dioxide.

2 have less impact on the environment.

3 produce more electricity.

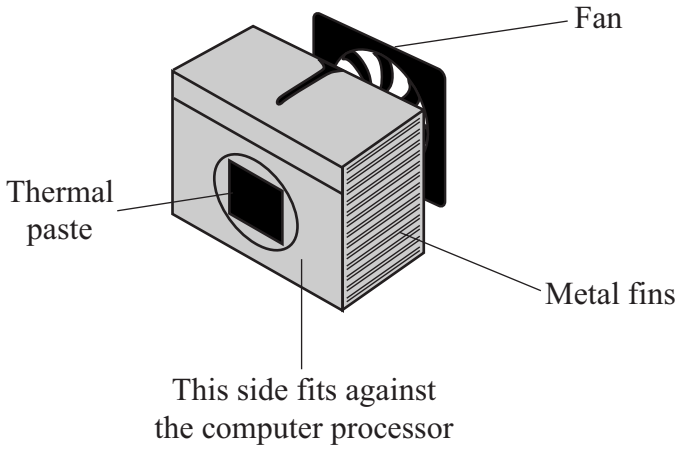
4 transfer the same amount of useful energy.

Turn over for the next question

QUESTION NINE

The diagram 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.



9A The metal fins are painted black to . . .

1 increase heat transfer by conduction.

2 increase heat transfer by radiation.

3 reduce heat transfer by conduction.

4 reduce heat transfer by radiation.

9B The thermal paste is there to . . .

1 decrease the transfer of heat by conduction.

2 decrease the transfer of heat by radiation.

3 increase the transfer of heat by conduction.

4 increase the transfer of heat by radiation.

9C Which process or processes is/are aided by the fan?

1 conduction only

2 convection and conduction

3 conduction and radiation

4 radiation only

9D Which one of the following causes the heat transfer through the metal fins?

1 electrons which collide with both ions and other electrons

2 electrons which do **not** collide with either ions or other electrons

3 ions which collide with both electrons and other ions

4 ions which do **not** collide with either electrons or other ions

END OF TEST

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