Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education
March 2009

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

PHYSICS
Unit Physics P1a (Energy and Electricity)

Wednesday 4 March 2009 Morning Session

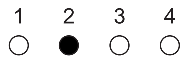
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

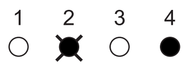
Time allowed: 30 minutes

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.

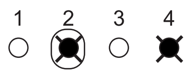
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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 16 of this booklet.

FOUNDATION TIER

SECTION ONE

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

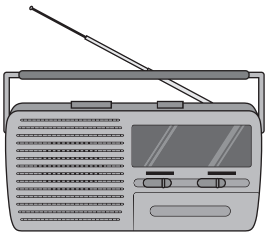
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

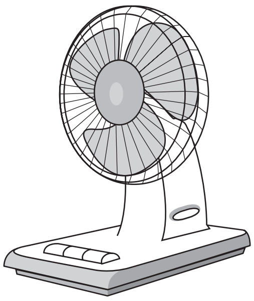
QUESTION ONE

This question is about useful energy transformations in domestic appliances.

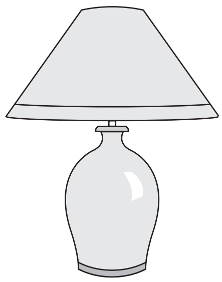


A
Radio

B
Toaster



C
Fan



D
Lamp

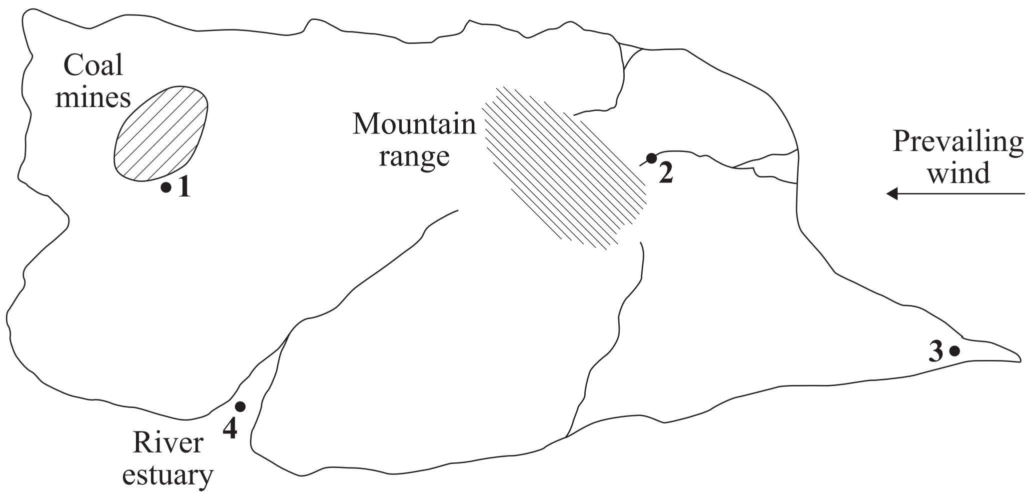
Match appliances, **A**, **B**, **C** and **D**, with the statements **1–4** in the table.

	Useful energy transformations
1	electrical to heat
2	electrical to kinetic
3	electrical to light
4	electrical to sound

QUESTION TWO

The map shows some features of a large island.

It also shows four places, **1**, **2**, **3** and **4**, where electricity could be generated.



Match energy sources, **A**, **B**, **C** and **D**, with the labels **1–4** on the map.

A falling water (hydroelectric)

B fossil fuel

C tides

D wind

Turn over for the next question

QUESTION THREE

Some people feel strongly about the environment. They can use posters to protest against the location of new power stations.

Match energy sources, **A**, **B**, **C**, and **D**, with the protesters' posters **1–4**.

A fossil fuels

B nuclear

C tides

D wind

QUESTION FOUR

Various energy sources can be used to generate electricity.

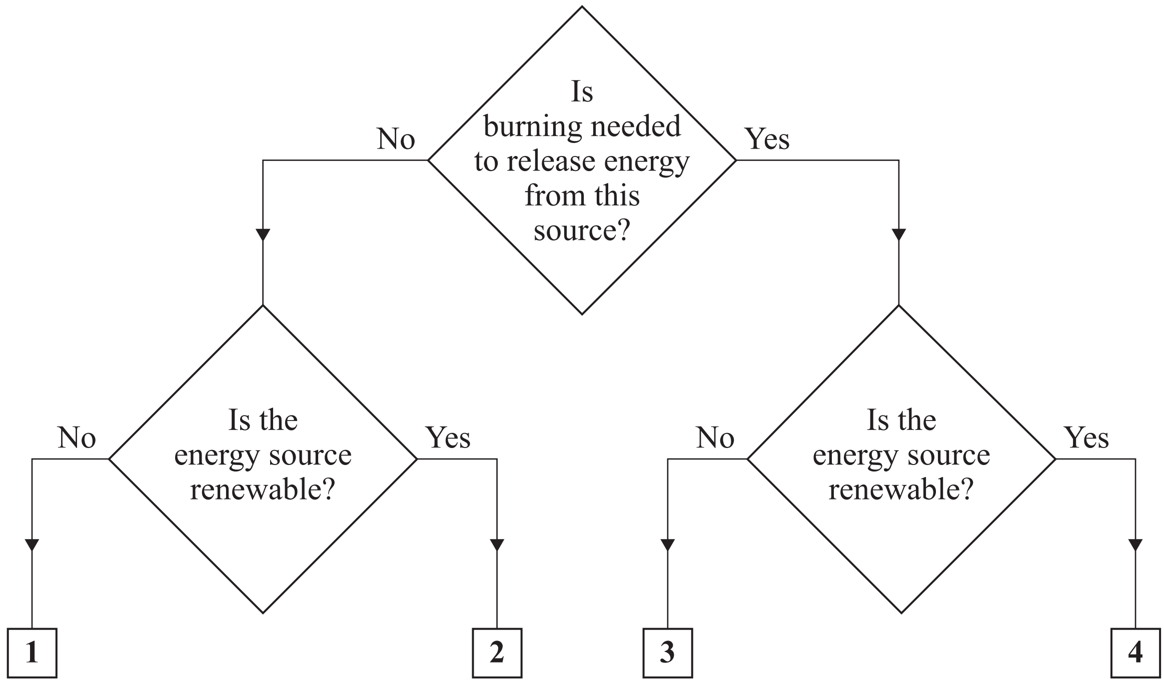
Match energy sources, **A**, **B**, **C**, and **D**, with the numbers **1–4** in the flow chart.

A coal

B biofuel

C geothermal

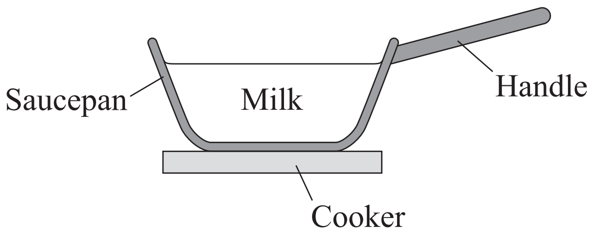
D uranium



Turn over for the next question

QUESTION FIVE

The diagram shows a saucepan of hot milk on a cooker.



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

A conduction

B convection

C insulation

D radiation

Heat is transferred from the cooker to the milk.

The heat is transferred from the cooker through the saucepan by . . . **1** . . . .

Heat is transferred through the milk by . . . **2** . . . .

The saucepan is shiny to reduce heat loss by . . . **3**. . . .

The handle of the saucepan is made of plastic. The plastic acts as . . . **4** . . . .

Turn over for the next question

SECTION TWO

Questions **SIX** to **NINE**.

Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION SIX

This question is about the use of energy in cars that use petrol.

6A A car engine transfers kinetic energy.

The kinetic energy is transformed from . . .

1 chemical energy.

2 electrical energy.

3 light energy.

4 sound energy.

6B Car makers are producing engines that are more efficient.

Compared with a less efficient engine of the same power, a more efficient engine always . . .

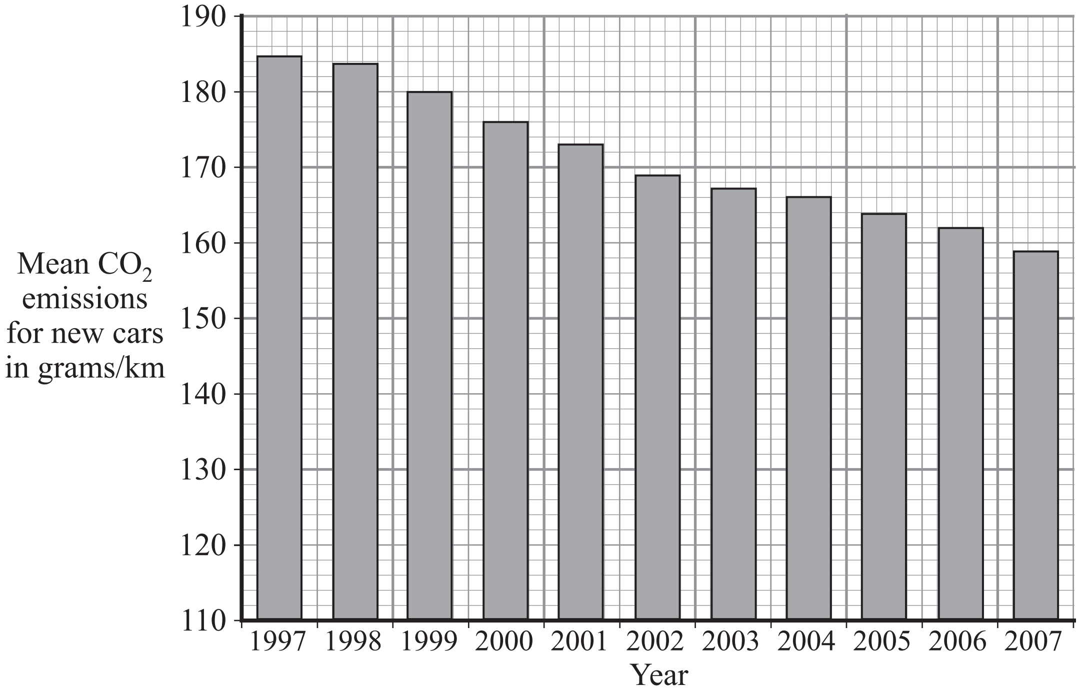
1 has a higher top speed.

2 has a lower top speed.

3 uses less petrol.

4 uses more petrol.

Cars release harmful gases into the atmosphere. The mean amount of carbon dioxide (CO_2) emitted by new cars for every kilometre driven has changed. The display shows how these emissions have changed since 1997.



6C The display is called a . . .

1 bar chart.

2 line graph.

3 pie chart.

4 scattergram.

6D The display shows that between 1997 and 2007, the amount of carbon dioxide released per kilometre by new cars has . . .

1 steadily increased.

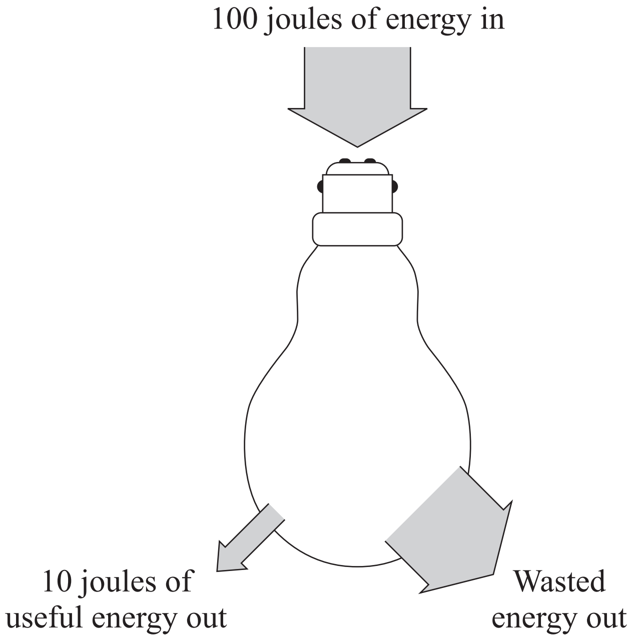
2 steadily decreased.

3 decreased and then increased.

4 stayed the same.

QUESTION SEVEN

The diagram shows a tungsten filament lamp and the energy used by the lamp in one second.



7A How many joules of energy are wasted each second?

1 10

2 80

3 90

4 100

7B What type of wasted energy is produced by the lamp?

1 electrical

2 heat

3 light

4 sound

7C What happens to the wasted energy?

1 It is transformed into useful energy.

2 It is destroyed.

3 It spreads out and becomes easier to use.

4 It spreads out and becomes more difficult to use.

7D What is the efficiency of the lamp?

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

1 0.1

2 0.8

3 0.9

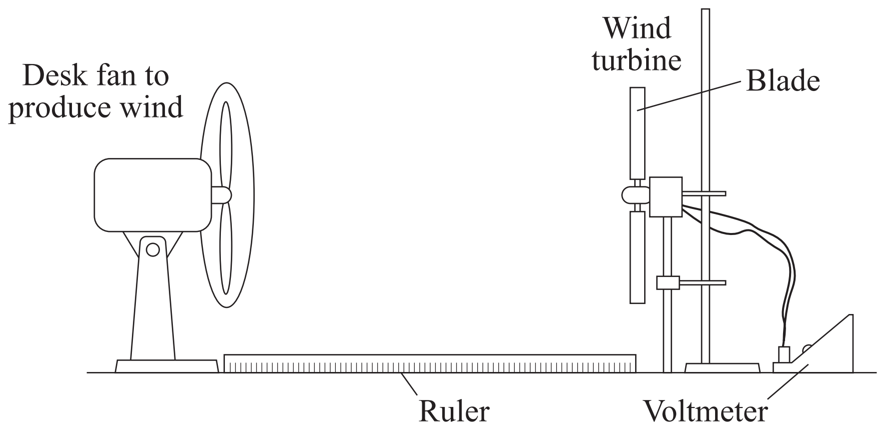
4 1.0

Turn over for the next question

QUESTION EIGHT

A student investigated a model wind turbine.

The diagram shows the apparatus he used.



8A He noticed that most real wind turbines have three blades. He thought that a model wind turbine with three blades would give the best output.

This thought is known as a . . .

1 conclusion.

2 phenomenon.

3 fair test.

4 prediction.

8B The student wanted to know if the output of the model wind turbine depends on the number of blades.

Which row of the table shows the correct combination of variables?

	Independent variable	Dependent variable	Control variables
1	wind speed	number of blades	distance from fan to turbine, angle of blades to wind, voltage
2	wind speed	voltage	distance from fan to turbine, angle of blades to wind, number of blades
3	number of blades	voltage	distance from fan to turbine, angle of blades to wind, wind speed
4	number of blades	wind speed	distance from fan to turbine, angle of blades to wind, voltage

8C The student took each of his measurements three times and then calculated a mean.

His reason for this was to improve the . . .

1 reliability.

2 sensitivity.

3 validity.

4 calibration.

8D When he had completed his measurements, the student wanted to display his results.

He chose a bar chart because one of the variables was . . .

1 continuous.

2 controlled.

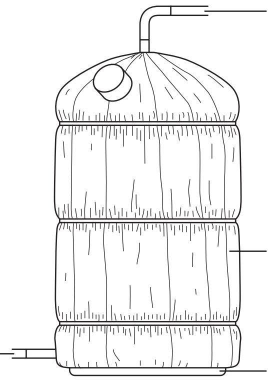
3 discrete.

4 independent.

Turn over ▶

QUESTION NINE

The diagram shows a hot water cylinder. The cylinder contains an electric heater.



9A A jacket is wrapped round the cylinder to keep the water warm. The jacket contains trapped air.

Trapped air reduces heat loss by . . .

1 conduction only.

2 conduction and radiation.

3 conduction and convection.

4 conduction, convection and radiation.

9B If a jacket is not fitted, it would be best to have a shiny surface for the cylinder rather than a dark matt one.

This is because dark matt surfaces are . . .

1 good conductors.

2 poor conductors.

3 good radiators.

4 poor radiators.

9C The heater has a power of 3000 W. The heater is switched on for 6 hours.

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

How many kilowatt-hours of energy does the heater use?

1 0.5

2 18

3 500

4 18 000

9D A household receives an electricity bill every 3 months. The total amount of electrical energy used during one 3-month period was 2000 kWh. Electricity costs 10 p per kWh.

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

How much was the bill?

1 £200

2 £600

3 £20 000

4 £60 000

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**.

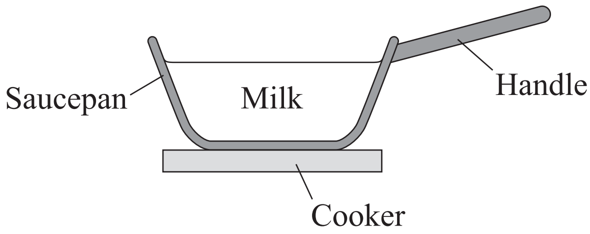
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

The diagram shows a saucepan of hot milk on a cooker.



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

A conduction

B convection

C insulation

D radiation

Heat is transferred from the cooker to the milk.

The heat is transferred from the cooker through the saucepan by . . . **1** . . . .

Heat is transferred through the milk by . . . **2** . . . .

The saucepan is shiny to reduce heat loss by . . . **3**. . . .

The handle of the saucepan is made of plastic. The plastic acts as . . . **4** . . . .

QUESTION TWO

This question is about power stations and the distribution of electricity.

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

A generator

B grid

C transformer

D turbine

In most power stations, steam is used to drive a . . . **1** . . . .

Electricity is produced at a power station by a . . . **2** . . . .

The voltage of the electricity is stepped up by a . . . **3** . . . .

Electricity is transferred from the power station to our homes by the national . . . **4** . . . .

Turn over for the next question

SECTION TWO

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

Each of these questions has four parts.

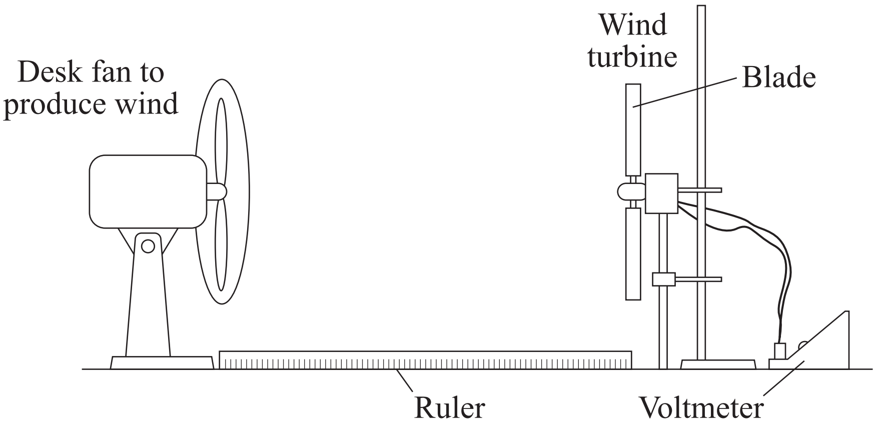
In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION THREE

A student investigated a model wind turbine.

The diagram shows the apparatus he used.



3A He noticed that most real wind turbines have three blades. He thought that a model wind turbine with three blades would give the best output.

This thought is known as a . . .

1 conclusion.

2 phenomenon.

3 fair test.

4 prediction.

3B The student wanted to know if the output of the model wind turbine depends on the number of blades.

Which row of the table shows the correct combination of variables?

	Independent variable	**Dependent variable**	**Control variables**
1	wind speed	number of blades	distance from fan to turbine, angle of blades to wind, voltage
2	wind speed	voltage	distance from fan to turbine, angle of blades to wind, number of blades
3	number of blades	voltage	distance from fan to turbine, angle of blades to wind, wind speed
4	number of blades	wind speed	distance from fan to turbine, angle of blades to wind, voltage

3C The student took each of his measurements three times and then calculated a mean.

His reason for this was to improve the . . .

1 reliability.

2 sensitivity.

3 validity.

4 calibration.

3D When he had completed his measurements, the student wanted to display his results.

He chose a bar chart because one of the variables was . . .

1 continuous.

2 controlled.

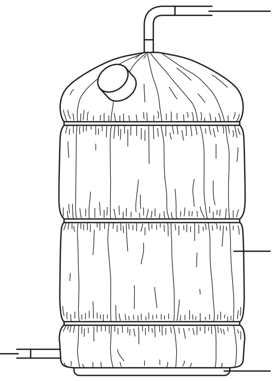
3 discrete.

4 independent.

Turn over ▶

QUESTION FOUR

The diagram shows a hot water cylinder. The cylinder contains an electric heater.



4A A jacket is wrapped round the cylinder to keep the water warm. The jacket contains trapped air.

Trapped air reduces heat loss by . . .

1 conduction only.

2 conduction and radiation.

3 conduction and convection.

4 conduction, convection and radiation.

4B If a jacket is not fitted, it would be best to have a shiny surface for the cylinder rather than a dark matt one.

This is because dark matt surfaces are . . .

1 good conductors.

2 poor conductors.

3 good radiators.

4 poor radiators.

4C The heater has a power of 3000 W. The heater is switched on for 6 hours.

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

How many kilowatt-hours of energy does the heater use?

1 0.5

2 18

3 500

4 18 000

4D A household receives an electricity bill every 3 months. The total amount of electrical energy used during one 3-month period was 2000 kWh. Electricity costs 10 p per kWh.

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

How much was the bill?

1 £200

2 £600

3 £20 000

4 £60 000

Turn over for the next question

QUESTION FIVE

A double-glazed window is made up of two sheets of glass with a gap between them.

This gap may be filled with air or a gas such as argon.

The table gives some information from a double-glazing manufacturer.

Better insulators have lower U-values.

Type of double glazing	**U-value for different gap widths**				
	6 mm	**8 mm**	**10 mm**	**12 mm**	**14 mm**
Reflective glass, argon filled	2.0	2.1	1.5	1.3	1.2
Reflective glass, air filled	2.5	2.1	1.8	1.6	1.5
Plain glass, argon filled	3.1	2.9	2.8	2.7	2.6
Plain glass, air filled	3.3	3.1	3.0	2.9	2.8

5A What is the general effect of increasing the gap width?

1 The bigger the gap, the better the window is at insulating.

2 The bigger the gap, the worse the window is at insulating.

3 There is no change in the window's ability to insulate.

4 Some types of window become better at insulating and others become worse.

5B One of the four types of double-glazing contains a result that does not fit the general pattern.

Which type of double-glazing is this?

1 reflective glass, argon filled

2 reflective glass, air filled

3 plain glass, argon filled

4 plain glass, air filled

5C Which one of these statements is true for the data for the 6 mm gap width?

1 The type of glass is more important for insulation than the type of filling.

2 The type of filling is more important for insulation than the type of glass.

3 The type of filling and the type of glass are equally important for insulation.

4 It is impossible to tell from the data whether the type of filling or the type of glass is more important for insulation.

5D What can you conclude about argon from the data in the table?

1 It has a higher density than air.

2 It has a higher U-value than air.

3 It has a lower freezing point than air.

4 It is a worse conductor than air.

Turn over for the next question

QUESTION SIX

This question is about energy sources.

6A Look at this list of energy sources for power stations.

Biomass **Coal** **Falling water (hydroelectric)** **Nuclear**

Hydroelectric is the odd one out because it is . . .

1 the only renewable energy source.

2 the only non-renewable energy source.

3 the only energy source that is not used to produce steam.

4 the only energy source that is used to produce steam.

6B Which one of the following lists contains only **one** energy source that costs nothing?

1 biomass, gas, solar, tidal

2 geothermal, hydroelectric, wave, wind

3 coal, hydroelectric, solar, wave

4 coal, gas, nuclear, wind

6C Which of the sequences shows what happens in a fossil fuel power station?

1 electricity → generator → steam → turbine

2 steam → generator → turbine → electricity

3 steam → turbine → generator → electricity

4 electricity → generator → steam → generator

6D At present, gas-fired power stations emit fewer harmful gases than coal-fired power stations. Britain's gas reserves are running out. Gas for power stations is imported from Europe. The government has decided to build a new coal-fired power station.

What is the most likely reason for this?

1 Britain's coal reserves will never run out.

2 It is easier to transport coal than gas.

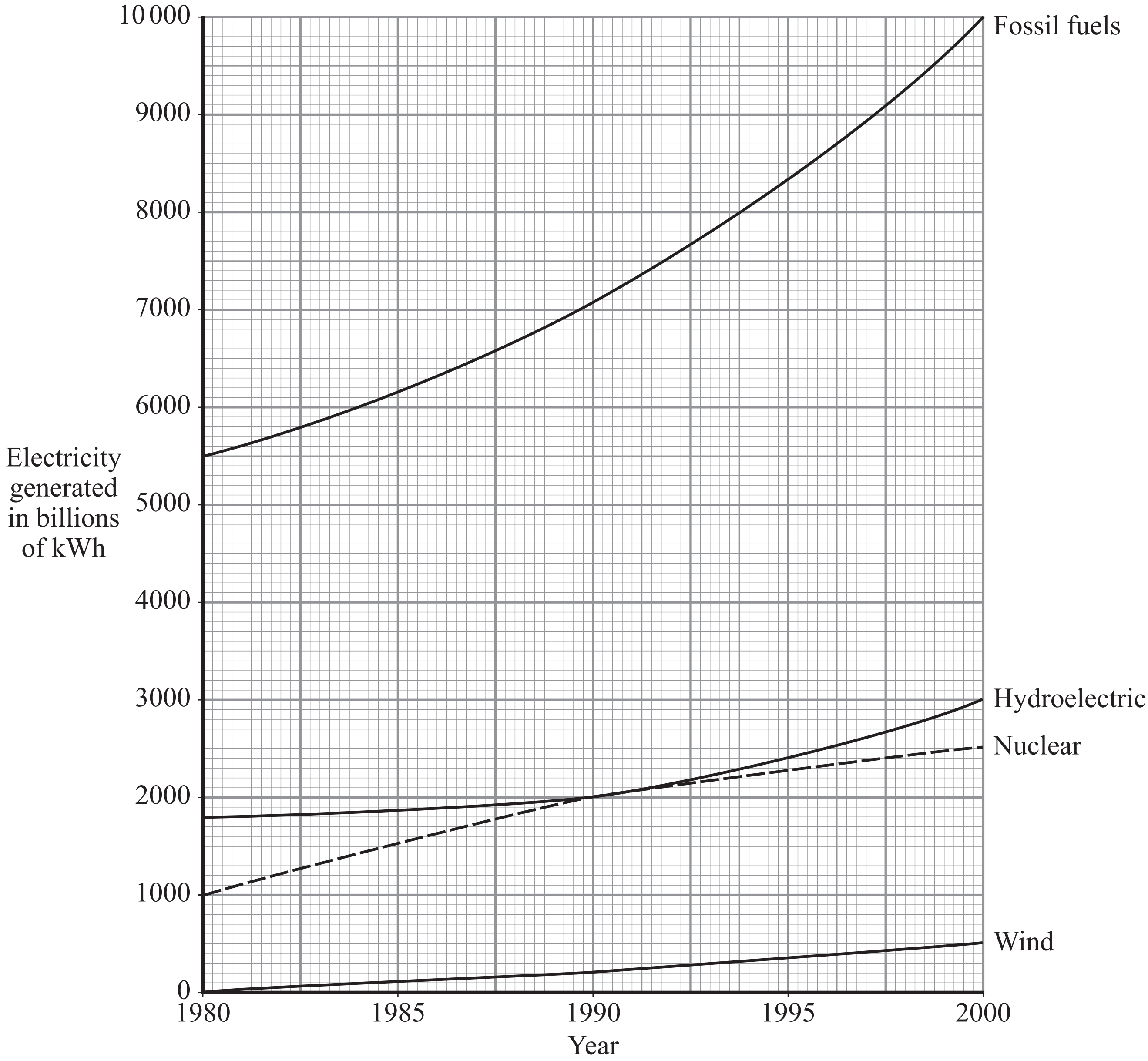
3 Britain would not have to rely so much on imported gas.

4 The government intends to stop all fossil fuel use by 2020.

Turn over for the next question

QUESTION SEVEN

The graph shows how much electricity has been generated worldwide from four different energy sources, from 1980 to 2000.



7A Which source has shown the smallest increase in electricity generation between 1990 and 2000?

1 fossil fuels

2 falling water (hydroelectric)

3 nuclear

4 wind

7B In 2000, about what percentage of the total electricity was generated by hydroelectricity, nuclear and wind?

1 38 %

2 42 %

3 55 %

4 60 %

7C By 2030, the amount of electricity generated from hydroelectricity, nuclear and wind is likely to be 5 times greater than in 1990.

In 2030, the amount of electricity generated from these three sources, in billions of kWh, will be . . .

1 10 500.

2 11 000.

3 20 500.

4 21 000.

7D Some energy sources can be used to drive turbines directly.

Which two energy sources **cannot** be used to drive turbines directly?

1 nuclear and fossil fuel

2 hydroelectric and fossil fuel

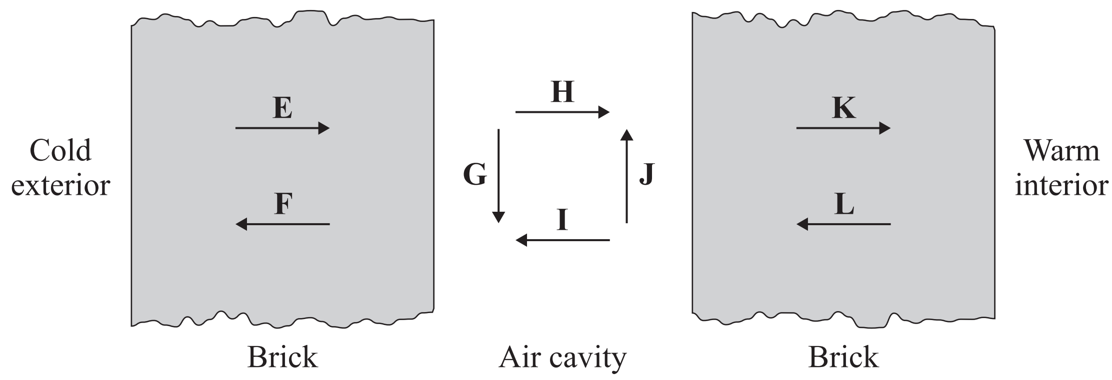
3 nuclear and wind

4 hydroelectric and nuclear

Turn over for the next question

QUESTION EIGHT

The diagram shows a section through the cavity wall of a house. The arrows indicate the directions by which heat transfer might take place.



8A Which arrows represent the process of heat transfer called conduction?

1 **E**, **H** and **K**

2 **H** and **I**

3 **L**, **I** and **F**

4 **J** and **G**

8B Conduction in metals is the transfer of heat by . . .

1 the movement of free electrons.

2 the heated substance expanding and rising.

3 the heated substance contracting and rising.

4 the heated substance expanding and falling.

8C Which arrows represent the process of heat transfer called convection?

1 **E**, **H** and **K**

2 **H** and **I**

3 **L**, **I** and **F**

4 **J** and **G**

8D Convection is the transfer of heat by . . .

1 the movement of free electrons.

2 the heated substance expanding and rising.

3 the heated substance contracting and rising.

4 the heated substance expanding and falling.

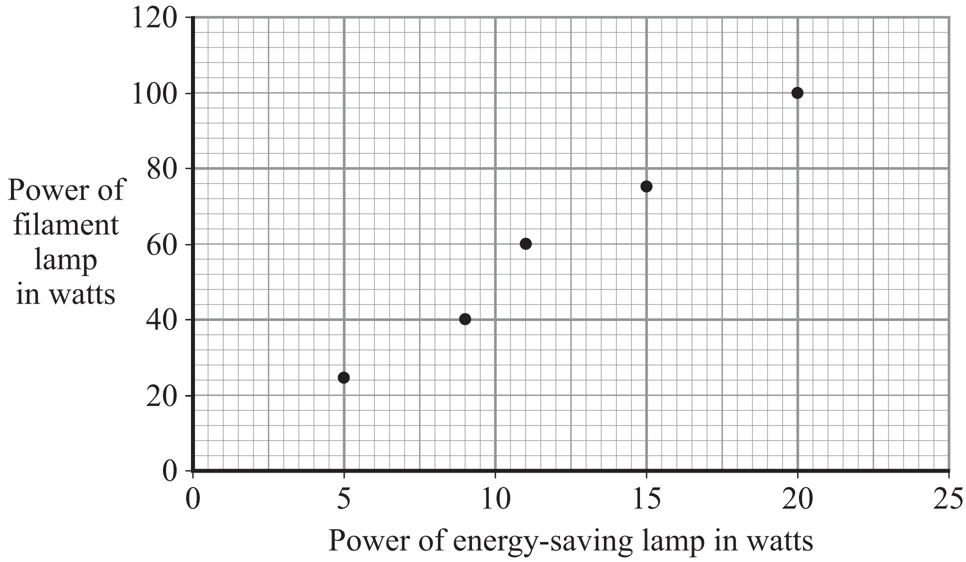
Turn over for the next question

QUESTION NINE

A householder bought an energy-saving lamp. She found the following table printed on its packaging.

Power of energy-saving lamp in W	Equivalent power of filament lamp in W
5	25
9	40
11	60
15	75
20	100

The graph shows the data.



9A To see if the power of the filament lamp is directly proportional to the power of the energy-saving lamp, you should . . .

1 draw a line of best fit.

2 draw a straight line of best fit and see whether it passes through (0,0).

3 plot more points and see whether a straight line is produced.

4 produce a bar chart and see whether there is a positive relationship.

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

9B A 25 W lamp transforms 25 joules of electrical energy each second.

The efficiency of a 25 W energy-saving lamp is 0.6

How much energy does it waste each second?

1 10.0 J

2 15.0 J

3 41.2 J

4 62.5 J

9C The efficiency of a 100 W filament lamp is 0.15

From the data in the table on page 30, what is the approximate efficiency of the 20 W energy-saving lamp?

1 0.03

2 0.15

3 0.30

4 0.75

9D The government has recommended that the sale of filament lamps should be stopped.

Why is this?

1 to give shops new products to sell

2 to use less fuel for generating electricity

3 to make electricity cheaper to buy

4 to give householders brighter lamps

END OF TEST

There are no questions printed on this page