Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

ASSESSMENT AND QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education
Foundation Tier and Higher Tier
June 2010

Science A
Unit Physics P1a (Energy and Electricity)

Physics
Unit Physics P1a (Energy and Electricity)

PHY1AP

Monday 28 June 2010 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 plus your additional time allowance.**

At the top of the page write your surname and other names, your centre number, your candidate number and add your signature.

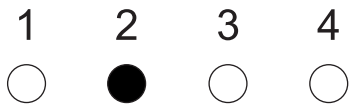
[Turn over]

INSTRUCTIONS

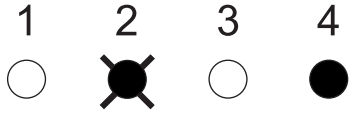
- **Check that your name, candidate number and centre number are printed on the separate answer sheet.**
- **Check that the separate answer sheet has the title 'Physics Unit 1a' printed on it.**
- **Attempt ONE TIER ONLY, EITHER the Foundation Tier OR the Higher Tier.**
- **Make sure that you use the 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

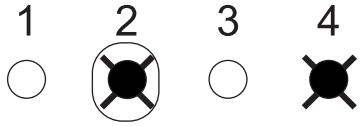
- **Use a BLACK BALL-POINT PEN.**
- **For each answer COMPLETELY FILL IN THE CIRCLE as shown:**



- **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.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

You must do ONE TIER only, EITHER the Foundation Tier OR the Higher Tier.

The Higher Tier starts on page 26 of this booklet.

FOUNDATION TIER

SECTION ONE

Questions ONE to FIVE.

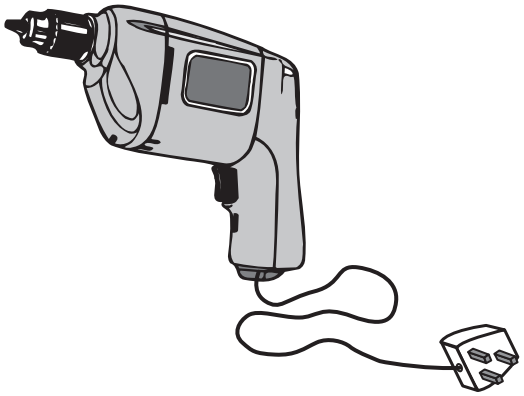
In these questions, match the letters A, B, C and D, with the numbers 1–4.

Use EACH answer only ONCE.

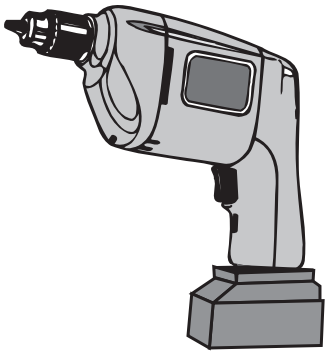
Mark your choices on the answer sheet.

QUESTION ONE

The diagrams show a mains electric drill and a cordless electric drill. The cordless drill has a rechargeable battery.



Mains electric drill



Cordless electric drill

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

A chemical energy

B electrical energy

C heat (thermal energy)

D kinetic energy

Drills are designed to produce . . . 1 . . . .

The drills also produce . . . 2 . . . and sound energy which are wasted.

Both drills use . . . 3 . . . to make their motors work.

The cordless drill has a battery that stores . . . 4 . . . .

QUESTION TWO

This question is about the transfer of heat.

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

A conduction

B convection

C insulation

D radiation

The rate of heat loss from a hot object can be reduced by . . . 1 . . . .

Heat is transferred from the Sun to the Earth by . . . 2 . . . .

Heat is transferred through the air in a room mainly by . . . 3 . . . .

Heat is transferred along a metal bar by . . . 4 . . . .

QUESTION THREE

Various sources of energy can be used to produce electricity.

Match sources of energy, A, B, C and D, with the methods of producing electricity 1–4 in the table.

A fossil fuels

B hot rocks

C moving air

D sunlight

	METHOD OF PRODUCING ELECTRICITY
1	coal-fired power station
2	geothermal power station
3	solar cells
4	wind farm

QUESTION FOUR

The use of various types of power station raises different environmental issues.

Match types of power station, A, B, C and D, with the numbers 1–4 in the table.

A gas-fired

B hydroelectric

C nuclear

D wind farm

	ENVIRONMENTAL ISSUE
1	large areas of land are flooded to form reservoirs
2	pollutes the atmosphere with carbon dioxide
3	produces radioactive waste
4	rotating blades may kill birds

QUESTION FIVE

The table gives data for some energy sources used to generate electricity in the UK.

	Energy source	Generating cost in pence per kWh	Number of grams of carbon dioxide produced per kWh
A	Coal	2·6	1000
B	Gas	2·2	500
C	Hydroelectric (falling water)	3·4	20
D	Nuclear	3·5	5

Use the data in the table above to match energy sources, A, B, C and D, with the numbers 1–4 in the table below.

1	produces the cheapest electricity
2	is renewable
3	contributes least to global warming
4	contributes most to global warming

[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

An instruction booklet for a washing machine contains the following information.

WASH CYCLE	AVERAGE POWER DURING CYCLE	TIME TAKEN TO RUN CYCLE
HOT	1·6 kW	2 hours
WARM	1·0 kW	$1\frac{1}{2}$ hours
COOL	0·8 kW	$1\frac{1}{2}$ hours

6A The washing machine is designed to transform electrical energy into heat (thermal energy) and . . .

1 chemical energy.

2 kinetic energy.

3 light energy.

4 sound energy.

6B How much energy is transferred to the washing machine when it is used on the HOT wash cycle?

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

1 3·6 kWh

2 3·2 kWh

3 0·8 kWh

4 0·4 kWh

6C Why does it cost more to use the washing machine on the HOT cycle than on the WARM or COOL cycle?

1 The HOT cycle has the lowest average power.

2 The HOT cycle takes the shortest time to run.

3 More energy is transferred during the HOT cycle.

4 The WARM and COOL cycles both run for $1\frac{1}{2}$ hours.

[Question 6 continues on the next page]

6D The washing machine also has a FAST cycle setting. When used on this setting, 0·8 kWh of energy are transferred to the washing machine.

$$\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$$

Electricity costs 15 p per kilowatt-hour (kWh).

How much does the washing machine cost to run on the FAST cycle?

1 £1·20

2 12 p

3 1·2 p

4 0·12 p

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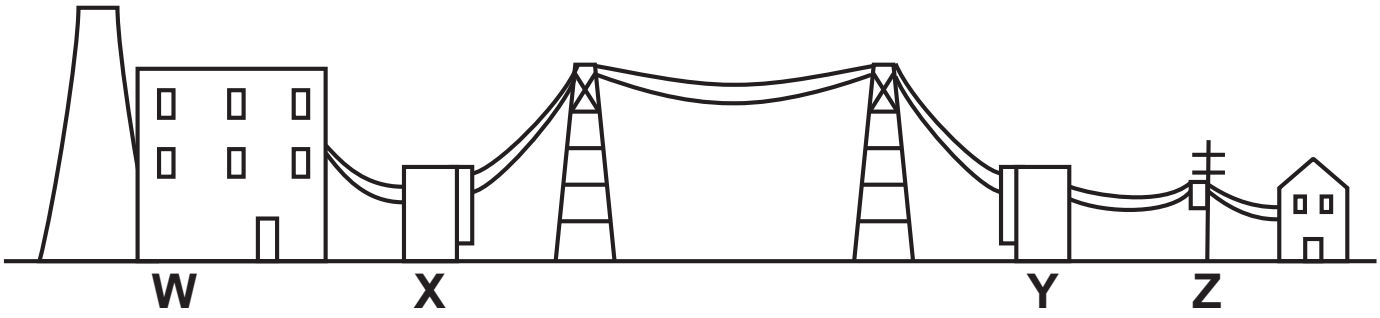
TURN OVER FOR THE NEXT QUESTION

QUESTION SEVEN

The diagram shows how electricity is transferred from a power station to consumers.



7A Which labelled part, W, X, Y or Z, is a step-up transformer?

1 W

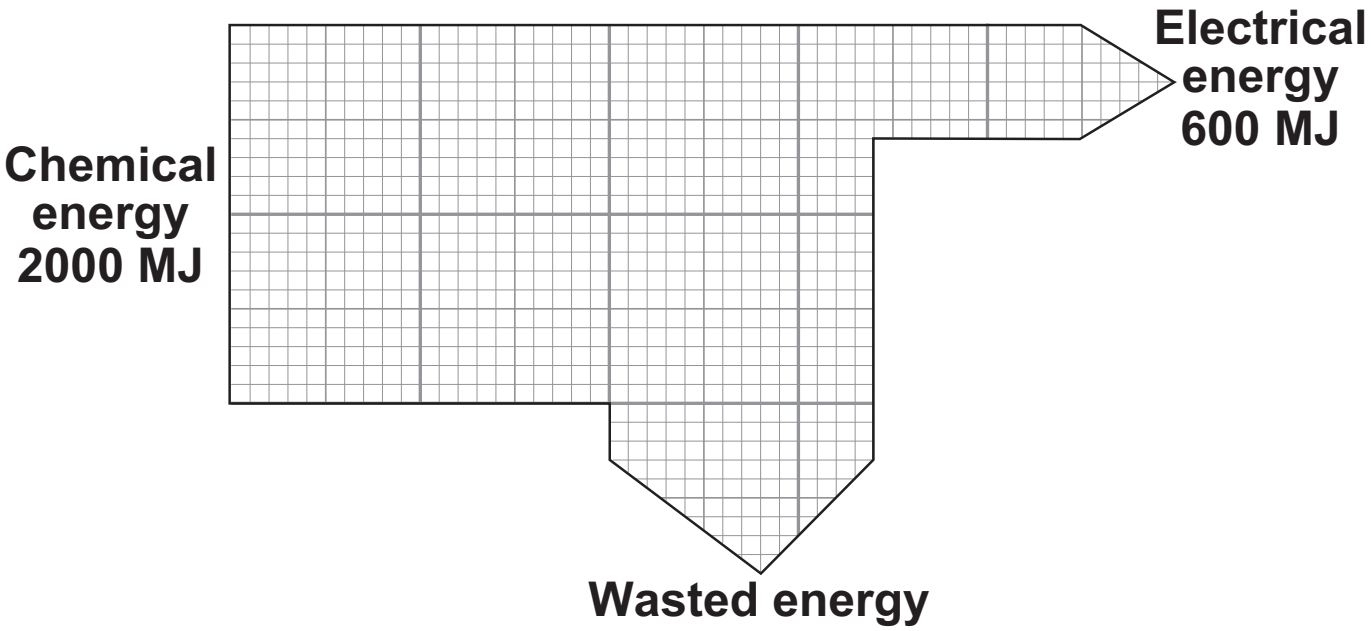
2 X

3 Y

4 Z

Fuel is burned in this power station.

The Sankey diagram shows the energy transformations for this power station.



7B How much energy is wasted?

1 30 MJ

2 600 MJ

3 1400 MJ

4 2600 MJ

[Question 7 continues on the next page]

7C The efficiency of the power station can be calculated using this equation.

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

What is the efficiency of this power station?

1 0·30

2 0·33

3 0·60

4 0·70

7D What happens to the energy that is wasted?

1 It is transferred into useful energy.

2 It warms up the surroundings.

3 It is recycled.

4 It is stored until needed.

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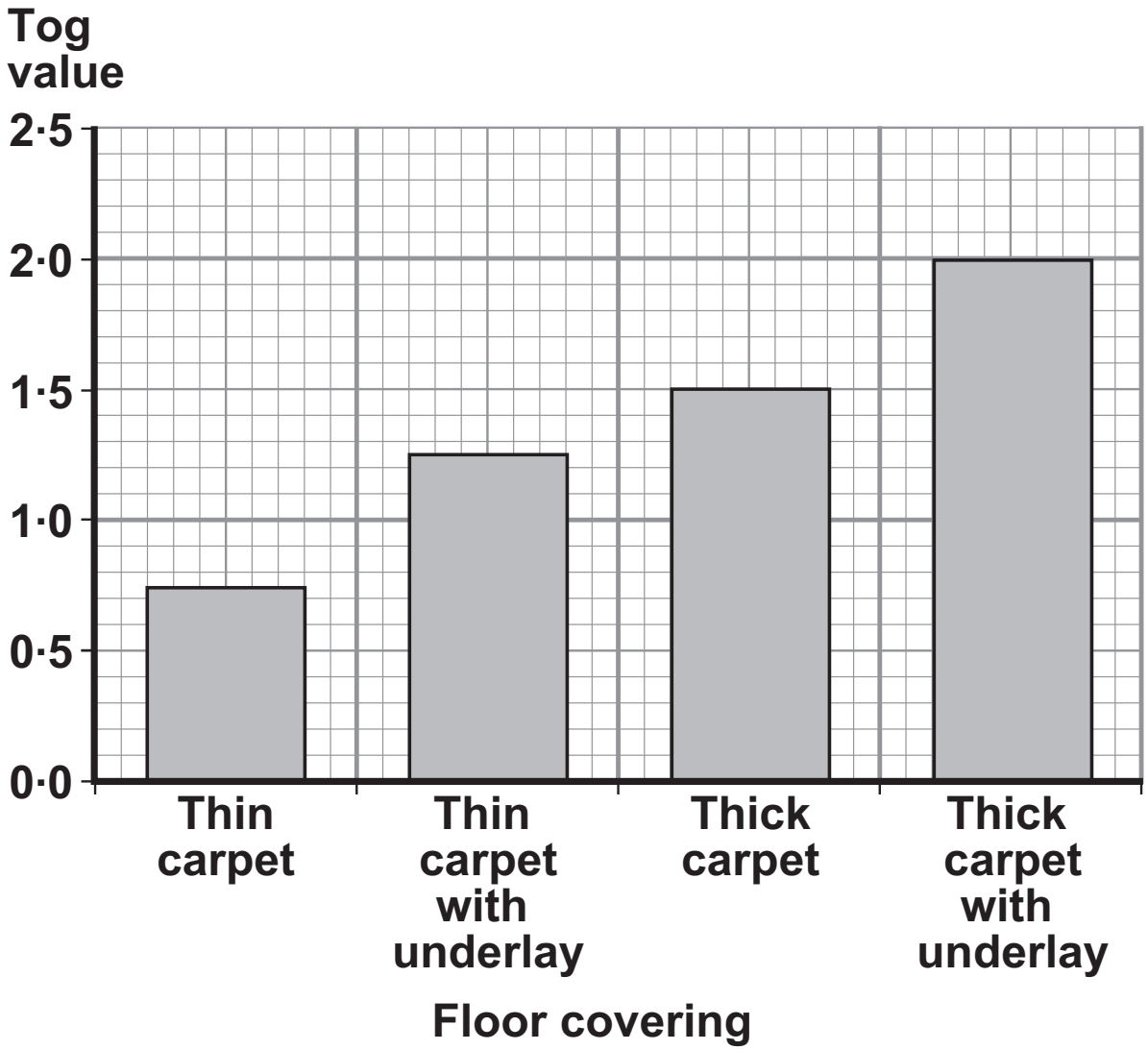
TURN OVER FOR THE NEXT QUESTION

QUESTION EIGHT

Insulating materials have a 'tog value'. The better the insulation, the higher the tog value.

The bar chart shows the tog values of some floor coverings.



8A The data is plotted as a bar chart because . . .

1 both the tog value and the floor covering are categoric variables.

2 both the tog value and the floor covering are continuous variables.

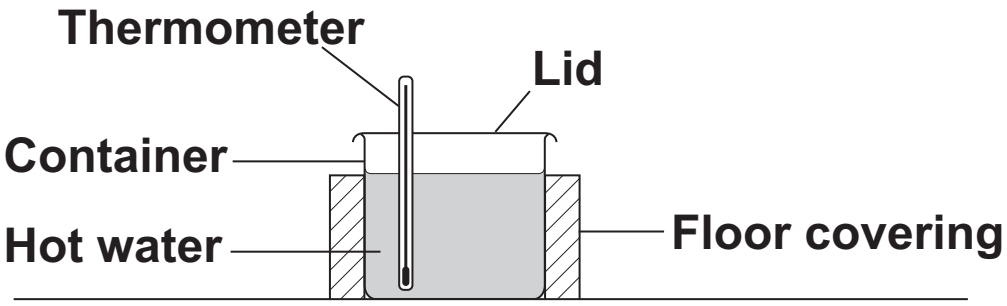
3 the tog value is a categoric variable and the floor covering is a continuous variable.

4 the tog value is a continuous variable and the floor covering is a categoric variable.

[Question 8 continues on the next page]

An experiment was carried out to compare the insulating properties of different floor coverings.

- **A container was wrapped in thin carpet.**
- **Hot water was placed in the container.**
- **A lid was put on the container.**
- **The temperature of the water was measured.**
- **The temperature was measured again after a certain time interval.**
- **The experiment was repeated with each of the other floor coverings.**



8B To make this experiment a fair test, which variables must be controlled?

1 mass of water and final temperature

2 time interval and final temperature

3 initial temperature, final temperature and the time interval

4 mass of water, initial temperature and time interval

8C Which row in the table correctly describes the variables in this experiment?

	INDEPENDENT VARIABLE	DEPENDENT VARIABLE
1	mass of water	final temperature
2	type of floor covering	mass of water
3	type of floor covering	final temperature
4	final temperature	type of floor covering

8D A householder buys a new carpet. The cost is £400. He estimates that he will save £140 on his heating bill each year.

How long will it be before the owner has recovered his £400?

1 less than 1 year

2 between 1 and 2 years

3 between 2 and 3 years

4 more than 3 years

QUESTION NINE

The UK government has decided that filament lamps must be replaced by energy-saving lamps. Some people want to continue using filament lamps. Below are some of the arguments for using each type of lamp.

FILAMENT LAMPS

- Filament lamps cost only 42 p; energy-saving lamps are more expensive.
- Filament lamps reach full brightness almost immediately; energy-saving lamps take a long time to warm up.
- The extra heat given out from a filament lamp helps to warm the room.

ENERGY-SAVING LAMPS

- An 11 watt energy-saving lamp gives as much light as a 60 watt filament lamp.
- Energy-saving lamps produce very little waste energy; filament lamps have an efficiency of only 0·1.
- Energy-saving lamps are cheaper to use.
- Energy-saving lamps last about 7 times longer than filament lamps.

9A Filament lamps are less efficient than energy-saving lamps.

This means that they . . .

1 cost less.

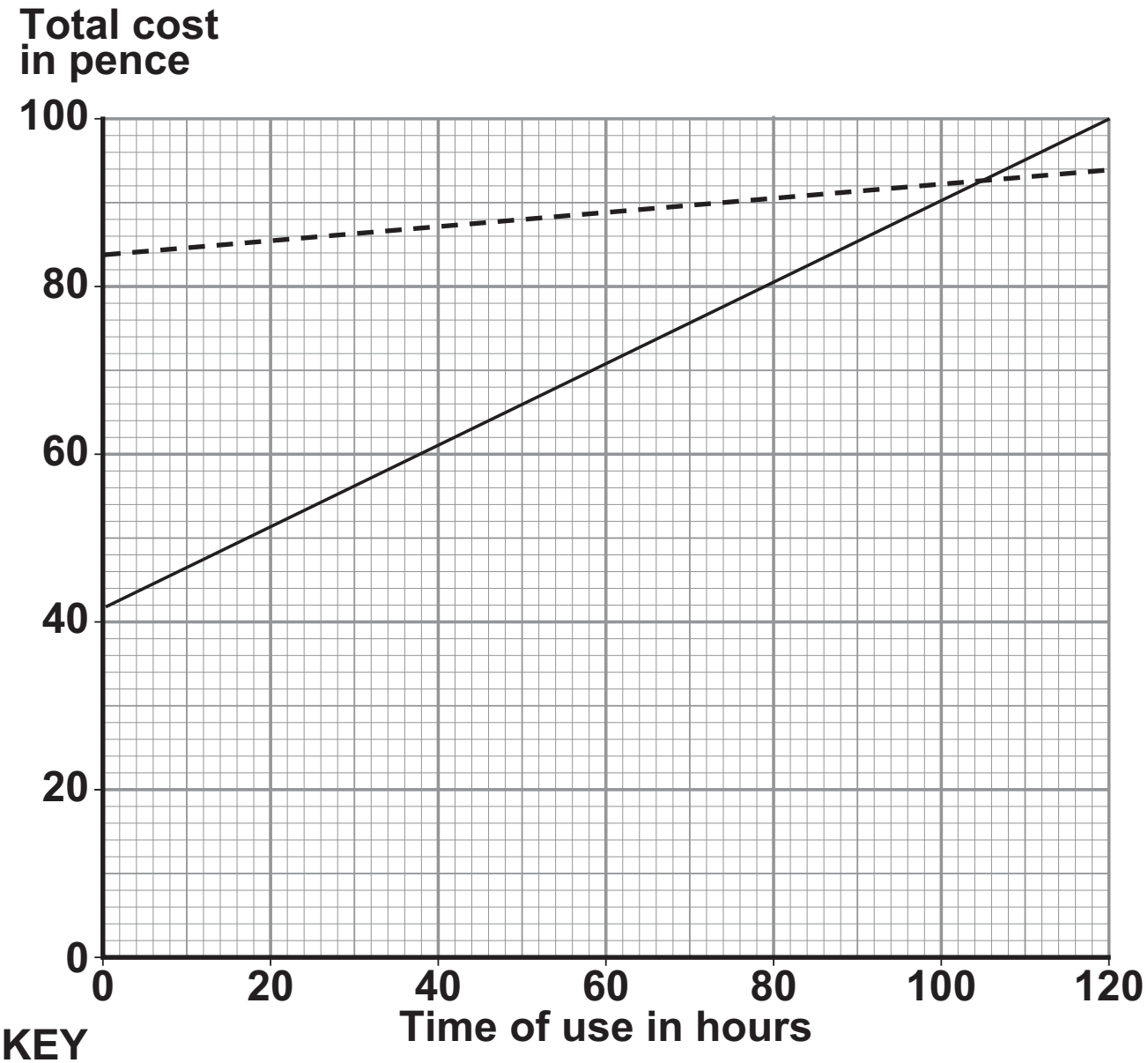
2 do not last as long.

3 have a larger input power for the same light output.

4 reach full brightness straight away.

[Question 9 continues on the next page]

The graph shows the total cost of buying and using each type of lamp.



9B The graph shows that the cost of buying an energy-saving lamp compared with buying a filament lamp is . . .

1 half as much.

2 twice as much.

3 the same.

4 four times as much.

9C An energy-saving lamp becomes more economical than a filament lamp after . . .

1 86 hours of use.

2 93 hours of use.

3 103 hours of use.

4 105 hours of use.

9D Supporters of filament lamps believe that the 'waste' heat from each lamp is used to heat their houses. They believe that this saves on their heating costs. They say that the total energy used to LIGHT AND HEAT their houses would not be reduced by using energy-saving lamps.

To find out if they are correct, it is necessary to compare the costs . . .

1 in a small house using filament lamps and in a large house using energy-saving lamps.

2 in a small house using energy-saving lamps and in a large house using filament lamps.

3 using two identical houses with filament lamps in one and energy-saving lamps in the other.

4 using some filament lamps and some energy-saving lamps in the same house.

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 table gives data for some energy sources used to generate electricity in the UK.

	Energy source	Generating cost in pence per kWh	Number of grams of carbon dioxide produced per kWh
A	Coal	2·6	1000
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C	Hydroelectric (falling water)	3·4	20
D	Nuclear	3·5	5

Use the data in the table above to match energy sources, A, B, C and D, with the numbers 1–4 in the table below.

1	**produces the cheapest electricity**
2	**is renewable**
3	**contributes least to global warming**
4	**contributes most to global warming**

[Turn over for the next question]

QUESTION TWO

Hydroelectric schemes use falling water to produce electricity.

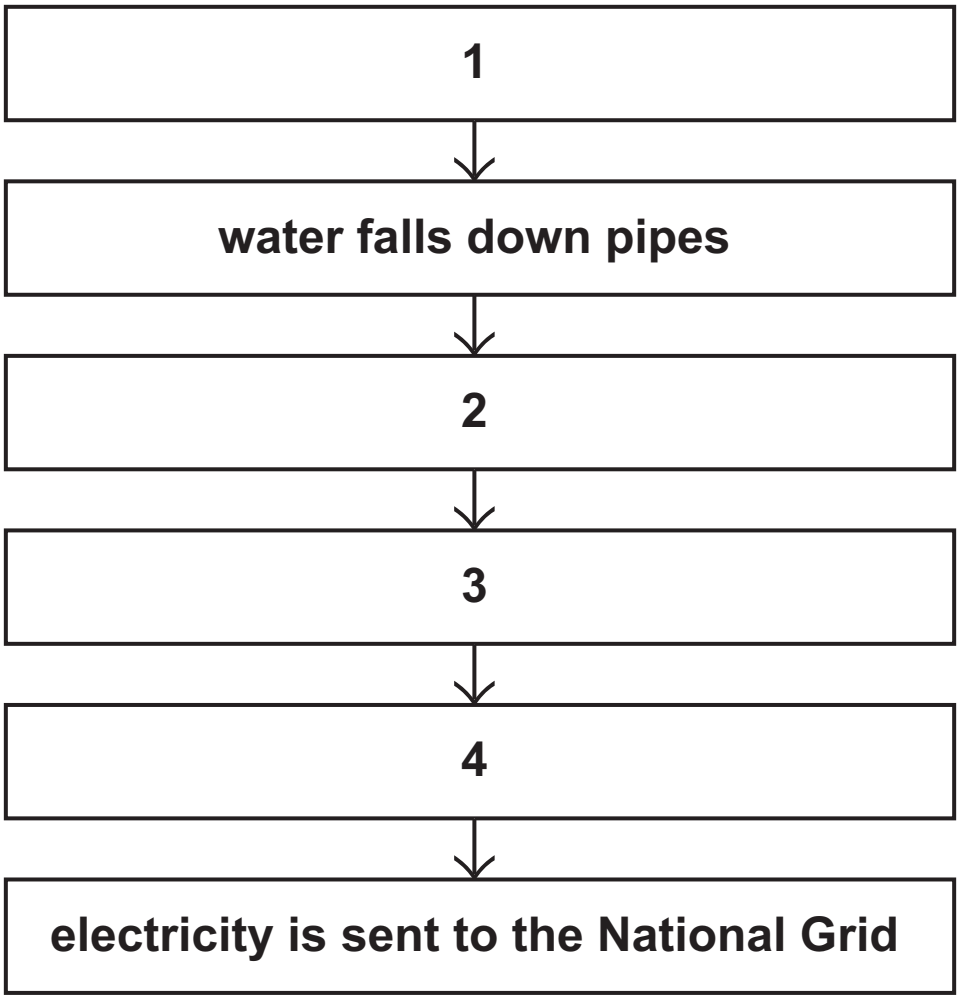
Match statements, A, B, C, and D, with the boxes 1–4 in the flow chart to show how a hydroelectric scheme works.

A electricity is produced

B moving water drives turbines

C turbines drive generators

D water collects in a reservoir



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TURN OVER FOR THE NEXT QUESTION

SECTION TWO

Questions THREE to NINE.

Each of these questions has four parts.

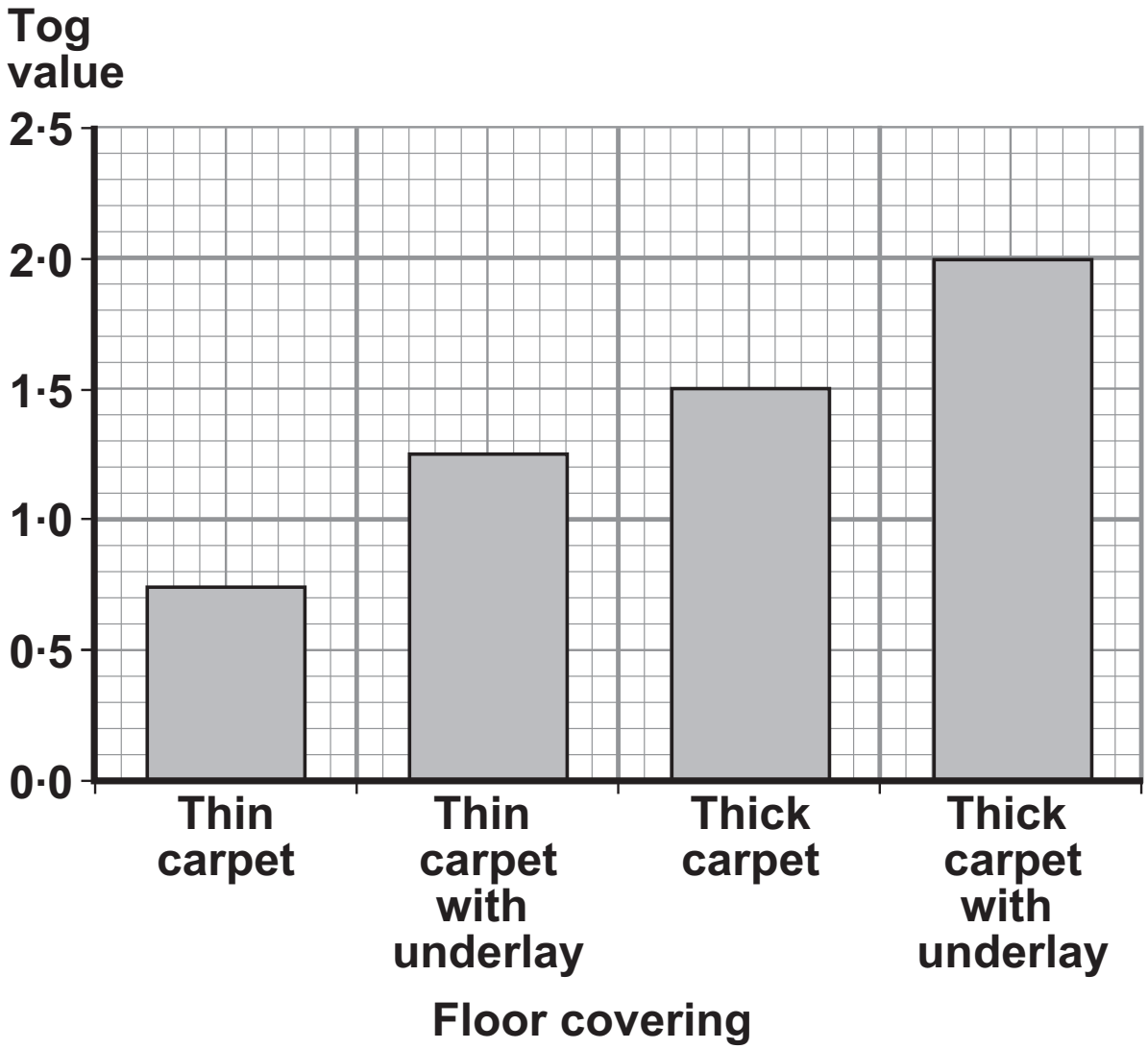
In each part choose only ONE answer.

Mark your choices on the answer sheet.

QUESTION THREE

Insulating materials have a 'tog value'. The better the insulation, the higher the tog value.

The bar chart shows the tog values of some floor coverings.



3A The data is plotted as a bar chart because . . .

1 both the tog value and the floor covering are categoric variables.

2 both the tog value and the floor covering are continuous variables.

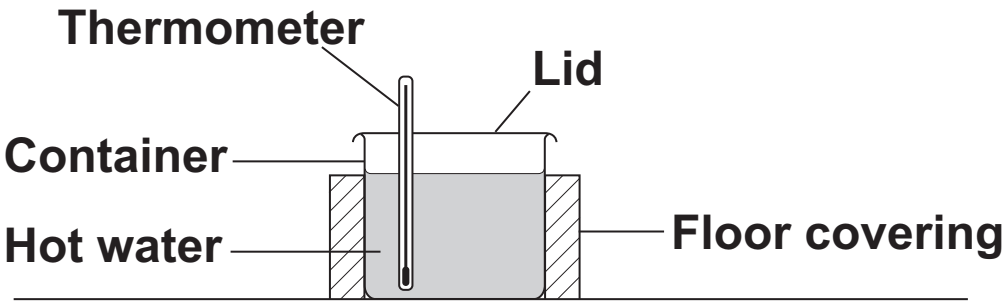
3 the tog value is a categoric variable and the floor covering is a continuous variable.

4 the tog value is a continuous variable and the floor covering is a categoric variable.

[Question 3 continues on the next page]

An experiment was carried out to compare the insulating properties of different floor coverings.

- **A container was wrapped in thin carpet.**
- **Hot water was placed in the container.**
- **A lid was put on the container.**
- **The temperature of the water was measured.**
- **The temperature was measured again after a certain time interval.**
- **The experiment was repeated with each of the other floor coverings.**



3B To make this experiment a fair test, which variables must be controlled?

1 mass of water and final temperature

2 time interval and final temperature

3 initial temperature, final temperature and the time interval

4 mass of water, initial temperature and time interval

3C Which row in the table correctly describes the variables in this experiment?

	INDEPENDENT VARIABLE	DEPENDENT VARIABLE
1	mass of water	final temperature
2	type of floor covering	mass of water
3	type of floor covering	final temperature
4	final temperature	type of floor covering

3D A householder buys a new carpet. The cost is £400. He estimates that he will save £140 on his heating bill each year.

How long will it be before the owner has recovered his £400?

1 less than 1 year

2 between 1 and 2 years

3 between 2 and 3 years

4 more than 3 years

QUESTION FOUR

The UK government has decided that filament lamps must be replaced by energy-saving lamps. Some people want to continue using filament lamps. Below are some of the arguments for using each type of lamp.

FILAMENT LAMPS

- Filament lamps cost only 42 p; energy-saving lamps are more expensive.
- Filament lamps reach full brightness almost immediately; energy-saving lamps take a long time to warm up.
- The extra heat given out from a filament lamp helps to warm the room.

ENERGY-SAVING LAMPS

- An 11 watt energy-saving lamp gives as much light as a 60 watt filament lamp.
- Energy-saving lamps produce very little waste energy; filament lamps have an efficiency of only 0·1.
- Energy-saving lamps are cheaper to use.
- Energy-saving lamps last about 7 times longer than filament lamps.

4A Filament lamps are less efficient than energy-saving lamps.

This means that they . . .

1 cost less.

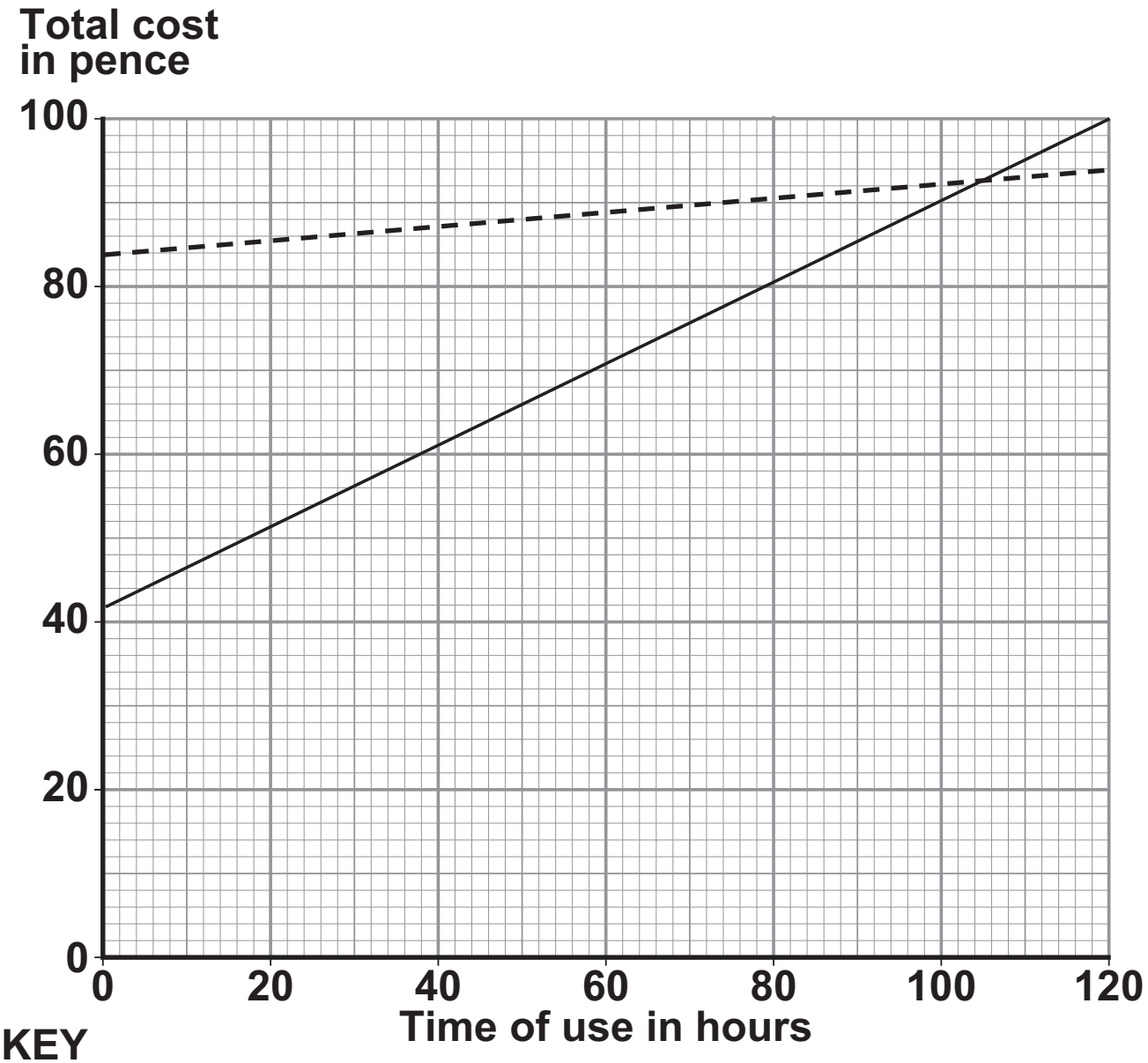
2 do not last as long.

3 have a larger input power for the same light output.

4 reach full brightness straight away.

[Question 4 continues on the next page]

The graph shows the total cost of buying and using each type of lamp.



4B The graph shows that the cost of buying an energy-saving lamp compared with buying a filament lamp is . . .

1 half as much.

2 twice as much.

3 the same.

4 four times as much.

4C An energy-saving lamp becomes more economical than a filament lamp after . . .

1 86 hours of use.

2 93 hours of use.

3 103 hours of use.

4 105 hours of use.

4D Supporters of filament lamps believe that the 'waste' heat from each lamp is used to heat their houses. They believe that this saves on their heating costs. They say that the total energy used to LIGHT AND HEAT their houses would not be reduced by using energy-saving lamps.

To find out if they are correct, it is necessary to compare the costs . . .

1 in a small house using filament lamps and in a large house using energy-saving lamps.

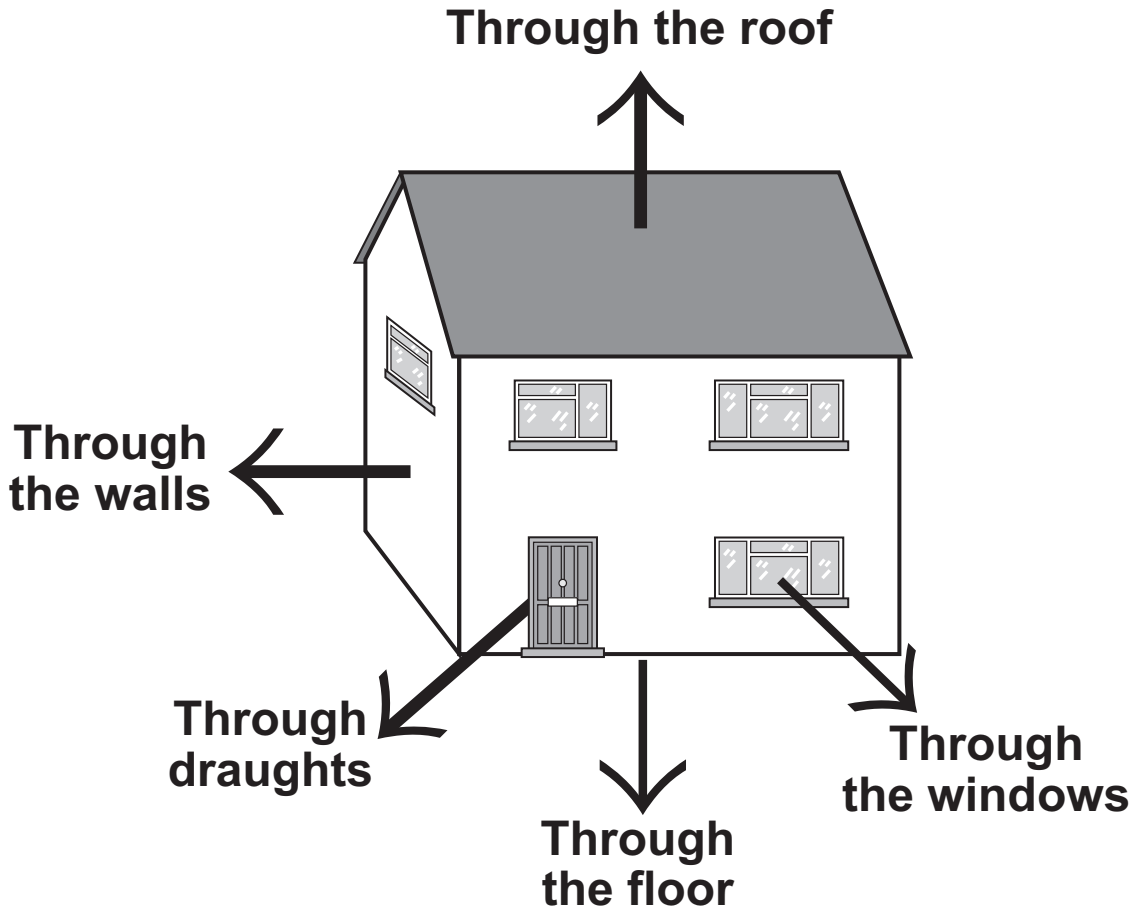
2 in a small house using energy-saving lamps and in a large house using filament lamps.

3 using two identical houses with filament lamps in one and energy-saving lamps in the other.

4 using some filament lamps and some energy-saving lamps in the same house.

QUESTION FIVE

The diagram shows the ways in which energy can be lost from a house.



5A This house is losing heat at a rate of 30 kW.

What power must be supplied by the central heating system to maintain a steady temperature?

1 less than 30 kW

2 30 kW

3 60 kW

4 more than 60 kW

5B One day, the central heating boiler uses 10 kWh of energy.

The efficiency of the central heating boiler is 0·9

How much of the energy from the fuel is usefully transferred?

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

1 1 kWh

2 9 kWh

3 10 kWh

4 11 kWh

5C What happens to the energy that is NOT usefully transferred?

1 It is stored in the boiler until needed.

2 It is turned mainly into sound energy.

3 It warms the air surrounding the house.

4 It leaves the house in the form of light energy.

[Question 5 continues on the next page]

5D In the UK, the government has ruled that central heating boilers must have an efficiency of at least 0·9

Why might the government wish to raise this figure above 0·9?

Because . . .

1 householders would have to pay more for their energy supplies.

2 it would help to conserve energy supplies.

3 it would help to protect the ozone layer.

4 more polluting gases would be produced.

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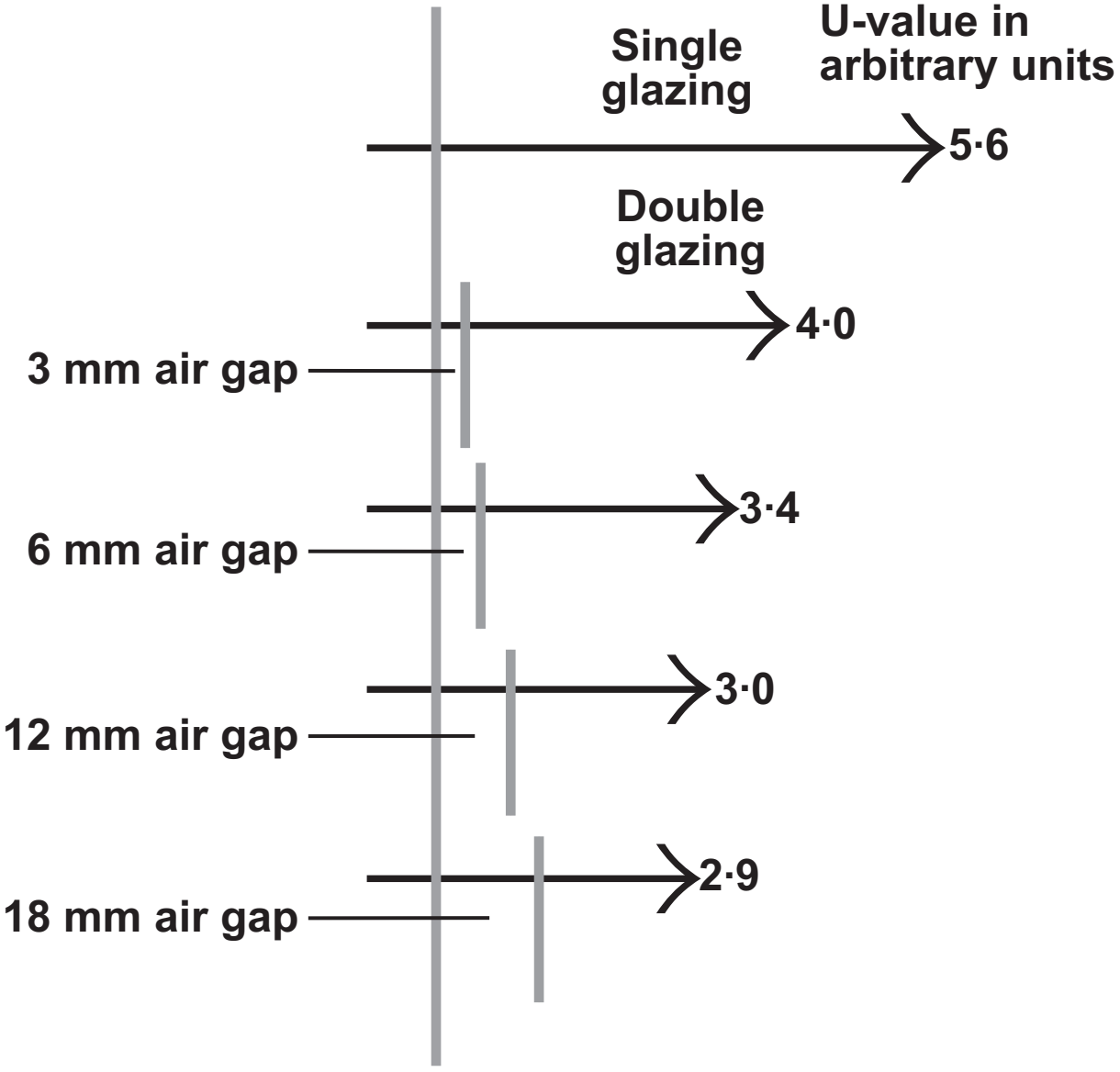
TURN OVER FOR THE NEXT QUESTION

QUESTION SIX

A double-glazing manufacturer published the results of some tests that his company had carried out on the effect of altering the air gap in double-glazed windows.

The diagram shows the effect of altering the width of the air gap.

The higher the U-value, the faster the rate at which heat will escape.



6A How does double glazing reduce the rate of loss of heat from a building?

1 The air trapped in the gap generates extra heat as it moves around.

2 The air trapped in the gap is a good insulator and reduces heat loss by conduction.

3 The air trapped in the gap is able to circulate by convection currents.

4 The air trapped in the gap stops heat from being radiated through the glass.

6B What happens to the U-value as the width of the air gap is increased?

1 It decreases by equal amounts with equal increases in width of the gap.

2 It decreases slowly at first and then more quickly.

3 It decreases quickly at first and then more slowly.

4 It decreases at first and then increases.

[Question 6 continues on the next page]

6C You want to determine the U-value for a 7 mm air gap.

What is the best way to display the data to do this?

1 a bar chart

2 a line graph

3 a pie chart

4 a scattergram

6D Another double-glazing manufacturer says "I don't trust these figures, I think they used different thicknesses of glass for the different air gaps".

If this had been true, the test results would not have been valid because . . .

1 known systematic errors would not have been eliminated.

2 random errors would not have been eliminated.

3 measurements were not taken with sufficient precision.

4 measurements taken were affected by more than one independent variable.

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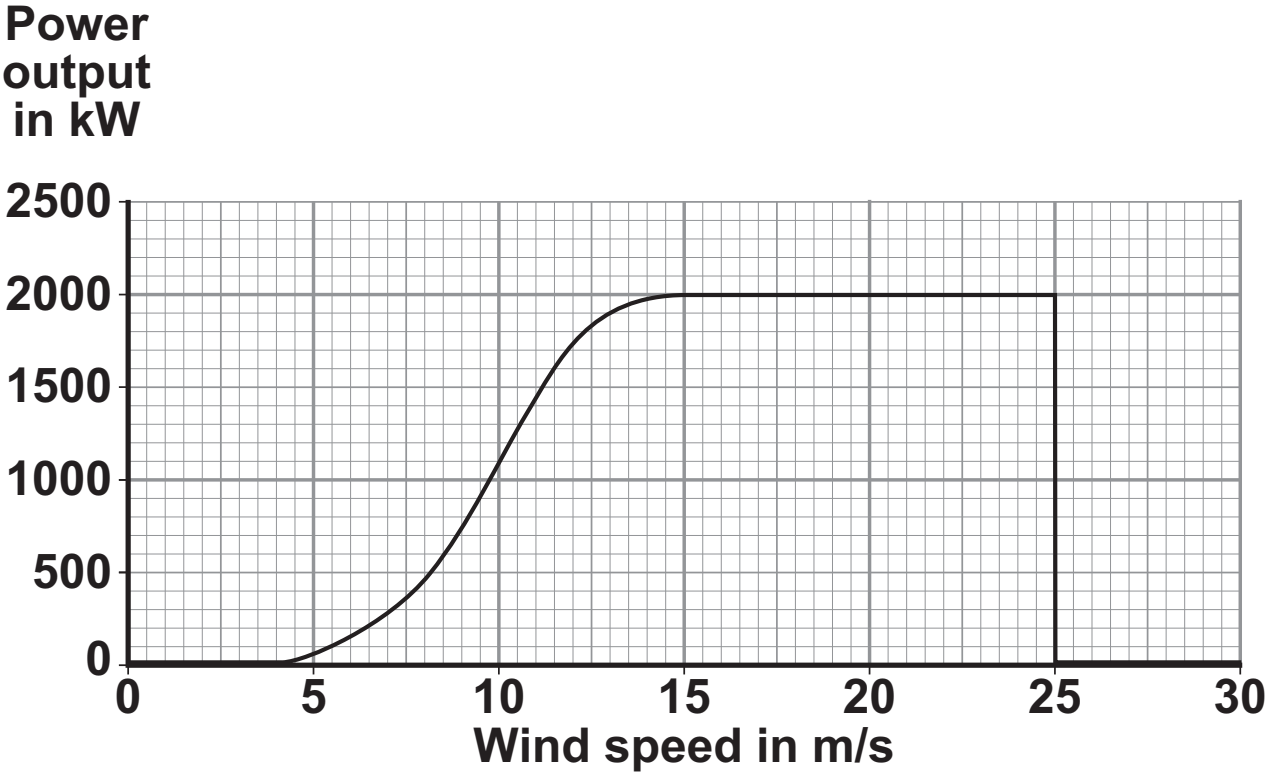
TURN OVER FOR THE NEXT QUESTION

QUESTION SEVEN

A wind turbine can be used to produce electricity.

The graph shows how the power output of a particular turbine varies with wind speed.



The turbine is designed to operate best at a minimum wind speed of 15 m/s. This is called the rated wind speed.

7A How much energy would be transferred if the turbine operated at its rated wind speed for 2 hours?

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

1 2 kWh

2 4 kWh

3 2000 kWh

4 4000 kWh

7B The turbine will work only when the wind speed is above a value called the cut-in wind speed. The turbine shuts down when the wind speed reaches a certain value.

Which row in the table gives the correct wind speeds?

	Cut-in wind speed	Shut-down wind speed
1	4 m/s	15 m/s
2	9 m/s	20 m/s
3	4 m/s	25 m/s
4	13 m/s	25 m/s

7C What happens to the energy of the wind at speeds lower than the cut-in speed and higher than the shut-down speed?

1 It will all be transformed into heat.

2 It will all be transformed into sound.

3 It will be stored in the turbine for future use.

4 It will stay as kinetic energy of moving air.

[Question 7 continues on the next page]

7D The efficiency of this turbine is 0·7

How many kilowatt-hours of wind energy would be needed to produce 10 kilowatt-hours of electrical energy?

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

1 7·0

2 9·3

3 10·7

4 14·3

QUESTION EIGHT

Worldwide, the demand for electrical energy is rising rapidly. Many countries are building new coal-fired power stations to help meet the demand.

The UK government is committed to reducing carbon emissions.

The government wants to generate 20% of the country's electricity from renewable sources by 2020.

8A What can UK electricity generating companies do to help achieve the government's aims?

1 close some coal, gas and oil-fired power stations

2 build more nuclear power stations

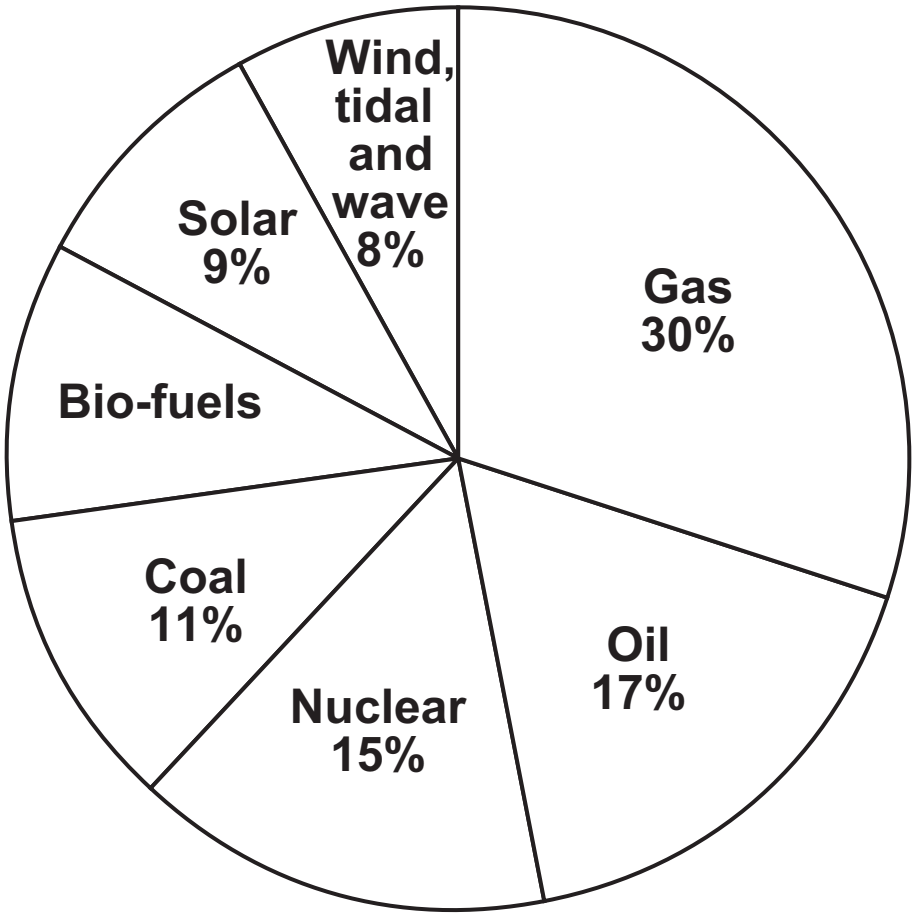
3 build more tidal and wave power stations

4 build more wind and nuclear power stations

[Question 8 continues on the next page]

By 2050, the ways in which electricity is generated in the UK will be very different from today's methods.

8B The pie chart shows the predicted percentages of different sources of energy that will be used to generate electricity in 2050.



What percentage of this energy will be provided by renewable sources?

1 17

2 27

3 42

4 58

8C It is predicted that by 2050, many more power stations will use uranium as a fuel.

What is the main process by which uranium produces heat in a power station?

1 decay

2 fission

3 fusion

4 radiation

8D In 2008, 1500 wind turbines produced 1600 MW of power in the UK. It is predicted that by the year 2050, there will be 12 000 wind turbines providing a total of 60 000 MW.

The average output per wind turbine is predicted to increase by the year 2050.

The increase from the 2008 value would be . . .

1 1·1 MW

2 3·9 MW

3 5·0 MW

4 6·1 MW

QUESTION NINE

In a recent speech, a politician called for a European energy policy that gives sustainable, affordable and secure energy resources. The issues in the policy are given in the table.

	POLICY ISSUE
L	Break the dependency on fossil fuels, which are damaging the atmosphere
M	Guarantee realistic and stable costs to customers
N	Free citizens from dependence on unreliable energy suppliers

9A Which row in the table below describes correctly the issues in the energy policy?

	L	M	N
1	economic	environmental	political
2	environmental	economic	political
3	environmental	environmental	economic
4	economic	economic	environmental

9B The politician also stated that the electricity would be transferred by energy-efficient cables.

The cables would be 'energy-efficient' so that . . .

1 energy would be created along the cables.

2 energy would be transformed along the cables.

3 energy loss in the cables would be kept to a minimum.

4 energy would be destroyed along the cables.

9C Part of the policy is to transfer electricity from renewable sources along a 'Super Grid'. This 'Super Grid' could use transformers to achieve energy efficiency.

Just before the electricity entered the 'Super Grid', the transformer would . . .

1 decrease the voltage and decrease the current.

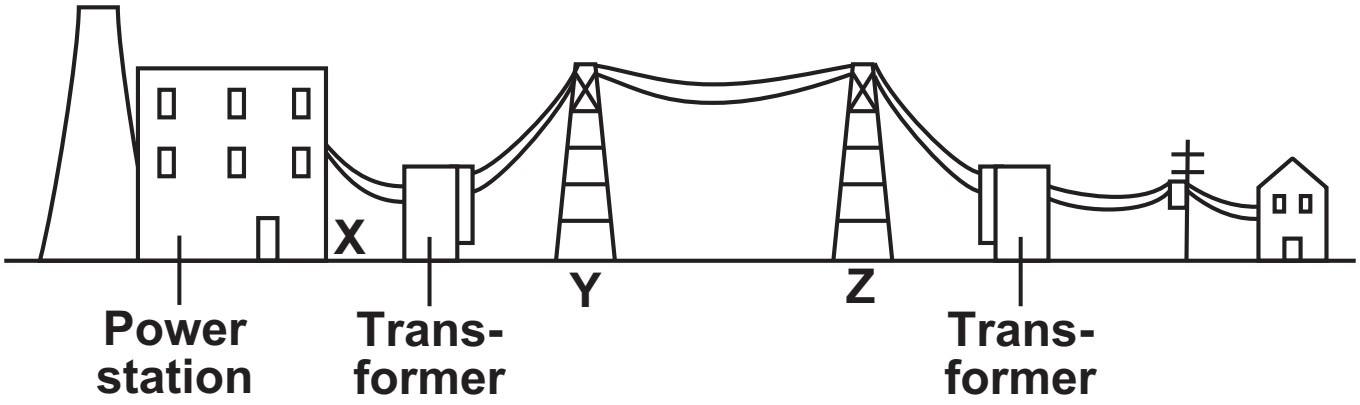
2 decrease the voltage and increase the current.

3 increase the voltage and decrease the current.

4 increase the voltage and increase the current.

[Question 9 continues on the next page]

9D In the UK, electricity is transferred by the National Grid.



Which row in the table could give the correct voltages at X, Y and Z?

	X	Y	Z
1	25 kV	400 kV	25 kV
2	25 kV	400 kV	400 kV
3	400 kV	25 kV	25 kV
4	400 kV	400 kV	25 kV

END OF TEST