

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										



General Certificate of Secondary Education
Foundation Tier and Higher Tier
November 2012

Science A
Unit Physics P1a (Energy and Electricity)
Physics
Unit Physics P1a (Energy and Electricity)

PHY1AP
F&H

Tuesday 6 November 2012 Afternoon Session

For this paper you must have:

- a black ball-point pen
 - an objective test answer sheet.
- You may use a calculator.

Time allowed

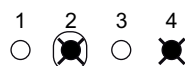
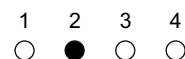
- 30 minutes

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**.

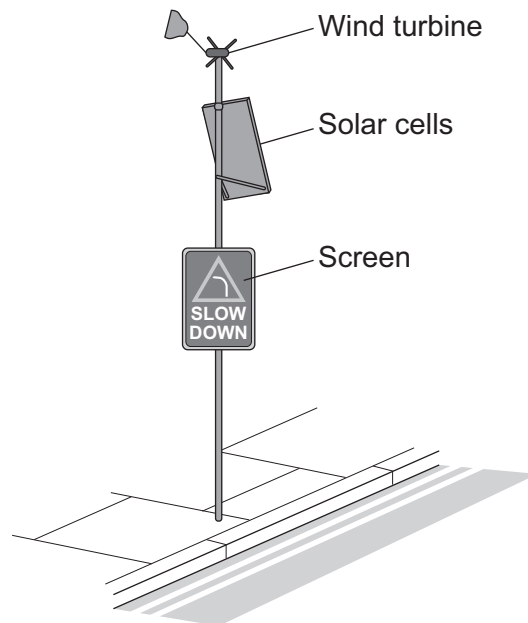
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

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
- B** thermal
- C** light
- D** kinetic

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

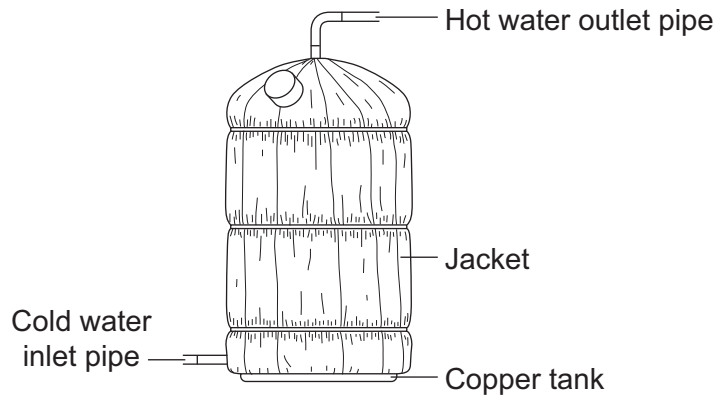
The energy input to the wind turbine is . . . **2** . . . energy.

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

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

QUESTION TWO

The diagram shows a jacket fitted to a hot water tank.



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

- A** conduction
- B** convection
- C** insulation
- D** radiation

Heat will travel through the copper wall of the tank by . . . **1**

The jacket helps to keep the water warm because the fibreglass inside the jacket provides . . . **2**

The hot water outlet is at the top of the tank because hot water will rise to the top by . . . **3**

Heat is lost from the surface of the tank by . . . **4**

Turn over for the next question

Turn over ►

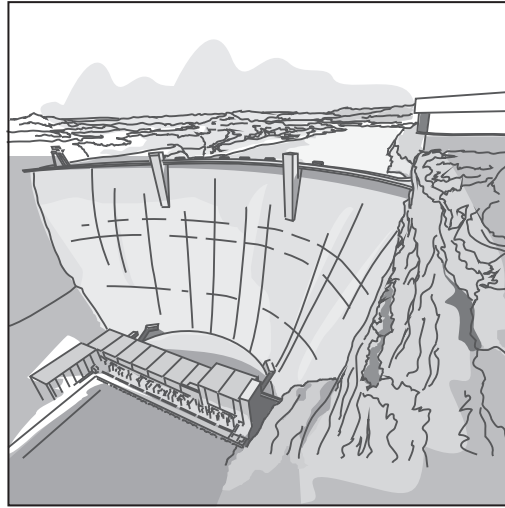
QUESTION THREE

Some people feel strongly about the environment. They may protest against the location of new power stations.

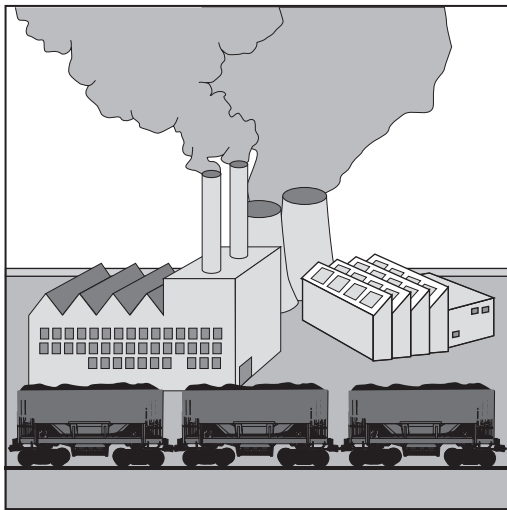
The diagrams show four types of power station.



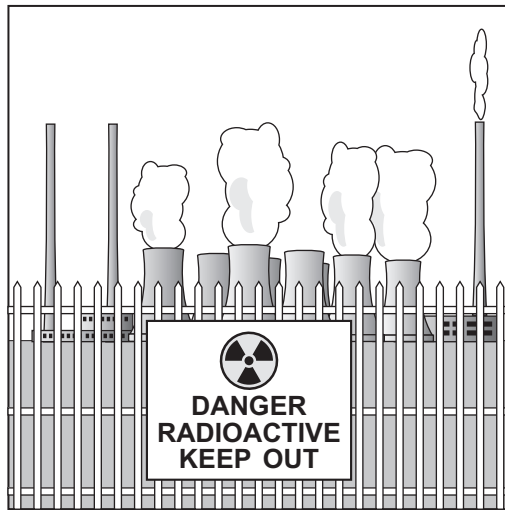
1



2



3



4

The statements, **A**, **B**, **C**, and **D**, were made by different groups of protesters.

Match the protesters' statements, **A**, **B**, **C**, and **D**, with the power stations **1–4**.

- A** Don't flood our farmland.
- B** Don't let turbines kill our birds.
- C** Nuclear waste causes cancer.
- D** Stop releasing polluting gases.

QUESTION FOUR

Various energy sources can be used to generate electricity.

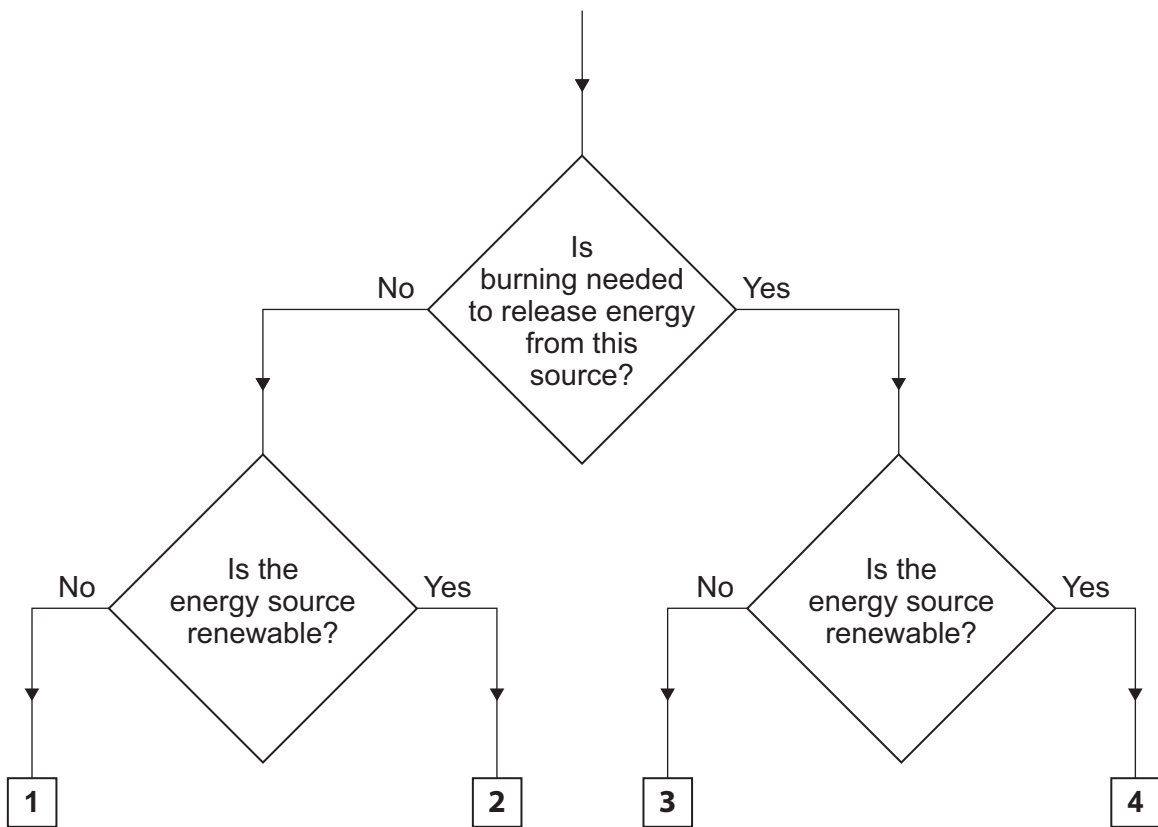
Match energy sources, **A**, **B**, **C**, and **D**, with the numbers **1–4** in the flow chart.

A falling water

B oil

C plutonium

D wood

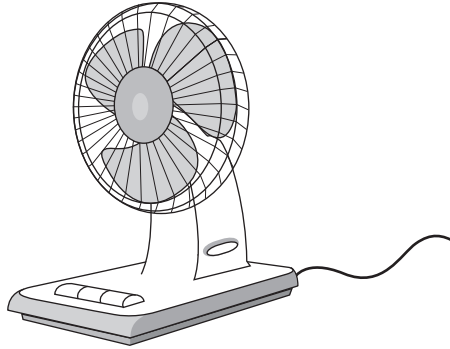


Turn over for the next question

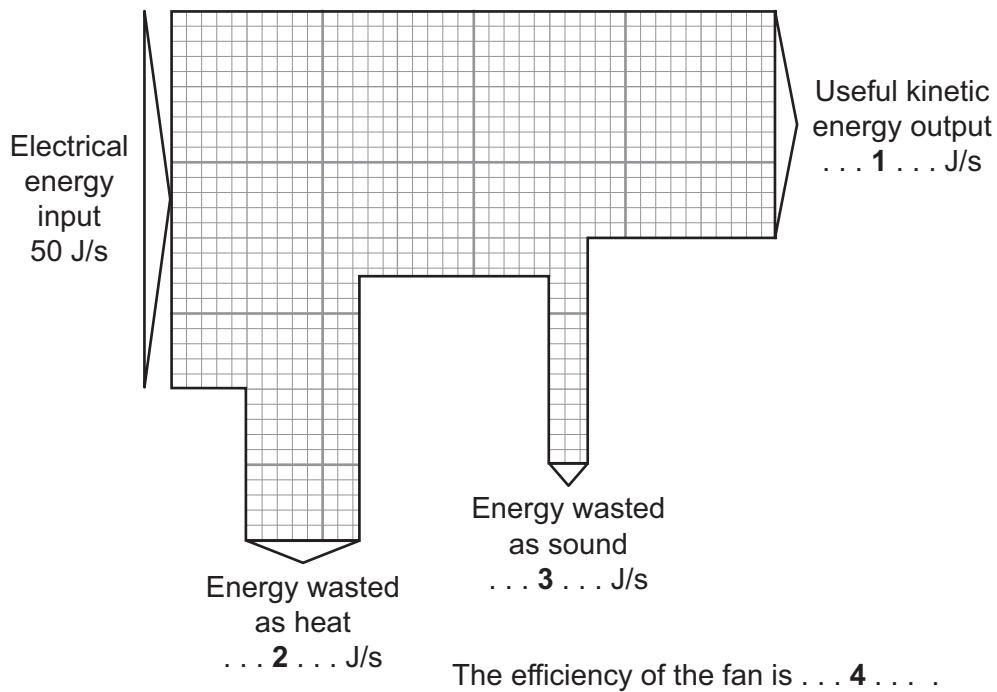
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QUESTION FIVE

The diagram shows an electric fan.



The Sankey diagram gives the energy transformations for the fan.



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

Match numbers, **A**, **B**, **C** and **D**, with the labels **1–4** on the Sankey diagram.

- A** 0.6
- B** 5
- C** 15
- D** 30

Turn over for the next question

Turn over ►

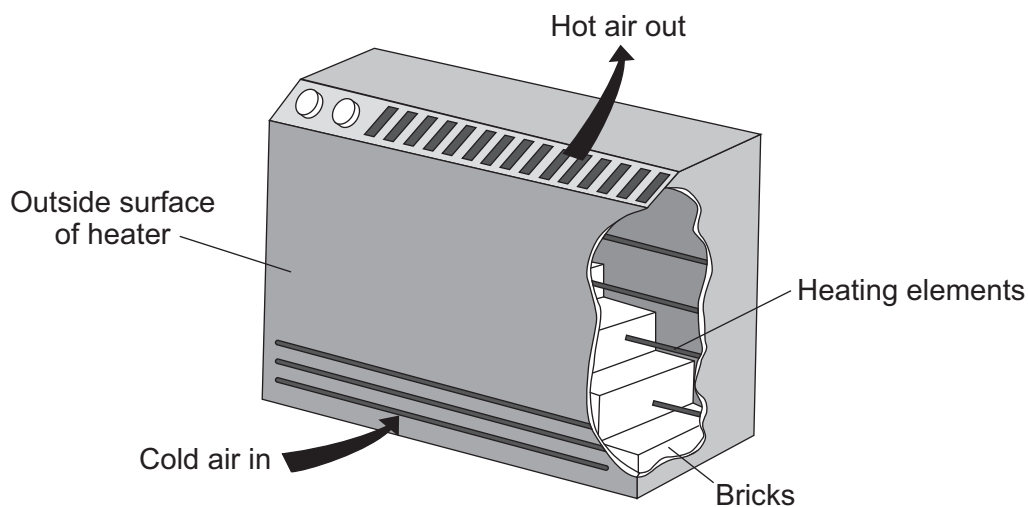
Section TwoQuestions **SIX** to **NINE**.

Each of these questions has four parts.

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

QUESTION SIX

The diagram shows the construction of one type of heater. The bricks inside the heater warm up during the night when electricity is cheaper. The bricks then emit heat (thermal energy) during the day.



6A The bricks warm up because they . . .

- 1 absorb heat.
- 2 insulate heat.
- 3 radiate heat.
- 4 reflect heat.

6B The diagram shows the main thermal energy transfer of the heater as it warms the room.

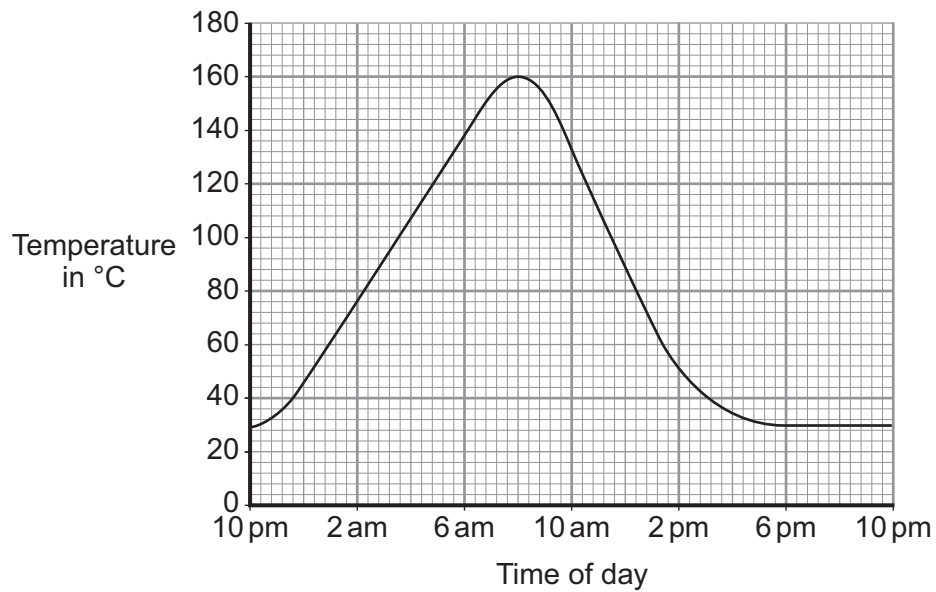
By what process does this heater transfer most of its energy to all parts of a room?

- 1 conduction from the bricks
- 2 conduction from the outside surface of the heater
- 3 convection currents in the air
- 4 radiation from the outside surface of the heater

6C To give out the most heat by radiation, what would be the best outside surface for the heater?

- 1 dark, matt
- 2 dark, shiny
- 3 light, shiny
- 4 light, matt

6D The graph shows how the temperature of the bricks changes during a 24-hour period.



At what time did the bricks reach their highest temperature?

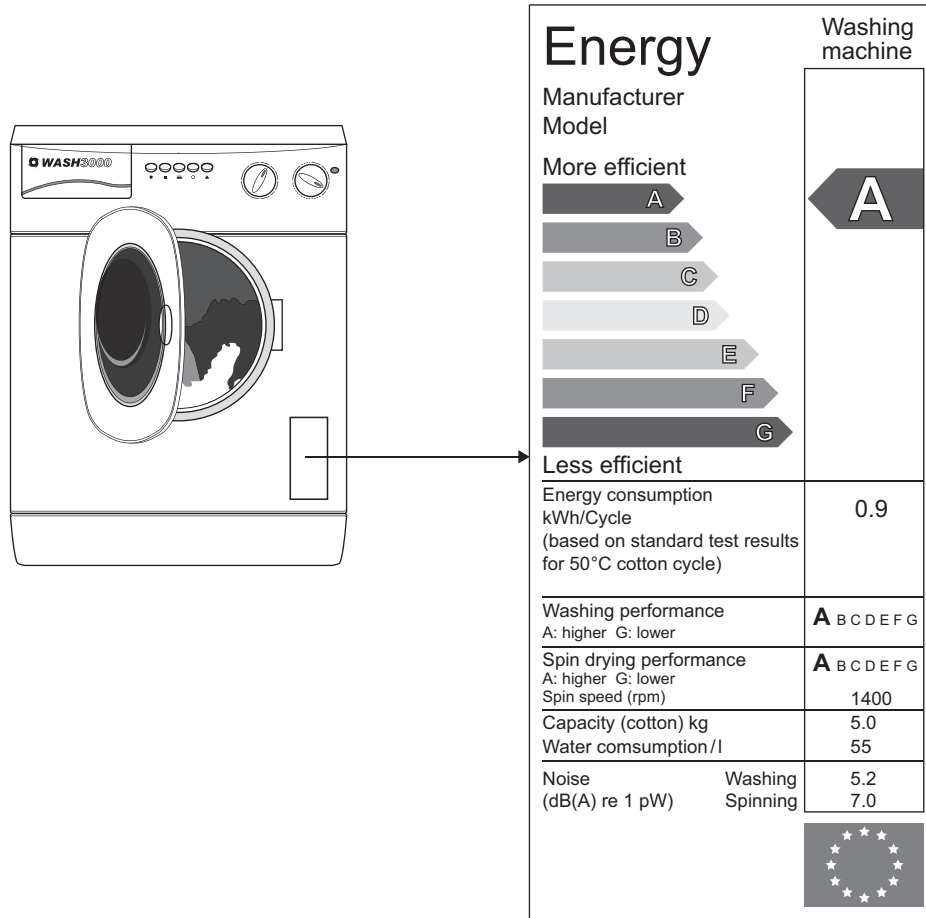
- 1 8 am
- 2 10 am
- 3 6 pm
- 4 10 pm

Turn over for the next question

Turn over ►

QUESTION SEVEN

The energy label gives information about the washing machine shown in the diagram.



7A The energy label states that this washing machine has an efficiency rating of **A**.

A different washing machine has an efficiency rating of **C**.

This means the A-rated washing machine . . .

- 1 uses the same amount of energy for each wash cycle as the C-rated washing machine.
- 2 uses more energy for each wash cycle than the C-rated washing machine.
- 3 wastes more energy for each wash cycle than the C-rated washing machine.
- 4 wastes less energy for each wash cycle than the C-rated washing machine.

7B Washing machines do **not** transfer all of the supplied energy into useful forms of energy.

Information on the energy label suggests that some energy is wasted as . . .

- 1 heat.
- 2 light.
- 3 kinetic energy.
- 4 sound.

7C The A-rated washing machine is used for 300 standard washing cycles per year.

How much energy does this number of cycles transfer?

- 1 270 kWh
- 2 1500 kWh
- 3 2700 kWh
- 4 3600 kWh

7D A large family uses the A-rated washing machine for 500 standard washing cycles in a year.

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

1 kilowatt-hour of electricity costs 12p.

How much does the washing machine cost to run for that year?

- 1 £40.00
- 2 £41.60
- 3 £54.00
- 4 £60.00

Turn over for the next question

Turn over ►

QUESTION EIGHT

Some students investigated how effective three different devices were at drying things.

They added water to a paper towel until the mass of the paper towel was 45.6 g. They then hung the paper towel in front of one of the devices. After five minutes, they measured the mass of the paper towel again.

The test was carried out three times and the mean mass of the paper towels after five minutes was calculated.

The whole procedure was repeated with the other devices, using identical paper towels.

Their results are shown below.

		Mass after 5 minutes in grams			
Device used	Mass at start in grams	1st test	2nd test	3rd test	Mean
No device	45.6	45.5	45.4	45.6	45.5
Handheld mini fan	45.6	45.4	45.2	45.3	45.3
Hairdryer	45.6	41.2	41.0	41.1	41.1
Desk fan	45.6	43.7	43.6	43.8	43.7

8A The size of the paper towels, their mass at the start and the distance of the device from the towels are . . .

- 1 independent variables.
- 2 dependent variables.
- 3 control variables.
- 4 discrete variables.

8B The tests are repeated to . . .

- 1 check for systematic errors.
- 2 improve the reliability of the experiment.
- 3 see if the devices have an effect.
- 4 improve the precision of the tests.

8C The students calculated the mean mass of water lost from the paper towels at the end of five minutes for each device.

The students were told to display their results on graph paper.

To show which device was best at drying the paper towels, the students should plot . . .

- 1 a line graph of the mean mass of water lost against the device used.
- 2 a bar chart of the mean mass of water lost against the time.
- 3 a bar chart of the mean mass of water lost against the device used.
- 4 a line graph of the mean mass of water lost against the time.

8D The results show that the device that dried the paper towels best was . . .

- 1 the hairdryer because the mean mass of water lost in five minutes was highest.
- 2 the hairdryer because it produces hot air.
- 3 the desk fan because it had the largest fan blades.
- 4 the handheld mini fan because the mean mass of water lost in five minutes was lowest.

Turn over for the next question

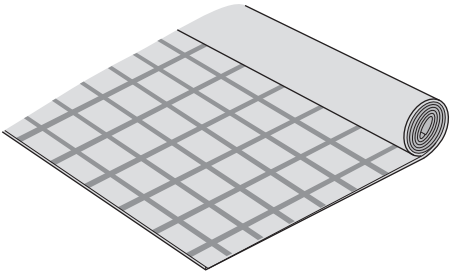
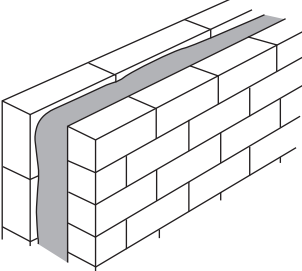
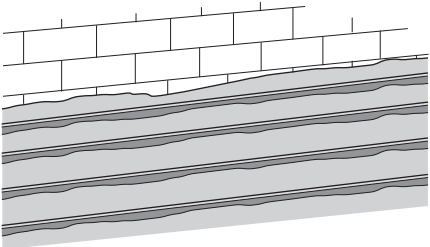
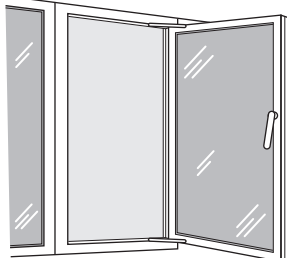
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QUESTION NINE

Energy costs rising

Many householders are worried about the rising cost of energy.

The drawings are from a magazine article on how to reduce the cost of home heating by using insulation.

<p style="text-align: center;">Carpeting the floor</p>  <p style="text-align: center;">Saving per week for each square metre 25p</p>	<p style="text-align: center;">Putting foam in wall cavities</p>  <p style="text-align: center;">Saving per week for each square metre 20p</p>
<p style="text-align: center;">Insulating the loft</p>  <p style="text-align: center;">Saving per week for each square metre 10p</p>	<p style="text-align: center;">Fitting double-glazed windows</p>  <p style="text-align: center;">Saving per week for each square metre 24p</p>

9A All the methods of insulation shown in the diagrams use materials that . . .

- 1 are good emitters of thermal radiation.
- 2 prevent warm air from rising.
- 3 trap air.
- 4 are warm.

- 9B** A student is asked to explain why the savings in the magazine article may not be correct for different houses.

The student makes three points:

- not all double glazing is equally good
- not all insulation in lofts is the same depth
- the difference between the outside temperature and the inside temperature of different houses is not constant.

Which one of the following statements is correct?

- 1 Only the student's first point is correct.
 - 2 Only the student's first two points are correct.
 - 3 All three of the student's points are correct.
 - 4 None of the student's points is correct.
- 9C** An energy-saving expert suggests how to reduce the heating bill for a house. She says that having foam put in the wall cavity will reduce the heating bill more than having double glazing fitted.

Her statement is correct because . . .

- 1 foam insulation is cheaper than double glazing.
 - 2 more heat is lost through each square metre of window compared with each square metre of wall.
 - 3 the area of the walls is much greater than the area of the windows.
 - 4 the windows are not always shut.
- 9D** The Government wants to encourage energy-saving. There will be several advantages to the environment if people use less energy.

Which of the following will be the most important advantage to the environment?

- 1 It will be more important to develop renewable energy technology.
- 2 Less energy will need to be transformed from fossil fuels.
- 3 Less energy will need to be transformed from renewable resources.
- 4 People will save money on their fuel bills.

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**.

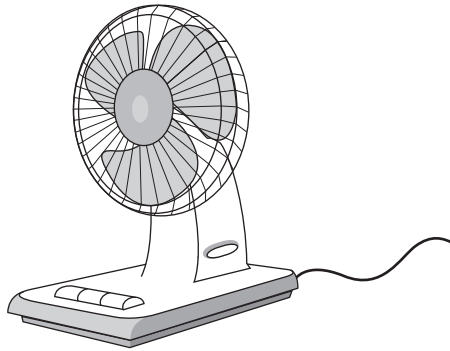
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

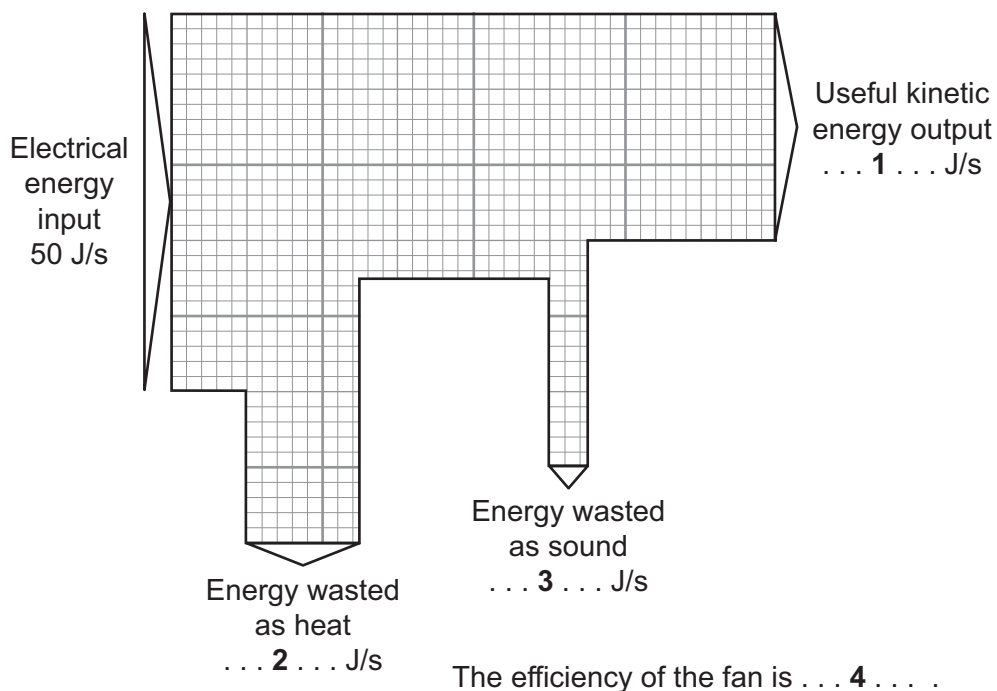
Mark your choices on the answer sheet.

QUESTION ONE

The diagram shows an electric fan.



The Sankey diagram gives the energy transformations for the fan.



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

Match numbers, **A**, **B**, **C** and **D**, with the labels **1–4** on the Sankey diagram.

A 0.6

B 5

C 15

D 30

QUESTION TWO

This question is about some of the energy sources used to generate electricity.

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

A coal

B hydroelectric

C nuclear

D wind

	Feature
1	Has the highest decommissioning cost
2	The supply is not reliable
3	No fuel costs, and can be used to meet sudden demands for electricity
4	Transformation of chemical energy to heat energy

Turn over ►

Section TwoQuestions **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

Some students investigated how effective three different devices were at drying things.

They added water to a paper towel until the mass of the paper towel was 45.6 g. They then hung the paper towel in front of one of the devices. After five minutes, they measured the mass of the paper towel again.

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3A The size of the paper towels, their mass at the start and the distance of the device from the towels are . . .

- 1 independent variables.
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- 4 discrete variables.

3B The tests are repeated to . . .

- 1 check for systematic errors.
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3C The students calculated the mean mass of water lost from the paper towels at the end of five minutes for each device.

The students were told to display their results on graph paper.

To show which device was best at drying the paper towels, the students should plot . . .

- 1 a line graph of the mean mass of water lost against the device used.
- 2 a bar chart of the mean mass of water lost against the time.
- 3 a bar chart of the mean mass of water lost against the device used.
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3D The results show that the device that dried the paper towels best was . . .

- 1 the hairdryer because the mean mass of water lost in five minutes was highest.
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Turn over for the next question

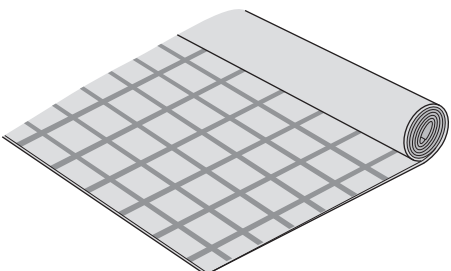
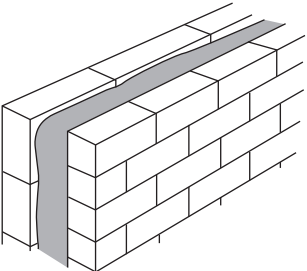
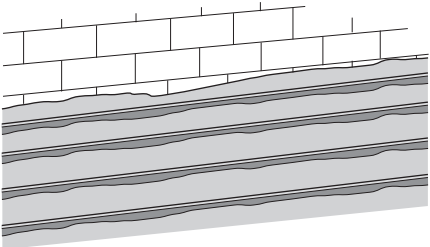
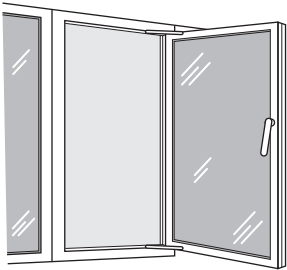
Turn over ►

QUESTION FOUR

Energy costs rising

Many householders are worried about the rising cost of energy.

The drawings are from a magazine article on how to reduce the cost of home heating by using insulation.

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<p>Insulating the loft</p>  <p>Saving per week for each square metre 10p</p>	<p>Fitting double-glazed windows</p>  <p>Saving per week for each square metre 24p</p>

4A All the methods of insulation shown in the diagrams use materials that . . .

- 1 are good emitters of thermal radiation.
- 2 prevent warm air from rising.
- 3 trap air.
- 4 are warm.

- 4B** A student is asked to explain why the savings in the magazine article may not be correct for different houses.

The student makes three points:

- not all double glazing is equally good
- not all insulation in lofts is the same depth
- the difference between the outside temperature and the inside temperature of different houses is not constant.

Which one of the following statements is correct?

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- 4C** An energy-saving expert suggests how to reduce the heating bill for a house. She says that having foam put in the wall cavity will reduce the heating bill more than having double glazing fitted.

Her statement is correct because . . .

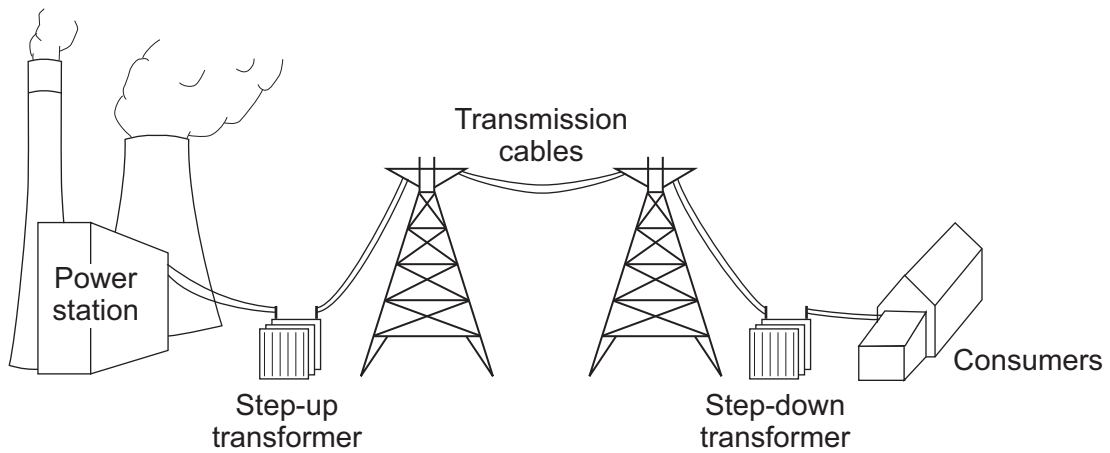
- 1 foam insulation is cheaper than double glazing.
 - 2 more heat is lost through each square metre of window compared with each square metre of wall.
 - 3 the area of the walls is much greater than the area of the windows.
 - 4 the windows are not always shut.
- 4D** The Government wants to encourage energy-saving. There will be several advantages to the environment if people use less energy.

Which of the following will be the most important advantage to the environment?

- 1 It will be more important to develop renewable energy technology.
- 2 Less energy will need to be transformed from fossil fuels.
- 3 Less energy will need to be transformed from renewable resources.
- 4 People will save money on their fuel bills.

QUESTION FIVE

The diagram shows how electricity is distributed from a coal-fired power station to consumers.



5A Which row in the table shows what happens at the step-up transformer?

	Current	Voltage
1	decreased	decreased
2	decreased	increased
3	increased	decreased
4	increased	increased

5B The purpose of the step-up transformer is to . . .

- 1 allow the electricity to travel further.
- 2 increase the speed of the electricity through the cables.
- 3 reduce energy losses from the cables.
- 4 reduce vibrations in the cables.

5C Which type of power station adds the least amount of polluting gases to the atmosphere?

- 1 coal
- 2 gas
- 3 nuclear
- 4 oil

5D What process produces the heat in a nuclear power station?

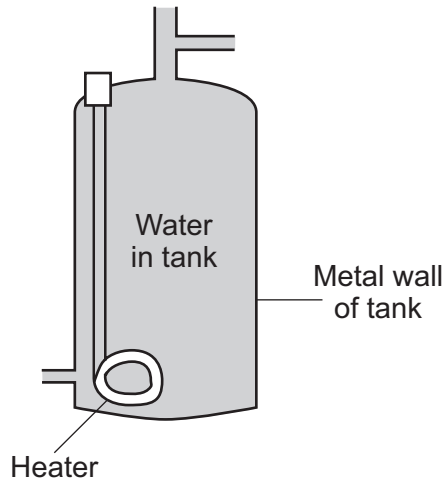
- 1 combustion
- 2 fission
- 3 fusion
- 4 transmission

Turn over for the next question

Turn over ►

QUESTION SIX

Many homes have hot-water tanks. An electric heater may be used to heat the water. Some heat (thermal energy) is lost through the metal walls to the surroundings.



- 6A** The energy spreads through the water by . . .
- 1 heated water contracting and falling.
 - 2 heated water expanding and rising.
 - 3 heat rising.
 - 4 the movement of free electrons.
- 6B** The energy is transferred through the metal walls by . . .
- 1 heated water expanding and rising.
 - 2 infra red waves passing through the metal.
 - 3 the atoms gaining energy and moving faster through the metal.
 - 4 the movement of free electrons.
- 6C** The outside of the metal walls of the tank transfer energy to the surroundings by . . .
- 1 heated air contracting and falling.
 - 2 infra red waves passing through the air.
 - 3 metal atoms gaining energy and escaping into the air.
 - 4 the movement of free electrons.

6D The air in contact with the outside of the metal walls . . .

- 1 contracts and falls due to decreased density.
- 2 contracts and falls due to increased density.
- 3 expands and rises due to decreased density.
- 4 expands and rises due to increased density.

Turn over for the next question

Turn over ►

QUESTION SEVEN

Read this summary of a report on future energy supplies.

- By 2020, the UK should get 20% of its electricity from wind power.
- Thousands of wind turbines will need to be erected.
- Very large wind turbines should be erected out at sea.
- More nuclear power stations will need to be built.

7A Which of the following statements describes an advantage of wind power over nuclear power?

- 1 Wind power does not make any dangerous waste.
- 2 Wind power puts less carbon dioxide into the atmosphere.
- 3 Wind power puts less sulfur dioxide into the atmosphere.
- 4 Wind turbines do not cause pollution during their manufacture.

7B Large wind turbines may be erected far out at sea because . . .

- 1 there is less air pollution than on land.
- 2 there is no danger to wildlife.
- 3 they cause less visual pollution than on land.
- 4 the wind speed is constant.

7C Why does a nuclear power station take up less space than a wind farm producing the same amount of energy?

- 1 The nuclear power station produces less electricity than a wind farm.
- 2 The energy in the wind is more spread out than the energy in nuclear fuels.
- 3 Nuclear power stations are usually built near the coast.
- 4 Nuclear power stations produce radioactive waste which must be contained.

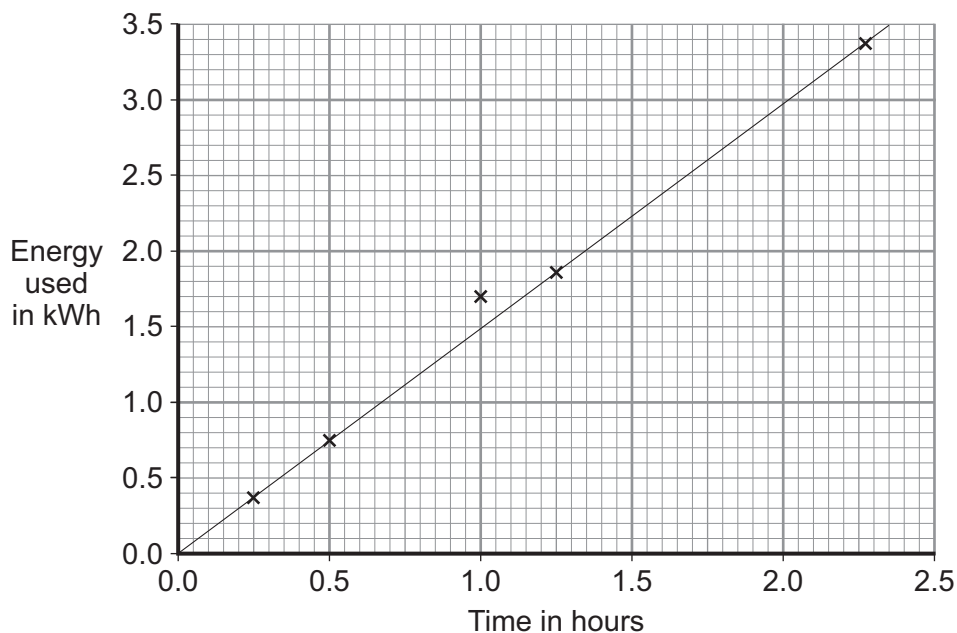
- 7D** Which of the following statements describes an advantage of nuclear power over wind power?
- 1 Electricity can be produced from nuclear power at any time and in any weather.
 - 2 Fuel costs for nuclear power are very low.
 - 3 Nuclear power does not cause atmospheric pollution.
 - 4 Nuclear power does not damage river estuaries.

Turn over for the next question

Turn over ►

QUESTION EIGHT

The graph shows the amount of energy an electric fire uses plotted against the time for which the fire is switched on.



8A The unit of energy on the graph is the kilowatt-hour (kWh).

Energy is usually measured in . . .

- 1 joules.
- 2 joules per second.
- 3 watts.
- 4 watts per second.

8B The point on the graph at the time of one hour could be anomalous.

This means that the value of the energy . . .

- 1 was measured with too little precision.
- 2 was measured with too much precision.
- 3 does not fit the general pattern.
- 4 has a systematic error.

8C The graph shows that . . .

- 1 the energy used decreases with time.
- 2 the energy used is directly proportional to the time.
- 3 the energy used is inversely proportional to the time.
- 4 the energy used halves when the time is doubled.

8D What is the power of the electric fire?

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)
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- 1 1.5 W
- 2 6.7 W
- 3 1500 W
- 4 6700 W

Turn over for the next question

Turn over ►

QUESTION NINE

A notice in an office says:

Leaving your computer on standby overnight uses as much energy as microwaving six frozen meals
Switch your computer OFF

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

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

Electricity costs 12 p per kilowatt-hour.

- 9A** The instructions on a frozen meal say: 'Cook in an 850 W microwave oven for 6 minutes'.

Approximately how much would it cost to cook 6 of these meals, if they are cooked one at a time?

- 1 6p
- 2 £1.02
- 3 £3.66
- 4 £36.72

- 9B** A computer monitor in an office has a power rating of 300 W. Normal office hours are 9 am to 5 pm.

A sensible estimate of the energy wasted if the monitor is on overnight at full power is . . .

- 1 4.8 kWh
- 2 7.2 kWh
- 3 4800 kWh
- 4 7200 kWh

9C The 300W computer monitor can be switched to standby. The standby power is 3W.

How much money is saved each hour by switching the monitor from full power to standby?

- 1 less than 1p
- 2 3.6p
- 3 33p
- 4 36p

9D It is estimated that in Britain 15 million televisions are left on standby power for 20 hours per day. The European Parliament has passed a law to help to reduce this problem.

Which of the following is most likely to have been included in the law?

- 1 decrease the price of televisions
- 2 make it compulsory for television owners to switch off their television sets when not in use
- 3 set a 1 W limit on standby power for all televisions
- 4 set a 1 W limit on standby power for all new televisions

END OF TEST

There are no questions printed on this page