Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

General Certificate of Secondary Education
November 2006

SCIENCE A **PHY1A**
Unit Physics P1a (Energy and Electricity)

PHYSICS
Unit Physics P1a (Energy and Electricity)

Wednesday 22 November 2006 Morning Session

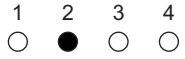
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

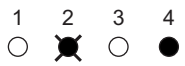
Time allowed: 30 minutes

Instructions
- Fill in the boxes at the top of this page.
- Check that your name, candidate number and centre number are printed on the separate answer sheet.
- Check that the separate answer sheet has the title 'Energy and Electricity' 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.

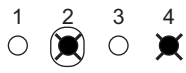
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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**.

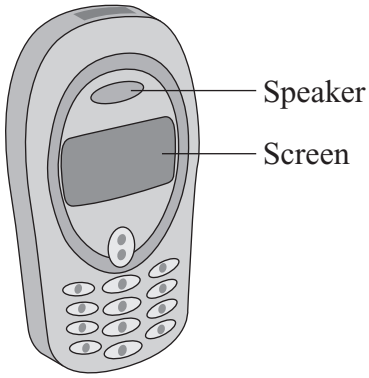
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

Most people now have a mobile phone. Mobile phones transform energy.



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

A electrical

B heat

C light

D sound

The energy input to the mobile phone is . . . **1** . . . energy.

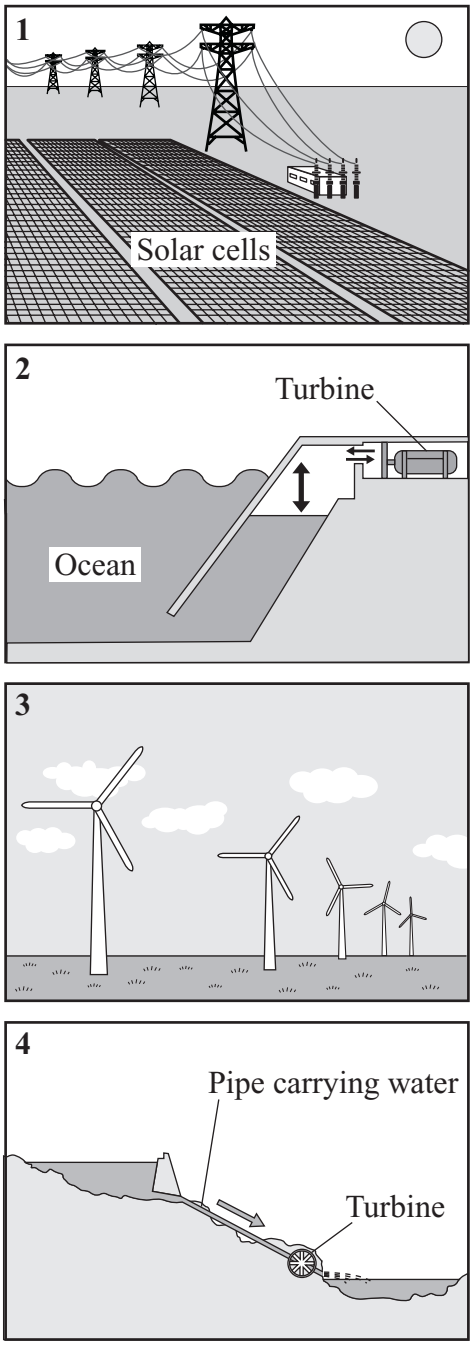
The useful energy output from the speaker is . . . **2** . . . energy.

The useful energy output from the screen is . . . **3** . . . energy.

The wasted energy output from the mobile phone is . . . **4** . . . energy.

QUESTION TWO

The diagrams show four types of power station, which may help to meet our future energy needs. Each one uses a different energy source to produce electricity.



Match energy sources, **A**, **B**, **C** and **D**, with the power stations **1–4**.

A falling water

B sunlight

C waves

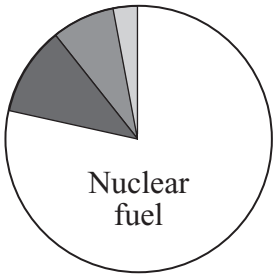
D wind

QUESTION THREE

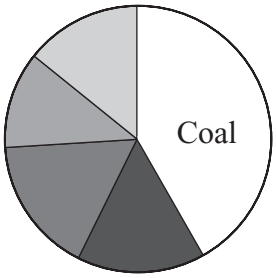
Different countries generate their electricity from different sources of energy.

The pie charts are for four different countries.

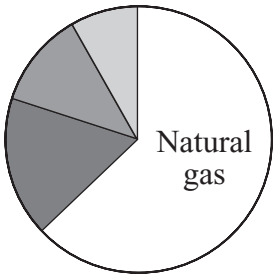
On each pie chart, the main source of energy used to generate electricity is named.



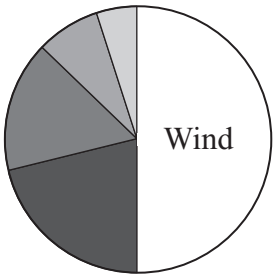
1



2



3



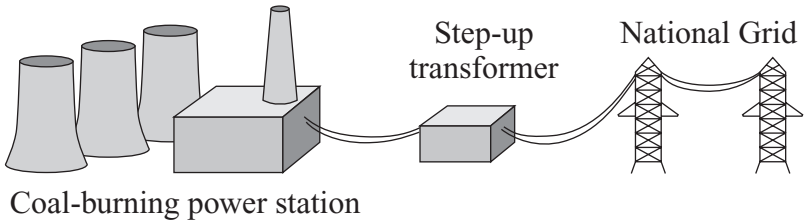
4

Match the countries, **A**, **B**, **C** and **D**, in the table, with the pie charts **1–4**.

Country	Most likely pollution
A	Atmosphere becomes polluted with extra carbon dioxide and with sulfur dioxide
B	Atmosphere becomes polluted with extra carbon dioxide but not with sulfur dioxide
C	Noise pollution produced
D	Environment may become polluted with radioactive substances

QUESTION FOUR

Power stations supply electricity to the National Grid.



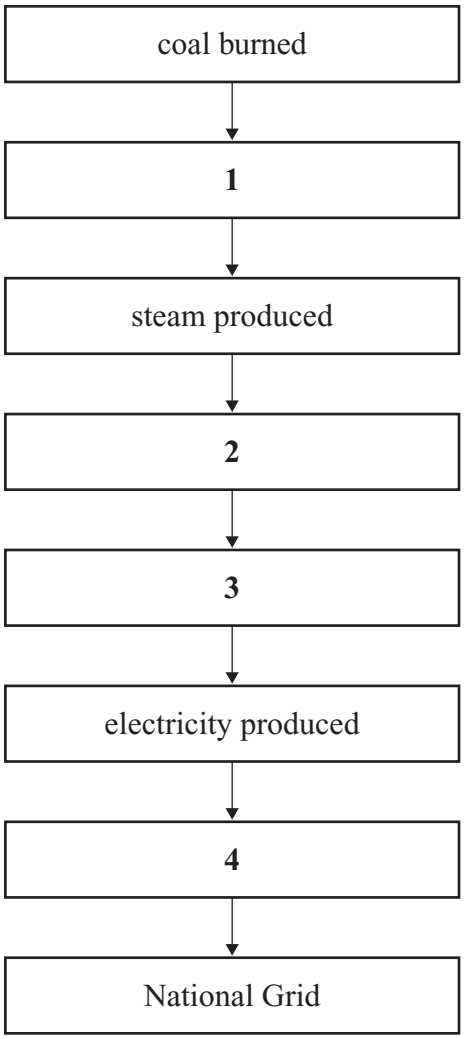
Match names of parts, **A**, **B**, **C** and **D**, with the numbers **1– 4** in the flow chart for a coal-burning power station.

A boiler

B generator

C transformer

D turbine



QUESTION FIVE

Getting to Mars

The temperature in space is very low. Human body temperature must remain at 37 °C. Heat transfer from the spacecraft is a problem which scientists and engineers have to overcome if travel to Mars is to be possible.

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

A conduction

B convection

C insulation

D radiation

Heat passes through the metal walls of the spacecraft by . . . **1** . . . .

Heat transfer through metal walls can be reduced by . . . **2** . . . .

Heat leaves the spacecraft by the process of . . . **3** . . . .

The process of . . . **4** . . . takes place in air but cannot take place through the vacuum of space.

QUESTION SIX

Read this extract from a magazine article.

Cold fusion – energy for the future?

On 23rd March 1989, two scientists claimed to have discovered a process which they called cold fusion.

They thought that cold fusion might be a source of cheap energy.

All over the world, other scientists tried to copy the process but none of them had any success.

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

A conclusion

B evidence

C reliable

D research

Other scientists were not able to reproduce the results, so the evidence for cold fusion was not . . . **1** . . . .

These scientists came to the . . . **2** . . . that cold fusion did not happen.

So far, no one has achieved the dream of cold fusion.

Although further . . . **3** . . . has been carried out, no . . . **4** . . . supporting the existence of cold fusion has been found.

Turn over for the next question

SECTION TWO

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

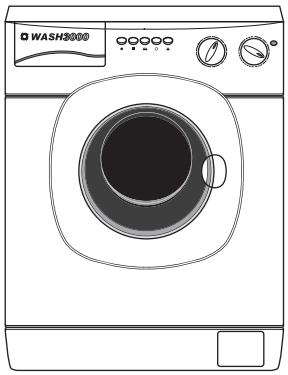
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION SEVEN

A family needs to replace their old washing machine. They go to look at some new models.



7A One model has a sticker which reads:

More efficient than any other washing machine at this price

If this is scientifically true, it means that, compared with other washing machines, this washing machine must . . .

1 cost less to run.

2 use less electrical energy.

3 usefully transform a larger percentage of the electrical energy supplied to it.

4 usefully transform a smaller fraction of the electrical energy supplied to it.

7B More efficient washing machines will benefit society by . . .

1 being easier to recycle in the future.

2 having less impact on the environment.

3 using less water.

4 washing clothes at a lower temperature.

7C The average power of one washing machine is 2400 watts.

2400 watts is equal to . . .

1 0.24 kW

2 2.40 kW

3 24 kW

4 240 kW

7D

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

How much energy, in kilowatt-hours, is transferred when a 2400 watt washing machine is used for 60 minutes?

1 2.4

2 40

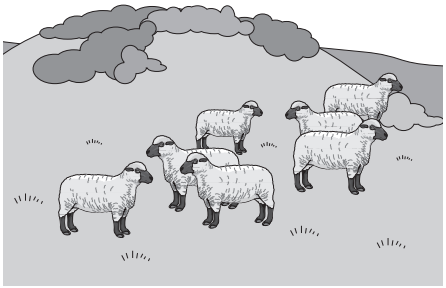
3 144

4 144 000

Turn over for the next question

QUESTION EIGHT

Farmers usually keep their sheep outdoors. The air temperature is usually well below the body temperature of the sheep, but their woollen coats are poor heat conductors.



8A Wool is a poor conductor of heat because it . . .

1 is natural.

2 is soft.

3 is warm.

4 traps air.

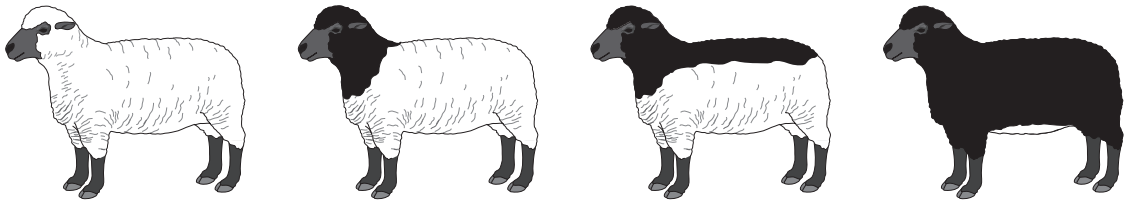
8B A farmer knows that different sheep transfer heat at different rates.

Which row in the table is correct for the two possible explanations given?

	Because of differences in their shapes	**Because of differences in their sizes**
1	no	no
2	no	yes
3	yes	no
4	yes	yes

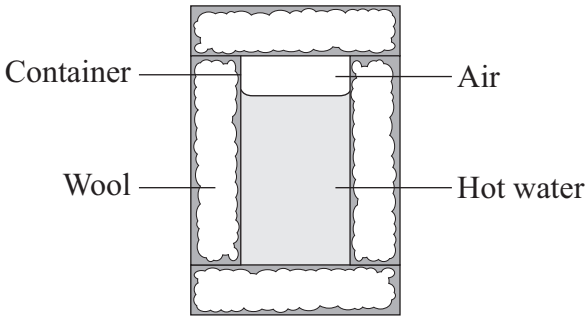
8C The drawings show four black and white sheep. They are identical apart from their colour.

Which sheep will emit most thermal radiation on a cold day?



1 **2** **3** **4**

8D Two students plan to investigate heat transfer through wool. They plan to use a container of hot water which they will insulate with wool.



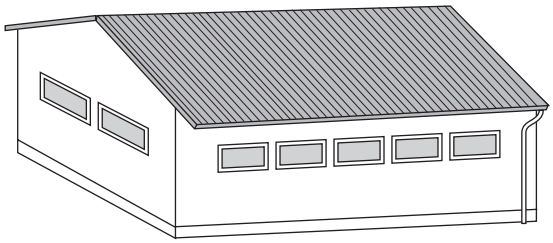
Which row in the table describes the plan for a series of experiments which are most likely to give useful results?

	Thickness of insulation	**Starting temperature**	**Time interval**	**Mass of water in container**
1	different for each	same for each	same for each	same for each
2	different for each	different for each	same for each	same for each
3	same for each	different for each	different for each	same for each
4	same for each	same for each	different for each	different for each

Turn over for the next question

QUESTION NINE

This is a design for a new workshop.



9A The owner wants to reduce heat loss from the workshop.

Which decision about changing the design should she make?

1 Have larger windows

2 Have single-glazed, rather than double-glazed, windows

3 Increase the temperature inside the building

4 Increase the thickness of the roof insulation

9B There will be several machines in the building. All of them will have moving parts.

Which statement is **not** correct?

1 All of the machines waste some energy.

2 Friction is often a cause of inefficiency.

3 None of the machines is perfectly efficient.

4 The total energy input is equal to the useful energy output.

9C All energy is eventually transferred to the surroundings as . . .

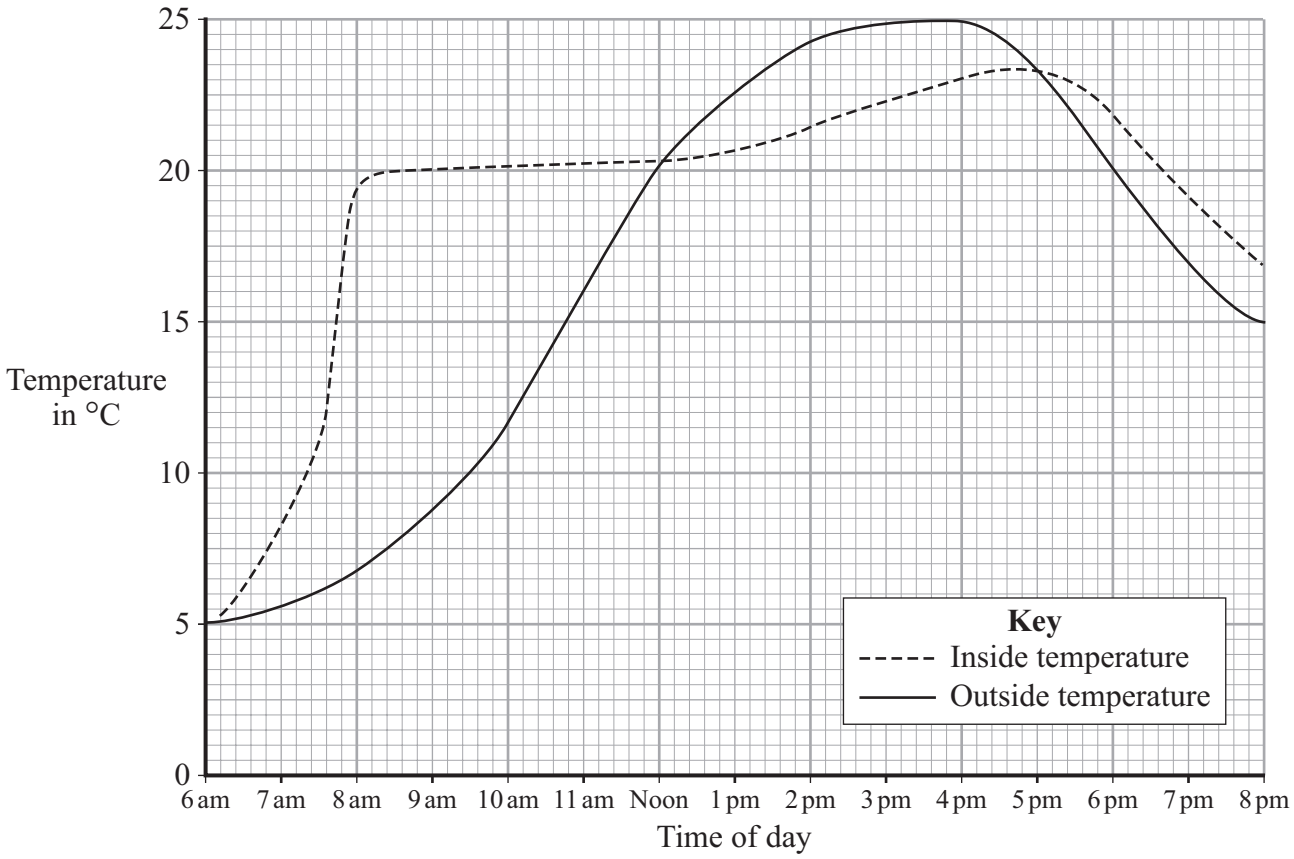
1 electricity.

2 heat.

3 light.

4 sound.

9D The graph shows the temperatures inside and outside the workshop.



Which conclusion can be drawn?

The heating in the building was . . .

1 switched on at 6 am, and switched off at noon.

2 switched on at 8 am, and switched off at noon.

3 switched on at 6 am, and switched off at 5 pm.

4 switched on at noon, and switched off at 5 pm.

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**.

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QUESTION ONE

Read this extract from a magazine article.

Cold fusion – energy for the future?

On 23rd March 1989, two scientists claimed to have discovered a process which they called cold fusion.

They thought that cold fusion might be a source of cheap energy.

All over the world, other scientists tried to copy the process but none of them had any success.

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

A conclusion

B evidence

C reliable

D research

Other scientists were not able to reproduce the results, so the evidence for cold fusion was not . . . **1** . . . .

These scientists came to the . . . **2** . . . that cold fusion did not happen.

So far, no one has achieved the dream of cold fusion.

Although further . . . **3** . . . has been carried out, no . . . **4** . . . supporting the existence of cold fusion has been found.

QUESTION TWO

This question is about some of the energy sources that are 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	causes noise pollution, and the supply is not constant
3	no fuel costs, and can be used to meet sudden demands for electricity
4	transformation of chemical energy to heat energy

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.

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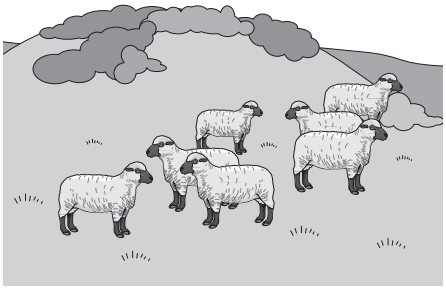
QUESTION THREE

Farmers usually keep their sheep outdoors. The air temperature is usually well below the body temperature of the sheep, but their woollen coats are poor heat conductors.



3A Wool is a poor conductor of heat because it . . .

1 is natural.

2 is soft.

3 is warm.

4 traps air.

3B A farmer knows that different sheep transfer heat at different rates.

Which row in the table is correct for the two possible explanations given?

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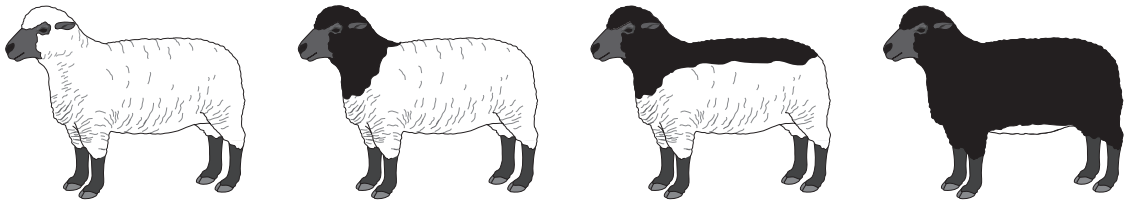
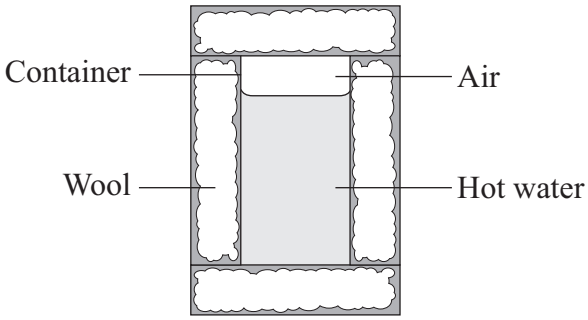


1 **2** **3** **4**

3D Two students plan to investigate heat transfer through wool. They plan to use a container of hot water which they will insulate with wool.



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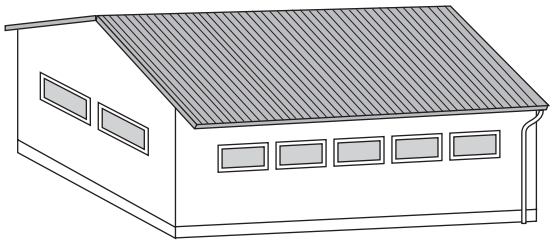
2	different for each	different for each	same for each	same for each
3	same for each	different for each	different for each	same for each
4	same for each	same for each	different for each	different for each

Turn over for the next question

QUESTION FOUR

This is a design for a new workshop.



4A The owner wants to reduce heat loss from the workshop.

Which decision about changing the design should she make?

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4B There will be several machines in the building. All of them will have moving parts.

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2 heat.

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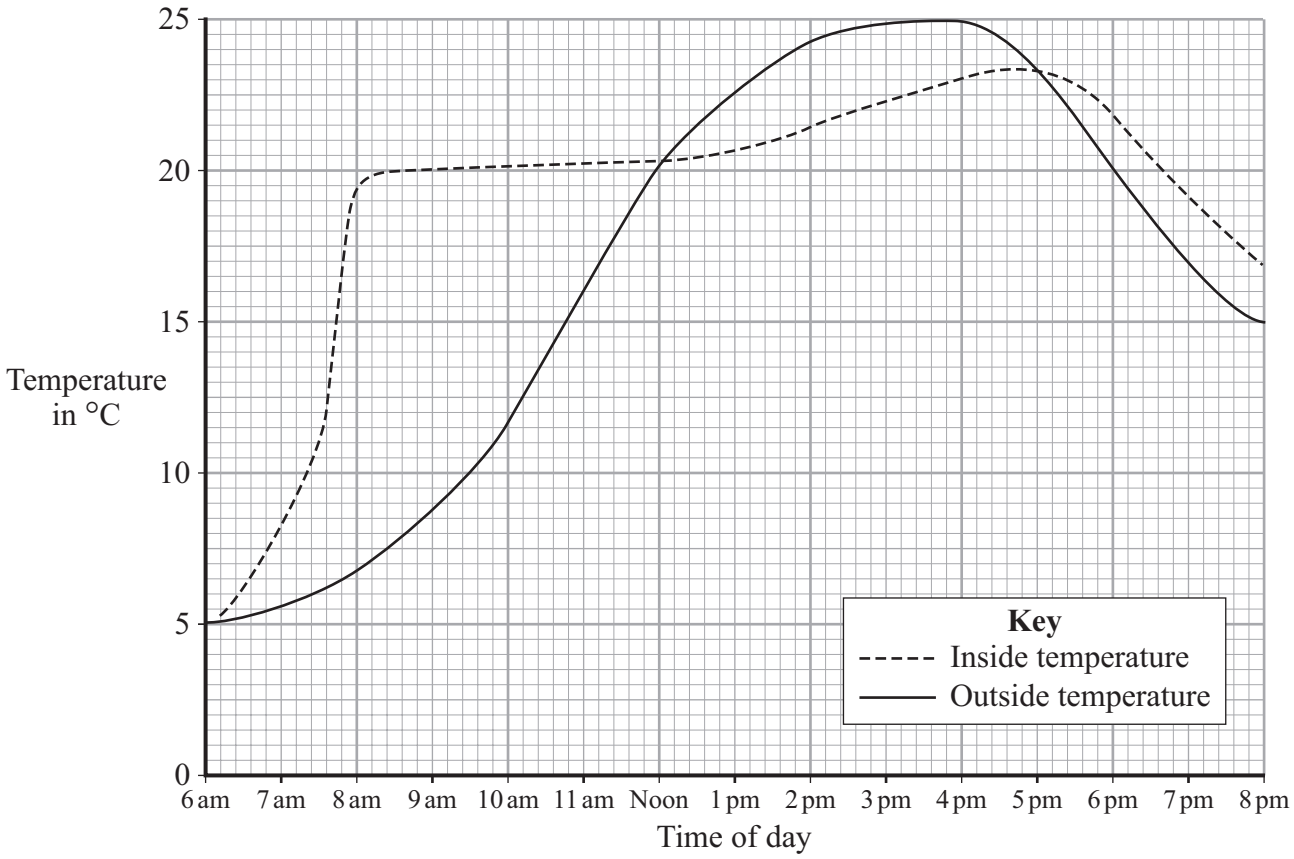

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3 switched on at 6 am, and switched off at 5 pm.

4 switched on at noon, and switched off at 5 pm.

Turn over for the next question

QUESTION FIVE

New power stations need to be built soon – says report

This question is about the production and distribution of electricity. In many types of power station, heat is produced.

5A In a power station which uses plutonium, what is the process which produces this heat?

1 chemical reaction

2 combustion

3 nuclear fission

4 nuclear fusion

5B In a heat-producing power station, what is the heat used for?

1 to boil oil

2 to boil water

3 to power a generator

4 to power a turbine

5C In **most** power stations in the UK, most of the waste heat . . .

1 is recycled.

2 is released to the surroundings.

3 is transformed into electricity.

4 is used to heat neighbouring buildings.

5D Step-up transformers are used in the National Grid to . . .

1 increase the current.

2 increase the efficiency of the system.

3 increase safety.

4 increase the speed of the transmission.

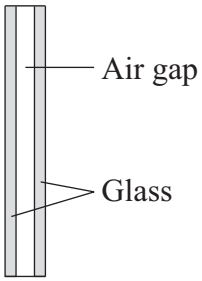
Turn over for the next question

QUESTION SIX

Save energy with double glazing

The diagram shows a cross-section through a double-glazed window.

There is an air gap between the two sheets of glass.



The table shows the U-values for some double-glazed windows. The U-value relates to the rate at which thermal energy passes through the window. The lower the U-value, the better the insulation.

Type of glass	Gap width			
	12 mm	**16 mm**	**20 mm**	**24 mm**
Plain	2.9	2.7	2.8	3.0
Reflective	1.9	1.7	1.8	2.0

6A How does thermal energy pass through a sheet of glass?

1 By conduction

2 By convection

3 By evaporation

4 By reflection

6B For the best insulation, the glass should be designed to reduce the transmission of . . .

1 infra red radiation.

2 microwaves.

3 ultraviolet radiation.

4 visible light.

6C Which combination of glass and gap width gives the best insulation?

1 plain glass, 12 mm gap

2 reflective glass, 16 mm gap

3 reflective glass, 20 mm gap

4 plain glass, 24 mm gap

6D Which one of these conclusions is correct, according to the data in the table?

1 Plain glass is always better at reducing heat transfer than reflective glass.

2 The wider the gap, the less heat is transferred.

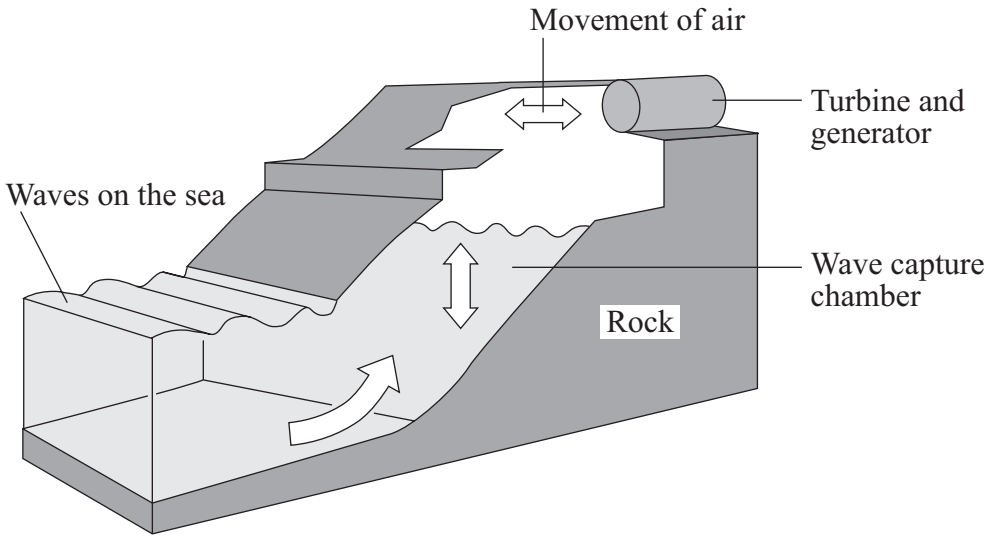
3 The narrower the gap, the less heat is transferred.

4 The type of glass has more effect on heat transfer than the width of the gap.

Turn over for the next question

QUESTION SEVEN

The diagram shows a cross-section through the wave power station on the island of Islay in Scotland.



The wave capture chamber has been built into the rock. As water moves into and out of the chamber, the air above it is pushed up and down, and this drives a special turbine which operates when air flows through it in either direction. The turbine drives a generator with an average power output of 500 kilowatts.

7A The average power input to the wave power station is . . .

1 less than 250 kilowatts.

2 less than 500 kilowatts.

3 500 kilowatts.

4 more than 500 kilowatts.

7B Which one of these statements is true for a wave power station?

1 It cannot be damaged by storms.

2 It does no harm to wildlife.

3 It does not require any maintenance.

4 It does not use fuel.

7C The people on another island are thinking about building a wave power station. Not everybody on the island agrees with the suggestion.

The most likely reasons for objections to the wave power station will be noise and . . .

1 atmospheric pollution.

2 chemical pollution.

3 heat pollution.

4 visual pollution.

7D When all the costs for the project have been taken into account, including the cost of borrowing the money, the total cost will be about £3.4 million. The average value of the electricity generated will be about £86 000 per year.

How long will it take for the project to pay for itself?

1 About 25 years

2 About 30 years

3 About 35 years

4 About 40 years

Turn over for the next question

QUESTION EIGHT

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
- Fewer nuclear power stations will need to be built

8A Which one 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 in their manufacture.

8B Large wind turbines may be set up 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.

8C 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.

8D Which one 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

QUESTION NINE

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

A village is many kilometres away from a supply of mains electricity. The sun shines for at least a few hours nearly every day. The villagers want a supply of electricity for a radio receiver. The table shows the costs of two different ways of providing the electricity over a 20-year period.

Way of providing electricity	Equipment cost	Cost of a set of batteries	Number of sets of batteries needed
Solar cells and rechargeable batteries	£75.00	£12.50	4
'Throwaway' batteries	Zero	£2.75	80

9A What are the total costs over the 20-year period of the different ways of providing electricity?

	Solar cells and rechargeable batteries	'Throwaway' batteries
1	£87.50	£220.00
2	£87.50	£231.00
3	£125.00	£220.00
4	£125.00	£231.00

9B One disadvantage of using solar cells and rechargeable batteries is that . . .

1 new batteries are needed more often.

2 the radio could not be used at night.

3 they are more expensive in the long run.

4 they cost more in the first place.

9C Another battery of solar cells has a maximum output of 1 kW. The battery, when used in the UK, produces, on average, 10 % of its maximum output. The battery costs £ 4000 and has an expected life of 200 000 hours. The cells have no maintenance costs.

What is the cost of each kilowatt-hour of electricity produced by the battery of solar cells when used in the UK?

1 20 p

2 25 p

3 40 p

4 50 p

9D Electricity from solar cells is more expensive than electricity generated in power stations.

Which of the following would make the cost of electricity from solar cells cheaper?

1 A decrease in the cost of fuel for normal types of power station.

2 Developing solar cells that are smaller.

3 Developing other alternative energy technologies.

4 Reducing the cost of solar cells by mass production.

END OF TEST

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