AQA

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

Science A
Unit Physics P1a (Energy and Electricity)

Physics
Unit Physics P1a (Energy and Electricity)

PHY1AP

F&H

Thursday 11 November 2010   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.
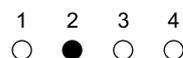
Information
- The maximum mark for this paper is 36.

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.

PHY1AP

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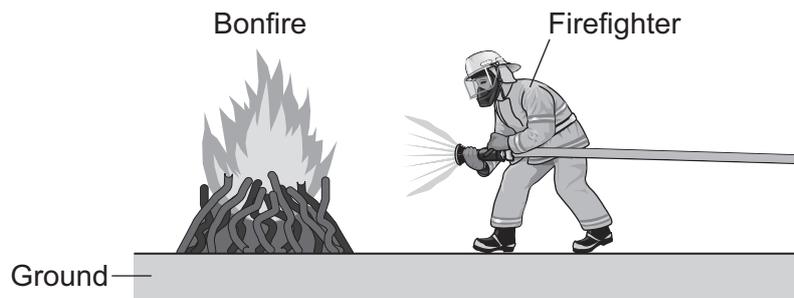
Use **each** answer only **once**.

Mark your choices on the answer sheet.

QUESTION ONE

The drawing shows a firefighter putting out a bonfire. The firefighter wears thick, woollen clothing.
The clothing has a light-coloured, shiny surface.

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

A   conduction

B   insulation

C   radiation

D   reflection

Heat is transferred from the fire to the firefighter's clothing by . . . **1** . . . .

The ground underneath the fire will get hot when heat is transferred to it by . . . **2** . . . .

The thick, woollen clothing provides good heat . . . **3** . . . .

The light-coloured, shiny surface of the clothing provides good . . . **4** . . . of infra red.

QUESTION TWO

This question is about generating electricity.

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

A   gas

B   geothermal

C   moving water

D   uranium

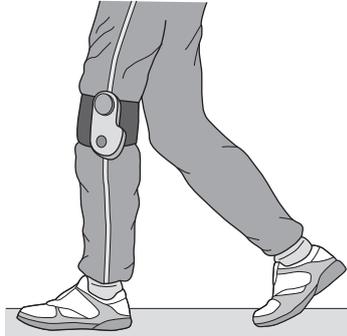|	Description
1	produces energy from fission
2	is used in hydroelectric schemes
3	energy from underground hot rocks
4	is burnt in some power stations

Turn over for the next question

QUESTION THREE

An inventor has designed a way of charging a mobile phone battery as a person is walking.
The charger unit contains a generator. The unit is strapped to a leg.

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

A   chemical

B   electrical

C   heat

D   kinetic

As the person walks, . . . **1** . . . energy from food is transformed to . . . **2** . . . energy of the moving legs.

The generator produces useful . . . **3** . . . energy.

Some energy is wasted as . . . **4** . . . .

QUESTION FOUR

Power stations used to generate electricity affect the environment in different ways.

Match types of power station, **A**, **B**, **C** and **D**, with effects on the environment **1**–**4** in the table.

A   coal-fired

B   hydroelectric

C   nuclear

D   tidal barrage

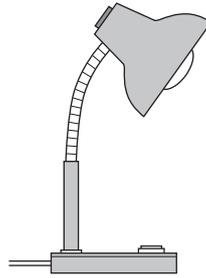|		**Effect on environment**
	1	destroys the habitats of wading birds
	2	produces waste that is radioactive
	3	destroys large areas of farmland by flooding
	4	produces gases that pollute the atmosphere

Turn over for the next question

Turn over ▶

QUESTION FIVE

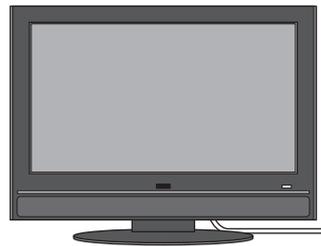The diagrams show four electrical devices. The Sankey diagrams show the energy transformations involved in the four electrical devices.
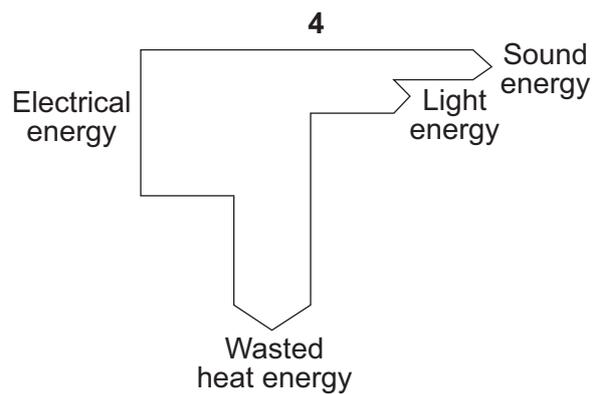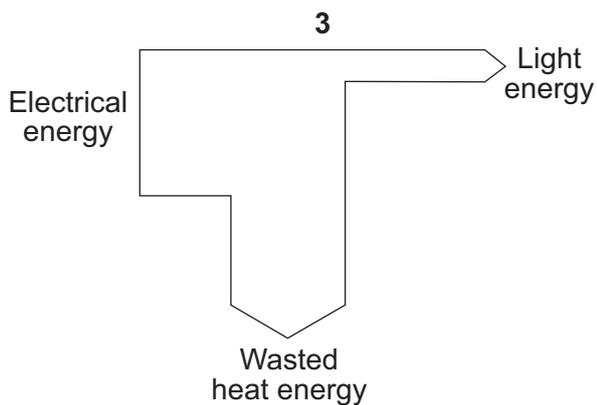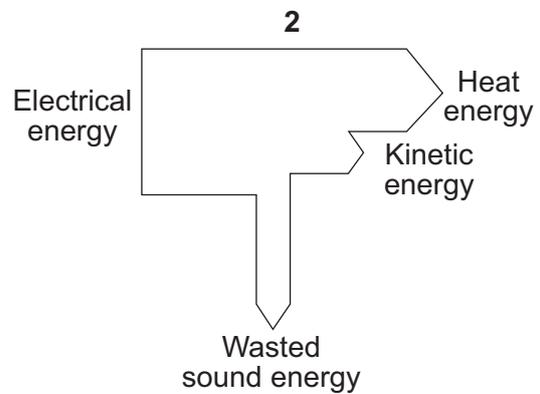
A
Electric drill

B
Desk lamp

C
Hair dryer

D
Television

Match devices, **A**, **B**, **C** and **D**, with the Sankey diagrams **1**–**4**.

1
Electrical energy → Kinetic energy
Wasted sound energy   Wasted heat energy

2
Electrical energy → Heat energy / Kinetic energy
Wasted sound energy

3
Electrical energy → Light energy
Wasted heat energy

4
Electrical energy → Sound energy / Light energy
Wasted heat energy
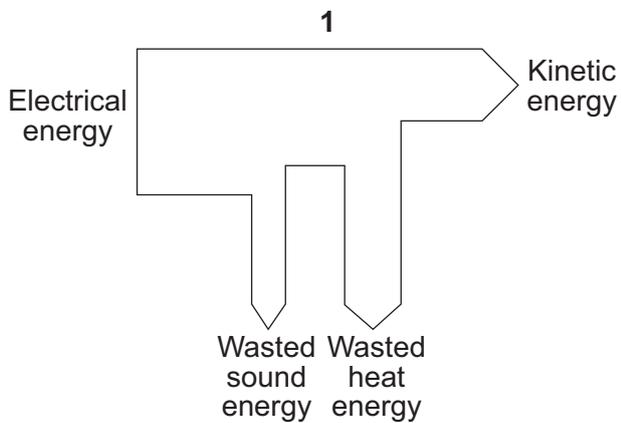
Turn over for the next question

Section Two

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

Each of these questions has four parts.
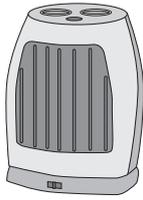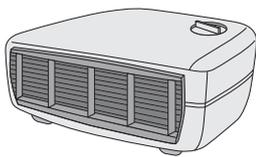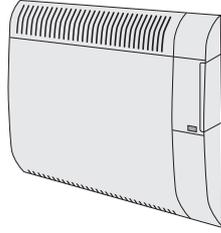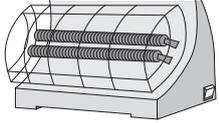
In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION SIX

The pictures show four different types of electric heater.

1800 W ceramic heater	**3 kW fan heater**	**400 W oil-filled panel heater**	**2 kW radiant heater**
• 2 heat settings • 8 hour timer • Power indicator light • Safety overheat cut-out	• 2 heat settings • Power indicator light • Cool air fan setting	• 3 heat settings • Efficient background heat • Safety overheat cut-out	• 2 heat settings

6A Which heater is the most powerful?

    1   the ceramic heater

    2   the fan heater

    3   the oil-filled panel heater

    4   the radiant heater

6B The fan heater is run on full power for 4 hours.

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

How much energy, in kWh, is transferred from the mains supply to the fan heater?

    1   0.75

    2   3.0

    3   7.0

    4   12.0

6C   In one week, the oil-filled panel heater used 10 kWh of electrical energy.

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

Electricity costs 14p per kWh

How much did it cost to run the oil-filled panel heater for the week?

1   £0.14

2   £1.40

3   £14.00

4   £140.00

6D   Which of the following is an advantage of the fan heater compared with the other heaters?

1   The fan heater can make a room feel cooler in summer.

2   The fan heater has a power indicator light.

3   The fan heater has a safety overheat cut-out.

4   The fan heater has more than one heat setting.

Turn over for the next question

QUESTION SEVEN

A student investigated the cooling of a hot liquid. She used three identical beakers that contained equal volumes of water. Two of the beakers were insulated and one beaker also had a lid. The water temperature in each beaker started at 90°C.

| No insulation | Insulation | Insulation and lid |
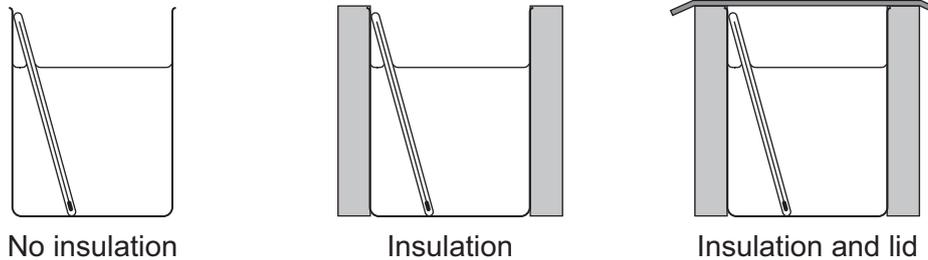
She recorded the temperature decrease of the water in each beaker after 10 minutes.

Her results are shown in the table.

Method of insulation	Temperature decrease in °C
no insulation	30
insulation	25
insulation and lid	10

7A   The method of insulation is a . . .

   1   categoric variable.

   2   continuous variable.

   3   control variable.

   4   ordered variable.

7B   The best way to display the results in the table would be a . . .

   1   bar chart.

   2   line graph.

   3   pie chart.

   4   scattergram.

7C She repeated the experiment with a starting temperature of 70 °C instead of 90 °C.

The temperature decrease after 10 minutes was smaller than before in . . .

1 only the beaker with no insulation.

2 only the beaker with insulation.

3 only the beaker with insulation and lid.

4 all three beakers.

7D The lid stopped hot air rising.
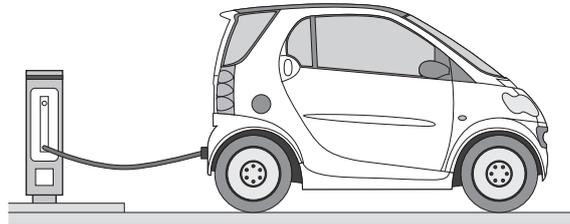
This reduced heat loss by . . .

1 conduction only.

2 convection only.

3 radiation only.

4 conduction, convection and radiation.

Turn over for the next question

Turn over ▶

QUESTION EIGHT

A manufacturer is producing a new electric car. Batteries in the car store the energy needed for driving. These batteries need to be charged for 6 hours every night.

The manufacturer carried out four tests to find out how far the car can be driven after the batteries had been charged for 6 hours. All the tests were carried out under the same conditions, with the car being driven at the same speed.

8A Four tests were carried out. The distances travelled were measured and a mean was calculated.

Why is this better than simply carrying out a single test?

1 It decreases the validity of the results.

2 It makes the results more precise.

3 It makes sure that the results will be true for all road conditions.

4 It minimises the effect of random errors.

8B The table shows the results of the four tests.

Test number	Distance travelled in km
1	31
2	57
3	61
4	62

Which one of the results, **1**, **2**, **3** or **4**, appears to be anomalous?

8C How should the mean of the measurements be calculated?

1 Add all four results together and divide by four.

2 Add the highest and the lowest together and divide by two.

3 Ignore the anomalous result, add the other three results together and divide by three.

4 Ignore the anomalous result and take the middle value of the other three results.

8D A person who bought the car found that the distance the car could travel on a single charge was a lot less than that stated by the manufacturer.

What could be the reason for this?

1 The batteries had been left on charge for more than 6 hours.

2 The distance recorder on the car lacked precision.

3 The meter that records the total distance travelled had not been set to zero.

4 The owner did not control the same variables as the manufacturer.

Turn over for the next question

Turn over ▶

QUESTION NINE

A householder is thinking about buying and installing a wind turbine on his roof.
The turbine costs £3000 to buy and install.

9A The householder estimates that the wind turbine would generate electricity worth an average of £1.50 each day.

What would be the pay-back time?

1 1000 days

2 2000 days

3 3000 days

4 4000 days

The graph shows how the power produced by the wind turbine changes with the wind speed. The wind turbine shuts down at high wind speeds.

Power output in kW vs Wind speed in m/s
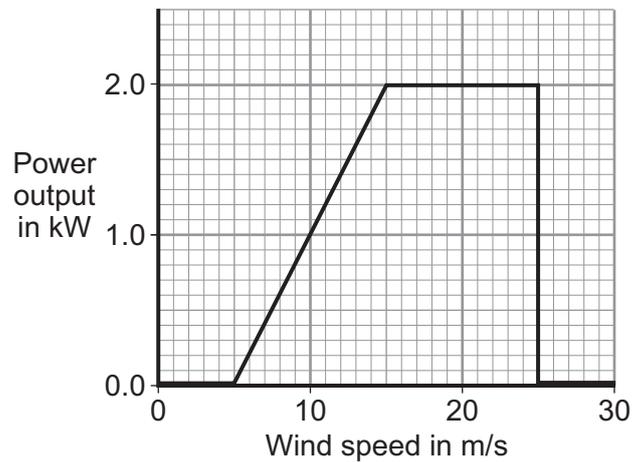
9B The maximum power output occurs when the wind speed reaches . . .

1 5 m/s

2 10 m/s

3 15 m/s

4 20 m/s

9C The bar chart shows the wind speed at the house and the number of days in the year on which the wind has that speed.

Wind speed in m/s
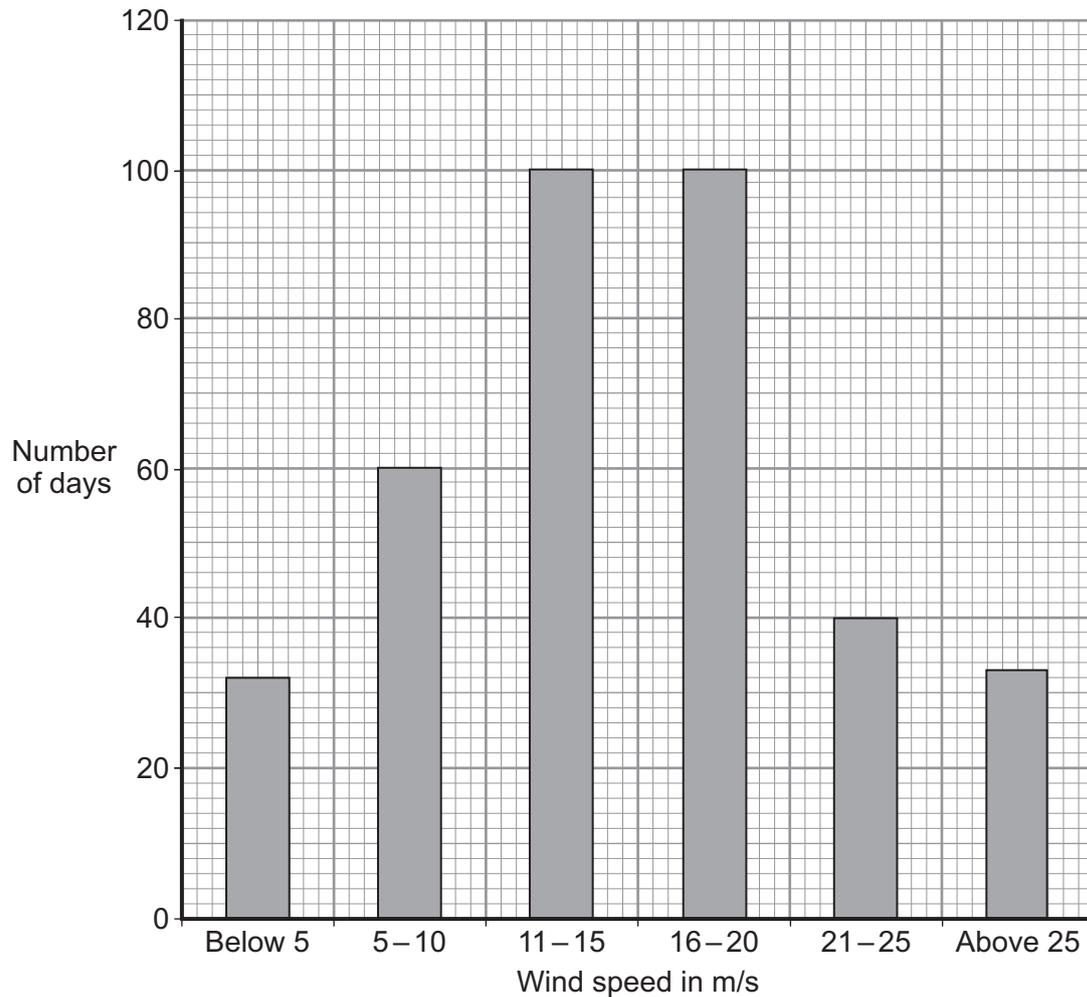
For how many days in the year could the householder get some energy from the wind turbine?

1   160

2   260

3   300

4   330

9D The householder decides not to buy the wind turbine.

The most likely reason for his decision is that the wind turbine . . .

1   has fuel costs that are too high.

2   produces no greenhouse gases.

3   uses a non-renewable energy source.

4   uses an unreliable energy source.

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.
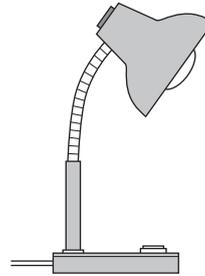
QUESTION ONE

The diagrams show four electrical devices. The Sankey diagrams show the energy transformations involved in the four electrical devices.

A
Electric drill

B
Desk lamp

C
Hair dryer

D
Television

Match devices, **A**, **B**, **C** and **D**, with the Sankey diagrams **1–4**.

1

Electrical energy

Kinetic energy

Wasted sound energy

Wasted heat energy

2

Electrical energy

Heat energy

Kinetic energy

Wasted sound energy

3

Electrical energy

Light energy

Wasted heat energy

4

Electrical energy

Sound energy

Light energy

Wasted heat energy
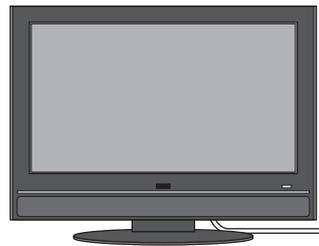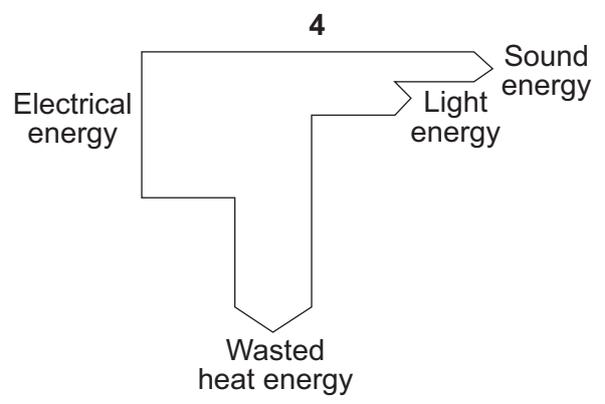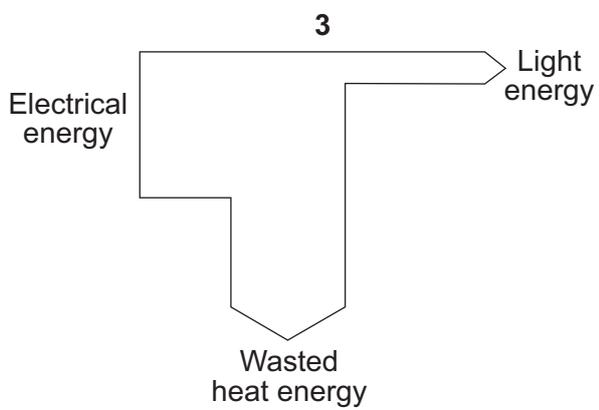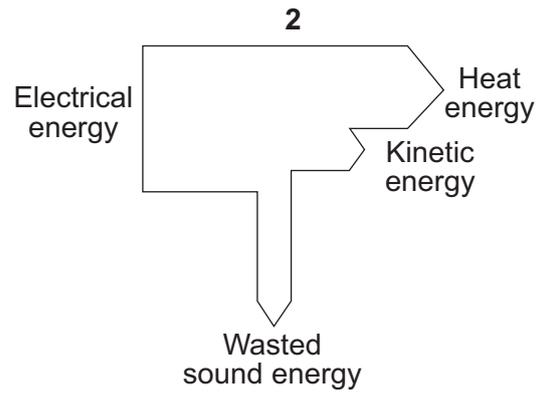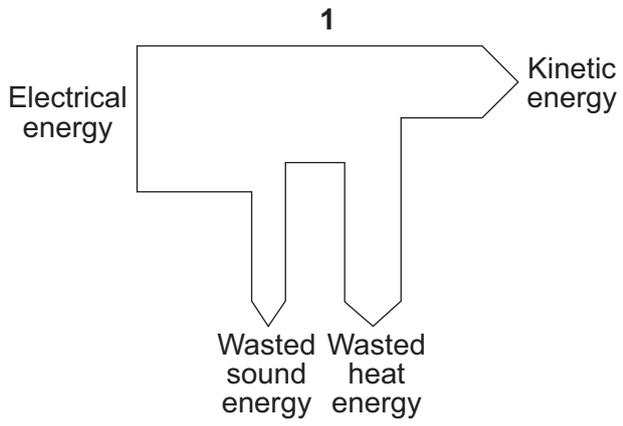
Turn over for the next question

Turn over ▶

QUESTION TWO

The drawing shows a mobile phone. This phone also has a digital camera.

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

A   electrical to light

B   electrical to sound

C   light to electrical

D   sound to electrical

1	the useful energy transformation in the display screen
2	the useful energy transformation in the loudspeaker
3	the useful energy transformation in the microphone
4	the useful energy transformation in the digital camera

Turn over for the next question

Turn over ▶

Section Two

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

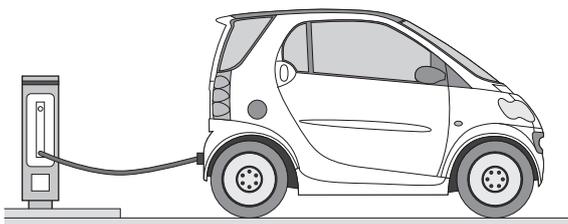Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION THREE

A manufacturer is producing a new electric car. Batteries in the car store the energy needed for driving. These batteries need to be charged for 6 hours every night.

The manufacturer carried out four tests to find out how far the car can be driven after the batteries had been charged for 6 hours. All the tests were carried out under the same conditions, with the car being driven at the same speed.

3A Four tests were carried out. The distances travelled were measured and a mean was calculated.

Why is this better than simply carrying out a single test?

1 It decreases the validity of the results.

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3B The table shows the results of the four tests.

Test number	Distance travelled in km
1	31
2	57
3	61
4	62

Which one of the results, **1**, **2**, **3** or **4**, appears to be anomalous?

3C How should the mean of the measurements be calculated?

1 Add all four results together and divide by four.

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4 Ignore the anomalous result and take the middle value of the other three results.

3D A person who bought the car found that the distance the car could travel on a single charge was a lot less than that stated by the manufacturer.

What could be the reason for this?

1 The batteries had been left on charge for more than 6 hours.

2 The distance recorder on the car lacked precision.

3 The meter that records the total distance travelled had not been set to zero.

4 The owner did not control the same variables as the manufacturer.

Turn over for the next question

Turn over ▶

QUESTION FOUR

A householder is thinking about buying and installing a wind turbine on his roof.
The turbine costs £3000 to buy and install.
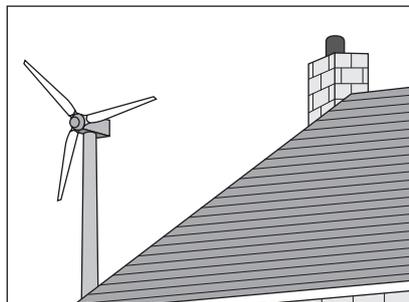
4A The householder estimates that the wind turbine would generate electricity worth an average of £1.50 each day.

What would be the pay-back time?

1 1000 days

2 2000 days

3 3000 days

4 4000 days

The graph shows how the power produced by the wind turbine changes with the wind speed.
The wind turbine shuts down at high wind speeds.
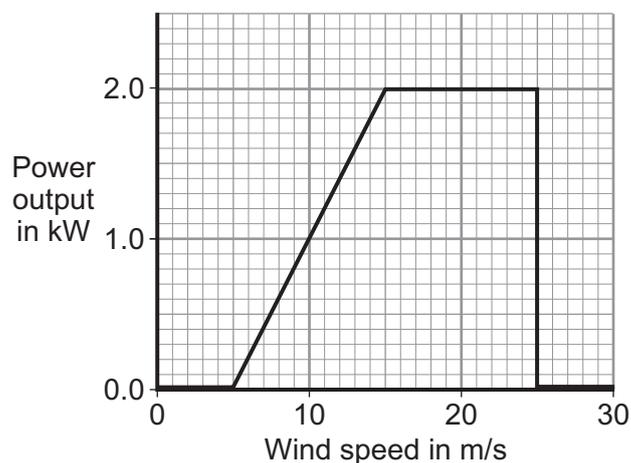
4B The maximum power output occurs when the wind speed reaches . . .

1 5 m/s

2 10 m/s

3 15 m/s

4 20 m/s

4C The bar chart shows the wind speed at the house and the number of days in the year on which the wind has that speed.
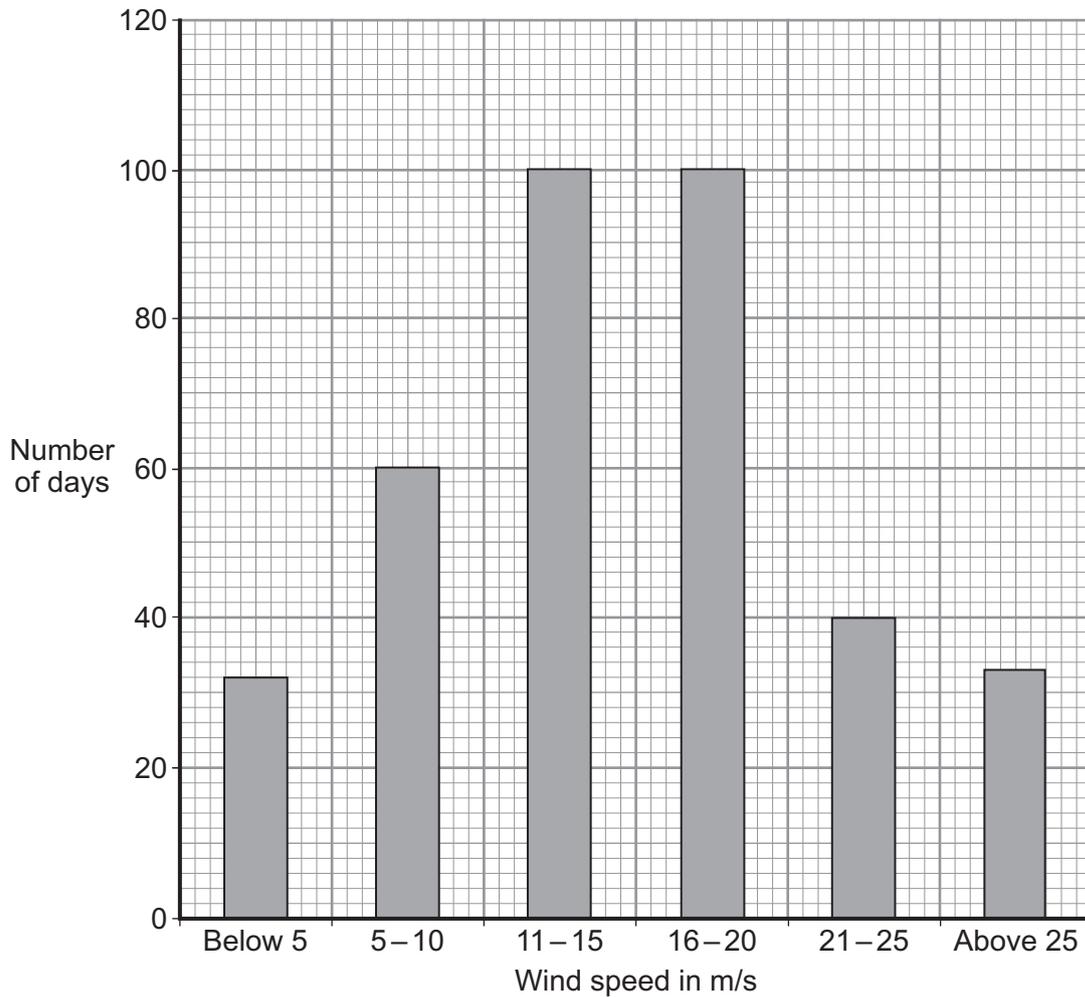
For how many days in the year could the householder get some energy from the wind turbine?

1 160

2 260

3 300

4 330

4D The householder decides not to buy the wind turbine.

The most likely reason for his decision is that the wind turbine . . .

1 has fuel costs that are too high.

2 produces no greenhouse gases.

3 uses a non-renewable energy source.

4 uses an unreliable energy source.

Turn over ▶

QUESTION FIVE

A wind turbine manufacturer investigates how the power output from a wind turbine depends on the height of the turbine blades above ground.
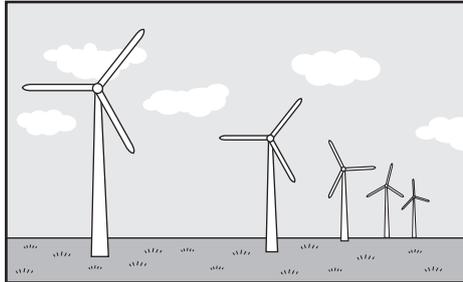
The results are shown in the table.

Height above ground in m	Power output in kW
10	0
30	160
40	190
50	220
60	250
70	280
80	305
90	310

5A In the table, the height of the turbine above ground is . . .

    1   a categoric variable.

    2   a control variable.

    3   the dependent variable.

    4   the independent variable.

5B From the data, which of the following can be deduced?

    1   Above a height of 90 m, the power output will not increase.

    2   A height of 65 m would produce a power output of about 260 kW.

    3   Doubling the height will always double the power output.

    4   The minimum height needed to produce a power output is 20 m.

5C Which is the best way to display the pattern of the results for height and power output?

    1   construct a pie chart

    2   draw a bar chart

    3   find the mean of all the power outputs and heights

    4   plot a line graph of power output against height

5D The statement below appeared in a newspaper.

<div align="center">

*Huge expansion of wind power in the UK
is to be launched, with turbines that will reach
260 metres into the sky!*

</div>

What types of pollution are people most likely to complain about when wind farms are built?

    1   carbon dioxide and noise
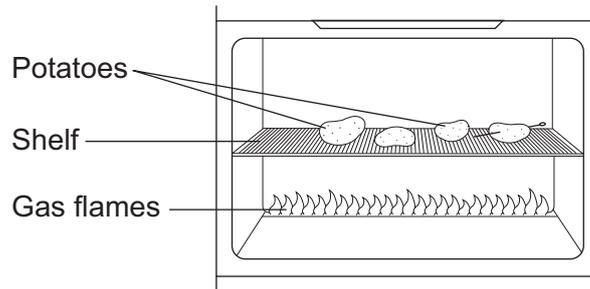
    2   carbon dioxide and sulfur dioxide

    3   sulfur dioxide and visual

    4   visual and noise

<div align="center">

Turn over for the next question

</div>

<div align="right">

Turn over ▶

</div>

QUESTION SIX

The diagram shows some potatoes cooking on a shelf in a gas oven.

6A   Heat is transferred from the gas flames to the potatoes.

The air particles just above the gas flames . . .

1   contract to become smaller.

2   expand to become bigger.

3   move apart, making the air less dense.

4   move together, making the air denser.

6B   One of the potatoes has a metal skewer through it. This potato cooks fastest because heat is transferred through the skewer to the potato.

This heat transfer takes place because . . .

1   convection currents are set up in the metal.

2   the metal contains electrons that are free to move within the metal.

3   the metal expands when heated.

4   the metal is a good emitter of radiation.

6C The diagram shows the potato and skewer one minute after the potato is put into the oven.
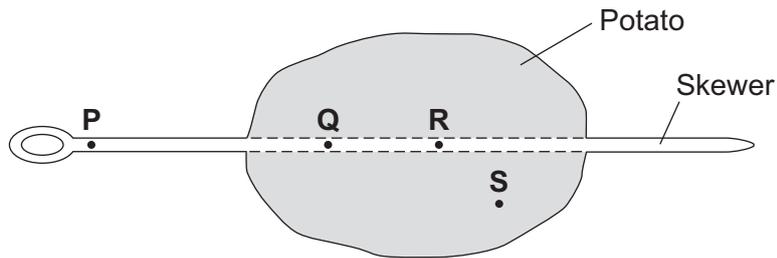
Which of the four points, **P**, **Q**, **R** and **S**, will be the coolest?

1   P

2   Q

3   R

4   S

6D The cooked potatoes are taken out of the oven and left to cool. The graph shows how the surface temperature of one potato changes as it cools.
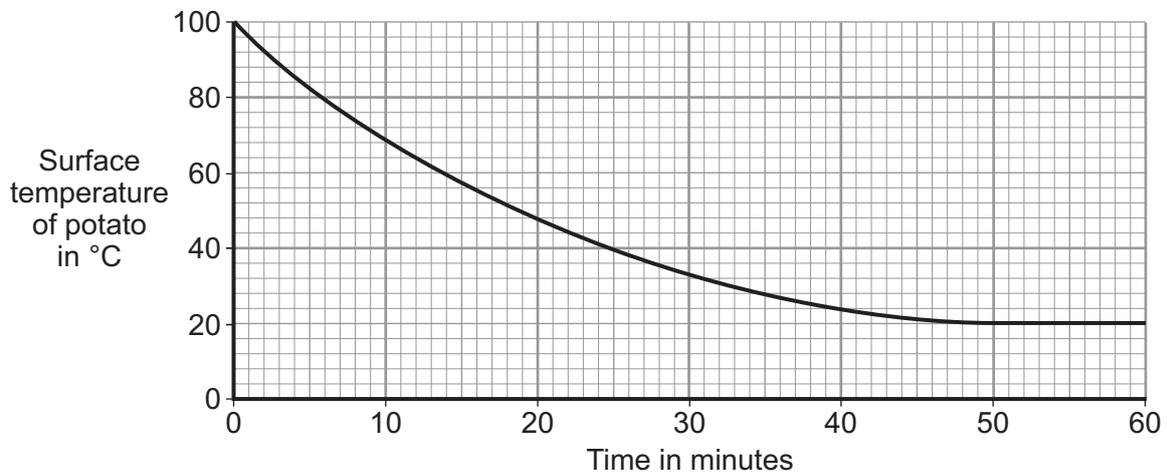
At which of the following times is heat transferred from the potato at the fastest rate?

1   10 minutes

2   20 minutes

3   30 minutes

4   40 minutes

Turn over ▶

QUESTION SEVEN

The diagram shows a power station connected to the National Grid. The National Grid distributes the electrical energy to homes.
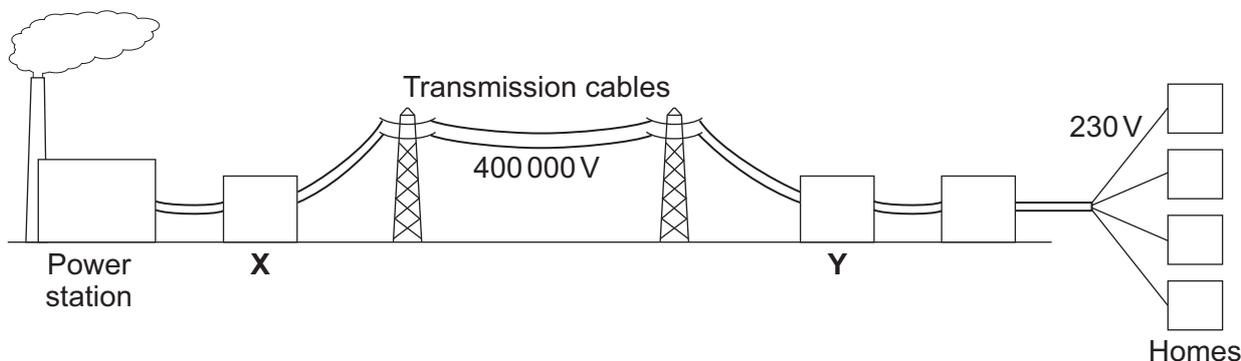

7A Which row in the table correctly describes the transformers **X** and **Y**?

	X	Y
1	step-down	step-down
2	step-down	step-up
3	step-up	step-down
4	step-up	step-up

7B Why is the voltage (potential difference) across the transmission cables of the National Grid very high?

1 so that the electricity travels faster

2 so that the electric current is large

3 to make the transmission of electricity safe

4 to reduce energy loss from the cables

7C A transformer changes both the voltage and the current.

Which row in the table correctly describes the changes of current in transformers **X** and **Y**?

	X	Y
1	decrease	decrease
2	decrease	increase
3	increase	decrease
4	increase	increase

7D In the power station, the boiler has an efficiency of 0.75. The turbine and generator system have an efficiency of 0.80.

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

For every 1000 J of energy supplied to the boiler, what is the useful output energy from the turbine and generator system?
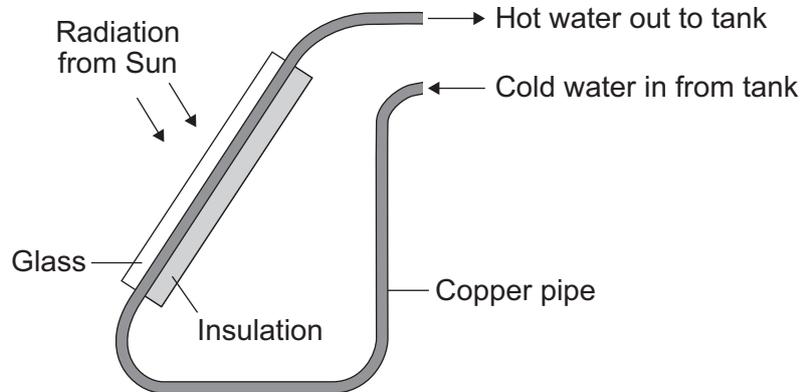
1   600 J

2   750 J

3   800 J

4   1670 J

Turn over for the next question

Turn over ▶

QUESTION EIGHT

The diagram shows a solar panel fitted to the roof of a house.
The solar panel is used for heating water.

- The panel is 5 m long and 2 m wide.
- Each square metre of panel receives 0.6 kJ of solar energy each second when the Sun is shining.

8A The solar panel collects . . .

    1   infra red radiation from the Sun and transforms it into electricity.

    2   infra red radiation from the Sun and uses it to heat water.

    3   light energy from the Sun and transforms it into electricity.

    4   ultraviolet radiation from the Sun and uses it to heat water.

8B The total amount of solar energy, in kJ, collected by the panel in 5 hours when the Sun is shining is . . .

    1   1 800

    2   10 800

    3   21 600

    4   108 000

8C   The pipe inside the solar panel has a black surface because . . .

1   black surfaces are good reflectors of radiation.

2   black surfaces are good absorbers of radiation.

3   black surfaces are good emitters of radiation.

4   black surfaces stay hot for longer.

8D   The hot water tank is placed higher than the solar panel.
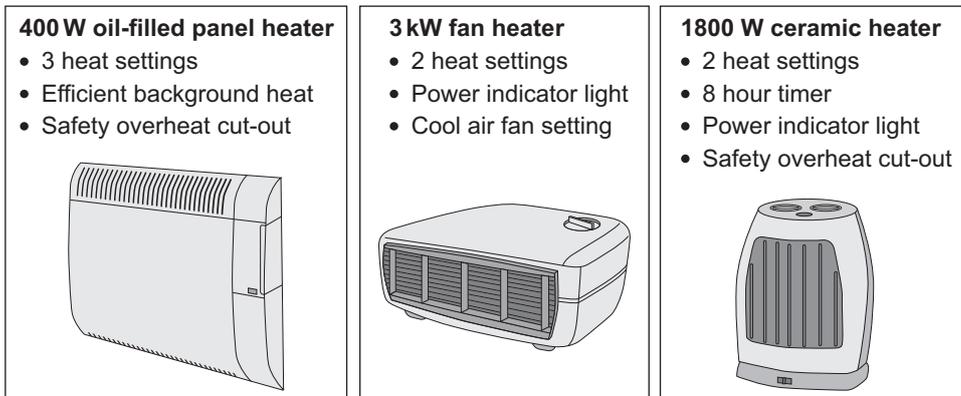
This is because . . .

1   heated water contracts, and sinks.

2   heated water contracts, and rises.

3   heated water expands, and rises.

4   heated water expands, and sinks.

Turn over for the next question

QUESTION NINE

The pictures show three different types of electric heater.

400 W oil-filled panel heater	**3 kW fan heater**	**1800 W ceramic heater**
• 3 heat settings • Efficient background heat • Safety overheat cut-out	• 2 heat settings • Power indicator light • Cool air fan setting	• 2 heat settings • 8 hour timer • Power indicator light • Safety overheat cut-out

9A Two 400 W oil-filled panel heaters are both switched on in an office.

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

How much energy, in kWh, is transferred from the mains to the heaters in 12 hours?

1 4.8

2 9.6

3 2400

4 4800

9B The cost of using the ceramic heater during one week was £6.00. During this week, the heater transferred 40 kWh.

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

What was the cost per kWh of the electricity?

1 1.50p

2 6.67p

3 £0.15

4 £6.67

9C   When the fan heater is working at less than full power, 2 kilojoules of energy are usefully transferred every second. The efficiency of the fan heater at this power is 0.95.

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

How many joules of electrical energy are supplied to the fan heater each second?

1   0.000475

2   0.475

3   2.1

4   2105

9D   The fan heater cannot be 100% efficient.

Why is this?

1   The fan heater is the most powerful of the four heaters.

2   The fan heater does not have a safety overheat cut-out.

3   The fan heater makes a noise.

4   The fan heater's case becomes warm during use.

END OF TEST

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