Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

Science A

Unit Physics P1a (Energy and Electricity)

Physics

Unit Physics P1a (Energy and Electricity)

PHY1AP

F&H

Thursday 1 March 2012 Morning Session

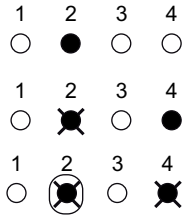
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

Time allowed
- 30 minutes

Instructions
- Fill in the boxes at the top of this page.
- Check that your name, candidate number and centre number are printed on the separate answer sheet.
- Check that the separate answer sheet has the title 'Physics Unit 1a' printed on it.
- Attempt **one Tier only**, **either** the Foundation Tier **or** the Higher Tier.
- Make sure that you use the correct side of the separate answer sheet; the Foundation Tier is printed on one side and the Higher Tier on the other.
- Answer **all** the questions for the Tier you are attempting.
- Record your answers on the separate answer sheet only.
- Do all rough work in this book, **not** on your answer sheet.

Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown.
- Do **not** extend beyond the circles.
- If you want to change your answer, **you must** cross out your original answer, as shown.
- If you change your mind about an answer you have crossed out and now want to choose it, draw a ring around the cross as shown.



Information
- The maximum mark for this paper is 36.

Advice
- Do **not** choose more responses than you are asked to. You will lose marks if you do.
- Make sure that you hand in both your answer sheet and this question paper at the end of the test.
- If you start to answer on the wrong side of the answer sheet by mistake, make sure that you cross out **completely** the work that is not to be marked.

You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Higher Tier starts on page 16 of this booklet.

FOUNDATION TIER

Section One

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

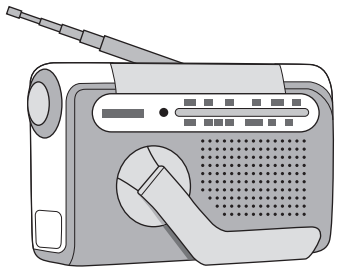
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1**–**4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

The diagram shows a clockwork radio.



Turning the handle winds up a spring. When the spring unwinds, it turns a small generator.

The generator provides the energy to operate the radio.

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

A elastic potential (strain)

B electrical

C kinetic

D sound

When the spring is wound up, energy is stored as . . . **1** . . . energy.

When the spring unwinds, the stored energy is transformed into . . . **2** . . . energy.

As the generator turns, it produces . . . **3** . . . energy.

The loudspeaker in the radio gives out . . . **4** . . . energy.

QUESTION TWO

Different power stations use different energy sources.

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

A gas-fired power stations

B nuclear power stations

C oil-fired power stations

D wood-burning power stations

A liquid fossil fuel is used in . . . **1** . . . .

A renewable fuel is used in . . . . **2** . . . .

The smallest contribution to global warming is made by . . . **3** . . . .

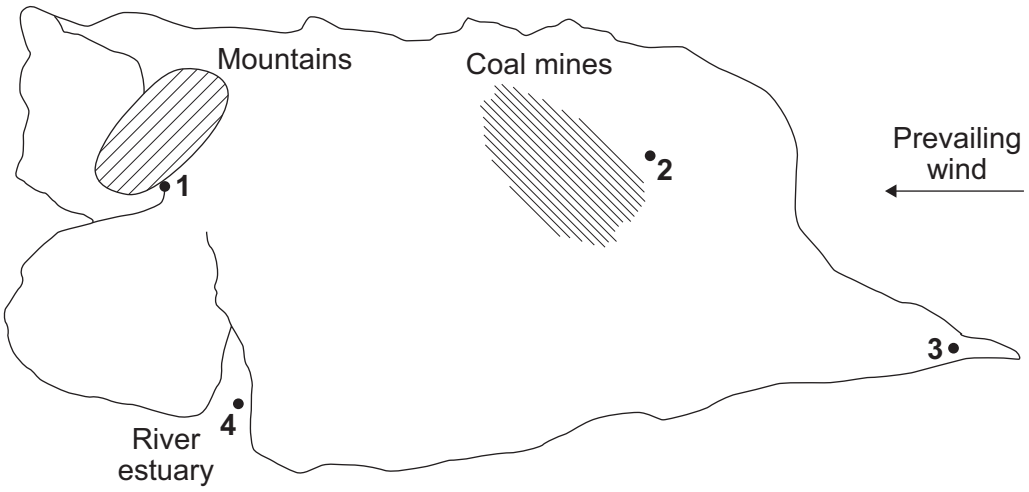
The shortest start-up time is for . . . **4** . . . .

Turn over for the next question

QUESTION THREE

The map shows some features of a large island.

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



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

A falling water (hydroelectric)

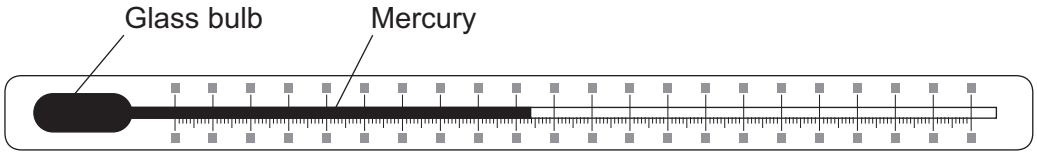
B fossil fuel

C tides

D wind

QUESTION FOUR

The diagram shows a mercury-in-glass thermometer. It is used to measure the temperature at different places in a room.



Match words, **A**, **B**, **C**, and **D**, with the numbers **1**–**4** in the sentences about thermal energy (heat).

A conductor

B convector

C insulator

D radiator

Mercury is a metal, so it is a good . . . **1** . . . .

The temperature may be different at different places in the room because air is a good . . . **2** . . . .

The shiny surface of the mercury makes it a poor . . . **3** . . . .

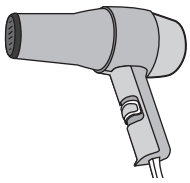
The glass bulb must be made very thin because glass is a good . . . **4** . . . .

Turn over for the next question

QUESTION FIVE

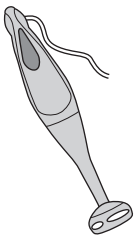
The diagrams show four electrical appliances. Each appliance is designed to produce useful energy but some energy is wasted.

A



Hairdryer

B



Hand whisk

C

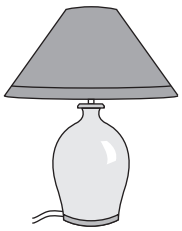
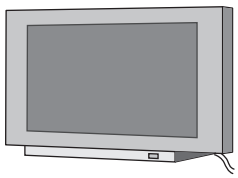


Table lamp

D



Television

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

	Designed to produce . . .	**Also produces wasted . . .**
1	thermal energy (heat) and kinetic energy	sound energy
2	kinetic energy	sound energy and thermal energy (heat)
3	light energy	thermal energy (heat)
4	light energy and sound energy	thermal energy (heat)

Turn over for the next question

Section Two

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

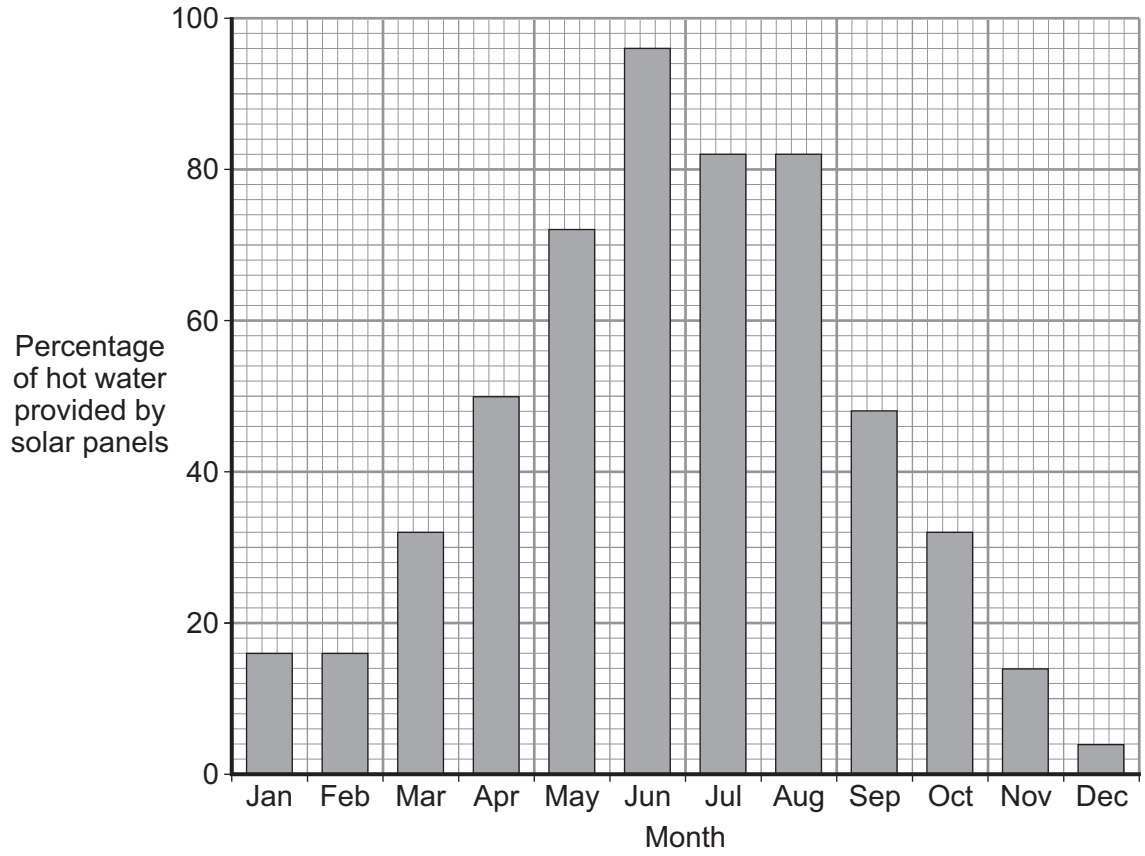
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION SIX

Manufacturers claim that 60 % of a household's annual hot water can be provided by solar panels. The graph shows the typical percentages of hot water provided by solar panels throughout the year.



6A The data is shown as a bar chart.

This is because one of the variables is . . .

1 a control variable.

2 a categoric variable.

3 a dependent variable.

4 an independent variable.

6B In which month do the solar panels provide the lowest percentage of hot water?

1 January

2 February

3 June

4 December

6C What is the highest percentage (%) of hot water provided by the solar panels in any month?

1 60

2 72

3 96

4 100

6D One type of solar panel transfers 80 J of energy to heat the water from every 200 J of energy that falls on it.

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

What is the efficiency of this solar panel?

1 0.4

2 0.8

3 2.5

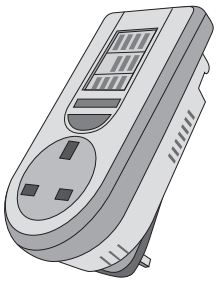
4 120

Turn over for the next question

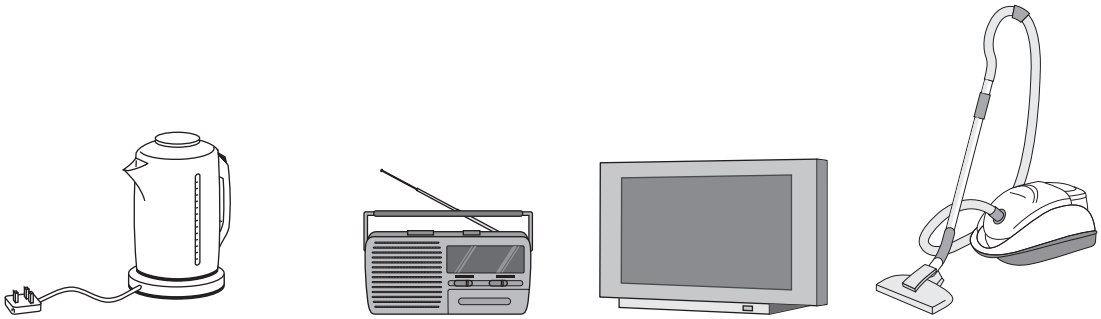
QUESTION SEVEN

The diagram shows a device for measuring the electrical energy used by domestic appliances.

The device is plugged into an electrical socket. The domestic appliance is then plugged into the device.



7A The diagrams show some domestic appliances.



Kettle
2 kW

Radio
6 W

Television
200 W

Vacuum cleaner
0.1 kW

Which appliance will use the most electrical energy when switched on for 5 minutes?

1 kettle

2 radio

3 television

4 vacuum cleaner

7B The device can also show the cost of electricity used by a domestic appliance.

The user must enter some information into the device.

What information needs to be entered?

1 the current that the appliance uses

2 the length of time for which the appliance is connected

3 the mains voltage that is being used

4 the cost of one unit of electrical energy

7C The kettle uses 8 kWh of electrical energy in one week.

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

1 kWh of electrical energy costs 16 p.

What is the cost of this electrical energy?

1 20 p

2 12.8 p

3 £1.28

4 £20

7D It is important that we should use less electrical energy because . . .

1 electrical energy will run out in the future.

2 generating electricity can pollute the environment.

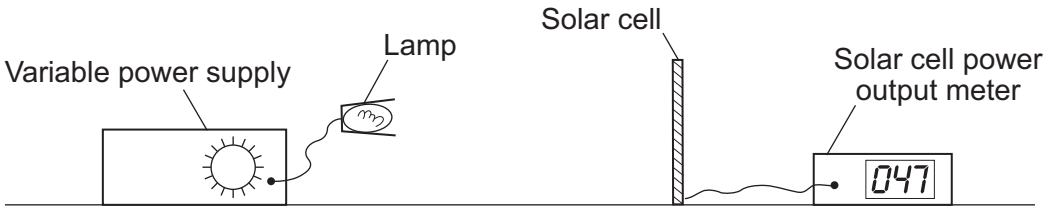
3 waste electrical energy can cause electric shocks.

4 we can store electrical energy for future use.

Turn over for the next question

QUESTION EIGHT

A scientist measured the electrical power output from a solar cell as the intensity of light falling on it changed. The intensity was changed using a variable power supply. The investigation was carried out in a darkened room.



8A Which row in the table is a correct description of the variables?

	Independent variable	Dependent variable
1	intensity of light	power output from solar cell
2	power output from solar cell	intensity of light
3	distance from lamp to solar cell	power output from solar cell
4	intensity of light	distance from lamp to solar cell

8B The control variable was the distance from the . . .

1 power supply to the lamp.

2 power supply to the solar cell.

3 lamp to the solar cell.

4 solar cell to the solar cell power output meter.

8C The distance from the lamp to the solar cell was measured with a ruler. The scale on the ruler was divided into centimetres.

If the scale on the ruler had been divided into millimetres instead of centimetres, the measurement of the distance would have been more . . .

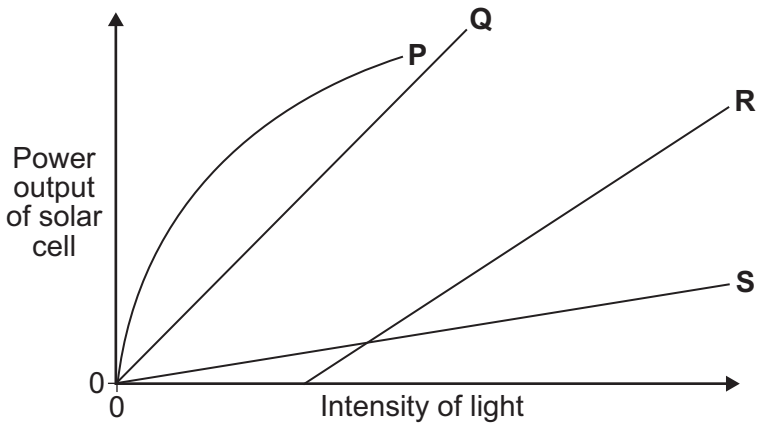
1 precise.

2 reliable.

3 valid.

4 variable.

8D Four different solar cells, **P**, **Q**, **R** and **S**, were investigated using the apparatus. The results of the investigations are shown in the graph.



Which solar cell does **not** give a power output in low light intensity?

1 **P**

2 **Q**

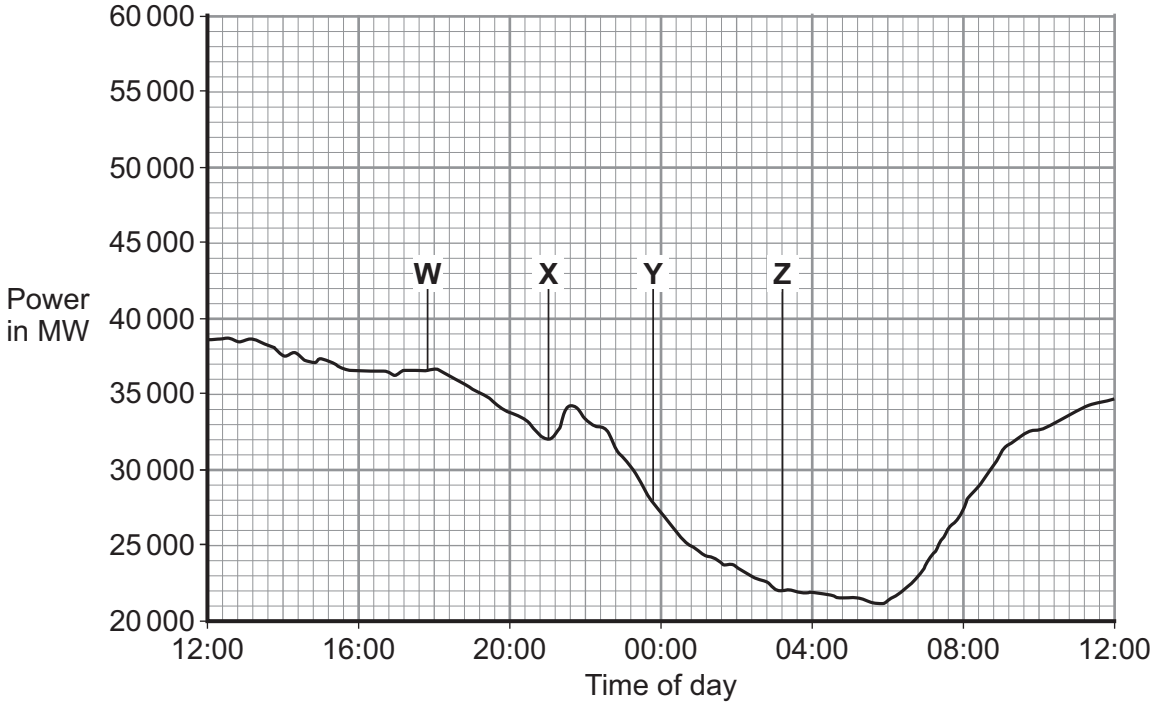
3 **R**

4 **S**

Turn over for the next question

QUESTION NINE

The graph shows how the electrical power supplied by the National Grid varied during one day.



9A At one point, a World Cup football match on the television finished. Millions of people switched on their electric kettles to make a cup of tea.

Which point on the graph shows the time at which the kettles were switched on?

1 **W**

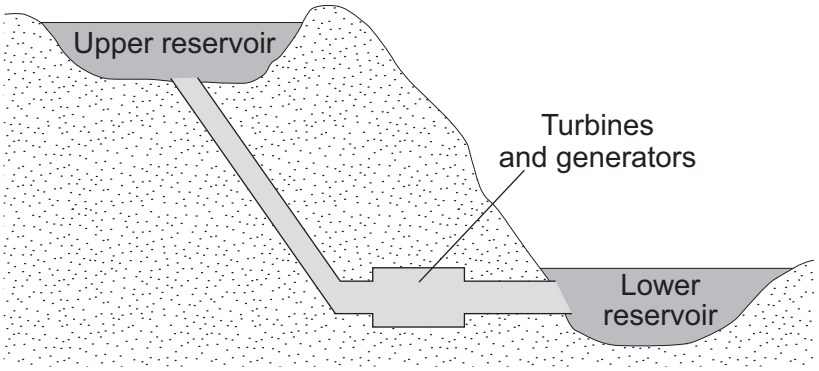
2 **X**

3 **Y**

4 **Z**

9B The National Grid has to be able to cope with sudden surges in demand. One way of doing this is to use a pumped storage system.

The diagram shows a pumped storage system.



During times of low demand, electricity is used to pump water up from the lower reservoir to the upper reservoir.

At which point on the graph is this most likely to be happening?

1 **W**

2 **X**

3 **Y**

4 **Z**

9C Electrical energy cannot be stored directly in large quantities.

In what form is energy stored in the pumped storage system?

1 chemical

2 gravitational potential

3 kinetic

4 thermal

9D Which row in the table shows a correct advantage **and** a correct disadvantage of a pumped storage system?

	Advantage	**Disadvantage**
1	short start-up time	can lead to loss of habitat for wildlife
2	no fossil fuels are used	long start-up time
3	short start-up time	fuel costs are very high
4	no fossil fuels are used	fuel costs are very high

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**.

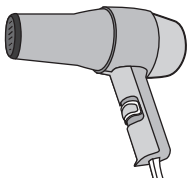
Use **each** answer only **once**.

Mark your choices on the answer sheet.

QUESTION ONE

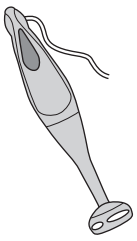
The diagrams show four electrical appliances. Each appliance is designed to produce useful energy but some energy is wasted.

A



Hairdryer

B



Hand whisk

C

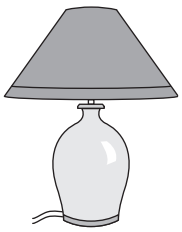
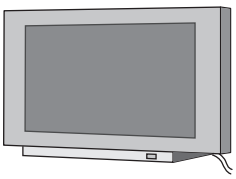


Table lamp

D



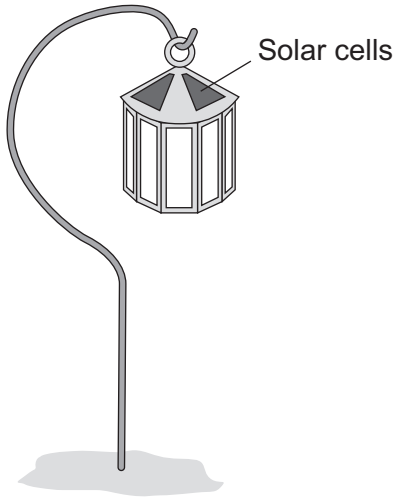
Television

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

	Designed to produce . . .	**Also produces wasted . . .**
1	thermal energy (heat) and kinetic energy	sound energy
2	kinetic energy	sound energy and thermal energy (heat)
3	light energy	thermal energy (heat)
4	light energy and sound energy	thermal energy (heat)

QUESTION TWO

A garden light has panels of solar cells that collect energy from the Sun. The energy is transformed for storage in rechargeable batteries. The stored energy is used to power the lamp when it is dark.



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

A chemical energy to electrical energy

B electrical energy to chemical energy

C electrical energy to light energy

D light energy to electrical energy

	Where and when the transformation takes place
1	in the batteries during darkness
2	in the batteries during daylight
3	in the lamp during darkness
4	in the solar cells during daylight

Section Two

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

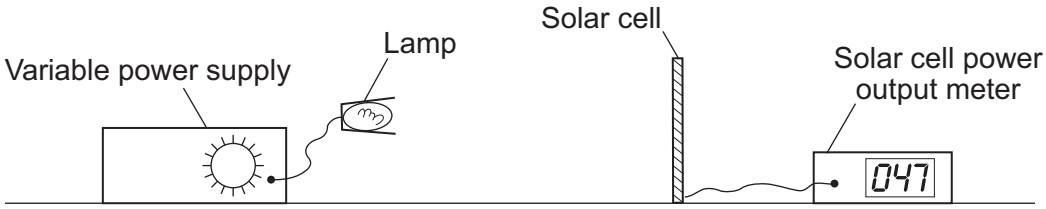
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION THREE

A scientist measured the electrical power output from a solar cell as the intensity of light falling on it changed. The intensity was changed using a variable power supply. The investigation was carried out in a darkened room.



3A Which row in the table is a correct description of the variables?

	Independent variable	Dependent variable
1	intensity of light	power output from solar cell
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3 lamp to the solar cell.

4 solar cell to the solar cell power output meter.

3C The distance from the lamp to the solar cell was measured with a ruler. The scale on the ruler was divided into centimetres.

If the scale on the ruler had been divided into millimetres instead of centimetres, the measurement of the distance would have been more . . .

1 precise.

2 reliable.

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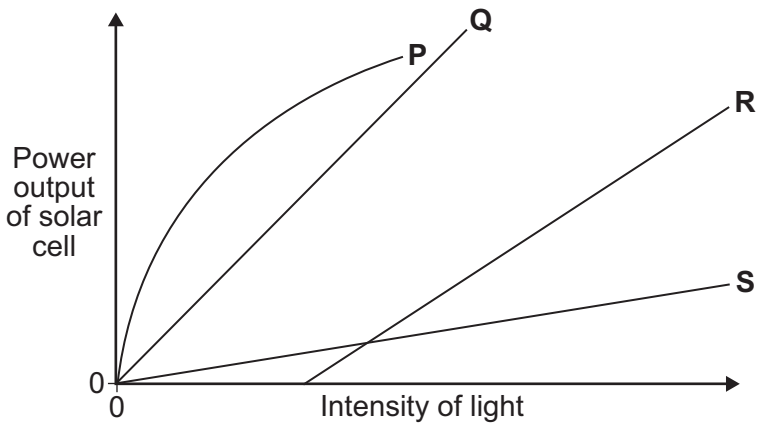
4 variable.

3D Four different solar cells, **P**, **Q**, **R** and **S**, were investigated using the apparatus. The results of the investigations are shown in the graph.



Which solar cell does **not** give a power output in low light intensity?

1 **P**

2 **Q**

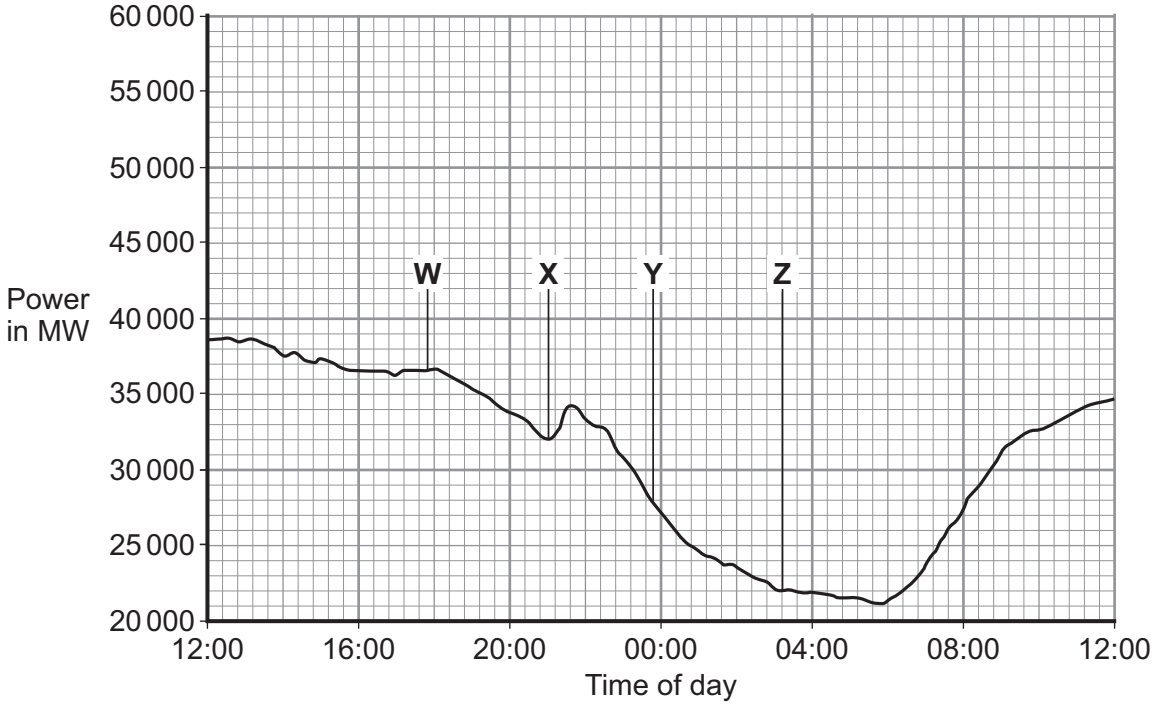
3 **R**

4 **S**

Turn over for the next question

QUESTION FOUR

The graph shows how the electrical power supplied by the National Grid varied during one day.



4A At one point, a World Cup football match on the television finished. Millions of people switched on their electric kettles to make a cup of tea.

Which point on the graph shows the time at which the kettles were switched on?

1 **W**

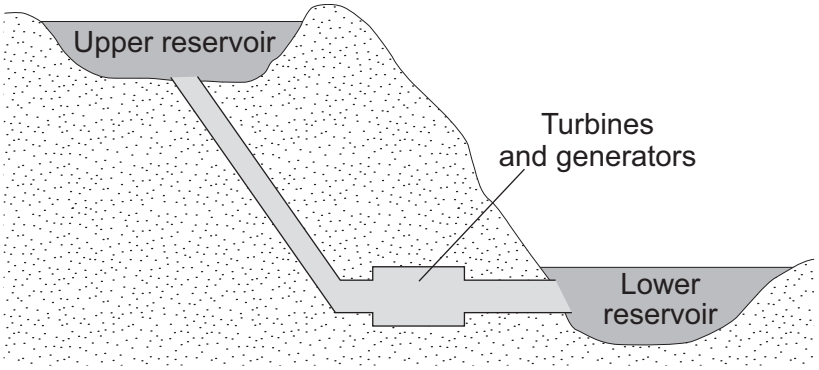
2 **X**

3 **Y**

4 **Z**

4B The National Grid has to be able to cope with sudden surges in demand. One way of doing this is to use a pumped storage system.

The diagram shows a pumped storage system.



During times of low demand, electricity is used to pump water up from the lower reservoir to the upper reservoir.

At which point on the graph is this most likely to be happening?

1 **W**

2 **X**

3 **Y**

4 **Z**

4C Electrical energy cannot be stored directly in large quantities.

In what form is energy stored in the pumped storage system?

1 chemical

2 gravitational potential

3 kinetic

4 thermal

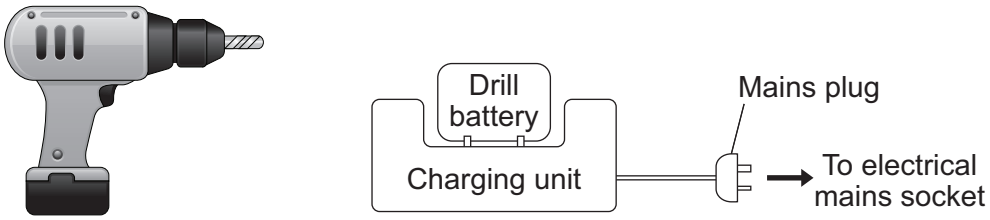
4D Which row in the table shows a correct advantage **and** a correct disadvantage of a pumped storage system?

	Advantage	**Disadvantage**
1	short start-up time	can lead to loss of habitat for wildlife
2	no fossil fuels are used	long start-up time
3	short start-up time	fuel costs are very high
4	no fossil fuels are used	fuel costs are very high

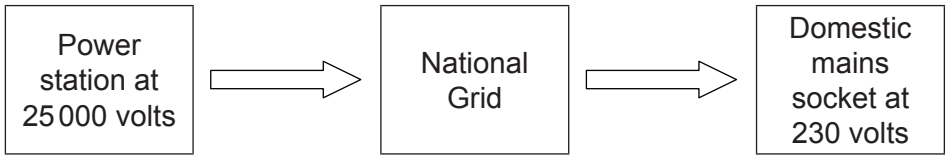
Turn over for the next question

QUESTION FIVE

The diagram shows a cordless drill. The drill is powered by a 24-volt battery, which must be charged before the drill can be used. The battery is plugged into a charging unit, and the charging unit is connected to an electrical mains socket. The mains voltage is 230 volts.



5A The flow diagram shows how electricity is delivered to the mains socket from a power station.



The process of getting electricity from the power station to a domestic mains socket involves . . .

1 step-up transformers only.

2 step-down transformers only.

3 step-up and step-down transformers.

4 no transformers.

5B A manufacturer makes several statements about a 24-volt cordless drill compared to a 230-volt mains-operated drill.

Which of the following statements about the cordless drill are true?

J It is safer because there are no trailing cables to trip over.

K There is less risk of severe electrical shock because it operates at a lower voltage and current.

L When charged, it can be used in remote locations where there is no electricity supply.

1 **J** and **K** only

2 **K** and **L** only

3 **J** and **L** only

4 **J**, **K** and **L**

5C The drill can produce a maximum of 72 watts continuous power for 6 minutes before it starts to overheat.

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

The energy transferred by the drill during this time is . . .

1 0.0072 kWh

2 0.0432 kWh

3 7.2 kWh

4 432 kWh

5D A workman uses several different electrical tools to complete a job. The total cost of the electricity is 6.4 p.

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

1 kWh of electrical energy costs 16 p

How much electrical energy do the tools transfer?

1 0.25 kWh

2 0.40 kWh

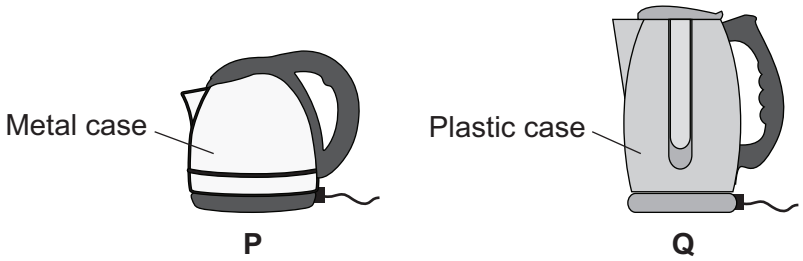
3 2.50kWh

4 4.00kWh

Turn over for the next question

QUESTION SIX

A student carried out a test to compare two kettles, **P** and **Q**. The kettles had the same power rating.



He heated one litre of water in each kettle until the water boiled.
Every 30 seconds, he measured:

- the total energy input to each kettle
- the temperature of the water.

These are the results for kettle **P**.

Time in s	0	30	60	90	120	150
Total energy input in kJ	0	45	90	135	180	225
Water temperature in °C	16	44	65	81	92	100

6A From these results, which of the following is directly proportional to the time?

1 total energy input

2 water temperature

3 both total energy input and water temperature

4 neither total energy input or water temperature

6B The water in kettle **Q** took a shorter time to boil than the water in kettle **P**.

This was because . . .

1 less energy was lost from kettle **Q**, making it less efficient than kettle **P**.

2 less energy was lost from kettle **Q**, making it more efficient than kettle **P**.

3 more energy was lost from kettle **Q**, making it less efficient than kettle **P**.

4 more energy was lost from kettle **Q**, making it more efficient than kettle **P**.

6C In kettles, heat is transferred through the water by convection currents.

In convection, the water around the heating element . . .

1 contracts, becomes less dense and falls.

2 contracts, becomes more dense and rises.

3 expands, becomes less dense and falls.

4 expands, becomes less dense and rises.

6D The metal case is better than the plastic case at transferring thermal energy.

This is because . . .

1 convection currents are harder to set up in plastics than in metals.

2 there are free electrons in metals but not in plastics.

3 infra red radiation can pass through metals more easily than through plastics.

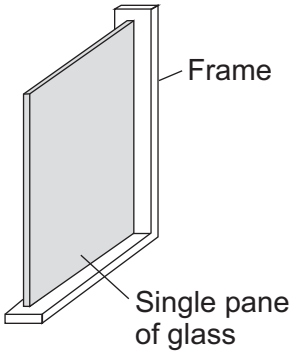
4 atoms can move more easily through metals than through plastics.

Turn over for the next question

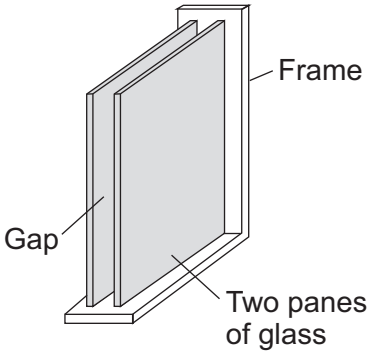
QUESTION SEVEN

The diagrams show two types of window.

Single-glazed window



Double-glazed window



7A A double-glazed window consists of two panes of glass with a gap between.

The gap between the two panes of glass helps to reduce the rate of heat loss by . . .

1 conduction and radiation.

2 conduction and convection.

3 convection and radiation.

4 conduction, convection and radiation.

7B The rate of heat loss from a double-glazed window depends on . . .

1 the area of the pane of glass only.

2 the thickness of glass only.

3 the width of the gap only.

4 all of the above.

7C The average rate of heat loss from a single-glazed window is 500 W.

Replacing this window with a double-glazed window reduces the average rate of heat loss to 300 W.

What is the percentage reduction in heat loss when this is done?

1 33 %

2 40 %

3 60 %

4 67 %

7D The yearly energy bill for a house with single-glazed windows is £1200.

After being fitted with double-glazing, the yearly energy bill is reduced to £1000.

The cost of installing the double-glazing is £3600.

What is the payback time?

1 1.6 years

2 3.0 years

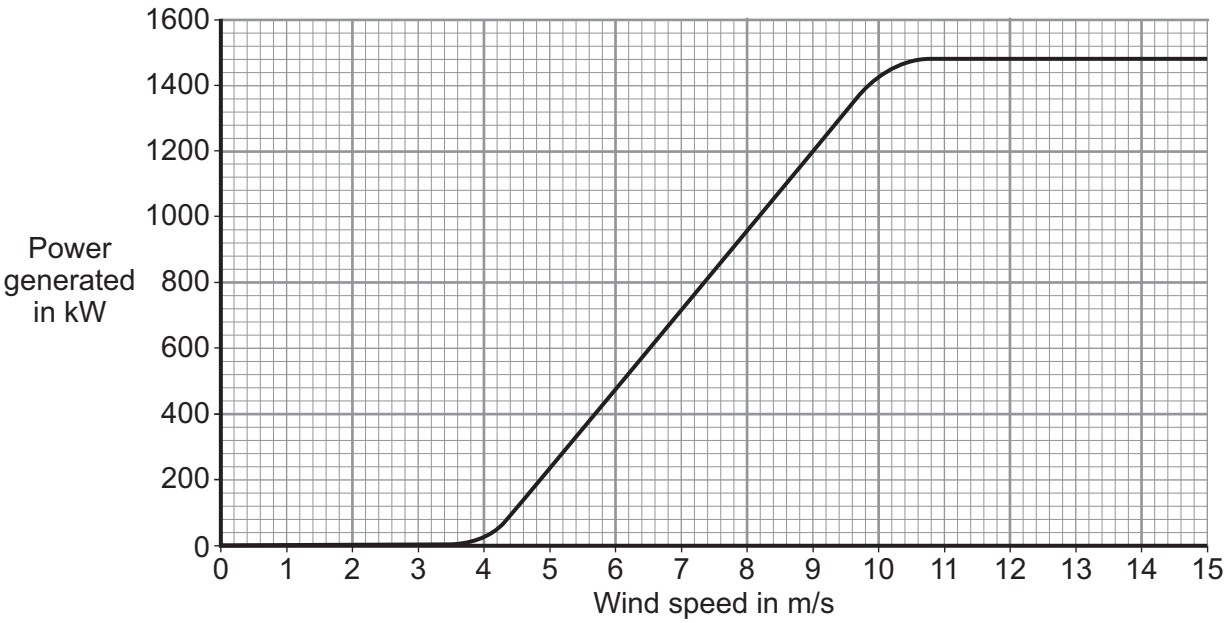
3 3.6 years

4 18 years

Turn over for the next question

QUESTION EIGHT

The graph shows how the power generated by a wind turbine varies with wind speed.



8A The graph shows that . . .

1 the wind speed has a maximum value of 15 m/s.

2 the wind turbine shuts down at a wind speed of 15 m/s.

3 the wind speed has a minimum value of 3.5 m/s.

4 the wind turbine does not work at speeds below 3.5 m/s.

8B The wind turbine transfers 6000 kWh of energy in 5 hours.

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

What was the average wind speed?

1 6.4 m/s

2 9.0 m/s

3 10.5 m/s

4 15.0 m/s

8C The Thanet Offshore wind farm was opened in 2010. It has 100 turbines, each 380 feet high. The wind farm cost £780 million to build. The scheme has many critics.

Which of the following statements is a legitimate criticism?

1 Wind-generated electricity now powers 3 million homes in the UK.

2 Wind farms use a renewable source and, when working, do not contribute to global warming.

3 Wind farms must be backed up by more reliable energy sources such as coal or nuclear.

4 In the next decade, it is expected that 30 % of the UK's electricity will be generated from wind.

8D A wind farm sends its electricity to the National Grid.

To transmit the electricity using the National Grid, with a minimum of energy loss, the electricity has to be transmitted at . . .

1 low voltage and low current.

2 low voltage and high current.

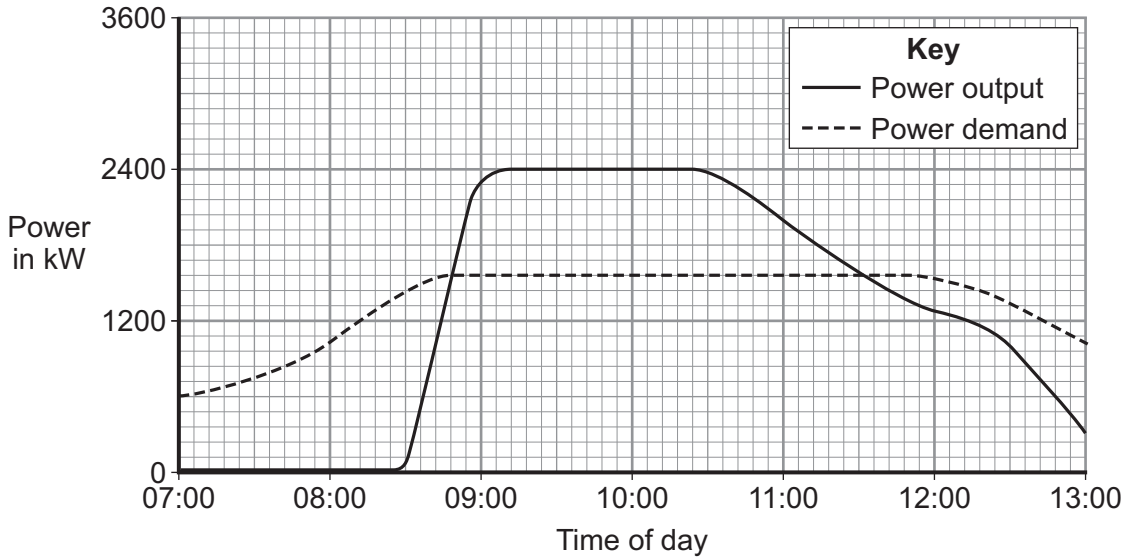
3 high voltage and low current.

4 high voltage and high current.

Turn over for the next question

QUESTION NINE

The graph shows how the power output of a tidal power station varies over a 6-hour period. It also shows the power demand.



9A For how many hours is the power demand greater than the power output?

1 1.30

2 2.75

3 3.25

4 6.00

9B The average power demand per house is 1200 watts.

What is the maximum number of houses that this tidal power station could supply at this level of demand?

1 500

2 1000

3 1500

4 2000

9C Europe's only tidal power station is in France. This produces an average output of 2000 MWh of electricity per day.

1 MWh = 1 000 000 Wh

The maximum number of houses that can be supplied by this tidal power station is 25 000.

How much electricity does an average house use each day?

1 0.08 kWh

2 12.5 kWh

3 80 kWh

4 80 000 kWh

9D There are very few suitable sites in the UK for tidal power stations.

The difference in height between high tide and low tide must be . . .

1 big, so that the number of habitats of wading birds destroyed is kept to a minimum.

2 big, so that the gravitational potential energy stored at high tide is as large as possible.

3 small, so that the kinetic energy of the water flowing through the turbines is small.

4 small, so that the decommissioning costs are as low as possible.

END OF TEST

There are no questions printed on this page