Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

Science A

Unit Physics P1a (Energy and Electricity)

Physics

Unit Physics P1a (Energy and Electricity)

PHY1AP

F&H

Friday 22 June 2012 Afternoon Session

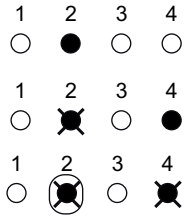
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

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**.

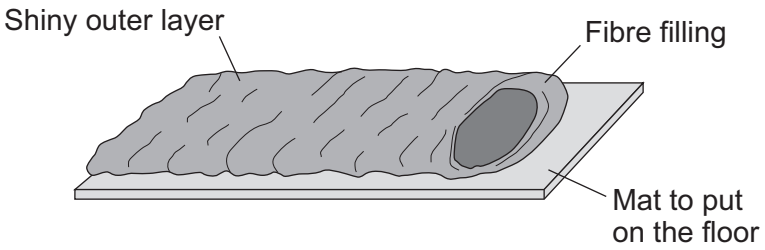
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1**–**4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

The diagram shows a sleeping bag on a mat. The mat is made from expanded polystyrene foam. The sleeping bag is designed to keep people warm when sleeping in a tent.



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

A conduction

B convection

C insulation

D radiation

The mat on the floor reduces heat loss by . . . **1** . . . .

The shiny outer layer of the sleeping bag reduces heat loss by . . . **2** . . . .

The fibre filling of the sleeping bag reduces heat loss by conduction and by . . . **3** . . . .

The mat and the fibre filling are designed to improve . . . **4** . . . .

QUESTION TWO

Many devices transform electrical energy into other forms of energy.

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

A kinetic

B light

C sound

D thermal

The useful output from an electric drill is . . . **1** . . . energy.

The useful output from a radio is . . . **2** . . . energy.

The useful output from a toaster is . . . **3** . . . energy.

The useful output from a torch is . . . **4** . . . energy.

Turn over for the next question

QUESTION THREE

The flow chart shows how a nuclear power station produces electricity for the National Grid.

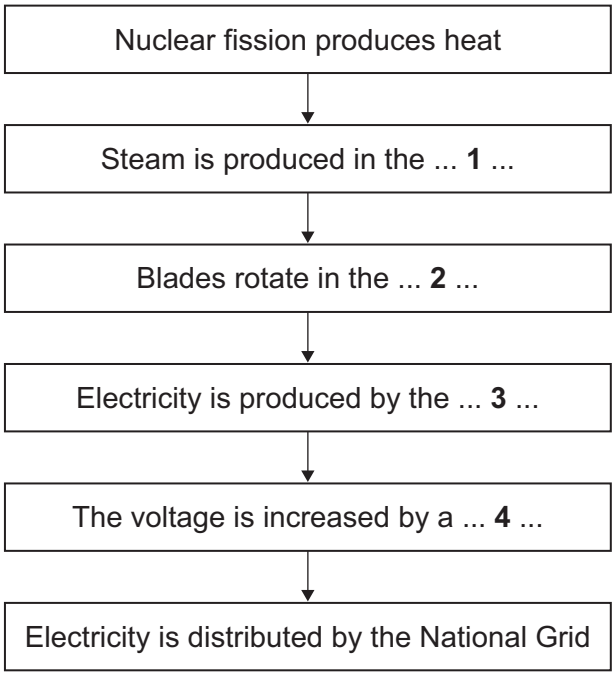
Match words, **A**, **B**, **C** and **D**, with the numbers **1**–**4** on the flow chart.

A boiler

B generator

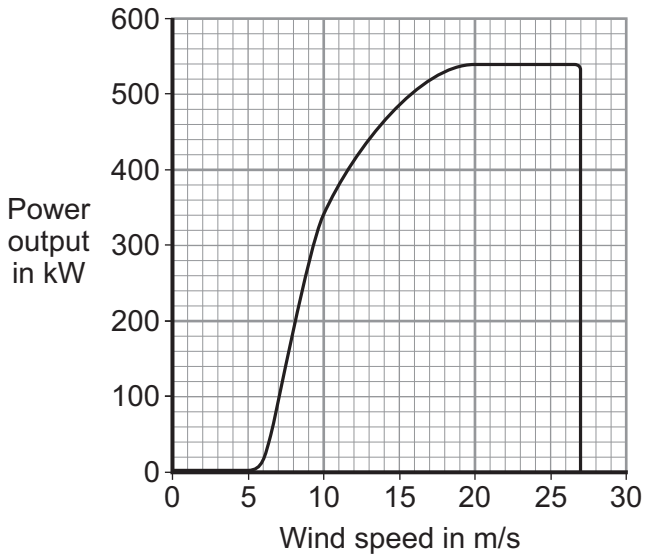
C transformer

D turbine



QUESTION FOUR

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



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

A 5

B 27

C 340

D 540

The minimum wind speed required to generate electricity is . . . **1** . . . m/s.

The maximum power output of the wind turbine is . . . **2** . . . kW.

At a wind speed of 10 m/s, the power output is . . . **3** . . . kW.

The turbine has a safety device that reduces the power output when the wind speed reaches . . . **4** . . . m/s.

Turn over for the next question

QUESTION FIVE

Power stations involve energy transfers.

Match power stations, **A**, **B**, **C** and **D**, with the useful energy transfers **1**–**4** in the table.

A coal-fired

B geothermal

C hydroelectric

D wind farm

1	chemical → heat (thermal energy) → kinetic → electrical
2	gravitational potential → kinetic → electrical
3	heat (thermal energy) → kinetic → electrical
4	kinetic → electrical

Turn over for the next question

Section Two

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

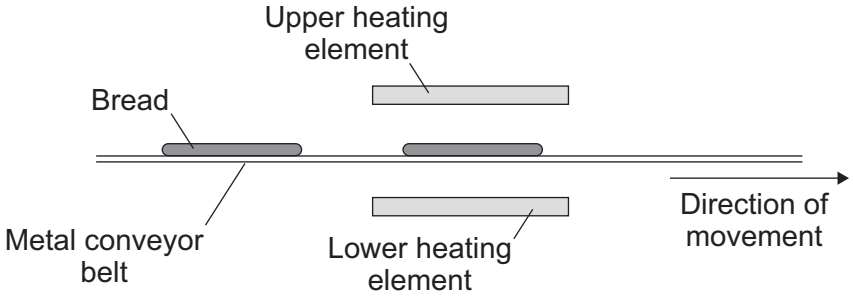
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION SIX

Busy restaurants toast bread using a conveyor toaster. Pieces of bread move on a metal conveyor belt between two heating elements.



6A What type of heat transfer browns the bread on the upper side?

1 conduction and convection

2 convection only

3 convection and radiation

4 radiation only

6B To make the toast browner, the controls on the toaster should be altered to . . .

1 provide less heat to the heating elements.

2 reverse the direction of the conveyor belt.

3 slow down the conveyor belt.

4 speed up the conveyor belt.

6C As the surface of the toast becomes darker, the surface will . . .

1 absorb more heat.

2 radiate less heat.

3 reflect more heat.

4 transmit less heat.

6D The toaster has a power of 1.8 kilowatts and operates for 30 minutes.

How much energy is transferred?

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

1 0.54 kWh

2 0.60 kWh

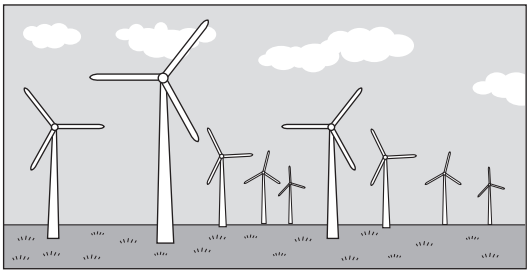
3 0.90 kWh

4 5.40 kWh

Turn over for the next question

QUESTION SEVEN

Many new wind farms are being built in the UK.



Scientists state that the turbine blades attract insects. During the day, when birds eat the insects, many birds are killed by the blades. At night, when bats eat the insects, many bats are killed by the blades.

Some colours attract insects better than other colours. Research has been carried out into the number of insects attracted by different colours. Turbine blades could then be painted so that fewer bats and birds are killed.

Cards, painted different colours, were set out in a field at the base of a turbine. The researchers counted the number of insects attracted to each card.

7A What type of variable was the colour of the card?

1 continuous

2 control

3 dependent

4 independent

7B The results were recorded in a table. An example is given below.

Colour of card	Number of insects attracted

What is the best way of displaying the results?

1 bar chart

2 line graph

3 pie chart

4 scattergram

7C The chart shows the results.

Largest number of insects attracted ⟶				**Smallest number attracted**
yellow	white	light grey	red	purple

To make birds and bats safer, what would be the best colour to paint the turbine blades?

1 light grey

2 purple

3 white

4 yellow

7D The issue of birds and bats being killed by wind turbine blades is . . .

1 an economic issue.

2 an environmental issue.

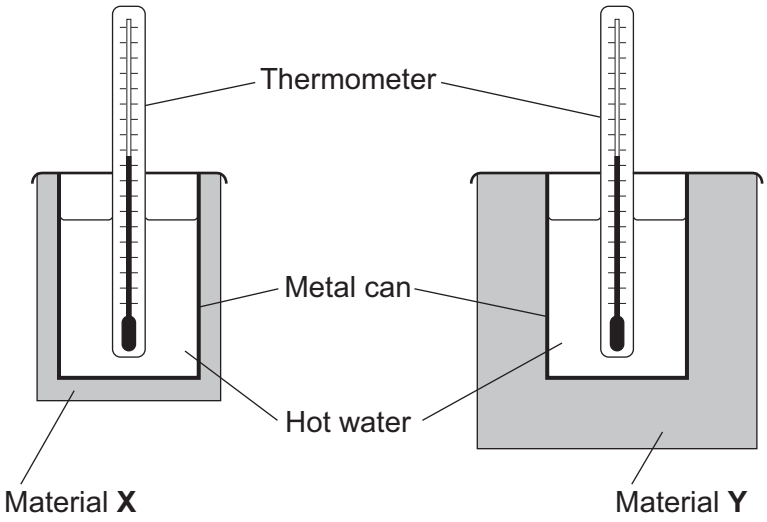
3 a political issue.

4 a scientific issue.

Turn over for the next question

QUESTION EIGHT

A student compared the insulating properties of two different materials, **X** and **Y.** She set up the apparatus as shown below. She filled each can with hot water.



She measured the temperature of the water in each can at the start and again after 10 minutes.

These are the results.

	Starting temperature of the water	Temperature of the water after 10 minutes
Can insulated by material **X**	95 °C	78 °C
Can insulated by material **Y**	95 °C	85 °C

8A The test was **not** fair because she used . . .

1 the same amount of water.

2 the same starting temperature.

3 different thicknesses of material.

4 identical cans.

8B What was the average rate of temperature fall for the water in the can insulated by material **X**?

1 8.5 °C per minute

2 7.8 °C per minute

3 1.7 °C per minute

4 1.0 °C per minute

8C Which material is the better thermal insulator?

1 Material **X** because the temperature fall is smaller.

2 Material **Y** because the temperature fall is bigger.

3 We cannot say, because the results are not valid.

4 We cannot say, because the results are not precise enough.

8D Heat (thermal energy) passes through the walls of the can by . . .

1 conduction only.

2 convection only.

3 radiation only.

4 conduction and convection.

Turn over for the next question

QUESTION NINE

In 2009, the UK government introduced a car 'scrappage' scheme. The scheme was introduced to help car manufacturers. A person with a car that was at least 10 years old could scrap it and claim up to £2000 towards the cost of a new car.

9A The new cars were generally more efficient than the old scrapped cars.

A more efficient car . . .

1 pollutes the atmosphere more than a less efficient car.

2 has a bigger engine than a less efficient car.

3 travels faster than a less efficient car.

4 uses less fuel per kilometre than a less efficient car.

9B Another benefit of the car scrappage scheme was that the new cars produced less carbon dioxide (CO_2) per kilometre than the scrapped cars.

Carbon dioxide is a . . .

1 greenhouse gas and contributes to the ozone layer.

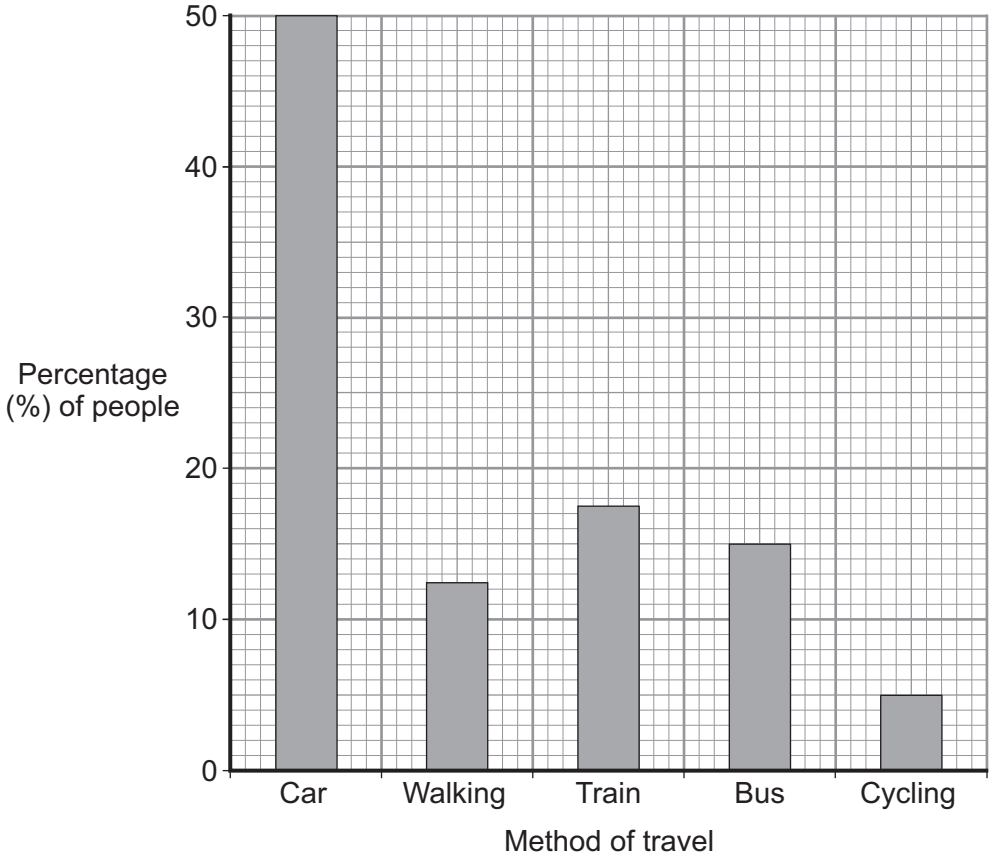
2 greenhouse gas and contributes to global warming.

3 radioactive gas and contributes to acid rain.

4 radioactive gas and contributes to radioactive waste.

People in the UK travel to work by different methods.

The bar chart shows the percentage of people using each method.



9C The data has been shown as a bar chart.

It could also have been shown as a . . .

1 pie chart.

2 Sankey diagram.

3 scattergram.

4 straight line graph.

9D What percentage of people in the UK use a method of travel to work that does **not** contribute to global warming?

1 5.0 %

2 12.5 %

3 17.5 %

4 82.5 %

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

Power stations involve energy transfers.

Match power stations, **A**, **B**, **C** and **D**, with the useful energy transfers **1**–**4** in the table.

A coal-fired

B geothermal

C hydroelectric

D wind farm

1	chemical → heat (thermal energy) → kinetic → electrical
2	gravitational potential → kinetic → electrical
3	heat (thermal energy) → kinetic → electrical
4	kinetic → electrical

QUESTION TWO

This question is about the advantages and disadvantages of different energy resources that can be used to produce electricity.

Match words, **A**, **B**, **C** and **D**, with the advantages and disadvantages **1**–**4** in the table.

A coal

B nuclear

C tides

D wind

	Advantage	**Disadvantage**
1	no polluting gases produced	unpredictable supply of energy
2	no polluting gases produced	radioactive waste produced
3	plentiful supply of fuel	produces acid rain
4	no fuel needed	may destroy habitats of wading birds

Turn over for the next question

Section Two

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

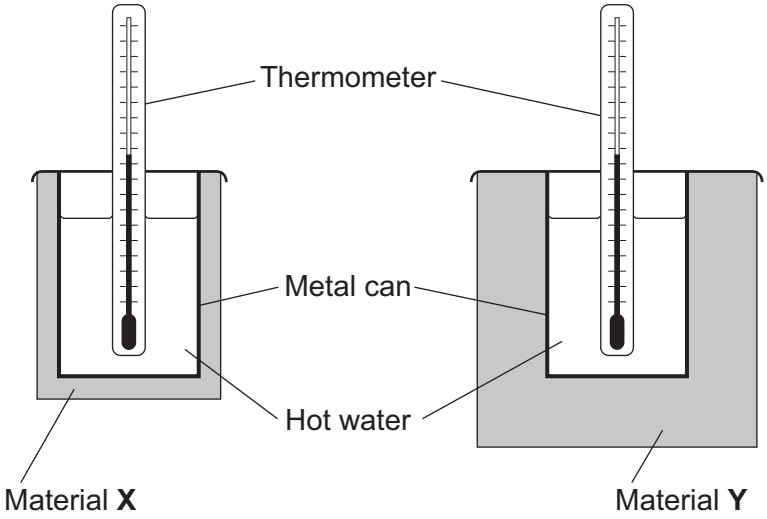
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION THREE

A student compared the insulating properties of two different materials, **X** and **Y.** She set up the apparatus as shown below. She filled each can with hot water.



She measured the temperature of the water in each can at the start and again after 10 minutes.

These are the results.

	Starting temperature of the water	**Temperature of the water after 10 minutes**
Can insulated by material **X**	95 °C	78 °C
Can insulated by material **Y**	95 °C	85 °C

3A The test was **not** fair because she used . . .

1 the same amount of water.

2 the same starting temperature.

3 different thicknesses of material.

4 identical cans.

3B What was the average rate of temperature fall for the water in the can insulated by material **X**?

1 8.5 °C per minute

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3D Heat (thermal energy) passes through the walls of the can by . . .

1 conduction only.

2 convection only.

3 radiation only.

4 conduction and convection.

Turn over for the next question

QUESTION FOUR

In 2009, the UK government introduced a car 'scrappage' scheme. The scheme was introduced to help car manufacturers. A person with a car that was at least 10 years old could scrap it and claim up to £2000 towards the cost of a new car.

4A The new cars were generally more efficient than the old scrapped cars.

A more efficient car . . .

1 pollutes the atmosphere more than a less efficient car.

2 has a bigger engine than a less efficient car.

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4B Another benefit of the car scrappage scheme was that the new cars produced less carbon dioxide (CO_2) per kilometre than the scrapped cars.

Carbon dioxide is a . . .

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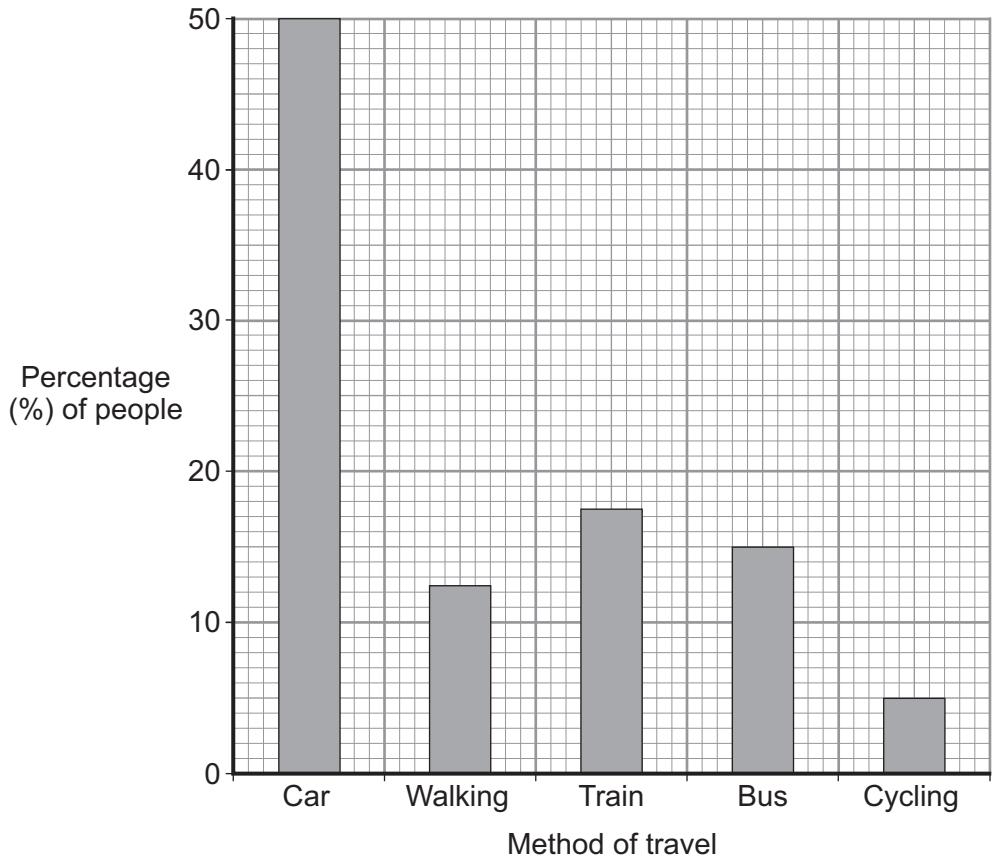
The bar chart shows the percentage of people using each method.



4C The data has been shown as a bar chart.

It could also have been shown as a . . .

1 pie chart.

2 Sankey diagram.

3 scattergram.

4 straight line graph.

4D What percentage of people in the UK use a method of travel to work that does **not** contribute to global warming?

1 5.0 %

2 12.5 %

3 17.5 %

4 82.5 %

QUESTION FIVE

Offshore wind farms are used to generate electricity.

5A What is the main form of wasted energy in a wind turbine?

1 electrical

2 heat (thermal energy)

3 kinetic

4 light

5B A single wind turbine supplying 360 kW of electricity can power 300 homes.

What is the average power consumption per home?

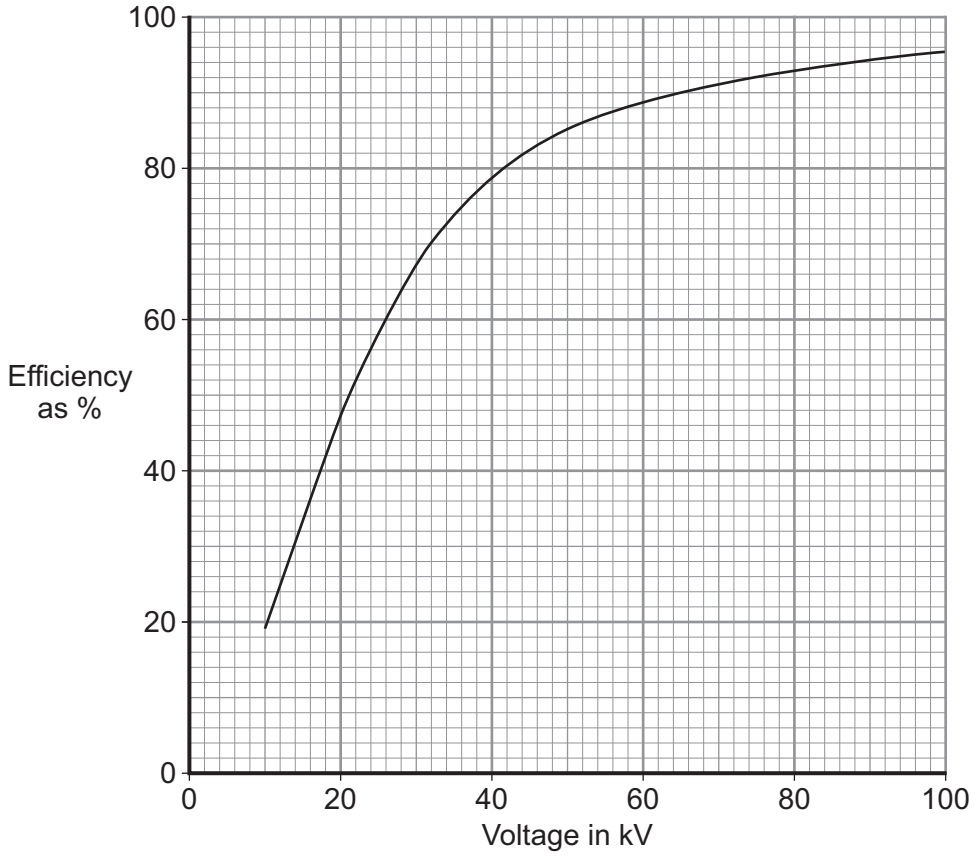
1 108 watts

2 120 watts

3 1080 watts

4 1200 watts

5C Cables under the sea are used to transmit electricity from offshore wind farms to the mainland. The graph shows how the efficiency of the transmission depends on the voltage.



What is the efficiency at 32 kilovolts?

1 14 %

2 32 %

3 65 %

4 70 %

5D On the mainland, electricity is transmitted using the National Grid.
A power station supplies 1500 MJ of energy each second to the National Grid.
The efficiency of the National Grid is 0.9.

How much energy is received each second by consumers?

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

1 135 MJ

2 249 MJ

3 1350 MJ

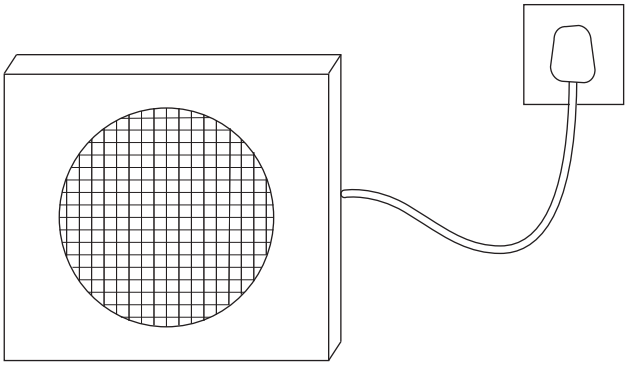
4 1485 MJ

Turn over for the next question

QUESTION SIX

The picture shows part of a leaflet about the 'Ceramic heater'.

Ceramic Heater

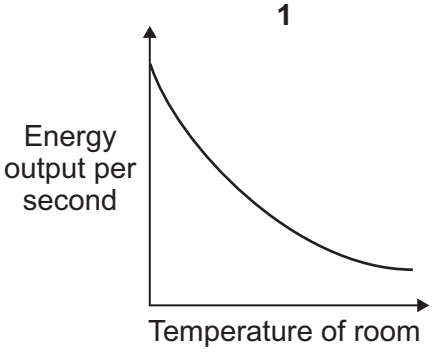


The ceramic heater is a new type of heater. Although smaller than nearly all other domestic heaters, it is very efficient, economical and safe. It can heat a room in minutes.

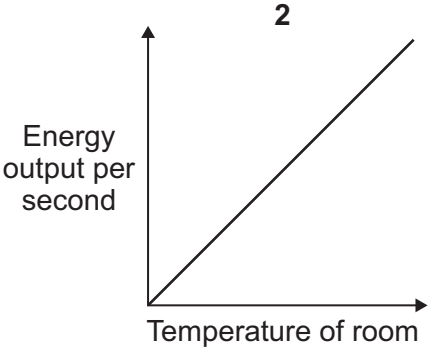
It works by using a powerful fan to pull air through a ceramic heating element. This heating element automatically reduces its power output as the temperature increases. The ceramic heater has a **maximum** energy output of 1000 joules per second.

6A Which graph shows how the energy output from the *Ceramic heater* varies with the temperature of the room?

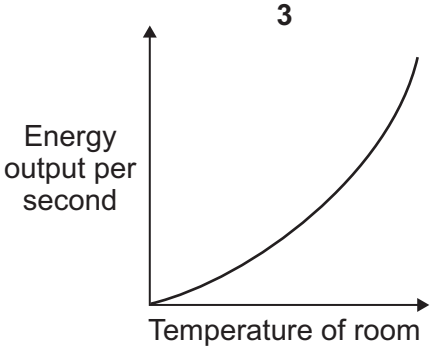
1



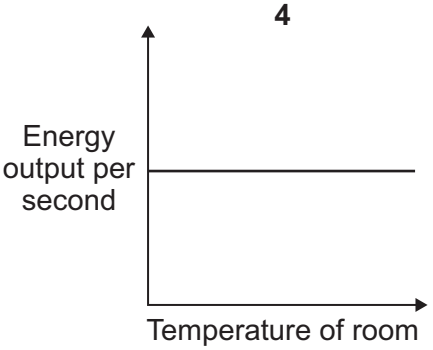
2



3



4



6B In five hours, the *Ceramic heater* transfers 3.8 kWh of electrical energy to heat (thermal energy).

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

During this time, the average power output of the *Ceramic heater* is . . .

1 240 W

2 480 W

3 380 W

4 760 W

6C The air in the room is heated mainly by convection.

Which row of the table correctly shows what happens to the air in the room as it is being heated?

	Density of air	**Movement of air**
1	decreases	falls
2	increases	rises
3	decreases	rises
4	increases	falls

6D Heat (thermal energy) is transferred through the metal casing of the heater.

Metals are good thermal conductors because they have . . .

1 free electrons that can move through the metal.

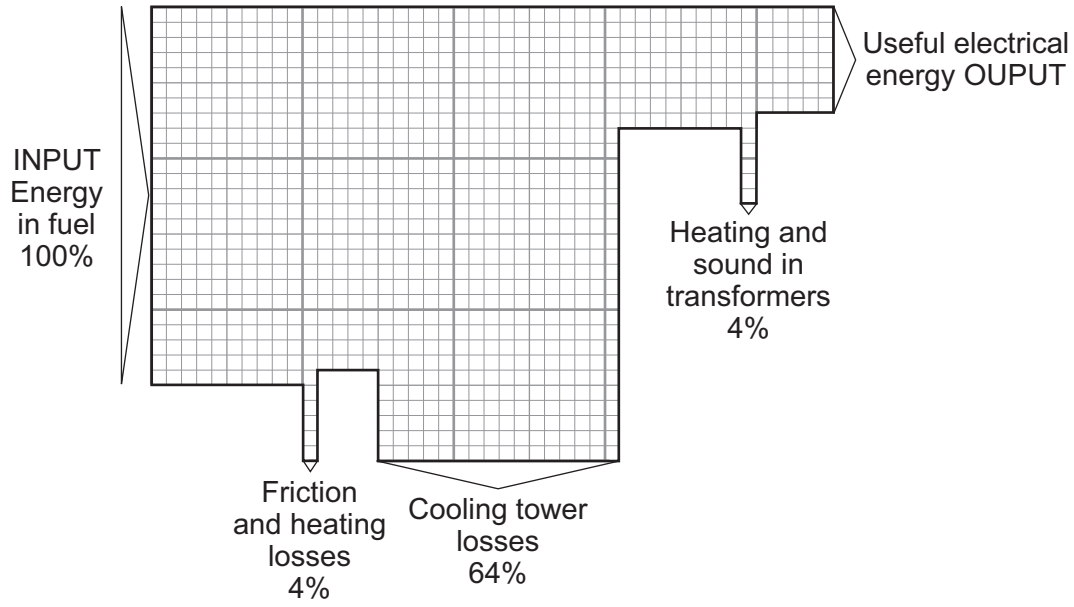
2 atoms that can move through the metal.

3 ions that can move through the metal.

4 particles that are far apart.

QUESTION SEVEN

The Sankey diagram shows the energy changes in a coal-fired power station.



7A What is the efficiency of this power station as a producer of electrical energy?

1 0.28

2 0.32

3 0.68

4 0.72

7B The cooling tower energy losses are mainly in the form of heat (thermal energy).

The energy transferred from the cooling tower is no longer useful because . . .

1 the energy is highly concentrated, making it difficult to control.

2 the energy cannot be transformed into any other type of energy.

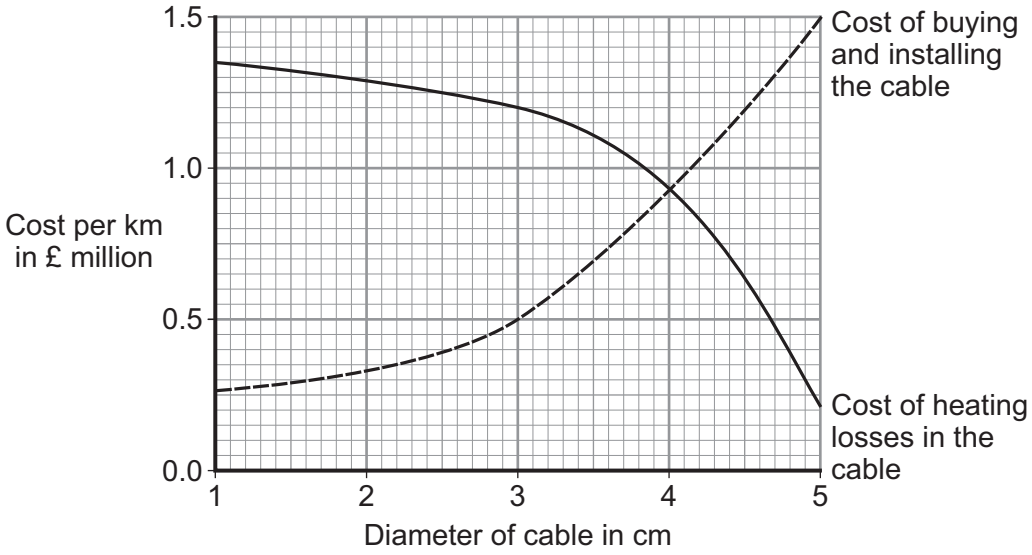
3 the energy becomes spread out and more difficult to transform to other forms.

4 the energy causes global warming and climate change.

After the electricity has been generated, it is sent along overhead cables. When deciding on how thick these cables should be, two costs have to be considered:

- the cost of buying and installing the cable
- the cost of the energy lost because the cable heats up when the electric current passes through it.

The graph shows how these two costs vary with the thickness of the cable.



7C What is the total cost per km if a cable of diameter 3 cm is used?

1 £0.5 million

2 £0.7 million

3 £1.2 million

4 £1.7 million

7D To keep energy losses in the cable to a minimum, electricity is transmitted at . . .

1 high current, high voltage.

2 high current, low voltage.

3 low current, high voltage.

4 low current, low voltage.

QUESTION EIGHT

The table gives information for two types of lamp. Both lamps have the same maximum brightness.

	Filament lamp	Energy-saving lamp
Power rating	100 W	20 W
Lifetime	1000 hours	15 000 hours
Cost to buy	50 p	£3.00

Electricity costs 15 p per kWh

8A Each lamp is used for 500 hours per year.

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

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

How much does it cost to use the lamps for a year?

	Filament lamp	Energy-saving lamp
1	£7.50	£1.50
2	£15.00	£3.00
3	£7.50	£4.50
4	£50.00	£10.00

8B A filament lamp is used for its lifetime.

How much money could have been saved over this time if an energy-saving lamp had been bought and used instead of a filament lamp?

1 £9.00

2 £9.50

3 £12.00

4 £12.50

8C Filament lamps reach maximum brightness almost immediately after switching on. Energy-saving lamps can take several minutes to reach maximum brightness after switching on.

In which one of the following applications could an energy saving lamp be a suitable replacement for a filament lamp?

1 traffic lights

2 emergency lighting

3 car headlights

4 shop lighting

8D The UK government has recently banned the manufacture of tungsten filament lamps.

This is because tungsten filament lamps . . .

1 cannot use green electricity from renewable sources.

2 cost too much to produce.

3 produce too much light pollution.

4 waste too much energy.

Turn over for the next question

QUESTION NINE

This question is about different ways of generating electricity.

9A The table gives data for the cost of generating electricity in different types of power station.

Type of power station	Building and operating costs in pence per kWh	Fuel costs in pence per kWh	Total cost in pence per kWh
Coal	1.3	1.2	2.5
Gas	0.7	1.5	2.2
Woodchip	5.9	0.8	6.7
Nuclear	1.8	0.4	2.2
Wave	6.6	0.0	6.6
Wind	3.7	0.0	3.7

Which one of the following is correct?

1 Electricity generated from fossil fuels is always the cheapest.

2 The fuel cost for all renewable sources is zero.

3 The most expensive electricity comes from renewable sources.

4 Wind power stations produce the cheapest electricity.

9B The total cost per kilowatt-hour of electricity from a wind-powered station is more than the total cost of electricity per kilowatt-hour from a gas-powered station.

By what percentage would the **fuel** cost of gas have to increase to make the **total** costs the same?

1 15 %

2 41 %

3 68 %

4 100 %

9C Fossil fuel power stations release polluting gases into the atmosphere. The government has suggested a carbon tax because of this. This tax would add 0.8 p/kWh to coal prices and 0.4 p/kWh to gas prices.

Which type of power station would produce the cheapest electricity if a carbon tax was added?

1 coal

2 gas

3 nuclear

4 wind

9D The table shows that electricity produced from the wind costs more than electricity produced by nuclear power stations.

This is an unfair comparison because . . .

1 each wind turbine has a low output so hundreds of turbines are needed to produce as much electricity as a nuclear power station.

2 wind farms are usually built on high ground or offshore and are unsightly and noisy.

3 nuclear power stations have high decommissioning costs compared to those of a wind farm.

4 wind farms have high operating costs due to the high cost of maintaining a large number of turbines.

END OF TEST

There are no questions printed on this page