Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

Science A
Unit Physics P1a (Energy and Electricity)

Physics
Unit Physics P1a (Energy and Electricity)

PHY1AP

F&H

Wednesday 3 March 2010 Morning Session

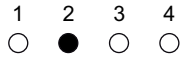
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

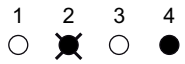
Time allowed
- 30 minutes

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.

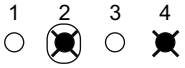
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown.



- 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**.

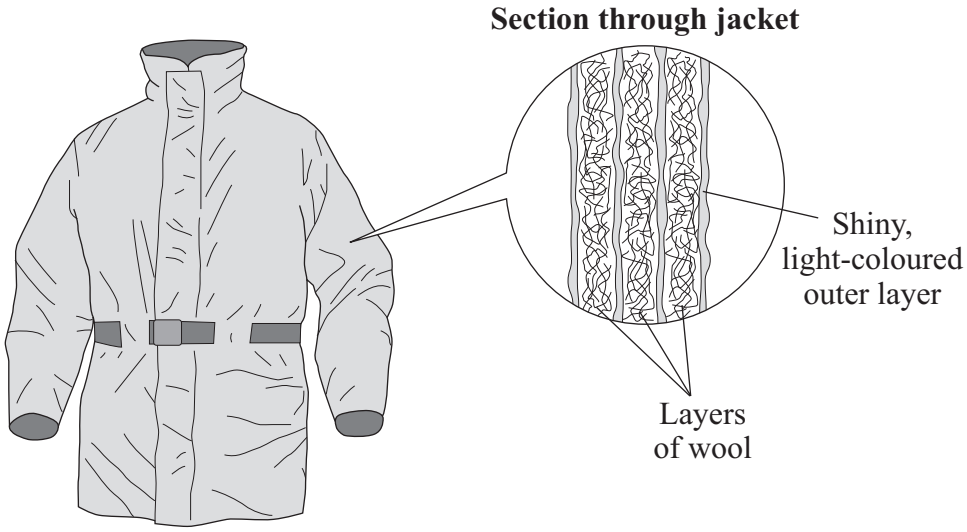
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

The diagram shows a jacket designed to keep Arctic explorers warm.



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

A conduction

B convection

C insulation

D radiation

The shiny, light-coloured outer layer of the jacket reduces heat loss by . . . **1** . . . .

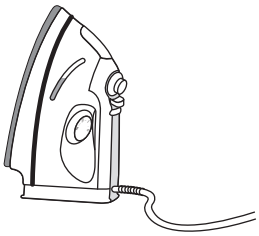
Using more layers of wool improves . . . **2** . . . .

The air trapped in the wool cannot rise, which reduces heat loss by . . . **3** . . . .

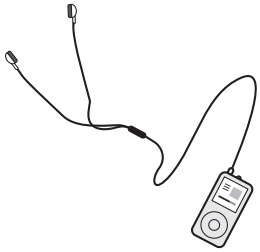
Heat is transferred through a solid material by . . . **4** . . . .

QUESTION TWO

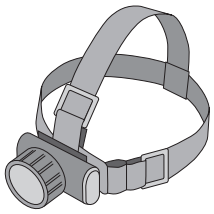
These devices transform electrical energy into other useful forms of energy.



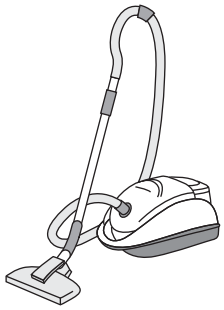
1
Iron



2
MP3 player



3
Head torch



4
Vacuum cleaner

Match the useful forms of energy, **A**, **B**, **C** and **D**, with the devices **1–4**.

A heat (thermal energy)

B light

C movement (kinetic energy)

D sound

Turn over for the next question

QUESTION THREE

The table shows the power of four electrical appliances found in a home.

	Appliance	Power in watts
A	electric kettle	2000
B	electric oven	4000
C	electric shower	8000
D	flat-screen television	200

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

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

Each appliance is used for 3 minutes. The one that transfers the most energy is the . . . **1** . . . .

The appliance that has a power of 2 kW is the . . . **2** . . . .

The appliance that is **not** designed to produce heat (thermal energy) is the . . . **3** . . . .

The appliance that transfers electrical energy at half the rate of the shower is the . . . **4** . . . .

QUESTION FOUR

This question is about nuclear power stations.

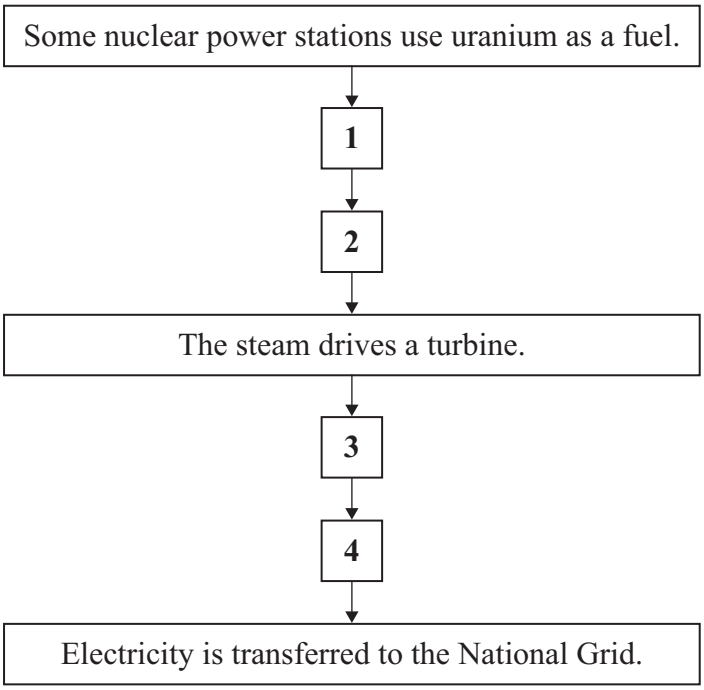
Match statements, **A**, **B**, **C** and **D**, with the boxes **1–4** in the flow chart to describe how nuclear power stations work.

A Electricity is produced.

B Fission of uranium produces heat.

C The heat is used to produce steam.

D The turbine drives a generator.

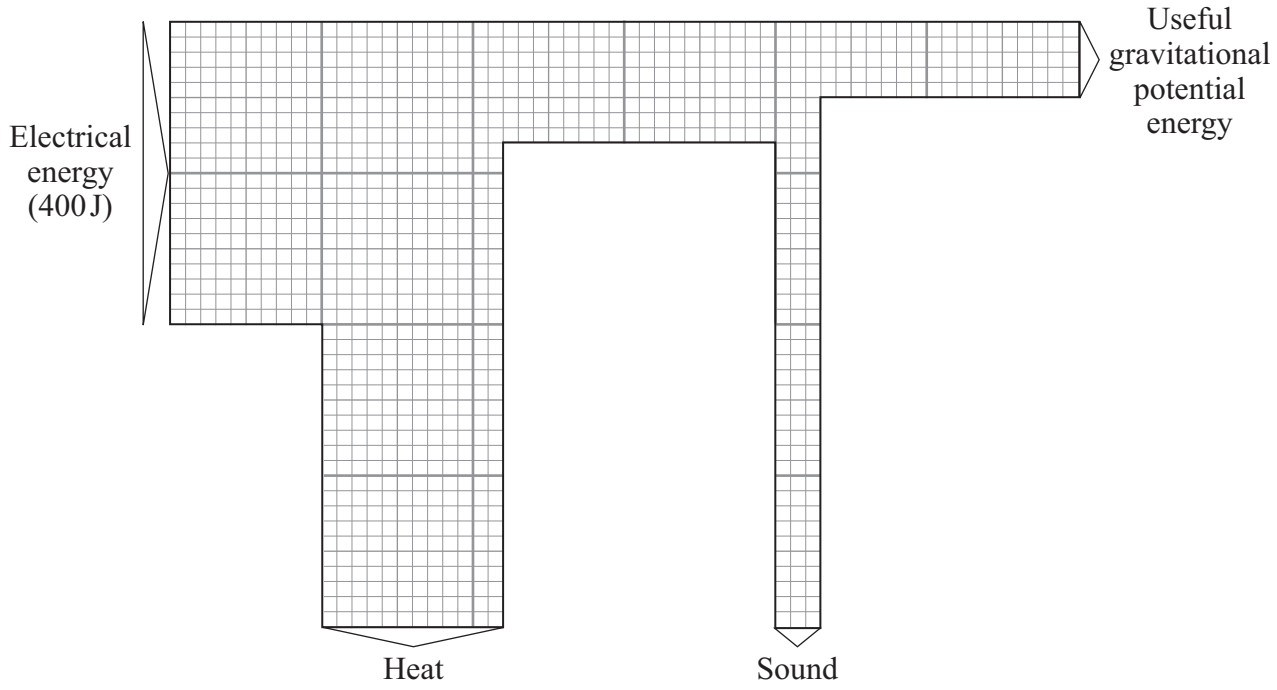


Turn over for the next question

QUESTION FIVE

An electric motor is used to lift a weight.

The Sankey diagram shows the energy transformations that take place each second in the electric motor.



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

A 0.25

B 60

C 100

D 240

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

The useful gravitational potential energy gained each second is . . . **1** . . . J.

The heat (thermal energy) produced each second is . . . **2** . . . J.

The sound energy produced each second is . . . **3** . . . J.

The total energy wasted each second is 300 J. The efficiency of the electric motor is . . . **4** . . . .

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

In the past fifty years, electricity has become the most important source of energy in the home.

6A Which of the following is a **disadvantage** of using electricity in the home compared with using natural gas or heating oil?

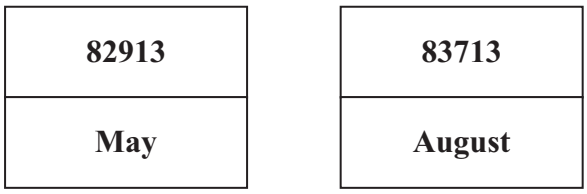
1 Electricity can be switched on and off easily.

2 Electricity can be transferred into many different types of energy.

3 Electricity cannot be stored in the home.

4 Devices using electricity can be moved from place to place easily.

The diagrams show the readings on a domestic electricity meter in May and August.



6B The electrical energy used between May and August is . . .

1 600 kWh

2 650 kWh

3 700 kWh

4 800 kWh

6C During the next three-month period, the householder used 600 kWh.

Electricity costs 15 pence per kilowatt-hour.

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

What was the total cost of the electricity for this period?

1 £80

2 £90

3 £100

4 £110

6D Television advertisements encourage people to compare the prices charged by electricity companies. Many people change their electricity provider after they have looked at the websites.

People usually make this change for . . .

1 economic reasons.

2 environmental reasons.

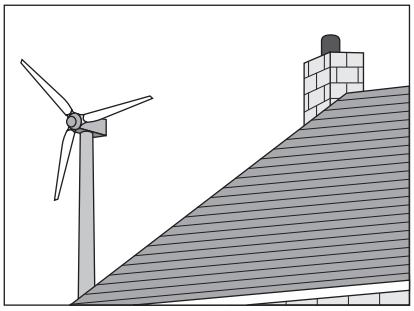
3 ethical reasons.

4 social reasons.

Turn over for the next question

QUESTION SEVEN

A newspaper reports that small wind turbines for home use have a long pay-back time.



Energy experts say that the turbines produce less energy than householders expect.

7A Neighbours of people who have installed a wind turbine are most likely to be annoyed because they think that wind turbines . . .

1 are noisy and unsightly.

2 are unreliable.

3 have a long pay-back time.

4 produce less energy than expected.

7B The turbines do not produce power all of the time because the wind . . .

1 cannot reach the turbines.

2 is renewable.

3 is too noisy.

4 is unreliable.

7C A wind turbine for a house costs £1500. The manufacturer claims that householders can save £100 a year on electricity bills.

If this claim is correct, the pay-back time for the wind turbine is . . .

1 1.5 years.

2 15 years.

3 150 years.

4 1500 years.

7D One householder does not believe the manufacturer's claim. He calculated that his wind turbine saved less than £10 a year on his electricity bill.

What is the likely reason for this?

1 The amount of electricity generated by the wind turbine is less than the manufacturer's claim.

2 The amount of electricity generated by the wind turbine is more than the manufacturer's claim.

3 The energy source is renewable.

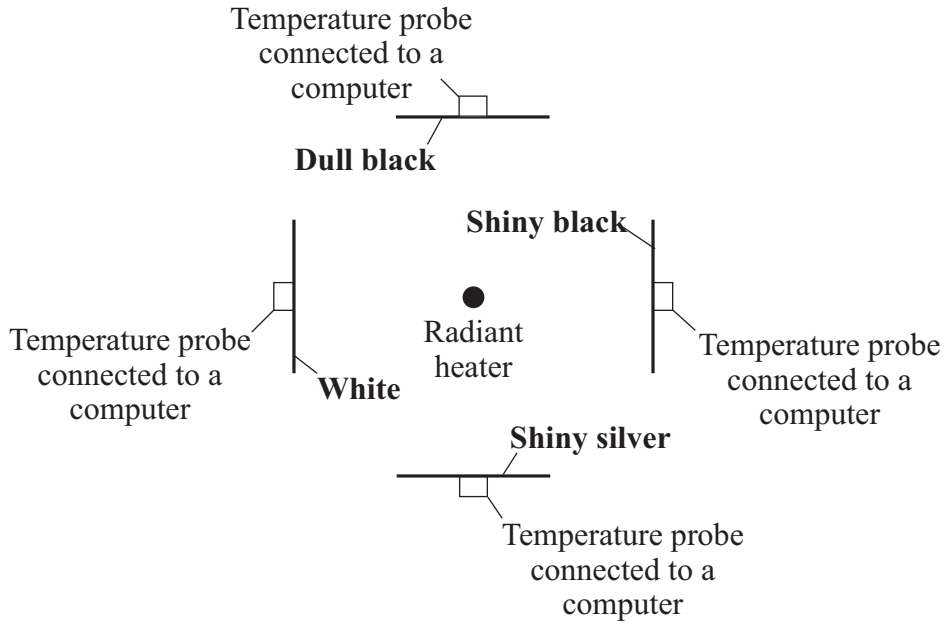
4 The price of electricity has risen.

Turn over for the next question

QUESTION EIGHT

In an experiment, a student placed four cards of equal thickness at equal distances from a radiant heater. The cards had different surfaces. Behind each card was a temperature probe connected to a computer.

The diagram shows a view of the experiment from above.



8A Which was the independent variable in this experiment?

1 the distance of the cards from the heater

2 the intensity of the heat

3 the surface of the cards

4 the thickness of the cards

8B Which was the dependent variable in this experiment?

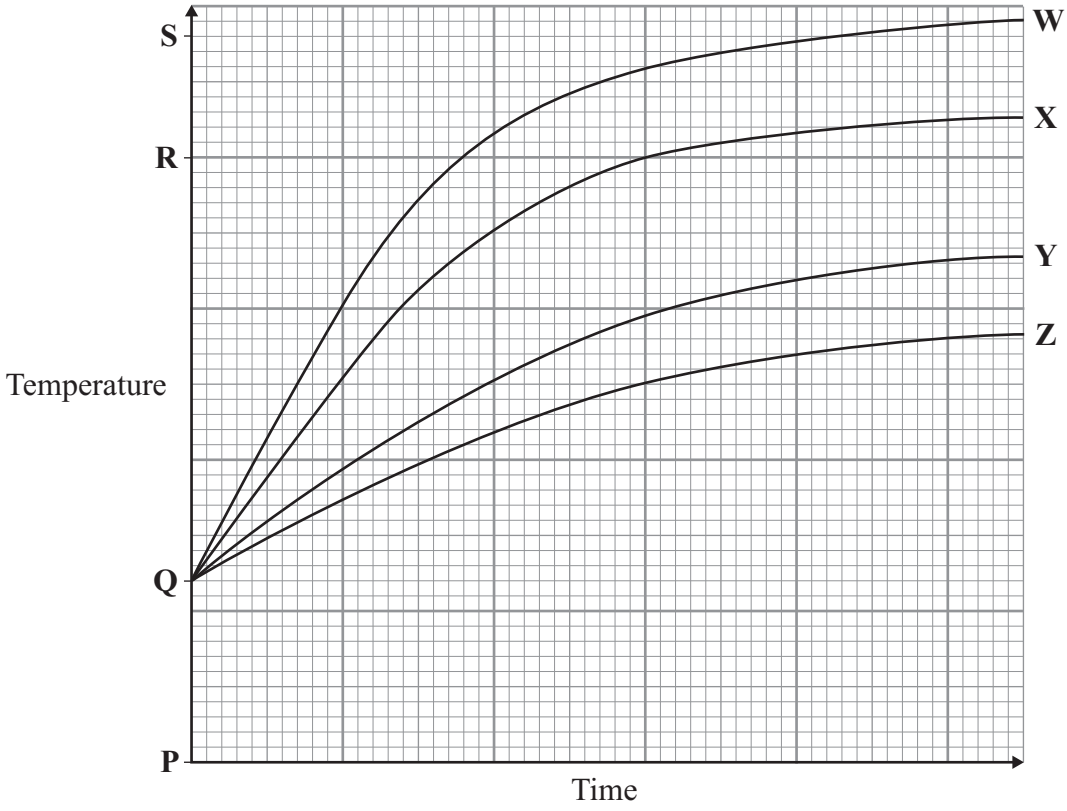
1 the distance from the heater

2 the intensity of the heat

3 the temperature of the cards

4 the thickness of the cards

The computer display shows how the temperature of each card changes over a period of time.



8C Which line on the graph shows the temperature change of the dull black card?

1 **W**

2 **X**

3 **Y**

4 **Z**

8D Which point on the temperature axis shows room temperature?

1 **P**

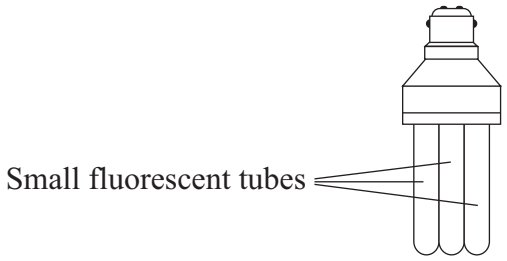
2 **Q**

3 **R**

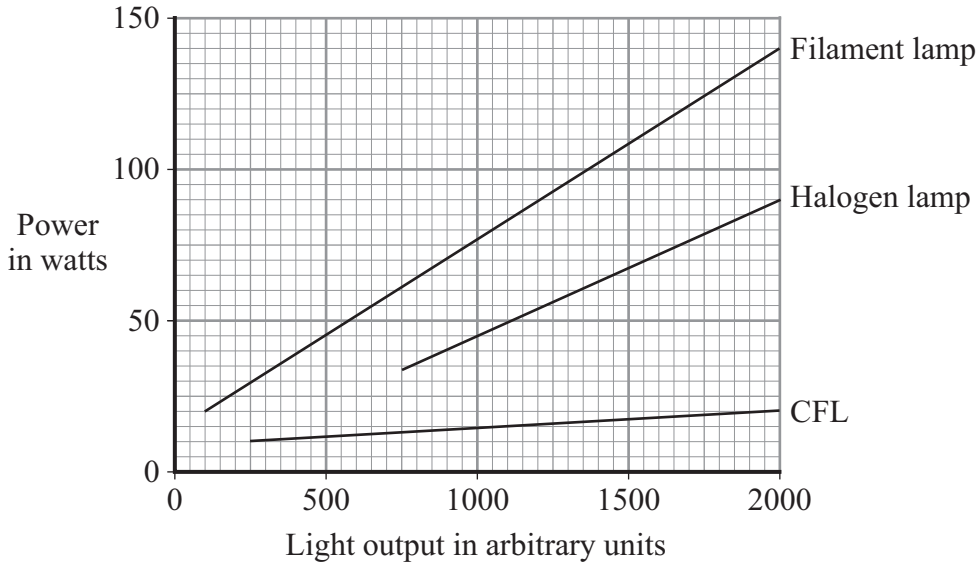
4 **S**

QUESTION NINE

The diagram shows a compact fluorescent lamp (CFL).



The graph shows the electrical power of a CFL compared with a filament lamp and a halogen lamp.



9A How much power does a halogen lamp need in order to give an output of 1000 units of light?

1 40 watts

2 45 watts

3 50 watts

4 55 watts

9B How many more watts of power would a filament lamp need, compared with a halogen lamp, to produce 2000 units of light?

1 40

2 50

3 70

4 120

9C What happens to the extra energy that the filament lamp uses compared with the halogen lamp?

The extra energy . . .

1 is stored in the filament of the lamp.

2 is transferred as heat to the surroundings.

3 is used to produce a chemical reaction in the lamp.

4 returns to the electricity supply.

9D In some countries, governments are making it compulsory to use CFLs rather than filament lamps.

What is the reason for this?

1 CFLs are more powerful than filament lamps.

2 CFLs can give out much more light than filament lamps.

3 CFLs can heat the room as well as light it.

4 CFLs save energy because they are more efficient.

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**.

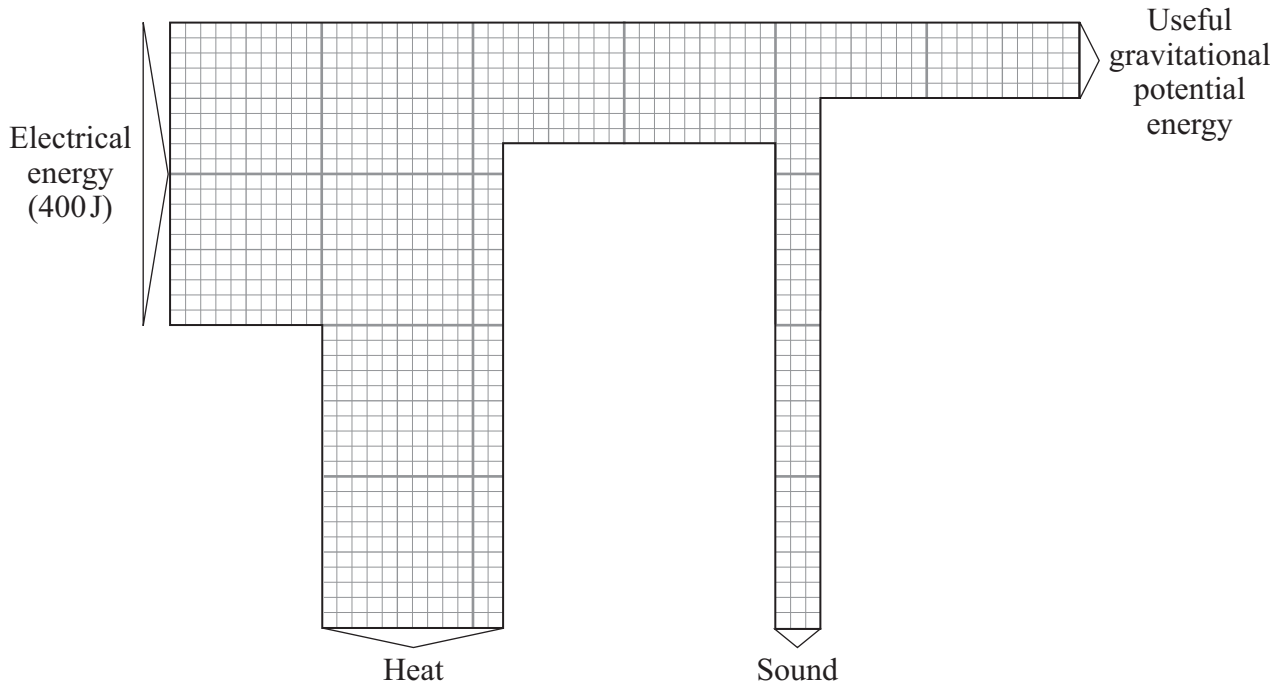
Use **each** answer only **once**.

Mark your choices on the answer sheet.

QUESTION ONE

An electric motor is used to lift a weight.

The Sankey diagram shows the energy transformations that take place each second in the electric motor.



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

A 0.25

B 60

C 100

D 240

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

The useful gravitational potential energy gained each second is . . . **1** . . . J.

The heat (thermal energy) produced each second is . . . **2** . . . J.

The sound energy produced each second is . . . **3** . . . J.

The total energy wasted each second is 300 J. The efficiency of the electric motor is . . . **4** . . . .

QUESTION TWO

This question is about useful energy transformations by different electrical devices.

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

A computer monitor

B loudspeaker

C microphone

D solar cell

	Useful energy transformations
1	electrical energy into light energy
2	sound energy into electrical energy
3	electrical energy into sound energy
4	light energy into electrical energy

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

In an experiment, a student placed four cards of equal thickness at equal distances from a radiant heater. The cards had different surfaces. Behind each card was a temperature probe connected to a computer.

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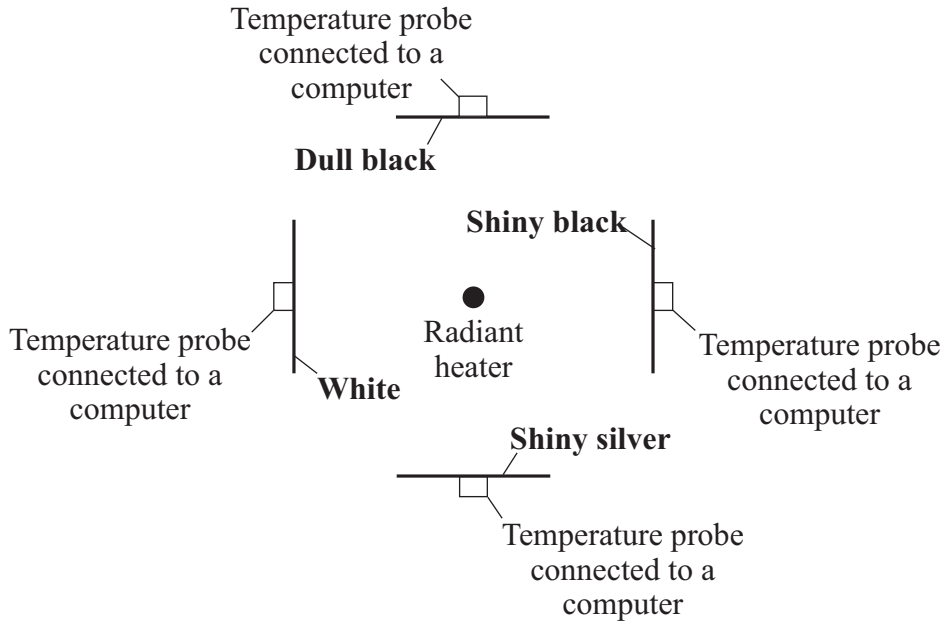

3A Which was the independent variable in this experiment?

1 the distance of the cards from the heater

2 the intensity of the heat

3 the surface of the cards

4 the thickness of the cards

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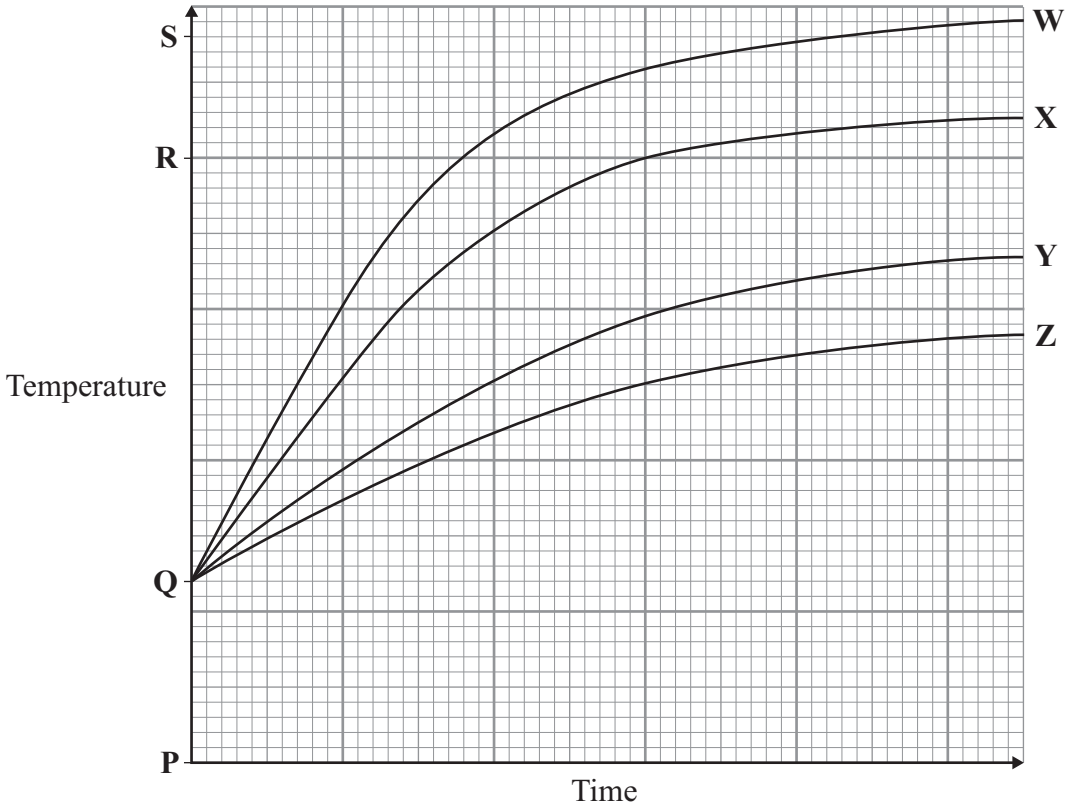

3C Which line on the graph shows the temperature change of the dull black card?

1 **W**

2 **X**

3 **Y**

4 **Z**

3D Which point on the temperature axis shows room temperature?

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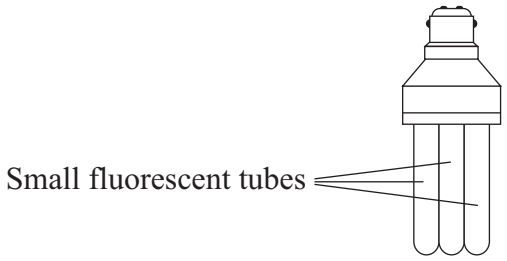
3 **R**

4 **S**

QUESTION FOUR

The diagram shows a compact fluorescent lamp (CFL).



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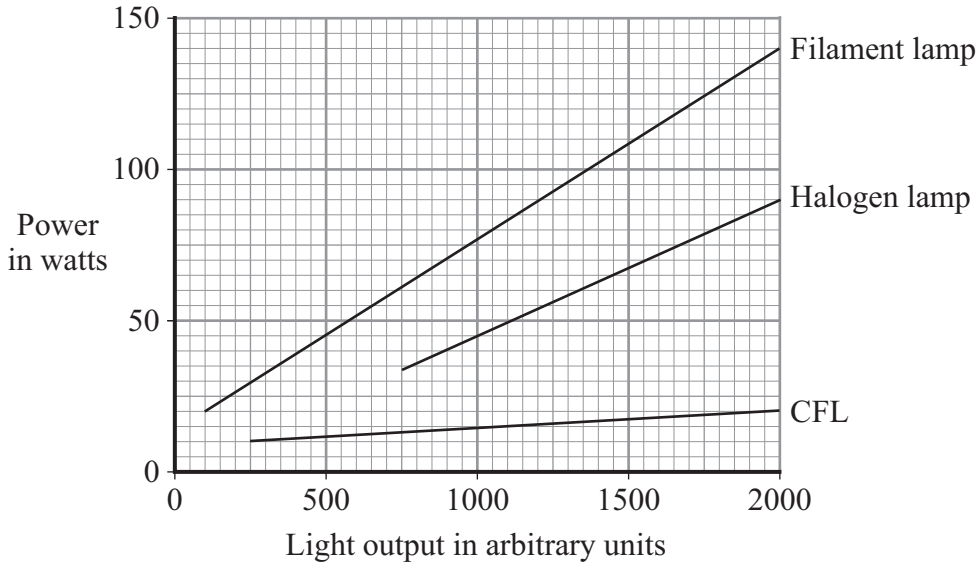

4A How much power does a halogen lamp need in order to give an output of 1000 units of light?

1 40 watts

2 45 watts

3 50 watts

4 55 watts

4B How many more watts of power would a filament lamp need, compared with a halogen lamp, to produce 2000 units of light?

1 40

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4D In some countries, governments are making it compulsory to use CFLs rather than filament lamps.

What is the reason for this?

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4 CFLs save energy because they are more efficient.

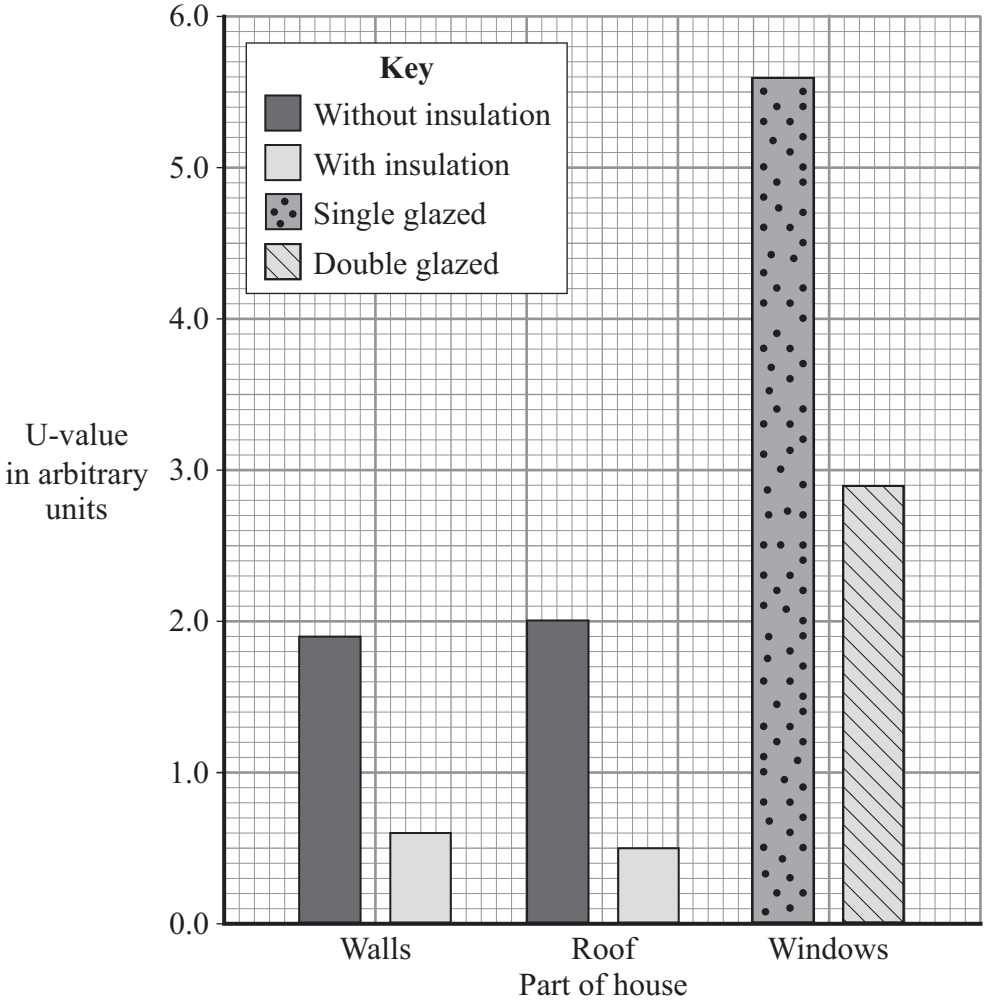
Turn over for the next question

QUESTION FIVE

Different parts of a house have different 'U-values'.

Figure 1 shows some U-values for the walls, the roof and the windows of a house with and without insulation.

Figure 1



5A The U-value for a cavity wall with insulation is different from the U-value of a cavity wall without insulation.

Using **Figure 1**, what is the percentage change in U-value when cavity wall insulation is fitted?

1 25%

2 33%

3 68%

4 75%

5B Which of the following statements is correct?

1 Double-glazed windows have a higher U-value than single glazed windows.

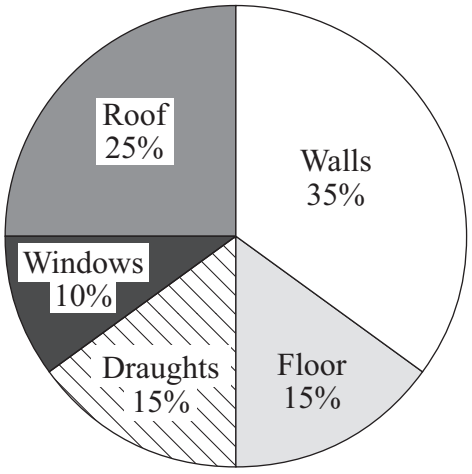
2 The higher the U-value, the higher the rate of loss of heat.

3 Putting insulation in the loft, halves the U-value of the roof.

4 U-values are always greater than 1.

Figure 2 shows the percentage of heat lost from different parts of a house **without** insulation.

Figure 2



A house that is **not** insulated loses heat at the rate of 2 kW.

5C According to **Figure 2**, the combined rate of loss of heat from draughts and through the floors is . . .

1 0.3 kW

2 0.6 kW

3 1.4 kW

4 1.7 kW

5D The rate of loss of heat through the walls, roof and windows of a house that is **not** insulated will be reduced by 50 % if insulation is installed.

What would be the rate of loss of heat from the house after this installation?

1 0.3 kW

2 0.7 kW

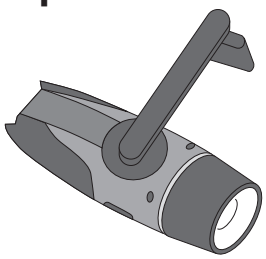
3 1.0 kW

4 1.3 kW

QUESTION SIX

Read this advertisement for a wind-up torch.

Wind-up Torch



£19.99

This torch is always ready to go. Simply wind the handle for just 1 minute and this will power your torch for up to 2 hours of use.

The torch also has a mobile phone connection that will power mobile phones for up to 7 minutes of talk-time for every 1 minute of winding.

You won't have to scrabble around in the dark looking for your torch. The 1 minute of winding also powers a standby light for up to 2 months.

The wind-up torch is strong, splash-proof and eco-friendly.

6A The wind-up torch and a power station both generate electricity.

Which feature of the power station process is the equivalent of the torch's winding handle?

1 boiler

2 generator

3 steam

4 turbine

6B The source of energy for the operator of the torch's winding handle is food.

Which of these forms of energy is **not** involved in the chain of useful energy transformations for the torch as it is wound up?

1 chemical

2 electrical

3 kinetic

4 thermal

6C What feature of the wind-up torch enables the advertisement to claim that it is eco-friendly?

1 It can be used to power mobile phones.

2 It has a standby light.

3 It is splash-proof.

4 It produces no waste products when in use.

6D A dog owner uses a conventional torch every night. The torch she uses is powered by 4 batteries. She has to replace the batteries every 3 months. The batteries cost 75p each.

If she bought this wind-up torch, how long would the pay-back time be?

1 between 6 months and 1 year

2 between 1 year and 1.5 years

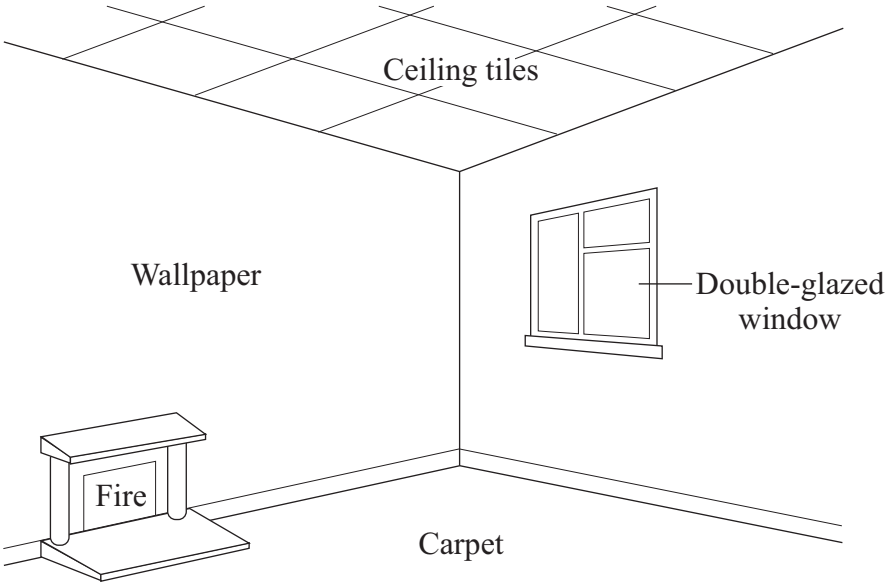
3 between 1.5 years and 2 years

4 between 2 years and 2.5 years

Turn over for the next question

QUESTION SEVEN

The diagram shows a room which is heated by an electric fire.



7A How does the thermal energy spread through the room?

The particles of air become . . .

1 closer together, making the heated air denser so that it falls.

2 closer together, making the heated air denser so that it rises.

3 further apart, making the heated air less dense so that it falls.

4 further apart, making the heated air less dense so that it rises.

7B Thermal energy is transferred through the glass of the windows mainly by . . .

1 convection of the air in contact with the glass.

2 infra red electromagnetic waves.

3 convection currents in the glass.

4 vibration of particles within the glass.

7C The double glazing involves trapped air.

Trapped air reduces heat loss because . . .

1 air is a good conductor and the trapped air cannot move far.

2 air is a poor conductor and trapped air cannot move far.

3 air molecules are close together.

4 air molecules have free electrons.

7D The table gives temperatures inside and outside the room.

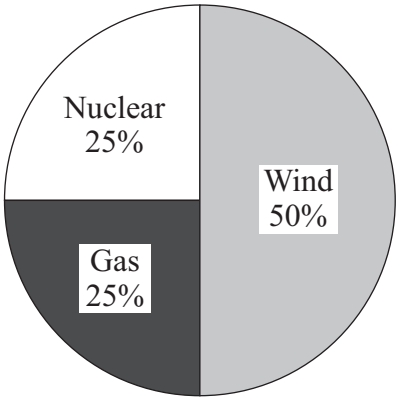
Which row in the table gives the greatest rate of heat loss from the room?

	Temperature inside in °C	**Temperature outside in °C**
1	16	−2
2	16	0
3	16	16
4	16	36

Turn over for the next question

QUESTION EIGHT

An electricity company claims to generate its electricity from environmentally friendly energy sources. Its sources are shown below.



The table shows the cost of generating one kilowatt-hour of electricity using each energy source.

Energy source	Cost in pence per kilowatt-hour
Gas	2.2
Nuclear	2.2
Wind	3.6

8A The average cost per kilowatt-hour for the electricity company is . . .

1 2.5p

2 2.7p

3 2.9p

4 3.1p

8B How much of the company's electricity is produced by sources that do not release polluting gases?

1 25%

2 50%

3 75%

4 100%

8C Pumped storage hydroelectric power stations have two reservoirs of water. One reservoir is at a high level, the other at a low level. Water can be released from the high reservoir to flow through turbines to the low reservoir. The turbines drive electrical generators. At night, when demand for electricity is low, water is pumped back to the high reservoir.

The electricity company buys a pumped storage hydroelectric power station.

When is the company likely to use this power station to generate electricity?

1 when the demand for electricity is low

2 when there is a sudden increase in demand for electricity

3 when the wind is blowing at a steady speed

4 when a constant increase in generating capacity is needed

8D The government wants 20% of all electricity to be generated from renewable sources by 2020. It is considering building more wind farms, tidal and wave-powered generators and nuclear power stations.

Why would a scientist consider this statement to be wrong?

1 Coal will continue to be available for another 200 years.

2 Nuclear energy should not be included as a renewable source.

3 The decision should be made by scientists, not politicians.

4 These renewable energy sources are not reliable.

Turn over for the next question

QUESTION NINE

In the south of Spain, there is an electricity generator which is powered by the Sun.

- Mirrors reflect the Sun's radiation onto a container of water at the top of a tower.
- The water is changed to steam.
- The steam is used to turn a generator.

9A The main source of energy for this generator is . . .

1 infra red.

2 light.

3 microwave.

4 ultraviolet.

9B Which row in the table gives a correct advantage and disadvantage for this generator?

	Advantage	**Disadvantage**
1	It cannot be used continuously over a 24-hour period.	It has low running costs.
2	It has low running costs.	It produces atmospheric pollution.
3	It produces no atmospheric pollution.	It uses non-renewable energy.
4	It uses renewable energy.	It cannot be used continuously over a 24-hour period.

9C The electricity is transferred to a nearby city using overhead cables.

At the power station, a transformer is used to . . .

1 increase the current, decrease the power and reduce energy losses.

2 increase the energy, increase the power and reduce energy losses.

3 increase the power, decrease the current and reduce energy losses.

4 increase the voltage, decrease the current and reduce energy losses.

The maximum output of the generator is 11 000 000 watts.

9D A typical household needs 2 kW of electrical power.

If the solar generator is working at 60 % of its maximum output, the number of typical households that could be supplied is . . .

1 3 300

2 198 000

3 3 300 000

4 198 000 000

END OF TEST

There are no questions printed on this page