Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature								

General Certificate of Secondary Education
June 2009

SCIENCE A **PHY1AP**
Unit Physics P1a (Energy and Electricity)

PHYSICS
Unit Physics P1a (Energy and Electricity)

Monday 22 June 2009 Morning Session

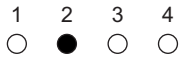
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

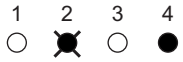
Time allowed: 30 minutes

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.

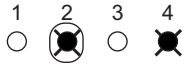
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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

This question is about useful electrical devices.

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

A fan

B lamp

C oven

D radio

1	an electrical device designed to produce sound energy
2	an electrical device designed to produce light energy
3	an electrical device designed to produce kinetic energy
4	an electrical device designed to produce heat (thermal energy)

QUESTION TWO

Four students are discussing ways in which electricity could be generated in their home countries.

Match sources of energy, **A**, **B**, **C** and **D**, with the students' descriptions of their countries **1**–**4**.

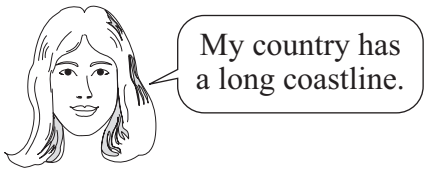
A falling water (hydroelectric)

B geothermal

C solar

D wave

1



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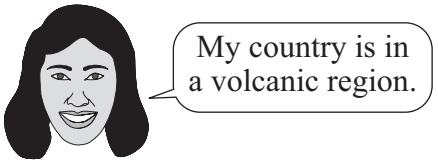

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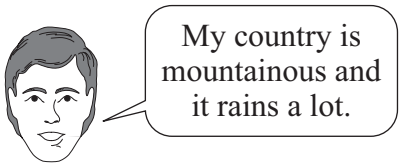
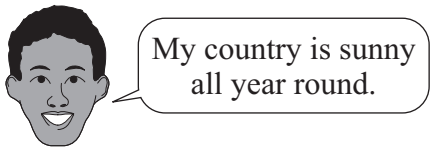


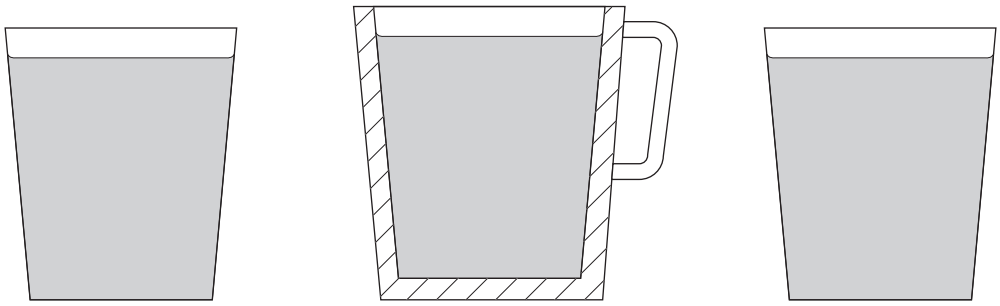
4



Turn over for the next question

QUESTION THREE

The diagram shows three mugs containing hot tea. The second mug is in a plastic holder.



Metal mug | Metal mug in plastic holder | Plastic mug

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

A conduction

B convection

C insulation

D radiation

Putting a lid on a mug reduces heat loss by . . . **1** . . . .

Placing a mug in a plastic holder increases . . . **2** . . . .

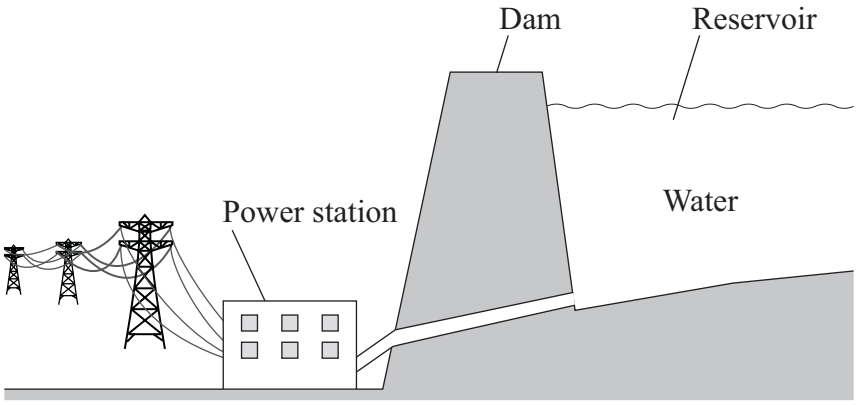
Painting a mug so that it has a light, shiny surface decreases heat loss by . . . **3** . . . .

Using a plastic mug, rather than a metal one, reduces heat loss by . . . **4** . . . . .

QUESTION FOUR

Useful energy can be obtained from falling water.

The diagram shows one way of doing this.



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

A electrical

B gravitational potential

C heat (thermal energy)

D kinetic

Large amounts of . . . **1** . . . energy are stored in the water in the reservoir.

Water flowing down from this reservoir has . . . **2** . . . energy which can turn a turbine.

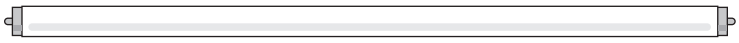
The turbine can power a generator which produces useful . . . **3** . . . energy.

Some energy is wasted in the power station as . . . **4** . . . .

Turn over for the next question

QUESTION FIVE

The diagram shows a fluorescent tube used for lighting. The inside of the tube is coated with a chemical which gives out light when supplied with energy.



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

A environmental

B efficient

C electrical

D economical

More of the . . . **1** . . . energy is transformed into light energy in the fluorescent tube than in a filament lamp.

This makes the fluorescent tube more . . . **2** . . . than a filament lamp.

A fluorescent tube costs less to run than a filament lamp, which makes the fluorescent tube more . . . **3** . . . .

The chemicals inside the fluorescent tube must be properly disposed of to prevent any . . . **4** . . . problem.

Turn over for the next question

SECTION TWO

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

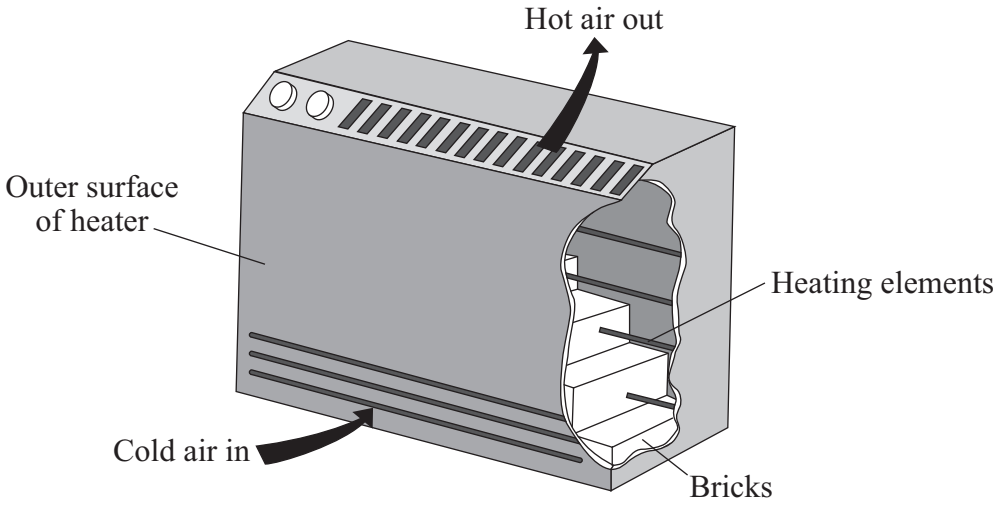
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION SIX

The diagram shows the construction of one type of heater. The bricks inside the heater warm up during the night when the cost of electricity is lower. The bricks then emit heat (thermal energy) during the day.



6A The bricks warm up because they . . .

1 absorb heat.

2 insulate heat.

3 radiate heat.

4 reflect heat.

6B The diagram shows the main thermal energy transfer of the heater as it warms the room.

By what process does this heater transfer most of its energy throughout a room in a house?

1 conduction from the bricks

2 conduction from the outside surface of the heater

3 convection currents in the air

4 radiation from the outside surface of the heater

6C To give out the most heat, what would be the best outside surface for the heater?

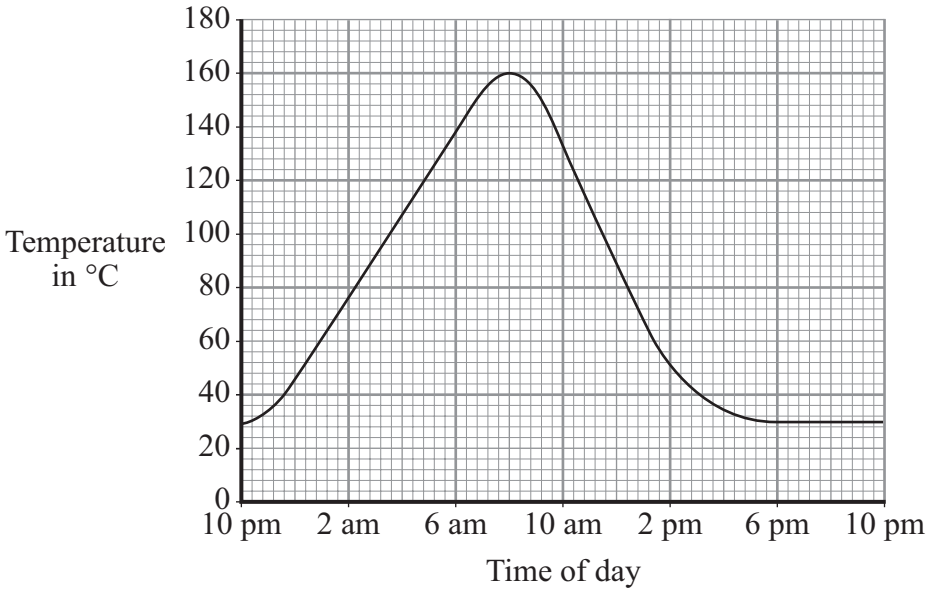
1 dark, matt

2 dark, shiny

3 light, shiny

4 light, matt

6D The graph shows how the temperature of the bricks changes during a 24-hour period.



At what time did the bricks reach their highest temperature?

1 8 am

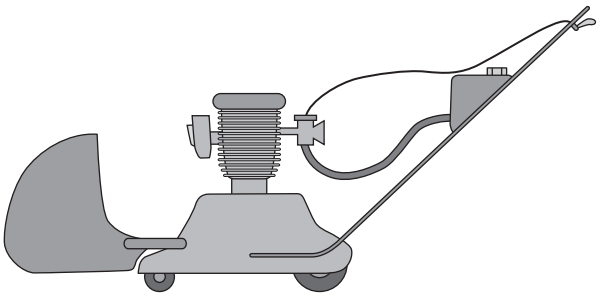
2 10 am

3 6 pm

4 10 pm

QUESTION SEVEN

The diagram shows a petrol-driven lawn mower.



7A The useful energy transformation is . . .

1 chemical energy to kinetic energy.

2 heat (thermal energy) to kinetic energy.

3 kinetic energy to chemical energy.

4 sound energy to heat (thermal energy).

7B The wasted energy is . . .

1 elastic potential.

2 heat only.

3 heat and sound.

4 sound only.

7C All wasted energy will eventually . . .

1 be destroyed.

2 be transferred to the surroundings.

3 cause the machine to overheat.

4 no longer exist anywhere.

7D Another lawn mower is said to be more efficient than this one.

This is because . . .

1 it cuts the grass more quickly.

2 it leaves fewer loose grass clippings.

3 it cuts the grass shorter.

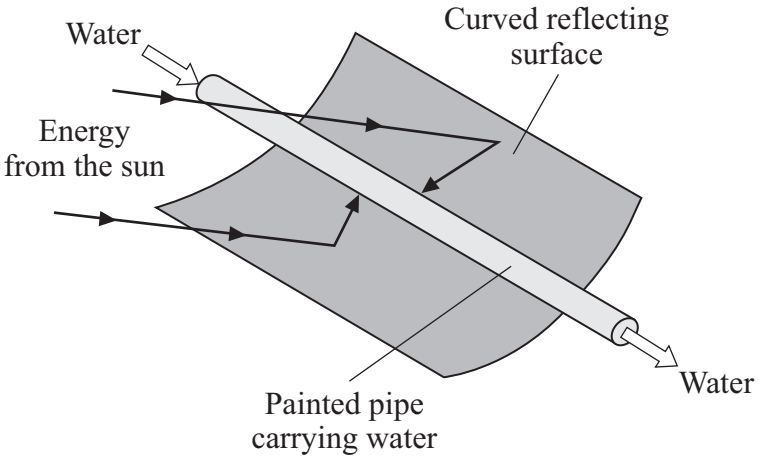
4 it uses less petrol.

Turn over for the next question

QUESTION EIGHT

Solar collectors absorb energy from the Sun to heat water.

The diagram shows part of a solar collector.



Two students thought that the colour of the pipe would affect the amount of energy the water absorbed.

They painted some test tubes different colours. Then they added 50 cm^3 of water to each test tube. They measured the temperature of the water at the start and then put the test tubes outside in a sunny place for two hours. They measured the final temperature of the water in each tube. Then they recorded the temperature rise of the water in each tube.

This is part of their results table.

Colour of paint	**Temperature rise in °C**
Silver	3
White	9
Unpainted	11
Yellow	16
Black	25

8A Which was the categoric variable?

1 colour of paint

2 temperature rise

3 time left in sunshine

4 volume of water

8B Which was the dependent variable?

1 colour of paint

2 temperature rise

3 type of thermometer

4 volume of water

8C Which was the control variable?

1 colour of paint

2 final temperature

3 temperature rise

4 volume of water

8D How should the students display the results?

1 as a bar chart

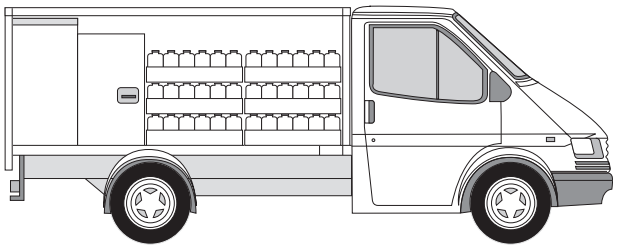
2 as a line graph

3 as a pie chart

4 as a scattergram

QUESTION NINE

The diagram shows an electrically powered milk float.



In a milk float, batteries drive an electric motor.
A milk float travels 40 km a day.
The batteries are recharged overnight.

9A When the milk float is travelling along the road, the batteries transform . . .

1 electrical energy to kinetic energy.

2 kinetic energy to chemical energy.

3 chemical energy to electrical energy.

4 kinetic energy to electrical energy.

9B When charging the batteries, the battery charger transfers 1.5 kW of power for 5 hours.

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

The energy transferred to the batteries is . . .

1 0.3 kWh

2 3.3 kWh

3 7.5 kWh

4 75 kWh

9C During a day, the electric motor usefully transfers 1600 kJ. The energy supplied to the electric motor is 4000 kJ.

What is the efficiency of the motor?

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

1 0.4

2 2.5

3 2400

4 5600

9D The milk float is said to be more 'environmentally friendly' than a petrol-driven vehicle.

This is because . . .

1 the batteries store energy.

2 it produces no harmful waste gases.

3 the batteries can be recharged many times.

4 the top speed is only 20 km/h.

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**

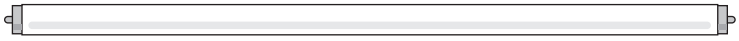
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1**–**4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

The diagram shows a fluorescent tube used for lighting. The inside of the tube is coated with a chemical which gives out light when supplied with energy.



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

A environmental

B efficient

C electrical

D economical

More of the . . . **1** . . . energy is transformed into light energy in the fluorescent tube than in a filament lamp.

This makes the fluorescent tube more . . . **2** . . . than a filament lamp.

A fluorescent tube costs less to run than a filament lamp, which makes the fluorescent tube more . . . **3** . . . .

The chemicals inside the fluorescent tube must be properly disposed of to prevent any . . . **4** . . . problem.

QUESTION TWO

This question is about energy resources that can be used to produce electricity.

Match words, **A**, **B**, **C** and **D**, with the pairs of statements **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 in Britain	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.

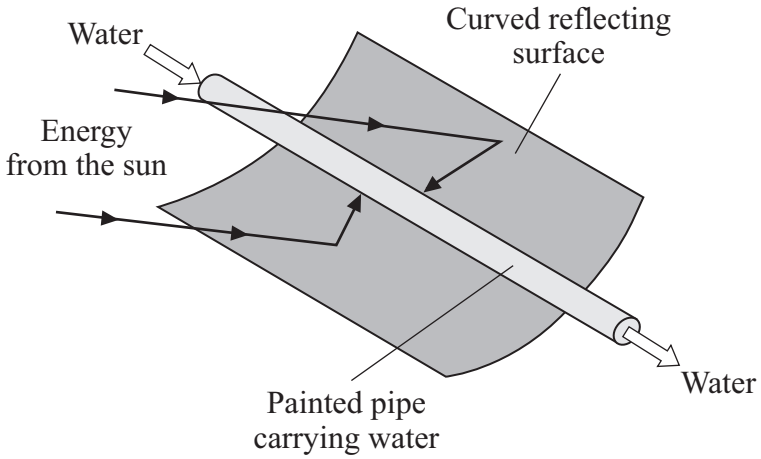
In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION THREE

Solar collectors absorb energy from the Sun to heat water.

The diagram shows part of a solar collector.



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This is part of their results table.

Colour of paint	Temperature rise in °C
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White	9
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Yellow	16
Black	25

3A Which was the categoric variable?

1 colour of paint

2 temperature rise

3 time left in sunshine

4 volume of water

3B Which was the dependent variable?

1 colour of paint

2 temperature rise

3 type of thermometer

4 volume of water

3C Which was the control variable?

1 colour of paint

2 final temperature

3 temperature rise

4 volume of water

3D How should the students display the results?

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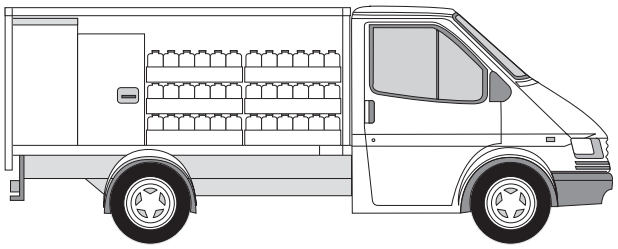
4 as a scattergram

QUESTION FOUR

The diagram shows an electrically powered milk float.



In a milk float, batteries drive an electric motor.
A milk float travels 40 km a day.
The batteries are recharged overnight.

4A When the milk float is travelling along the road, the batteries transform . . .

1 electrical energy to kinetic energy.

2 kinetic energy to chemical energy.

3 chemical energy to electrical energy.

4 kinetic energy to electrical energy.

4B When charging the batteries, the battery charger transfers 1.5 kW of power for 5 hours.

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

The energy transferred to the batteries is . . .

1 0.3 kWh

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3 7.5 kWh

4 75 kWh

4C During a day, the electric motor usefully transfers 1600 kJ. The energy supplied to the electric motor is 4000 kJ.

What is the efficiency of the motor?

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

1 0.4

2 2.5

3 2400

4 5600

4D The milk float is said to be more 'environmentally friendly' than a petrol-driven vehicle.

This is because . . .

1 the batteries store energy.

2 it produces no harmful waste gases.

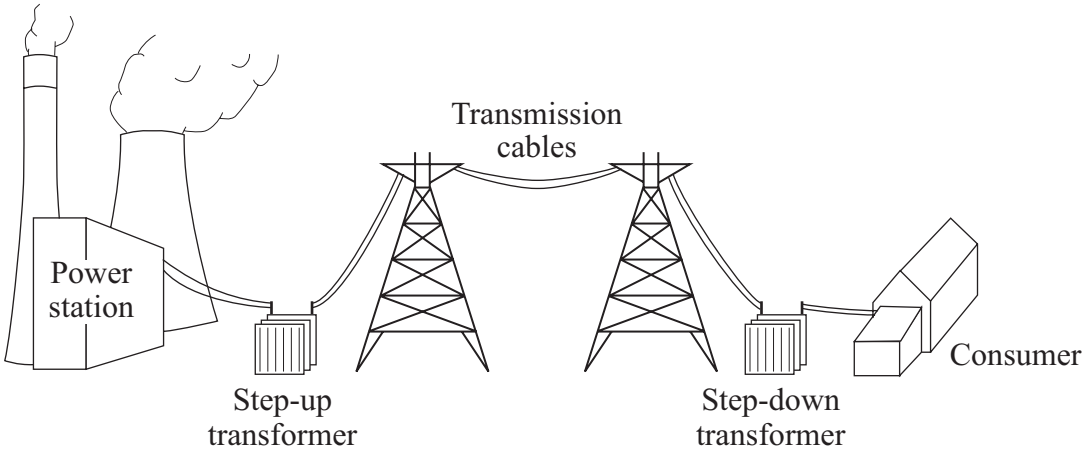
3 the batteries can be recharged many times.

4 the top speed is only 20 km/h.

Turn over for the next question

QUESTION FIVE

The diagram shows how electricity is distributed from a coal-fired power station to consumers.



5A Which row in the table shows what happens at the step-up transformer?

	Current	**Voltage**
1	decreased	decreased
2	decreased	increased
3	increased	decreased
4	increased	increased

5B The purpose of the step-up transformer is to . . .

1 allow the electricity to travel further.

2 increase the speed of the electricity through the cables.

3 reduce energy losses from the cables.

4 reduce vibrations in the cables.

5C Which one of the following power stations has the shortest start-up time?

1 coal

2 gas

3 nuclear

4 oil

5D Which of these fuels undergoes nuclear fission to produce heat in a power station?

1 coal

2 gas

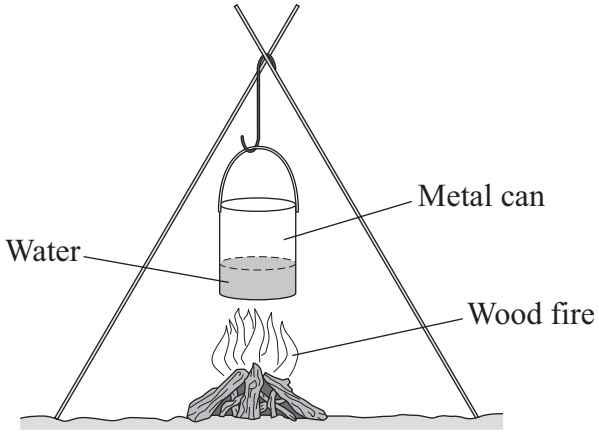
3 oil

4 uranium

Turn over for the next question

QUESTION SIX

On a camping trip, some students heated some water in a metal can.



6A Thermal energy is transferred through the metal walls of the can by . . .

1 convection currents in the metal.

2 free electrons gaining energy and moving quickly.

3 infra red radiation passing through the metal.

4 atoms moving through the metal.

6B Thermal energy spreads through the water by . . .

1 ions moving more quickly.

2 particles of water expanding, becoming less dense and rising.

3 particles of water contracting, becoming denser and falling.

4 the water expanding, becoming less dense and rising.

6C A lot of thermal energy is lost from the fire into the air by . . .

1 conduction only.

2 convection only.

3 mainly convection and radiation.

4 conduction, convection and radiation.

6D The can and the water become hot.

The outer surface of the can transfers energy to the surroundings by . . .

1 infra red radiation passing through the air.

2 metal particles gaining energy and escaping.

3 the air contracting, becoming less dense and falling.

4 the air expanding, becoming denser and rising.

Turn over for the next question

QUESTION SEVEN

The table compares data for two types of lamp.

	Filament lamp	**Compact fluorescent lamp (CFL)**
Cost	80p	£3.00
Efficiency	0.2	0.8
Expected life	1000 hours	8000 hours

7A People may decide **not** to buy CFLs because CFLs are . . .

1 more expensive to buy.

2 more efficient.

3 cheaper to run.

4 longer lasting.

7B A filament lamp with a power rating of 100 W gives 2000 units of light.

What power rating would a CFL need to provide 2000 units of light?

1 8000 W

2 20 W

3 25 W

4 25 kW

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

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

Electricity costs 15 p per kWh

7C What will be the cost of using a 100 W filament lamp during its expected life?

1 £1.50

2 £15.00

3 £150.00

4 £1500.00

7D In its lifetime, a security light is used for 15 000 hours.

How much would you expect to spend on buying CFLs for the security light in that time?

1 £5.63

2 £6.00

3 £12.00

4 £45.00

Turn over for the next question

QUESTION EIGHT

This question is about the energy available from various fuels.

The table shows the amount of energy that 1 kg of different fuels can produce when the fuel energy is transformed.

Fuel	Energy available in MJ per kg
Uranium	70 million
Hydrogen	115
Gas	50
Oil	45
Coal	20
Wood	15

1 MJ = 1 million joules

8A What mass of coal, in kg, would provide the same amount of energy as 1 kg of uranium?

1 0.29

2 3.5

3 0.29 million

4 3.5 million

8B Which three fuels are non-renewable?

1 coal, gas and wood

2 coal, gas and uranium

3 gas, oil and wood

4 gas, uranium and wood

8C Coal is burned at a rate of 100 kg per second in a power station. The overall efficiency of the power station is 0.3.

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

What is the energy output per second, in MJ, of this power station?

1 600

2 1400

3 1500

4 6700

8D A factory gets all of its energy by burning oil.

Only half of the energy from burning oil is transformed into useful energy.

For a working day, the energy required to run the factory is 10 800 MJ.

What is the mass of oil, in kg, needed each day?

1 24

2 48

3 240

4 480

Turn over for the next question

QUESTION NINE

The following information is from a leaflet produced by a double-glazing company.

Change your single-glazed windows to our energy-efficient double glazed windows and save a massive £167 a year

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

9A The company assumes that energy costs 11p per kWh.

How much energy does the company claim would be saved each year by fitting its double-glazing?

1 15.2 kWh

2 1 520 kWh

3 1 837 kWh

4 183 700 kWh

9B Double glazing for a house costs £4000. A householder saves £200 in the first year after installing the double-glazing. Fuel prices rise steadily during that year.

The pay-back time is likely to be . . .

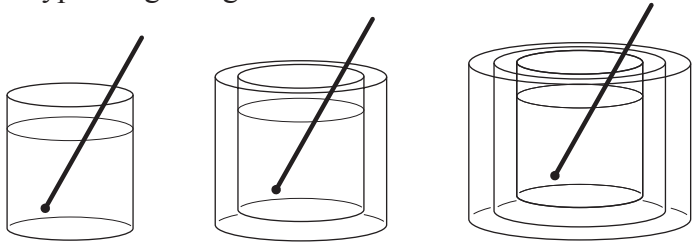
1 exactly 20 years.

2 more than 20 years if fuel prices continue to rise.

3 less than 20 years if fuel prices continue to rise.

4 less than 20 years if fuel prices fall steadily over the next few years.

9C Some students investigated the effectiveness of double and triple glazing. They let 100 cm^3 of boiling water cool in a glass beaker for 20 minutes. They repeated the cooling with the beaker placed inside another one and then inside two beakers. The students also looked up the U-value of different types of glazing on the Internet.



Single glazing | Double glazing | Triple glazing

The results are shown in the table.

	Single glazing	Double glazing	Triple glazing
Temperature in °C after 20 minutes	68	81	88
U-value	1.0	0.5	0.3

Which of these conclusions should the students draw from their results?

1 Double glazing is more effective than triple glazing and a greater U-value means a larger heat loss.

2 Double glazing is more effective than triple glazing and a greater U-value means a smaller heat loss.

3 Triple glazing is more effective than double glazing and a smaller U-value means a larger heat loss.

4 Triple glazing is more effective than double glazing and a smaller U-value means a smaller heat loss.

9D One student stated that the investigation was not realistic. He said that:

- there is a difference between the area of a window and the surface area of the beakers
- the temperature difference across a window is different from the temperature difference across the beakers.

The table compares a window with the beakers in the experiment.

Which row in the table is correct?

	Surface area of window		Temperature difference across window	
	Compared with the beaker	**Effect on rate of heat transfer**	**Compared with the beaker**	**Effect on rate of heat transfer**
1	larger	slower	larger	slower
2	smaller	slower	larger	faster
3	larger	faster	smaller	slower
4	smaller	faster	smaller	faster

END OF TEST

There are no questions printed on this page