Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

General Certificate of Secondary Education
November 2008

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

PHYSICS
Unit Physics P1a (Energy and Electricity)

Thursday 20 November 2008 Morning Session

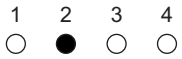
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

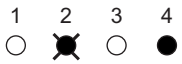
Time allowed: 30 minutes

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.

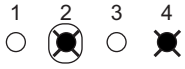
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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**.

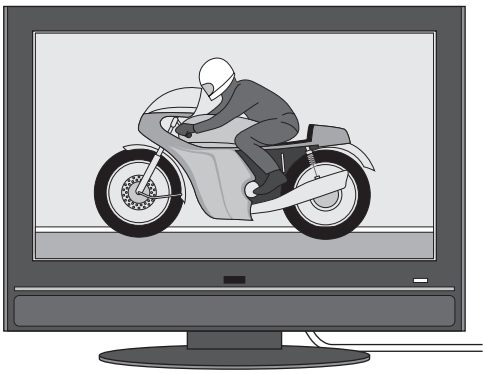
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

The drawing shows a television set.



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

A electrical

B heat

C light

D sound

The television is designed to transform . . . **1** . . . energy into . . . **2** . . . energy at the screen.

The loudspeaker transforms kinetic energy into . . . **3** . . . energy.

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

QUESTION TWO

Some power stations must be built in special places.

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

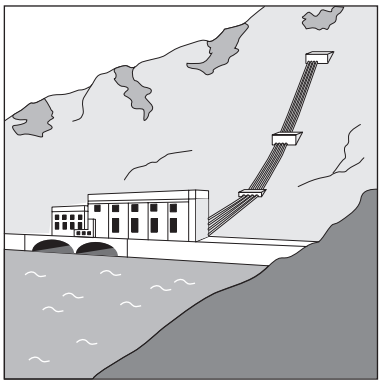
A geothermal

B falling water (hydroelectric)

C tides

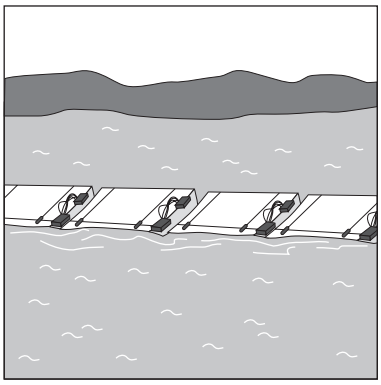
D waves

1



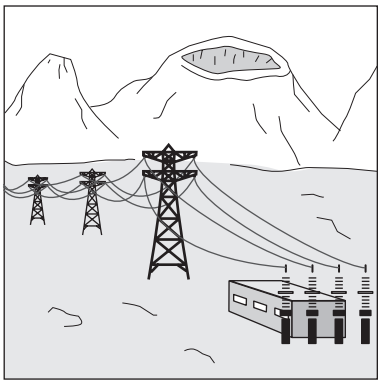
Mountainous region

2



Coastal region

3



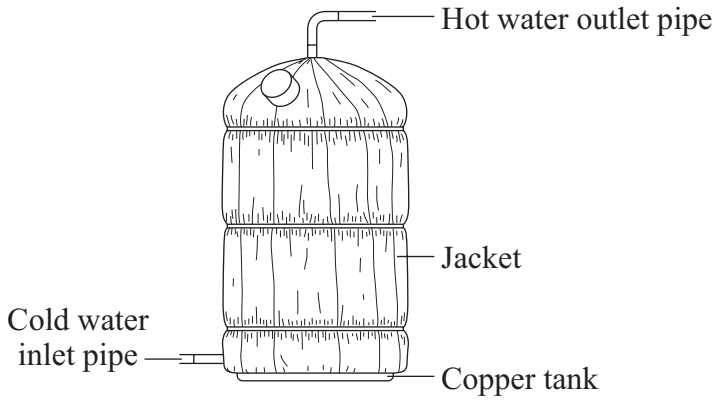
Volcanic region

4

River estuary

QUESTION THREE

The diagram shows a jacket fitted to a hot water tank.



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

A conduction

B convection

C insulation

D radiation

Heat will travel through the copper wall of the tank by . . . **1** . . . .

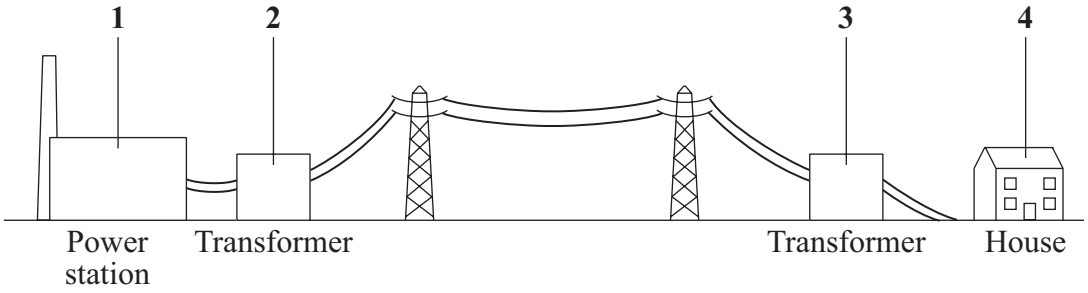
The jacket helps to keep the water warm because the fibreglass inside the jacket provides . . . **2** . . . .

The hot water outlet is at the top of the tank because hot water will rise to the top by . . . **3** . . . .

Heat would be lost from the surface of the tank by . . . **4** . . . .

QUESTION FOUR

The diagram shows part of the National Grid.



Match statements, **A**, **B**, **C** and **D**, with the labels **1–4** on the diagram.

A This is where the electricity is being used.

B This is where the electricity is being generated.

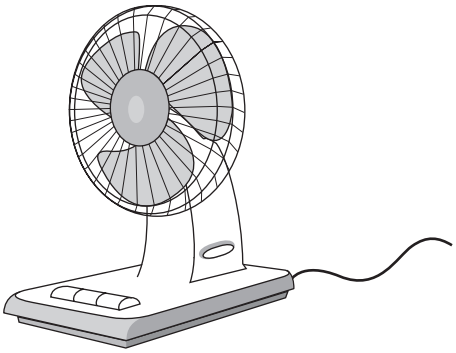
C This is where the voltage is increased.

D This is where the voltage is decreased.

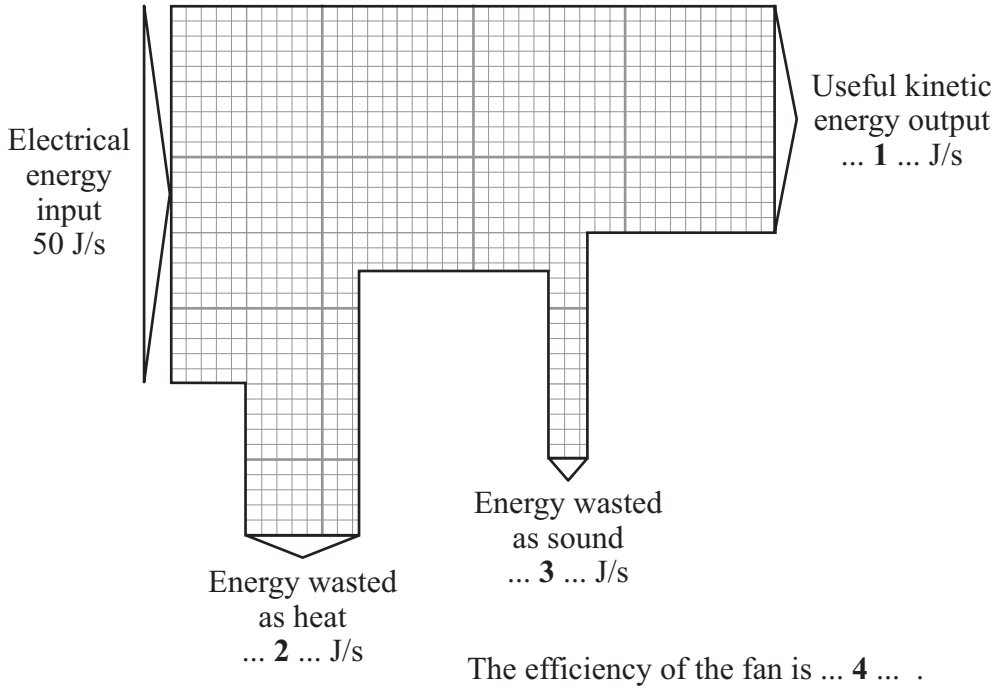
Turn over for the next question

QUESTION FIVE

The diagram shows an electric fan.



The Sankey diagram gives the energy transformations for the fan.



The efficiency of the fan is ... **4** ... .

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

Match numbers, **A**, **B**, **C** and **D**, with the labels **1–4** on the Sankey diagram.

A 0.6

B 5

C 15

D 30

Turn over for the next question

SECTION TWO

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

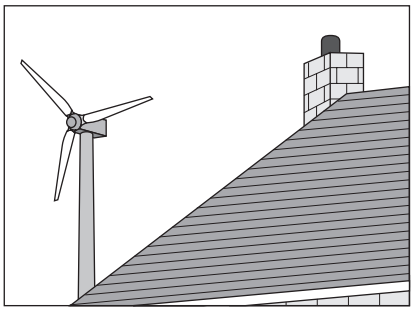
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION SIX

You can generate electricity for use in your own home using a wind turbine fixed above the roof.



6A Wind is a renewable energy source.

Which one of the following is **not** a renewable energy source?

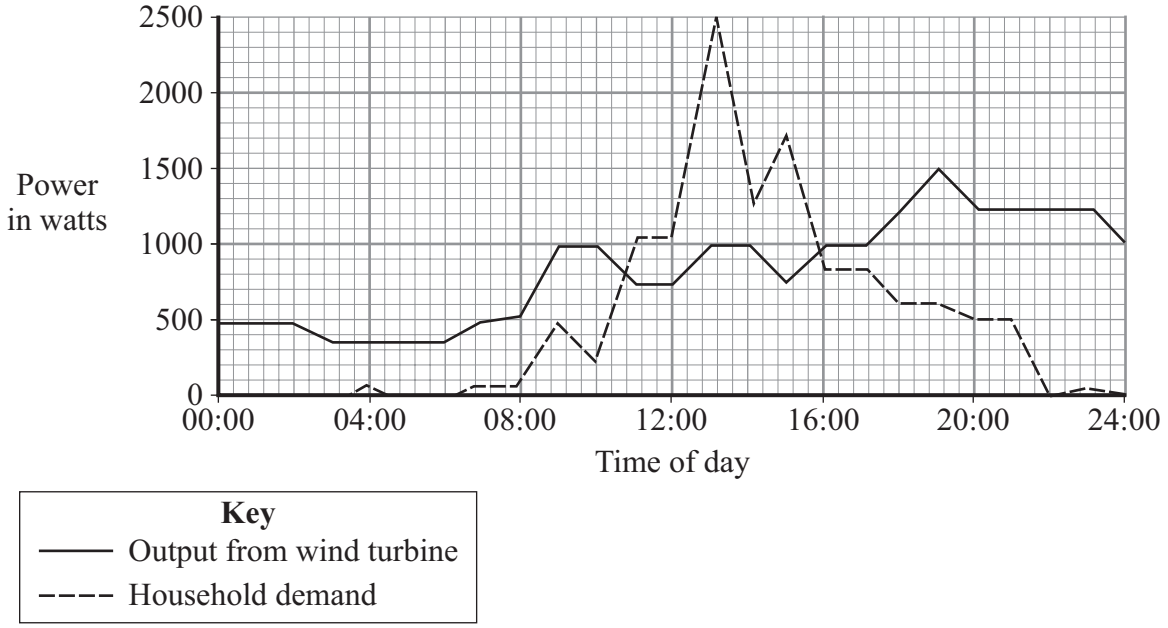
1 biomass

2 nuclear

3 solar

4 wave

The graph shows how the power output from a small wind turbine changes during 24 hours. It also shows how the demand for power for one household changes during the same period.



6B Which statement is correct for 12:00?

1 The demand is larger than the power output from the wind turbine.

2 The demand is a maximum.

3 The power output from the wind turbine is larger than the demand.

4 The power output from the wind turbine is the same as the demand.

6C The maximum household demand during the 24-hour period is . . .

1 1000 W

2 1500 W

3 2000 W

4 2500 W

6D For how long, approximately, during the 24-hour period, does the power output from the wind turbine exceed the household demand?

1 0 hours

2 5 hours

3 19 hours

4 24 hours

QUESTION SEVEN

This is part of a report in a newspaper.

> **Tidal Barrage will power Britain**
>
> A 10-mile tidal barrage across the Severn Estuary could provide 5% of Britain's electricity needs. The project would cost £15 billion. It is one option being considered to reduce the use of fossil fuels in generating electricity.

7A We need to reduce the use of fossil fuels because . . .

1 burning fossil fuels releases harmful gases into the atmosphere.

2 tidal power is less expensive than fossil fuels.

3 tidal power is more efficient than fossil fuels.

4 we have no fossil fuels left.

7B Which of the following is **not** an argument in favour of building a tidal power station?

Tidal power stations . . .

1 are a predictable source of energy.

2 endanger wildlife and destroy habitats.

3 create jobs.

4 release no harmful gases in the atmosphere.

7C In a tidal barrage, the water moves through a chamber and turns a turbine.

The turbines are connected to a . . .

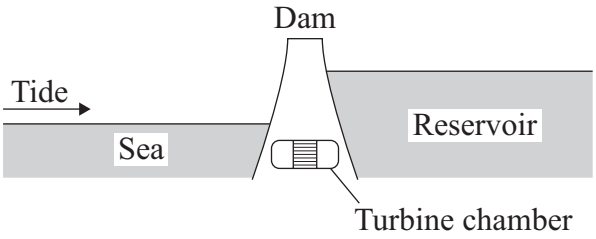
1 boiler.

2 generator.

3 pump.

4 transformer.

7D In some tidal power stations the water that arrives on the incoming tide is stored in a reservoir behind a dam.



Water is then allowed to flow out of the reservoir, through the turbine chamber and back out to sea.

The main useful energy transformations during this flow are . . .

1 from kinetic to gravitational potential to electrical.

2 from gravitational potential to kinetic to electrical.

3 from chemical to kinetic to electrical.

4 from kinetic to heat to electrical.

Turn over for the next question

QUESTION EIGHT

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by post from AQA Publications or online from http://shop.aqa.org.uk

Turn over for the next question

QUESTION NINE

The table gives information about the cost of fitting different types of insulation in a house. The table also gives the savings made per year after insulation was fitted.

Method of insulation	Cost to install	Savings per year
Double glazing	£8000	£150
Cavity wall insulation	£1250	£150
Loft insulation	£400	£100
Foil behind radiators	£10	£5

9A Which method of insulation in the table does **not** involve trapped air?

1 cavity wall insulation

2 double glazing

3 foil behind radiators

4 loft insulation

9B Double glazing reduces heat loss by . . .

1 conduction only.

2 convection only.

3 conduction and convection.

4 convection and radiation.

9C Which method of insulation pays for itself in the shortest time?

1 cavity wall insulation

2 double glazing

3 foil behind radiators

4 loft insulation

9D What is the pay-back time for loft insulation?

1 0.25 year

2 0.50 year

3 2 years

4 4 years

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**.

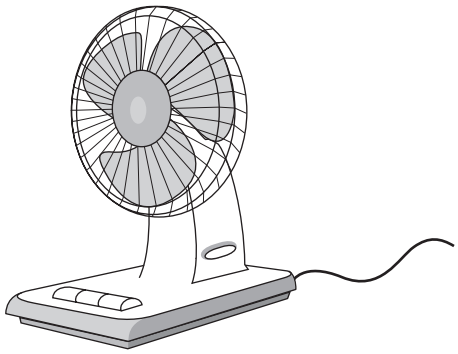
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

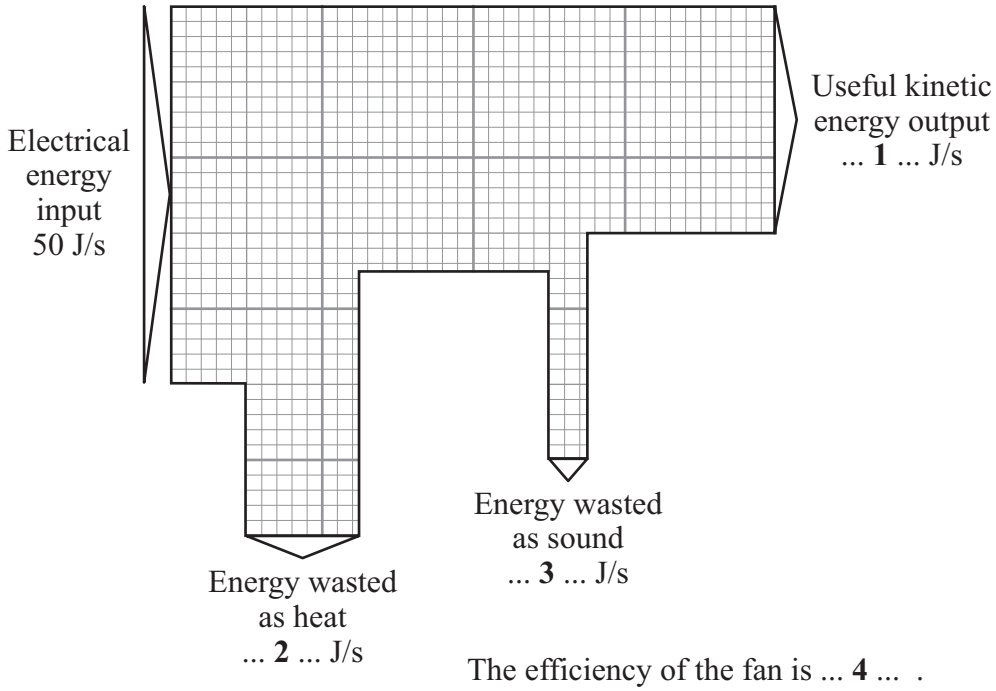
Mark your choices on the answer sheet.

QUESTION ONE

The diagram shows an electric fan.



The Sankey diagram gives the energy transformations for the fan.



The efficiency of the fan is ... **4** ... .

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

Match numbers, **A**, **B**, **C** and **D**, with the labels **1–4** on the Sankey diagram.

A 0.6

B 5

C 15

D 30

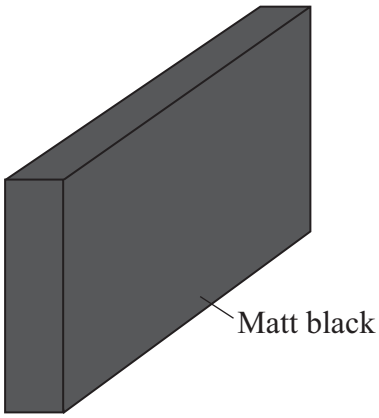
Turn over for the next question

QUESTION TWO

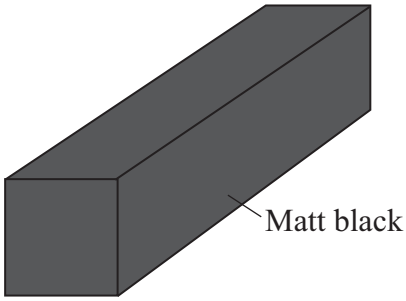
Four hot objects, **A**, **B**, **C** and **D**, at the same temperature, are allowed to cool.

Each object has the same volume and is made of the same material. **B**, **C** and **D** have the same surface area, **A** has a larger surface area.

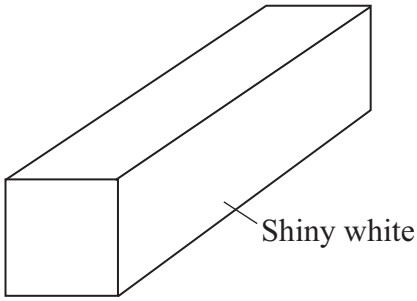
A



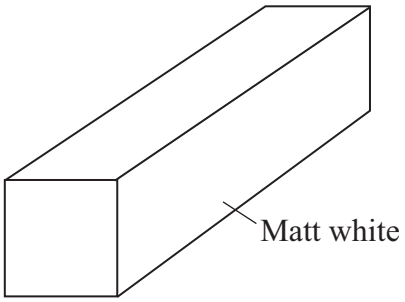
B



C

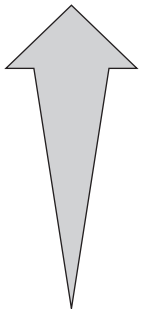


D



Match the objects, **A**, **B**, **C** and **D**, with their relative rate of heat loss **1–4**.

1	Fastest heat loss
2	
3	
4	Slowest heat loss



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

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Turn over for the next question

QUESTION FOUR

The table gives information about the cost of fitting different types of insulation in a house. The table also gives the savings made per year after insulation was fitted.

Method of insulation	Cost to install	Savings per year
Double glazing	£8000	£150
Cavity wall insulation	£1250	£150
Loft insulation	£400	£100
Foil behind radiators	£10	£5

4A Which method of insulation in the table does **not** involve trapped air?

1 cavity wall insulation

2 double glazing

3 foil behind radiators

4 loft insulation

4B Double glazing reduces heat loss by . . .

1 conduction only.

2 convection only.

3 conduction and convection.

4 convection and radiation.

4C Which method of insulation pays for itself in the shortest time?

1 cavity wall insulation

2 double glazing

3 foil behind radiators

4 loft insulation

4D What is the pay-back time for loft insulation?

1 0.25 year

2 0.50 year

3 2 years

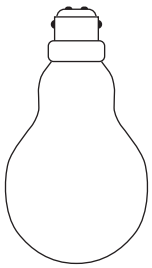
4 4 years

Turn over for the next question

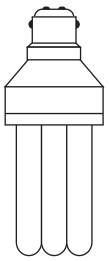
QUESTION FIVE

The diagram shows information about four types of electric lamp.

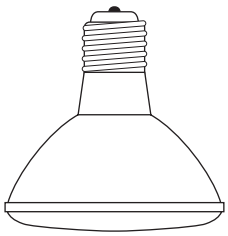
Each lamp produces the same amount of light energy in the same time.



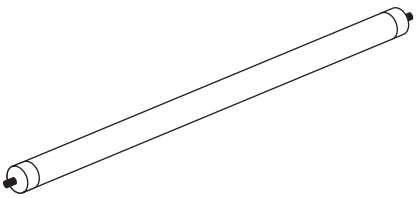
100 watt filament lamp
Average life = 1000 hours
Cost = £0.50



20 watt energy-saving lamp
Average life = 10 000 hours
Cost = £3.00



10 watt LED spotlight
Average life = 60 000 hours
Cost = £30.00



15 watt fluorescent tube
Average life = 5000 hours
Cost = £5.00

5A Which lamp is the most efficient?

1 100 watt filament lamp

2 20 watt energy-saving lamp

3 10 watt LED spotlight

4 15 watt fluorescent tube

5B Which lamp would get the hottest when it is working?

1 100 watt filament lamp

2 20 watt energy-saving lamp

3 10 watt LED spotlight

4 15 watt fluorescent tube

5C Which lamp would be the cheapest to run for 1000 hours?

1 100 watt filament lamp

2 20 watt energy-saving lamp

3 10 watt LED spotlight

4 15 watt fluorescent tube

5D You want a lamp that will provide light for 60 000 hours. You realise that you may have to buy more than one lamp to last this long.

Which type of lamp would work out the cheapest to buy?

1 100 watt filament lamp

2 20 watt energy-saving lamp

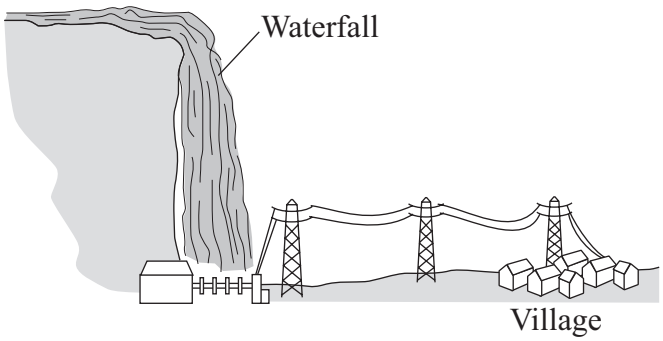
3 10 watt LED spotlight

4 15 watt fluorescent tube

Turn over for the next question

QUESTION SIX

The diagram shows a hydroelectric scheme.



A small mountain village lies near a waterfall.

The energy of the falling water is used to generate electricity for the village.

The table gives some information about the village and the electrical supply.

Efficiency of generating system	0.12
Energy of water entering turbines per second	10 000 kJ
Population of the village	1200
Average number of people per household	4
Average electrical demand per household	3.0 kW

6A The reason why the energy transformation is so inefficient is that . . .

1 the waterfall is not high enough.

2 water is a poor conductor of electricity.

3 heat is produced in the turbines.

4 maintenance costs are high.

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

6B The electrical energy available to the village is . . .

1 833 kJ

2 1 200 kJ

3 83 300 kJ

4 120 000 kJ

6C The average power demand for the whole village is . . .

1 900 kW

2 3 600 kW

3 4 800 kW

4 14 400 kW

6D The total energy used by the village each day is, on average, 21 600 kWh. The daily maintenance cost of running the hydroelectric scheme is £1200.

What is the price, in pence per kWh, which must be charged to cover the daily maintenance costs?

$$\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$$

1 2.8 p

2 5.6 p

3 11.2 p

4 22.4 p

QUESTION SEVEN

This question is about some of the different ways of generating electricity.

7A Some power stations in the UK burn coal to produce heat.

Which row in the table gives the correct order of operations in a coal-fired power station?

1	The turbine heats the boiler	The boiler produces steam	Steam drives the generator which produces electricity
2	The boiler produces steam	Steam turns the blades of the turbine	The turbine produces electricity
3	The boiler produces steam	Steam turns the blades of the turbine	The turbine drives the generator which produces electricity
4	The turbine heats the boiler	The boiler produces steam	Steam from the boiler makes electricity

7B Wind farms can be used to produce electricity.

A wind farm consists of a number of . . .

1 transformers connected to turbines.

2 turbines connected to generators.

3 generators only.

4 turbines only.

7C The government wants more nuclear power stations to be built. Nuclear power stations have advantages and disadvantages.

Which of the following statements about nuclear power stations is correct under normal working conditions?

1 They use a renewable energy source, do not release harmful substances into the atmosphere and produce radioactive waste.

2 They use a renewable energy source, do not release harmful substances into the atmosphere and have a long start-up time.

3 They do not release harmful substances into the atmosphere, have a relatively short start-up time and produce radioactive waste.

4 They do not release harmful substances into the atmosphere, have a relatively long start-up time and produce radioactive waste.

7D Solar cells can be used to produce electricity on a large scale in places like Australia and California. At present, they are not used on a large scale in the UK.

Which of the following statements about solar cells used to produce electricity on a large scale is correct?

1 They can be used where the Sun shines every day and they need only a small area of land.

2 They can harness a vast amount of energy from the Sun each day and they need only a small area of land.

3 They need a large area of land because the energy from the Sun is dilute.

4 They need a large area of land because the solar cells are very efficient.

Turn over for the next question

QUESTION EIGHT

Australia's carbon emissions are among the highest in the developed world at 540 million tonnes per year.

Australia is to build the world's most advanced solar power station. It will use thousands of mirrors to concentrate the Sun's energy onto solar cells. This power station will produce enough electricity for 45 000 households.

8A The main advantage of the solar power scheme over coal-fired power stations is that . . .

1 it will not produce radioactive waste.

2 it will not produce noise pollution.

3 it will not produce greenhouse gas emissions.

4 it will not destroy wildlife habitats.

8B A fossil fuel power station producing enough electricity for 45 000 households produces 390 000 tonnes of carbon emissions per year.
How many tonnes of carbon emissions are produced each year on average per household by this electricity production?

1 8.7

2 83.3

3 722.2

4 1384.6

8C Australia plans to build a series of advanced solar power stations to reduce carbon emissions by 10 million tonnes per year.

The number of solar power stations needed would be about . . .

1 10

2 25

3 50

4 100

8D California has a solar power station that is larger than the advanced solar power station planned for Australia. However, the Californian power station uses similar technology to a coal-fired power station instead of using solar cells.

In the Californian power station, solar energy is transformed directly into . . .

1 movement (kinetic energy) in a turbine.

2 movement (kinetic energy) in a generator.

3 heat to produce steam which drives a turbine.

4 heat which drives a turbine.

Turn over for the next question

QUESTION NINE

This question is about using electricity in the home.

9A When electricity is transmitted from a power station, it is stepped up from 25 kV to 300 kV.

This is done by a . . .

1 generator to decrease the current and make it safer.

2 generator to increase the current and make the electricity travel faster.

3 transformer to increase the current and reduce energy losses.

4 transformer to reduce the current and reduce energy losses.

The table shows the power ratings of four electrical appliances.

Fan heater	2 kW
Oven	3 kW
Kettle	2 kW
Microwave oven	0.75 kW

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

$$\text{energy transferred (kilowatt-hour, kWh)} = \text{power (kilowatt, kW)} \times \text{time (hour, h)}$$

$$\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$$

The cost of electrical energy is 10 p per kilowatt-hour.

9B The kettle is used for a total of 30 minutes a day. It has an efficiency of 0.9

What is the cost of the energy wasted by the kettle each day?

1 0.6 p

2 1.0 p

3 6.0 p

4 9.0 p

9C The fan heater has a heating element and a motor to turn the blades of the fan. The power rating of the heater is 1800 W. To cool a room in the summer, only the fan is used.

How much would it cost to use the fan to cool a room for 5 hours?

1 0.1 p

2 1.0 p

3 10.0 p

4 100.0 p

9D A bowl of cauliflower cheese is cooked in a microwave oven for 6 minutes on half power.

How much does it cost to cook the cauliflower cheese?

1 0.375 p

2 0.750 p

3 1.500 p

4 2.250 p

END OF TEST

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