Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

General Certificate of Secondary Education
Foundation Tier and Higher Tier
November 2009

Science A
Unit Physics P1a (Energy and Electricity)

Physics
Unit Physics P1a (Energy and Electricity)

PHY1AP

F&H

Thursday 19 November 2009 Morning Session

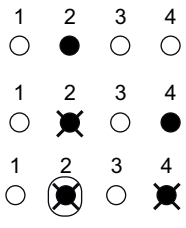
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

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 heat transfer.

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

A conductors

B convectors

C radiators

D reflectors

Light, shiny surfaces are good . . . **1** . . . of heat.

Very hot objects are good . . . **2** . . . of heat.

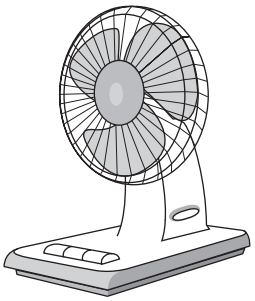
Gases are good . . . **3** . . . of heat.

All metals are good . . . **4** . . . of heat.

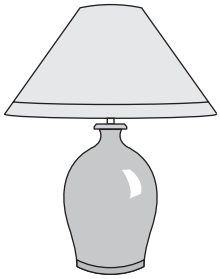
QUESTION TWO

The diagrams show four electrical appliances.

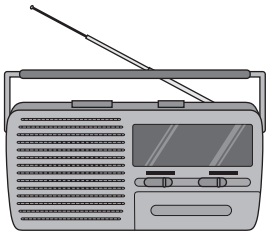
A
Toaster



B
Fan



C
Lamp



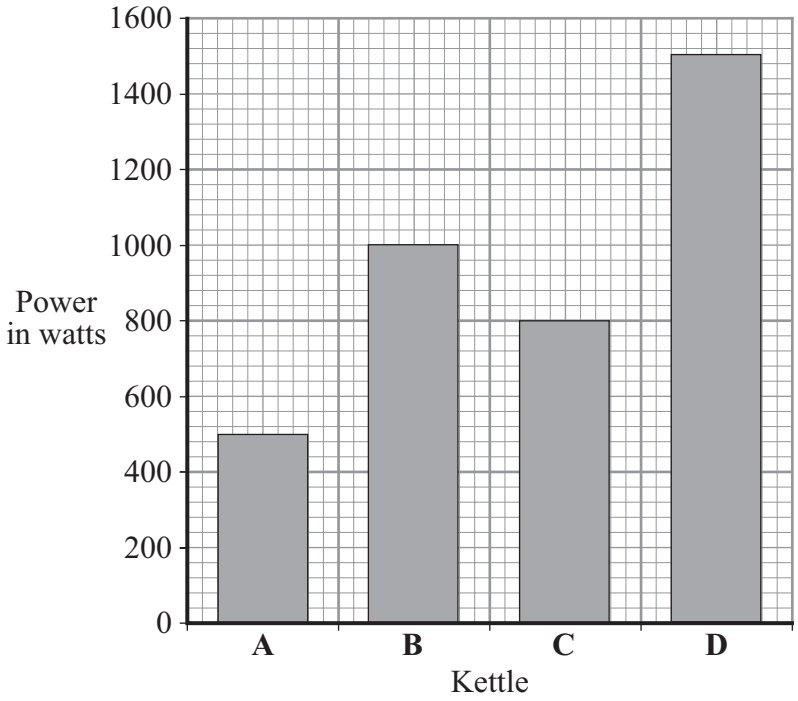
D
Radio

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

	Useful energy	**Wasted energy**
1	sound	heat
2	kinetic	heat and sound
3	light	heat
4	heat	light

QUESTION THREE

The bar chart shows the power of four different electric kettles, **A**, **B**, **C** and **D**.



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

The kettle with the highest power is kettle . . . **1** . . . .

The kettle with a power of 800 W is kettle . . . **2** . . . .

The kettle with a power of 1 kW is kettle . . . **3** . . . .

Each kettle contains the same volume of water at 20 °C. The kettle that takes the longest time to boil the water is kettle . . . **4** . . . .

QUESTION FOUR

The flow chart shows the steps involved in producing electricity in a coal-fired power station. It also shows the steps involved in transferring the electricity to the National Grid.

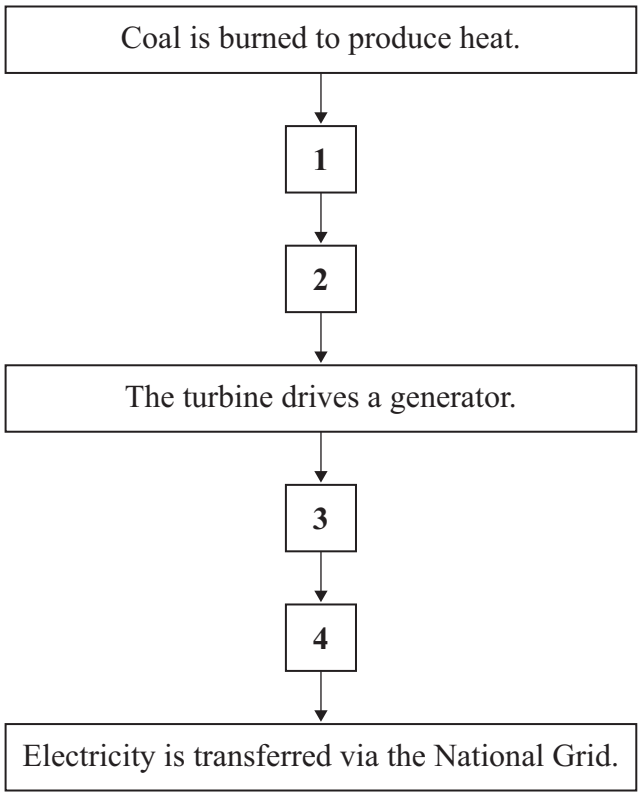
Match stages, **A**, **B**, **C** and **D**, with the boxes **1–4** in the flow chart.

A A step-up transformer increases the voltage.

B Steam drives a turbine.

C The generator produces electricity.

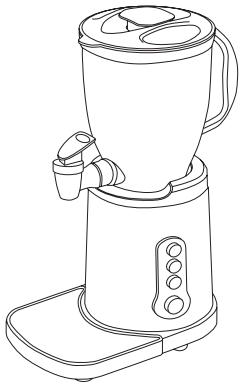
D Water is heated to produce steam.



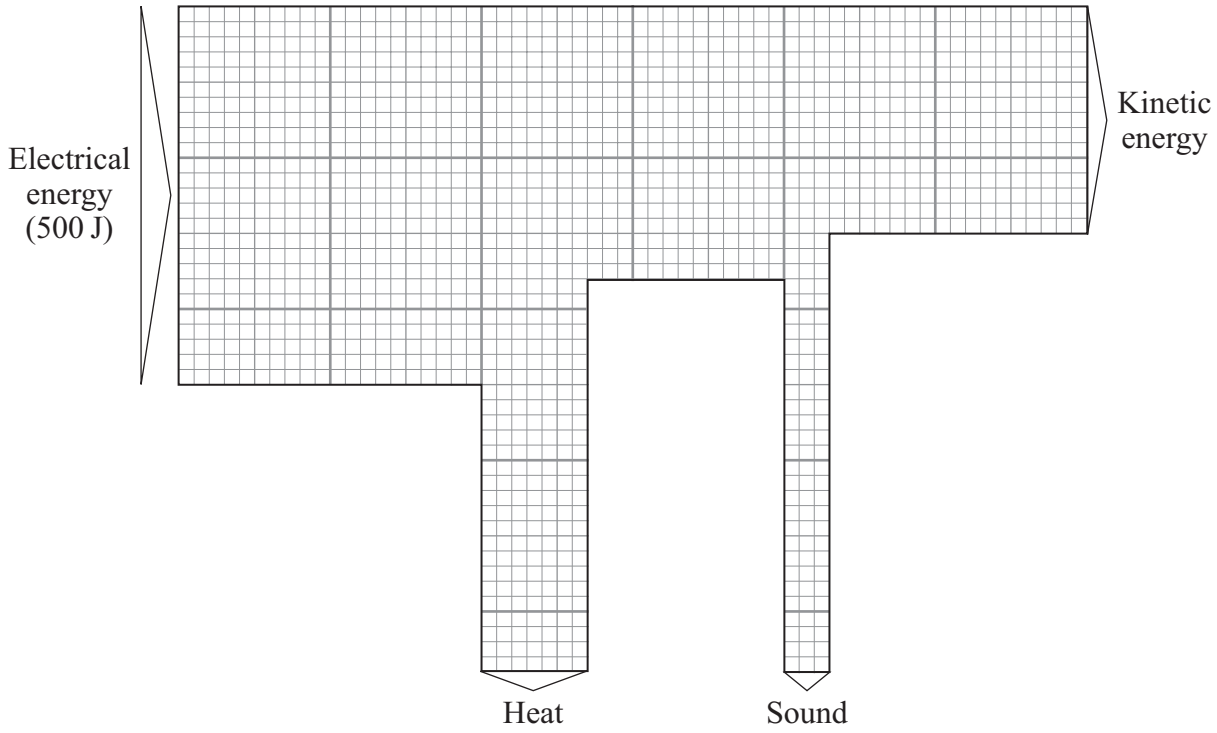
Turn over for the next question

QUESTION FIVE

The diagram shows a smoothie maker.



The Sankey diagram shows the energy transfers that take place each second in this smoothie maker.



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

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

A 0.6

B 140

C 200

D 300

The kinetic energy produced each second is . . . **1** . . . J.

The heat produced each second is . . . **2** . . . J.

The total energy wasted each second is . . . **3** . . . J.

The efficiency of the smoothie maker 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

This question is about different ways of producing electrical energy.

6A Which of the following fuels used for producing electricity is **not** a fossil fuel?

1 coal

2 natural gas

3 oil

4 uranium

6B Which of the following is a renewable energy source?

1 coal

2 falling water (hydroelectric)

3 plutonium

4 uranium

6C Where is a geothermal power station most likely to be sited?

1 along a coastline

2 in hot countries

3 in large cities

4 near volcanoes

6D Which of the following methods of producing electricity always causes atmospheric pollution?

1 burning fossil fuels

2 solar cells

3 nuclear energy

4 wind turbines

Turn over for the next question

QUESTION SEVEN

Biodiesel is a biofuel.

- Biodiesel can be made from the waste products from the manufacture of chocolate.
- The chocolate waste products would otherwise be sent to landfill sites.
- Biodiesel can also be made from crops such as oilseed rape and palm trees.
- Biodiesel can be mixed with ordinary diesel and used to run vehicles.

7A It is better to make biodiesel from chocolate waste than from crops because this biodiesel . . .

1 can be mixed with ordinary diesel.

2 can be used to run vehicles.

3 makes use of a waste product.

4 requires the use of agricultural land.

7B Cars can run on different fuels.

- In the early 20th century, the Model T Ford car ran on ethanol, a biofuel.
- Large reserves of crude oil were discovered in America in the 1920s. As a result, cars were made to run on petrol.
- After World War II, oil from the Middle East was cheap, so cars continued to run on petrol.

What was the biggest influence in producing the change of fuel from ethanol to petrol?

1 environmental concerns

2 the price of the fuel

3 wars between countries

4 whether the fuel was renewable

7C A farm is located on a hillside. There are no rivers or streams near the farm. The farmer wants to help the environment by generating his electricity from a renewable source.

Which of these sources is he most likely to choose?

1 a hydroelectric generator

2 a petrol generator

3 a wave generator

4 a wind generator

7D A renewable energy source is one that . . .

1 can be used again.

2 will not run out.

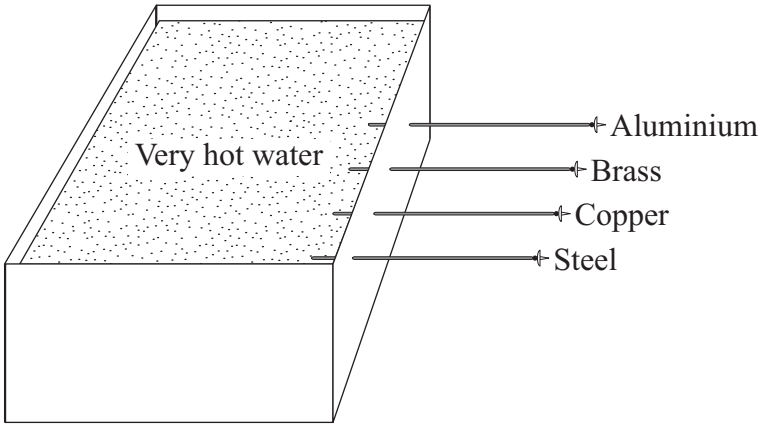
3 does not pollute the atmosphere.

4 is always available.

Turn over for the next question

QUESTION EIGHT

A student did an experiment to find out which of four metals is the best conductor of heat. He used rods of equal length and thickness. The student used wax to stick a drawing pin to the end of each rod. Very hot water was poured into the tank. The times taken for the wax to melt and the drawing pins to fall off were measured.



8A Which was the independent variable in the experiment?

1 the final temperature of the water

2 the initial temperature of the water

3 the length of the rods

4 the type of metal

8B Which of these is a control variable in the experiment?

1 the final temperature of the water

2 the length of the rods

3 the type of metal

4 the time taken for the drawing pin to fall off

8C The table shows the student's results.

Which metal is the best conductor of heat?

	Metal	Time taken for the drawing pin to fall off in seconds
1	Aluminium	59
2	Brass	110
3	Copper	32
4	Steel	188

8D The student wanted to improve the results. He repeated the experiment twice and calculated the mean times for the drawing pins to fall off.

What has the student improved by doing this?

1 the calibration

2 the fairness

3 the precision

4 the reliability

Turn over for the next question

QUESTION NINE

The table gives information about some ways of insulating a house.

Type of insulation	Cost of insulation	Savings per year	Pay-back time
Double glazing	£6000	£200	30 years
Cavity wall insulation	£500	£100	
Loft insulation		£90	3 years
Draught proofing	£100		10 years

9A What is the pay-back time for cavity wall insulation?

1 $\frac{1}{5}$ year

2 1 year

3 4 years

4 5 years

9B What would be the cost of loft insulation for this house?

1 £30

2 £90

3 £270

4 £540

9C Some methods of insulation involve trapped air.

Which methods of heat transfer are reduced by trapped air?

1 conduction and convection

2 conduction and radiation

3 convection and radiation

4 conduction, convection and radiation

9D The government often gives grants for fitting insulation.

What is the main reason for the government doing this?

1 Fitting insulation helps to conserve energy resources.

2 Fitting insulation increases the value of the house.

3 Governments are trying to support double-glazing companies.

4 Governments make a lot of money out of selling insulation.

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**.

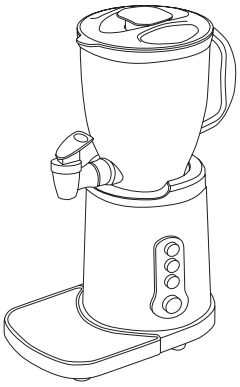
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

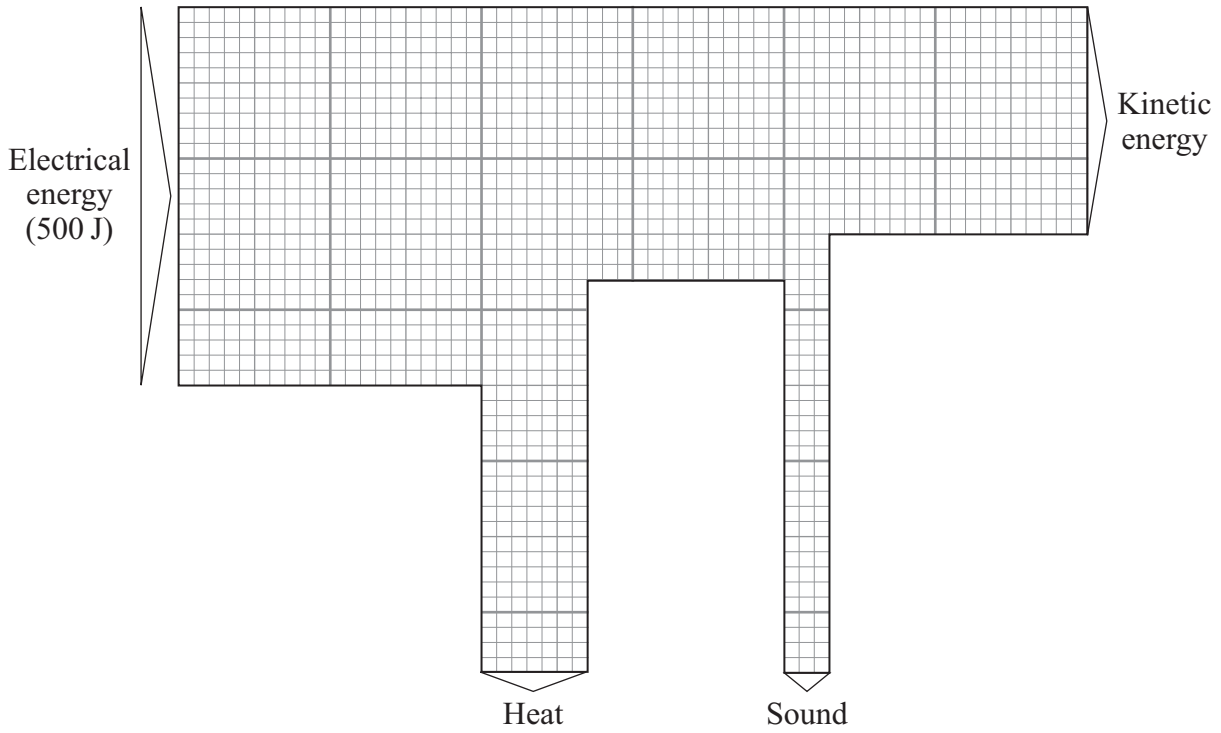
Mark your choices on the answer sheet.

QUESTION ONE

The diagram shows a smoothie maker.



The Sankey diagram shows the energy transfers that take place each second in this smoothie maker.



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

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

A 0.6

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The kinetic energy produced each second is . . . **1** . . . J.

The heat produced each second is . . . **2** . . . J.

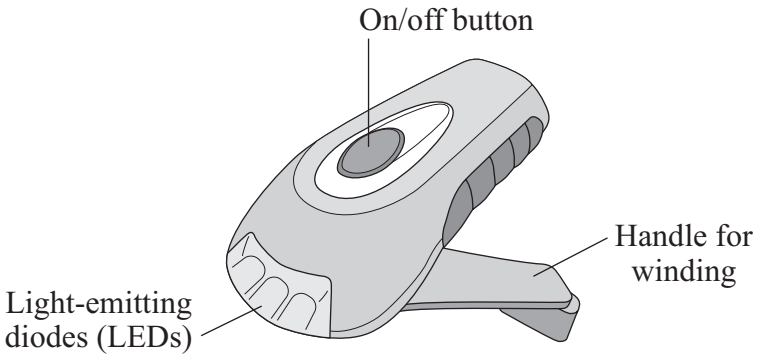
The total energy wasted each second is . . . **3** . . . J.

The efficiency of the smoothie maker is . . . **4** . . . .

Turn over for the next question

QUESTION TWO

The diagram shows a torch which contains a rechargeable battery. The battery is recharged by winding the handle.



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

A chemical

B electrical

C kinetic

D light

When the user winds the handle, the useful energy transformation is from . . . **1** . . . energy to . . . **2** . . energy which is stored in the battery.

When the torch is switched on, the useful output from the battery is . . . **3** . . . energy and the useful output from the LEDs is . . . **4** . . . energy.

Turn over for the next question

SECTION TWO

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

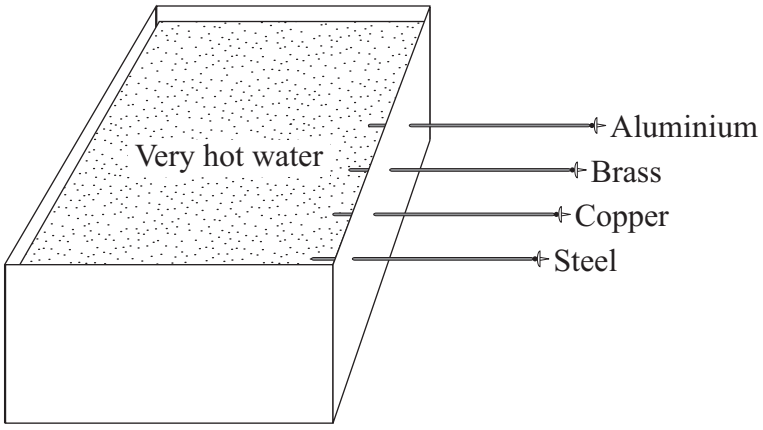
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION THREE

A student did an experiment to find out which of four metals is the best conductor of heat. He used rods of equal length and thickness. The student used wax to stick a drawing pin to the end of each rod. Very hot water was poured into the tank. The times taken for the wax to melt and the drawing pins to fall off were measured.



3A Which was the independent variable in the experiment?

1 the final temperature of the water

2 the initial temperature of the water

3 the length of the rods

4 the type of metal

3B Which of these is a control variable in the experiment?

1 the final temperature of the water

2 the length of the rods

3 the type of metal

4 the time taken for the drawing pin to fall off

3C The table shows the student's results.

Which metal is the best conductor of heat?

	Metal	**Time taken for the drawing pin to fall off in seconds**
1	Aluminium	59
2	Brass	110
3	Copper	32
4	Steel	188

3D The student wanted to improve the results. He repeated the experiment twice and calculated the mean times for the drawing pins to fall off.

What has the student improved by doing this?

1 the calibration

2 the fairness

3 the precision

4 the reliability

Turn over for the next question

QUESTION FOUR

The table gives information about some ways of insulating a house.

Type of insulation	Cost of insulation	Savings per year	Pay-back time
Double glazing	£6000	£200	30 years
Cavity wall insulation	£500	£100	
Loft insulation		£90	3 years
Draught proofing	£100		10 years

4A What is the pay-back time for cavity wall insulation?

1 $\frac{1}{5}$ year

2 1 year

3 4 years

4 5 years

4B What would be the cost of loft insulation for this house?

1 £30

2 £90

3 £270

4 £540

4C Some methods of insulation involve trapped air.

Which methods of heat transfer are reduced by trapped air?

1 conduction and convection

2 conduction and radiation

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4 conduction, convection and radiation

4D The government often gives grants for fitting insulation.

What is the main reason for the government doing this?

1 Fitting insulation helps to conserve energy resources.

2 Fitting insulation increases the value of the house.

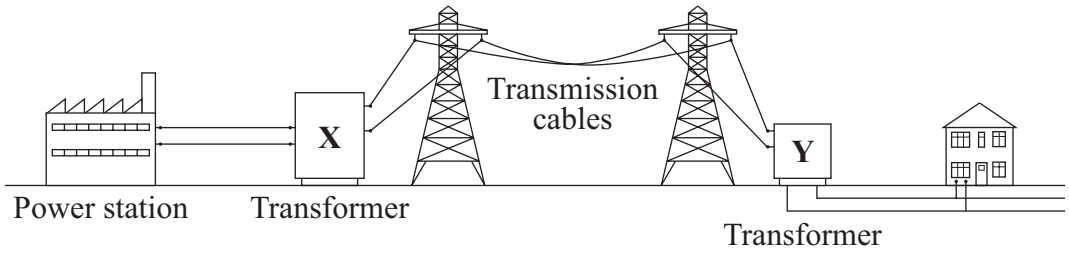
3 Governments are trying to support double-glazing companies.

4 Governments make a lot of money out of selling insulation.

Turn over for the next question

QUESTION FIVE

Power stations produce electricity and the National Grid distributes it to our homes and to factories.



5A Electricity is transferred along the transmission cables at high voltage so that . . .

1 fewer pylons need to be used.

2 less energy is lost in the cables.

3 the current in the cables is also high.

4 thicker cables can be used.

5B The two transformers, **X** and **Y**, are needed to . . .

1 change heat to electrical energy at **X** and electrical energy to heat at **Y**.

2 change the current at **X** to a higher value and the current at **Y** to a lower value.

3 change the voltage at **X** from ac to dc and the voltage at **Y** from dc to ac.

4 change the voltage at **X** to a higher value and the voltage at **Y** to a lower value.

5C Power stations use gas, coal, oil or uranium as the fuel.

Which of these fuels does **not** produce carbon dioxide when it is used?

1 coal

2 gas

3 oil

4 uranium

5D A hydroelectric power station does not release carbon dioxide into the atmosphere.

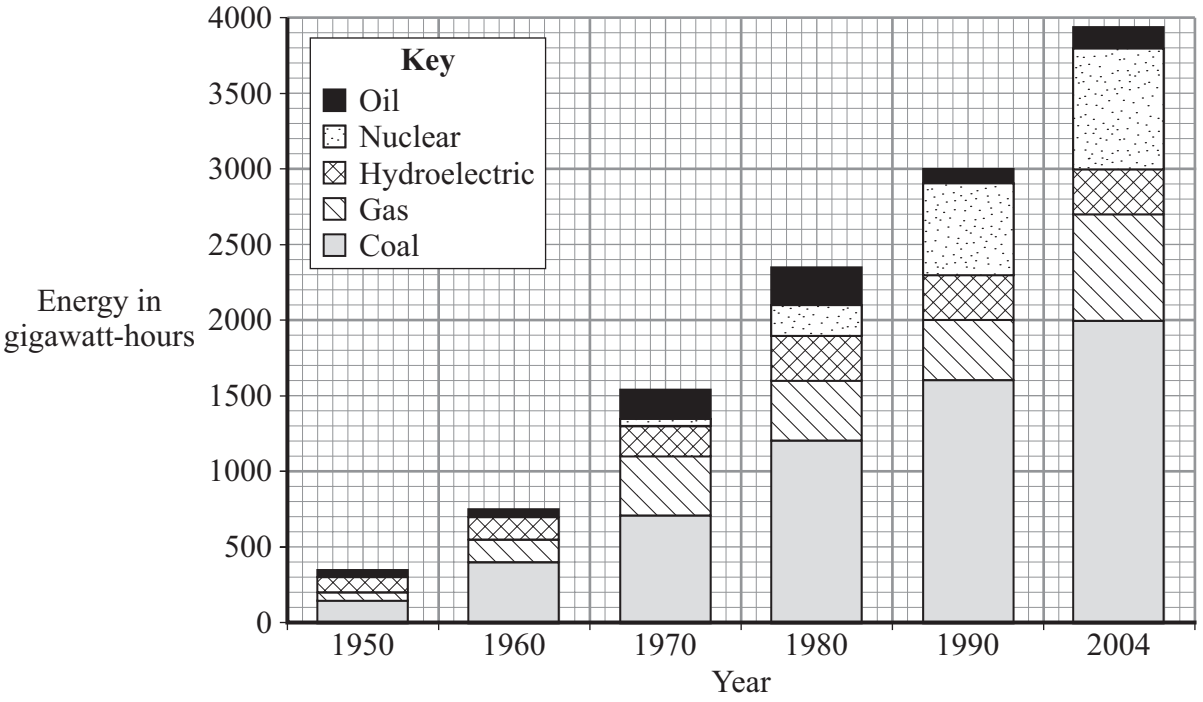
Which row in the table gives a correct advantage and a correct disadvantage of hydroelectric power stations?

	Advantage	**Disadvantage**
1	Valleys are flooded to form large lakes.	The building costs are very high.
2	There are no fuel costs.	They take a long time to start up.
3	They can be started up quickly.	Habitats are flooded to make large lakes.
4	No wildlife habitats are destroyed during construction.	Valleys are flooded to produce large lakes.

Turn over for the next question

QUESTION SIX

The bar chart shows the generation of electricity, in gigawatt-hours for a certain country, from five different energy sources between 1950 and 2004.



6A Of the following energy sources, which one produced the greatest amount of electricity in 1980?

1 gas

2 hydroelectric

3 nuclear

4 oil

6B In 1990, which of the following energy sources was producing approximately 600 gigawatt-hours of electricity?

1 coal

2 gas

3 hydroelectric

4 nuclear

6C Which of the following useful energy transformations takes place in power stations using coal, oil, gas and uranium?

1 kinetic to chemical

2 chemical to heat

3 electrical to kinetic

4 heat to kinetic

6D In 2004, over 50% of the electricity was generated using coal as the fuel. The government of the country is committed to reducing carbon dioxide emissions.

Which row in the table shows how the energy sources used for generating electricity may change in the next 10 years?

	Increased use	**Decreased use**
1	coal and gas	hydroelectric and nuclear
2	wave and wind	coal and gas
3	gas and nuclear	coal and wind
4	tidal and wave	nuclear and wind

Turn over for the next question

QUESTION SEVEN

This question is about different ways of generating electricity.

7A Some types of power station heat water to produce steam. The steam then drives a turbine connected to an electrical generator.

Which types of power station produce steam?

1 biomass, coal and nuclear

2 biomass, wind and wave

3 coal, nuclear and wave

4 gas, wind and wave

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
Biomass	5.9	0.8	6.7
Coal	1.3	1.2	2.5
Gas	0.7	1.5	2.2
Nuclear	1.8	0.4	2.2
Wave	6.6	0.0	6.6
Wind	3.7	0.0	3.7

7B 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.

7C 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

7D 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? (Assume that no carbon tax has been added.)

1 15%

2 41%

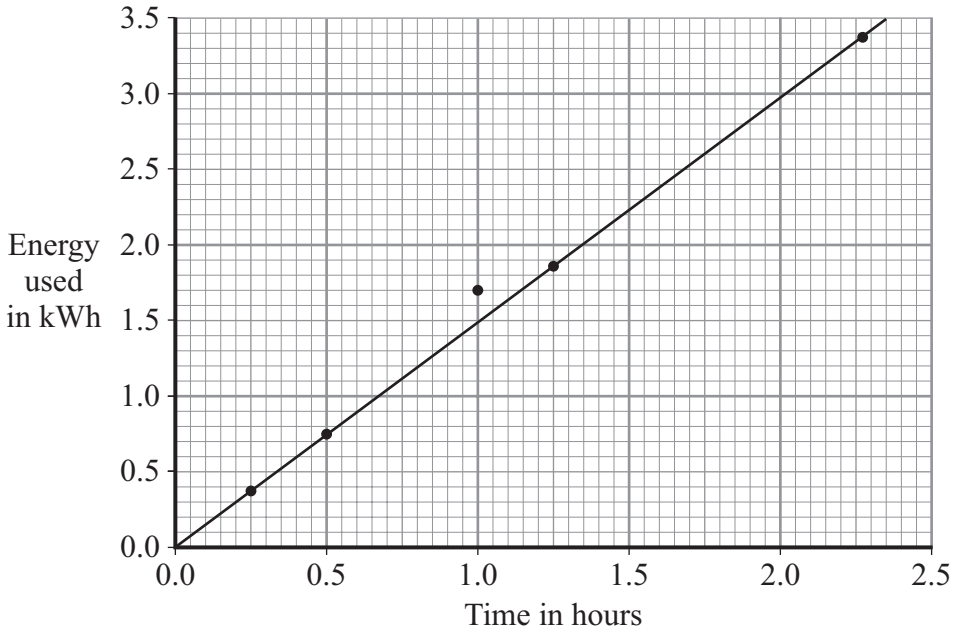
3 68%

4 100%

Turn over for the next question

QUESTION EIGHT

The graph shows the amount of energy used by an electric fire plotted against the length of time it is switched on.



8A The unit of energy on the graph is the kilowatt-hour (kWh).

Energy is usually measured in . . .

1 joules.

2 joules per second.

3 watts.

4 watts per second.

8B The point on the graph at the time of one hour could be anomalous.

This means that the value of the energy . . .

1 was measured with too little precision.

2 was measured with too much precision.

3 does not fit the general pattern.

4 is subject to a systematic error.

8C The graph shows that . . .

1 the energy used decreases with time.

2 the energy used is directly proportional to the time.

3 the energy used is inversely proportional to the time.

4 the energy used halves when the time is doubled.

8D What is the power of the electric fire?

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

1 1.5 W

2 6.7 W

3 1500 W

4 6700 W

Turn over for the next question

QUESTION NINE

A notice in an office says:

Leaving your computer on standby overnight uses as much energy as microwaving six dinners

Switch it OFF

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

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

Electricity costs 12 p per kilowatt-hour.

9A The instructions on a frozen cottage pie say: 'Cook in an 850 W microwave oven for 6 minutes'.

Approximately how much would it cost to cook 6 cottage pies, if they are cooked one at a time?

1 6 p

2 £1.02

3 £3.66

4 £36.72

9B A computer monitor in an office has a power rating of 300 W. Normal office hours are 9 am to 5 pm.

A sensible estimate of the energy wasted if it is left on overnight at full power is . . .

1 4.8 kWh

2 7.2 kWh

3 4800 kWh

4 7200 kWh

9C The 300 W computer monitor can be switched to standby. The standby power is 3 W.

How much money is saved each hour by switching the monitor from full power to standby?

1 less than 1 p

2 3.6 p

3 33 p

4 36 p

9D It is estimated that in Britain 15 million televisions are left on standby for 20 hours per day. The European Parliament has passed a law to help to reduce this problem.

Suggest which of the following would have been included in the law.

1 decrease the price of televisions

2 make it compulsory for television owners to switch off their television sets when not in use

3 set a 1 W limit on standby power for all televisions

4 set a 1 W limit on standby power for all new televisions

END OF TEST

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