Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

General Certificate of Secondary Education
June 2007

SCIENCE A **PHY1A**
Unit Physics P1a (Energy and Electricity)

PHYSICS
Unit Physics P1a (Energy and Electricity)

Monday 25 June 2007 Morning Session

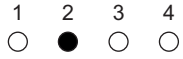
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

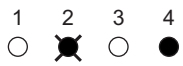
Time allowed: 30 minutes

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 'Energy and Electricity' 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.

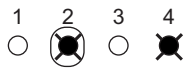
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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 14 of this booklet.

FOUNDATION TIER

SECTION ONE

Questions **ONE** to **SIX**.

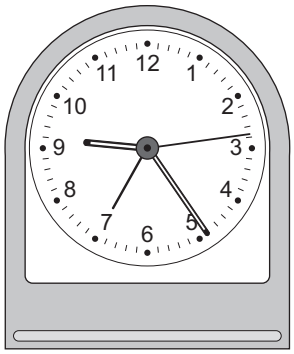
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

The drawing shows a battery-operated alarm clock.



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

A chemical

B electrical

C kinetic

D thermal

The clock contains a battery and an electric motor.

The battery is designed to transform . . . **1** . . . energy to . . . **2** . . . energy.

The motor is designed to transform electrical energy to . . . **3** . . . energy.

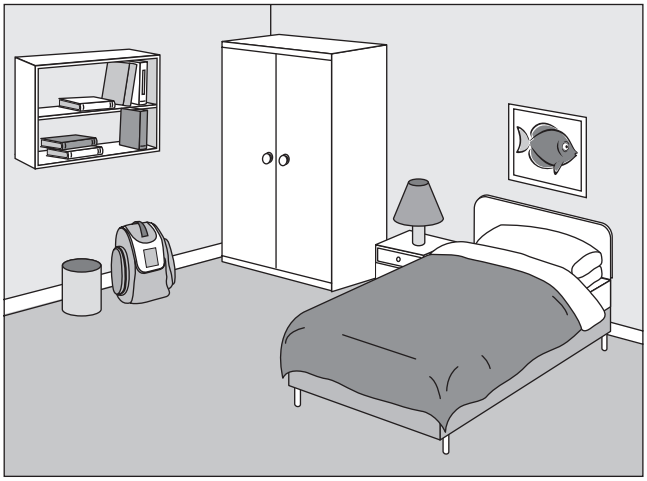
In the motor, some energy is wasted as . . . **4** . . . energy.

QUESTION TWO

The drawing shows part of a bedroom. The bedroom is heated by an electric fire.

There is a loft space above the bedroom ceiling. Above the bedroom ceiling is a layer of fibreglass.

When the electric fire is switched off, the bedroom cools down.



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

A conduction

B convection

C insulation

D radiation

The bedroom cools down because heat is transferred through the floor, the ceiling and the walls by . . . **1** . . . .

Heat is transferred from the outside of the walls by . . . **2** . . . .

Heat is transferred through the air in the loft by . . . **3** . . . .

Fibreglass reduces heat transfer through the ceiling because it has good . . . **4** . . . properties.

QUESTION THREE

This question is about different types of power station which produce electricity.

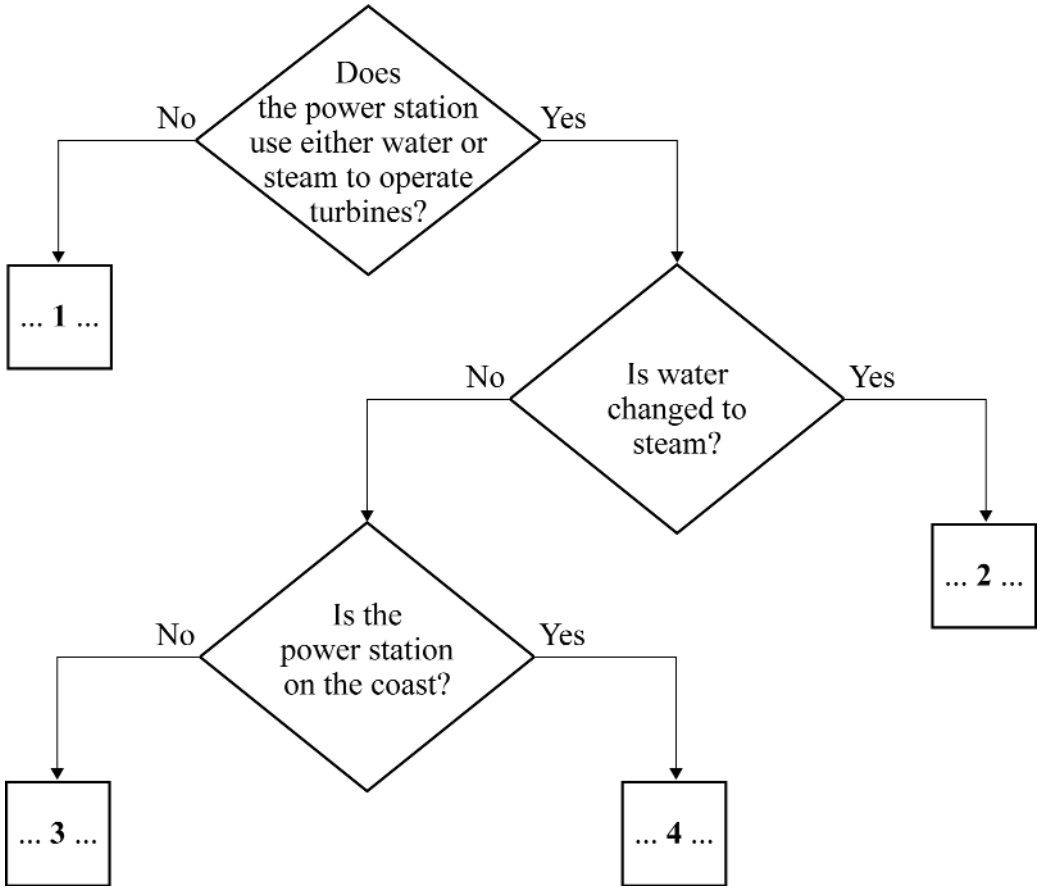
Match the types of power station, **A**, **B**, **C** and **D**, with the numbers **1 – 4** in the flow chart.

A hydroelectric

B nuclear

C wind

D tidal



QUESTION FOUR

The Sankey diagram shows energy transfers in a petrol engine.

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

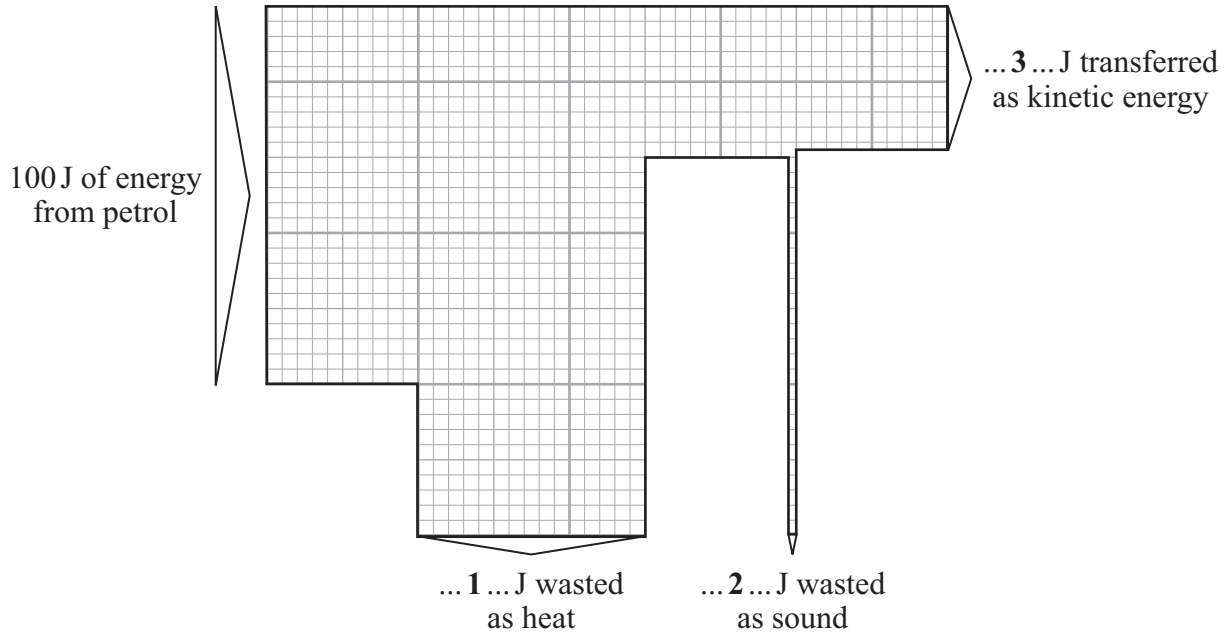
Match numbers, **A**, **B**, **C** and **D**, with the spaces **1–4** on the diagram.

A 0.38

B 2

C 38

D 60



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

QUESTION FIVE

Convection currents are formed when liquids are heated.

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

A decreases

B increases

C is unchanged

D rises

When liquids are heated, the particles gain kinetic energy.

The space between the particles in the liquid . . . **1** . . . so the density of the liquid . . . **2** . . . .

The warm liquid . . . **3** . . . .

The total mass of the liquid . . . **4** . . . .

QUESTION SIX

Read this article.

Save energy and save money

Recent research shows that money can be saved in most houses by reducing energy losses. Scientists investigated energy costs in houses. They compared houses where the occupants had similar lifestyles. Some of the houses had large amounts of thermal insulation.

The scientists compared these houses to similar houses with only small amounts of thermal insulation. They found that some households could save more than £500 per year by improving insulation.

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

A conclusion

B control variable

C dependent variable

D independent variable

In this investigation, the amount of insulation was the . . . **1** . . . .

Lifestyle was the . . . **2** . . . .

Energy cost in a house was the . . . **3** . . . .

The amount of money that could be saved by insulation was the . . . **4** . . . .

Turn over for the next question

SECTION TWO

Questions **SEVEN** to **NINE**.

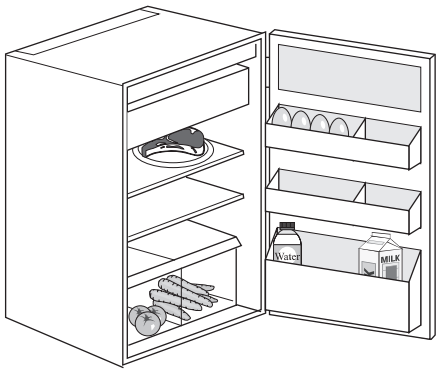
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION SEVEN

The electricity supplied to a fridge costs 11p for each kilowatt-hour (kWh).



energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)
total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

During one summer month, the fridge used 20 kWh of electricity.

7A How much did this electricity cost?

1 20 p

2 £2.00

3 £2.20

4 £220.00

7B The fridge has a power of 50 W.

How much energy does it transfer in 24 hours?

1 1.2 kWh

2 2.4 kWh

3 50 kWh

4 1200 kWh

UK households spend £1.2 billion on electricity every year, just on refrigeration and freezing. Buying a new *Energy Efficiency Recommended* fridge can save each household up to £35 a year.

7C An *Energy Efficiency Recommended* fridge will be better than an older fridge because . . .

1 it will keep food colder.

2 it will keep food fresh longer.

3 it will use less electricity.

4 it will not break down.

7D The Government is encouraging people to use *Energy Efficiency Recommended* electrical appliances so that . . .

1 people will be better off.

2 less carbon dioxide will be released into the atmosphere.

3 less food will be wasted.

4 more jobs will be created.

Turn over for the next question

QUESTION EIGHT

A student investigated the question: Does the type of surface affect how an object loses or gains heat? She carried out two experiments.

In her first experiment, she filled two cans with boiling water. One can had a dull, black surface. The other can had a shiny, silver surface.

Later, she measured the temperature of the water in each can.

These are her results.

	Starting temperature of the water	**Temperature of the water 15 minutes later**
Can with dull, black surface	100 °C	74 °C
Can with shiny, silver surface	100 °C	93 °C

8A The student wanted her experiment to be a fair test.

Which row of the table is most likely to give a fair test?

	Volume of cans	**Volume of water**	**Metal of the cans**	**Shape of cans**
1	same	different	same	same
2	same	same	different	same
3	same	same	same	different
4	same	same	same	same

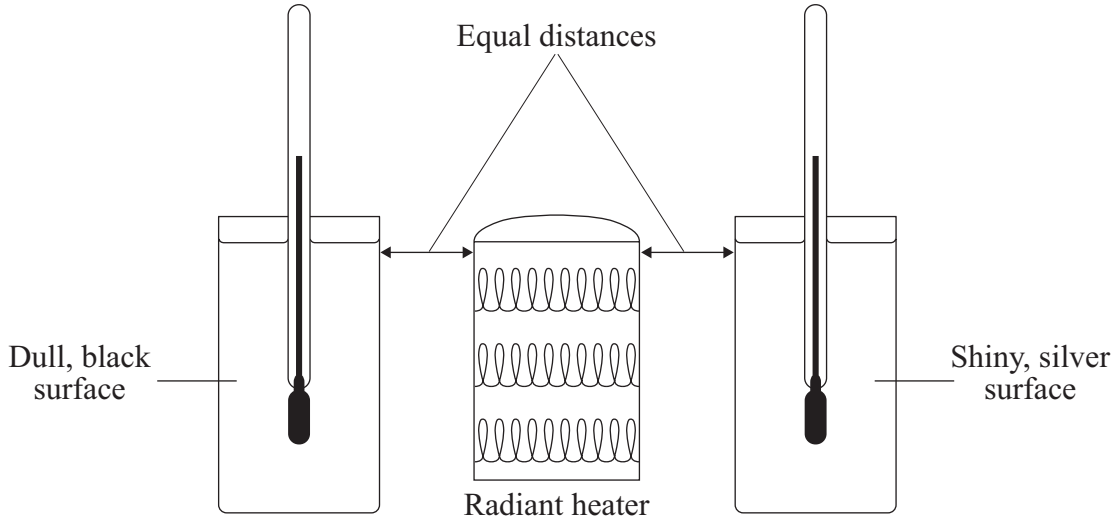
8B If her results are reliable, the experiment shows that, compared with a shiny, silver surface, a dull, black surface is a . . .

1 better absorber of thermal radiation.

2 better conductor of thermal radiation.

3 better emitter of thermal radiation.

4 better reflector of thermal radiation.



In her second experiment, the student put cold water in each can. She put a heater (which is a source of thermal radiation) between the cans. She switched the heater on and, ten minutes later, she measured the temperature of the water in each can.

These are the results of her second experiment.

	Starting temperature of the water	**Temperature of the water 10 minutes later**
Can with dull, black surface	16 °C	37 °C
Can with shiny, silver surface	16 °C	23 °C

8C If her results are reliable, the second experiment shows that, compared with a shiny, silver surface, a dull, black surface is a . . .

1 better absorber of thermal radiation.

2 better conductor of thermal radiation.

3 better emitter of thermal radiation.

4 better reflector of thermal radiation.

8D What was the average (mean) rate of the rise in temperature of the water in the can with a dull, black surface?

1 0.9 °C per minute

2 2.1 °C per minute

3 9 °C per minute

4 21 °C per minute

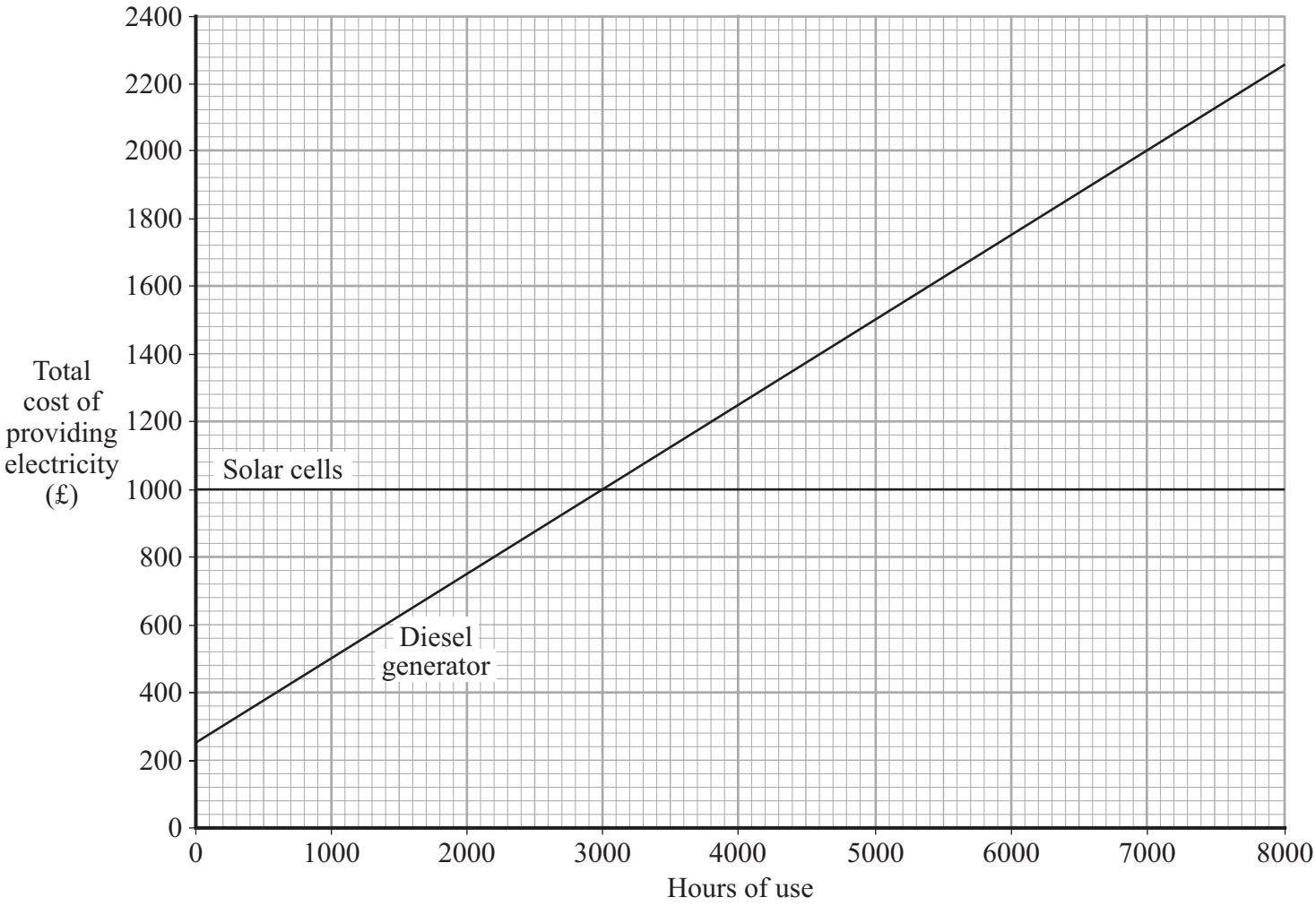
QUESTION NINE

A remote village in South America is many kilometres from a mains electricity supply.

The villagers plan to pump water from the river and to use some of the water to irrigate fields.

They need an electricity supply to operate the pump.

The graph shows the total cost of two different ways of providing this electricity over time.



9A The graph shows that . . .

1 there are fuel costs but no maintenance costs for the solar cells.

2 there are maintenance costs but no fuel costs for the solar cells.

3 there are no fuel costs and no maintenance costs for the solar cells.

4 there are no fuel costs and no maintenance costs for the diesel generator.

9B The price to buy the solar cells, compared with buying the diesel generator, is . . .

1 twice as much.

2 three times as much.

3 four times as much.

4 five times as much.

9C Providing electricity by diesel generator becomes more expensive than by solar cells after . . .

1 1000 hours of use.

2 2000 hours of use.

3 3000 hours of use.

4 4000 hours of use.

9D Maintenance of solar cells costs less than maintenance of the diesel generator mainly because . . .

1 solar cells have no moving parts.

2 solar cells do not produce exhaust gases.

3 solar cells operate at lower temperatures than diesel generators.

4 solar cells work only during the day.

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** to **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

Read this article.

Save energy and save money

Recent research shows that money can be saved in most houses by reducing energy losses. Scientists investigated energy costs in houses. They compared houses where the occupants had similar lifestyles. Some of the houses had large amounts of thermal insulation.

The scientists compared these houses to similar houses with only small amounts of thermal insulation. They found that some households could save more than £500 per year by improving insulation.

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

A conclusion

B control variable

C dependent variable

D independent variable

In this investigation, the amount of insulation was the . . . **1** . . . .

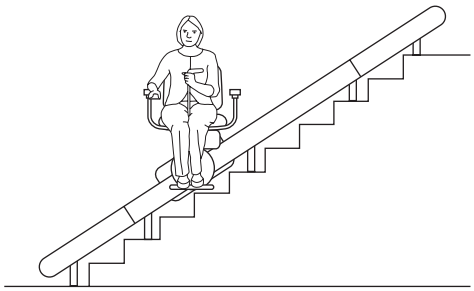
Lifestyle was the . . . **2** . . . .

Energy cost in a house was the . . . **3** . . . .

The amount of money that could be saved by insulation was the . . . **4** . . . .

QUESTION TWO

The drawing shows a woman being moved upstairs by a stair lift.



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

A electrical energy

B gravitational potential energy

C sound energy

D thermal energy

As the stair lift moves upwards, . . . **1** . . . is usefully transformed to . . . **2** . . . .

Some energy is wasted, mainly as . . . **3** . . . , but also as . . . **4** . . . .

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 investigated the question: Does the type of surface affect how an object loses or gains heat? She carried out two experiments.

In her first experiment, she filled two cans with boiling water. One can had a dull, black surface. The other can had a shiny, silver surface.

Later, she measured the temperature of the water in each can.

These are her results.

	Starting temperature of the water	**Temperature of the water 15 minutes later**
Can with dull, black surface	100 °C	74 °C
Can with shiny, silver surface	100 °C	93 °C

3A The student wanted her experiment to be a fair test.

Which row of the table is most likely to give a fair test?

	Volume of cans	**Volume of water**	**Metal of the cans**	**Shape of cans**
1	same	different	same	same
2	same	same	different	same
3	same	same	same	different
4	same	same	same	same

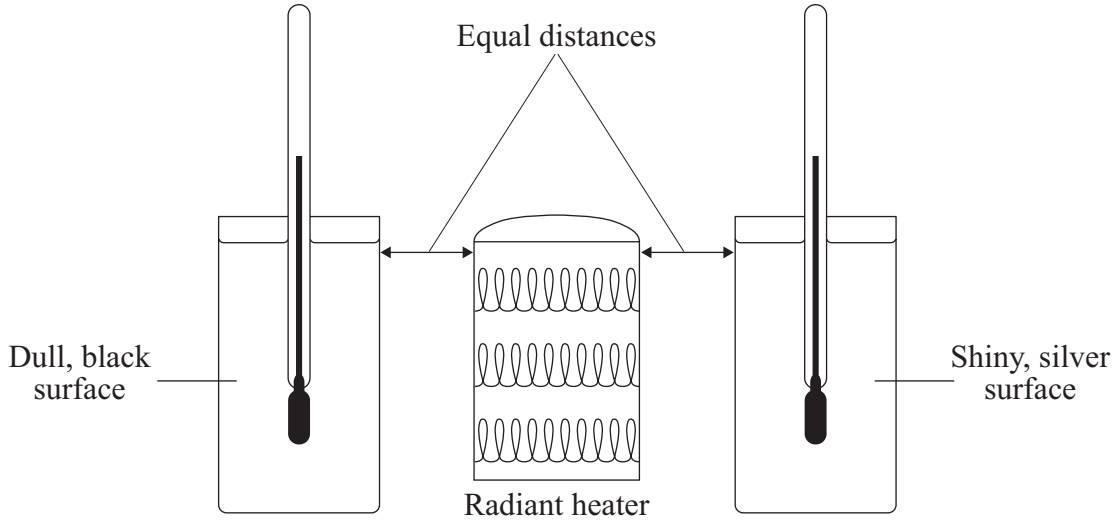
3B If her results are reliable, the experiment shows that, compared with a shiny, silver surface, a dull, black surface is a . . .

1 better absorber of thermal radiation.

2 better conductor of thermal radiation.

3 better emitter of thermal radiation.

4 better reflector of thermal radiation.



In her second experiment, the student put cold water in each can. She put a heater (which is a source of thermal radiation) between the cans. She switched the heater on and, ten minutes later, she measured the temperature of the water in each can.

These are the results of her second experiment.

	Starting temperature of the water	**Temperature of the water 10 minutes later**
Can with dull, black surface	16 °C	37 °C
Can with shiny, silver surface	16 °C	23 °C

3C If her results are reliable, the second experiment shows that, compared with a shiny, silver surface, a dull, black surface is a . . .

1 better absorber of thermal radiation.

2 better conductor of thermal radiation.

3 better emitter of thermal radiation.

4 better reflector of thermal radiation.

3D What was the average (mean) rate of the rise in temperature of the water in the can with a dull, black surface?

1 0.9 °C per minute

2 2.1 °C per minute

3 9 °C per minute

4 21 °C per minute

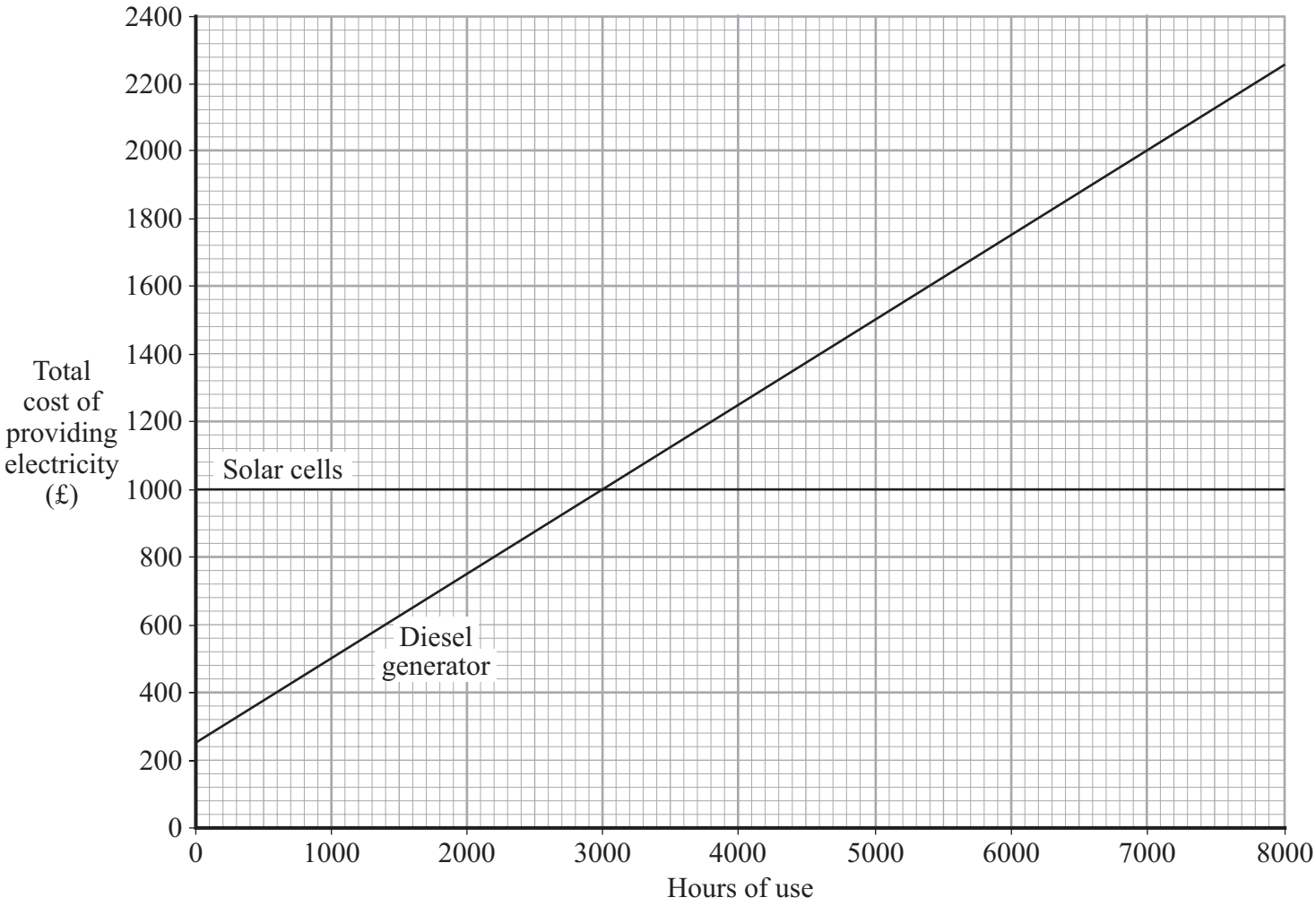
QUESTION FOUR

A remote village in South America is many kilometres from a mains electricity supply.

The villagers plan to pump water from the river and to use some of the water to irrigate fields.

They need an electricity supply to operate the pump.

The graph shows the total cost of two different ways of providing this electricity over time.



4A The graph shows that . . .

1 there are fuel costs but no maintenance costs for the solar cells.

2 there are maintenance costs but no fuel costs for the solar cells.

3 there are no fuel costs and no maintenance costs for the solar cells.

4 there are no fuel costs and no maintenance costs for the diesel generator.

4B The price to buy the solar cells, compared with buying the diesel generator, is . . .

1 twice as much.

2 three times as much.

3 four times as much.

4 five times as much.

4C Providing electricity by diesel generator becomes more expensive than by solar cells after . . .

1 1000 hours of use.

2 2000 hours of use.

3 3000 hours of use.

4 4000 hours of use.

4D Maintenance of solar cells costs less than maintenance of the diesel generator mainly because . . .

1 solar cells have no moving parts.

2 solar cells do not produce exhaust gases.

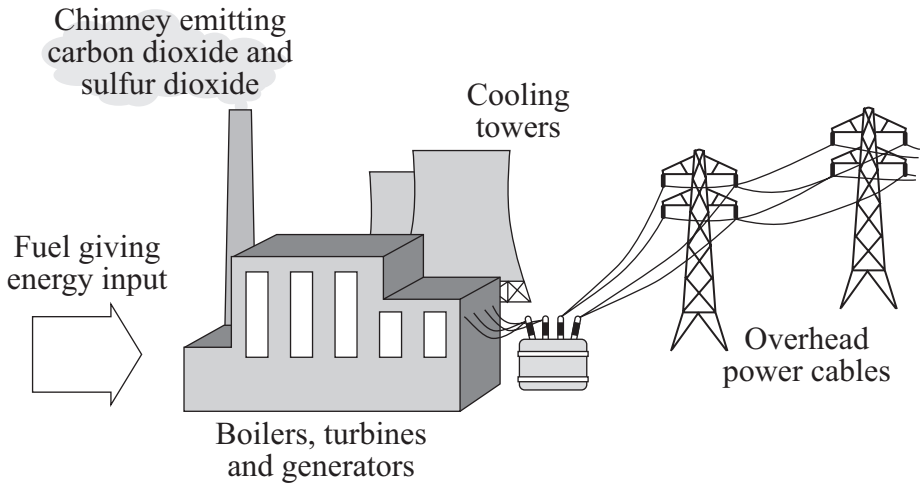
3 solar cells operate at lower temperatures than diesel generators.

4 solar cells work only during the day.

Turn over for the next question

QUESTION FIVE

The diagram shows a power station.



5A What type of power station is this?

1 coal-burning

2 gas-burning

3 geothermal

4 nuclear

5B Which part transforms kinetic energy into electrical energy?

1 boiler

2 cooling tower

3 generator

4 turbine

5C After steam has passed through the turbines, it is passed upwards through the cooling towers. Here, the steam condenses to form water vapour.

What types of pollution are caused by the cooling towers?

1 chemical and noise

2 noise and thermal

3 thermal and visual

4 visual and chemical

5D A fossil-fuel power station is going to be built in a part of the country that does not have a power station.

Which one of the following is **not** an advantage to the local economy?

1 Carbon dioxide from the power station can be used in local commercial greenhouses.

2 More jobs will be created.

3 The power station will be connected to the National Grid.

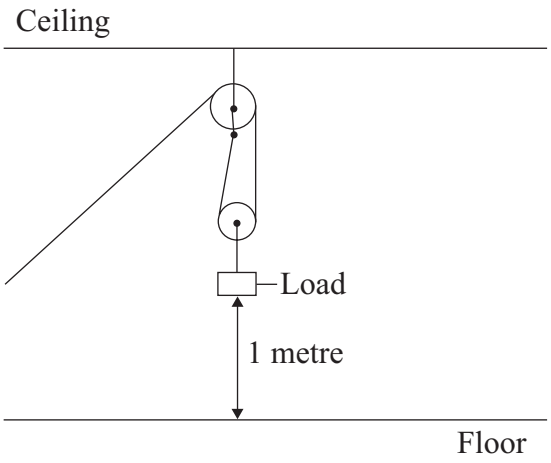
4 Waste heat can be used in nearby buildings.

Turn over for the next question

QUESTION SIX

A student investigated a pulley system used to lift different loads. The student calculated the useful energy transferred by the pulley system for each load as it was lifted one metre. She then calculated the efficiency of the pulley system using the following equation.

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



The table shows the student's results.

Useful energy transferred by the pulley system (in J)	**Total energy supplied to the pulley system (in J)**	**Calculated efficiency**
1.00	3.33	0.30
2.00	4.16	0.48
3.00	5.00	
4.00	5.05	0.79
5.00	6.25	0.80

6A What was the efficiency when the useful energy transferred by the pulley system was 3 J?

1 0.15

2 0.167

3 0.60

4 1.67

6B Which value of total energy supplied to the pulley system is probably anomalous?

1 3.33 J

2 4.16 J

3 5.05 J

4 6.25 J

6C Using both your knowledge and the data in the table, suggest what would happen to the efficiency of the pulley system if the energy supplied continued to increase.

The efficiency would eventually . . .

1 exceed 1.00.

2 reach a maximum.

3 begin to decrease.

4 increase, then begin to decrease.

6D The difference between the useful energy transferred by the pulley system and the total energy supplied to the pulley system is called the . . .

1 effective energy.

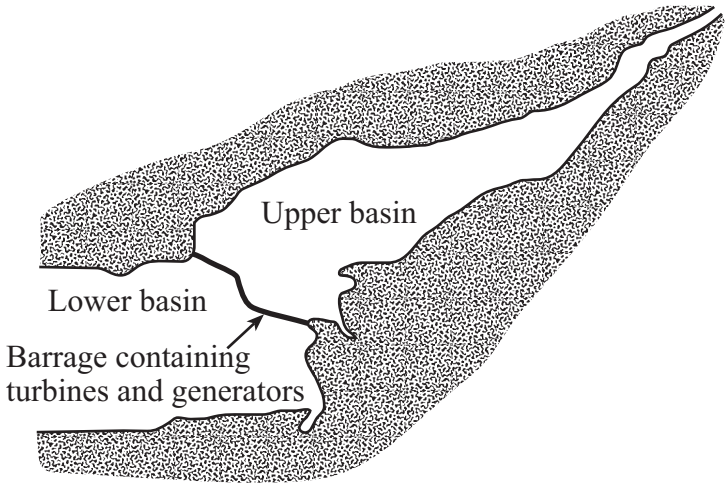
2 transferred energy.

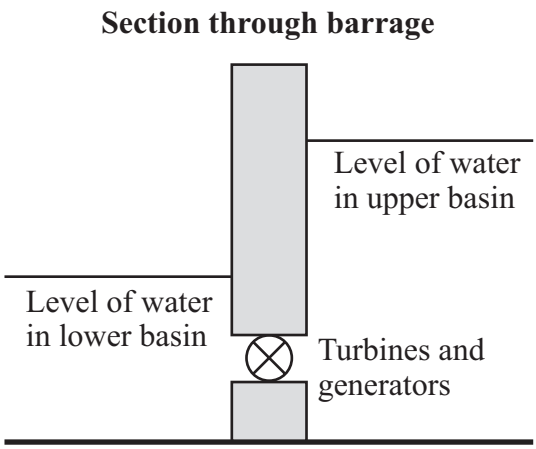
3 transformed energy.

4 wasted energy.

QUESTION SEVEN

The diagram shows a tidal barrage used to generate electricity. Before the barrage was built, the mudflats on the estuary were repeatedly covered with sea water as the tide came in and went out again.





7A As water moves from the lower basin into the upper basin, it gains mainly . . .

1 electrical energy.

2 gravitational potential energy.

3 sound energy.

4 thermal energy.

7B Which is the main energy transformation as water flows from the upper basin through the turbine?

1 electrical energy to gravitational potential energy

2 electrical energy to kinetic energy

3 gravitational potential energy to kinetic energy

4 kinetic energy to gravitational potential energy

7C Compared with a coal-fired power station with a similar generating capacity, a tidal barrage usually . . .

1 costs more to build.

2 has a more concentrated energy supply.

3 has higher fuel costs.

4 has a more constant energy output.

7D One disadvantage of this tidal barrage is that . . .

1 it cannot be used in summer.

2 it has high decommissioning costs.

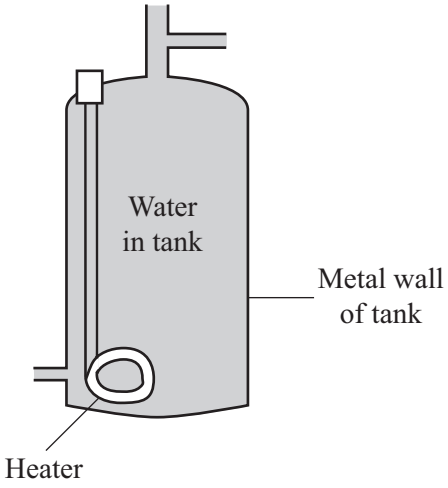
3 its output depends on the weather.

4 large areas forming habitats for wildlife will be lost.

Turn over for the next question

QUESTION EIGHT

Many homes have hot-water tanks. An electric heater is used to heat the water. Some heat (thermal energy) is lost through the metal walls to the surroundings.



8A The energy spreads through the water by . . .

1 heated water contracting and falling.

2 heated water expanding and rising.

3 heat rising.

4 the movement of free electrons.

8B The energy is transferred through the metal walls by . . .

1 heated water expanding and rising.

2 infra red waves passing through the metal.

3 the atoms gaining energy and moving faster through the metal.

4 the movement of free electrons.

8C The metal walls of the tank transfer energy to the surroundings by . . .

1 heated air contracting and falling.

2 infra red waves passing through the air.

3 metal atoms gaining energy and escaping into the air.

4 the movement of free electrons.

8D The air in contact with the outside of the metal walls . . .

1 contracts and falls due to decreased density.

2 contracts and falls due to increased density.

3 expands and rises due to decreased density.

4 expands and rises due to increased density.

Turn over for the next question

QUESTION NINE

The table shows the various costs, per kilowatt-hour, of electricity that is generated in four different ways.

Energy source	Capital cost	Running cost	Decommissioning cost
Nuclear	3.0 p	0.5 p	2.5 p
Gas	1.5 p	2.0 p	0.1 p
Coal	2.0 p	2.5 p	0.1 p
Wind	4.5 p	0.1 p	0.2 p

9A Considering only running cost, how much more does it cost to generate 1000 kilowatt-hours of electricity in a coal-fired power station than in a gas-fired power station?

1 £ 5

2 £ 15

3 £ 20

4 £ 25

9B It costs more to produce electricity from wind farms than from fuel-burning power stations.

This is mainly because wind generators . . .

1 have higher decommissioning costs.

2 have only very recently been developed.

3 have higher running costs.

4 use a dilute energy source.

9C In the UK, most new power stations are gas-fired.

This is because, compared with all the other ways of generating electricity shown in the table, . . .

1 they cause less atmospheric pollution.

2 they are cheaper to build and cheaper overall.

3 they have lower running costs.

4 they use a renewable energy source.

9D Which one of the four ways of generating electricity is most suited to meeting short surges in the demand for electricity at any time of the day?

1 coal

2 gas

3 nuclear

4 wind

END OF TEST

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