Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

General Certificate of Secondary Education
March 2007

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

PHYSICS
Unit P1a (Energy and Electricity)

Monday 12 March 2007 Morning Session

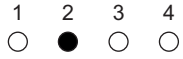
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

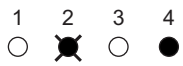
Time allowed: 30 minutes

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.

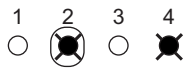
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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 16 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

Energy is supplied to a microwave oven by mains electricity.

The oven transforms this energy in various ways.

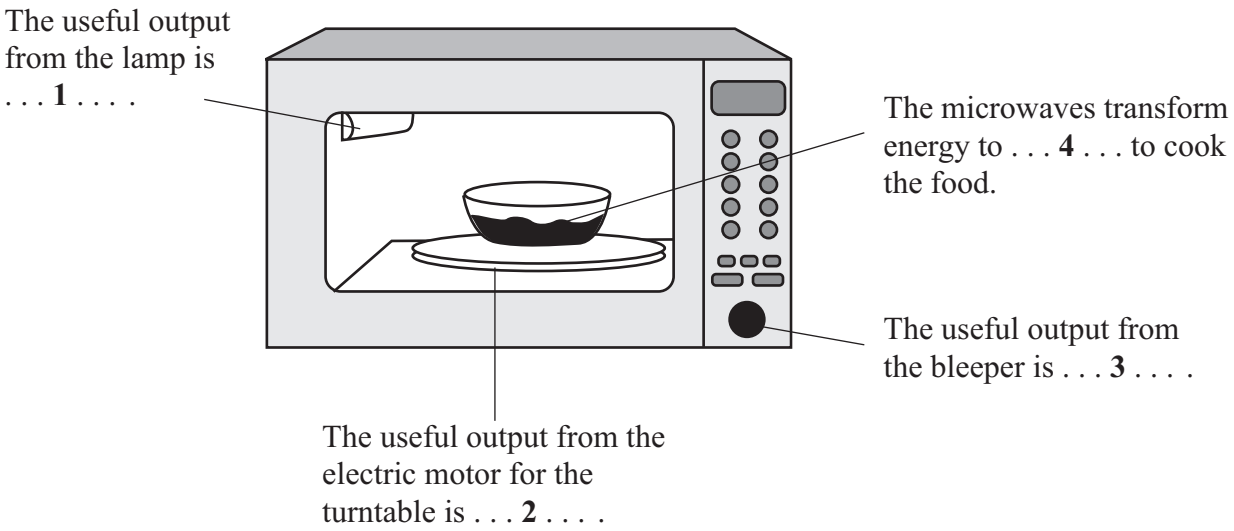
Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A heat

B light

C movement

D sound



QUESTION TWO

Various types of power station use different energy sources and affect the environment in various ways.

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

A Coal-fired power stations

B Geothermal power stations

C Nuclear power stations

D Tidal power stations

. . . **1** . . . use energy from the natural decay of radioactive substances in the Earth.

. . . **2** . . . use no fuel but river estuaries have to be flooded.

. . . **3** . . . use uranium as a fuel in reactors.

. . . **4** . . . can pollute the atmosphere with sulfur dioxide.

Turn over for the next question

QUESTION THREE

A gas fire transfers heat to a room in various ways.

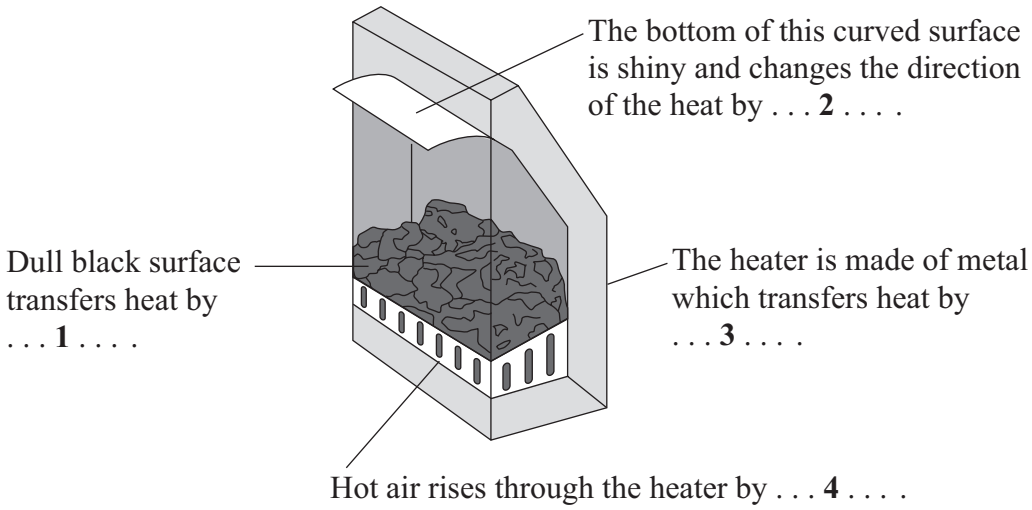
Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A conduction

B convection

C radiation

D reflection



QUESTION FOUR

This question is about an electric kettle which is used to boil some water.

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

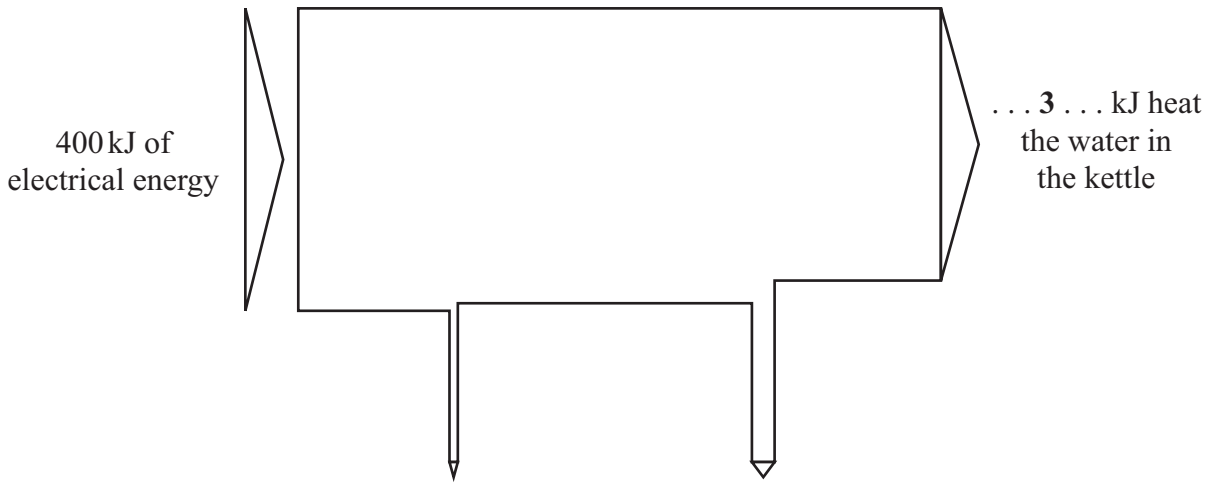
Match numbers, **A**, **B**, **C** and **D**, with the spaces **1–4**.

A 0.9

B 10

C 30

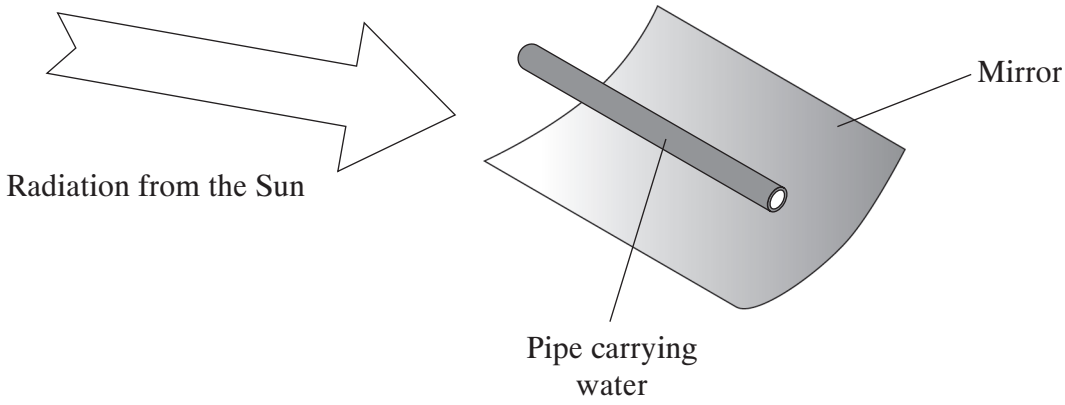
D 360



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

QUESTION FIVE

The diagram shows part of a solar-powered power station.



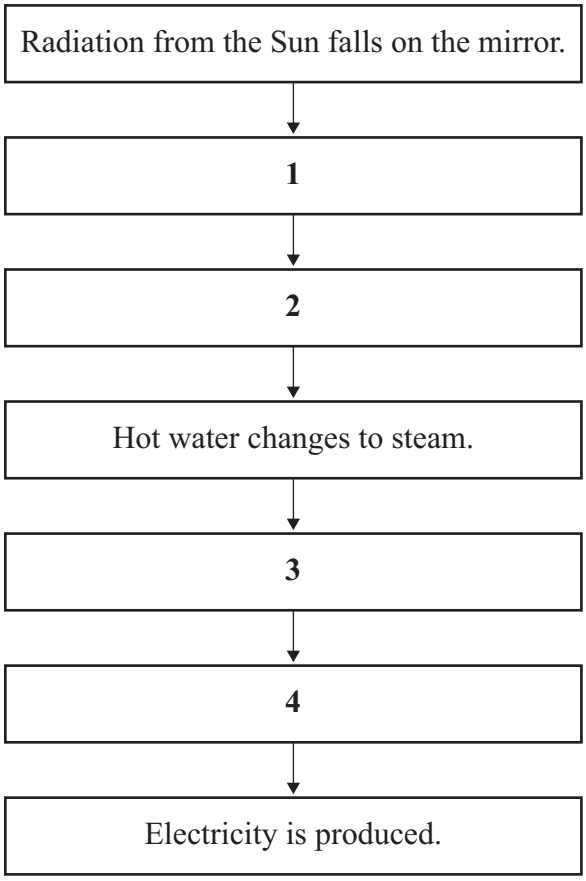
Match stages, **A**, **B**, **C** and **D**, with the boxes **1–4** in the flow chart on the next page to explain how the power station works.

A The turbine turns the generator.

B Radiation is reflected onto the pipe.

C Steam drives the turbine.

D Water in the pipe absorbs energy.



Turn over for the next question

QUESTION SIX

Read this extract from a magazine article.

New device improves wind turbines

A recent study found that wind turbines fitted with a new device, which makes them more responsive to small changes in wind direction, give a better output.

Scientists investigated the output of some wind turbines. They compared wind turbines of similar design, in similar locations. Half of the turbines were fitted with 'wind finders' which respond to small changes in wind direction. They found that 'wind finders' can improve the useful output of wind turbines by up to 10%.

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

A conclusion

B control

C environment

D evidence

The wind turbines without 'wind finders' were the scientists' . . . **1** . . . .

The useful output from the wind turbines was the scientists' . . . **2** . . . .

What the scientists found out helped them to reach their . . . **3** . . . .

Improving wind turbines is important for 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

An electricity company plans to build a new power station and it is in the process of consulting local people.

The decisions are not straightforward because various points need to be considered.

7A Every type of energy source for a power station is unreliable in some circumstances.

Which energy source is unreliable on a day-to-day basis?

1 coal

2 oil

3 uranium

4 wind

7B Every type of power station makes some contribution to global warming.

Which type of power station makes the **least** contribution?

1 a coal-fired power station

2 a gas-fired power station

3 a nuclear power station

4 an oil-fired power station

7C Every type of power station changes the local environment in some way.

Which type of power station involves the damming of an upland river valley?

1 a geothermal power station

2 a hydroelectric power station

3 a tidal barrage

4 a wind farm

7D Which type of power station can also be used to store energy from surplus electricity?

1 a coal-fired power station

2 a gas-fired power station

3 a hydroelectric power station

4 a nuclear power station

Turn over for the next question

QUESTION EIGHT

Electrical appliances usefully transform only part of the energy that is supplied to them. The rest of the energy is wasted.

Chefs often use electric mixers to combine ingredients.

8A A mixer **usefully** transforms electrical energy to . . .

1 kinetic energy.

2 light energy.

3 sound energy.

4 thermal energy.

8B The energy that is **not** usefully transformed by the mixer is wasted as . . .

1 heat and sound.

2 heat only.

3 sound and kinetic energy.

4 sound only.

8C Which of the following statements is **false**?

1 The energy transformed by the mixer becomes difficult to use for other energy transformations.

2 The energy transformed by the mixer ends up making the surroundings a little warmer.

3 The energy transformed by the mixer ends up very spread out.

4 The energy transformed by the mixer no longer exists.

8D A second mixer transforms useful energy at the same rate as this one however, it wastes more energy.

This means that the second mixer . . .

1 costs less per minute to run.

2 is less efficient.

3 is more efficient.

4 transforms energy at a slower rate.

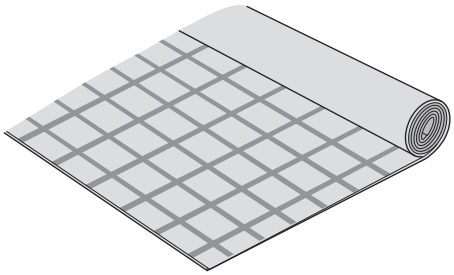
Turn over for the next question

QUESTION NINE

Energy costs rising

Many householders are concerned at the rising cost of energy.

The drawings are from a magazine article on how to reduce the cost of home heating by using insulation.

<table>
<tr>
<td>Carpeting the floor
 
Saving per week for each square metre
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 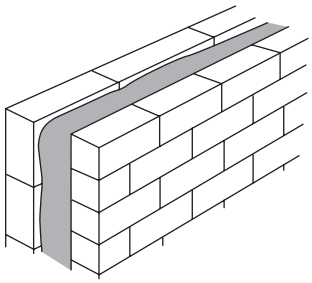
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 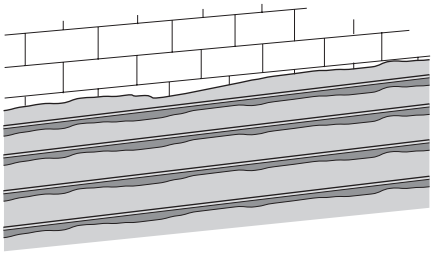
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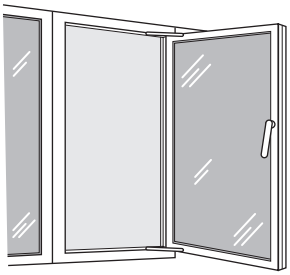
<td>Fitting double-glazed windows
 
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9A All the methods shown in the diagrams make use of . . .

1 good emitters of thermal radiation.

2 materials that prevent warm air from rising.

3 trapped air.

4 warm materials.

9B A student is asked to explain why the savings in the magazine article may not be correct for different houses.

The student makes the following points:

- not all double glazing is equally good
- not all insulation in the loft is to the same depth
- the difference between the outside temperature and the inside temperature of the different houses is not constant.

Which one of the following statements is correct?

1 Only the student's first point is correct.

2 Only the student's first two points are correct.

3 All three of the student's points are correct.

4 None of the student's points is correct.

9C An energy saving expert suggests how to reduce the heating bill for a house. She says that having foam inserted in the wall cavity will reduce the heating bill more than having double glazing fitted.

Her statement is correct.

This is because . . .

1 foam insulation is cheaper than double glazing.

2 more heat is lost through each square metre of window compared with each square metre of wall.

3 the area of the walls is much greater than the area of the windows.

4 the windows are not always closed.

9D The Government wants to encourage energy saving. There will be several advantages to the environment if this is achieved.

Which of the following will be the most important advantage to the environment?

1 It will be more important to develop renewable energy technology.

2 Less energy will need to be transformed from fossil fuels.

3 Less energy will need to be transformed from renewable resources.

4 There will be no need to build new nuclear power stations.

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 extract from a magazine article.

New device improves wind turbines

A recent study found that wind turbines fitted with a new device, which makes them more responsive to small changes in wind direction, give a better output.

Scientists investigated the output of some wind turbines. They compared wind turbines of similar design, in similar locations. Half of the turbines were fitted with 'wind finders' which respond to small changes in wind direction. They found that 'wind finders' can improve the useful output of wind turbines by up to 10%.

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

A conclusion

B control

C environment

D evidence

The wind turbines without 'wind finders' were the scientists' . . . **1** . . . .

The useful output from the wind turbines was the scientists' . . . **2** . . . .

What the scientists found out helped them to reach their . . . **3** . . . .

Improving wind turbines is important for the . . . **4** . . . .

QUESTION TWO

Thermal energy can be transferred in several ways.

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

A free electrons

B ions

C particles

D waves

Convection currents in liquids and gases are the result of expansion caused by . . . **1** . . . moving faster in hotter regions.

Thermal radiation is energy transfer by . . . **2** . . . .

The hotter a metal is, the greater the kinetic energy of the vibrating . . . **3** . . . in the metal structure.

Kinetic energy is transferred to cooler parts of the metal by . . . **4** . . . diffusing through it.

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

Electrical appliances usefully transform only part of the energy that is supplied to them. The rest of the energy is wasted.

Chefs often use electric mixers to combine ingredients.

3A A mixer **usefully** transforms electrical energy to . . .

1 kinetic energy.

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4 thermal energy.

3B The energy that is **not** usefully transformed by the mixer is wasted as . . .

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3C Which of the following statements is **false**?

1 The energy transformed by the mixer becomes difficult to use for other energy transformations.

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3D A second mixer transforms useful energy at the same rate as this one however, it wastes more energy.

This means that the second mixer . . .

1 costs less per minute to run.

2 is less efficient.

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Turn over for the next question

QUESTION FOUR

Energy costs rising

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 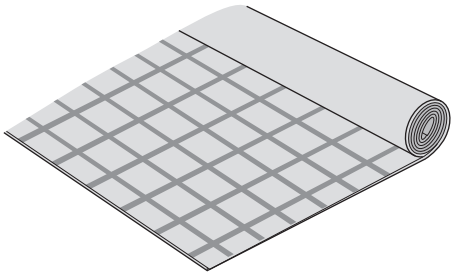
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 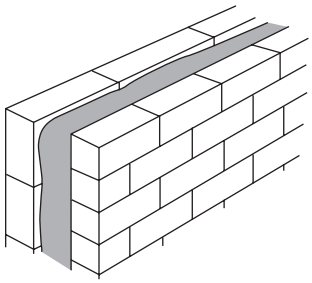
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 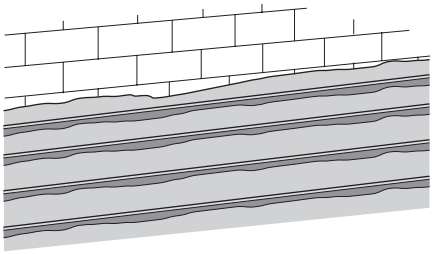
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 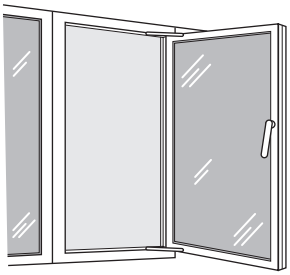
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The student makes the following points:

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4D The Government wants to encourage energy saving. There will be several advantages to the environment if this is achieved.

Which of the following will be the most important advantage to the environment?

1 It will be more important to develop renewable energy technology.

2 Less energy will need to be transformed from fossil fuels.

3 Less energy will need to be transformed from renewable resources.

4 There will be no need to build new nuclear power stations.

QUESTION FIVE

This statement was made during a recent television news programme.

> Environmentalists expressed concern today about possible increases in acid rain if the Government goes ahead with its plans for more power stations.
>
> "If the world needs more power stations, they should be wind farms, tidal barrages or geothermal," a spokesperson said.

5A The gas mainly responsible for producing acid rain is . . .

1 natural gas.

2 nitrogen.

3 oxygen.

4 sulfur dioxide.

5B The source of energy for geothermal power stations is . . .

1 combustion.

2 decay of radioactive elements.

3 movement of air.

4 movement of water.

5C Which is the main advantage of a tidal barrage over a wind farm?

1 More power is produced at times of high demand.

2 More power is produced in winter than in summer.

3 There are no environmental impacts.

4 The outputs for each day can be predicted.

5D 700 000 kilowatts of power are produced when 100 tonnes of coal are burned in one hour.

How quickly must the coal be burned to produce 7 000 000 kilowatts?

1 10 tonnes/hour

2 70 tonnes/hour

3 100 tonnes/hour

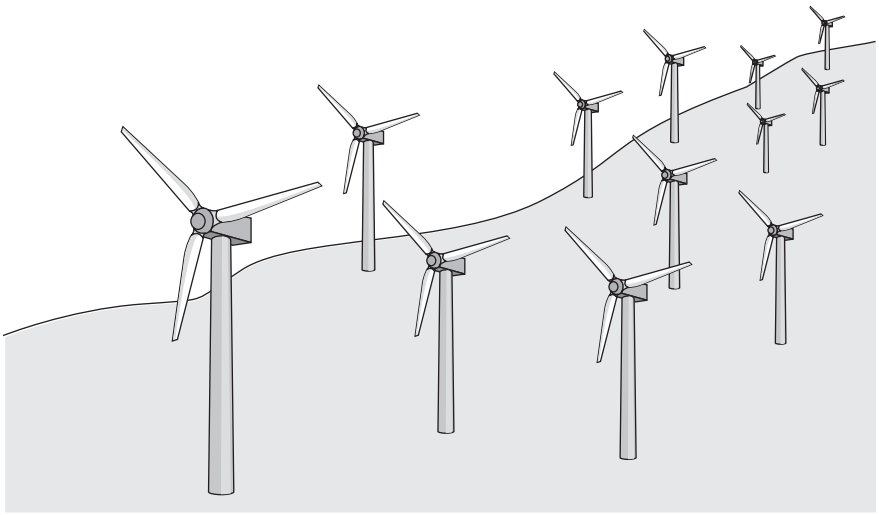
4 1000 tonnes/hour

Turn over for the next question

QUESTION SIX

Wind turbines on Coldharbour site

The drawing shows part of a wind farm which will supply electricity to a small town.



6A Which type of energy is transformed from the wind to generate electricity?

1 elastic potential

2 gravitational potential

3 kinetic

4 sound

6B Where would you **least** expect to find a wind farm?

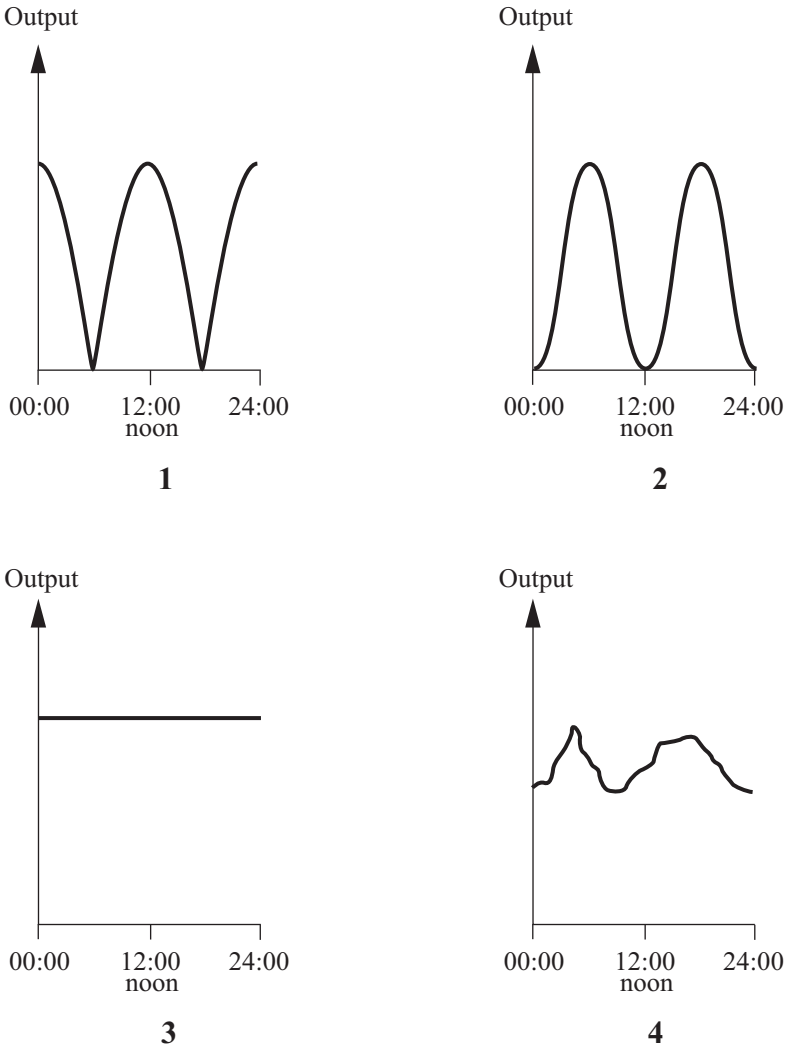
1 in a town

2 offshore – out at sea

3 on a coastal cliff

4 on the top of a hill

6C Which graph is most likely to show the output from a wind farm over one day?



6D There are 10 000 homes in the town. The average electrical power input into each home is 0.5 kW. The average useful power output of the wind farm is 5 MW.

Why is this insufficient to meet the needs of the town?

1 0.5 kW × 10 000 is more than 5 MW.

2 5 MW is less than 0.5 kW × 10 000.

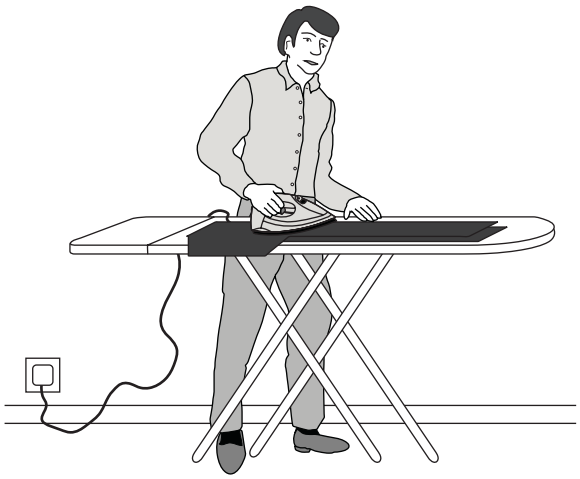
3 Supply and demand will often not coincide.

4 The wind farm wastes energy because it is noisy.

QUESTION SEVEN

energy transferred (joule, J)	=	power (watt, W)	×	time (second, s)
energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)
total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

This question is about an electric iron. The power of the iron is 1.2 kW.



7A The base of the iron radiates energy.

It will radiate **least** energy when the base is . . .

1 at a high temperature and black.

2 at a high temperature and shiny.

3 at a low temperature and black.

4 at a low temperature and shiny.

7B What is the maximum quantity of energy, in joules, that can be transformed by the iron in one hour?

1 72 J

2 4320 J

3 72 000 J

4 4 320 000 J

7C When the iron is used for one hour, less than the calculated maximum amount of energy is transformed.

Why is this?

1 Some energy is provided by the person doing the ironing.

2 Some energy is transferred to the surroundings.

3 The ironing board is covered with an insulator.

4 The iron switches off at times to keep it at the correct temperature.

7D Electricity costs 10 p per kilowatt-hour. In one week, the iron uses electricity for a total of 90 minutes.

Calculate the cost of this electricity.

1 £ 0.15

2 £ 0.18

3 £ 0.90

4 £ 1.08

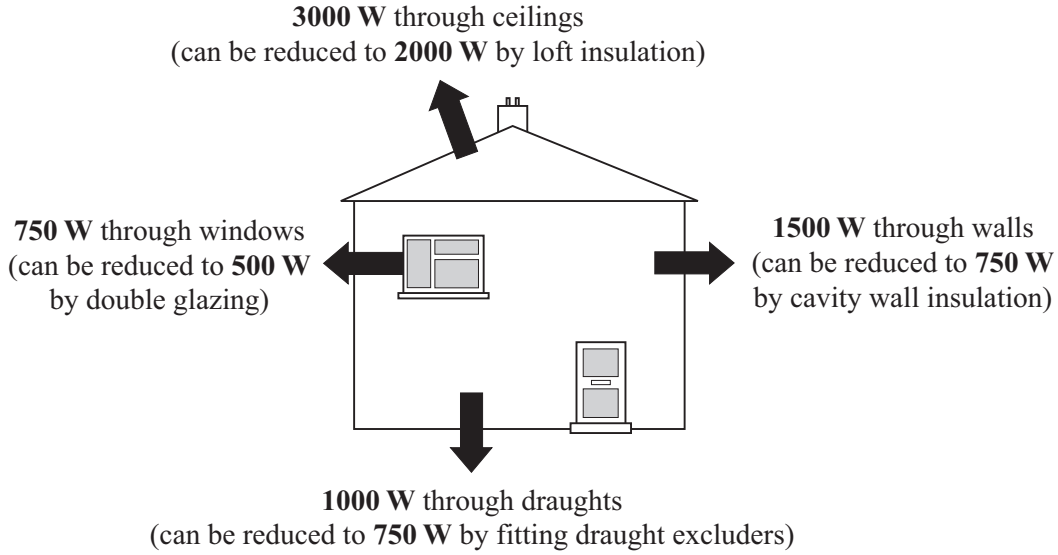
Turn over for the next question

QUESTION EIGHT

Save money with home insulation

The information in this question is taken from a magazine article about home insulation.

The diagram shows some of the ways that heat can be lost from the inside of a house. It also shows how these heat losses may be reduced.



The table shows the cost of reducing the heat loss, how much money can be saved and the pay-back time.

Way of reducing heat loss	Cost	Money saved per year	Pay-back time
Cavity wall insulation	£675		5 years
Double glazing	£2250	£45	50 years
Draught excluders	£15	£45	
Loft insulation	£360	£180	2 years

8A How much money is saved each year if cavity wall insulation is fitted?

1 £ 135

2 £ 145

3 £ 155

4 £ 165

8B What is the pay-back time if draught excluders are fitted?

1 3 months

2 4 months

3 3 years

4 4 years

8C Which way of reducing heat loss gives the greatest reduction as a fraction of the total heat loss from the house?

1 cavity wall insulation

2 double glazing

3 draught excluders

4 loft insulation

8D The owner installs draught excluders and loft insulation.

By what approximate percentage can she expect the total heat loss through the ceilings and by draughts to be reduced?

1 20 %

2 30 %

3 40 %

4 60 %

QUESTION NINE

The table gives the estimated costs, per kilowatt-hour, of generating electricity from four different energy sources.

Use the information in the table to help you to answer some of the questions.

Energy source	Building cost	Fuel cost	Operating cost	Decommissioning cost
Coal	2.0 p	0.6 p	0.9 p	0.1 p
Gas	2.3 p	1.4 p	0.3 p	0.1 p
Nuclear	4.2 p	0.4 p	0.7 p	2.5 p
Wind	4.8 p	zero	0.9 p	0.2 p

9A A power station must run continuously to meet a steady demand.

Ignoring the decommissioning and building costs, which power station would be economically best?

1 coal

2 gas

3 nuclear

4 wind

9B Which of the following is the correct order, cheapest first, for the **total** cost of producing each kWh of electricity?

1 coal, gas, wind, nuclear

2 gas, coal, nuclear, wind

3 nuclear, wind, gas, coal

4 wind, gas, coal, nuclear

9C Which type of power station is the best for meeting short surges in demand for electricity?

1 coal

2 gas

3 nuclear

4 wind

9D Electricity produced from the wind costs more than electricity produced from fossil fuel power stations.

This is mainly because . . .

1 each wind turbine has a low output, so hundreds of them are needed to produce as much electricity as a fossil fuel power station.

2 wind turbines are usually erected on high ground and are unsightly, noisy and dependent on the weather conditions.

3 wind turbines have high decommissioning costs compared with fossil fuel power stations such as those using coal or oil.

4 wind turbines have high operating costs resulting from the high cost of maintaining a large number of them.

END OF TEST

There are no questions printed on this page