**OCR**
RECOGNISING ACHIEVEMENT

**H**

# Thursday 24 May 2012 – Morning

## GCSE GATEWAY SCIENCE
## SCIENCE B

**B712/02** Science modules B2, C2, P2 (Higher Tier)

Candidates answer on the Question Paper.
A calculator may be used for this paper.

**OCR supplied materials:**
None

**Other materials required:**
• Pencil
• Ruler (cm/mm)

**Duration:** 1 hour 30 minutes

| Candidate forename | | Candidate surname | |
|---|---|---|---|

| Centre number | | | | | Candidate number | | | | |
|---|---|---|---|---|---|---|---|---|---|

## INSTRUCTIONS TO CANDIDATES

• Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
• Use black ink. HB pencil may be used for graphs and diagrams only.
• Answer **all** the questions.
• Read each question carefully. Make sure you know what you have to do before starting your answer.
• Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
• Do **not** write in the bar codes.

## INFORMATION FOR CANDIDATES

• Your quality of written communication is assessed in questions marked with a pencil (✐).
• A list of equations can be found on page 2.
• The Periodic Table can be found on the back page.
• The number of marks is given in brackets **[ ]** at the end of each question or part question.
• The total number of marks for this paper is **85**.
• This document consists of **28** pages. Any blank pages are indicated.

OCR is an exempt Charity

**Turn over**

**EQUATIONS**

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

$$\text{efficiency} = \frac{\text{useful energy output (× 100%)}}{\text{total energy input}}$$

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

distance = average speed × time

$$s = \frac{(u + v)}{2} \times t$$

$$\text{acceleration} = \frac{\text{change in speed}}{\text{time taken}}$$

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

power = force × speed

$$KE = \frac{1}{2}mv^2$$

momentum = mass × velocity

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

GPE = mgh

$$mgh = \frac{1}{2}mv^2$$

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

**3**

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**Question 1 begins on page 4.**

**PLEASE DO NOT WRITE ON THIS PAGE**

Answer **all** the questions.

**Section A – Module B2**

**1** Look at the picture of an Arabian Oryx.



The table shows the classification of the Arabian Oryx.

| group | Arabian Oryx |
|---|---|
| kingdom | animalia |
| phylum | chordata |
| | mammalia |
| order | artiodactyla |
| family | bovidae |
| genus | *Oryx* |
| species | *Oryx leucoryx* |

**(a)** One group is missing.

Write down the missing group. ....................................................................................... **[1]**

**(b)** The **binomial** name for Arabian Oryx is *Oryx leucoryx.*

**(i)** Explain why binomial names are used to identify a species.

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**(ii)** The Arabian Oryx is similar to another oryx called the Scimitar Oryx.

Describe how scientists could prove that they are **not** the same species.

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**(c)** In the 1960s the Arabian Oryx became an endangered species.

In 1986 Saudi Arabia started a breeding programme to reintroduce the Arabian Oryx.

The graph shows the change in population from 1986 to 2006.
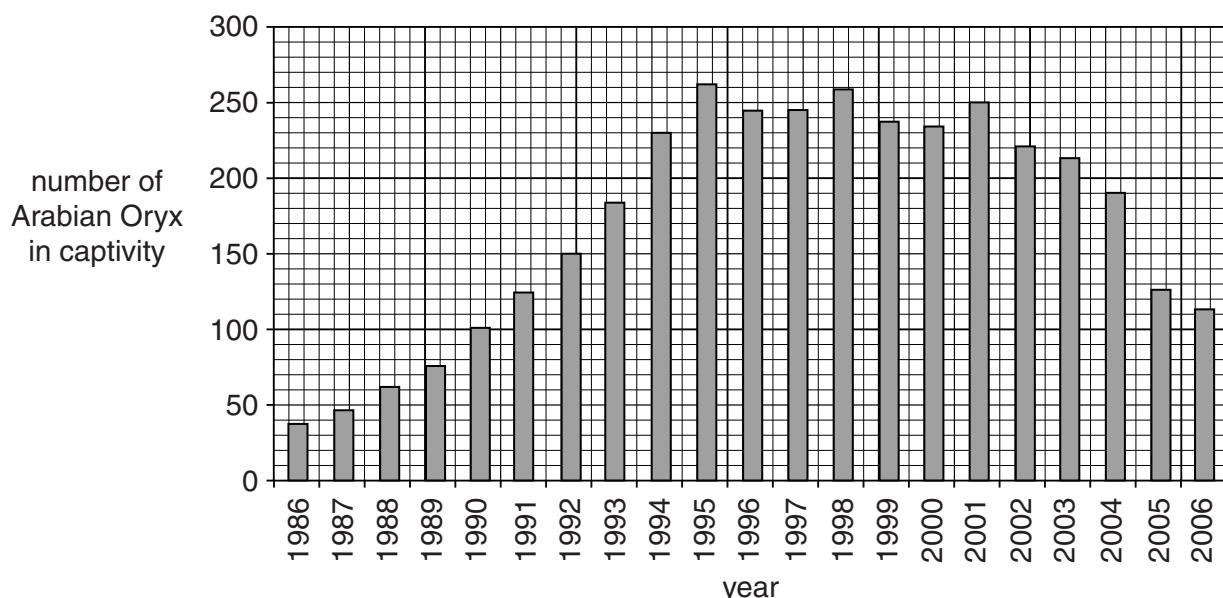


**(i)** The graph shows a change in population between 2001 and 2006.

One conclusion from the data is that the population has dropped by more than 50% in five years.

Show by calculation, whether this conclusion is correct.

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**(ii)** The Arabian Oryx are kept in a national park.

The park has fences all around.

Some people want to remove the fences so that the Arabian Oryx can roam free.

Local people do not want this to happen.

Suggest why.

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**[Total: 8]**

**Turn over**

**2** Look at the food chain.

| dead plants | ⟶ | mushrooms | ⟶ | humans |
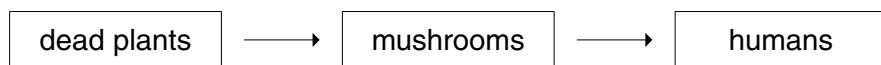
**(a)** Energy flows through this food chain to the humans.

Suggest how energy is lost from this food chain.

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**(b)** The diagram shows a pyramid of biomass for this food chain.

humans

mushrooms

dead plants
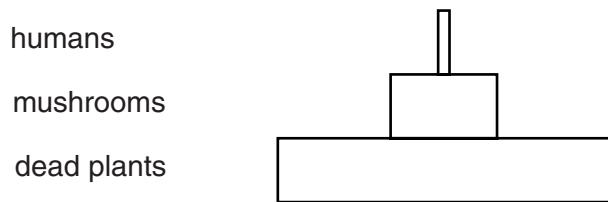
The pyramid is only an estimate of biomass.

Why is it difficult to construct an accurate pyramid of biomass for **this** food chain?

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**(c)** Mushrooms are decomposers.

Explain the role of mushrooms in the nitrogen cycle.

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**[Total: 5]**

**3** Look at the picture of a Cactus Wren sitting on a cactus plant.



   **(a)** The Cactus Wren builds its nest in the cactus to protect its young from predators.

   It may also eat seeds from the cactus. This helps to spread the seeds across the desert.

   Both the wren and the cactus benefit from the relationship.

   Write down the word used to describe this relationship.

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   **(b)** Cactus plants are adapted to live in the desert.

   Look at the picture. It shows a stone plant which also lives in the desert.

   The stone plant has leaves that look like stones. Most of the plant is below ground.
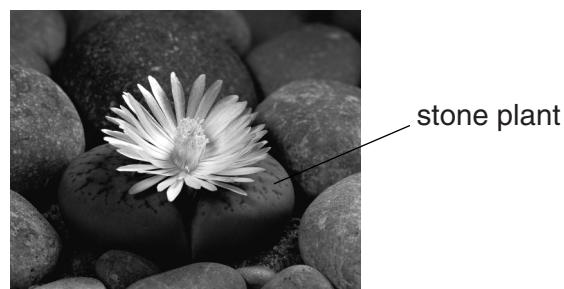


stone plant

   Suggest how stone plants are adapted to live in hot dry conditions.

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   **[Total: 4]**

**4** Read the information about one species of tortoise.

**Tortoises and natural selection**

Tortoises lived on a group of islands in the Indian Ocean. The tortoises ate the leaves of small trees. The leaves higher up the trees were more nutritious.

Some of the tortoises on each island had longer necks than others and were able to get more food. They survived and passed on this adaptation to their young.

Smaller islands had less food available. Eventually all the tortoises with shorter necks on the smaller islands died.

**(a)** After many years, the original tortoises evolved into different species. One species was the long-necked tortoise.

Use the information to explain why the long-necked tortoise only evolved on **some** of the islands.

*The quality of written communication will be assessed in your answer to this question.*

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**(b)** The information explains how the tortoise **might** have got a long neck.

Explain why we cannot be certain it happened in this way.

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**[Total: 8]**

**Turn over**

**Section B – Module C2**

**5**   Look at the table. It shows some information about materials used for making cars.

| material | appearance | density in g/cm³ | melting point in °C | relative strength | cost per tonne in £ |
|---|---|---|---|---|---|
| aluminium | shiny grey | 2.7 | 660 | 240 | 1350 |
| copper | shiny red/brown | 8.9 | 1083 | 220 | 3800 |
| glass | colourless transparent | 2.5 | 730 | 100 | 800 |
| perspex | colourless transparent | 1.2 | 160 | 60 | 1290 |
| resin | brown transparent | 1.4 | decomposes when heated | 50 | 480 |
| steel | dull grey | 7.7 | 1510 | 250 | 440 |

**(a)**   Look at the picture of a wheel rim.

Which material is the best for making wheel rims?

Explain your answer.

wheel rim

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**(b)** Iron reacts with oxygen, $O_2$, to make iron(III) oxide, $Fe_2O_3$.

   **(i)** Write a **balanced symbol** equation for this reaction.

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   **(ii)** During this reaction iron atoms are changed into iron(III) ions.

$$Fe \ - \ 3e^- \ \rightarrow \ Fe^{3+}$$
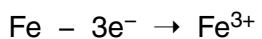
   What is the name of this process?

   Explain your answer.

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   ................................................................................................................................................... [2]

**[Total: 7]**

**Turn over**

**6** This question is about **reversible reactions**.

Ethanol, $C_2H_6O$, (alcohol) is made by reacting ethene, $C_2H_4$, with steam.

A catalyst of phosphoric acid is used.

$$ethene \ + \ steam \ \rightleftharpoons \ ethanol$$

**(a)** Write a **balanced symbol** equation for this reaction.

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**(b)** Look at the flow chart of the process.

unreacted gases recycled

| ethene ⟶ | 300 °C a pressure of 70 atmospheres catalyst of phosphoric acid | ⟶ | gases cooled |
| steam ⟶ | | | |
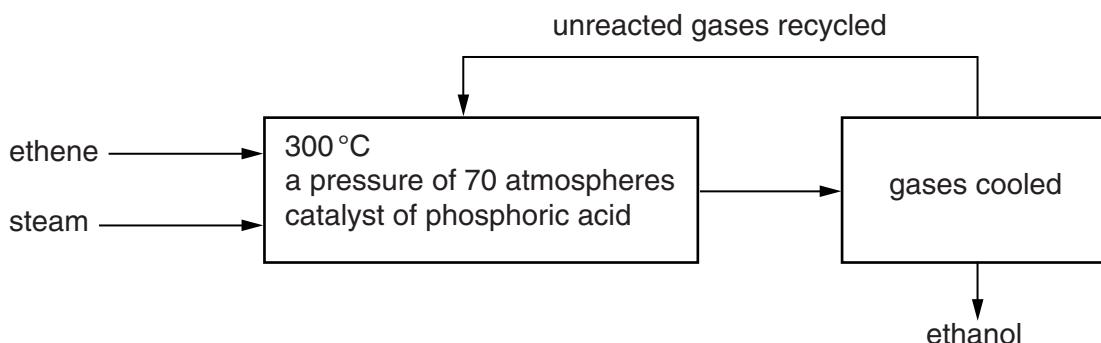
ethanol

Look at the table. It gives some information about the percentage yield of ethanol at different temperatures and pressures.

| temperature | percentage yield of ethanol at a pressure of | | | | |
| --- | --- | --- | --- | --- | --- |
| | 20 atmospheres | 40 atmospheres | 60 atmospheres | 80 atmospheres | 100 atmospheres |
| 250 | 32% | 40% | 43% | 46% | 50% |
| 300 | 30% | 38% | 42% | 44% | 45% |
| 350 | 28% | 34% | 38% | 42% | 43% |
| 400 | 22% | 28% | 33% | 38% | 40% |

What happens to the percentage yield of ethanol as the **temperature** increases?

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**(c)** The conditions used in the process are

- 300 °C
- a pressure of 70 atmospheres
- phosphoric acid catalyst.

These conditions do not give the highest possible yield of ethanol.

Using ideas about rate of reaction and percentage yield, suggest why these conditions are chosen.

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**[Total: 5]**

**7** Geologists study volcanoes.
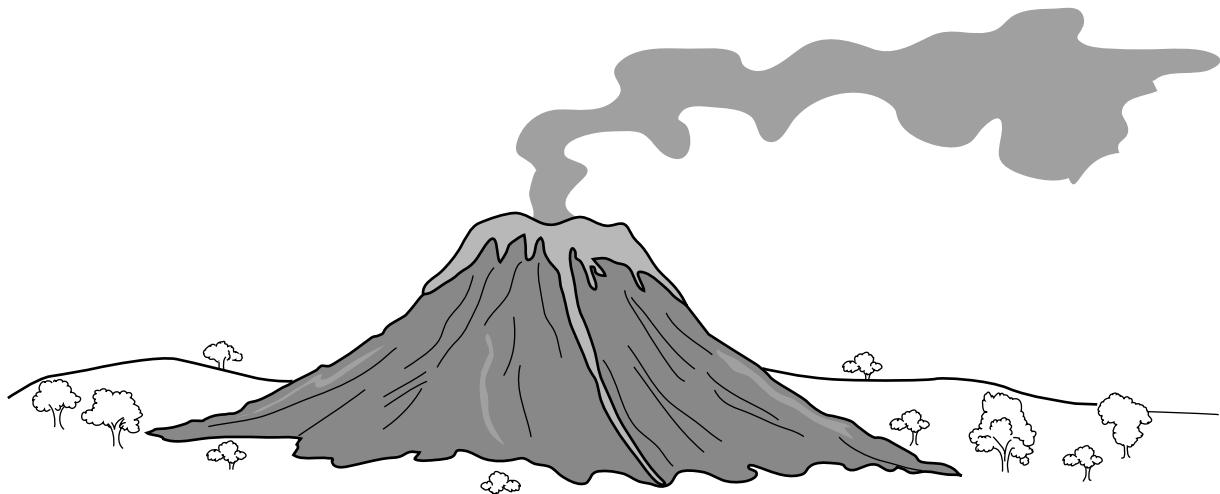


Explain why it is important that geologists study volcanoes.

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**[Total: 2]**

**8** Potassium nitrate is a fertiliser.

It is made by neutralisation.

Look at the word equation for neutralisation.

$$acid \ + \ alkali \ \longrightarrow \ salt \ + \ water$$
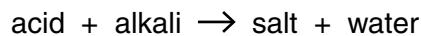
Fertilisers such as potassium nitrate can cause **eutrophication**.

Write down the names of the acid and alkali needed to make potassium nitrate and explain the problem of eutrophication caused by such fertilisers.

🖉 *The quality of written communication will be assessed in your answer to this question.*

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**[Total: 6]**

**9** Salt is sodium chloride.

Look at the diagram. It shows the electrolysis of concentrated sodium chloride solution.
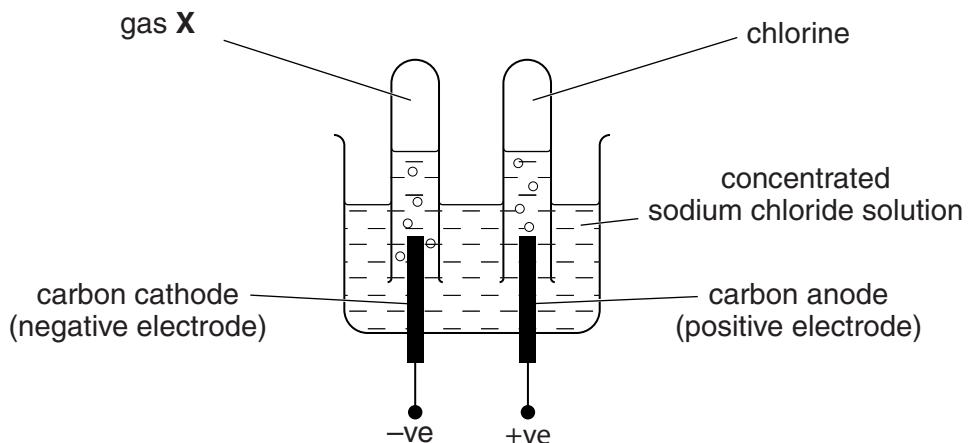


**(a)** What is gas **X**?

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**(b)** Sodium chloride solution contains the ions $Na^+$, $OH^-$, $H^+$ and $Cl^-$.

Sodium hydroxide is made during the electrolysis of sodium chloride solution.

Explain how.

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**(c)** Describe how salt solution can be extracted from salt deposits by solution mining.

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**[Total: 5]**

**Turn over**

**Section C – Module P2**

**10** Anna tells her friend Ben that the electricity in her house comes from coal.

Ben asks how this can happen.

**(a)** Write about how electricity is produced in a coal fired power station.

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**(b)** Producing electricity by using the energy stored in coal is not very efficient.

Look at the Sankey diagram.

input energy
850 MJ

output energy
200 MJ

wasted
energy
650 MJ
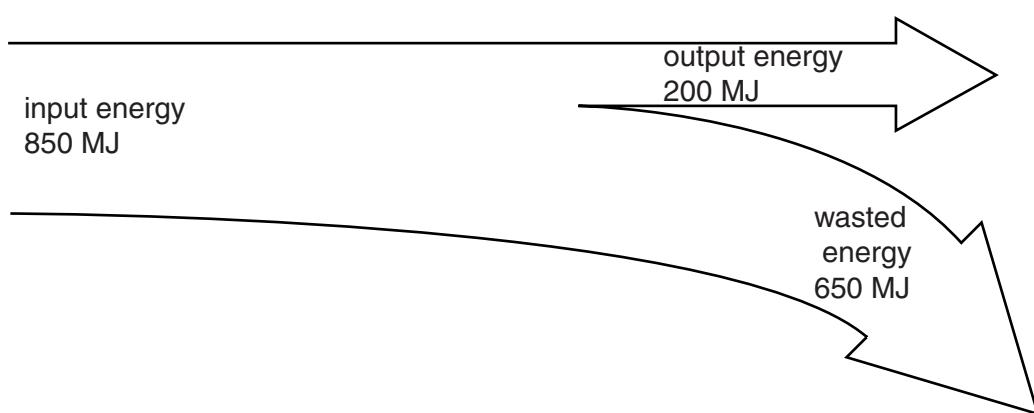
Calculate the efficiency of the power station.

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**(c) (i)** This power station transmits 500 MW of electrical power through the National Grid at a voltage of 100 000 V.

Calculate the current in the power lines.

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answer ........................................ A **[2]**

**(ii)** Other power stations with the same power output use a higher voltage of 200 000 V.

Explain why this is a good idea.

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**Turn over for the remainder of question 10**

**(d)** Look at the information about fuels used to generate electricity in the UK.

| year | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|
| **% of electricity from renewable sources** | 4.4 | 4.7 | 4.8 | 5.4 | 6.6 |

 **(i)** Use the data and the graph below to predict the percentage of electricity from renewable sources in 2015.

 Some of the data has been plotted for you.
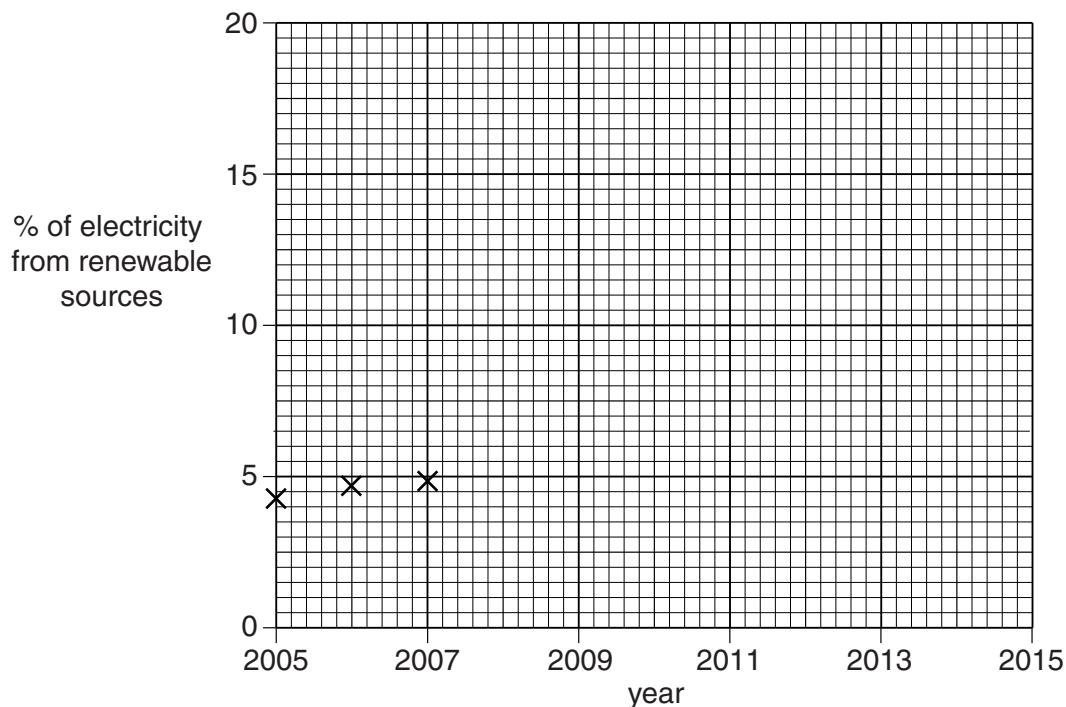


 prediction …………………………….% **[1]**

 **(ii)** The actual value may be different from the value indicated by the data.

 Explain why.

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**[Total: 10]**

**11** This question is about nuclear radiation.

Emma investigates the radiation from a radioactive source.

Here is a diagram of her apparatus.

radioactive source            absorber            detector
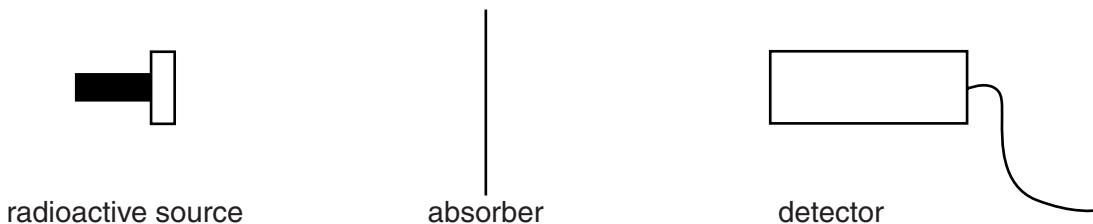
Look at the table of her results.

| absorber | count rate in counts per minute (cpm) |
|----------|---------------------------------------|
| no absorber | 6750 |
| paper | 6752 |
| 3 mm aluminium | 3200 |
| 5 mm lead | 400 |

The count rate with no source present is 25 cpm.

**(a)** Use the information in the table to identify the type(s) of radiation given out by the radioactive source and explain your answer.

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**(b)** Nuclear radiation produces ionisation.

**(i)** What is ionisation?

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**(ii)** This can cause cancer in living animals.

Explain how.

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**[Total: 5]**

**Turn over**

**12** Ocrashire Council needs to illuminate a road sign in a remote part of the county.

The Council decides to use a panel of photocells to provide power for a lamp.

A photocell panel with an area of $200\,cm^2$ produces $1\,W$ of power.



Look at the information about lamps that could be used to light up the sign.

| lamp | lifetime in hours | power in W | amount of light given out in lumens | cost in £ | time taken for light to come on |
|---|---|---|---|---|---|
| LED lamp | 50 000 | 8 | 60 | 50 | immediate |
| filament | 800 | 60 | 800 | 3 | immediate |
| fluorescent | 15 000 | 9 | 800 | 40 | 5 seconds |

Write about the advantages and disadvantages of using each type of lamp to light up the sign and explain which one the council should use.

*The quality of written communication will be assessed in your answer to this question.*

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**[Total: 6]**

**13** This question is about electrical energy.

(a) Fred uses a 3000 W heater to heat his house.

He uses the heater for 30 hours each week.

Each kWh (unit) of electricity costs 20p.

Calculate the cost of using the heater for one week.

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(b) Fred switches to using off-peak electricity.

One advantage for Fred is that it is cheaper.

Write down one advantage for the **power company** of consumers using off-peak electricity.

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(c) Fred could **not** use off-peak electricity for all his electricity use.

Explain why.

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**[Total: 4]**

**Turn over**

**Section D**

In this section you will need to interpret data.

**14** Some scientists are worried about global warming.

They say that we are burning too much fossil fuel.

They say that more **renewable energy** sources should be used.

Renewable energy sources include

- wind power

- hydro-electric power

- others, eg tidal power.

**(a)** Sophia researches renewable energy sources on the internet.

The bar chart shows her findings.

It shows the energy generated using renewable energy sources between 2005 and 2010.
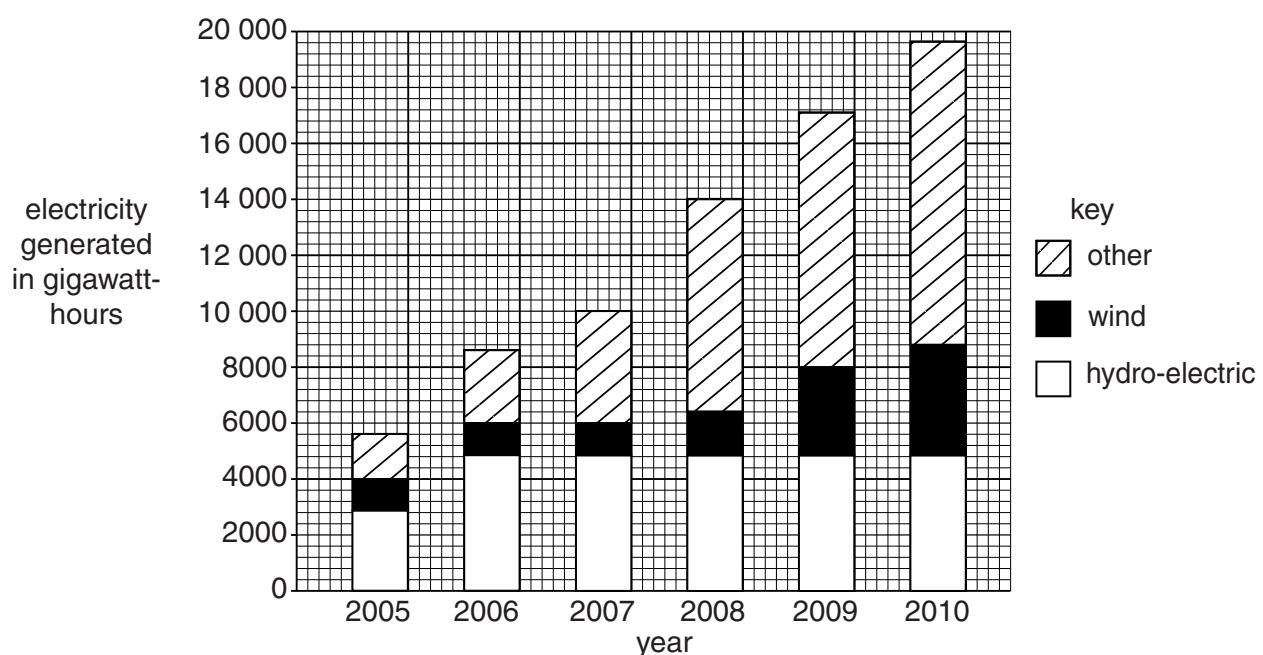


Look at the trends shown on the bar chart.

Suggest how energy generated from renewable sources is likely to change between 2010 and 2014.

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**(b)** Another possible way to reduce global warming is to use **bio-fuels**.

The main bio-fuels are bio-diesel and bio-ethanol.

Bio-ethanol is made from sugar cane.

Bio-diesel is made from rape seed oil or waste vegetable oil.

Look at the table. It shows some information about bio-fuel production in the USA.

The energy is measured in relative energy units.

| year | net amount of energy supplied by bio-ethanol | net amount of energy supplied by bio-diesel |
|---|---|---|
| 2000 | 137 | 0.00 |
| 2001 | 149 | 0.98 |
| 2002 | 180 | 0.98 |
| 2003 | 236 | 1.95 |
| 2004 | 287 | 3.90 |
| 2005 | 329 | 11.80 |
| 2006 | 411 | 31.60 |
| 2007 | 546 | 63.00 |

  **(i)** Describe, in detail, the trends in the net amount of energy supplied by bio-ethanol and bio-diesel from 2000 to 2007.

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  **(ii)** Suggest consequences of the changing bio-fuel production in the USA.

  Explain your answer.

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**Turn over**

**(c)** Look at the photograph of a wind farm.



There are plans for a new UK wind farm to produce power for the National Grid.

Look at the data about average wind speeds in different places in the UK.

| place | average wind speed at 10 m above ground level for each month in m/s | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Jan** | **Feb** | **Mar** | **April** | **May** | **Jun** | **July** | **Aug** | **Sept** | **Oct** | **Nov** | **Dec** |
| Bedford | 5.64 | 5.35 | 5.45 | 4.99 | 4.57 | 4.43 | 4.01 | 4.16 | 4.47 | 4.78 | 5.09 | 4.40 |
| Blackpool | 6.32 | 6.07 | 5.96 | 5.14 | 5.04 | 5.09 | 5.09 | 5.14 | 5.55 | 5.81 | 5.91 | 6.12 |
| Durham | 4.27 | 3.80 | 3.75 | 3.08 | 2.62 | 2.62 | 2.52 | 2.57 | 3.03 | 3.24 | 3.70 | 3.96 |
| Manchester | 4.83 | 4.73 | 4.78 | 4.32 | 4.16 | 3.80 | 3.60 | 3.60 | 3.86 | 4.11 | 4.27 | 4.58 |
| St. Mawgan | 7.14 | 6.89 | 6.58 | 5.71 | 5.54 | 5.14 | 4.99 | 4.93 | 5.50 | 6.37 | 6.63 | 7.09 |

**(i)** Based on wind speed, which place would be best to build the wind farm?

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Explain your answer.

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**(ii)** Suggest **another** factor that engineers would need to consider when they decide where to build a wind farm.

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**[Total: 10]**

**END OF QUESTION PAPER**

**25**

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# The Periodic Table of the Elements

**Key**

| relative atomic mass |
| **atomic symbol** |
| name |
| atomic (proton) number |

| 1 | 2 | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | 4<br>**He**<br>helium<br>2 |
| 7<br>**Li**<br>lithium<br>3 | 9<br>**Be**<br>beryllium<br>4 | | | | 11<br>**B**<br>boron<br>5 | 12<br>**C**<br>carbon<br>6 | 14<br>**N**<br>nitrogen<br>7 | 16<br>**O**<br>oxygen<br>8 | 19<br>**F**<br>fluorine<br>9 | 20<br>**Ne**<br>neon<br>10 |
| 23<br>**Na**<br>sodium<br>11 | 24<br>**Mg**<br>magnesium<br>12 | | | | 27<br>**Al**<br>aluminium<br>13 | 28<br>**Si**<br>silicon<br>14 | 31<br>**P**<br>phosphorus<br>15 | 32<br>**S**<br>sulfur<br>16 | 35.5<br>**Cl**<br>chlorine<br>17 | 40<br>**Ar**<br>argon<br>18 |

| 1 | 2 | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39<br>**K**<br>potassium<br>19 | 40<br>**Ca**<br>calcium<br>20 | 45<br>**Sc**<br>scandium<br>21 | 48<br>**Ti**<br>titanium<br>22 | 51<br>**V**<br>vanadium<br>23 | 52<br>**Cr**<br>chromium<br>24 | 55<br>**Mn**<br>manganese<br>25 | 56<br>**Fe**<br>iron<br>26 | 59<br>**Co**<br>cobalt<br>27 | 59<br>**Ni**<br>nickel<br>28 | 63.5<br>**Cu**<br>copper<br>29 | 65<br>**Zn**<br>zinc<br>30 | 70<br>**Ga**<br>gallium<br>31 | 73<br>**Ge**<br>germanium<br>32 | 75<br>**As**<br>arsenic<br>33 | 79<br>**Se**<br>selenium<br>34 | 80<br>**Br**<br>bromine<br>35 | 84<br>**Kr**<br>krypton<br>36 |
| 85<br>**Rb**<br>rubidium<br>37 | 88<br>**Sr**<br>strontium<br>38 | 89<br>**Y**<br>yttrium<br>39 | 91<br>**Zr**<br>zirconium<br>40 | 93<br>**Nb**<br>niobium<br>41 | 96<br>**Mo**<br>molybdenum<br>42 | [98]<br>**Tc**<br>technetium<br>43 | 101<br>**Ru**<br>ruthenium<br>44 | 103<br>**Rh**<br>rhodium<br>45 | 106<br>**Pd**<br>palladium<br>46 | 108<br>**Ag**<br>silver<br>47 | 112<br>**Cd**<br>cadmium<br>48 | 115<br>**In**<br>indium<br>49 | 119<br>**Sn**<br>tin<br>50 | 122<br>**Sb**<br>antimony<br>51 | 128<br>**Te**<br>tellurium<br>52 | 127<br>**I**<br>iodine<br>53 | 131<br>**Xe**<br>xenon<br>54 |
| 133<br>**Cs**<br>caesium<br>55 | 137<br>**Ba**<br>barium<br>56 | 139<br>**La***<br>lanthanum<br>57 | 178<br>**Hf**<br>hafnium<br>72 | 181<br>**Ta**<br>tantalum<br>73 | 184<br>**W**<br>tungsten<br>74 | 186<br>**Re**<br>rhenium<br>75 | 190<br>**Os**<br>osmium<br>76 | 192<br>**Ir**<br>iridium<br>77 | 195<br>**Pt**<br>platinum<br>78 | 197<br>**Au**<br>gold<br>79 | 201<br>**Hg**<br>mercury<br>80 | 204<br>**Tl**<br>thallium<br>81 | 207<br>**Pb**<br>lead<br>82 | 209<br>**Bi**<br>bismuth<br>83 | [209]<br>**Po**<br>polonium<br>84 | [210]<br>**At**<br>astatine<br>85 | [222]<br>**Rn**<br>radon<br>86 |
| [223]<br>**Fr**<br>francium<br>87 | [226]<br>**Ra**<br>radium<br>88 | [227]<br>**Ac***<br>actinium<br>89 | [261]<br>**Rf**<br>rutherfordium<br>104 | [262]<br>**Db**<br>dubnium<br>105 | [266]<br>**Sg**<br>seaborgium<br>106 | [264]<br>**Bh**<br>bohrium<br>107 | [277]<br>**Hs**<br>hassium<br>108 | [268]<br>**Mt**<br>meitnerium<br>109 | [271]<br>**Ds**<br>darmstadtium<br>110 | [272]<br>**Rg**<br>roentgenium<br>111 | | | | | | | |

1<br>**H**<br>hydrogen<br>1

Elements with atomic numbers 112-116 have been reported but not fully authenticated

***The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.