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**H**

Friday 10 June 2016 – 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<br>forename |  | Candidate<br>surname |  |
|-----------------------|--|----------------------|--|

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|---------------|--|--|--|--|--|------------------|--|--|--|--|
| 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. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

**INFORMATION FOR CANDIDATES**

- The 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.

## 2

## EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

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

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

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

distance = average speed × time

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

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

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

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

power = force × speed

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

momentum = mass × velocity

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

GPE = mgh

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

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

3

Answer **all** the questions.

**SECTION A – Module B2**

1 Look at the picture of a sperm whale.



(a) Sperm whales were once hunted.

Hunting of sperm whales was made illegal to prevent the number falling to a critical level.

(i) Explain why it is important that the number of sperm whales does not fall to a critical level.

.....  
 ..... [1]

(ii) Describe **two** reasons why it is difficult to prevent whales being hunted.

1 .....  
 .....  
 2 .....  
 ..... [2]

(b) Some other species of whales are still being hunted as **sustainable resources**.

Explain how whale populations can be sustained.

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

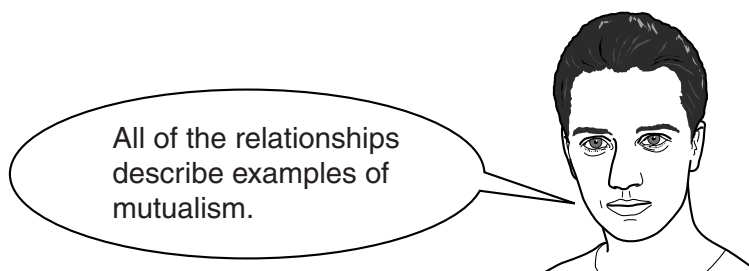
[Total: 5]

Turn over

2 Jack reads this information about relationships between organisms.

| Organisms involved                     | Information about the relationship between the organisms  |
|--|---|
| bees<br>and<br>flowers                 | Bees transfer pollen from one flower to another.<br>Bees make less honey in years when there are fewer flowers.                             |
| acacia trees<br>and<br>ants            | Ants feed on nectar from the trees.<br>The ants kill trees next to the acacia tree they live on.  |
| mistletoe plants<br>and<br>birch trees | The mistletoe plant gets nutrients from the tree.<br>Trees with mistletoe growing on them are usually smaller than those with no mistletoe. |

(a) Jack makes a statement about the relationships.



Is Jack correct? .....

Explain your answer.

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..... [2]

(b) Jack finds out about another type of mutualism.

Leguminous plants have root nodules with bacteria living inside the nodule.

Explain why this is an example of mutualism.

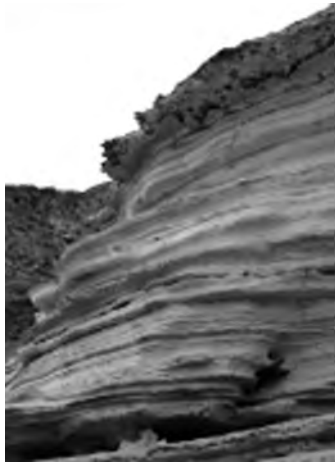
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[Total: 4]

- 3 Look at the picture of some limestone rock.



- (a) The limestone formed millions of years ago at the bottom of a shallow sea.

Acid rain is now weathering the rock.

Explain how carbon became locked up in the limestone and how weathering contributes to global warming.



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

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..... [6]

- (b) Acid rain is one type of air pollution.

Some organisms living on trees and rocks can be used to indicate the levels of air pollution.

These organisms are one of many different types of indicator species.

Write down the name of this type of indicator species that lives on trees and rocks.

..... [1]

[Total: 7]

Turn over

6

4 Matt and Ellie are investigating the animals living in a lake.

They collect some of the animals.

(a) Ellie identifies some of the beetles they collect and writes their names in a table.

| Beetle | Common name                             | Binomial name                |
|--------|---|------------------------------|
| A      | whirligig beetle                        | <i>Gyrinus natator</i>       |
| B      | hairy whirligig beetle                  | <i>Orectochilus villosus</i> |
| C      | great diving beetle                     | <i>Dytiscus marginalis</i>   |
| D      | there is no common name for this beetle | <i>Dytiscus latissimus</i>   |

Ellie makes this statement about the beetles.



Beetles **A** and **B** are more closely related than the other beetles because they are both called whirligig beetles.

Is Ellie correct? .....

Explain your answer.

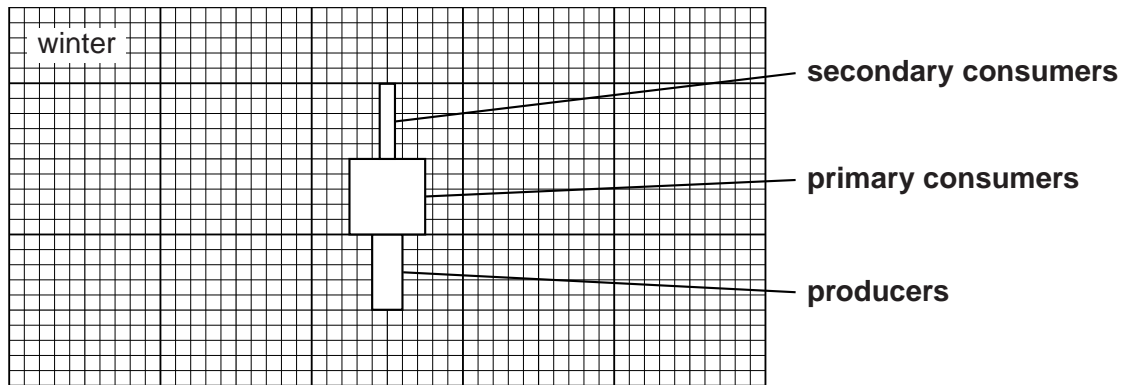
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 ..... [1]

(b) Matt finds some information about the biomass values for the lake in winter and spring.

Look at the table.

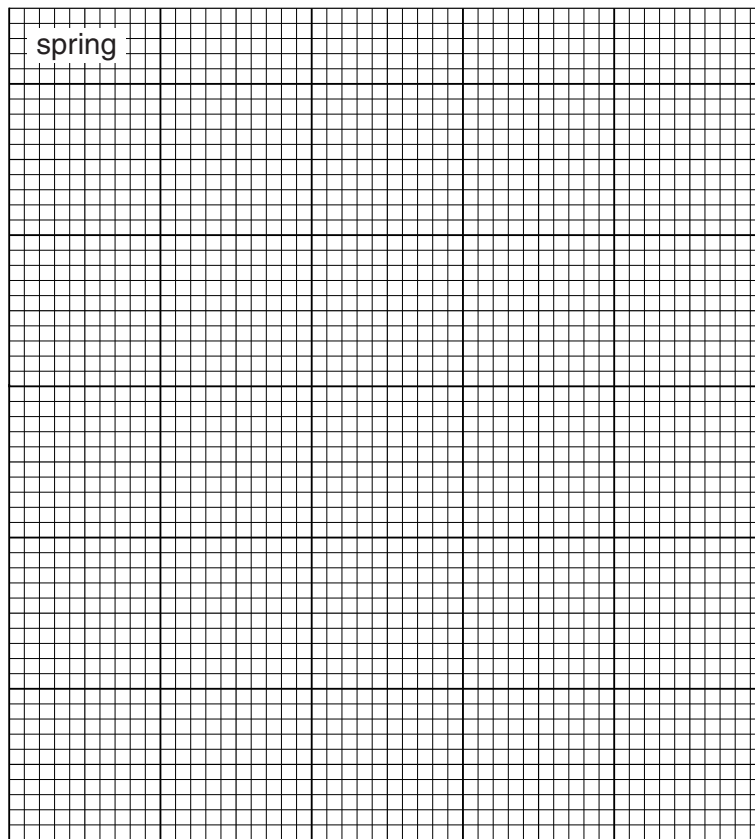
| Trophic level       | Biomass in mg dry mass per m <sup>3</sup> |        |
|---------------------|---|--------|
|                     | Winter                                    | Spring |
| producers           | 4   | 100    |
| primary consumers   | 10  | 12     |
| secondary consumers | 2   | 6      |

The diagram below shows the pyramid of biomass for winter.



(i) Draw the pyramid of biomass for spring on the grid below.

Make sure the bars are drawn to the **same** scale and **labelled**.



[2]

(ii) The pyramid of biomass for winter is a different shape to the spring pyramid of biomass.

Describe **one** way the winter pyramid is different in shape and suggest a reason for the difference.

.....

.....

..... [2]

[Total: 5]

Turn over

5 Look at the pictures of different birds.



puffin



herring gull



penguin

(a) Classifying these birds as seabirds is an **artificial** classification.

Explain why.

.....  
..... [1]

(b) Puffins live in the Arctic.

Penguins live in the Antarctic.

Suggest reasons why puffins and penguins are both similar and different.

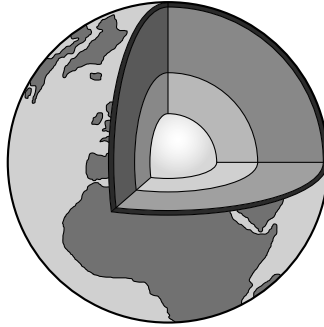
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[Total: 4]



SECTION B – Module C2

6 Look at the diagram of the structure of the Earth.



(a) The surface of the Earth is made up of tectonic plates.

This was first suggested by a scientist called Wegener in 1914.

The theory of tectonic plates is now widely accepted.

Explain why theories proposed by scientists like Wegener take some time to become widely accepted.

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..... [2]

(b) The theory of plate tectonics can be used to explain **subduction**.

What is subduction and how does it happen?

You may wish to draw a **labelled** diagram.

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.....  
..... [3]

[Total: 5]

Turn over

## 10

7 Rachel is making some fertilisers by neutralising acids with alkalis.

Complete the table.

| Name of fertiliser | Name of alkali used | Name of acid used |
|--------------------|---------------------|-------------------|
| ammonium phosphate | ammonia             | phosphoric acid   |
| potassium nitrate  | potassium hydroxide | .....             |
| .....              | ammonia             | sulfuric acid     |

[2]

[Total: 2]

11

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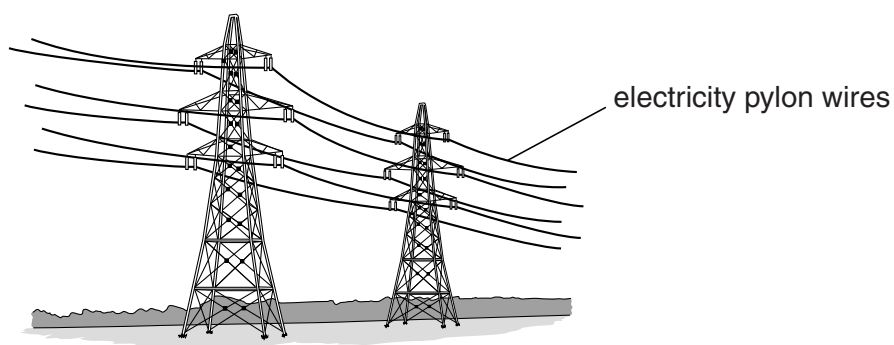
**Question 8 begins on page 12**

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8 Look at the table. It shows some properties of different metals.

| Metal    | Density<br>in $\text{g/cm}^3$ | Relative<br>electrical<br>conductivity | Relative<br>strength | Melting point<br>in $^{\circ}\text{C}$ | Cost<br>per tonne<br>in £ |
|----------|-------------------------------|--|----------------------|--|---------------------------|
| <b>A</b> | 8.9                           | 64                                     | 13                   | 1083                                   | 3800                      |
| <b>B</b> | 7.7                           | 11                                     | 21                   | 1510                                   | 440                       |
| <b>C</b> | 2.7                           | 40                                     | 15                   | 660                                    | 1350                      |

(a) Look at the diagram. It shows electricity pylon wires.



Jo says that metal **A** is the best for making electricity pylon wires.

Dave says that metal **C** is the best.

Evaluate metals **A** and **C** for making electricity pylon wires.

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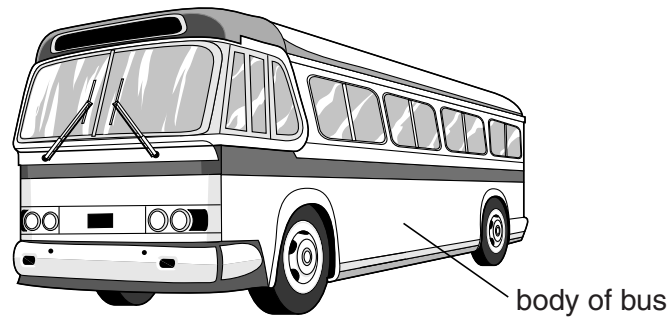
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13

(b) Metals **A**, **B** and **C** can be used to make the body of a bus.



Describe the advantages and disadvantages of metals **A**, **B** and **C** for making the body of a bus.

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..... [3]

[Total: 6]

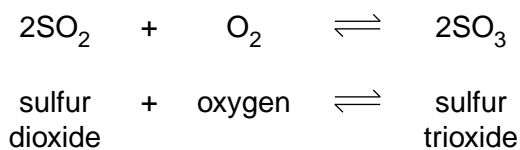
Question 9 begins on page 14

14

9 Sulfur trioxide,  $\text{SO}_3$ , is made in a chemical factory.

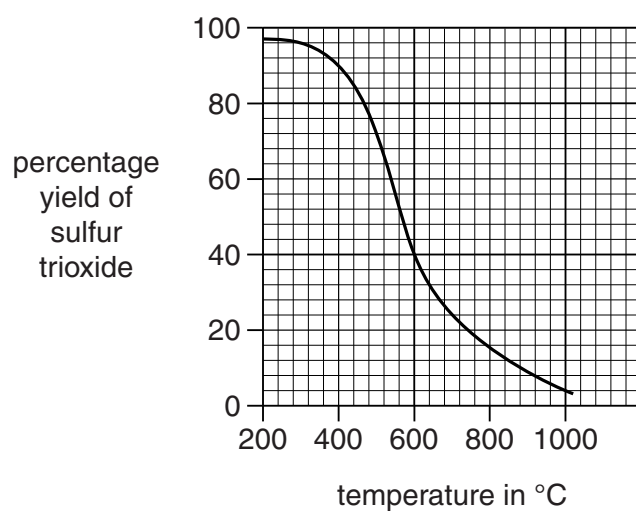
It is used to make sulfuric acid.

The equations show how sulfur trioxide is made.



Look at the graph below.

It shows how the percentage yield of sulfur trioxide changes as the temperature changes.



(a) How does **increasing** the temperature affect the percentage yield?

..... [1]

15

(b) The conditions used in the reaction are

- 450 °C
- low pressure
- catalyst of vanadium(V) oxide.

(i) Suggest why a catalyst is used.

..... [1]

(ii) Suggest why a temperature of 450 °C rather than 200 °C is used.

Use ideas about rate of reaction and percentage yield.

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

(c) In another industrial process, nitrogen,  $N_2$ , reacts with hydrogen,  $H_2$ , to make ammonia,  $NH_3$ .

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

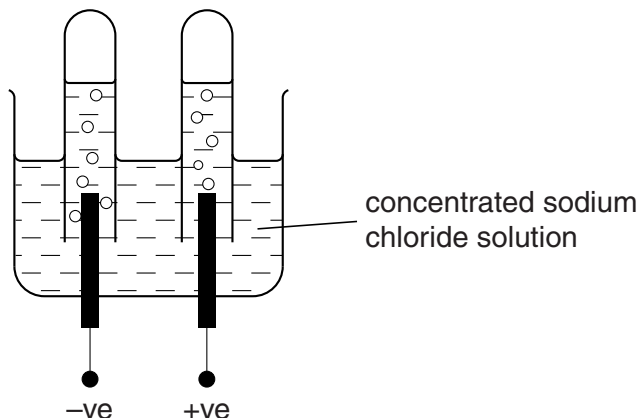
..... [2]

[Total: 6]

10 Sodium chloride (salt) is a very important chemical.

Concentrated sodium chloride solution can be electrolysed to make useful products.

Look at the diagram below. It shows how this can be done in the laboratory.



Sodium chloride solution contains the ions  $\text{Na}^+$ ,  $\text{Cl}^-$ ,  $\text{H}^+$  and  $\text{OH}^-$ .

What happens during the electrolysis of concentrated sodium chloride solution?

Your answer should include equations for the reactions at each electrode.

Use  $e^-$  to represent an electron.



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

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..... [6]

[Total: 6]



**SECTION C – Module P2**

**11** Nuclear radiation can be alpha, beta or gamma radiation.

**(a)** Draw one line from each **radiation** to its correct **use**.

| <b>radiation</b> | <b>use</b>              |
|------------------|-------------------------|
| alpha            | paper thickness gauge   |
| beta             | non-destructive testing |
| gamma            | smoke detector          |

**[2]**

**(b)** Polly and Oliver were talking about the factory that is near their home.

Polly said that the factory produces dangerous radioactive waste.

Oliver said that if the waste was put into thick aluminium cans it could be stored safely.

Is Oliver correct? .....

Explain your answer.

.....

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

**[Total: 4]**

12 (a) Most of our electrical energy is produced in large power stations.

A large power station produces up to 2000 MW of power.

Some of our electrical energy is now produced by wind farms.



A wind farm is made up of several wind turbines.

Each turbine produces up to 2 MW of power.

Suggest one reason why some people are **for** more wind farms and one reason why others are **against**.

reason for .....

.....

reason against .....

.....

[2]

(b) Some companies are now designing and heating their offices using passive solar heating.

Explain how passive solar heating works and suggest why the position of the windows is important.

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..... [3]

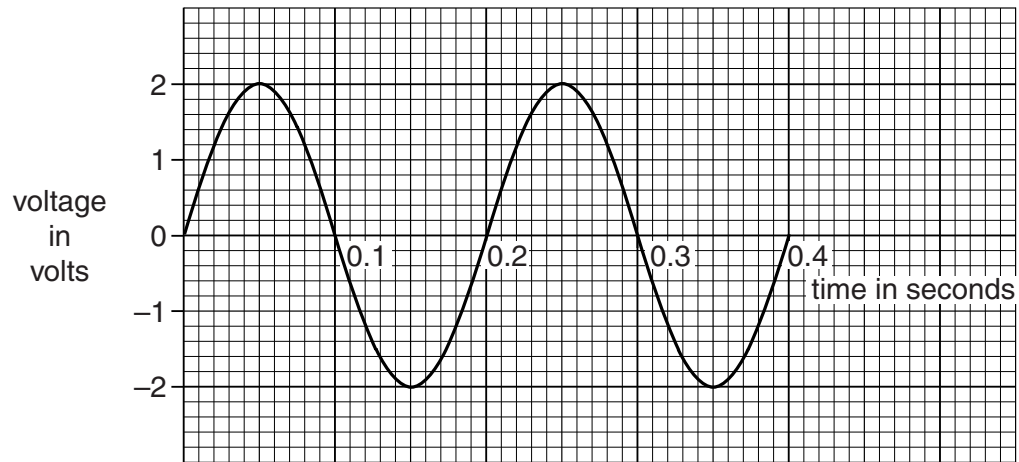
[Total: 5]



20

(b) Ruth investigates the output of a model a.c. generator.

Look at the graph below showing the voltage output of the generator.



She increases the number of rotations of the coil each second.

How will this affect the output of this generator?

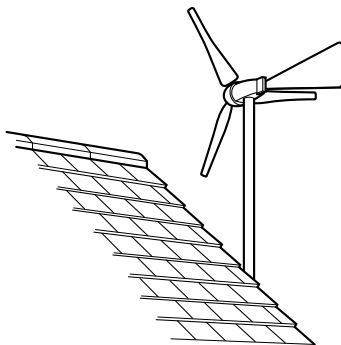
**Draw** your answer on the graph.

[2]

[Total: 8]

14 Sam wants to reduce his energy costs.

He fits a wind generator to his house.



The generator produces 1.8 kWh (kilowatt hour) of energy each day (24 hours).

(a) Calculate the average power output of the generator in kW.

answer ..... kW [2]

(b) Electricity costs 16p per kWh.

How much money will Sam save on his electricity bills each day?

answer ..... pence [1]

(c) A factory needs 100 kW of electrical power to operate its machinery.

Energy is wasted in transmitting the electricity from the power station to the factory.

Look at the data showing the effect of using different transmission voltages for the power cables to the factory.

|  |      |      |      |       |
|--|------|------|------|-------|
| <b>Transmission voltage in volts</b>                         | 1000 | 2000 | 5000 | 10000 |
| <b>Energy wasted per second for each km of cable in W/km</b> | 8000 | 2000 | 320  | 80    |

10000 volts is the most efficient voltage for the transmission of 100 kW of electricity.

Explain why.

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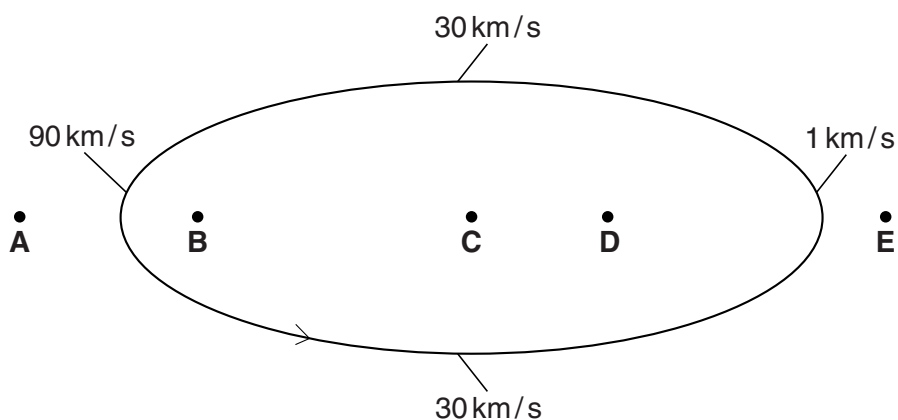
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[Total: 5]

Turn over

15 Comets are objects in our solar system that orbit the Sun with highly elliptical orbits.

Look at the diagram below showing the path of a comet and its speed at different points on the path.



(a) Where is the Sun on the diagram?

Choose from: **A B C D E**

answer .....

Use information from the diagram and ideas about forces to explain your answer.

.....

.....

.....

..... [2]

(b) There is an asteroid belt between Mars and Jupiter.

Some people think that some asteroids in this belt could join together to form a new planet.

There is no sign of this happening.

Explain why.

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..... [1]

[Total: 3]

23

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**Question 16 begins on page 24**

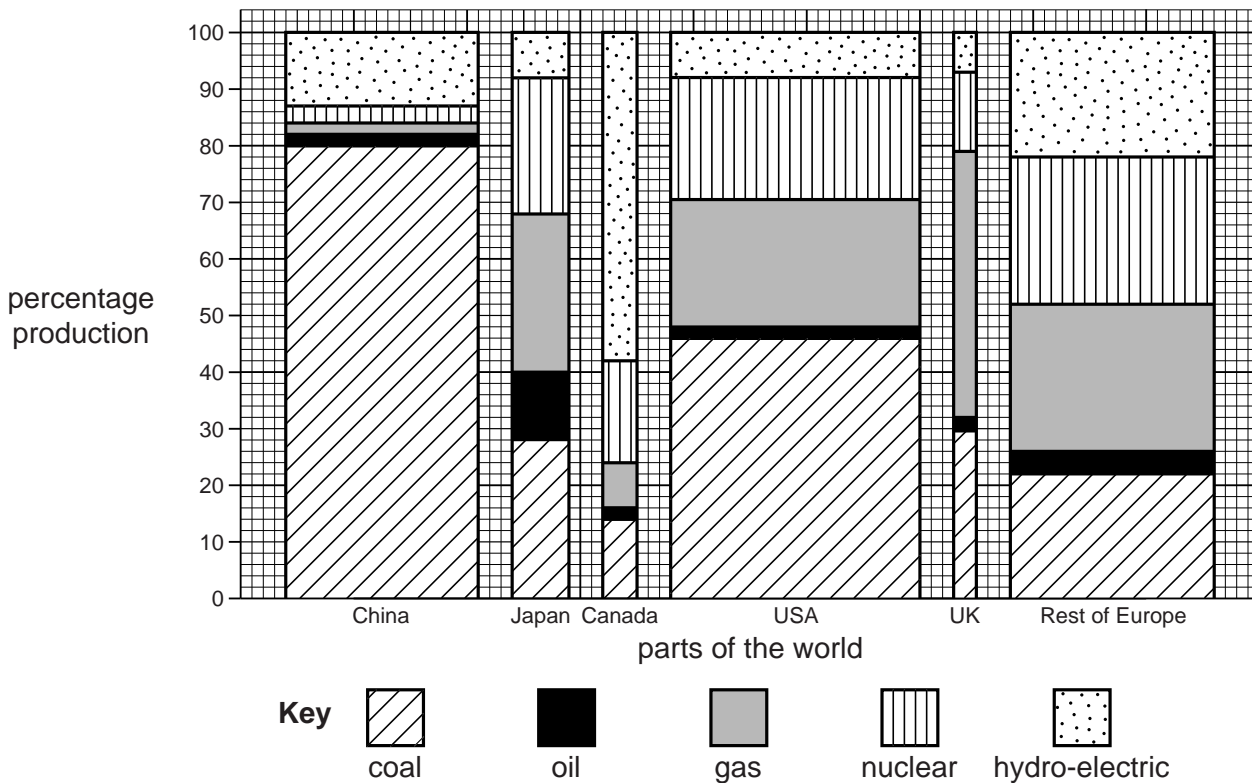
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SECTION D

16 (a) Look at **Graph 1**. This bar chart shows how electricity was produced in different parts of the world.

The **width** of each bar is a measure of the total amount of electricity produced in 2008.

**Electricity production in 2008**



**Graph 1**



25

(i) Look at the percentage of electricity produced from **coal** in each part of the world.

Put these parts of the world in the correct order. Put the highest first.

highest percentage from coal .....

.....

.....

.....

.....

lowest percentage from coal ..... [2]

(ii) China, USA and the rest of Europe generated the largest amounts of electricity in 2008.

Suggest why they need to produce the largest amounts of electricity.

.....

..... [1]

(iii) What **other** conclusions can you make from this bar chart about electricity production in different parts of the world?

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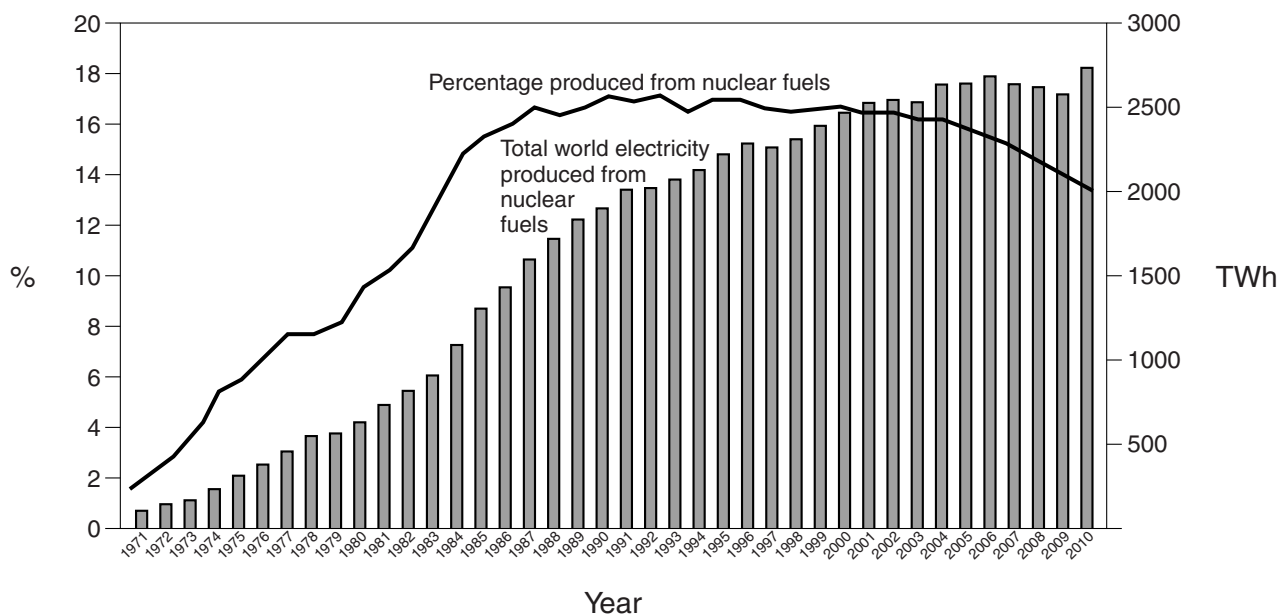
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..... [3]

(b) The production of electricity from nuclear fuels changed between 1971 and 2010.

Look at **Graph 2**.

- The bars show the **total** world electricity produced from nuclear fuels (in TWh).
- The line shows the **percentage** of world electricity produced from nuclear fuels.



**Graph 2**

What conclusions can you make from **Graph 2**?

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..... [2]

(c) Using **Graphs 1** and **2**, suggest what problems may arise for electricity production during the next 30 years.

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..... [2]

[Total: 10]

**END OF QUESTION PAPER**

**ADDITIONAL ANSWER SPACE**

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margins.

A large rectangular area with horizontal dotted lines for writing, bounded by a solid vertical line on the left and a solid horizontal line at the bottom.



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