OCR
Oxford Cambridge and RSA

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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 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. 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.

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

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

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

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

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

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 .....

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2 .....

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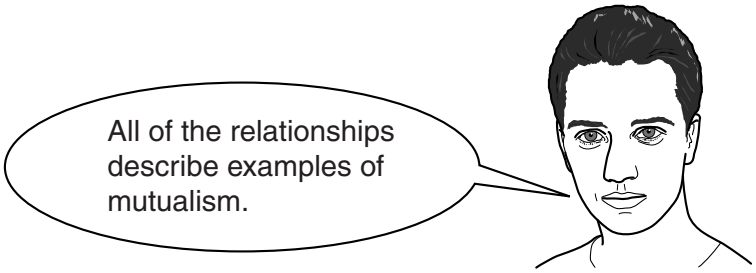
..... **[2]**

[Total: 5]

2 Jack reads this information about relationships between organisms.

Organisms involved	Information about the relationship between the organisms
bees and flowers	Bees transfer pollen from one flower to another. Bees make less honey in years when there are fewer flowers.
acacia trees and ants	Ants feed on nectar from the trees. The ants kill trees next to the acacia tree they live on.
mistletoe plants and birch trees	The mistletoe plant gets nutrients from the tree. 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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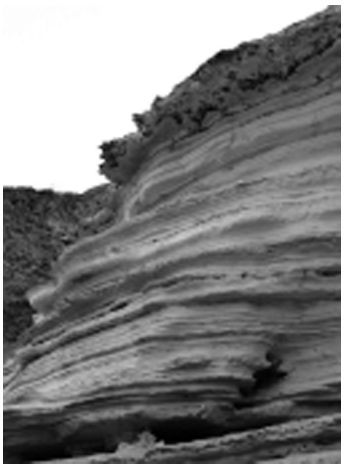
..... **[2]**

[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]

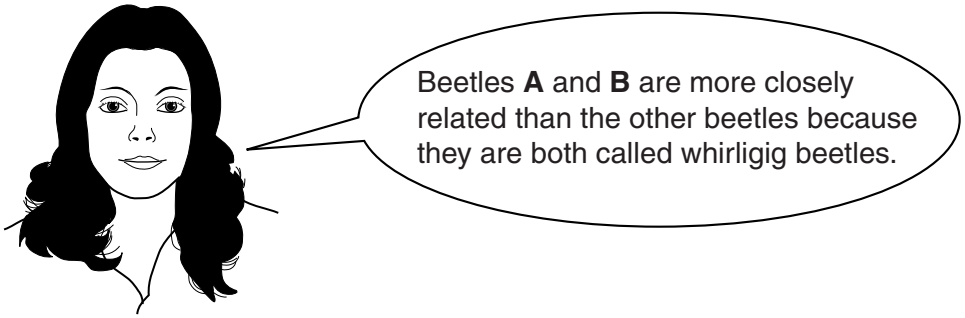
4 Matt and Ellie are investigating the animals living in a lake.

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	*Gyrinus natator*
B	hairy whirligig beetle	*Orectochilus villosus*
C	great diving beetle	*Dytiscus marginalis*
D	there is no common name for this beetle	*Dytiscus latissimus*

Ellie makes this statement about the beetles.



Is Ellie correct? .....

Explain your answer.

.....

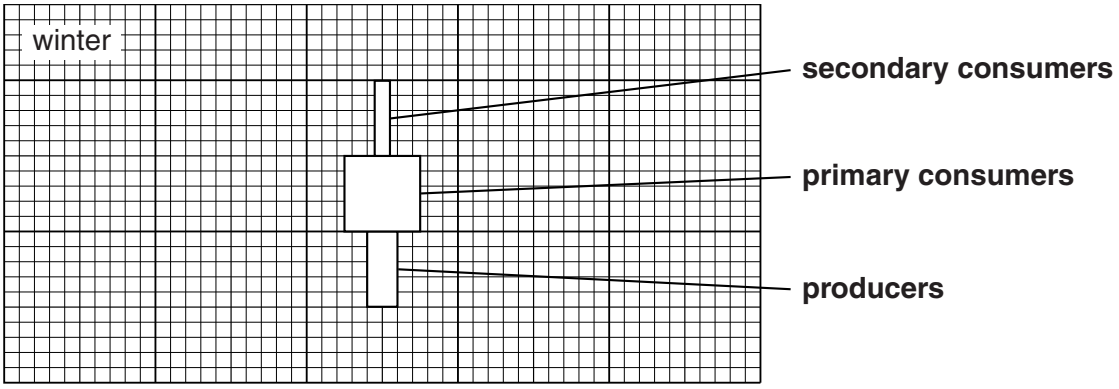
..... **[1]**

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

Look at the table.

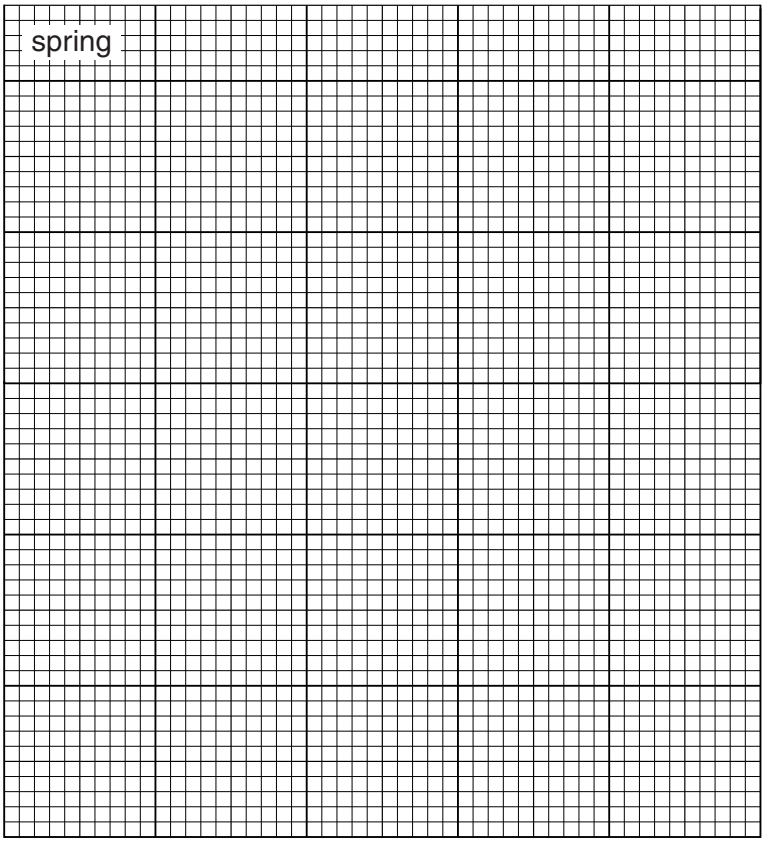
Trophic level	Biomass in mg dry mass per m^3	
	Winter	**Spring**
producers	4	100
primary consumers	10	12
secondary consumers	2	6

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.

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

[Total: 5]

5 Look at the pictures of different birds.

puffin

herring gull

penguin

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

Explain why.

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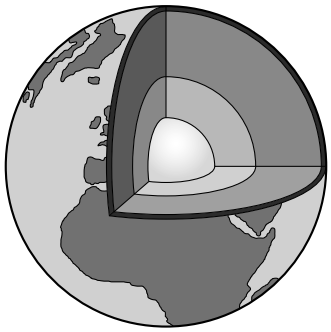
..... **[3]**

[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]

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]

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Question 8 begins on page 12

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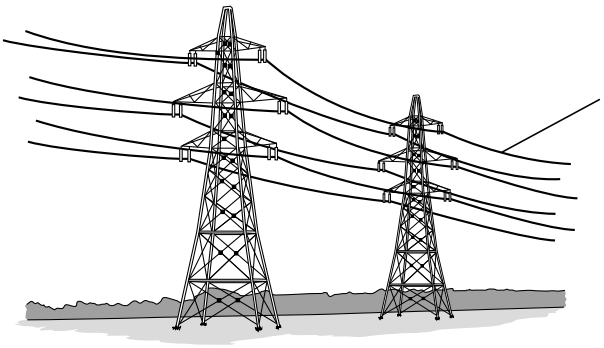
8 Look at the table. It shows some properties of different metals.

Metal	Density in g/cm^3	Relative electrical conductivity	Relative strength	Melting point in °C	Cost per tonne in £
A	8.9	64	13	1083	3800
B	7.7	11	21	1510	440
C	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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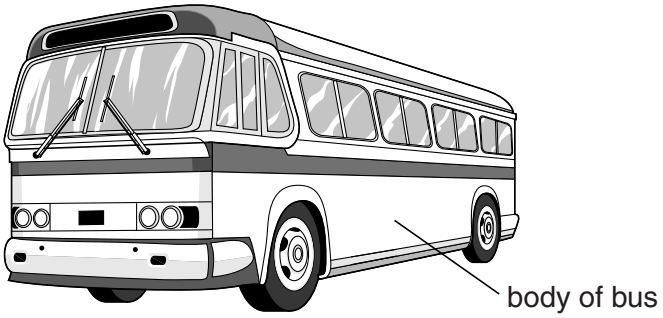
..... **[3]**

(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

9 Sulfur trioxide, SO_3, is made in a chemical factory.

It is used to make sulfuric acid.

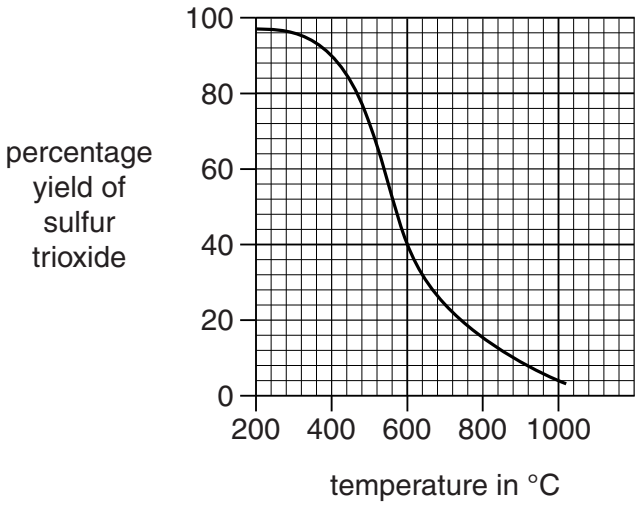
The equations show how sulfur trioxide is made.

$$2SO_2 + O_2 \rightleftharpoons 2SO_3$$

sulfur dioxide + oxygen ⇌ sulfur trioxide

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]**

(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.

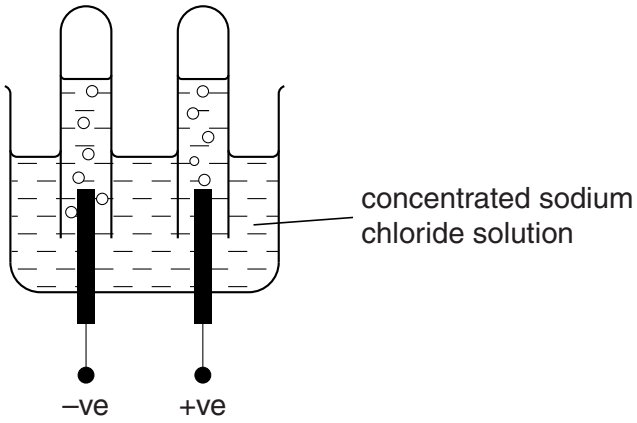
..... **[2]**

[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 Na^+, Cl^-, H^+ and 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**.

radiation	use
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 .....

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reason against .....

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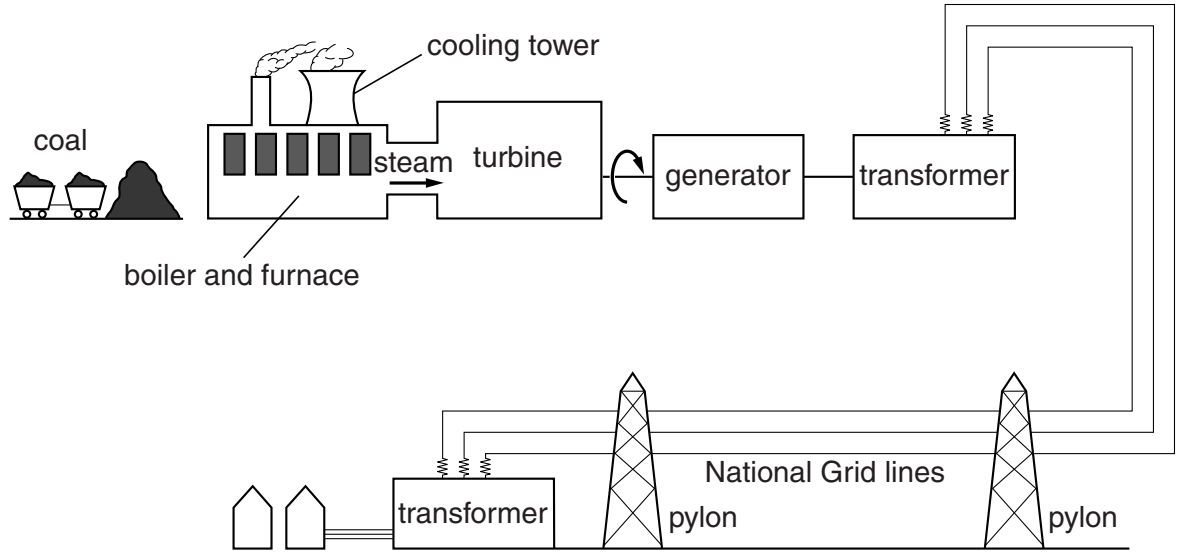
..... **[3]**

[Total: 5]

13 Power stations generate electricity.



Look at the data for a coal-fired power station.

efficiency of power station	30%
average electrical energy generated each second	1.5×10^6 J
heat energy produced by 1 kg of coal	2×10^4 J

(a) Describe in detail the different stages in the production of electricity from this power station and use the information to calculate the mass of coal (in kg) burnt each second.

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

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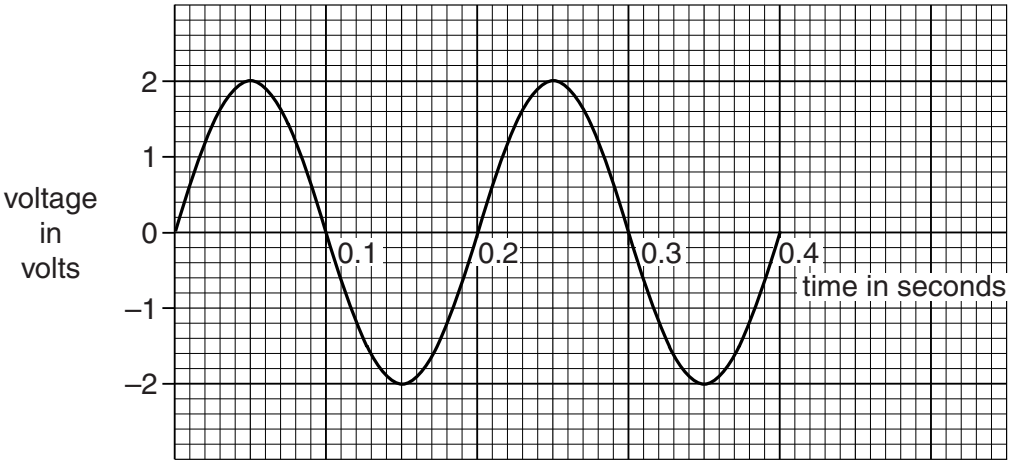
..... **[6]**

Turn over for the remainder of question 13

(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.

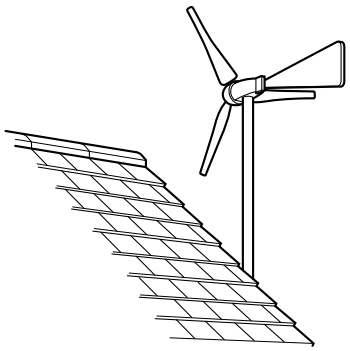
How will this affect the output of this generator?

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.

Transmission voltage in volts	1000	2000	5000	10 000
Energy wasted per second for each km of cable in W / km	8000	2000	320	80

10 000 volts is the most efficient voltage for the transmission of 100 kW of electricity.

Explain why.

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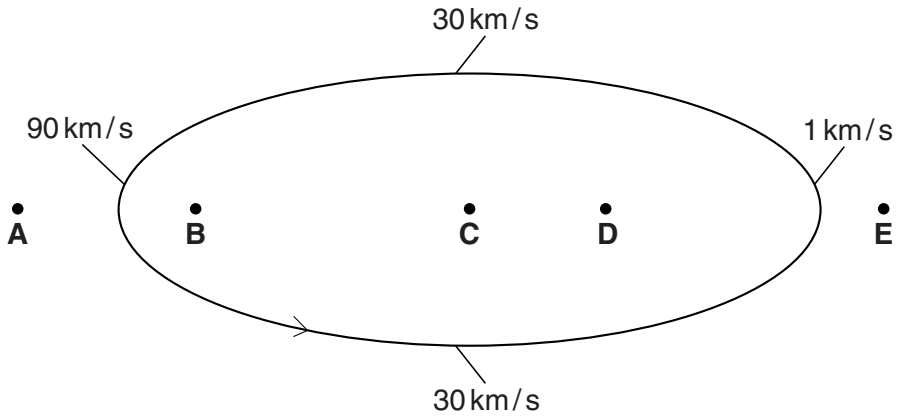
..... **[2]**

[Total: 5]

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.

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..... **[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]

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Question 16 begins on page 24

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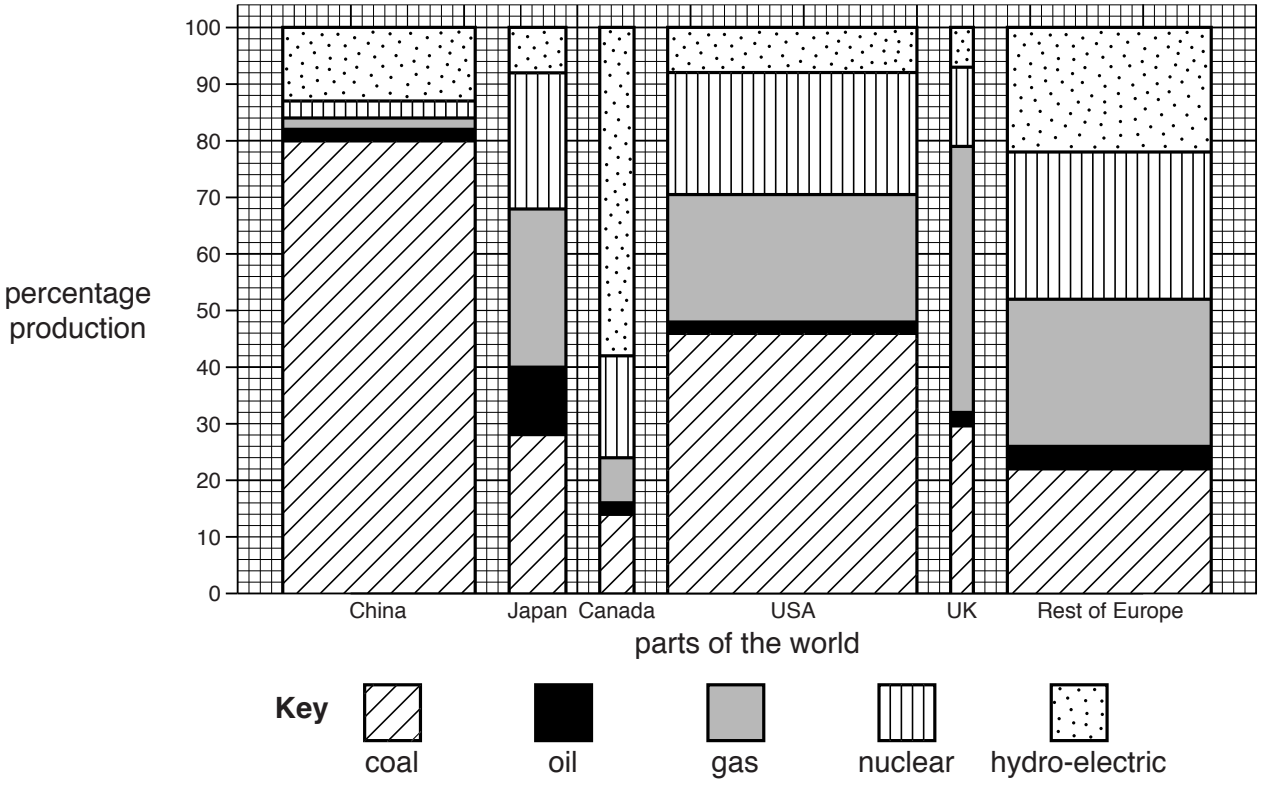
SECTION D

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

(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 .....

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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.

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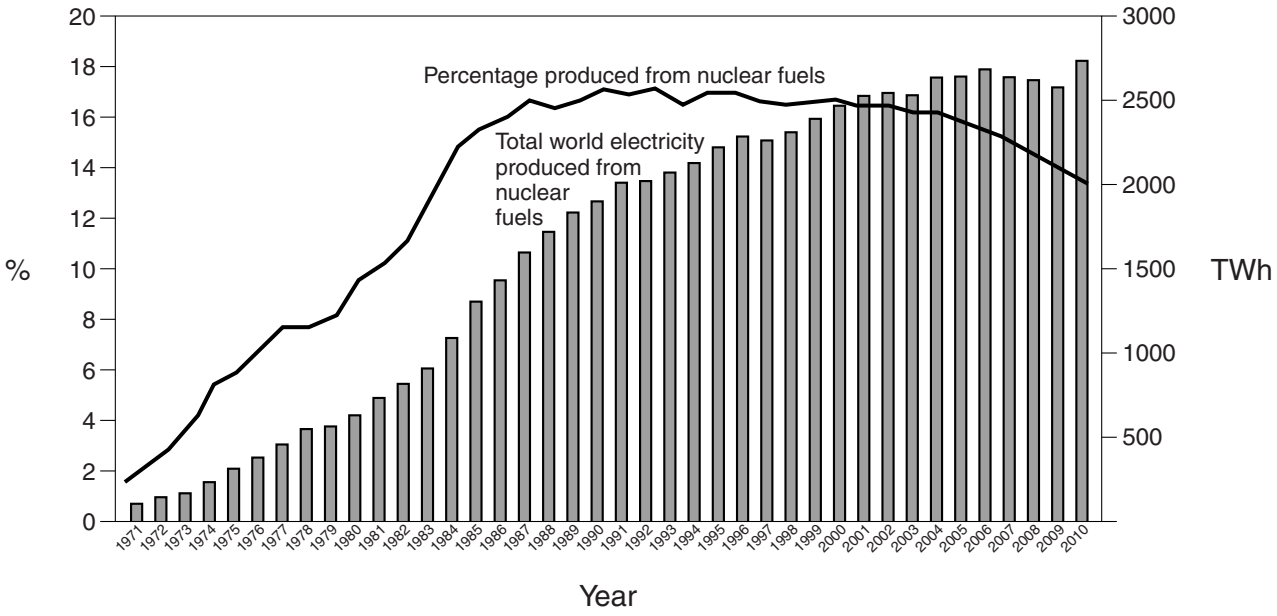
..... **[3]**

(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.

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 H hydrogen 1										4 He helium 2
7 Li lithium 3	9 Be beryllium 4											11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
23 Na sodium 11	24 Mg magnesium 12											27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18
39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	63.5 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	[98] Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
133 Cs caesium 55	137 Ba barium 56	139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** 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.