THIS IS A NEW SPECIFICATION

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F

Thursday 17 January 2013 – Afternoon

GCSE GATEWAY SCIENCE
SCIENCE B

B712/01 Science modules B2, C2, P2 (Foundation Tier)

1524696345

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

MODIFIED LANGUAGE

B712/01

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 **32** 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

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

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

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Question 1 begins on page 4

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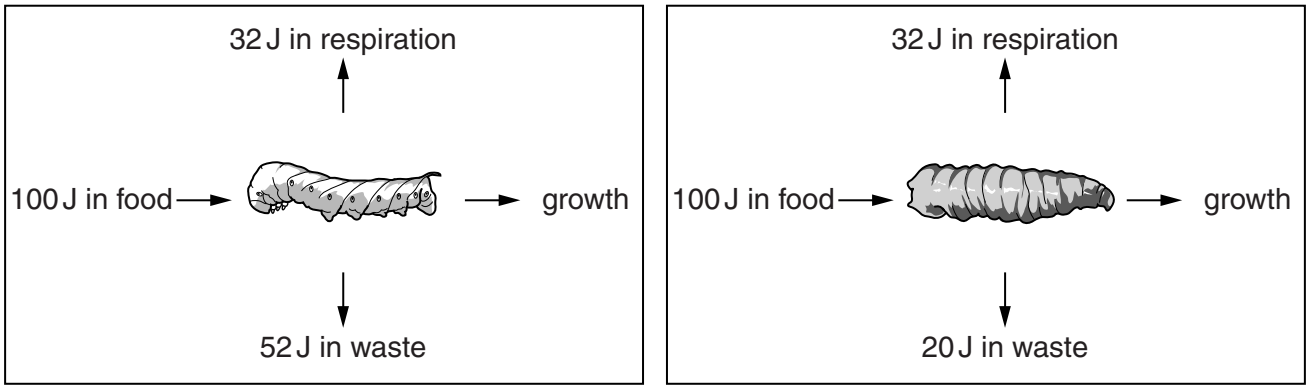
Answer **all** the questions.

SECTION A – Module B2

1 The diagram shows energy transfers through a caterpillar and a maggot.

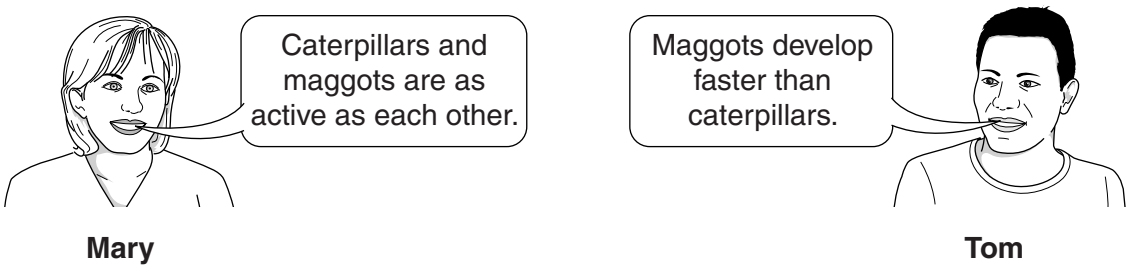


(a) (i) Calculate the amount of energy used for growth in the caterpillar and the amount of energy used for growth in the maggot for every 100 J of energy in their food.

Show your working.

caterpillar = ... J maggot = ... J **[2]**

(ii) Mary and Tom are talking about the two animals.



Use the data and your calculations to show how Mary and Tom are both correct.

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.....

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

(b) Caterpillars and maggots are both the larvae (young) of adult insects.

Look at the diagrams.

How do caterpillars and maggots look different from **adult** insects?

.....

.....

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

(c) Look at the list.

Which groups are insects in?

Put a (ring) around each of the **two** correct answers.

animal **arachnid** **arthropod** **crustacean** **protoctista** **[2]**

[Total: 8]

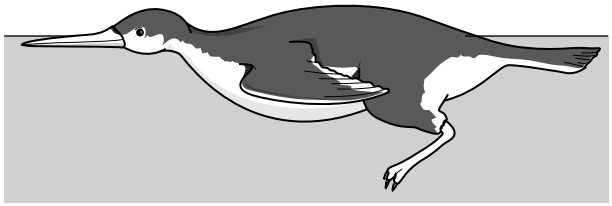
Question 2 begins on page 6

2 *Waimanu manneringi* is the oldest known species of penguin.

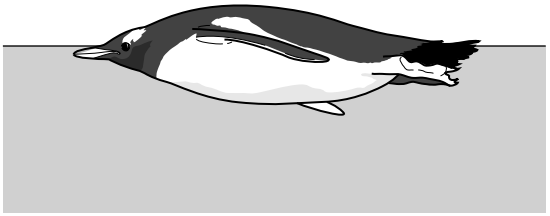
It lived around 62 million years ago in what is now New Zealand.

Scientists have used its fossils to work out what they think it looked like.

The Gentoo penguin is a modern species of penguin that is alive today.



Waimanu manneringi



Gentoo penguin

Scientists think that Gentoo penguins are better swimmers than *Waimanu manneringi*. One reason for this is that Gentoo penguins have a better body shape for moving through the water.

(a) Explain how Gentoo penguins could have evolved to become better swimmers. Use the theory of natural selection to explain how the changes in body shape could have happened.

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

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

(b) Paul says that because *Waimanu manneringi* is the oldest known species of penguin, then it must have been the **first** species of penguin.

Liz says that we can **not** be sure until we have looked for more fossils.

Kevin says that even if we find other fossils we will **never** be sure we have found the first species of penguin.

Who has made the best statement? .....

Explain your answer.

.....

.....

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

(c) Look at the picture of the Gentoo penguin.

One way that the Gentoo penguin is adapted is its smooth body shape.

Describe and explain **other** ways that **you can see in the picture** that the Gentoo penguin is adapted.

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.....

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

[Total: 11]

3 This question is about gases in the atmosphere.

(a) Carbon dioxide is added to the atmosphere when fossil fuels are burnt.

(i) Describe another way carbon dioxide is added to the atmosphere.

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.....

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

(ii) How is carbon dioxide removed from the atmosphere?

.....

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

(b) Nitrogen is another gas in the atmosphere.

Plants and animals contain many nitrogen compounds but they can **not** use nitrogen gas to make these compounds.

(i) Why can plants and animals **not** use nitrogen gas directly?

.....

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

(ii) What nitrogen compound do plants take in?

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

[Total: 6]

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Question 4 begins on page 10

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SECTION B – Module C2

4 David uses potassium sulfate, K_2SO_4, as a fertiliser.

(a) Fertilisers contain one or more of the three **essential elements** for plant growth.

(i) Write down the **name** of the essential element in potassium sulfate.

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

(ii) Sarah uses a mixture of potassium sulfate, K_2SO_4, and ammonium phosphate, $(NH_4)_3PO_4$, as a fertiliser.

Suggest why Sarah's fertiliser is a better choice than David's.

.....

.....

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

(b) Some people want to use more fertiliser and other people want to use less fertiliser.

Write about the advantages and disadvantages of using fertilisers.

.....

.....

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

(c) David wants to make some potassium sulfate solution.

He decides to neutralise an acid with potassium hydroxide.

(i) Which **acid** should he use?

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

(ii) David wants to check that a solution of potassium sulfate is neutral.

Write about how he could check.

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

[Total: 7]

Question 5 begins on page 12

5 Stowmarket Synthetics want to make hydrogen from methane and water.

Look at the balanced symbol equation for this reaction.

$$CH_4 + H_2O \rightleftharpoons CO + 3H_2$$

(a) What does the symbol $\rightleftharpoons$ mean?

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

(b) Phil is a research chemist who works for Stowmarket Synthetics.

He investigates how the **percentage yield (%)** of this process changes with temperature and with pressure.

He does his investigation with and without a catalyst.

Look at the percentage yield (%) **with** a catalyst.

	Temperature in °C	**Pressure in atmospheres**		
		20	**30**	**40**
With a catalyst	**300**	60%	42%	34%
	500	67%	49%	42%
	700	70%	64%	58%

Look at the percentage yield (%) **without** a catalyst.

	Temperature in °C	**Pressure in atmospheres**		
		20	**30**	**40**
Without a catalyst	**300**	60%	42%	34%
	500	67%	49%	42%
	700	70%	64%	58%

What conclusions can Phil make about the effect on the percentage yield when:

- using the catalyst?
- changing the temperature?
- changing the pressure?

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

(c) Write about the **costs** of making hydrogen by this method.

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

[Total: 6]

Question 6 begins on page 14

6 The body of a railway carriage can be made from either aluminium or steel.

(a) Steel is an alloy.

What is an alloy?

.....

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

(b) Look at the table. It shows some of the properties of aluminium and steel.

Property	Aluminium	Steel
corrosion in moist conditions	does not corrode	slowly rusts
density (1 = low, 10 = high)	3	8
magnetic attraction	not attracted	attracted
hardness (1 = soft, 10 = hard)	5	8
strength (1 = weak,10 = strong)	4	9
electrical conductivity (1 = poor, 10 = good)	8	7
other properties	malleable and a good conductor of heat	malleable and a good conductor of heat

Explain, with reasons, if aluminium or steel is the best metal to use to make the body of a railway carriage. Write about what properties should the metal used have.

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

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

(c) Old railway carriages are recycled in the same way as cars are recycled.

Write about the **advantages**, other than cost, of recycling metals.

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

[Total: 9]

7 Sodium chloride is found in sea water.

It is an important raw material used in the chemical industry.

Sodium chloride solution can be chemically changed into:

- sodium hydroxide
- chlorine
- hydrogen.

(a) Look at the symbol equation for this reaction. It is **not** balanced.

$$NaCl + H_2O \rightarrow NaOH + H_2 + Cl_2$$

Write down the **balanced symbol** equation for this reaction.

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

(b) Write down the name of a substance that can be made from hydrogen.

Choose from the list.

ammonia

cement

household bleach

soap

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

(c) Write down the name of a substance that can be made from chlorine.

Choose from the list.

ammonia

cement

household bleach

soap

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

[Total: 3]

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Question 8 begins on page 18

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SECTION C – Module P2

8 Paula fits solar panels to the roof of her house.

The panels contain photocells.

The photocells transfer light energy to electricity.

(a) What sort of electricity do photocells produce?

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

(b) Paula wants to **double** the electrical power produced from sunlight.

What should she do to the **area** of her solar panels?

.....

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

(c) Paula wants to reduce her fuel bills by using the Sun's energy in **another** way.

Describe a method she could use and explain how this method would reduce her fuel bills.

.....

.....

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

[Total: 4]

9 Producing electricity in power stations is not very efficient.

(a) In power station **A**, 800 joules of energy from coal produce 300 joules of electrical energy.

Calculate the efficiency of this power station.

.....

.....

.....

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

(b) In another power station, **B**, 800 joules of energy from coal produces 350 joules of electrical energy.

Compare the efficiency of power stations **A** and **B**.

.....

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

[Total: 3]

Question 10 begins on page 20

10 This question is about dealing with radioactive materials safely.

(a) Radioactive waste is produced by some industries and hospitals.

Half-life is the time it takes for the waste to become half as radioactive.

Look at the information in the table.

Waste containing...	Level of radiation	Half-life	Type of radiation given out
uranium	very radioactive	700 000 000 years	alpha
iodine	very radioactive	8 days	beta and gamma
a mix of sources from hospitals	slightly radioactive	up to 20 years	alpha, beta and gamma

Suggest what should be done with each type of waste to make sure it is disposed of safely. Give reasons for your answer.

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

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

(b) Radioactive materials can be used by science teachers in classrooms.

There are risks involved in handling radioactive materials.

Write about how these risks can be reduced.

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

[Total: 8]

Question 11 begins on page 22

11 Tammy uses electrical appliances in her home.

Look at the information.

Appliance	Power in watts	Time used each day in hours
 kettle	2500	0.5
 lamp	60	8.0
 toaster	800	0.1
 washing machine	2500	1.0

(a) Which appliance costs the **least** to use for one hour?

Choose from the table.

answer …… **[1]**

(b) The kettle and the washing machine have the same power rating.

The washing machine costs Tammy more to use each day than the kettle.

Explain why.

.....

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

(c) Tammy has a television.

It is connected to the 230 V mains.

The television takes a current of 0.8 A from the mains.

Calculate the power of the television.

.....

.....

answer .....W **[2]**

(d) The toaster is also connected to the 230 V mains.

Use information from the table to suggest why the toaster takes more current than the television.

.....

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

[Total: 5]

Question 12 begins on page 24

12 (a) Stars give off their own light.

Explain why.

.....

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

(b) Spacecraft are used to explore space.

Some spacecraft have astronauts in them. Other spacecraft are controlled by computers and don't have any people on board.

The distance from Earth to Mars is 200 million km.

It takes about 2 years for a spacecraft to reach Mars.

Look at the information about Neptune.

Distance from Earth	4500 million km
Diameter	49 600 km
Time to orbit Sun	165 years
Average temperature	–225 °C

A space exploration agency wants to send a spacecraft to Neptune.

They decide to send a spacecraft with astronauts on board.

Is this a good decision?

.....

Explain your answer.

.....

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

(c) Large asteroids have hit the Earth in the past.

What effect did these collisions have on the Earth?

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

[Total: 5]

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Question 13 begins on page 26

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SECTION D

13 This question is about the greenhouse effect and global warming.

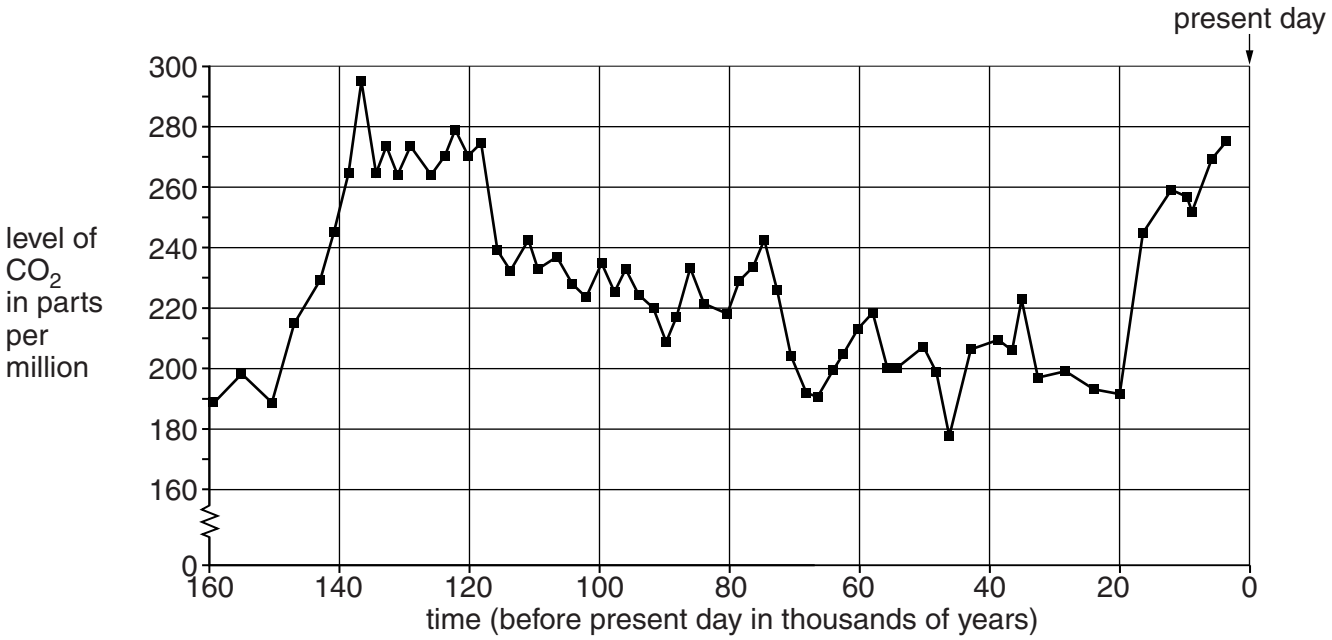
Some scientists say that an increase in global warming is part of a natural cycle.

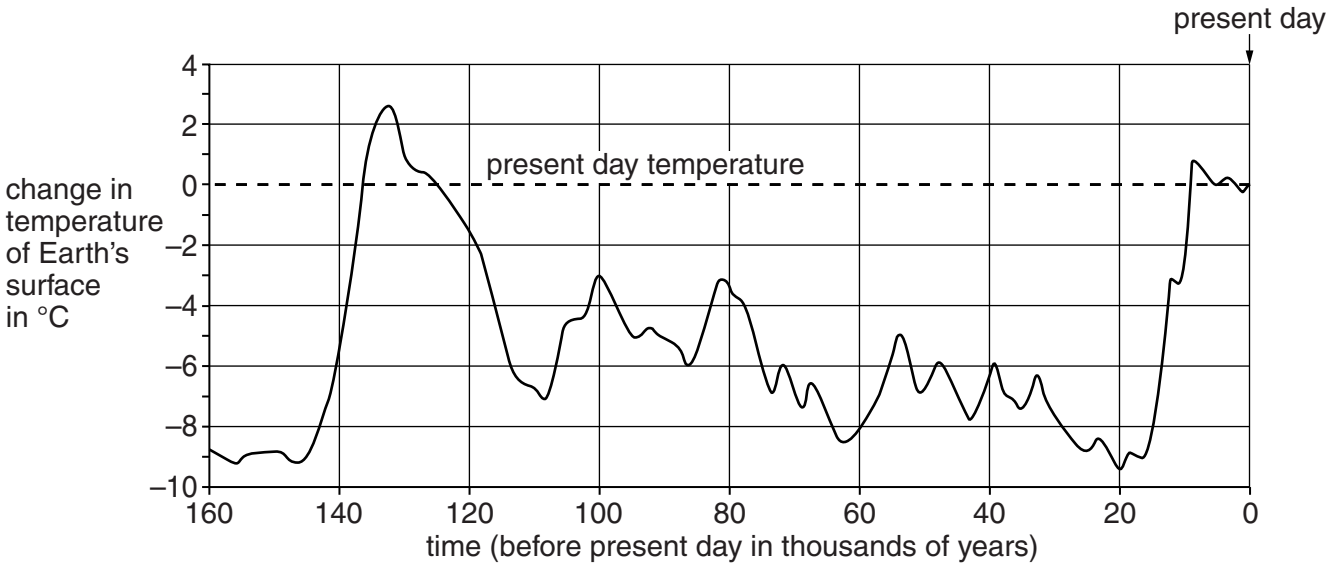
Other scientists think that an increase in global warming will be terrible for the world. They think that the surface temperature of the Earth is increasing and that this is because more fossil fuels are being burned.

Burning fossil fuels makes a lot of carbon dioxide.

Look at the graphs.

They show how the amount of carbon dioxide in the air and the temperature of the Earth have changed over the last 160 000 years.





(a) (i) What is the **highest** level of carbon dioxide in the air during the last 160 000 years?

..... parts per million **[1]**

(ii) Describe what has happened to the surface temperature of the Earth in the last 160 000 years.

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

(iii) Is there a link between the surface temperature of the Earth and the level of carbon dioxide in the air?

Explain your answer. Use information from the graphs.

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

Question 13(b) begins on page 28

(b) Look at the table. It shows the carbon dioxide emissions for some countries in 2003.

It also shows the population for these countries in 2003.

Country	Continent	Carbon dioxide emissions in million tonnes per year	Population in millions
Botswana	Africa	4	2
China	Asia	3762	1254
France	Europe	390	62
Germany	Europe	854	82
Ghana	Africa	7	23
India	Asia	1050	1064
Indonesia	Asia	318	215
Japan	Asia	1201	128
Mozambique	Africa	2	21
Russia	Asia	1527	143
UK	Europe	540	59
USA	America	5729	291
World		24983	6268

(i) Which **three** countries had the **lowest** carbon dioxide emissions in 2003?

.....

Suggest why.

.....

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

(ii) Show that the percentage of the world emissions of carbon dioxide in 2003 made by the USA was 22.9%.

.....

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

(iii) In 2003, about 4.6% of the world's population lived in the USA.

22.9% of the world's emissions of carbon dioxide came from the USA.

Some other countries are concerned about the difference between these two percentages.

Suggest why.

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

[Total: 10]

END OF QUESTION PAPER

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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.