THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

H

Thursday 17 January 2013 – Afternoon

GCSE GATEWAY SCIENCE
SCIENCE B

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

B734520113

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

B712021

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.

© OCR 2013 [D/601/6896]
OCR is an exempt Charity

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

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

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

© OCR 2013

BLANK PAGE

Question 1 begins on page 4

PLEASE DO NOT WRITE ON THIS PAGE

© OCR 2013

Answer **all** the questions.

SECTION A – Module B2

1 This question is about gases in the atmosphere.

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

(i) Describe how else carbon dioxide is added to the atmosphere.

.....

.....

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

(ii) What process removes carbon dioxide from the atmosphere?

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

(b) Sulfur dioxide is also added to the atmosphere when fossil fuels are burnt.

(i) What are the consequences of adding sulfur dioxide to the atmosphere?

.....

.....

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

(ii) Air can be chemically tested to monitor sulfur dioxide levels.

Write down **one other** way of monitoring sulfur dioxide levels in the air.

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

[Total: 6]

© OCR 2013

2 The diagram shows some of the energy transfers through a countryside ecosystem.

The numbers show the energy at each stage in kJ/m^2/year.

	A		**B**		**C**	
green plants	→	plant-eating insects	→	insect-eating birds	→	birds of prey
42 500		4000		800		150

(a) Calculate the efficiency for each energy transfer **A**, **B** and **C**.

efficiency of **A** ..... %

efficiency of **B** ..... %

efficiency of **C** ..... %

[2]

(b) Which energy transfer is least efficient? .....

Suggest why this energy transfer is least efficient.

.....

.....

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

(c) There are only four stages to this chain.

In terms of energy transfer, explain why there can **not** be any more stages.

.....

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

[Total: 5]

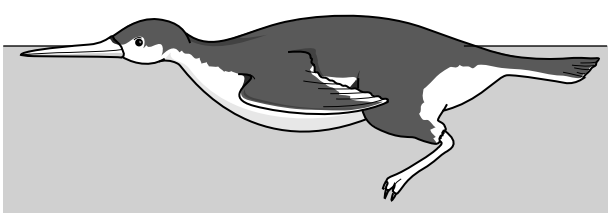
© OCR 2013

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

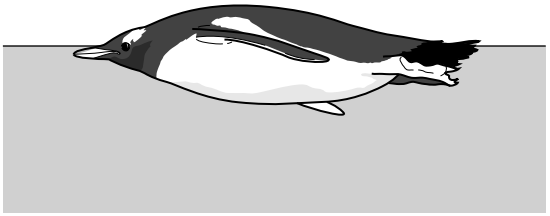
It lived around 62 million years ago in what is now New Zealand.

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

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



Waimanu manneringi



Gentoo penguin

Scientists think that *Waimanu manneringi* was a **less** efficient swimmer than the Gentoo penguin.

One reason for this is that *Waimanu manneringi* was **not** as streamlined as the Gentoo penguin.

(a) Scientists think that the Gentoo penguin species evolved from a species that looked very similar to *Waimanu manneringi*.

Explain how the Gentoo penguin species could have evolved from this different species.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

© OCR 2013

(b) What genus does *Waimanu manneringi* belong to?

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

(c) *Waimanu manneringi* lived around 3 million years after the mass extinction of about 85% of the world's species.

This mass extinction included most of the world's dinosaurs.

After the extinction there was a relatively rapid evolution of many new species which included the first penguins.

Suggest why there was a rapid evolution of many new species at this time.

.....

.....

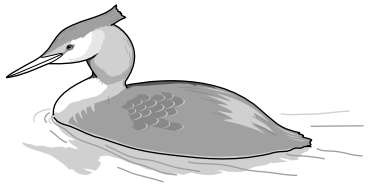
.....

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

(d) Scientists used to think that penguins were closely related to some other water birds such as grebes.

They thought this because of similarities between the two types of bird.

However, new evidence now suggests that penguins and grebes are **not** closely related.



grebe

(i) Explain why penguins and grebes have similarities although they are **not** closely related.

.....

.....

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

(ii) Suggest what new evidence could be used to show that penguins and grebes are **not** closely related.

.....

.....

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

Turn over for the remainder of question 3

© OCR 2013

(e) Penguins use a counter-current system to keep their feet cooler than the rest of the body.

This reduces heat loss from their feet.

Describe how the counter-current system works.

.....

.....

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

[Total: 14]

© OCR 2013

BLANK PAGE

Question 4 begins on page 10

PLEASE DO NOT WRITE ON THIS PAGE

© OCR 2013

SECTION B – Module C2

4 Sarah is a farmer.

Look at the table.

It shows information about some of the chemicals Sarah uses while farming.

Chemical	Formula	Colour	State at room temperature	Solubility in water
Ammonia	NH_3	colourless	gas	soluble
Ammonium phosphate	$(NH_4)_3PO_4$	white	solid	soluble
Calcium carbonate	$CaCO_3$	white	solid	insoluble
Potassium sulfate	K_2SO_4	white	solid	soluble

(a) How many **atoms** are there in the formula for ammonium phosphate, $(NH_4)_3PO_4$?

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

(b) Sarah uses one of the **solid** chemicals to neutralise acid soils.

Which one?

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

(c) David is a scientist who works with fertilisers. Potassium sulfate is a fertiliser.

It is important that potassium sulfate is soluble in water.

Explain why.

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

(d) 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) Describe the experimental method he should use to make potassium sulfate solution.

.....

.....

.....

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

© OCR 2013

(e) Some scientists want farmers all over the world to use more fertiliser.

Other scientists want farmers all over the world to use less fertiliser.

Evaluate the use of fertilisers in terms of which view will have the best outcome for the majority of people.

.....

.....

.....

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

[Total: 8]

Question 5 begins on page 12

© OCR 2013

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

Look at the balanced symbol equation for this reaction.

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

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 this 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%

(a) What conclusions can Phil make about the effect of:

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

on the percentage yield?

.....

.....

.....

.....

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

© OCR 2013

(b) Stowmarket Synthetics know that many factors affect the cost of making hydrogen.

The high temperature and high pressure are two of these factors.

Explain how two **other** factors can reduce the cost of making hydrogen.

.....

.....

.....

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

[Total: 5]

Question 6 begins on page 14

© OCR 2013

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

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

© OCR 2013

15

Evaluate the advantages and disadvantages of using aluminium and of using steel to make the bodies of railway carriages.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

[Total: 6]

Question 7 begins on page 16

© OCR 2013

7 Sodium chloride is found in sea water.

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

Sodium chloride solution can be electrolysed to make sodium hydroxide, chlorine and hydrogen.

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

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

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

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

(b) Look at the equations for the electrode reactions that happen during this electrolysis.

cathode reaction $2H^+ + 2e^- \longrightarrow H_2$

anode reaction $2Cl^- - 2e^- \longrightarrow Cl_2$

The electrolysis of sodium chloride solution involves **both** oxidation and reduction.

Explain which reaction shows oxidation and which reaction shows reduction.

.....

.....

.....

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

[Total: 3]

© OCR 2013

8 The theory of plate tectonics explains many of the geological events that occur on the Earth's surface.

The theory was first proposed in 1914, by a scientist called Wegener.

In 1914, not many scientists believed Wegener's theory.

(a) It took almost 50 years until scientists widely accepted the theory of plate tectonics.

Explain why.

.....

.....

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

(b) The theory of plate tectonics explains what happens when a continental and an oceanic plate collide.

Describe what happens when these plates collide.

.....

.....

.....

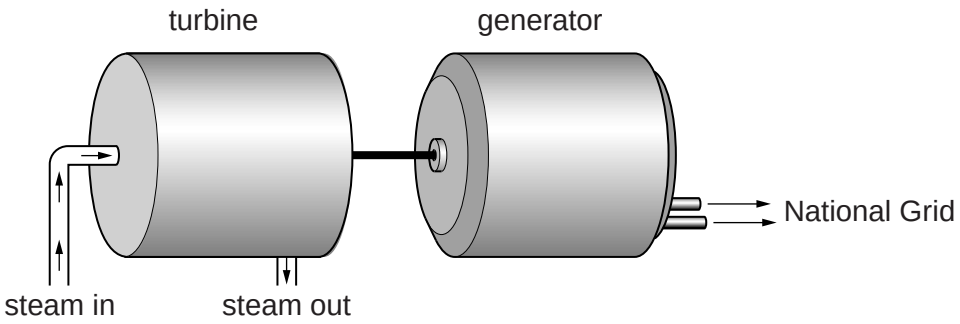
..... **[2]**

[Total: 3]

© OCR 2013

SECTION C – Module P2

9 Power stations generate electricity.



A turbine drives a generator.

(a) Describe how the generator produces electricity.

.....

.....

.....

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

(b) In a power station a large amount of energy is wasted.

For every 1.0×10^6 J of energy supplied in coal only 2.8×10^5 J are changed to electrical energy.

7.2×10^5 J of energy are wasted.

Calculate the efficiency of the power station.

.....

.....

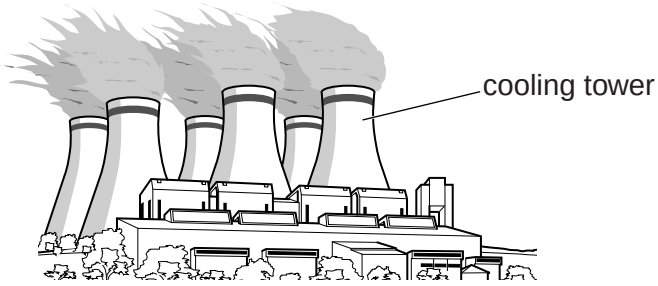
.....

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

© OCR 2013

(c) A community group says that they can make the existing power station more efficient.

They can use steam from the cooling towers to heat local homes.



This will increase the efficiency of the power station.

Explain how.

.....

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

[Total: 5]

Question 10 begins on page 20

© OCR 2013

10 Hannah investigates photocells.

(a) She finds that a panel of photocells 30 cm × 20 cm produces 20 watts of power.

Hannah needs to produce 50 watts of power.

Calculate the panel area of photocells she must use.

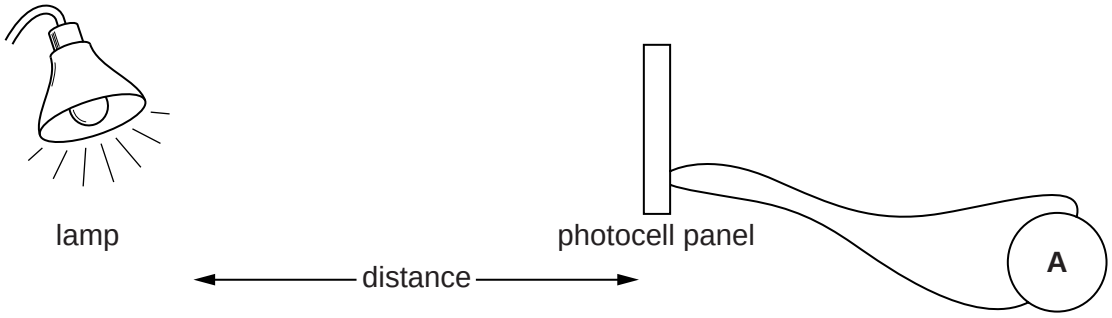
.....

.....

answer.....cm^2 **[2]**

(b) Hannah now investigates a small panel of photocells.

Look at the diagram of the apparatus she uses.



Hannah experiments to find out how the current produced by the panel changes as she moves the lamp away.

Look at the table of her results.

Distance of lamp from panel in cm	Current in mA
5	120.0
10	30.0
15	13.3
20	7.5
30	3.3
40	2.2
60	1.5
80	1.4

© OCR 2013

21

Hannah makes a conclusion from her results.

'When I double the distance from the lamp, the current from the panel is a quarter of the original value.'

Is this a sensible conclusion for **all** her results?

.....

Use the data to explain your answer.

.....

.....

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

[Total: 5]

Question 11 begins on page 22

© OCR 2013

11 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 how each type of waste can be disposed of safely, giving reasons for your answer.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

© OCR 2013

(b) There are many useful applications for radioactive sources.

Alpha radiation is used in smoke detectors.

(i) Write down one use of beta radiation.

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

(ii) Write down one use of gamma radiation.

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

[Total: 8]

12 **(a)** Comets orbit our Sun.

The speed of a comet increases as it gets closer to the Sun.

Explain why.

.....

.....

.....

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

(b) Near Earth Objects (NEOs) are threats to the Earth.

Suggest what actions can be taken to reduce the threat from these objects.

.....

.....

.....

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

[Total: 4]

© OCR 2013

13 **(a)** The Big Bang theory accounts for the start of the Universe.

Light observed from distant galaxies is shifted towards the red end of the spectrum.

How do these observations support the Big Bang theory?

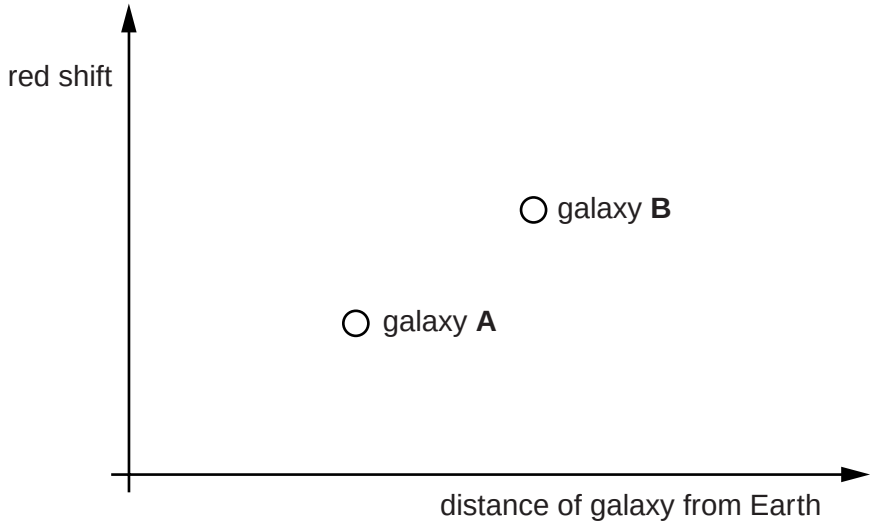
.....

.....

.....

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

(b) Look at the graph.



The graph shows that galaxy **B** is further away from Earth than galaxy **A**.

What conclusions can be made about galaxies **A** and **B**?

.....

.....

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

[Total: 3]

© OCR 2013

BLANK PAGE

Question 14 begins on page 26

PLEASE DO NOT WRITE ON THIS PAGE

© OCR 2013

SECTION D

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

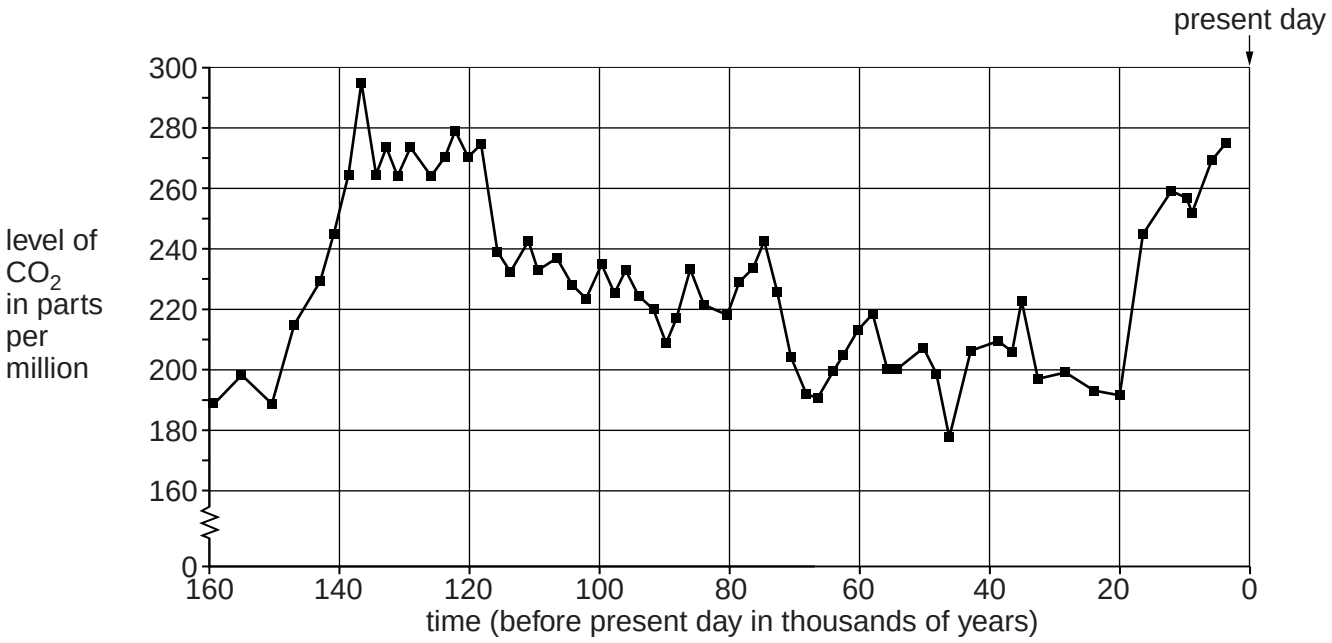
Some scientists say that an increase in global warming is part of a natural cycle.

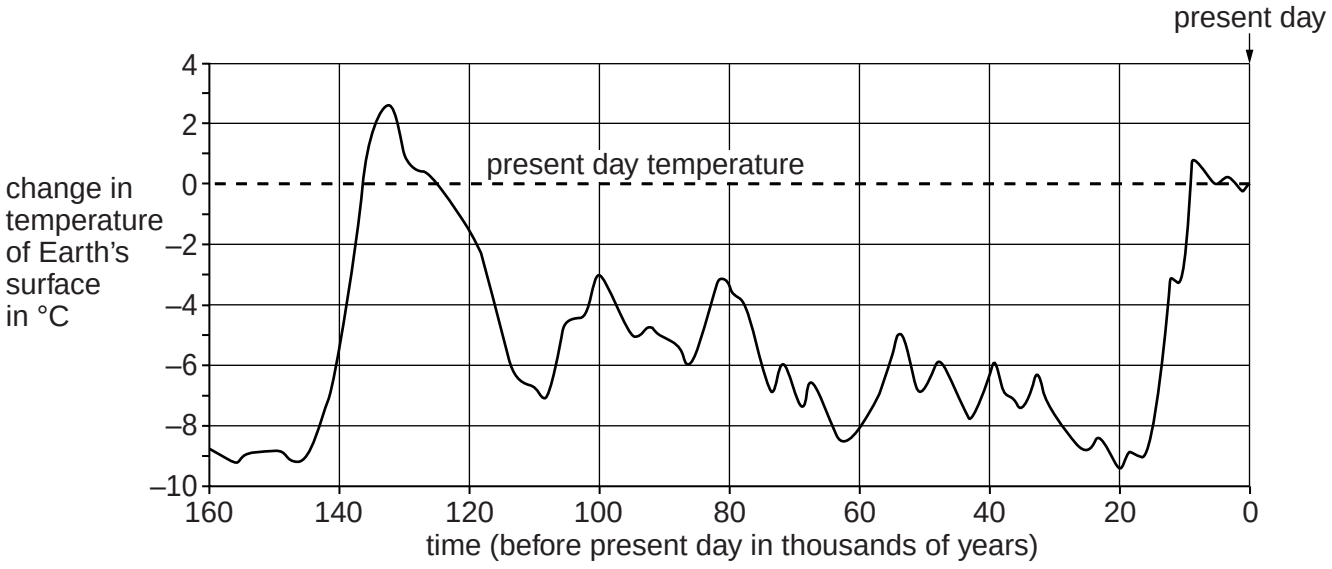
Other scientists think that an increase in global warming will be disastrous for the world. They think that the surface temperature of the Earth is increasing and that this is because more fossil fuels are being burned.

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.





© OCR 2013

(a) 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.

.....

.....

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

Question 14(b) begins on page 28

© OCR 2013

(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	Carbon dioxide emissions per million of population in millions of tonnes
Botswana	Africa	4	2	2.0
China	Asia	3762	1254	3.0
France	Europe	390	62	6.3
Germany	Europe	854	82	10.4
Ghana	Africa	7	23	0.3
India	Asia	1050	1064	1.0
Indonesia	Asia	318	215	1.5
Japan	Asia	1201	128	9.4
Mozambique	Africa	2	21	0.1
Russia	Asia	1527	143	10.7
UK	Europe	540	59	9.2
USA	America	5729	291	19.7
World		24983	6268	3.9

(i) What percentage of the world emissions of carbon dioxide in 2003 was made by the USA?

Give your answer correct to **one** decimal place.

.....

.....

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

(ii) Comment on any patterns you can see in the table between carbon dioxide emissions and population.

.....

.....

.....

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

© OCR 2013

(c) Other gases can contribute to global warming.

Look at the table.

It shows how long each gas remains in the air (lifetime), its global warming potential and the current level of each gas in the air.

Gas	Lifetime in years	Global warming potential	Current level in the air in parts per million
carbon dioxide	1	1	388.0
methane	12	72	1.7
nitrous oxide	114	289	0.3

Evaluate the likely contribution of each gas to global warming.

.....

.....

.....

.....

.....

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

[Total: 10]

END OF QUESTION PAPER

© OCR 2013

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

© OCR 2013

PLEASE DO NOT WRITE ON THIS PAGE

OCR
RECOGNISING ACHIEVEMENT

Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

© OCR 2013

© OCR 2013

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.

PMT