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Monday 10 June 2013 – Afternoon

GCSE GATEWAY SCIENCE
SCIENCE B

B711/02 Science modules B1, C1, P1 (Higher Tier)

B722240613

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 15 minutes

B711102

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 **75**.
- This document consists of **28** pages. Any blank pages are indicated.

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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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BLANK PAGE

Question 1 begins on page 4

PLEASE DO NOT WRITE ON THIS PAGE

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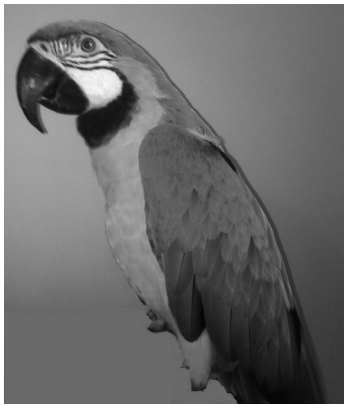
Answer **all** the questions.

SECTION A – Module B1

1 Look at the picture of a macaw.



(a) (i) There are 70 chromosomes in each **body** cell of a macaw.

Humans have 23 pairs of chromosomes in each body cell.

How many **pairs** of chromosomes are in a body cell of a macaw?

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

(ii) The macaw in the picture is male.

Sex is determined by sex chromosomes.

Write down the pair of sex chromosomes that are in each body cell of a **human male**.

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

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(b) In humans, like many animals, equal numbers of males and females are produced.

Explain how equal numbers of male and female offspring are produced.

Use a genetic diagram.

.....

.....

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

(c) The natural environment for a macaw is the top of trees in tropical rainforests.

The position of the eyes on the head of a macaw makes it difficult for it to judge distance.

Explain why.

.....

.....

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

[Total: 6]

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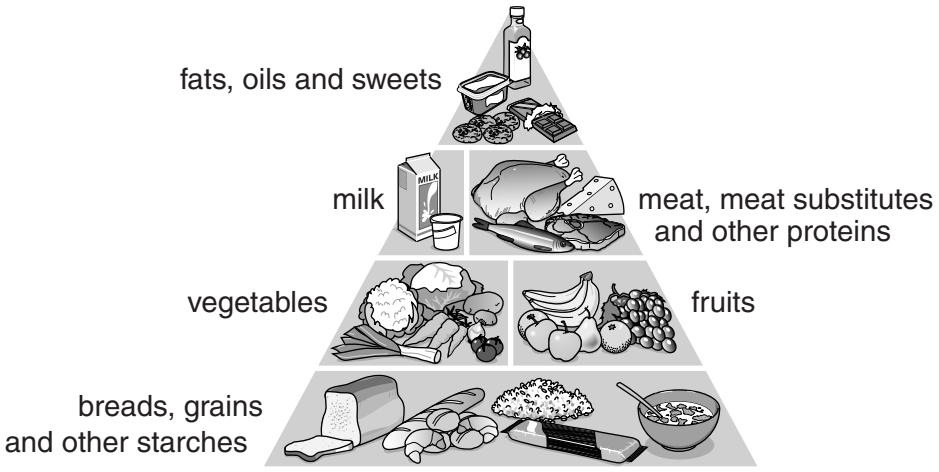
2 This question is about diabetes.

People who have diabetes lack a hormone or the hormone doesn't work properly.

(a) What does this hormone normally control in the body?

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

(b) Look at the picture of the diabetic food pyramid.
It is a guide to the amounts of different types of food that people with diabetes should eat.



There are two forms of diabetes known as Type 1 and Type 2.

The diabetic food pyramid is used as a guide for people with diabetes.

Explain why using this food guide can help with the control of diabetes and explain the importance of this to people with Type 1 diabetes.

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

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

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(c) Diabetes can affect the retina.

The retina is part of the eye.

Describe the job of the retina.

.....

.....

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

[Total: 9]

Question 3 begins on page 8

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3 Look at the table.

It shows the number of cases and the number of deaths for four different types of cancer in the UK, in 2008.

	Number of cases		Number of deaths	
Type of cancer	**Male**	**Female**	**Male**	**Female**
colon	13359	12192	5226	4938
lung	22846	17960	19863	15393
stomach	4923	2687	3186	1992
thyroid	558	1596	138	216

Use data from the table to answer the questions.

(a) (i) In this study, lung cancer is the most common cancer in both males and females.

The lifestyle of a person can greatly affect the chance of getting lung cancer.

What changes might someone make to their lifestyle to reduce the risk of lung cancer?

.....

.....

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

(ii) Calculate the ratio between cases and deaths for **thyroid** cancer in both males and females.

male cases to male deaths ratio .....

female cases to female deaths ratio .....

[2]

(iii) Use your answer from **part (ii)** to explain whether males or females are more at risk of dying from thyroid cancer.

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

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(b) The treatment of cancer has been improved by the research of Sir Paul Nurse.

Read the article about his research.

> Sir Paul Nurse is a scientist who investigated cell division in yeast.
>
> In 1980, his research produced results that were unexpected. He found that, the increase in cell numbers was due to delayed cell death rather than more rapid cell division.
>
> For some time, he thought his experiment was flawed. After repeating the experiment, he still got the same results.
>
> Cancer researchers used these results to help them develop entirely new cancer treatments.
>
> In 2001, Sir Paul Nurse received the Nobel Prize for his work.

Suggest reasons why this work has led to him receiving the Nobel Prize.

.....

.....

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

[Total: 7]

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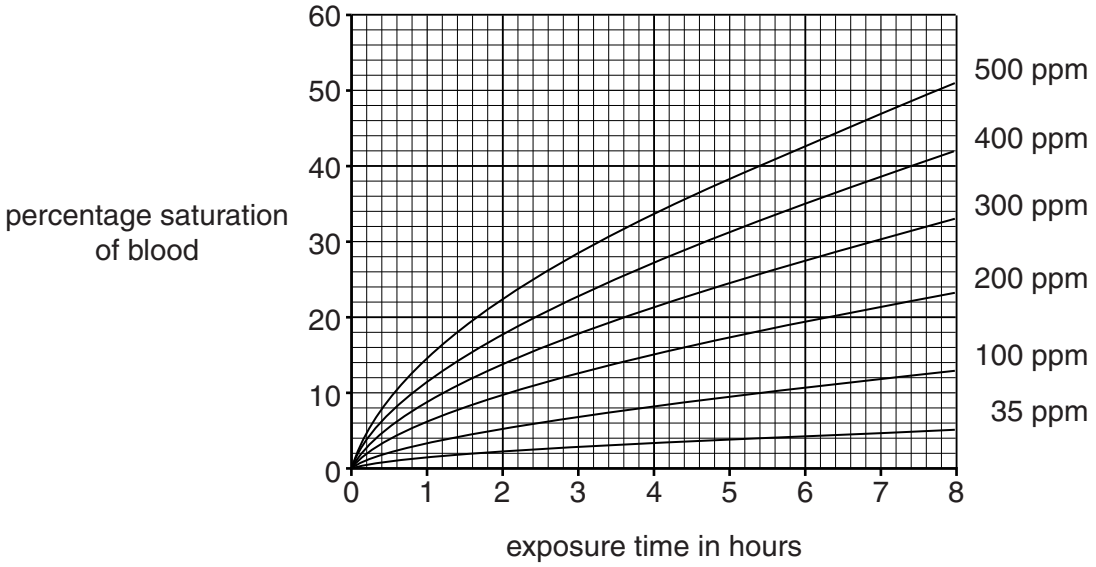
4 Carbon monoxide is a poisonous gas. It causes many deaths in the UK.

Look at the graph.

It shows the percentage saturation of blood during exposure to different levels of carbon monoxide (parts per million).



(a) A person becomes unconscious at 40 per cent saturation of blood.

How much longer will it take to become unconscious at a carbon monoxide concentration of 400 ppm compared to 500 ppm?

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

(b) An unconscious patient can be treated with oxygen.

The patient needs to breathe 100 per cent oxygen at high pressure.

Suggest how this treatment helps the body recover from carbon monoxide poisoning.

.....

.....

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

[Total: 3]

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SECTION B – Module C1

5 Crude oil is a mixture of hydrocarbons.

Crude oil is separated into fractions in an oil refinery.

Look at the table. It shows information about some of the fractions.

Fraction	Number of carbon atoms per molecule	Boiling point in °C	Percentage in crude oil (the supply)	Percentage needed by the oil refinery (the demand)
Liquefied Petroleum Gases (LPG)	1 – 4	less than 30	4	11
Petrol	5 – 9	30 – 65	11	32
Naphtha	6 – 12	65 – 180	22	4
Paraffin	10 – 14	160 – 250	12	20
Diesel	13 – 20	250 – 340	18	15
Bitumen	Over 20	more than 340	23	4

(a) An alkane has the molecular formula $C_{11}H_{24}$.

Estimate the boiling point of this alkane.

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

(b) The petrol fraction has a lower boiling point than the diesel fraction.

Explain why.

.....

.....

.....

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

(c) Cracking helps an oil refinery to match the **supply** of certain fractions with the **demand** for them.

Use information from the table to explain how.

.....

.....

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

[Total: 5]

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6 The air may contain different pollutants.

Look at the table.

It shows the relative concentration of pollutants found in the air in two places in the world.

Pollutant	Relative concentration in the air	
	in a city centre	near a volcano
carbon monoxide	0.3	0.01
hydrogen sulfide	0.01	210
oxides of nitrogen	1.5	0.1
sulfur dioxide	200	1500
trichlorofluoromethane	0.01	0.005

(a) Some scientists think that volcanic eruptions cause acid rain.

What evidence is there in the table of data to support this idea?

.....

.....

.....

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

(b) Nitrogen monoxide, NO, reacts with oxygen, O_2.

Nitrogen dioxide, NO_2, is made.

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

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

[Total: 4]

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7 Butane, C_4H_{10}, is a hydrocarbon.

Butane is used as a fuel in a camping stove.

Butane burns in oxygen, O_2, from the air.

Both **complete** combustion and **incomplete** combustion can happen when butane burns.

Explain, with the help of **balanced symbol** equations, the advantages of complete combustion over incomplete combustion of butane.

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

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

[Total: 6]

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8 Chemists are developing new types of polymers that are:

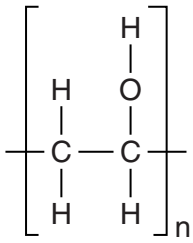
- biodegradable
- soluble in water.

(a) Explain why chemists are developing these new types of polymers.

.....

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

(b) Look at the displayed formula of a polymer that is soluble in water.



This polymer is **not** a hydrocarbon.

Explain why.

.....

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

(c) These chemists publish their results using books, the internet and conferences.

Why is it important that these chemists publish their results?

.....

.....

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

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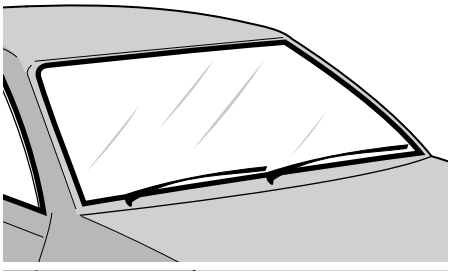
(d) Look at the table. It shows the properties of some polymers.

Polymer	Colour	Strength (1 = Weak, 10 = Strong)	Hardness (1 = Soft, 10 = Hard)	Biodegradable	Density (1 = Low, 10 = High)
A	white	10	10	yes	8
B	black	3	1	no	1
C	colourless	8	9	no	10
D	colourless	7	1	no	3
E	colourless	8	9	yes	1



Polymer **C** is used to make the windscreen of this car.

Explain why.

.....

.....

.....

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

[Total: 6]

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9 Potato salad is a mixture of cooked potatoes and mayonnaise.

The mayonnaise contains an emulsifier to help stop oil and water from separating.

(a) Explain, using a labelled diagram, how an emulsifier helps to stop oil and water from separating.

.....

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

(b) Potato is easier to digest if it is cooked.

Explain why.

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

[Total: 4]

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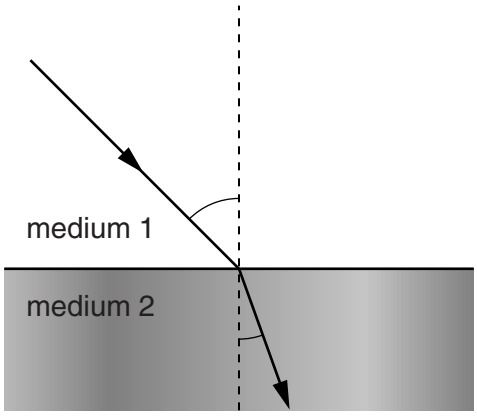
SECTION C – Module P1

10 This question is about light.

(a) **(i)** The diagram shows light being refracted from medium 1 to medium 2.



Why does **refraction** occur?

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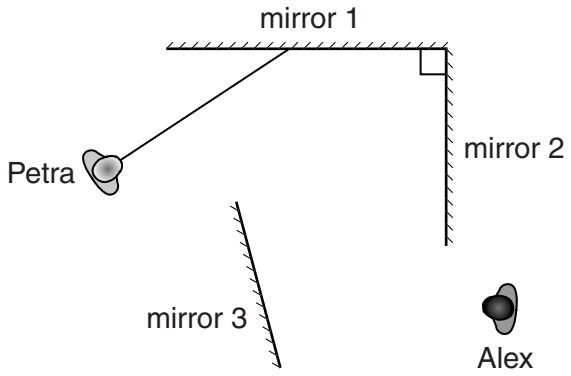
..... **[1]**

(ii) Alex and Petra are at a fairground.

They visit the Hall of Mirrors.

Complete the ray diagram to show how Alex and Petra can see each other.



[1]

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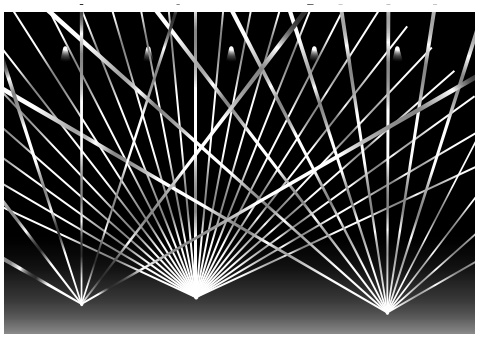
(b) Light can be produced by lasers.

Look at the picture of a laser light show.



Laser light shows use lasers with intense coherent beams.

Explain what is meant by an **intense coherent** laser beam.

.....

.....

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

(c) Morse code can be used for communication.

Look at the table showing part of the Morse code.

A	•–	1	•– – – –
B	–•••	2	••– – –
C	–•–•	3	•••– –
D	–••	4	••••–
E	•	5	•••••
F	••–•	6	–••••

Morse code can be sent by light.

(i) In the past, coded light signals were used to send messages over **long** distances.

Explain how this was done.

.....

.....

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

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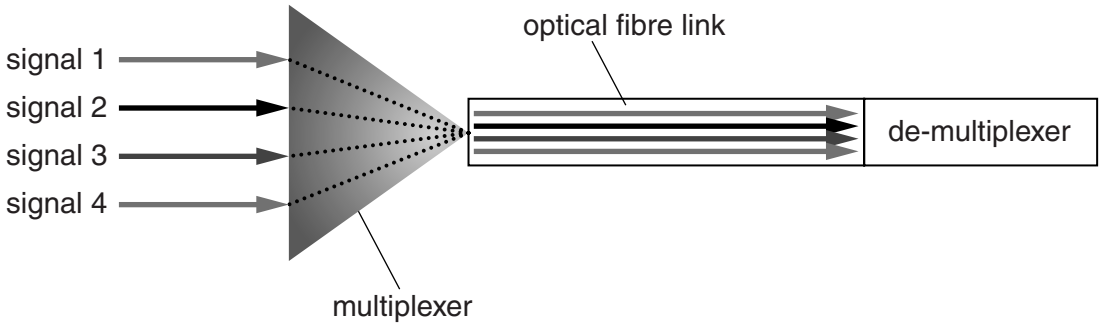
(ii) Coded signals can also be sent using electrical pulses.

Explain **one advantage** of using light signals rather than electrical pulses in modern cable communication systems.

.....

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

(d) Light signals can be transmitted using an optical fibre link.



Describe the job of the **de-multiplexer**.

.....

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

[Total: 8]

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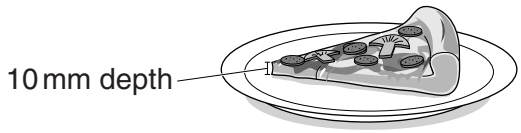
11 Gino wants to heat a thin slice of pizza.

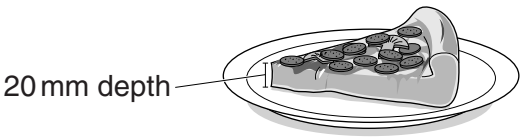


thin pizza slice

Look at the information about the two different methods of heating the **thin** pizza slice.

Method of heating	**How a pizza slice is heated**	**Distance waves can penetrate into a pizza slice in mm**	**Time to heat the thin pizza slice in minutes**
oven using infrared waves	heats the top surface of the pizza	<1	5
oven using microwaves	heats water and fat in the pizza	>7	1.5

Gino also wants to heat a thicker slice of pizza.



thick pizza slice

The **thick** pizza contains a greater percentage (%) of **water and fat.**

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Estimate how long it would take to heat the **thick** pizza slice using each of the two different methods of heating.

Use your knowledge and understanding about energy transfer, and the information in the table, to explain your answers.

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

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

[Total: 6]

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12 Kathy and Jonathan collect information about different electromagnetic waves.

Type of electromagnetic wave	Wave speed in m/s	Wavelength in m
microwave	3×10^8	2×10^{-2}
radio	3×10^8	2
X-ray	3×10^8	2×10^{-9}
infrared	3×10^8	2×10^{-5}

(a) Use the information in the table to calculate the **frequency** of the **microwave**.

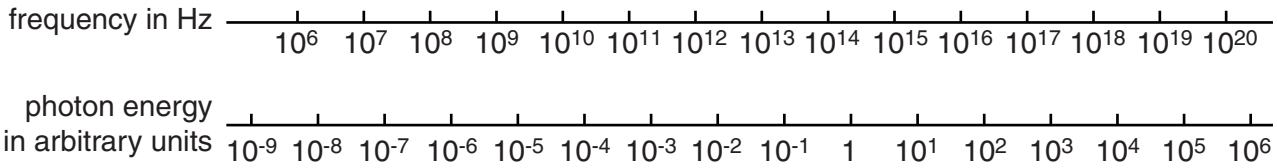
.....

.....

frequency = ... Hz **[3]**

(b) The energy of electromagnetic waves is carried by photons.

The chart shows information about frequency and photon energy.



(i) Use the chart to describe the relationship between frequency and energy.

.....

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

(ii) Infrared waves can vary in wavelength.

Infrared radiation from source **A** has a wavelength of 1×10^{-5} m.

Infrared radiation from source **B** has a wavelength of 1×10^{-6} m.

Compare the energy **and** potential dangers to humans of the radiation emitted by sources **A** and **B**.

.....

.....

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

[Total: 6]

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13 Some waves are potentially harmful to humans.

(a) (i) Noah's skin is naturally **darker** than Aiden's skin.

Noah

Aiden

Noah thinks this may reduce his skin cancer risk from ultraviolet waves.

Is he correct?

.....

Explain why.

.....

.....

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

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(ii) Sunscreens can reduce the risk of sunburn.

A scientist collects evidence about a new sunscreen.

The scientist carries out four tests.

Test	Time taken for skin to burn in minutes	
	Without sunscreen	**With the new sunscreen**
A	30	70
B	40	90
C	10	15
D	20	50

The scientist **cannot** conclude that the sunscreen **more than** doubles the time you can safely stay in the sun.

Identify the conflicting evidence and suggest how the confidence of the conclusion could be increased.

.....

.....

.....

.....

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

(b) The ozone layer protects the Earth from ultraviolet radiation.

Environmental pollution from CFCs has depleted the ozone layer.

Explain why people are concerned about this.

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

[Total: 5]

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.