OCR
Oxford Cambridge and RSA

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Wednesday 8 November 2017 – Afternoon

GCSE GATEWAY SCIENCE
ADDITIONAL SCIENCE B

B722/02 Additional Science modules B4, C4, P4 (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

* B 7 2 2 0 2 *

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 barcodes.

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.

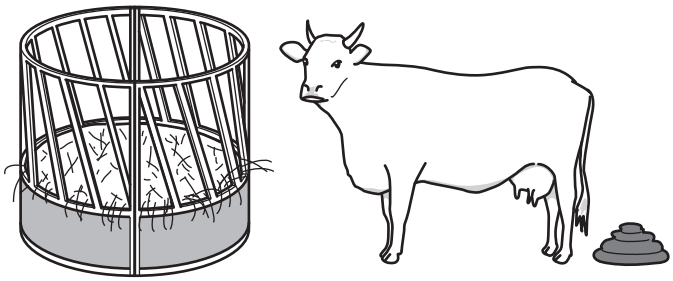
SECTION A – Module B4

1 A farmer keeps cows in a field.

In the middle of the field is a food container for the cows.

The cows spend a lot of time around the food container.

This means they drop lots of manure on the ground.



(a) Saprophytes and detritivores work together to release minerals from the manure.

Write about how they do this.

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

(b) Some students measure the percentage of the ground that is covered in plants.

They do this at different distances away from the feeding food container.

(i) Put a tick (✓) next to the equipment they use to sample the plants.

net and tape measure	
pitfall trap and pooter	
pooter and quadrat	
transect line and quadrat	

[1]

(ii) The students observe the cows trampling the ground around the food container.

The students also measure the nitrates in the soil at different distances from the food container.

The table below shows their results.

Distance from food container in metres	1	2	3	4	5	6	7
Percentage cover by plants	40	75	95	65	55	40	40
Nitrate content in mg per kg	12	10	9	7	6	4	4

Suggest explanations for the percentage cover by plants at different distances from the food container.

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

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

2 This question is about diffusion and osmosis.

(a) A student writes two sentences about diffusion and osmosis.

Each sentence contains **one** mistake.

- **Diffusion** occurs when all the particles in a liquid or gas move from a high concentration to a low concentration.
- ***Osmosis*** in plant cells involves the movement of water across a permeable cell membrane.

Rewrite each sentence correcting the mistake.

Diffusion .....

.....

Osmosis .....

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

(b) Red blood cells change when they are put into different liquids.

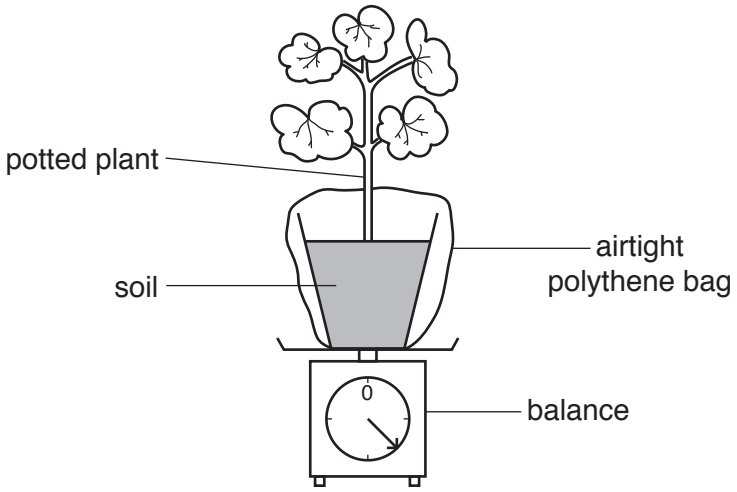
Draw a straight line to join each **treatment** to the **change** in the red blood cells.

Draw only **two** lines.

treatment	**change**
placed in distilled water	crenated
	lysed
placed in concentrated salt solution	plasmolysed
	turgid

[2]

3 Jemima sets up an experiment with a potted plant.



(a) Jemima changes the conditions in the room.

She wants to see if this causes more or less mass to be lost.

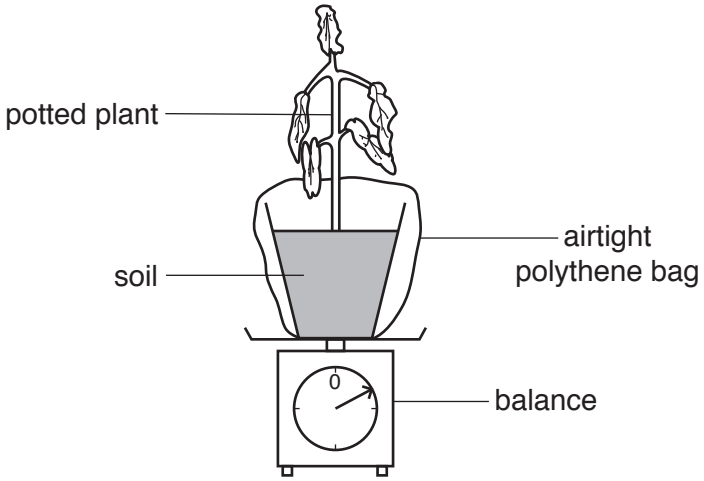
Write **more** or **less** in the table below to show what would happen to the loss of mass.

Change to conditions	Is the change in mass more or less than in normal conditions?
a bright light shines at the plant	
the air in the room is more humid	
the room is colder	
a fan is pointed at the plant	

[2]

(b) Jemima leaves the potted plant on the balance.

When she looks at the plant after a week she notices that the leaves have drooped.



Explain what changes have occurred inside the cells of the plant to cause the leaves to droop.

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

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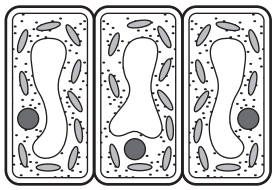
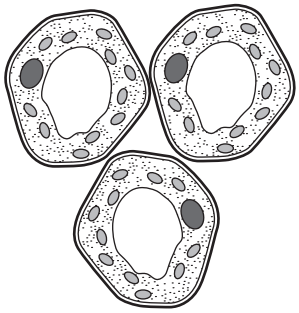
PLEASE DO NOT WRITE ON THIS PAGE

4 Tim is using a microscope to look at a section of a leaf.

(a) He draws two types of cells from the leaf.

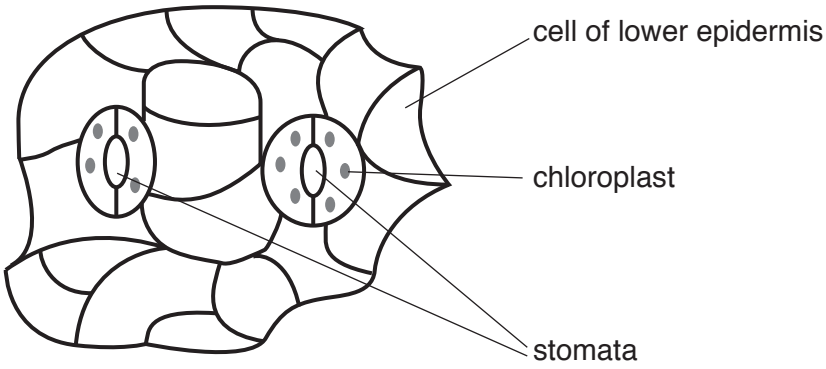
Complete Tim's table to show

- the **name** of each type of cell
- how the **position or shape** of the cells allow efficient photosynthesis in the leaf.

Drawing	Type of cell	Ways that the cells allow efficient photosynthesis
		
		

[2]

(b) Tim now draws a labelled diagram of the lower surface of the leaf.



The stomatal index of a leaf gives a measurement of how many stomata are present.

It can be calculated using this formula:

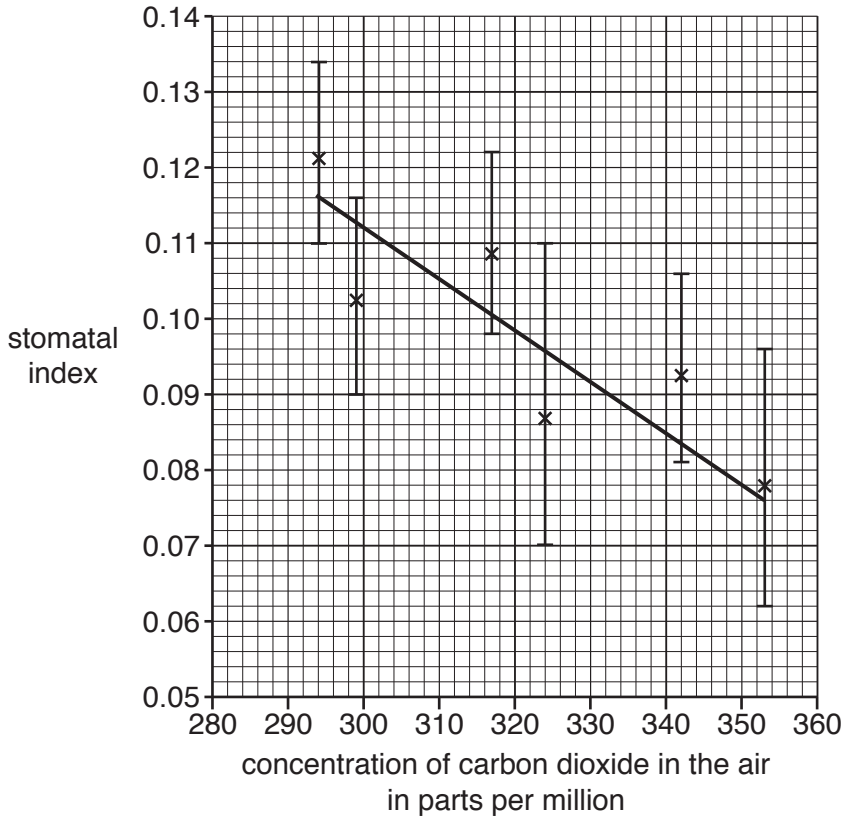
$$\textbf{stomatal index} = \frac{\text{number of stomata}}{\text{number of lower epidermis cells + number of stomata}}$$

Work out the stomatal index for Tim's leaf.

stomatal index = ... **[2]**

(c) The stomatal index of a plant may depend on the level of carbon dioxide in the air around the plant.

Look at the graph.



(i) Suggest an explanation for the shape of the graph.

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

(ii) Tim wants to use the graph and the stomatal index for his leaf to estimate the concentration of carbon dioxide around the plant.

His estimate would not be accurate. Use the features of the graph to explain why.

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

SECTION B – Module C4

5 This question is about elements in the Periodic Table.

Look at the list of elements.

chlorine, Cl

copper, Cu

hydrogen, H

iron, Fe

neon, Ne

nitrogen, N

nickel, Ni

oxygen, O

Answer the questions.

Choose your answers from the list.

Each element can be used once, more than once or not at all.

(a) Which element is used as a catalyst in the manufacture of margarine?

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

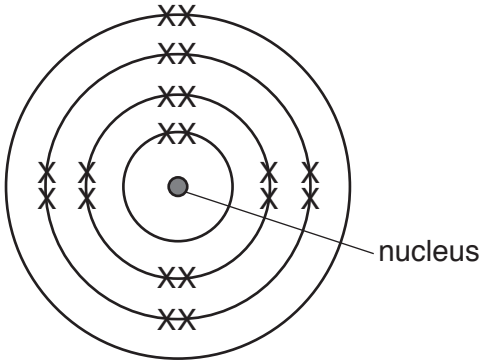
(b) Which element is a pale green gas at room temperature and pressure?

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

(c) Which element has some **compounds** that are orange/brown in colour?

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

6 Look at the electronic structure of an atom of an element.



(a) To which **group** and which **period** does this element belong?

Use the electronic structure to explain your answer.

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

(b) Look at the two atoms of hydrogen below.

$^{1}_{1}H$ $^{2}_{1}H$

What is the name given to atoms that are related in this way?

Explain your answer.

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

(c) Scientists such as Dalton, J.J. Thomson, Rutherford and Bohr have been involved in the development of the atomic model.

The atomic model has changed over the years and even now atomic theory is still being developed.

Explain why.

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

7 Kevin and Ann test a solution.

They use two chemical tests.

- Test 1 – they add sodium hydroxide solution
- Test 2 – they add barium chloride solution

Look at their results.

Test	Result
1	grey / green solid is made
2	white solid is made

(a) Kevin and Ann conclude that the solution contains copper ions, Cu^{2+}, and sulfate ions, SO_4^{2-}.

Do the results support this conclusion?

Explain your answer.

Refer to **both** tests in your answer.

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

(b) Kevin and Ann test aluminium chloride solution, $AlCl_3$, with silver nitrate solution, $AgNO_3$.

A white solid of silver chloride, $AgCl$ is made.

The other product is aluminium nitrate solution, $Al(NO_3)_3$.

Construct the **balanced symbol** equation for this reaction.

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

8 Potassium has the electronic structure 2.8.8.1.

Chlorine has the electronic structure of 2.8.7.

Potassium reacts with chlorine to make potassium chloride, KC*l*.

Potassium chloride has a giant ionic lattice containing potassium ions, K^+, and chloride ions, Cl^-.

Use the "dot and cross" model to explain the bonding in potassium chloride.

Predict and explain **one** physical property of potassium chloride.

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

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

9 Fluorine is the most reactive element in Group 7.

The electronic structure of fluorine is 2.7.

(a) Draw a "dot and cross" model for a fluorine molecule, F_2.

You only need to show the outer shell electrons.

[1]

(b) Explain why all Group 7 elements form a negative ion with a stable electronic structure.

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

(c) Explain, in terms of electrons, why fluorine is the most reactive element in Group 7.

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

(d) **Reduction** takes place when fluorine molecules react to form fluoride ions.

What is meant by the word reduction?

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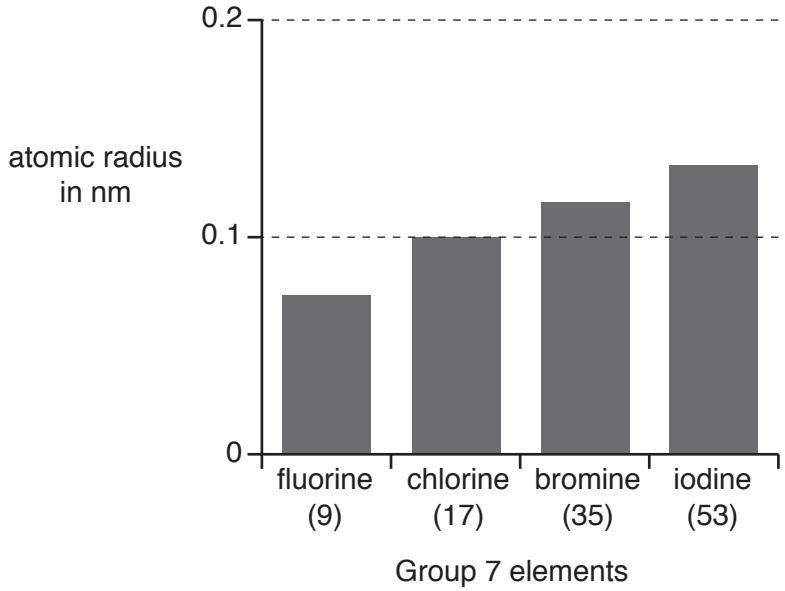
..... **[1]**

(e) Look at the bar chart of the atomic radii of the elements in Group 7.

The atomic number of each element is shown in brackets.



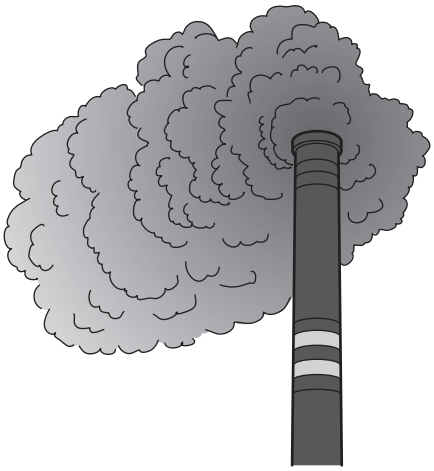
Astatine has an atomic number of 85.

Estimate the atomic radius of astatine.

answer = ... nm **[1]**

SECTION C – Module P4

10 **(a)** Electrostatic dust precipitators can be used to remove dust and smoke particles from chimneys.



Explain how these precipitators use static electricity to remove dust and smoke particles from chimneys.

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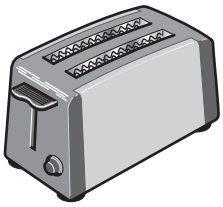
..... **[3]**

(b) Suggest why removing smoke particles from chimneys is useful.

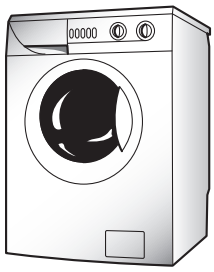
..... **[1]**

11 Raoul and Mick are finding out about double insulation in household appliances.

Look at the diagrams below.



toaster



washing machine

hairdryer

(a) Explain what double insulated means and why the hairdryer is the only one of the three appliances which is double insulated.

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

(b) Raoul and Mick obtain some data on one of these appliances.

Look at the table.

Appliance	Voltage in volts	Current in amps	Power in kilowatts
toaster	230		1.2

Calculate the missing value from the table.

Write your answer to **three significant figures**.

answer = ... A **[3]**

(c) Raoul and Mick also investigate a 12 V car starter motor.

The resistance of the starter motor is 50 mΩ.

Calculate the power of the starter motor when it is used.

answer = ... W **[3]**

12 The table below contains information about six radioactive sources.

Source	Type of radiation emitted	Half-life
A	alpha	432 years
B	alpha	45 minutes
C	beta	14 days
D	beta	12 years
E	gamma	6 hours
F	gamma	30 years

One of these sources is used as an industrial tracer to find leaks and blockages in underground pipes.

Explain which source would be most suitable to use and describe how a radioactive tracer is used to find a leak or blockage.

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

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

13 **(a)** Aisha is investigating nuclear decay.

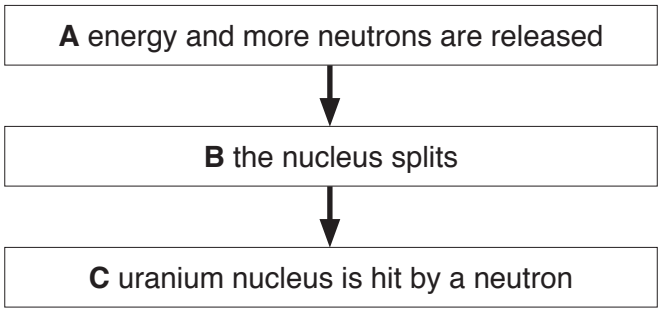
She has written part of a nuclear decay equation.

$$^{238}_{92}U \longrightarrow {}^{\ldots\ldots}_{\ldots\ldots}Th + {}^{4}_{2}He$$

Complete the missing numbers in the decay equation. **[2]**

(b) Uranium is used as a fuel in a nuclear **fission** power station.

Aisha has written down the stages by which uranium releases energy.



Aisha has got the stages in the wrong order.

(i) Write the stages **A, B** and **C** in the correct order.

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

(ii) A chain reaction can occur during nuclear fission.

How is this reaction kept under control in power stations?

.....

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

(c) Energy can also be released using nuclear **fusion**.

(i) Many scientists from different countries work together on nuclear fusion research.

Suggest some of the benefits of working together on research in this way.

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

(ii) Write down an equation to show how two different isotopes of hydrogen can undergo fusion to create helium.

[1]

SECTION D

14 Vitamin A is an important chemical needed in the body.

A low level of vitamin A can cause conditions such as night blindness.

(a) In an investigation on night blindness people were sampled in four countries in Africa.

Details are shown in the table.

Country	Population of the country	Number of people sampled
Ethiopia	82 000 000	1000
Burundi	8 200 000	400
Burkina Faso	2 600 000	260
Gabon	1 000 000	200

(i) What percentage of the total population in Gabon was sampled?

answer = ... %

[2]

(ii) Scientists want to use the samples to make estimates for the whole population.

Two scientists are talking about this.

Use the data in the table to explain why Jerry is correct.

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

(b) The people were sampled for the vitamin A level in their blood.

The percentage of people with night blindness was also recorded.

Country	Percentage of people with a low level of vitamin A	Percentage of people with night blindness
Ethiopia	46	5.0
Burundi	28	2.0
Burkina Faso	54	1.5
Gabon	18	1.0

(i) Estimate how many people in the whole Burundi population have night blindness.

Use this sample data and the information from the table in part **(a)**.

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

(ii) Write about how well the data supports a link between lack of vitamin A and night blindness.

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

(c) Vitamin A can be made in the body from a chemical called carotene.

Carotene is found in many foods.

The table below shows the amount of carotene in different foods and a conversion factor.

The conversion factor shows how easily carotene can be converted into vitamin A in the body.

The conversion factor is calculated using this formula:

$$\textbf{conversion factor} = \frac{\text{vitamin A made in the body in mg}}{\text{carotene content of food in mg}}$$

Food	Carotene content in mg per 100 g of food	Conversion factor
spinach	3.8	0.20
carrots (cooked)	7.6	0.15
carrots (raw)	7.6	0.13
sweet potato	4.0	0.12

(i) What do the results in the table show about the effects of cooking carrots?

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

(ii) Scientists have produced a new type of rice called golden rice.

It has been made by genetic engineering.

The scientists found that

- 100 g of golden rice contained 3.5 mg of carotene
- eating 100 g of the rice caused the vitamin A content of the body to increase by 1 mg.

Write about how useful golden rice might be in preventing night blindness compared with the foods shown in the table.

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

END OF QUESTION PAPER

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.