

# H

### Friday 16 June 2017 - Morning

## 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



Candidate forename		Candidate surname					
Centre number				Candidate nu	ımber		

### **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 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 24 pages. Any blank pages are indicated.



### **EQUATIONS**

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

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

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

average speed = 
$$\frac{\text{distance}}{\text{time}}$$

distance = average speed × time

$$s = \frac{(u+v)}{2} \times t$$

$$acceleration = \frac{change \ in \ speed}{time \ taken}$$

force =  $mass \times acceleration$ 

weight = mass × gravitational field strength

work done = force  $\times$  distance

$$power = \frac{work \ done}{time}$$

 $power = force \times speed$ 

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

momentum = mass × velocity

$$force = \frac{change \ in \ momentum}{time}$$

$$GPE = mgh$$

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

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

### Answer all the questions.

### **SECTION A - Module B4**

1 (a) Mites are small animals that are similar to spiders.

Some mites are pests that eat farmers' crop plants.

Some farmers use insects that are predators to kill the mites.

The table shows information about four species of predator insects, A, B, C and D.

Predator species	Temperature the predators are most active at in °C	Relative humidity the predators are most active at %	Number of mites eaten by predators each week, in ideal conditions	Which part of the predator life cycle eats the mites
Α	21 – 27	> 60	300	larva and adult
В	18 – 26	40 – 80	500	larva only
С	5 – 16	> 50	425	larva and adult
D	26 – 35	40 – 50	350	adult only

Sue is a farmer. She grows crop plants inside a glasshouse.

There are mite pests living on her crop plants.

In her glasshouse

- the temperature is kept between 20 and 25 °C
- the relative humidity is kept between 50 and 60%.

Look at the table.

Which predator species will be the best one for Sue to use to kill the mites	W	/hich	predator	species	will b	e the	best one	of for	Sue to	use to	kil	l the	mites
--	---	-------	----------	---------	--------	-------	----------	--------	--------	--------	-----	-------	-------

Choose from A, B, C or D.

Explain your answer.
oredator species
explanation
[3]

(b)	Sue could also us	se chemical p	pesticides to kill the mites.	
	What are the disa	advantages	of using pesticides compared with u	sing predator insects?
				[2]
(-)	0			[-]
(C)	Sue wants to esti	mate now ma	any mites are in her glasshouse.	
	She has 320 plan	its in the glas	sshouse.	
	She counts how r	many mites a	re on five of the plants.	
	The table shows I	her results.		
		Plant	Number of mites on each plant	
		1 <sup>st</sup>	62	
		2 <sup>nd</sup>	108	
		3 <sup>rd</sup>	85	
		4 <sup>th</sup>	67	
		5 <sup>th</sup>	168	
	(i) Estimate the	total numbe	r of mites in the glasshouse.	
	You should s		-	
	Tod Shodid S	mow your we	ming.	
			answer =	[2]
	(ii) Why might th	nie <b>not</b> he a v	very accurate estimate?	
	(ii) Willy linglic ti	iis <b>riot</b> be a v	rery accurate estimate:	
				[2]

2 Sam is investigating diffusion	am is investigating diff	fusion
----------------------------------	--------------------------	--------

He uses cubes of agar jelly that contain an alkali.

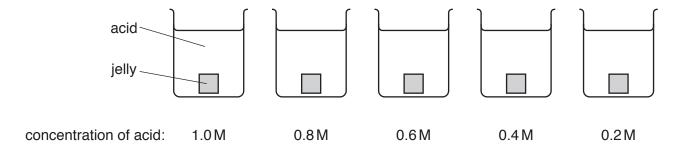
The jelly also contains an indicator.

The indicator is a pink colour when alkaline but goes colourless when neutral or acidic.

Sam puts a cube of jelly in each of five different concentrations of acid.

He times how long it takes each cube to completely change from pink to colourless.

Each cube is identical to begin with.



Explain why the cubes eventually go completely colourless.

Predict which cube goes colourless first and explain why.

The quality of written communication will be assessed in your answer to this question.	
 [6	<b>[</b> [

3 Liz is investigating why plants need different minerals. She puts some seedlings in different solutions to grow.

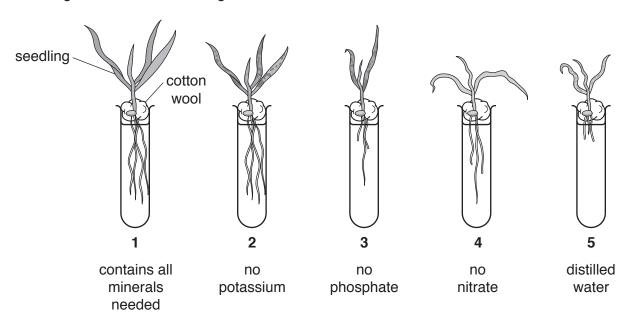
Test tube 1 contains all the minerals the seedlings need.

Test tubes 2, 3 and 4 are each missing a different mineral.

The distilled water in test tube 5 contains no minerals.

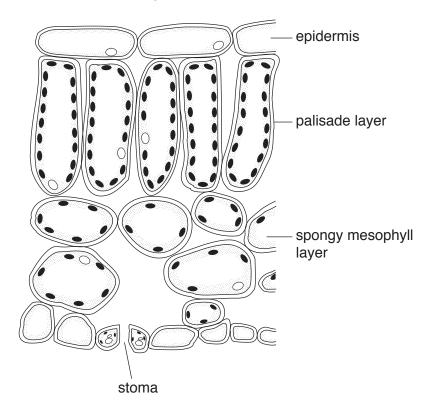
Liz makes sure that the seedlings all get the same amount of light and are kept at the same temperature.

The diagram shows the seedlings after four weeks.



(a)	Explain the results for test tube 3.
	[2]
(b)	If oxygen is bubbled through the solution in test tube 1, this will speed up the rate of growth.
	Explain why.
	[3]

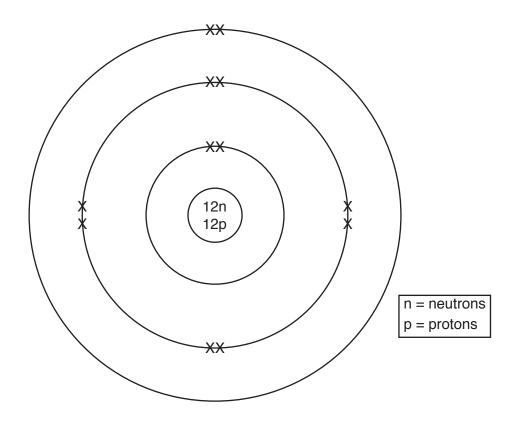
4 The diagram shows a section through a leaf.



(a)	The epidermis is transparent.
	Explain how this is an adaptation to the job of the leaf.
	[1]
(b)	Palisade cells and spongy mesophyll cells convert sugar into starch and store it as starch grains.
	Explain why they store food as starch and <b>not</b> as sugar.
	[2]
(c)	Most stomata are on the bottom surface and <b>not</b> on the top surface.
	Explain why.

### **SECTION B - Module C4**

5 Look at the diagram of the structure of an atom of an element.



		[1]
b)	To which <b>period</b> of the Periodic Table does the element belong?	

.....[1]

(a) To which **group** of the Periodic Table does the element belong?

(c) The element has several **isotopes**. This atom is one of these isotopes.

What is meant by the word isotopes?

- 6 Phil tests two unknown solutions, A and B, with
  - silver nitrate solution
  - sodium hydroxide solution.

Look at his table of results.

Solution	Effect of silver nitrate solution	Effect of sodium hydroxide solution
Α	white solid	blue solid
В	stays the same	grey/green solid

Phil makes two conclusions.

- Solution A contains chloride ions.
- Solution B contains iron(III) ions.

Do Phil's results support each of these conclusions?

plain your answer.
[2]

Chlorine	e has the electronic structure 2.8.7.	
Chlorine reacts with non-metals and metals.		
(a) Ch	lorine, $Cl_2$ , reacts with hydrogen, $H_2$ , to make hydrogen chloride, $HCl$ .	
(i)	Write the <b>balanced symbol</b> equation for this reaction.	
		[2]
(ii)	Hydrogen chloride is a <b>covalent</b> molecule.	
	Use the 'dot and cross' model to show the covalent bonding in hydrogen chloride.	
	Hydrogen has the electronic structure 1.	
	You only need to show the outer shell electrons.	

[1]

7

(b)	Chlorine has the electronic structure 2.8.7 and sodium the electronic structure 2.8.1.	
	Chlorine reacts with sodium to make sodium chloride, NaCl.	
	Sodium chloride is an <b>ionic</b> compound.	
	Use the 'dot and cross' model to show the ionic bonding in sodium chloride.	
	Include the charges on the ions.	
	You only need to show the outer shell electrons.	
		[2]
(c)	Sodium chloride has a high melting point.	
	Explain why.	
	Use ideas about structure and bonding.	
		[2]

8	Water in rive	ers, lakes and	l reservoirs	contains	many im	nurities
U	vvalor in nive	oro, ranco arre	1030170113	Contains	many m	puntos.

These impurities include insoluble materials, microbes, pesticides and fertilisers.

Water in rivers, lakes and reservoirs needs to be purified before it can be used as drinking water.

Describe the three processes involved in water purification.

Explain why some soluble substances are not removed by these processes.

The quality of written communication will be assessed in your answer to this question.
 [6]

**9** The Group 7 elements are called the halogens.

Look at the table. It shows some of the physical properties of the halogens.

Halogen	Atomic number	Atomic radius in pm	Melting point in °C
fluorine	9	64	
chlorine	17	99	-101
bromine	35	114	-7
iodine	53	133	114
astatine	85		

(a)	The physical properties of the halogens show a trend as the atomic number increases.	
	Complete the table by predicting the missing atomic radius and melting points.	[3]
(b)	The halogens have similar chemical properties.	
	Explain why.	
		. [1]
(c)	Bromine will react with potassium iodide in a displacement reaction.	
	The ionic equation for this reaction is	
	$\mathrm{Br_2} + \mathrm{2I}^- \longrightarrow \mathrm{2Br}^- + \mathrm{I_2}$	
	The reaction involves both oxidation and reduction.	
	Explain why the reaction involves both oxidation and reduction.	

### 14

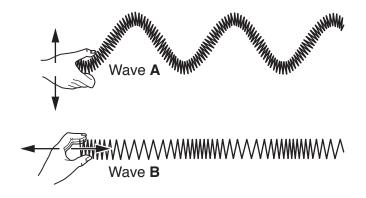
### **SECTION C - Module P4**

- 10 Ultrasound is used in hospitals.
  - (a) Ultrasound is used to scan unborn babies in the womb.

(i)	Explain how ultrasound waves produce an image showing different depths of tissue.
	[2]
(ii)	X-rays are <b>not</b> used to scan unborn babies in the womb.
	Explain reasons why.
	ro1

**(b)** Ultrasound and water waves are different types of waves.

Look at the diagrams of slinky springs being used to model the different types of waves.



	Explain how wave <b>A</b> and wave <b>B</b> model the particles in the two different types of waves.
	[3]
(c)	What are the differences between sound waves and ultrasound waves?
	[2]

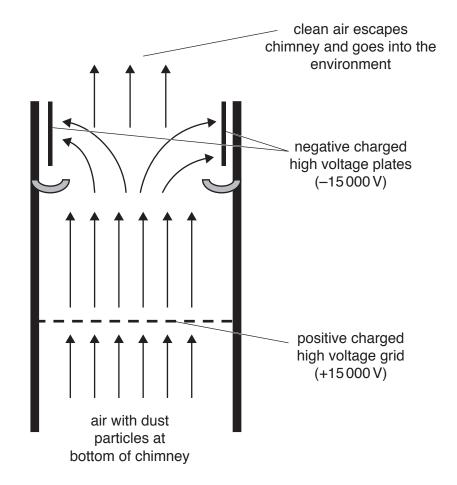
1	An e	engineer tests underground pipes to see if they have a fault.	
	She	uses a gamma radioactive tracer to find the faults.	
	(a)	Why are alpha and beta tracers <b>not</b> used to check pipes?	
			. [1]
	(b)	She measures the radioactivity above ground every 10 m along the pipe.	
		Look at her results.	

Distance along the pipe in m	Radiations in one minute
0	110
10	108
20	112
30	109
40	190
50	150
60	12
70	11
80	13
90	12

What can you conclude about the fault in the pipe?	
Use the data to explain your answer.	
	[3]

**12** Electrostatic precipitators remove dust particles in chimneys.

Look at the diagram.



The dust particles have a neutral charge at the bottom of the chimney. The dust particles rise through the charged grids and are removed from the air.

Explain how electron transfer helps remove dust particles from the air.

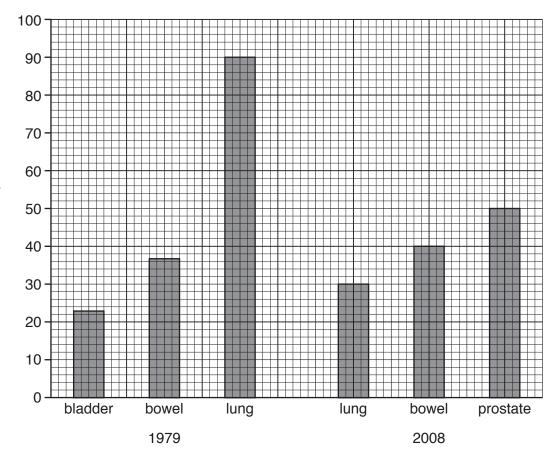
The quality of written communication will be assessed in your answer to this question.
[6]

13	Bill has electrical appliances in his home.				
	One	e of the appliances stops working.			
	(a)	He fits a new fuse in the plug.			
		Explain how a fuse can help prevent electrical fires.			
		[2	2]		
	(b)	This appliance has only two wires.			
		Explain how the appliance can remain safe without an earth wire.			
		[2	2]		
	(c)	The appliance uses 230 V to supply a maximum current of 3A.			
		Calculate the maximum power of the appliance.			
		answer unit	2]		

### **SECTION D**

- 14 Radioactive isotopes are used to treat different types of cancer.
  - (a) The graph shows the rates of cancer in men aged 40–50 in Great Britain.

It shows the rates for the three most common types of cancer in these men in 1979 and the three most common types of cancer in these men in 2008.



rate of cancer in cases per 100 000 men

(i) What can you conclude about the rate of bladder cancer in 2008?

\_\_\_\_\_[1]

(ii) In 2008 there were 4 million men aged between 40 and 50 in Great Britain.

Calculate how many of these men would be expected to have prostate cancer.

You should show your working.

answer = ......[2]

20	
(iii) The data about cancers in each year is give	en as a rate per 100 000 men.
The rate is often used rather than giving the	actual number of cancer cases.
Suggest a reason why the rate is used.	
	[1]
(b) Patients with cancer often have the cancer tissu They are then treated with radioactive isotopes to	·
<ul><li>stop the tumour growing back</li><li>stop any cancer cells in the surroundin body.</li></ul>	ng tissue spreading to somewhere else in the
The diagram shows two ways of using radioactive	ve isotopes.
The numbers show the amount of radiation rece	ived in different areas.
surrounding tissue  site of tumour	0.5
Method A  The radiation is supplied by putting the isotope inside the tissue	Method B  The radiation is supplied from the isotope outside the body
Compare the amount of radiation received by t	he calls in different parts of the tissue using

Compare the amount of radiation received method <b>A</b> and method <b>B</b> .	by the cells in different parts of the tissue using
	[2]

(c)	Doctors designed a trial to compare the two methods of giving radiation.				
	They used 3000 patients in 11 different countries in the trial.				
	The patients were randomly divided into two groups.				
One group was treated with method <b>A</b> and the other with method <b>B</b> .					
(i) Suggest a reason why they chose patients in 11 different countries.					
					[1]
	(ii)	Here are some results from the trial.			
			Method A	Method B	
		deaths from the tumour growing back in the next five years	17	15	
		deaths from diseases such as cancers elsewhere in the body in the next five years	12	27	
Compare the success of the two treatments and suggest reasons for any difference of the two treatments and suggest reasons for any difference of the two treatments and suggest reasons for any difference of the two treatments and suggest reasons for any difference of the two treatments and suggest reasons for any difference of the two treatments and suggest reasons for any difference of the two treatments and suggest reasons for any difference of the two treatments and suggest reasons for any difference of the two treatments and suggest reasons for any difference of the two treatments and suggest reasons for any difference of the two treatments and suggest reasons for any difference of the two treatments and suggest reasons for any difference of the two treatments and the two treatments and the two treatments are differenced on the two treatments and the two treatments are differenced on the tw				y differences.	

### **END OF QUESTION PAPER**

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### **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 margin(s).				




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# The Periodic Table of the Elements

0	4 He hetium 2	20 <b>Ne</b> neon 10	40 <b>Ar</b> argon 18	84 Kr krypton 36	131 <b>Xe</b> xenon 54	[222] Rn radon 86	t fully
7		19 F fluorine 9	35.5 Cl chlorine 17	80 Br bromine 35	127 I iodine 53	[210] <b>At</b> astatine 85	rted but no
9		16 0 oxygen 8	32 S sulfur 16	79 Se setenium 34	128 Te tellurium 52	[209] Po potentium 84	ve been repc I
2		14 N nitrogen 7	31 P phosphorus 15	75 As arsenic 33	122 Sb antimony 51	209 Bi bismuth 83	Elements with atomic numbers 112-116 have been reported but not fully authenticated
4		12 C carbon 6	28 Si silicon	73 <b>Ge</b> germanium 32	119 <b>Sn</b> tin 50	207 <b>Pb</b> tead 82	mic numbers a
8		11 <b>B</b> boron 5	27 Al aluminium 13	70 <b>Ga</b> gallium 31	115 In indium 49	204 <b>T</b> thatlium 81	nts with ator
	'			65 <b>Zn</b> zinc 30	112 Cd cadmium 48	201 Hg	Eleme
				63.5 Cu copper 29	108 <b>Ag</b> silver 47	197 <b>Au</b> gold 79	Rg roentgenium 111
				59 <b>Ni</b> nicket 28	106 Pd palladium 46	195 Pt platinum 78	Ds darmstadtium 110
				59 Co cobalt 27	103 Rh rhodium 45	192 Ir iridium 77	[268] Mt meitnerium 109
	1 H hydrogen 1			56 <b>Fe</b> iron 26	101 Ru ruthenium 44	190 Os osmium 76	[277] Hs hassium 108
·				55 Mn manganese 25	[98] Tc technetium 43	186 Re rhenium 75	[264] Bh bohrium 107
		mass <b>ool</b> uumber		52 Cr	96 <b>Mo</b> motybdenum 42	184 W tungsten 74	[266] Sg seaborgium 106
	Key	relative atomic mass atomic symbol <sub>name</sub> atomic (proton) number		51 V vanadium 23	93 <b>Nb</b> niobium 41	181 <b>Ta</b> tantalum 73	[262]
		relati <b>atc</b> atomic		48 Ti titanium 22	91 Zr zirconium 40	178 Hf hafinium 72	[261] Rf rutherfordium 104
	·			45 Sc scandium 21	89 Y yttrium 39	139 La* lanthanum 57	[227] <b>Ac*</b> actinium 89
2		9 Be beryllium 4	24 Mg magnesium 12	40 Ca calcium 20	88 Sr strontium 38	137 <b>Ba</b> barium 56	[226] Ra radium 88
<b>—</b>		7 Li lithium 3	23 Na sodium 11	39 K potassium 19	85 Rb rubidium 37	133 Cs caesium 55	[223] Fr francium 87

\* 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.