SPECIMEN   F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

SCIENCE B

B712/01

Unit B712: Science modules B2, C2, P2 (Foundation Tier)

Candidates answer on the question paper
A calculator may be used for this paper.

OCR Supplied Materials:
None

Duration: 1 hour 30 minutes

Other Materials Required:
• Pencil
• Ruler (cm/mm)

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number					

INSTRUCTIONS TO CANDIDATES

• Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
• Use black ink. Pencil may be used for graphs and diagrams only.
• Read each question carefully and make sure that you know what you have to do before starting your answer.
• Answer **all** the questions.
• Write your answer to each question in the space provided, however additional paper may be used if necessary.

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 for each question 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.

Examiner's Use Only:			
1		8	
2		9	
3		10	
4		11	
5		12	
6		13	
7		14	
Total			

OCR is an exempt Charity

Turn over

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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Answer **all** the questions.

Section A – Module B2

1 Look at the pictures of four organisms.

organism **W**

organism **X**

organism **Y**
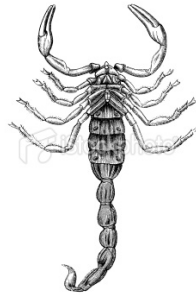
organism **Z**

(a) Which organisms are classified in the same class of arthropod?

Explain your answer.

....

....

.... **[2]**

(b) Organism **X** is a hover fly. It is a prey species. It has wings which help it to escape predators.

Explain how **two other** adaptations of this organism help it to avoid being caught as prey.

....

....

....

.... **[2]**

[Total: 4]

2 Banana plants are grown in large fields called plantations.

(a) The banana plants grow very close together.

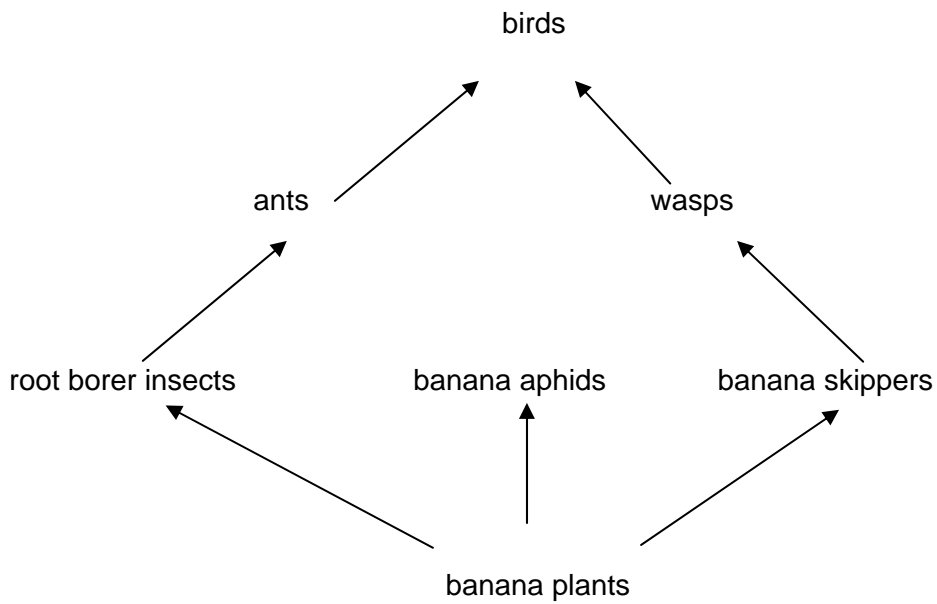One advantage of this is that it reduces the growth of weeds.

Explain how.

....

.... **[2]**

(b) The plants also need carbon and nitrogen to survive. These are recycled in nature when plants and animals decay.

In what form is carbon taken up by plants?

....**[1]**

(c) Banana plants are part of a food web.

birds

ants   wasps

root borer insects   banana aphids   banana skippers

banana plants

(i) How many trophic levels are there in this food web?

....**[1]**

(ii) One year there are fewer ants in the plantation.

The crop of bananas decreases.

Use the food web to suggest why this happens.

....

.... **[2]**

(iii) Energy **enters** this food web and **passes** from organism to organism. Some energy is **lost** from the food web.

Write about how these transfers of energy happen in this food web.

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

....

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.... **[6]**

[Total 12]

3 This article about the Great Bustard appeared in a newspaper.

© iStockphoto.com/Steven Cooper

Welcome back Big Bird

The Great Bustard was a giant among British birds.

It had a wingspan of nearly two metres and used to be a great sight as it flew over the countryside. Great Bustards needs a lot of space around them to breed. In the 1870s they became extinct in Britain.

The Great Bustard has now been reintroduced into Britain.

(a) The Great Bustard is not extinct in Turkey.

A group of scientists looked at Great Bustards in three different regions in Turkey.

They measured the area of each region and counted the number of Great Bustards living there.

Their results are shown in the table.

region	area of the region in km²	number of birds		male:female ratio	total number of birds
		male	female		
1	898	10	14	5:7	24
2	383	1	30	1:30	31
3	754	14	21		35

(i) Finish the table.

Write the missing male:female ratio in the empty box.

[1]

(ii) Use this data and your own knowledge to suggest in which region the Great Bustard is most likely to become extinct. Explain why.

....

....

....

....

.... **[3]**

(b) What steps could be taken to help the Great Bustard to survive in Britain now it has been reintroduced?

....

....

.... **[2]**

[Total: 6]

4 Alexandra is worried about the amount of air pollution in her village.

She wants to find out whether the level of air pollution in her village is higher than in another village 20 miles away.

She could measure the level of air pollution in the two villages using two different methods.

Describe the methods she could use and how she would know where the air pollution is higher.

....

....

....

.... **[3]**

[Total: 3]

Section B – Module C2

5 This question is about metals.

Look at the table. It shows the properties of some metals.

metal	melting point in °C	density in g/cm³	relative electrical conductivity	cost per tonne in £
aluminium	660	2.7	40	1350
copper	1083	8.9	64	3800
iron	1535	7.9	11	400
silver	962	10.5	67	20 000

(a) Which metal would you chose to make a container in which to melt copper?

.... **[1]**

(b) Pylon wires are made from metal.

pylon wire

Which metal would be most suitable for using for pylon wires?

Use information about each of the metals in the table to explain your answer.

....

....

.... **[3]**

(c) Brass is made from copper and zinc.

Write down one use of brass.

.... **[1]**

[Total: 5]

6 Look at the diagram of the structure of the Earth.

The surface of the Earth is made up of tectonic plates.

(a) Describe the structure of the Earth and the effects of plate tectonics.

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

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.... **[6]**

(b) The theory of plate tectonics is widely accepted by scientists.

Give **two** reasons why.

....

....

....

.... **[2]**

[Total: 8]

7 This question is about the manufacture of ammonia.

Ammonia is made in the Haber process.

Look at the equation for the Haber process.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

(a) There are many different factors that affect the cost of making ammonia.

Look at the table about the costs of making 10 tonnes of ammonia in a factory.

factor	cost in £
energy	1000
hydrogen	250
nitrogen	50
others	100

(i) Nitrogen is a much cheaper raw material than hydrogen.

Suggest why.

....**[1]**

(ii) Calculate what percentage of the total cost of making ammonia is for energy.

Suggest why the energy costs are so high.

....

....

....

.... **[2]**

(iii) The ammonia made during this reaction is quickly removed to prevent it breaking down.

What substances are made when ammonia breaks down?

Use the symbol equation to help you answer.

....

.... **[1]**

(b) Nitric acid is made from ammonia.

The first reaction in this process involves the oxidation of ammonia.

ammonia + oxygen ⇌ nitrogen(II) oxide + water
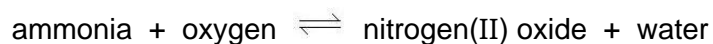
Look at the sketch graph.

It shows the percentage yield of nitrogen(II) oxide (NO) at different temperatures and pressures.

pressure in atmospheres
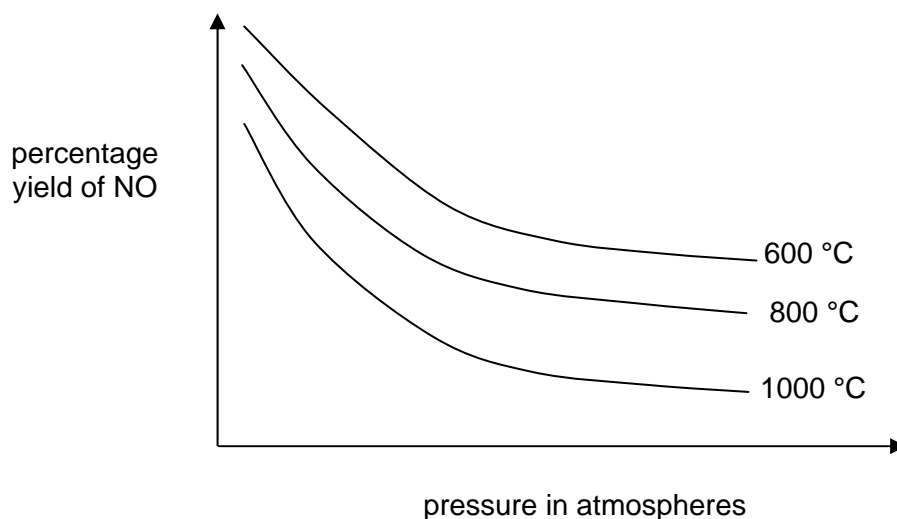
(i) How does increasing the **temperature** change the percentage yield?

....**[1]**

(ii) How does increasing the **pressure** change the percentage yield?

....**[1]**

[Total: 6]

8 This question is about fertilisers.

Fertilisers can be made by **neutralisation**.

(a) Look at the equation for a neutralisation reaction to make a fertiliser.

$$2KOH + H_2SO_4 \rightarrow K_2SO_4 + H_2O$$
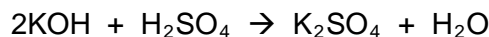
Write down the formula of one **reactant**.

.... **[1]**

(b) Sodium hydroxide reacts with phosphoric acid.

Construct the **word equation** for this reaction.

.... **[1]**

(c) Elizabeth is a farmer. She is given some ammonium sulfate to use on her fields.

Elizabeth is deciding whether or not to use the ammonium sulfate on her fields.

What factors should she consider?

....

....

....

.... **[2]**

(d) Elizabeth uses a bag of fertiliser that contains only ammonium sulfate, $(NH_4)_2SO_4$.

Anna uses a bag of fertiliser that is a mixture of potassium nitrate, KNO_3, and ammonium phosphate $(NH_4)_3PO_4$.

Suggest why Anna's bag of fertiliser is better than Elizabeth's.

....

....

.... **[2]**

[Total: 6]

Section C – Module P2

9   Electricity is produced by power stations.
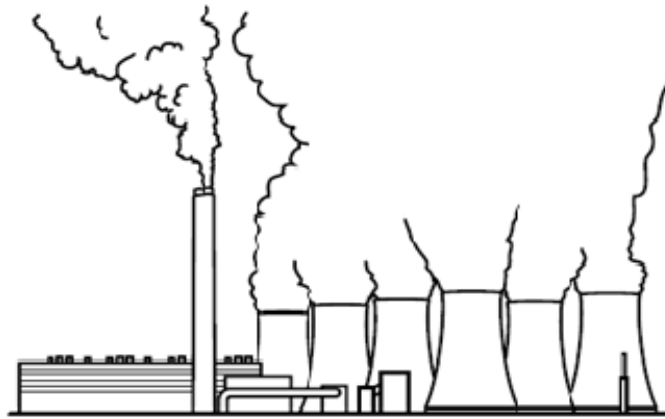
(a)   Describe the distribution of mains electricity.

....

....

....**[2]**

(b)   The **total input** for a power station is 6MW of power from the fuel.

The **useful output** is 2MW of electrical power.

Calculate the efficiency of the power station.

....

....

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

(c) Look at the table. It gives information about the efficiency of different power stations.

type of power station	efficiency (the longer the bar the more efficient)
hydroelectric	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
tidal power	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
nuclear fission	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
wind turbine	IIIIIIIIIIIIIIIIIIIIIIII
geothermal	IIIIIIIIIIII
oceanic thermal conversion	III

(i) What can be concluded about tidal power stations from this table?

....

....**[1]**

(ii) How could the presentation of this data be improved?

....**[1]**

[Total: 6]

10 Distant galaxies can be observed from Earth using telescopes.

Mary is an astronomer.

She makes some observations of a distant galaxy. She finds it contains millions of stars.

She has found a dark region in the middle of several stars.

Mary makes a hypothesis that there must be a black hole in this darker region.

Other astronomers are not sure she is right.

What should Mary do to increase confidence in her hypothesis?

....

....

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....

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.... **[3]**

[Total: 3]

11 Photocells can make use of energy from the Sun.

Look at the picture of a panel of photocells.

© Stockphoto.com/Phillip Lange

Joshua works as a park keeper in a very remote area.

He is keen to use photocells for all of the energy needs of the park.

Discuss if this is a good idea or not.

In your answer suggest arguments for **and** arguments against using only photocells in the park.

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

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.... **[6]**

[Total: 6]

12 This question is about using electrical appliances.

Look at the information about some electrical appliances.

appliance	power rating in kilowatts	time used each week in hours
CD player	0.01	5
computer	0.18	10
dishwasher	1.20	2
garage door opener	0.35	0
popcorn maker	0.25	1
satellite dish	0.01	168
vacuum cleaner	0.60	1
washing machine	0.50	8
iron		4

 (a) The iron is connected to the 230 V mains.

3.5 A flows through the circuit.

Calculate the power rating of the iron in kilowatts.

Copy your answer into the table.

 ....

 ....

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

 (b) Alan needs to save some money on his electricity bills.

Use the information in the table to identify which appliance **costs the most** to run each week **and** explain why.

 ....

 ....

 .... **[2]**

(c) Alan prepares for a power cut. He supplies his family with battery-powered torches.

   (i) Name the type of current supplied by a battery.

   .... **[1]**

   (ii) Write down **one difference** between the power supplied by a battery and the power supplied by the National Grid.

   ....

   .... **[1]**

[Total: 6]

13 This question is about radioactivity.

Claire investigates the relative penetrating power of different types of radiation.

Here is a diagram of her apparatus.

radioactive source   **absorber**   radiation detector
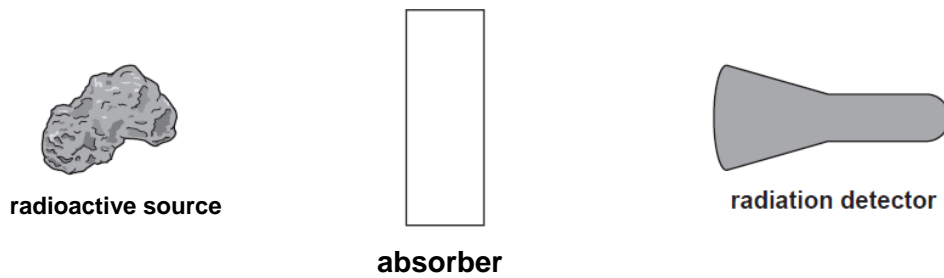
(a) Claire is considering using nuclear radiation emitters as tracers **inside** the human body.

A radiation detector would detect the nuclear radiation outside the patient's body.

Look at the table.

type of emitter	typical range in air in cm	typical range in soft body tissue in cm
alpha	3.7	0.0005
beta	90	1.2
gamma	70000	100

Claire decided that Alpha emitters should not be used as tracers in the human body.

Use the information in the table to suggest why.

....

....

.... **[2]**

(b) Claire uses radioactive materials for her investigation.

This can be dangerous.

What **precautions** should she take when handling radioactive materials?

....

....

.... **[2]**

[Total: 4]

Section D

14 Elizabeth is a farmer.

She has to make some decisions about growing crops on her fields which will be used for bio-fuels.

If she does decide to grow crops for bio-fuels she will need to decide what crops to grow.

Look at the information about bio-fuels.

Bio-fuels

- are renewable fuels used in motor vehicles

- are made from plant materials.

Farmers have to use valuable land to grow crops for bio-fuels.

They cannot use the same land to grow food crops.

(a) Write down **two** factors Elizabeth needs to consider so that she can make a decision about growing crops for bio-fuels.

....

.... **[1]**

(b) Elizabeth is considering growing crops which could be used for two bio-fuels:

1. bio-ethanol

2. bio-diesel.

Look at Table 1.

It gives some information about the production of bio-fuels in 2007.

Table 1

bio-fuel	units of energy used during growth and manufacture	total energy content of bio-fuel produced in units of energy
bio-ethanol	378	924
bio-diesel	1	64

Energy is used during the growth and manufacture of bio-fuels.

This has to be set against the total energy content of the fuel.

Suggest, with a reason, an advantage of producing bio-diesel rather than bio-ethanol.

....

....

....**[1]**

(c) Elizabeth finds out more information about making bio-diesel.

Bio-diesel can be produced from a wide range of different plants.

Look at Table 2.

It shows the average volume of bio-diesel you can get from different plants.

Table 2

plant used to make bio-diesel	average volume of bio-diesel in dm^3 from a 1000 m^2 area
coconut	35
corn	7
hemp	15
palm	115
peanut	15
rape	16
soy	12
sunflower	13

Elizabeth has a field with an area of 10 000 m^2.

She wants to produce as much bio-diesel as possible from her field.

Which plant should she grow and how much bio-diesel would she produce?

....

....

....**[1]**

(d) Look at the bar chart.

It shows the total energy content of the bio-diesel produced each year since the year 2000.
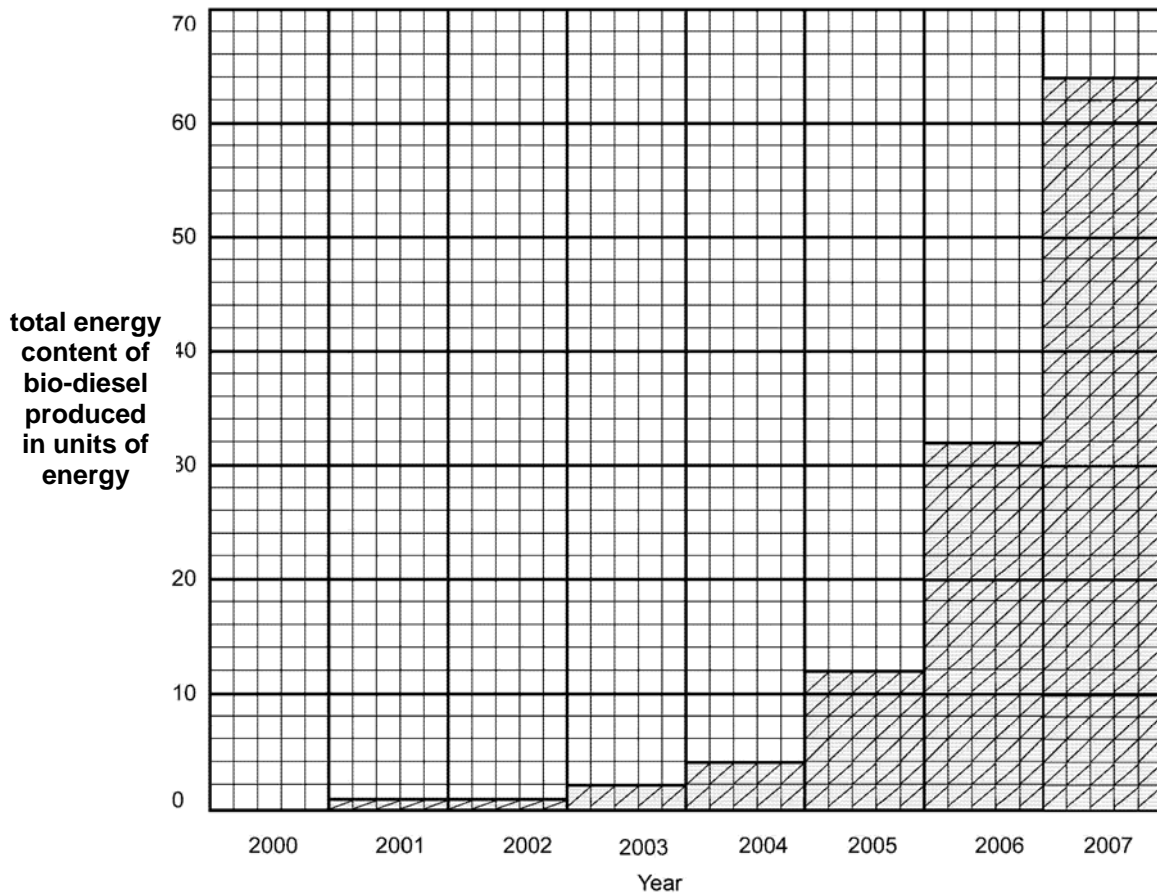
(i) The amount of bio-diesel produced is likely to continue to increase.

Suggest **two** reasons why it is difficult to predict the total energy content of bio-diesel produced in 2011.

....

....

....

.... **[2]**

(ii) What are the possible consequences of this increase in bio-diesel production?

....

.... **[1]**

(e) Elizabeth's friends are discussing her choices.

Sally
Using bio-fuels means that non-renewable fossil fuels will not be used up.

Guy
Because the plants take in carbon dioxide when they grow, there is no overall production of carbon dioxide when using bio-fuels.

Sharon
The technology needed to use bio-fuels is not very well developed.

Use the evidence in this section to recommend what decision Elizabeth should make.

Explain your reasoning.

....

....

....

....

....

....

.... **[4]**

[Total: 10]

[Paper Total: 85]

END OF QUESTION PAPER

PERIODIC TABLE

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							

Key
relative atomic mass
atomic symbol
name
atomic (proton) number

Elements with atomic numbers 112-116 have been reported but not fully authenticated

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE   **B712/01**

SCIENCE B

Unit B712: Science modules B1, C1, P1 (Foundation Tier)

MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK   **85**

Guidance for Examiners

Additional Guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.

2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.

3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).

4. Abbreviations, annotations and conventions used in the detailed mark scheme:

   / = alternative and acceptable answers for the same marking point
   (1) = separates marking points
   not/reject = answers which are not worthy of credit
   ignore = statements which are irrelevant - applies to neutral answers
   allow/accept = answers that can be accepted
   (words) = words which are not essential to gain credit
   <u>words</u> = underlined words must be present in answer to score a mark
   ecf = error carried forward
   AW/owtte = alternative wording
   ORA = or reverse argument

   eg mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)
   work done = 0 marks
   work done lifting = 1 mark
   change in potential energy = 0 marks
   gravitational potential energy = 1 mark

5. If a candidate alters his/her response, examiners should accept the alteration.

6. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

Question			Expected answers	Marks	Additional guidance
1	**(a)**		scorpion and spider (1) because they both have 8 legs (1)	2	both needed for mark **allow** body **not** divided into head, thorax and abdomen (1)
	(b)		has warning colouration to deter predators (1) mimicry of wasps which have stings (1) eyes on the side of its head giving a wide field of vision (1)	2	
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
2	**(a)**		idea of competition (1) bananas stop light reaching the weeds / weeds cannot photosynthesise (1) bananas use water / stop water / overshadow reaching weeds so weeds do not grow (1) banana plants outcompete weeds for minerals etc. (1)	2	
	(b)		carbon dioxide (1)	1	**Not** gas
	(c)	**(i)**	4 (1)	1	
		(ii)	number of root borers and aphids increases because fewer ants are eating them (1) the increase in numbers of root borers and banana aphids causes more damage to the roots and leaves of the banana plants, reducing the banana crop (1)	2	**allow** higher level answers specifically referring to the increased action of banana aphids on leaves and root borer insects in roots and how this will limit water uptake/photosynthesis, decreasing growth of banana crop (2) **ignore** references to reduced number of banana plants

Question			Expected answers	Marks	Additional guidance
2	**(c)**	**(iii)** ✏	**Level 3** Applies understanding of energy transfers to describe in detail the processes of energy capture, transfer between trophic levels and loss at all stages for the banana plant food web and clearly sequences them in the correct order. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5–6 marks) **Level 2** Answer may describe some processes and may not make the correct order clear. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3–4 marks) **Level 1** An incomplete answer, naming some processes without describing them and omitting other processes. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1–2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**Relevant points include:** • energy enters the food chain from sunlight • energy trapped by banana plants/chlorophyll in leaves of banana plants • by photosynthesis • energy trapped in food/sugar then • energy transferred from one organism to another (from producer to primary consumer) by feeding • energy in banana plants transferred to root borers, banana aphids and banana skippers by feeding • energy transferred from primary consumers to secondary consumers/ants and wasps • energy transferred from secondary consumers to tertiary consumers/birds then • energy is lost at each stage/trophic level as it is converted into less useful forms • examples of methods of energy loss from this food web includes excretion, heat from respiration and egestion
			Total	**12**	

Question			Expected answers	Marks	Additional guidance
3	(a)	(i)	2:3 (1)	1	
		(ii)	become extinct in region 2(no mark) only 1 male in <u>region 2</u> so more likely to become extinct / male:female ratios <u>more favourable</u> in regions 1 and 3 (1) if male in region 2 dies none of the females will reproduce (1) <u>small area of territory</u> per bird so, not a large enough habitat / may not have enough territory to breed / be competing with each other (1)	3	**must use data they have selected to give a valid explanation and justify choice** **allow** higher level answers above target grade in terms of offspring of Great Bustards in region 2 will have less <u>genetic diversity</u> (1) **allow** specific examples of competition, eg in the small area they are all competing for a small amount of food (1)
	(b)		protect habitat / create new habitats (1) legal protection (1) education programmes (1) captive breeding (1) cull predators (1)	2	
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
4			direct measurement of pollutant levels, where higher values show more pollution (1) measurement of presence/absence of indicator species (1) where less <u>lichen</u> (in village) shows higher pollution (1)	3	**allow** examples of direct measurement of pollutants eg sulfur dioxide, nitrogen oxides max (1)
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
5	**(a)**		iron (1)	1	
	(b)		aluminium (no mark) because density too high (so wires would sag) for copper, iron and/or silver / ora (1) because iron is too poor an electrical conductor / ora (1) because copper and/or silver are too expensive / ora (1)	3	**answers must support the candidates choice to gain credit** **if iron or silver max 1 mark** **allow** idea of wires are heavy **allow** reference to just one metal e.g. silver is expensive **ignore** any comments about corrosion
	(c)		musical instruments / coins / door decorations / horse brasses (1)	1	
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
6	(a)	✎	**Level 3** Detailed description of Earth structure, including all the main parts of the Earth, and the effects of plate movement. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** Limited description of Earth structure with some reference to the effects of plate movement. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** Identifies some parts of the Earth and recognises that tectonic plates move. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**Relevant points include:** • Earth is a sphere • Earth is made up of core, thin, rocky crust and mantle • core contains iron • beneath the surface there is molten rock called magma • tectonic plates move (very slowly or about 2.5cm per year) • tectonic plate movement causes volcanoes • tectonic plate movement causes earthquakes • idea of over millions of years movement results in the formation of continents **allow** tectonic plate movement causes mountain ranges to be formed **allow** higher level answers involving convection currents in the mantle, that crust is less dense than the mantle or a description of the lithosphere

Question			Expected answers	Marks	Additional guidance
6	(b)		theory explains the evidence (1) discussed and tested by a number of scientists (1)	2	**allow** idea of peer review or results published in scientific publications and conferences enables results to be checked (1) as alternative to second mark
			Total	**8**	

Question			Expected answers	Marks	Additional guidance
7	(a)	(i)	because nitrogen comes from the air (1)	1	**allow** higher level answers above target demand eg nitrogen does not need to be extracted from air at high cost
		(ii)	71.4% (1) because energy is needed to heat the reaction / maintain high pressure / AW (1)	2	**allow** 71% (1)
		(iii)	nitrogen **and** hydrogen (1)	1	both needed for mark **allow** N_2 and H_2
	(b)	(i)	yield decreases / AW (1)	1	
		(ii)	yield decreases / AW (1)	1	
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
8	(a)		KOH / H_2SO_4 (1)	1	
	(b)		sodium hydroxide + phosphoric acid → sodium phosphate + water (1)	1	
	(c)		benefits: fertilisers can increase food supply / AW (1) problems: fertilisers can kill aquatic organisms / eutrophication / can cause water pollution / AW (1)	2	**allow** idea of whether her use will be 'excessive' and therefore have negative impacts (1) **allow** idea of benefits and problems with no specific references for 1 mark
	(d)		ammonium sulfate contains only one essential element / nitrogen so the mixture is better because it contains **all three** essential elements / nitrogen phosphorous **and** potassium (2) **OR** the mixture contains more essential elements than the ammonium sulphate / ora (1)	2	**answers must be a comparison in terms of specific numbers / names of essential elements in order to gain 2 marks**
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
9	(a)		mains electricity is distributed from power station to consumers (1) via **national grid /** via a **network** of power cables on pylons (1)	2	**allow** example of consumer types – homes, factories, businesses etc.
	(b)		0.33 or 33% (2) **but if answer incorrect** 2 / 6 (1)	2	**allow** 1 / 3 [2] correct substitution into correct equation will score (1) if answer is incorrect **allow** correct number with incorrect unit eg 33MW / 0.33MJ (1)
	(c)	(i)	(chart shows) tidal power is (slightly) less efficient than hydroelectric and is (a lot) more efficient than nuclear / wind / geothermal / oceanic thermal conversion (1)	1	
	(c)	(ii)	needs a scale / need to show efficiency as a ratio / percentage / displayed as a bar chart with figures on it (1)	1	
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
10			she should make predictions based on her hypothesis (1) then she should test her predictions / gather more data / gather more evidence (1) compare this new data to her original prediction (1)	3	**Marking points must be in correct order to gain full credit for this question** **allow** idea of using a more accurate telescope (1) **allow** examples of the type of evidence she should gather eg to show the effects of a black hole (1) **allow** (conclusion) not been peer reviewed / checked by other scientists (1) as alternative to any of the marking points
			Total	**3**	

Question	Expected answers	Marks	Additional guidance
11 ✎	**Level 3** A balanced answer, including arguments for and against using photocells, arguments are developed to explain their relevance and linked to the context in the question. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** Answer includes arguments for and against using photocells; arguments are limited in detail and relevance not fully explained. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** Answer includes arguments for or against using photocells, arguments are simplistic. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**Relevant points include:** **arguments for** • light energy from the Sun is transferred into electricity • able to produce direct current (DC) • can operate in remote locations like a park • low maintenance • no need for power cables • no need for fuel • long life • renewable energy source • no polluting waste • not dependent on National Grid for electricity • can generate surplus electricity to sell to electricity companies **arguments against** • amount of sunlight that arrives at the surface on Earth is not constant • amount of light available depends on location, idea that could be covered by trees in a park • amount of light available depends on time of day • amount of light available depends on weather conditions • as the Sun does not deliver that much energy to any one place at any one time, a large surface area is required to collect the energy at a useful rate. **example of simplistic approach:** • amount of light available depends on time of day **example of developed approach:** • amount of electricity produced depends on the amount of light available so no electricity is produced at night (when it is dark)
	Total	**6**	

Question			Expected answers	Marks	Additional guidance
12	(a)		0.805 (kilowatts) (2) **but if answer incorrect** 230 x 3.5/1000 (1)	2	**allow** 0.8 / 0.81 (kilowatts) [2]
	(b)		**appliance that costs most to run** washing machine (1) **because** **any one from** 0.5 X 8 = 4 (kilowatt hours)which is the highest value (1) cost depends on power rating and time switched on and the washing machine is on for a long time with (quite a) high power (1)	2	**allow** formula cost = time x power (x cost per kilowatt hour) (1)
	(c)	(i)	DC / direct current (1)	1	
		(ii)	National Grid supplies AC (battery supplies DC) / AW (1) National Grid has a higher voltage / ora (1)	1	**allow** higher level descriptions of how power is generated eg National Grid uses power from a generator and battery does not (1)
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
13	(a)		alpha would not be able to penetrate the skin and so would not reach a detector outside the body (2) **OR** alpha would not be able to penetrate the skin / alpha would not reach the detector (1)	2	answers must link penetration of alpha to reaching detector outside the bodty to gain 2 marks
	(b)		wear protective clothing (1) use tongs / keep her distance (1) short exposure time (1) shielded / labelled storage (1)	2	**allow** lead shield / lined apron (1) **ignore** lab coat / goggles
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
14	(a)		1. cost of growing crops / price of crop / idea of making profit 2. suitability of climate / soil 3. impact on the environment 4. need for fertilisers / pesticides 5. need for new equipment	1	**two factors needed for 1 mark**
	(b)		(proportion of) energy lost / wasted / used in manufacture and growth is less / biodiesel is more efficient / bio-ethanol uses 40% of the energy produced in manufacture and growth (1)	1	
	(c)		palm and 115 (1)	1	**both needed for mark**
	(d)	(i)	**any two from** idea that the trend is difficult to work out because there has been such a sudden rise (1) idea that it can be affected by other factors eg economics (1) availability of other fuels (1) changes in weather (1) or changes in government policies (1) better extraction techniques may be developed (1)	2	
		(ii)	food shortage / not enough food crops are grown (1)	1	**allow** over production and cannot sell the bio-diesel **allow** food prices increase **allow** less fossil fuels burnt / less carbon dioxide produced

Question			Expected answers	Marks	Additional guidance
	(e)		**max 4 from:** reasoning for type of bio-fuel (1) reasoning for type of plant (1) reasoning based on environmental /social issues (max 2) reasoning based on technology required (1) reasoning based on lack of information (max 2)	4	**arguments must support decision to score** eg she should grow crops for bio-diesel because it is more efficiently produced (1) eg she should grow hemp because she gets the biggest yield (1) eg she should grow crops for bio-fuels because it will reduce carbon dioxide emissions / will reduce global warming / reduce greenhouse effect (1) she should grow crops for bio-fuels because bio-fuels could be used instead of petrol in cars / can be burnt instead of fossil fuels (1) eg she should not grow crops for bio-fuels because she may use lots of fertiliser / pesticide / cause eutrophication (1) she should not grow crops bio-fuels because she should be growing food / people are in the world are starving / food is a better use of the land (1) eg she should not grow crops for bio-fuels because the technology is not ready yet / there are not enough cars that can use bio-fuels (1) eg she can not make a decision because she doesn't know about cost (1) she can not make a decision about plants because it depends on the conditions (on her farm) (1)
			Total	**10**	

Assessment Objectives (AO) Grid

(includes quality of written communication ✏)

Question	AO1	AO2	AO3	Total
1(a)		2		2
1(b)		2		2
2(a)		2		2
2(b)	1			1
2(c)(i)		1		1
2(c)(ii)		2		2
2(c)(iii)✏	4	2		6
3(a)(i)		1		1
3(a)(ii)		1	2	3
3(b)	2			2
4	3			3
5(a)		1		1
5(b)		1	2	3
5(c)	1			1
6(a) ✏	6			6
6(b)	2			2
7(a)(i)		1		1
7(a)(ii)		2		2
7(a)(iii)		1		1
7(b)(i)		1		1
7(b)(ii)		1		1
8(a)		1		1
8(b)		1		1
8(c)	2			2
8(d)		2		2
9(a)	2			2
9(b)	1	1		2
9(c)(i)			1	1
9(c)(ii)			1	1
10		3		3
11 ✏	3	3		6
12(a)	1	1		2
12(b)		2		2
12(c)(i)	1			1
12(c)(ii)	1			1
13(a)		2		2
13(b)	2			2

Question	AO1	AO2	AO3	Total
14(a)			1	**1**
14(b)			1	**1**
14(c)			1	**1**
14(d)(i)			2	**2**
14(d)(ii)			1	**1**
14(e)			4	**4**
Totals	**32**	**37**	**16**	**85**

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