OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

SCIENCE B

B712/02

Unit B712: Science modules B2, C2, P2 (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 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 **32** pages. Any blank pages are indicated.

Examiner's Use Only:			
1		9	
2		10	
3		11	
4		12	
5		13	
6		14	
7		15	
8			
Total			

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

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

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

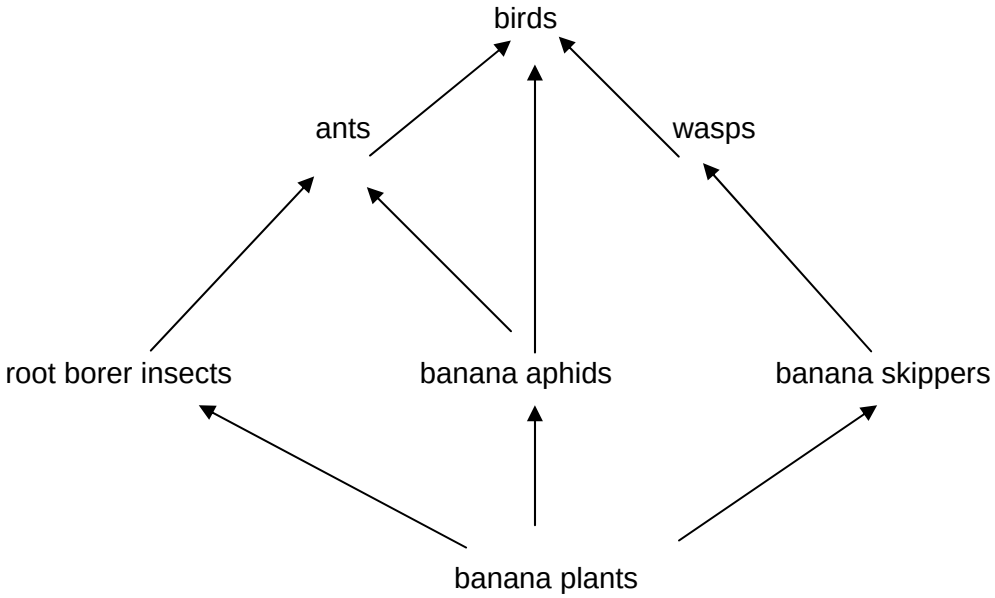
Answer **all** the questions.

Section A – Module B2

1 This question is about bananas.

Banana plants are grown in large fields called plantations.

They are part of a food web.



(a) Ecologists studying this food web want to construct a pyramid of biomass for this food web,

Why is it difficult to draw an accurate pyramid of biomass for this food web?

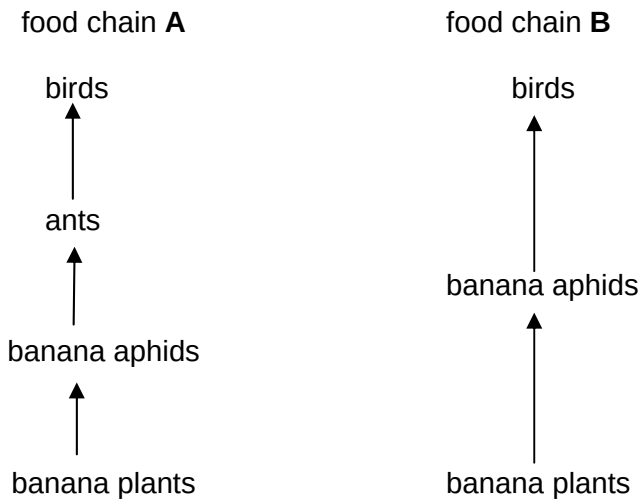
Make reference to organisms in the food web in your answer.

.....

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

(b) Energy **enters** this food web from the Sun and **passes** from organism to organism as they feed.

Look at the two food chains from this food web.



Explain which food chain is more efficient and explain how the efficiency of energy transfer impacts on the populations of organisms.

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

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

[Total: 7]

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

Read the article carefully and use it to help you answer the questions.

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. However, in the 1870s it became extinct in Britain.
The problem was that the birds need a lot of space around them to breed. If there are too many people, machines or animals near them they are disturbed. They were also widely hunted.
The Great Bustard has now been reintroduced into Britain.

(a) The Great Bustard still lives 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 km^2	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		21		35

(i) Finish the table.

Write the answers in the empty boxes. **[1]**

(ii) Scientists are worried that the bird population in one of the areas will not be able to adapt to changes in the environment.

Which area is this likely to be? Explain your answer.

.....

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

(b) Scientists are setting up conservation programs to save the Great Bustard.

Write down **one** reason why people think it is important to conserve endangered organisms preventing extinction.

.....

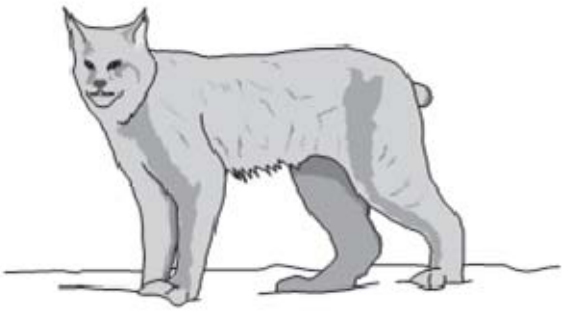
..... **[1]**

[Total: 4]

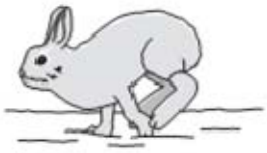
3 Lynx and snowshoe hares live in northern Canada.

Lynx are the main predators of snowshoe hares.

Snowshoe hares are the main prey of lynx.

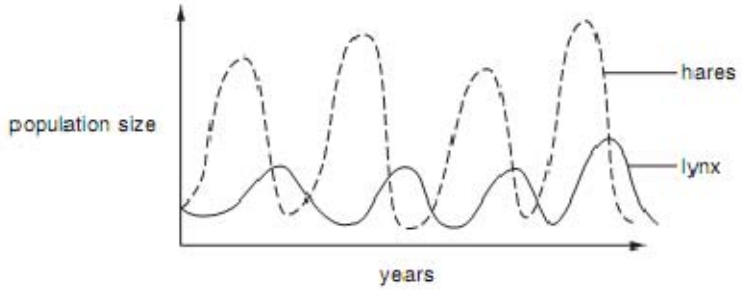


lynx



snowshoe hare

The graph shows how the lynx and snowshoe hare populations changed over a number of years.



(a) Look at the graph.

Explain why the two populations are out of phase.

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

(b) Do the snowshoe hare and the lynx occupy the same ecological niche?

Explain your answer.

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

(c) Another predator of snowshoe hares is the wolf.

Wolves feed on a wide variety of prey, not just snowshoe hares.

Suggest how the cycle shown on the graph is likely to affect wolf numbers.

Explain your answer.

.....

.....

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

[Total: 5]

4 Both carbon and nitrogen are recycled in nature.

(a) The carbon cycle is affected by human activity.

Every person is said to have a **carbon footprint.**

What is meant by the term carbon footprint?

.....

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

(b) Both the carbon cycle and the nitrogen cycle involve bacteria acting as decomposers (saprophytes).

The nitrogen cycle also involves three other types of bacteria.

Write down **one** of these other types of bacteria and explain what they do in the cycle.

type of bacteria .....

what they do in the nitrogen cycle .....

.....

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

[Total: 3]

5 **(a)** Scientists have been collecting evidence about the size of animals that live on islands. Islands often have a shortage of food and other resources. They are often exposed to the wind and have little shelter.

Some scientists report that animals living on islands are bigger than similar animals living on the mainland.

Other scientists report that animals living on islands are smaller than similar animals living on the mainland.

Show how Charles Darwin's theory of natural selection can explain **both** sets of evidence.

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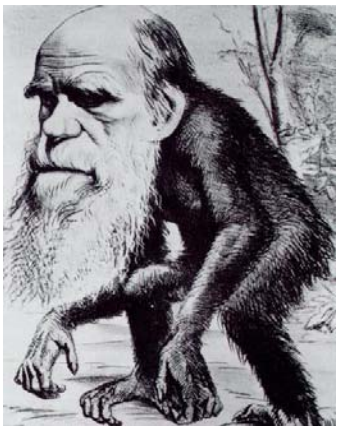
..... **[4]**

(b) Look at the cartoon that was published soon after Darwin put forward his ideas about evolution.



Write about why people wanted to criticise Darwin by publishing this cartoon.

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

[Total: 6]

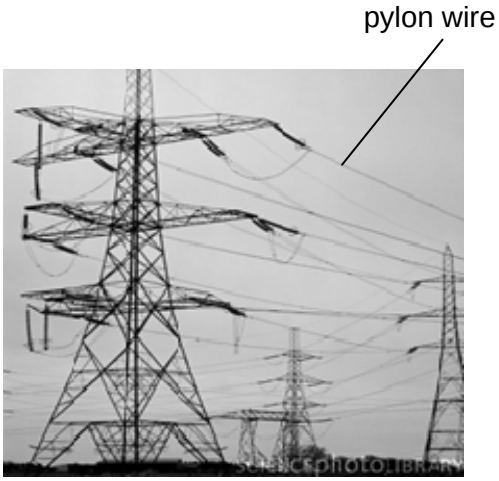
Section B – Module C2

6 This question is about metals.

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

metal	melting point in °C	density in g/cm^3	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
zinc	420	7.1	18	870

(a) Aluminium is used to make pylon wires.



Silver is not used because it is too expensive.

Explain why aluminium is the most suitable metal for using to make pylon wires.

.....

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

(b) Which metal would be the best to use for a door stop for keeping doors open?

Choose from the table.

metal .....

Write down **two** reasons why.

.....

.....

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

(c) Brass is an alloy.

Which **two** metals make up brass?

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

[Total: 5]

7 This question is about fertilisers.

Fertilisers can be made by **neutralisation**.

(a) Sulfuric acid, H_2SO_4, will neutralise ammonia solution, NH_3, to make ammonium sulfate.

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

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

(b) Sodium hydroxide reacts with phosphoric acid.

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

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

(c) Elizabeth and Anna are farmers. They use fertilisers to increase their crop yields.

Elizabeth uses only potassium sulfate fertiliser.

Anna uses a fertiliser that is a mixture of ammonium nitrate and phosphorus(V) oxide.

Explain why Anna's fertiliser will result in better plant growth than Elizabeth's.

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

(d) One disadvantage of using too much fertiliser is that some of it runs off into rivers and lakes.

This causes eutrophication which kills the aquatic organisms living in the rivers and lakes.

Explain how eutrophication leads to the death of aquatic organisms.

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

[Total: 8]

8 This question is about the manufacture of nitric acid.

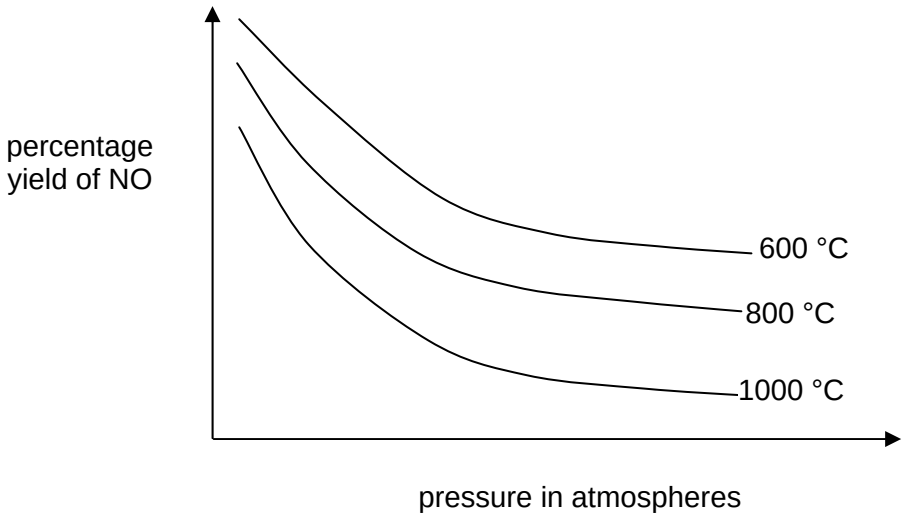
Nitric acid is made from ammonia.

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

$$\text{ammonia} + \text{oxygen} \rightleftharpoons \text{nitrogen(II) oxide} + \text{water}$$

Look at the sketch graph.

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



(a) How does increasing the **temperature** change the percentage yield?

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

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

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

(c) A low pressure of 10 atmospheres and a high temperature of 950 ^{o}C are used for the production of nitrogen oxide.

Suggest why.

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

[Total: 4]

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

The plates move very slowly.

A process called subduction can happen at plate boundaries.

(a) Describe the theory of plate tectonics and use it to explain how subduction happens.

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

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

Give **two** reasons why.

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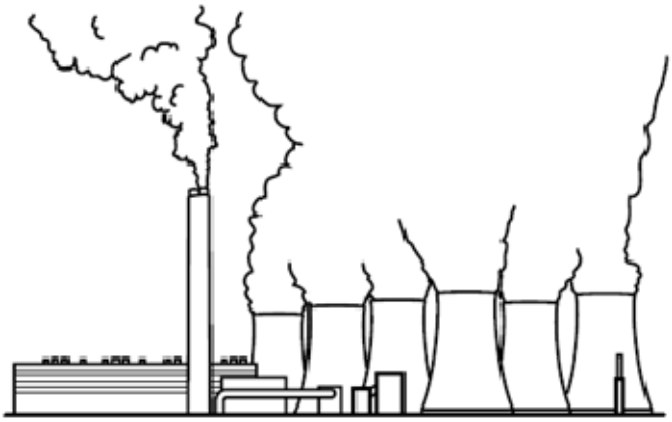
..... **[2]**

[Total: 8]

Section C – Module P2

10 Electricity is generated in power stations.



(a) In conventional power stations fuels are burned to release energy which is used to make steam.

Describe how an AC generator uses this steam to generate electricity.

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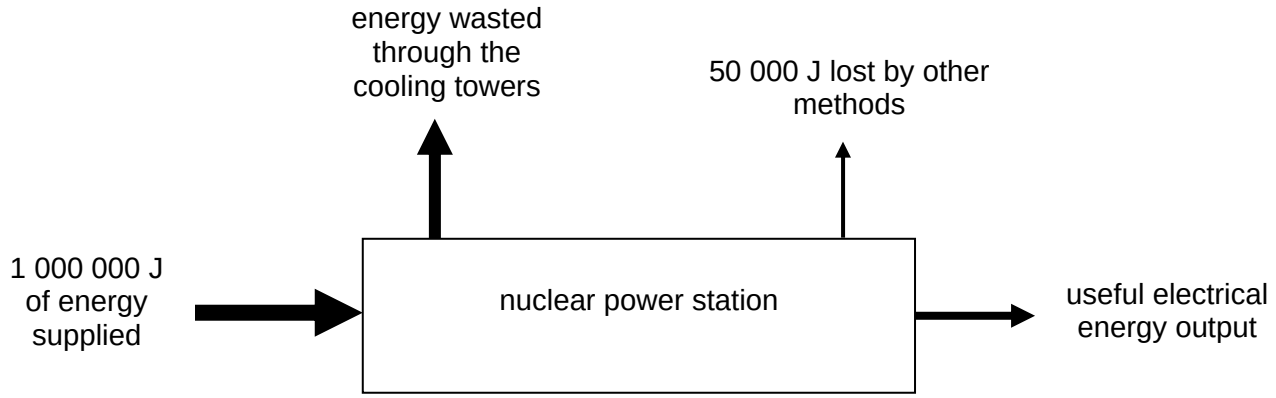
..... **[3]**

(b) A **nuclear power** station makes useful electrical energy.

It also wastes energy.

Look at the diagram.



The power station has an electrical efficiency of 0.35 (35%).

Calculate the **energy wasted through the cooling towers**.

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answer ..... J **[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	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
tidal power	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
nuclear	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
wind turbine	IIIIIIIIIIIIIIIIIIIIIIIIII
geothermal	IIIIIIIIIIII
oceanic thermal conversion	III

Eric is told the **nuclear** power station is **35%** efficient.

He uses the table and concludes the hydroelectric power station is 100% efficient.

Explain whether the information supports this conclusion?

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.... **[2]**

[Total: 7]

11 This question is about the Universe.

(a) Look at the following information about the **Copernican model**.

Before the Copernican model
Assumptions that held back the development of modern astronomy were: 1. The Earth was the centre of the Universe 2. There was uniform circular motion in the heavens 3. Objects in the heavens were made from a special unchanging substance not found on the Earth.

During the life of Copernicus
Copernicus challenged assumption 1 but not assumption 2. Copernicus did question the 3rd assumption since the Earth is just another planet.

After the life of Copernicus
His book was only published at the end of his life. He set in motion a chain of events that would eventually (long after his lifetime) produce new theories. About 100 years after his death the work of Kepler, Galileo, and Newton built on the Sun centered Copernican model.

Give **two** reasons why the Copernican model was not widely accepted until many years had passed.

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

(b) In 2009 an asteroid, called Almahata Sitta, collided with the Earth's atmosphere.

It exploded in the atmosphere and small fragments were found on the surface of the Earth.

The asteroid was identified as on a collision course with the Earth only 19 hours before it collided.

Suggest why the asteroid was only identified 19 hours before collision.

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

[Total: 4]

12 Photocells can make use of energy from the Sun.

Light produces electricity in a photocell.

Joshua is a park keeper.

He is keen to use photocells for lighting in the park.

Describe how photocells produce electricity **and** how this influences the position and maintenance of the photocells.

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

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

[Total: 6]

13 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.

(i) Use the information in the table to identify the appliance that **costs the most** to run each week **and** explain why.

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.....

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

(ii) Alan thinks he can make a big reduction to his electricity bill by switching off his satellite dish overnight.

He is surprised that his bill stays about the same.

Use the evidence in the table to explain why his bill has stayed about the same.

.....

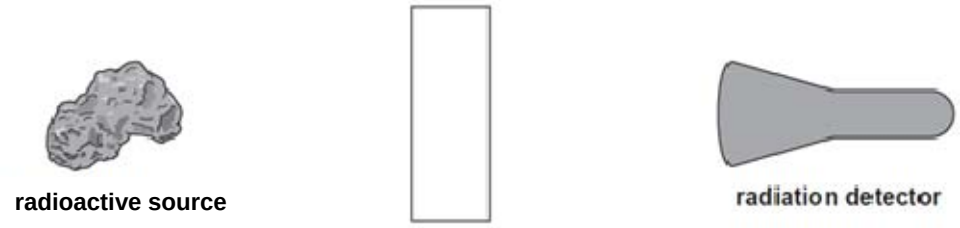
..... **[1]**

[Total: 4]

14 This question is about radioactivity.

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

Here is a diagram of her apparatus.



(a) Claire is considering using nuclear radiation emmiters 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 tissue in cm
alpha	3.7	0.0005
beta	90	1.2
gamma	70000	100

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

Use the information in the table to suggest why.

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

(b) Clare uses a very small amount of radioactive material for her investigation.

Radioactive waste must be disposed of carefully.

Describe some ways of **disposing** of radioactive waste.

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

[Total: 4]

Section D

15 Look at the information about bio-fuels.

Bio-fuels

- are renewable fuels used in motor vehicles
- are made from plant materials
- burn in air to release useful energy in the form of heat
- burn in air to make carbon dioxide and water.

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

They cannot use the same land to grow food crops.

Some people call bio-fuels carbon-neutral.

This is because plants use carbon dioxide to photosynthesise.

(a) 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, one advantage of producing bio-diesel rather than bio-ethanol.

.....

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

(b) 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 is a farmer.

She 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?

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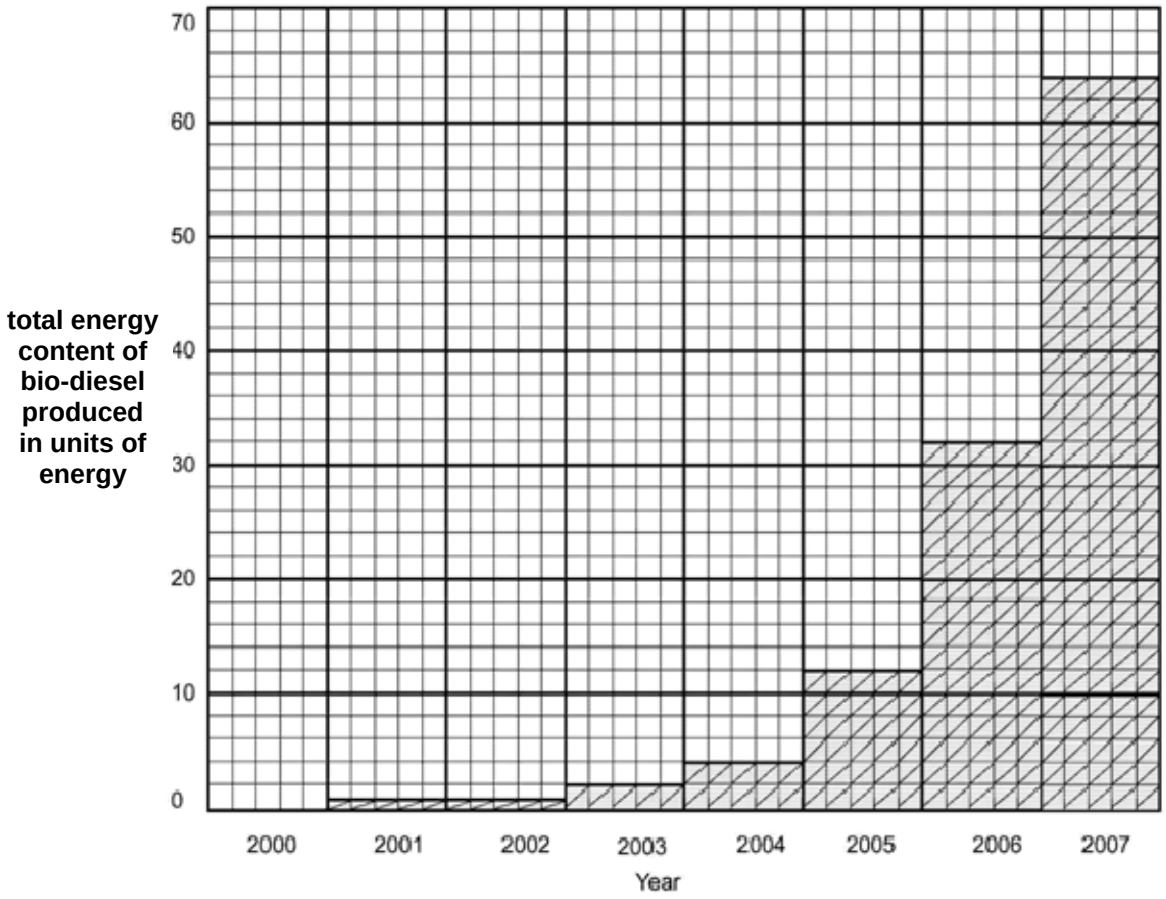
..... **[1]**

(c) 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.

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

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

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

(d) Three friends are discussing using bio-fuels.

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

Guy
Bio-fuels are better because they are carbon-neutral.

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

Use all the evidence in this section to discuss the reasons for and against growing crops for bio-fuels.

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..... **[5]**

[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	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.

OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

SCIENCE B

B712/02

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

MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 85

This document consists of 20 pages

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
   words = 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)		birds feeding at two different trophic levels so not easy to allocate their biomass to a particular trophic level (1) OR dry mass of banana plants / insects / birds difficult to measure due to seasonal fluctuations / the need to kill the organism (1)	1	**allow** birds likely to also rely on other food webs (1)
	(b)		**Level 3** Answer correctly applies knowledge of energy transfers to give a well-reasoned explanation of which chain is more efficient and comprehensively explains the implications of efficiency. 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 applies knowledge of energy transfers to give a partial explanation of which chain is more efficient and shows understanding of some of the implications of efficiency. 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, identifies B as more efficient, recognises that energy is lost at each stage. 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:** **B** more efficient • because it is the shorter chain / has fewer trophic levels • energy is lost at each trophic level • energy is lost by respiration, as heat, excretion, egestion and movement by consumers • not all parts of organism gets eaten / some parts of organisms not digested so not all passes to consumer • consumer loses up to 90% at each level • energy input gradually decreases up the chain • fewer levels result in a more efficient chain implications • food chain **B** will support more birds • shape of pyramid of biomass / biomass decreases at the top of the food chain/web • lower efficiency results in fewer organisms at the next stage • limited length of food chains as energy 'runs out' at the top
			Total	**7**	

Question			Expected answers	Marks	Additional guidance
2	(a)	(i)	14 2:3	1	
		(ii)	no mark for decision genetic diversity/variation (in region 2) reduced because of limited gene pool / genetic diversity/variation (in region 2) reduced because only 1 male in region 2 (1) because there is a limited gene pool species do not show a lot of variation therefore changes to the environment are likely to affect all of the population (1)	2	**marks for reasoning but must support decision** **allow** number of individuals below critical level (in region 2) / few organisms in large territories means difficult to find a mate (in region 1) / idea that animals isolated from each other so cannot interbreed to increase variation max (1)
	(b)		idea of conserve useful genes (1) cultural aspects (1) medical products (1) do not know what will happen to food chains if they are allowed to die out (1)	1	
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
3	(a)		because the number of prey goes up which makes more food available for lynx so more lynx reproduce and survive causing lynx population to increase (1) but it takes some time for the lynx population to reproduce and increase in numbers, creating a lag (1) OR because if the hare numbers are decreasing then there is less food for lynx and so fewer lynx survive (1) but it takes some time for the lynx to die due to lack of food and decrease in numbers (1)	2	**answers must link decrease/increase in prey to lifespan/ reproduction rate of lynx to gain full credit** **allow** reverse arguments in terms of hares eg hares increasing again before lynx because the lynx level is low enough to allow them to reproduce successfully, and they can rapidly reproduce (without death of offspring) because lynx numbers are low (2)
	(b)		no because they live in the same habitat but hares are prey and lynx are predators (1)	1	
	(c)		similar fluctuation in numbers / similar effect (as lynx) (1) but over a smaller range / but not so dramatic because wolves have other prey (1) OR no fluctuation / no effect (1) because wolves will replace hares with other prey (1)	2	**must link answer to wolves having other prey to gain full credit**
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
4	(a)		amount of carbon dioxide given off in a certain period of time (1)	1	
	(b)		nitrifying bacteria (1) convert ammonia to nitrates (1) OR denitrifying bacteria (1) convert nitrates to nitrogen gas (1) OR nitrogen fixing bacteria (1) convert nitrogen gas into nitrates / nitrogen compounds (1)	2	**allow** word equations **allow** correctly named bacteria e.g. *Nitrobacter* is a nitrifying bacteria name of bacteria scores 1 in spite of incorrect description if no bacteria named score 0 **allow** returns nitrogen gas to atmosphere
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
5	(a)		struggle for food could lead to the largest and strongest being more likely to survive and reproduce (1) **and** larger animals have smaller surface area to volume ratio and therefore lose less heat (1) **but** lack of food may mean that only smaller animals can eat enough to survive and reproduce (1) **in each case** alleles for smaller or larger size more likely to be passed on so over many generations size of animals changes (1)	4	**allow** references to genes rather than alleles
	(b)		they tried to insult his theory (1) they thought that Darwin suggested that we evolved from apes (1) they did not believe in evolution (1) his theory was against their religious beliefs / they thought that a god created man (1)	2	
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
6	(a)		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 is too expensive / ora (1)	2	**answers must support aluminium to gain credit** **allow** idea of wires are heavy **allow** reference to just one metal **ignore** any comments about corrosion
	(b)		copper (no mark) and then **any two from** because it has a high density (1) it is lustrous (1) it is relatively cheap (1) it does not rust (1)	2	no mark for name of metal **allow** iron (no mark) because it has a high density (1) and is cheap / cheapest (1) **allow** silver (no mark) because it has a high density(1) but no other mark
	(c)		copper and zinc (1)	1	both required **allow** Cu and Zn
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
7	(a)		$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$ correct reactants and products (1) balancing (dependent on correct formulae) (1)	2	**allow** = for arrow **not** and or & instead of +
	(b)		sodium hydroxide + phosphoric acid → sodium phosphate + water (1)	1	
	(c)		Anna's contain nitrogen and phosphorus and Elizabeth's only contains potassium (1) **if this mark is scored then in addition:** this means only Anna's will have nitrogen used to **make plant protein** for growth / phosphorus needed to **make DNA or RNA** needed for growth (1)	2	**second mark only awarded if first marking point is gained** **ignore** just idea of nitrogen / phosphorus needed for plant growth
	(d)		idea that fertiliser or nitrates increase the growth of water plants and produce an algal bloom (1) **if this mark is scored then in addition:** this algal bloom then blocks off sunlight from other plants causing them to die (1) **if these marks scored then in addition:** idea that (aerobic) bacteria feed on these dead and decaying plants and use up the oxygen in the water so no oxygen for other aquatic organisms (so they die) (1)	3	**marking points must be linked and in order to gain full credit** **allow** idea that plants below surface cannot photosynthesis and so die **allow** decomposers or microbes or micro-organisms for bacteria i idea that fertiliser kills or poisons fish does not score
			Total	**8**	

Question			Expected answers	Marks	Additional guidance
8	**(a)**		yield decreases / AW (1)	1	
	(b)		yield decreases / AW (1)	1	
	(c)		high temperature to increase the rate of reaction (1) but low pressure to keep the percentage yield high and decrease building/operating costs (1)	2	
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
9	(a)		**Level 3** A comprehensive answer which accurately describes convection currents in the mantle and gives a thorough explanation of subduction. 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 describes how plates move and gives a partial explanation of subduction, recognising the types of plate involved. 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** A simplistic description, which recognises the relative densities of tectonic plates and the mantle and attempts a simplistic explanation of subduction. 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:** • lithosphere made of tectonic plates • energy transfer through convection currents in the semi-rigid mantle causing plate movement • tectonic plates less dense than mantle • oceanic crust more dense than continental crust • collision between oceanic plates and continental plates leads to subduction • subduction is one plate going underneath the other • partial melting occurs • plates cooler at ocean margins so sink and pull plates down
9	(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 marking point.
			Total	**8**	

Question			Expected answers	Marks	Additional guidance
10	(a)		steam turns turbine (1) turbine causes coil to rotate in a magnetic field (1) rotation induces (alternating) current in the coil (1)	3	**answers must be in correct order to gain full marks**
	(b)		600 000 J (2) **but if final answer incorrect** addition of output and losses **or** 1 000 000 (J) – 400 000 (J) (1) **or** 350 000 (J) (useful output) + 50 000 (1)	2	**allow** 600 kJ if unit is clear (2)
	(c)		no (no mark) because the hydroelectric bar is not 3 times as long as nuclear (1) no scale to show efficiency / not clear if bars are relative lengths (1)	2	**allow** approximate calculations of efficiency for hydroelectric power stations assuming bars a proportional eg if nuclear is 33% efficient then hydroelectric is about 70% efficient (1)
			Total	**7**	

Question			Expected answers	Marks	Additional guidance
11	(a)		previous models had been regarded as correct for a very **long time** / (the Copernican model) went against the (religious) beliefs of the time so it was opposed by **many** people (1) it required technological development / development of telescope to provide evidence / test (1)	2	**allow** idea that other scientists did not confirm the Copernican model until much later (1) **allow** idea that it took a long time for the model to spread because of slow communication and printing (1)
	(b)		it was relatively small / faint / did not shine very brightly (1) need a (large diameter) telescope to see it / not possible to view with the naked eye (1) idea of not possible to look at all the sky at once / limited resources (1)	2	**allow** because it was coming towards the Earth (on a collision course) it did not change position (1)
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
12			**Level 3** A clear and detailed description of how a photocell produces electricity including how the electrons are knocked loose from the silicon atoms **and** applies knowledge of factors that affect how output can be maximised to describe in detail methods relating to light intensity and surface area. 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 clearly describes how photocells produce electricity but may lack fine detail, for example only 'electrons come from the silicon'. Application of knowledge of factors that affect how output can be maximised may lack detail, for example just 'increase light intensity', OR may be limited to light intensity or surface area. 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 attempts to describe how photocells produce electricity but details are not included. Applies knowledge of factors that affect how output can be maximised to suggest one method which is not fully explained. 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:** **photocell produces electricity by** • photons / energy absorbed by photocell • photocells made up of silicon • electrons are knocked loose from the silicon atoms in the crystal • electrons flow freely • flow of electrons produced is direct current **output can be maximised by** • **increased** surface area exposed by removing anything/trees that could block the Sun • **increased** surface area exposed by increasing the size of the photocell. • site away from trees for maximum light intensity • clean regularly to ensure maximum light intensity **allow** **more flexibility than conventional methods as photocells can be located adjacent to lights** **accept** higher level answers describing flow of electrons between n-type silicon and p-type silicon in a p-n junction
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
13	(a)		0.805 (kilowatts) (2) **but if answer incorrect** 230 x 3.5/1000 (1)	2	**allow** 0.8/0.81 (kilowatts) (1)
	(b)	(i)	**appliance that costs most to run** washing machine (no mark) **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)	1	**allow** formula cost = time x power (x cost per kilowatt hour) (1)
		(ii)	power rating of satellite dish is very low / total cost of satellite is currently only 1.68 kilowatt hours so will not be much of reduction (1)	1	
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
14	(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 body to gain 2 marks
	(b)		low level waste can be put in land-fill sites (1) waste can be encased in glass and left under ground (1) waste can be reprocessed to be less harmful (1)	2	 **not** recycled **allow** no (completely) safe way found yet (1)
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
15	(a)		(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	
	(b)		palm and 115 (1)	1	**both needed for mark**
	(c)	(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
(d)	**max 5 from:**	5	**reasoning for both sides of the argument must be used to score max 5** **reasoning must be linked to evidence in the section**
	reasoning for type of bio-fuel and plant (1)		eg she should grow hemp for bio-diesel because it is more efficiently produced and gets the biggest yield (1)
	reasoning based on environmental /social issues (max 3)		eg she should grow crops for bio-fuels because burning bio-fuels 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) bio-fuels are carbon-neutral due to plants taking in energy for photosynthesis unlike other 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) idea of the production of bio-fuels is not that efficient and a lot of energy is needed (1)
	reasoning based on technology required (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)
	reasoning based on lack of information (max 2)		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)		1		1
1(b) ✎	4	2		6
2(a)(i)		1		1
2(a)(ii)		1	1	2
2(b)	1			1
3(a)	2			2
3(b)		1		1
3(c)		2		2
4(a)	1			1
4(b)	2			2
5(a)		4		4
5(b)	2			2
6(a)			2	2
6(b)		2		2
6(c)	1			1
7(a)	1	1		2
7(b)		1		1
7(c)		2		2
7(d)	3			3
8(a)		1		1
8(b)		1		1
8(c)		2		2
9(a) ✎	6			6
9(b)	2			2
10(a)	3			3
10(b)	1	1		2
10(c)			2	2
11(a)	1	1		2
11(b)		2		2
12✎	3	3		6
13(a)	1	1		2
13(b)(i)		1		1
13(b)(ii)			1	1
14(a)		2		2
14(b)	2			2
15(a)			1	1
15(b)			1	1
15(c)(i)			2	2
15(c)(ii)			1	1
15(d)			5	5
Total	**36**	**33**	**16**	**85**

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