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National
Qualifications
SPECIMEN ONLY

Mark

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S826/75/01**Environmental Science**

Date — Not applicable

Duration — 2 hours 15 minutes



* S 8 2 6 7 5 0 1 *

Fill in these boxes and read what is printed below.

Full name of centre

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Town

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Forename(s)

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Surname

--

Number of seat

--

Date of birth

Day

--	--

Month

--	--

Year

--	--

Scottish candidate number

--	--	--	--	--	--	--	--	--

Total marks — 90**SECTION 1 — 63 marks**

Attempt ALL questions.

SECTION 2 — 20 marks

Attempt ALL questions.

SECTION 3 — 7 marks

Question 10 contains a choice.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers and rough work is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting. Any rough work must be written in this booklet. Score through your rough work when you have written your final copy.

Use **blue** or **black** ink.

Do not remove any exam materials. You must leave this booklet on your desk; if you do not, you could lose all the marks for this paper.



* S 8 2 6 7 5 0 1 0 1 *

SECTION 1 — 63 marks

Attempt ALL questions

1. Buzzards are birds of prey, commonly found throughout Scotland.



- (a) State the term used to describe the place where buzzards live.

1

- (b) Buzzards are part of the woodland ecosystem, which has several different components.

Complete the table to identify the terms and their definitions.

2

Term	Definition
	all the organisms that live together in an ecosystem
species	
	the variety that exists within living things

1. (continued)

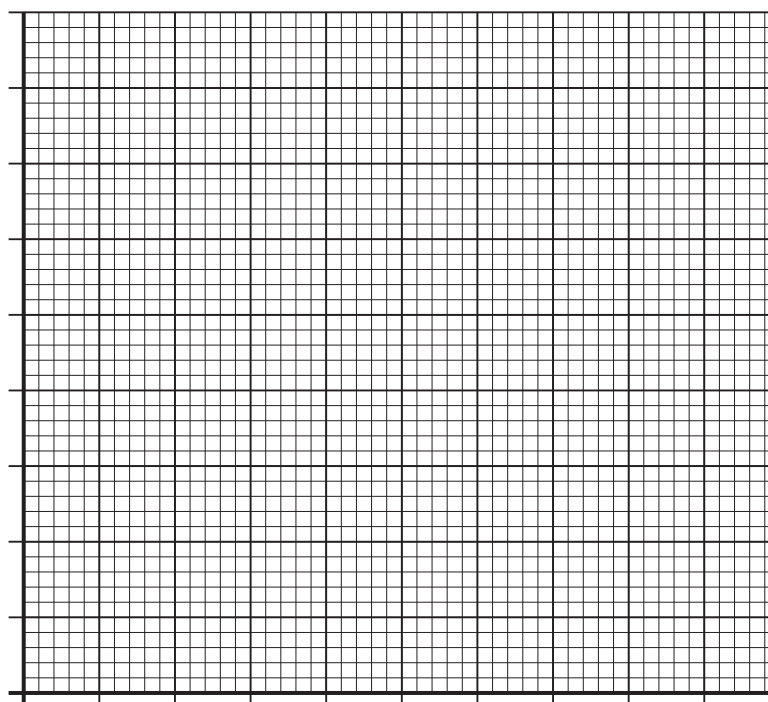
- (c) The table below shows the number of nesting buzzards in northern Scotland between 2017 and 2025.

Year	Number of nesting buzzards (thousands)
2017	30.0
2019	30.5
2021	31.5
2023	32.5
2025	34.0

- (i) Using the information from the table, draw a **line graph** to show the number of nesting buzzards each year.

3

(Additional graph paper, if required, can be found on *page 28*.)



- (ii) Use the data to predict the nesting buzzard population in 2027.

1



2. (a) Global sales of electric vehicles have increased rapidly in recent years.

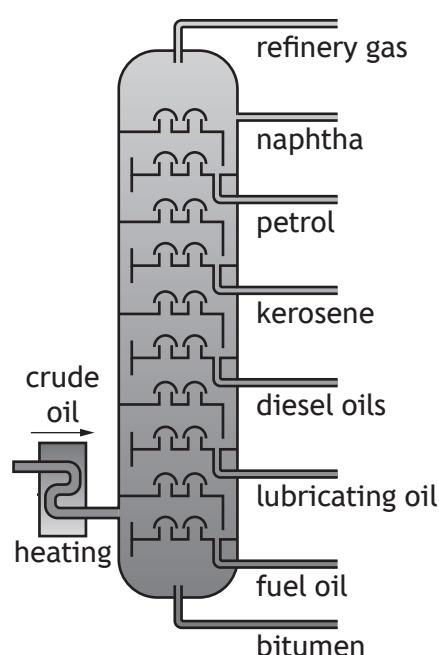
The change from fossil-fuel powered vehicles to electric vehicles has resulted in a reduction in the extraction and processing of crude oil.

The International Energy Agency has estimated that the current number of electric vehicles has reduced the extraction and processing of approximately 550 000 barrels of crude oil each day.

- (i) State the method used to extract crude oil from beneath the Earth's crust.

1

- (ii) During processing, the crude oil is separated into useful products, known as fractions.



Using the information provided, identify the fraction with:

- (A) the lowest boiling point

1

- (B) the greatest molecular size.

1



* S 8 2 6 7 5 0 1 0 4 *

2. (a) (continued)

- (iii) Describe the role of temperature in the formation of the different fractions.

3

- (b) Suggest **one** positive social impact of switching from fossil-fuel powered vehicles to electric vehicles.

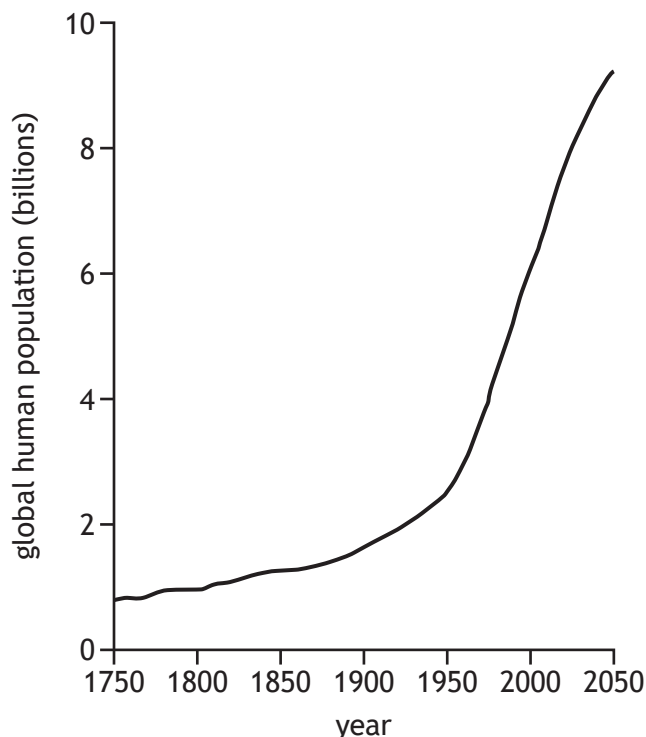
1

[Turn over



3. The global human population is estimated at 8.3 billion. Current projections suggest that this figure will continue to rise.

The graph shows the growth in the global human population since 1750 and the projected figures for 2050.



- (a) Suggest **one** reason for the increase in global human population since the 1750s.

1

- (b) Explain an impact that an increasing global human population will have on the environment.

2

Environmental impact _____

Explanation _____



3. (continued)

- (c) Due to an increasing global human population, there will be a greater demand for food crops.

- (i) Explain how one named strategy could increase the yield of food crops.

3

Strategy _____

Explanation _____

- (ii) Despite organic farming generally producing a lower crop yield, many farmers are adopting organic farming methods.

State two advantages of using organic farming methods for crop production.

2

1 _____

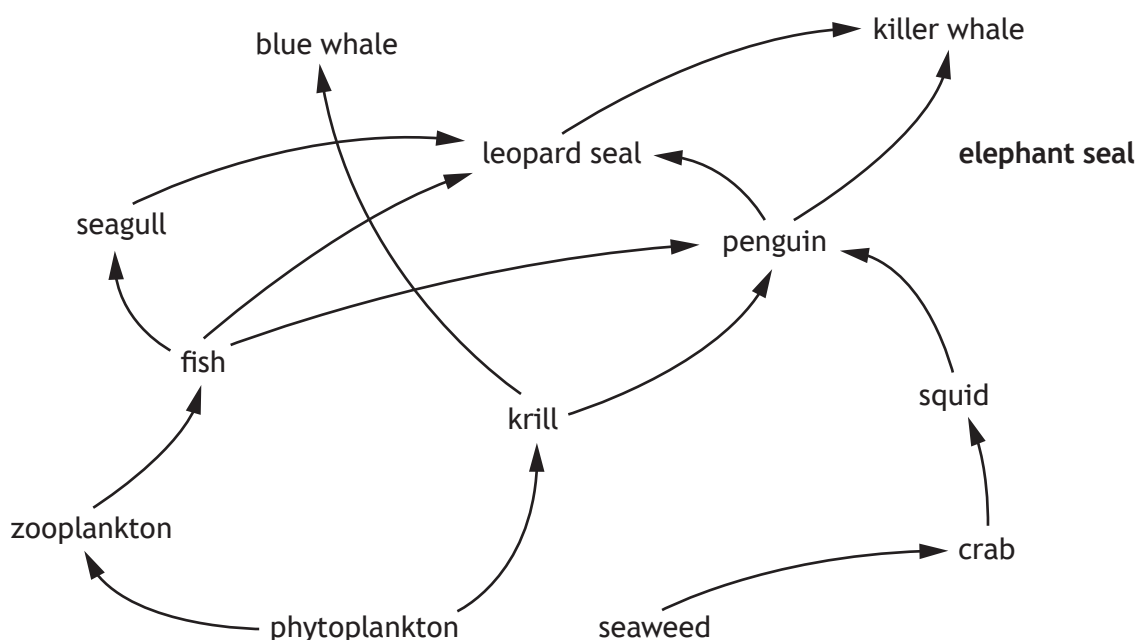
2 _____

[Turn over



4. (a) The diagram shows the feeding relationships between some organisms in an ecosystem in Antarctica.

The diagram is not complete.



- (i) State the term given to the diagram above that shows the feeding relationships between organisms in an ecosystem. 1
- _____
- (ii) The elephant seal is a predator of squid and crab. It is the prey of the killer whale.
- Complete the diagram above by adding arrows to show these feeding relationships. 1
- (iii) Disease would reduce the population of the leopard seal.
- Explain the impact this may have on the elephant seal population. 1
- _____
- _____
- _____
- _____

4. (continued)

- (b) There are several species of penguin in Antarctica. Information about some of the penguin species is shown in the table.

Penguin species	Adult height range (cm)	Foot colour	Beak colour	Facial feathers
Adélie	40–70	pink	black	all black, flat
Chinstrap	68–76	pink	black	black and white, flat
Gentoo	50–90	orange	orange and black	black and white, flat
King	90–100	black	yellow and black	black and yellow, flat
Rockhopper	45–52	pink	orange	black and yellow, projecting

- (i) Using the information from the table, complete the paired statement key.

2

- | | |
|------------------------------------|------------|
| 1. Foot colour pink | go to 2 |
| Foot colour not pink | go to 3 |
| 2. Beak colour orange | Rockhopper |
| Beak colour black | go to 4 |
| 3. Facial feathers black and white | _____ |
| Facial feathers black and yellow | _____ |
| 4. _____ | Adélie |
| _____ | Chinstrap |

- (ii) From the information provided in the table, describe one similarity and one difference between the Adélie penguin and the Gentoo penguin.

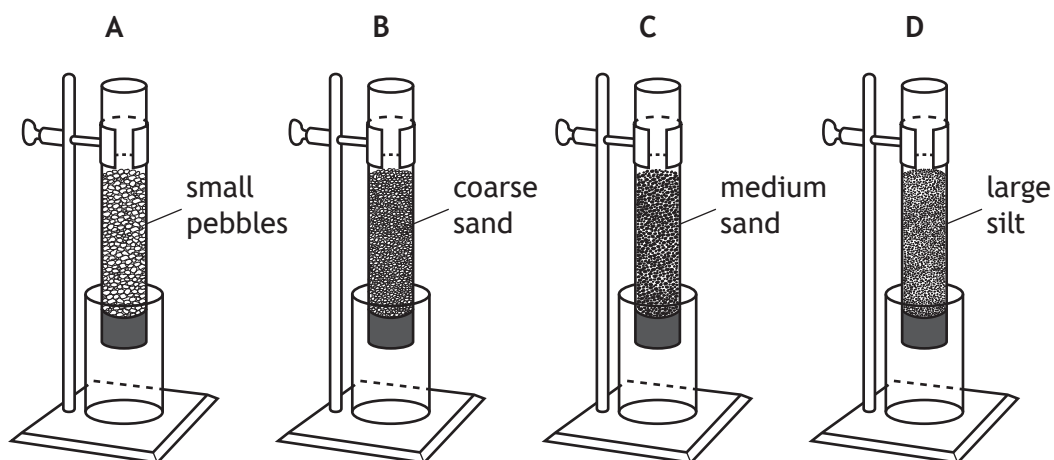
2

Similarity _____

Difference _____



5. A group of students wanted to investigate the effect of grain size on permeability. The students used the equipment shown below. Water was added to each column and the time taken for 20 ml of water to pass into the beaker was recorded.



- (a) The students changed the size of the grains. All other variables were controlled.

(i) Explain why it is necessary to control all other variables.

1

(ii) State two variables that should be controlled in this investigation.

2

1 _____

2 _____

5. (continued)

(b) The students' results are shown in the table.

Column	Material in column	Average grain size (mm)	Time taken for 20 ml to pass through (s)
A	small pebbles	6.00	12
B	coarse sand	0.80	28
C	medium sand	0.30	53
D	large silt	0.04	167

(i) Explain why column A took the shortest time for 20 ml of water to pass through.

2

(ii) Based on the students' results, state an appropriate conclusion.

1

(c) Suggest **one** improvement that could be made to the investigation.

1

(d) Permeability is closely related to porosity.

Explain why a rock may have a low permeability but a high porosity.

2



6. A construction company reuses or recycles waste materials where possible.

- (a) The table shows the company's waste management strategy and the mass of waste produced at a construction site during one month.

Waste management strategy	Mass of waste (tonnes)
Reused on site	5.00
Recycled off site	14.89
Sent to landfill	2.28

Calculate the percentage of waste that is reused at the construction site.

1

Space for calculation

_____ %

- (b) Describe how reuse and recycling of a product differ.

1



6. (continued)

- (c) As a result of the construction company's waste management strategy, it is estimated that 22 fewer journeys were made between the construction site and the landfill site.

Suggest **one** benefit to the construction company and **one** benefit to the environment of reducing the number of journeys to the landfill site.

2

Benefit to the construction company _____

Benefit to the environment _____

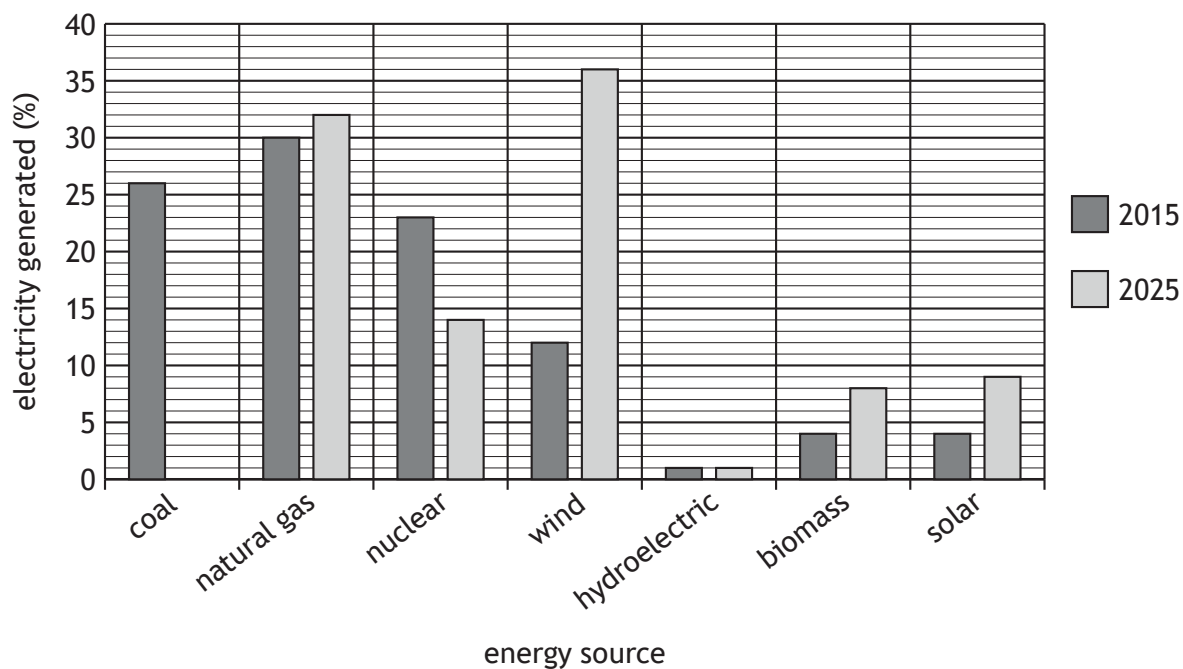
- (d) Name **one** national organisation that could advise the company on how to further improve their waste management strategy.

1

[Turn over



7. The bar graph shows the percentages of electricity generation in Scotland from different sources in 2015 and 2025.



- (a) Fossil fuels are classified as a non-renewable resource.

(i) Define the term *non-renewable*.

1

(ii) Describe **fully** two major changes between 2015 and 2025 shown in the graph.

2

1

2

(iii) Calculate the change in the percentage of electricity generated using fossil fuels from 2015 to 2025.

1

Space for calculation



7. (continued)

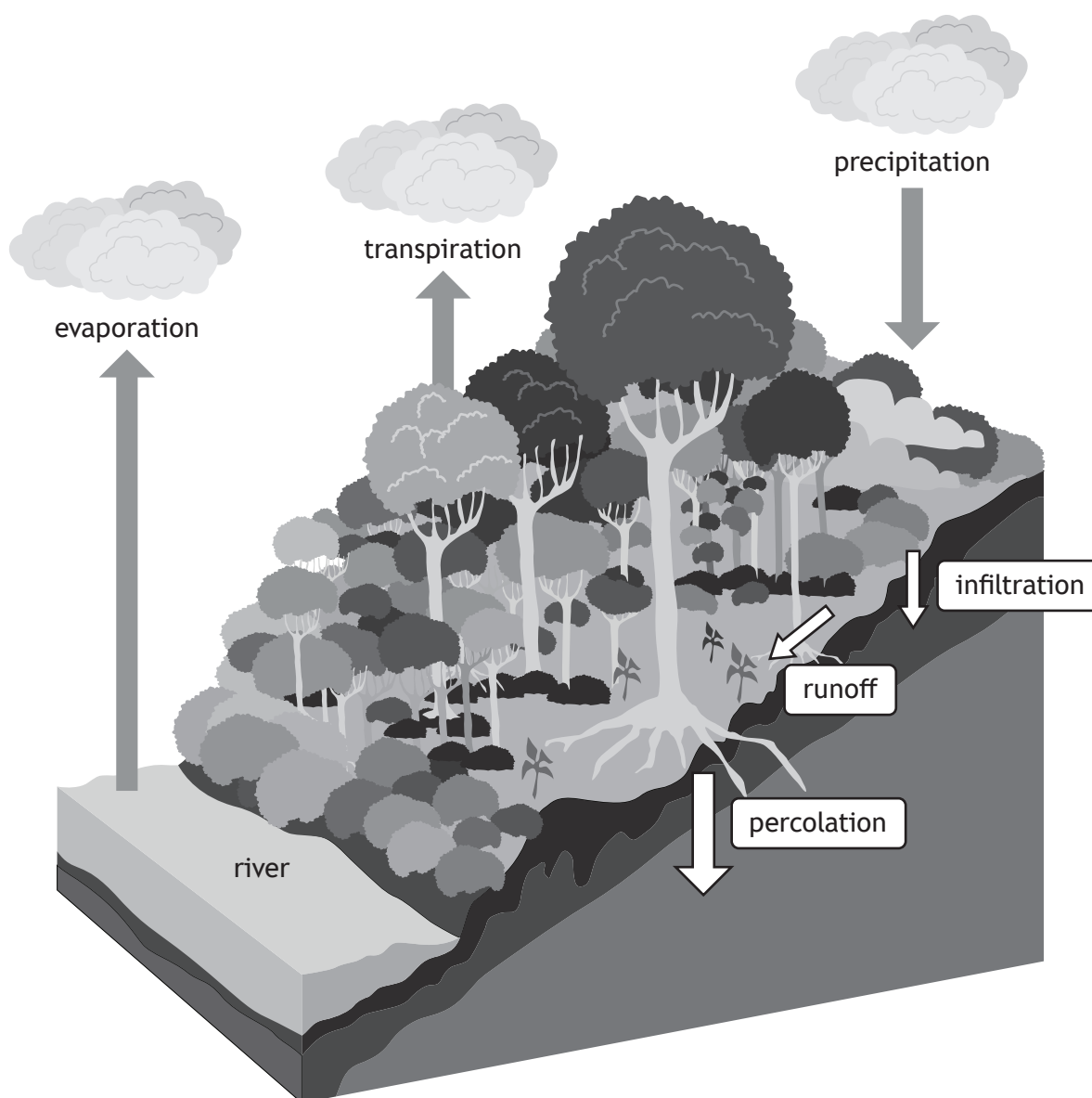
- | | MARKS |
|---|-------|
| (b) Hydro-electric power schemes contribute to Scotland's renewable energy production. | |
| (i) State the energy change in the generator in a hydro-electric scheme. | 1 |
| _____ | |
| (ii) State two factors that must be considered before siting a hydro-electric power station. | 2 |
| 1 _____ | |
| 2 _____ | |
| (c) Explain why a hydro-electric power station is considered an example of a sustainable development. | 2 |
| _____ | |
| _____ | |
| _____ | |
| _____ | |
| (d) Water from the hydro-electric power station can infiltrate into surrounding soils and rock. | |
| Suggest the impact this will have on nearby aquifers. | 1 |
| _____ | |
| _____ | |
| (e) Governments around the world are attempting to combat the effects of the enhanced greenhouse effect. One way is to invest in renewable energy sources. However, it is important to recognise the importance of the natural greenhouse effect. | |
| Explain the importance of the natural greenhouse effect for sustaining life on Earth. | 2 |
| _____ | |
| _____ | |
| _____ | |
| _____ | |
| (f) The atmosphere is one of the Earth's systems. | |
| Name one other Earth system. | 1 |
| _____ | |

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MARGIN



8. Significant areas of the Amazon rainforest have been cleared over time. As a result, scientists have observed changes in rainfall patterns and river flow in the region.

The diagram shows parts of the water cycle in the Amazon rainforest.



- (a) Name **one** process of the water cycle **not** shown in the diagram.

1

8. (continued)

- (b) (i) With reference to the water cycle, explain how deforestation may result in reduced levels of precipitation.

2

- (ii) With reference to the water cycle, explain how deforestation may result in flooding in the region.

2

- (c) During long periods of low precipitation, governments may promote water conservation methods to homeowners.

Suggest two pieces of advice that governments may give to homeowners to conserve water.

2

1

2

[Turn over



SECTION 2 — 20 marks

Attempt ALL questions

9. *Sargassum* is a type of brown algae. It is found floating on the surface of oceans and obtains its energy through photosynthesis. Wind and ocean currents cause the *Sargassum* to form large rafts.

In the Atlantic Ocean, the *Sargassum* rafts have increased in size to form an 8000-km long belt. This belt is known as the Great Atlantic Sargassum Belt, which stretches from the west coast of Africa to the Gulf of Mexico.

Giant clumps of *Sargassum* are breaking off the belt and washing ashore on beaches and coastlines in the Caribbean and Gulf of Mexico, where they start to decompose. Countries affected by this are concerned about the social, economic, and environmental impacts of decomposing *Sargassum* on the beaches along the coastlines.

One of the countries affected is exploring ways to deal with this challenge and is considering two proposals.

The first proposal involves the collection of washed-up *Sargassum*. Salt, sand, microplastics, and heavy metals, such as toxic mercury, will be removed. The cleaned *Sargassum* will then be processed into biofuel and used as an alternative to traditional fuels.

The second proposal involves the use of solar-powered robots to collect any broken-off clumps of *Sargassum* before they reach beaches and coastlines. The robot will take the *Sargassum* back into the ocean and submerge it to a minimum depth of 135 m, where the *Sargassum* will then sink to the bottom of the ocean.

Using the information shown in the supplementary source booklet and your knowledge of environmental science, answer the following questions.



9. (continued)

- (a) Air bladders present in *Sargassum* allow it to float on water. They contain gas that the *Sargassum* produces during photosynthesis.

(i) Name the gas found in the air bladders.

1

(ii) Suggest one benefit to the *Sargassum* of floating on the surface of the ocean.

1

- (b) The Amazon River carries nutrients from several South American countries into the Atlantic Ocean. These nutrients cause the Great Atlantic Sargassum Belt to grow quickly in mass.

(i) Suggest one reason why the Amazon River is nutrient rich.

1

(ii) One of the areas experiencing the greatest build-up of *Sargassum* is the Gulf of Mexico.

Suggest why large quantities of *Sargassum* are found in this area.

2

[Turn over



* S 8 2 6 7 5 0 1 1 9 *

9. (continued)

- (c) The South Atlantic Fishery Management Council has banned the removal of *Sargassum* from the Great Atlantic Sargassum Belt. This was due to the habitat it provides for a variety of organisms.

- (i) Explain the impact that the removal of such habitats would have on biodiversity.

2

- (ii) Suggest one conflict that may arise between another named stakeholder and the South Atlantic Fishery Management Council.

1



9. (continued)

- (d) One proposal suggests processing the *Sargassum* into biofuel.

Under the proposal, the government would pay for the collection and transportation of the *Sargassum* to biofuel production plants. These production plants would be built, and paid for, by a private company. The company would receive 80% of profits from the sale of the biofuel.

- (i) State what is meant by the term *biofuel*.

1

- (ii) The *Sargassum* would be processed into biofuel using fermentation. Describe the process of fermentation.

2

[Turn over



9. (continued)

- (e) The second proposal suggests the use of solar-powered robots to collect *Sargassum* floating on the surface of the ocean. Solar energy would be stored in batteries inside the robot.

The process, shown in **Source 4**, involves the robots taking the *Sargassum* down to a minimum depth of 135 m. The pressure at 135 m affects the *Sargassum*'s air bladders, causing the *Sargassum* to sink to the ocean floor.

- (i) Suggest how the air bladders are affected when the *Sargassum* reaches a depth of 135 m.

1

- (ii) The average density of seawater in the Atlantic Ocean is 1024 kg m^{-3} . The pressure due to the seawater can be calculated using the formula

$$p = \rho gh$$

where: p is the pressure in pascals (Pa)

ρ is the density of the seawater in kg m^{-3}

g is the gravitational field strength = 9.8 N kg^{-1}

h is the depth in metres (m).

Calculate the pressure at a depth of 135 m.

1

Space for calculation

_____ Pa



* S 8 2 6 7 5 0 1 2 2 *

9. (e) (continued)

- (iii) It is estimated that 6 tonnes of *Sargassum* can absorb 1.2 tonnes of carbon dioxide. This carbon dioxide is then trapped in the *Sargassum* deposited on the ocean floor.

The robot collects 16 tonnes of *Sargassum* before each dive.

Calculate the mass of carbon dioxide that could be trapped with each dive.

1

Space for calculation

- (iv) The mass of *Sargassum* available for collection by the robots would be greatest in the summer months.

Suggest why there is a greater mass of *Sargassum* available for collection by the robots in the summer.

2

[Turn over



9. (continued)

- (f) Using the evidence from the sources and your knowledge of environmental science, decide which proposal should be adopted.

Indicate your choice by ticking (✓) **one** of the boxes.

Justify your decision.

4

7

Process into biofuel

7

Sink using solar-powered robots

[illegible]

SECTION 3 — 7 marks

Question 10 contains a choice.

Attempt one of the following questions.

Write your answer to question 10 on the following pages.

You may use diagrams where appropriate.

- | | |
|--|---|
| <p>10. A Freshwater loch ecosystems can be damaged by human activity.
Describe how this may occur and suggest conservation measures that could be taken to minimise this damage.</p> | 7 |
| OR | |
| <p>B The Scottish Government aims to cut Scotland's greenhouse gas emissions.
Explain ways in which individuals could contribute towards this reduction.</p> | 7 |

[Turn over



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* S 8 2 6 7 5 0 1 2 6 *

SPACE FOR ANSWERS

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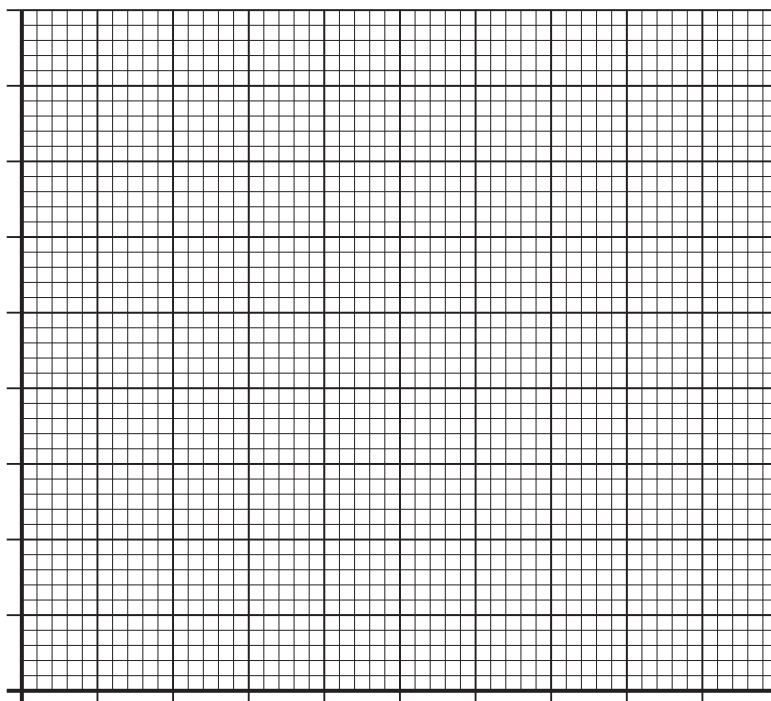
[END OF QUESTION PAPER]



* S 8 2 6 7 5 0 1 2 7 *

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional graph for question 1 (c) (i)



* S 8 2 6 7 5 0 1 2 8 *

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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* S 8 2 6 7 5 0 1 2 9 *

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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Acknowledgement of copyright

Question 1 Mircea BEZERGHEANU/shutterstock.com





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Environmental Science Supplementary source booklet

Date — Not applicable

Duration — 2 hours 15 minutes

This booklet contains sources for use with question 9 in Section 2.

Supplementary sources of information

Source 1 is a photograph showing *Sargassum* floating on the surface of the ocean.

Source 2 is a map showing the location of the Great Atlantic Sargassum Belt.

Source 3 is a photograph of *Sargassum* deposits washed up on a beach.

Source 4 is a diagram showing the process of a solar-powered robot sinking *Sargassum*.

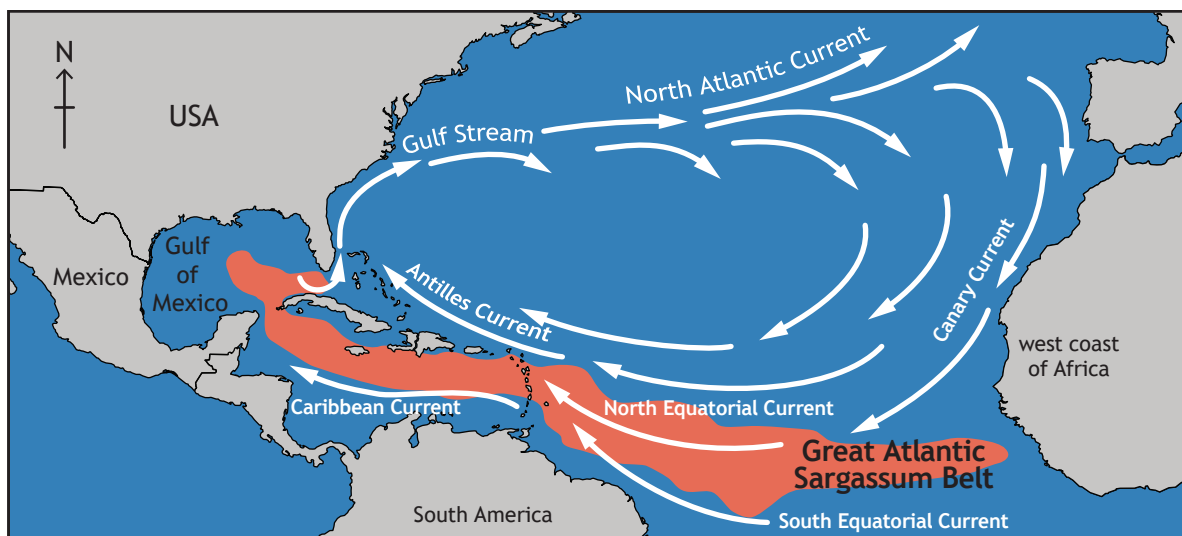


* S 8 2 6 7 5 1 1 *

Source 1 A photograph showing *Sargassum* floating on the surface of the ocean



Source 2 A map showing the location of the Great Atlantic Sargassum Belt

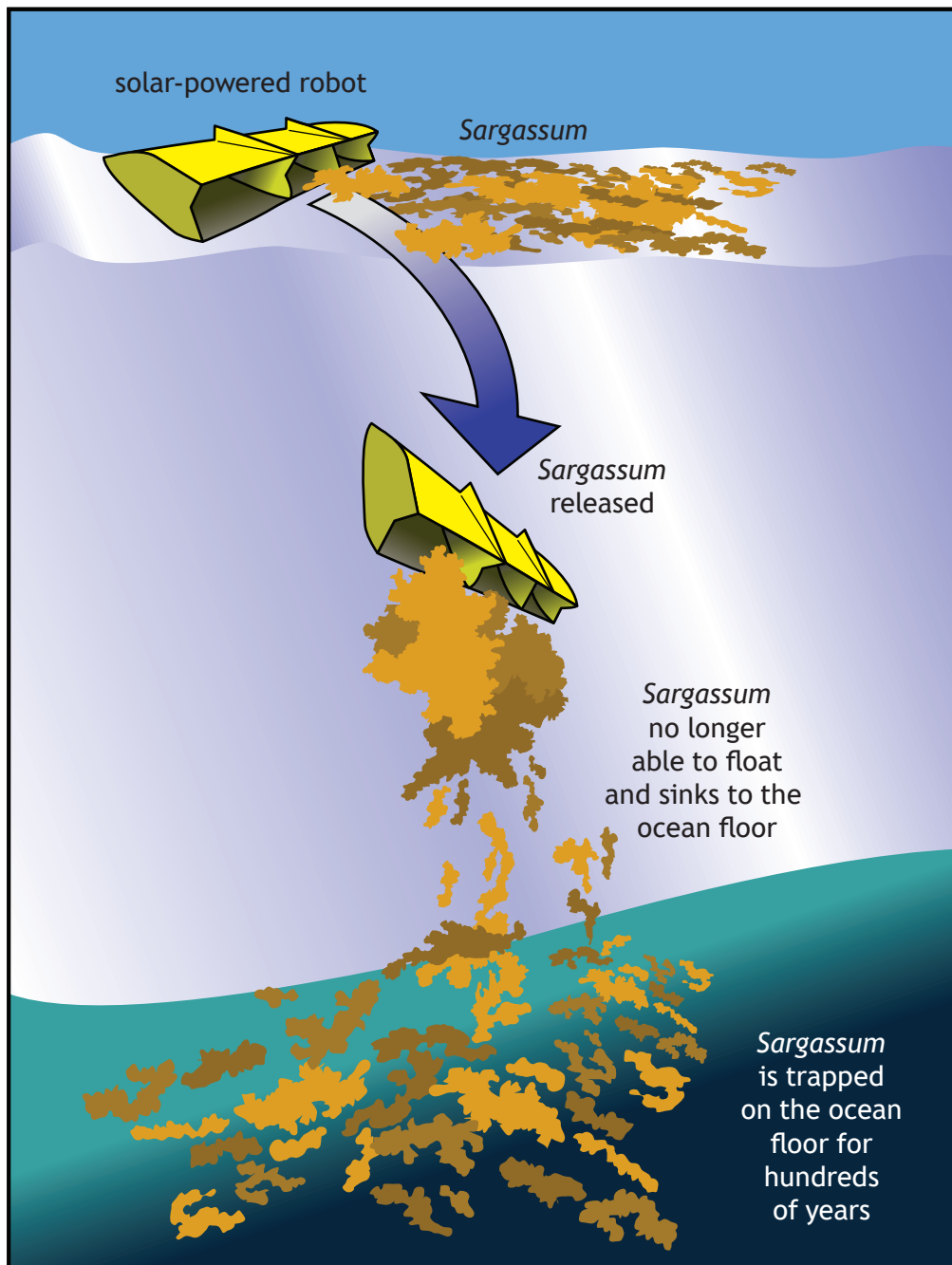


Source 3 A photograph of *Sargassum* deposits washed up on a beach



[Turn over

Source 4 A diagram showing the process of a solar-powered robot sinking *Sargassum*



[END OF SUPPLEMENTARY SOURCE BOOKLET]

Acknowledgement of copyright

- Source 1 File:Sargassum natans (brown algae) (San Salvador Island, Bahamas) 2 (16055332975).jpg — Wikimedia Commons. Image is licensed under the Creative Commons Attribution 2.0 Generic license.
- Source 3 Arkadij Schell/shutterstock.com



National
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S826/75/01

Environmental Science

Marking Instructions

These marking instructions have been provided to show how Qualifications Scotland would mark this specimen question paper.

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General marking principles for National 5 Environmental Science

Always apply these general principles. Use them in conjunction with the detailed marking instructions, which identify the key features required in candidates' responses.

- (a) Always use positive marking. This means candidates accumulate marks for the demonstration of relevant skills, knowledge and understanding; marks are not deducted for errors or omissions.
- (b) If a candidate response does not seem to be covered by either the principles or detailed marking instructions, and you are uncertain how to assess it, you should seek guidance from your team leader.
- (c) Where a candidate makes an error at an early stage in a multi-stage calculation, award marks for correct follow-on working in subsequent stages. Do not award marks if the error significantly reduces the complexity of the remaining stages. Apply the same principle in questions that require several stages of non-mathematical reasoning.
- (d) Award full marks for a correct final answer (including units if required) on its own with no working shown.
- (e) Candidates may access larger mark allocations fully, whether they respond in continuous prose, linked statements, or a series of discrete developed points.
- (f) In the detailed marking instructions, if a word is underlined then it is essential; if a word is **(bracketed)** then it is not essential.
- (g) In the detailed marking instructions, words separated by/are alternatives.
- (h) Do not award marks if a candidate gives two answers, where one is correct and the other is incorrect.
- (i) Where the candidate is instructed to choose one question to answer but instead answers both questions, mark both responses and award the better mark.
- (j) Award marks for a valid response, even if the response is not presented in the format expected. For example, award the mark if the response is correct but is not presented in the table as requested, or if it is circled rather than underlined as requested.
- (k) Candidates may use abbreviations (for example, SEPA or INNS) or chemical formulae (for example, CO₂ or H₂O) as acceptable alternatives to naming, unless required by the question, but these must be correct. For instance, chemical formulae with an incorrect subscript or superscript component (for example CO²), or full-size number (for example CO2) should not be awarded the mark.
- (l) Award marks, up to the maximum mark allocation for the question, for content that is outwith the course specification but used appropriately at the correct level for National 5.
- (m) If candidates are required to give a numerical answer, and units are not given in the stem of the question or the answer space, they must supply the units to gain the mark.
- (n) If incorrect **spelling** is used:
 - and the term is recognisable, then award the mark;
 - and the term can easily be confused with another scientific term, then do not award the mark, for example quadrat and quadrant, or nitrite and nitrate, or fractional distillation and frictional distillation;
 - and the term is a mixture of other terms, then do not award the mark.

(o) When presenting data:

- for marking purposes no distinction is made between bar charts (used to show discontinuous features, have descriptions on the x -axis and have separate columns) and histograms (used to show continuous features, have ranges of numbers on the x -axis and have contiguous columns)
- other than in the case of bar charts/histograms, if the question asks for a particular type of graph or chart and the wrong type is given, then do not award the plotting mark. Marks may still be awarded for other required components, as specified in the detailed marking instructions.
- do not award the relevant mark if the graph too small to check the accuracy of plotting; or if 0 is plotted when no data for this is given (ie candidates should only plot the data given)

(p) Award marks only for a valid response to the question asked. For example, in response to questions that ask candidates to:

- **identify, name, give, or state**, they need only name or present in brief form;
- **define**, they should give a statement of the definition;
- **calculate**, they must determine a number from given facts, figures, or information;
- **compare**, they must demonstrate knowledge and understanding of the similarities and/or differences between things;
- **describe**, they must provide a statement or structure of characteristics and/or features;
- **evaluate**, they must make a judgement based on criteria;
- **explain**, they must relate cause and effect and/or make relationships between things clear;
- **justify**, they must give reasons to support their suggestions or conclusions;
- **discuss**, they must write about a topic in detail, taking into account different issues or ideas;
- **outline**, they must provide a brief sketch of content - more than naming but not a detailed description;
- **predict**, they must suggest what may happen based on available information;
- **suggest**, they must apply their knowledge and understanding of Environmental Science to a new situation. A number of responses are acceptable: marks will be awarded for any suggestions that are supported by knowledge and understanding of Environmental Science.

Note that this list is not exhaustive.

Marking instructions for each question

Section 1

Question			Expected response	Max mark	Additional guidance
1.	(a)		Habitat	1	
	(b)		Community (Species -) a group of organisms that can interbreed to produce fertile offspring. Biodiversity	2	3 correct = 2 marks 2 correct = 1 mark 0/1 correct = 0 marks
	(c)	(i)	The axis/axes of the graph has/ have suitable scales. (1 mark) The axes of the graph have suitable labels AND units. (1 mark) Accurate plotting of points and points joined by a line. (1 mark)	3	Do not accept: line of best fit
		(ii)	Any single value in the range 35 500 to 36 000.	1	

Question			Expected response	Max mark	Additional guidance
2.	(a)	(i)	Drilling	1	
		(ii) (A)	Refinery gas	1	
		(ii) (B)	Bitumen	1	
		(iii)	The column is hotter at the bottom and cooler at the top. (1 mark) The crude oil is heated until it (mostly) becomes a gas/evaporates and passes into the column. (1 mark) Different fractions have different boiling points. (1 mark) The fraction will eventually reach the part of the tower cooler than their boiling point range, (1 mark) and will condense/turn to liquid and flow out of the column. (1 mark)	3	Any three
	(b)		Fewer people get sick because no toxic gases/particulates released as they are driven. OR Less noise pollution. OR EV charging at home is more convenient than visiting petrol stations.	1	Accept: secondary social impacts as a result of climate change only if the candidate has made the link between impact and the switch to electric vehicles. Any other valid response.

Question			Expected response	Max mark	Additional guidance
3.	(a)		Better access to food/water/medicines/welfare.	1	Any other valid response.
	(b)		Reduced biodiversity (1 mark) due to habitat destruction. (1 mark) OR (Increased) death of organisms (1 mark) due to contamination of land or water. (1 mark)	2	1 mark for environmental impact. 1 mark for explanation. Do not accept: pollution alone. Candidates must state type of pollution. Any other valid response.
	(c)	(i)	Fertilisers (1 mark) provide nutrients (1 mark) allowing plants to grow larger/ grow faster. (1 mark) OR Pesticides (1 mark) kill organisms (1 mark) that may eat/destroy/ damage crops/may compete against crops for resources. (1 mark) OR Genetic modification (1 mark) alters the crop's DNA (1 mark) to ensure larger plants/pest resistance/disease resistance/ tolerance to extreme conditions. (1 mark)	3	1 mark for named strategy. 1 mark for effect of strategy. 1 mark for explanation of how strategy increases yield. Any other valid response.
		(ii)	Less use of agrochemicals/ less potential for runoff into watercourses/lower health risk to farmers/improves soil structure or fertility/no impact on non-target species.	2	Any two Any other valid response.

Question			Expected response	Max mark	Additional guidance
4.	(a)	(i)	Food web	1	Do not accept: food chain
		(ii)	Arrows pointing from: - squid AND crab to elephant seal - elephant seal to killer whale	1	All 3 arrows must be correctly placed.
		(iii)	Decrease because the killer whale would lose a food source/have no leopard seal to eat and would eat more elephant seal. (1 mark) OR Decrease because there would be more penguin which would eat more squid, meaning less food for elephant seal. (1 mark)	1	1 mark for explanation. Any other valid response.
	(b)	(i)	3. Gentoo King 4. facial feathers all black facial feathers black and white	2	1 mark awarded for each correct paired statement.
		(ii)	Similarity: Both have flat facial feathers. OR The adult height range of both includes 50-70 cm. (1 mark) Difference: The Adélie has pink feet whereas the Gentoo has orange feet. OR The Adélie has a black beak whereas the Gentoo has an orange and black beak. OR The Adélie has all black facial feathers whereas the Gentoo has black and white facial feathers. OR The adult height range of the Adélie is 40-70 cm whereas the Gentoo is 50-90 cm. (1 mark)	2	Do not accept characteristic alone eg 'they have a different foot colour'. Candidates must describe the difference between the two species.

Question			Expected response	Max mark	Additional guidance
5.	(a)	(i)	To increase validity/to ensure that it is only size of grain affecting the results.	1	Any other valid response.
		(ii)	Mass of material/volume of materials in the column/volume of water added.	2	Any two Any other valid response.
	(b)	(i)	Because small pebbles have the largest grain size (1 mark) therefore, will have large interconnected pore spaces (that allow the water to flow through). (1 mark)	2	
		(ii)	As grain size increases, so does permeability. OR As grain size decreases, so does permeability.	1	
	(c)		Repeat the experiment and calculate an average/replace the beaker with a measuring cylinder/ if repeating, ensure that the grains are dried before each repeat.	1	Do not accept: reference to controlling variables. Do not accept: repeat the experiment on its own. Any other valid response.
	(d)		High porosity because the rock has a high percentage of pore space between the grains and will hold fluid. (1 mark) Low permeability because the pores are not very well connected and fluid cannot flow through easily. (1 mark)	2	1 mark for explanation of porosity. 1 mark for explanation of permeability. Accept: water/liquid/gas in place of fluid

Question			Expected response	Max mark	Additional guidance
6.	(a)		22.6 (%)	1	$\frac{5.00}{5.00 + 14.89 + 2.28} \times 100$ Accept: 23, 22.55, 22.553
	(b)		Reuse does not require any processing of the original product (other than cleaning), whereas recycling involves processing materials into a new product.	1	Must refer to both reuse and recycling.
	(c)		Construction company: Saving in costs due to reduced fuel consumption/employee time. Environment: Reduction in vehicle emissions/air pollution/noise pollution.	2	1 mark for benefit to company. 1 mark for benefit to environment. Any other valid response.
	(d)		Scottish Environment Protection Agency/SEPA	1	

Question			Expected response	Max mark	Additional guidance
7.	(a)	(i)	Finite/will run out/cannot be remade in a human's lifetime.	1	Do not accept: can't be used again
		(ii)	Electricity generated from coal has decreased from 26% in 2015 to 0 in 2025. Electricity generated from wind has increased from 12% in 2015 to 36% in 2025.	2	1 mark for each. Must include values Give credit where a candidate has calculated the actual % change eg electricity from coal has decreased 100% between 2015 and 2025.
		(iii)	24% decrease	1	Coal + gas: 56% in 2015 and 32% in 2025. Must indicate a decrease.
	(b)	(i)	Kinetic to electrical	1	Do not accept: movement/electricity
		(ii)	(Steep) gradient/(high) precipitation/landscape (eg narrow deep valley)/(impermeable) geology/population density/proximity to National Grid/current land use.	2	Any two
	(c)		Ensures that an energy source is available now. (1 mark) Without further depletion of natural resources/less contribution to climate change/slowing increase of global temperatures/ensures a renewable energy source will be available in the future. (1 mark)	2	1 mark for reference to meeting current needs. 1 mark for reference to not compromising future needs. Maximum 1 mark for sustainable development definition alone. Any other valid response.
	(d)		It will recharge them/increase water levels in them.	1	Any other valid response.
	(e)		Greenhouse gases absorb (re-radiated infrared) radiation, (1 mark) allowing the temperature of the Earth to be warm enough for organisms to survive/allow freshwater to be available. (1 mark)	2	
	(f)		Hydrosphere/geosphere/biosphere	1	

Question			Expected response	Max mark	Additional guidance
8.	(a)		Condensation/throughflow/ groundwater flow	1	Any other valid response.
	(b)	(i)	Deforestation will result in less/no transpiration (1 mark) which will reduce the water/ moisture/clouds in the air. (1 mark)	2	Any other valid response.
		(ii)	There would be more (surface) run-off (1 mark) as there would be fewer canopies/ root systems/trees to absorb/intercept the water.(1 mark)	2	Any other valid response.
	(c)		Showering rather than bathing/ use of water butt/turn tap off whilst brushing teeth/full load appliance running/fixing leaks/ low flow aerators/hippo bricks/ using grey water.	2	Any two Any other valid response.

Section 2

Question			Expected response	Max mark	Additional guidance
9.	(a)	(i)	Oxygen/O ₂	1	Do not accept: O/o/o ₂ /O2/O ²
		(ii)	Allows more light/greater light intensity which is required for photosynthesis.	1	Any other valid response.
	(b)	(i)	The river contains fertiliser/ sewage/organic waste run-off.	1	Any one Do not accept waste on its own. Any other valid response.
		(ii)	(<i>Sargassum</i>) is carried by the water/currents to the Gulf of Mexico. (1 mark) Land/USA/Florida traps/prevents much of the <i>Sargassum</i> from being carried back out to sea. (1 mark)	2	1 mark for reference to <i>Sargassum</i> being carried to the Gulf of Mexico. 1 mark for reference to trapping by land. Any other valid response.
	(c)	(i)	Biodiversity will decrease (1 mark) because organisms would no longer be able to hide from predators/ lose their breeding ground/be carried away more easily by the current/lose food sources associated with the habitat. (1 mark)	2	1 mark for impact on biodiversity. 1 mark for explanation. Any other valid response.
		(ii)	Governments concerned over impact on economy/public health/pollution. OR Locals/tourists who cannot/will not visit beaches due to visual pollution/smell/health risks. OR Fishers who cannot fish close to area/have <i>Sargassum</i> choking engines.	1	Any one Any other valid response.
	(d)	(i)	Combustible biomass/fuels derived from biomass.	1	
		(ii)	Sugar/glucose is converted into alcohol. (1 mark) In the absence of oxygen/ anaerobically. (1 mark)	2	1 mark for reference to raw materials AND product. 1 mark for reference to anaerobic conditions.

Question			Expected response	Max mark	Additional guidance
9.	(e)	(i)	The bladders implode/burst. OR Air/oxygen is forced out of the air bladders.	1	Any other valid response.
		(ii)	1 354 752 (Pa)	1	$1024 \times 9.8 \times 135$
		(iii)	3.2 tonnes	1	$\left(\frac{1.2}{6}\right) \times 16$ Unit must be included.
		(iv)	More sunlight/warmer temperatures, (1 mark) allow for a greater rate of photosynthesis/reproduction. (1 mark) OR Calmer waters/less adverse weather (1 mark) reduces mass of <i>Sargassum</i> breaking off. (1 mark)	2	1 mark for link to summer conditions. 1 mark for impact. Any other valid response.
	(f)		Process into biofuel - creates a fuel source, increasing energy security - biofuel can be used to transport <i>Sargassum</i> to processing plant reducing fuel usage/emissions - less risk of damaging the habitat - creates a fuel source, therefore can reduce use of fossil fuels/dependence on other countries for fuel - is considered carbon neutral so no contribution to climate change - may limit the use of crops for fuels increasing energy security/not impact food prices - government will still receive some of the profits from biofuel sales - may create more jobs than using robots	4	Any four Any other valid response. Marks allocated must be in support of the candidate's decision.

Question			Expected response	Max mark	Additional guidance
9.	(f)		(continued)		
			Sink using robots • prevents <i>Sargassum</i> from reaching beaches and impacting tourism/health/economy • solar-powered therefore do not require fossil fuels to run • solar-powered therefore do not require collection cycle to be interrupted to charge/refuel • may require fewer workers, therefore reducing wages that need to be paid • solar-powered and rechargeable batteries mean that it can be a continual/constant process • will prevent carbon dioxide from escaping into the atmosphere for hundreds of years, by which time we may be able to deal with CO₂ better/addresses current climate crisis • does not require new plants to be built therefore may save on cost • does not require new production facilities to be built which may destroy habitats/decrease biodiversity/cause pollution • does not process/transport/ burn <i>Sargassum</i> therefore less CO₂ released • for the biofuel option, it may be difficult and expensive to remove salt/sand/microplastics/ heavy metals/ toxic compounds from <i>Sargassum</i> before it used as a biofuel	4	Any four Any other valid response. Marks allocated must be in support of the candidate's decision.

Question		Expected response	Max mark	Additional guidance
10.	A	Activity/impact (1 mark for each named activity, up to max of 3 marks; and 1 mark for each named impact, up to max of 3 marks) • pollution from industry (eg chemical, paper) could impact on water quality/biodiversity • pollution from agriculture (eg fertiliser, slurry) could enter the loch and affect water quality/cause eutrophication • pollution from transport/boats (eg oil, fuel) could cause a slick and coat/be ingested by aquatic organisms • anglers removing (too many) fish could affect the aquatic food web • habitat disturbance (eg draining, road building, transport, construction) could drive away species • noise from motorised recreational activity (eg water skiing, jet skiing) could drive away species Conservation measures (1 mark for each named conservation measure, up to max of 3 marks) • awarding of legal protection (eg national designation or local bylaw. • monitoring of water quality/ pollution by SEPA • monitoring of species (eg by NatureScot) • creation of conservation areas (SSSI, nature reserve) • education • introduction of fishing permits • follow polluter pays principle	7	Or other valid response. Maximum of 3 marks awarded for named activities. Maximum of 3 marks awarded for impacts associated with named activities. Maximum of 3 marks awarded for conservation measures.

Question			Expected response	Max mark	Additional guidance
10.	B		Greenhouse gas emissions from human activities include carbon dioxide, nitrous oxide and methane. (max of 2 marks for named examples of GHGs). Examples could include: Domestic • turning heating/boiler down or off will reduce energy use • using energy-efficient light bulbs will reduce energy use • draughtproofing/insulating the house will reduce heat loss • installing solar panels/PV tiles/small-scale renewable technology will make use of renewable energy sources/ reduce reliance on fossil fuels Transport • using public transport/park & ride/car share will reduce the number of vehicles on the road • active travel (walk/cycle) will not emit GHG emissions and will improve health & wellbeing • using a fuel-efficient/electric/hybrid vehicle will reduce fuel consumption Other • buying locally produced food will reduce food miles • buying seasonal food will reduce food miles • reducing food waste will reduce methane emissions from its decomposition in landfill • composting waste food will make use of a waste product/ produce compost that can be used to enrich soil • planting trees will reduce emissions as the trees capture and store carbon dioxide	7	Responses must include an explanation of how the action could contribute to a reduction in GHG(s). 1 mark for each valid explanation. Any other valid response.

[END OF SPECIMEN MARKING INSTRUCTIONS]

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Change since last published:

The duration of the paper has been shortened and the number of marks reduced. Some questions have been removed from the previous specimen question paper, some have been edited or updated, and some have been replaced.