

FOR OFFICIAL USE



National
Qualifications
2024

Mark

X826/75/01

Environmental Science

FRIDAY, 26 APRIL

9:00 AM – 11:30 AM



* X 8 2 6 7 5 0 1 *

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth

Day

Month

Year

Scottish candidate number

Total marks — 100 marks

SECTION 1 — 66 marks

Attempt ALL questions.

SECTION 2 — 20 marks

Attempt ALL questions.

SECTION 3 — 14 marks

Questions 10 and 11 each contain 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. You should score through your rough work when you have written your final copy.

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

Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

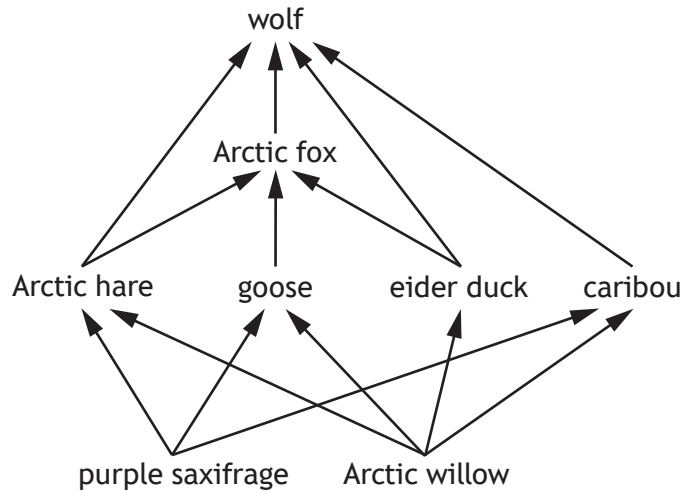


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SECTION 1 — 66 marks

Attempt ALL questions

1. (a) The diagram shows part of an Arctic food web.



(i) Name one producer from the food web. 1

(ii) Using information from the food web, describe how competition between the goose and eider duck is reduced. 1

(iii) Using information from the food web, describe the niche of the caribou. 1

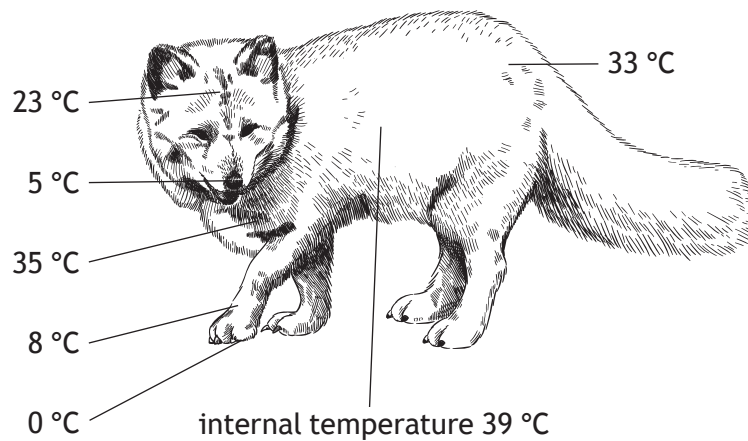
(iv) Heat energy is lost at each stage of the food web.
State one other way in which energy may be lost from the food web. 1



1. (continued)

- (b) The diagram shows an Arctic fox and the temperatures recorded at different parts of its body.

The surrounding air temperature is $-10\text{ }^{\circ}\text{C}$.



- (i) Identify the coldest part of the Arctic fox's body.

1

- (ii) Calculate the difference between the Arctic fox's internal temperature and the surrounding air.

1

Space for calculation

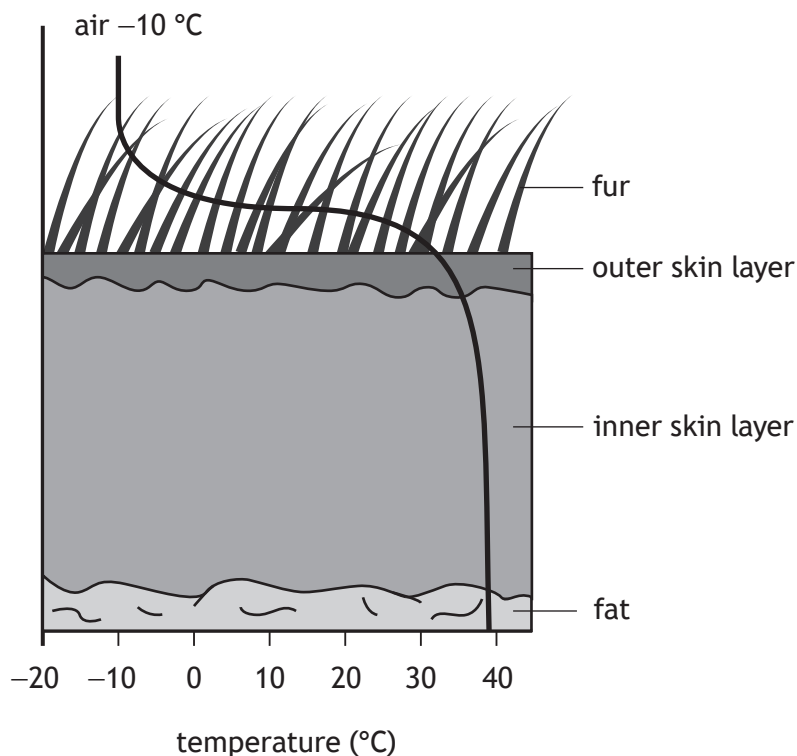
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1. (continued)

- (c) (i) The diagram shows a cross-section through a small area of skin of an Arctic fox.

The line shows the temperatures at different sites in and out of the skin section.



Describe the effect of the fur on the **internal** temperature of the Arctic fox.

1

- (ii) State the term used to describe the features that make an Arctic fox well suited to living in its environment.

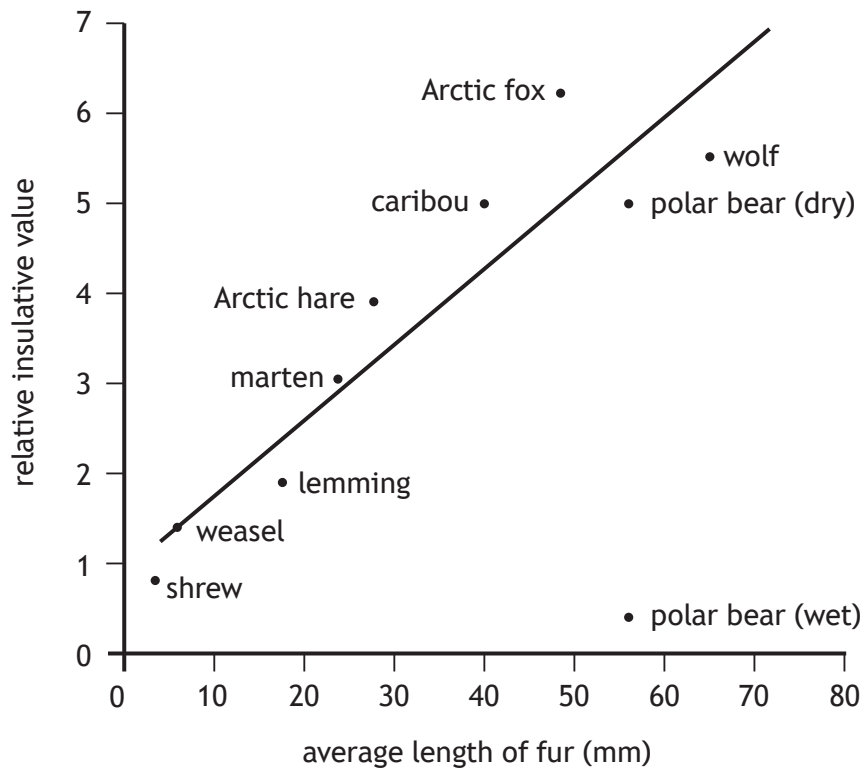
1



1. (continued)

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(d) The graph shows the relationship between the average length of fur in some Arctic mammals and the relative amount of insulation provided.



Using information from the graph:

- (i) name the mammal with the longest fur 1

- (ii) state the relative insulation value of the mammal with an average fur length of 40 mm 1

- (iii) describe the overall trend shown in the graph. 1

- (iv) Suggest a possible impact on the temperature of the polar bear of having wet fur. 2
Justify your answer.



2. Nitrogen is an essential element for plants and animals as it is required for protein production. It is constantly recycled in the nitrogen cycle.

(a) Decide if each of the following statements about the nitrogen cycle is True or False and tick (✓) the appropriate box.

If the statement is False, write the correct word(s) in the Correction box to replace the word underlined in the statement.

3

Statement	True	False	Correction
<u>Denitrification</u> is the conversion of nitrates in the soil to nitrogen in the air			
Some <u>plants</u> can convert nitrogen gas into nitrates			
Lightning can be responsible for <u>nitrification</u>			

(b) Describe how carnivores obtain nitrogen for protein production.

1

(c) Name the type of organism responsible for breaking down dead plants and animals during the nitrogen cycle.

1



3. An energy company considered two sites for a new wind farm.

(a) The table gives information about the two sites.

Site A	Site B
moorland	wooded valley
cheap land	cheap land
10 km from National Grid	50 km from National Grid

(i) The energy company selected site A as their preferred choice.

Explain why site A was chosen rather than site B.

2

(ii) Wind farms may be sited near areas of high population density.

Give one advantage and one disadvantage of siting wind farms near areas of high population density.

2

Advantage _____

Disadvantage _____

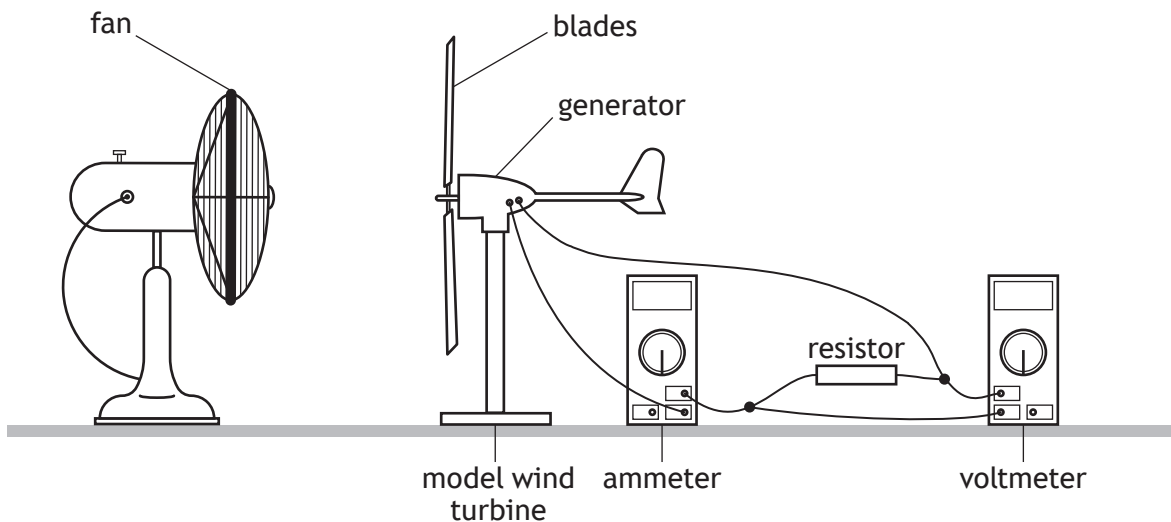
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3. (continued)

(b) A group of students investigated how the distance of a fan from a model wind turbine affects the power generated.

The students used the equipment shown below.



The generator of the wind turbine produces electrical energy.

(i) Name the type of energy converted into electrical energy by the generator.

1

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

2

3. (b) (continued)

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- (iii) The students varied the distance between the fan and the model wind turbine. They measured the current (I) produced and the voltage (V) generated at each distance.

Distance between fan and turbine (cm)	Current produced (A)	Voltage generated (V)	Power (W)
100	0.21	0.57	0.12
80	0.34	0.93	0.32
50	0.45	1.22	0.55
30	0.54	1.45	0.78
20	0.59	1.59	

Power (P) is calculated using the formula

$$P = IV$$

- (A) Using this information, calculate the power generated when the distance between the fan and the turbine is 20 cm. 1

Space for calculation

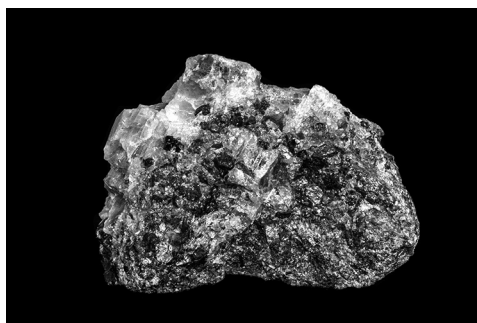
- (B) Based on the students' results, state an appropriate conclusion. 1

- (iv) Describe how the students could establish whether their results are reliable. 2



4. Sweden is one of the world's largest producers of iron ore. The ore is mined in the north of the country and transported by train to ironworks elsewhere.

The picture shows magnetite-apatite, which is an iron ore.



- (a) State what is meant by the term *ore*.

1

- (b) One train pulls 68 wagons. Each wagon carries 1000 tonnes of iron ore.

This ore contains 60% iron oxide, which is required to produce iron.

Calculate how much iron oxide could be processed from the iron ore carried by this train.

1

Space for calculation

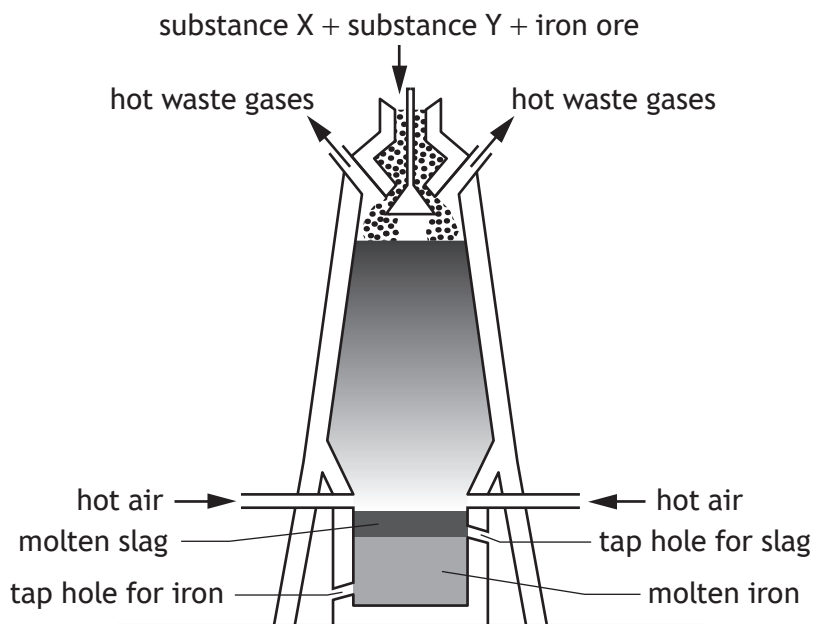
_____ tonnes



4. (continued)

(c) The diagram shows a blast furnace, which is an industrial plant used to extract iron from its ore.

Substance X and substance Y are also required for this process.



(i) Identify substance X and substance Y. 2

X _____

Y _____

(ii) Name the type of iron produced by a blast furnace. 1

(iii) Slag is the solid waste product of the iron production process. Suggest an environmental challenge of dealing with this waste. 1

[Turn over



4. (continued)

(d) The production of iron using a blast furnace has a high carbon footprint. As an alternative, Sweden has begun to process iron using electrolysis. Electrolysis uses electricity to separate the iron from its ore.

(i) Define the term *carbon footprint*.

1

(ii) Explain why electrolysis may be considered a sustainable alternative to the blast furnace.

2



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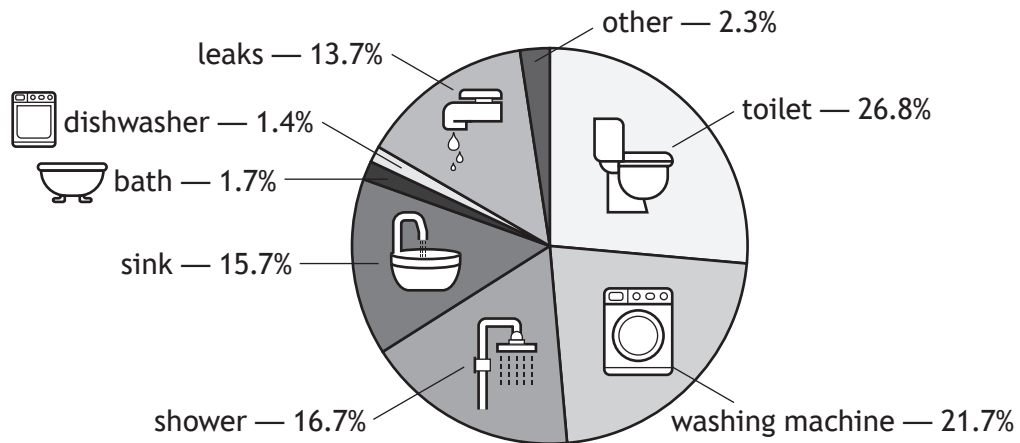
* X 8 2 6 7 5 0 1 1 3 *

5. A greywater recovery system is installed in a house. It collects and treats water from the shower, bath, and sink, which can then be used for flushing the toilet.

(a) State the term used to describe water that has been used in the home, in a business, or as part of an industrial process.

1

(b) The pie chart shows how water is used in the house.



(i) Calculate the percentage of household water that the greywater recovery system will recycle for flushing the toilet.

1

Space for calculation

(ii) 13.7% of water is lost through leaks in the home.

Other than repairing leaks and using a greywater recovery system, state **two** methods of conserving water in the home.

2

6. The Scottish Invasive Species Initiative (SISI) is a partnership project that aims to reduce the number of invasive non-native species (INNS) alongside rivers and waterways in northern Scotland.

(a) (i) Invasive non-native species can outcompete native species.

Describe one other impact of an INNS.

1

(ii) Name the national organisation responsible for providing advice to the partnership on managing INNS.

1

(b) The picture shows giant hogweed.



Giant hogweed is an example of an INNS that SISI is trying to tackle. It often grows on riverbanks and can grow up to 5 m tall, with their leaves reaching up to 1 m in size.

(i) Giant hogweed was first introduced into the UK in the 19th century. Suggest a reason for introducing giant hogweed to the UK.

1

(ii) Using the information provided, explain why giant hogweed is able to successfully outcompete native species.

2



6. (continued)

- (c) As a method of controlling giant hogweed, sheep grazing was trialled along the River Deveron, between 2019 and 2022.

Data relating to the trial are shown in the table.

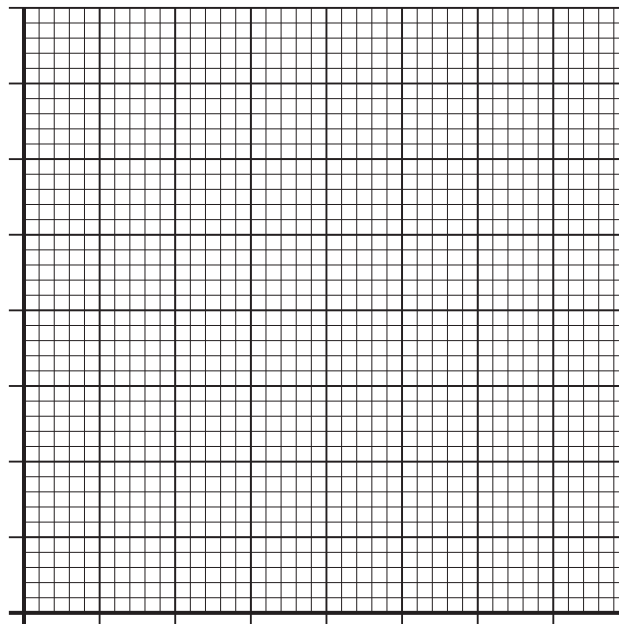
Grazing pressure is the amount of vegetation required by the sheep compared to how much is available.

Year	Number of sheep	Sheep per hectare	Grazing pressure (units)
2019	25	3.6	0.30
2020	23	3.3	0.19
2021	12	1.7	0.08
2022	11	1.6	0.07

Using the information from the table, draw a **scatter graph** to show the relationship between sheep per hectare and grazing pressure.

3

(An additional graph, if required, can be found on *page 36.*)



6. (continued)

(d) The trial found that a low to medium grazing pressure worked best when controlling giant hogweed numbers.

(i) Other than reducing the number of sheep, suggest how the grazing pressure can be reduced.

1

(ii) Suggest the impact of high grazing pressure on biodiversity.

1

[Turn over



7. An increasing global population has resulted in increased waste.

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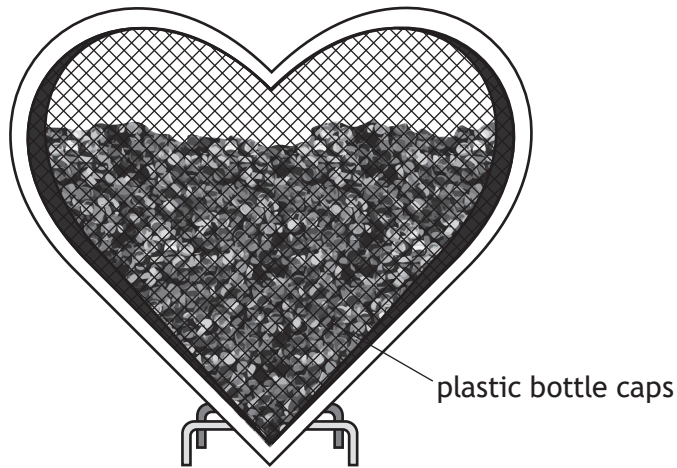
Governments around the world are exploring various sustainable approaches and initiatives to manage waste.

(a) Other than an increase in global population, give a reason why there is an increase in global waste.

1

(b) Plastic bottle caps are an example of waste that often ends up in landfill.

Large, heart-shaped containers have been installed around the city of Budapest, in Hungary, to help manage this type of waste. Residents and tourists are encouraged to place their bottle caps in the containers. The containers are emptied frequently, and the bottle caps recycled.



(i) Describe what is meant by the term *recycling*.

1

(ii) Suggest why it is more sustainable to reuse, rather than recycle, plastic items.

1

(iii) Explain one economic benefit of installing these containers around the city.

2



7. (continued)

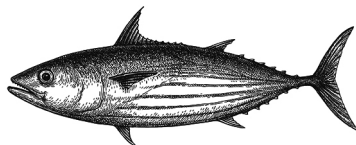
(c) Suggest **two** other ways in which local councils can encourage recycling.

2

[Turn over



8. Skipjack tuna is an important species for the global fishing industry.



Regional fisheries management organisations (RFMOs) are responsible for global tuna fishery management.

The table shows skipjack tuna catch by RFMO area for a single year.

RFMO area	Indian Ocean	Western and Central Pacific Ocean	Eastern Pacific Ocean	Atlantic Ocean
Annual catch (tonnes)	481 000	1 571 000	261 000	147 000

(a) The Western and Central Pacific Ocean includes the seas off Japan, China, Australia, and other nations.

Suggest **two** reasons why the Western and Central Pacific Ocean area has the largest catch.

2

8. (continued)

- (b) The sustainability of fish is rated for consumers by the Marine Conservation Society (MCS), based on the location and method of capture. MCS use a rating scale from 1 (best choice) to 5 (avoid).

MCS advises consumers to avoid skipjack tuna caught by net in the Western and Central Pacific Ocean and the Indian Ocean.

Skipjack tuna caught using hook and line fishing from certified fisheries in the Western and Central Pacific Ocean are rated best choice.

- (i) Explain why net fishing may be less environmentally sustainable than hook and line fishing in the same ocean.

2

- (ii) The MCS rates some other fishery areas that use hook and line fishing as 4 (fishery requires improvement).

Suggest a reason why there may be a problem with using hook and line fishing in these areas.

1

- (iii) Other than hook and line fishing, explain how one sustainable fishing method may allow fish populations to recover.

2

Method _____

Explanation _____



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SECTION 2 — 20 marks

Attempt ALL questions

9. Storm Arwen hit Scotland in November 2021. Strong northeasterly winds caused damage to an estimated 16 million trees across the country. Many forests and woodlands, including community woodlands, were affected.

Community woodlands are controlled by a group of local people and aim to build sustainable, flourishing, creative, resilient, and vibrant local communities.

One such community woodland was damaged by Storm Arwen. The fallen and damaged trees have been removed and the community must now decide what type of trees to plant.

A meeting was held where users of the community woodland were asked their opinions on whether the damaged area should be planted with non-native conifers or native mixed woodland.

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

[Turn over



* X 8 2 6 7 5 0 1 2 3 *

9. (continued)

- (a) Extreme weather events, such as Storm Arwen, may be a result of climate change.

State one other environmental impact of climate change.

1

- (b) Wind speeds up to 195 km h^{-1} were recorded in some areas.

Name the piece of equipment used to measure wind speed.

1

- (c) The sketch map in **Source 1** shows the area damaged in the community woodland.

Predict the direction in which the majority of the damaged trees fell.

1



9. (continued)

- (d) Wood from the fallen trees could be used as fuel or to produce picnic benches. Suggest one other use that could be made of the wood from the fallen trees.

1

- (e) (i) Sustainability is a key aspect of community woodlands. State the meaning of the term *sustainability*.

1

- (ii) **Source 4** shows opinions of community woodland users. These opinions support different public benefits.

Complete the table to match each public benefit with **one different** opinion from **Source 4**.

2

(The first entry has been completed for you.)

Public benefit	Opinion
Environmental conservation	F
Economic development	
Renewable energy	
Social inclusion	

[Turn over

9. (continued)

- (f) Before a decision can be made on the type of trees to plant, the community must test the soil conditions. Tests were carried out to measure soil moisture, pH, and nutrient availability.

The results of the tests are shown in the table.

Soil Test	Result
Soil moisture	medium
Nutrient availability	low
Soil pH	6.6

- (i) Choose one of the soil conditions and describe a method used to test your chosen soil condition.

2

Soil condition _____

Method _____

- (ii) For your chosen method, state one potential source of error that may occur during testing.

1



9. (f) (continued)

(iii) The table shows the pH and soil moisture requirements of some native and non-native tree species.

Species	Native or non-native	Range of pH requirements	Soil moisture requirements
Birch	native	4.5–6.5	medium
Hazel	native	5.0–7.5	medium
Lodgepole pine	non-native	6.2–7.5	high
Noble fir	non-native	5.0–6.0	high
Oak	native	5.0–8.0	medium
Scots pine	native	4.0–6.0	medium
White spruce	non-native	4.5–7.5	medium
Willow	native	5.5–8.0	high

Identify all the species that are suitable for planting in the community woodland.

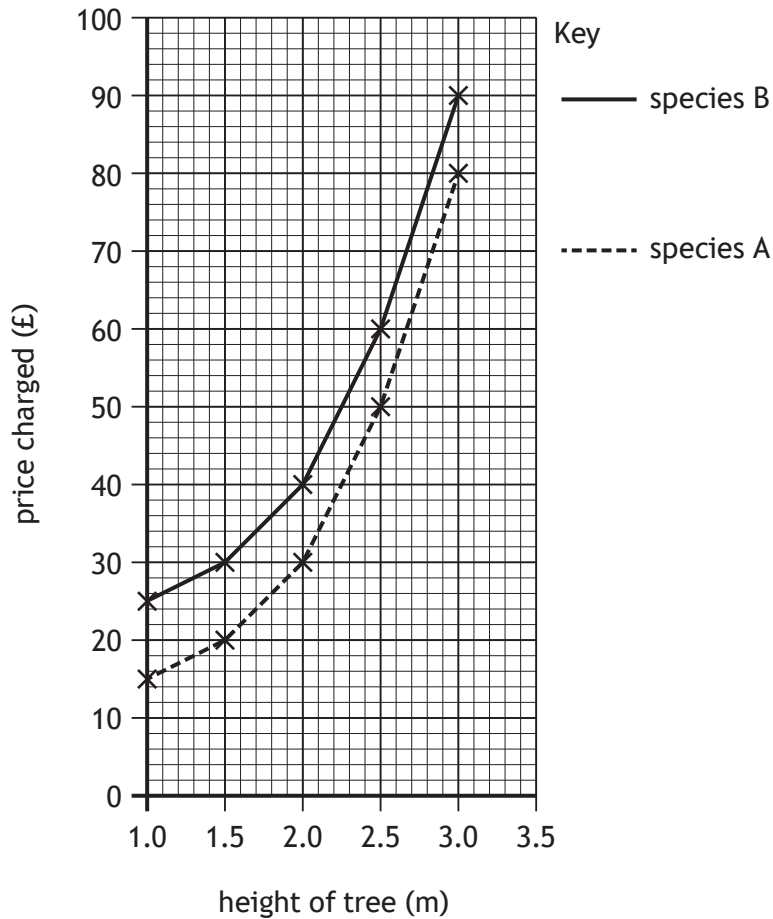
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[Turn over

9. (continued)

- (g) Most tree species sold as Christmas trees are non-native conifers. The price charged depends on the species and the height.

The graph shows the prices of Christmas trees for two different species of differing heights.



- (i) A company orders 50 species B trees, each measuring 3.0 m in height. Calculate the total cost of the order.

Space for calculation

1



9. (g) (continued)

- (ii) Calculate the percentage difference in price charged between a 2.0 m species A tree and a 3.0 m species A tree.

1

Space for calculation

- (h) The diagrams show native mixed woodland and non-native conifer woodland.



native mixed woodland



non-native conifer woodland

Predict which type of woodland will have the greatest animal biodiversity.
Explain your answer.

2

[Turn over

SECTION 3 — 14 marks

Questions 10 and 11 each contain a choice

Write your answers to questions 10 and 11 on the following pages.

You may use diagrams where appropriate.

- 10. A** There are many plant species that provide the raw materials to make economically important products.
Other than trees, discuss economically important plant species from:
(a) terrestrial environments
(b) aquatic environments. 7
- OR**
- B** There are many animal species that provide the raw materials to make economically important products.
Other than tuna, discuss economically important animal species from:
(a) terrestrial environments
(b) aquatic environments. 7
- 11. A** Climate change is impacting every region across the world, in various ways.
Discuss social and economic impacts of climate change. 7
- OR**
- B** To reduce the impact of climate change, governments around the world are investing in sustainable approaches to reduce greenhouse gas emissions.
Discuss sustainable approaches that may be taken to reduce greenhouse gas emissions in the transport and agricultural sectors. 7

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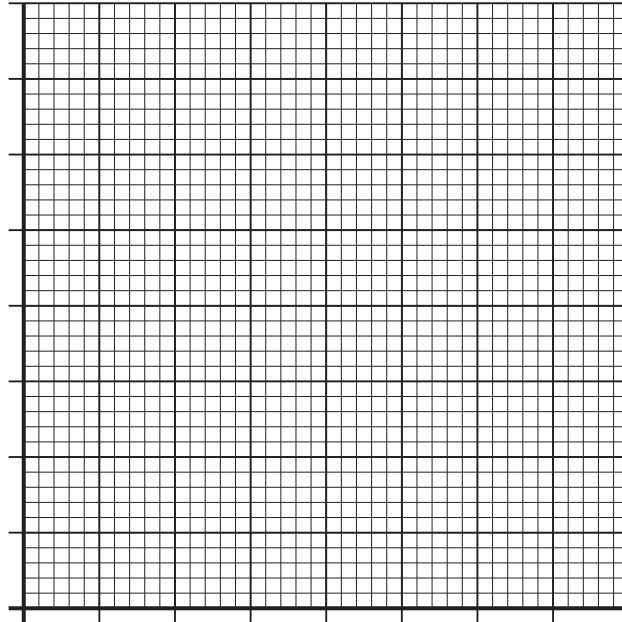
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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional graph for question 6 (c)



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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK



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