

FOR OFFICIAL USE



National
Qualifications
2023

Mark

X826/75/01

Environmental Science

TUESDAY, 30 MAY
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.



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

SECTION 1 — 66 marks

Attempt ALL questions

1. Almond milk is made by blending almonds with water and then straining the mixture to remove the solids. Many people now choose almond milk over cows' milk because it has a smaller carbon footprint.

(a) State what is meant by the term *carbon footprint*.

1

- (b) Most of the world's almonds are grown in California, USA, which has been experiencing severe drought in recent years. Almond trees need constant water throughout the year.

(i) Suggest one strategy that farmers could use to ensure their almond trees have a constant water supply.

1

- (ii) One production method requires 371 litres of water to produce 1 litre of almond milk.

A family uses 5 litres of almond milk per week.

Calculate how many litres of water are required to produce the almond milk used by this family in one year.

1

Space for calculation

_____ litres



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

1. (continued)

(c) As well as reducing their carbon footprint by choosing almond milk, the family also offset carbon.

(i) State what is meant by the term *carbon offsetting*.

1

(ii) Suggest one way in which the family could offset carbon.

1

[Turn over



2. Grey partridges live in farmland used for growing cereal crops such as wheat and barley.



- (a) State the term used to describe the place where the partridge lives. 1

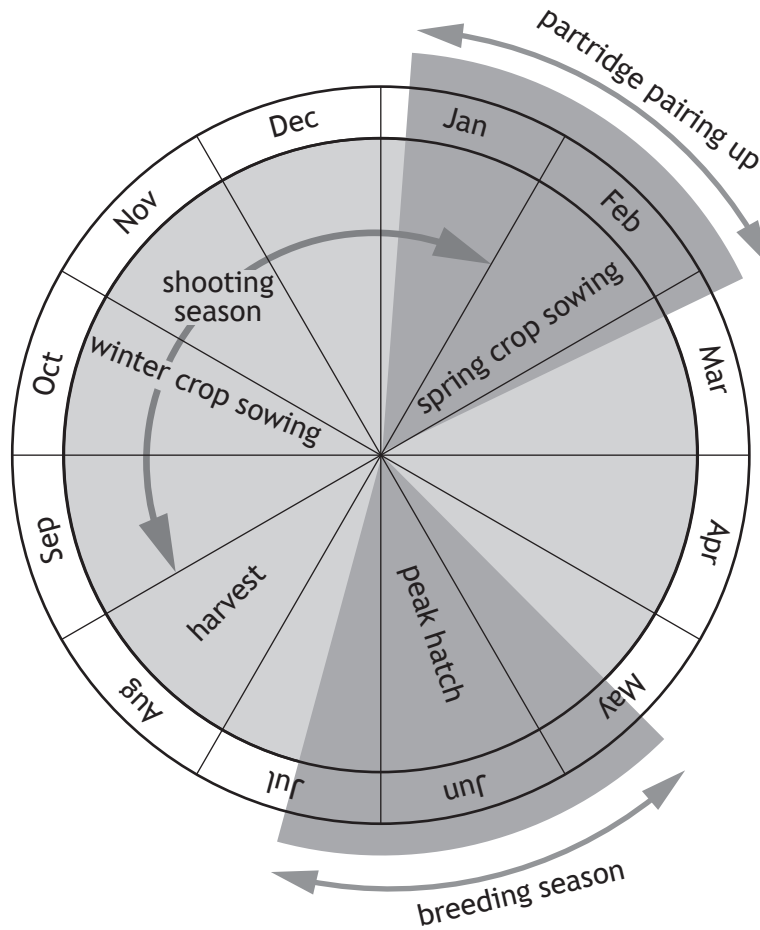
- (b) Conservationists monitor the number of grey partridges in some areas. Describe a named technique used to monitor grey partridge numbers. 2

Technique _____

Description _____

2. (continued)

- (c) The diagram shows the life cycle of the grey partridge in relation to the growth of cereal crops and the grey partridge shooting season.



- (i) Determine how many weeks the grey partridge breeding season lasts. 1

- (ii) Calculate the ratio of shooting to non-shooting months. 1

Space for calculation

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2. (c) (continued)

(iii) Using information from the diagram, suggest how conflict between conservationists and shooters has been reduced.

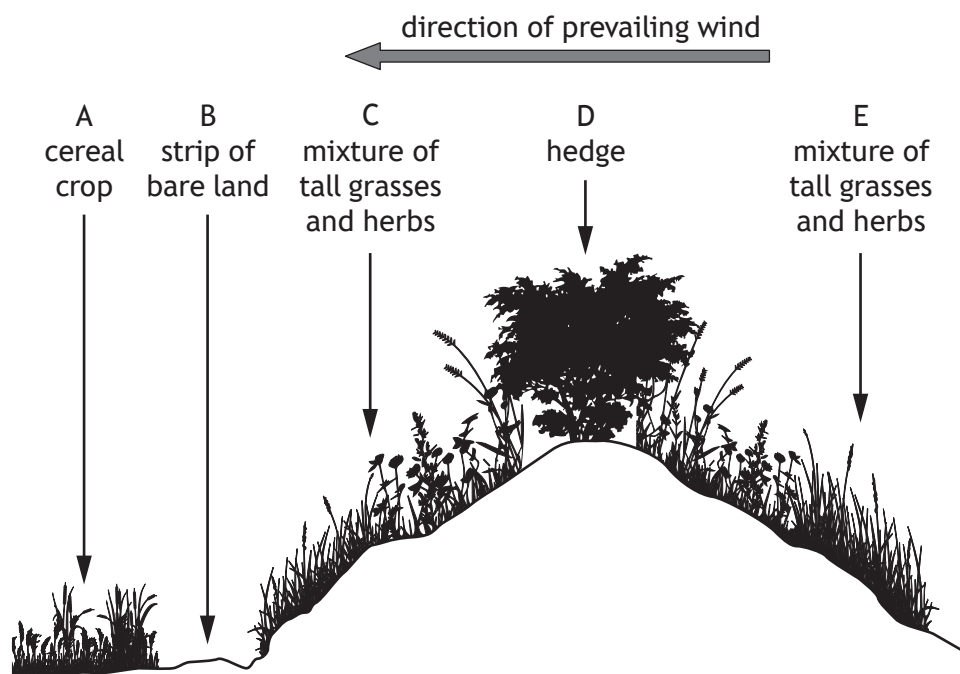
1

(d) By the end of February, most partridges have paired up and started to look for somewhere to nest.

Nests are made on the ground, concealed in dense vegetation.

The nests are usually on sloped soil with shelter from the prevailing wind.

The diagram shows a profile of potential grey partridge nesting sites.



On the diagram, circle the site where the grey partridge is most likely to make a nest.

1



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

2. (continued)

(e) During the first few days after hatching partridge chicks need to feed on plant-eating insects to grow quickly. As they get older the birds feed on young cereal shoots and seeds. Insect numbers are reduced in cereal crops because pesticides are used to help improve crop yield.

(i) State the term that describes the type of feeder that the grey partridge is:

(A) during the first few days after hatching; 1

(B) as an adult. 1

(ii) Predict the impact the use of pesticides would have on chick numbers. Explain your answer. 2

(iii) The impact of pesticides on chick numbers would not have to be taken into consideration on organic farms. Explain one disadvantage of organic farming. 2

[Turn over



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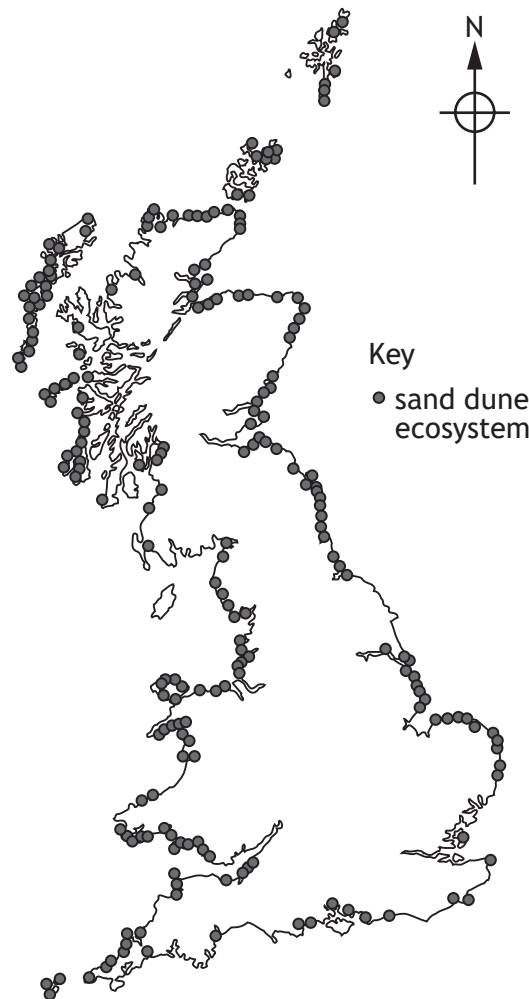
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3. Many sand dune ecosystems have SSSI status. However, there is potential conflict because they are also important recreational areas. Many of the plants found in sand dunes are susceptible to damage from human activity, such as trampling. As a result, sand dunes can become eroded.

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The map shows the location of some of the major sand dune ecosystems in Great Britain.



- (a) (i) State what is meant by SSSI. 1

- (ii) Describe a human activity that could result in damage to the plants through trampling. 1

- (iii) Suggest why sand dunes located in the northern and westernmost parts of Scotland may be less likely to be damaged than elsewhere in Great Britain. 1



3. (continued)

- (b) Some plant species are more resistant to trampling than others.

The table shows some plant species found growing on sand dunes and their vulnerability to trampling.

Plant species	Vulnerability to trampling
Birdsfoot trefoil	resistant
Buttercup	resistant
Dandelion	resistant
Lesser hawkbit	less susceptible
Marram grass	very susceptible
Meadow grass	very resistant
Ragwort	less resistant
Ribwort plantain	very resistant
Sand sedge	resistant
Sea bindweed	susceptible
Sea couch grass	susceptible
Stagshorn plantain	very resistant



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

3. (b) (continued)

(i) Identify the plant species most likely to be damaged by trampling.

1

(ii) Calculate the percentage of plant species listed that are very resistant to trampling.

1

Space for calculation

_____ %

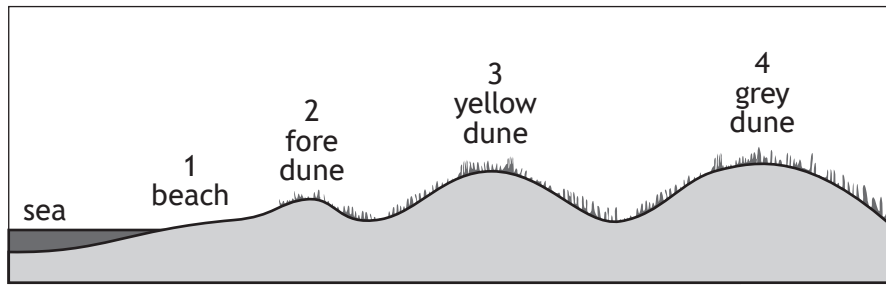
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3. (b) (continued)

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(iii) The diagram shows the types of sand dunes found on a seashore.



A group of students investigated which type of sand dune was most likely to be damaged. A transect was set up from the beach to the grey dune. The plants growing at four sample points were identified.

The results are shown in the table below.

Plant	Plants found at each sample point			
	1	2	3	4
Birdsfoot trefoil			✓	✓
Buttercup			✓	✓
Dandelion			✓	✓
Lesser hawkbit			✓	✓
Marram grass		✓	✓	
Meadow grass				✓
Ragwort			✓	✓
Ribwort plantain				✓
Sand sedge			✓	
Sea bindweed		✓		
Sea couch grass		✓		
Stagshorn plantain			✓	✓

Suggest an abiotic factor that could prevent plants from growing on the beach.

Explain your answer.

2



3. (b) (continued)

(iv) For your chosen abiotic factor, describe how it can be measured.

2

(v) Using information from the tables on pages 10 and 12, explain which type of dune is most likely to be damaged.

2

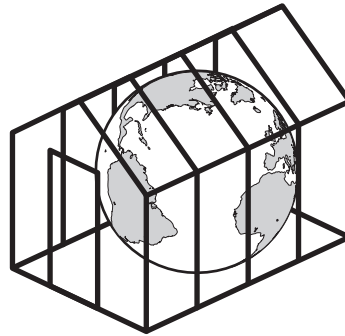
(c) It has been suggested that sand dunes require protection from human activity. Suggest one way in which this could be achieved.

1

[Turn over



4. The diagram represents the natural greenhouse effect.



(a) Explain the importance of the natural greenhouse effect for sustaining life on Earth.

2

(b) The atmosphere is one of the Earth's systems.
Name one other Earth system.

1

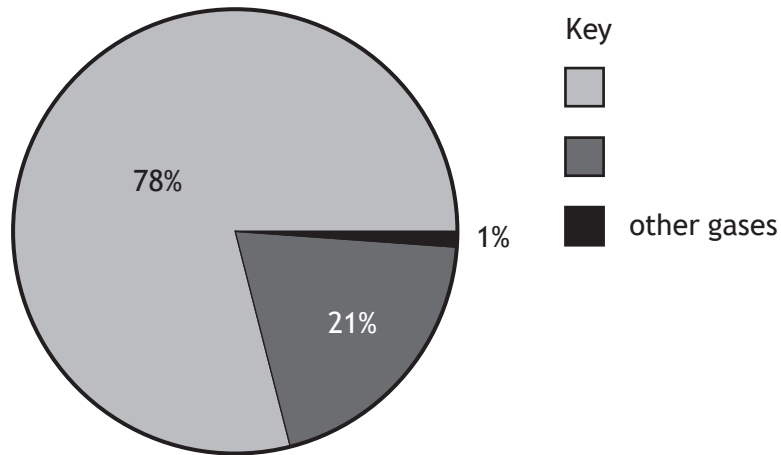
4. (continued)

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(c) The Earth's atmosphere is made up of several gases.

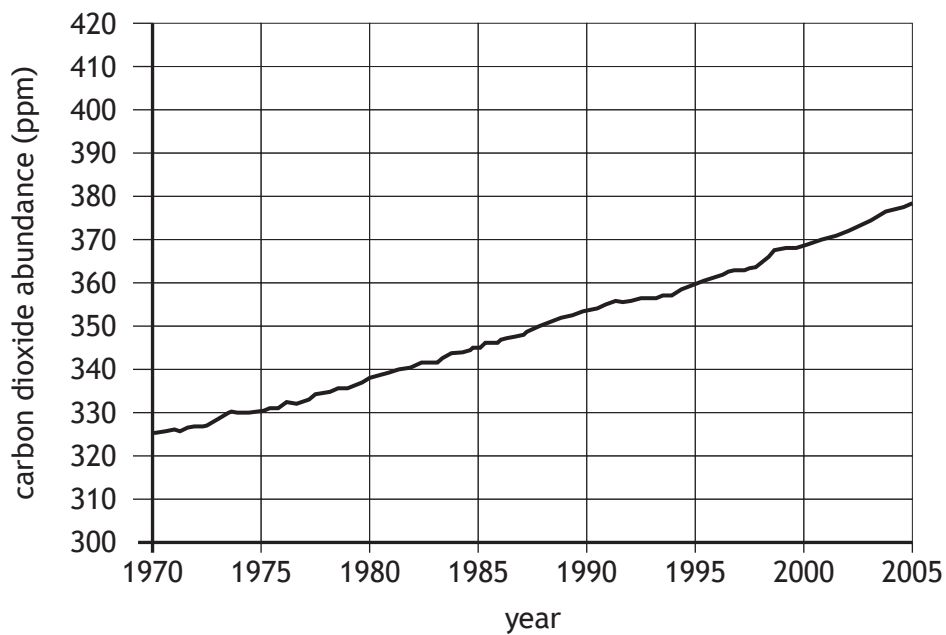
Complete the pie chart key to show the composition of the gases in the atmosphere.

1



(d) The abundance of carbon dioxide in the atmosphere is rising.

The abundance of carbon dioxide in the atmosphere, between 1970 and 2005, is shown in the graph.



Use the information from the graph to predict the carbon dioxide abundance in 2030.

1



5. Many countries are developing biofuels as an alternative to fossil fuels. Nuts are one material currently being tested for this purpose. At present, whole nuts are burned to release energy.

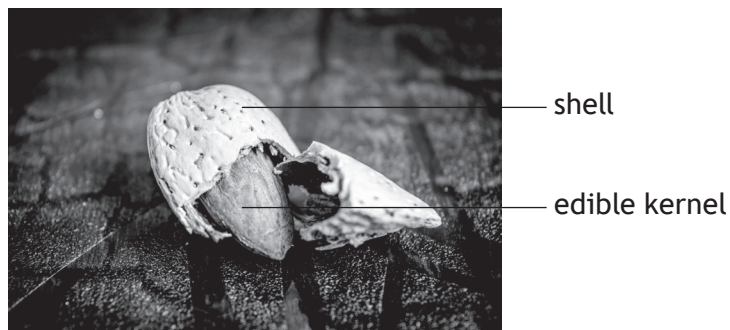
(a) State the meaning of the term *biofuel*.

1

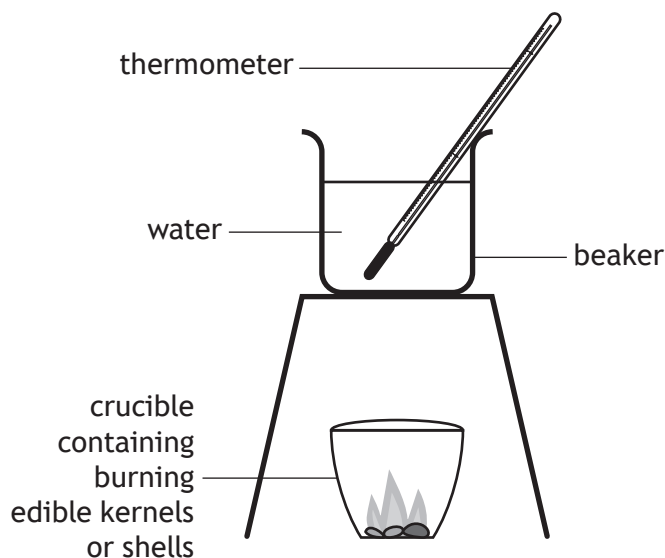


5. (continued)

- (b) A group of students wanted to investigate using nuts as a source of energy. They separated the edible kernels from the shells of various types of nuts.



The students used the equipment shown below.



They measured the temperature of the water in the beaker at the start of the experiment and then again when the edible kernels or shells had finished burning.

They then calculated the heat energy that was transferred from the burning edible kernels or shells to the water in the beaker.

- (i) State two variables that should be controlled in this experiment.

2

[Turn over

5. (b) (continued)

MARKS DO NOT WRITE IN THIS MARGIN

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

Nut type	Mean heat energy transferred ($\times 10^4 \text{ kJ kg}^{-1}$)	
	Edible kernel	Shell
Walnut	1.46	0.53
Hazelnut	1.42	0.53
Almond	1.17	1.07
Pistachio	0.67	0.52

Compare the results for the edible kernels to the shells.

1

(iii) The students compared their results for edible kernels to values that are available in scientific publications.

The students' results for edible kernels and the published scientific data are shown in the table below.

Nut type	Mean heat energy ($\times 10^4 \text{ kJ kg}^{-1}$)		% difference in values
	<i>Students' results</i>	<i>Published value</i>	
Walnut	1.46	2.74	-87.7
Hazelnut	1.42	2.70	-90.1
Almond	1.17	2.30	
Pistachio	0.67	1.15	-71.6

(A) Complete the table by calculating the percentage difference in the students' results compared to the published value for almonds.

1

Space for calculation

_____ %



5. (b) (iii) (continued)

(B) Suggest two sources of error that could explain the difference between the students' results and the published values.

2

(c) The students concluded that both edible kernels and shells could be used as a biofuel.

Discuss the sustainability of using edible kernels and shells as a biofuel.

3

[Turn over



6. Landfill sites are a common way to dispose of waste.



(a) State one disadvantage of using a landfill site.

1

(b) Since 2005 there has been an increase in initiatives by local authorities that aim to reduce the amount of waste going to landfill.

(i) Describe one initiative introduced by local authorities to achieve this.

1

6. (b) (continued)

MARKS DO NOT WRITE IN THIS MARGIN

- (ii) The table shows the total amount of waste going to landfill in Scotland over a 12-year period.

Year	Total amount of waste sent to landfill (million tonnes)
2005	7.05
2007	7.36
2009	4.71
2011	4.67
2013	4.07
2015	4.17
2017	3.74

- (A) Based on the data, explain whether these initiatives have been successful.

2

- (B) In 2015, 70% of the total waste going to landfill came from household waste.

Calculate the total amount of waste, in million tonnes, which did **not** come from household waste.

1

Space for calculation

_____ million tonnes

- (c) (i) Globally, waste production has increased.

Suggest a reason for this increase.

1

- (ii) Sustainable management of waste is a good example of global citizenship.

Define the term *global citizenship*.

1



7. Some farmers are reducing the amount of agrochemicals they use. Chemical fertilisers are an example of an agrochemical.

- (a) (i) Chemical fertilisers are applied to crops to increase yield. If excess fertiliser gets into rivers, it can cause pollution.

The following statements describe the stages involved in the pollution of rivers caused by fertiliser.

- A Plants then die and are decomposed by bacteria.
- B Spreading algae prevents sunlight reaching plants on the riverbed.
- C Excess fertiliser gets into waterways.
- D Oxygen levels decrease, causing fish to die.
- E Fertilisers cause an increase in algae

Arrange the statements in the correct order to describe the pollution of rivers caused by excess fertiliser.

The first statement has been identified for you.

1

C					
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7. (a) (continued)

(ii) Statement A states that plants are decomposed by bacteria.

Describe one similarity and one difference between decomposers and detritivores.

2

Similarity

Difference

(b) As an alternative to chemical fertilisers farmers grow legumes such as clover, which contain nitrogen-fixing bacteria.

(i) State the location of the nitrogen-fixing bacteria in legumes such as clover.

1

(ii) Name the type of nitrogen compound taken up by plants for healthy growth.

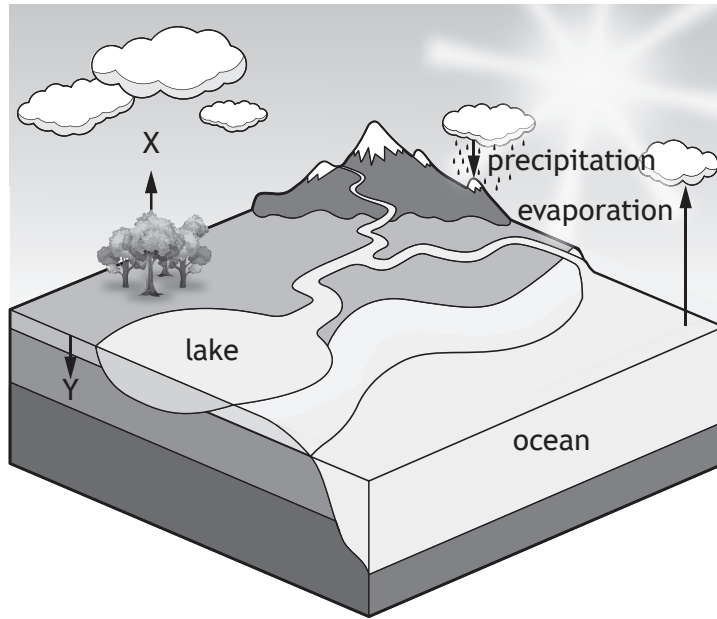
1

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

8. The diagram shows some of the processes involved in the water cycle.



(a) Name process X.

1

(b) Clouds are formed when water evaporates from the oceans.
Name the source of energy required for this process.

1

(c) Describe fully the **two** processes that take place at Y.

4

8. (continued)

(d) Hydro-electric power stations can be used to generate a sustainable source of electricity.

(i) Place an **H** on the diagram to show a suitable site for a hydro-electric power station.

Give two reasons for your choice.

2

(ii) State one other method of generating electricity using water.

1

[Turn over



SECTION 2 — 20 marks

Attempt ALL questions

9. The North Sea is often an extremely harsh marine environment with strong winds and rough, cold seas. It is a challenging place to work for fishing and oil industry workers.

The large oil field shown in Source 1 has been producing crude oil for forty years. Each of the four oil platforms has drilled many oil wells into the oil field below.

Three of the four platforms have recently shut down. The oil company must plug each disused well with large quantities of cement. This prevents any remaining oil from leaking into the sea. The platform must then be dismantled.

The oil company needs to decide what to do with the legs of the platform.

The legs of each platform are built of concrete. They were designed to be heavy enough to sit on the seabed and never removed. Removing these structures will require advanced engineering and technology that has never been tested in waters such as the North Sea.

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



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

9. (continued)

(a) (i) Describe the formation of crude oil.

2

(ii) Explain why crude oil is found in porous rocks.

1

(b) The topsides of the oil platforms will be removed and taken to a recycling yard.

(i) Define the term *recycling*.

1

[Turn over



9. (b) (continued)

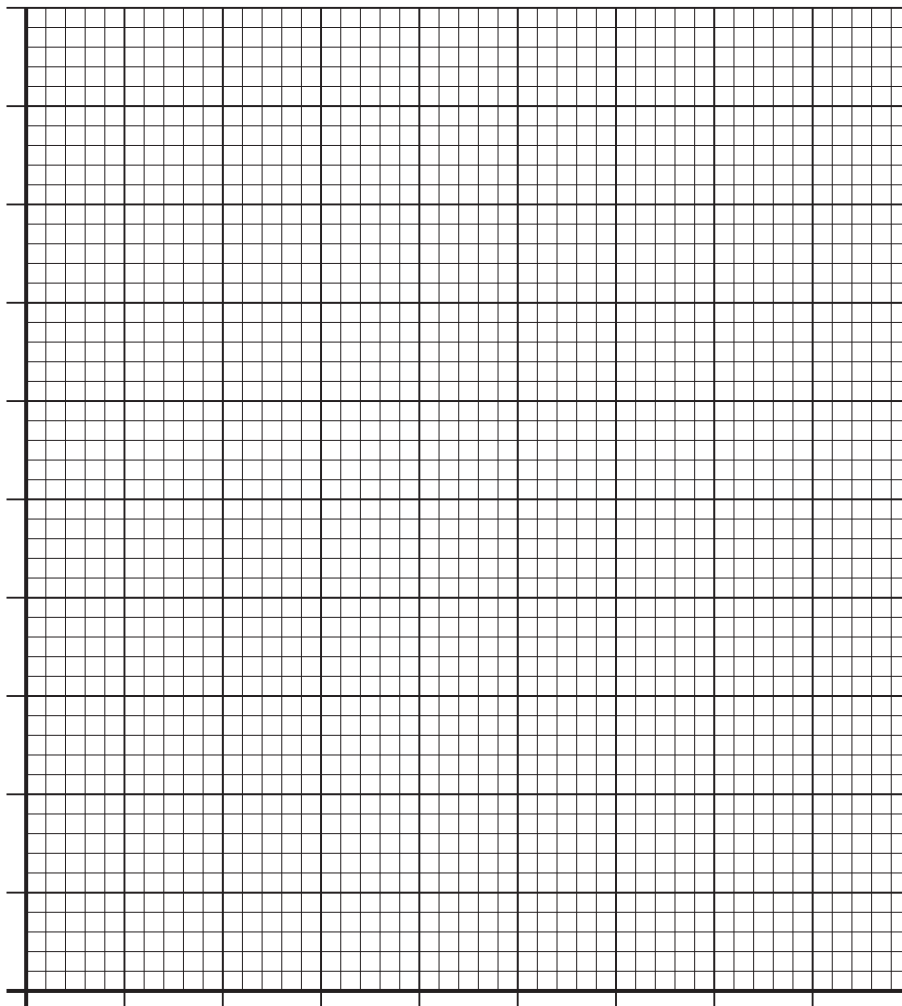
(ii) The table shows some selected materials contained within the topside of an oil platform.

Material	Mass (tonnes)
Alloy steel	230
Aluminium	420
Copper	100
Stainless steel	420
Zinc	450

Using the information in the table, draw a bar graph to show the mass of each material contained within the topside of an oil platform.

3

(An additional graph, if required, can be found on page 38)



9. (continued)

- (c) Some disused oil platforms, located in tropical waters, have been converted into offshore hotels.

Suggest two reasons why this type of venture is unlikely to succeed on the oil platforms shown in Source 1.

2

- (d) 140 oil wells have been drilled in the oilfield shown in Source 1.

- (i) Calculate the average number of oil wells each platform has drilled.

1

Space for calculation

- (ii) Many tonnes of cement will be needed to seal the oil wells to prevent oil leaking out into the sea.

Cement requires large amounts of limestone, which is quarried on land.

Describe one environmental impact and one social impact of limestone quarrying.

2

Environmental

Social

[Turn over



9. (continued)

- (e) Fishing boats fish intensively for a variety of species, including cod, which live in deep water.

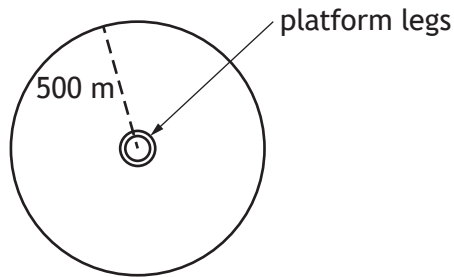
They are banned from fishing within 500 metres of the oil platform legs.

- (i) Calculate the total area, in km^2 , around the platform legs within which fishing boats are banned.

2

Area of circle

$$A = \pi r^2$$



Space for calculation

_____ km^2

- (ii) Describe a named method of intensive cod fishing.

2

9. (continued)

- (f) Using the evidence from all the sources and your knowledge of environmental science, decide whether the legs of the oil platforms should be removed from the seabed or left in place.

Give reasons for your decision.

4

Remove from seabed

Leave in place

[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 Water is becoming an increasingly valuable resource.

Describe ways in which water could be used more sustainably in:

- (a) the home
- (b) schools
- (c) industry.

7

OR

B Most of Scotland's electricity is generated from wind power.

Describe the generation of energy through wind power and its impacts on:

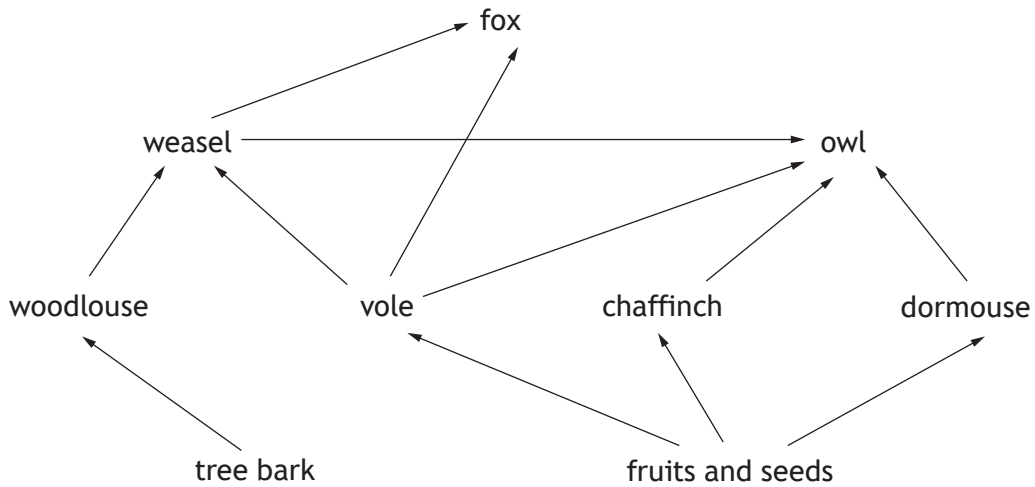
- (a) the environment
- (b) the economy.

7



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

11. A The diagram shows some of the relationships between organisms found in a woodland ecosystem.



Name the type of diagram shown and describe the energy flow through it. 7

OR

B Plants and animals depend on each other for survival. Explain, with reference to the processes of photosynthesis and respiration, how plants and animals are interdependent. 7

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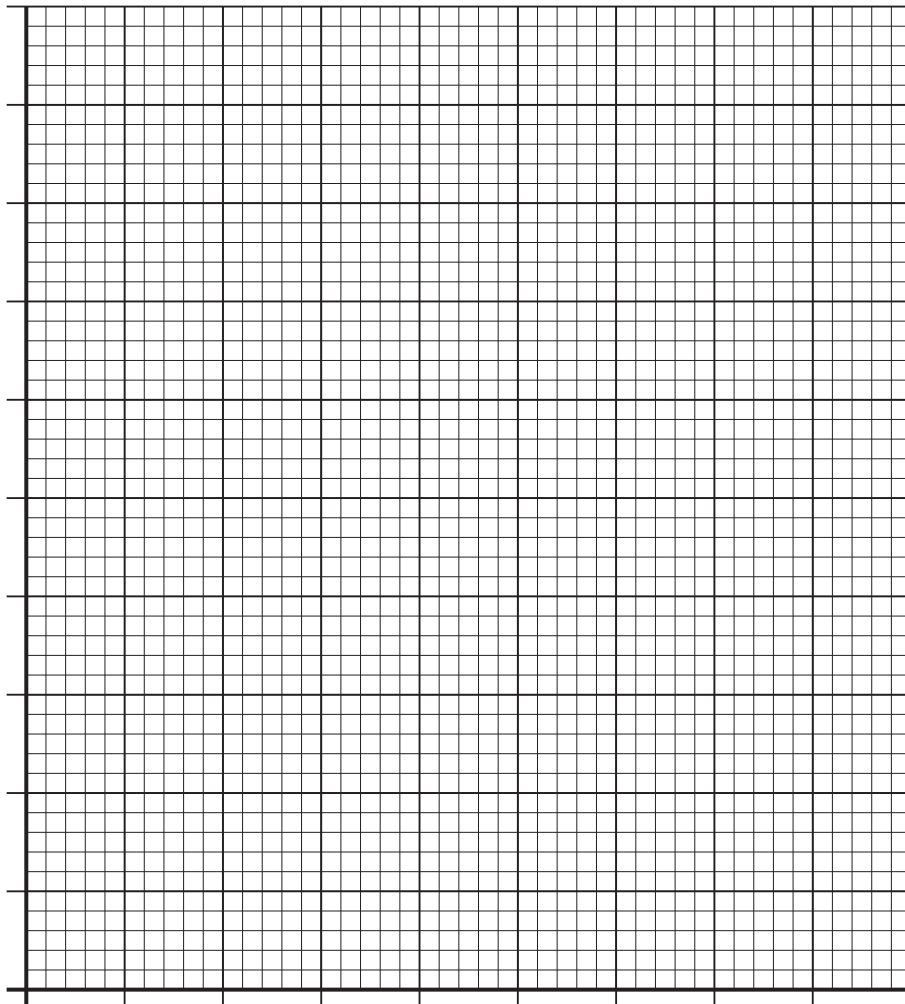
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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional graph for Question 9 (b) (ii)



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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK



ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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