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National Qualifications 2019

Mark

X826/76/01

Environmental Science Paper 1

WEDNESDAY, 29 MAY

9:00 AM – 9:45 AM

X8267601

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 — 20

Attempt ALL questions.

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.

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X826760101

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Total marks — 20

Attempt ALL questions

Since achieving city status in 2000, Inverness has experienced significant urban expansion. Ongoing improvements to communication routes include road, rail and airport developments. It is anticipated that these will attract more businesses and people into the area and therefore more housing and services will be required.

An environmental consultancy group has been commissioned to assess potential environmental impacts resulting from construction of a new section of dual carriageway.

Using the information provided in the supplementary source booklet and your knowledge of Environmental Science, answer the following questions.

1. The A96 is the main trunk road running between Aberdeen and Inverness, and is a mix of single and dual carriageways. Construction of a 100 mile-long dual carriageway between the two cities is underway and is forecast to be complete by 2030.

Congestion on the road means that traffic rarely achieves speeds of 50 miles per hour (mph) during busy periods. The new dual carriageway will reduce congestion and will have a speed limit of 70 mph.

(a) Name a greenhouse gas associated with vehicle emissions. **1**

(b) Using information provided above and in Source B, predict the impact that dualling the road will have on vehicle emissions.

Justify your response. **2**

[Turn over

1. (continued)

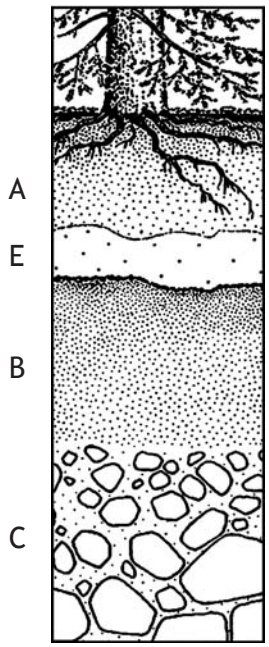
(c) A belt of native tree species will be planted along the proposed stretch of dual carriageway.

(i) Suggest a possible benefit of these trees to

(A) wildlife **1**

(B) residents along the route. **1**

(ii) Before selecting the best species to plant, an observation pit was dug to identify the soil type in this area.



Name the soil type from the profile shown above. **1**

2. Loch Flemington is situated beside the proposed new section of dual carriageway as shown in Source A. It is a shallow loch that has a significant eutrophication problem. Scottish Natural Heritage (SNH) has rated the loch's condition as 'unfavourable'. This is now affecting the loch's conservation status as part of a local SSSI, which cites rare aquatic plants, water birds and amphibians being present in the loch area.

The environmental consultants have conducted a series of tests to assess water quality. They used the following sampling protocol.

- Use of a random number generator to select coordinates for five sample sites on the loch
- A 100 m line transect at each of the five sample sites
- Twenty sampling points per transect, set at equal intervals
- A fixed time period of two hours per transect

(a) (i) Explain why the sampling protocol used represents good experimental practice. **1**

(ii) Identify the random sampling approach that involves sampling at equal intervals along a transect. **1**

Circle your choice.

simple *systematic* *stratified*

[Turn over

2. (continued)

(b) Water analysis has shown that the loch has a high phosphate content. This is probably due to phosphate-rich sewage effluent and animal waste runoff entering the loch from the surrounding area over many years, resulting in eutrophication.

(i) Explain the impact of eutrophication on biological oxygen demand (BOD). **2**

(ii) Suggest a strategy that could be used to reduce eutrophication in the loch.

Justify your response. **2**

[Turn over for next question

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2. (continued)

(c) The Trophic Ranking Score (TRS) system is a biotic index based on the presence and abundance of aquatic vegetation in standing water. It uses a simple scoring system to describe the trophic status of the waterbody.

Species are assigned a score between 1·0 and 10·0 according to their tolerance of nutrient enrichment; the higher the score, the more tolerant a plant species is of eutrophic conditions. A mean score for the site provides a good indication of the nutrient status of the water. Changes in TRS over time reflect a change in nutrient enrichment status.

The table below shows some of the plant species that were monitored at Loch Flemington between 1988 and 2011.

Species	Trophic ranking score	Year present				
		1988	2004	2009	2010	2011
Apium inundatum	7·0				✓	✓
Chara virgata	7·3				✓	
Elodea canadensis	8·5	✓	✓	✓	✓	✓
Lemna minor	9·0			✓	✓	✓
Littorella uniflora	6·7	✓	✓	✓	✓	✓
Myriophyllum alterniflorum	5·5			✓	✓	✓
Myriophyllum spicatum	10·0		✓	✓	✓	
Persicaria amphibian	9·0	✓	✓	✓	✓	✓
Potamogeton gramineus	7·3		✓	✓	✓	✓
Potamogeton natans	6·7		✓	✓	✓	✓
Potamogeton obtusifolius	7·3	✓	✓	✓	✓	✓
Potamogeton perfoliatus	7·3			✓		✓
Ranunculus aquatilis	8·5	✓				
Total number of species		5	7	10	11	
Total TRS		40·0	55·5	77·3	84·3	
Mean TRS		8·0	7·93	7·73	7·66	

2. (c) (continued)

(i) Name the species that is least tolerant of eutrophic conditions. **1**

(ii) Calculate the mean TRS score for 2011. **2**

Space for working

[Turn over for next question

3. A decision must be made whether to grant permission to construct the stretch of dual carriageway in this location.

Using the evidence from the sources and your knowledge of Environmental Science, decide whether or not permission should be granted.

Justify your answer. **5**

Permission should be granted ☐

OR

Permission should not be granted ☐

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3. (continued)

SPACE FOR ANSWER

[END OF QUESTION PAPER]

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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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MARKS | DO NOT WRITE IN THIS MARGIN

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Qualifications
2019

X826/76/11 Environmental Science
Paper 1 — Supplementary source booklet

WEDNESDAY, 29 MAY
9:00 AM – 9:45 AM

Supplementary sources of information

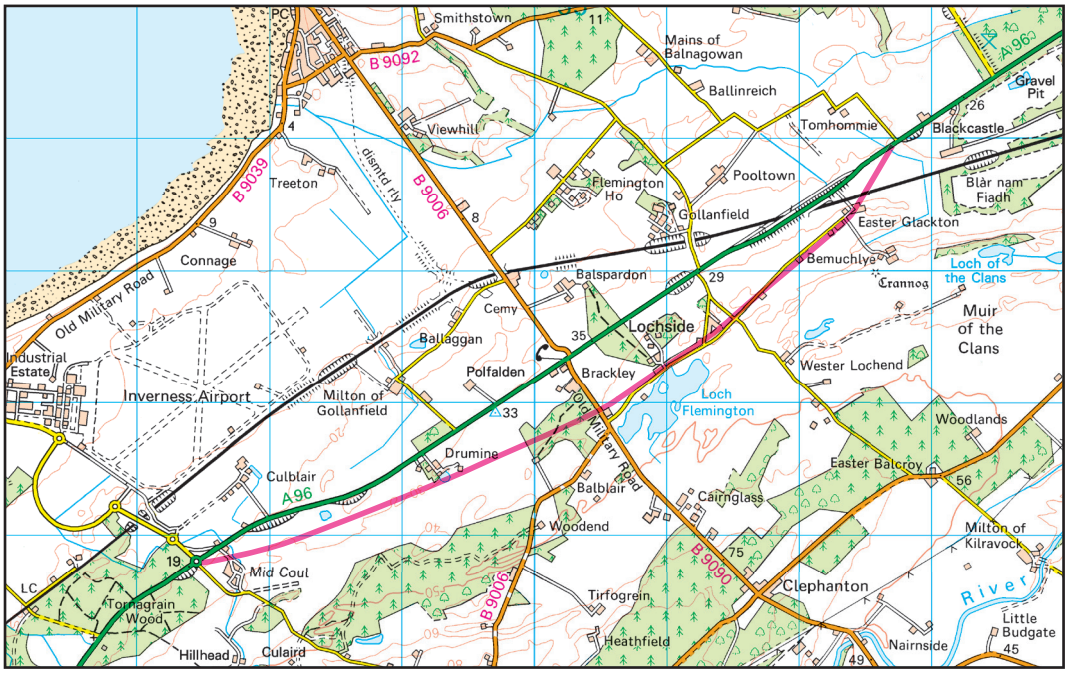
Source A is a map extract showing the area where the proposed stretch of dual carriageway will be constructed. It also shows the proximity of Loch Flemington to the proposed new dual carriageway.

Source B is a graph showing the relationship between speed and vehicle emissions.

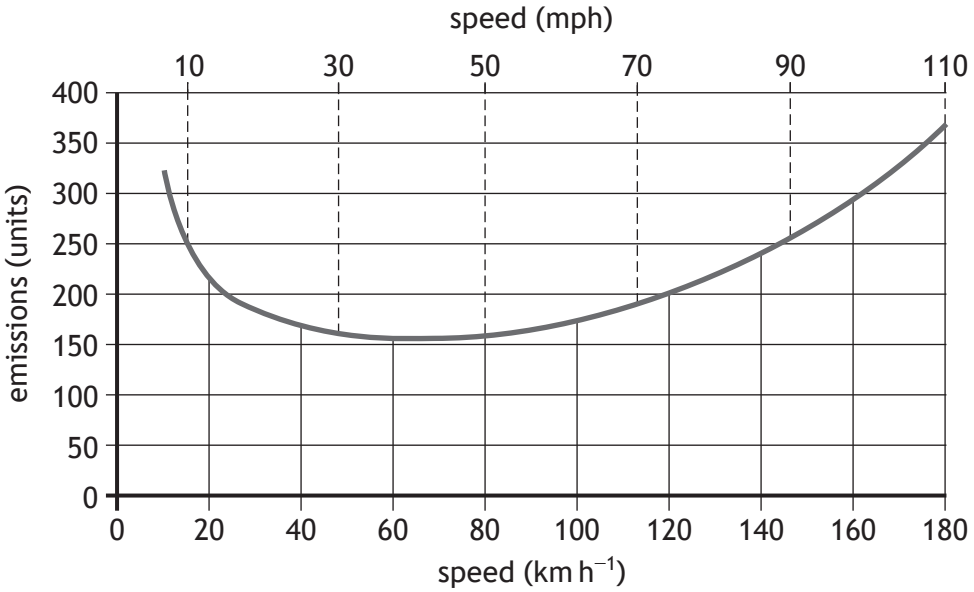
Source C is a series of statements extracted from the Environmental Statement for the A96 Dualling Inverness to Nairn (Transport Scotland, 2016).

Source D is a graph showing mean monthly precipitation and temperatures for the Inverness area.

Source A: OS map extract



Source B: graph showing the relationship between speed and vehicle emissions



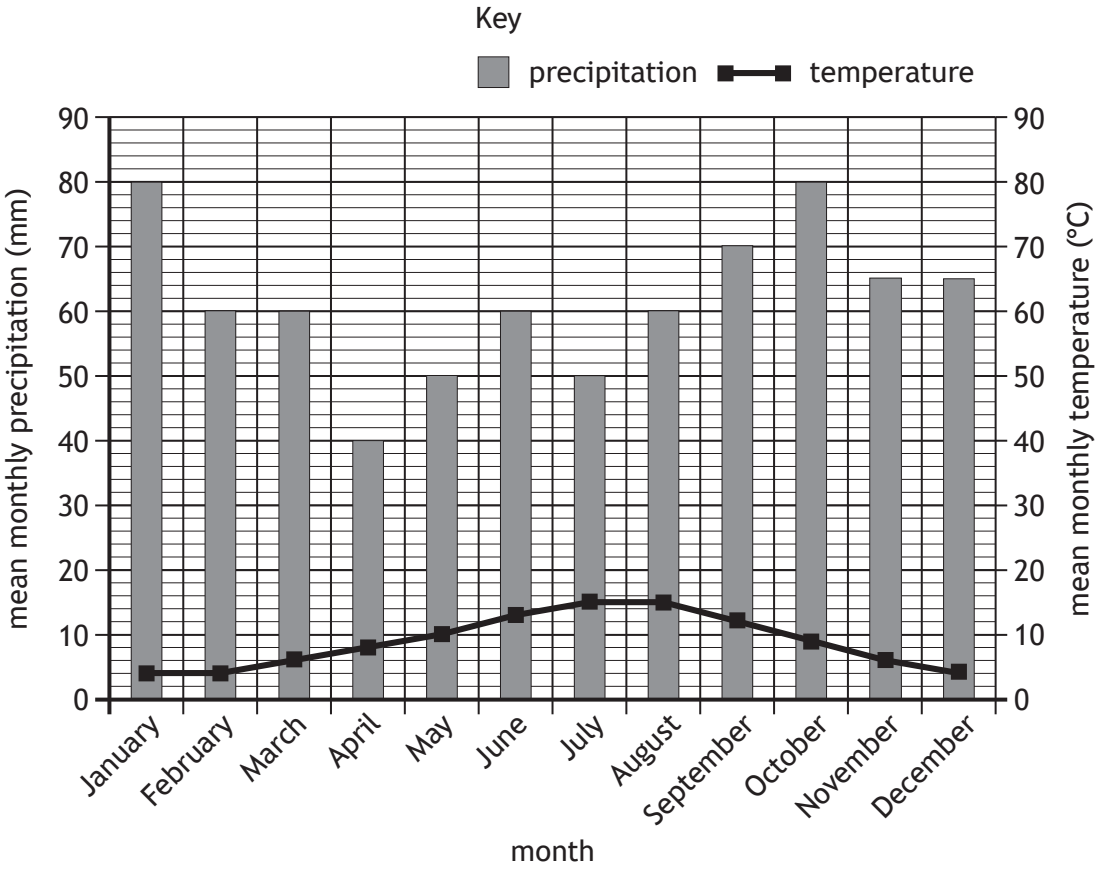
Source C: statements extracted from the *Environmental Statement for dualling of the A96* (Transport Scotland 2016)

The A96 Aberdeen—Inverness trunk road forms a strategic link in Scotland's transport network, and is vital in supporting the growth and development of the economy in the north and north east of Scotland.

During construction, the principal risks to the water environment relate to suspended sediments contained in runoff from the site, airborne dust and accidental spillage of fuel, oil or other chemicals used on site. Construction work can also create new pathways by which pollution can reach surface water or groundwater.

Once the road is in use, the principal areas of concern arise from pollutants washed from the road surface by rainwater, and spillages of fuel or other contaminants as a result of road traffic accidents. Creation of new roads can also affect flood risk due to increased areas of impermeable surfaces (which increases the rate of runoff during rainfall), loss of floodplain capacity, or the obstruction of overland flows.

Source D: graph showing mean monthly precipitation and temperatures for the Inverness area



[END OF SUPPLEMENTARY SOURCE BOOKLET]

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National Qualifications 2019

Mark

X826/76/02

Environmental Science Paper 2

WEDNESDAY, 29 MAY

10:15 AM – 12:45 PM

X8267602

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

Attempt ALL questions.

Questions 8 and 9 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. 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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X8267602 01

Total marks — 100 marks

Attempt ALL questions

Questions 8 and 9 each contain a choice.

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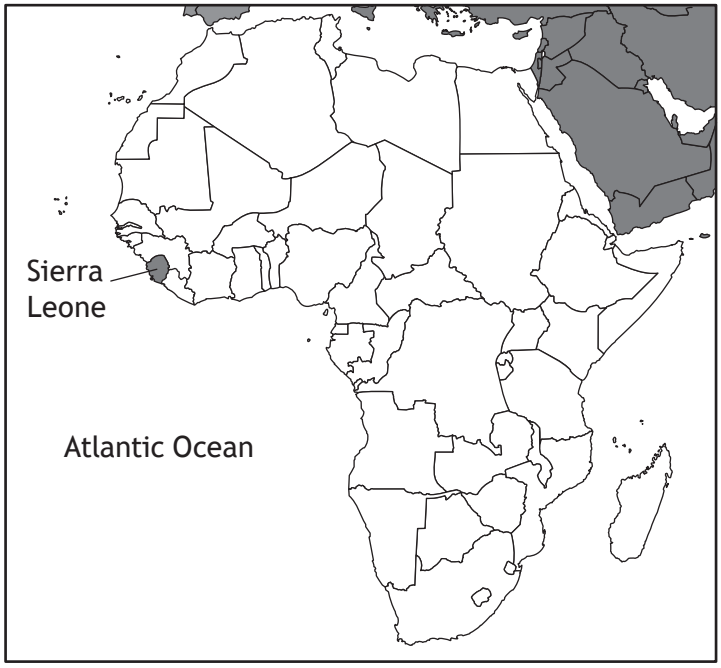
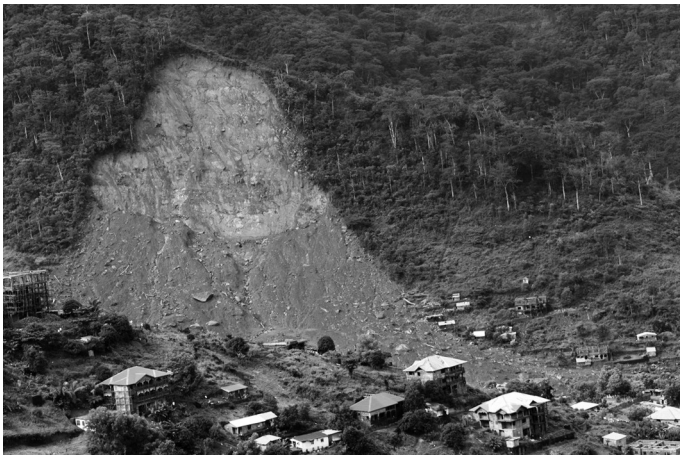
1. In August 2017, following three days of torrential rain a hillside collapsed on the outskirts of Sierra Leone's capital, Freetown. This triggered a series of mudslides that caused damage over an area of approximately 117 km^2.

Map of Africa showing the location of Sierra Leone



The image below shows the impact of one mudslide on an area of steep hillside.



1. (continued)

(a) The mudslides overwhelmed natural and man-made drainage systems, causing extensive damage and flooding.

State one social, one economic and one environmental impact that the mudslides would have had on the area.

(i) Social impact **1**

(ii) Economic impact **1**

(iii) Environmental impact **1**

(b) Torrential rainfall over a prolonged period was one factor that triggered the mudslides.

Describe the atmospheric pressure conditions that would most likely result in torrential rainfall. **1**

1. (continued)

(c) The hillsides in the area have dense cover of tropical rainforest. Unregulated deforestation on steep slopes is also believed to have been a major factor in causing the mudslides.

(i) Describe the role that vegetation plays in maintaining soil stability. **2**

(ii) Before the mudslides, the forest had reached its climax community.

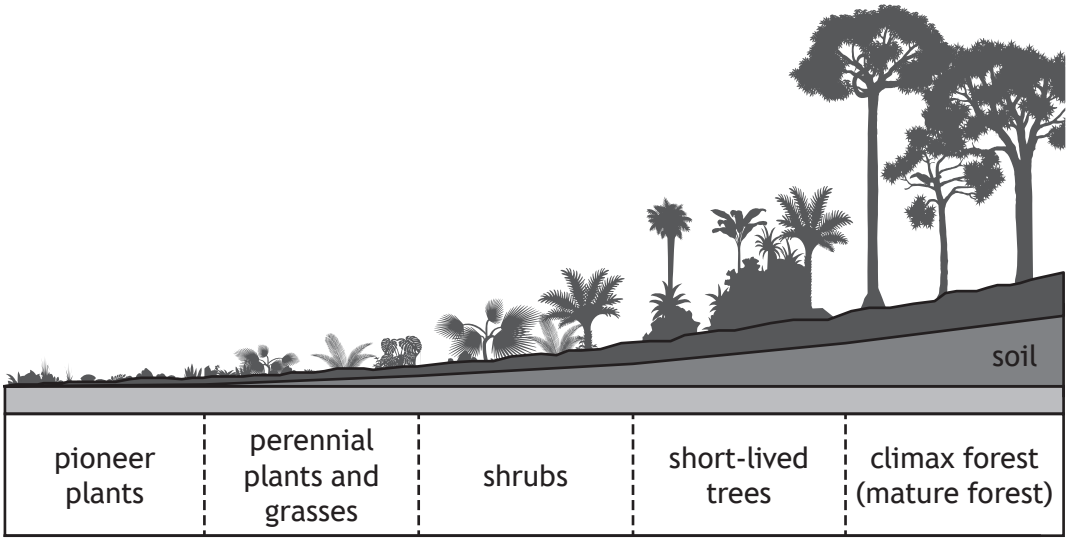
State two characteristics of a climax community. **2**

(iii) Name the type of succession that will occur as a result of the mudslides.

Justify your answer. **2**

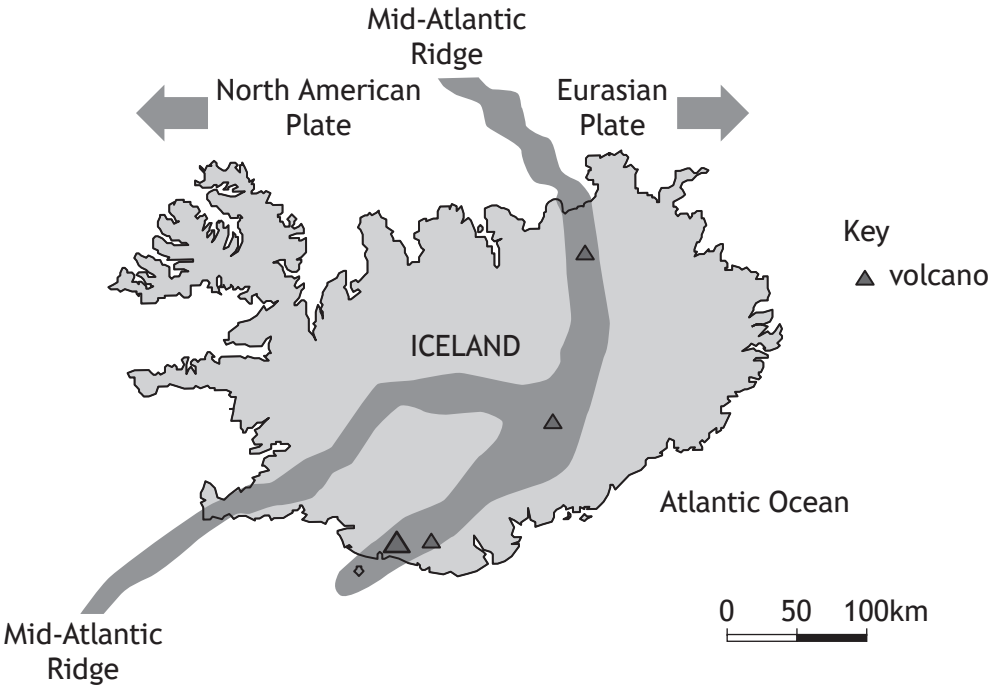
1. (c) (continued)

(iv) The diagram below highlights the sequence of vegetation changes that are predicted to occur as a result of the mudslides.



Explain the sequence of changes shown in the diagram. **3**

2. (a) The Mid-Atlantic Ridge extends through the centre of Iceland. It is located at the boundary of the North American and Eurasian plates.



(i) Name the type of plate boundary shown in the diagram. **1**

(ii) Explain how convection currents drive the plate boundary movement in this area. **3**

You may wish to include a diagram.

2. (continued)

(b) (i) Name a source of Earth's internal heat. **1**

(ii) State the type of renewable energy generated from the Earth's internal heat. **1**

(iii) Iceland sources 85% of its energy from renewables.

Explain why Iceland's location on an active plate boundary offers a large potential for renewable energy generation. **2**

[Turn over

MARKS

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(iv) A new area has been identified as a potential site for renewable power in Iceland.

To determine its viability, a calculation must be performed to establish the temperature change per kilometre of depth.

Temperature change per kilometre of depth $= \dfrac{T_2 - T_1}{D_2 - D_1}$

Where

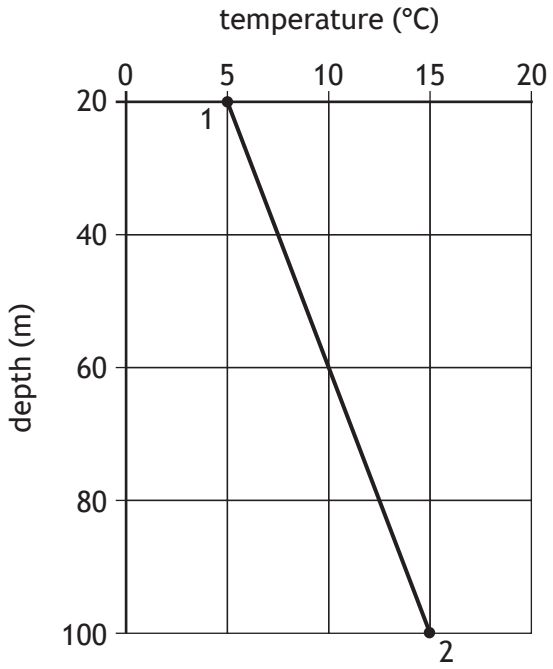
T_1 = initial temperature

T_2 = final temperature

D_1 = initial depth

D_2 = final depth.

The graph shows the change in temperature between a depth of 20 metres and 100 metres, for this area.



Using the information provided, calculate the temperature change **per kilometre of depth** for this area. **2**

Space for working

°C km^{-1}

[Turn over for next question

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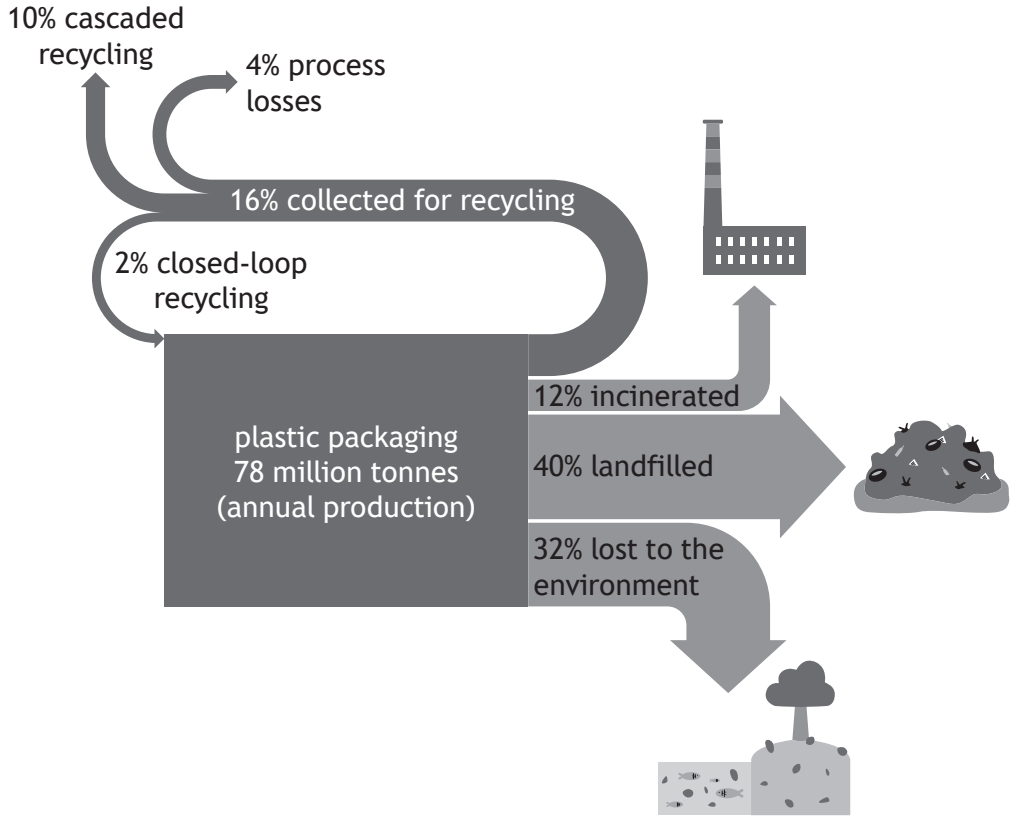
MARKS DO NOT WRITE IN THIS MARGIN

3. The flow diagram shows the fate of plastic packaging produced each year.



(a) (i) The production of plastic packaging is considered to be a linear economy.

Define *linear economy*. **1**

(ii) Calculate the mass of plastic packaging that is **not** collected for recycling. **2**

Space for working

3. (a) (continued)

(iii) Plastics are often used in place of other packaging materials, such as cardboard.

Suggest one short term environmental benefit of using plastic packaging. **1**

(iv) The diagram shows the fate of the plastic packaging produced.

Express, as a single whole number ratio, the percentage of plastic packaging that is incinerated to landfilled to lost to the environment. **1**

Space for working

incinerated : landfilled : lost to the environment

(b) In the UK there is increasing pressure to reduce plastic waste.

(i) State two reasons why global plastic waste production continues to increase. **2**

3. (b) (continued)

(ii) Waste management strategies are in place to manage waste from its production to its final disposal.

Select one of the following waste management strategies.

A Recycling

B Incineration

Outline the advantages and disadvantages of your chosen strategy. **3**

Waste management strategy

3. (continued)

(c) Persistent bioaccumulating toxins (PBTs) collect on the surface of plastics that have been lost into the marine environment.

PBTs can bioaccumulate in seabirds such as the black tern (*Chlidonius niger*), which consume plastics mistaking them for small fish.

(i) Define *bioaccumulation*. **1**

(ii) The sea eagle (*Haliaeetus sp*.) is a predator of the black tern.

Explain why increasing levels of plastics in the marine environment could result in the death of predators such as the sea eagle. **2**

(iii) The sea eagle was reintroduced to Scotland in 1975.

Name one other species which has been reintroduced to Scotland. **1**

[Turn over

4. The image shows a nuclear power station on the east coast of Scotland.

(a) (i) Name a radioactive source that could be used to generate nuclear energy. **1**

(ii) Describe a property of the radioactive source that makes it suitable for nuclear energy production. **1**

(b) Fission is a process that releases energy from nuclear material.

Describe how electrical power can be generated from this process. **4**

4. (continued)

(c) The half-life of a substance is the time it takes for half the radioactive particles to decay.

The half-life of a particular radioactive substance is 4 hours.

Calculate the percentage of the substance remaining after 12 hours. **2**

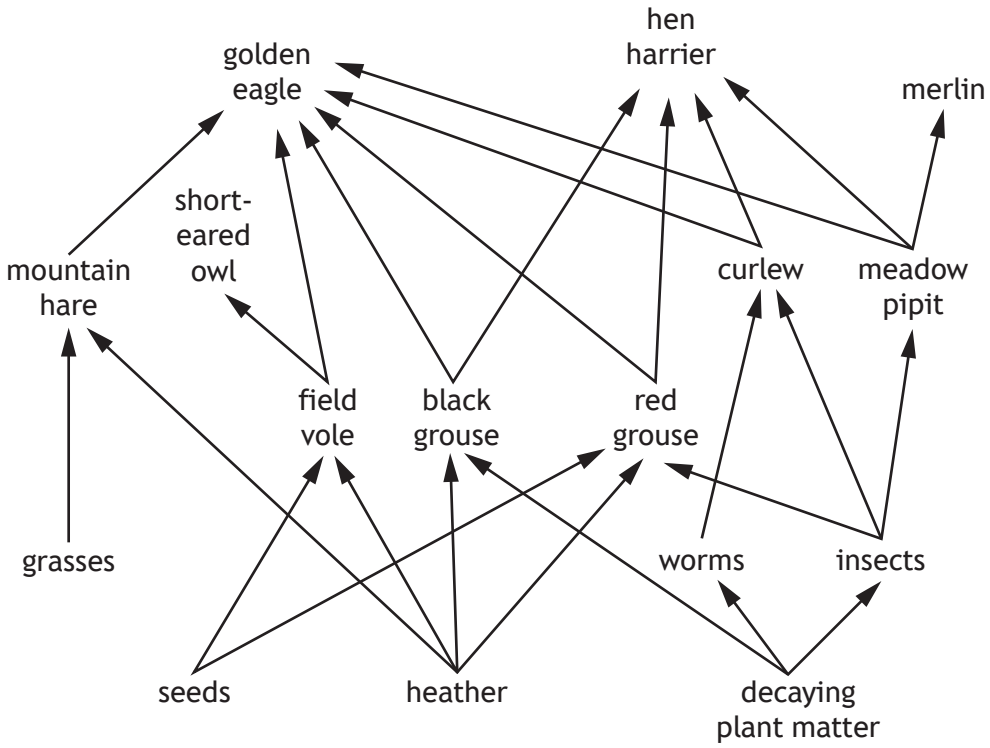
Space for working

(d) SEPA is the environmental agency with responsibility for regulating the storage and use of radioactive substances in Scotland.

State two **main** roles of SEPA. **2**

[Turn over

5. The food web shows some of the interactions on a typical upland moorland in Scotland.



(a) Using information from the food web, answer the following questions.

(i) Black grouse and red grouse occupy a similar niche.

State why both species can survive within the same habitat. **1**

(ii) Red grouse are managed on moorland for recreational shooting.

Describe two long term effects of increased red grouse numbers on the moorland ecosystem. **2**

5. (continued)

(b) On average, only 10% of the energy that enters a trophic level is passed on to the next trophic level.

(i) State the term used to describe the percentage of biomass produced by one trophic level that is transferred and incorporated into biomass at the next trophic level. **1**

(ii) Explain why food chains containing mainly ectotherms tend to be longer than those containing mainly endotherms. **2**

(c) Heather is burned periodically in a practice known as muirburn. This maintains favourable conditions for red grouse.

(i) State the term used to describe the interruption of natural succession by human activity. **1**

(ii) Suggest one positive and one negative impact of muirburn.

(A) Positive **1**

(B) Negative **1**

6. Processed biofuels are used extensively throughout the world as an alternative to traditional fossil fuels.

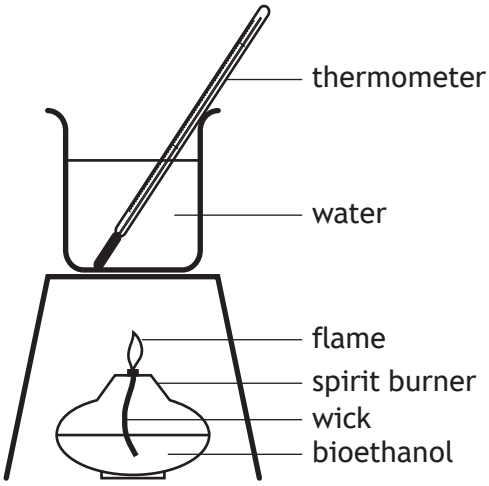
(a) Define the term *biofuel*. **1**

(b) Explain why biofuels can be described as a renewable energy source. **2**

(c) State one disadvantage of the production of biofuels. **1**

6. (continued)

(d) The energy stored in bioethanol can be measured by heating a beaker containing water for 30 seconds, using the apparatus below.



(i) Name a processed biofuel, other than bioethanol, that could be tested in this experiment. **1**

(ii) Identify an improvement that could be made to the experimental set up that will increase the validity of the results.

Justify your answer. **2**

[Turn over

6. (continued)

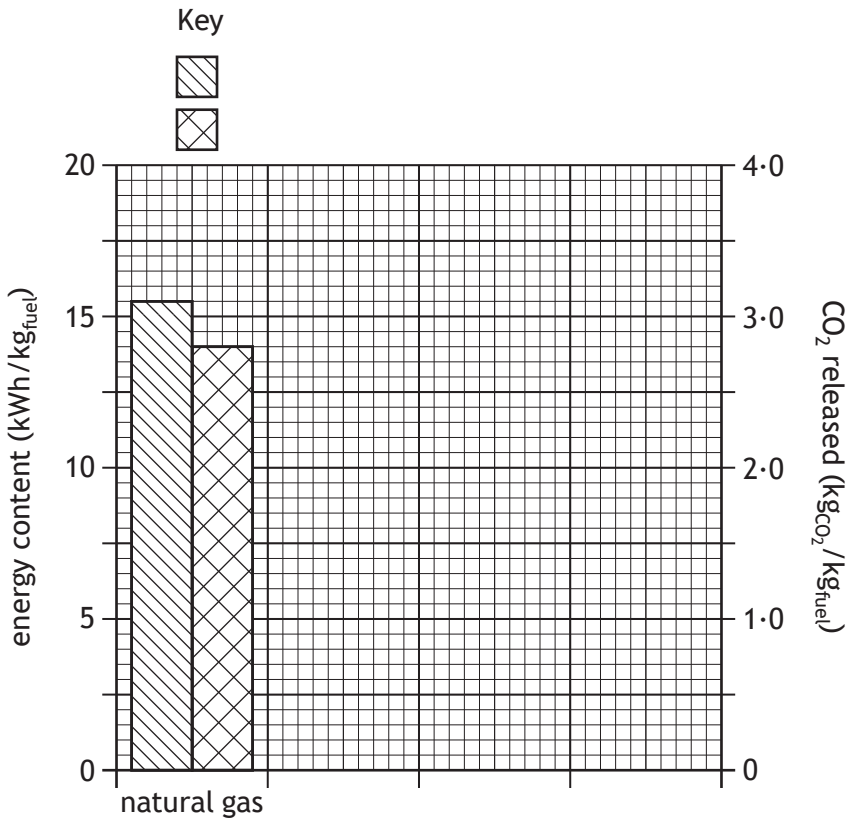
(e) The table below shows the energy content of various fuels and the mass of carbon dioxide released when they are burned.

Fuel	Energy content (kWh/kg_{fuel})	Mass of CO_2 released (kg_{CO_2}/kg_{fuel})
Natural gas	15·5	2·8
Petrol	13·0	3·3
Diesel	13·0	3·2
Bioethanol	8·5	1·9

Using information from the table, complete the bar graph to show the energy content and CO_2 released by 1 kg of each fuel when burned, by

- plotting the data for the energy content and mass of CO_2 released by each fuel
- completing the labelling on the x-axis
- completing the key. **3**

(Additional graph, if required, can be found on *page 30*.)



6. (continued)

(f) A driver is planning to purchase a new car. They are concerned with fuel consumption and climate change.

They are considering either a petrol-driven or a bioethanol-driven vehicle.

Using data from the table, suggest which type of vehicle they should purchase.

Justify your answer. **3**

7. Water conservation is an important aspect of sustainable water management. In the summer of 2018, high temperatures and low rainfall caused water insecurity throughout the Mediterranean region.

(a) State a factor, other than high temperatures and low rainfall that could lead to water insecurity. **1**

(b) Agriculture in the Mediterranean region accounts for almost 75% of total water used for agriculture in Europe.

(i) Drip irrigation is a method used to conserve water.

Explain why drip irrigation minimises water usage. **2**

7. (b) (continued)

(ii) Name an agricultural practice, other than drip irrigation, which aims to save water. **1**

(c) The industrial sector also demands large quantities of water.

In order to conserve water, greywater and blackwater can be reused.

Describe the difference between greywater and blackwater. **1**

(d) The populations of small Mediterranean islands increase dramatically due to tourism pressure. The service sector, including tourism businesses, accounts for 11% of total annual water use.

To conserve water for these islands, governments have introduced policies.

(i) State what is meant by a *policy*. **1**

(ii) Suggest a government-level strategy that could be used to conserve water on these islands. **1**

[Turn over

7. (continued)

(e) The extreme weather events experienced in the Mediterranean region in 2018 are predicted to become more frequent as a consequence of anthropogenic climate change.

Explain the impact of anthropogenic climate change on

(i) species distribution **2**

(ii) soil stability. **2**

Questions 8 and 9 each contain a choice

For each question, attempt either A or B. Write your answers to questions 8 and 9 on the following pages. You may use diagrams where appropriate.

8. A Population growth for any given species depends on the initial population size, plus its birth and death rate.

Changes in population growth in response to changes in limiting factors can be modelled.

Discuss population growth under the following headings.

(a) Exponential population growth

(b) Logistic population growth **10**

OR

B Human activities can impact positively or negatively on species and on biodiversity.

Discuss the impact of the following human activities on biodiversity.

(a) Habitat fragmentation

(b) Rewilding **10**

9. A Geological records spanning millions of years indicate a number of significant variations in Earth's climate, evidenced by ice ages and warmer interglacial periods.

Discuss the impact of long-term orbital changes on Earth's climate. **10**

OR

B The global ocean conveyor belt is a constantly moving system of deep oceanic circulation.

Discuss three factors that affect oceanic circulation. **10**

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SPACE FOR ANSWERS

SPACE FOR ANSWERS (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

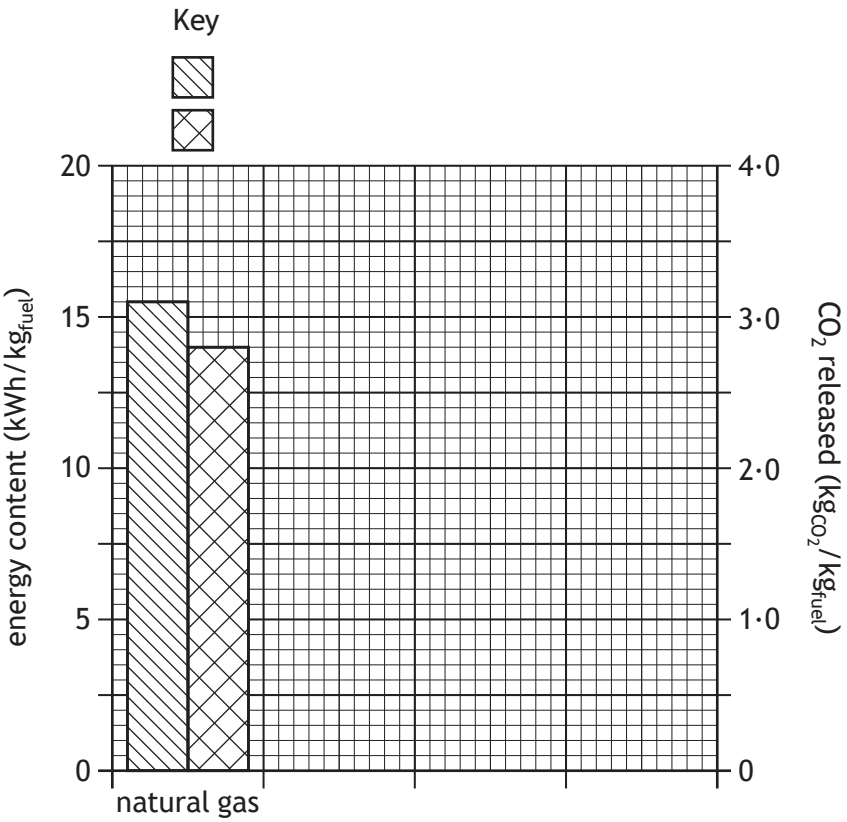
SPACE FOR ANSWERS (continued)

[END OF QUESTION PAPER]

X8267602 29

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

ADDITIONAL GRAPH FOR QUESTION 6 (e)



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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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Question 1 Pavlo S/shutterstock.com

Question 1 Photograph of a mudslide by Phileas Jusu. © Phileas Jusu, UM News.

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Question 7 Peter Hermes Furian/shutterstock.com