AQA

A-level
ENVIRONMENTAL SCIENCE

Paper 2

Tuesday 19 May 2020   Afternoon   Time allowed: 3 hours

Materials
For this paper you may use:
• a calculator.

Instructions
• Use black ink or black ball-point pen. Pencil should only be used for drawing.
• Fill in the boxes at the top of this page.
• Answer **all** questions 1 to 10 and **one** essay from question 11.
• You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
• If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
• Do all rough work in this book. Cross through any work you do not want to be marked.

Information
• The marks for questions are shown in brackets.
• The maximum mark for this paper is 120.
• All questions should be answered in continuous prose.
• You will be assessed on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

For Examiner's Use	
Question	Mark
1	
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11	
TOTAL	

Answer **all** questions in the spaces provided.

0 1 **Table 1** shows details of some ecological sampling activities and equipment that may be used.

Complete **Table 1** by adding the appropriate ecological activity or equipment in the blank spaces.

The first row has been completed.

[5 marks]

Table 1

Ecological activity	Equipment
Estimating the turbidity of water	Secchi disk
	Surber sampler
Sampling night-flying moths	
	Sweep net
Collecting insects in overhead vegetation	
	Tüllgren funnel

5

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED**

Turn over ▶

0 2 A research group investigated the effects of the eradication of rats on the abundance of tree species on an island in the Central Pacific Ocean.

The results are shown in **Table 2**.

Table 2

Tree species	Mean number of trees per unit area	
	Before eradication of rats	**After eradication of rats**
A	100	688
B	12	250
C	6	35
D	2	4
E	4	26
F	6	150

Simpson's Index of Biodiversity $D = \dfrac{N(N-1)}{\sum n(n-1)}$

Key

Where **D** = index of diversity
  N = total number of organisms of all species
  n = number of individuals of a species
  ∑ = sum of

0 2 . 1 Calculate the Simpson's Index of Biodiversity (D) for the trees before the eradication of rats.

Give your answer to **two** decimal places.

Show your working.

[3 marks]

| 0 | 2 | . | 2 | Suggest how **two** variables may have been standardised during the collection of the data in **Table 2** to ensure that the results were representative.

[2 marks]

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| 0 | 2 | . | 3 | The rats were eradicated from the island because they were predators of indigenous wildlife.

Outline **two** other ways that introduced species may threaten indigenous wildlife.

[2 marks]

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Where woodland is well developed, a dense tree canopy affects the abiotic factors beneath it.

| 0 | 2 | . | 4 | Explain why the reduction in light levels caused by the dense canopy may affect the biodiversity of invertebrates.

[3 marks]

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Turn over ▶

The Northern Pool Frog, *Pelophylax lessonae*, was declared extinct in the UK in 1995. A re-introduction programme imported 50 Northern Pool Frogs from Sweden to the UK, with the aim of establishing a breeding population.

The habitat at the release sites was managed to increase the carrying capacity for the frogs. The population of frogs was monitored over time.

| 0 | 3 |.| 1 | Define the term 'carrying capacity'.

[1 mark]

Figure 1 shows the design of two habitats considered as release sites for the Northern Pool Frog.

Figure 1
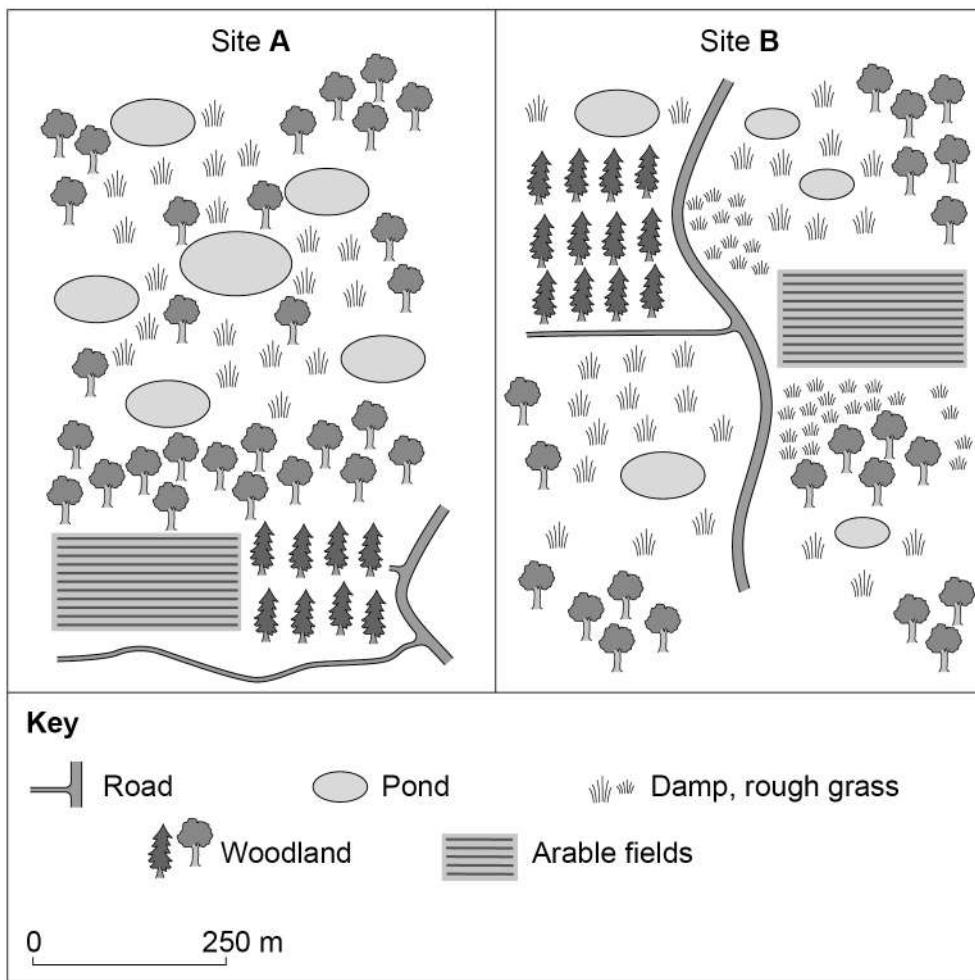
0 3 . 2 Explain why **Site A** would be the better habitat design to increase the population of the Northern Pool Frog.

[4 marks]

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The population of frogs was monitored using two methods:

- traditional methods of listening for the calls and finding individual frogs
- detecting eDNA.

0 3 . 3 Describe **two** advantages and **two** disadvantages of using eDNA instead of the traditional methods as a technique for monitoring aquatic species.

[4 marks]

Advantages _____

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Disadvantages _____

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Turn over ▶

The amount of eDNA present in 10 different ponds was investigated. The aim was to find out if the amount of eDNA correlated with the number of frogs found using traditional monitoring methods.

The results are shown in **Table 3**.

Table 3

Pond	eDNA / g x 10^{-12} dm^{-3}	Frogs counted by traditional method
1	0.0	3
2	8.0	14
3	0.0	4
4	0.2	2
5	0.2	1
6	0.9	2
7	0.0	18
8	0.0	6
9	4.0	34
10	0.0	0

| 0 | 3 |.| 4 | Describe how **three** factors may have been standardised during the collection of data in **Table 3** to ensure the results were valid.

[3 marks]

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Only **one** answer per question is allowed.

For each answer completely fill in the circle alongside the appropriate answer.

CORRECT METHOD ⬤   WRONG METHODS ⊗ ⊙ ⊜ ⬭

If you want to change your answer you must cross out your original answer as shown. ⊠

If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown. ⊗

| 0 3 . 5 | Which of the following methods may be used to assess whether there is a significant correlation between the data in **Table 3**? |

Shade **one** box only.

[1 mark]

A Chi-squared ⬭

B Spearman's rank ⬭

C Standard deviation ⬭

D Student's t-test ⬭

A statistical test on the data in **Table 3** produced a test value of 0.198. The critical value for these data was 0.648 at a p-value of 0.05.

| 0 3 . 6 | Explain how these values can be used to determine whether there is a significant correlation between the two data sets. |

[2 marks]

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Turn over for the next question

Turn over ▶

0 4 The Living Planet Index (LPI) is a measure of the state of the world's biodiversity.
It uses the population trends of thousands of vertebrate species from monitored sites around the world.

Figure 2 shows the numbers of known bird, mammal, reptile and amphibian species in different regions of the world and the numbers that were used in the calculation of the LPI.

Figure 2

Key
- • Birds
- ■ Mammals
- ▲ Reptiles and amphibians
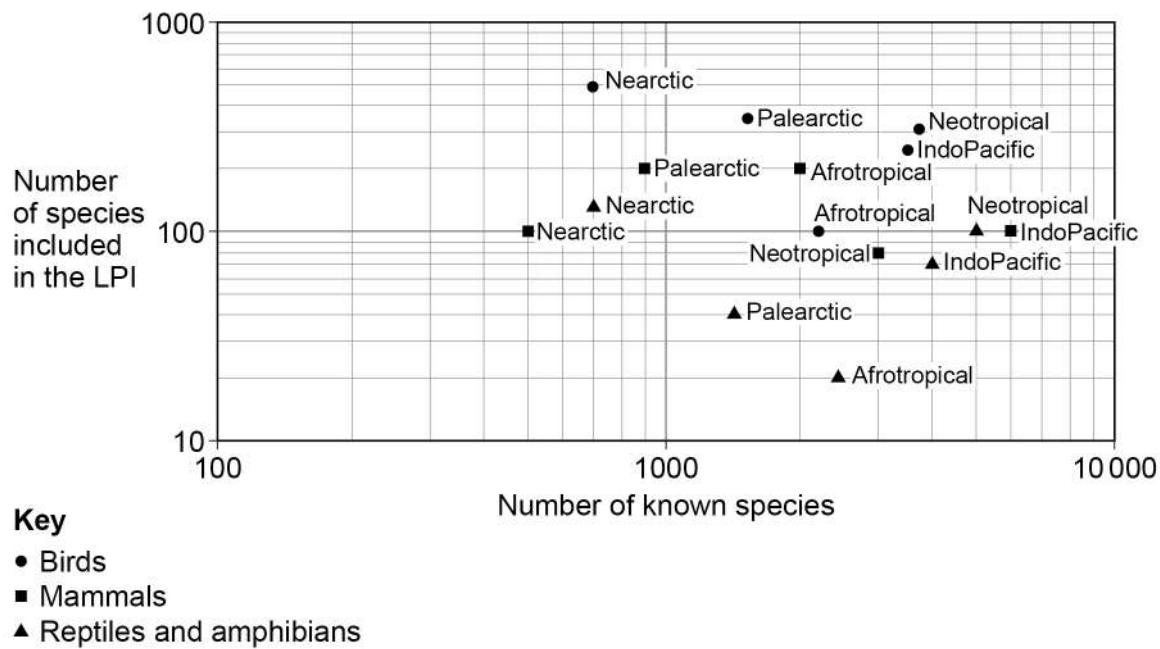
0 4 . 1 Use data in **Figure 2** to calculate the percentage (%) of known reptile and amphibian species living in the Neotropical region that have been included on the LPI.

[1 mark]

_____ %

0 4 . 2 Explain how the use of electronic monitoring technology may provide information that is useful for the conservation of wildlife.

[9 marks]

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0 5 **Table 4** includes details of the features of Earth that makes it suitable for life.

Complete **Table 4**.

[5 marks]

Table 4

Feature of Earth	How the feature makes Earth suitable for life
Distance from the sun	Suitable temperature range
	Retention of an atmosphere
Speed of rotation	
Presence of a magnetic field	
	Seasonal climatic changes
High atmospheric pressure	

Turn over for the next question

Turn over ▶

0 6 . 1 The yields of agricultural production systems may be increased by using more intensive methods.

Explain why intensive agricultural systems have higher energy inputs.

[3 marks]

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Table 5 gives some features of the production of orange crops.

Table 5

Total energy input	46 600 MJ ha^{-1}
Total orange yield	41 000 kg ha^{-1}
Edible proportion of the harvested crop mass	85%
Energy content of edible material	3.0 MJ kg^{-1}

0 6 . 2 Use the information in **Table 5** to calculate the energy ratio for production of the edible proportion of the orange harvest.

Give your answer to **two** significant figures.

Show your working.

[2 marks]

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Aphids are a common type of pest in orange farms. Scientists investigated the effectiveness of two pest control methods in killing aphids.

Test area 1: trees were sprayed with a pesticide.

Test area 2: parasitic wasps were released. The wasps laid eggs in the aphids so that the developing wasp larvae killed the aphids.

0 6 . 3 Describe a plan that may have been used to determine if there was a significant difference in the aphid populations of the two pest control areas after treatment.

[5 marks]

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Turn over for the next question

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0 7 Oil palm is one of many oil-seed crops grown for vegetable oil.
Figure 3 shows the global area of land used to grow each oil-seed crop in 2015.
Figure 4 shows how much each contributed to the global production of oil-seed crops in 2015.

Figure 3

**Global land area used for growing major oil-seed crops (millions of hectares)**

Other 51.07

Oil palm 16.46

Sunflower 24.15

Cotton seed 26.34

Rapeseed 32.90

Soybean 123.48
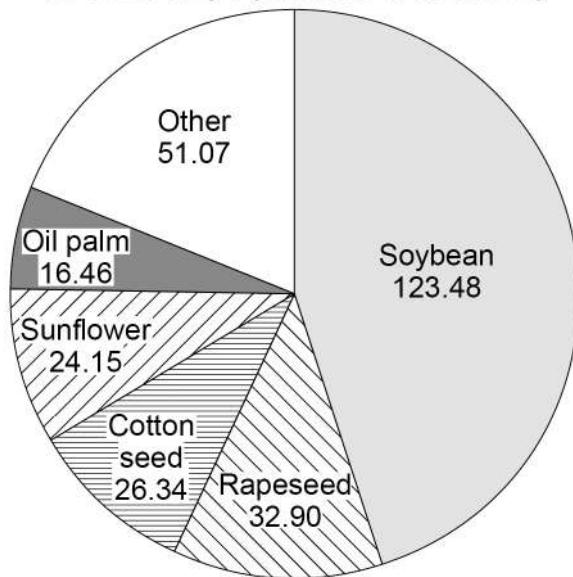
Figure 4

Global yield of major vegetable oils (millions of tonnes)

Other 9.55

Soybean oil 53.89

Palm oil 69.50

Rapeseed oil 29.27

Sunflower oil 12.99

Cotton seed oil 4.40
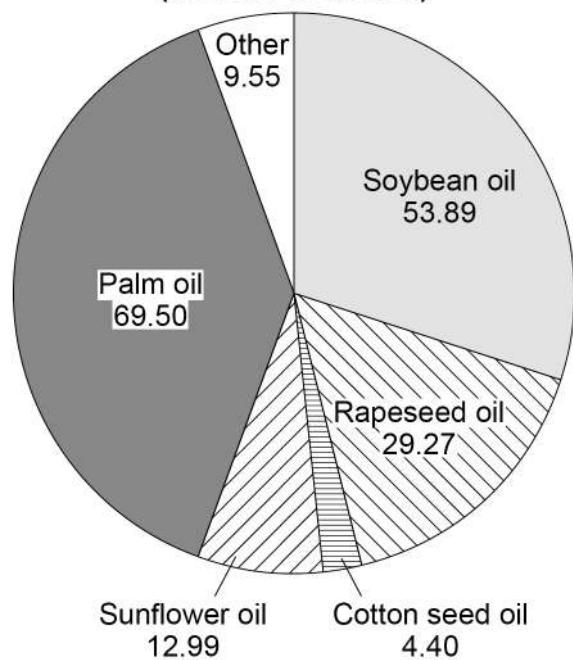
0 7 . 1 Use data in **Figure 3** and **Figure 4** to calculate the difference in productivity of oil palm and rapeseed.

Give your answer to **two** decimal places.

Show your working.

[2 marks]

_____ t ha⁻¹

Many people have stopped buying food products containing palm oil due to the impacts that its production may have on the environment. However, production of the other oil-seed crops also creates environmental impacts.

0 7 . 2 Use information in **Figure 3** and **Figure 4** to suggest why replacing oil palm with any of the other oil-seed crops may cause more environmental damage.

[2 marks]

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Question 7 continues on the next page

Turn over ▶

0 7 . 3 Explain how factors that limit productivity may be managed to increase the sustainability of crop production.

[6 marks]

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ANSWER IN THE SPACES PROVIDED

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0 8 **Table 6** shows the primary productivity of three areas of ocean.

Table 6

Ocean area	Mean primary productivity / g m^{-2} yr^{-1}
Upwelling	700
Continental shelf	300
Open ocean	100

0 8 . 1 Explain why primary productivity varies between open oceans and continental shelves.

[3 marks]

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Figure 5 shows how light levels and nutrient concentrations vary with depth in the open ocean.

Figure 5
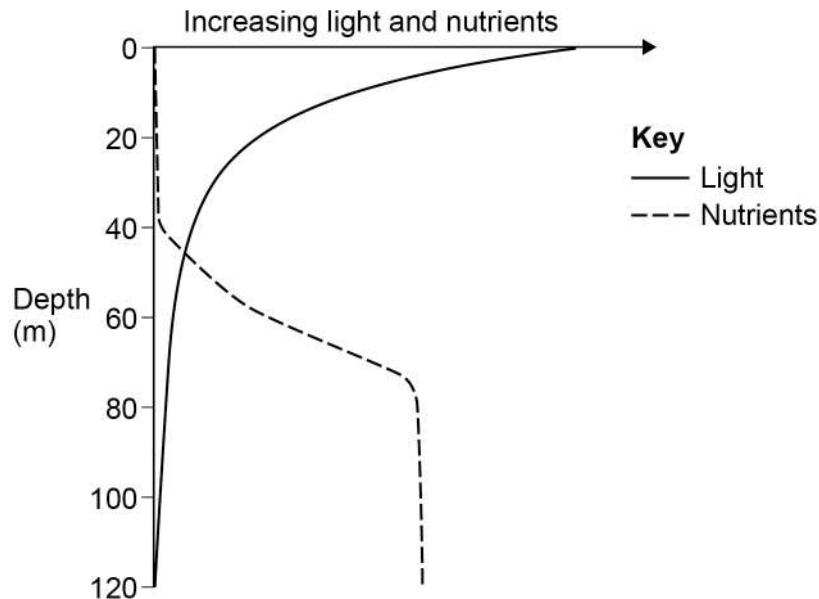
Giant Kelp, *Macrocystis pyrifera*, is a seaweed being researched as a new biofuel. The kelp is grown in the open ocean on a 'Kelp Elevator'. This is a large frame connected to motors that move it up and down in the water column to maximise the growth of kelp.

| 0 | 8 | . | 2 | Use data in **Figure 5** to explain how the timing of the vertical movements of the Kelp Elevator may be controlled to increase the growth rate of kelp.

[3 marks]

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Question 8 continues on the next page

Turn over ▶

0 8 . 3 Explain why biofuel production in the open ocean is more sustainable than growing biofuel crops on land.

[4 marks]

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ANSWER IN THE SPACES PROVIDED**

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0 9 **Figure 6** shows the change in the percentage cover of woodland in England since the year 1100.

Figure 6
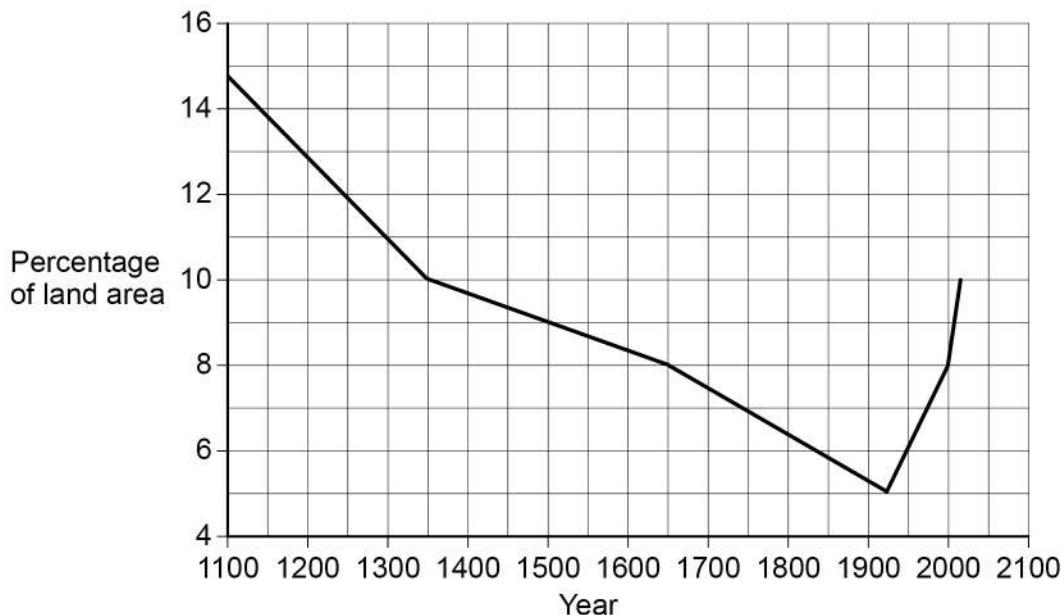
0 9 . 1 Explain how the change in woodland cover between 1100 and 1900, shown in **Figure 6**, may have caused changes to the local hydrology.

[2 marks]

One reason for the increase in woodland cover since 1920 has been the planting of non-indigenous conifer forests for commercial purposes.

0 9 . 2 State why non-indigenous conifers were favoured over indigenous broadleaved trees for timber production in the UK.

[1 mark]

Students investigated the species richness of ground invertebrates in mixed deciduous woodland and compared this to the species richness of ground invertebrates in conifer woodland. The results are shown in **Table 7**.

Table 7

Mean number of ground invertebrate species (± 2 standard deviations)	
Mixed deciduous woodland	**Conifer woodland**
11 (± 4.8)	4 (± 1.2)

0 9 . 3 Explain how the standard deviations in **Table 7** may be used to analyse the data from the two woodland habitats.

[2 marks]

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0 9 . 4 Describe how the students may have collected representative data for the number of ground invertebrate species in the different woodland habitats.

[4 marks]

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0 9 . 5 Suggest why the invertebrate species richness is lower in the conifer woodland.

[1 mark]

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Turn over ▶

1 0   **Figure 7** shows two feedback mechanisms affecting global climate.

Figure 7

Increase in atmospheric temperature	Increase in atmospheric temperature
⇩	⇩
⇩	⇩
Increased absorption of CO_2 from the atmosphere	Increased release of CO_2 to the atmosphere
⇩	⇩
Decrease in atmospheric temperature	Increase in atmospheric temperature
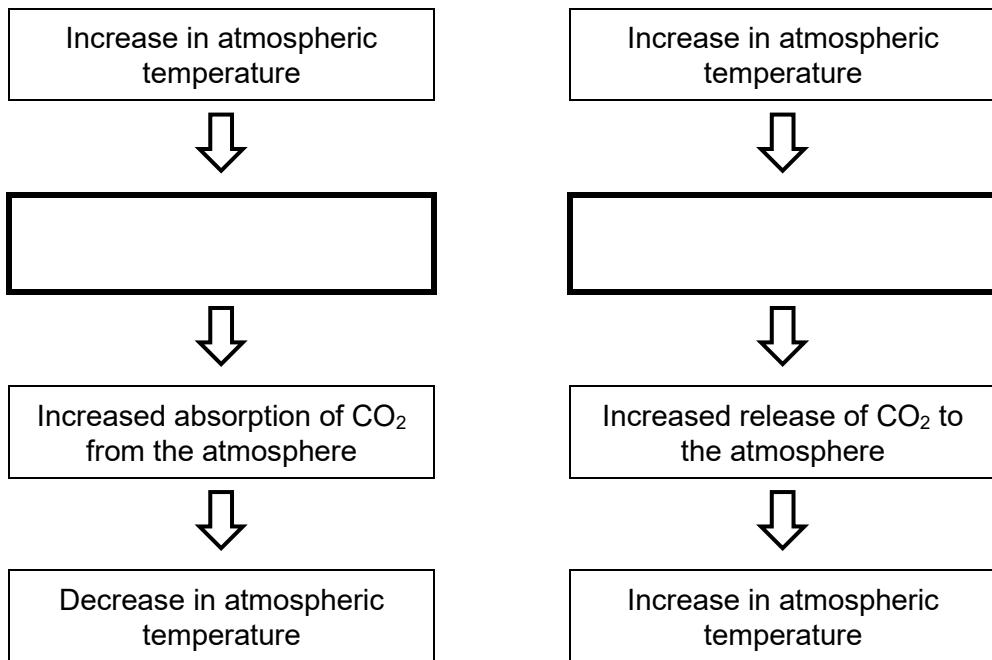
1 0 . 1   Complete the blank boxes in **Figure 7** with the changed processes that would cause the feedback mechanisms shown.

[2 marks]

1 0 . 2   Describe how a positive feedback mechanism involving a change in albedo may lead to a tipping point for Global Climate Change.

[4 marks]

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Figure 8 shows the changes in atmospheric CO_2 between the years 1850 and 2020.
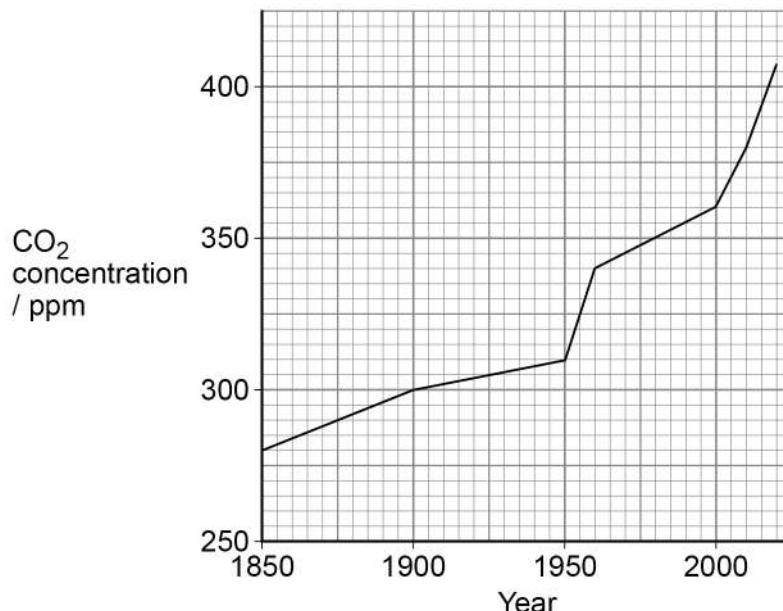
Figure 8

| 1 | 0 |.| 3 | Use **Figure 8** to calculate the difference in mean annual change in CO_2 between the period 1900–1950 and the period 1960–2010.

Show your working.

[2 marks]

_____ppm yr^{-1}

Since the 1950s, studies of ice cores have been used to produce proxy data on past climatic conditions.

| 1 | 0 |.| 4 | State **one** type of proxy data that can be obtained from ice cores to estimate past climatic conditions.

[1 mark]

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| 1 | 0 |.| 5 | Outline **one** limitation of using proxy data to estimate past climates.

[1 mark]

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Turn over ▶

Write an essay on one of the following topics.

1 1 . 1 Discuss how the environmental impacts of aquaculture may be reduced.

[25 marks]

OR

1 1 . 2 Discuss how the environmental impacts of livestock production may be reduced.

[25 marks]

Shade the lozenge below to indicate which optional question you have answered.

Question **1 1 . 1** ⬭   Question **1 1 . 2** ⬭

CORRECT METHOD ⬤   WRONG METHODS ⊗ ⊙ ⬱ ⌀

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END OF QUESTIONS

25

There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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