

Structured Questions

Transfer of Energy & Matter

Ecosystems as Open Systems / Energy Flow in Ecosystems / Obtaining Carbon Compounds in Ecosystems / Trophic Levels / Pyramids of Energy: Skills / Energy Losses / Primary & Secondary Production / The Carbon Cycle / Nutrient Cycling

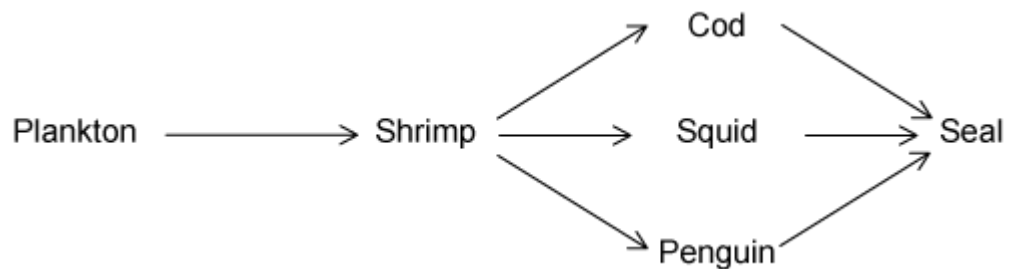
Easy (6 questions)	/41
Medium (5 questions)	/35
Hard (5 questions)	/36
Total Marks	/112

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Easy Questions

1 (a) This is a simple food web found in an ocean ecosystem.



Identify an example of an organism from the food web which obtains food using the method of nutrition named in the table.

Autotroph	
Heterotroph	

(2 marks)

(b) Identify an organism (or a group of organisms), not shown in the ocean food web, which feeds on all trophic levels of the food chain.

(1 mark)

(c) Each of the three sentences about ecosystems contains **one** error.

- In a functioning ecosystem, organisms are constantly recycled.
- Detritivores obtain inorganic nutrients from the abiotic environment and convert them to organic molecules during photosynthesis.
- Decomposition is fundamental in ensuring that ecosystems remain unsustainable over long periods of time.

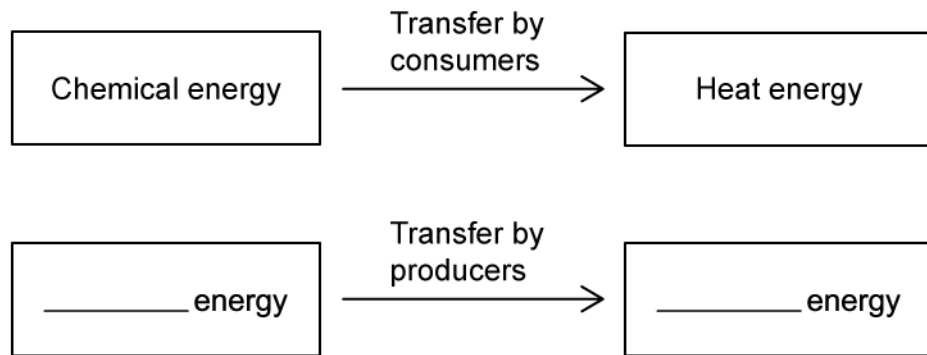
Identify and replace the incorrect word in each sentence.

(3 marks)

(d) Where does the organism in the first trophic level of this ocean food web obtain the carbon that it uses to build organic molecules?

(2 marks)

- 2 (a) When a consumer eats another organism, it converts chemical energy into other forms of energy, such as heat energy. This is represented in the energy transfer diagram below.



Complete the diagram to identify the **main** energy transfer carried out by producers in a food chain.

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(2 marks)

- (b) A blackbird ate snails containing 1150 kJ of energy. Only 10% of this energy was transferred to the blackbird.

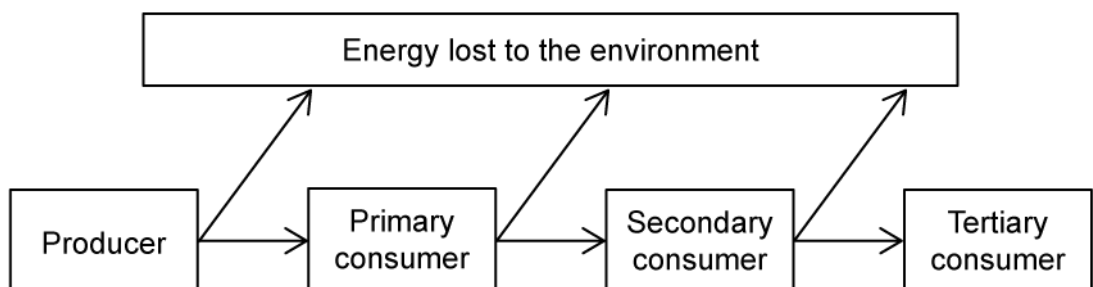
Calculate the energy transferred from the snails to the blackbird.

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(2 marks)

- (c) The diagram shows the movement of energy through a food web.



Explain why energy is transferred to the environment at each trophic level.

(2 marks)

3 (a) *One mark is available for clarity of communication throughout this question.*

Outline some of the reasons that energy is lost between each trophic level of the food chain.

(4 marks)

(b) Describe, with examples, the different modes of nutrition used by organisms.

(6 marks)

4 (a) The following table shows the atmospheric carbon dioxide levels over time.

Year	Carbon dioxide concentration / ppm
1960	316
1970	325
1980	338
1990	354
2000	369
2010	387

Calculate the percentage increase in carbon dioxide concentration between 1960 and 2010. Record your answer to one decimal place.

(2 marks)

(b) Atmospheric carbon dioxide levels have shown a dramatic increase since the industrial revolution.

State the main reason for this increase.

(1 mark)

5 (a) Carbon dioxide is an example of a greenhouse gas.

Define the term 'greenhouse gas'.

(2 marks)

(b) List **two** other examples of greenhouse gases, other than carbon dioxide.

(2 marks)

(c) The impact of greenhouse gas in the atmosphere can vary considerably.

State **two** factors that determine the significance of the impact that a greenhouse gas can have.

(2 marks)

6 (a) *One mark is available for clarity of communication throughout this question.*

Describe the role of autotrophs within the carbon cycle.

(4 marks)

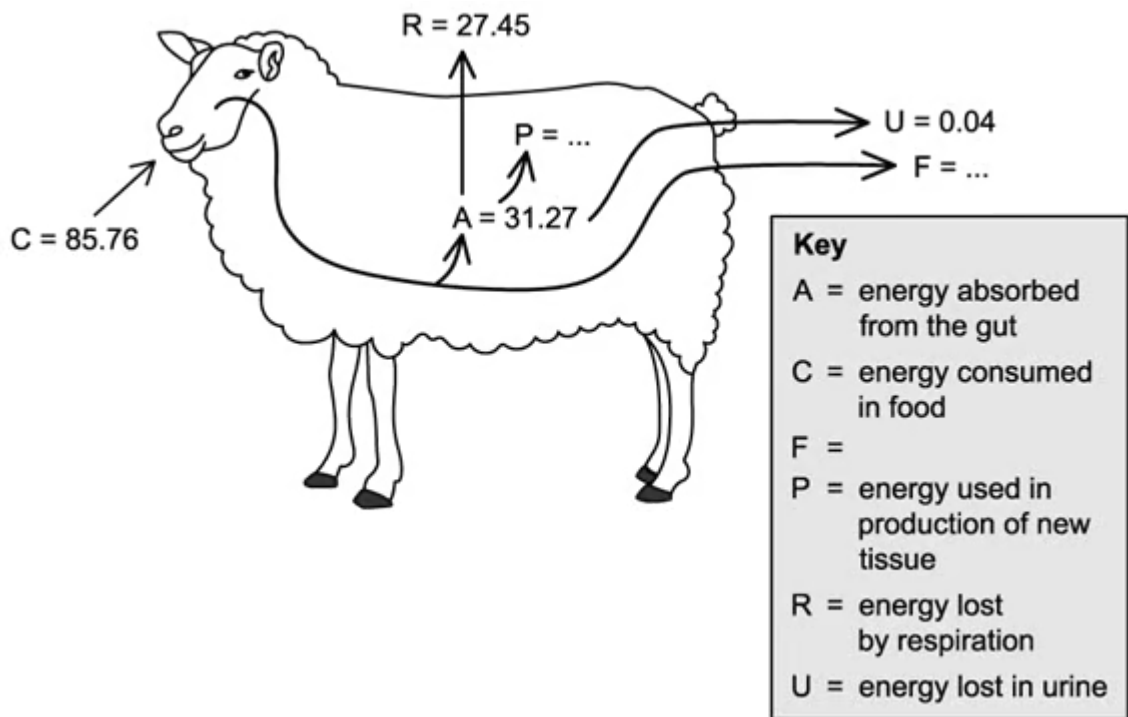
(b) There are several processes in the carbon cycle that increase the levels of carbon dioxide in the atmosphere.

List **two** of these processes and state how they increase carbon dioxide levels in the atmosphere.

(4 marks)

Medium Questions

1 (a) The diagram shows the flow of energy through a sheep. The figures are in $\text{kJ} \times 10^6 \text{ year}^{-1}$.



Suggest what label **F** represents

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(1 mark)

(b) Calculate the value of **P**. Give your answer in $\text{kJ} \times 10^6 \text{ year}^{-1}$.

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(1 mark)

(c) A sheep farmer wanted to increase the amount of energy used for the production of new tissue (**P**) in his livestock (his sheep).

Suggest **two** methods that could be used by the farmer to achieve this.

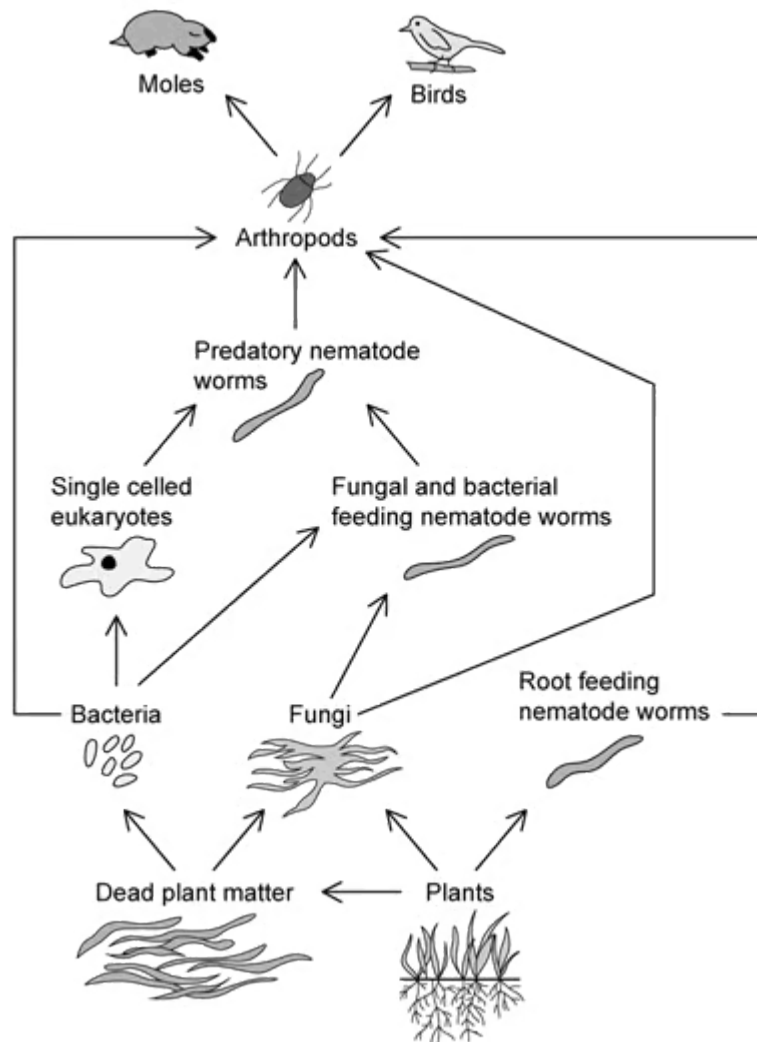
(2 marks)

- (d)** When the sheep have grown to a specific body mass they can be consumed for food by humans. Assume that the sheep consume grass, and that humans gain $0.57 \text{ kJ} \times 10^6 \text{ year}^{-1}$ from eating sheep meat.

Draw a labelled pyramid of energy to represent this food chain.

(3 marks)

2 (a) The diagram below shows a soil food web.



State the specific mode of nutrition used by the following organisms:

- (i) Plants
- (ii) Fungi
- (iii) Root feeding nematode worms

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(3 marks)

(b) Draw a food chain that includes bacteria from the food web shown above

(1 mark)

(c) The longest food chain in the food web above contains 7 organisms. Explain why it is unusual to see food chains of this length.

(2 marks)

3 (a) *One mark is available for clarity of communication throughout this question.*

Outline the processes by which energy flows through ecosystems.

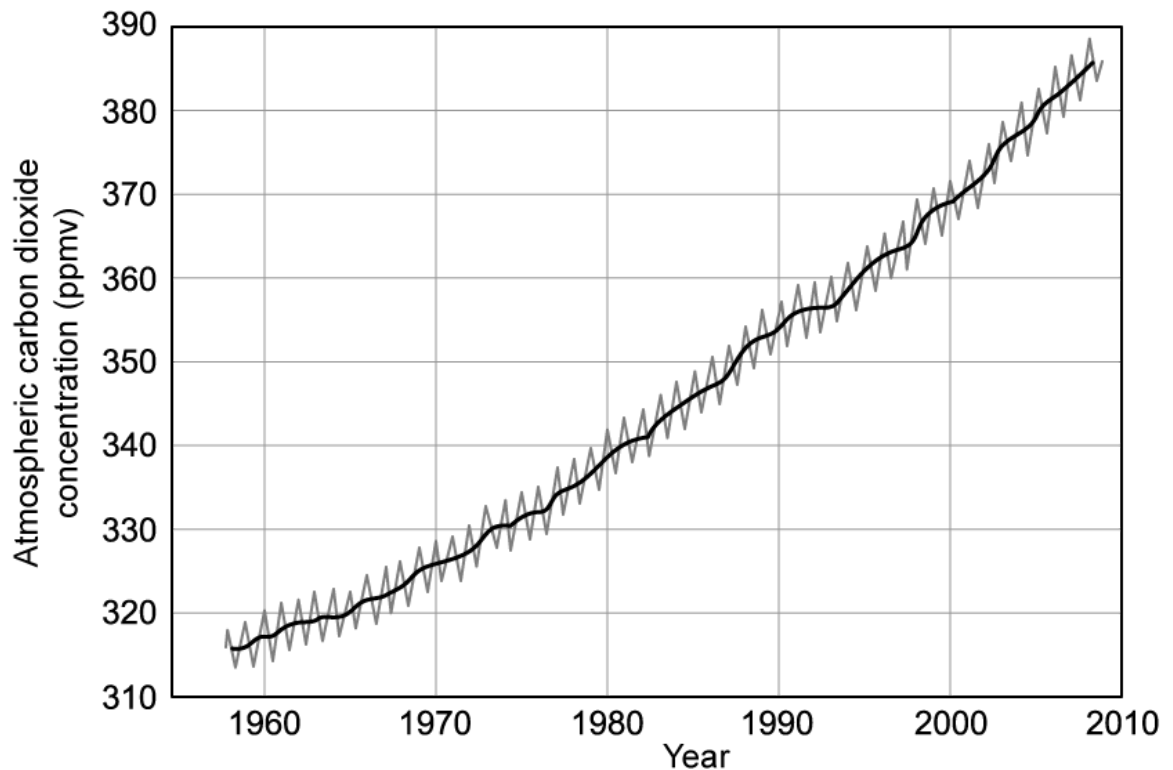
(7 marks)

(b) Some plants are parasitic, gaining their carbon compounds by tapping into the roots of other plants, for example.

Explain how this mode of plant nutrition is unusual.

(3 marks)

- 4 (a) The graph below shows changes in atmospheric carbon dioxide levels between 1960-2010, recorded at Mauna Loa observatory, Hawaii.



Key: — = Average carbon dioxide concentration per year
— = Actual carbon dioxide concentration

Estimate the increase in average atmospheric carbon dioxide concentration between 1960 and 2000.

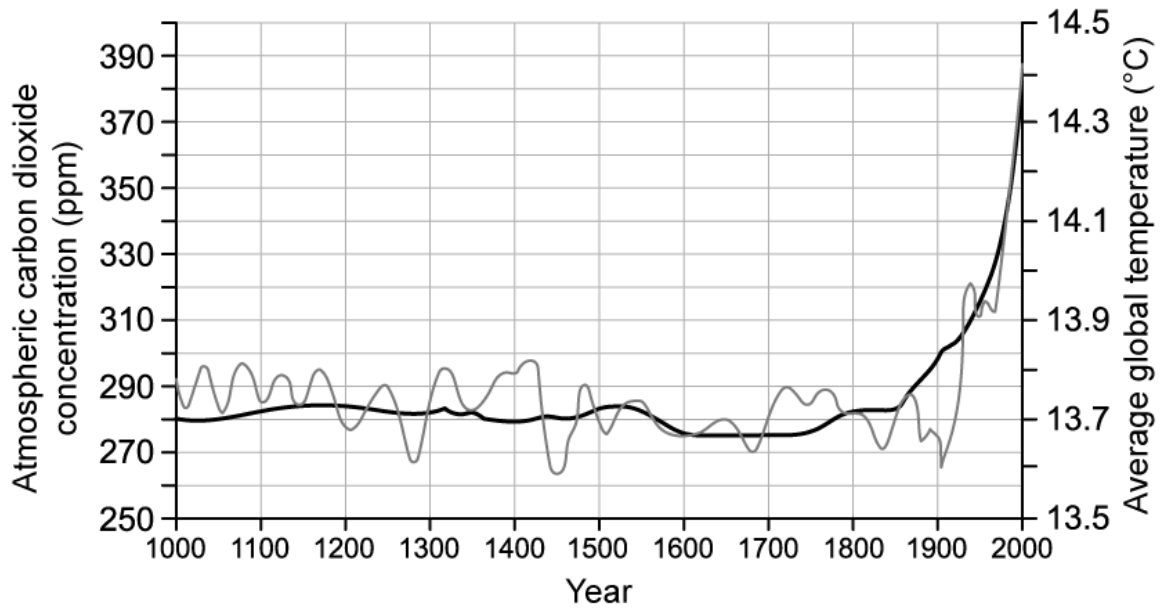
(1 mark)

- (b) Suggest why yearly fluctuations occur in actual atmospheric carbon dioxide concentration, as seen in the graph in part (a) above.

(2 marks)

- (c) In addition to collecting data on atmospheric carbon dioxide levels, scientists also collect data on average global temperatures. Both sets of data between the years 1000 and

2000 are shown together in the graph below.



Key: — = Carbon dioxide — = Temperature

Evaluate the claim that rising global temperatures are caused by rising atmospheric carbon dioxide levels.

(3 marks)

(d) State what the graph shows about the impact of human activities on atmospheric carbon dioxide levels **and** average global temperatures. Note that the Industrial Revolution began in the mid-1700s.

(1 mark)

5 One mark is available for clarity of communication throughout this question.

Draw a labelled diagram of the carbon cycle.

(5 marks)

Hard Questions

1 (a) All ecosystems are powered by autotrophic organisms.

Discuss this statement.

(4 marks)

(b) A species of alga, *Cephaleuros virescens*, has been identified as a plant pathogen living on the leaves and fruit of guava plants in Hawaii. *C. viscerens* is non-photosynthetic and has been shown to cause a disease known as leaf and fruit spots.

Identify, with a reason, the mode of nutrition that is represented by *C. viscerens*.

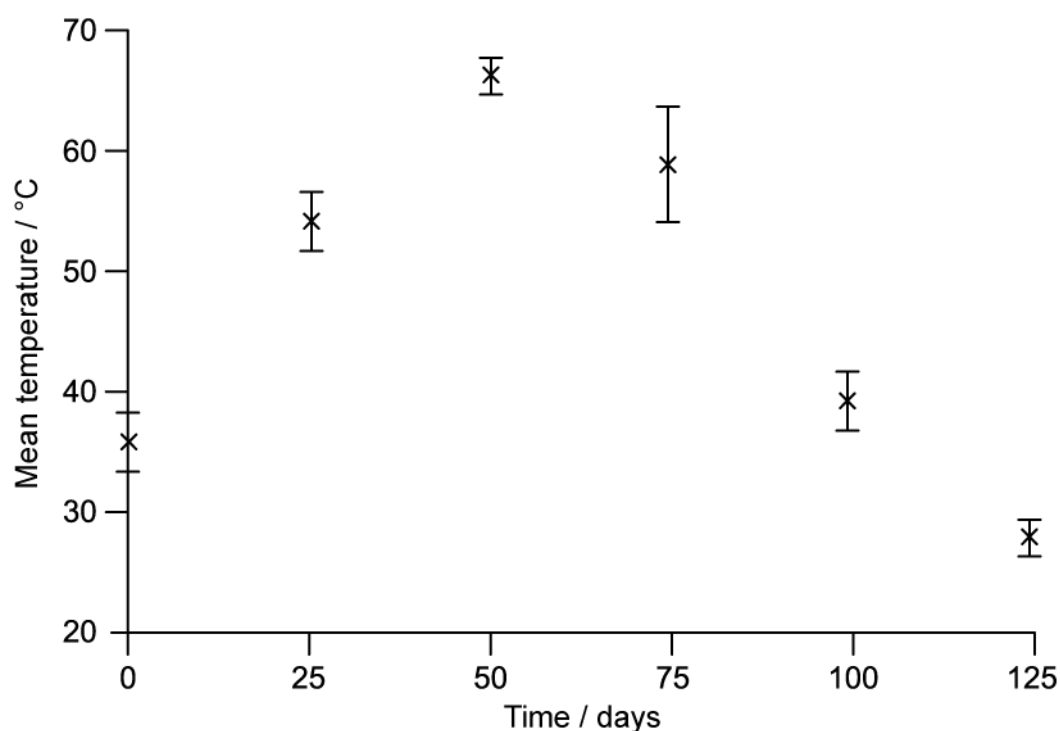
(2 marks)

2 (a) Scientists investigated the production of high nutrient compost made from organic household waste.

The method they used was as follows:

1. Place waste in a large container for 125 days
2. Rotate the container each day
3. Record the temperature of the waste every 25 days
4. Remove samples of waste and test nutrient content

The temperature changes that they recorded were as follows:



Describe and explain what these data show about the processes occurring in the composter.

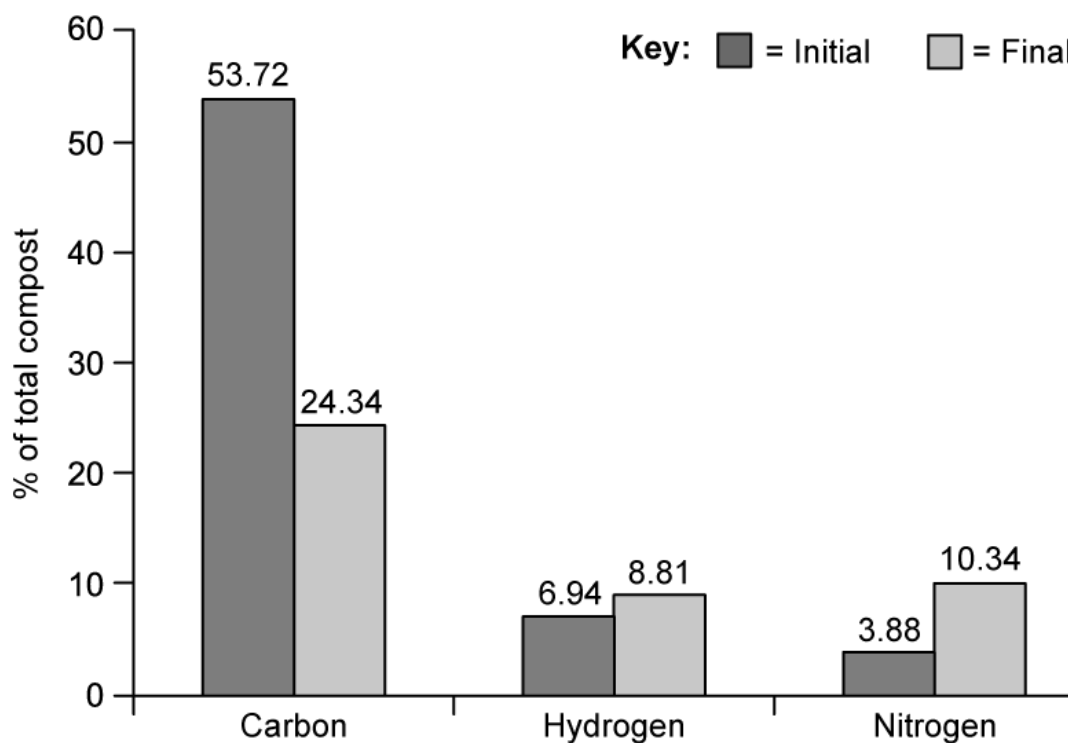
(4 marks)

(b) Explain the reason for step 2. in the method described in part a).

(2 marks)

(c) Nutrient content of the compost was measured at the start and the end of the process.

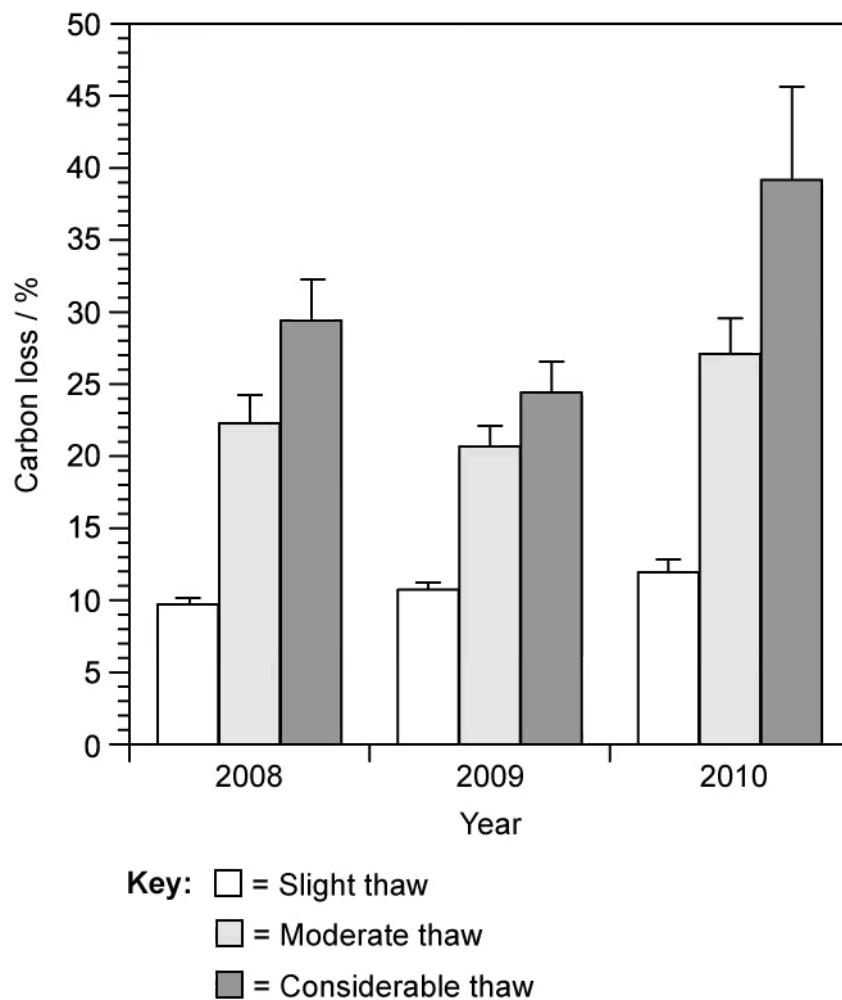
The results can be seen in the chart below.



Suggest reasons for the changes in carbon and nitrogen shown in the graph.

(3 marks)

3 (a) Tundra soils are mainly composed of peat that forms in the extreme cold conditions found within this ecosystem. Peat contains large amounts of carbon which is released when the tundra soils thaw during warmer seasons. Scientists investigated the amount of carbon released from tundra soils at one location, that were thawed to different extents over the course of three years. The results from this investigation can be seen in the graph below.



Explain why tundra soils act as a carbon store.

(2 marks)

(b) Calculate the difference in the mean carbon loss that occurred in tundra soils that were thawed considerably and those that were thawed slightly. Show your working.

(2 marks)

- (c)** Compare the rate of carbon release in moderately thawed soils with those in soils that were considerably thawed.

(2 marks)

- (d)** Scientists concluded that the carbon released from the considerable thawing of tundra soils will lead to a further increase in global temperatures.

Evaluate this statement based on the investigation that was done.

(2 marks)

4 (a) The following data show fluxes in carbon between different storage reserves in an ecosystem, measured in gigatonnes per year (GT yr⁻¹). A gigatonne equals 1 billion tonnes.

Process of carbon transfer	Flux / GT yr ⁻¹
Release from the oceans	101
Ocean dissolving	104
Release from soil	62
Incomplete decomposition	52
Respiration of terrestrial organisms	53
Photosynthesis	117
Deforestation	2.0
Combustion of fossil fuels	4.9

(i) Calculate the net flux of carbon. Show your working.

[2]

(ii) State the direction of this movement with regards to the atmosphere.

[1]

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(3 marks)

(b) Explain how the combustion of fossil fuels can affect the carbon balance in the atmosphere.

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(2 marks)

- (c) Estimating global carbon fluxes are of great interest to scientists, even though it may be challenging to make accurate measurements.

Discuss the scientific importance of estimating carbon fluxes.

(2 marks)

- 5 The amount of carbon in the atmosphere is constantly changing over time. Carbon dioxide and methane gases contribute to carbon levels in the atmosphere and have important impacts on the planet.

Discuss the importance of obtaining reliable data on the atmospheric concentration of these gases over time.

(6 marks)