

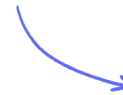
Structured Questions: Paper 2

4.1 Species, Communities, Ecosystems & Energy Flow

4.1.1 Species & Population / 4.1.2 Methods of Nutrition / 4.1.3 Community / 4.1.4 Nutrient Cycling / 4.1.5 Energy Flow / 4.1.6 Energy Losses / 4.1.7 Skills: Species, Communities, Ecosystems & Energy Flow / 4.1.8 Skills: Chi-squared test & Statistical Significance / 4.1.9 Skills: Pyramids of Energy

Easy (5 questions)	/48
Medium (5 questions)	/46
Hard (5 questions)	/54
Total Marks	/148

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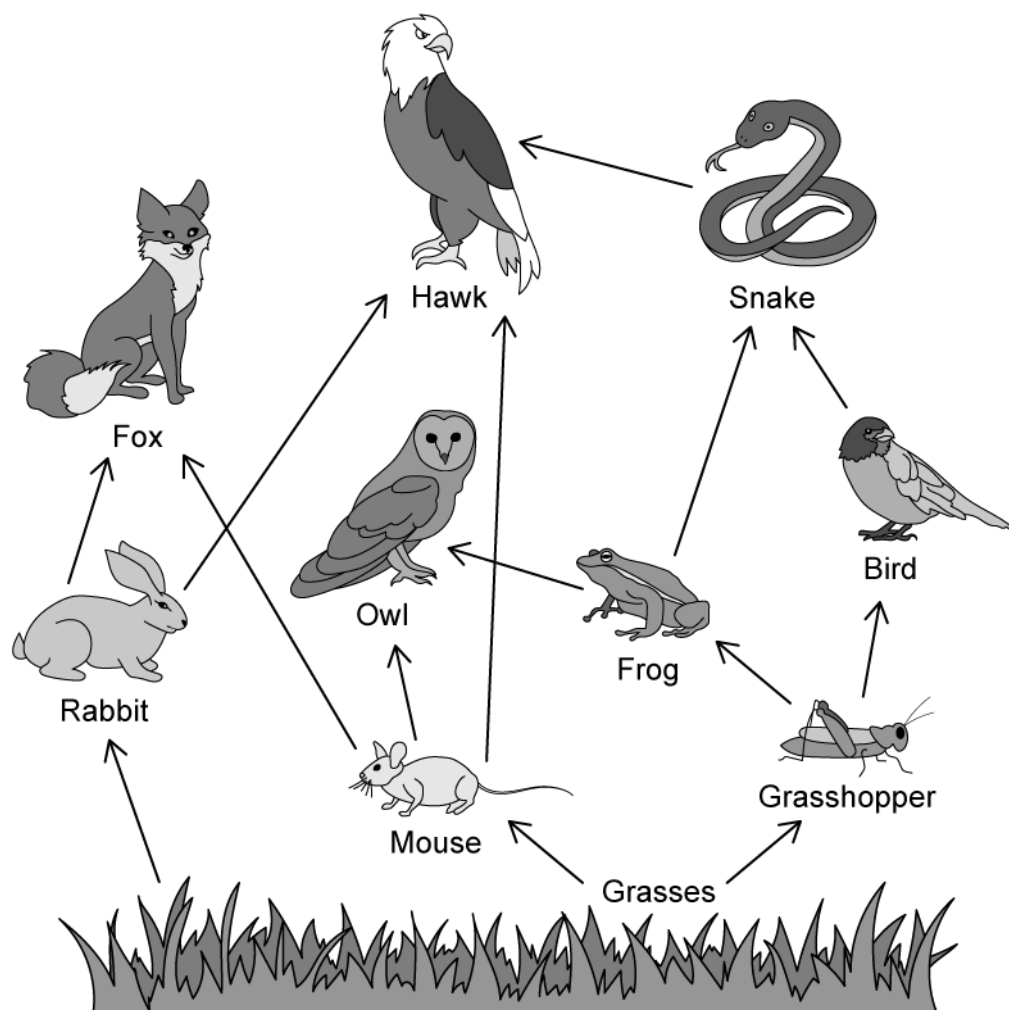


Easy Questions

1 (a) Give the definition of a species.

(1 mark)

(b) The image shows a woodland food web.



What word is used to collectively describe all the interbreeding foxes in the woodland represented by this food web?

(1 mark)

(c) Identify all the primary consumers from the forest food web.

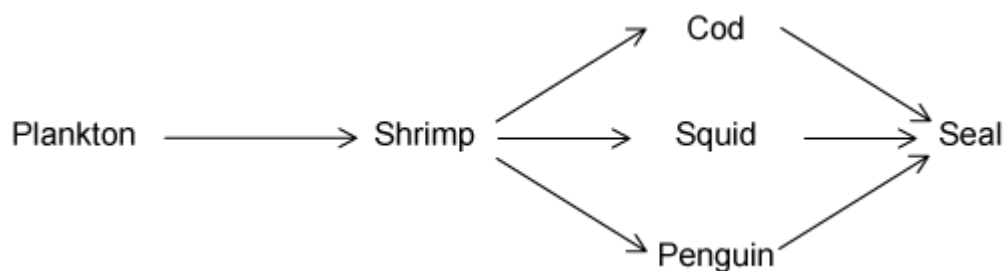
(1 mark)

(d) Consumers in this forest food web obtain organic molecules through eating organisms in the trophic level before.

Which two elements do all organic molecules contain?

(2 marks)

2 (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)

3 (a) Place a (✓) or (X) in the correct columns for each of the factors listed in the table below:

	Biotic	Abiotic
Sunlight		
Predation		
Food availability		
Mineral availability		
Temperature		

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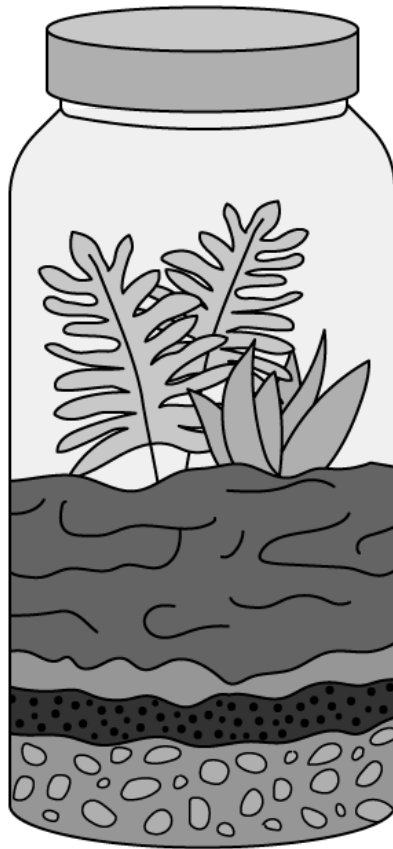
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(5 marks)

(b) Abiotic factors can be controlled in order to study the response of a naturally occurring ecosystem using the set up below.



What is the name given to the set up shown in the image which allows the study of ecosystems?

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(1 mark)

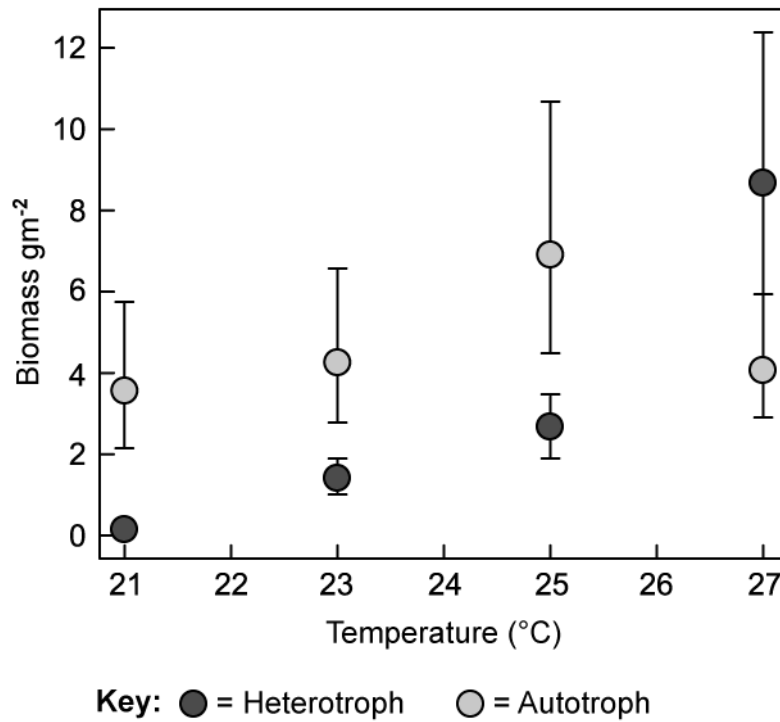
(c) Suggest why the experiment set up in part **b)** should include the following features:

- A transparent container
- A lid to seal the container
- Minimal primary consumers and no secondary consumers

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(3 marks)

(d) A mesocosm was set up to study the effect of increasing global temperatures on the biomass of aquatic autotrophs and heterotrophs.

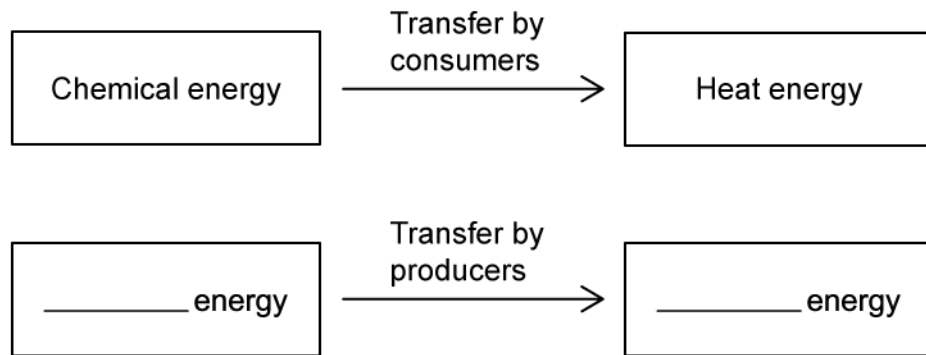
The graph shows the data collected.



Describe what happened to the biomass of heterotrophs and autotrophs as temperatures increased from 21 °C to 27 °C.

(2 marks)

4 (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.

.....

.....

(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.

.....

.....

(2 marks)

(c) Identify three functions of life which rely on energy transferred in respiration.

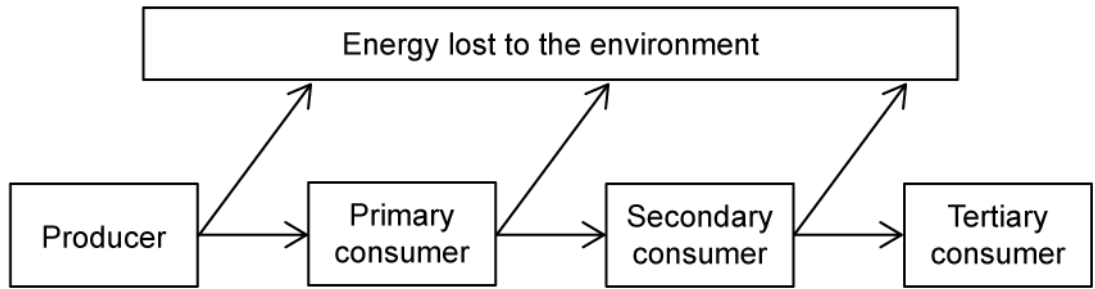
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(3 marks)

(d) 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)

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

Describe how a quadrat could be used to study the distribution of a particular species of clover plant in a meadow compared to a forest.

(5 marks)

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

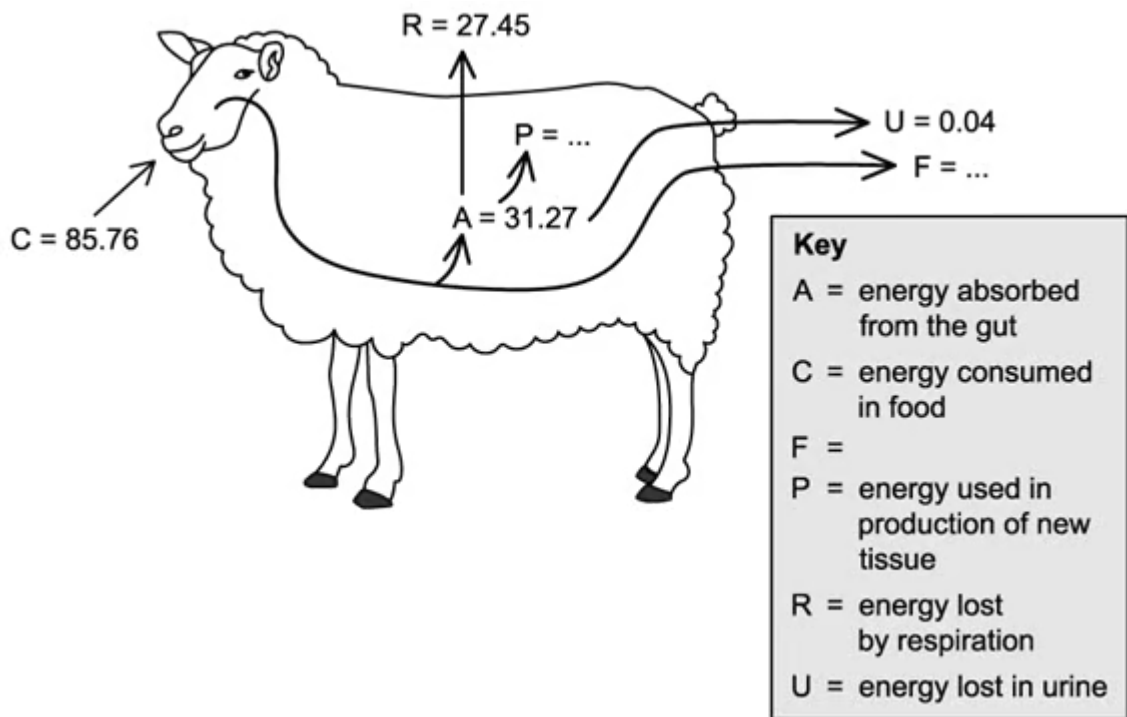
(4 marks)

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

(6 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

.....
(1 mark)

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

.....
(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.

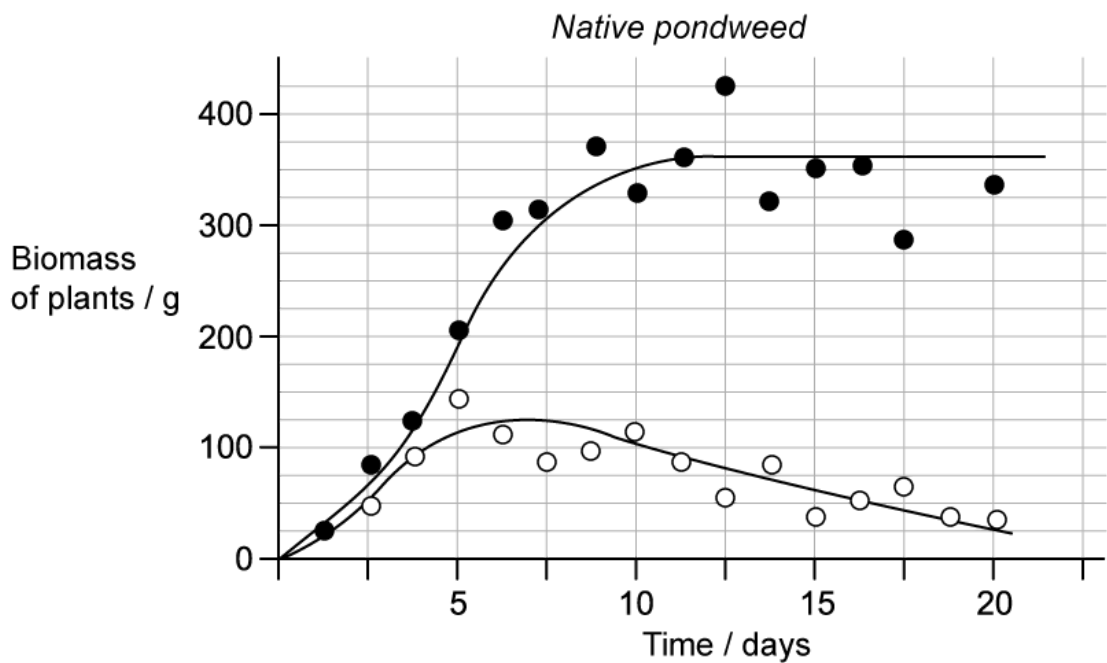
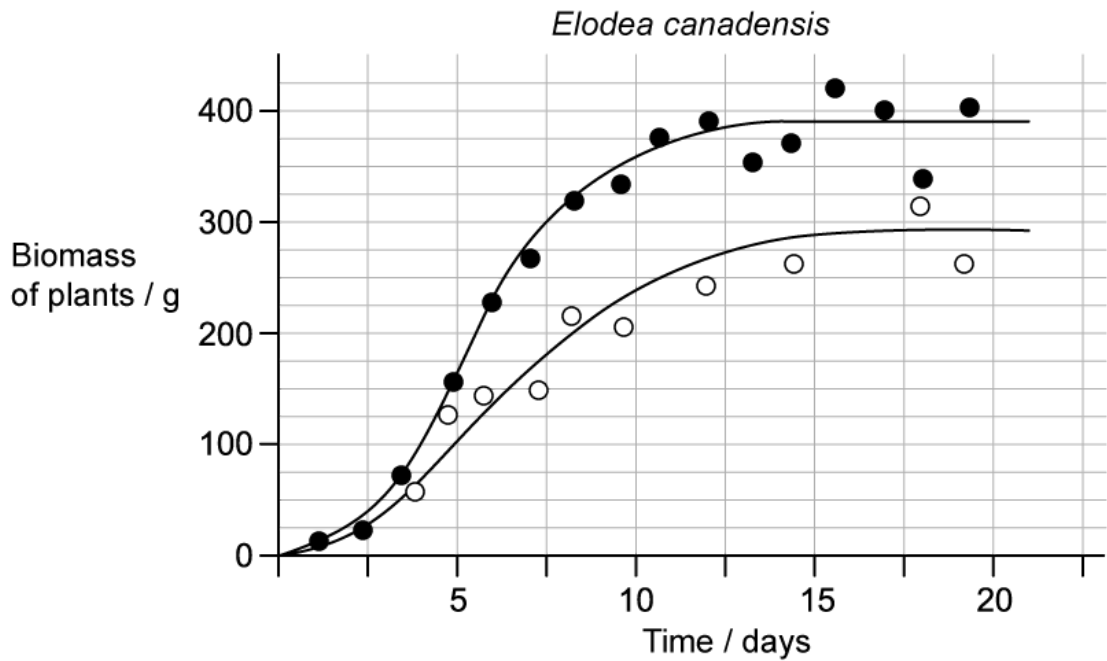
(2 marks)

- (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) *Elodea canadensis* (Canadian pondweed) is a species of aquatic plant from North America. A student grew *Elodea canadensis*, along with a pondweed species native to the UK, in water tanks both separately and together. The graphs below show their results.



Key: ● = Plants grown in separate tanks ○ = Plants grown together in same tank

State **two** abiotic factors the student should have controlled throughout the experiment.

(2 marks)

- (b)** Calculate the difference in biomass between native pondweed grown separately and native pondweed grown in a tank together with *E. canadensis* after 15 days.

(1 mark)

- (c)** Explain the results for native pondweed for when both species of pondweed are grown together.

(2 marks)

- (d)** Evaluate the benefit of mesocosm experiments, similar to the one in part (a), in understanding interactions between organisms in their natural environment.

(3 marks)

- 3 (a)** Ecologists studied a rocky shore habitat which contained, among other organisms, several barnacle species, purple topshell snails (*Gibbula umbilicalis*), seaweeds, and lichens.

State, with a reason, which of the organisms listed above make up a single population.

.....

.....

(2 marks)

- (b)** The ecologists wanted to find out whether there was an association between the distributions of purple topshell snails and the common rock barnacle, *Semibalanus balanoides*.

Outline the method ecologists would use to collect data to determine whether or not such an association existed.

.....

.....

.....

(3 marks)

- (c)** A chi-squared test was carried out to determine whether or not there was a significant association between purple topshells and common rock barnacles on a rocky shore. When the calculated chi-squared value was compared to values in a critical values table it was found to be smaller than the critical value at a 0.05 probability level.

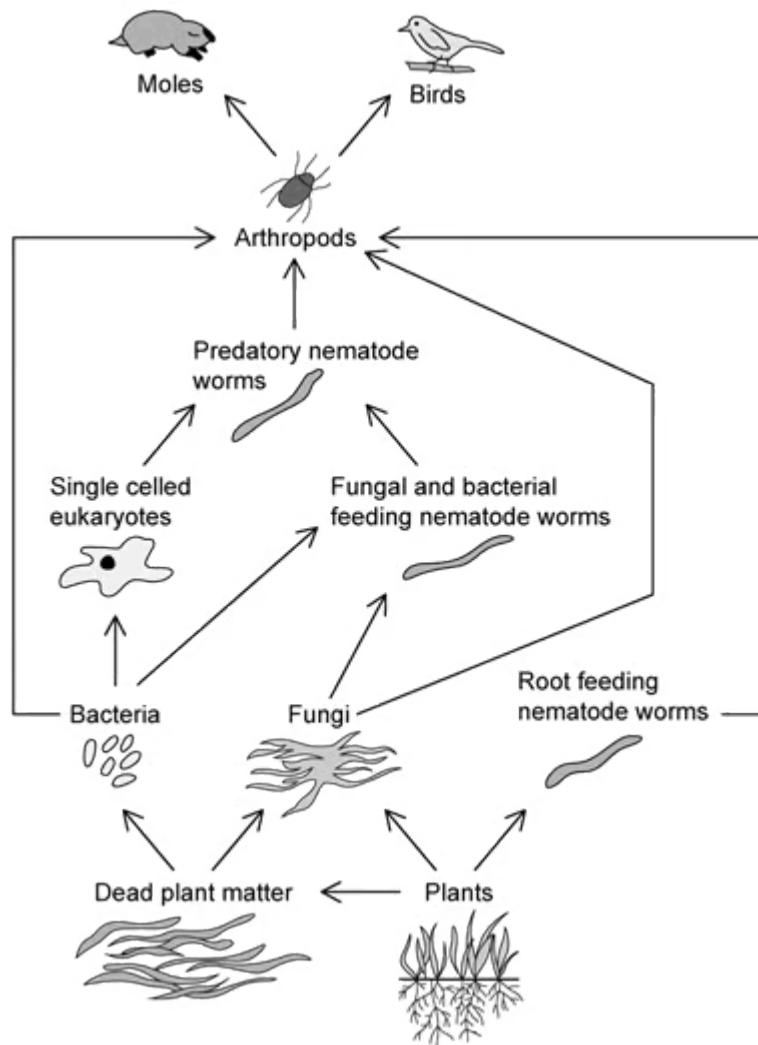
Deduce what can be concluded from this analysis?

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.....

(2 marks)

4 (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

.....

.....

.....

(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)

(d) Outline how the soil food web will be affected by a farmer harvesting crop plants from a field.

.....
.....
.....
(3 marks)

5 (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)

(c) Explain the concept of ecosystem sustainability.

(5 marks)

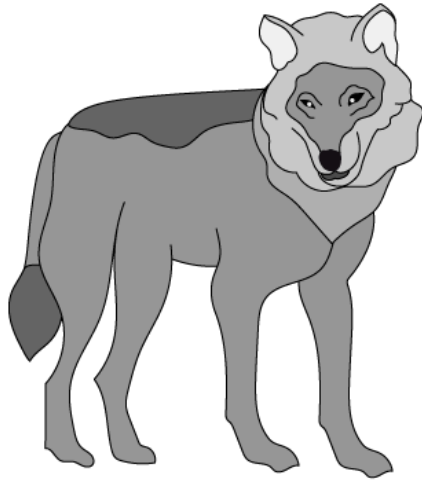
Hard Questions

1 (a) The images show two organisms from the genus *Canis*.

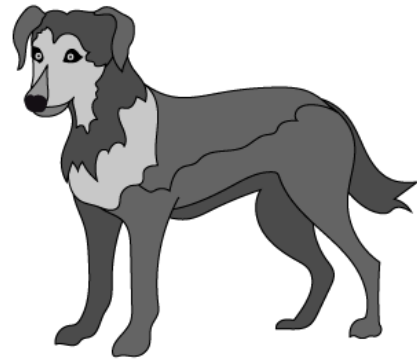
Grey wolves, *Canis lupus*, are wild animals native to Eurasia and North America.

Domestic dogs, *Canis familiaris*, descended from wolves and became domesticated over many years.

Canis lupus



Canis familiaris



A wolfdog is a hybrid produced when a domesticated dog (*Canis familiaris*) breeds with a wolf (*Canis lupus*). Genetically, dogs and wolves are very similar and the resulting offspring are fertile. Wolfdog hybrids are rare as natural habitats and territorial behaviours isolate wolves from domestic dogs.

Using the information provided, discuss the validity of the claim that wolves and dogs are the same species.

(4 marks)

(b) Suggest how isolation may result in the development of a new species.

(4 marks)

(c) A taxonomist suggested that the wolf and the domestic dog should be re-categorised as follows:

- *Canis lupus familiaris*
- *Canis lupus lupus*

Identify the genus name and the species name for the wolf and the domestic dog under this re-categorisation.

(2 marks)

(d) Outline how artificial selection has led to the domestication of wolves over many years to result in the domestic dogs of the modern day.

(3 marks)

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

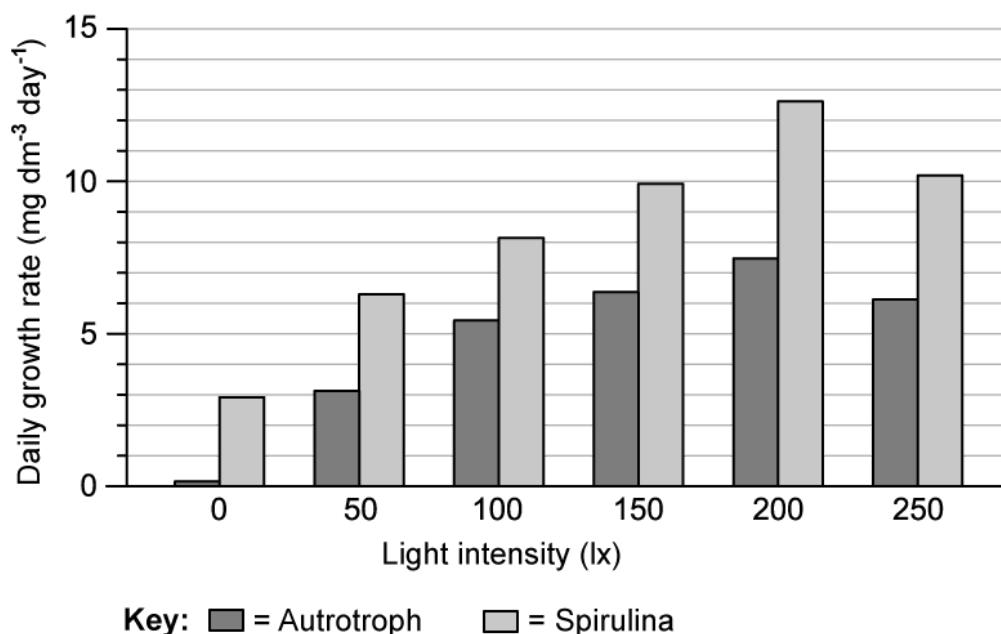
Discuss this statement.

(4 marks)

(b) *Spirulina* (*Athrospira platensis*) is a blue-green alga that is consumed for its nutritional benefits, which are considered to be good for oral health, eye health and maintaining healthy blood pressure, amongst other benefits.

The graph shows the results from an investigation into the optimum growing conditions for *Spirulina*.

Spirulina was grown in a glucose medium and exposed to different intensities of light. The same method was carried out with an autotrophic species of alga.



Explain how the results show that *Spirulina* is a mixotrophic organism.

(3 marks)

- (c)** Compare the growth rate of *Spirulina* and the autotrophic algal species when light intensity was increased from 0 to 200 lx.

(2 marks)

- (d)** Suggest how *Spirulina* may be adapted to function as a mixotroph.

(2 marks)

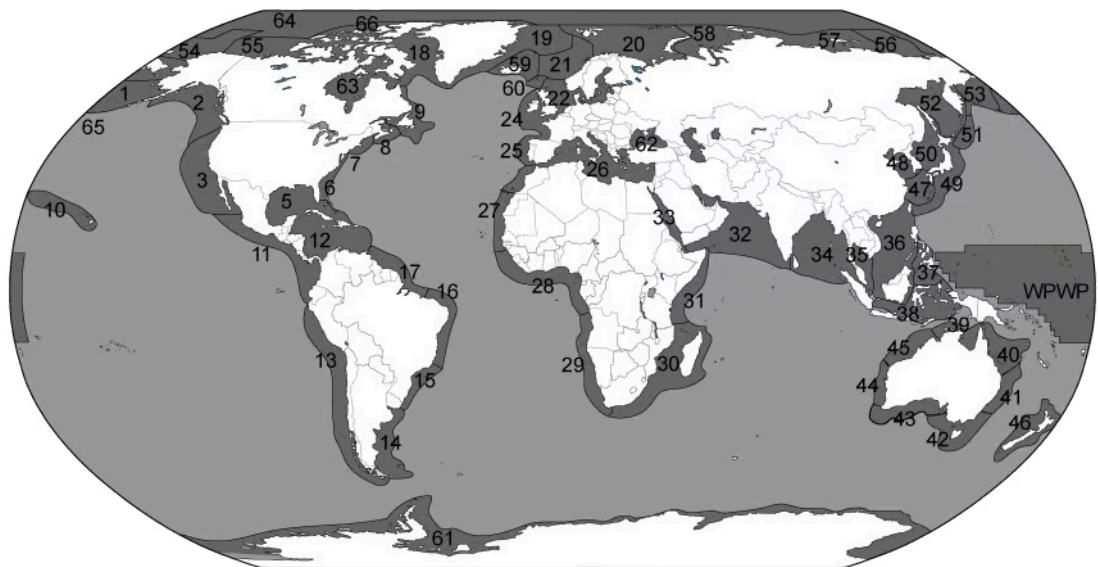
- (e)** Another species of alga, *Cephaleuros virescens*, has been identified as a plant pathogen living on the leaves and fruit of guava plants in Hawaii. *C. viscerens* is non-photosynthetic and has been shown to cause a disease known as leaf and fruit spots.

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

(2 marks)

3 (a) Many large marine ecosystems across the world's oceans boast high productivity and biodiversity. As a result, they contribute substantially to the global economy through practices such as fishing.

The map below shows 66 large marine ecosystems, which are identified as being key areas of conservational interest, due to the risks associated with their proximity to developed coastlines and the impact this may have on the biodiversity of these ecosystems.



Suggest **four** abiotic factors that may impact communities living within large marine ecosystems.

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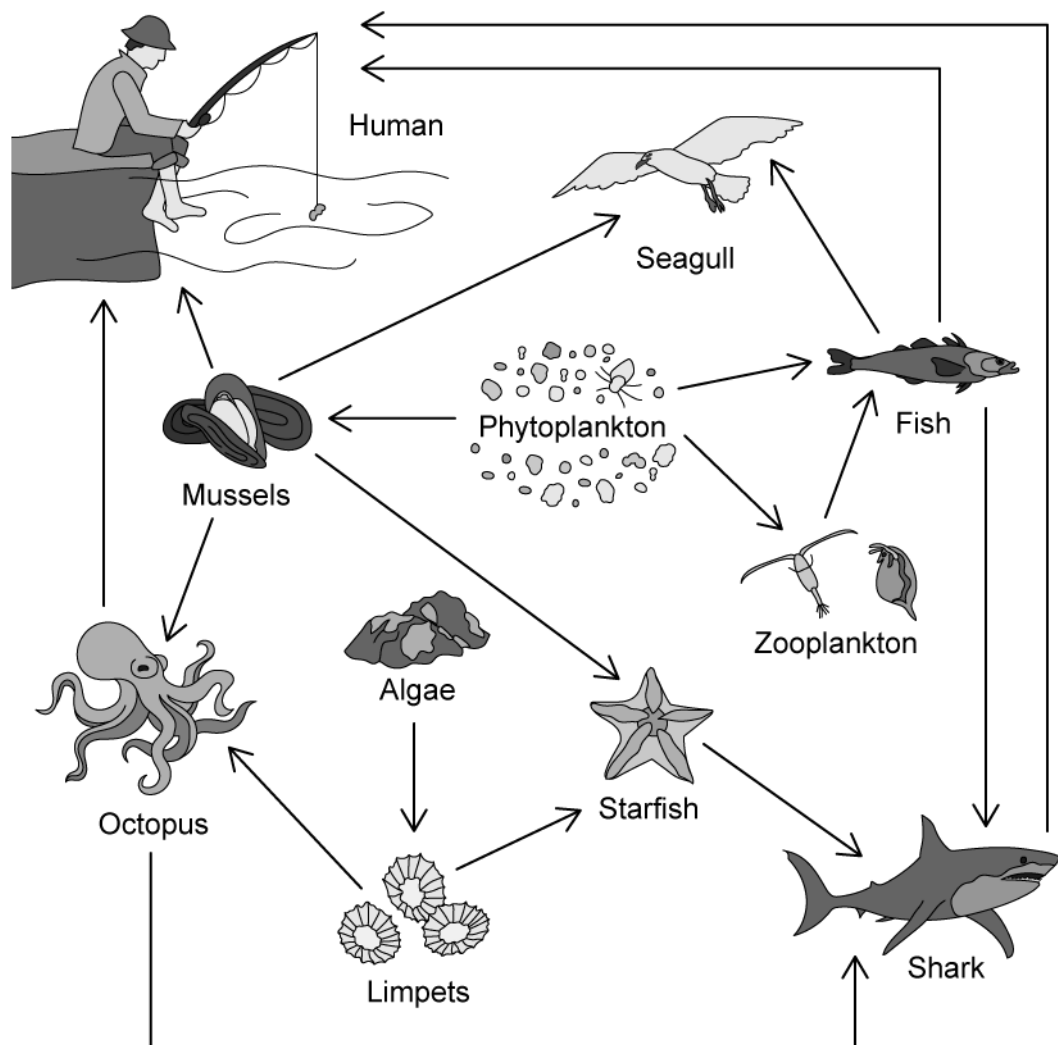
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(4 marks)

(b) A basic food web for a large marine ecosystem can be seen below.



Nutrient-rich sewage from coastal settlements results in rapid growth of algae (algal blooms), which leads to a reduction in light intensity on the ocean floor.

Suggest the general effects this may have on a community in a marine ecosystem.

(4 marks)

- (c) Since 2013, numbers of starfish in the large marine ecosystems have been seen to dramatically reduce by up to 80% in some regions.

Starfish act as detritivores in the marine ecosystems, feeding on dead and decaying organic matter, as well as preying on organisms such as mussels and limpets.

Some scientists have suggested that a decline in starfish numbers may have a positive impact on the marine ecosystem.

Evaluate this statement.

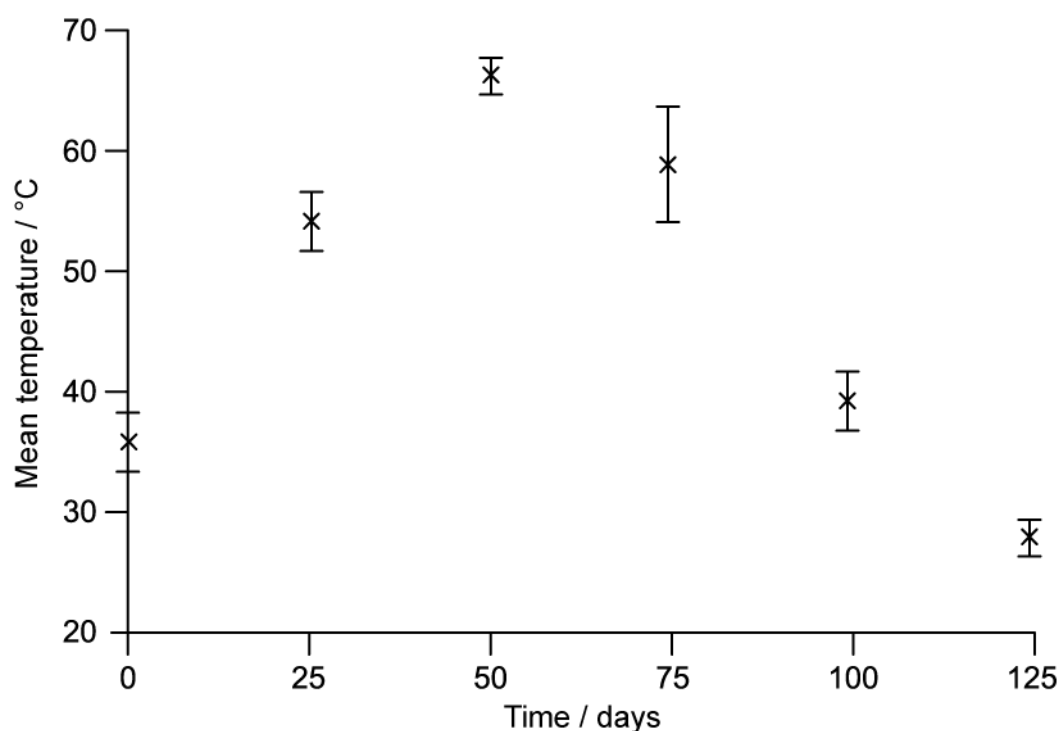
(4 marks)

4 (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.

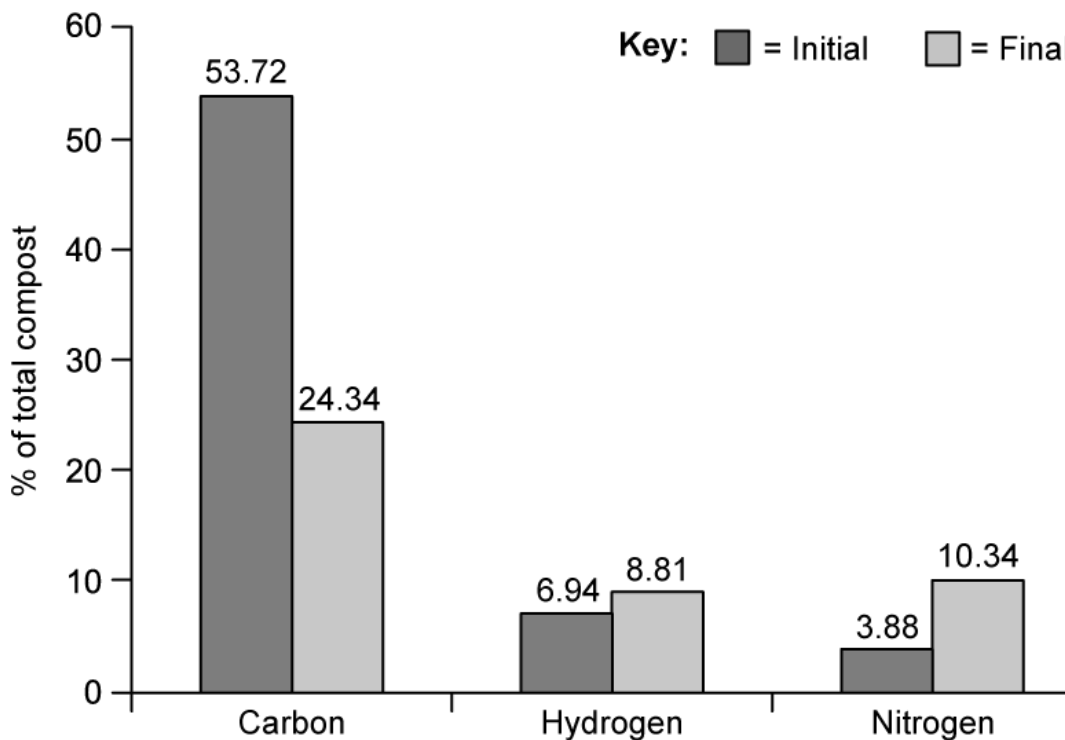
(4 marks)

(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)

5 (a) *One mark is available for clarity of communication in this question.*

Outline how scientists may simulate a naturally occurring ecosystem to establish how the sustainability of that ecosystem may be influenced by global warming.

(4 marks)

(b) Explain the use of the chi-squared test to analyse data collected from the simulated ecosystem.

(3 marks)