

# Ecosystems

## Model Answers 1

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Genetics, evolution and ecosystems
Topic	Ecosystems
Booklet	Model Answers 1

**Time allowed:** 76 minutes

**Score:** /56

**Percentage:** /100

**Grade Boundaries:**

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

## Question 1

A scientist was investigating the effect of two different temperatures on the rate of enzyme controlled decomposition of ammonia, in soil bacteria.

They repeated their experiment ten times for each of the two different temperatures.

Which of the following, **A** to **D**, should they use to determine if there was a significant difference between these two sets of times? **[1]**

- A. standard deviation
- B. Student's t-test**
- C. chi squared test
- D. Spearman's rank correlation coefficient

Standard deviation measures the spread of results about the mean

t-test compares two sets of results

Chi squared compares expected results with observed

Spearman's measures the correlation between two variables

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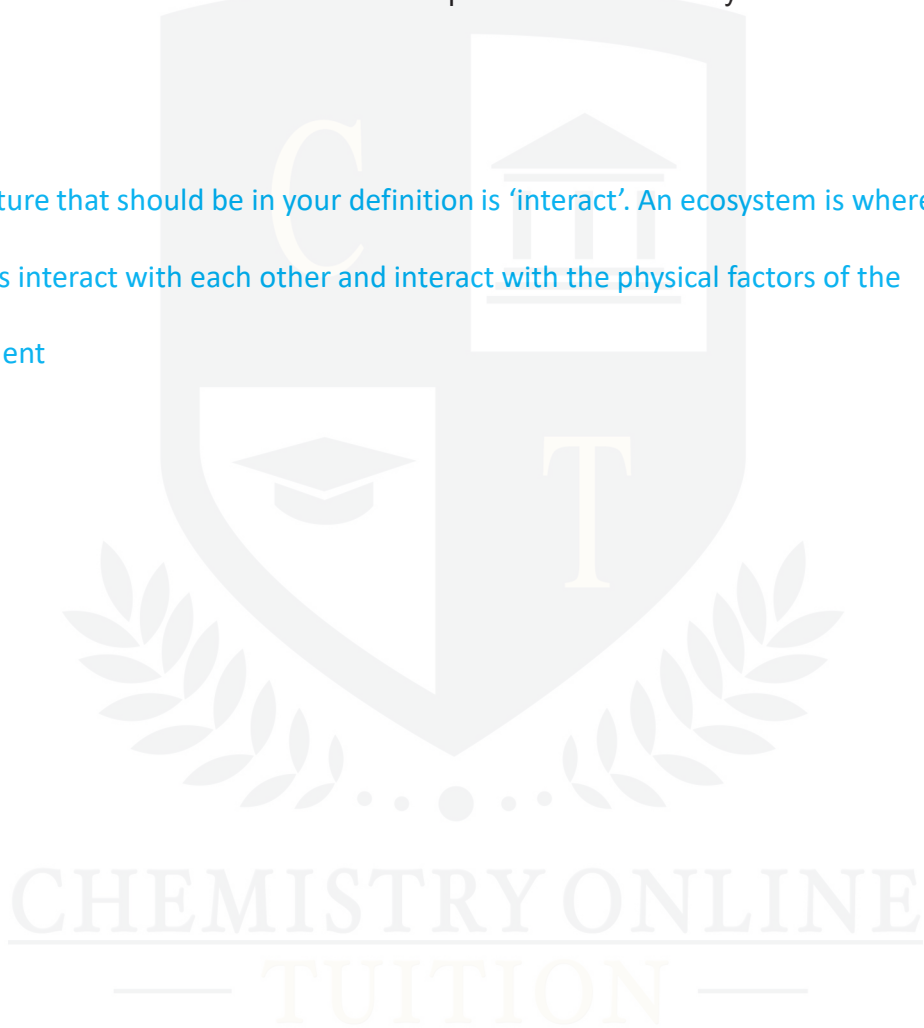
## Question 2

Which of the following statements about ecosystems is **not** true?

- A. An ecosystem is affected by biotic and abiotic factors.
- B. An ecosystem is all of the organisms and habitats in a large area.
- C. An ecosystem is dynamic.
- D. There is a flow of biomass between trophic levels in an ecosystem.

[1]

A key feature that should be in your definition is 'interact'. An ecosystem is where organisms interact with each other and interact with the physical factors of the environment



### Question 3

Deep sea vents on the ocean floor are surrounded by unusual organisms such as chemosynthetic bacteria and eyeless shrimp.

Which of the following statement(s) about these ecosystems is/are true?

**Statement 1:** The temperature of the vents influences the organisms that live there.

**Statement 2:** A predatory octopus would affect the balance of these organisms.

**Statement 3:** The number of eyeless shrimp found at each vent is constant.

A 1, 2 and 3

**B** Only 1 and 2

C Only 2 and 3

D Only 1

[1]

The number of shrimp will be different depending upon the size of the vent

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## Question 4

The first stage of primary succession is the pioneer community.

Which of the following statements about a pioneer community are correct?

- 1 species produce large numbers of wind-carried seeds or spores
- 2 biomass is low
- 3 many species are lichens and mosses

A. 1, 2 and 3

B. Only 1 and 2

C. Only 2 and 3

D. Only 1

[1]

They have to produce large numbers of seeds or spores as wastage is high

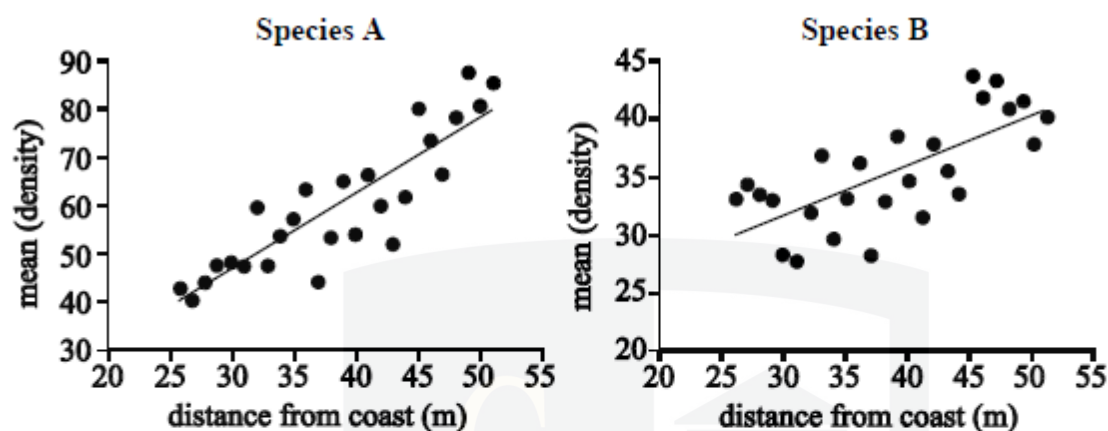
Their biomass is low as productivity is low in extreme conditions

Many species are mosses and lichens which grow on rocks

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## Question 5

The graphs below show the density of two different plant species as proximity to the coast changes.



Which of the following statements correctly describes one aspect of the technique used to collect these data?

- A Quadrats were randomly placed using a random number generator and coordinates.
- B Larger quadrats were required for species A because their mean density was higher.
- C A belt transect has been used to allow calculation of density.**
- D Abiotic factors were measured at every point of quadrat sampling.

[1]

A transect is used to sample areas where there is an environmental gradient. If the mean density is needed then the number of a species in a particular area must be estimated. To do this a quadrat is placed at intervals along the transect line

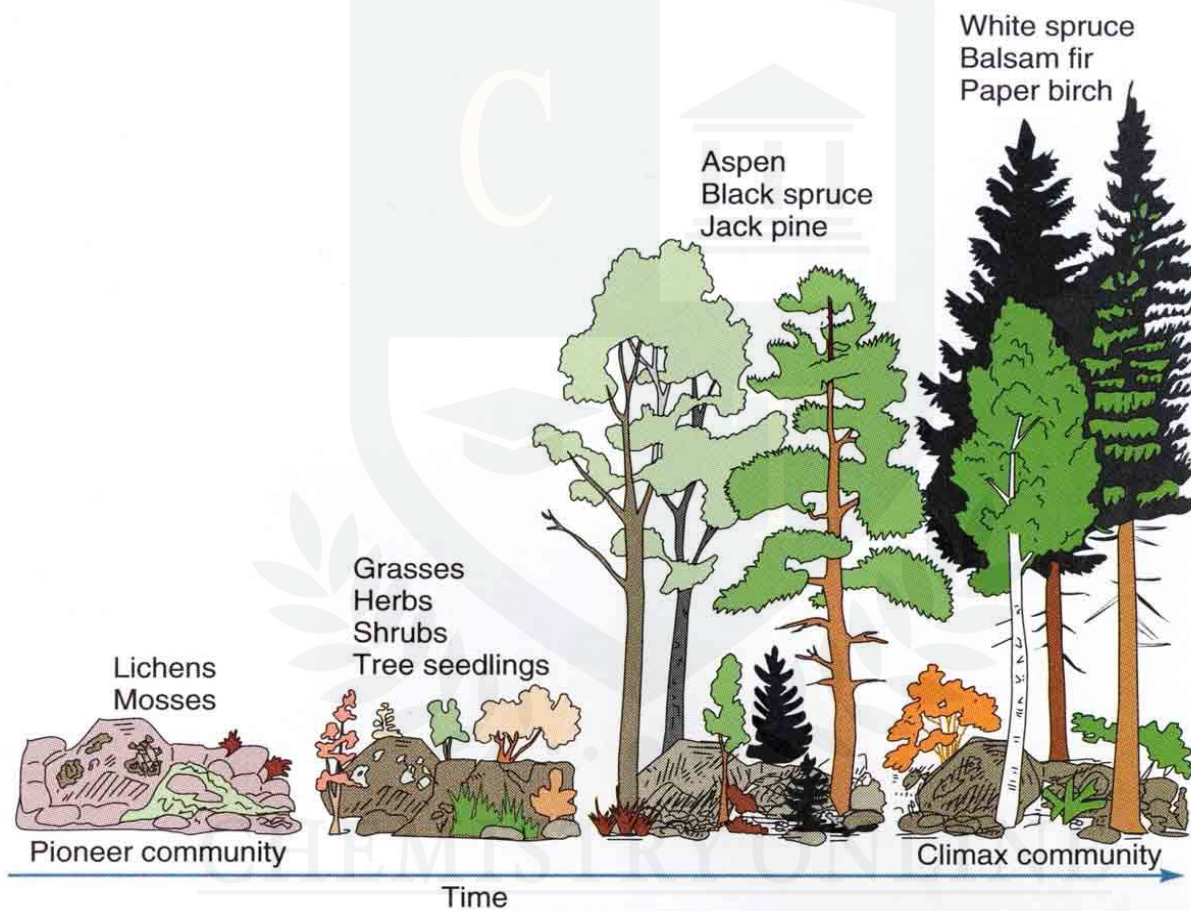
## Question 6

Describe the differences between the following biological terms:

(a) a pioneer community and a climax community

[2]

- A **pioneer** community will have arrived **before** a **climax** community.
- Pioneer communities usually have less **biodiversity** than a climax community.
- Pioneer communities are usually **subject to greater change** and are therefore often **less stable**



(b) decomposition and denitrification

[2]

- **Decomposition** is the **break-down of dead organic matter** to non-organic waste.
- Whereas, **denitrification** is the conversion of **nitrates** in the soil into **nitrogen gas**.
- Therefore **decomposition increases** nitrate supply to the soil, whereas **denitrification reduces** the nitrate concentration in the soil.

(c) conservation and preservation

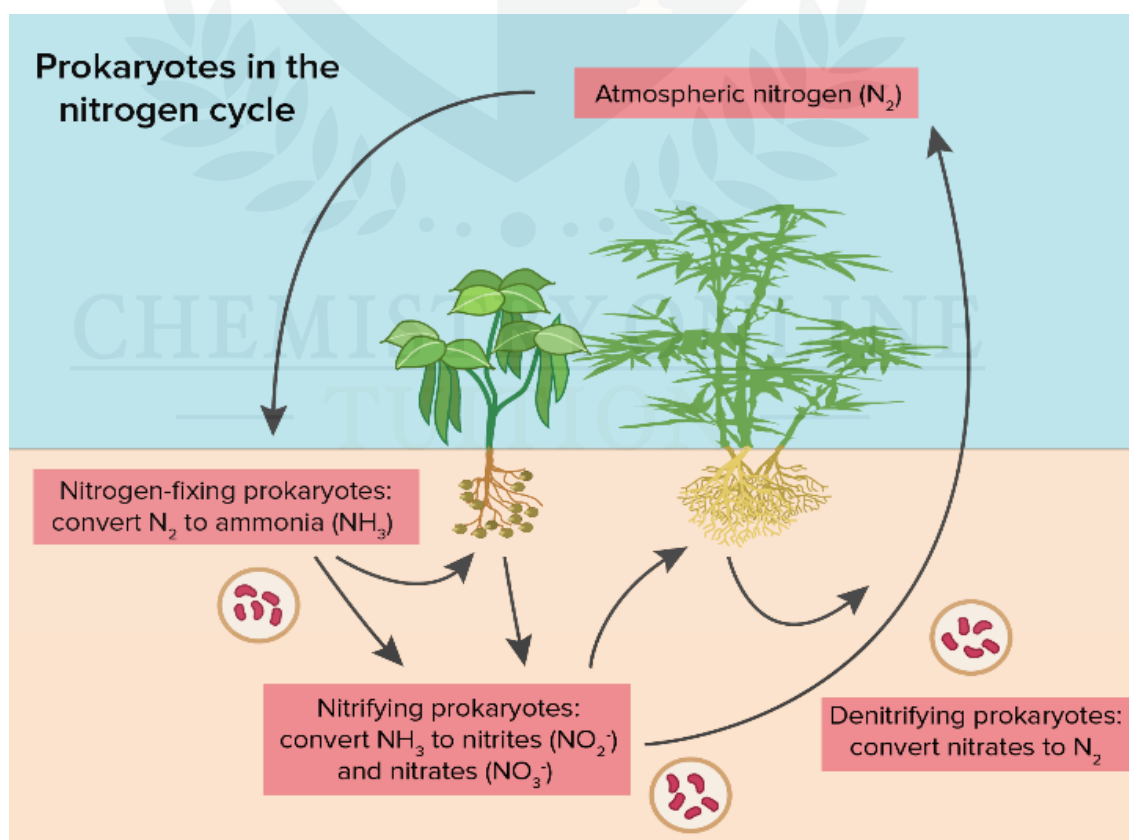
[2]

- Conservation **maintains** the **biodiversity** of an ecosystem.
- It involves **active management** of a resource or habitat
- Preservation is the choice to **leave ecosystems undisturbed** by human action (i.e. no active management).

(d) nitrogen fixation and nitrification.

[2]

- **Nitrogen fixation** is the conversion of **atmospheric nitrogen** into **ammonium ions**.
- **Nitrification** is the conversion of **ammonium ions** into **nitrite** and **nitrate ions**.
- Both process involve the action of **microorganisms** such as *Rhizobium* (fixation) and *Nitrosomonas/ Nitrobacter* (nitrification)



[Total: 8]

## Question 7

Earthworms are abundant in fertile soil where they play an important role in the transfer of energy in the ecosystem. An example of a food chain involving earthworms is shown in Fig. 8.1.

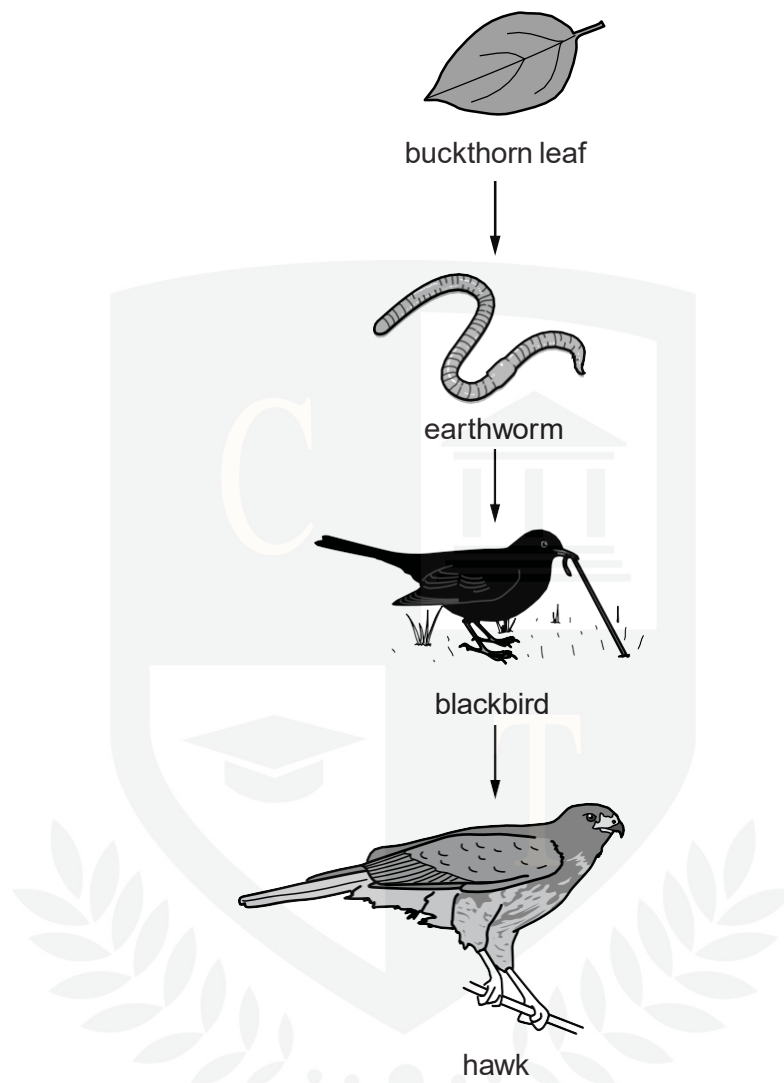


Fig. 8.1

(a) Define the following terms:

[3]

*producer*

- Producers (leaves / plants) carry out autotrophic nutrition, that is, they fix carbon dioxide to sugars using light energy. In other words, photosynthesis.

*consumer*

- Consumers such as birds get their energy from the other organisms it feeds on

*trophic level*

- A trophic level is the stage an organism occupies in a food chain or web eg a primary consumer occupies the second trophic level

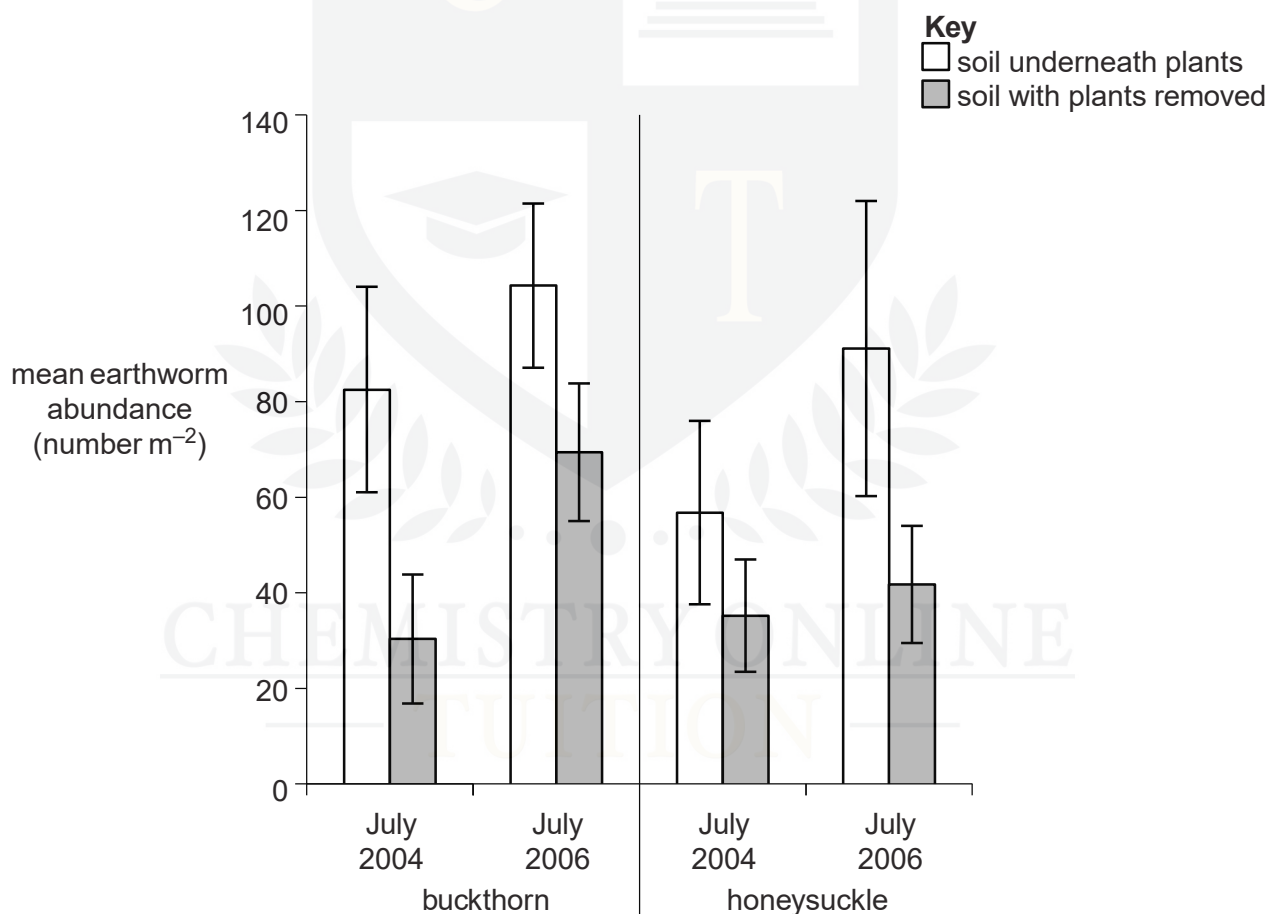
(b) One way of measuring the abundance of earthworms is as follows:

- place quadrat frames of known area onto the ground
- pour a chemical solution onto the soil to cause the earthworms to come up to the surface
- wait and then count the earthworms.

Researchers used this technique in 2004 and 2006 to compare the abundance of earthworms in four areas of soil:

- soil underneath buckthorn plants
- soil underneath honeysuckle plants
- bare soil after the removal of buckthorn plants
- bare soil after the removal of honeysuckle plants.

The results are shown in Fig. 8.2.



**Fig. 8.2**

- (i) Suggest **two** variables which the researchers should have controlled in order to make the results comparable.

[2]

The following should have been controlled:

- The number of quadrats per unit area
- Randomise the placing of the quadrats
- The time spent waiting for the earthworms to rise
- The volume of solution poured onto the ground
- The concentration of the solution poured to make the earthworms rise

These are all needed to make the investigation valid. Remember never to use the word 'amount' of solution, always use volume AND concentration

- (ii) Evaluate, with reference to the error bars in Fig. 8.2, whether the data show a valid difference in the abundance of earthworms between the 'soil underneath honeysuckle' and 'soil with honeysuckle removed' sites for July 2004. [2]

- The mean of earthworm numbers in soil with plants removed is less than soil with plants
- However the error bars overlap
- Some of the earthworm numbers in soil with plants removed is greater the soil with plants remaining
- This overlap makes the results less valid

Error bars are represented by the standard deviation from the means, the larger the error bars the wider the range of results so they are less reliable and the investigation is not as valid. Error bars are always equidistant from the mean whereas range bars, which represent the lowest and highest values, are not necessarily equidistant. Examiners tend to allow answers that switch from error to range bars though.

(iii) Ecosystems can be described as dynamic.

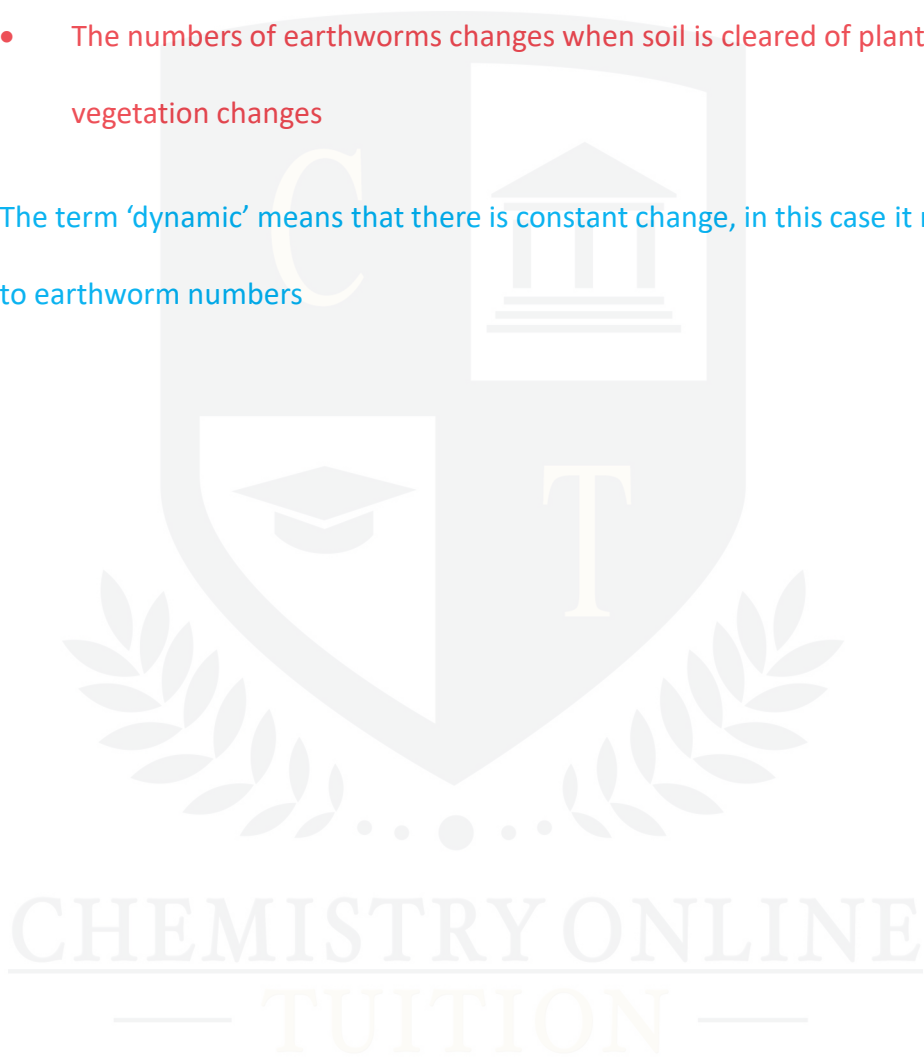
State **two** pieces of evidence from Fig. 8.2 that show that the ecosystem is dynamic.

[2]

- The numbers of earthworms changes from year to year, there were more in 2006 than 2004
- The numbers of earthworms changes when soil is cleared of plants and vegetation changes

The term 'dynamic' means that there is constant change, in this case it refers to earthworm numbers

[Total: 9]

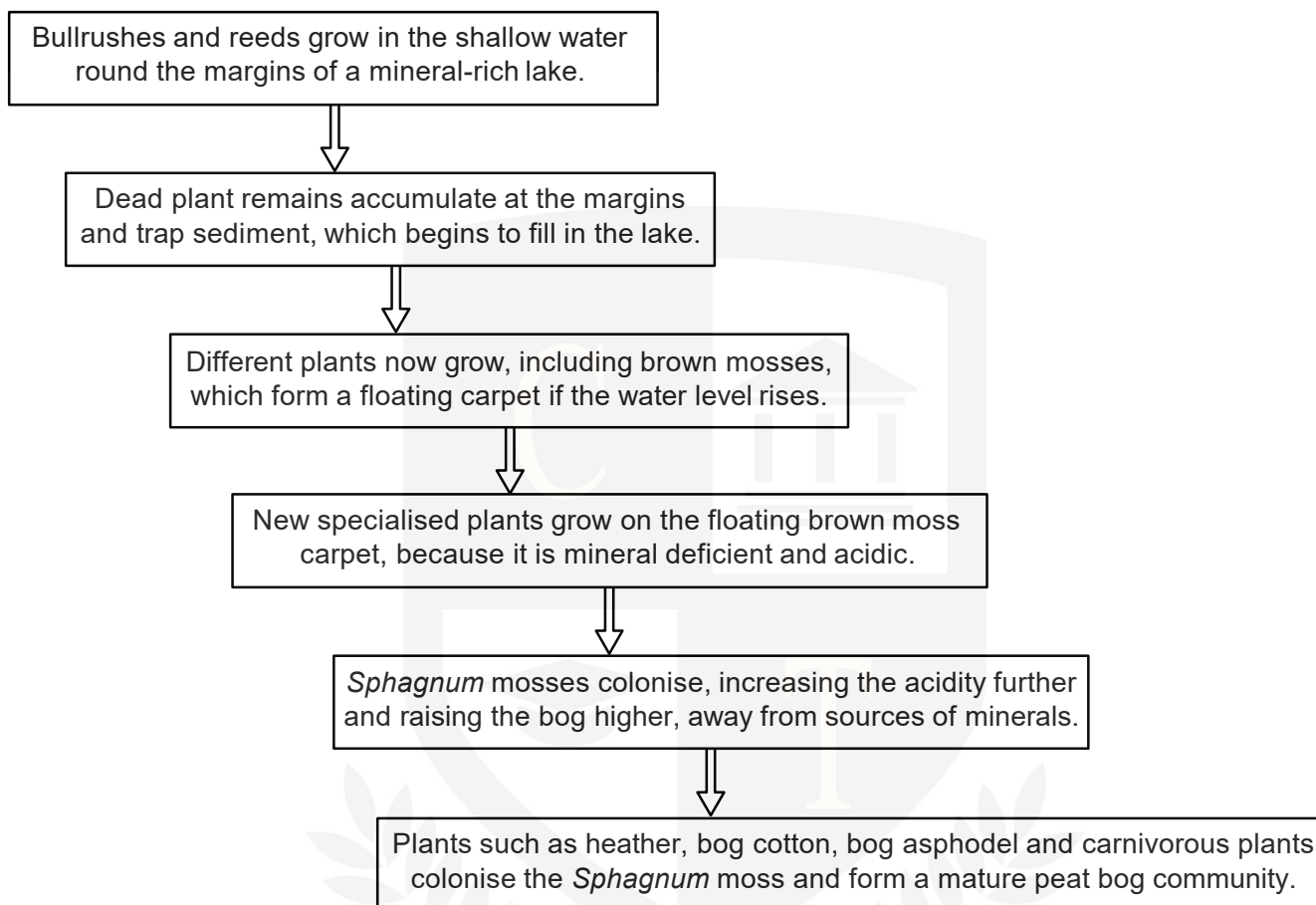




## Question 8

Peat bogs are large areas of waterlogged land that support a specialised community of plants. Peat bogs take thousands of years to form.

Fig. 5.1 lists the main stages in the formation of a peat bog.



**Fig. 5.1**

- (a) (i) Name the process summarised in Fig. 5.1 that changes a lake community into a peat bog community.

[1]

- Succession

Succession begins with a pioneer species such as Marram grass, it grows on sand dunes where it binds the sand together and creates conditions that other plants can exploit. Each stage of succession is called a sere, so you will see a collection of seral changes, these changes happen over time and are predictable and directional. Eventually there will be a final sere called a climax community. This will include a wide variety of plants and animals with a high biodiversity which are in a balanced equilibrium, this will remain stable unless there are no changes to the environment or human influence.

(ii) Using Fig. 5.1, list **two abiotic** factors that play a role in determining what species of plant can grow in an area.

[2]

- Mineral content
- Acidity or pH
- Water depth

(b) Most of the minerals in a peat bog are held within the living plants at all times, **not** in the soil.

- Plants like bog cotton and bog asphodel recycle the minerals they contain.
- The leaves of these plants turn orange as the chlorophyll within them is broken down.
- Minerals such as magnesium ions are transported from the leaves to the plants' roots for storage.

Describe **one** similarity and **two** differences in mineral recycling in a peat bog and in a **deciduous forest**.

[3]

similarity

- One similarity is that chlorophyll breaks down and all the leaves change colour

differences

- Differences are that the minerals staying in the plant whereas in the forest minerals are recycled into the soil
- The composers such as fungi and bacteria are not present in the bog



Peat bogs are created where soil is permanently waterlogged. The oxygen levels in the soil are very low and conditions are anaerobic, this leads to low pH. Decomposers are unable to decay organic matter which builds up over many years, all the nutrients though are 'locked up' in the peat. Pollen can survive in these conditions for hundreds of years, so scientists can estimate the climate at the time by the trees and plants that were present.

- (c) In Ireland in 2002, two well-preserved Iron Age human bodies were found in peat bogs. Despite having been dead for over two thousand years, the bodies had not decomposed. They still had skin, hair and muscle.

Suggest why these bodies had not decomposed.

[2]

- The bodies but not decompose because the decomposes were not present in the peat bog
- Waterlogging reduces the oxygen content in the peat bog
- The build-up of acid that was the pH which stops any enzymes in the decomposes from my account

- (d) Suggest **two** reasons why the large scale removal of peat from bogs for use in gardens is discouraged by conservation groups.

[2]

- Large scale removal of peat from bogs is discouraged because the habitat takes a long time to form and is very hard to replace
- It also means loss of biodiversity potentially the loss of any rare species

[Total: 10]

## Question 9

A small, permanent pond is the habitat for a climax community of producers (aquatic plants and algae) and consumers (bacteria, protoctista, worms, snails, arthropods and small vertebrates like newts and fish).

- (a) Why might ecologists call this a 'climax community'? [1]

The community is stable and not subject to succession any more

- (b) The protoctist *Paramecium caudatum* is usually between 200 and 300  $\mu\text{m}$  in length. An accurate measurement would help in the correct identification of a specimen from this pond.

What laboratory equipment would you select to make an accurate measurement of the length of *Paramecium caudatum*? [2]

- Light microscope
- Eyepiece graticule / stage micrometer

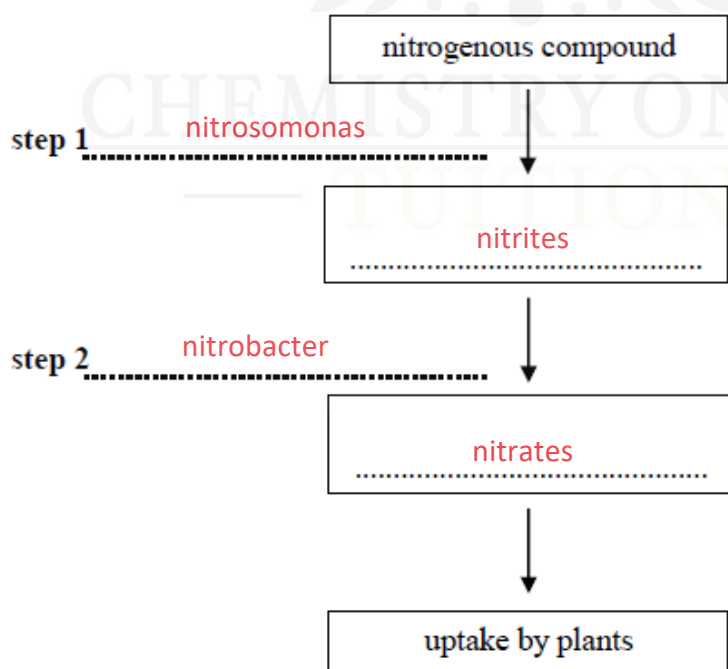
- (c) An animal fell into the pond. It drowned and decayed. Within a year the biological compounds in its body had been completely recycled.

- (i) What nitrogenous excretory molecule from the decomposers would pass to the next stage of the nitrogen cycle? [1]

Ammonia / urea

Ammonia is produced when amino acids are deaminated by saprotrophs

- (ii) Complete the flow chart to show what happens to this nitrogenous compound, and name the groups of bacteria involved at steps 1 and 2, as it is converted to a form that plants can take up and use. [4]



[Total: 8]

## Question 10

The effect of wave action on the height of the shells of the dog whelk (*Nucella lapillus*) was investigated by comparing an exposed shore and a sheltered shore.



shell height  
measured  
from base to  
conical tip

- A random sampling technique was used to collect 50 shells from an exposed shore.
- The shell height was measured from the base to the conical tip. The whelk was returned to its location.
- The process was repeated for the sheltered shore.
- All the results were recorded in **Table 3.1**.

Location	Height of shell (mm)										Range	Mean	SD
Sheltered shore	26	28	27	26	28	23	28	23	26	28	16	31.3	4.1
	29	29	29	29	29	28	29	29	29	29			
	30	31	30	29	32	29	30	29	30	32			
	33	35	34	32	35	32	34	32	33	35			
	37	39	38	37	39	35	38	36	37	39			
Exposed shore	15	17	16	15	23	15	23	16	13	15	15	20.0	4.2
	17	24	18	17	17	14	17	18	16	17			
	19	19	20	24	18	20	19	20	18	20			
	23	14	24	14	21	20	23	17	21	23			
	25	25	28	26	25	27	25	28	25	27			

**Table 3.1**

(a) The  $t$  test can be used to determine the significance of the differences between shell height on the exposed shore and the sheltered shore.

(i) Calculate the  $t$  value for the data using the formula:

$$t = \frac{|\bar{x}_1 - \bar{x}_2|}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}}$$

where,

$|\bar{x}_1 - \bar{x}_2|$  is the difference in mean values of sample 1 and sample 2

$s_1^2$  and  $s_2^2$  are the squares of the standard deviations of the samples

$n_1$  and  $n_2$  are the sample sizes.

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

[2]

**13.61**

- (ii) The null hypothesis is that there is no difference between the means of the two shell populations.

The critical values at 98 degrees of freedom are shown in **Table 3.2**.

Degrees of freedom	$p = 0.10$	$p = 0.05$	$p = 0.01$	$p = 0.001$
98	1.67	2.00	2.64	3.41

**Table 3.2**

Using the table of critical values, explain whether the student would be able to accept or reject the null hypothesis as a result of the  $t$  value you calculated in part (i).

[1]

Reject the null hypothesis as the  $t$  value is greater than the critical value. There is less than a 1% probability that the results could have occurred by chance and so the results are significant.

Remember. If it's greater than the critical value reject the null hypothesis and the results are significant, it is extremely unlikely they could have arisen by chance

- (b) The students organised the data from **Table 3.1** into classes.

The organised data is shown in **Table 3.3**.

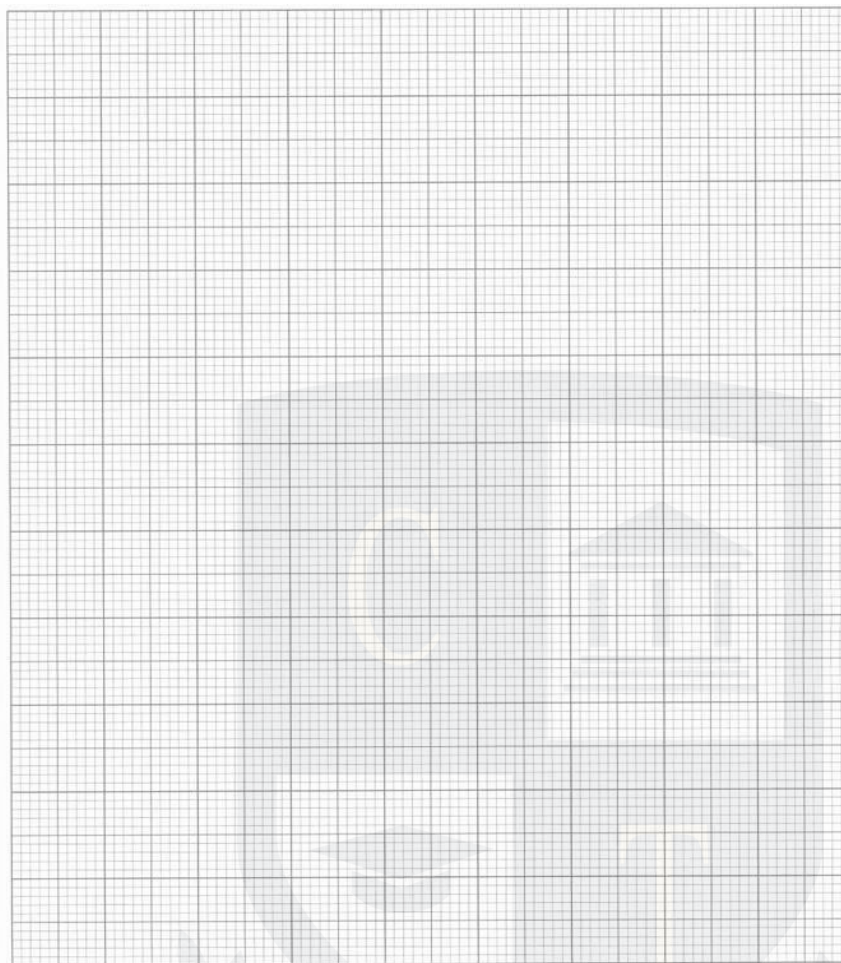
Sheltered shore			Exposed shore		
Height (mm)	Tally	Total	Height (mm)	Tally	Total
23–26	III	5	11–14	III	4
27–30	III III III III II	22	15–18	III II	7
31–34	III III I	11	19–22	III III II	12
35–38	III III	9	23–26	III III II	12
39–42	III	3	27–30	III	4

**Table 3.3**

Plot the most suitable graph of the data given in **Table 3.3**.

- Plot a histogram (or frequency polygon)
- On the x axis should be 'height' in mm and on the y axis should be number of dog whelks
- Both sets of data distinguished by a key or shading
- Graph should fill two-thirds of the graph paper with scales which have equal distances between values





[4]

- (c) Use the data and graph to discuss any correlation between the height of the whelk shell and the type of shore.

Suggest explanations for your findings.

[3]

- There is a strong correlation between the height of the shell its position on the shore
- Shore exposure has an impact upon height
- Taller shells are found more on the unexposed shores, shorter ones on the exposed shores
- Nucella is adapted to harsher wave action

NB not all the shells measured will be exposed to wave action. You can also mention that there is very little overlap between the histogram bars.

(d) Suggest a limitation of the procedure used to gather the data in this experiment and recommend how you could improve this. [2]

- There are no details about the random sampling technique, a tape measure should have been used to create a grid with random coordinates
- No detail of the measuring device, use a vernier calipers
- Incorrect identification of the shells, use a key to identify species

(e) How could the students improve the accuracy of their data? [1]

Take a larger sample of shells and repeat the investigation

This question is rather confusing. Accuracy is improved if the distance between the intervals is narrowed, however the answer given is more appropriate to repeatability

(f) Discuss the validity of the conclusions you have made during this experiment. [3]

- Only a small sample of Nucella were taken so the data could have been skewed
- The size of the shell was subjective and open to interpretation

Or

- The sample was large enough as 100 shells were used
- Precise instructions were given for consistent measurements of height
- Random sampling was carried out so there should be no bias

When the validity of an investigation is questioned then you can discuss accuracy, reliability, precision as part of the whole procedure

[Total: 16]