1. On a biology field trip, some students are studying an area of mixed woodland.

The teacher described the mixed woodland as a climax community that had resulted from succession.

Succession involves a series of changes in community over time, known as seres.

i. The first sere is the pioneer community. The final sere is the climax community.

The species that make up the pioneer and climax communities are different.

Compare the plant **and** animal species that make up the climax and the pioneer communities.

[6]

ii. Succession involves changes in the species that live in an area over time.

State **one** other change that takes place in the same area over the same time.

[1]

iii. Suggest what was present in the area that is now occupied by mixed woodland before the pioneer community arrived.

[1]

2. What explains why food chains rarely have more than five trophic levels?

A Parts of the food organism are not eaten by organisms higher in the food chain.
B Plants absorb only a small proportion of the Sun's energy.
C There is a limit to the size to which a predator can grow.
D Transfer of biomass between trophic levels is inefficient.

Your answer ☐ **[1]**

3. The rate at which plants produce biomass is known as productivity.

What is a suitable unit with which to measure productivity at different depths in the ocean?

A kg day^{-1} m^{-2}
B kg day^{-1} m^{-3}
C kg $year^{-1}$ m^{2}
D m kg^{-1} $year^{-1}$

Your answer ☐ **[1]**

4. Biomass is transferred through ecosystems.

What process makes biomass available for transfer to the next trophic level in the food chain?

A Excretion
B Growth
C Removal of undigested food
D Respiration

Your answer ☐ **[1]**

5(a). The element nitrogen is recycled within ecosystems.

Complete the sentences using the most appropriate terms.

When animals die microorganisms convert nitrogen-containing molecules in the animals' bodies to ammonia in a process known as ..... . This ammonia is converted into nitrites and nitrates by ..... bacteria. The bacterium ..... converts ammonia to nitrites and the bacterium ..... converts nitrites to nitrates. Nitrates can be absorbed by plants and converted to ..... Nitrogen gas is very unreactive but it can enter the nitrogen cycle by being converted to ammonia by ..... bacteria such as *Rhizobium*.

[6]

(b). Use your knowledge of the nitrogen cycle to suggest **and** explain why plants do not grow well in soil with a low oxygen content.

[2]

6(a). The abundance and distribution of plants can be surveyed in different ways.

Some students wanted to survey abundance and distribution of plants on a small area of grass outside the school. The area was roughly 20 m × 20 m in size.

They used the following method:

1 Lay two 20 m tape measures at right angles starting in the south east corner of the grass area.
2 Use a random number generator to select *x* and *y* coordinates.
3 While facing north, place the left-hand corner of a quadrat on the point where the coordinates meet.
4 Identify the species present in the quadrat using a key.
5 Count the number of each species present.
6 Record the information in a table.
7 Generate a new set of coordinates and repeat steps 2 to 6 until 10 quadrats have been sampled.

The teacher said that this method would not allow the students to measure the distribution of plant species.

i. Suggest an improvement to the method that would allow the distribution of plants to be measured.

[2]

ii. Identify a limitation with step 3 of the students' method and explain why this limitation might affect the data collected.

[2]

(b). The students' results are shown in the table.

Plant species	Mean number of individuals per quadrat
Creeping buttercup	3
Daisy	7
Dandelion	1
Grass	26
Red clover	4
Ribwort plantain	3
White clover	6

i. Calculate the Simpson's Index of Diversity (*D*) for the students' data.

Use the formula: $D = 1 - \left(\Sigma\left(\frac{n}{N}\right)^2\right)$

D = ... **[3]**

ii. The students found grass species difficult to distinguish from one another so they decided to record any grass species as 'grass'.

Explain how the students' decision might have affected the calculated value for *D*.

[2]

(c). On a biology field trip, students surveyed a large area of heather moorland.

On this occasion they did not use quadrats.

Pairs of students were each assigned a large area of moorland. They rated the abundance of plant species using the following scale:

A = Abundant
C = Common
F = Frequent
O = Occasional
R = Rare

One reason the use of quadrats was inappropriate was that many moorland plants are too large to fit in the quadrat.

i. Suggest **one** other advantage of using an ACFOR rating scale for the students' survey.

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[1]

ii. Suggest **one** limitation of using an ACFOR rating scale, instead of quadrat sampling, to rate the abundance of plant species.

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[1]

7. *Nitrobacter* is a bacterium that is involved in recycling nitrogen in an ecosystem.

Which nitrogen cycle reaction is carried out by *Nitrobacter*?

A $2NO_2^- + O_2 \rightarrow 2NO_3^-$
B $N_2 + 8H^+ + 8e^- \rightarrow 2NH_3 + H_2$
C $NH_2CONH_2 + H_2O \rightarrow 2NH_3 + CO_2$
D $NO_3^- \rightarrow NO_2 \rightarrow N_2O \rightarrow N_2$

Your answer ☐ **[1]**

END OF QUESTION PAPER