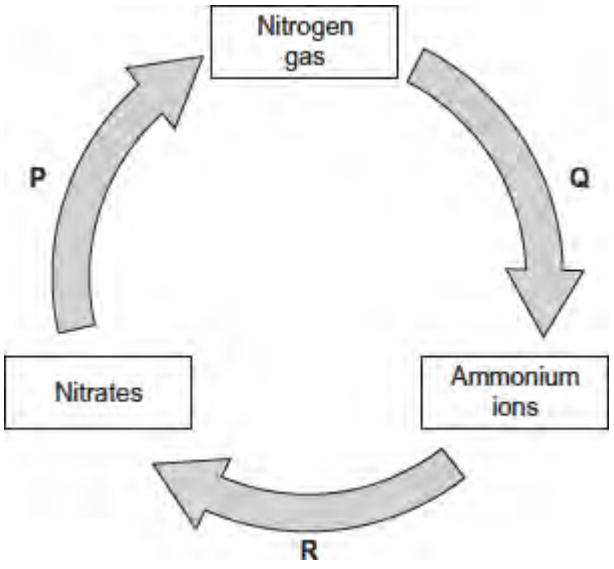
Q1. The diagram shows part of the nitrogen cycle.



(a) Which **one** of the processes **P**, **Q** or **R** involves nitrification?

(1)

(b) The diagram above includes one process in which microorganisms add ammonium ions to soil.

Describe another process carried out by microorganisms which adds ammonium ions to soil.

.....

.....

.....

.....

.....

(2)

(c) Denitrification requires anaerobic conditions. Ploughing aerates the soil. Explain how ploughing would affect the fertility of the soil.

.....

.....

.....

.....

.....

(2)

(d) One farming practice used to maintain high crop yields is crop rotation. This involves growing a different crop each year in the same field.

Suggest **two** ways in which crop rotation may lead to high crop yields.

1 .....

.....

.....

2 .....

.....

.....

(2)
(Total 7 marks)

Q2. Scientists investigated the effect of a mycorrhizal fungus on the growth of pea plants with a nitrate fertiliser or an ammonium fertiliser. The fertilisers were identical, except for nitrate or ammonium.

The scientists took pea seeds and sterilised their surfaces. They planted the seeds in soil that had been heated to 85 °C for 2 days before use. The soil was sand that contained no mineral ions useful to the plants.

(a) Explain why the scientists sterilised the surfaces of the seeds and grew them in soil that had been heated to 85 °C for 2 days.

.....

.....

.....

.....

(2)

(b) Explain why it was important that the soil contained no mineral ions useful to the plants.

.....

.....

(1)

The pea plants were divided into four groups, **A**, **B**, **C** and **D**.

- **Group A** – heat-treated mycorrhizal fungus added, nitrate fertiliser
- **Group B** – mycorrhizal fungus added, nitrate fertiliser
- **Group C** – heat-treated mycorrhizal fungus added, ammonium fertiliser
- **Group D** – mycorrhizal fungus added, ammonium fertiliser

The heat-treated fungus had been heated to 120 °C for 1 hour.

(c) Explain how groups **A** and **C** act as controls.

.....

.....

.....

.....

(2)

After 6 weeks, the scientists removed the plants from the soil and cut the roots from the shoots. They dried the plant material in an oven at 90 °C for 3 days. They then determined the mean dry masses of the roots and shoots of each group of pea plants.

(d) Suggest what the scientists should have done during the drying process to be sure that all of the water had been removed from the plant samples.

.....

.....

.....

.....

(2)

The scientists' results are shown in the table below.

Treatment	**Mean dry mass / g per plant (standard deviation)**	
	Root	**Shoot**
A – heat-treated fungus and nitrate fertiliser	0.40 (±0.05)	1.01 (±0.12)
B – fungus and nitrate fertiliser	1.61 (±0.28)	9.81 (±0.33)
C – heat-treated fungus and ammonium fertiliser	0.34 (±0.03)	0.96 (±0.26)
D – fungus and ammonium fertiliser	0.96 (±0.18)	4.01 (±0.47)

(e) What conclusions can be drawn from the data in the table about the following?

The effects of the fungus on growth of the pea plants.

.....

.....

.....

.....

The effects of nitrate fertiliser and ammonium fertiliser on growth of the pea plants.

.....

.....

.....

.....

(4)

The scientists determined the dry mass of the roots and shoots separately. The reason for this was they were interested in the ratio of shoot to root growth of pea plants. It is the shoot of the pea plant that is harvested for commercial purposes.

(f) Explain why determination of dry mass was an appropriate method to use in this investigation.

.....

.....

.....

.....

(2)

(g) Which treatment gave the best result in commercial terms? Justify your answer.

.....

.....

.....

.....

(2)
(Total 15 marks)

Q3. Upwelling is a process where water moves from deeper parts of the sea to the surface. This water contains a lot of nutrients from the remains of dead organisms.

(a) (i) Nitrates and phosphates are two of these nutrients. They provide a source of nitrogen and phosphorus for cells.

Give a biological molecule that contains:

1. nitrogen .....

2. phosphorus.....

(2)

(ii) Describe the role of microorganisms in producing nitrates from the remains of

dead organisms.

.....

.....

.....

.....

.....

.....

(Extra space) .....

.....

.....

(3)

(b) Upwelling often results in high primary productivity in coastal waters.
Explain why some of the most productive fishing areas are found in coastal waters.

.....

.....

.....

.....

(2)
(Total 7 marks)

Q4. During the light-independent reaction of photosynthesis, carbon dioxide is converted into organic substances. Describe how.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Extra space) .....

.....

.....

.....

.....

.....

.....

.....

.....

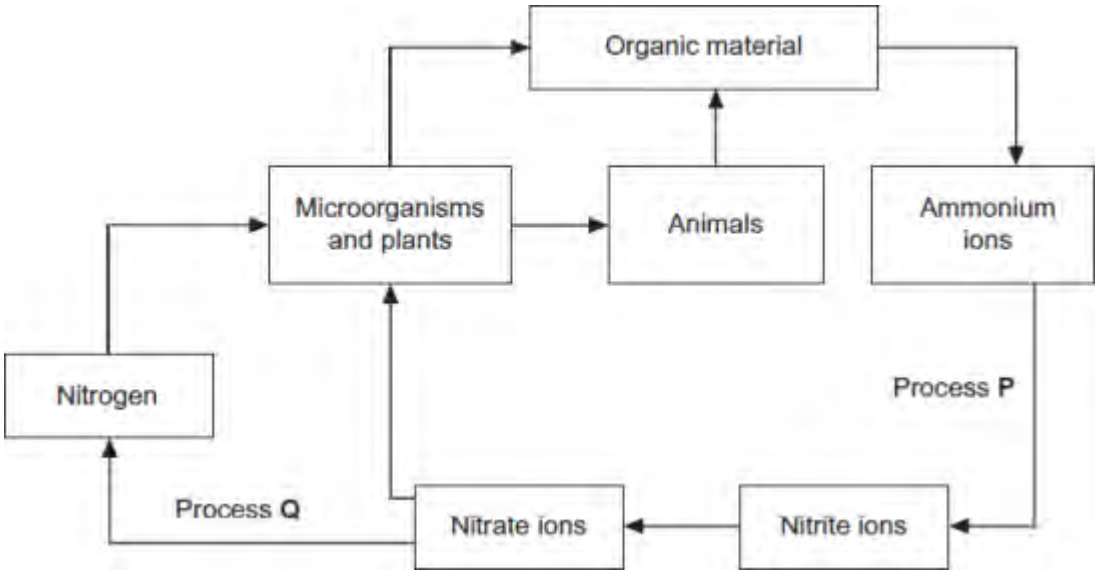
.....

(Total 6 marks)

Q5. Nitrate from fertiliser applied to crops may enter ponds and lakes. Explain how nitrate may cause the death of fish in fresh water.

(Total 5 marks)

Q6. The diagram shows the nitrogen cycle.



(a) (i) Name process **P**.

.....

(1)

(ii) Name process **Q**.

.....

(1)

(b) Leguminous crop plants have nitrogen-fixing bacteria in nodules on their roots. On soils with a low concentration of nitrate ions, leguminous crops often grow better than other types of crop. Explain why.

.....

.....

.....

.....

.....

(2)

(c) Applying very high concentrations of fertiliser to the soil can reduce plant growth. Use your knowledge of water potential to explain why.

.....

.....

.....

.....

.....

(2)
(Total 6 marks)