1 **(a** List four chemical elements that are found in proteins.

1. .....

2. .....

3. .....

4. ..... [4]

Fig. 6.1 is a photograph of some root nodules from a pea plant, which is a type of legume.

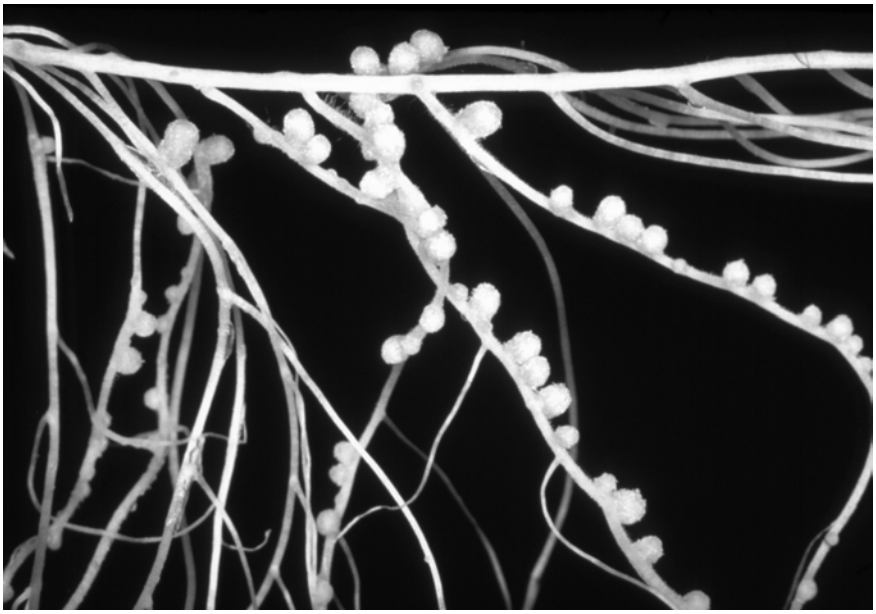

Fig. 6.1

(b) Nodules like those in Fig. 6.1 develop on the roots of pea plants and other legumes when the soil is lacking in nitrate ions.

Explain what happens inside the nodule to help legume plants grow in soils lacking nitrate ions.

.....

.....

.....

.....

.....

..... [3]

(c) After the peas have been harvested, the plants are ploughed back into the soil.

Describe what happens in the soil to convert dead plant material into nitrate ions that plants can absorb.

.....

.....

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.....

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.....

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.....

.....

..... [6]

(d) Nutrients in the soil can act as a limiting factor for crop growth.

List three **other** factors that may limit the growth of a crop plant.

1. .....
2. .....
3. ..... [3]

(e) The soya bean aphid is an insect pest of soya bean plants in North America. The aphids can show an exponential growth rate where populations can double in two to three days under favourable conditions.

Fig. 6.2 shows the growth of soya bean aphids in a field in North America during the growing season.

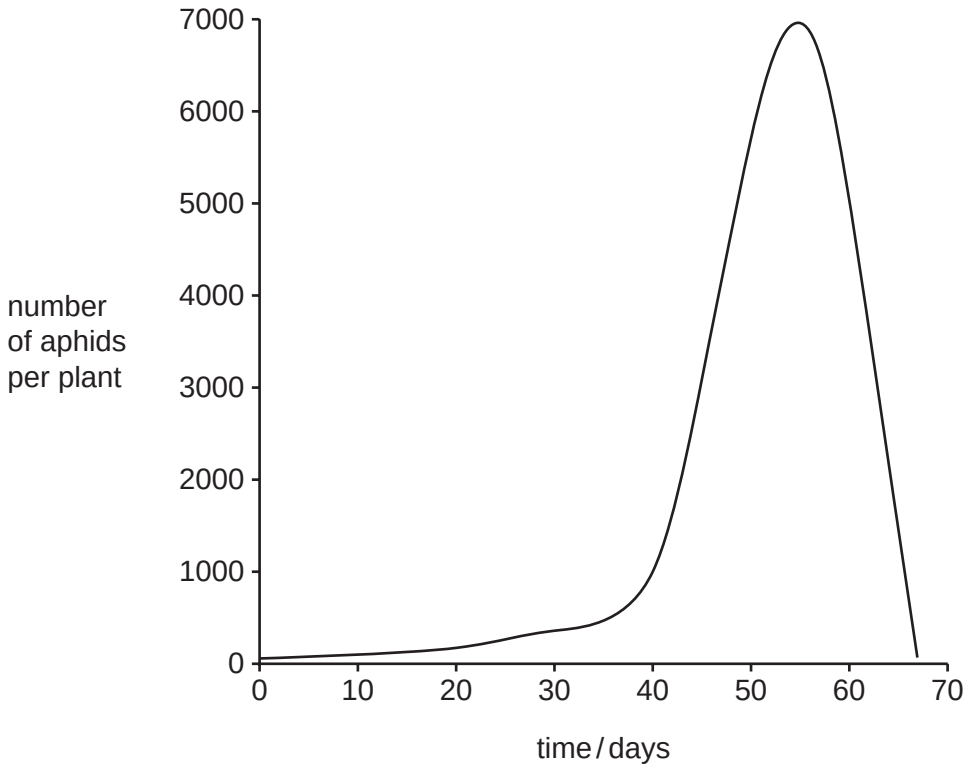

Fig. 6.2

Suggest why the population of aphids did not increase rapidly until about day 40.

.....

.....

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.....

.....

..... [3]

[Total: 19]

2 Table 5.1 shows the energy reserves for skeletal muscles in an athlete.

Table 5.1

energy reserve	mass / g	energy / kJ	time the reserve would last / min	
			walking	marathon running
blood glucose	3	48	4	1
liver glycogen	100	1660	86	20
muscle glycogen	350	5800		71
fat in skin	9000	337 500	15 500	4018

(a) (Compare the effect of walking and marathon running on energy reserves.

.....

..... [2]

(ii) Suggest which two energy reserves would be most readily available to muscles during exercise.

1. .....

2. ..... [1]

(iii) Underline the **two** food groups to which the energy reserves in Table 5.1 belong.

protein fibre fat carbohydrate [1]

(iv) Calculate the energy per gram of glycogen.

Show your working.

energy = ... kJ [2]

(b) Suggest why athletes eat foods high in

(i) proteins, during training;

.....

..... [1]

(ii) carbohydrates, for three days before a marathon race.

.....

.....

..... [2]

(c) During a fast race (a 100 metre sprint), 95% of the energy comes from anaerobic respiration.

During a marathon, only 2% of the energy comes from anaerobic respiration.

(i) State the equation, in symbols, for anaerobic respiration in muscles.

..... [2]

(ii) Suggest and explain why a sprinter can use mainly anaerobic respiration during the race, while a marathon runner needs to use aerobic respiration.

.....

.....

.....

.....

..... [4]

(iii) Explain how, during a marathon race, the blood glucose concentration stays fairly constant, but the mass of glycogen in the liver decreases.

.....

.....

..... [2]

[Total: 17]