1 Moose, *Alces americanus*, shown in Fig. 6.1, are large herbivores that primarily live in northern parts of North America. They have a varied diet that includes young shoots of willow trees and aquatic plants.

Fig. 6.1

Isle Royale is a large island in Lake Superior in the United States where there is a population of moose that has been studied by ecologists for a long time. The animals' only predator is the wolf. The island has a population of wolves that has changed in numbers over the years.

(a) (i) Draw a food chain for the organisms in the passages above.

[2]

(ii) Complete Table 6.1 by stating the name and identifying the trophic level of each organism in the food chain.

Table 6.1

name of organism	trophic level

[3]

(iii) State **two** factors that influence the numbers of a top predator, such as wolves.

1 .....

2 .....

[2]

(b) In the 1970s, the American ecologist Paul Colinvaux investigated the energy flow between moose and wolves.

His results are summarised in Table 6.2.

Table 6.2

energy input or output or energy flow	energy / MJ
consumed by moose	4 320 000
respiration of moose	380 000
consumed by wolves	56 000
respiration of wolves	53 000

(i) Calculate the percentage of the energy obtained by the moose that is consumed by the wolves. Show your working.

..... % [2]

(ii) Explain why the number of wolves on Isle Royale has never risen above 50 while the highest number of moose recorded is 2450.

.....

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.....

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.....[5]

[Total: 14]

2 The human population is growing rapidly. This is increasing the pressure on the world food supply.

(a) Name the rapid growth phase of any population of organisms.

..... [1]

In Canada farmers are breeding fish in large nets because the wild stocks of fish are decreasing. Fig. 6.1 is a diagram of a salmon fish farm in the ocean. The salmon only eat the food provided by the worker.

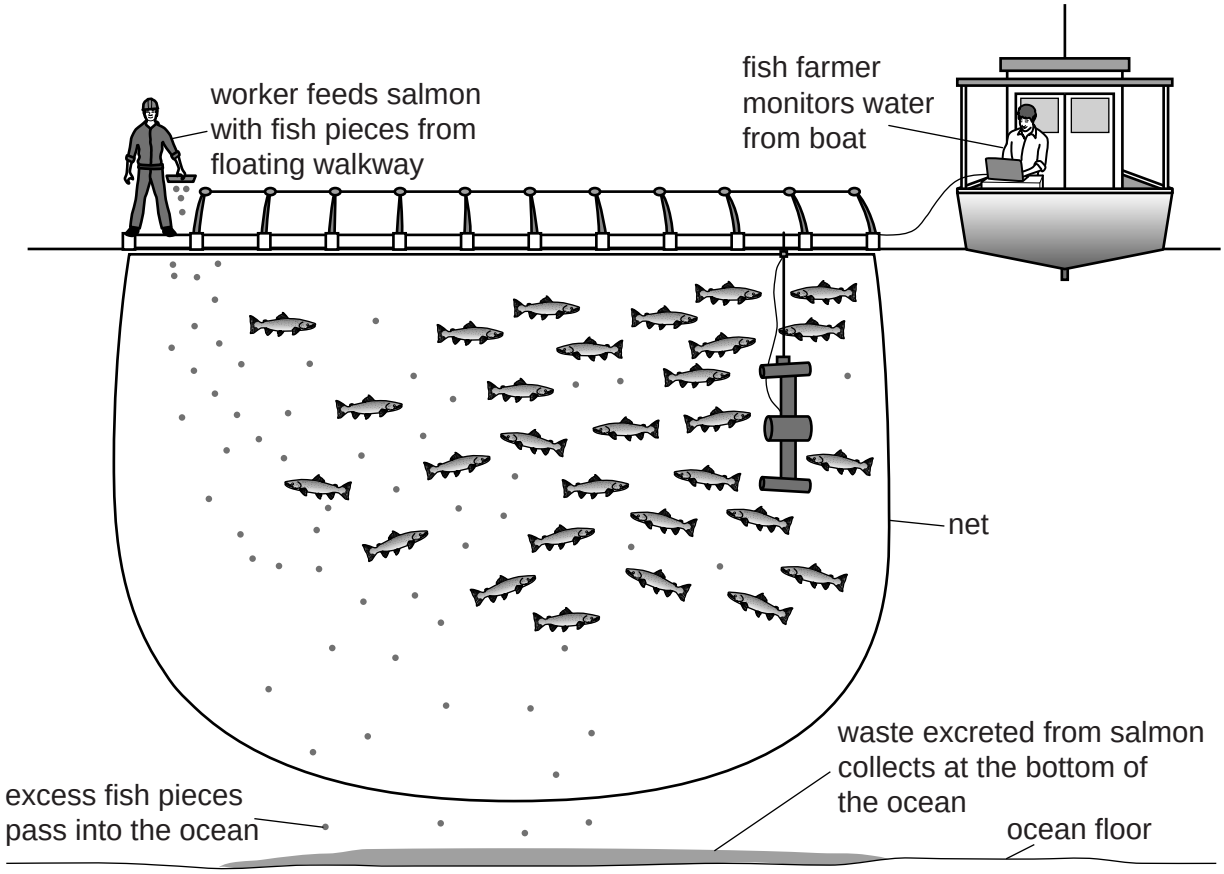

Fig. 6.1

(b) Explain the effects of the excess fish pieces and waste excreted from the salmon on the environment.

.....

.....

.....

.....

.....

.....

..... [3]

(c) State the lowest possible trophic level of the salmon shown in Fig. 6.1.

..... [1]

(d) Other farmers grow seaweed. Salmon farming is a less energy efficient way of producing food for humans than seaweed farming.

Explain why.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 8]

3 The pea plant, *Pisum sativum*, is a legume which is grown both as a human food and as livestock feed.

Fig. 6.1 shows some of the root nodules on a pea plant.

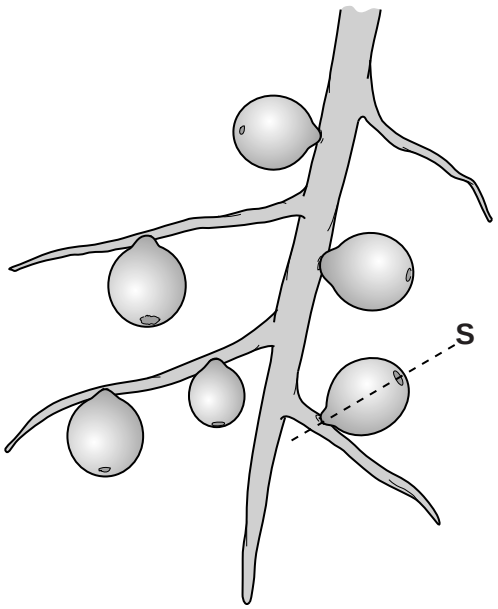

Fig. 6.1

Fig. 6.2 shows a cross-section through the root nodule at **S** on Fig. 6.1.

T indicates the transport tissue in the root.

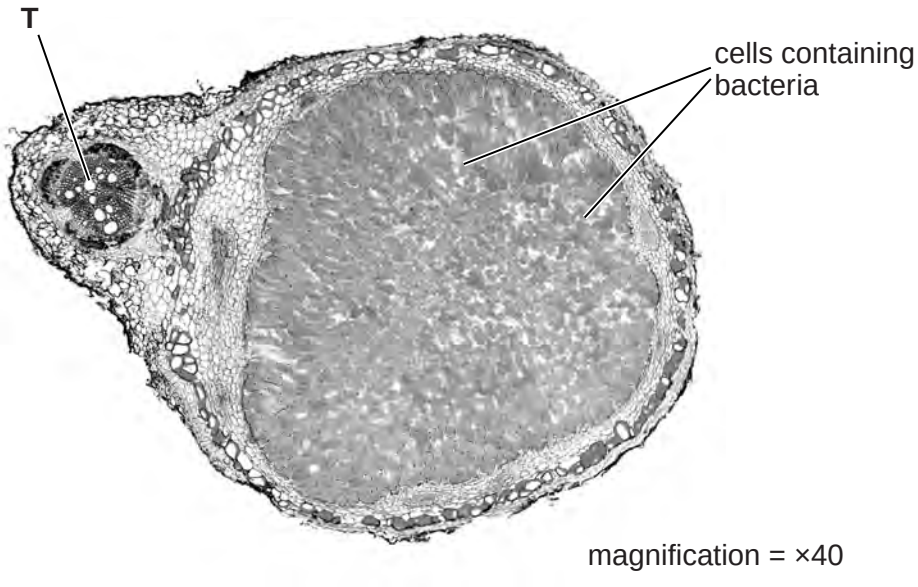

Fig. 6.2

(a) The maximum diameter of the root nodule in Fig. 6.2 is 73 mm.

Calculate the actual diameter of the root nodule.

actual diameter ..... [1]

(b) Describe the role of the bacteria in the root nodules of *P. sativum*.

.....

.....

.....

.....

.....[2]

(c) The bacteria require carbohydrates that are supplied by the pea plant.

Describe how the carbohydrates are produced and transported by the plant to the bacteria.

(i) produced

.....

.....

.....

.....[2]

(ii) transported

.....

.....

.....

.....[2]

(d) Pea plants grow well in soils that are deficient in nitrogen.

Explain how root hair cells of pea plants absorb nitrate ions from soils with low nitrate concentrations.

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.....[2]

[Total: 9]

4 Fig. 1.1 shows the change in the biomass of the fungus *Penicillium* when grown in a fermenter to produce the antibiotic penicillin.

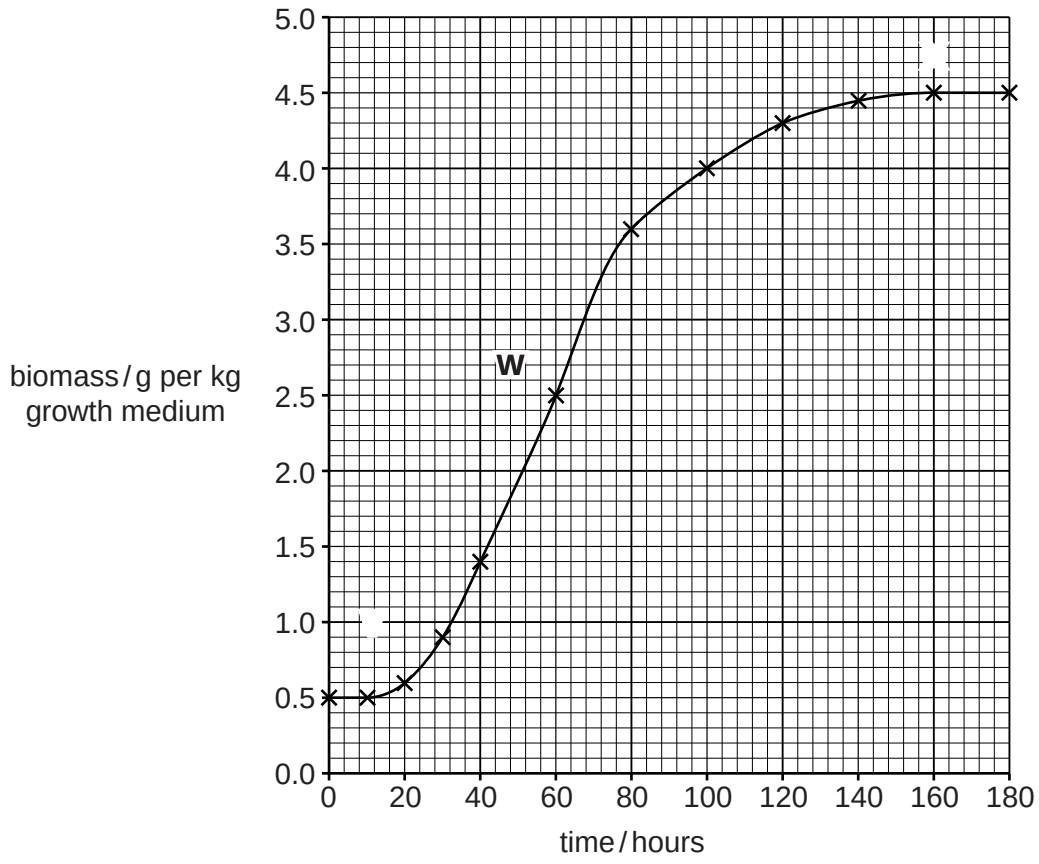

Fig. 1.1

(a) Name the stages in the growth of *Penicillium* indicated by **V**, **W** and **X**.

V .....

W .....

X ..... [3]

(b) State **two** factors that are kept constant when *Penicillium* is grown in a fermenter.

1 .....

2 ..... [2]

(c) Suggest why the growth of *Penicillium* is measured in biomass rather than numbers of cells.

.....

..... [1]

[Total: 6]