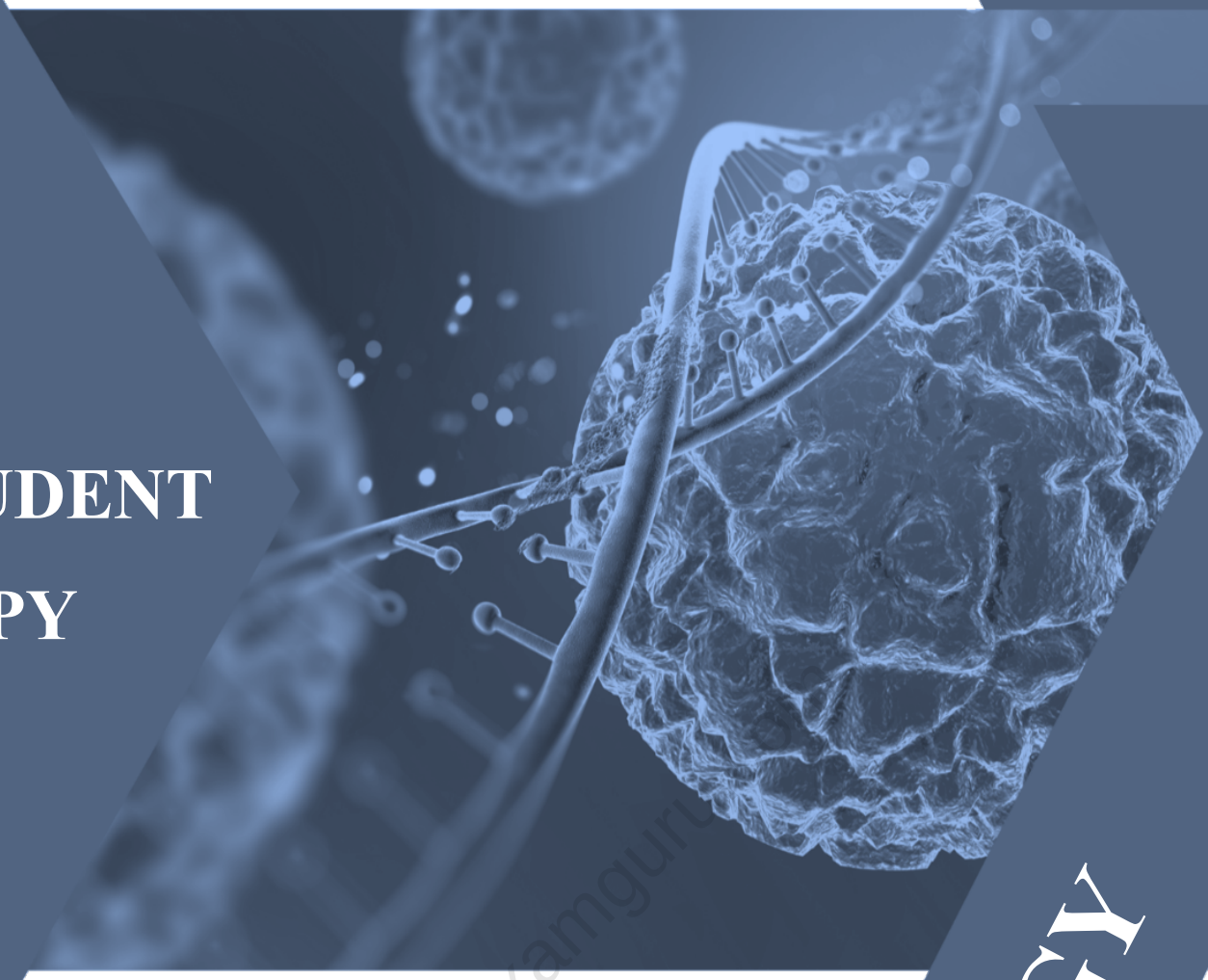

STUDENT COPY

HEADS-UP
REACH FOR THE STARS

IGCSE BIOLOGY

TOPICAL PRACTICE QUESTIONS

PAPER 4

VOL. 6

2020 EDITION

CHAPTERS 19-20

1 The Galápagos Islands in the Pacific Ocean have many species of animals and plants that live nowhere else. Iguanas are large herbivorous reptiles. Four species of iguana live on the Galápagos Islands:

- marine iguana, *Amblyrhynchus cristatus*
- land iguana, *Conolophus subcristatus*
- Santa Fe land iguana, *Conolophus pallidus*
- pink land iguana, *Conolophus rosada*

Fig. 2.1 shows a marine iguana.

Fig. 2.1

(a) Reptiles and mammals are both vertebrates.

State three features of mammals that are **not** found in reptiles.

1 .....

2 .....

3 ..... [3]

(b) The marine iguana, *A. cristatus*, feeds on seaweed and must therefore dive several metres into the cold waters that surround the Galápagos Islands. Iguanas can only stay in the water for a short length of time, until their body temperature drops too low. Mammals of an equivalent size, such as sea otters, can stay in cold water for a long time.

Explain how some mammals are able to stay in cold water for a long time.

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..... [5]

Land iguanas live on Isabela, the largest island in the Galápagos. In 1986, some rangers from the Galápagos National Park found a population of pink land iguanas living at the northern end of the island. These iguanas have been studied in detail and are now classified as a new species, *C. rosada*.

(c) Define the term *population*.

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..... [2]

(d) Suggest how a study of the DNA of iguanas helps to classify them.

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..... [1]

(e) The International Union for the Conservation of Nature describes these iguanas as vulnerable. This means that their populations are likely to become extinct.

Suggest two reasons why it is important to conserve individual species, such as the four species of iguana on the Galápagos Islands.

1 .....

.....

2 .....

..... [2]

[Total: 13]

2 The red slender loris, *Loris tardigradus*, is a nocturnal mammal that feeds at night on flowers, fruit and a variety of small animals. It is found in forest ecosystems in South Asia.

Fig. 3.1 shows a red slender loris.

Fig. 3.1

(a) Explain the meaning of the term *ecosystem*.

.....

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..... [2]

(b) State three ways in which mammals, such as the red slender loris, differ from other groups of vertebrates.

1 .....

2 .....

3 ..... [3]

(c) The large eyes of the red slender loris show that it is well adapted for a nocturnal way of life.

Suggest other features that the animal is likely to have that are adaptations to being active at night.

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..... [2]

Two species of slender loris are found in Sri Lanka, the grey slender loris, *L. lydekkerianus*, and *L. tardigradus*.

The International Union for Conservation of Nature describes the red slender loris as endangered. Horton Plains National Park in Sri Lanka is one of the few places where *L. tardigradus* is found.

(d) Discuss why areas of land, such as the Horton Plains National Park, must be conserved.

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..... [4]

(e) State how scientists could show that two populations of slender loris belong to the same species or to two different species.

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..... [1]

[Total: 12]

3 Fig. 2.1 shows the flow of energy through a natural ecosystem that is **not** used by humans at any of the trophic levels.

The unit of energy flow is kJ per m^2 per year.

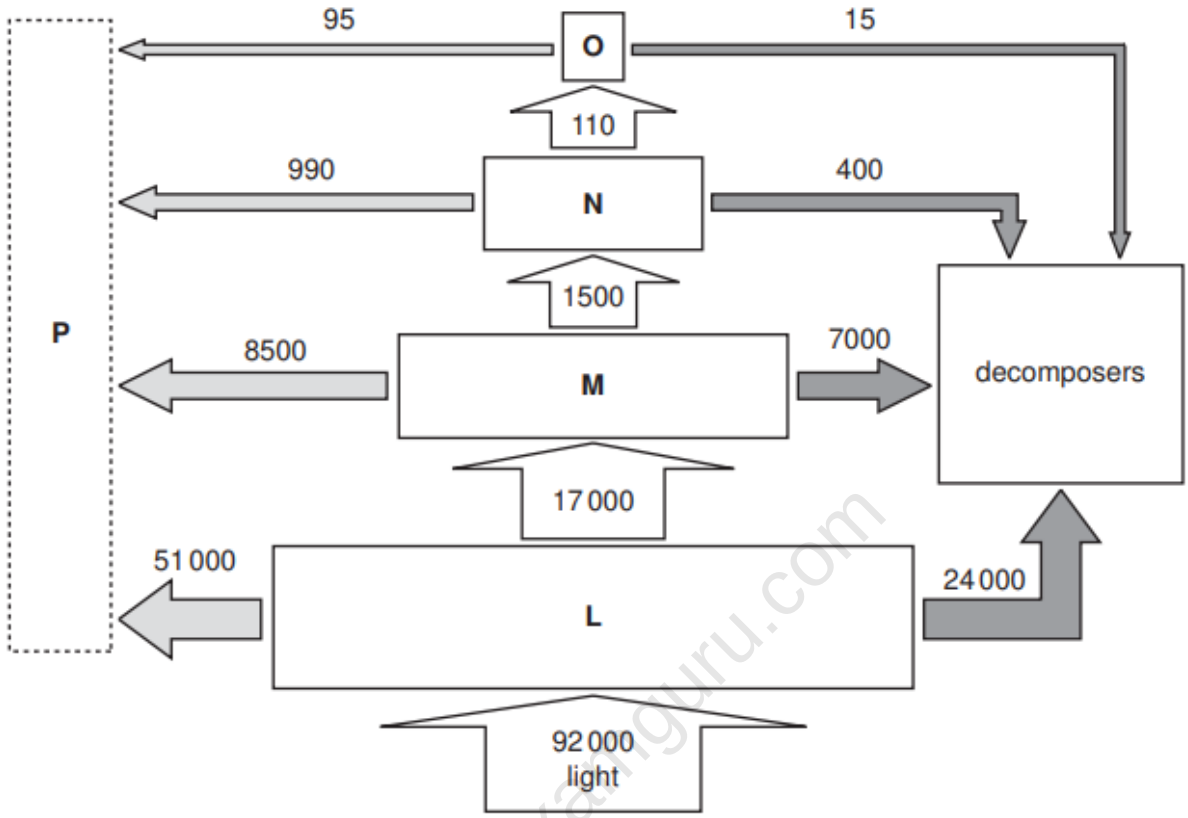

Fig. 2.1

(a) The letters **L** to **O** represent the different trophic levels in the ecosystem.

(i) Name the first and third trophic levels, **L** and **N**.

L .....

N ..... [2]

(ii) Suggest what is shown by the relative sizes of the boxes, **L** to **O**, in the energy flow diagram in Fig. 2.1.

..... [1]

(iii) There are no predators in the ecosystem feeding on the animals in trophic level **O**.

Suggest **and** explain why there are no predators in the ecosystem feeding on the animals in trophic level **O**.

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..... [3]

(iv) **P** in Fig. 2.1 does **not** represent any organisms.

Explain what **P** represents in the energy flow diagram.

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..... [2]

(b) People who live near this ecosystem **would like** to use some of the organisms at trophic level **M** for food.

Suggest **and** explain what might happen to the ecosystem if the people took too many of the organisms at trophic level **M**.

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..... [3]

[Total: 11]

4 Bacteria and animals are found in many habitats on land and in the sea.

(a) State **two** ways in which the structure of a bacterial cell differs from the structure of an animal cell.

1 .....

2 ..... [2]

(b) Some bacteria were grown in the laboratory. Fig. 6.1 shows the change in numbers of bacteria when grown in a closed flask containing nutrients and oxygen.

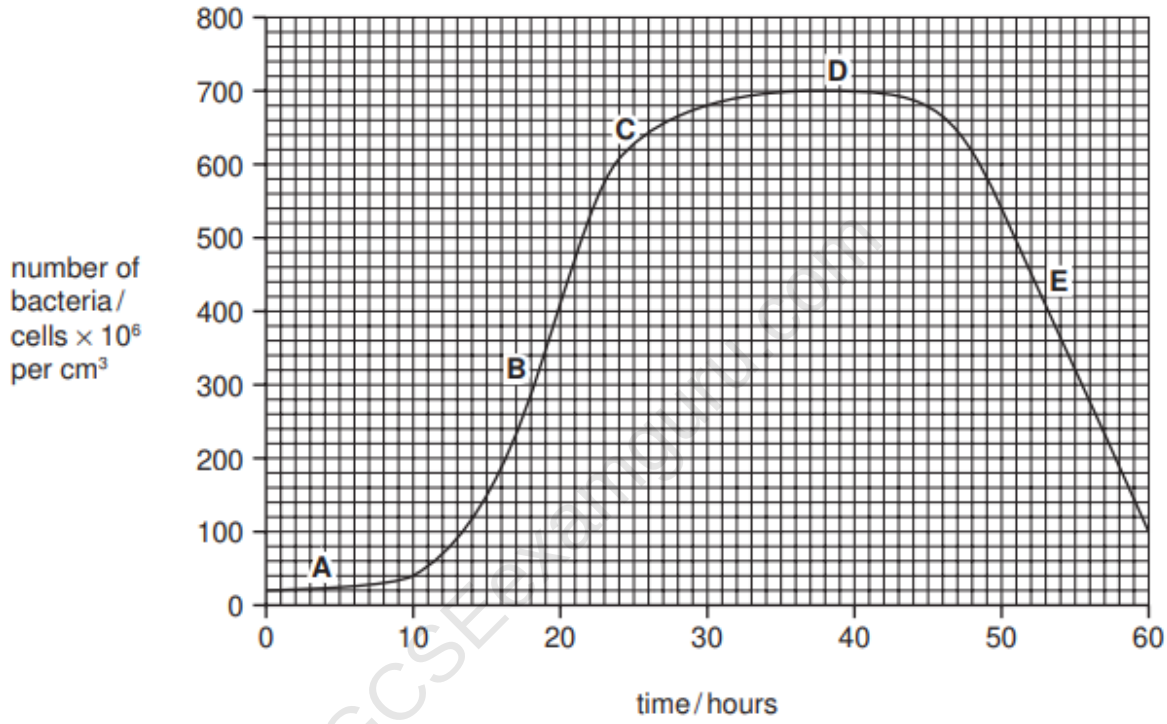

Fig. 6.1

(i) Name the phases of growth, **A** and **B**.

A .....

B ..... [2]

(ii) Explain why the numbers of bacteria do not change in phase **D and** decrease in phase **E**.

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..... [3]

(c) Fig. 6.2 shows the vent crab, *Bythograea thermydron*, which lives at great depths in the sea where there is no light.

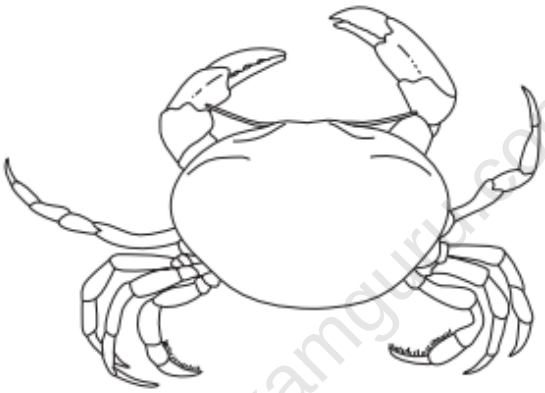

Fig. 6.2

(i) State **one** feature, **visible** in Fig. 6.2, that show that *B. thermydron* is an arthropod.

..... [1]

(ii) Although most species of crabs are red, brown or green, *B. thermydron* is white.

Suggest **and** explain how white crabs evolved at great depths in the sea.

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..... [4]

[Total: 12]

5 Fanwort, *Cabomba caroliniana*, is an aquatic plant often used to provide oxygen in fish tanks.

Some students investigated the effect of temperature on the rate of photosynthesis of *C. caroliniana*. The apparatus that they used is shown in Fig. 2.1.

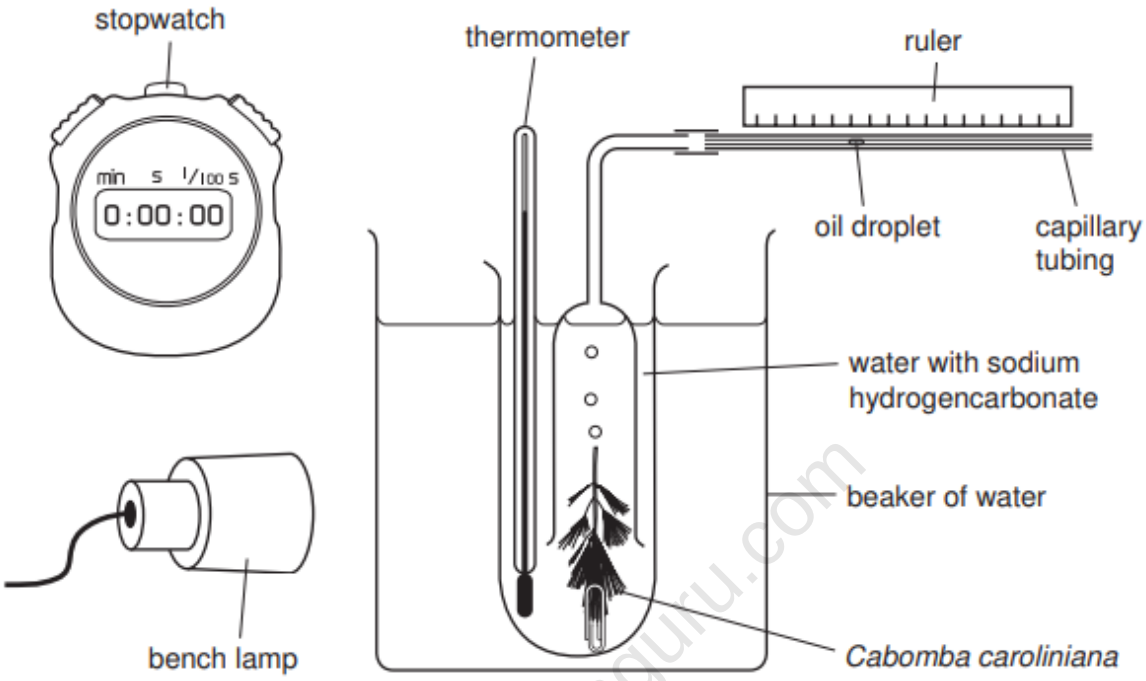

Fig. 2.1

(a) Explain why:

(i) the lamp was kept at the same distance from the *C. caroliniana* throughout the investigation;

.....

.....

.....

..... [2]

(ii) the water was enriched with carbon dioxide by adding sodium hydrogencarbonate.

.....

.....

.....

..... [2]

The students determined the rate of photosynthesis by measuring the movement of the oil droplet along the glass tubing.

Their results are shown in Table 2.1.

Table 2.1

temperature / °C	distance travelled by the droplet / mm per minute			
	1	2	3	mean
17	5	3	3	3.7
21	10	15	11	12.0
23	20	10	15	15.0
25	30	15	15	20.0
30	50	40	30	40.0
45	5	3	5	4.3
50	1	0	1	0.7

(b) Describe the effect of temperature on the **rate of photosynthesis** of *C. caroliniana*.

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..... [3]

(c) Photosynthesis is a chemical process catalysed by enzymes.

Explain how the results shown in Table 2.1 support the idea that enzymes are involved in photosynthesis.

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..... [4]

(d) *C. caroliniana* originally grew only in Latin America.

This plant has escaped into the wild in Australia where its rapid growth has reduced the biodiversity of many streams and rivers.

Suggest why the growth of *C. caroliniana* in Australia is far greater than in Latin America.

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..... [2]

[Total: 13]

6 Many biologists study populations of organisms in their natural habitats.

(a) Define the term *population*.

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..... [2]

(b) A 10-year study was carried out to investigate the relationship between voles and owls. Voles are small mouse-like mammals and owls are carnivorous birds.

The results are shown in Fig. 6.1 and Fig. 6.2.

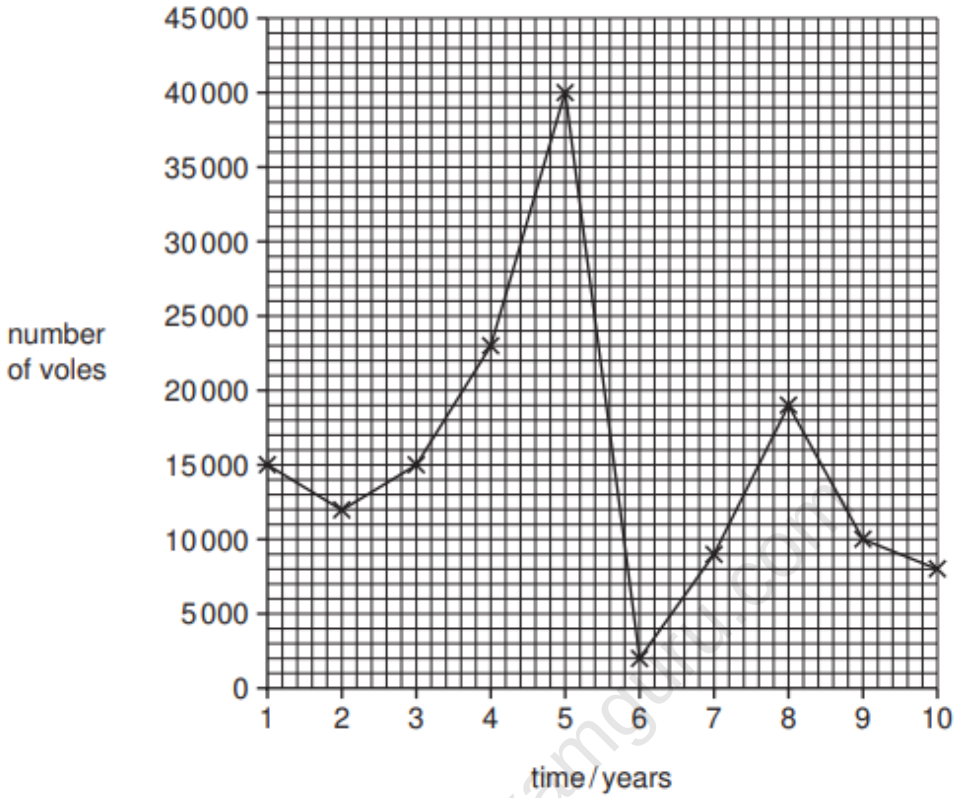

Fig. 6.1

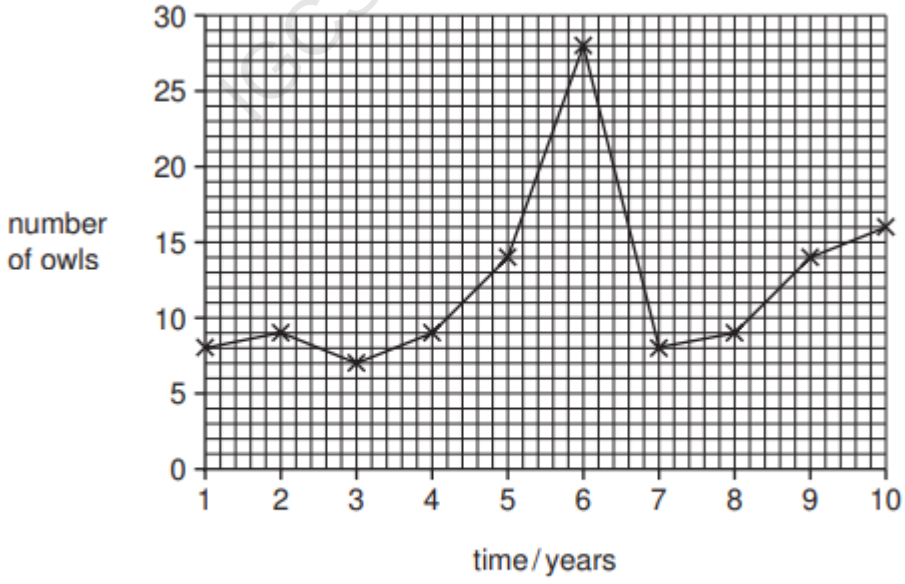

Fig. 6.2

(i) Suggest **three** reasons for the decrease in the population of voles between years 5 and 6.

1 .....

.....

2 .....

.....

3 .....

..... [3]

(ii) State the evidence from Fig. 6.1 and Fig. 6.2 that supports the idea that voles form a large part of the food eaten by owls.

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..... [2]

[Total: 7]

7 Crabs are classified, along with prawns, shrimps and lobsters, as crustaceans. Most crabs live in the sea, although some live in freshwater and there are a few land-dwelling crabs.

Fig. 1.1 shows the structure of a typical crab.

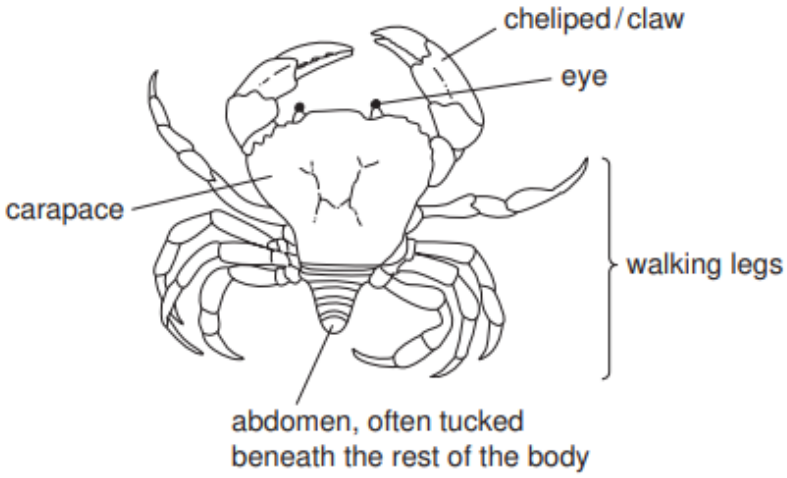
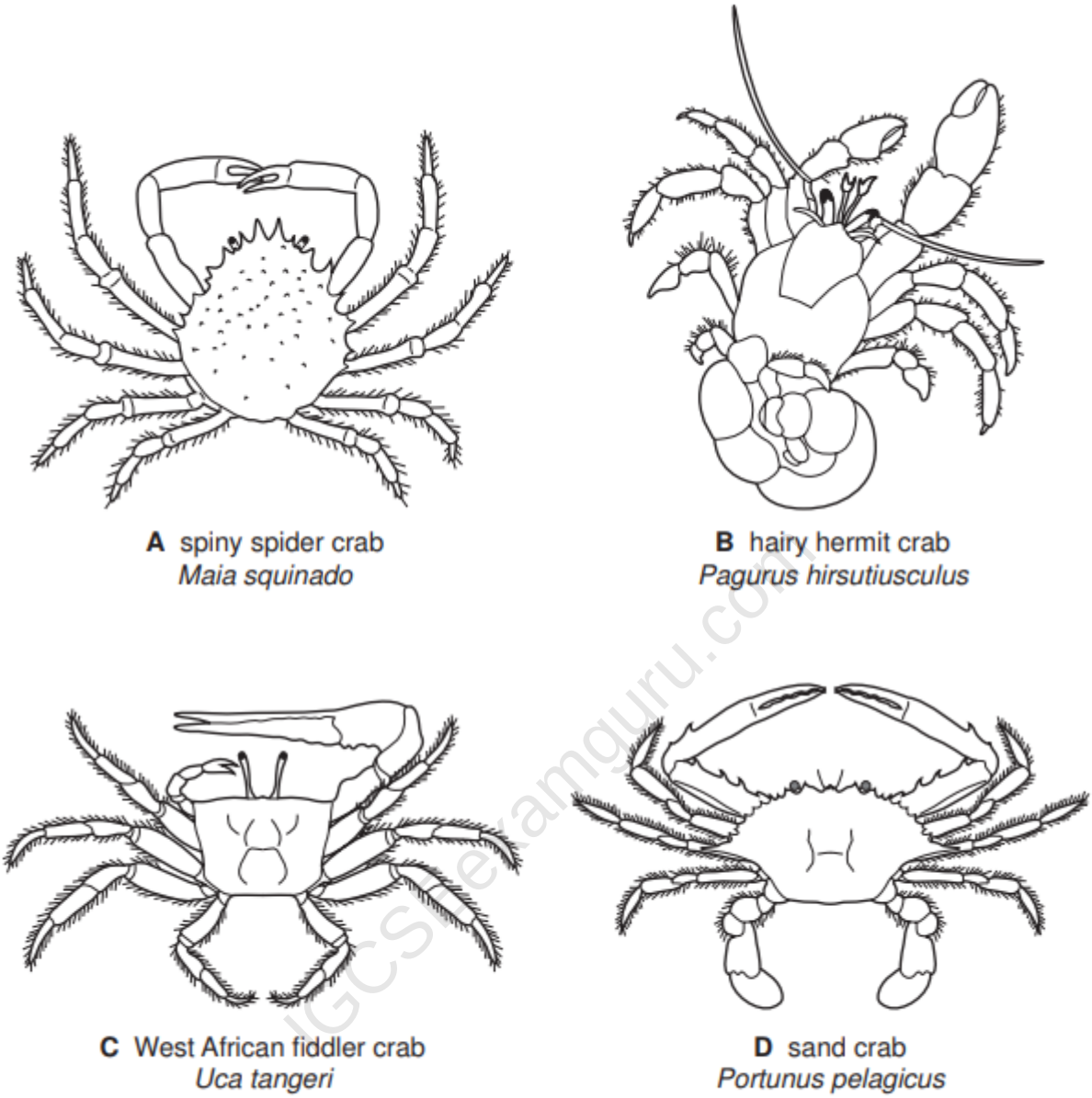


Fig. 1.1

(a) State the group of animals that includes crustaceans, insects, arachnids and myriapods.

..... [1]

Fig. 1.2 shows four different species of crab.



A spiny spider crab
Maia squinado

B hairy hermit crab
Pagurus hirsutiusculus

C West African fiddler crab
Uca tangeri

D sand crab
Portunus pelagicus

Fig. 1.2

(b) Biologists use dichotomous keys to identify different species.

Use Fig. 1.1 and Fig. 1.2 to state **one visible** feature of each species of crab **A**, **B**, **C** and **D**, that could be used in a dichotomous key to identify crabs.

A .....

.....

B .....

.....

C .....

.....

D .....

..... [4]

(c) Crabs show variation in many features.

(i) State **one** feature of crabs that shows **continuous variation**.

..... [1]

(ii) Describe how you would measure variation in the feature you have given in **(i)**.

.....

..... [1]

(d) Crabs produce huge numbers of offspring, but their populations remain fairly constant from year to year.

Explain why.

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..... [3]

(e) Emergency medical packs contain bandages made from chitosan.

Chitosan comes from the exoskeleton of crustaceans and has a positive charge to attract red blood cells. It helps blood clot quickly and also has antibacterial properties.

Explain the benefits of using bandages made from chitosan.

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.....

.....

..... [3]

[Total: 13]

8 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.

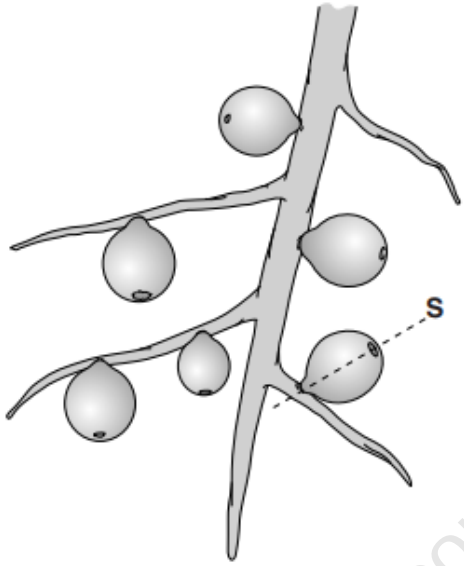

Fig. 6.1

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.

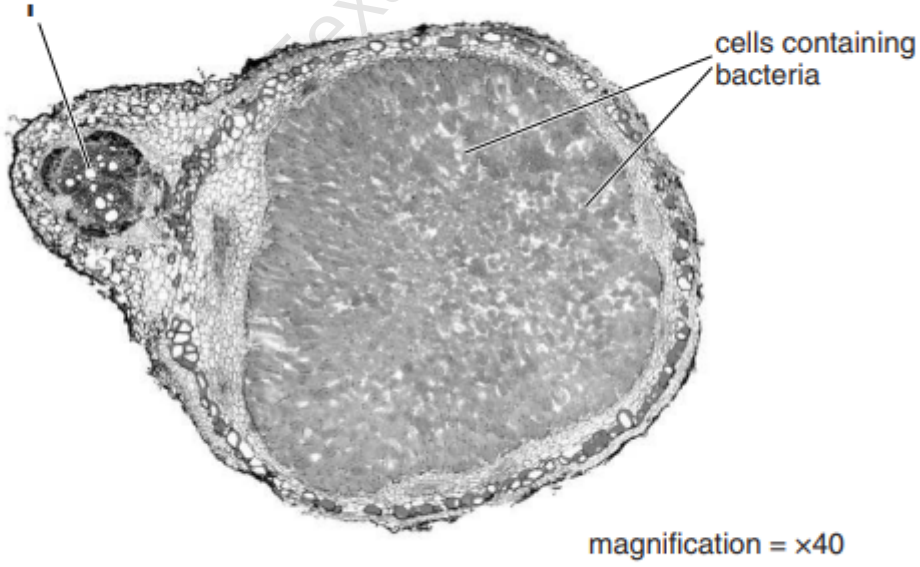

Fig. 6.2

(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*.

.....

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.....[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

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.....[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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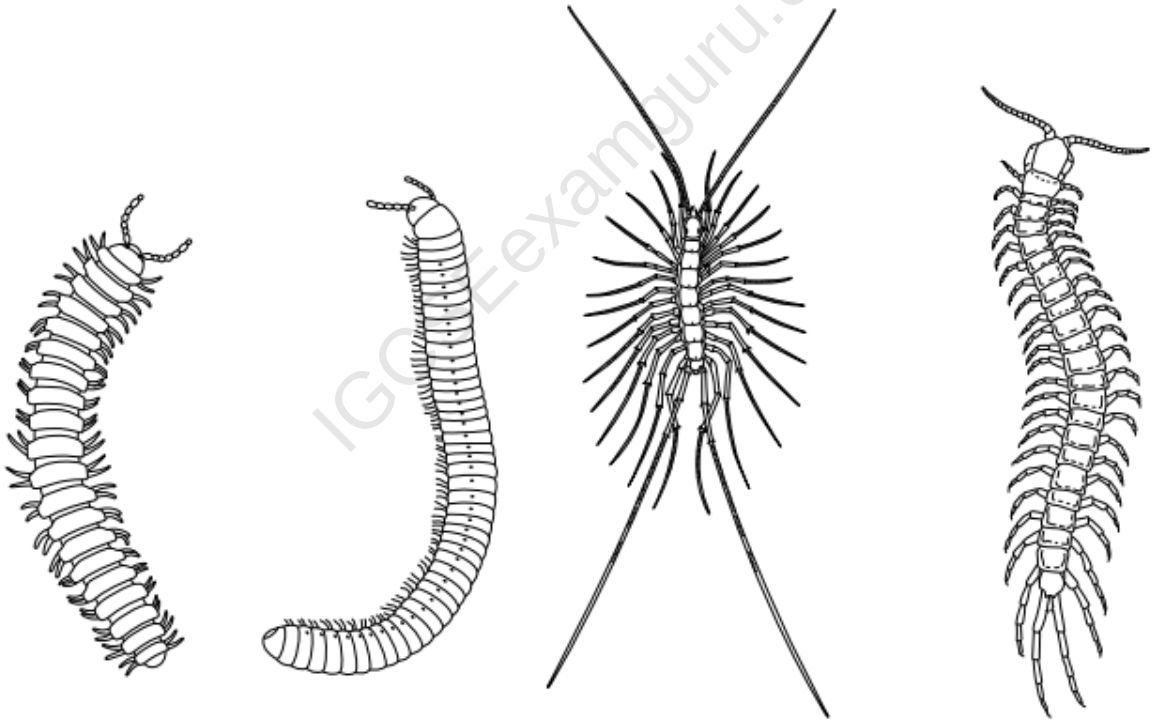
.....[2]

[Total: 9]

9 Myriapods are a group of arthropods that are commonly found in soil habitats in many parts of the world. Many myriapods are very small and not easy to identify.

Fig. 6.1 shows four species of myriapod, not drawn to the same scale.



Polydesmus denticulatus | *Cylindroiulus punctatus* | *Scutigera coleoptrata* | *Scolopocryptops sexspinosus*

Fig. 6.1

(a) State **three** features of **all** myriapods that are visible in Fig. 6.1.

1 .....

.....

2 .....

.....

3 .....

..... [3]

(b) Describe **three** features of myriapods that could be used to make a dichotomous key to distinguish between the four species in Fig. 6.1.

1 .....

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2 .....

.....

3 .....

..... [3]

(c) Mitochondria are cell structures that contain a small quantity of DNA.

Scientists are sequencing the DNA of one particular gene in mitochondria to help identify different species of many animals including myriapods. The sequences that they find are called 'barcodes'.

(i) State the part of the cell that contains most of the DNA.

..... [1]

(ii) Suggest how DNA barcoding might be useful in the conservation of animals, such as myriapods.

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.....

..... [2]

(iii) State the function of DNA in cells.

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..... [2]

(d) A student found the following information about the feeding relationships between some organisms in a soil habitat.

Dead organic matter, such as leaves, provides food for bacteria and soil fungi.

Earthworms eat dead leaves.

Many millipedes feed on dead plant matter and also on soil fungi.

Nematodes feed on bacteria and are eaten by springtails.

Centipedes are predators that feed on earthworms, millipedes and springtails.

(i) Draw a food web to show the feeding relationships described above.

[4]

(ii) Describe the roles of the soil organisms in the **carbon** cycle.

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.....

..... [2]

[Total: 17]

10 Microorganisms in the soil release enzymes to digest dead leaves.

(a) Explain how enzymes catalyse chemical reactions.

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.....

..... [3]

(b) Protease and cellulase are two enzymes secreted by soil microorganisms. Protease digests protein.

Suggest what part of the dead leaf cells are digested by the enzyme cellulase.

..... [1]

(c) Table 6.1 shows the results of a study comparing the decomposition of dead leaves at two locations **A** and **B**.

Table 6.1

	location **A**	location **B**
protease activity / μmol min^{-1}	2750	2670
cellulase activity / μmol min^{-1}	4790	2500
soil pH	6.0	3.5
soil water content / %	10	77

(i) Compare the enzyme activity at location **A** with the enzyme activity at location **B**.

You will gain credit for using the data from Table 6.1 to support your answer.

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.....

..... [3]

(ii) Suggest possible reasons for any differences in the enzyme activity at location **A** and location **B**.

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..... [3]

(d) Describe how nitrogen in proteins in dead leaves is recycled to be absorbed by plants.

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..... [4]

(e) Microorganisms also process and convert atmospheric nitrogen to form a nitrogen compound that can be absorbed by plants.

(i) Name this process of converting atmospheric nitrogen.

..... [1]

(ii) Explain how this process happens.

.....

.....

.....

.....

..... [2]

[Total: 17]

11 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	4320000
respiration of moose	380000
consumed by wolves	56000
respiration of wolves	53000

(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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.....[5]

[Total: 14]

Chapter 20: Biotechnology & Genetic Engineering

1 The fungus, *Trichophyton violaceum*, reproduces asexually by releasing spores.

A single spore was placed in the centre of a Petri dish containing an agar medium with starch and protein.

Fig. 1.1 shows the fungus that grew from the spore.

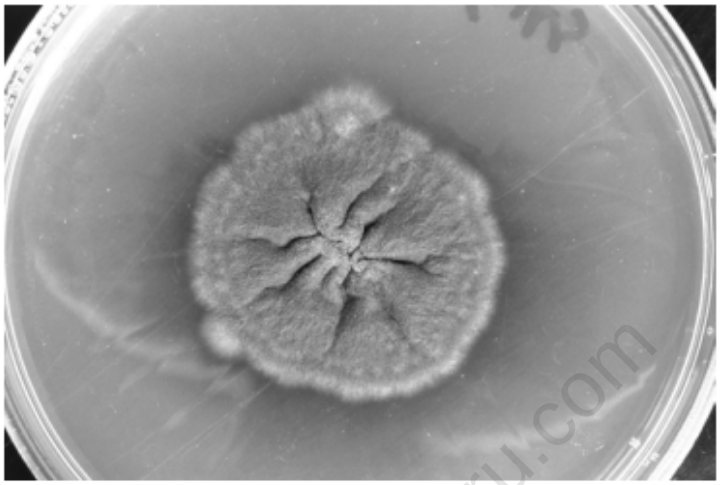

Fig. 1.1

(a) State the name given to

(i) the body of the fungus that grows from a single spore

..... [1]

(ii) the thin threads that make up the body of the fungus.

..... [1]

(b) Describe how a fungus, such as *T. violaceum*, obtains nutrients from the agar medium.

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..... [4]

Streptomyces, a soil bacterium, is a major source of antibiotics that are produced by pharmaceutical companies. An antibiotic sensitivity test can be carried out to help doctors decide which antibiotic should be used to treat a specific disease, such as gonorrhoea.

Gonorrhoea bacteria isolated from a person are grown on an agar medium. A ring with eight different antibiotics (**1** to **8**) is placed on the agar medium and left for 24 hours at 35 °C.

Fig. 1.2 shows the growth of bacteria on the agar medium after 24 hours.

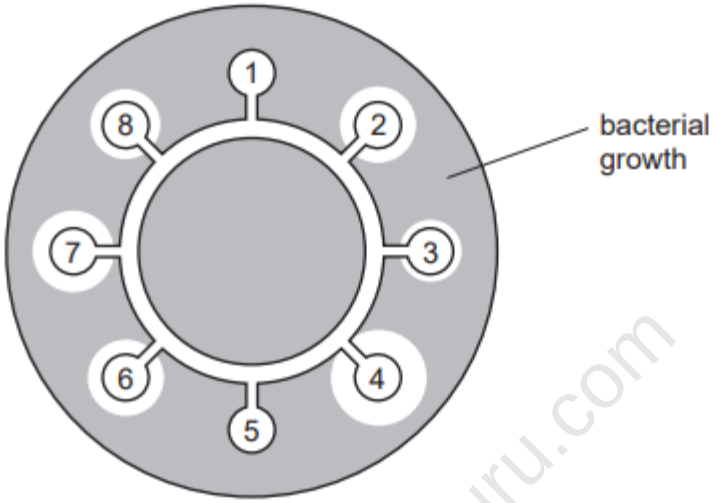

Fig. 1.2

(c) (i) Suggest why there is a clear area around some of the antibiotics.

.....

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.....

..... [2]

(ii) Explain why antibiotics **1** and **5** would **not** be chosen to treat the gonorrhoea infection.

.....

.....

.....

.....

..... [2]

(iii) People who take antibiotics should always be told to complete the treatment rather than stop taking the antibiotics when they feel better.

Suggest why people are given this advice.

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..... [2]

[Total: 12]

2 Mycoprotein is a form of single cell protein. It is produced by growing the fungus, *Fusarium venenatum*, in a fermenter. As the fungus grows in the fermenter it produces large quantities of hyphae which are extracted and processed as shown in Fig. 3.1.

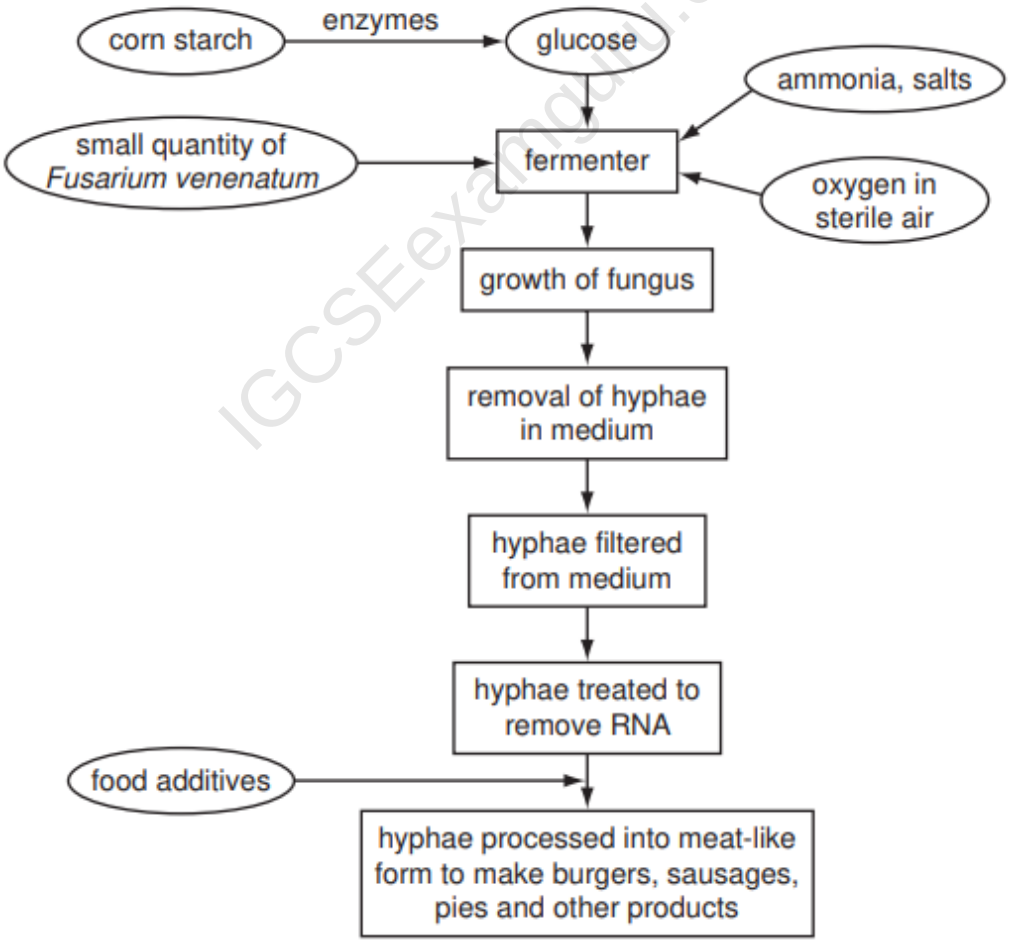

Fig. 3.1

(a) (i) Name an enzyme used to digest the corn starch.

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[1]

(ii) Explain why it is necessary to digest the corn starch.

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.....

[2]

(b) Explain why sterile conditions are necessary in the fermenter.

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[2]

In 2008, there were riots in some parts of the world in protest against shortages of staple foods, such as rice.

(c) Explain why it is better ecologically for people to eat foods made from plants rather than from animal products, such as meat.

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[3]

(d) Describe three possible advantages of using foods prepared from mycoprotein as substitutes for animal products, such as meat.

1 .....

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2 .....

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3 .....

..... [3]

(e) Discuss whether production of foods made from mycoprotein might **not** reduce food shortages in the future.

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..... [3]

[Total: 14]

3 **(a)** Starch, glucose and fructose are carbohydrates. Fructose syrup is used as a sweetening agent as an alternative to sucrose.

The flow chart in Fig. 3.1 shows how fructose is prepared from maize starch.

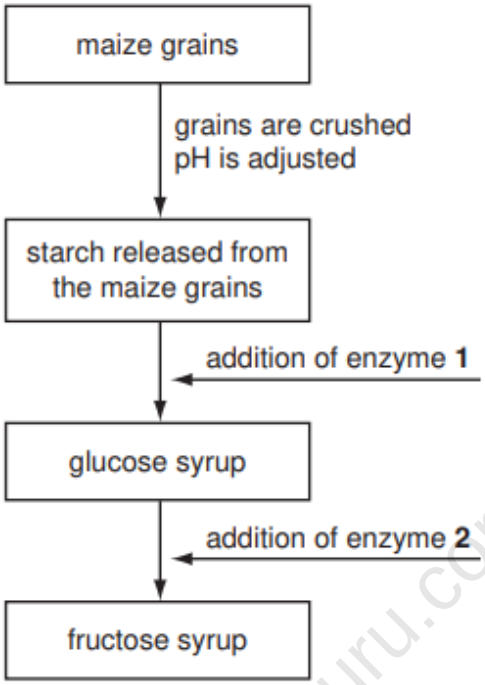

Fig. 3.1

(i) Name enzyme **1**.

.....[1]

(ii) State why it is necessary to adjust the pH before an enzyme is added to the process.

.....

.....[1]

(b) Maize grains contain protease enzymes. With reference to the processes shown in Fig. 3.1, suggest why it is important that these enzymes do not contaminate the glucose syrup.

.....

.....[1]

(c) The formation of fructose syrup from glucose syrup is carried out at a temperature of 60 °C.

Suggest an important property of enzyme **2** that allows it to be used at temperatures as high as 60 °C.

.....

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..... [1]

(d) Enzyme **2** is found naturally in many bacteria. Enzymes for use in washing powders are obtained from bacteria.

Describe how bacteria are used to produce enzymes for washing powders.

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..... [3]

(e) Pectinase is an enzyme that breaks down compounds known as pectins. Cell walls of fruits, such as apples and mangoes, contain pectins.

Explain the **advantages** of using pectinase in fruit juice production.

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.....

..... [3]

[Total: 10]

4 **(a)** The production of yoghurt involves the fermentation of milk by two types of bacteria that use the protein and sugar (lactose) in milk.

Lactobacillus bulgaricus breaks down proteins into short chains of amino acids.

Streptococcus thermophilus uses the chains of amino acids to make formic acid.

L. bulgaricus then uses lactose and formic acid to make lactic acid.

The flow diagram in Fig. 3.1 shows the production process.

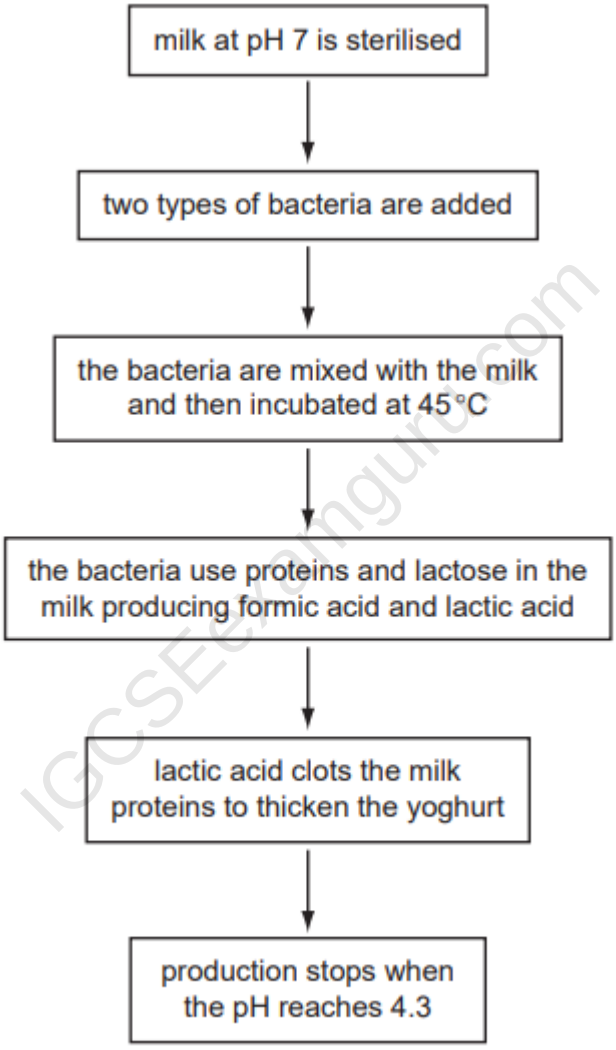

Fig. 3.1

(i) Explain why the milk is sterilised at the start of the process.

.....

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.....

..... [2]

(ii) Explain why the bacteria are incubated at 45 °C.

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..... [2]

(iii) State **and** explain what happens to the populations of the bacteria during the yoghurt-making process.

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..... [5]

(iv) Explain why yoghurt cannot be made by using only one of the types of bacteria.

.....

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.....

..... [2]

(b) At the end of the fermentation, food additives may be added to the yoghurt.

State **three** types of food additive that may be used in producing yoghurt.

1 .....

2 .....

3 ..... [3]

[Total: 14]

5 Bovine somatotropin (BST) is a protein hormone that stimulates growth in cows.

(a) (i) Name the small molecules that are joined together to make proteins.

.....[1]

(ii) Define the term *growth*.

.....

.....

.....

.....

.....[2]

(b) Genetic engineering techniques similar to those used for producing human insulin were used to make bacteria produce BST.

Outline the way in which genetic engineering was used to produce BST.

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.....[3]

(c) The effects of BST on milk production and the food energy intake of cows were investigated.
The milk yield and food energy intake were recorded each day for each cow in two groups, **A** and **B**.

- Group **A** received BST treatment at week 10.
- Group **B** did not receive any BST.

The results are shown in Fig. 2.1.

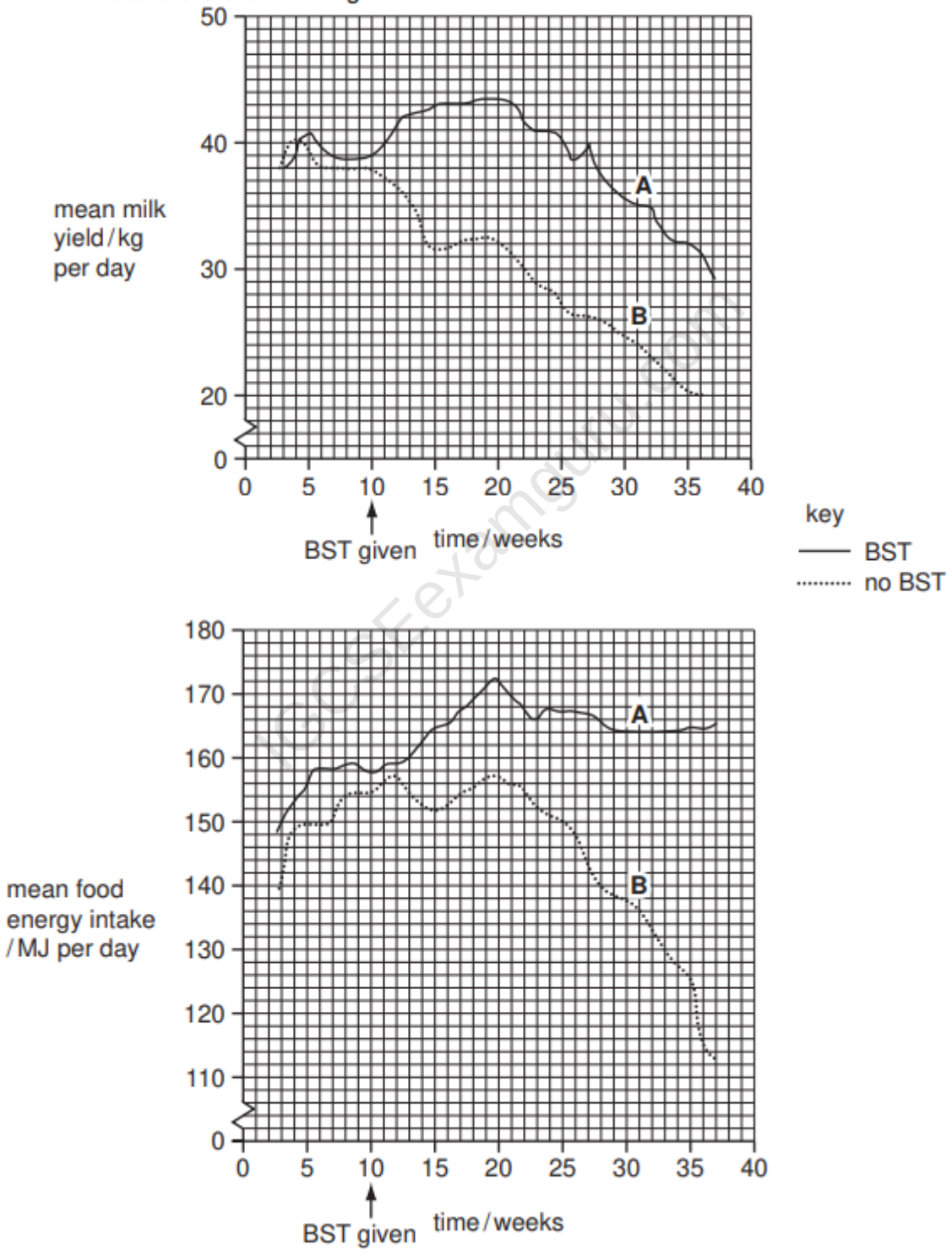

Fig. 2.1

(i) Use Fig. 2.1 to describe the effect of BST treatment on mean milk yield and mean food energy intake. You will gain credit if you use data from Fig. 2.1 in your answer.

mean milk yield .....

.....

.....

.....

.....

.....

mean food energy intake .....

.....

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.....

.....

..... [6]

(ii) Various studies have shown that there is little economic benefit from using BST.

Use the results from Fig. 2.1 to explain why this might be so.

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..... [3]

(d) The US Food and Drug Administration certifies that milk from cows treated with BST is as safe as milk from cows not treated with the hormone.

It is impossible to test milk to detect the use of BST, but some milk producers in the US label their milk to indicate that it is BST-free.

Discuss the reasons for labelling milk to show whether it has come from cattle treated with BST or not.

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..... [3]

[Total: 18]

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

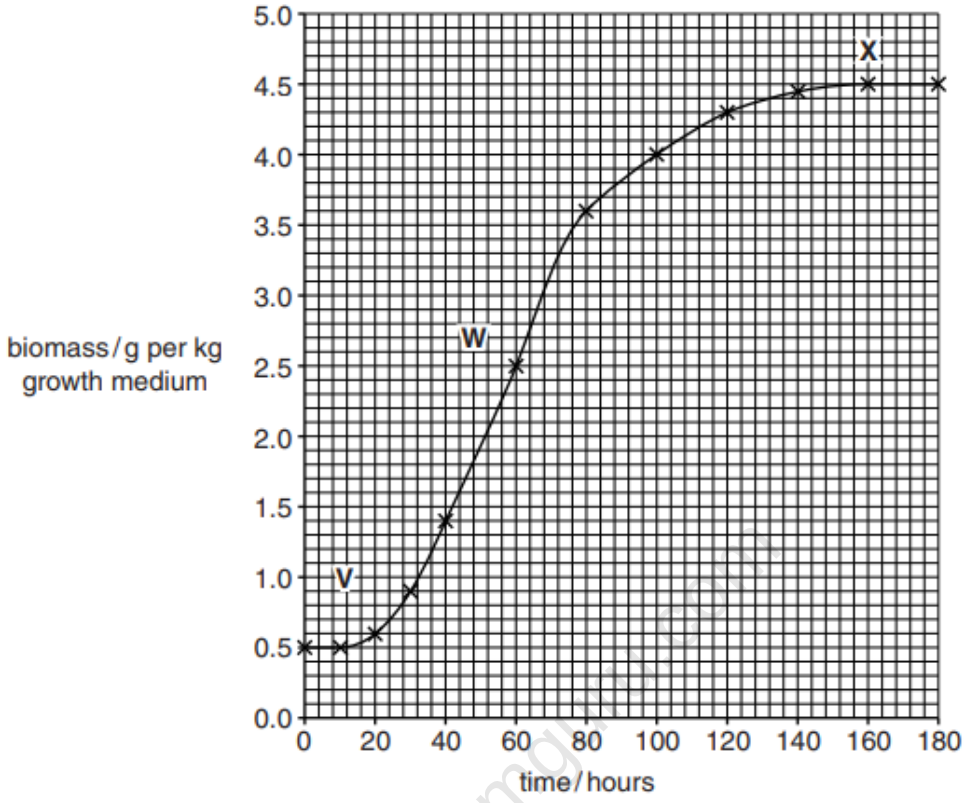

Fig. 1.1

(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]

7 Fig. 5.1 shows a species of bacterium, *Lactobacillus bulgaricus*.

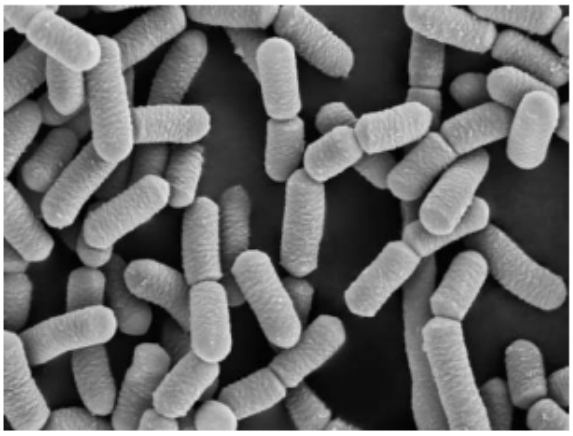

Fig. 5.1

(a) List **two** features that distinguish bacteria from other groups of organisms.

1 .....

2 ..... [2]

(b) *L. bulgaricus* are added to milk to make yoghurt.

Fig. 5.2 shows the changes in a population of *L. bulgaricus* during fermentation to make yoghurt.

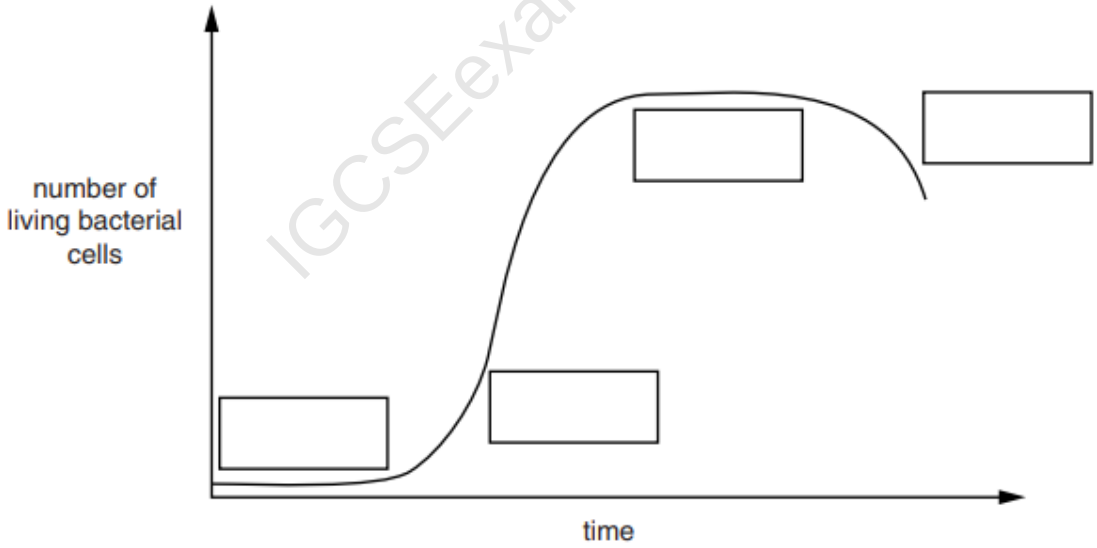

Fig. 5.2

(i) Name the stages shown on Fig. 5.2. Write your answers in the boxes on Fig. 5.2. [4]

(ii) Explain why the population of *L. bulgaricus* does not continue to increase during the fermentation to make yoghurt.

.....

.....

.....

.....

..... [2]

(c) The curve shown in Fig. 5.2 is a sigmoid population growth curve.

Define the term *growth*.

.....

.....

.....

.....

..... [2]

(d) Bacteria, such as *L. bulgaricus*, can reproduce rapidly.

Name the process of reproduction in bacteria.

..... [1]

(e) Sometimes food additives are added to yoghurt. Some people suggest that it is healthier to eat yoghurt without additives.

Suggest the advantages and disadvantages of putting food additives into yoghurt.

advantages .....

.....

.....

.....

disadvantages .....

.....

.....

..... [4]

[Total: 15]

8 Yeast, *Saccharomyces cerevisiae*, is a single-celled fungus.

(a) State **one** reason why yeast is classified as a fungus and **not** as a bacterium.

.....

.....[1]

(b) A student investigated the anaerobic respiration of yeast to find out how the yeast population changed and how much alcohol was produced over a period of 14 hours.

Complete **and** balance the chemical equation for anaerobic respiration in yeast.

$C_6H_{12}O_6$ ⟶ ..... + ... [2]

(c) The student set up a small fermenter containing:

- 1.0 g dry yeast
- 250 cm^3 glucose solution
- a solution containing ammonium compounds as a source of nitrogen.

The fermenter is shown in Fig. 4.1.

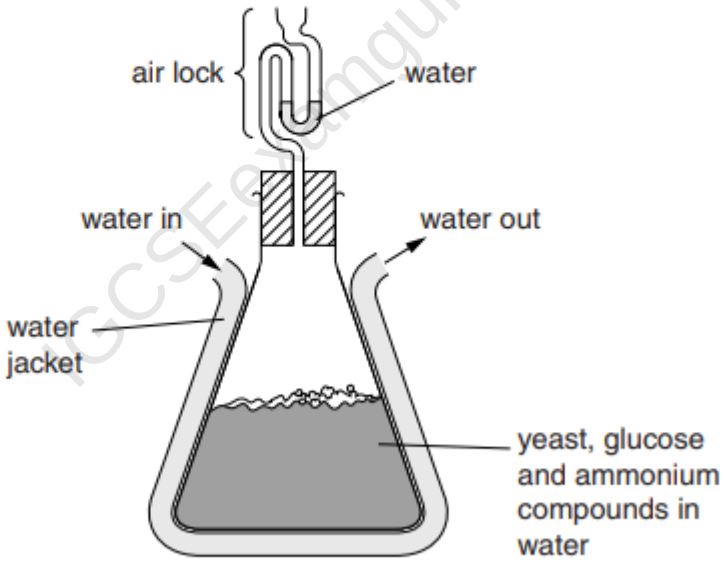

Fig. 4.1

Explain the importance of each of the following:

(i) the water jacket

.....

.....

.....[2]

(ii) a source of nitrogen

.....

.....

.....

.....[2]

(iii) the air lock.

.....

.....

.....

.....[2]

(d) Fig. 4.2 shows the change in the yeast population and in the alcohol content in the student's fermenter.

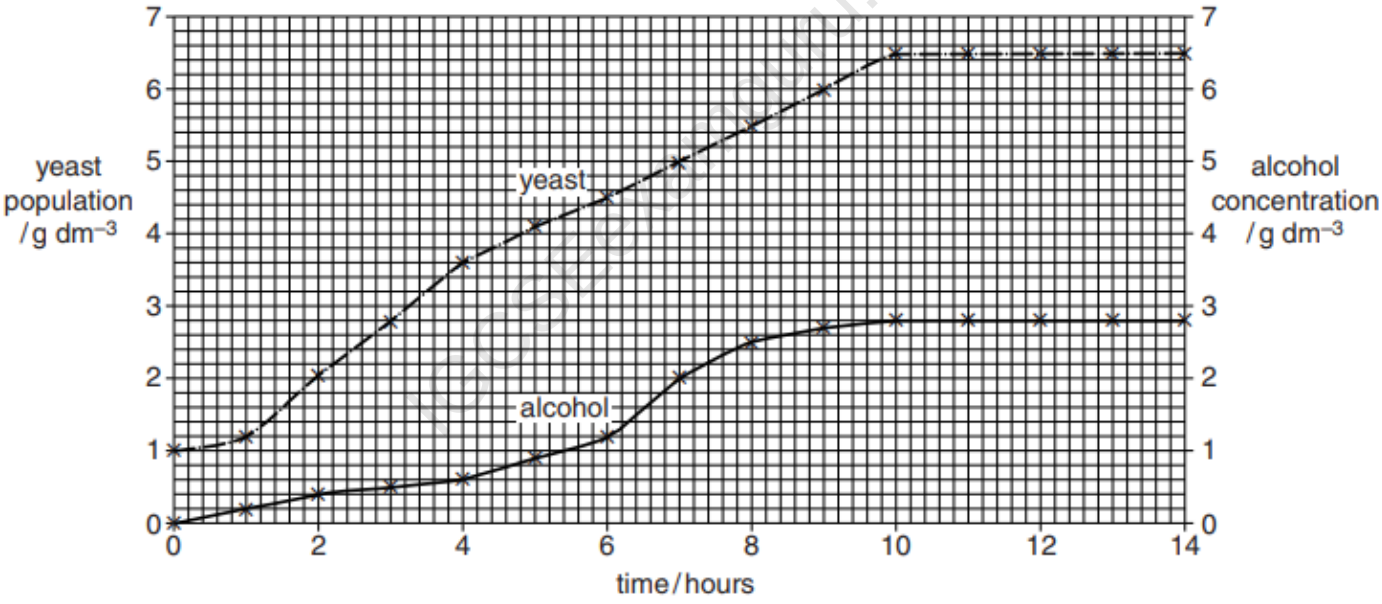

Fig. 4.2

(i) Describe the changes in the population of yeast.

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.....[3]

(ii) Explain the changes you have described.

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.....

.....[3]

(e) Name **two** industrial processes that rely on anaerobic respiration of yeast.

1.....

2.....[2]

[Total: 17]

9 Bacteria can be grown on nutrient agar in Petri dishes. The main nutrients in the agar are glucose and amino acids. The bacteria reproduce asexually to form colonies. Each colony is formed from one bacterium.

(a) (i) Explain why glucose and amino acids are included in the agar medium.

glucose .....

.....

amino acids .....

.....

[2]

(ii) Describe how bacteria reproduce asexually.

.....

.....

.....

.....

.....[2]

A microbiologist collected bacteria from a kitchen which was suspected to be responsible for an outbreak of food poisoning.

The microbiologist spread the bacteria on nutrient agar and let them reproduce to form colonies. The bacterial colonies were transferred onto new nutrient agar that contained high concentrations of antibiotics **S** or **T**, as shown in the flow diagram in Fig. 5.1.

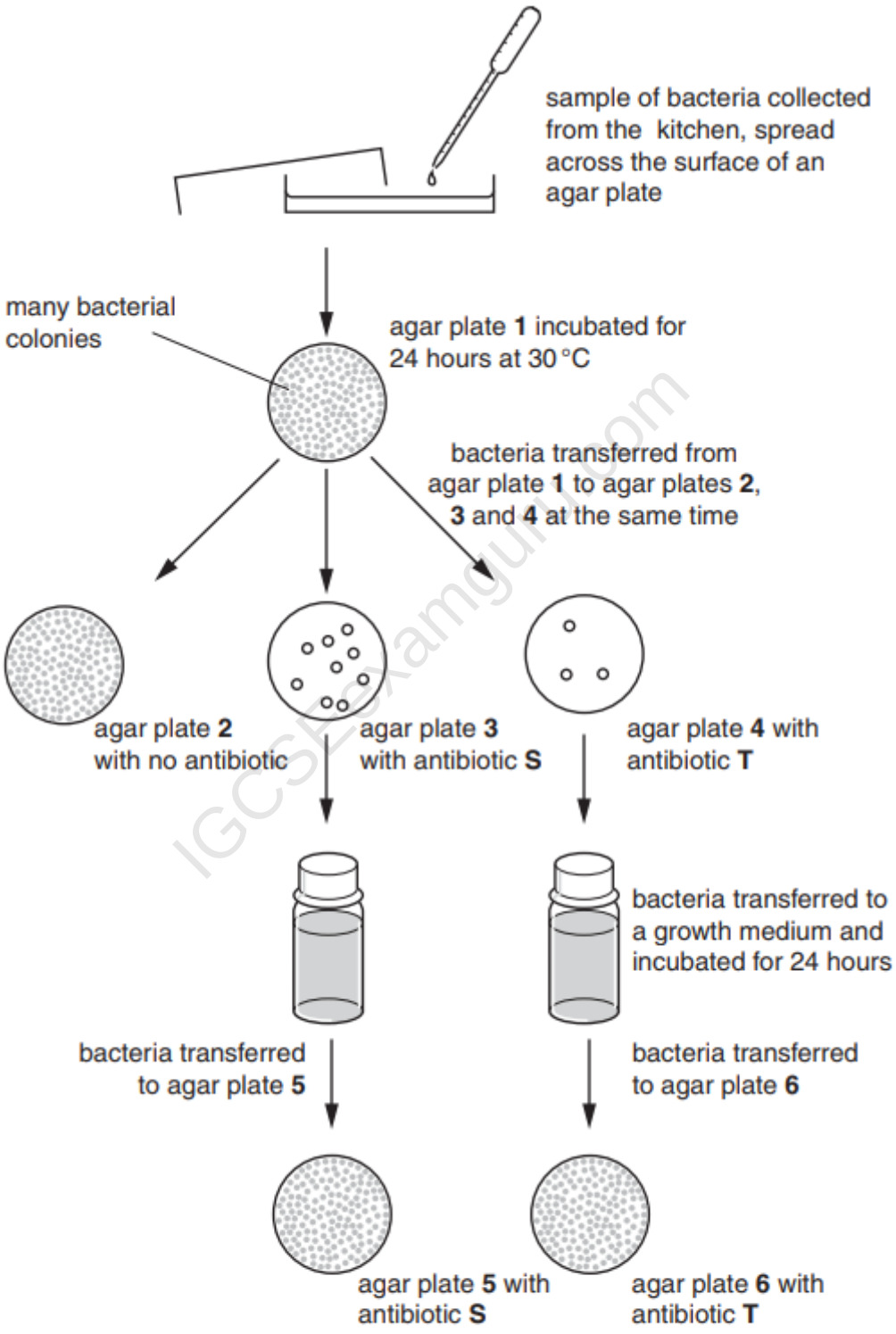

Fig. 5.1

(b) Explain the appearance of agar plates **3** and **4**.

.....

.....

.....

.....[2]

(c) Explain why many bacterial colonies were found on agar plates **5** and **6**.

.....

.....

.....

.....

.....[2]

(d) Gonorrhoea is a sexually transmitted disease. It is caused by the bacterium, *Neisseria gonorrhoeae*. Many strains of this bacterium cannot be treated by common antibiotics.

Explain how strains of antibiotic-resistant bacteria are formed **and** then spread.

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.....[5]

[Total: 13]

10 **(a)** Define the term *genetic engineering*.

.....

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.....[2]

(b) Fig. 6.1 is a flow diagram that shows how insulin can be produced using genetic engineering.

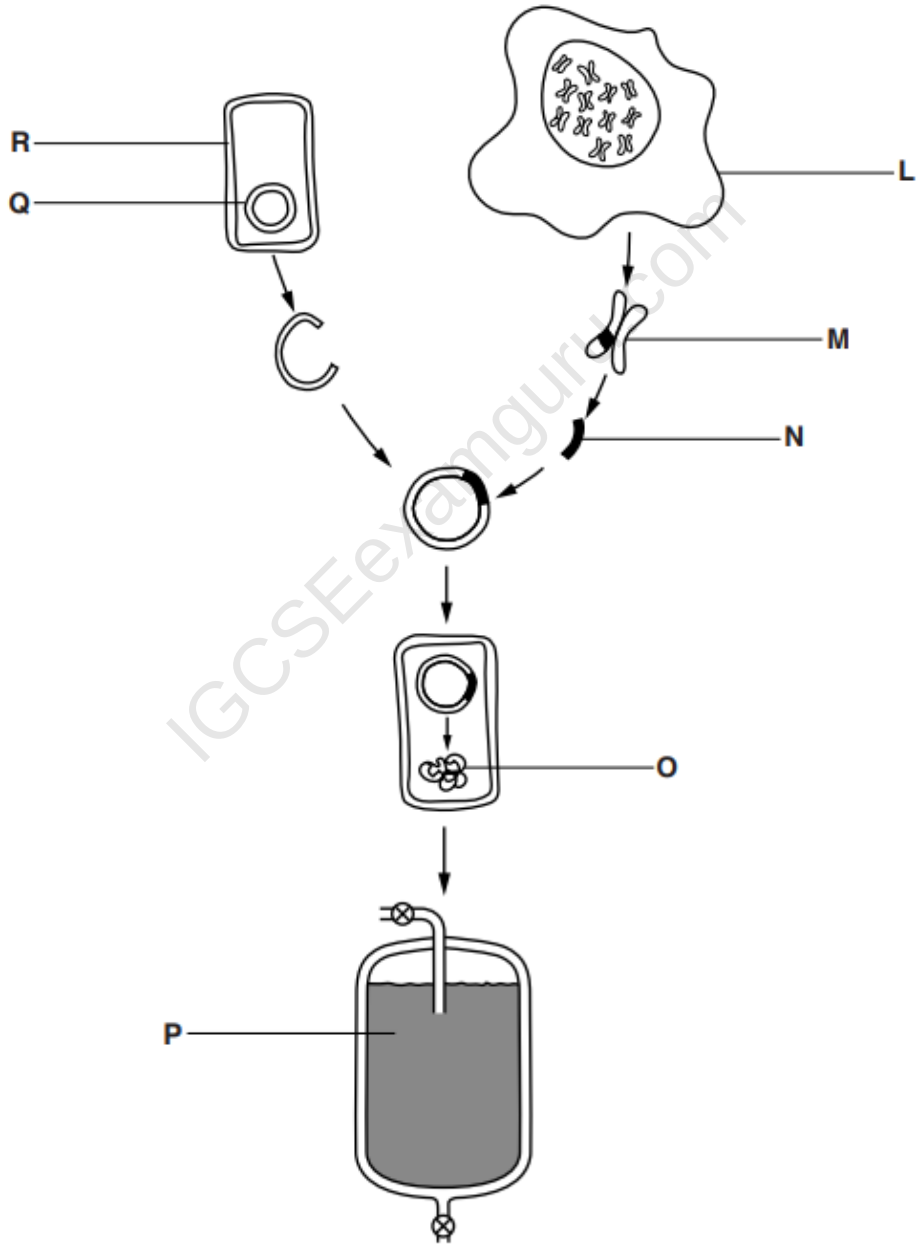

Fig. 6.1

Table 6.1 shows stages in the production of insulin by genetic engineering.

Complete Table 6.1. The first row has been done for you.

Table 6.1

letter from Fig. 6.1	name	description
M	chromosomes	threads of DNA found in the nucleus
		section of DNA removed from human cell
	plasmid	
		type of cell that is genetically engineered
		specific chain of amino acids coded by the section of DNA removed from the human cell
	fermenter	

[5]

(c) The genetically engineered cells in Fig. 6.1 reproduce asexually.

Explain the advantages of asexual reproduction for insulin production by genetic engineering.

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.....[3]

[Total: 10]