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BIOLOGY **9700/21**

Paper 2 Structured Questions AS **October/November 2012**

1 hour 15 minutes

Candidates answer on the Question Paper.

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Answer **all** the questions.

For Examiner's Use

1 Fig. 1.1 is a drawing made from an electron micrograph of a mammalian liver cell.

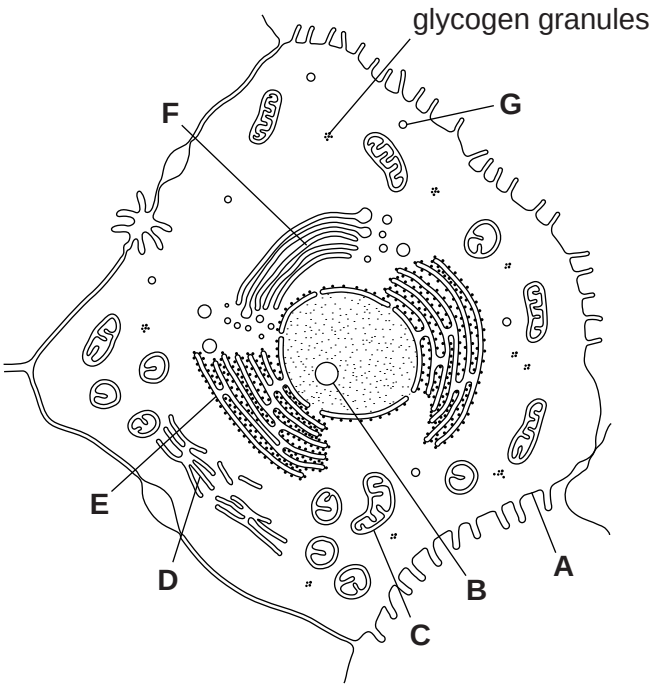


Fig. 1.1

(a) Complete the table by naming the structures **B** to **G** and stating **one** function of each. The first one (**A**) has been completed for you.

	name of organelle	**function**
A	cell surface membrane	controls movement of substances into and out of the cell
B		
C		
D		
E		
F		
G		

[6]

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(b) As shown in Fig. 1.1, liver cells contain many storage granules of glycogen.

For Examiner's Use

Describe the molecular structure of glycogen **and** explain how this structure makes it suitable for storage.

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.....[4]

[Total: 10]

2 Thale cress, *Arabidopsis thaliana*, is used to study the roles of genes and proteins in plants.

For Examiner's Use

The cell membranes of the root hairs of *A. thaliana* contain proteins called aquaporins that allow the movement of water between the soil and the cytoplasm as shown in Fig. 2.1.

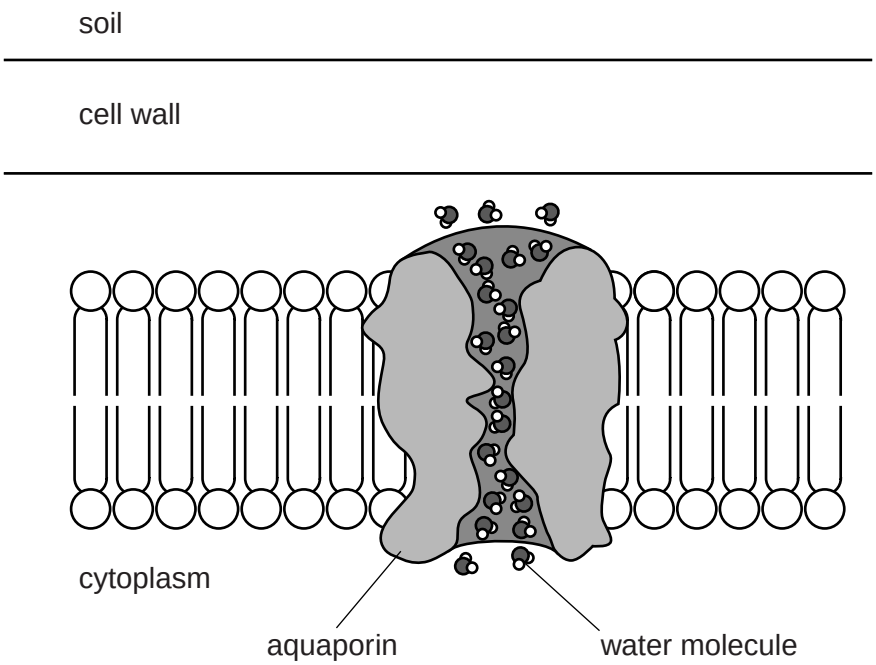


Fig. 2.1

(a) With reference to Fig. 2.1:

(i) explain how water is absorbed by root hairs of *A. thaliana*

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..... [3]

(ii) state why aquaporins are necessary in cell surface membranes.

.....

..... [1]

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(b) Describe the pathway taken by water from the cytoplasm of the root hair cell to a xylem vessel in the centre of the root.

For Examiner's Use

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.....[3]

For Examiner's Use

An investigation was carried out to find the effect of an enzyme in *A. thaliana* on the composition of the cuticle. The enzyme is involved in the production of lipid that accumulates in the cuticle.

Plants were discovered with a mutation of the gene that codes for the enzyme.

Some of these mutant plants (Group **A**) were grown in pots and their rate of transpiration was determined over three days. They were compared with control plants (Group **B**) in which the gene was switched on and the enzyme present. The results are shown in Fig. 2.2.

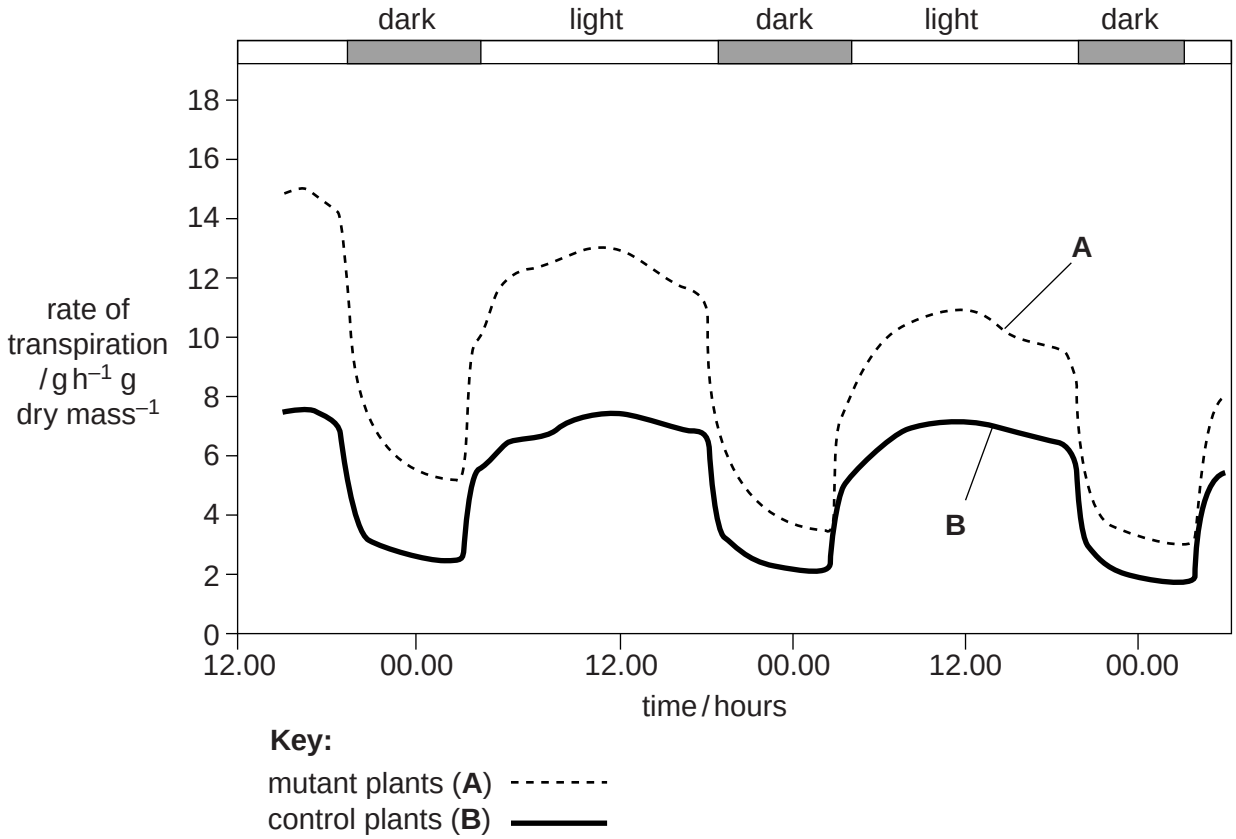


Fig. 2.2

(c) With reference to Fig. 2.2, explain:

(i) why the rate of transpiration is higher during the day than at night in both groups of plants

.....

.....

.....[1]

(ii) how the results show that the cuticle is less effective in the mutant plants.

For Examiner's Use

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.....[3]

[Total: 11]

For Examiner's Use

3 Bone marrow contains stem cells that divide by mitosis to form blood cells. Each time a stem cell divides it forms a replacement stem cell and a cell that develops into a blood cell.

Fig. 3.1 shows changes in the mass of DNA in a human stem cell from the bone marrow during three cell cycles.

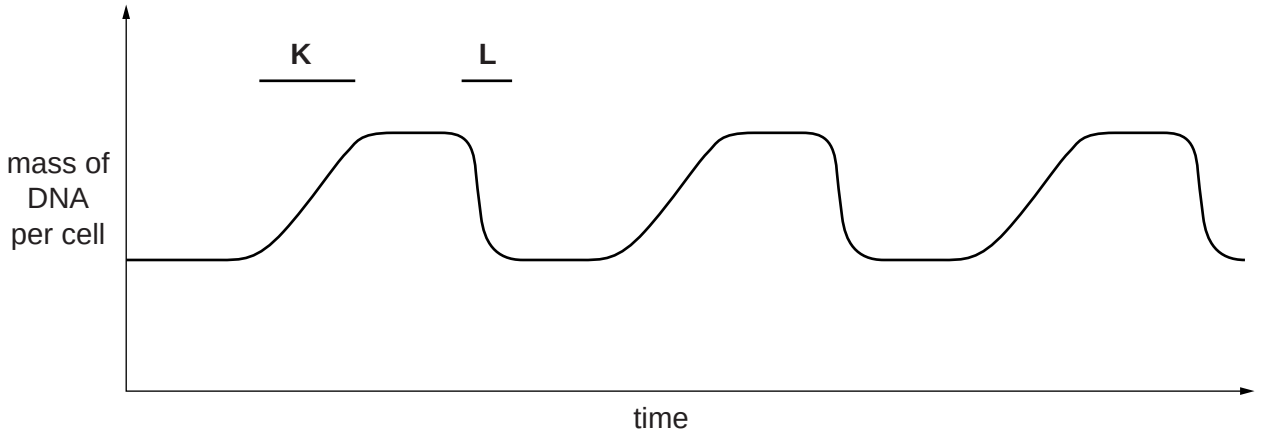


Fig. 3.1

(a) With reference to Fig. 3.1, state:

(i) what happens to bring about the changes in the mass of DNA per cell at **K** and at **L**

K .....

.....

L .....

.....[2]

(ii) how many blood cells are formed from the stem cell in the time shown

.....[1]

(iii) what happens to the number of chromosomes in the stem cell.

.....[1]

Stem cells in bone marrow give rise to phagocytes, B-lymphocytes and T-lymphocytes.

For Examiner's Use

(b) Describe how a red blood cell develops from a stem cell.

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.....[3]

(c) During an immune response, cells divide by mitosis.

Describe how mitosis is involved in an immune response.

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.....[3]

(d) Describe the modes of action of T-lymphocytes during an immune response.

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.....[3]

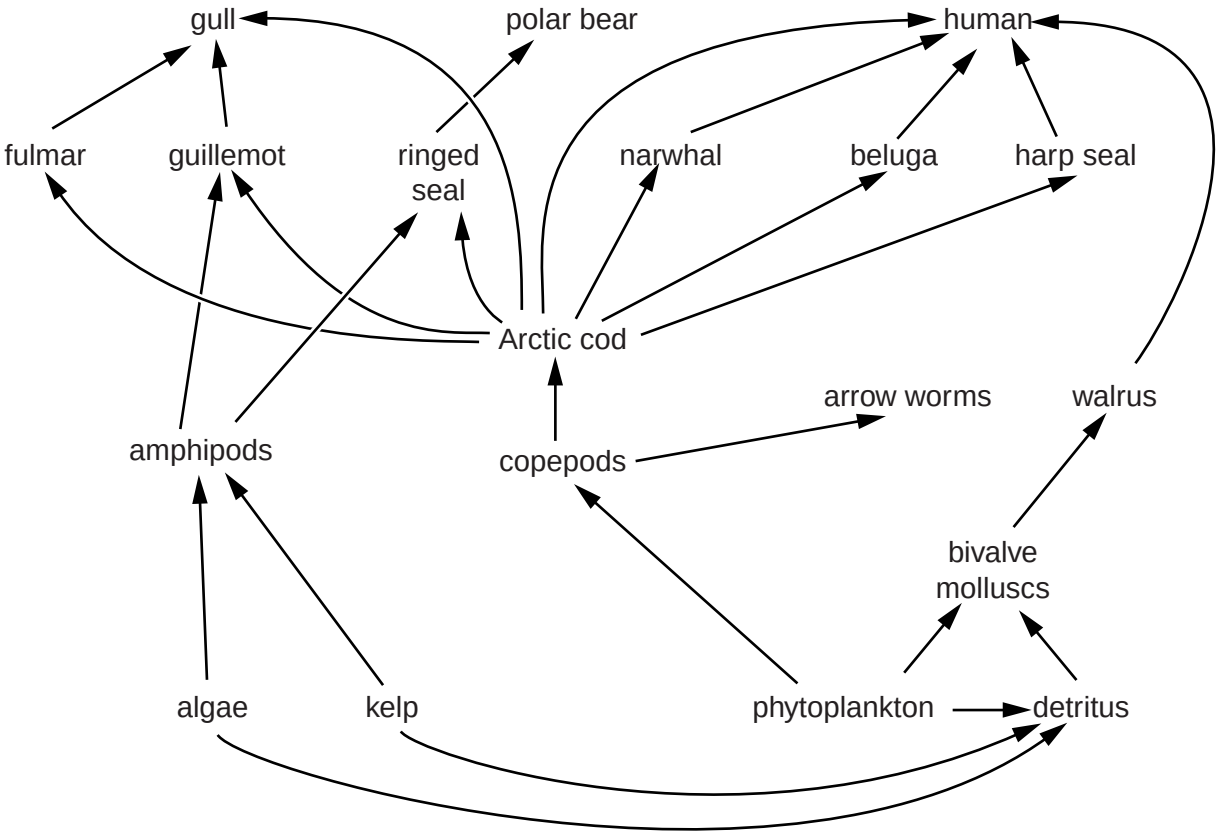
[Total: 13]

4 Lancaster Sound in the Canadian Arctic is a very productive marine environment and supports large populations of sea birds and marine mammals.

For Examiner's Use

Studies of the area have shown the importance of Arctic cod, *Boreogadus saida*, in the flow of energy to marine birds, such as guillemots and fulmars, and marine mammals, such as narwhals and belugas. Arctic cod forms the main, or only, source of food for many such animals.

The flow of energy through the food web in Lancaster Sound is shown in Fig. 4.1.



Note: detritus is dead and decaying matter

Fig. 4.1

(a) Name the trophic levels occupied by the following organisms in the food web in Fig. 4.1:

kelp .....

arrow worms .....

narwhals. ..... [3]

(b) The population of polar bears in the Lancaster Sound area is quite small in comparison to populations of animals that feed on Arctic cod.

For Examiner's Use

Using **only** the information shown in Fig. 4.1, explain why the population of polar bears is small.

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.....[4]

(c) Populations of many fish species are under threat of extinction as a result of over-fishing.

Explain the likely consequences of over-fishing of Arctic cod.

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.....

.....

.....

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.....[3]

[Total: 10]

5 Mammals have closed, double circulatory systems.

For Examiner's Use

(a) Explain what are meant by the terms *closed* and *double* as applied to mammalian circulatory systems.

closed .....

.....

.....

double .....

.....

.....[2]

Fig. 5.1 shows a longitudinal section through a mammalian heart.

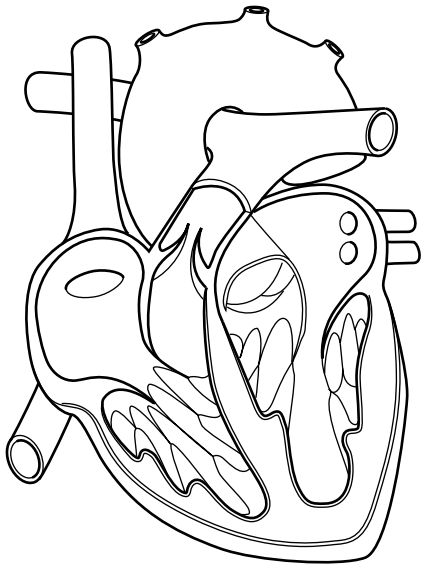


Fig. 5.1

(b) Use label lines and the letters **P**, **Q**, **R** and **S** to label the following on Fig. 5.1:

P the right atrium

Q a semilunar valve

R a blood vessel that carries deoxygenated blood

S the position of Purkyne tissue [4]

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Catheters are small tubes that are inserted into blood vessels. A catheter was inserted into an artery in the arm and then moved into the aorta and then into the left ventricle during a diagnostic investigation. The catheter contained a device to measure the blood pressure in the aorta and in the left ventricle. The results are shown in Fig. 5.2.

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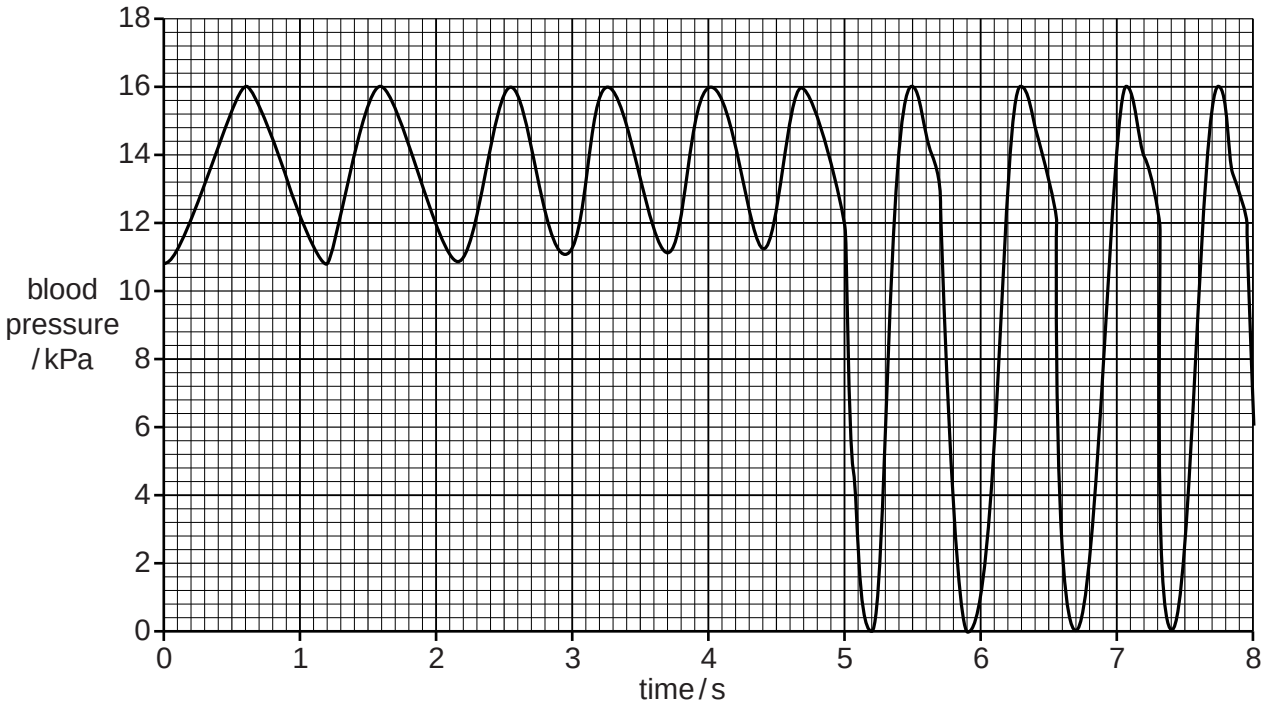


Fig. 5.2

(c) (i) Calculate the heart rate during the period of the investigation.

Show your working.

answer .....[2]

(ii) Describe **and** explain the differences in pressure as the catheter moves from the aorta into the left ventricle.

.....

.....

.....

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.....[4]

Fig. 5.3 is an X-ray showing narrowing in the blood vessels supplying muscles in the heart. A catheter is used to insert a dye into the blood vessels so that they appear clearly in the X-ray. The arrows indicate where there is narrowing of the blood vessels.

For Examiner's Use



Fig. 5.3

(d) (i) Name the blood vessels shown in Fig. 5.3.

.....[1]

(ii) State the likely effect of narrowing of these blood vessels.

.....[1]

(e) Suggest ways in which the condition shown in Fig. 5.3 may be treated.

.....

.....

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.....[2]

[Total: 16]

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Question 5, Fig. 5.3 ZEPHYR / SCIENCE PHOTO LIBRARY

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BIOLOGY **9700/22**

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Answer **all** the questions.

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1 Fig. 1.1 is a labelled diagram of a leaf palisade mesophyll cell, as seen with a high quality light microscope.

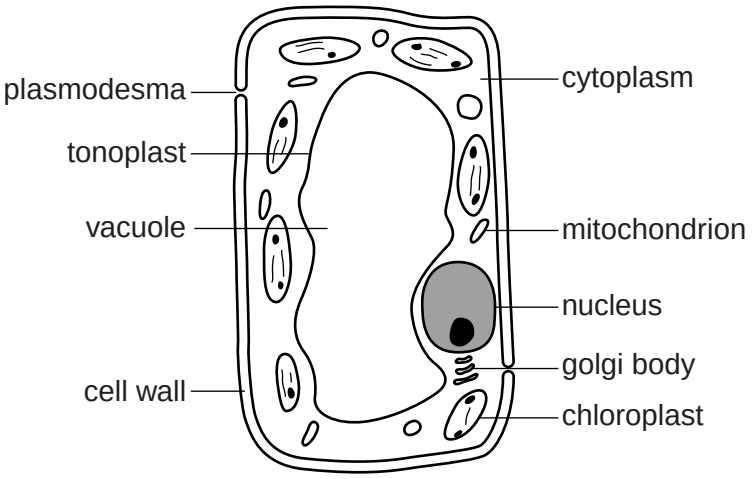


Fig. 1.1

An electron micrograph of the same leaf mesophyll cell at the **same magnification** would show more detail than is shown in Fig. 1.1.

(a) Explain why, at the **same magnification**, an electron micrograph is able to provide more detail than a light micrograph.

.....

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..... [2]

(b) **Describe** three additional features that could be seen on an electron micrograph of the leaf mesophyll cell that are not seen in Fig. 1.1.

1. .....

.....

2. .....

.....

3. .....

..... [3]

(c) The length of the labelled chloroplast in Fig. 1.1 is 5.0 μm. Calculate the magnification of the cell shown in Fig. 1.1.

For Examiner's Use

Show your working.

magnification × ..... [2]

(d) In Fig. 1.1, starch granules are visible within the chloroplasts. Starch is the most common storage compound of plants. It is composed of amylopectin and amylose.

(i) Describe the structural differences between amylopectin and amylose.

.....

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.....

..... [2]

(ii) State **one** role of magnesium ions within chloroplasts.

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..... [1]

[Total: 10]

2 The fluid mosaic model of membrane structure was first proposed in 1972 by Singer and Nicolson. The model describes in detail how the components of a membrane are organised.

For Examiner's Use

(a) Some of the components of the cell surface membrane are:

- phospholipid molecules
- protein molecules
- cholesterol molecules.

(i) In the box below, draw a labelled diagram of a section through a cell surface membrane to show how the above components are organised within the membrane.

The diagram should include other named components of the membrane.

Label the inner and outer surfaces of the membrane.

[5]

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(ii) Suggest why 'fluid mosaic' is an appropriate term to use to describe membrane structure.

For Examiner's Use

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..... [3]

[Total: 8]

3 The humpback whale, *Megaptera novaeangliae*, is one of the world's largest aquatic mammals. It can grow to a length of up to 15 metres and a mass of up to 36 000 kg. A large proportion of the mass of a humpback whale is a very thick layer of fat-filled cells stored under the skin, called blubber.

For Examiner's Use

The humpback whales are seasonal feeders. They feed in polar regions during the summer and then migrate to warmer temperate and tropical waters to mate and have their young during the polar winter.

(a) One reason that the humpback whale has managed to reach its enormous size is because it is a member of a simple food web. Fig. 3.1 is an example of such a food web.

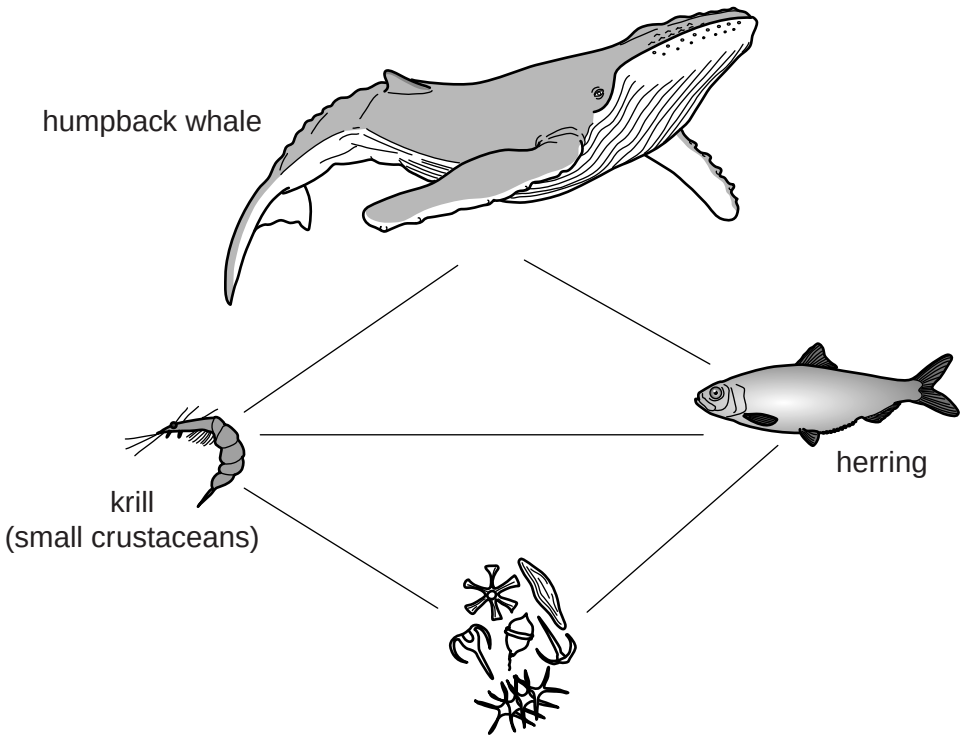


Fig. 3.1

(i) The humpback whale is a carnivore, feeding on krill and herring. The herring feed on krill.

Add **arrow heads** to the lines drawn on Fig. 3.1 to show the direction of energy flow in the food web. [1]

(ii) State the trophic level to which the humpback whale belongs.

..... [1]

For Examiner's Use

(iii) In terms of energy transfer, explain how the humpback whale is able to reach such a large size.

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..... [3]

(b) The thickness of blubber in humpback whales decreases during the non-feeding season and increases during the feeding season.

Suggest explanations for this observation.

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..... [2]

(c) Describe the roles of water as an environment for organisms, such as those shown in Fig. 3.1.

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..... [3]

[Total: 10]

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[Turn over

4 Diseases are either infectious or non-infectious.

For Examiner's Use

(a) Complete Table 4.1 to produce a summary of four important infectious diseases.

Table 4.1

name of disease	type of causative organism	name of causative organism
cholera	bacterium	*Vibrio cholerae*
HIV/AIDS	virus	
malaria		
tuberculosis (TB)		*Mycobacterium tuberculosis*

[4]

(b) Typhoid is an example of an infectious disease.

Some features of typhoid include:

- caused by a bacterium that can only infect humans
- caused by the ingestion of contaminated food and water
- can be treated with drugs
- can be prevented by a vaccine.

(i) State which of the diseases named in Table 4.1 is transmitted in the same way as typhoid.

..... [1]

(ii) State which type of drug can be used in the treatment of typhoid. Give a reason for your answer.

.....

.....

..... [1]

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(iii) Child vaccination programmes against typhoid in some countries have had considerable success. The numbers contracting the disease have decreased, not only in the vaccinated children, but also in other age groups that were not part of the programme.

Suggest explanations for this observation.

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..... [2]

(c) After infection, the ingested typhoid bacteria are engulfed by phagocytes.

(i) Explain why the phagocytes act only against the bacteria and not against human cells.

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..... [3]

(ii) Unlike other bacteria, the typhoid bacteria are able to survive and multiply within the phagocytes.

Suggest an explanation for this observation.

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.....

..... [1]

(iii) Explain why people with HIV/AIDS are more susceptible to infections, such as typhoid.

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..... [2]

[Total: 14]

5 **(a)** State the structural features of DNA that make it a stable molecule.

For Examiner's Use

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..... [2]

(b) DNA has been described as a 'carrier of coded information'.

Explain this statement.

.....

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..... [2]

(c) State when, during a cell cycle, DNA replication occurs.

..... [1]

(d) There are two alleles of the gene for the β-haemoglobin polypeptide:

- HbA (normal)
- HbS (sickle cell).

Describe **and** explain the difference between the HbA and HbS alleles of this gene.

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..... [3]

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(e) DNA polymerase is an enzyme involved in the replication of DNA.

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One of the substrates required by DNA polymerase is ATP.

ara-ATP is a chemical that affects DNA polymerase activity.

In an investigation, the effect of different concentrations of ATP on the rate of DNA synthesis was determined:

- with no ara-ATP
- with a low concentration of ara-ATP
- with a high concentration of ara-ATP.

The results of the investigation are shown in Fig. 5.1.

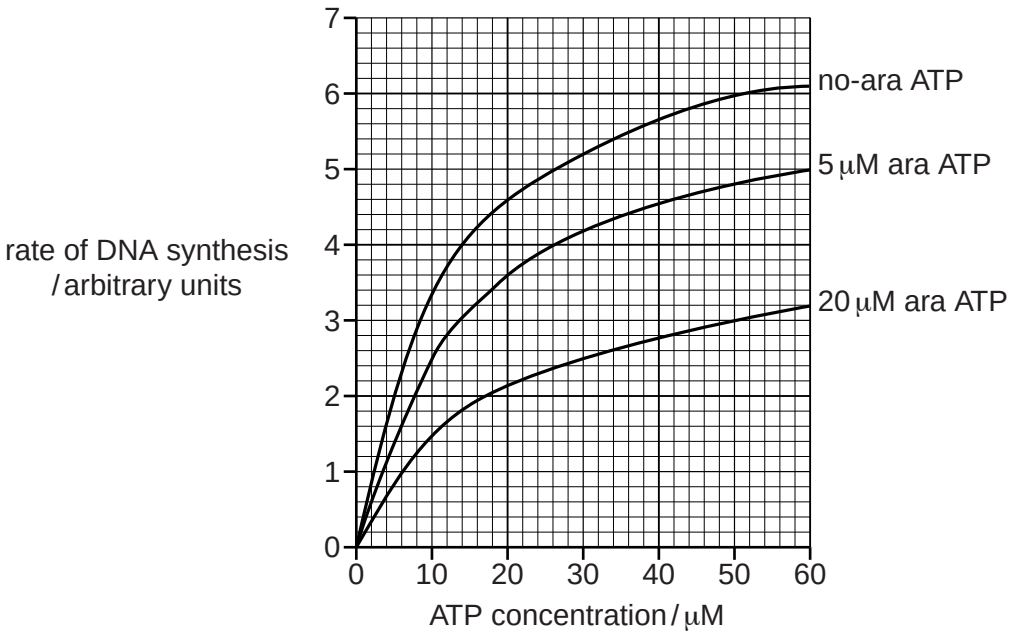


Fig. 5.1

Explain, in terms of the mode of action of enzymes, the results of the investigation shown in Fig. 5.1.

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.....

.....

..... [3]

[Total: 11]

For Examiner's Use

6 Coronary artery bypass grafting is the most common heart operation in the world.

Fig. 6.1 is a diagram of a coronary bypass. The graft is a section of a healthy blood vessel. The blood vessel used in Fig. 6.1 is the internal mammary artery. It is a common choice for surgeons as it is quite resistant to arteriosclerosis.

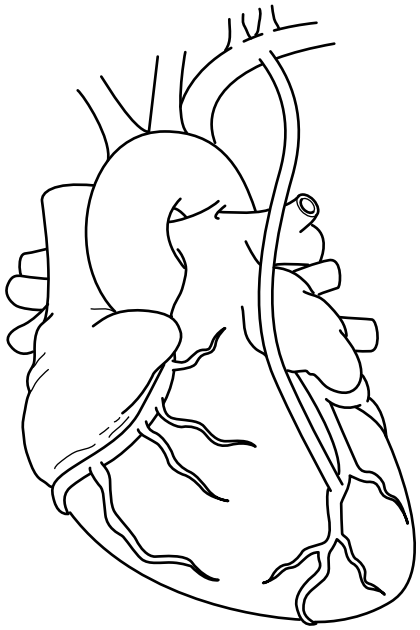


Fig. 6.1

(a) Use label lines and the following letters to label the following on Fig. 6.1:

A aorta
B coronary artery
C internal mammary artery
D pulmonary artery
E right atrium
F vena cava [3]

(b) On Fig. 6.1, mark with an **X**, the diseased area of the coronary artery for which the surgery has been performed. [1]

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(c) With reference to coronary heart bypass surgery, discuss the difficulties in achieving a balance between prevention and cure.

For Examiner's Use

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..... [3]

[Total: 7]

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BIOLOGY **9700/23**

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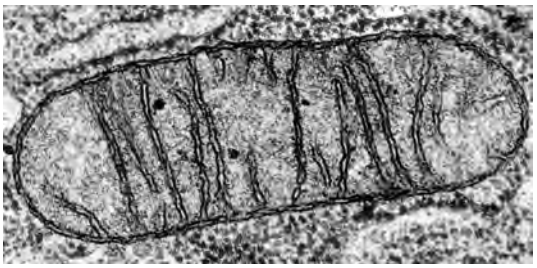
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Answer **all** the questions.

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1 Fig. 1.1 shows electron micrographs of some eukaryotic cell organelles.

A



B



C



D

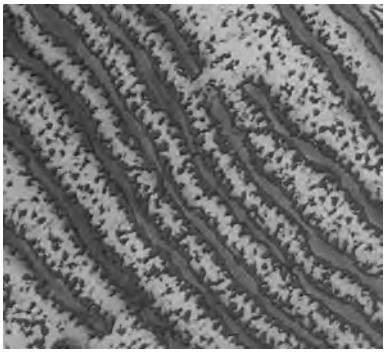


Fig. 1.1

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For each of the organelles **A**, **B**, **C** and **D**, shown in Fig. 1.1, state the name and function of each.

For Examiner's Use

A *name* .....

function .....

B *name* .....

function .....

C *name* .....

function .....

D *name* .....

function .....[8]

[Total: 8]

2 Antibiotics are drugs which are very important in the treatment and cure of some diseases.

For Examiner's Use

(a) Underline the disease or diseases in the list below which are treatable with antibiotics.

cholera

malaria

HIV/AIDS

tuberculosis (TB)

[1]

(b) When patients are prescribed a course of antibiotics, they must not stop taking the antibiotics as soon as they start to feel better, or when they feel that the disease symptoms have gone.

Explain the importance of taking a complete course of antibiotics.

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.....

.....[3]

(c) Some antibiotics act as competitive inhibitors of enzymes in pathogens.

(i) Describe what is meant by the term competitive inhibitor.

.....

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.....[3]

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Penicillin acts as a competitive inhibitor of one of the enzymes involved in bacterial cell wall synthesis.

For Examiner's Use

(ii) State why penicillin, which is an enzyme inhibitor, can be taken by humans.

.....

.....

..... [1]

(iii) Suggest the effect which penicillin will have on bacterial cells.

.....

.....

.....

.....

..... [3]

[Total: 11]

3 A study was carried out on a large number of people, some of whom were smokers. The study investigated the link between percentage of deaths due to lung cancer in smokers and their smoking habits. The age at which they started smoking and the number of cigarettes smoked per day were recorded. The results of the study are shown in Fig. 3.1.

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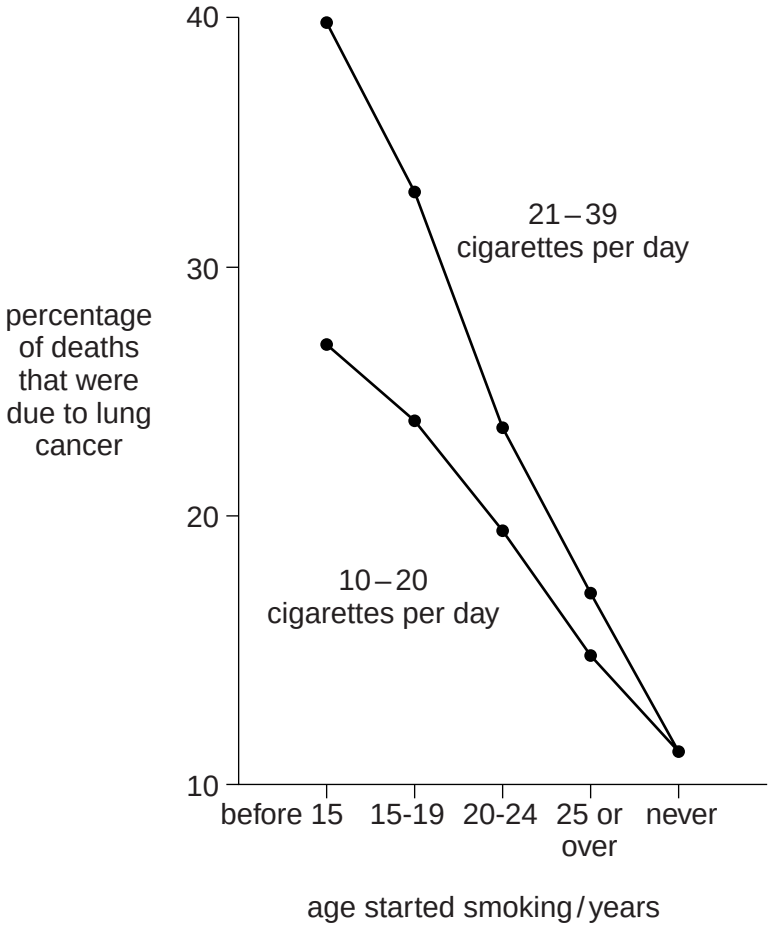


Fig. 3.1

(a) Explain what the results in Fig. 3.1 show about the link between cigarette smoking and percentage of deaths due to lung cancer.

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.....[4]

(b) Tobacco smoke contains many substances which are harmful to the body.

For Examiner's Use

Outline the harmful effects on the cardiovascular system of:

(i) carbon monoxide

.....

.....

.....

.....[2]

(ii) nicotine.

.....

.....

.....

.....[2]

(iii) Describe briefly the effects of tar on the goblet cells and cilia of the trachea.

goblet cells .....

.....

.....

.....

cilia .....

.....

.....

.....[4]

[Total: 12]

4 Fig. 4.1 is an electron micrograph of a transverse section through a plant stem. The xylem vessels are clearly visible.

For Examiner's Use

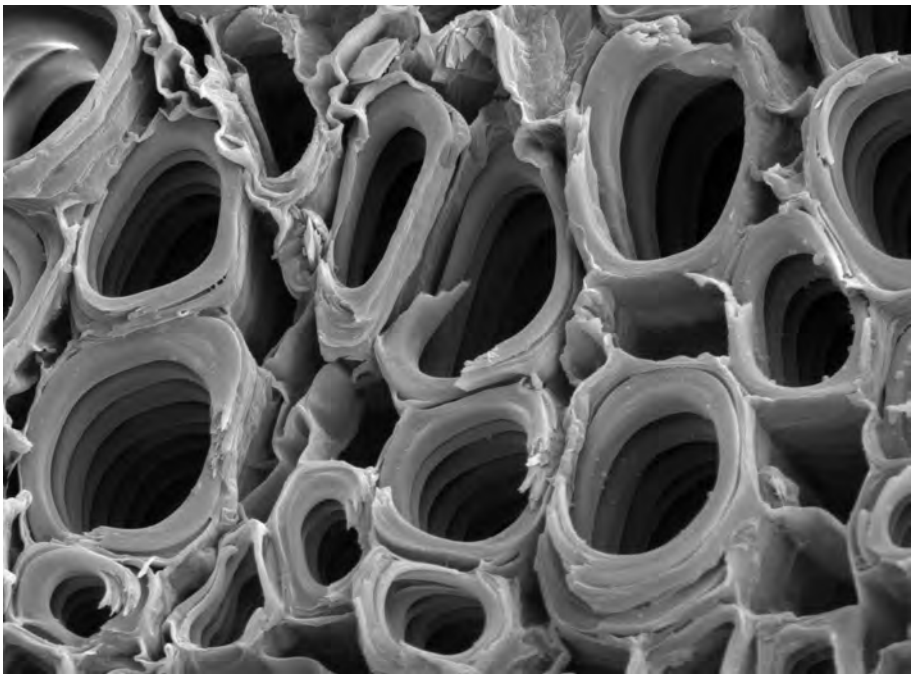


Fig. 4.1

(a) Calculate the magnification of the electron micrograph in Fig. 4.1.

Show your working and give your answer to the nearest 100.

answer .....[2]

(b) Describe how the structure of xylem vessels is adapted to their function.

For Examiner's Use

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.....[3]

(c) Describe **and** explain how water moves from the xylem vessels in the leaves to the atmosphere surrounding the leaves of the plant.

.....

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.....[5]

[Total: 10]

5 **(a)** Describe the role of the ribosome in translation.

For Examiner's Use

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..... [4]

Fig. 5.1 is a diagram of a section of mRNA showing the sequence of three of the codons.

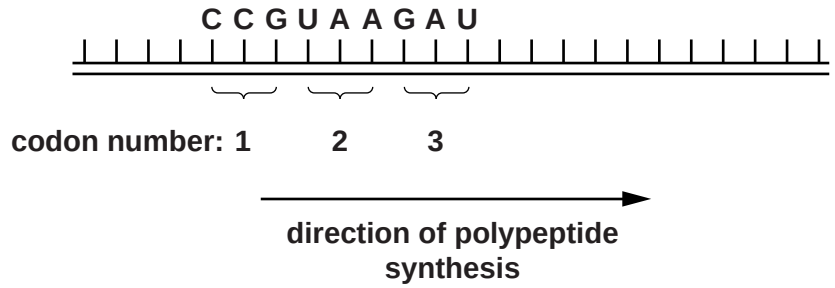


Fig. 5.1

(b) State the base sequences of:

(i) the tRNA anticodon complementary to **codon 1**

..... [1]

(ii) the DNA sequence which coded for **codon 3**.

..... [1]

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(c) The three codons in Fig. 5.1 are near the start of the sequence coding for a protein.

For Examiner's Use

Explain the consequence of a mutation which deletes the **U** from **codon 2**.

.....

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.....[3]

[Total: 9]

6 A woodland ecosystem was investigated and a food web was constructed. This food web is shown in Fig. 6.1.

For Examiner's Use

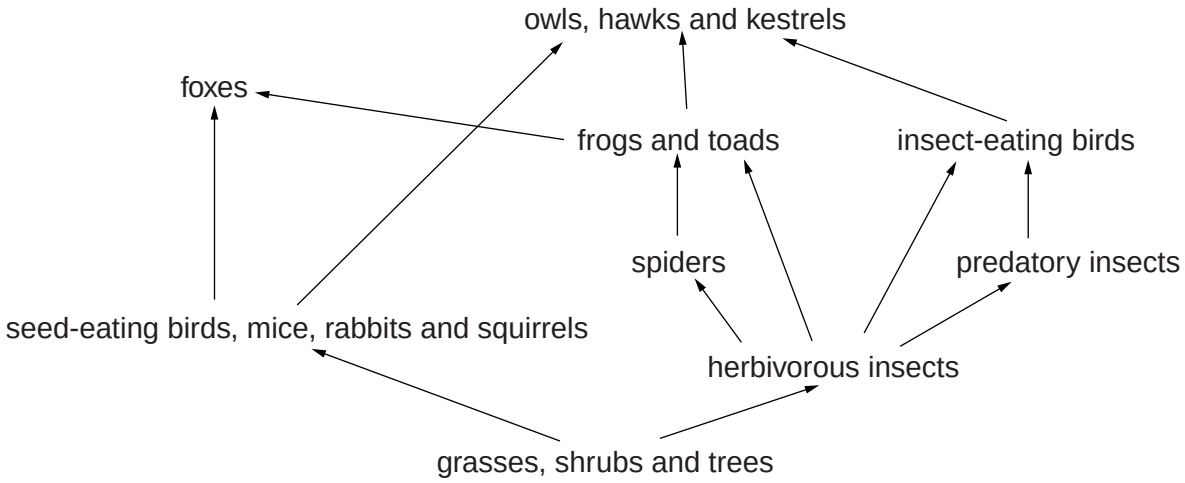


Fig. 6.1

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

.....

.....

.....[2]

(b) Name one group of organisms from Fig. 6.1 that are:

(i) producers

.....[1]

(ii) **only** secondary consumers.

.....[1]

(c) Explain why only a small percentage of the energy present at each trophic level is available to the organisms at the next level.

.....

.....

.....

.....

.....

.....[3]

(d) Fig. 6.1 shows the flow of energy but not the cycling of nutrients in the ecosystem.

For Examiner's Use

Outline what happens to the nitrogen-containing compounds in the organisms at the top of the food web.

.....

.....

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.....[3]

[Total: 10]

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