Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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1184804973

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **May/June 2018**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **17** printed pages and **3** blank pages.

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Answer **all** questions.

1 Fig. 1.1 is a photomicrograph of root tip meristem. Different stages of the cell cycle are visible. Some cells are in the same stage of the cell cycle and some are in the same stage of mitosis.

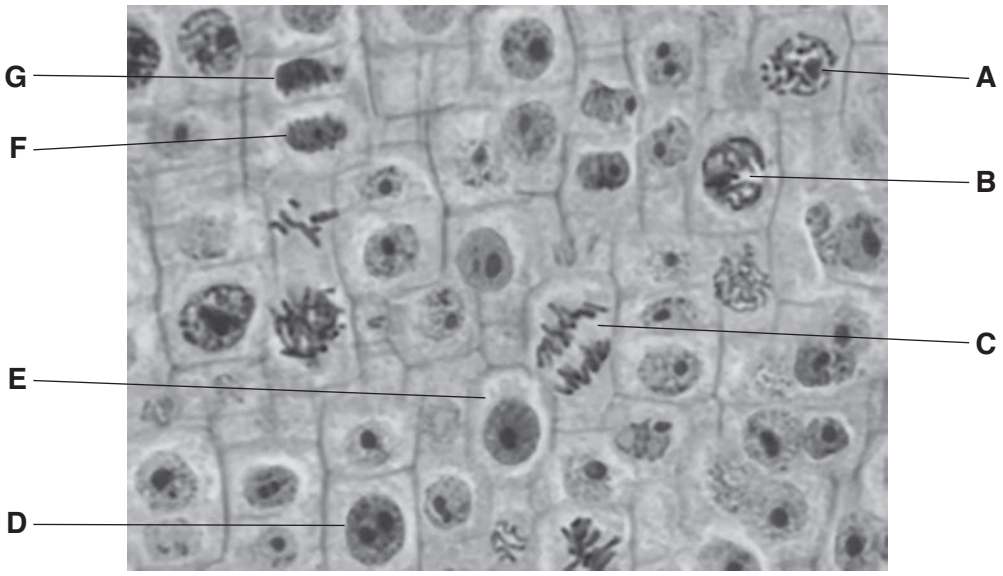


Fig. 1.1

(a) Cell **D** and cell **E** are in the same stage of the cell cycle.

State the difference between the nucleus of cell **D** and cell **E**.

.....

.....[1]

(b) Name the stage of mitosis occurring in each of cells **A**, **B** and **C**.

cell **A** .....

cell **B** .....

cell **C** .....[3]

(c) Cells **F** and **G** are newly formed cells. Cytokinesis has occurred with the formation of a cell plate.

Describe the events that have occurred in the stage of mitosis immediately **before** cytokinesis.

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.....[2]

[Total: 6]

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2 Adipose tissue, which is composed of cells known as adipocytes, stores large quantities of triglycerides and functions as an energy storage tissue.

Fig. 2.1 is a photomicrograph of adipose tissue.

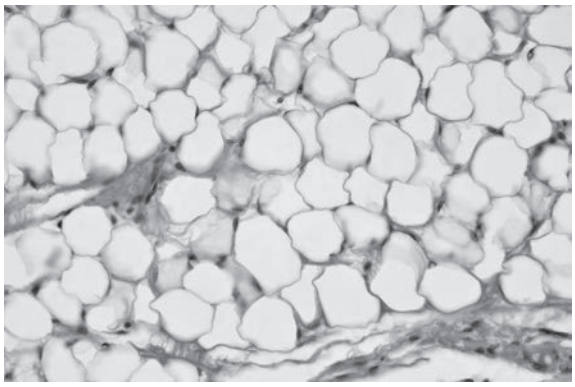


Fig. 2.1

(a) Adipocytes can be very large in size compared to other body cells. This is due to a large lipid droplet within the cell.

The largest adipocyte in Fig. 2.1 has a mean diameter of 35 μm. A person with good eyesight can see cells of 0.05 mm or greater diameter without a magnifying glass or any other optical aid.

State whether the person can see this adipocyte without any optical aid. Show your working to justify your answer.

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.....[1]

(b) Only some of the organelles within the adipocyte can be seen using a high quality light microscope set at the highest magnification.

Organelles such as rough endoplasmic reticulum, smooth endoplasmic reticulum and ribosomes are only visible using an electron microscope.

Explain why these organelles are **not** visible using a light microscope.

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.....[2]

(c) Adipocytes synthesise triglyceride lipase (ATGL), an enzyme that catalyses the formation or breakdown of triglycerides, as shown in Fig. 2.1.

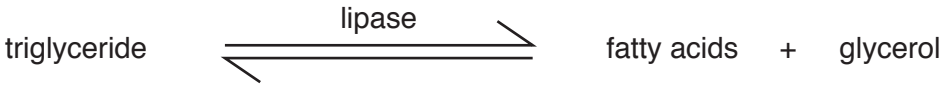


Fig. 2.1

The balance between triglyceride formation and breakdown is controlled by hormones. Fig. 2.2 is a summary of events occurring in an adipocyte when glycogen energy stores have been used up.

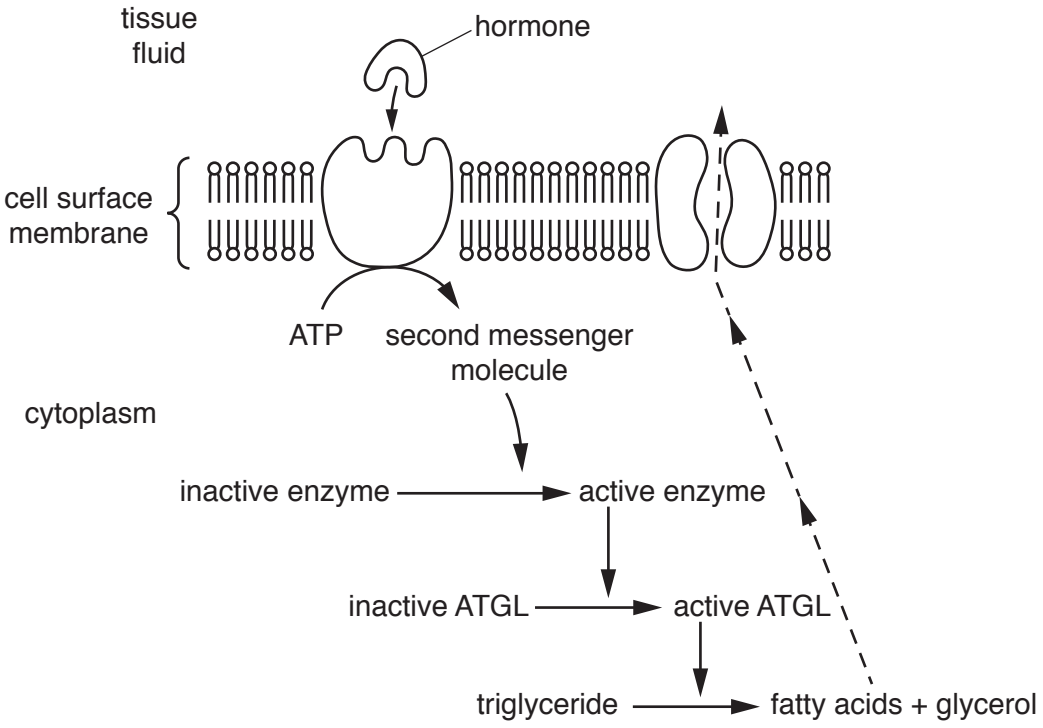


Fig. 2.2

(i) Name the type of bond broken by active ATGL to produce fatty acids and glycerol.

.....[1]

(ii) Name **and** outline the process by which the fatty acids shown in Fig. 2.2 exit the cell.

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.....[3]

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(iii) Fig. 2.2 is an example of cell signalling within the body.

With reference to Fig. 2.2, outline the process of cell signalling.

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.....[4]

(d) The fatty acids released from adipocytes are transported in blood plasma and are taken up by cells.

Although most cell types can metabolise fatty acids to synthesise ATP in the presence of oxygen, red blood cells **cannot** do this.

Suggest why red blood cells **cannot** metabolise fatty acids to synthesise ATP.

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.....[1]

[Total: 12]

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[Turn over

3 *Nerium oleander* is a xerophytic plant. A photomicrograph of a section through the leaf of *N. oleander* is shown in Fig. 3.1.

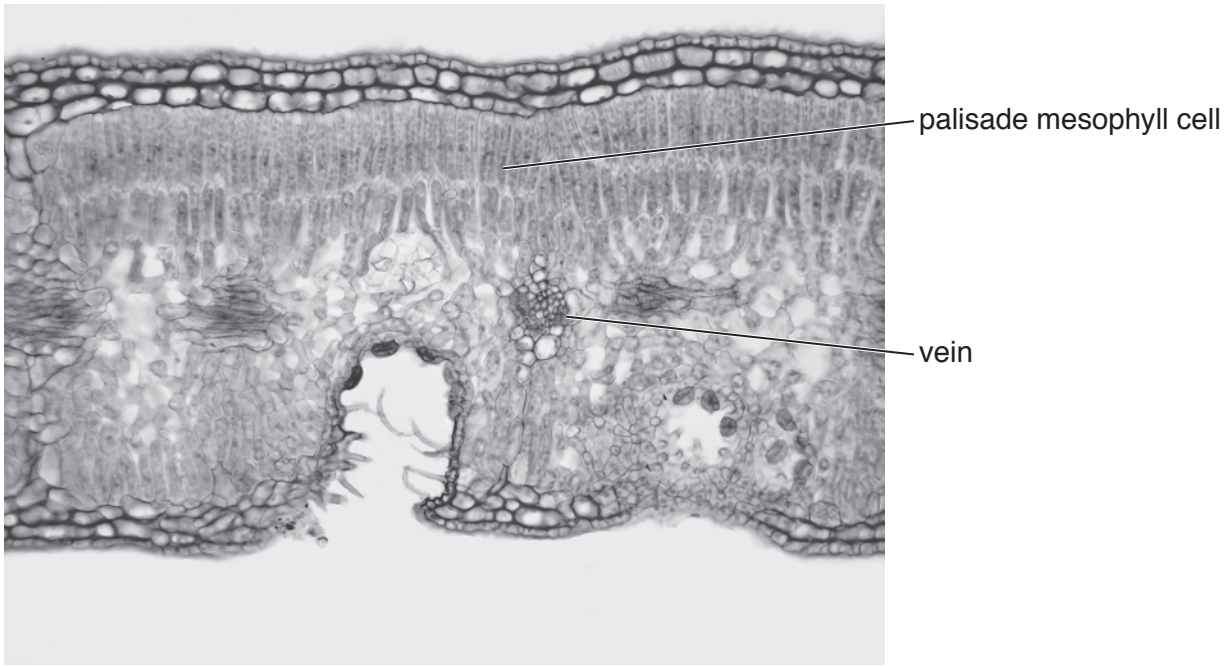


Fig. 3.1

(a) The leaf shown in Fig. 3.1 has a number of adaptations to reduce water loss by transpiration. Two of these adaptations are:

- a multilayered epidermis
- stomata only found in depressions, known as stomatal crypts, on the lower surface of the leaf.

Explain how a multilayered epidermis **and** stomatal crypts will help to reduce water loss in *N. oleander*.

multilayered epidermis .....

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.....

.....

stomatal crypts .....

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.....[3]

Sucrose, amino acids and other assimilates synthesised in palisade mesophyll cells of *N. oleander* pass to the vein, where they can be transported within specialised cells from the source to the sink.

(b) Name the cells specialised for the transport of assimilates in *N. oleander.*

.....[1]

(c) Explain the difference between a source and a sink.

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.....[2]

One of the enzymes involved in the synthesis of sucrose in the cytoplasm of palisade mesophyll cells is known as cyFBPase. The gene coding for this enzyme is *cyFBP*.

The importance of cyFBPase in plant growth can be investigated using plants with a mutation in gene *cyFBP.* These plants cannot synthesise cyFBPase.

(d) (i) State what is meant by a gene mutation.

.....

.....[1]

(ii) Suggest **one** way in which the mutation of *cyFBP* prevents the synthesis of cyFBPase.

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.....[1]

(e) Monoclonal antibody can be produced that is specific to cyFBPase. This antibody is used by investigators to check that the plants with the *cyFBP* mutation do not synthesise this enzyme.

(i) In monoclonal antibody production, a small mammal is inoculated with cyFBPase and several weeks later cells are removed from the spleen. Some of these cells are required for the production process.

Describe the events occurring within the body of the small mammal that lead to the formation of the cells needed for monoclonal antibody production.

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.....[4]

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(ii) Anti-cyFBPase monoclonal antibody is added to extracts taken from the leaves of the plants with the *cyFBP* mutation.

State the expected results following addition of the monoclonal antibody that would confirm the **absence** of cyFBPase in the leaf extracts.

.....

.....[1]

(f) Investigations have shown that plants with the *cyFBP* mutation grow to a much smaller height and have proportionately far less starch stored in their roots than normal plants.

Suggest why plants with the *cyFBP* mutation will store less starch in their roots.

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.....[2]

[Total: 15]

4 Oxygen enters the blood stream from the alveoli in the lungs and carbon dioxide leaves the bloodstream to enter the alveoli. Most of the oxygen is carried by haemoglobin in red blood cells to the body tissues.

(a) Outline how oxygen enters the blood stream from an alveolus.

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.....[3]

Fig. 4.1 is an oxygen dissociation curve for adult haemoglobin. The curve shows the affinity of haemoglobin for oxygen at the range of partial pressures found in the body.

The values for plotting the curve are obtained in the laboratory by bubbling oxygen at different partial pressures through a solution of haemoglobin at 37 °C and pH 7.4. At a different temperature or pH the measured values will change, resulting in a different oxygen dissociation curve.

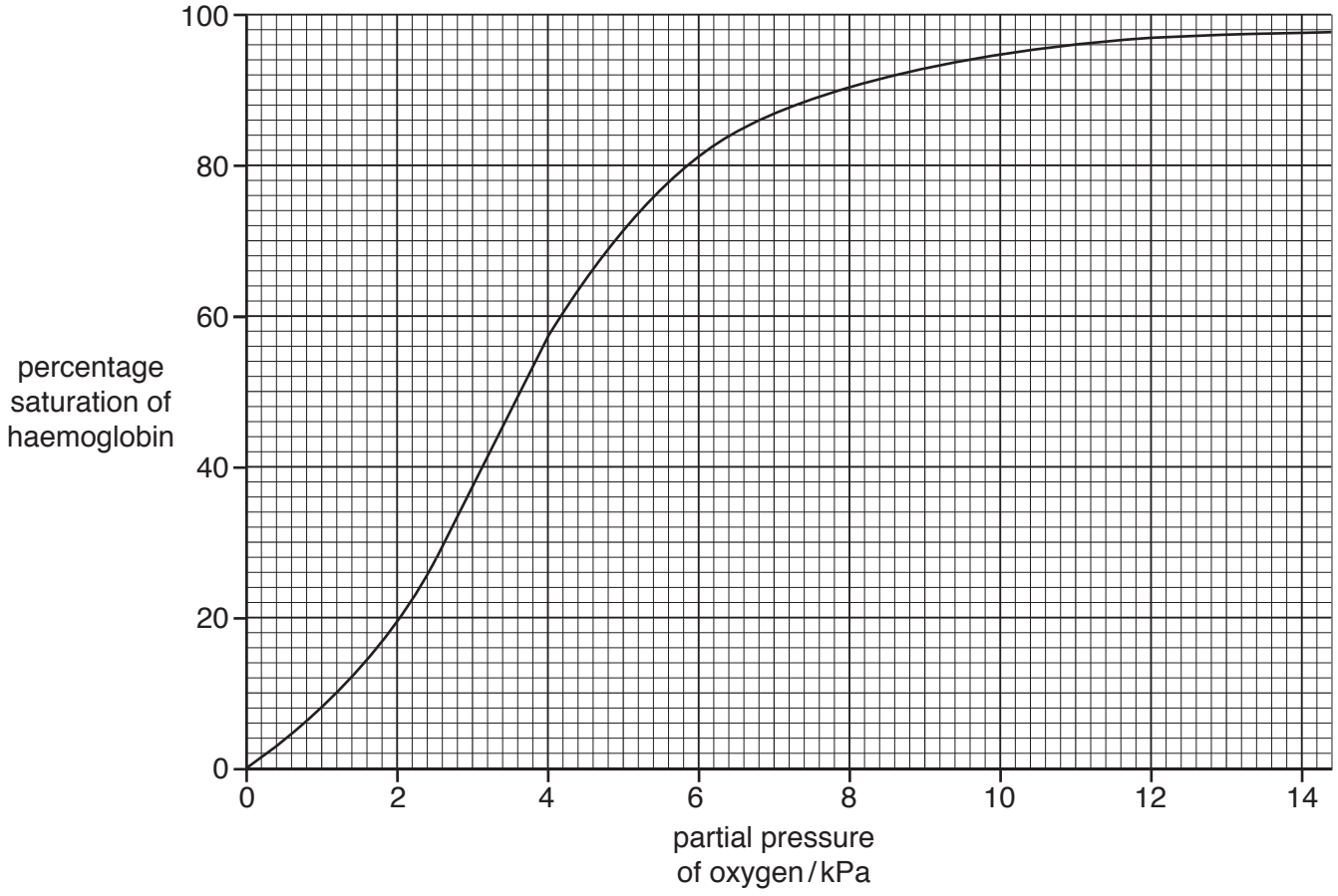


Fig. 4.1

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(b) Fig. 4.1 shows that the percentage saturation of haemoglobin changes at different partial pressures of oxygen.

(i) Use Fig. 4.1 to calculate the difference in percentage saturation of haemoglobin at the lower partial pressure of oxygen of 2.7 kPa compared to the higher partial pressure of 13.0 kPa.

Show your working.

difference = ...[1]

(ii) Explain the advantage of having a difference in percentage saturation of haemoglobin at lower and higher partial pressures of oxygen.

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.....[3]

In a person with sickle cell anaemia, the ability of haemoglobin to transport oxygen and carbon dioxide is severely affected.

The cause of this disease is a mutation in the gene coding for the β-globin polypeptide of haemoglobin.

(c) Define the term *disease*.

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.....[2]

(d) Outline the differences between the Hb^A (normal) and Hb^S (sickle cell) alleles of the gene coding for the β-globin polypeptide **and** explain how these differences lead to a change in the haemoglobin molecule formed.

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.....[5]

[Total: 14]

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Question 5 starts on page 14

5 The fig tree, *Ficus carica*, and the papaya tree, *Carica papaya*, produce a milky-looking fluid known as latex. The latex is released when plant tissue is wounded and it is thought to act as a defence against attack by herbivorous insects or parasitic worms.

Latex is a complex mixture of substances and the exact composition of the mixture depends on the plant species. A group of enzymes that hydrolyse proteins, known as cysteine proteases, are commonly found in latex.

Ficin, found in *F. carica*, and papain, found in *C. papaya*, are both cysteine protease enzymes. These enzymes have been extracted and purified for use commercially.

(a) An investigation was carried out to compare the effect of temperature on the activity of ficin and papain.

The results are shown in Fig. 5.1.

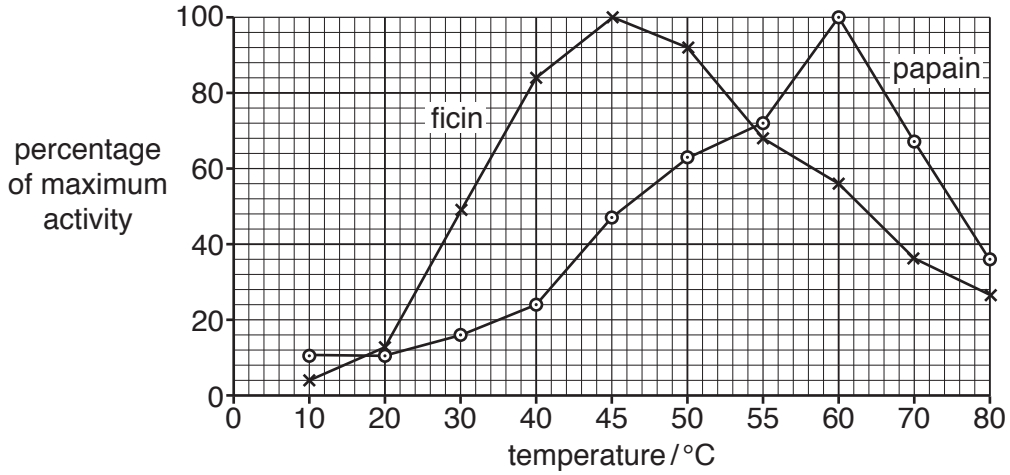


Fig. 5.1

(i) With reference to Fig. 5.1, describe the differences between the activity of papain compared to the activity of ficin between 20 °C and 80 °C.

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.....[3]

(ii) Ficin and papain have been shown to be effective in the digestion of parasitic nematodes (roundworms).

With reference to Fig. 5.1, explain which enzyme you would select to use in an oral medication for the treatment of human intestinal parasitic nematodes.

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.....[1]

(b) One commercial use of the enzyme ficin is the production of Fab fragments (antigen binding regions) of mouse IgG antibodies for use in immunological studies. The process uses immobilised ficin to cleave (cut) the antibodies in the hinge region.

Suggest **one** practical advantage of using immobilised ficin for this process, rather than ficin free in solution.

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.....[1]

(c) *Streptococcus pyogenes* is a bacterium that can cause a range of diseases in humans.

S. pyogenes synthesises streptopain, a cysteine protease that hydrolyses structural proteins in human connective tissue.

(i) Streptopain is secreted to the outside of the cell.

State the term given to an enzyme that is produced by a cell and is then secreted to the outside, where it has its action.

.....[1]

(ii) Suggest **one** example of a structural protein in connective tissue that can be hydrolysed by streptopain.

.....[1]

[Total: 7]

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[Turn over

6 **(a)** Fig. 6.1 is a list of infectious diseases. Each of the statements **A** to **D** describes a feature that applies to one or more of these diseases.

cholera
HIV/AIDS
malaria
measles
smallpox
tuberculosis (TB)

Fig. 6.1

For each of the statements **A**, **B**, **C** and **D**, name **all** the diseases in Fig. 6.1 that match the feature described.

A The causative organism of the disease is a virus.

.....

B The causative organism of the disease is a prokaryote.

.....

C The disease is transmitted by a faecal-oral route, for example, sewage containing the pathogen contaminates drinking water.

.....

D The causative organism of the disease spends part of its life cycle inside an insect, which acts as a vector of the disease.

.....

[4]

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(b) Although many infectious diseases are caused by prokaryotic organisms, there are some that are caused by eukaryotic organisms.

Complete Table 6.1 to show some differences between a prokaryotic cell and a eukaryotic cell.

Table 6.1

prokaryotic cell	**eukaryotic cell**
no true nucleus, genetic material not enclosed	true nucleus, genetic material enclosed by a double membrane known as a .....
..... DNA	linear DNA
70S ribosomes only	70S and ..... ribosomes
no double membrane-bound organelles	double membrane-bound organelles such as .....
cell wall contains	where cell wall is present, generally contains mainly cellulose or chitin

[2]

[Total: 6]

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