Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4239248638

BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **May/June 2022**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

DC (CJ/CB) 302733/2

1 Fig. 1.1 and Fig. 1.2 are photomicrographs showing the distribution of tissues in the lungs.

Fig. 1.1 is a photomicrograph of a section through part of the lungs.

Fig. 1.2 is a high-power view of the area indicated on Fig. 1.1.

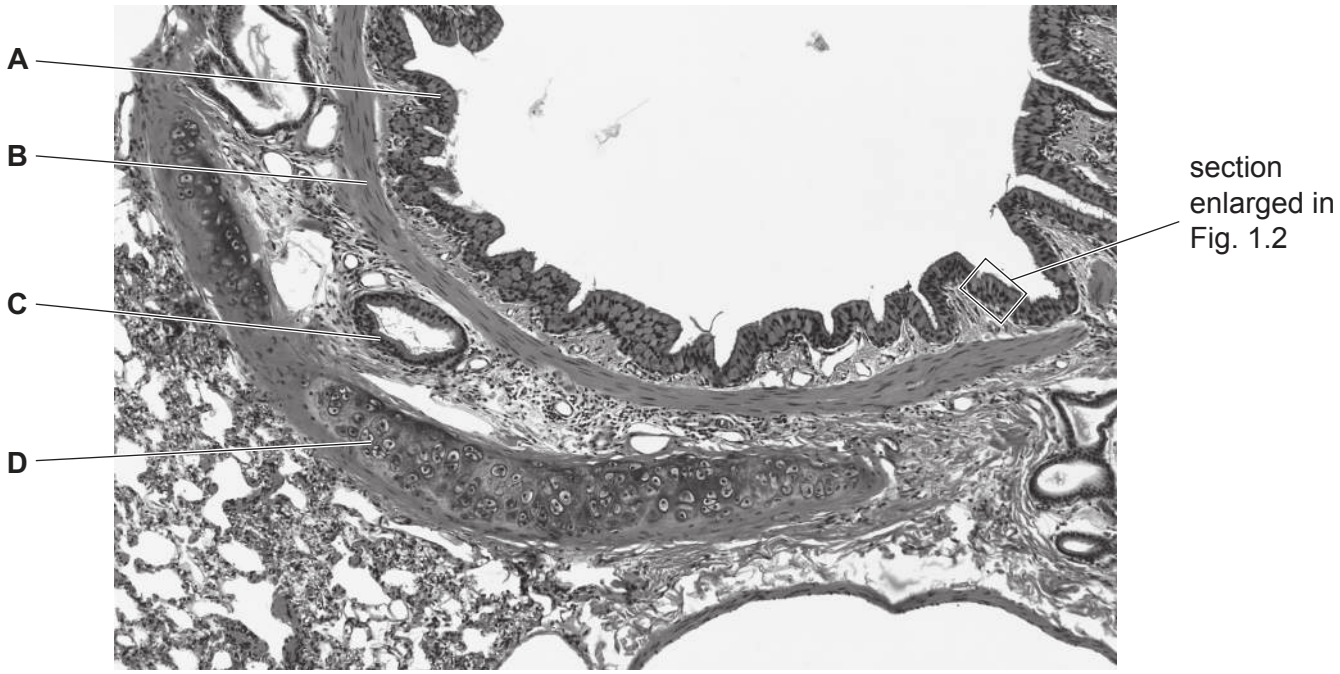

Fig. 1.1

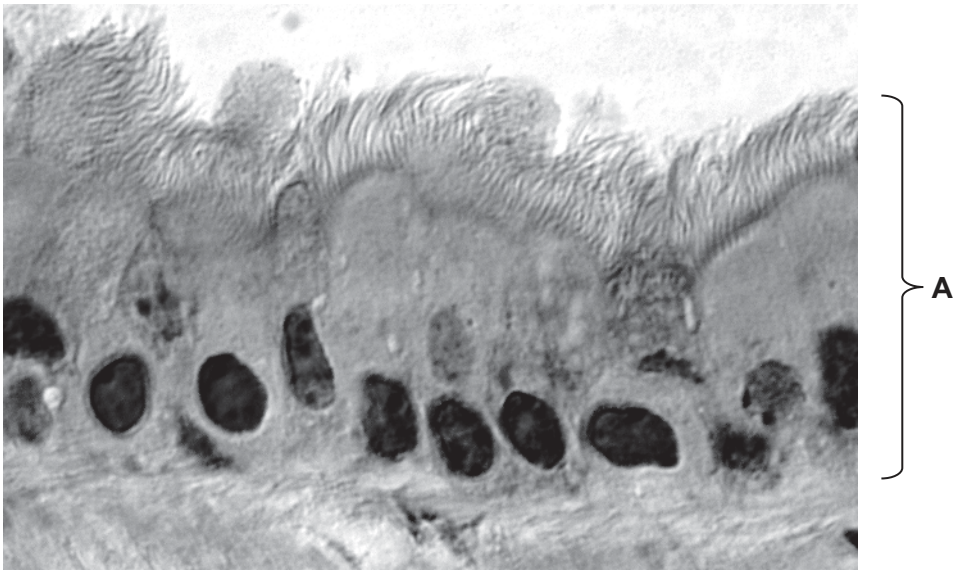

Fig. 1.2

(a) State the names of the tissues **A**, **B** and **D**.

A .....

B .....

D .....
[3]

(b) Describe the role of the glands labelled **C** in Fig. 1.1 in maintaining the health of the gas exchange system.

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..... [3]

(c) Hyperventilation occurs when a person breathes too fast or too deeply.

The effects of hyperventilation are:

- a decrease in the partial pressure of carbon dioxide in alveolar air
- an increase in the pH of the blood.

Fig. 1.3 shows the change in the oxygen dissociation curve as a result of hyperventilation.

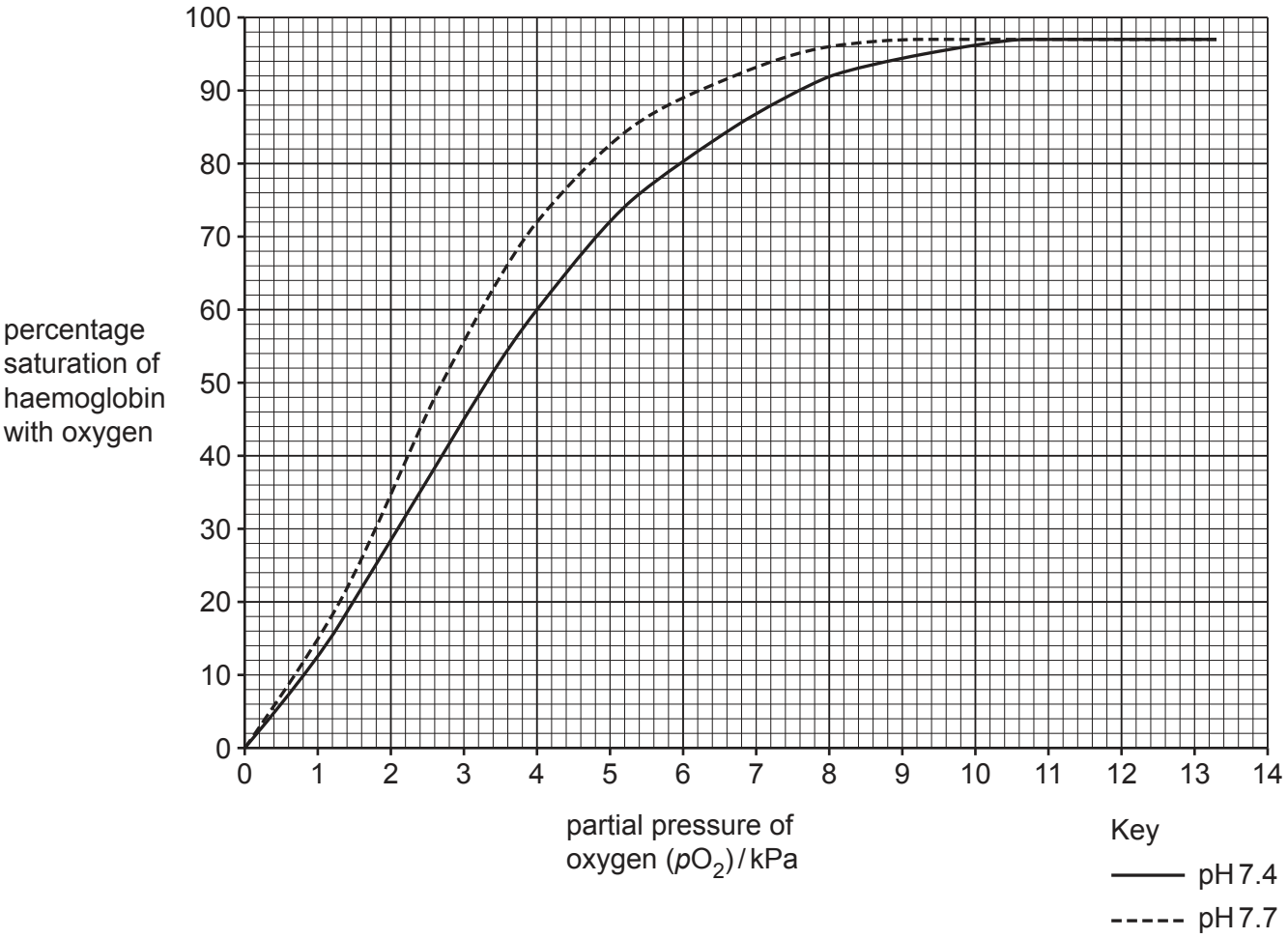

Fig. 1.3

(i) State the percentage saturation of haemoglobin at a pO_2 of 4.0 kPa.

pH = 7.7 ..... kPa

pH = 7.4 ..... kPa [1]

(ii) Use the information in Fig. 1.3 to state **and** explain the effect of hyperventilation on the supply of oxygen to the respiring tissues.

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..... [2]

[Total: 9]

2 B-lymphocytes are activated to form plasma cells during immune responses.

Fig. 2.1 is a drawing of a plasma cell made from a transmission electron micrograph.

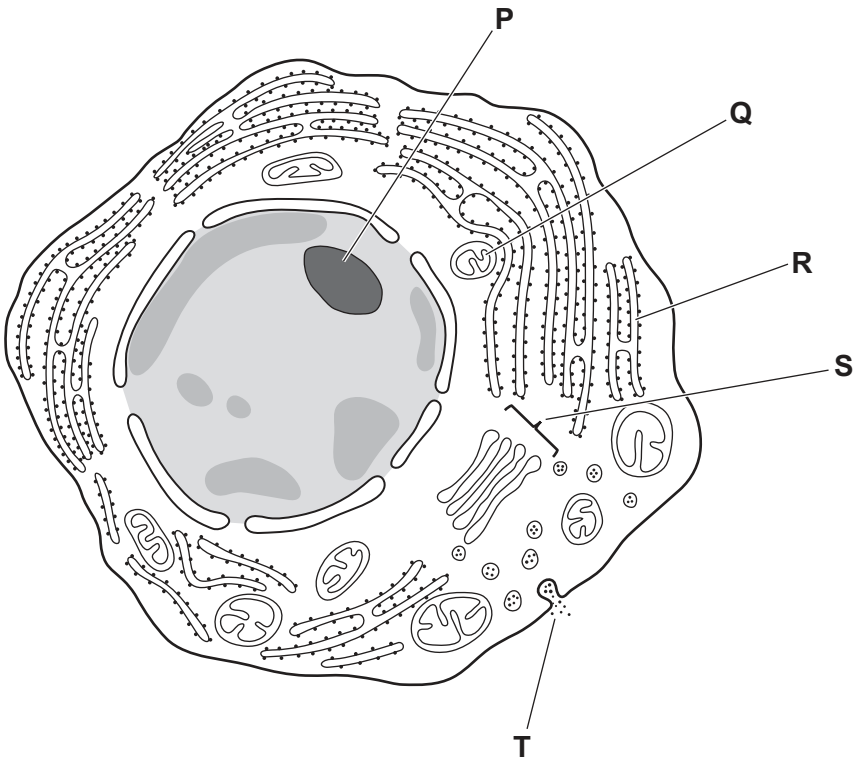

Fig. 2.1

(a) (i) State the name of the process that is occurring at **T**.

..... [1]

(ii) Complete Table 2.1 to show the names and functions of the cell structures labelled **P**, **Q**, **R** and **S** in the plasma cell shown in Fig. 2.1.

Table 2.1

cell structure in Fig. 2.1	name of cell structure	function of cell structure in plasma cell
P		
Q		
R		
S		

[4]

(b) Plasma cells can be used in the commercial production of some monoclonal antibodies.

The method of production is known as the hybridoma method.

Outline the steps in the production of monoclonal antibodies by the hybridoma method.

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..... [3]

(c) Antibodies can be collected from human blood donors and used to treat people that may have been infected with a pathogen. This prevents them becoming ill with the disease.

Explain why this treatment does not prevent people becoming ill if they are infected again with the same pathogen.

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..... [4]

[Total: 12]

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3 A tyrosine kinase receptor (TKR) is a protein complex found in the cell surface membrane of mammalian cells.

TKR has two components involved in the process of cell signalling:

- a receptor for the signalling molecule (ligand)
- an enzyme that catalyses the transfer of a phosphate group from ATP to an intracellular protein.

Fig. 3.1 is a diagram to show how TKR is involved in cell signalling.

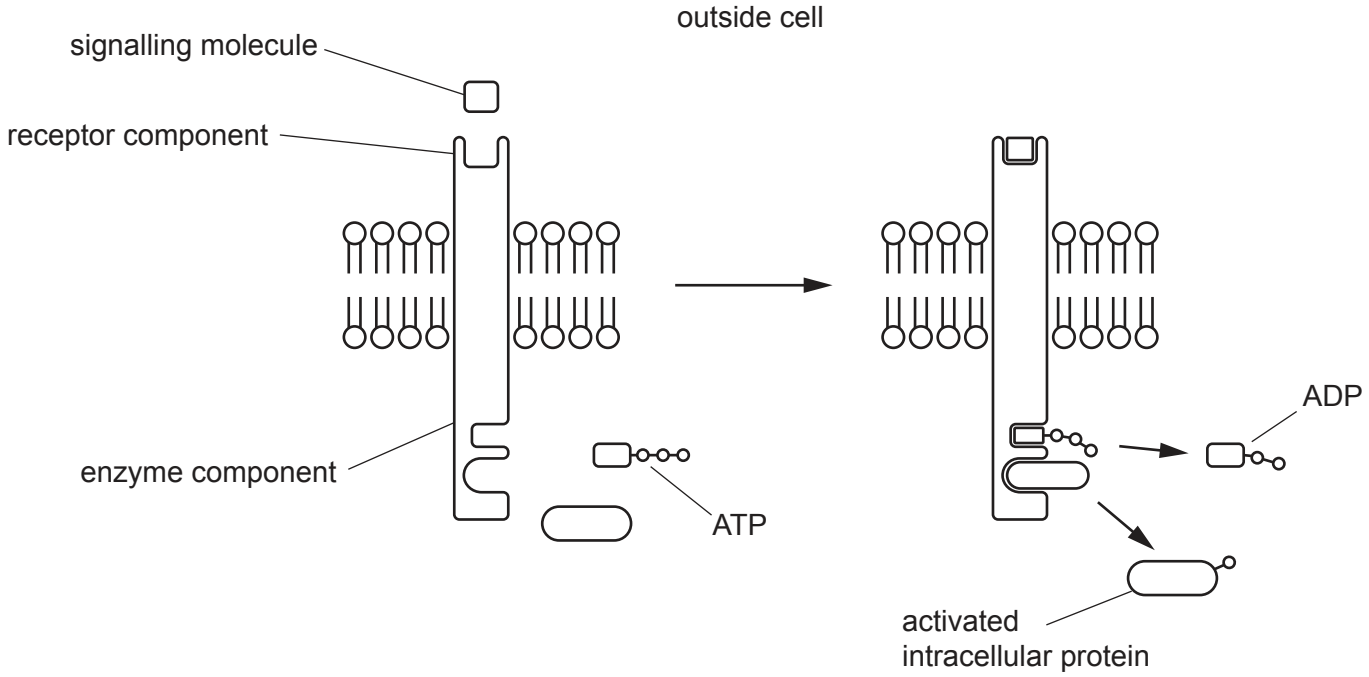

Fig. 3.1

(a) Most enzymes are specific to one reaction.

With reference to Fig. 3.1, explain how the structure of an enzyme provides its specificity.

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..... [2]

The drug GNF-5 is used in the treatment of some cancers. GNF-5 affects the activity of TKR by binding to the enzyme component of the complex.

Researchers investigated the effect of GNF-5 on the activity of TKR using different concentrations of ATP solution. In an experiment the activity of TKR was measured with no GNF-5 **and** with GNF-5.

The results are shown in Fig. 3.2.

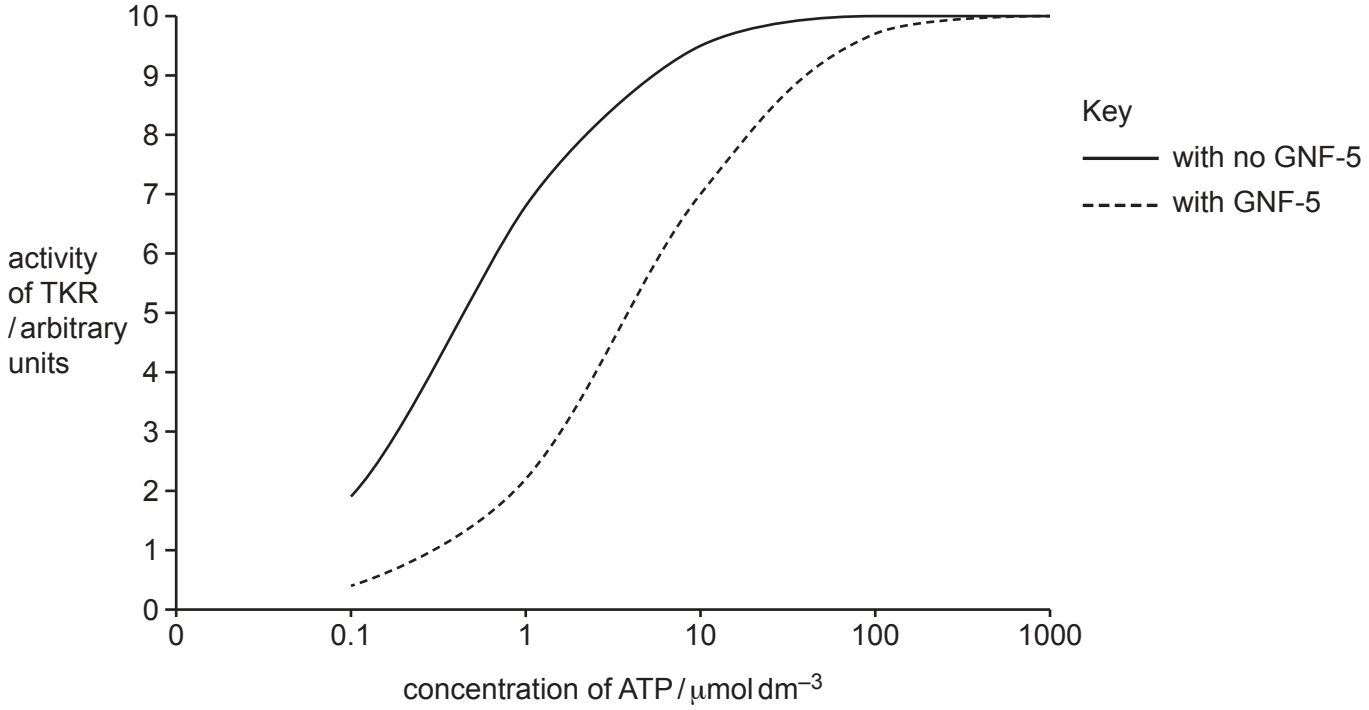

Fig. 3.2

(b) The researchers concluded that GNF-5 acts as an inhibitor of the enzyme component of TKR **and** that it is a competitive inhibitor.

Use Fig. 3.2 to provide evidence for these conclusions.

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..... [3]

(c) A mutation of the gene coding for TKR results in changes to the enzyme component of TKR. This altered form of TKR is known as T315L.

The effect of GNF-5 on the activity of T315L was also investigated.

The results of this investigation are shown in Fig. 3.3.

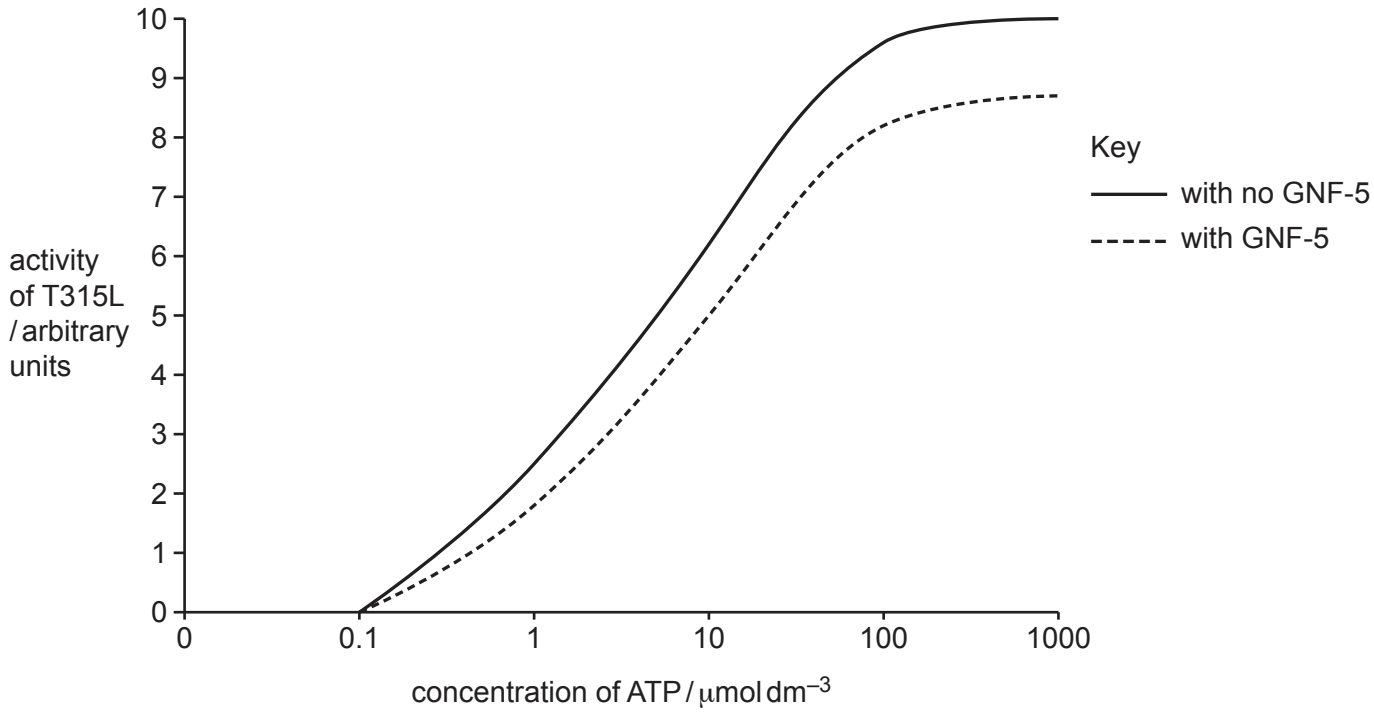

Fig. 3.3

Use Fig. 3.2 **and** Fig. 3.3 to:

(i) State how the activity of T315L differs from TKR when **no** GNF-5 was present.

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..... [1]

(ii) State how the effect of GNF-5 on T315L differs from the effect of GNF-5 on TKR.

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..... [2]

[Total: 8]

4 Adipocytes are cells found in adipose tissue in mammals. These cells absorb glycerol and fatty acids to make triglycerides for long-term storage.

Fig. 4.1a shows a glycerol molecule and three fatty acids. Fig. 4.1b shows the triglyceride molecule formed from these components.

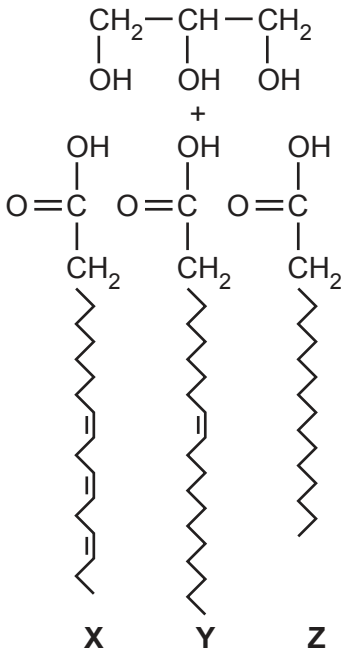

Fig. 4.1a

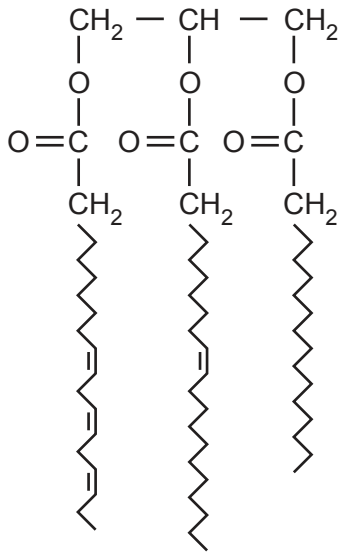

Fig. 4.1b

(a) (i) State the name of the bonds that form between glycerol and fatty acids.

..... [1]

(ii) When a bond forms between glycerol and a fatty acid, water is a product of the reaction.

State the name given to this type of reaction.

..... [1]

(iii) Describe the differences between the fatty acids, **X**, **Y** and **Z**, shown in Fig. 4.1a.

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..... [3]

(b) (i) State reasons why triglycerides are described as hydrophobic.

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..... [2]

(ii) Explain why triglycerides are **not** suitable as a component of cell surface membranes.

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..... [2]

[Total: 9]

5 **(a)** Infectious diseases are caused by pathogens and are described as transmissible diseases.

Explain what is meant by the term transmissible.

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..... [1]

(b) *Vibrio cholerae* is the bacterium that causes cholera.

Fig. 5.1 is a transmission electron micrograph of *V. cholerae*.

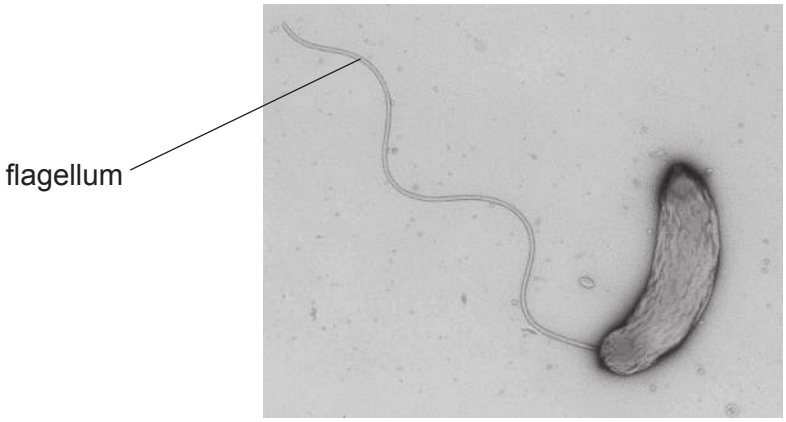

Fig. 5.1

A student wanted to know the actual length of the flagellum shown in Fig. 5.1.

State the information that is needed so that the student can calculate the actual length of the flagellum.

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..... [2]

(c) Table 5.1 shows data on large outbreaks of cholera that occurred in seven countries in 2019.

The case-fatality rate is the number of deaths as a percentage of the number of cases.

Table 5.1

country	number of cases of cholera	number of deaths from cholera	case-fatality rate /%
Cameroon	1307	55	4.2
DR Congo	29087	501	1.7
Haiti	684	3	0.4
Kenya	5150	39	0.8
Somalia	9968	50	0.5
Sudan	346	11	3.2
Yemen	2260495	3767	

(i) Complete Table 5.1 by calculating the case-fatality rate for Yemen. [1]

(ii) Suggest why large outbreaks of cholera occurred in the countries listed in Table 5.1, but there were very few cases in most other countries.

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[Total: 9]

6 Cotransporter proteins are membrane proteins found in companion cells of phloem tissue.

Messenger RNA (mRNA) is the molecule in cells that carries genetic information in the DNA that codes for cotransporter proteins to the sites of protein synthesis in the cytoplasm.

(a) Complete Table 6.1 to compare the structure of a molecule of mRNA with the structure of a molecule of DNA.

Table 6.1

feature	mRNA	DNA
names of four bases		
name of pentose sugar present		
number of strands		

[3]

(b) Fig. 6.1 shows the events that occur in the nucleus of a companion cell in phloem tissue to synthesise molecules of mRNA.

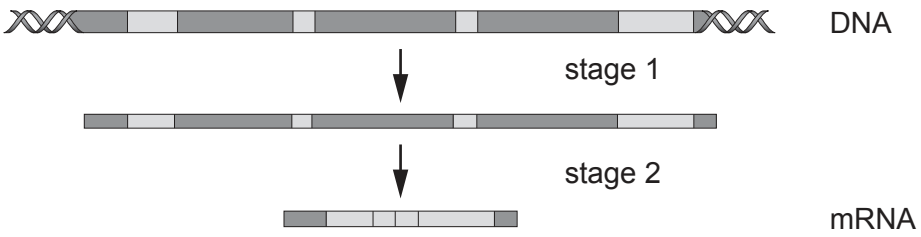

Fig. 6.1

(i) Name stage 1 shown in Fig. 6.1.

..... [1]

(ii) Describe what happens at stage 2, shown in Fig. 6.1, to shorten the length of the RNA molecule.

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..... [2]

(c) Cotransporter molecules are proteins produced in companion cells.

Fig. 6.2 shows what happens in the cytoplasm of a companion cell to a transfer RNA molecule before the cotransporter proteins can be produced.

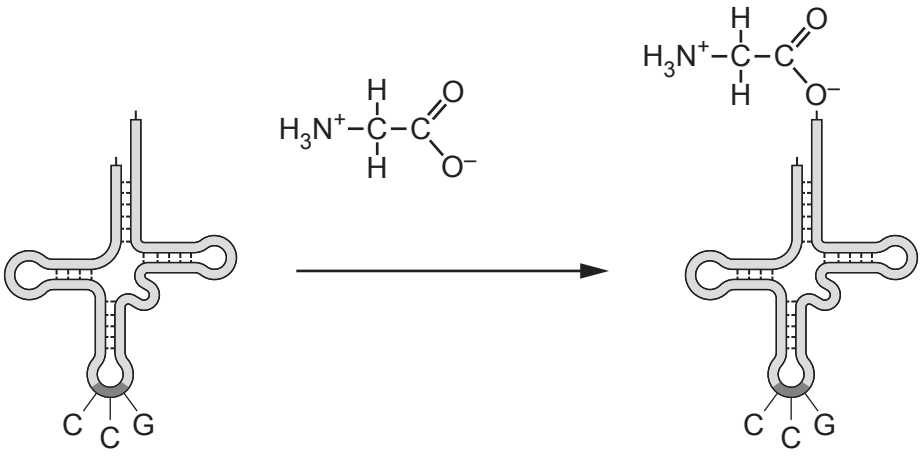

Fig. 6.2

(i) Describe the role of the transfer RNA shown in Fig. 6.2 in the synthesis of a cotransporter protein.

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(ii) Outline the role of cotransporter proteins in companion cells.

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[Total: 13]

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