Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **May/June 2017**

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 **13** printed pages and **3** blank pages.

CAMBRIDGE International Examinations

[Turn over

Answer **all** the questions.

1 **(a)** Each of the statements **A** to **D** describes a structure found in eukaryotic cells.

Identify the structure that is described in each statement.

A An organelle that contains 70S ribosomes.

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B A thread-like structure composed of DNA and histone proteins.

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C The organelle that modifies and packages proteins for secretion.

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D The structure that synthesises rRNA and combines it with proteins.

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[4]

(b) Prokaryotes and plant cells have cell walls.

Outline the composition of the cell wall of a prokaryote **and** the composition of the cell wall of a plant cell to show how they differ.

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[Total: 6]

2 Phosphatases are enzymes that catalyse the removal of phosphate groups from organic compounds.

Some students investigated the effect of substrate concentration on the rate of the reaction catalysed by an acid phosphatase (enzyme **A**). The results are shown in Fig. 2.1.

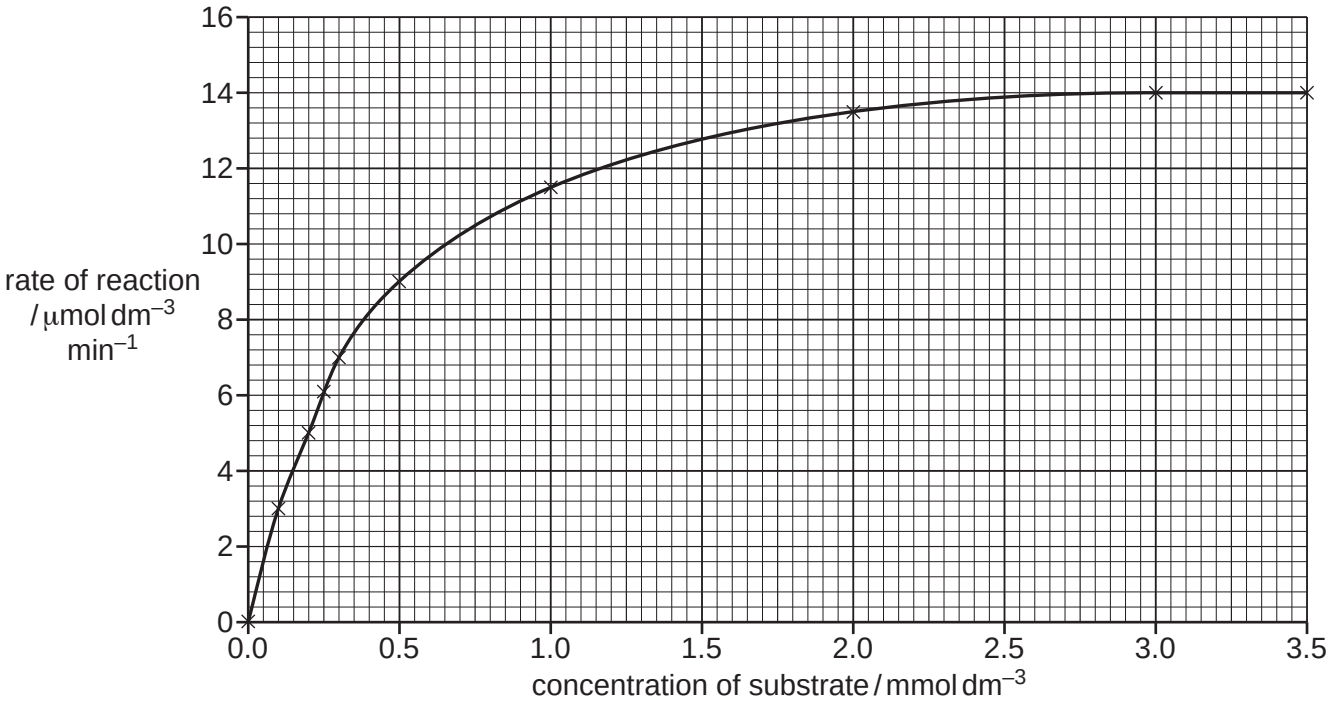

Fig. 2.1

(a) The students used Fig. 2.1 to derive the Michaelis-Menten constant (K_m) for enzyme **A** as 0.3 mmol dm^{-3}.

Explain how they derived K_m.

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(b) The students investigated a different phosphatase enzyme (enzyme **B**) and found the value of K_m to be higher than $0.3\,mmol\,dm^{-3}$.

Explain the difference between the values of K_m for these two phosphatase enzymes.

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(c) The students repeated their investigation on enzyme **A** with a competitive inhibitor.

They used the same concentrations of substrate as before, but added a competitive inhibitor to each reaction mixture.

They used the same concentration of the inhibitor in each reaction mixture.

The students found that V_{max} was the same as before, but K_m was higher than $0.3\,mmol\,dm^{-3}$.

Explain how the addition of the competitive inhibitor results in the same value for V_{max} but a higher value for K_m.

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[Total: 8]

3 Fig. 3.1 is a diagram that shows the structure of an antibody molecule.

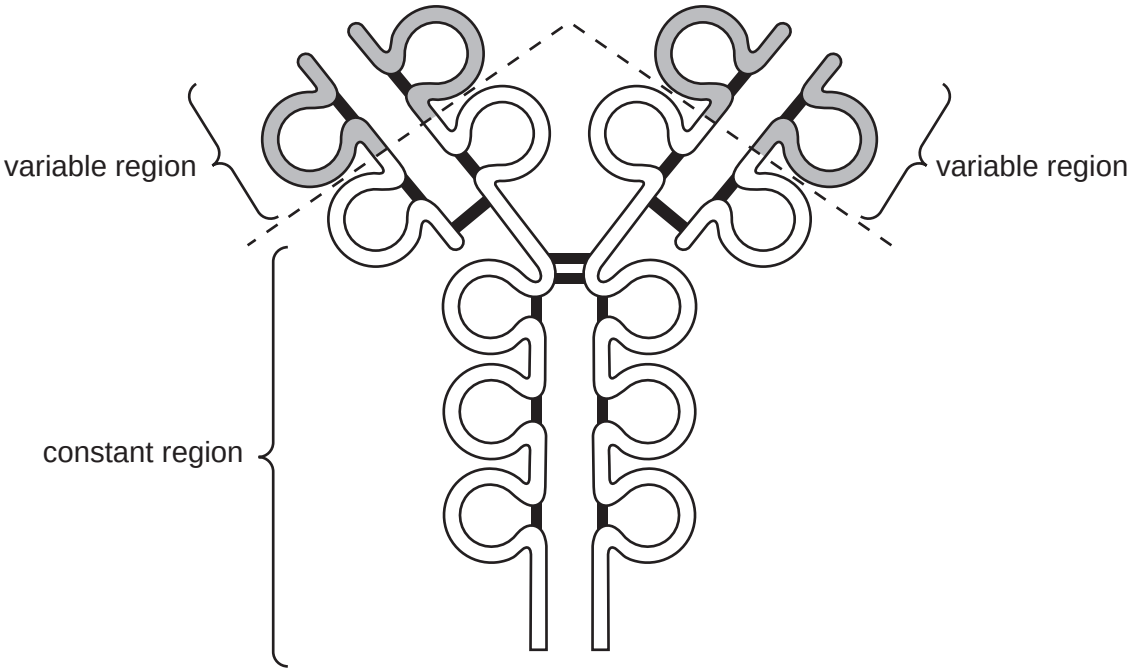

Fig. 3.1

(a) State why the antibody molecule shown in Fig. 3.1 has quaternary structure.

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(b) **(i)** Use Fig. 3.1 to explain how the structure of the variable region of an antibody molecule is related to its function.

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(ii) State the role of the constant region of an antibody.

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(c) Monoclonal antibodies are used both in diagnosis and in treatment of disease.

(i) Outline how monoclonal antibodies are produced.

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(ii) Suggest the advantages of using monoclonal antibodies in diagnosis of disease.

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[Total: 11]

4 **(a)** Fig. 4.1 shows part of a DNA molecule.

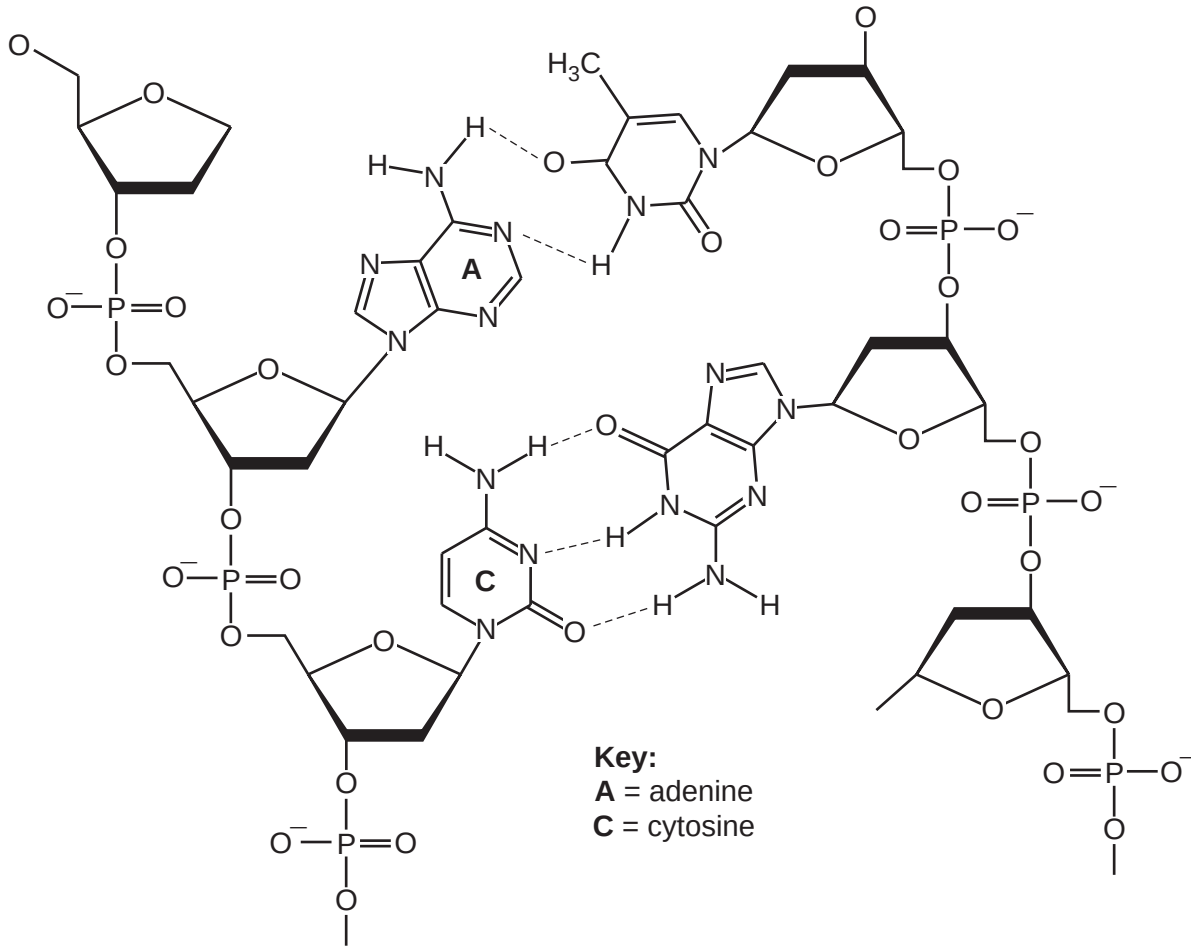

Fig. 4.1

Use Fig. 4.1 to explain how the structure of mRNA differs from the structure of DNA.

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(b) Fig. 4.2 shows:

- the first seven amino acids of the β chain of haemoglobin
- the first amino acid in the sequence is valine (Val)
- the 21 base pairs in the sequence of DNA that code for these seven amino acids.

amino acid sequence	Val	His	Leu	Thr	Pro	Glu	Glu
base sequence in DNA	CAC	GTG	GAC	TGA	GGA	CTC	CTC
	GTG	CAC	CTG	ACT	CCT	GAG	GAG

Fig. 4.2

Table 4.1 shows the triplets of bases that code for seven amino acids.

Using Fig. 4.2 and Table 4.1, state what will happen to the sequence of amino acids in the first part of the β chain of haemoglobin:

(i) if the base pair at position 6 is deleted

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(ii) if the three base pairs at positions 7, 8 and 9 are deleted.

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Table 4.1

amino acid		**DNA triplets**
cysteine	(Cys)	TGT TGC
glutamic acid	(Glu)	GAA GAG
histidine	(His)	CAT CAC
leucine	(Leu)	CTT CTC CTA CTG
proline	(Pro)	CCT CCC CCA CCG
threonine	(Thr)	ACT ACC ACA ACG
valine	(Val)	GTT GTC GTA GTG
no amino acid	STOP	TAA TAG TGA

(c) DNA is involved in the processes of replication and transcription.

Complete Table 4.2 by using a tick (✓) to indicate which features apply to each of the processes. Use a cross (✗) for features that do **not** apply.

The first row has been completed for you.

Table 4.2

feature	replication	transcription
a single-stranded molecule is produced	✗	✓
hydrogen bonds are broken		
both strands of DNA act as templates		
phosphodiester bonds are formed		
DNA polymerase is used		

[4]

(d) Telomeres are parts of chromosomes. Describe the function of telomeres.

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(e) Describe the function of ribosomes in protein synthesis.

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[Total: 16]

[Turn over

5 Sugar molecules enter cells through transport proteins.

(a) Explain why transport proteins are required for the movement of sugar molecules, such as glucose and fructose, into cells.

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Some plant cells convert fructose and glucose into sucrose for transport from sources to sinks. Sucrose is moved into phloem sieve tubes as shown in Fig. 5.1.

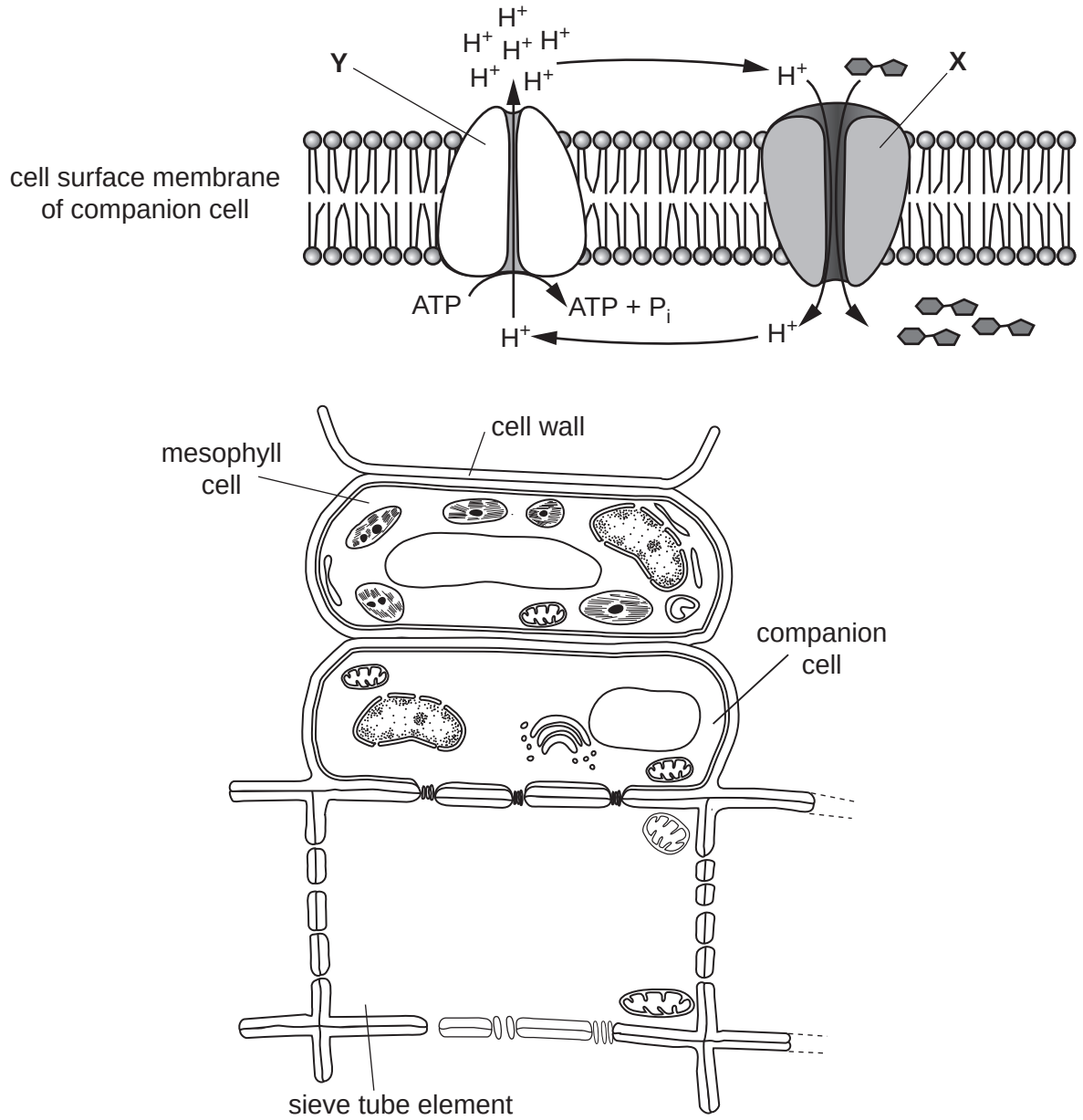

Fig. 5.1 not to scale

(b) Use the information in Fig. 5.1 to explain how sucrose:

- moves into the companion cell
- moves from the companion cell into the sieve tube element.

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(c) Sucrose travels in phloem sieve tubes to sinks.

State two examples of sinks.

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[Total: 8]

6 Cholera bacteria release the toxin, choleragen, when they are in the intestine.

(a) (i) Name the bacterium that is the pathogen of cholera.

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(ii) Describe the way in which cholera is transmitted from an infected person to an uninfected person.

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Gangliosides are glycolipids that bind choleragen. These glycolipids are found on many cell surface membranes.

When choleragen is released from the bacteria in the intestine, it binds to gangliosides on epithelial cells and enters these cells as shown in Fig. 6.1.

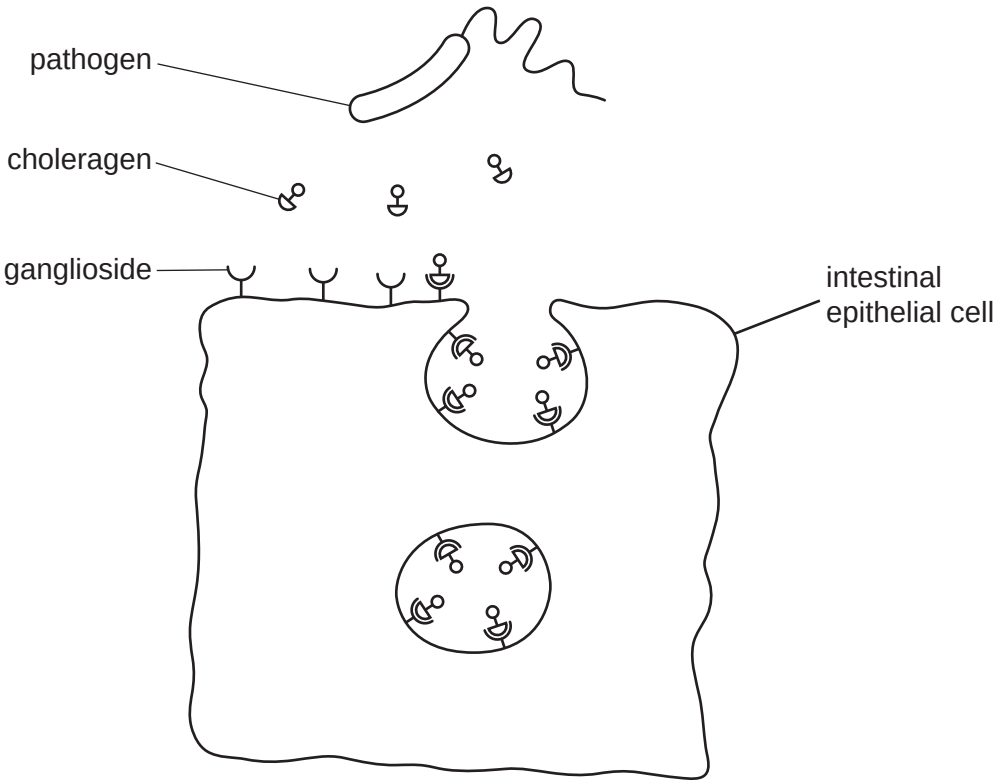

Fig. 6.1 not drawn to scale

(b) Suggest how choleragen interacts with gangliosides on intestinal epithelial cells.

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(c) Name the process by which choleragen enters the intestinal epithelial cell as shown in Fig. 6.1.

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Once inside the cells choleragen is activated. One effect is to increase the movement of chloride ions through channel proteins out of cells.

(d) Suggest **and** explain the likely consequences on the intestinal epithelial cells of the loss of chloride ions through the channel proteins.

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(e) Health authorities recommend that antibiotics, such as tetracycline, are **only** to be used for treating people with severe cases of cholera.

Explain why it is recommended that antibiotics should **not** be given to people with mild cases of cholera or to protect people from cholera.

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[Total: 11]

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