

19 A human muscle cell contains 46 chromosomes.

How many centromeres will be present in a cell during the stages of the mitotic cell cycle?

	early prophase	metaphase	anaphase
A	46	46	92
B	46	92	92
C	46	46	46
D	92	46	46

20 Telomeres become shorter during each cell cycle of a specialised cell.

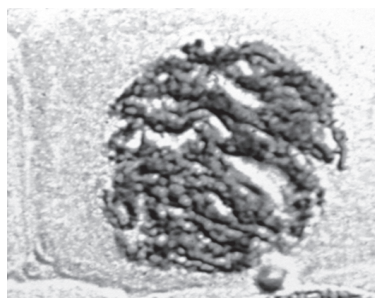
In which phase of the cell cycle do telomeres shorten?

- A** cytokinesis
- B** G_1
- C** S
- D** G_2

21 The photomicrographs show stages of mitosis.



1



2



3



4



5

What is the correct order for the stages of mitosis?

- A** 2 → 3 → 5 → 1 → 4
B 2 → 4 → 1 → 5 → 3
C 3 → 2 → 5 → 4 → 1
D 5 → 1 → 4 → 3 → 2

21 Telomeres prevent the loss of genes during DNA replication.

Which row correctly shows cell types that contain telomeres?

	typical animal cell	typical plant cell	typical bacterial cell
A	✓	✓	✓
B	✓	✓	x
C	x	x	✓
D	✓	x	x

key

✓ = present

x = **not** present

21 What are roles of adult stem cells in humans?

- 1 repair other cells by mitosis
- 2 divide to replace cells in tissues
- 3 differentiate into a new organism

A 1 and 3 **B** 1 only **C** 2 and 3 **D** 2 only

- 1 The wall of the small intestine is highly folded to form villi. Between the villi are infoldings known as crypts of Lieberkühn.

Fig. 1.1 is a diagram of a section through a single villus and a crypt of Lieberkühn.

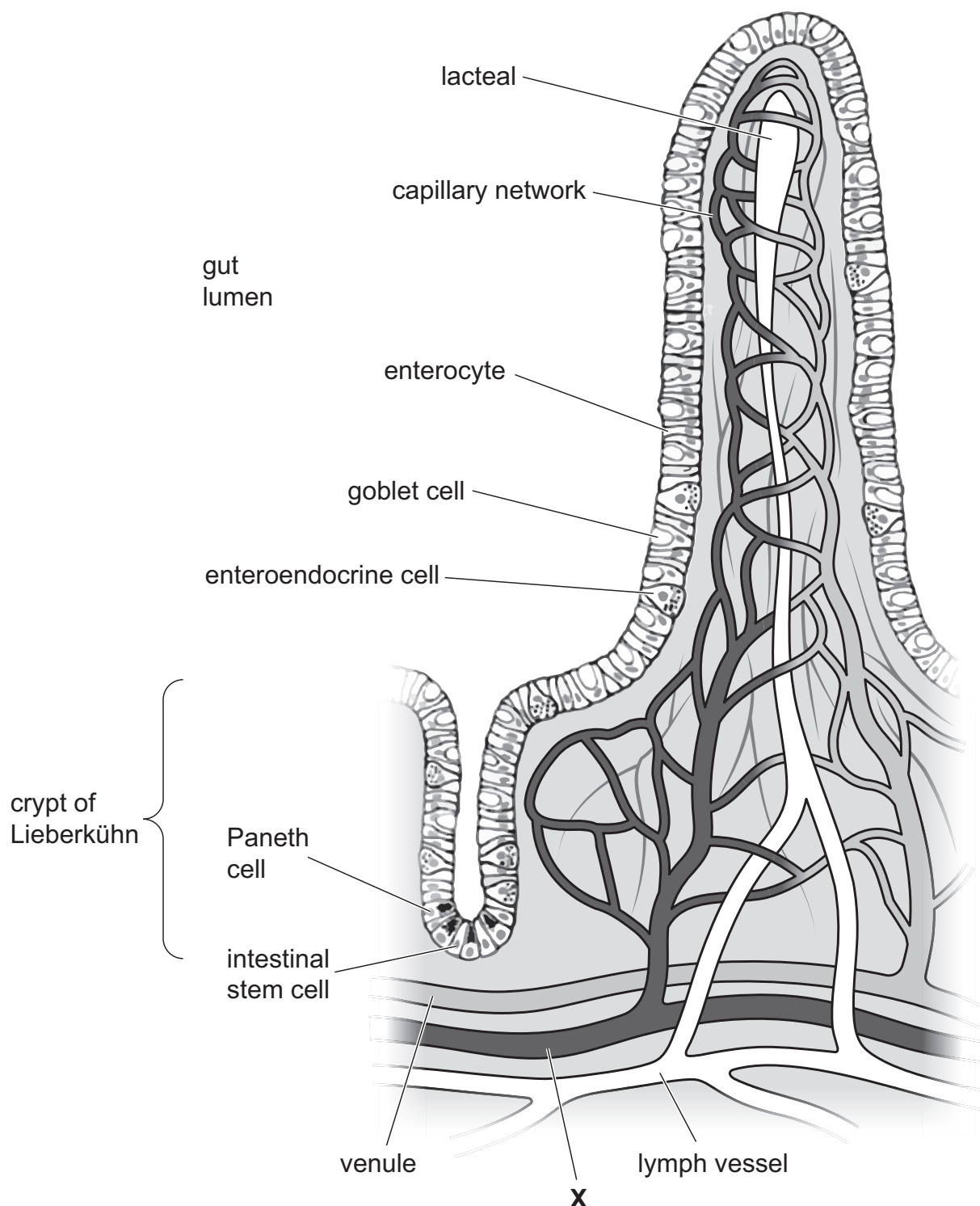


Fig. 1.1

Fig. 1.1 shows that the epithelium of the villus contains mainly goblet cells and cells known as enterocytes. Both cell types have microvilli on the apical surface (surface facing the gut lumen).

Goblet cells are involved in the production of mucus.

Enterocytes are adapted for the absorption of the soluble products of digestion. These products enter the circulatory system.

- (a) A student incorrectly stated that an enterocyte has many **cilia** on its apical surface.

Explain the difference between a cilium and a microvillus.

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- (b) Suggest **one** role of the mucus produced by the goblet cells of the villus.

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- (c) In Fig. 1.1, blood vessel **X** delivers blood to the capillary network of the villus, where tissue fluid is formed. Some of the fluid passes back into the capillaries and then into the venule.

- (i) Blood vessel **X** receives blood from an artery.

Name the type of blood vessel represented by **X**.

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- (ii) Describe the formation of tissue fluid in the capillary network of the villus.

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- (d) In response to the presence of compounds in the gut lumen, enteroendocrine cells synthesise and release peptides (short chains of amino acids) that are cell-signalling molecules. One of these cell-signalling molecules is known as GLP-1.

GLP-1 initiates a number of responses in different body cells. Some of these responses include:

- the increase in release of the hormone insulin from cells in the pancreas
- the decrease in release of acid from cells in the stomach.

Outline, **in sequence**, the main stages involved in the process of cell signalling by GLP-1.

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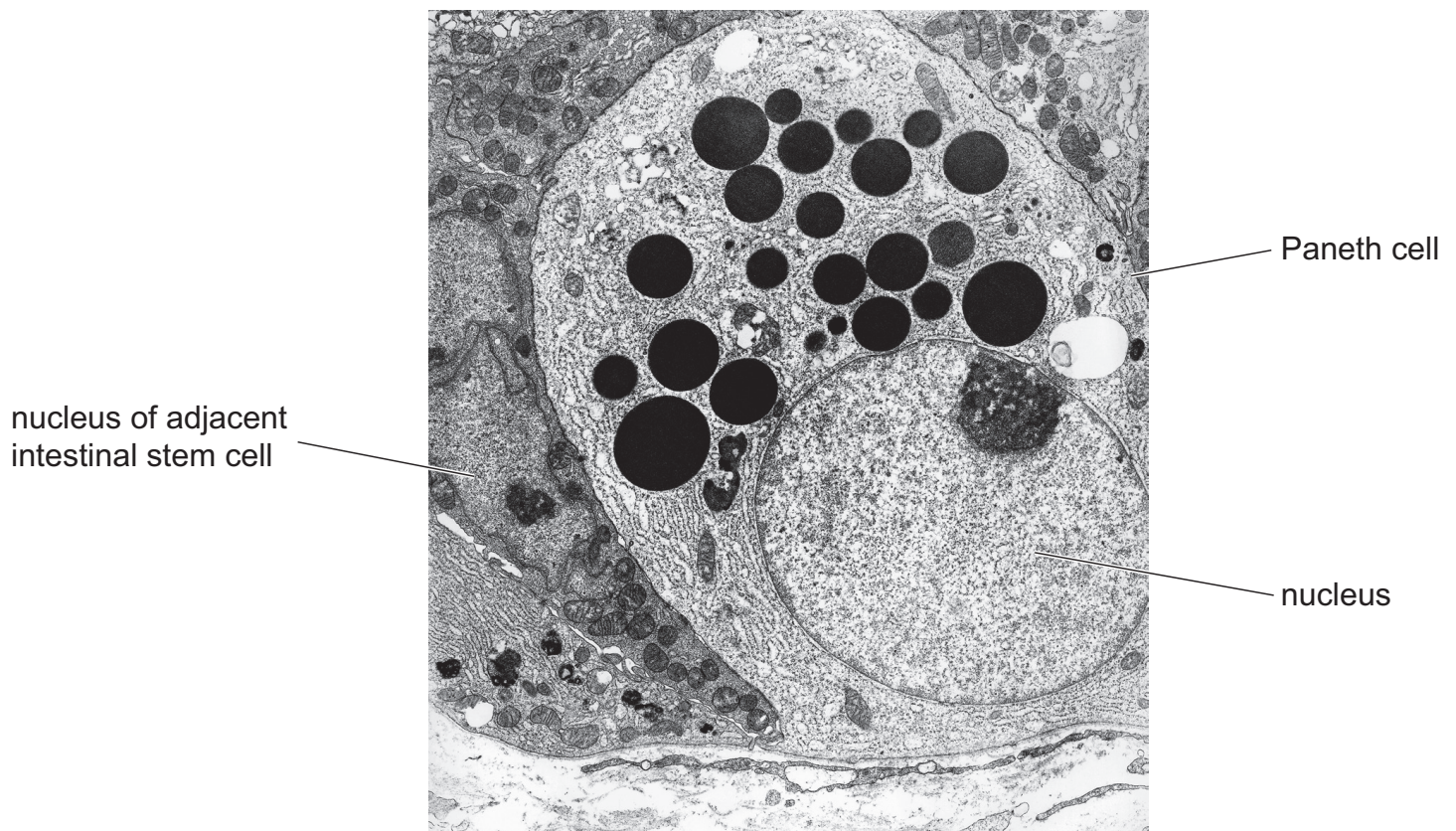
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..... [3]

- (e) Paneth cells, which are secretory cells, are located between intestinal stem cells at the base of the crypt of Lieberkühn, as shown in Fig. 1.1.

A Paneth cell has a very different appearance to an intestinal stem cell.

Fig. 1.2 is a transmission electron micrograph of a Paneth cell.



- (i) Paneth cells are formed following the mitotic division of an intestinal stem cell during a cell cycle.

Complete the cell cycle shown in Fig. 1.3 by naming, **in sequence**, the stages of mitosis.

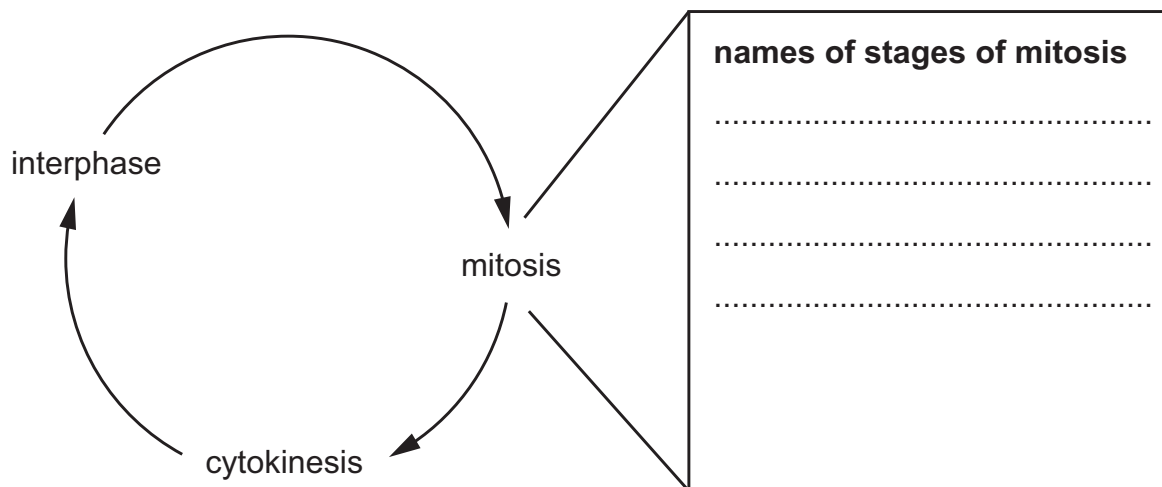


Fig. 1.3

[1]

- (ii) One of the functions of a Paneth cell is to synthesise and secrete peptides and proteins that act against pathogens in the gut lumen.

State **and** explain the evidence, **visible in Fig. 1.2**, which suggests that a Paneth cell:

- is a secretory cell
- synthesises many peptides and proteins.

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- (iii) Explain why a Paneth cell has a very different appearance to an intestinal stem cell.

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- There are similarities and differences between the structure of a typical plant cell and a typical animal cell.
- (a)
- The nucleus of plant cells and animal cells contains chromosomes. In interphase of the cell cycle, individual chromosomes are present but cannot be seen. The chromosome material is known as chromatin.

- (i)
- Changes occur in interphase, which result in a difference between the chromatin in the G1 phase compared with the chromatin in the G2 phase.

State **and** explain the difference in chromatin in the G1 phase compared with chromatin in the G2 phase.

[2]

- (ii)
- Describe the features of a nucleus, **other than** containing chromatin.

You may use the space below the lines for a diagram.

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- (b)** Starch, cellulose and pectins are polysaccharides found in plant cells but **not** in animal cells.

Pectins are complex polysaccharides that are found in the cell wall.

- (i) Describe the structural features of starch that are **different** from the structural features of cellulose.

[4]

- (ii) Cell wall pectins can vary in different plant cell types and in different stages of cell development. Pectin molecules are released from cells as basic structures and then modified within the cell wall by adding side chains.

RG-I is a pectin molecule with a variable structure. The basic structure is a repeated disaccharide made from two different monosaccharides. RG-I has three different side chains that can be added in different positions.

Monoclonal antibodies (mAbs) are used to investigate the structure, location and role of cell wall pectins.

Suggest **and** explain why scientists need to use a number of different monoclonal antibodies when investigating a pectin such as RG-I.

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[Total: 12]

5 Veins transport blood towards the heart. The structure of a vein is adapted to its function.

(a) The inner layer of a vein is the tunica intima, composed of a single layer of endothelial cells that form a protective barrier.

When the tunica intima of a blood vessel is damaged, endothelial cells can carry out mitosis to allow tissue repair to occur.

(i) The spindle that is formed during mitosis is composed of spindle fibres.

Name the cell structures that are organised to form spindle fibres during mitosis.

..... [1]

(ii) Describe the **telophase** stage of mitosis.

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(b) Explain how the structure of a vein is related to its function.

You **do not** need to include details of the structure of the tunica intima and its function.

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[Total: 6]