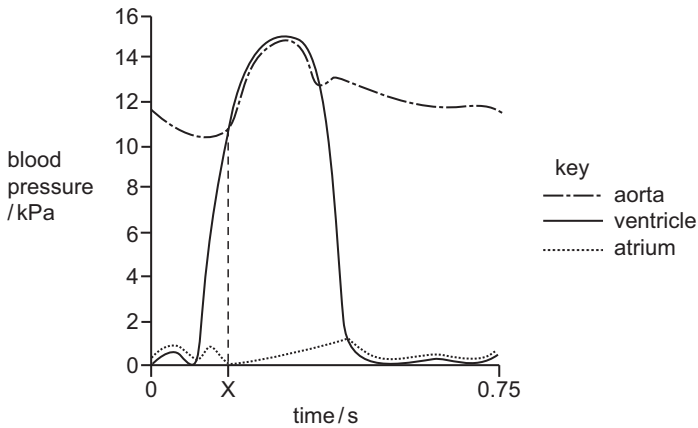


- 30 Which statement correctly compares blood plasma and tissue fluid in a healthy person?
- A Blood plasma contains more protein than tissue fluid.
  - B Both blood plasma and tissue fluid contain red blood cells.
  - C Tissue fluid contains white blood cells whereas blood plasma does **not** contain lymphocytes.
  - D Tissue fluid is formed from blood plasma and is **not** returned to blood plasma.
- 31 The body maintains an average normal blood pH of 7.4.
- Which row describes the conditions that would increase the dissociation rate of haemoglobin the most during periods of intense exercise?

|   | blood pH | blood CO <sub>2</sub> partial pressure/kPa |
|---|----------|--------------------------------------------|
| A | 7.2      | 5.6                                        |
| B | 7.2      | 9.5                                        |
| C | 7.6      | 5.6                                        |
| D | 7.6      | 9.5                                        |

- 32 The graph shows changes in blood pressure during one cardiac cycle.

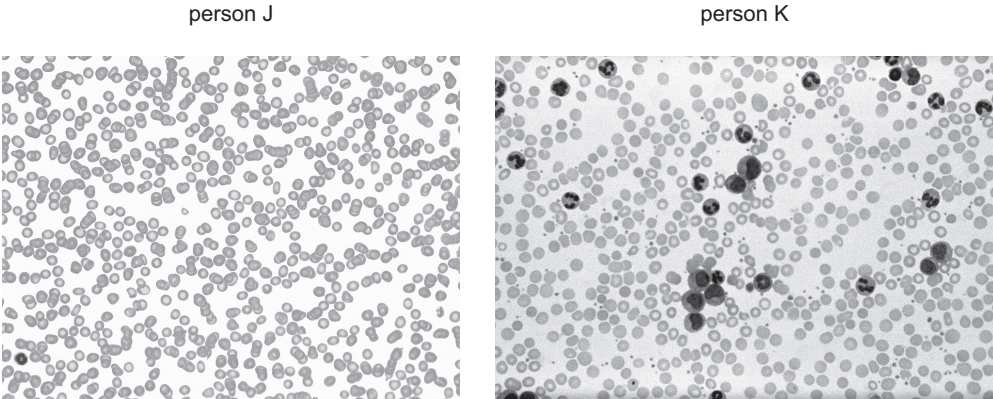


What is happening at time X?

|   | aortic semilunar valve | atrium   |
|---|------------------------|----------|
| A | closing                | emptying |
| B | closing                | filling  |
| C | opening                | emptying |
| D | opening                | filling  |

- 33 How many times must a carbon dioxide molecule pass through a cell surface membrane to travel from the tissue fluid into the blood plasma?
- (Assume there are no pores between the cells the carbon dioxide molecule must pass through.)
- A 1                      B 2                      C 3                      D 4

32 The photomicrographs show blood smears from two different people. Person J does **not** have a disorder that affects their blood. Person K does have a disorder that affects their blood.



The table shows some disorders that increase or decrease the number of neutrophils, red blood cells or lymphocytes.

|                | disorders related to blood count changes |                        |
|----------------|------------------------------------------|------------------------|
|                | increase                                 | decrease               |
| neutrophil     | chronic inflammation                     | autoimmune neutropenia |
| red blood cell | heart failure                            | anaemia                |
| lymphocyte     | chronic leukaemia                        | sepsis                 |

Which disorder does person K have?

- A autoimmune neutropenia
- B heart failure
- C sepsis
- D chronic leukaemia

2 (a) Haemoglobin is a globular protein containing haem groups.

Explain how the presence of haem groups allows the haemoglobin molecule to transport oxygen.

[2]

(b) In certain situations, such as during intense exercise, a person may breathe very quickly and deeply. This is known as hyperventilation.

This hyperventilation causes more carbon dioxide to be exhaled. As a result, there is a lower concentration of carbon dioxide in the blood that passes through the capillary network in respiring tissues. This increases the affinity of haemoglobin for oxygen so that there is a decrease in the release of oxygen from red blood cells.

Explain why a decrease in the concentration of carbon dioxide in the blood passing through respiring tissues leads to a decrease in the release of oxygen from red blood cells.

[3]



- ..5

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



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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..... [2]

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

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..... [1]

- (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**.

..... [1]

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

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..... [2]

- (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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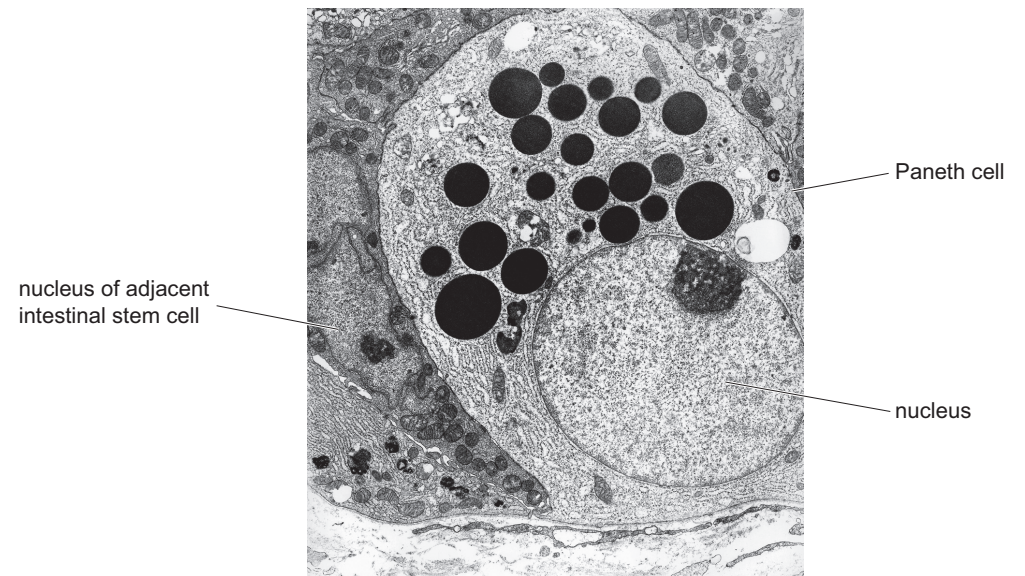
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..... [3]

- (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.

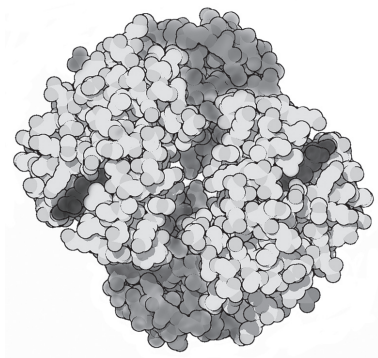
Fig. 1.2 is a transmission electron micrograph of a Paneth cell.



8  
Fig. 1.2

. [5]

(b) Fig. 6.1 is a drawing of a haemoglobin molecule to show its globular structure.



**Fig. 6.1**

(i) Describe the quaternary structure of a haemoglobin molecule.

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..... [2]

(ii) Outline how a haemoglobin molecule can become fully saturated with oxygen to form oxyhaemoglobin.

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..... [2]

[Total: 9]