OCR
Oxford Cambridge and RSA

Thursday 26 May 2016 – Afternoon

AS GCE HUMAN BIOLOGY

F221/01 Molecules, Blood and Gas Exchange

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
- Electronic calculator
- Ruler (cm/mm)

Duration: 1 hour

* F 2 2 1 0 1 *

* 5 9 5 1 7 4 5 4 3 2 *

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- The Insert will be found inside this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **60**.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **20** pages. Any blank pages are indicated.

Answer **all** the questions.

1 Leucocytes (white blood cells) make up approximately 1% of the total blood volume of a healthy adult. These cells can be viewed in stained blood smears using a light microscope.

(a) Neutrophils and monocytes are types of leucocyte.

(i) Compare the structure of a neutrophil and a monocyte, as seen using a light microscope.

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..... **[2]**

(ii) Describe what happens to monocytes after their release into the blood circulation.

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..... **[2]**

(b) A full blood count (FBC) is a screening test that can be used to monitor health. The FBC includes a count of the number of each type of leucocyte in a cubic decimetre (dm^3) of blood.

Fig. 1.1 shows the result of a leucocyte count for a healthy adult.

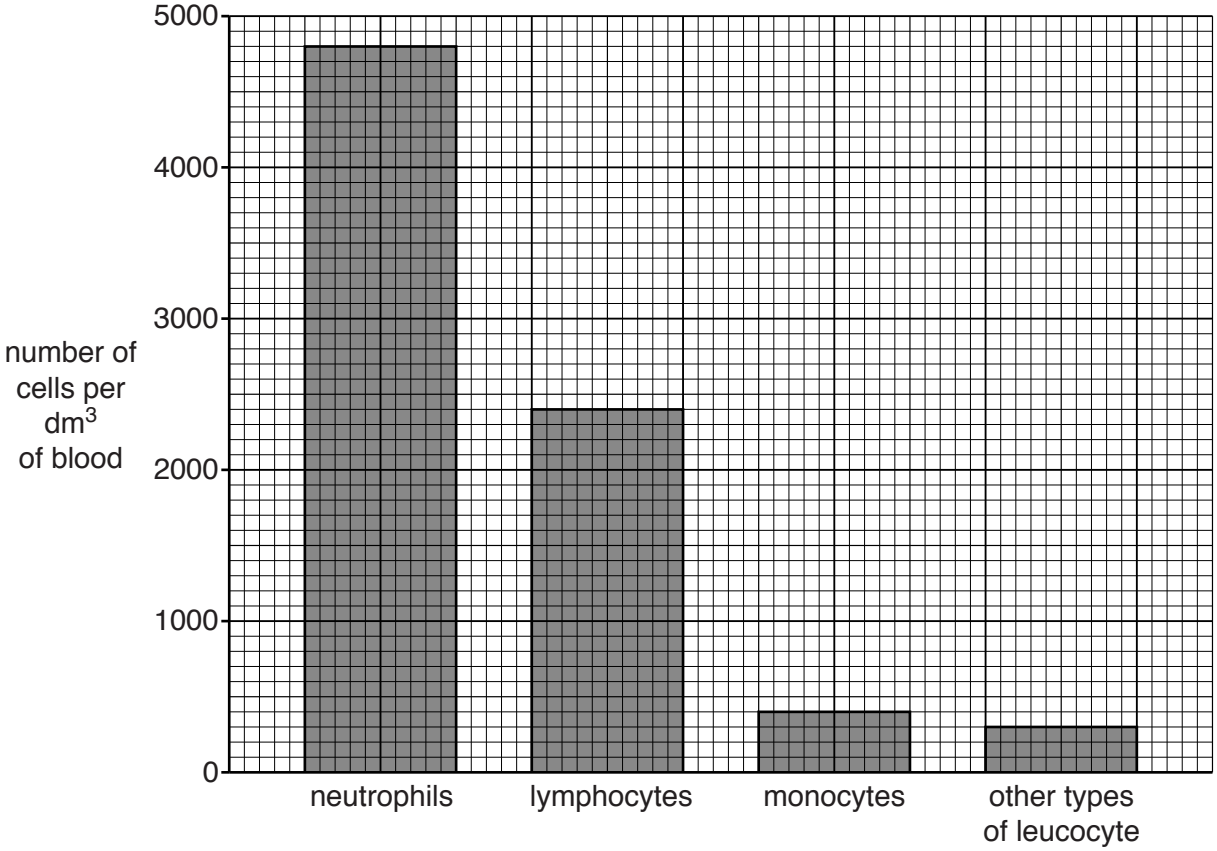

Fig. 1.1

(i) Using Fig. 1.1, calculate the percentage of lymphocytes in the total leucocyte count for this adult.

Show your working. Give your answer to **one** decimal place.

Answer = ... % **[2]**

(ii) The result of a FBC for another adult showed more than 50% of the leucocyte count to be lymphocytes.

Suggest **one** reason for the difference in the result for this adult compared with the result for the healthy adult shown in Fig. 1.1.

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..... **[1]**

(iii) As well as being found in blood plasma, leucocytes may also be present in other body fluids, such as lymph.

Name **one** other component of **blood plasma** that is present in lymph.

..... **[1]**

(c) Eosinophils are another type of leucocyte circulating in blood. These cells produce a large number of **proteins**, such as cytokines.

Cytokines are proteins that are involved in cell signalling.

Fig. 1.2 shows the structure of an eosinophil.

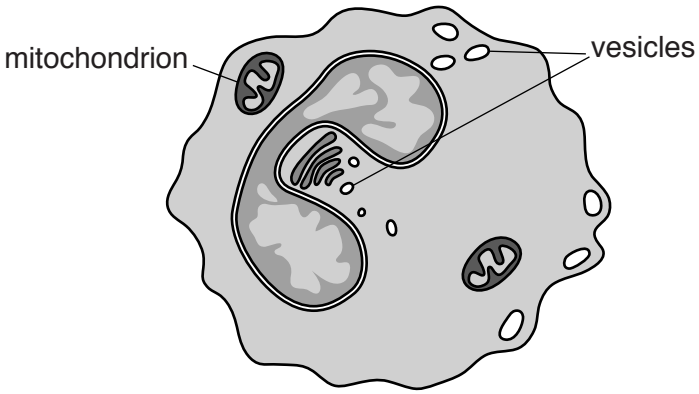

Fig. 1.2

Using Fig. 1.2, describe how **proteins** such as cytokines, made by eosinophils, are processed before being released from the cell.

In your answer, you should use appropriate technical terms, spelled correctly.

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..... **[4]**

(d) Two students viewed blood samples under a microscope and used haemocytometers to count the number of leucocytes.

Fig. 1.3 shows two different haemocytometers, **A** and **B**, that were prepared by the students.

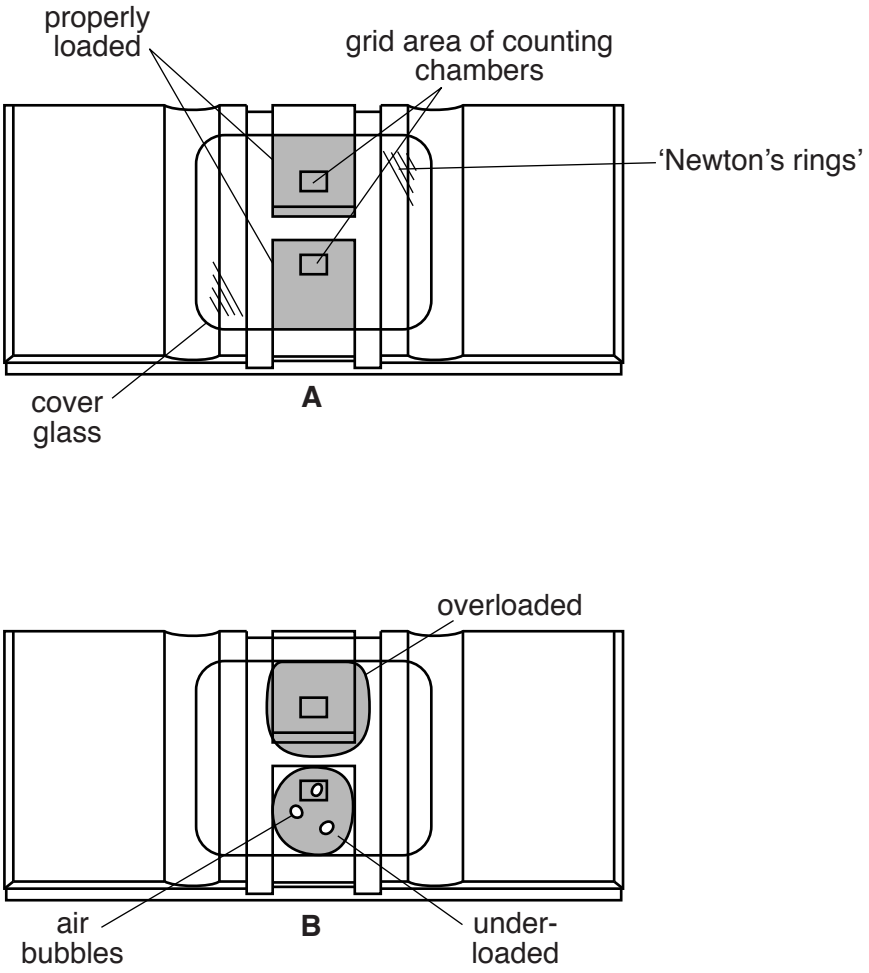

Fig. 1.3

The blood samples had been diluted so that the number of leucocytes could be counted accurately.

Other than diluting the sample, give **two** reasons why haemocytometer **B** would not allow the students to count the cells accurately. Explain your answers.

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..... **[2]**

[Total: 14]

2 Fig. 2.1 shows the structure of a phospholipid molecule.

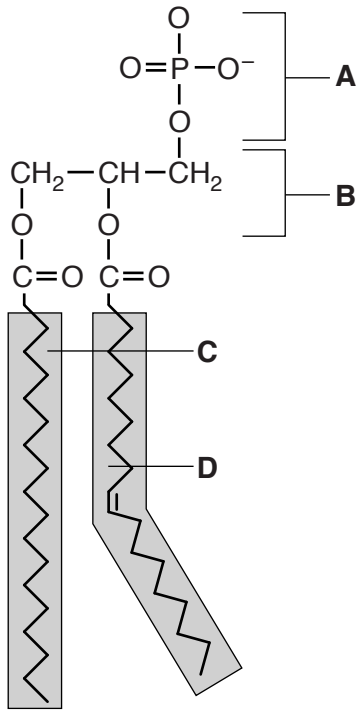

Fig. 2.1

(a) (i) Name the parts of the molecule labelled **B**, **C** and **D**.

B .....

C .....

D .....

[3]

(ii) Which part of the molecule, **A**, **B**, **C** or **D**, is hydrophilic?

..... **[1]**

(b) Phospholipid molecules are components of cell membranes that surround organelles such as mitochondria and chloroplasts.

Outline the role of membranes **within** the cell.

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..... **[2]**

[Total: 6]

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3 Blood clotting involves a series of enzyme-controlled reactions.

(a) Complete the table below for two of the enzyme-controlled reactions involved in blood clotting.

Enzyme	Substrate	Product
	prothrombin	
thrombin		

[2]

(b) Enzymes control the rate of metabolic reactions, such as blood clotting, by affecting the activation energy of reactions.

The activation energy is the minimum energy needed for a reaction to start.

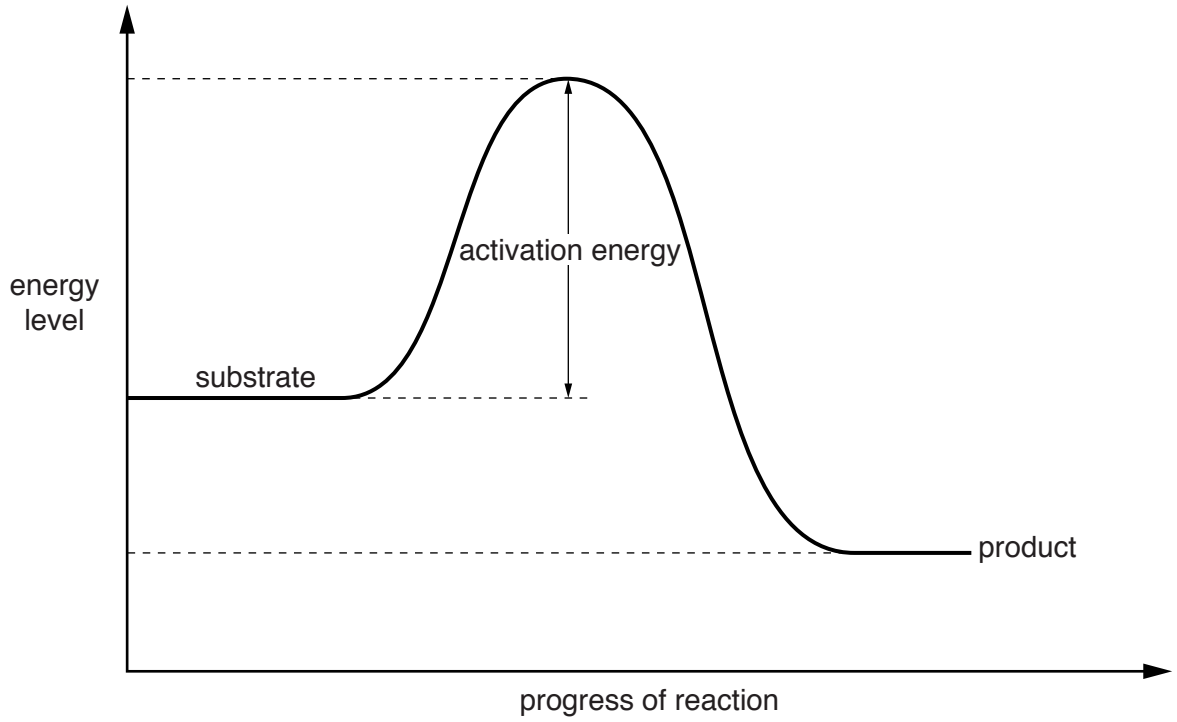

Fig. 3.1

Fig. 3.1 shows changes in energy level of a reaction taking place **without** an enzyme catalyst.

Describe **and** explain how the appearance of Fig. 3.1 would change if this reaction were catalysed by an enzyme.

In your answer, you should use appropriate technical terms, spelled correctly.

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..... **[5]**

(c) Blood clots may develop following a heart attack. Drugs called anticoagulants are used to prevent blood clots from forming.

Warfarin is an anticoagulant drug. It prevents blood clots from forming by interfering with the action of vitamin K, a cofactor involved in blood-clotting reactions.

(i) What is the role of a cofactor in an enzyme-controlled reaction?

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..... **[1]**

(ii) Suggest **one** way in which warfarin could interfere with the action of vitamin K in blood-clotting reactions.

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..... **[1]**

(d) Proteases are a class of enzyme that break down proteins.

Name the products resulting from the **complete** breakdown of a protein molecule.

..... **[1]**

(e) As humans have evolved, enzymes have also evolved, resulting in greater control over metabolic pathways. For example, some protease enzymes have evolved from a single enzyme called a *promiscuous ancestral* enzyme.

Fig. 3.2 is a diagram that shows how **two** enzymes may have evolved from **one** promiscuous ancestral enzyme.

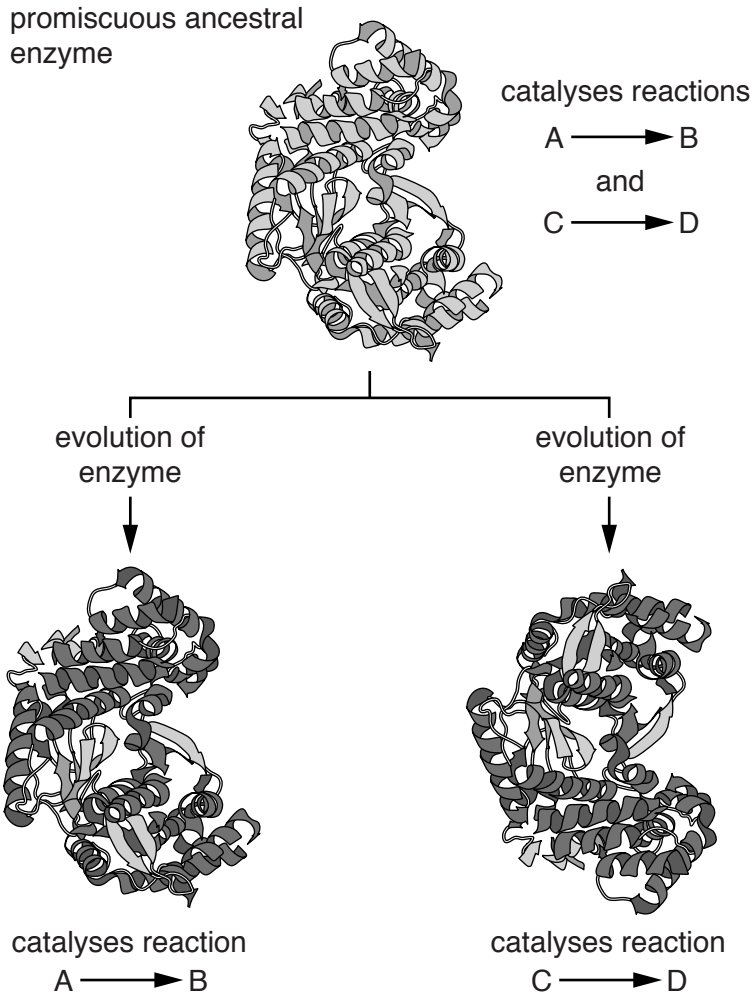

Fig. 3.2

Using Fig. 3.2 and your knowledge of enzyme action, suggest why enzyme activity has changed as the enzymes have evolved.

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..... **[2]**

[Total: 12]

4 Valves help to regulate the flow of blood through the heart.

Valve stenosis is a heart condition caused by a narrowing of the opening between the atrium and ventricle.

Fig. 4.1 is a diagram that shows the flow of blood through one side of heart **Y**, a normal heart, and one side of heart **Z**, a heart with valve stenosis.

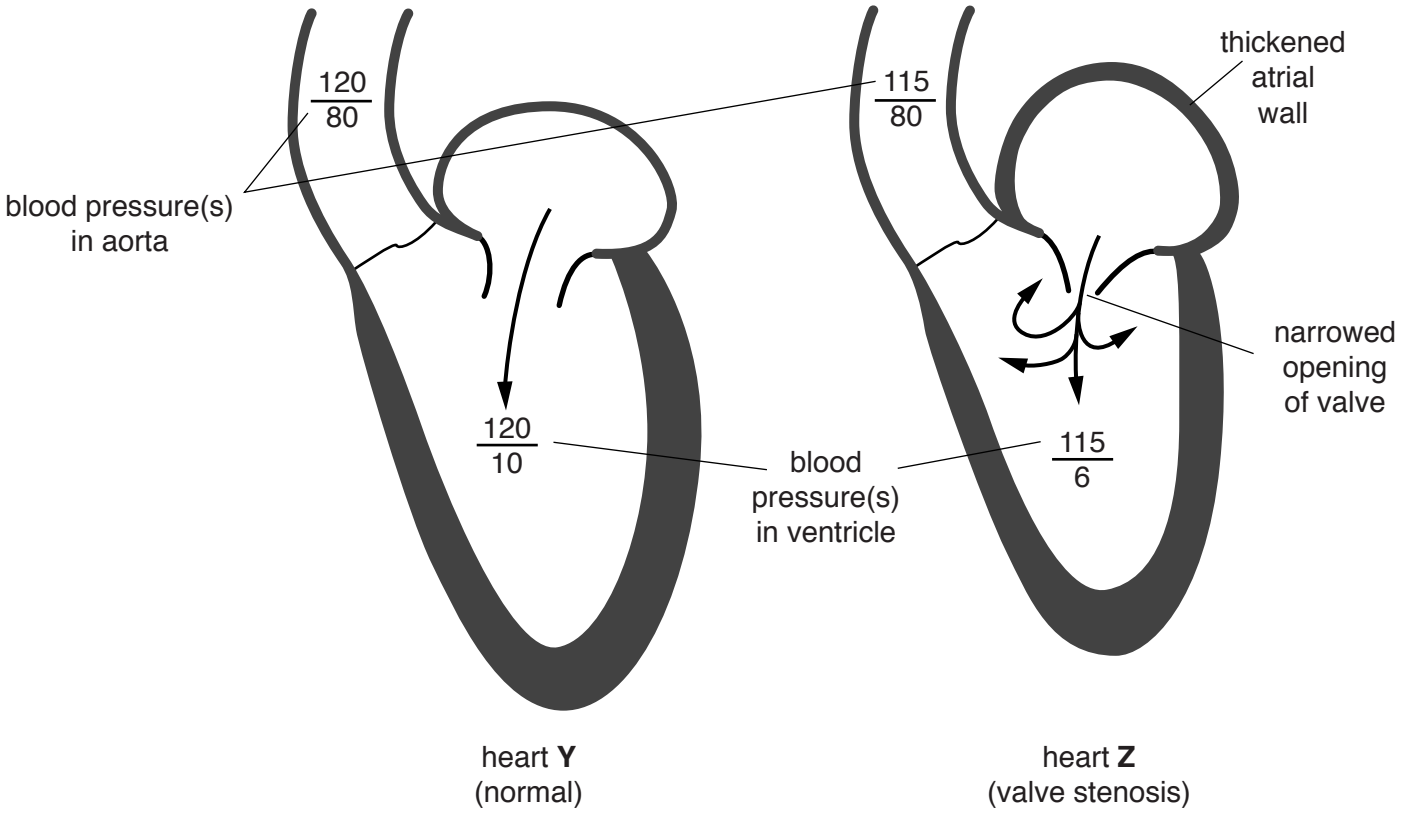

Fig. 4.1

(a) (i) Name the valve shown in Fig. 4.1 that is affected by valve stenosis.

..... **[1]**

(ii) Using the information in Fig. 4.1, compare the blood pressure within heart **Y** and heart **Z**.

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..... **[1]**

(iii) Suggest why the atrial wall becomes thickened in heart **Z**.

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..... **[1]**

(b) Valve stenosis increases the turbulence within the heart as blood flows through the valve. This causes a heart murmur.

Heart murmurs can be detected and monitored by health professionals using a stethoscope.

Other than using a stethoscope, outline a procedure that can be used by health professionals for monitoring heart function.

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..... **[3]**

[Total: 6]

5 Squamous epithelial cells in the alveoli of mammalian lungs facilitate gaseous exchange.

(a) Outline the process of gaseous exchange in the alveoli of mammalian lungs.

No details of squamous epithelial cells or rate of gaseous exchange are required.

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..... **[2]**

(b) The shape of cells is important to their function. For example, squamous epithelial cells are thin and flat, which increases the rate of gaseous exchange in the alveoli.

Fig. 5.1 shows how the surface area and volume of two differently shaped cells change as they increase in size.

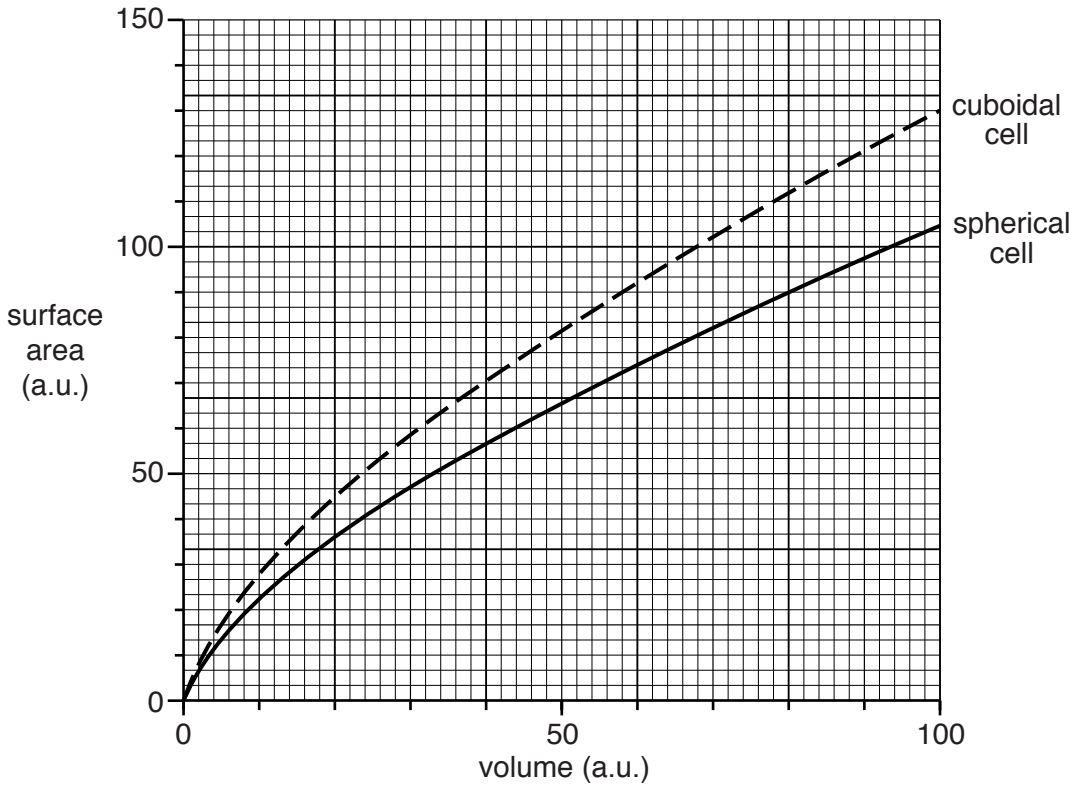

Fig. 5.1

(i) Using Fig. 5.1, compare the changes in surface area and volume as the two differently shaped cells increase in size.

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..... **[3]**

(ii) Draw, **on the graph in Fig. 5.1**, the expected line or curve for a thin, flat cell, such as a squamous epithelial cell.

This answer should be drawn on Fig. 5.1. **[2]**

Question 5(c) begins on page 16

(c) Kartagener syndrome is a genetic disorder that affects the respiratory system.

Children born with Kartagener syndrome commonly have the following symptoms:

- mucus retention
- recurrent infections of the respiratory system
- respiratory distress.

Suggest **one** reason why children with Kartagener syndrome may have '*mucus retention*' and **one** reason why they may have '*recurrent infections of the respiratory system*'.

reason for '*mucus retention*' .....

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reason for '*recurrent infections of the respiratory system*' .....

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[2]

(d) Spirometry measurements can be used to monitor respiratory disorders such as Kartagener syndrome.

Fig. 5.2 shows spirometry measurements taken during exhalation for a normal person and for a person with a respiratory disorder.

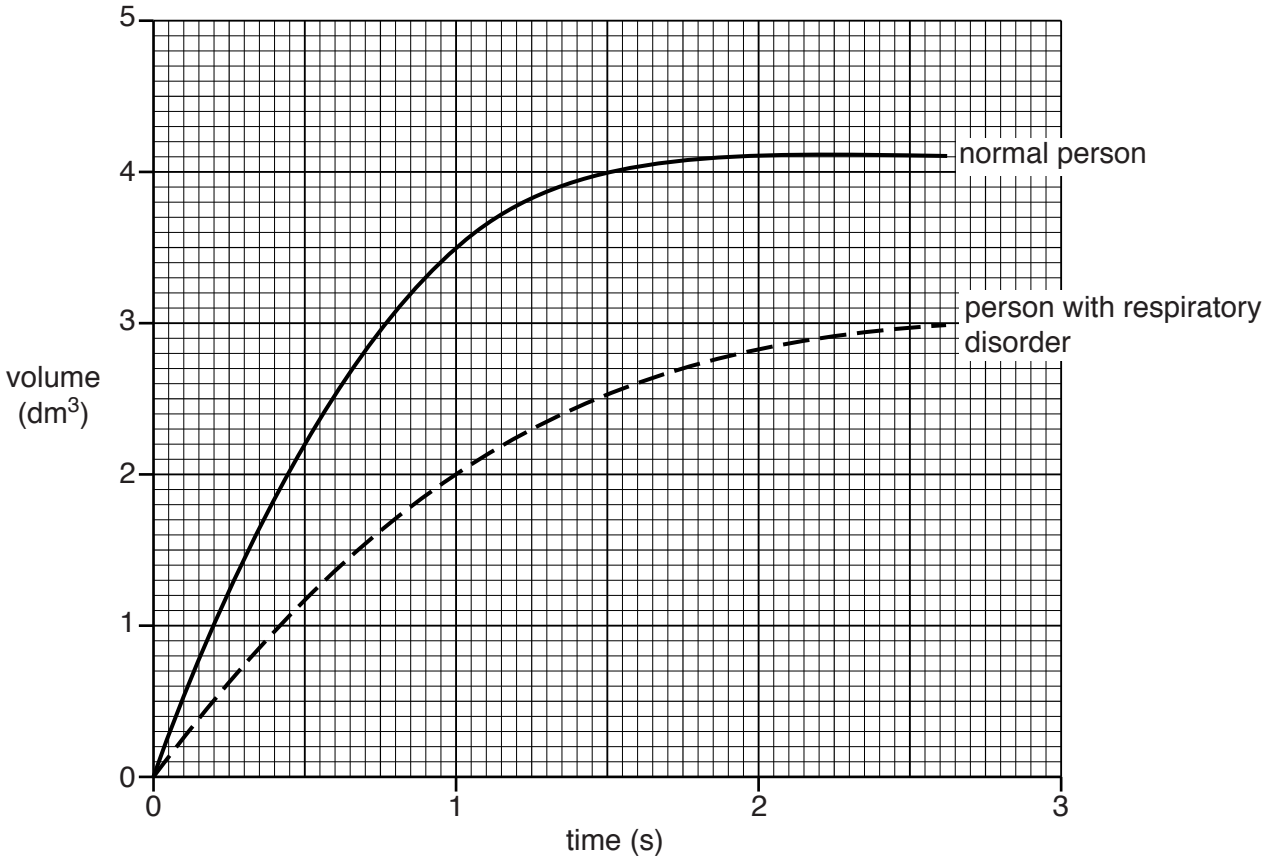

Fig. 5.2

(i) Using the information shown in Fig. 5.2, state the FEV^1 measurement for each person.

Explain the reason for the difference between the two FEV^1 measurements.

FEV^1 normal person ..... $dm^3 s^{-1}$

FEV^1 person with respiratory disorder ..... $dm^3 s^{-1}$

Explanation .....

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..... **[2]**

(ii) Suggest why FEV^1 measurements should be taken at least four times per year for people with respiratory disorders such as Kartagener syndrome.

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..... **[1]**

[Total: 12]

6 In humans, the blood is the medium for transporting substances such as oxygen around the body by mass transport.

(a) Define the term *mass transport*.

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..... **[1]**

(b) Organs that contain muscle cells, such as the heart, need large quantities of oxygen for aerobic respiration.

- Haemoglobin and myoglobin are protein molecules that are involved in supplying oxygen to cells.
- Haemoglobin is found in erythrocytes (red blood cells), enabling them to transport oxygen to respiring heart muscle.
- Myoglobin is found in heart muscle cells as an oxygen store.

(i) Explain why the heart is described as an organ.

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..... **[1]**

(ii) Outline how the structure of haemoglobin enables it to transport oxygen.

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..... **[3]**

(iii) Myoglobin is described as having a tertiary structure.

What is meant by *tertiary structure*?

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..... **[2]**

(c) Glycogen is another biological molecule found in heart muscle cells.

Glycogen is insoluble, which means it can be stored without affecting the water potential of cells.

(i) What type of biological molecule is glycogen?

..... **[1]**

(ii) Other than insolubility, state and explain **one** other feature of the glycogen molecule that enables it to be used as a storage molecule.

Feature .....

Explanation .....

.....

[2]

[Total: 10]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).