

## Module 9

**A1** When the skin is cut the blood forms clots.  
 In which order would the components of the blood become involved ?

	first	→		last
A	fibrin		red blood cell	fibrinogen
B	fibrinogen		platelet	fibrin
C	platelet		fibrinogen	red blood cell
D	platelet		fibrin	red blood cell

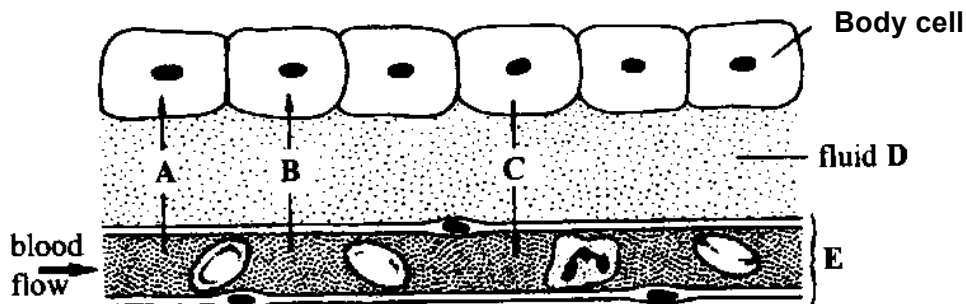
**A2** What causes an oxygen debt to develop ?

- A Breathing becomes very rapid.
- B Carbon dioxide levels in the blood rise.
- C Oxygen demand exceeds oxygen supply.
- D The heartbeat increases.

**A3** Which one of the following statements is true for the vena cava ?

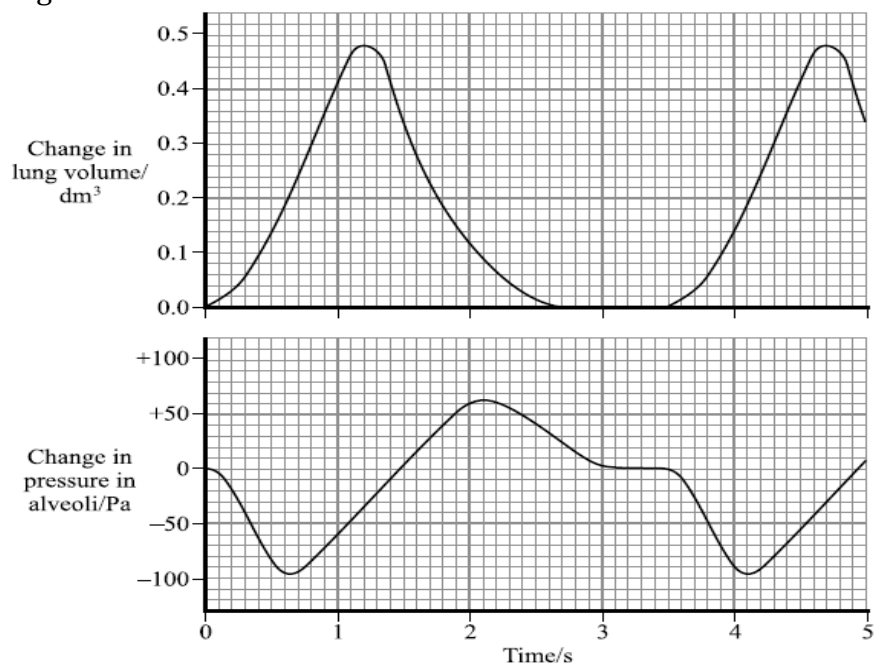
- A. It carries deoxygenated blood from the body tissues and returns it to the heart.
- B. The bicuspid valves prevent blood from flowing backwards in the vena cava.
- C. Blood flowing in it is at a higher pressure than blood in the pulmonary vein.
- D. It forms part of the pulmonary circulation.

**B1** The figure below shows the relationship between some body cells and their blood supply.



- (a) What is the name of fluid D?
- (b) Name the chemical compounds which could be represented by the letters A, B and C.

**B2** The graph shows some of the changes which take place in a man during breathing.



- (a) (i) Use the information in the graph to calculate this man's rate of breathing in breaths per minute. Show your working.
- (ii) The volume of air in the man's lung after he exhaled was 2400 cm<sup>3</sup>. What is the volume of air in his lungs immediately after he had inhaled?
- (b) Explain how muscles cause the change in alveolar pressure between 0 and 0.5 s.
- (c) Describe how the structure of the lungs and the red blood cells enable efficient diffusion and transport of oxygen.

**B3** Figure 1 shows the structures involved in oxygen uptake in the lungs.

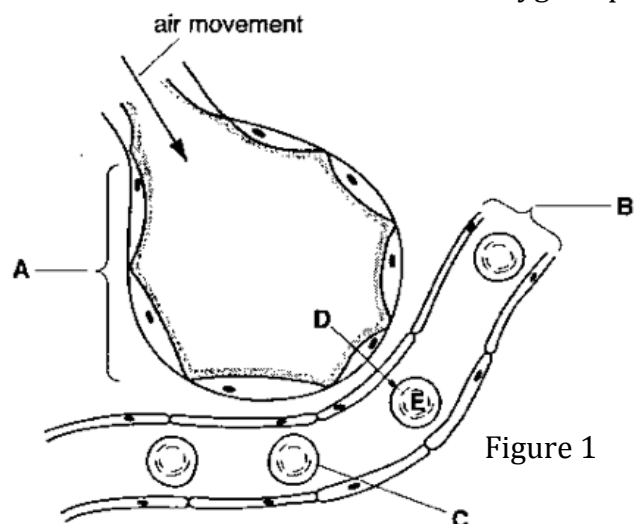


Figure 1

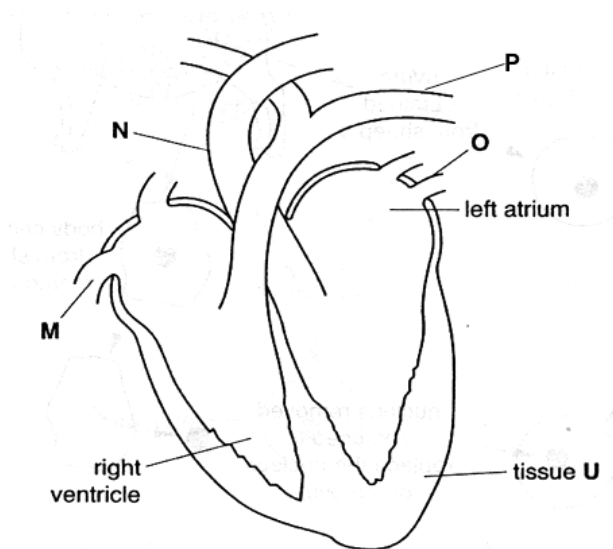
**5078 Science (Chemistry & Biology)**  
**Module 9: Circulatory & Respiratory System**

- (a) Identify the structures **A**, **B** and **C** and state their functions.
- (b) Describe the fate of an oxygen molecule in a body cell.
- (c) The table below shows the percentage of oxygen in the inspired air and the expired air of a healthy person.

% oxygen in inspired air	% oxygen in expired air
21	17

Suggest and explain how these figures might be different for a person whose diet had been deficient in iron over a period of several years. Write down, also, the effect on the person with such a deficiency.

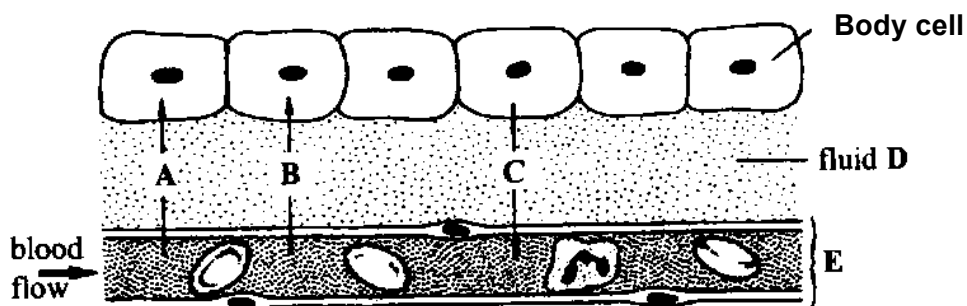
**B4** The diagram below shows the longitudinal section of a mammalian heart.



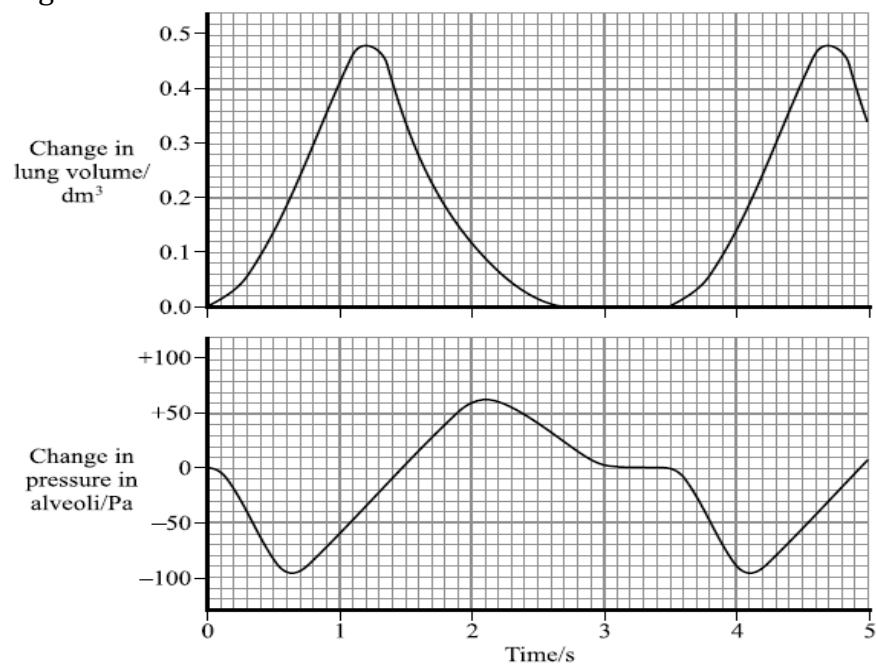
- (i) Identify blood vessels M, N, O and P.
- (ii) State the difference between the wall of right ventricle and tissue U. Explain this difference.
- (iii) Explain what will happen to the blood that returns from the lungs.

## Module 9 (Solutions)

- A1** When the skin is cut the blood forms clots.  
 In which order would the components of the blood become involved ? **D**
- A2** What causes an oxygen debt to develop ? **C**
- A3** Which one of the following statements is true for the vena cava ? **A**
- B1** The figure below shows the relationship between some body cells and their blood supply.



- (c) What is the name of fluid D? **Tissue (or interstitial) fluid.**
- (d) Name the chemical compounds which could be represented by the letters **A, B** and **C**. **Sugars, salts, fatty acids, amino acids, hormones, neurotransmitters or waste products (any three).**
- B2** The graph shows some of the changes which take place in a man during breathing.



- (a) (i) Use the information in the graph to calculate this man's rate of breathing in breaths per minute. Show your working.

Each breathing lasts 2.6 seconds (as per  $\Delta$  in lung volume).  
One minute has 60 seconds.

$$\text{Breathing rate} = 60 / 2.6 = 23.07 \text{ breath/min.}$$

Therefore, the breathing rate is 23.07 breaths/min.

- (ii) The volume of air in the man's lung after he exhaled was 2400 cm<sup>3</sup>. What is the volume of air in his lungs immediately after he had inhaled?

$$\text{Volume of air inhaled} = 0.48 \text{ dm}^3 = 480 \text{ cm}^3$$

$$\begin{aligned} \text{Volume of lungs after inhalation} &= 2400 + 480 \\ &= 2880 \text{ cm}^3 \end{aligned}$$

- (b) Explain how muscles cause the change in alveolar pressure between 0 and 0.5 s.

- Diaphragm contracts and flattens
- EIM contracts, IIM relaxes.
- Ribcage moves upwards and outwards.
- Volume of chest cavity increases.
- Lung pressure decreases.
- Difference in air pressure causes lung expansion.
- Atmospheric pressure is higher than lung pressure to allow inhalation.

- (c) Describe how the structure of the lungs and the red blood cells enable efficient diffusion and transport of oxygen.

Lungs have numerous alveoli, surrounded by a network of capillaries to allow efficient gaseous exchange to take place. Surface of alveoli also have thin film of moisture to allow oxygen gas to dissolve.

Red blood cells are biconcave in shape and lack nucleus to increase surface area for gaseous exchange and increase volume of oxygen carried.

B3 Figure 1 shows the structures involved in oxygen uptake in the lungs.

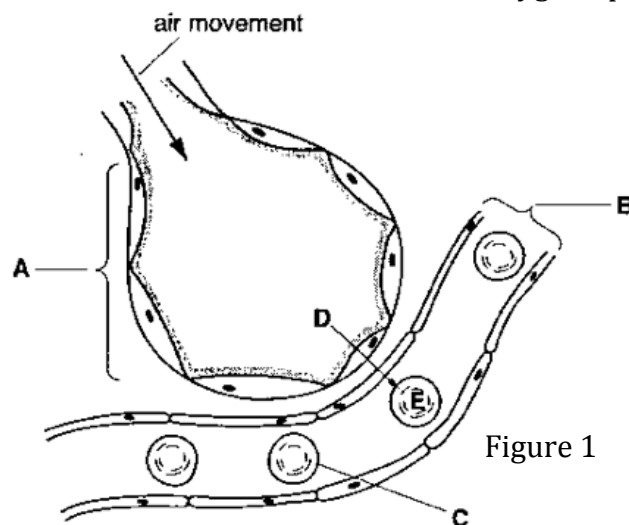


Figure 1

(a) Identify the structures A, B and C and state their functions.

A – Alveoli – allows exchange of gases into and out of the body *via* the lungs,

B – Capillary – provides a pathway for red blood cells to pass through the respiratory system.

C – Red Blood Cells – contains haemoglobin in order to carry oxygen for cellular respiration.

(b) Describe the fate of an oxygen molecule in a body cell.

Oxygen, when binds with haemoglobin, will form oxyhaemoglobin. It will return to the heart and pump out of the heart *via* the aorta to tissue or cells that lacks oxygen. Oxygen dissociates from the oxyhaemoglobin and enters them for cellular or tissue respiration.

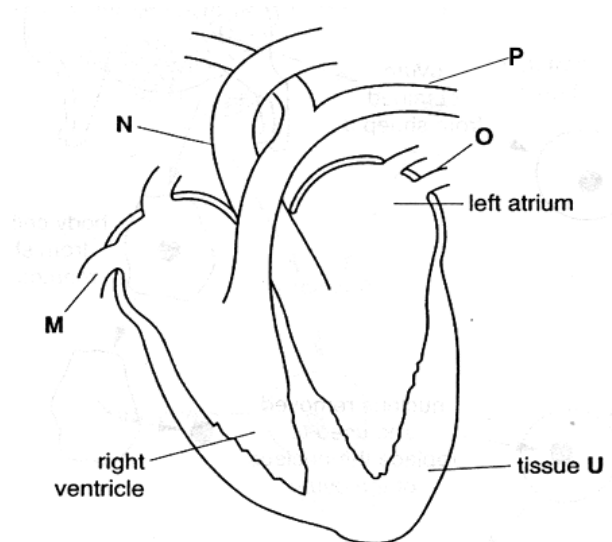
(c) The table below shows the percentage of oxygen in the inspired air and the expired air of a healthy person.

% oxygen in inspired air	% oxygen in expired air
21	17

Suggest and explain how these figures might be different for a person whose diet had been deficient in iron over a period of several years. Write down, also, the effect on the person with such a deficiency.

Lack of iron results in anaemia where an individual will carry insufficient oxygen in the body (due to lack of haemoglobin), resulting in frequent fatigue and giddiness. Since there is lower amount of haemoglobin, oxygen transported around the body will also be much lower. Hence, this contributes to a lowered % of oxygen content of inspired air and expired air.

**B4** The diagram below shows the longitudinal section of a mammalian heart.



- (i) Identify blood vessels M, N, O and P.

M – Vena Cava  
N – Pulmonary Artery  
O – Pulmonary Vein  
P – Aorta

- (ii) State the difference between the wall of right ventricle and tissue U.  
Explain this difference.

Tissue U is much thicker than right ventricle as the area must be able to provide and withstand high pressure when blood pumps out of the heart to the rest of the body.

- (ii) Explain what will happen to the blood that returns from the lungs.

As blood returns to the lung, it will be oxygen-rich. Oxygenated blood will return the heart *via* pulmonary vein and enters the left atrium. Atrial systole takes place to allow blood to reach the left ventricle (bypassing the bicuspid valve), followed by ventricular systole where the blood pumps out of the body *via* the aorta.