Transport in animals

Model Answers 3

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Exchange and transport
Topic	Transport in animals
Booklet	Model Answers 3

Time allowed: **72 minutes**

Score: **/53**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

Question 1

Read the following passage and complete each sentence by writing the most appropriate **term or phrase** in the spaces provided.

[6]

Large, active organisms need a circulatory system because they have a small

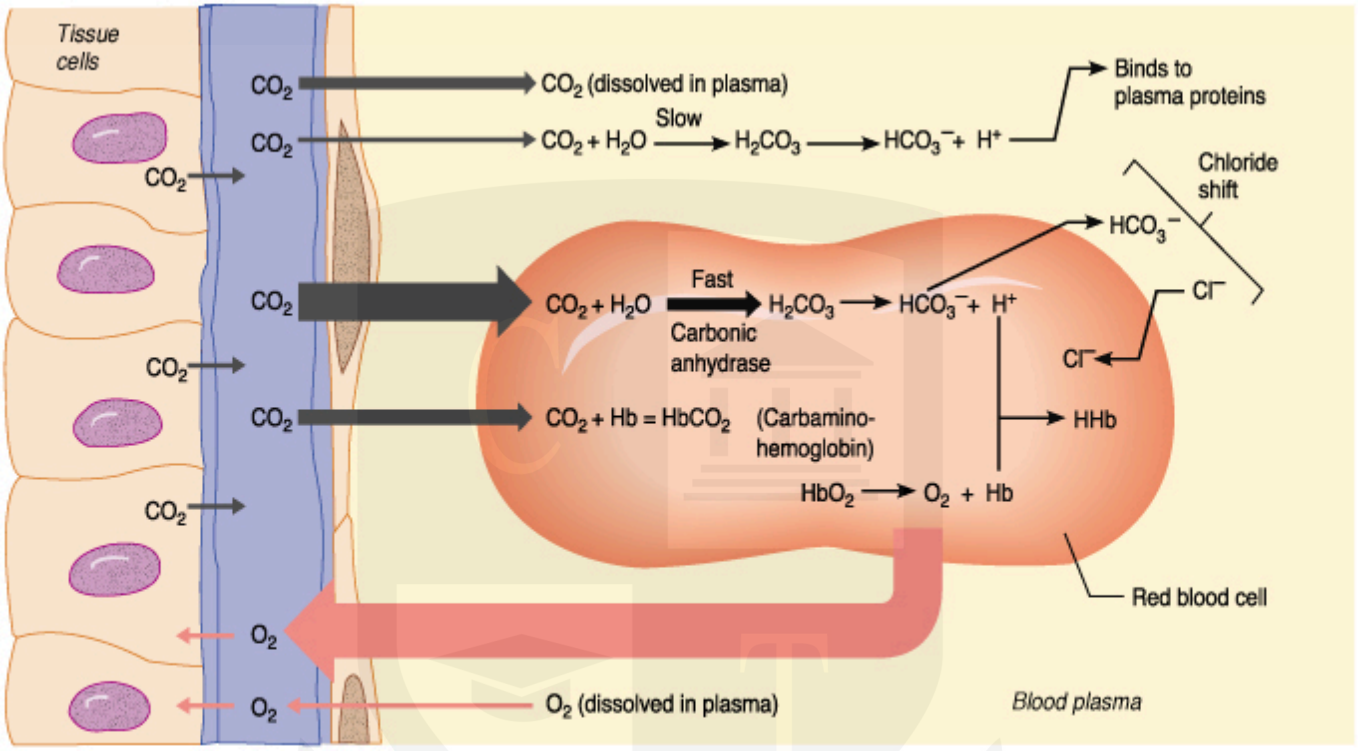
Surface area to volume ratio

Haemoglobin is a pigment found in red blood cells. These cells are also known as

Erythrocytes . Haemoglobin has a high affinity for oxygen. In the lungs, the haemoglobin associates with oxygen to form oxyhaemoglobin . In respiring tissues, the oxygen is released by dissociation. In very active tissues, the amount of oxygen released can be increased by the presence of more Carbon dioxide . This is called the Bohr effect.

Haemoglobin is a molecule contained within the red blood cells, to carry oxygen. In the presence of high levels of Carbon Dioxide, this molecule will compete with oxygen, to form Carbaminohaemoglobin, causing more oxygen to be released from the haemoglobin. Carbon Dioxide also reacts with water to form an acid, which dissociates. The hydrogen ions from this also compete for the haemoglobin, releasing oxygen further. This is useful because, where Carbon Dioxide levels are high, this means plenty of respiration is occurring, therefore the oxygen will be needed.

A diagram to show the exchange of Carbon Dioxide and Oxygen at respiring tissues:



(a) Oxygen release and carbon dioxide pickup at the tissues

[Total: 6]

Question 2

Fig. 6.1 shows two electrocardiogram (ECG) traces.

- Trace **A** is a normal trace.
- Trace **B** is a trace from a heart after treatment with the drug digitalis.

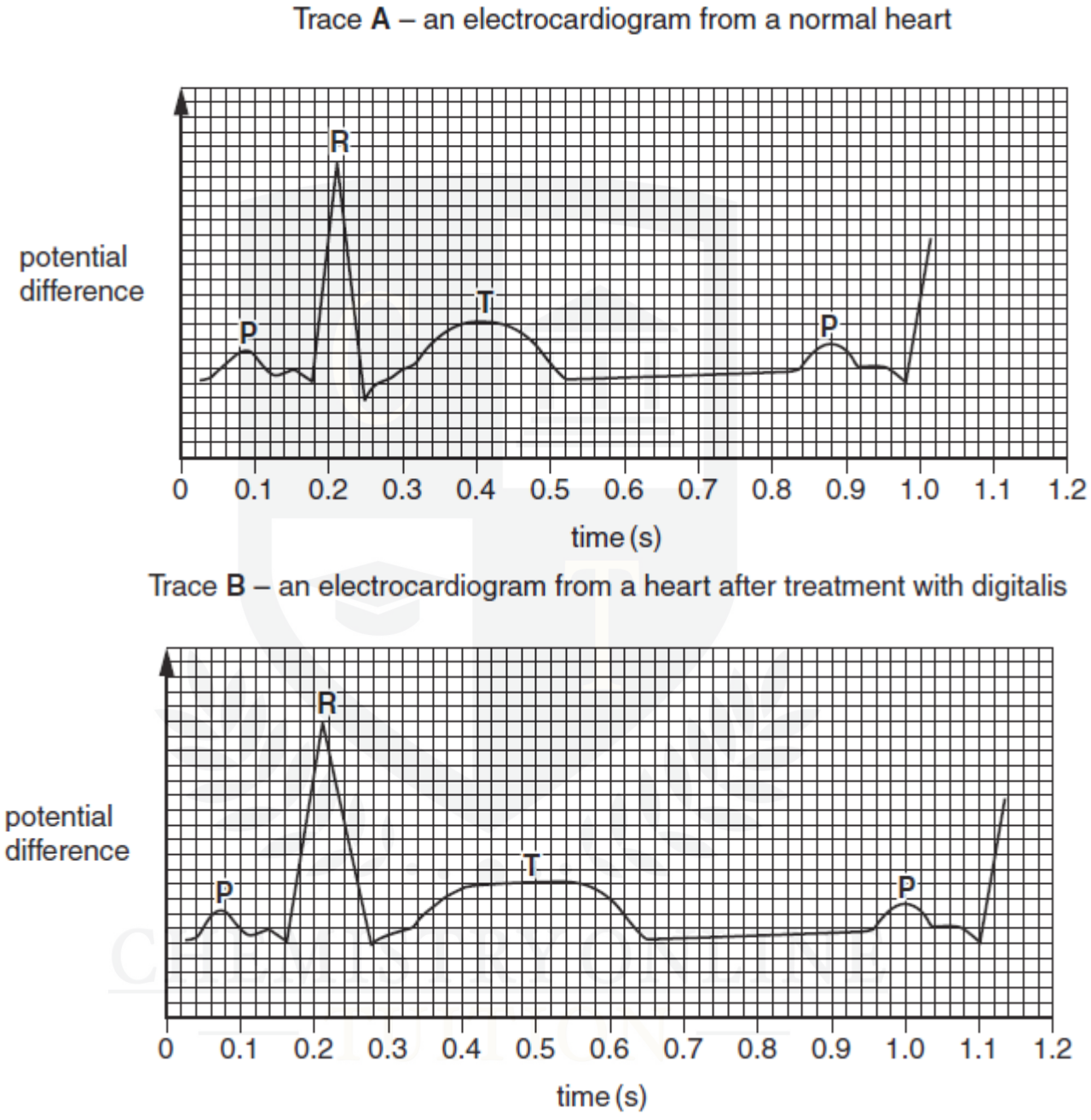


Fig. 6.1

(a) Calculate the heart rate using the information in Trace **A**.

Show your working. **[2]**

0.09s to 0.88s on graph is one heart beat =0.79s

- Number of heart beats per minute = 60/0.79
- =76 beats per minute

(b) Using the information in Fig. 6.1, state **two** effects of digitalis on the activity of the heart. **[2]**

Two effects of digitalis are:

- Heart rate is slower
- Diastole is longer (T wave elongated)
- Ventricles take longer to contract (R wave slightly elongated)

(c) Describe the roles of the sinoatrial node (SAN) **and** the atrioventricular node (AVN) in coordinating the cardiac cycle. **[3]**

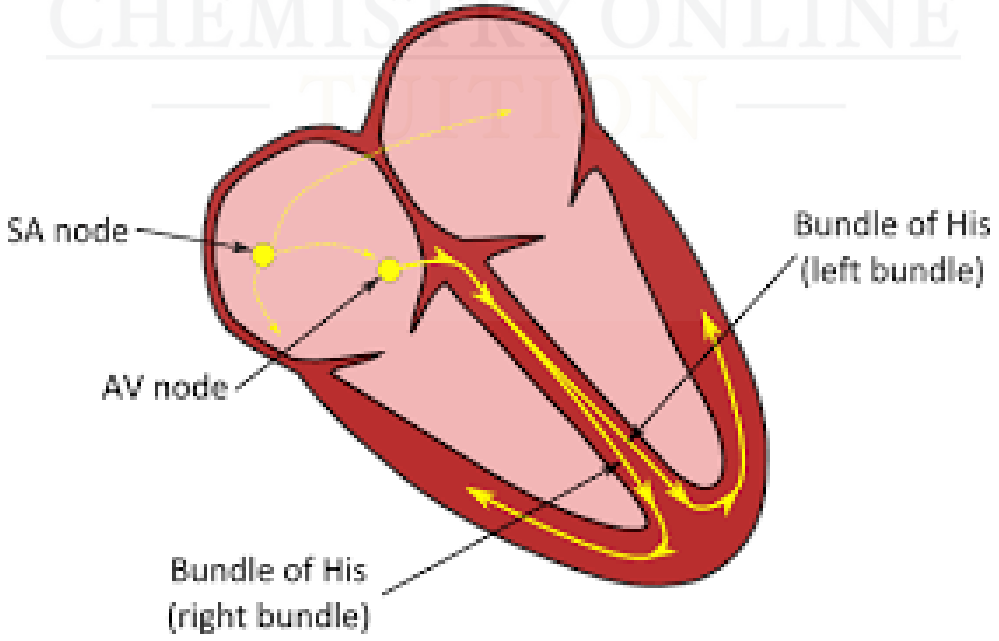
The SAN:

- Is the pacemaker
- It sends a wave of excitation over the atria

The AVN:

- Delays the impulse
- and then sends it down the Purkyne fibres/ Bundle of His

A diagram to show the SAN sending a wave of excitation over the atria. The impulse then 'collects' at the AVN, where there is a short delay and then the impulse continues down the fibres in the septum:



[Total: 7]

Question 3

(a) List **three** reasons why a large, multicellular animal, such as a mammal, needs a transport system.

[3]

A mammal needs a transport system because:

- They have a **small** surface area to volume ratio
- Therefore **diffusion** is too **slow**
- to supply enough **oxygen** and nutrients
- and to **prevent CO_2/** other waste products **building up**
- Mammals are also metabolically **active** so have a high demand for oxygen

Fig. 1.1, **on the insert**, shows the nervous pathways that coordinate heart action.

Above the diagram is a trace showing the electrical activity associated with one heart beat.

(b) **(i)** State the full name given to a trace showing the electrical activity of the heart. **[1]**

Electrocardiogram

***Exam tip**: you need to write the full name out here, 'ECG' is insufficient to gain you the mark.*

(ii) Identify the components of the heart labelled **A** and **B** on Fig. 1.1. **[2]**

A: **Sinoatrial node**

B: **Atrioventricular node**

***Exam tip**: be very careful with your spelling here; different variations of these words will not gain you marks. If at all in doubt, 'SAN' and 'AVN' will gain you marks in this question.*

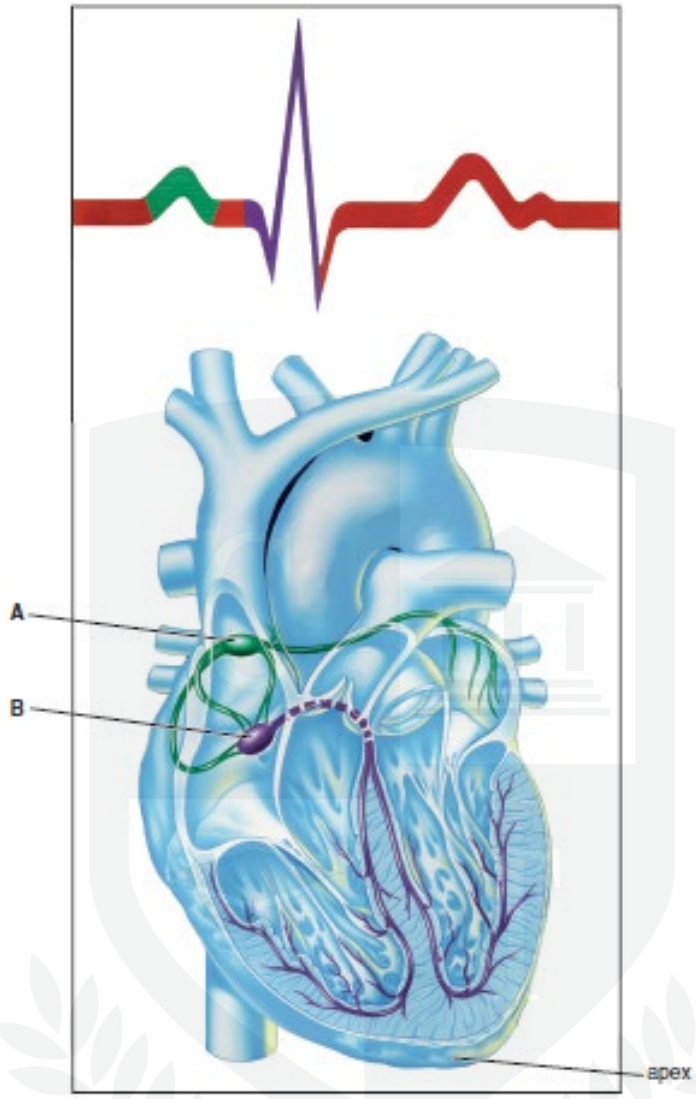


Fig. 1.1

(c) (i) During the electrical stimulation of the heart, there is a short delay between the excitation of the atria and excitation of the ventricles.

Explain why this delay is essential. **[2]**

The delay between excitation of atria and ventricles contracting is essential because:

- It allows time for the **atria to fully contract**
- Allowing time for the blood to fill the ventricles
- The delay means the ventricles do not **contract** too early (before they are full)

If there was no delay then this would be very inefficient, as less blood would be pumped around the body per beat (low stroke volume)

(ii) The Purkyne tissue carries the excitation wave down the septum to the apex of the heart.

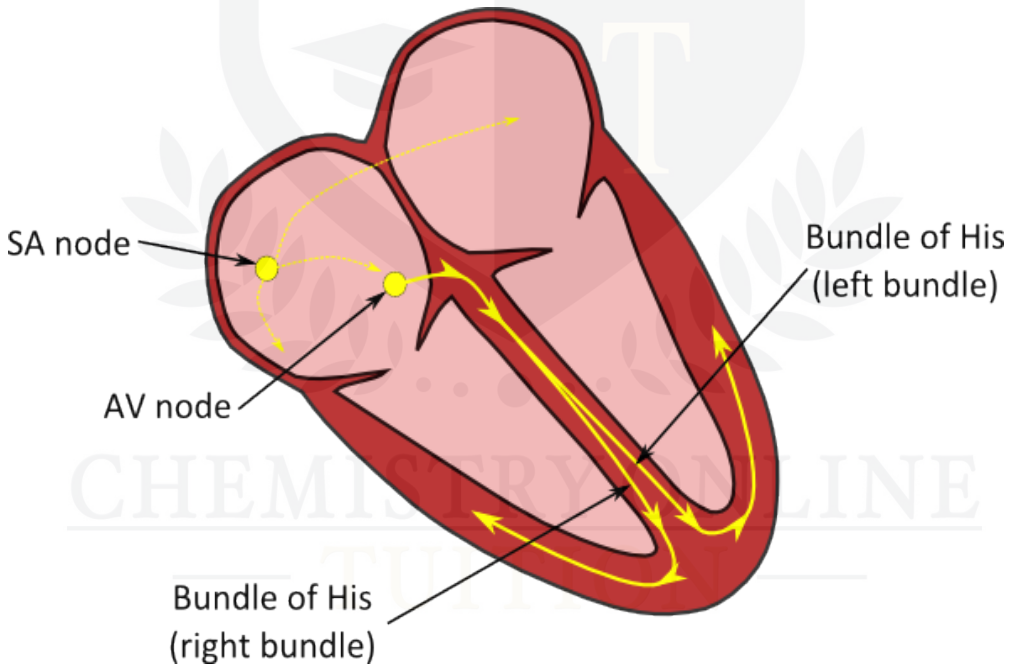
Explain why the excitation wave is carried to the apex. **[2]**

The excitation wave is carried to the apex:

- So that ventricular **contraction starts** from the **apex**/ bottom
- This means that blood is pushed **upwards** towards the arteries
- Ensuring **complete emptying** of the ventricles

Again, this would make the heart beat inefficient if contraction did not start at the bottom, as blood would be left in the ventricles.

Diagram to show the pathway of electrical conduction in the heart:



[Total: 10]

Question 4

(a) (i) Fig. 5.1 represents a transverse section of an artery and a vein.

Draw a line to show the relative position of the endothelium of the **vein**. **[1]**

Fig. 5.1

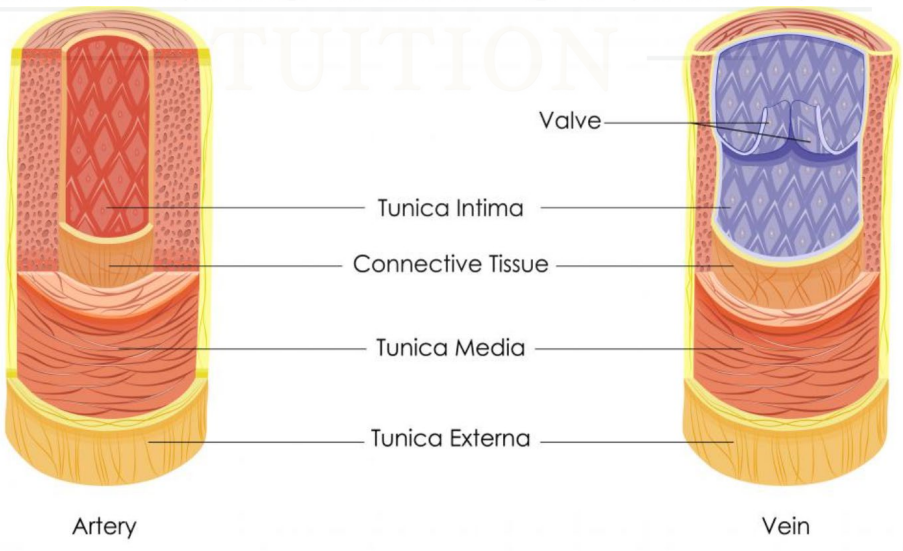
The vein should have a much thinner wall than the artery

(ii) State **two other** ways in which the wall of an artery is different from the wall of a vein. **[2]**

The wall of the artery and vein are different because:

- Arteries have a **folded endothelium** (**tunica intima**)
- Arteries have **thicker muscle** & elastic tissue (**tunica media**)
- Arteries have **thicker collagen** (**tunica externa**)
- Arteries have **no valves**

Diagram to show the structures of a vein and artery wall:



(b) (i) Blood in the arteries has a high hydrostatic pressure.

State how this hydrostatic pressure is generated in the heart. **[1]**

Hydrostatic pressure is generated in the heart via:

- Contraction of the **ventricle** wall

(ii) Explain why the hydrostatic pressure of the blood drops as blood moves away from the heart. **[2]**

Hydrostatic pressure of the blood drops away from the heart because:

- The blood flows into more vessels
- The vessels have larger total cross sectional areas
- There will be reduced resistance to blood flow
- The arteries stretch and expand
- There is loss of blood plasma from the capillaries

(iii) Capillaries have walls that are one cell thick.

Fig. 5.2 shows how the hydrostatic pressure of the blood changes as it moves through a capillary.

Fig. 5.2 also shows the water potential of the blood, due largely to the plasma proteins, which tends to move water into the blood.

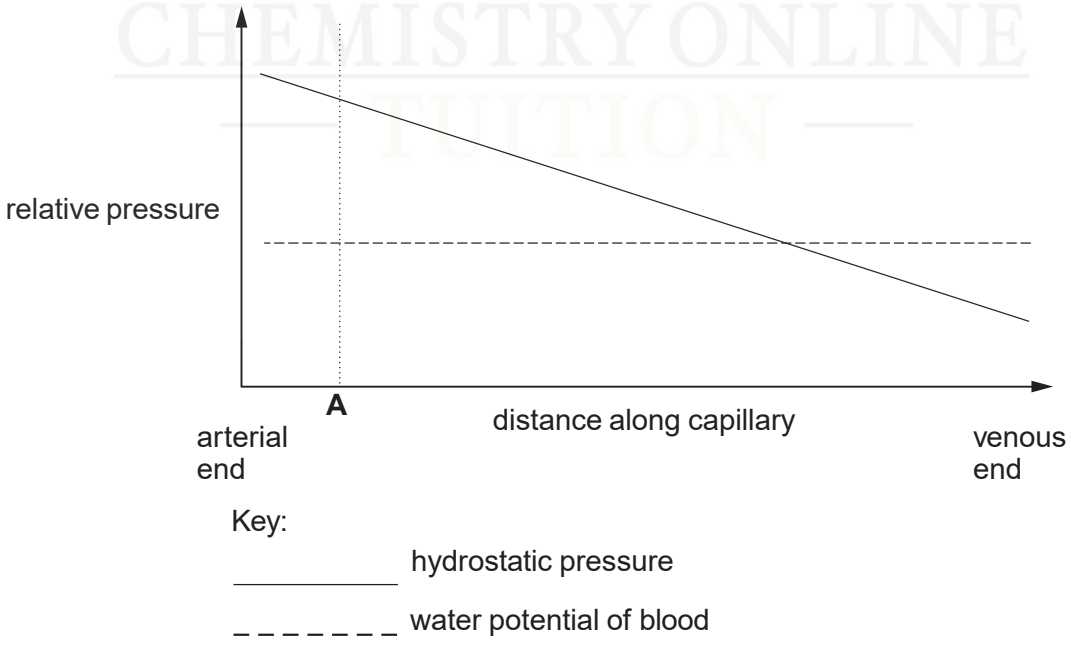


Fig. 5.2

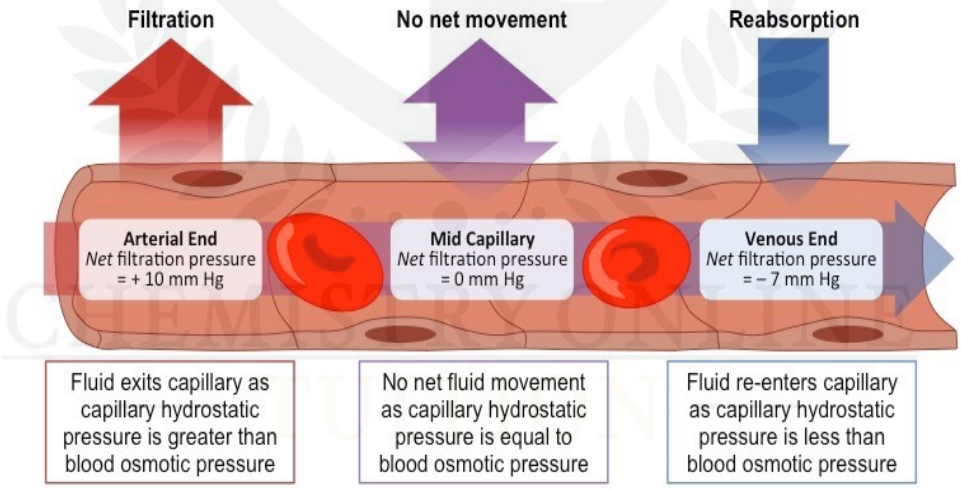
Describe **and** explain what happens to the blood plasma at point **A** along the capillary in Fig. 5.2.

[3]

At point A:

- Plasma moves out of the capillary
- and enters the tissue fluid
- Plasma proteins remain in the capillary as they are too large to pass through the capillary wall
- Fluid moves down a pressure gradient
- Because the hydrostatic pressure is greater than the water potential

A diagram to show the formation of tissue fluid:



(c) Carbon dioxide is produced in tissues as a waste product of respiration.

The majority of carbon dioxide is carried as hydrogencarbonate ions (HCO_3^-) in the plasma.

Fig. 5.3 shows the chemical pathway in which carbon dioxide is converted into HCO_3^- in a red blood cell.

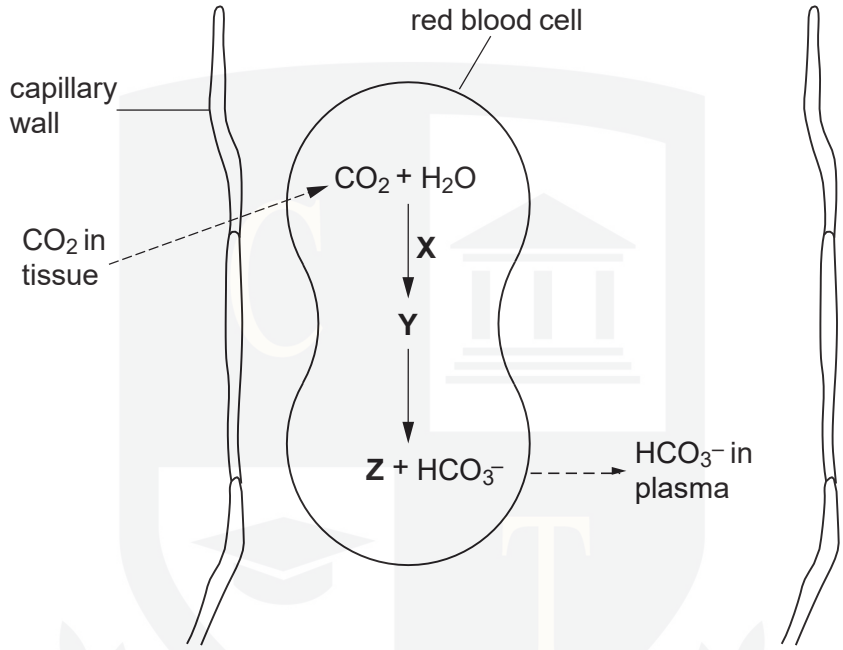


Fig. 5.3

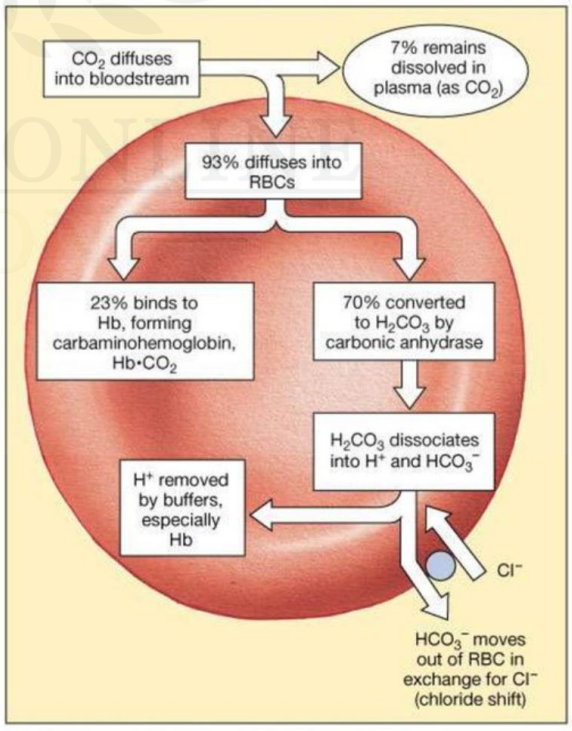
Identify the following: **[3]**

Enzyme X: **Carbonic anhydrase**

Substance Y: **Carbonic acid (H_2CO_3)**

Ion Z: **Hydrogen ion (H^+)**

Diagram to show the transport of carbon dioxide in the blood:



[Total: 12]

Question 5

(a) (i) Name the type of muscle found in the walls of the heart chambers. **[1]**

The type of muscle found in the wall of the heart chambers is called:

- Cardiac

Cardiac muscle is myogenic and does not tire.

(ii) Name the process that creates pressure inside the heart chambers. **[1]**

The process that creates pressure inside the heart is called:

- Contraction/ Systole

The muscles of the walls contract and create a pressure which pushes blood into the ventricles and atria.

(b) Fig. 6.1 shows the changes in pressure inside the heart chambers during one heart beat.

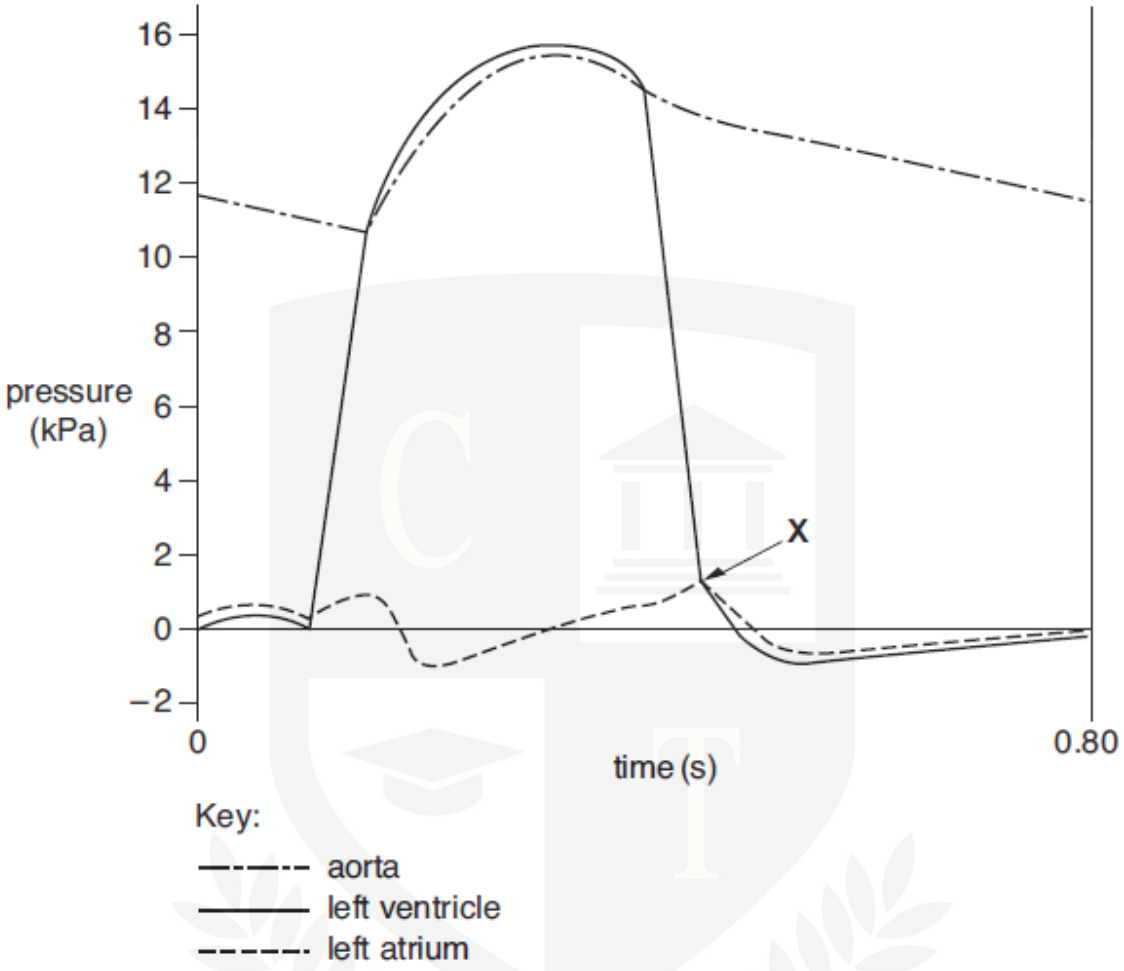


Fig. 6.1

(i) Calculate the heart rate from the information in Fig. 6.1.
Show your working and give your answer **to the nearest whole number**. **[2]**

One heart beat takes 0.8 seconds

Therefore in one minute: 60/0.8 heart beats (rate in beats per minute)

= 75 BPM

(ii) Describe and explain what happens **immediately after X** on Fig. 6.1.

In your answer, you should use appropriate technical terms, spelt correctly. **[4]**

After point x on Figure 6.1:

- the **pressure** in the **left ventricle** becomes **lower** than the pressure in the **left atrium**
- this results in the **bicuspid valve opening** and
- **blood** flowing **into the ventricle**

[Total: 8]

Question 6

Fish have a single, closed circulatory system.

(a) State the meaning of the terms *single circulatory system* and *closed circulatory system.* **[2]**

single circulatory system

- Where in one circuit of the body the blood travels through the heart once

closed circulatory system

- Where blood is contained within blood vessels

(b) The heart of a mammal contains four main chambers. The action of these chambers is coordinated by electrical activity in specialised tissues.

Fig. 5.1 shows where these tissues are found in the heart. **[3]**

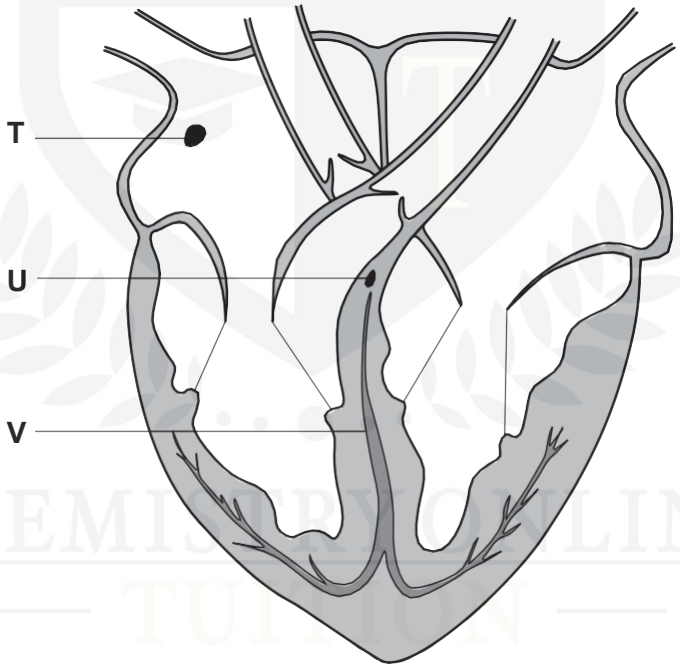


Fig. 5.1

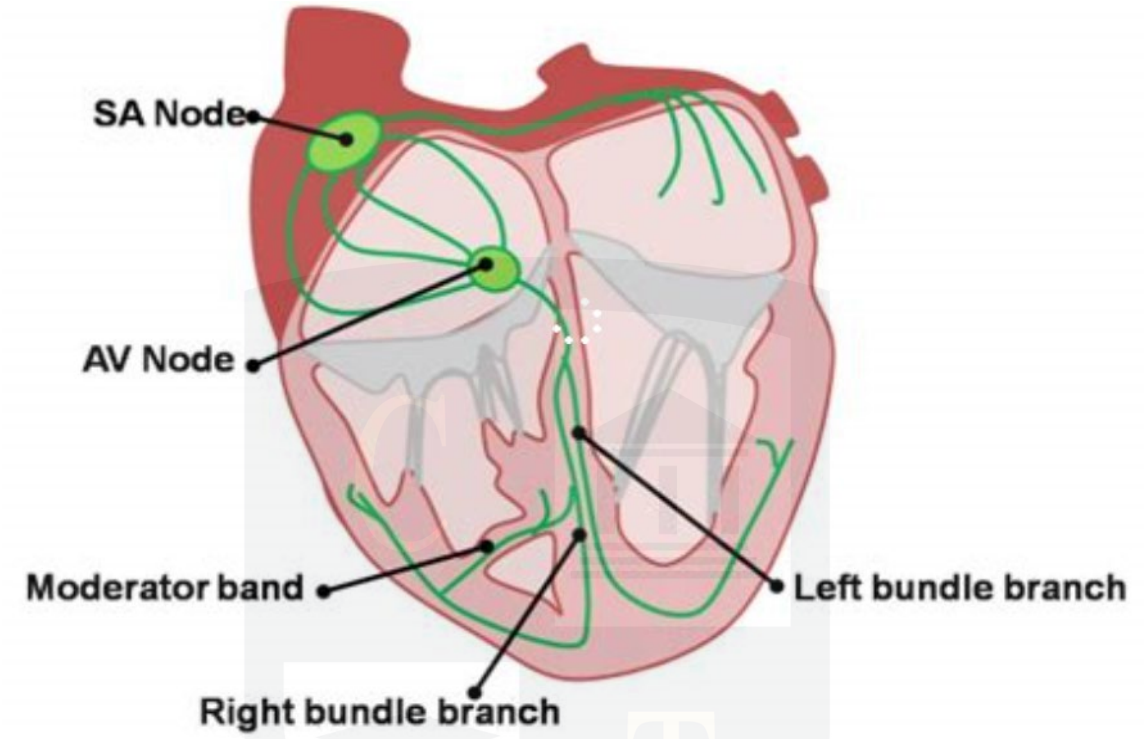
(i) Name the tissues labelled **T**, **U** and **V**.

T Sinoatrial node

U Atrioventricular node

V Bundle of His

Diagram to show the conduction tissue in the heart:



(ii) Describe how the action of the heart is initiated **and** coordinated.

In your answer, you should use appropriate technical terms, spelt correctly. **[5]**

- The **Sinoatrial** Node initiates the excitation
- a wave of **excitation** spreads over the **atrial** wall
- causing the atria to contract (atrial **systole**)
- contraction is synchronised
- the impulse reaches the AVN, where there is a delay
- then, the excitation spreads down **septum**
- via the **bundle of His** / **Purkyne** fibres
- causing the ventricles to contract (ventricular **systole**) from the **apex** upwards

***Exam tip**: in order to gain your QWC mark here, you need to ensure you are using your key terminology, shown here in **bold**.*

[Total: 10]