Week 22

A-Level Biology

Homework bundle for this week

本周作业合集

exercises.lol

Contents 目录

A-Level Biology Name: _____ Score: _____

1. A ”closed double circulation” means that:
   - ☐ blood stays in vessels and passes through the heart twice per circuit
   - ☐ blood flows freely through body spaces
   - ☐ blood passes through the heart once
   - ☐ there is only one loop
2. The straw-coloured liquid part of blood, which carries the cells, is the _____.

   _____
3. Where the partial pressure of oxygen is high (the lungs), haemoglobin:
   - ☐ becomes almost fully saturated with oxygen
   - ☐ releases all its oxygen
   - ☐ cannot bind oxygen
   - ☐ breaks down
4. Most carbon dioxide is carried in the blood as _____ ions in the plasma.

   _____
5. Ventricles have thicker walls than atria because they:
   - ☐ must pump blood out of the heart
   - ☐ only push blood a short distance down
   - ☐ hold more blood cells
   - ☐ contain the pacemaker
6. The circulation that carries blood from the heart to the lungs and back is the _____ circulation.

   _____
7. The main job of a red blood cell is to:
   - ☐ carry oxygen
   - ☐ fight infection
   - ☐ clot the blood
   - ☐ make antibodies
8. In respiring tissues, where oxygen is low, h lobin:

☐ unloads its oxygen for the cells to use

☐ becomes fully saturated

☐ gains more oxygen

☐ turns into carbon dioxide

9. The thickest, most muscular chamber, which pumps blood around the whole body, is the left _____.

_____

10. The oxygen dissociation curve is S-shaped (sigmoid).

☐ True ☐ False

8. Transport in mammals

Answers · 答案

A-Level Biology

1. **blood stays in vessels and passes through the heart twice per circuit**

   Closed = blood always in vessels; double = it passes through the heart twice (pulmonary then systemic).

2. **plasma**

   Plasma carries cells, dissolved nutrients, hormones and waste.

3. **becomes almost fully saturated with oxygen**

   At high oxygen partial pressure (lungs), haemoglobin loads up and becomes nearly fully saturated.

4. **hydrogencarbonate**

   Formed from CO_2 and water in the red blood cells, then carried in the plasma.

5. **must pump blood out of the heart**

   Atria only push blood into the ventricles below; ventricles pump blood out, so need thick muscular walls.

6. **pulmonary**

   Pulmonary = to the lungs; systemic = to the rest of the body.

7. **carry oxygen**

   Red blood cells are packed with haemoglobin to carry oxygen; white cells handle defence.

8. **unloads its oxygen for the cells to use**

   At low oxygen partial pressure (tissues), haemoglobin releases oxygen to the cells.

9. **ventricle**

   The left ventricle drives the systemic circulation (whole body), so it needs the most muscle.

10. **True**

    It is S-shaped: binding one oxygen makes the next bind more easily, giving the characteristic sigmoid curve.

A-LEVEL BIOLOGY • EXERCISE SHEET

8.1 The circulatory system

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

KEY WORDS blood vessel 血管 • capillary 毛细血管 • vein 静脉 • artery 动脉 • tissue fluid 组织液

Objective

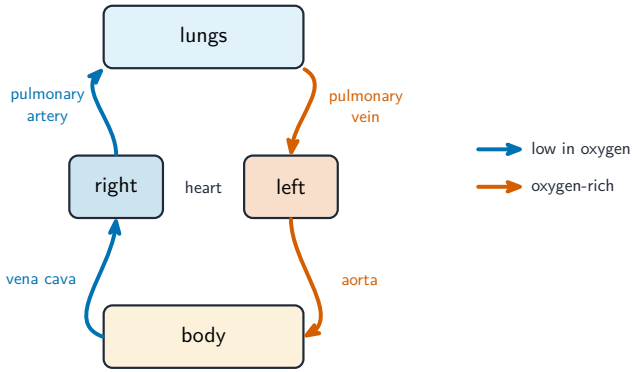
Build the skills to answer exam questions on **the circulatory system** — the **double circulation** 双循环, the structure of blood vessels, and the formation of **tissue fluid** 组织液.

You must be able to:

- describe the closed double circulation and the functions of the main vessels
- relate the structure of arteries, veins and capillaries to their functions
- describe the formation of tissue fluid in a capillary network

1 Worked examples

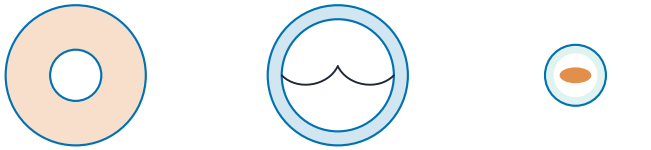
Double circulation



Pulmonary loop to the lungs, systemic loop to the body; blood passes through the heart twice

Main vessels: **pulmonary artery** (heart → lungs, low O_2); **pulmonary vein** (lungs → heart, high O_2); **aorta** 主动脉 (heart → body); **vena cava** 腔静脉 (body → heart).

Vessel structure and function



artery
thick muscular, elastic wall; narrow lumen (high pressure)

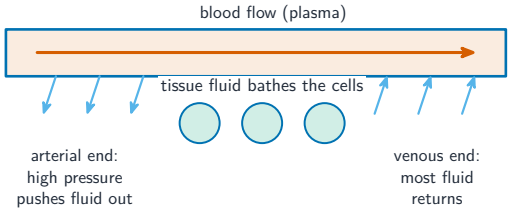
vein
thin wall; wide lumen; valves (low pressure)

capillary
wall one cell thick; very narrow (exchange)

Artery: thick wall, narrow lumen. Vein: thin wall, wide lumen, valves. Capillary: one cell thick.

vessel	structure	function
artery	thick muscle + **elastic** 弹性 wall, narrow lumen	high-pressure flow; recoil smooths flow
capillary	wall one cell thick	short distance for exchange
vein	thin wall, wide lumen, **valves** 瓣膜	low-pressure return; valves stop backflow

Tissue fluid



High pressure at the arterial end forces fluid out as tissue fluid; most returns at the venous end

At the arterial end the high blood pressure forces plasma (not cells or large proteins) out of the capillary to form **tissue fluid**, which supplies cells with O_2 and glucose. Most returns at the lower-pressure venous end.

2 Practice

2.1 Name the vessel that carries oxygen-rich blood from the lungs to the heart. [1]

2.2 Explain why an artery has a thick wall of elastic fibres. [2]

3 Exam-style questions

3.1 Which feature is found in veins but **not** in arteries? [1]

- **A** a muscular wall
- **B** valves
- **C** a lumen
- **D** an endothelium

3.2 Why is a capillary wall only one cell thick? [1]

- **A** to carry blood at high pressure
- **B** to give a short diffusion distance for exchange
- **C** to prevent backflow
- **D** to store tissue fluid

3.3 (a) Describe how tissue fluid is formed at the arterial end of a capillary. [3]

(b) State **two** substances that pass from the tissue fluid into the body cells. [1]

3.4 Explain why most tissue fluid returns to the capillary at the venous end. [2]

Solutions

2.1 the pulmonary vein.

2.2 the elastic wall stretches when the heart pumps and recoils between beats, smoothing the high-pressure flow / maintaining pressure.

3.1 B. Veins have valves to prevent backflow; arteries do not.

3.2 B. A one-cell-thick wall gives a short diffusion distance for exchange.

3.3 (a) at the arterial end the blood (hydrostatic) pressure is high; this forces plasma/fluid out through the capillary wall; cells and large plasma proteins stay in.
(b) oxygen and glucose.

3.4 at the venous end the blood pressure is lower; and the plasma proteins left behind lower the water potential, so water returns by osmosis.

Name:

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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.

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

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32 Which blood vessel carries blood with the lowest pressure?

A aorta

B pulmonary artery

C pulmonary vein

D vena cava

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31 The table shows the comparison of blood pressure in three main blood vessels during diastole.

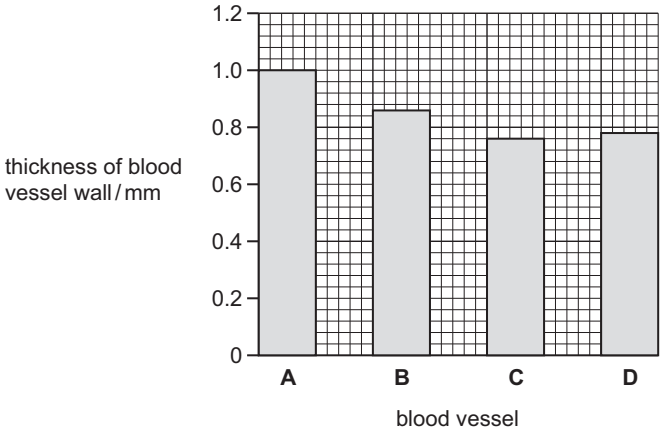
	vessel 1	vessel 2	vessel 3
blood pressure in the vessel during diastole	low	very high	high

Which row identifies the three blood vessels?

	vessel 1	vessel 2	vessel 3
A	pulmonary vein	pulmonary artery	aorta
B	vena cava	aorta	pulmonary vein
C	pulmonary vein	aorta	pulmonary artery
D	pulmonary artery	pulmonary vein	vena cava

31 The graph shows the thickness of the walls of the main blood vessels to and from a mammalian heart.

Which blood vessel is the pulmonary artery?



6 **(a)** A student studied the structure of a mammalian heart.

The student took a photograph of the left side of a dissected heart as shown in Fig. 6.1.

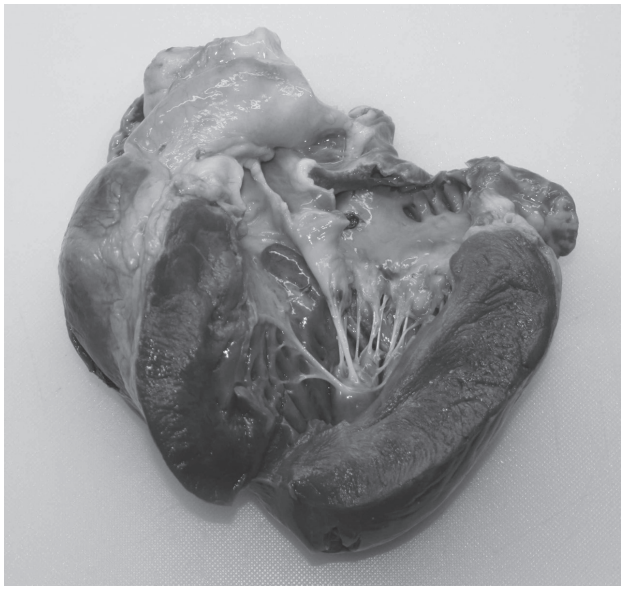


Fig. 6.1

Identify **two** features of the left side of the heart visible in Fig. 6.1 **and** explain how each feature is adapted to the function of the heart.

feature .....

explanation .....

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feature .....

explanation .....

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[4]

(b) Cardiac muscle is described as myogenic. This means the electrical activity controlling the rhythm of a regular heartbeat begins within the muscle tissue of the heart.

Describe how electrical activity within the heart controls each heartbeat.

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(c) Tissue fluid is formed from blood plasma as it flows through capillaries.

Fig. 6.2 is a diagram of a capillary and some adjacent tissue cells in a capillary network.

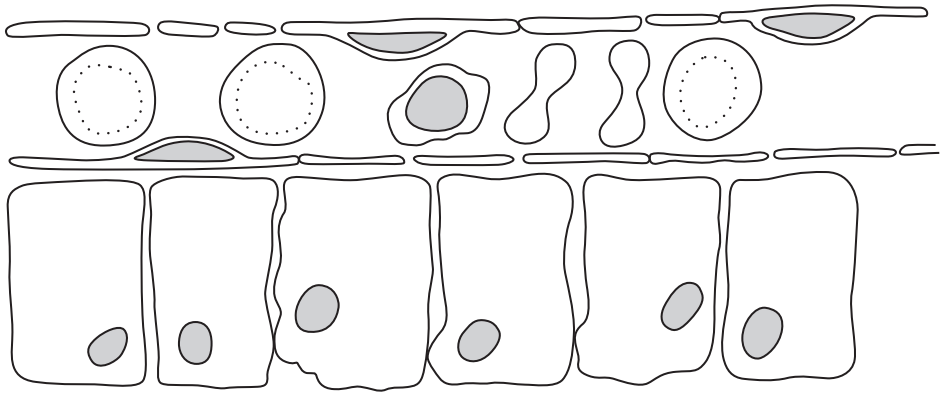

Fig. 6.2

(i) Describe **two** functions of tissue fluid.

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(ii) With reference to Fig. 6.2, describe how tissue fluid is formed.

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(d) Measles is a common disease caused by a virus. Vaccination to prevent the disease has been very successful.

(i) A child receives a vaccine for measles.

Explain why only some of the T-lymphocytes in the child respond to the measles vaccine.

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(ii) Describe the events that occur in an immune response to a vaccine that result in lymphocytes that provide long-term immunity to measles.

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..... [5]

[Total: 20]

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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..... [2]

(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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..... [3]

[Total: 6]

A-LEVEL BIOLOGY • EXERCISE SHEET

8.2 Transport of oxygen and carbon dioxide

Name: _____ Class: _____ Date: _____ **Total: 23 marks**

KEY WORDS carbon dioxide 二氧化碳 • bohr shift 波尔位移 • carbonic anhydrase 碳酸酐酶 • oxygen dissociation curve 氧解离曲线 • haemoglobinic acid 血红蛋白酸

Objective

Build the skills to answer exam questions on the **transport of oxygen and carbon dioxide** — the **oxygen dissociation curve** 氧解离曲线, the **Bohr shift** 波尔位移, and how carbon dioxide is carried.

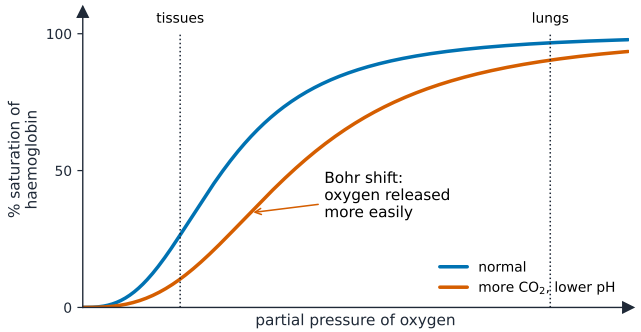
You must be able to:

- describe and explain the oxygen dissociation curve and its importance in the lungs and tissues
- describe and explain the Bohr shift
- describe carbon dioxide transport, including the **chloride shift** 氯转移

1 Worked examples

The oxygen dissociation curve

The S-shaped curve plots **saturation** 饱和度 of haemoglobin against the **partial pressure** 分压 of oxygen.



Bohr shift (right): ↑ CO_2/↓ pH → lower O_2 affinity → unload at tissues

Haemoglobin loads O_2 in the lungs (high pO_2) and unloads it in tissues (low pO_2); the Bohr shift moves the curve right

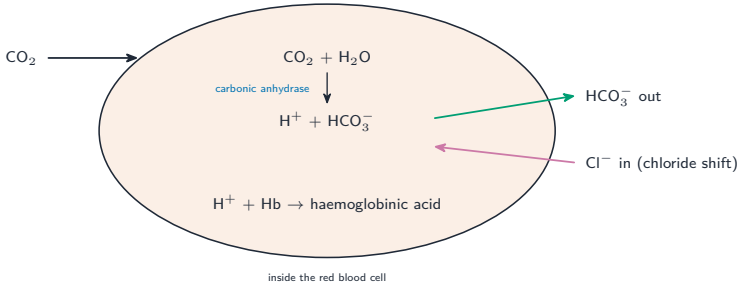
- in the lungs (high pO_2), haemoglobin becomes almost fully saturated (loads O_2).
- in respiring tissues (low pO_2), haemoglobin unloads O_2 for the cells.

Reading the curve: O_2 unloaded = saturation in lungs − saturation in tissues. E.g. 98% → 40% means 58% of the oxygen is released.

The Bohr shift

Active tissues make more **carbon dioxide** 二氧化碳, lowering pH; this makes haemoglobin release O_2 more easily, so the curve shifts **right** — O_2 is given up where it is most needed.

Carbon dioxide transport



Most CO_2 travels as hydrogencarbonate ions; the chloride shift balances charge; haemoglobin mops up H^+

Most CO_2 is carried as **hydrogencarbonate ions** 碳酸氢根离子: **carbonic anhydrase** 碳酸酐酶 catalyses CO_2 + water → carbonic acid → $H^+ + HCO_3^-$. HCO_3^- leaves the red cell and **chloride ions** move in (the chloride shift) to balance the charge; H^+ binds haemoglobin (**haemoglobinic acid** 血红蛋白酸).

2 Practice

2.1 State where on the dissociation curve haemoglobin (a) loads oxygen and (b) unloads oxygen. [2]

2.2 Name the enzyme that catalyses the reaction of carbon dioxide with water. [1]

3 Exam-style questions

3.1 In which form is **most** carbon dioxide carried in the blood? [1]

- **A** dissolved in plasma
- **B** as hydrogencarbonate ions
- **C** as carbaminohaemoglobin
- **D** as carbonic anhydrase

3.2 The Bohr shift moves the oxygen dissociation curve to the right. This means that, at a given partial pressure of oxygen, haemoglobin: [1]

- **A** is more saturated with oxygen
- **B** releases oxygen more readily
- **C** carries more carbon dioxide directly
- **D** has a higher affinity for oxygen

3.3 Use the dissociation curve idea: in the lungs haemoglobin is 98% saturated; in an exercising muscle it falls to 25%.

(a) Calculate the percentage of oxygen unloaded to the muscle. [1]

(b) Explain how the Bohr shift increases the oxygen delivered to exercising muscle. [3]

3.4 Explain the importance of the chloride shift. [2]

3.5 The graph described below shows two oxygen dissociation curves for human haemoglobin: curve **P** at a carbon dioxide partial pressure of 5 kPa, and curve **Q** at 9 kPa, which lies to the right of **P**.

(a) Explain the shape of curve **P**, referring to the effect of binding the first oxygen molecule. [3]

(b) Name the shift from **P** to **Q**, and explain how carbon dioxide causes it. [3]

(c) Explain the benefit of this shift to a person during vigorous exercise. [3]

(d) Describe **two** ways, other than as carbaminohaemoglobin, in which carbon dioxide is carried in the blood, and give the equation for the main one. [3]

Solutions

2.1 (a) at high partial pressure of oxygen (in the lungs); (b) at low partial pressure of oxygen (in respiring tissues).

2.2 carbonic anhydrase.

3.1 B. Most CO_2 is carried as hydrogencarbonate ions.

3.2 B. Shifting right means lower affinity, so haemoglobin releases oxygen more readily.

3.3 (a) $98 - 25 = 73\%$.
(b) exercising muscle releases more CO_2, lowering pH; this shifts the curve right, so at the same pO_2 haemoglobin is less saturated and releases more oxygen; so more oxygen is delivered exactly where respiration is fastest.

3.4 as HCO_3^- leaves the red cell, chloride ions move in to keep the charge balanced inside the cell.

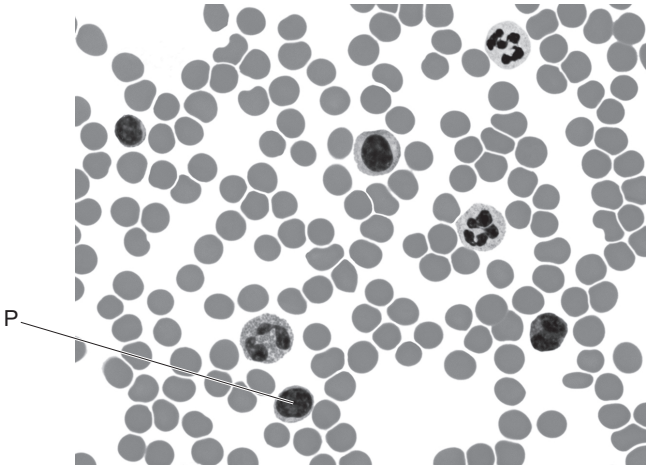
3.5 (a) The curve is **S-shaped** (sigmoid). At low partial pressures it is hard for the first oxygen to bind, so the curve rises slowly; binding it changes the shape of the haemoglobin so that the remaining sites are more accessible, and the next molecules bind much more readily — the steep middle section — until the molecule saturates and the curve levels off.
(b) The **Bohr shift**. Dissolved carbon dioxide forms carbonic acid, which dissociates and lowers the pH; the extra hydrogen ions bind to haemoglobin and change its shape, lowering its affinity for oxygen, so at any given oxygen partial pressure less oxygen is held.
(c) Exercising muscle respires faster and releases more carbon dioxide; the curve shifts right in exactly those tissues; so haemoglobin unloads more oxygen precisely where the demand is greatest, while the lungs — with low carbon dioxide — still load it fully.
(d) About 5% dissolves directly in the plasma; most, about 85%, is carried as **hydrogencarbonate ions** in the plasma; $CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$, catalysed inside the red cell by carbonic anhydrase.

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_2 partial pressure / kPa
A	7.2	5.6
B	7.2	9.5
C	7.6	5.6
D	7.6	9.5

33 The photomicrograph shows cells found in mammalian blood.



What is cell P?

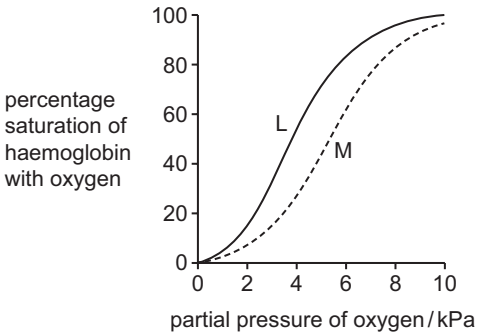
A lymphocyte

B monocyte

C neutrophil

D red blood cell

34 The diagram shows the Bohr shift in actively respiring cells.



What causes the shift from L to M?

A Carbonic acid dissociates to release protons that bind to oxyhaemoglobin, affecting the conformation of haemoglobin to reduce its affinity for oxygen.

B Hydrogencarbonate ions produced by carbonic anhydrase alter the charge of oxyhaemoglobin, reducing its ability to bind oxygen.

C Hydrogen ions combine with chloride ions in tissue fluid to produce hydrochloric acid, distorting oxyhaemoglobin and causing it to lose bound oxygen.

D A low concentration of oxygen in actively respiring cells causes oxyhaemoglobin to release oxygen more quickly down the concentration gradient.

32 Red blood cells may contain a molecule known as 2,3-bisphosphoglycerate (2,3-BPG).

When 2,3-BPG binds to haemoglobin, a higher partial pressure of oxygen is needed to bring about 50% saturation of haemoglobin with oxygen.

Which statements about the effect of 2,3-BPG are correct?

1 2,3-BPG in red blood cells causes the oxygen dissociation curve to shift to the right.

2 The binding of 2,3-BPG to haemoglobin reduces the Bohr effect.

3 The binding of 2,3-BPG to haemoglobin lowers the affinity of the haemoglobin for oxygen.

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

33 Which statement correctly describes the Bohr shift?

A the decrease in affinity of haemoglobin for oxygen that occurs when pH is lowered

B the increase in affinity of haemoglobin for oxygen that occurs when oxygen concentration rises

C the increase in affinity of haemoglobin for oxygen that occurs when pH is at an optimum

D the release of oxygen from oxyhaemoglobin in the absence of carbonic acid

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

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

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..... [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.

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(c) Fig. 2.1 is a diagram of a section through the heart.

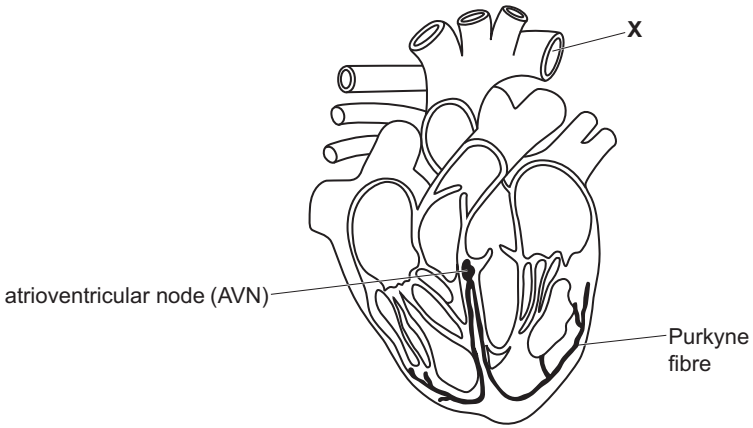

Fig. 2.1

(i) Describe and explain how the tunica media (middle layer of the wall) of blood vessel **X** adapts the blood vessel for its function.

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(ii) Describe the role of the atrioventricular node (AVN) and the Purkyne tissue in the cardiac cycle.

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6 In the pulmonary circulation of a mammal, deoxygenated blood becomes oxygenated when red blood cells pass through alveolar capillaries and haemoglobin within the cells combines with oxygen.

The blood returns to the heart to be pumped around the systemic circulation.

(a) Describe the sequence of events occurring in the heart that allows blood returning in the pulmonary circulation to then enter the systemic circulation.

You should include in your description:

- the names of the relevant blood vessels of the pulmonary circulation and systemic circulation that are connected to the heart
- reference to blood pressure changes that cause the opening and closing of valves.

You **do not** need to include details of control of the cardiac cycle.

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

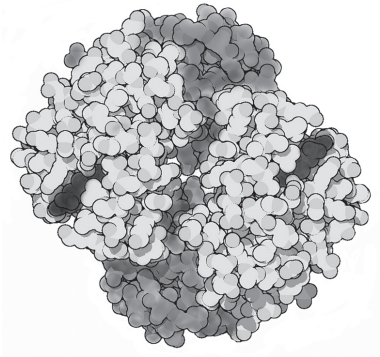

Fig. 6.1

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

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

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[Total: 9]

A-LEVEL BIOLOGY • EXERCISE SHEET

8.3 The heart

Name: _____ Class: _____ Date: _____ **Total: 12 marks**

KEY WORDS ventricle 心室 • cardiac cycle 心动周期 • systole 收缩期 • atrioventricular node 房室结 • atria 心房

Objective

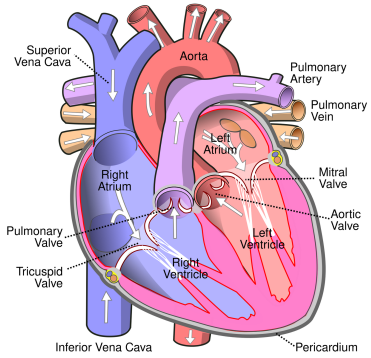
Build the skills to answer exam questions on **the heart** — its structure, the **cardiac cycle** 心动周期, and the control of the heartbeat by the **sinoatrial node** 窦房结.

You must be able to:

- describe the structure of the heart and explain the differences in wall thickness
- describe the cardiac cycle and how pressure changes open and close the valves
- explain the roles of the SAN, AVN and Purkyne tissue

1 Worked examples

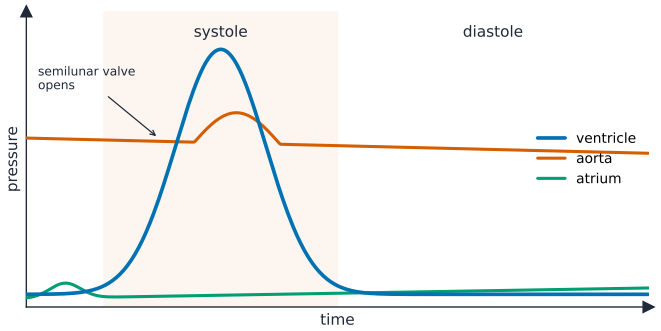
■ Heart structure



Four chambers, valves and main vessels; the left ventricle wall is the thickest

- **atria** 心房 — thin walls (only push blood into the ventricles).
- **ventricles** 心室 — thick muscular walls (pump blood out).
- the **left ventricle** wall is thickest, to pump blood all round the body; the right only pumps to the nearby lungs.

The cardiac cycle

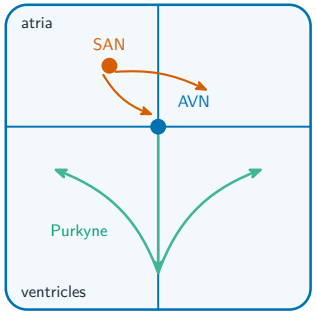


systole = contraction (high *P*) · diastole = relaxation/fill · valves open on *P* gradients

The ventricle pressure spikes in systole; a valve opens or closes whenever two pressure curves cross

Systole 收缩期 = contraction (pressure rises); **diastole** 舒张期 = relaxation/filling. A valve opens when the pressure behind it is higher, and closes when the pressure in front is higher — so blood flows one way only.

Controlling the heartbeat



SAN fires → atria contract → AVN delays → Purkyne → ventricles contract from the bottom up

The SAN sets the rhythm; the AVN delays the wave; the Purkyne tissue makes the ventricles contract bottom-up

The **SAN** (pacemaker) fires a wave that contracts the atria; the **AVN** delays it (so atria empty first); the **Purkyne tissue** 浦肯野组织 carries it through the ventricle walls so they contract from the bottom up.

2 Practice

2.1 Explain why the wall of the left ventricle is thicker than the wall of the right ventricle. [2]

2.2 State what happens to a heart valve when the pressure in front of it (downstream) becomes higher than the pressure behind it. [1]

3 Exam-style questions

3.1 What is the role of the atrioventricular node (AVN)? [1]

- **A** to set the basic heart rhythm
- **B** to delay the wave of excitation so the atria empty first
- **C** to pump blood into the aorta
- **D** to close the semilunar valves

3.2 During ventricular systole, the semilunar (aortic) valve opens when: [1]

- **A** atrial pressure exceeds ventricular pressure
- **B** ventricular pressure exceeds aortic pressure
- **C** the ventricle relaxes
- **D** the atria contract

3.3 A person has a stroke volume (volume pumped per beat) of 70 cm^3 and a heart rate of 75 beats per minute.

(a) Calculate the cardiac output (volume pumped per minute), in cm^3 per minute. [2]

(b) During exercise the heart rate rises to 150 beats per minute and stroke volume to 90 cm^3. Calculate the new cardiac output. [1]

3.4 Describe the sequence of events from the firing of the SAN to the contraction of the ventricles. [4]

Solutions

2.1 the left ventricle pumps blood all the way round the body (the systemic circulation), which needs a higher pressure, so it needs more muscle than the right, which only pumps to the lungs.

2.2 the valve closes.

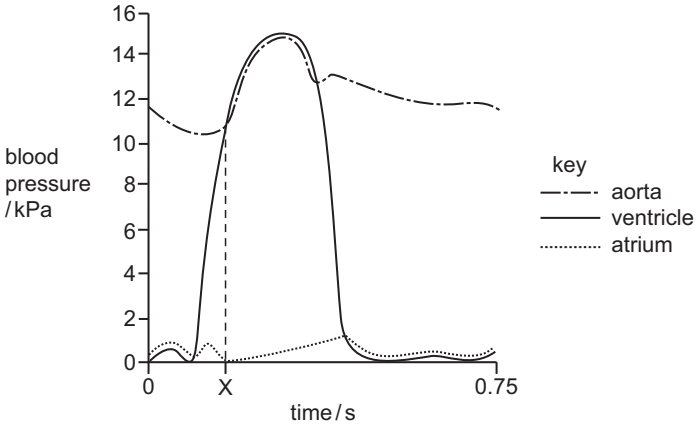
3.1 B. The AVN delays the wave so the atria finish emptying before the ventricles contract.

3.2 B. The semilunar valve opens when ventricular pressure rises above aortic pressure.

3.3 (a) cardiac output $= 70 \times 75 = 5250$ $cm^3\,min^{-1}$.
(b) $90 \times 150 = 13\,500$ $cm^3\,min^{-1}$.

3.4 the SAN fires and the wave spreads across the atria, making them contract; the AVN picks it up and delays it; the wave passes down the Purkyne tissue and up the ventricle walls, so the ventricles contract from the base upwards.

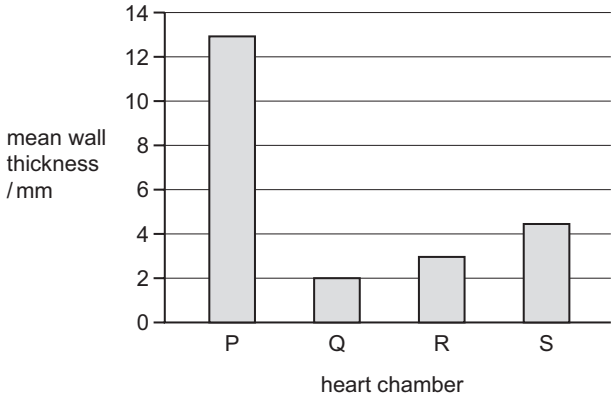
32 The graph shows changes in blood pressure during one cardiac cycle.



What is happening at time X?

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

35 The bar chart shows the mean thickness of the walls of the main chambers in a mammalian heart.



Which row correctly identifies the heart chambers?

	right atrium	left atrium	right ventricle	left ventricle
A	R	Q	S	P
B	Q	S	R	P
C	R	Q	P	S
D	Q	R	S	P

33 A person has a small hole in the septum between the ventricles. This is called a ventricular septal defect (VSD). The person has no other heart defects.

What is the direction of the net flow of blood during ventricular systole in the heart of this person?

A left ventricle to left atrium

B right ventricle to right atrium

C left ventricle to right ventricle

D right ventricle to left ventricle

34 Which row correctly describes the features for two of the heart chambers?

	left atrium	left ventricle
A	large force of contraction to allow blood to travel a long distance	large force of contraction to allow blood to travel a long distance
B	small force of contraction as blood only needs to travel a short distance	large force of contraction to allow blood to travel a long distance
C	small force of contraction as blood only needs to travel a short distance	small force of contraction as blood only needs to travel a short distance
D	large force of contraction to allow blood to travel a long distance	small force of contraction as blood only needs to travel a short distance

6 **(a)** A student studied the structure of a mammalian heart.

The student took a photograph of the left side of a dissected heart as shown in Fig. 6.1.

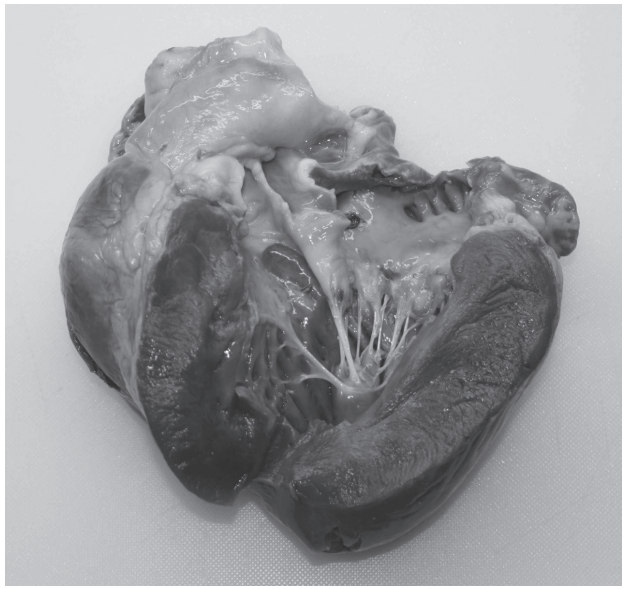


Fig. 6.1

Identify **two** features of the left side of the heart visible in Fig. 6.1 **and** explain how each feature is adapted to the function of the heart.

feature .....

explanation .....

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.....

.....

feature .....

explanation .....

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.....

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[4]

(b) Cardiac muscle is described as myogenic. This means the electrical activity controlling the rhythm of a regular heartbeat begins within the muscle tissue of the heart.

Describe how electrical activity within the heart controls each heartbeat.

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..... [4]

(c) Tissue fluid is formed from blood plasma as it flows through capillaries.

Fig. 6.2 is a diagram of a capillary and some adjacent tissue cells in a capillary network.

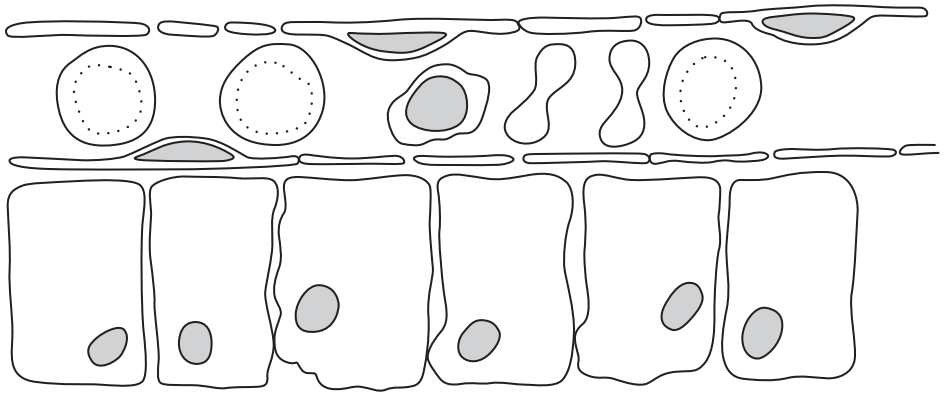

Fig. 6.2

(i) Describe **two** functions of tissue fluid.

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(ii) With reference to Fig. 6.2, describe how tissue fluid is formed.

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..... [3]

(d) Measles is a common disease caused by a virus. Vaccination to prevent the disease has been very successful.

(i) A child receives a vaccine for measles.

Explain why only some of the T-lymphocytes in the child respond to the measles vaccine.

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(ii) Describe the events that occur in an immune response to a vaccine that result in lymphocytes that provide long-term immunity to measles.

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..... [5]

[Total: 20]