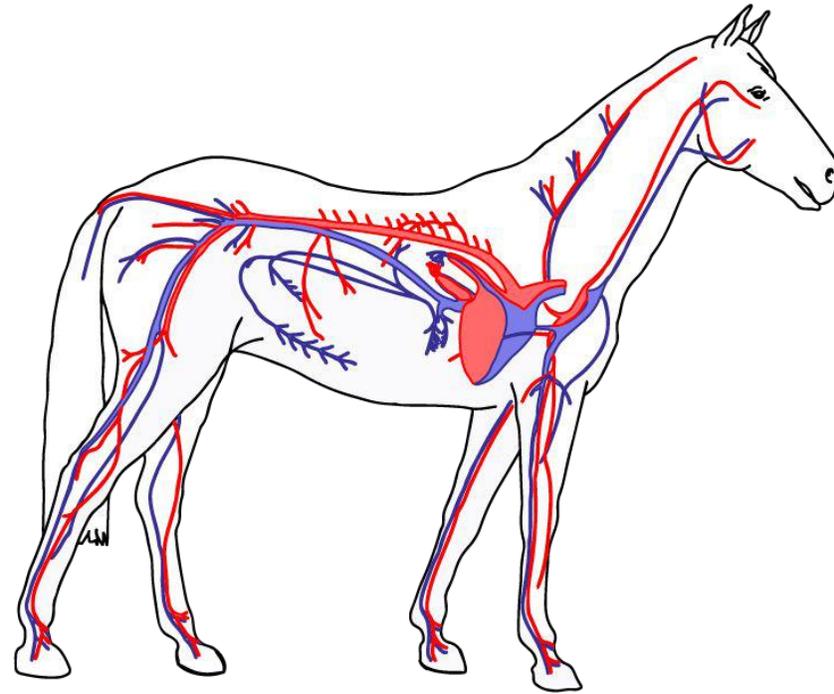


# Mass Transport in Animals



# Material Covered

## Circulatory Systems

1. The Need for Transport Systems
2. The Mammalian Circulatory System
3. Structure and Function of Blood Vessels

## Tissue Fluid & Pressure

1. Role of Tissue Fluid, Hydrostatic and Oncotic Pressure
2. Exchange at a Capillary Bed

# Material Covered

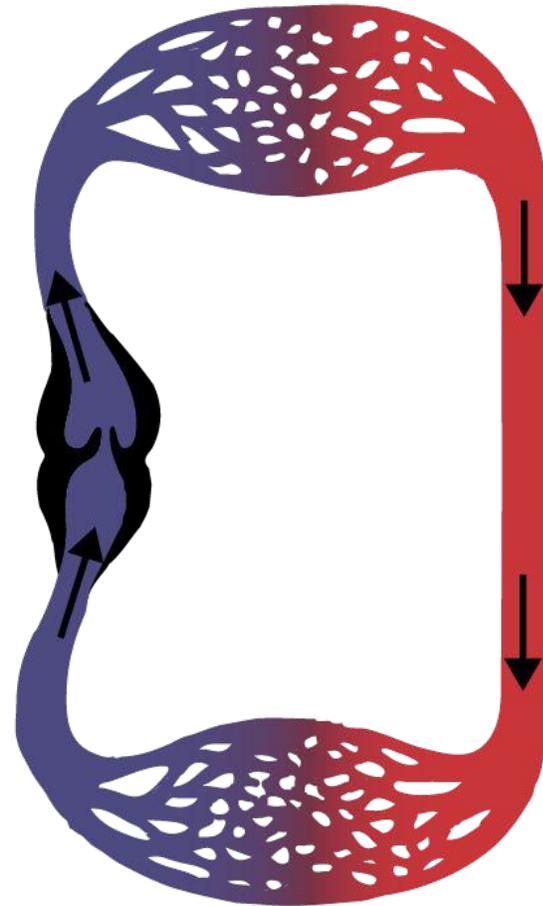
## Oxygen Transport

1. Oxygen Dissociation Curve & The Bohr Effect

## The Cardiac Cycle

1. Structure and Function of the Heart

# Circulatory Systems



# Specification Points

## AQA

### 3.3.4.1 Mass transport in animals

| Content  | Opportunities for skills development  |
|--|---|
| <p>The haemoglobins are a group of chemically similar molecules found in many different organisms. Haemoglobin is a protein with a quaternary structure.</p> <p>The role of haemoglobin and red blood cells in the transport of oxygen. The loading, transport and unloading of oxygen in relation to the oxyhaemoglobin dissociation curve. The cooperative nature of oxygen binding to show that the change in shape of haemoglobin caused by binding of the first oxygens makes the binding of further oxygens easier. The effects of carbon dioxide concentration on the dissociation of oxyhaemoglobin (the Bohr effect).</p> <p>Many animals are adapted to their environment by possessing different types of haemoglobin with different oxygen transport properties.</p> <p>The general pattern of blood circulation in a mammal. Names are required only of the coronary arteries and of the blood vessels entering and leaving the heart, lungs and kidneys.</p> <p>The gross structure of the human heart. Pressure and volume changes and associated valve movements during the cardiac cycle that maintain a unidirectional flow of blood.</p> <p>The structure of arteries, arterioles and veins in relation to their function.</p> <p>The structure of capillaries and the importance of capillary beds as exchange surfaces. The formation of tissue fluid and its return to the circulatory system.</p> | <p><b>AT h</b></p> <p>Students could design and carry out an investigation into the effect of a named variable on human pulse rate or on the heart rate of an invertebrate, such as <i>Daphnia</i>.</p> <p><b>MS 2.2</b></p> <p>Students could be given values of cardiac output (CO) and one other measure, requiring them to change the subject of the equation:</p> $CO = \text{stroke volume} \times \text{heart rate}$ |

## OCR

### 3.1.2 Transport in animals

|     | Learning outcomes   | Additional guidance  |
|-----|---|--|
| (a) | the need for transport systems in multicellular animals                             | To include an appreciation of size, metabolic rate and surface area to volume ratio (SA:V).  |
|     |   | <i>M0.1, M0.3, M0.4, M1.1, M2.1, M4.1</i><br>HSW1, HSW3, HSW5, HSW8                          |
| (b) | the different types of circulatory systems  | To include single, double, open and closed circulatory systems in insects, fish and mammals. |
| (c) | the structure and functions of arteries, arterioles, capillaries, venules and veins | To include the distribution of different tissues within the vessel walls.<br><b>PAG2</b>     |

# Specification Points

## Edexcel A

### Topic 1: Lifestyle, Health and Risk

#### Students should:

- 1.1 Understand why many animals have a heart and circulation (mass transport to overcome limitations of diffusion in meeting the requirements of organisms).

### Topic 1: Lifestyle, Health and Risk

#### Students should:

- 1.3 Understand how the structures of blood vessels (capillaries, arteries and veins) relate to their functions.

## Edexcel B

### Topic 4: Exchange and Transport

#### Students should:

#### 4.4 Circulation

- i Know the structure of the heart, arteries, veins and capillaries.

### Topic 4: Exchange and Transport

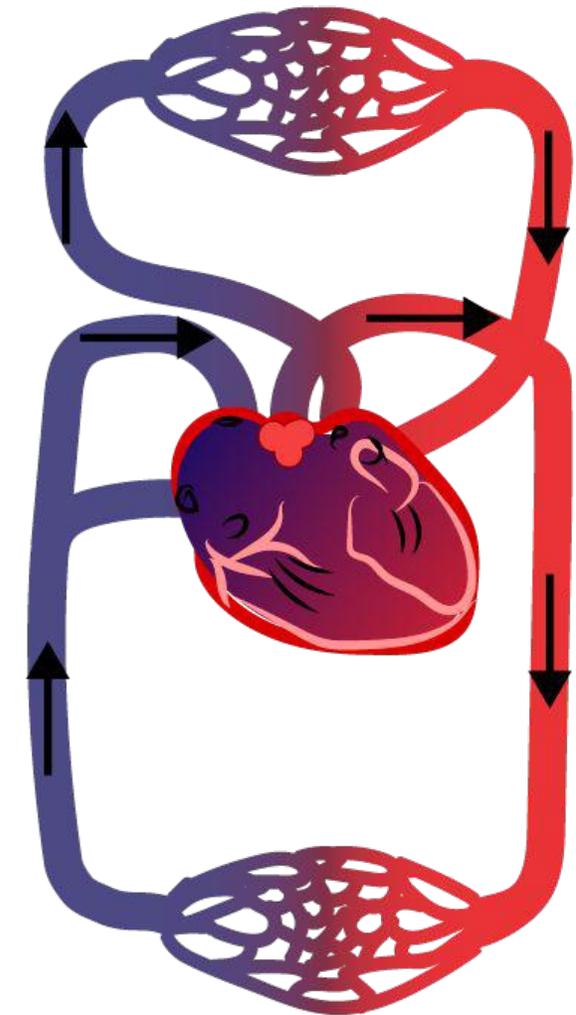
#### Students should:

#### 4.4 Circulation

- ii Understand the advantages of a double circulatory system in mammals over the single circulatory systems in bony fish, including the facility for blood to be pumped to the body at higher pressure and the splitting of oxygenated and deoxygenated blood.

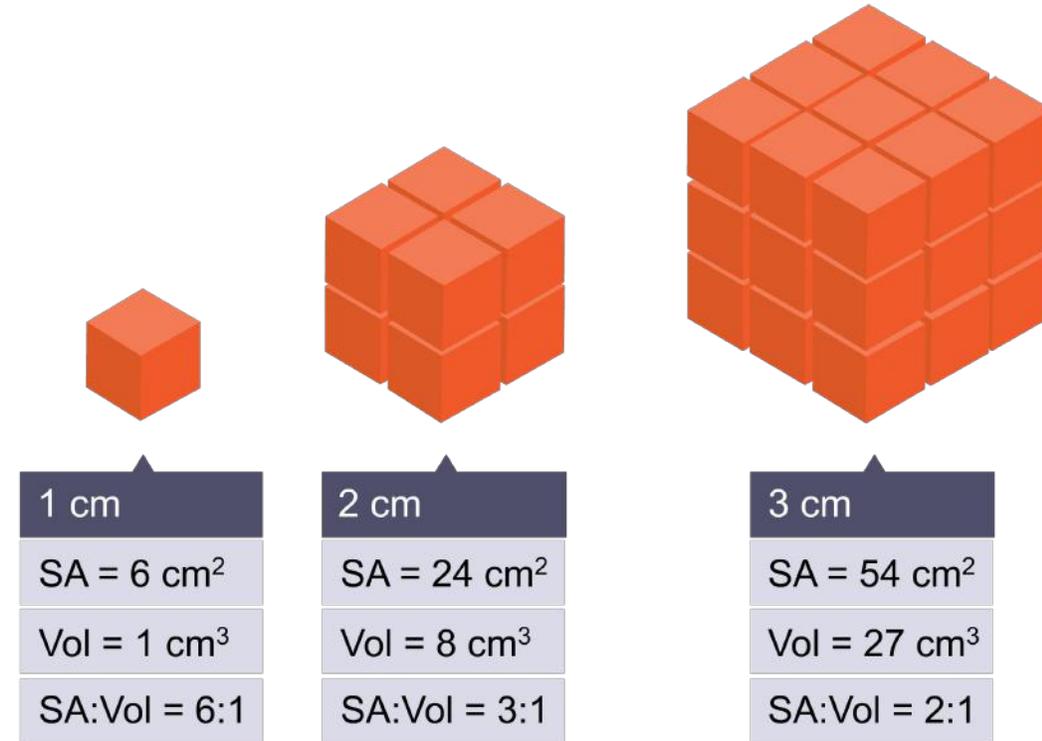
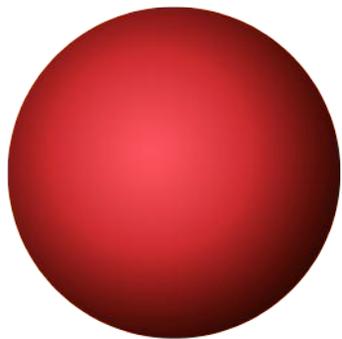
# The Need for a Transport System

- All **cells** need an **exchange** of **substances** in order to **survive**
- However, **diffusion** is **not** always **efficient** enough for all organisms to use
- The **three main factors** that determine whether an organism needs a **transport system** are:
  - **Size**
  - **Surface area to volume ratio**
  - **Metabolic rate**



# Surface Area to Volume Ratio

- The **larger** the **organism**, the **smaller** the **surface area to volume ratio**
- **Surface area to volume calculations** assume that the **cell** or **organism** has a **regular shape**, like a **sphere** or a **cube**



## Exemplar Exam Question – Calculation

1) A small mammal can be approximated as a cube with sides of 10cm.

Calculate its surface area to volume ratio.  
**[2 marks]**

**Command:** numerical response

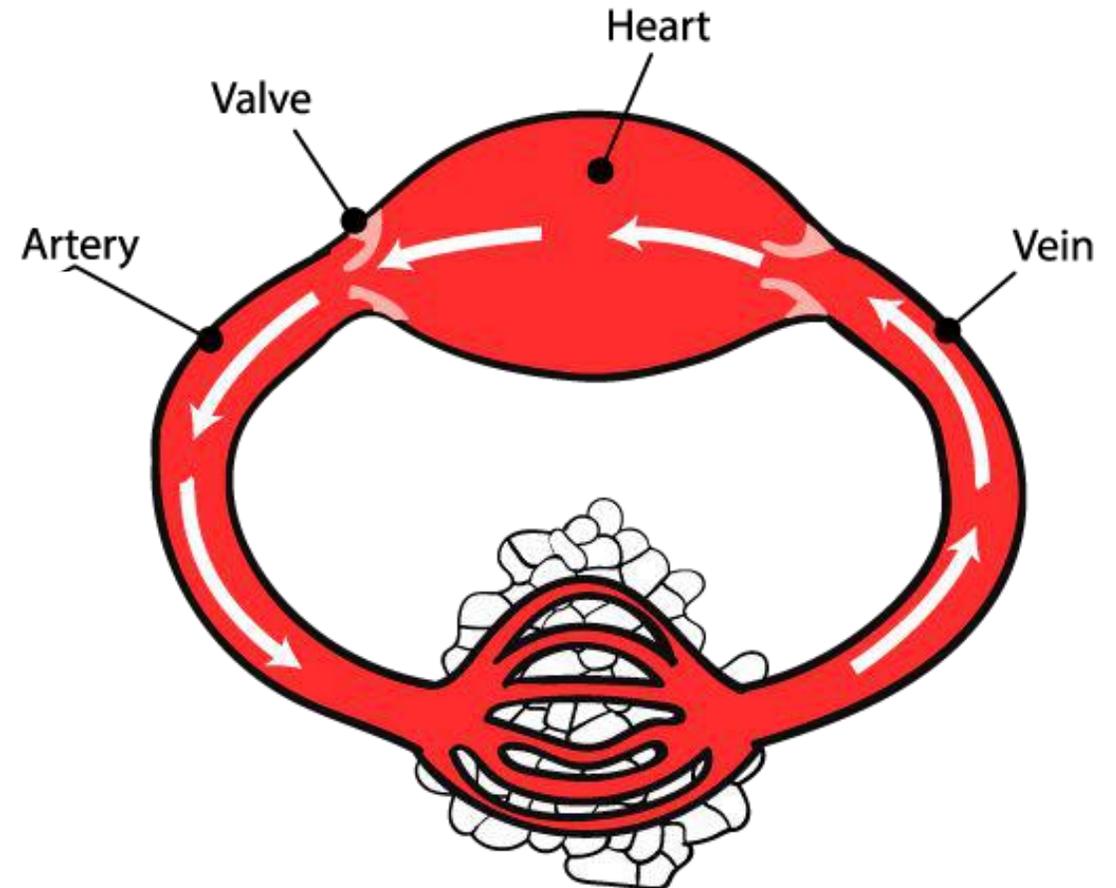
**Direction:** provide answer as a SA:V ratio

**Context:** surface area and volume calculations for cubes

## Exemplar Exam Question – Calculation

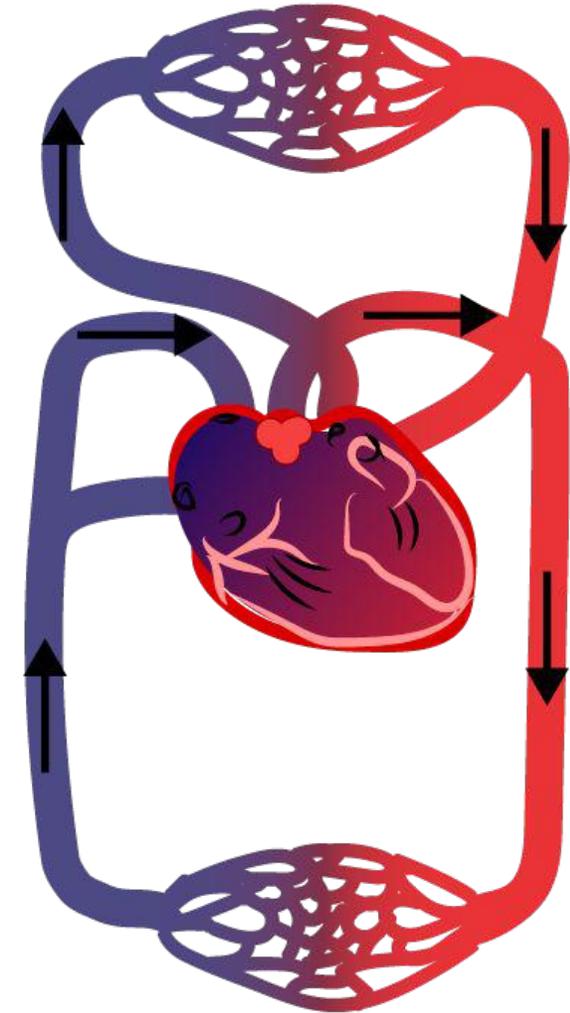
# Closed Circulatory Systems

- **Circulatory fluid is always contained within vessels**
- A separate **tissue fluid bathes cells** of the body
- **Exchange between the two fluids** occurs at **capillary beds** by **diffusion**



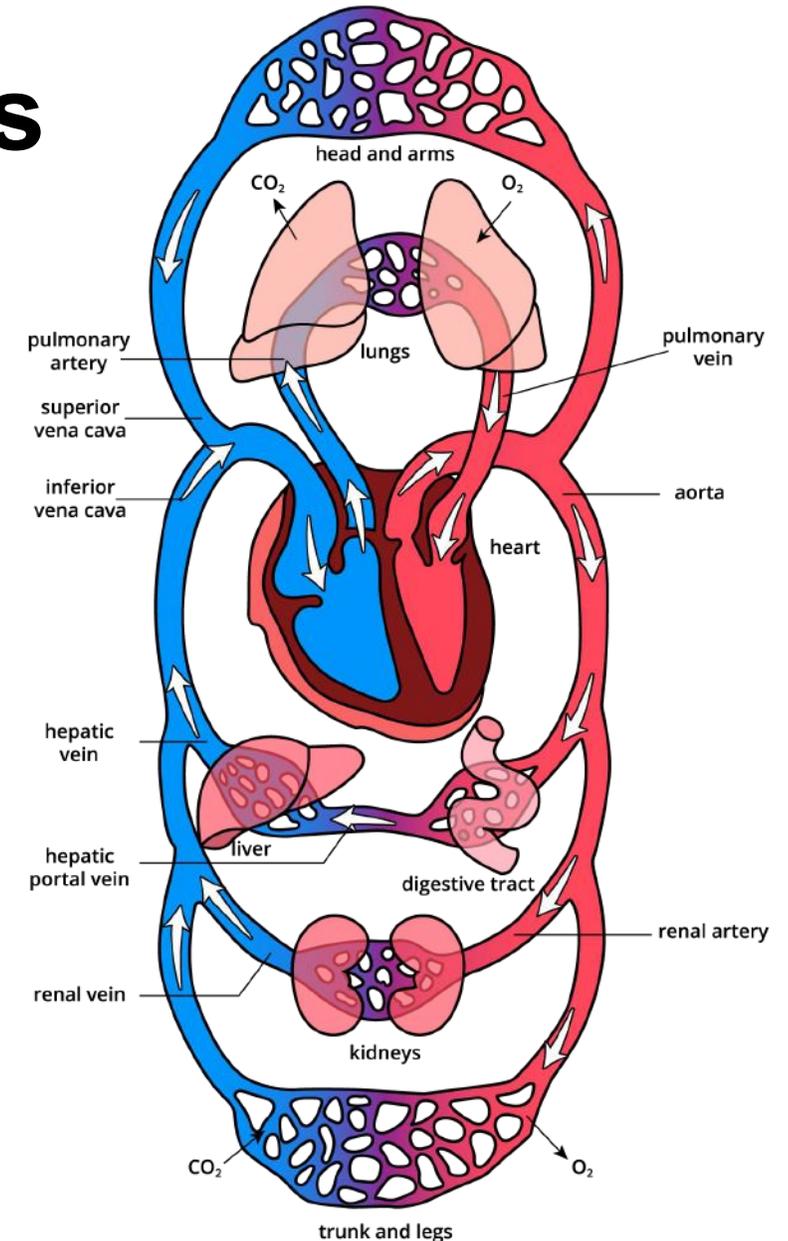
# Double Circulatory Systems

- **Blood passes** through the **heart twice** for **every full circuit** of the body.
- The two smaller circuits are called the **pulmonary circuit** and the **systemic circuit**
- **Double circulation** allows **blood pressure** to be **increased** when **pumped** around the **systemic circuit**



# Mammalian Circulatory Systems

- Mammals are **endotherms** and therefore have a **high metabolic rate**
- A **closed double circuit** is therefore needed as it is the **most efficient circulatory system**
- The blood is involved in **gas transport, nutrient transport** and **immune response**
- **Body cells** are **bathed** in **tissue fluid** and **substances** are **exchanged** between the **blood, tissue fluid** and **cells** by **diffusion**



## Exemplar Exam Question – Simple Explanatory

2) Double closed circulatory systems retain blood within blood vessels at all times.

Suggest two benefits of keeping blood within blood vessels.

**[2 marks]**

**Command:** single sentences or bullet points

**Direction:** focus only on the advantages

**Context:** closed circulatory systems

## Exemplar Exam Question – Simple Explanatory

2) Double closed circulatory systems retain blood within blood vessels at all times.

Suggest two benefits of keeping blood within blood vessels.

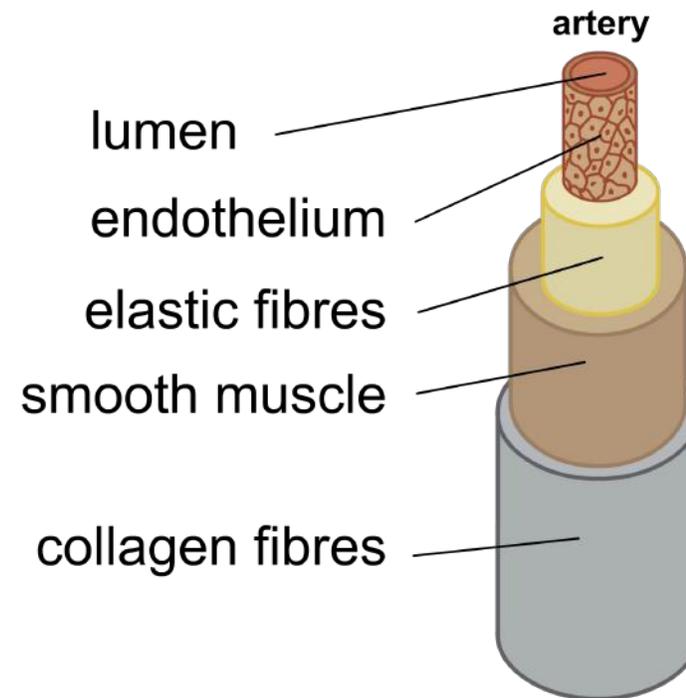
**[2 marks]**

- A closed system is more efficient at delivering oxygen to respiring tissues.
- The blood flow can be diverted or directed to specific places, by vasodilation and vasoconstriction.
- A higher blood pressure can be maintained

# Structure of Arteries

**Edexcel A & B** : do not need to know about **arterioles** and **venules**

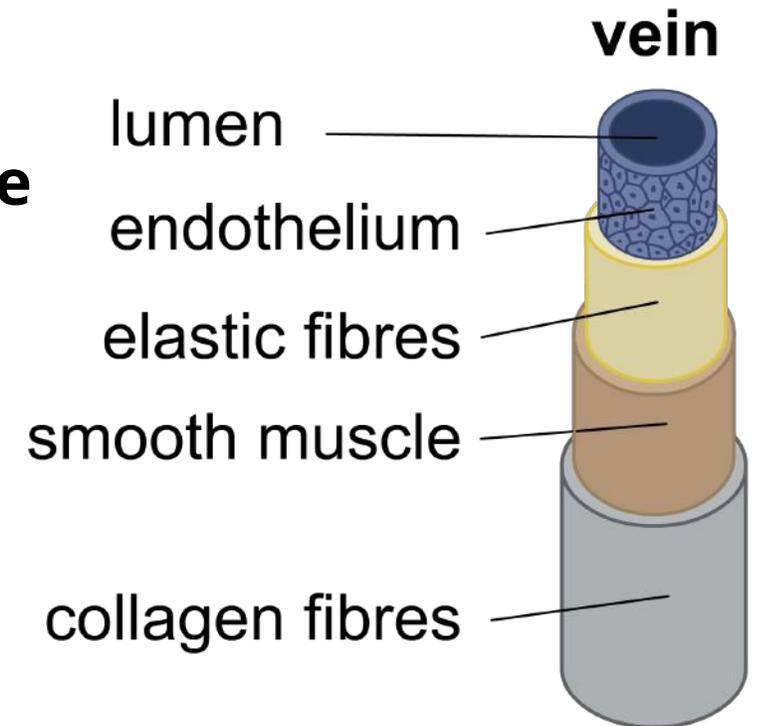
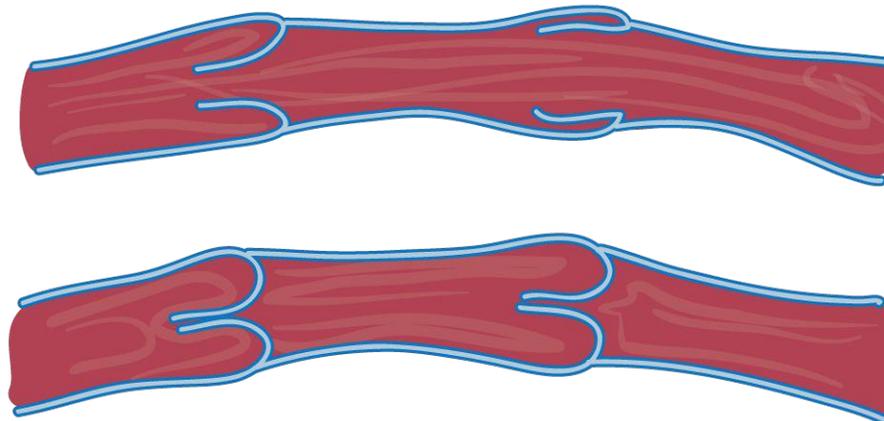
- **Arteries** carry **blood** under **high pressure** away from the **heart** and towards **arterioles** (and **capillaries**)
- They have **several common structural features**:
  - Relatively **thick** layers of **elastic tissue, smooth muscle tissue** and **collagen fibre** (tough outer layer)
  - **Smooth endothelium**
  - **Small lumen**



# Structure of Veins

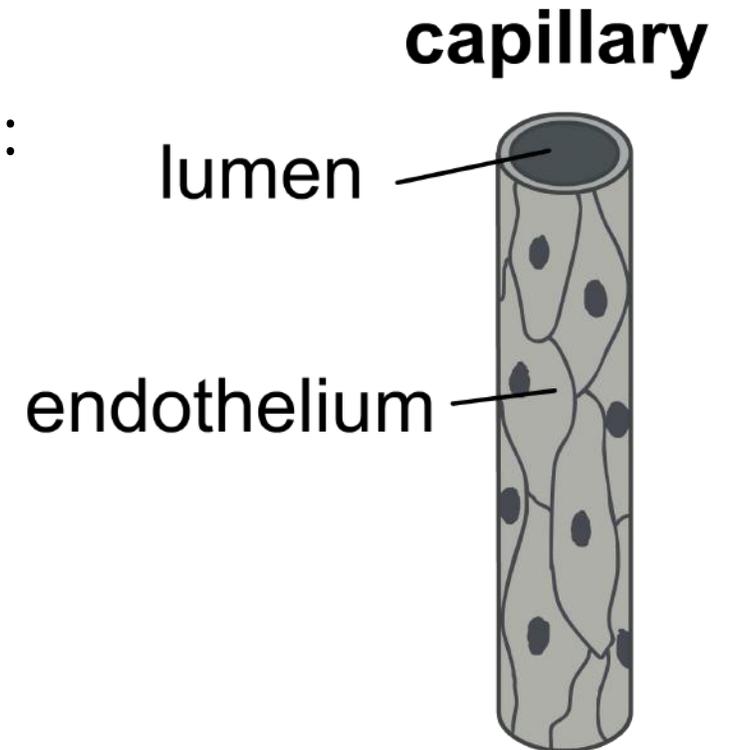
Edexcel A & B : do not need to know about arterioles and venules

- **Veins** carry **blood** under **low pressure** from **venules** (and **capillaries**) towards the **heart**
- They have **several common structural features**:
  - Relatively **thin** layers of **elastic, smooth muscle** and **collagen**
  - **Larger lumen**
  - Contain **valves**



# Structure of Capillaries

- **Capillary beds** are the **main site** of **exchange** between **blood vessels** and the **cells** of the **body**
- They have **several common structural features**:
  - **1 cell thick, leaky layer** of **endothelium**
  - **Highly numerous** and **branched**
  - **Narrow lumen**



## Exemplar Exam Question - Data Analysis

3) Figure 1 shows blood pressure changes and the total cross sectional area of blood vessels.

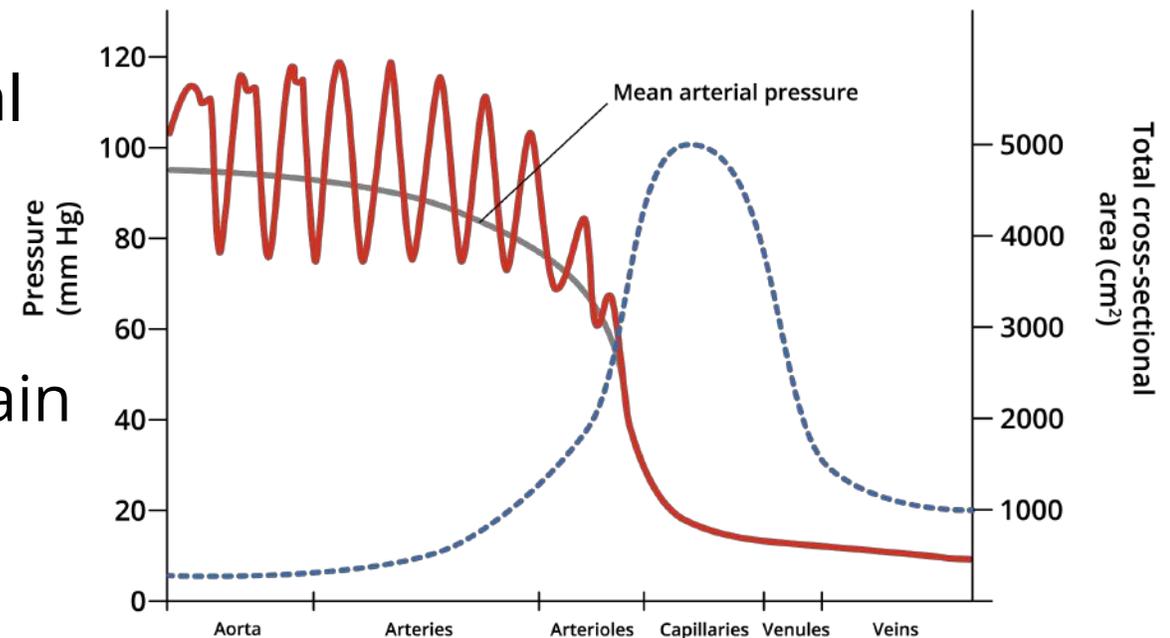
Using the graph and your own knowledge, describe and explain how the pressure changes as blood flows through the circulatory system.

**[6 marks]**

**Command:** Use figures when describing and give reasons

**Direction:** How blood pressure is affected by total cross-sectional area

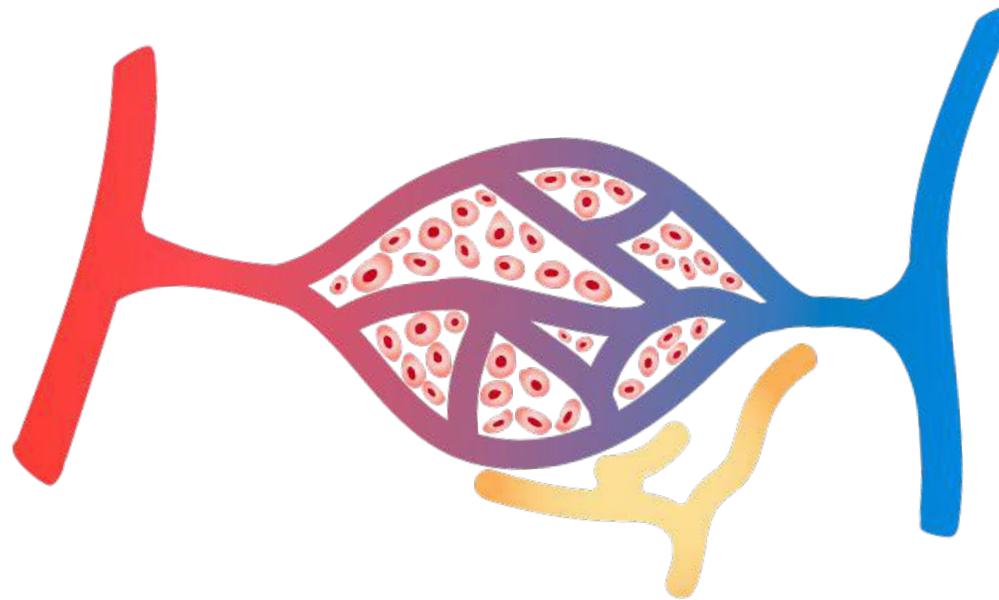
**Context:** Pressure in blood vessels



## Exemplar Exam Question – Data Analysis

The pressure fluctuates in the aorta, arteries and arterioles, with pressure increasing to around 120 mmHg during ventricular contraction and lowering to around 80 mmHg during relaxation. The mean blood pressure decreases when blood reaches the capillaries. This is due to the total cross-sectional area of the capillaries being higher than the arteries/arterioles (peaking at 5000cm<sup>2</sup>), due to capillaries being highly numerous. The blood pressure remains low when entering the veins as there is no ventricular contraction to increase blood pressure and the total cross-sectional area is higher than in the arteries.

# Tissue Fluid & Pressure



# Specification Points

## AQA

### 3.3.4.1 Mass transport in animals

| Content  | Opportunities for skills development  |
|--|---|
| <p>The haemoglobins are a group of chemically similar molecules found in many different organisms. Haemoglobin is a protein with a quaternary structure.</p> <p>The role of haemoglobin and red blood cells in the transport of oxygen. The loading, transport and unloading of oxygen in relation to the oxyhaemoglobin dissociation curve. The cooperative nature of oxygen binding to show that the change in shape of haemoglobin caused by binding of the first oxygens makes the binding of further oxygens easier. The effects of carbon dioxide concentration on the dissociation of oxyhaemoglobin (the Bohr effect).</p> <p>Many animals are adapted to their environment by possessing different types of haemoglobin with different oxygen transport properties.</p> <p>The general pattern of blood circulation in a mammal. Names are required only of the coronary arteries and of the blood vessels entering and leaving the heart, lungs and kidneys.</p> <p>The gross structure of the human heart. Pressure and volume changes and associated valve movements during the cardiac cycle that maintain a unidirectional flow of blood.</p> <p>The structure of arteries, arterioles and veins in relation to their function.</p> <p>The structure of capillaries and the importance of capillary beds as exchange surfaces. The formation of tissue fluid and its return to the circulatory system.</p> | <p><b>AT h</b></p> <p>Students could design and carry out an investigation into the effect of a named variable on human pulse rate or on the heart rate of an invertebrate, such as <i>Daphnia</i>.</p> <p><b>MS 2.2</b></p> <p>Students could be given values of cardiac output (CO) and one other measure, requiring them to change the subject of the equation:</p> $CO = \text{stroke volume} \times \text{heart rate}$ |

## OCR

### 3.1.2 Transport in animals

| Learning outcomes                                    | Additional guidance  |
|--|--|
| <p>(d) the formation of tissue fluid from plasma</p> | <p>To include reference to hydrostatic pressure, oncotic pressure and an explanation of the differences in the composition of blood, tissue fluid and lymph.</p> <p>HSW8</p> |

# Specification Points

## Edexcel A

### Topic 1: Lifestyle, Health and Risk

#### Students should:

- 1.3 Understand how the structures of blood vessels (capillaries, arteries and veins) relate to their functions.

## Edexcel B

### Topic 4: Exchange and Transport

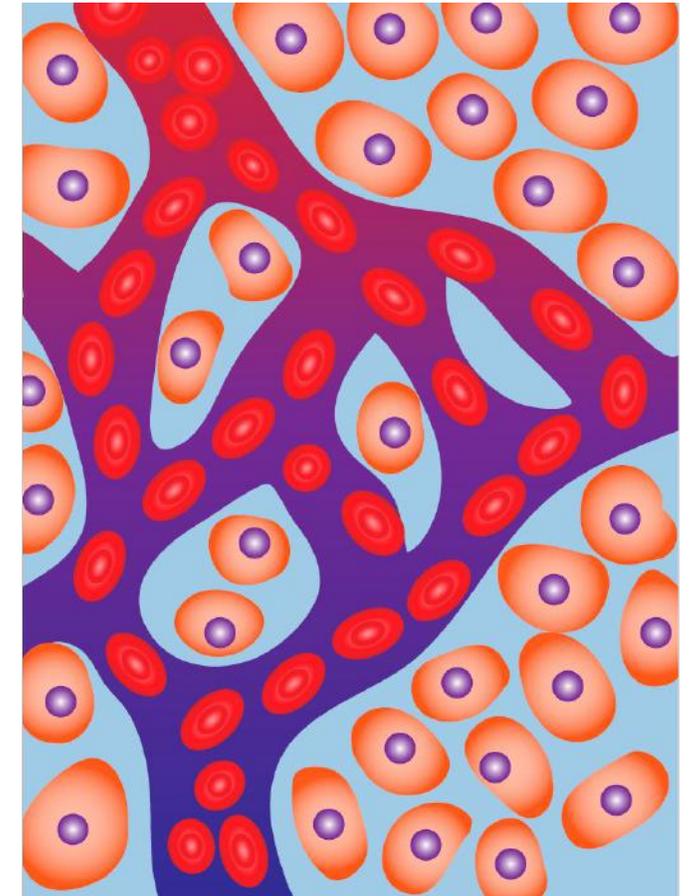
#### Students should:

#### 4.6 Transfer of materials between the circulatory system and cells

- i Understand how the interchange of substances occurs through the formation and reabsorption of tissue fluid, including the effects of hydrostatic pressure and oncotic pressure.
- ii Know that tissue fluid that is not reabsorbed is returned to the blood via the lymph system.

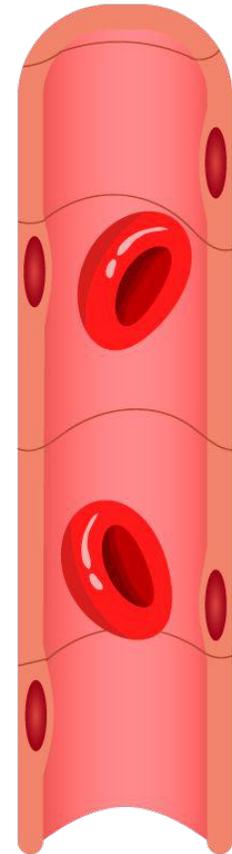
# Role of Tissue Fluid

- **Tissue fluid** is the **watery fluid** that **bathes tissues**, providing cells with a **stable environment**
- Tissue fluid allows **exchange** of **substances** between the **blood** and the **cells**
- Tissue fluid therefore contains **essential** substances such as **glucose**, **amino acids**, **fatty acids** and **oxygen**
- **Waste products** from cells such as **carbon dioxide** and **urea** are also found in tissue fluid



# Hydrostatic and Oncotic Pressure

- **Hydrostatic pressure** is the **positive** pressure (**pushes** water out) that a fluid exerts **against** a **vessel** that contains it
- Hydrostatic pressure **varies** throughout **capillaries** but remains **constant** in **tissue fluid**
- **Oncotic pressure** is the **negative** pressure (**pull** water in) created by the **osmotic effects** of **proteins**
- Oncotic pressure is **constant** through **capillaries** because **large plasma proteins** do **not leave blood**



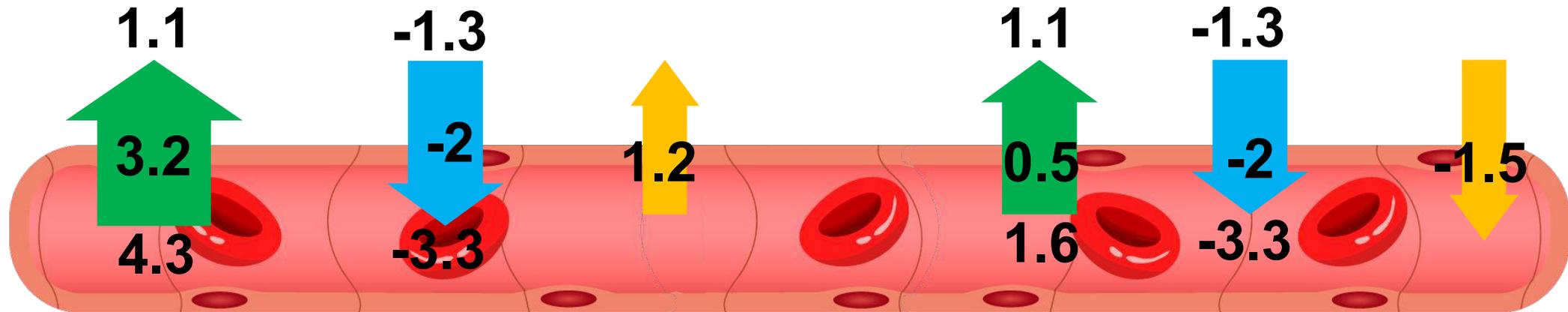
**AQA & Edexcel A:** do not need to know about **oncotic pressure**

# Hydrostatic vs. Oncotic Pressure

- The **hydrostatic pressure** is always a **net force outwards** and the **oncotic pressure** is always a **net force inwards**
- What determines whether the **overall net movement** is **outwards** or **inwards** is which **pressure** is **stronger**

| Pressure Type           | Blood Plasma          | Tissue Fluid           | Direction of Force     |
|-------------------------|-----------------------|------------------------|------------------------|
| Hydrostatic             | Higher                | Lower                  | Plasma to tissue fluid |
| Oncotic/Water potential | Lower (More negative) | Higher (Less negative) | Tissue fluid to plasma |

# Movement of Fluids



**AQA & Edexcel A:** do not need to know about **the numbers**

## Exemplar Exam Question – Statement

4) Which of the following is true?

- a) Hydrostatic pressure remains constant through capillaries
- b) Hydrostatic pressure varies through capillaries
- c) Oncotic pressure varies through capillaries
- d) Oncotic pressure varies throughout the tissue fluid

**[1 mark]**

**Command**

**Direction**

**Context**

Tip: If you do not know the answer, eliminate any obviously incorrect answers and guess from those remaining.

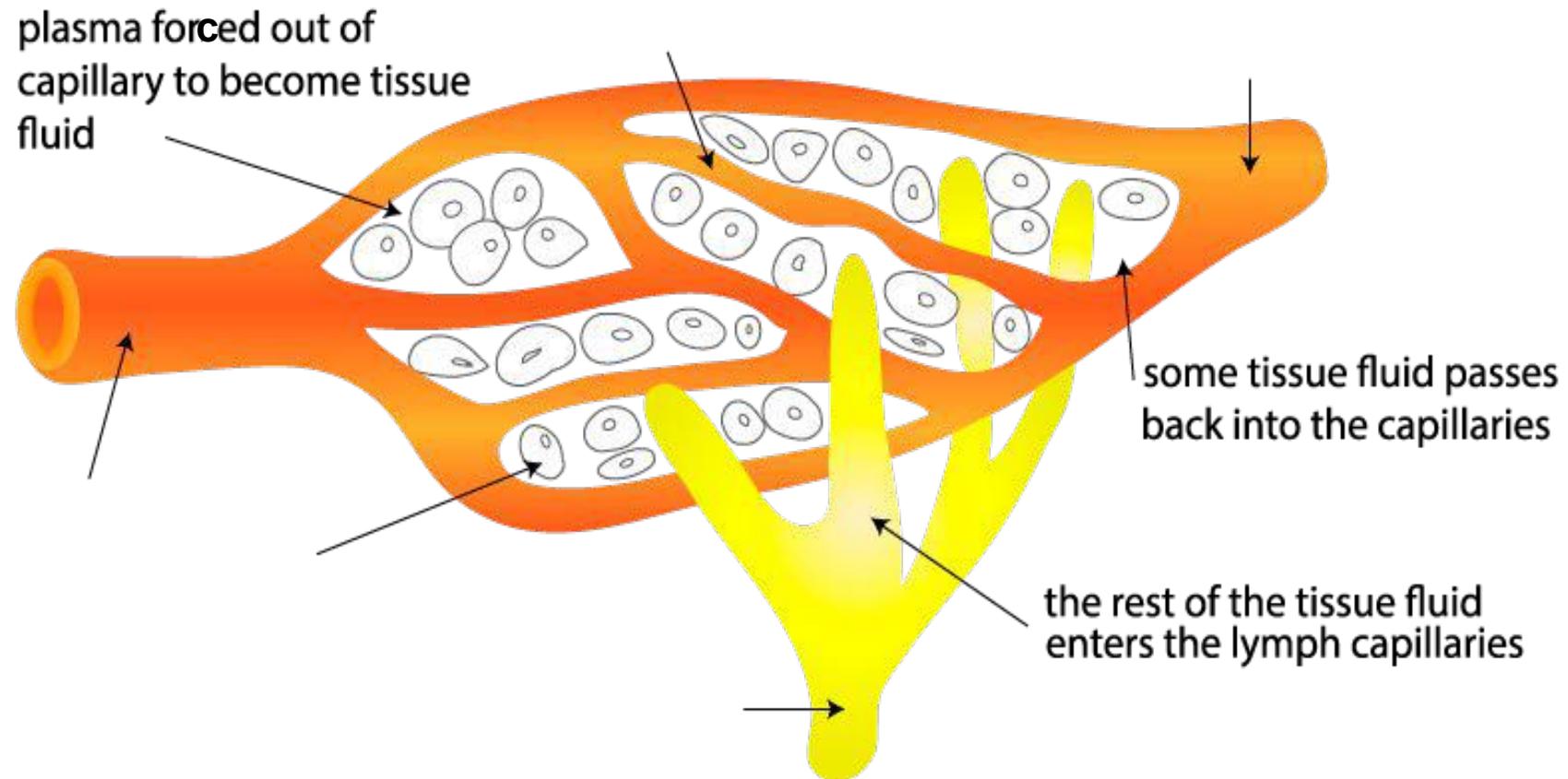
## Exemplar Exam Question – Statement

4) Which of the following is true?

- a) Hydrostatic pressure remains constant through capillaries
- b) Hydrostatic pressure varies through capillaries
- c) Oncotic pressure varies through capillaries
- d) Oncotic pressure varies throughout the tissue fluid

**[1 mark]**

# Exchange at a Capillary Bed



## Exemplar Exam Question – Simple Explanatory

5) Describe the movement of tissue fluid at the venous end of a capillary bed.

**[2 marks]**

**Command:** simple description of tissue fluid and how it may change

**Direction:** conditions different at arterial and venous ends?

**Context:** exchange at the capillaries

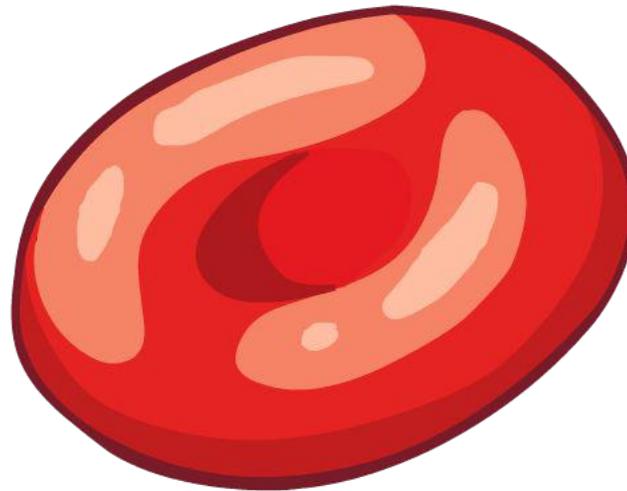
## Exemplar Exam Question – Simple Explanatory

5) Describe the movement of tissue fluid at the venous end of a capillary bed.

**[2 marks]**

Water from tissue fluid can drain into lymph capillaries and enter the lymphatic system, or oncotic pressure can pull the water from tissue fluid back into the capillaries as blood plasma.

# Oxygen Transport



**Edexcel A :** Do not need to know about **oxygen dissociation**

# Specification Points

## AQA

### 3.3.4.1 Mass transport in animals

| Content  | Opportunities for skills development  |
|--|---|
| <p>The haemoglobins are a group of chemically similar molecules found in many different organisms. Haemoglobin is a protein with a quaternary structure.</p> <p>The role of haemoglobin and red blood cells in the transport of oxygen. The loading, transport and unloading of oxygen in relation to the oxyhaemoglobin dissociation curve. The cooperative nature of oxygen binding to show that the change in shape of haemoglobin caused by binding of the first oxygens makes the binding of further oxygens easier. The effects of carbon dioxide concentration on the dissociation of oxyhaemoglobin (the Bohr effect).</p> <p>Many animals are adapted to their environment by possessing different types of haemoglobin with different oxygen transport properties.</p> <p>The general pattern of blood circulation in a mammal. Names are required only of the coronary arteries and of the blood vessels entering and leaving the heart, lungs and kidneys.</p> <p>The gross structure of the human heart. Pressure and volume changes and associated valve movements during the cardiac cycle that maintain a unidirectional flow of blood.</p> <p>The structure of arteries, arterioles and veins in relation to their function.</p> <p>The structure of capillaries and the importance of capillary beds as exchange surfaces. The formation of tissue fluid and its return to the circulatory system.</p> | <p><b>AT h</b></p> <p>Students could design and carry out an investigation into the effect of a named variable on human pulse rate or on the heart rate of an invertebrate, such as <i>Daphnia</i>.</p> <p><b>MS 2.2</b></p> <p>Students could be given values of cardiac output (CO) and one other measure, requiring them to change the subject of the equation:</p> $CO = \text{stroke volume} \times \text{heart rate}$ |

## OCR

### 3.1.2 Transport in animals

|     | Learning outcomes  | Additional guidance   |
|-----|--|---|
| (i) | the role of haemoglobin in transporting oxygen and carbon dioxide    | To include the reversible binding of oxygen molecules, carbonic anhydrase, haemoglobinic acid, $\text{HCO}_3^-$ and the chloride shift.<br><br>HSW8   |
| (j) | the oxygen dissociation curve for fetal and adult human haemoglobin. | To include the significance of the different affinities for oxygen<br><b>AND</b><br>the changes to the dissociation curve at different carbon dioxide concentrations (the Bohr effect).<br><br>M3.1<br>HSW2, HSW8 |

# Specification Points

## Edexcel A

### Topic 7: Run for your Life

#### Students should:

- 7.9 ii) Understand how variations in ventilation and cardiac output enable rapid delivery of oxygen to tissues and the removal of carbon dioxide from them, including how the heart rate and ventilation rate are controlled and the roles of the cardiovascular control centre and the ventilation centre in the medulla oblongata.

## Edexcel B

### Topic 4: Exchange and Transport

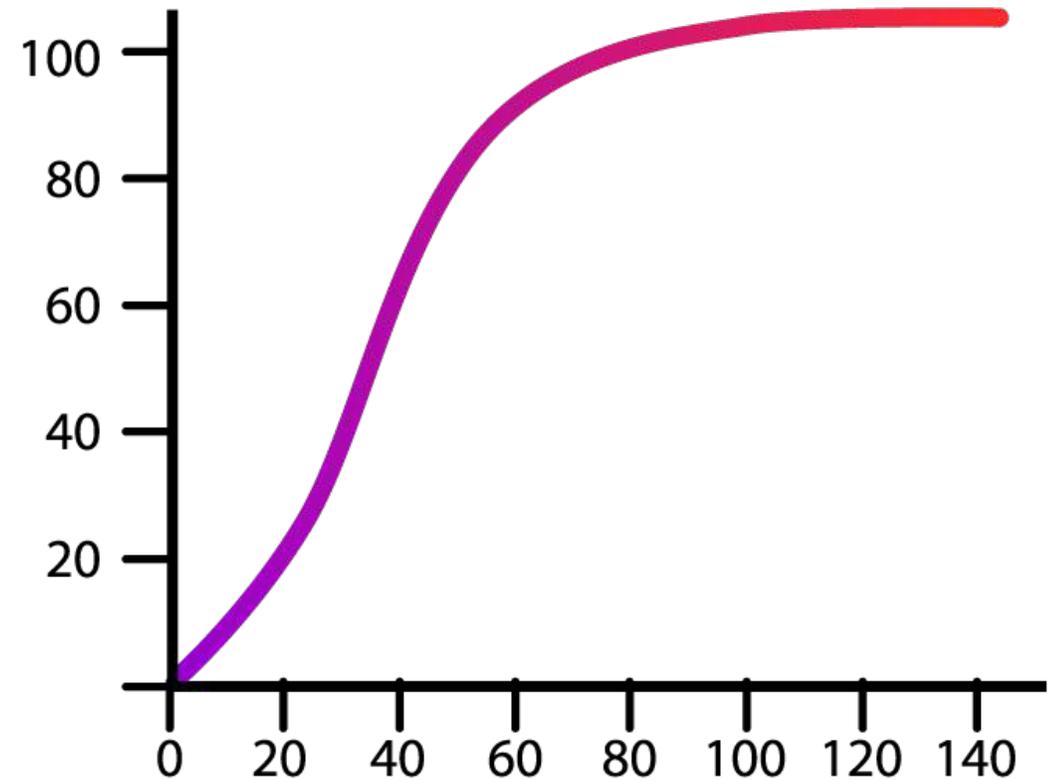
#### Students should:

#### 4.5 Transport of gases in the blood

- i Understand the structure of haemoglobin in relation to its role in the transport of respiratory gases, including the Bohr effect.
- ii Understand the oxygen dissociation curve of haemoglobin.
- iii Understand the similarities and differences between the structures and functions of haemoglobin and myoglobin.
- iv Understand the significance of the oxygen affinity of fetal haemoglobin as compared to adult haemoglobin.

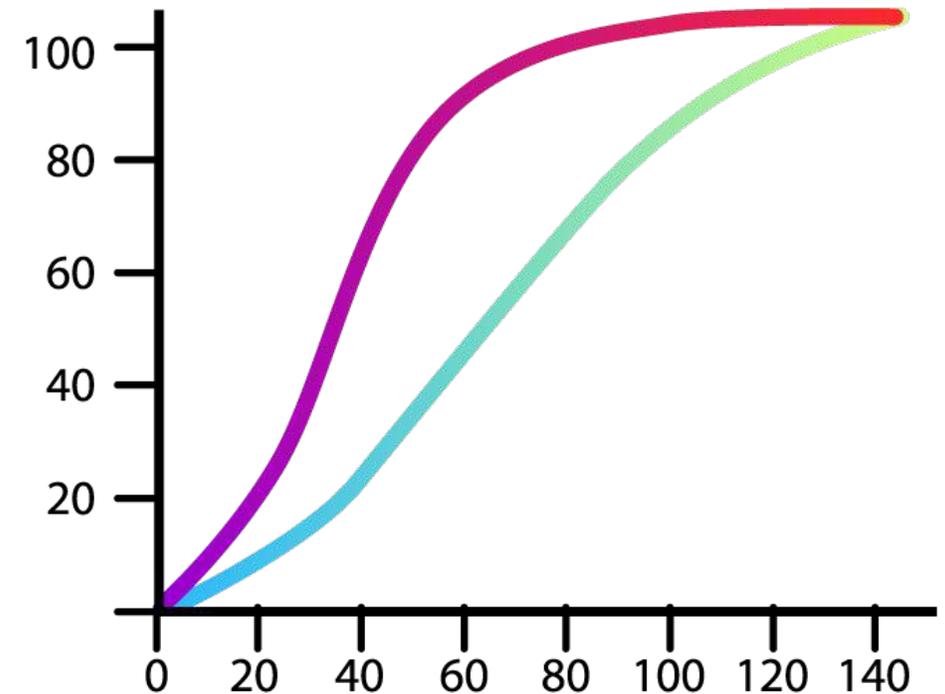
# Oxygen Dissociation Curve

- In the **lungs**, there is a **high partial pressure of oxygen** so **haemoglobin** has a **high affinity** for oxygen
- **Haemoglobin** therefore **binds** to **oxygen** in the **lungs: loading**
- In the **muscles**, there is a **low partial pressure of oxygen** so **haemoglobin** has a **low affinity** for oxygen
- **Haemoglobin** therefore **releases oxygen** in the **muscles: unloading**



# The Bohr Effect

- **CO<sub>2</sub>** produced by **respiring cells reacts** with **water** to form **carbonic acid**
- Carbonic acid **lowers pH** which **affects** the **structure of haemoglobin**, **reducing** its **affinity** for **oxygen** – the **Bohr effect**
- The **Bohr effect** causes the **oxygen dissociation curve** to **move** to the **right** – the **Bohr shift**
- This **shift** results in the **release** of **more oxygen** at **tissues** with **higher rates** of **respiration**



## Exemplar Exam Question – Explanation

6) Two samples of blood were drawn from a blood vessel near a muscle. The first was drawn before the individual exercised and the second was drawn immediately after exercise.

State which of the two samples you would expect to have a higher pH and explain why.

**[3 marks]**

**Command:** **State** and **explain** – give reasons for the answer you choose

**Context:** exercise and blood

**Direction:** link between exercise and blood pH (CO<sub>2</sub>)

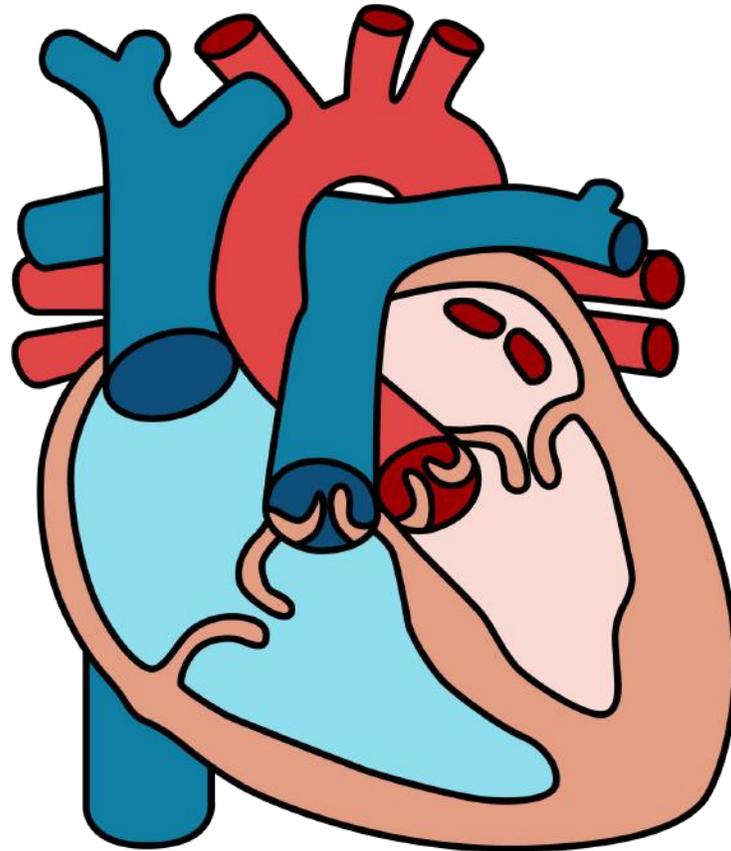
## Exemplar Exam Question – Explanation

6) State which of the two samples you would expect to have a higher pH and explain why.

**[3 marks]**

The sample of blood drawn before exercise will have a higher pH. This is because the muscle is respiring at a lower rate, which means CO<sub>2</sub> is also produced at a lower rate. Less CO<sub>2</sub> means less carbonic acid is released into the blood, meaning the pH will not be lowered as much compared to the blood sample after exercise.

# The Cardiac Cycle



# Specification Points

## AQA

### 3.3.4.1 Mass transport in animals

| Content  | Opportunities for skills development  |
|--|---|
| <p>The haemoglobins are a group of chemically similar molecules found in many different organisms. Haemoglobin is a protein with a quaternary structure.</p> <p>The role of haemoglobin and red blood cells in the transport of oxygen. The loading, transport and unloading of oxygen in relation to the oxyhaemoglobin dissociation curve. The cooperative nature of oxygen binding to show that the change in shape of haemoglobin caused by binding of the first oxygens makes the binding of further oxygens easier. The effects of carbon dioxide concentration on the dissociation of oxyhaemoglobin (the Bohr effect).</p> <p>Many animals are adapted to their environment by possessing different types of haemoglobin with different oxygen transport properties.</p> <p>The general pattern of blood circulation in a mammal. Names are required only of the coronary arteries and of the blood vessels entering and leaving the heart, lungs and kidneys.</p> <p>The gross structure of the human heart. Pressure and volume changes and associated valve movements during the cardiac cycle that maintain a unidirectional flow of blood.</p> <p>The structure of arteries, arterioles and veins in relation to their function.</p> <p>The structure of capillaries and the importance of capillary beds as exchange surfaces. The formation of tissue fluid and its return to the circulatory system.</p> | <p><b>AT h</b></p> <p>Students could design and carry out an investigation into the effect of a named variable on human pulse rate or on the heart rate of an invertebrate, such as <i>Daphnia</i>.</p> <p><b>MS 2.2</b></p> <p>Students could be given values of cardiac output (CO) and one other measure, requiring them to change the subject of the equation:</p> $CO = \text{stroke volume} \times \text{heart rate}$ |

## OCR

### 3.1.2 Transport in animals

| Learning outcomes     | Additional guidance  |
|-----------------------|--|
| (f) the cardiac cycle | <p>To include the role of the valves and the pressure changes occurring in the heart and associated vessels.</p> <p><i>cardiac output = heart rate × stroke volume</i></p> <p>HSW2, HSW5, HSW8</p> |

# Specification Points

## Edexcel A

### Topic 1: Lifestyle, Health and Risk

#### Students should:

- 1.4 i) Know the cardiac cycle (atrial systole, ventricular systole and cardiac diastole) and relate the structure and operation of the mammalian heart, including the major blood vessels, to its function.
- ii) Know how the relationship between heart structure and function can be investigated practically.

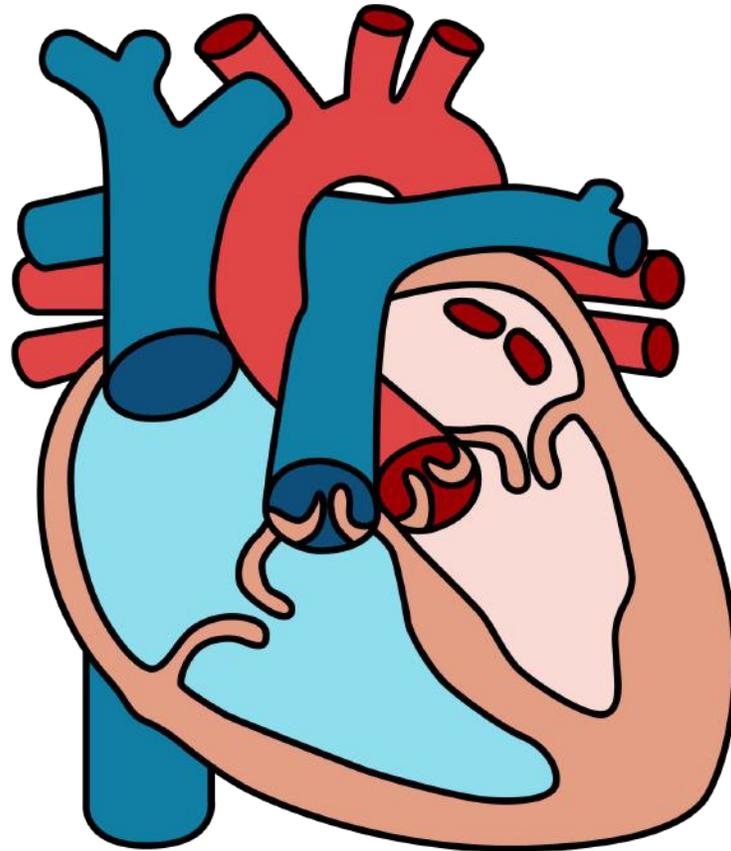
## Edexcel B

### Topic 4: Exchange and Transport

#### Students should:

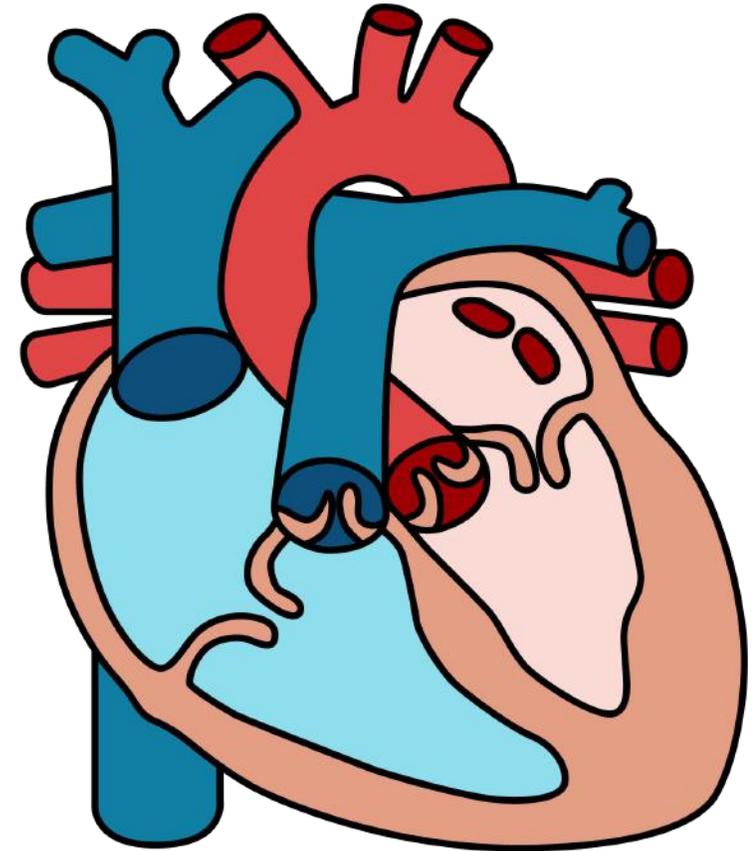
- 4.4 Circulation**
- iii Know the sequence of events of the cardiac cycle.
- v Be able to interpret data showing ECG traces and pressure changes during the cardiac cycle.

# Structure of the Heart



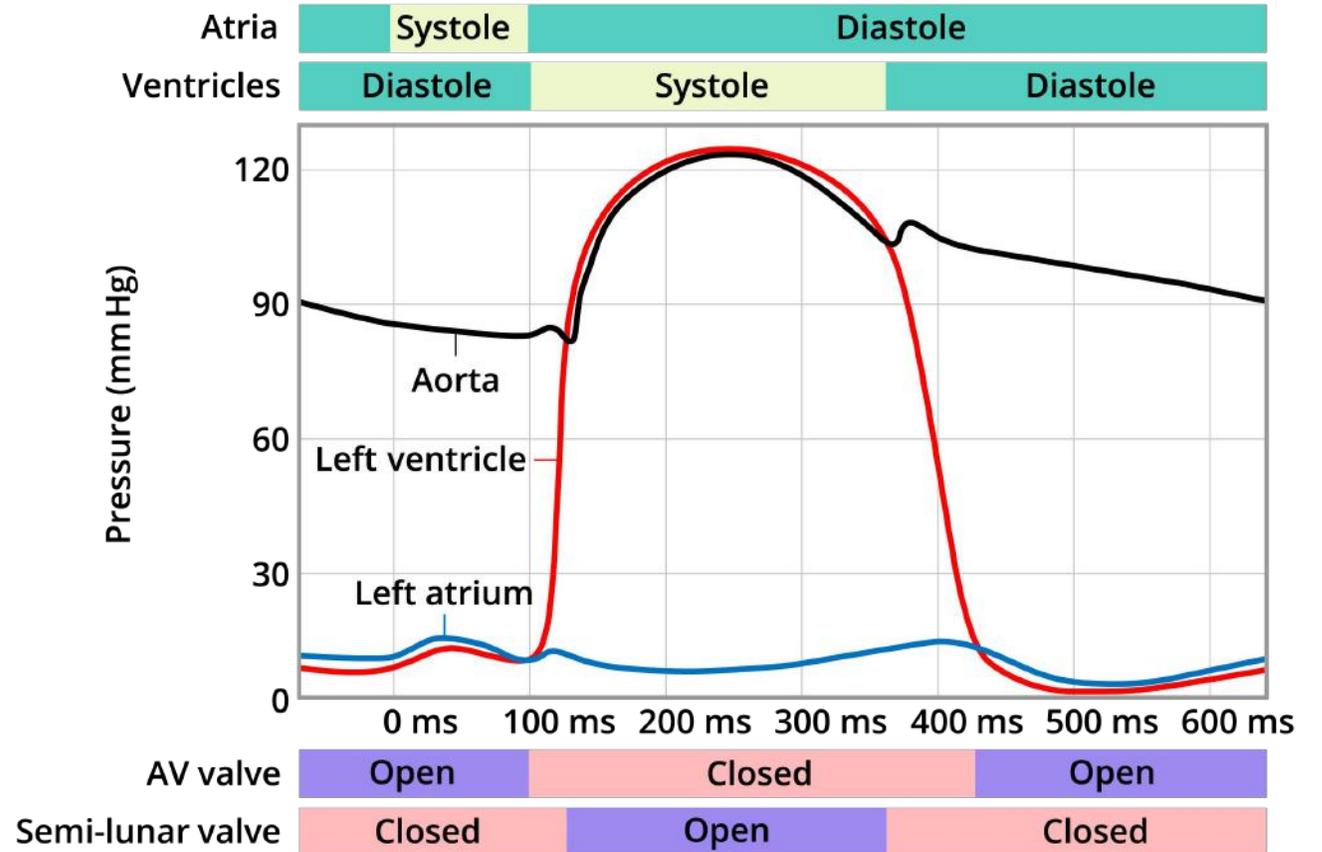
# The Cardiac Cycle

- The cardiac cycle contains three main stages: **Diastole**, **Atrial Systole** and **Ventricular Systole**
- In **diastole**, **both** atria and ventricles are **relaxed**
- In **atrial systole**, the **atria contract**, whilst the ventricles are relaxed
- In **ventricular systole**, **ventricles contract** whilst the atria relax



# Pressure in the Heart

- The pressure within the heart **varies** during the **cardiac cycle** and between **different regions**
- Pressure changes in the heart cause the **opening** and **closing** of the **semi-lunar** and **atrioventricular valves**
- The **ventricles** experience much **greater pressure variations** than the **aorta** and **atria**



## Exemplar Exam Question – Data Analysis

7) Table 1 shows pressure recorded in different parts of the heart at one stage of the cardiac cycle

i) Using your knowledge of the cardiac cycle, state which stage of the cardiac cycle Table 1 shows and explain why.

**[2 marks]**

|                | Pressure (mm Hg) |
|----------------|------------------|
| Aorta          | 123              |
| Left Ventricle | 127              |
| Left Atria     | 11               |

Table 1.

**Command:** analyse the table, write stage and give reasons

**Direction:** pressure changes in the heart

**Context:** cardiac cycle

## Exemplar Exam Question – Data Analysis

7) Table 1 shows pressure recorded in different parts of the heart at one stage of the cardiac cycle

i) Using your knowledge of the cardiac cycle, state which stage of the cardiac cycle Table 1 shows and explain why.

**[2 marks]**

|                | Pressure (mm Hg) |
|----------------|------------------|
| Aorta          | 123              |
| Left Ventricle | 127              |
| Left Atria     | 11               |

Table 1.

Ventricular systole because the pressure in the left ventricle is higher than in the aorta so blood must be flowing from the ventricle into the aorta, which only occurs during contraction of the ventricles in ventricular systole

## Exemplar Exam Question – Data Analysis

8) Table 1 shows pressure recorded in different parts of the heart at one stage of the cardiac cycle

ii) At this stage, tick **all** correct boxes

- Atrioventricular valve open
- Atrioventricular valve closed
- Semi-lunar valve open
- Semi-lunar valve closed

**Command:** Tick boxes

**Direction:** More than one correct box

|                | Pressure (mm Hg) |
|----------------|------------------|
| Aorta          | 129              |
| Left Ventricle | 128              |
| Left Atria     | 11               |

Table 1.

**Context:** pressure changes in the cardiac cycle **[2 marks]**

## Exemplar Exam Question – Data Analysis

8) Table 1 shows pressure recorded in different parts of the heart at one stage of the cardiac cycle

ii) At this stage, tick **all** correct boxes

- Atrioventricular valve open
- Atrioventricular valve closed
- Semi-lunar valve open
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|                | Pressure (mm Hg) |
|----------------|------------------|
| Aorta          | 129              |
| Left Ventricle | 128              |
| Left Atria     | 11               |

Table 1.

**[2 marks]**

# Mini Mock Paper



## Mini Mock Paper

a) Describe the exchange of oxygen between the capillaries and tissue fluid.

**[2 marks]**

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## Mini Mock Paper

b) What type of circulatory systems do mammals have?

**[1 mark]**

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## Mini Mock Paper

c) Explain the significance of the Bohr Effect in the delivery of oxygen by haemoglobin.

**[3 marks]**

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# Mini Mock Paper Answers



## Mini Mock Paper

a) Describe the exchange of oxygen between the capillaries and tissue fluid.

**[2 marks]**

Some of the oxygen dissolved in the bloodstream is forced out along with the fluid due to hydrostatic pressure. The rest of the oxygen dissolved in the blood diffuses into tissue fluid down a concentration gradient. The steep concentration gradient is maintained as oxygen is used by respiring cells.

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## Mini Mock Paper

b) What type of circulatory systems do mammals have?

**[1 mark]**

A double, closed circulatory system

## Mini Mock Paper

c) Explain the significance of the Bohr Effect in the delivery of oxygen by haemoglobin.

**[3 marks]**

The Bohr Effect reduces the affinity of haemoglobin for oxygen in the presence of dissolved carbon dioxide/carbonic acid due to a lower pH. This shifts the curve to the right. This means that haemoglobin releases more oxygen at tissues with higher levels of carbon dioxide, which are tissues with high respiratory rates. This allows more oxygen for respiration to be supplied to these tissues.