

**Name:**

3.2 Organisation and the Vascular Structures	Learning Outcomes
3.2.2 Organisational complexity of the human - Human Circulatory & Lymphatic Systems	<ol style="list-style-type: none"> <li>1. Understand what is meant by the term Closed Circulation System in humans</li> <li>2. Describe the structure and organisation of the human Closed Circulation System, i.e. strong muscular heart, arteries, arterioles, capillaries, venules, veins</li> <li>3. Identify the two circuits in the human system circulation system (1) pulmonary Circuit, (2) Systemic Circuit</li> <li>4. <b>Draw</b> and label the structure of the heart</li> <li>5. Mark the pathway of blood in a diagram of the heart and through the systemic and pulmonary circuits</li> <li>6. Explain the term Portal System and identify the Hepatic Portal Vein in a diagram</li> <li>7. Explain the role of muscles and valves in the heart and blood vessels</li> <li>8. Explain how the heart supplies blood to the heart wall through the Coronary arteries and Cardiac veins</li> <li>9. Understand and explain Pulse</li> <li>10. Understand and explain Blood Pressure</li> <li>11. Explain the effect of exercise on the circulation system</li> <li>12. Explain the effect of salt, fat and being overweight on the circulation system</li> <li>13. Give a simple explanation of the heart beat and how it is controlled (more detail in sec 3.2.4)</li> <li>14. Describe the structure of the Lymphatic System and describe three functions of the system</li> <li>15. State the four main parts in blood and give the function of each part (more detail for HL in sec 3.2.3)</li> <li>16. Name the four common blood groups and name the two rhesus blood types</li> </ol>
3.2.3.H Blood Cells extended study	<ol style="list-style-type: none"> <li>1. Describe the structure of red blood cells in detail</li> <li>2. Describe the structure of white blood cells</li> <li>3. Classification of white blood cells as Lymphocytes or monocytes</li> </ol>
3.2.4.H Heartbeat control	<ol style="list-style-type: none"> <li>1. Know the location of the Pacemaker (SA Node) ( sinoatrial node)</li> <li>2. Know the location of the Pacemaker (AV Node) ( atrioventricular node)</li> <li>3. Understand that the heart has specialised Cardiac Muscle</li> <li>4. Explain the stages in the cardiac Cycle</li> <li>5. Understand the terms Systole and Diastole</li> <li>6. Explain how the AV and SA nodes function in relation to the heart cycle</li> </ol>

### **Mandatory Experiments**

*Dissect and display and identify the dissected parts in a Sheep or Ox heart*

*Investigate the effect of exercise on pulse rate (or breathing rate)*

## NEED FOR A CIRCULATORY SYSTEM

**Internal transport** in small animals is by diffusion and active transport e.g. amoeba, jellyfish and flatworms whereas bigger and more complex animals e.g. humans need a vascular system.

**Open circulatory system – blood leaves the blood vessels.** Blood is pumped into open-ended vessels. The blood then passes into the body cavity where it bathes the cells. Later it goes back to the heart and enters via ostia e.g. insects, spiders, crabs, snails.

**Closed circulatory system** – blood is always enclosed in blood vessels. Tissue fluid bathes the cells and acts as a medium through which substances are exchanged between the blood and the cells e.g. earthworms and vertebrates. The closed circulatory systems are more efficient than open ones because:

- The blood can be pumped around the body faster and therefore exchange of food and oxygen is faster. This allows the animal to be more active.
- It allows the flow of blood to different organs to be increased or decreased.

## Human Circulatory System

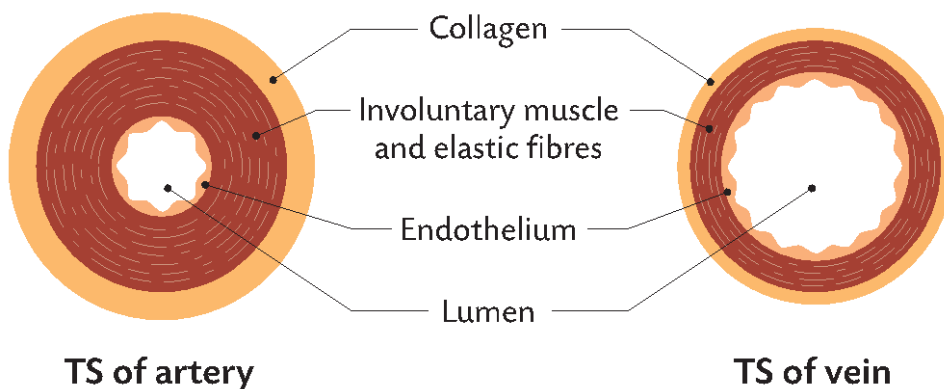
Double, closed circulatory system. Blood passes through heart twice for every complete circuit of body ('figure of eight'). A **pulmonary system** carries blood to the lungs where it becomes oxygenated and carries it back to the heart. The **systemic system** carries this oxygenated blood to the body and brings deoxygenated blood back to the heart. Advantages of this double system over a single one are (i) it separates the oxygenated from deoxygenated blood and (ii) it ensures that the blood pressure is high enough to reach all parts of the body (iii) allows a rapid and efficient delivery of nutrients.

A single-circulation system can only produce low blood pressure around most of the body. This restricts the activities of the animal e.g. earthworm and fish.

### Diagram - Circulatory system in humans

## BLOOD VESSELS

### Diagrams of arteries, veins and capillaries



**Differences:**

	<b>Artery</b>	<b>Vein</b>	<b>Capillary</b>
<b>Lumen</b>	Small	Large	Tiny
<b>Wall</b>	Thick wall –outer layer of collagen(connective tissue) and inner layer of smooth muscle and elastic fibres.	Thin wall	1 cell thick (endothelium allows exchange* of materials between blood and cells)
<b>Valves</b>	None (as blood under pressure)	Present (prevent backflow)	None
<b>Direction of blood flow</b>	Transport blood <b>away</b> from heart.	Transport blood <b>to</b> heart.	Link arteries to veins
	Carries oxygenated blood (except pulmonary artery)	Carries deoxygenated blood (except pulmonary vein)	Oxygenated and deoxygenated.
<b>Blood flow</b>	Rapid flow under high pressure.	Slow flow under low pressure – assisted by squeezing action of nearby arteries and muscles.	Slow, pressure falling (allows time for exchange of substances to occur)
Pulse	Blood flows in pulses.	Blood flows at a steady rate.	No pulse.

**\*Exchange of materials facilitated by:**

1. Thin walls (rapid entry/exit of materials)
2. Large surface area/branching – in close contact with all body cells.
3. Narrow tubes – pressure increases, causing leakage of plasma.

**Blood flow in arteries is helped by:**

1. A thick muscle layer – this contracts and pushes blood on
2. Elastic fibres – can expand and recoil to push blood on. Collagen layer prevents over-expansion.

**Relationship between blood vessels:**

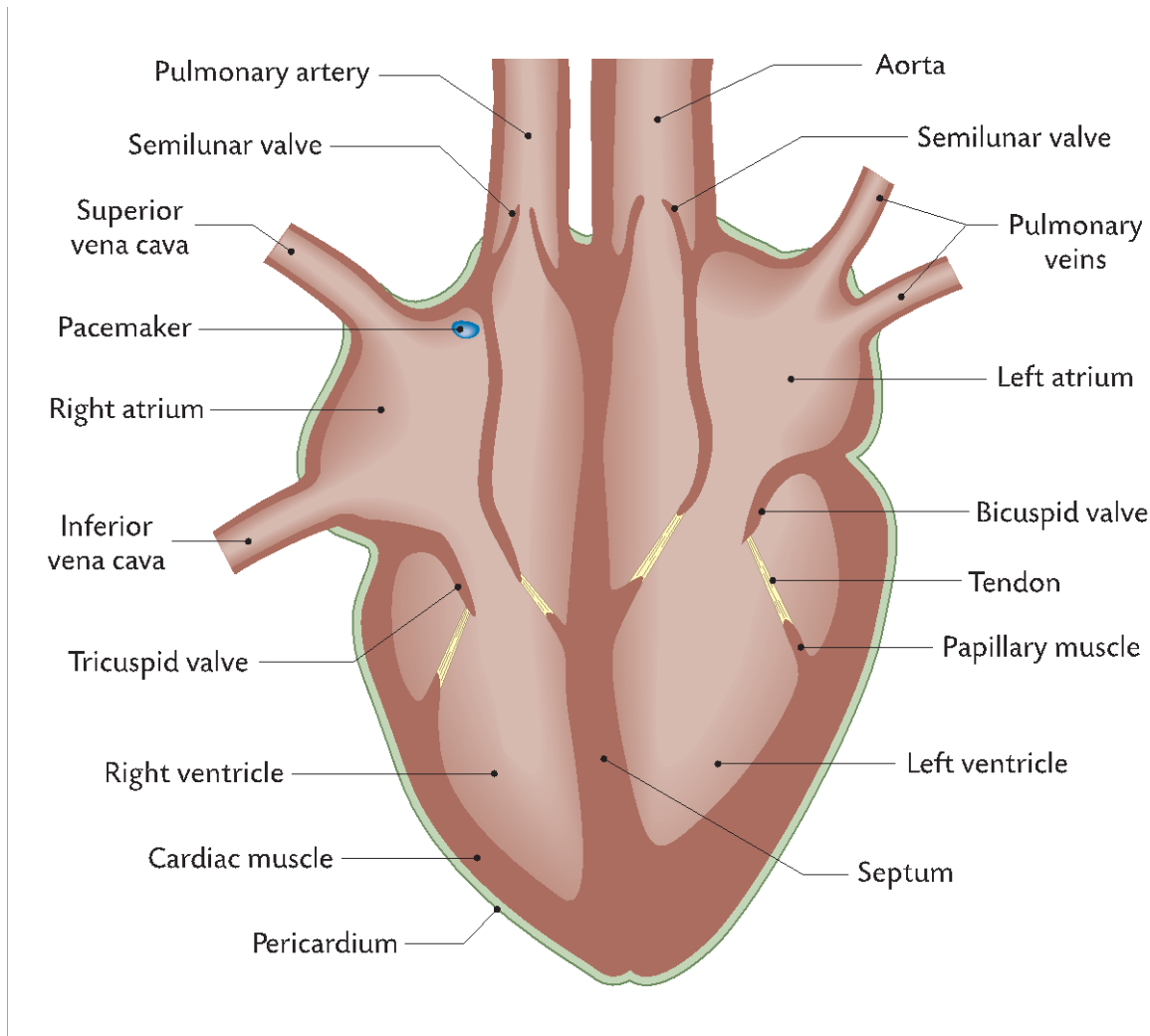
Artery – arteriole – capillary – venule – vein

**Heart**

The heart is located in the thoracic cavity - between the lungs, slightly to the left, above the diaphragm and behind the sternum. It is surrounded by the pericardium. This double membrane is filled with fluid, which allows friction-free movement when the heart is beating.

**Diagram - Internal structure of heart:**

(and blood flow)



Atrial walls are thinner than those of the ventricles because they only have to pump blood down into the ventricles. The left ventricle is much thicker than the right ventricle because it pumps blood to the entire body.

Valves are held in place by tendons ('heart strings'), which are attached to the ventricle wall by projections called papillary muscles. Valves prevent backflow of blood.

Septum divides heart right and left. It separates oxygenated and deoxygenated blood.

Cardiac muscle has its own **coronary arteries and veins**. Coronary arteries branch from aorta and coronary veins return blood to right atrium via vena cava. Coronary arteries carry oxygen and food to the heart muscle.

A **portal system** is a blood supply that flows from one organ directly to another organ without passing through the heart e.g. hepatic portal vein brings blood (rich in digested food but lacking in oxygen) from the intestine directly to the liver. Portal systems begin and end with capillaries.

Diagram

**Pulse:**

A pulse is caused by the expansion and contraction of an artery as blood is forced through it. When the left ventricle contracts, the pressure of the blood forced into the aorta causes the aorta to expand. Feel pulse easily in neck or wrist.

Average adult pulse (heart) rate = 72 beats per min. Range: 60-100.

Varicose veins can occur when valves are not working properly allowing the blood to pool. Most often seen in older people – can be painful and can become infected.

**Blood pressure** is the force exerted by the blood on the walls of the arteries due to the contracting of the heart. It depends on the volume of blood within the system and the space available within the blood vessels

Blood pressure is measured in an artery of the upper arm using a sphygmomanometer. An inflatable cuff is used to measure the pressure required to stop the blood flow at this point. Two pressures are measured: systolic and diastolic pressures of the ventricles (120/80 mm Hg – for a healthy adult). These values normally rise with age. If the lower of the two is above 95 the person is suffering from high blood pressure (hypertension). High blood pressure is often caused by blockages in arterioles or small arteries.

**Atherosclerosis** – hardening/narrowing of blood vessels. This is caused by excess cholesterol forming fatty deposits under the inner lining of an artery. An atheroma (raised lump of fatty deposits) in the artery will raise a patient's blood pressure and soon lead to the development of a blood clot (embolus). This clot will block the artery completely or break away and block some other smaller blood vessel. This is called thrombosis. This could lead to a **stroke**, if the blood supply to the brain is impaired.

Blockage in one of the coronary arteries may cause pain (angina). This may lead to a **heart attack**.

### Effects of exercise, diet and smoking on the circulatory system.

#### 1. Exercise

Exercise strengthens the heart and improves blood circulation. Aerobic exercises (high oxygen intake over a long period of time) are most beneficial e.g. walking, running, swimming, cycling. Exercise helps to lower blood pressure.

#### 2. Diet

- Large amounts of saturated (animal) **fat** raises cholesterol levels and increases risk of heart disease.
- High **salt** intake raises blood pressure. High salt levels mean more water is taken in, increasing blood volume causing blood pressure to rise. Patients with high blood pressure are often given diuretics to decrease blood volume and therefore blood pressure.
- **Obesity** causes high blood pressure and heart attacks.

#### 3. Smoking

- **Nicotine** stimulates adrenalin which increases heart rate and blood pressure thus increasing the workload of the heart. This may result in arrhythmia (extra heartbeats).
- **Carbon monoxide** destroys the oxygen-carrying ability of red blood corpuscles. This results in lower energy production by the body.
- Other chemicals in tobacco increase the likelihood of blood clots in blood vessels.

### Treatments for heart disease:

- No smoking and exercise more
- Eat fewer animal fats
- Coronary bypass surgery – coronary vessels are bypassed with blood vessels taken from leg.

### **CARDIAC CYCLE –**

The sequence of events which take place during the completion of one heartbeat.

Contraction of the heart is known as **systole** and relaxation of the heart (when the heart is filling with blood) is called **diastole**.

#### **1. Blood enters the heart.**

The atria and ventricles are both relaxed (diastole). Blood enters the atria. All valves are closed.

#### **2. Blood is pumped from atria to ventricles.**

Electrical impulses from the pacemaker (SA node) cause the atria to contract (atrial systole). This pumps blood to the ventricles. The tricuspid and bicuspid valves open. The venae cavae and pulmonary veins close to stop blood entering the atria. The semi-lunar valves remain closed.

#### **3. Blood leaves the heart.**

The atria relax and impulses from the AV node cause the ventricles to contract (ventricular systole). This forces blood out of the heart into the pulmonary artery and the aorta.

The pressure forces open the semilunar valves and closes the cuspid valves (making the 'lub' sound).

The ventricles now relax again. Closing of the semi-lunar valves prevents blood flowing back into the ventricles. This closure causes the 'dub' sound. The cycle now repeats itself – about 70 times per minute for an adult at rest.

Heart sounds are due to the closing of the valves – “lub dub” phonetically.

'lub' = low-pitched, quieter, long-lasting sound. 'hub' = higher-pitched, louder, shorter sound.

A heart murmur is any abnormal sound associated with the heart. It may indicate damage to one or more of the valves.

### **Control of heartbeat.**

- Contraction of the heart is preceded by a wave of electrical excitation. It is triggered off by a special node of heart muscle: the sino-atrial node or **pacemaker**, located in the right atrium.
- When impulses through the nerves stimulate the pacemaker a wave of contraction spreads over the two atria.

When the wave reaches the junction between the atria and ventricle, it excites **AVN**. The AV node then sends the electrical impulses down the septum. The impulse is passed out to the walls of the ventricles by thin fibres. The impulses from these fibres cause the ventricles to contract.

If electrodes are placed on the heart they can measure the electrical activity of the heart. A record of this activity is called an ECG (electrocardiogram).

While heartbeat is usually controlled by the pacemaker, it can be altered by nervous stimulation from the brain or by hormones.

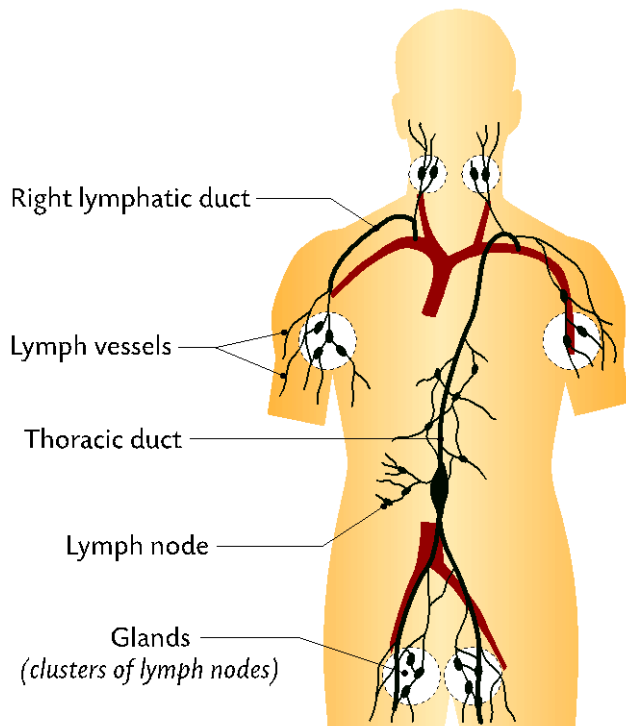
Patients with heartbeat irregularities use artificial battery-powered pacemakers to regulate the heart beat.

Factors that increase the rate of heartbeat include exercise, temperature, emotions and shock. Factors that decrease it are relaxation, sleep and alcohol.

## Lymphatic system

A secondary transport system that returns excess tissue fluid to the blood circulatory system. Consists of lymph, lymph vessels, lymph nodes, spleen, tonsils, adenoids, lacteals and thymus.

### Diagram of lymphatic system



**Tissue fluid** - liquid that is forced out of the capillary arterioles (due to high blood pressure). Contains no RBC and no plasma proteins.

**Lymph** = a clear, tissue fluid with lymphocytes, protein and lipids.

The cells take up the nutrients and oxygen from and excrete their waste (carbon dioxide, urea) into the tissue fluid. Most of the tissue (intercellular) fluid reenters the capillaries (venules) by osmosis. Approx. 1-2% is returned in separate vessels called lymphatics .

Valves ensure that the lymph flows in one direction only. Muscles squeeze the lymph through the tubes. The lymph capillaries, which unite to form two main vessels, right lymphatic duct (which drains upper right side of body) and the thoracic duct (which drains rest of body and returns the fluid to the blood in the subclavian veins).

**Lymph nodes** are swellings, found especially in groin and armpits.

### Functions of lymphatic system:

#### 1. Drainage

To **collect excess tissue fluid** from intercellular spaces and return it to the blood (keeping the volume of the blood constant).

#### 2. Defend against infection

- Filters out germs and then phagocytes engulf and destroy them.
- Stores **lymphocytes**, which produce antibodies.

#### 3. Transport

To absorb and transport **fatty acids and glycerol** via lacteals from the small intestine to skin or other organs for storage.

To transport hormones from endocrine glands into bloodstream.

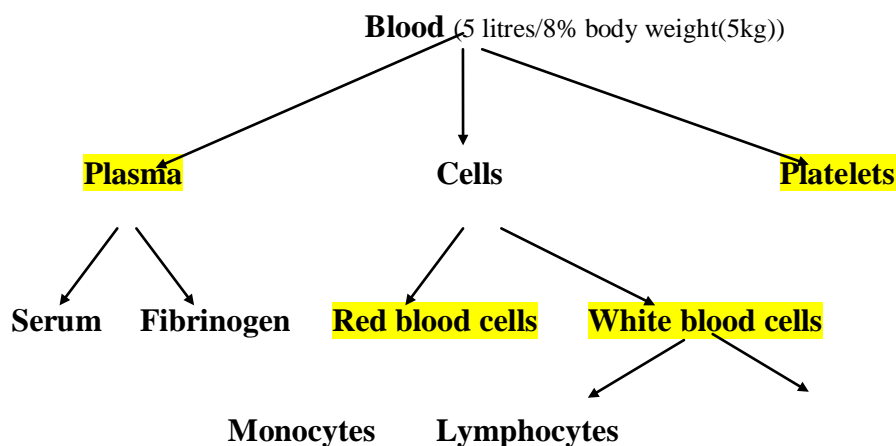
4. To help hearing and balance by carrying vibrations in the inner ear.

Lymphatic system	Blood system
Open circulatory system	Closed c.s.
No pump	Heart
No RBCs and proteins	Has both
Colourless fluid	Red
Nodes	None

**Oedema** is the swelling of the body (usually lower legs and feet) due to too much tissue fluid. It may be due to a failing circulation system or an unusual blood composition (too much water and salt or too little protein) due to a kidney complaint.

**Elephantiasis** is due to eggs from a parasitic roundworm getting in by mosquito bites. The young worms grow and block the lymph vessels giving an elephantiasis appearance of limbs. Treatment is by removal of worm, drainage of fluid and surgical repair of damaged vessels if necessary.

#### Composition of blood tissue:



#### Diagram of centrifuged blood

**PLASMA** is a straw-yellow liquid, pH of about 7.4, containing:  
90 % water, 10% dissolved substances

- proteins e.g. antibodies, hormones, fibrinogen
- nutrients e.g. amino acids, glucose, vitamins and minerals
- gases e.g. oxygen and carbon dioxide
- wastes e.g. urea.

#### Function:

- (a) **Transport** medium for **blood cells** and **dissolved substances**.
- (b) **Transport heat** from organs such as liver. Helps to maintain a constant body temperature

**Serum** is plasma minus fibrinogen. It is sometimes used in injections to give someone resistance to disease (contains antibodies).

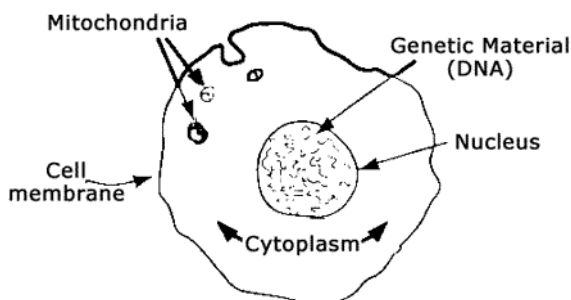


### **RED BLOOD CELLS** – aka erythrocytes (5 million per $\text{mm}^3$ )

Biconcave discs, 7-8 $\mu\text{m}$  in diameter, elastic membrane. Contain haemoglobin (red pigment made from protein), no mitochondria (can  $\therefore$  transport oxygen). Life span = about 4 months (no nuclei). Made in red bone marrow of e.g. ribs, vertebrae, femur.

Dead red blood cells are broken down in the liver. The iron is stored in liver and recycled to make haemoglobin and the pigments bilirubin & biliverdin form bile.

#### Diagram of a red blood cell



#### **Function:**

**Transport of oxygen** (haemoglobin + oxygen = oxyhaemoglobin).

**Anaemia** results from a lack of haemoglobin (or RBCs). The person lacks energy and can look pale. Causes are menstruation and lack of iron in diet. Iron-rich foods = red meat, liver, kidneys, chicken, eggs, sardines, nuts, prunes, apricots, bananas and green veg.

### **WHITE BLOOD CELLS** aka leucocytes $\approx 8000/\text{mm}^3$

Larger flattened discs, have no definite shape. Made in red bone marrow.

**Function:** defence against disease.

Two types are:

- **Monocytes** - comprise 5% WBC. Size 15-20 $\mu\text{m}$ . Nucleus (kidney-shaped). Life span: 6-9 days.

**Function:** They engulf foreign matter by phagocytosis. Some, called macrophages, can leave blood vessels and engulf damaged/dead cells as well as antigens in the tissues.

#### Diagram of monocyte

- **Lymphocytes** – comprise 25% of WBC. Size 8-10 $\mu\text{m}$ . Large, round nucleus. Some mature and all are stored in the lymphatic system. Life span: 3 months – 10 years.

**Function:** Produce **antibodies** to fight disease. This inactivates and immobilises the pathogen.

#### Diagram of lymphocyte

### **Leukaemia**

Is a form of cancer in which white blood cells are produced too rapidly and are immature. Cause is unknown but often linked to radiation exposure. They crowd out other blood cells and may cause

anaemia, increased risk of infection and reduced ability to clot blood. Treatment is by drugs and radiation.

**PLATELETS** – aka thrombocytes  $\approx 300,000/\text{mm}^3$   $2\mu\text{m}$

Tiny fragments of cells. No definite shape and no nuclei. Made in bone marrow. Live for about a week.

**Function:**

Blood clotting (prevents blood loss and entry of pathogens)

**Deep vein thrombosis (DVT)** – blood clot deep in vein, usually in leg. Can lead to pulmonary embolism which can be life threatening.

	Red blood cells	White blood cells	Platelets
<b>Shape</b>			
<b>Size</b>			
<b>Nucleus</b>			
<b>Frequency</b>			
<b>Function</b>			
<b>Site of production</b>			

**Blood clotting:**

When a blood vessel is cut:

1. The vessel narrows to reduce blood flow.
2. Platelets stick to the damaged cells to form a temporary clot.
3. A permanent clot is made when fibrin forms a mesh of strands at the site of the damaged cells. Blood cells are trapped in the mesh and later it hardens as a scab.

Blood clotting prevents further loss of blood and the entry of pathogenic micro-organisms.

In **haemophilia**, the platelets cannot make one of the clotting chemicals (usually factor VII) and so their blood will not clot easily if they cut themselves. They get regular injections of factor VII. Also their blood vessels are inclined to leak or burst under skin, leading to painful swelling, particularly in joints.

**Thrombosis** – a blood clot forms inside a blood vessel and may block it e.g. stroke or heart attack.

**BLOOD GROUPS - ABO system:**

Two antigens, A and B, can be present on the surface of red blood cells.

Blood group	O	A	B	AB
<b>Antigens</b>	Neither	A	B	A and B
<b>Antibodies (in plasma)</b>	A and B	B	A	neither
<b>Occurrence (Ireland)</b>	55%	31%	11%	3%

The immune system will not produce antibodies against its own antigens but will produce antibodies against the other antigens. When blood transfusions are given it is important that the recipient's blood matches that of the donor. If bloods are not the same clumping of donor's RBCs occurs. This may block a blood vessel with fatal consequences. In addition, haemoglobin leaks from the agglutinated cells and may eventually cause kidney failure.

**Universal donor** = Blood group O (no antigens). Can be given to all other groups.

**Universal recipient** = Blood group AB (no antibodies)

### Rhesus factor:

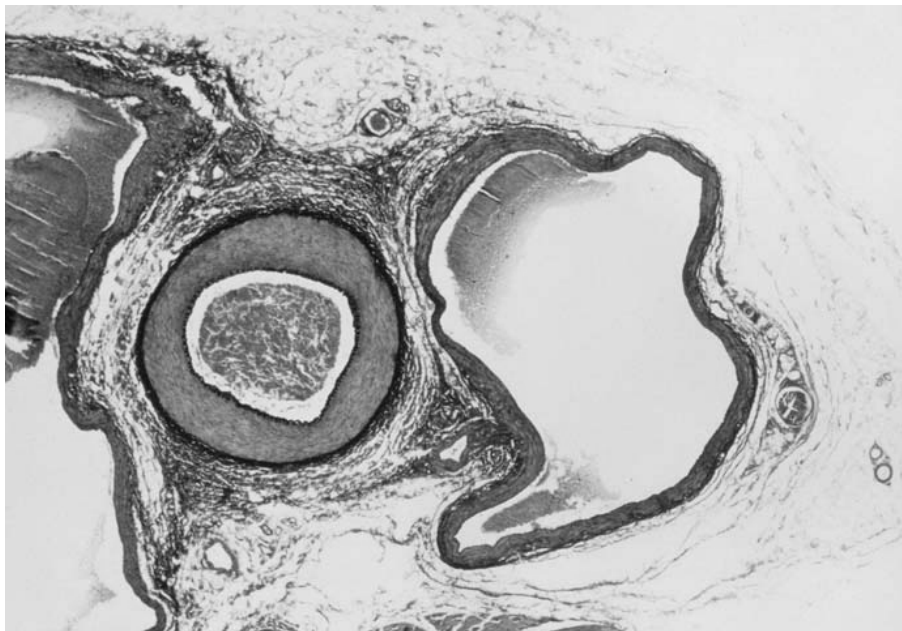
Rhesus<sup>+</sup> or Rhesus<sup>-</sup>

Grouping is determined by the presence or absence of a rhesus protein (first discovered in rhesus monkeys and then in humans). In Ireland about 85 % are rhesus positive and 15% rhesus negative. Important in prenatal life. If the mother is Rh<sup>-</sup> and the unborn child is Rh<sup>+</sup> then some of the baby's RBCs with D antigens may cross into the mother's bloodstream at the end of pregnancy (placenta becomes 'leaky'). The mother will recognise these rhesus antigens as 'foreign' and produce antibodies against them. Usually there is no danger to the baby during the first pregnancy, though the mother is now sensitised to rhesus antigen. These antibodies will destroy the baby's red blood cells in subsequent Rh<sup>+</sup> babies because antibodies pass into baby. This may cause the baby to be anaemic, brain damaged or stillborn. To prevent this happening the mother may be injected with Rh antibodies immediately after birth of first child. These will destroy the baby's RBC before they cause a natural build-up of anti Rh antibodies in her blood.

## Circulatory System

### SEC Sample Paper HL

3. The diagram shows a section of human tissue containing an artery and a vein.



[BIOPHOTO ASSOCIATES/SCIENCE PHOTO LIBRARY LTD.]

Identify the artery by writing A on it and the vein by writing B on it.

State two features of the artery that can be seen in the diagram which allowed you to identify it.

- 1 .....  
2 .....

Name two tissues that are present in the walls of arteries and veins and give a function of each of these tissues.

Tissue ..... Function .....

Tissue ..... Function .....

Veins contain valves whereas arteries do not. What is the function of the valves?

.....

### 2005 HL

3. Indicate whether the following are true (T) or false (F) by drawing a circle around T or F.

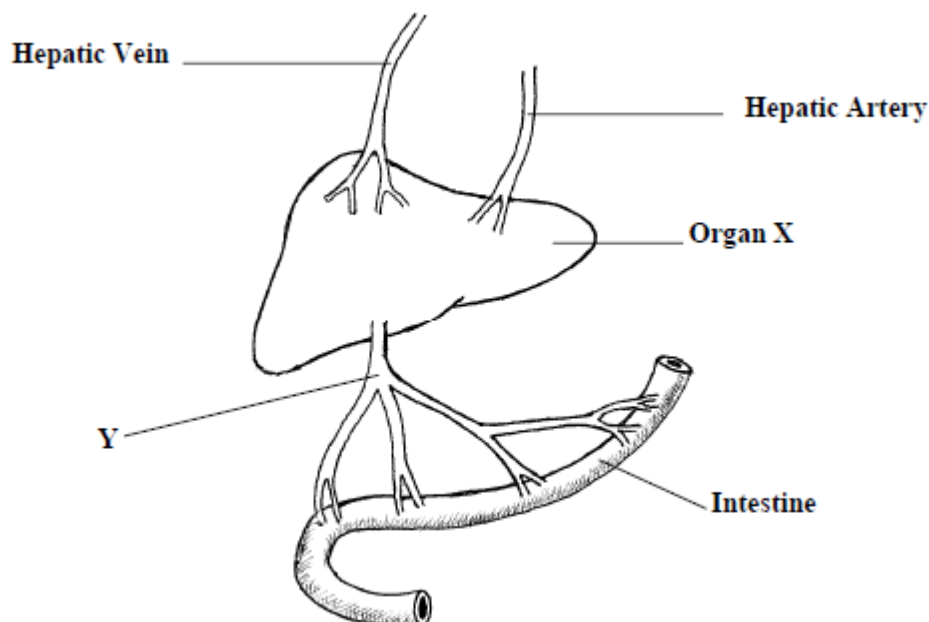
(e) The sino-atrial node (pacemaker) is located on the right side of the heart. T F

(f) A nucleus is absent from human red blood cells.

T F

**2006 HL**

5. Study the diagram and then answer the following questions.



(a) Name X and Y

X ..... Y .....

(b) Place arrows on Y, the hepatic artery and the hepatic vein to indicate the direction of blood flow.

(c) State the precise location of organ X in the human body .....

## Section B

**2004 HL**

9.(a)(i) Cardiac muscle may be described as a contractile tissue. Explain the meaning of the underlined term.

(ii) Which chamber of the heart has the greatest amount of muscle in its wall?

(b) Describe how you dissected a mammalian heart in order to investigate the internal structure of atria and ventricles.

Draw a labelled diagram of your dissection to show the location and structure of the bicuspid and tricuspid valves.

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.....

.....

.....

.....  
**Where in your dissertation did you find the origin of the common term?**

.....

7. (a) (i) Name the cavity of the body in which the heart and lungs are located.....

.....

(i) Describe the steps that you followed in order to identify and display the inner structures of the heart. Use suitably labelled diagrams if necessary

[illegible]

.....

07/07/2024

the right atrium and the right ventricle.

**2011 HL**

8. (iii) In the course of your practical studies you found that heart rate and breathing rate increase with exercise.

Explain why this is the case.

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**2012 HL**

7. (b) Answer the following by reference to some of the investigations that you carried out in the course of your studies.

(i) How did you expose the semi-lunar valves when dissecting the sheep's or ox's heart?

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2014 Q9

9. (a) (i) Give **one** example of a limitation of the scientific method.

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- (ii) Where do scientists usually publish the results and conclusions of their investigations?

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- (b) Answer the following in relation to investigations that you carried out in the laboratory.

- (i) 1. When dissecting a mammalian heart where, precisely, did you locate the tricuspid valve?

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2. Briefly describe how you carried out the dissection to expose this valve.

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3. Where did you find the semilunar valves during the dissection?

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- (ii) 1. When you investigated the effect of exercise on the human pulse rate or breathing rate what did you first establish?

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2. How did you measure pulse rate or breathing rate?

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2016 HL Q8

8. (a) Answer the following questions in relation to the human pulse.

(i) What is the pulse?

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(ii) What makes the wrist (or temple, or neck) a suitable part of the body to detect a pulse?

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(b) Answer the following questions in relation to the investigation you carried out on the effect of exercise on the breathing rate **or** pulse rate.

(i) What was the control in this investigation?

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(ii) What is the purpose of this control?

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(iii) You carried out this investigation on two women of the same age. One of the women (A) was a very fit athlete. The other (B) was overweight and rarely took exercise.

1. Appropriately label each of the axes below.

2. Draw two curves or plots to summarise the most likely results of your investigation, clearly labelling which curve relates to which individual.





- (iv) Recovery time is the duration of the period following exercise during which the breathing rate or pulse rate returns to normal. Suggest how you might measure recovery time.
- 

## Section C

### 2006 HL

- 13.(a) (i) State a precise location in the human body at which red blood cells are made.  
(ii) State **two** ways in which red blood cells differ from typical body cells e.g. from the cheek lining. (9)

### 2007 HL

- 13.(a)(i) Name the blood vessel that returns blood to the heart from the lungs.  
(ii) Name the main gas transported in the blood vessel that you have named in (i).  
How is this gas transported? (9)

### 2009 HL

- 13.(a) The human circulatory system has two circuits.  
(i) Give the name of each of these circuits.  
(ii) Which of these circuits involves the pumping of blood by the left ventricle? (9)
- (b)(i) Write a short note on **each** of the following:
1. Pulse.
  2. Blood pressure.
- (ii) Comment on the effect of **each** of the following on the circulatory system:
1. Diet.
  2. Exercise

- (iii) Give **two** ways, other than colour, in which a red blood cell differs in structure or composition from a typical body cell such as one in the cheek lining.
- (iv) What is the role of the SA (sinoatrial) and AV (atrioventricular) nodes in the heart?
- (v) Give the **precise** locations of **both** the SA and the AV nodes in the heart.

**2010 HL**

**5.** Answer any **two** of (a), (b), (c).

- (b)(i) Draw a labelled diagram to show the relationship between the liver, the small intestine and the hepatic portal vein.

**2012 HL**

**15.** Answer any **two** of (a), (b), (c).

- (b) (i) State **two** ways, other than colour, in which red blood cells differ from white blood cells.
- (ii) Name a group of white blood cells, other than lymphocytes.

**2016 HL Q15**

**15.** Answer any **two** of (a), (b), (c). **(30, 30)**

(a)

- (i) Draw a labelled diagram of a transverse section **and** a labelled diagram of a longitudinal section through a human vein to show its structure.

(ii) In **each** of the following cases name a vein which fits the description.

1. Transports blood out of the muscle of the heart.
2. Brings blood away from the kidneys.
3. Carries very little carbon dioxide.
4. Brings blood into the right atrium.
5. Has capillaries at both ends.

(iii) Briefly describe how blood is moved through veins.

**2018 HL**

**11.** (a)

- (i) Blood acts as a transport medium in the human body. Name **two** substances, other than food molecules and water, that are transported in the blood.

(ii) Give the location in the body where each of the substances you named in (i) enters the blood.

Vena cava; tricuspid valve; aorta; left ventricle; semi-lunar valve; pulmonary artery. (ii) 1. State the precise location **and** describe the role of the sinoatrial (SA) node.

2. State the precise location **and** describe the role of the atrioventricular (AV) node. (iii) What exactly is being measured when a person's blood pressure is taken?

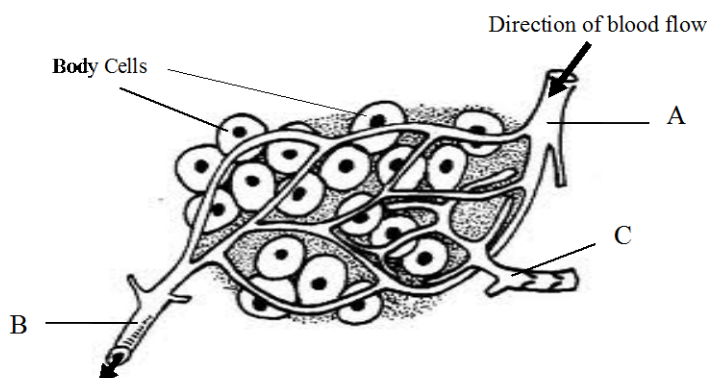
## Lymphatic System

### 2006 HL

13. (c) (i) Describe the structure of the lymphatic system.  
(ii) Give an account of **three** functions of the lymphatic system. (24)

2014 Q3

3. The diagram shows a region of tissue that includes body cells and parts of the circulatory and lymphatic systems.



- Name part C. \_\_\_\_\_
- What type of blood vessel is A? \_\_\_\_\_
- If a transverse section of A were viewed under the microscope state **one** way in which it would differ from a transverse section through B.  
\_\_\_\_\_
- Give **two** functions of the lymphatic system.  
1. \_\_\_\_\_  
2. \_\_\_\_\_
- Give **one** way in which lymph differs from blood.  
\_\_\_\_\_
- Name a major blood vessel that returns the blood in B to the heart.  
\_\_\_\_\_

Marking scheme

SEC Sample Paper HL Q3

3.		
	A on the left and B on the right	2(2)

		<b>Features:</b> thicker muscle wall/ smaller lumen	<b>2(2)</b>
		<b>Tissues:</b> Muscle tissue: Connective tissue: Endothelial tissue: <i>Any two</i>	<b>Functions:</b> shunt/move blood along prevent over expansion of walls/ support protection <i>Any two</i>
		Valves prevent a backflow of blood	<b>4</b>

2005 HL Q3

	(e)	True
	(f)	True

2006 HL Q5

(a)	X: liver Y: (hepatic) portal vein <b>or</b> portal system
(b)	Arrow 1 – Arrow 2 – Arrow 3 –
(c)	upper abdomen <b>or</b> under diaphragm <b>or</b> correctly related to stomach

2004 OL Q1

(a)	liver
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Section B

2004 HL Q9

9.	(a)	(i)	it can shorten or contract	<b>3</b>
		(ii)	left ventricle	<b>3</b>
	(b)		<b>Dissection:</b> Identify sides (or front/back) / how identified / ventral side uppermost / on board <b>or</b> dish / named cutting instrument / described (location of) cut / any safety procedure stated e.g. gloves, goggles, white coat <i>any three</i>	<b>3(3)</b>
			<b>Diagram</b> [4 chambers + indication of 2 valves] <b>labels</b> (bicuspid and tricuspid valves in correct position)	<b>3, 0</b>
			<b>Expose semilunar valve:</b> Cut aorta <b>or</b> cut pulmonary artery	<b>3</b>

			<b>Function semi lunar valve:</b> Stops back flow of blood (into ventricle or from artery)	<b>3</b>
			<b>Origin of coronary artery:</b> aorta <b>or</b> near semilunar valve	<b>3</b>

**2010 HL Q7**

<b>7.</b>	(a)	(i)	Thoracic <b>or</b> chest	<b>3</b>
		(ii)	Doesn't tire [ <i>allow involuntary</i> ]	<b>3</b>
	(b)	(i)	Identify front (or back or left or right) / how identified / named cutting instrument / location of first cut / second cut described / locate (find or flag label) named structure / safety precaution described ( <i>any of the above points can be got from labelled diagrams</i> )	<b>4(3)</b>
		(ii)	Cut open aorta <b>or</b> cut open pulmonary artery	<b>3</b>
		(iii)	Diagram of dissection	<b>3, 0</b>
			Labels: Right atrium, tricuspid valve, right ventricle	<b>3(2)</b>

**2011 HL Q8**

(iii)	More energy (required) / more oxygen (required) / more CO <sub>2</sub> (produced) <i>Any 2</i>	<b>2(3)</b>
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**2012 HL Q7**

<b>7</b>	(b)	(i)	Cut (open) the aorta <b>or</b> cut (open) the pulmonary artery	<b>3</b>
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**2014 HL Q9**

9.	(a)	(i)	(The extent of) our basic knowledge <b>or</b> the basis of investigation <b>or</b> our ability to interpret results <b>or</b> application to the natural world in state of change <b>or</b> accidental discoveries	3
		(ii)	Scientific journal(s)	3
	(b)	(i)	1. Between the right atrium and right ventricle	3
			2. Cut through the right side of the heart / using a scalpel	2(3)
			3. At the base / of the aorta <b>or</b> the pulmonary artery	2(3)
	(ii)	1.	The resting (pulse) rate <b>or</b> resting (breathing) rate	3
			2. Feel (or locate) pulse (or observe breathing) / Count heart beats (or breaths) for stated time / Repeat <b>and</b> find average.	2(3)

### Section C

#### 2006 HL Q13

13	(a)	(i)	marrow <b>or</b> named bone e.g. skull/ribs/long bones/sternum	3
		(ii)	no nucleus / haemoglobin / shape comment / size comment / / no mitochondria / carries oxygen or CO <sub>2</sub> <i>any two</i>	2(3)

#### 2007 HL Q13

13.	(a)	(i)	pulmonary vein*	3
		(ii)	oxygen* by (oxy)haemoglobin <b>or</b> by iron	3 3

#### 2009 HL Q13

13.	(a)	(i)	Pulmonary circuit	3
			Systemic circuit	3
		(ii)	Systemic or described	3

	(b)	(i)	1. Pulse: contraction of (wall of) artery <b>or</b> expansion of artery <b>or</b> due to pumping of heart (or of left ventricle) <b>or</b> rate at which heart beats [ <i>accept</i> relevant medical reference]	3
			2. Blood pressure: Force exerted by blood (or by heart) [ <i>accept</i> relevant medical reference]	3
		(ii)	1. Comment on diet: Dietary factor + matching effect	3
			2. Comment on exercise: Comment + matching effect	3
		(iii)	Contain haemoglobin / no nucleus (or other named organelle) / comment on shape	2(3)
		(iv)	Causes contraction (of heart muscle) <b>or</b> Pacemaker (or described) <b>or</b> impulse generation	3
		(v)	SA (In wall of) right atrium <b>or</b> indicated on diagram	3
			AV In (or near) septum <b>or</b> near tricuspid valve <b>or</b> between atrium and ventricle <b>or</b> indicated accurately on diagram	3

**2016 HL Q8**

**8. (a) 2(3)**

- (i) *Pulse:* The (rhythmic) stretching (or expanding or vibrating) of an artery
- (ii) *Why pulse at wrist:* Artery near the surface

**8. (b) 4(4) + 4(2)**

- (i) *Control:* Rate (measured) at rest
- (ii) *Purpose of control:* To compare with the results (of the experiment)
- (iii) *Axes labels* x-axis 'duration (of exercise)' **or** 'time' **or** level of exercise  
y-axis 'rate'
- Curve or plot showing:* B increases by a greater amount
- (iv) *How measure recovery time:* Immediately (after exercise)/ count pulse or breathing/  
rate or per minute/ measure length of time until resting rate reached **Any three**

**2010 HL Q15**

<b>15.</b>	(b)	(i)	Diagram (liver, connection, gut) Labels ( <i>liver, intestine and portal vein</i> )	<b>3, 0</b> <b>3(2)</b>
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2012 HL Q15(b)

15.	(b)	(i)	Smaller / more of them / biconcave / disc (shape) / no nucleus (when mature) / no mitochondria / transport oxygen / contain haemoglobin / transport CO <sub>2</sub>	2(3)
		(ii)	Phagocytic (white cells) <b>or</b> monocytes	3

2018 HL Q15

15.	(a)	(i)	<i>T.S. vein diagram:</i>	thin wall + large lumen (> 50% total diameter)
			<i>L.S. vein diagram:</i>	clearly longitudinal + valve
			<i>Labels:</i>	lumen/ muscle or wall or endothelium/ valve
		(ii)	1. <i>Heart muscle:</i>	Cardiac <b>or</b> coronary (vein)
			2. <i>Kidney:</i>	Renal (vein)
			3. <i>Little CO<sub>2</sub>:</i>	Pulmonary (vein)
			4. <i>Into R.A.:</i>	Vena cava
			5. <i>Capillaries at both ends:</i>	Hepatic portal (vein)
		(iii)	<i>How blood moved through veins:</i>	
				(Skeletal or voluntary) muscles contracting (squeezing)/ valves prevent backflow

## Lymphatic System

2006 HL Q13

	(c)	(i)	(lymph) nodes / (lymph) vessels	2(3)
		(ii)	transport / defence / fluid collection / (transport) of fats / (transport) of hormones / (transport) of excretory matter / nodes filter / bacteria <b>or</b> pathogens / produce lymphocytes <b>or</b> antibodies / returns fluid to blood / absorbs fat / at lacteals / <u>any six</u>	6(3)

2014 HL Q3

3.

8 + 7 + 5(1)

- (a) C = Lymph vessel
- (b) Arteriole [*accept* artery]
- (c) Narrow(er) lumen **or** thick(er) wall **or** no valves
- (d) Maintains a constant level of ECF **or** drains fluid or returns fluid to blood / manufacture of lymphocytes **or** maturation of lymphocytes / filtering bacteria / fighting infection / transport of named material
- (e) No red blood cells **or** no haemoglobin / no platelets / no clotting (proteins) / higher fat level [*accept* correct colour difference]
- (f) Vena cava

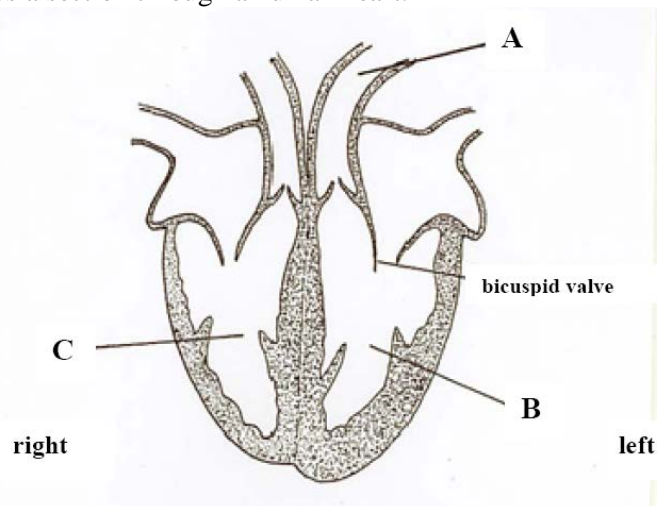
### Ordinary Level

2004 OL

1. (a) The hepatic portal vein carries blood from the alimentary canal to the .....

2008 OL

4. The diagram shows a section through a human heart.



- (a) Name blood vessel A. \_\_\_\_\_
- (b) Is the blood in A oxygenated or deoxygenated? \_\_\_\_\_
- (c) Name the chamber of the heart labelled B. \_\_\_\_\_
- (d) Give **one** reason why the wall of chamber B is thicker than the wall of chamber C. \_\_\_\_\_
- (e) What is the role of the bicuspid valve? \_\_\_\_\_

2009 OL

5. (a) Name the liquid part of blood. \_\_\_\_\_

(b) Give **two** components of this liquid.

- (i) \_\_\_\_\_  
(ii) \_\_\_\_\_

(c) Complete the following table in relation to blood cells:

Cell type	One function
Red blood cell	
White blood cell	
Platelet	

**2004 OL**

9. (a) Answer the following in relation to human breathing rate OR pulse rate.

State which of these you will refer to .....

What is the average rate at rest? .....

State a possible effect of smoking on the resting rate .....

.....

(b) How did you measure the resting rate? .....

.....

.....

.....

.....

Describe how you investigated the effect of exercise on this rate.

.....

.....

.....

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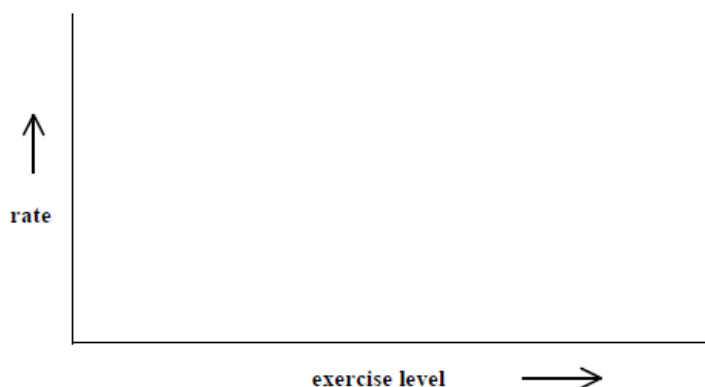
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.....

Using the axes below draw a graph to show how rate is likely to vary as the exercise level increases.



**2006 OL**

7. (a) (i) Name the chamber of the heart that receives blood back from the lungs.

.....

(ii) Name the blood vessels that bring this blood back from the lungs.

.....

(b) Answer the following in relation to the dissection of a heart.

- (i) What instrument did you use for the dissection? .....
- (ii) Describe how you carried out the dissection. ....  
.....  
.....  
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.....  
.....  
.....  
.....  
.....
- (iii) Draw a diagram of the dissected heart and on it label the following:  
bicuspid valve, left ventricle, right atrium, tricuspid valve.

**2008 OL**

**8.** (b) Answer the following questions about an activity that you carried out to investigate the effect of exercise on the breathing rate **or** pulse of a human.

- (i) At the start of the investigation you asked the person who was about to do the exercise to sit down for a few minutes. Explain the purpose of this. \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

- (ii) How did you measure the breathing rate **or** the pulse?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- (iii) Describe how you conducted the investigation after the period of rest.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
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\_\_\_\_\_  
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\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- (iv) State the results of your investigation. \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**2012 OL**

7. (b) Answer the following questions about an activity that you carried out to investigate the effect of exercise on your breathing rate **or** your pulse rate.

/Tick the rate you will refer to.

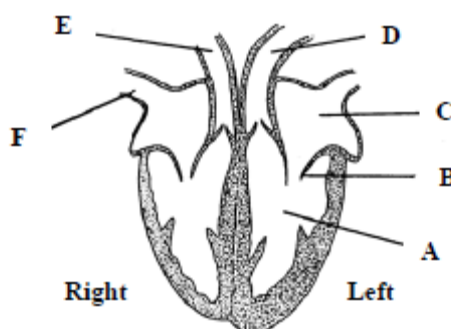
Breathing Rate	
Pulse Rate	

- (i) The investigation starts by measuring the resting rate. How did you measure the resting rate?  
 \_\_\_\_\_  
 \_\_\_\_\_
- (ii) After measuring your resting rate, what other steps did you carry out to complete the investigation?  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
- (iii) What was the result of your investigation?  
 \_\_\_\_\_  
 \_\_\_\_\_
- (iv) Does this investigation give the same result for both fit and non-fit people? \_\_\_\_\_
- (v) Give a reason for your answer.  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**SEC Sample Paper OL**

- 10.(a) (i) What is the average resting rate of the human heart in beats per minute?  
 (ii) State one factor that decreases heart rate and one factor that increases it. (9)

- (b) The diagram shows a vertical section through the human heart.



- (i) Name the parts A, B, C, D, E and F.  
 (ii) To where does E carry blood?  
 (iii) What is the function of B?  
 (iv) Name the artery that supplies the heart muscle with blood. (27)

- (c)(i) Name the liquid part of blood.  
 (ii) Name two substances that are dissolved in the liquid part of blood.

- (iii) State one function of the liquid part of blood.
- (iv) Blood contains red cells and white cells. State one function for each of these.
- (v) Name two common blood-grouping systems. (24)

**2005 OL**

**12.(a)(i)** Name the major blood vessels that carry blood

- 1. from the heart to the lungs
- 2. from the lungs to the heart.

**2005 OL**

**14.(c)** Answer the following questions in relation to blood vessels in the human body.

- (i) Valves are present in veins. What is their function?
- (ii) Why are valves not needed in arteries?
- (iii) Which has the bigger lumen (cavity), an artery or a vein?
- (iv) The wall of capillaries is only one cell thick. How is this related to their function?
- (v) How does a portal vein differ from other veins?
- (vi) Name the following blood vessels;
  - 1. the vessels that carry blood from the aorta to the kidneys.
  - 2. the vessels that supply the heart's muscle with blood.

**2008 OL**

**15.(b)** Answer the following questions in relation to blood.

- (i) What is blood plasma? Give a role for blood plasma.
- (ii) Name **two** types of cell found in the blood and give a function for each of them.
- (iii) The ABO blood group system has four blood groups. What are these **four** groups?
- (iv) Suggest a reason why it is important to know a person's blood group.

**2009 OL**

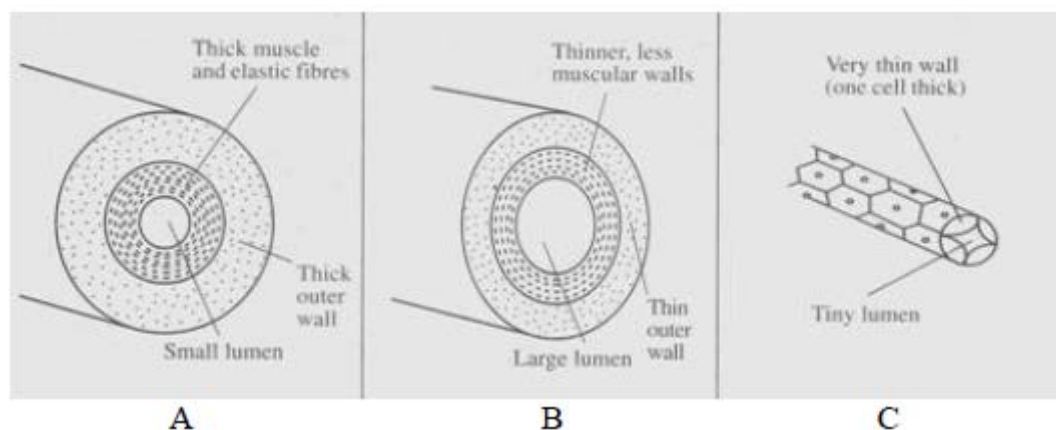
**13.(a)** Name the blood vessel referred to in each of the following cases:

- (i) The vein connected to the lungs.
- (ii) The artery connected to the kidneys.
- (iii) The vein that joins the intestine to the liver. (9)

(b) The following questions relate to the human heart.

- (i) Give the precise location of the heart in the human body.
- (ii) What structure(s) protects the heart?
- (iii) Name the upper chambers of the heart.
- (iv) Name the valve between the upper and lower chambers on the left-hand side.
- (v) What is the average resting human heart rate?
- (vi) Give **two** factors which cause an increase in heart rate.
- (vii) Name the blood vessels that bring oxygen to the heart muscle.
- (viii) Explain why the walls of the lower chambers of the heart are thicker than the walls of the upper chambers. (27)

(c) **Copy the table below into your answerbook** and use your knowledge of blood vessels and the information in diagrams A, B and C to complete the table. Some boxes have been filled as examples.



Vessel	A	B	C
Name		Vein	
Lumen	Small		
Wall			
Direction of blood flow			
Valves present			

(24)

2011 OL

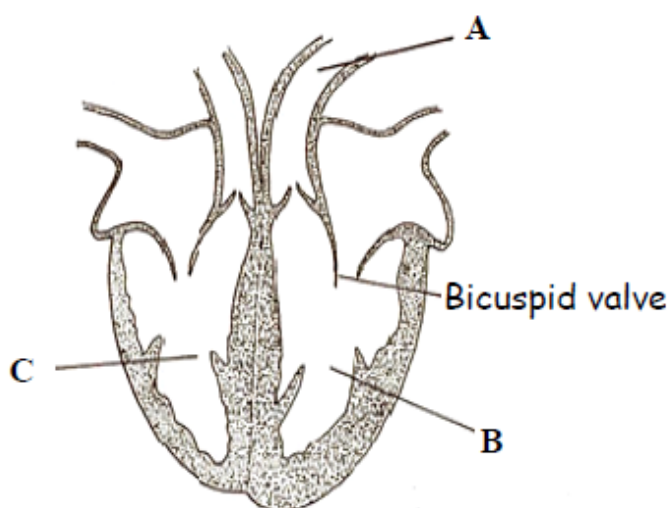
13. (a) (i) Name the liquid part of the blood.

(ii) Different lifestyle factors have an effect on the health of our circulatory system.

Name any **two** of these factors.

(9)

(b) The diagram shows a section through the human heart.



(i) Name the blood vessel labelled A.

(ii) Does A carry blood towards or away from the heart?

(iii) Name the chamber of the heart labelled C.

(iv) Why is the wall of chamber B thicker than the wall of chamber C?

(v) Name the arteries that supply the heart wall with blood.

(vi) What is the role of valves in the heart?

(vii) The lymphatic system is another series of vessels carrying fluid in the body.

Give any **two** functions of the lymphatic system.

(24)

**2013 OL**

**14.** Answer any **two** of (a), (b), (c).

**(30, 30)**

(b) (i) Blood is made up of plasma and blood cells. What is plasma?

(ii) What is the function of white blood cells?

(iii) Where in the body are white blood cells produced?

(iv) Some people may have the blood group B Positive (B+).

What factor is present in their blood that makes it positive?

(v) The heart pumps blood around the body.

1. Name the structure in the heart that controls the heartbeat.

2. Where is this structure located in the heart?

(vi) What causes the sound of a heartbeat?

(vii) Name the blood vessels that supply the heart cells with blood.

(viii) Mention **two** ways to maintain a healthy heart.

**2008 OL Q4**

<b>4.</b>				<b>2(7)+3+2+1</b>
	<b>(a)</b>	Aorta		
	<b>(b)</b>	Oxygenated (watch follow on)		
	<b>(c)</b>	Ventricle		
	<b>(d)</b>	pumps further/ maintains blood pressure / greater activity		
	<b>(e)</b>	stops back flow (of blood) / blood from atrium to ventricle		

**2009 OL Q5**

<b>5.</b>				<b>2(8) + 4(1)</b>
	<b>(a)</b>		Plasma	
	<b>(b)</b>	<b>(i)</b> <b>(ii)</b>	Any two	
	<b>(c)</b>		<b>(Red Blood Cells)</b> <b>(White Blood Cells)</b> <b>(Platelets)</b>	Transport O <sub>2</sub> / CO <sub>2</sub> e.g. to make antibodies e.g. Blood Clotting



2004 OL Q9

9.	(a)	State which one (No mark – repeat of quest Average rate at rest (Pulse 65 to 79 bpm or Breathing 11 to 21 bpm) Raises rate	0 3 3
	(b)	<b>measure of resting rate:</b> use pulse monitor / read result in bpm or use of finger or wrist (radial pulse) / use timer or calculate in bpm / observe / count / repeat / average / record	2(3)
		<b>investigation:</b> (measure) resting rate/ description of exercise/ measure rate during (or immediately after) exercise/ repeat / compare or state result / record <b><u>any three</u></b>	6+2(3)
		<b>graph</b> (Showing increase – starting at origin is OK)	6

11. 2006 OL Q7

7.	(a)		5+1
		(i)	Left atrium (auricle)
		(ii)	Pulmonary vein
	(b)		4(5)+4(1)
		(i)	Scalpel / blade / scissors / knife
		(ii)	Ventral side up (identify left and right)/ section or words to that effect / expose left ventricle / expose right ventricle /section to show aorta / pinning back/ [allow one]safety precaution <b><u>any three</u></b>
		(iii)	Diagram Labels <b><u>any three</u></b>

2008 OL Q8

8	(b)		4(5)+4
		(i)	Comparison /control / resting / normal / (breathing rate or pulse)
		(ii)	Method described /count number of breaths or number of pulses /per unit time <b>OR</b> sensor (data logger)
		(iii)	Exercise / description of exercise/ increased exercise/ breathing rate or pulse measured/ repeat/ average / <b>compare / record / result</b> <b>Any two</b>

		(iv)	Increases / comment on return to normal / different	
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**2012 OL Q7**

7.				5 + 1
	(a)	(i)	EG. Asthma	(1 pt)
		(ii)	EG. Use of Inhaler (must match)	(1 pt)
				2(6)+6(2)
	(b)		Ticking Breathing Rate/Pulse Rate	(0 pts)
		(i)	Count pulse or breaths / time or rate repeat or average	(2 pts) (1 pt)
		(ii)	Exercise / check rate	(2 pts)
		(iii)	Exercise causes increase in rate	(1 pt)
		(iv)	Yes / No	(1 pt)
		(v)	Must match (iv)	(1 pt)

**SEC Sample Paper OL Q10**

10.	(a)	(i)	72 beats per minute ( allow 5 either side)	3
		(ii)	Decrease: sleep / rest / cold / drugs <b>Any one</b> Increase: exercise / excitement / drugs <b>Any one</b>	3 3
	(b)	(i)	A- ventricle, B- bicuspid valve, C- atrium, D – aorta, E- pulmonary artery, F – vena cava	6(3)
		(ii)	The lungs	3
		(iii)	To prevent backflow (of blood)/ from ventricle to atrium	3
		(iv)	Coronary ( cardiac)	3
	(c)	(i)	Plasma	3
		(ii)	Glucose / amino acids / vitamins / urea / hormones <b>Any two</b>	2(3)
		(iii)	To transport substances / act as a medium <b>Any one</b>	3

		(iv)	<b>RBC-</b> transport oxygen <b>WBC-</b> defence against disease / produce antibodies / engulf bacteria	<b>Any one</b>  <b>Any one</b>	<b>3</b>  <b>3</b>
		(v)	ABO and Rhesus systems		<b>2(3)</b>

**2005 OL Q12**

<b>12.</b>	<b>(a)</b>	<b>(i)</b>	1. Pulmonary artery 2. Pulmonary vein	<b>3</b> <b>3</b>
		<b>(ii)</b>	carbon dioxide	<b>3</b>

**2005 OL Q14**

<b>(c)</b>	<b>(i)</b>	to prevent back flow of blood	<b>6</b>
	<b>(ii)</b>	blood is under pressure / blood from heart / blood pumped	<b>6</b>
	<b>(iii)</b>	vein	<b>6</b>
	<b>(iv)</b>	substances can diffuse easily/ in and out of blood / tissues/less fat content	<b>3</b>
	<b>(v)</b>	capillaries at both ends / joins two organs/ two named organs	<b>3</b>
	<b>(vi)</b>	1. renal (arteries) 2. coronary or cardiac(arteries)	<b>3</b> <b>3</b>

**2008 OL Q15**

<b>(b)</b>			<b>10(3)</b>
	<b>(i)</b>	a - blood without cells/ watery liquid part of blood b - carries dissolved substances /named substance / waste /hormones /gases /blood clotting agent/ water / antibodies / proteins / inorganic salts / fibrinogen / CO2 / Bicarbonate / <b>Heat</b>	
	<b>(ii)</b>	<b>a</b> - red blood cell / carries oxygen (also carries carbon dioxide) <b>b</b> - white blood cell / defence <b>c</b> – (allow Platelet / Blood Clotting )	<b>Any two types + function</b>
	<b>(iii)</b>	A/ B/ AB/ O [Four correct <b>9</b> ,Three correct <b>6</b> , two correct <b>3</b> ]	
	<b>(iv)</b>	transfusion/ to avoid reaction by mother to foetus/ to prevent loss of foetus	

**2009 OL Q13**

<b>13</b>	<b>(a)</b>		<b>7 + 2(1)</b>
		<b>(i)</b>	Pulmonary (vein)
		<b>(ii)</b>	Renal (artery)
		<b>(iii)</b>	Hepatic Portal (vein)

**Circulatory system – heart and blood vessels and Lymphatic system**

	(b)	(i)	Thorax	3																									
		(ii)	Rib cage	3																									
		(iii)	Atria / allow Auricle	3																									
		(iv)	Bicuspid (mitral) valve	3																									
		(v)	69 - 75	3																									
		(vi)	e.g. exercise / anxiety / drugs / infection	Any two 2(3)																									
		(vii)	Coronary (arteries) / allow cardiac	3																									
		(viii)	They pump	3																									
	(c)	<table><tr><td>Vessel</td><td>A</td><td>B</td><td>C</td></tr><tr><td>Name</td><td>ARTERY</td><td></td><td>CAPILLARY</td></tr><tr><td>Lumen</td><td></td><td>LARGE</td><td>SMALL</td></tr><tr><td>Wall</td><td>THICK</td><td>THIN(NER)</td><td>(VERY) THIN</td></tr><tr><td>Direction</td><td>FROM HEART</td><td>TO HEART</td><td></td></tr><tr><td>Valves present</td><td>NO</td><td>YES</td><td>NO</td></tr></table>			Vessel	A	B	C	Name	ARTERY		CAPILLARY	Lumen		LARGE	SMALL	Wall	THICK	THIN(NER)	(VERY) THIN	Direction	FROM HEART	TO HEART		Valves present	NO	YES	NO	12(2)
		Vessel	A	B	C																								
		Name	ARTERY		CAPILLARY																								
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		Direction	FROM HEART	TO HEART																									
		Valves present	NO	YES	NO																								

**2011 OL Q13**

13	(a)	(i)	Plasma	<b>7 + 2(1)</b>
		(ii)	Any two factors	
	(b)	(i)	Aorta	<b>2(6)+6(2)</b>
		(ii)	Away from	
		(iii)	Right ventricle	
		(iv)	Blood from B must be pumped further / greater pressure	<b>(1 Pt)</b>
		(v)	Coronary / Cardiac	
		(vi)	To prevent backflow (of blood)	
		(vii)	Returns fluid to blood / transport / lymphocytes(Immunity)	<b>(2 Pts)</b>
	(c)	(i)	A=bronchus; B= trachea (allow cartilage for A or B)	<b><u>3(5)+6(2)</u> (2 Pts)</b>
		(ii)	Alveoli or Air sacs	

		(iii)	Thin walls / moist surfaces / surrounded by capillaries/ large surface area / expandable	(1 Pt)
		(iv)	To make sound	
		(v)	Impulse from brain / (intercostal) muscles contract / diaphragm contracts / thoracic cavity increases <u>or</u> rib cage up and out <u>or</u> diaphragm flattens / pressure drops / air in (Any four points)	(4 Pts)

**2013 OL Q14(b)**

<b>14.</b>	(b)			<b>10(3)</b>
		(i)	Liquid (part of blood)	(1 pt)
		(ii)	Fight disease	(1 pt)
		(iii)	e.g. bone (marrow)	(1 pt)
		(iv)	Rhesus	(1 pt)
		(v)	1. Pacemaker 2. Right atrium	(2 pts)
		(vi)	Valves closing	(1 pt)
		(vii)	Coronary [accept cardiac] arteries	(1 pt)
		(viii)	e.g. eat less fat/ exercise regularly/ avoid excess stress/ eat less salt/ don't smoke/ avoid inheriting bad genes	(2 pts)

**Extra notes;**

- Haemoglobin – globular protein with a haem (iron-containing) group which can pick up 4 oxygen molecules.
  - Red blood cells – smaller than average cell (no nucleus/mitochondria), biconcave shape and flexible membrane makes it easy for them to fit through narrow capillaries. Biconcave shape gives a greater surface area for diffusion of oxygen. No mitochondria – no respiration. Destroyed in liver /spleen at a rate of 3 million per second.
  - Haemophiliacs lack factor 8, needed in blood clotting.
  - Blood grouping systems – about 30 in humans.
- ABO blood group system – discovered by Austrian Karl Landsteiner 1900.
- Haemolytic transfusion reaction – occurs when for example person group A receives B blood. B antigen stimulates production of anti – B antibodies which cause cells to break open – can be fatal.
- Group O people statistically have less chance of getting certain cancers. Why = ?
- Blood transfusion bag – show.
  - Rhesus blood grouping – first discovered in monkeys.
- Rhesus incompatibility in pregnancy – diagrams

Rh<sup>+</sup> people cannot make anti-D, the D antibody. Rh<sup>-</sup> people are not born with anti-D but can make it if they are given Rh<sup>+</sup> cells.

- DVT – occurs more in elderly and brought on by sitting still for long periods of time, especially long-haul flights. Walk around on long flights/journeys and wear flight socks. DVT leg photo.
  - CO – Haemoglobin has a higher affinity for carbon monoxide (230x) than oxygen. CO – from car exhausts and cigarette smoke prevents oxygen being carried which can be fatal.
  - Arteries – mesenteric (to small/large intestines), carotid (to head), subclavian(to arms), ilac (to legs)
  - Veins – coronary (from heart muscle to vena cava), jugular (from head).
  - Cardiac cycle – average length 0.8 sec. Diastole 0.4 sec, atrial systole 0.1 sec, ventricular systole 0.3 sec.
  - Earthworm heart beat = 17 bpm.
  - Other factors that may have a role in heart disease – heredity, age (increases with age), males more susceptible than females, being overweight, stress.
  - Activities:
- Artificial blood samples and related disease

#### Notes

Size of sheep heart = human heart.

Cigarettes have to have a sign on packet stating at least one serious effect of smoking e.g. smoking kills.

Fit athletes have lower heart rates e.g. cyclist Miguel Indurain 28 and Lance Armstrong 32 bpm.

#### Q

Why is blood considered to be a type of tissue?

What percentage of blood is white blood cells and platelets?

What group of biomolecules does haemoglobin belong to?

What happens to haemoglobin when it is broken down?

Why do you not use your thumb when measuring pulse rate?

Why, following exercise, is it more accurate to measure your pulse rate over 15 seconds and multiply by 4, instead of counting for 1 minute?

What type of tissue is the pacemaker?

### Quiz questions

- The hepatic portal vein carries blood from the alimentary canal to the
- Name the blood vessel that carries blood from the aorta to the kidneys
- Name the cavity of the body in which the heart and lungs are located.....
- The human circulatory system has two circuits.

Give the name of each of these circuits.

- Which has the bigger lumen (cavity), an artery or a vein?
- Name the liquid part of blood.

<input type="radio"/> <b>Cell type</b>	<input type="radio"/> <b>One function</b>
<input type="radio"/> Red blood cell	<input type="radio"/>
<input type="radio"/> White blood cell	<input type="radio"/>
<input type="radio"/> Platelet	<input type="radio"/>

- Which chamber of the heart has the greatest amount of muscle in its wall?
- What is the function of a semilunar valve?
- What is the role of the bicuspid valve?