

Circulatory System

These notes are your ultimate revision weapon to revise Circulatory System. We've distilled years of previous exam questions (PYQs) into one powerful, concise resource. Everything you need to know, nothing you don't.

- **PYQs, Decoded:** All key concepts from past exams, organized and simplified.
- **Revise in Record Time:** Short, precise, and designed for last-minute review.
- **Focus on What Matters:** Master high-probability topics and boost your confidence.

The Human Heart

Structure



- **Chambers:** Divided into four chambers:
 - Left Atrium
 - Right Atrium
 - Left Ventricle
 - Right Ventricle
- **Valves:** contain valves that ensure blood flows in only one direction.
- **Specialized Arteries:** The heart muscle is supplied by the **coronary arteries**.
- **Specialized Veins:** Deoxygenated blood is carried away from the heart muscle by **cardiac veins**.

Function & Heart Rate

- **Electrical Impulses:** Beats are caused by electrical impulses generated within the heart itself, specifically the **sinus node**.
- **Heart Rate:**
 - **Average Resting Rate (Adult):** 72-75 beats per minute (bpm).

- **During Sleep:** Slows down to 40-50 bpm.
- **Pulse Rate:** The pulse rate measured at the wrist is the same as the heart rate.
- **Cardiac Cycle:** The heart rests between two beats (during the relaxation phase).

Heart Attack (Myocardial Infarction)

- **Common Symptoms:** Chest pain or discomfort, shortness of breath, nausea, sweating, pain or numbness in arms, back, neck, jaw, or stomach.
- **Not a Typical Symptom:** Pain in the legs.
- **Variation:** Symptoms can vary between individuals, especially between men and women.

Blood: Composition and Properties

General Properties

- **Classification:** Classified as a **connective tissue**.
- **Volume:** A normal adult (70 kg) has a total blood volume of **5-6 litres (approx. 5000-6000 ml)**.
- **Components:** Composed of:
 - **Liquid Component:** Plasma (makes up about **55%** of total blood volume).
 - **Cellular Components:** Red Blood Cells, White Blood Cells, and Platelets.
- **pH Level:** Slightly alkaline, with a normal range of **7.35 to 7.45**.
- **Viscosity:** The thick, viscous nature is primarily due to the **proteins** present in it.

Blood Components

Red Blood Cells (Erythrocytes)

- **Primary Function:** Transport of **oxygen**.

- **Key Molecule:** Contains **haemoglobin**, an iron-containing compound responsible for the red colour of blood.
 - Haemoglobin carries oxygen from the lungs to the tissues and brings carbon dioxide back.
 - Its pH is slightly alkaline (around 7.1 to 7.4).
- **Formation (Erythropoiesis):**
 - Produced in the **red bone marrow** at a rate of about **2 million per second**.
 - Stimulated by the hormone **erythropoietin**, which is released by the kidneys.
- **Lifespan:** Exist for about **100-120 days**.
- **Immature RBCs:** Young RBCs released from bone marrow are called **reticulocytes** (about 1% of circulating RBCs).
- **Vertebrate Characteristic:** In vertebrates, RBCs are non-nucleated.

White Blood Cells (Leukocytes)

- **Primary Function:** Protecting the body from infection and developing disease resistance (immunity).
- **Lymphocytes:** A specific type of WBC crucial for immunity; they produce antibodies.
- **Characteristics:**
 - **Diameter:** Approximately 0.007 mm.
 - **Normal Count:** 4,000 - 11,000 per microliter of blood.
 - **Proportion of Blood Volume:** Constitute about **1%**.
- **Abnormal Conditions:**
 - **Leukocytosis:** Abnormally high WBC count.
 - **Leukopenia:** Abnormally low WBC count.
 - **Leukemia:** Cancer causing production of excess, abnormal, immature WBCs.

Platelets (Thrombocytes)

- **Function:** Essential for **blood clotting**.
- **Characteristics:**
 - **Size:** About 20% the size of a red blood cell.

- **Normal Count:** 150,000 - 350,000 per microliter of blood.
- **Relative Abundance:** Blood has a higher number of platelets than white blood cells.

Blood Plasma

- **Composition:** The liquid component of blood.
- **Water Content:** Comprised of **90-92% water**.
- **Components:** Contains proteins like **albumin, fibrinogen, and globulins** (including antibodies).

Blood-Related Organs & Their Functions

- **Bone Marrow:** Production site for all red blood cells, some white blood cells, and all platelets.
- **Spleen:**
 - Acts as a **blood filter**.
 - Destroys old and worn-out red blood cells.
 - Stores blood for emergencies.
 - Recycles iron.
 - Forms lymphocytes.
- **Lymphatic System:** Lymphocytes are also produced in lymphatic tissues (spleen, thymus, lymph nodes).

Blood Pressure

Normal Values & Measurement

- **Normal Blood Pressure: 120/80 mm Hg.**
 - **Systolic Pressure:** The higher number (~120 mm Hg) represents pressure during heart contraction.
 - **Diastolic Pressure:** The lower number (~80 mm Hg), representing pressure when the heart is at rest.
- **Instrument:** Measured using a **Sphygmomanometer**.
- **Unit:** "mm Hg" stands for **millimeters of Mercury**.

Characteristics and Comparisons

- Human blood pressure is **greater than atmospheric pressure**.
- Blood pressure generally **increases with age**.
- A reading lower than 120/80 (e.g., 90/60) is considered **low**.
- A reading higher than 120/80 (e.g., 140/100, 160/120) is considered **high**.

Blood Groups & Transfusion

Discovery and Naming

- **ABO System:** Discovered by **Karl Landsteiner** (1900).
- **Rh Factor:** Derives its name from the **Rhesus monkey**, in which the antigen was first identified.

ABO System

- **Group A:** Has A antigens on RBCs and anti-B antibodies in the plasma.
- **Group B:** Has B antigens on RBCs and anti-A antibodies in the plasma.
- **Group AB:** Has both A and B antigens on RBCs but **no antibodies** in the plasma. Known as the "**universal recipient**".
- **Group O:** Has **no antigens** on RBCs but has both anti-A and anti-B antibodies in the plasma. Known as the "**universal donor**".

Rh Factor

- **Rh-positive (Rh+):** RhD antigen is present on RBCs.
- **Rh-negative (Rh-):** RhD antigen is absent.
- **Rh Incompatibility:** A problem if an Rh-negative mother carries an Rh-positive foetus, potentially causing **Erythroblastosis fetalis** (hemolytic anemia) in the baby.

Safe Transfusion Practices

- **Universal Donor: O, Rh-negative (O-)** is safest for emergency transfusions when the recipient's blood group is unknown, as it lacks A, B, and RhD antigens.
- **Transfusion Rules:**
 - **Group A** can receive from A and O; can donate to A and AB.
 - **Universal Recipient: Group AB** can receive from any group.

Inheritance of Blood Groups

- Blood groups are inherited from parents according to Mendelian genetics.
- *Example 1:* A father (Group A) and mother (Group O) can have a child with Group A or O.
- *Example 2:* A couple (AB and O) can have children with Group A or B, but not AB or O.

Physiological Processes

Blood Clotting (Coagulation)

- **Key Enzyme: Thrombin** is the central enzyme.
- **Process:** Thrombin converts soluble **fibrinogen** into insoluble **fibrin**, which forms the clot mesh.
- **Coagulants:** Substances like **Alum** (containing Aluminum ions) have high coagulating power and can be applied to cuts to stop bleeding.

Immunity and Defense Mechanisms

- **Antigen:** A foreign substance that triggers an immune response and stimulates antibody formation.
- **Antibody:** A protein produced by the body in response to a specific antigen to neutralize it.

Comparative Biology

Iron-Containing Molecules

- **Myoglobin:** A protein found in **skeletal muscles** that binds oxygen and contains iron.
- **Haemoglobin in Earthworms:** In earthworms, haemoglobin is **dissolved in the plasma**, not contained within red blood cells.

Artificial Blood

- **'Plastic Blood':** An artificial blood substitute developed by **British** scientists.
- **Advantages:** Lightweight, does not require refrigeration, long shelf-life, can be administered to any patient regardless of blood group. It is stored as a paste and dissolved in water when needed.

Know More About Circulatory System:

- [Circulatory System – Old Year Questions](#)
- [Circulatory System One Liner Questions & Answers](#)