

Unit 11: Human Circulatory System

Short Questions

SHORT ANSWER QUESTIONS EXERCISE

Q1. What is the main difference between the walls of an artery and a vein?

Ans.

Arterial walls	Venous wall
• The walls of arteries are made up of three layers. • Outer layer i.e., tunica externa or adventitia is made of connective and elastic tissue. • Middle layer i.e., tunica media is made of thick muscular tissue and elastic fibres. • Inner layer i.e., tunica intima is made of thin layer of endothelial cells.	• The wall of veins has same three layers as are present in arteries. • The outer layer i.e., tunica externa (adventitia) is made of connective and elastic tissue. • The middle layer i.e., tunica media is relatively thin and only slightly muscular, with few elastic fibres. • The inner layer i.e., tunica intima is made of thin layer of endothelial cells.

Q2. Enlist the four valves present in heart and also state their locations.

Ans. AV-Valves: At the entrance points of ventricles (in atrioventricular septum), there are two **atrioventricular valves** i.e., a tricuspid valve and a bicuspid valve.

- **Tricuspid valve** (made of three cusps) is present between right atrium and right ventricle.

- **Bicuspid (mitral) valve** (made up of two cusps) is present between left atrium and left ventricle.

- **Semilunar Valves:** At the exit points of ventricles, there are two **semilunar valves** (with shapes like a half-moon).

There are two semilunar valves;

- **Pulmonary valve** is located at the base of pulmonary artery between right ventricle and pulmonary trunk.

- **Aortic valve** is located at the base aorta between left ventricle and aorta.

Q3. State the phases of heartbeat.

Ans. There are three phase of heart beat.

1. Diastole: When atria are relaxed and being filled with blood, the ventricles are also

relaxed. This **relaxed period of heart chambers** is called diastole.

2. Atrial systole: As blood accumulates in **atria**, their blood pressure rises, due to which both of them **contract**. This is called atrial systole. It passes the blood through tricuspid and bicuspid valves into the two relaxed ventricles.

3. Ventricular systole: When ventricles are filled with blood, both of them contract. This is called ventricular systole and it pumps the blood to pulmonary arteries and aorta.

Duration: In one complete heartbeat, diastole lasts about 0.4 sec, atrial systole takes about 0.1 sec, and the ventricular systole lasts about 0.3 sec.

Q4. List the principles and use of Electrocardiogram.

Ans. Principle: When cardiac impulse passes over the surface of heart a minute electrical current is generated. This current spreads into the tissues surrounding heart. This minute electrical current also travels to the surface of body.

- In ECG, the electrical potentials generated by this current are measured and recorded. For this purpose, electrodes are placed on skin on the opposite sides of heart. The electrodes are attached to a machine called **electrocardiograph** that records electrical potentials generated by this current.

Uses: ECG helps to **diagnose the abnormalities and abnormal rhythms** in conduction system of heart.

Q5. Define angiography and angioplasty.

Ans. Angiography

Coronary angiography is an X-ray examination of blood vessels or chambers of heart. In order to create the X-ray pictures, a physician guides a small tube-like device called **catheter** through the large arteries of

body fluid (contrast medium) is injected and pictures (angiograms) are obtained.

Angioplasty

Angioplasty is a procedure that opens a blocked or narrowed artery. During an angioplasty, a small wire called a catheter, under X-ray guidance is passed through the narrowed coronary artery the balloon is advanced through wire and inflated to dilate the narrowed section of block artery.

Q6. What is meant by Purkinje fibres?

Ans. These are the network of fibres formed by the division of AV-bundles in the walls of ventricles. Stimulation of these fibres causes the ventricles to contract almost simultaneously.

Q7. What do you mean by vasoconstriction and vasodilation?

Ans. Vasoconstriction: It is the decrease in **diameter** of a blood vessel due to **contraction** of smooth circular muscles, in the walls of arterioles, under the effect of **nervous or endocrine stimulation**. It reduces blood flow in arterioles.

Vasodilation: It is the **increase of diameter** of a blood vessel due to **relaxation** of smooth circular muscles in arterioles. It increases blood flow in arterioles.

Q8. What is the rate of blood flow in different types of blood vessels?

Ans. Rate of Blood Flow

The velocity of blood flow is different in different vessels. It is **highest in aorta (450-500 mm/sec)** and tends to fall along the network of arteries, arterioles and becomes **lowest in capillaries (01 mm/sec)**. It rises again in venules, veins and vena cavae (250-300 mm/sec). These changes in the velocity of blood **result from changes in the total cross section** of the vessel system.

Q9. State the role of baroreceptors and volume receptors in regulating the low blood pressure.

Ans. Regulation of Blood pressure

Role of baroreceptors: Pressure receptors, known as **baroreceptors** are present in **carotid arteries** (arteries that supply blood to the head region and brain) and **aortic arch** (portion of aorta that bends between the ascending and descending aorta).

When **blood pressure falls**, baroreceptors activate sensory neurons that send information to brain. The control centre in

brain reacts by increasing the rate and force of contraction of heart and by causing vasoconstriction in arterioles. Both these changes restore blood pressure to normal.

Role of volume receptors: Certain hormones regulate the volume of blood by effecting the reabsorption of water and salt in kidneys. When there is a decrease in blood volume and blood pressure, special receptors present in brain create thirst. They also stimulate posterior pituitary gland to secrete **antidiuretic hormone (ADH)**.

Q10. Differentiate between thrombus and embolus.

Ans.

Thrombus	Embolus
Thrombus is a solid mass or plug of blood constituents (clot) platelets, fibrin fibres in a blood vessel. This mass may block (wholly or only in part) the vessel. Causes: Thrombus formation may be due to; (i) irritation or infection of lining of blood vessels, (ii) reduced rate of blood flow, due to long periods of inactivity, or (iii) pneumonia, tuberculosis, emphysema etc.	The dislodged thrombus which has entered the blood circulation is called embolus. Embolus may be carried to some other locations in the circulatory system which may get stuck in smaller blood vessels and cease blood supply leading to death of the affected tissues.

SLO BASED SHORT QUESTION ANSWERS

Structure and Functioning of Heart

Q11. Name the transport systems of humans describe the composition of blood circulatory system of humans.

Ans. Humans have two systems for the transport of different materials in different parts of body i.e., **blood circulatory system** and **lymphatic system**.

- The **closed blood circulatory system** of humans consists of **blood, heart, and blood vessels** (arteries, capillaries and veins).

★**Q12. Why heart is felt on the left side of chest? Describe its relation with lungs.**

Ans. The heart is usually felt to be on the left side because the **left side** of heart is **stronger and larger**, since it pumps blood to all body parts.

Relation with lungs: Because the heart is between the lungs, the **left lung is smaller** than the right lung and has a **cardiac notch** in its border to accommodate the heart

Q13. Describe the position and location of heart.

Ans. It is situated in the middle of chest cavity (between the lungs). Its **back surface** is near vertebral column while its **front surface** is behind sternum and rib cartilages.

Q14. What is pericardium? Describe its layers with their roles.

Ans. Heart is enclosed in a sac called **pericardium**. Pericardium separates heart from surrounding organs. It is composed of the two layers, pericardial cavity and pericardial fluid.

1. **Outer layer** of pericardium is called **fibrous pericardium**. It is made of strong connective tissue.

- It protects heart against external pressure and shocks.
- It also prevents excessive dilation of heart.

2. **Inner layer** of pericardium is called **serous pericardium**. It is a sac, made of two layers i.e.,

a) **Outer parietal** pericardium - present beneath fibrous pericardium.

b) **Inner visceral** pericardium (also called epicardium) - closely attached to the underlying heart.

Pericardial cavity: The space between parietal and visceral pericardium is called **pericardial cavity**.

- It contains up to 50 mL **pericardial fluid**. It lubricates heart and protects it from infections.

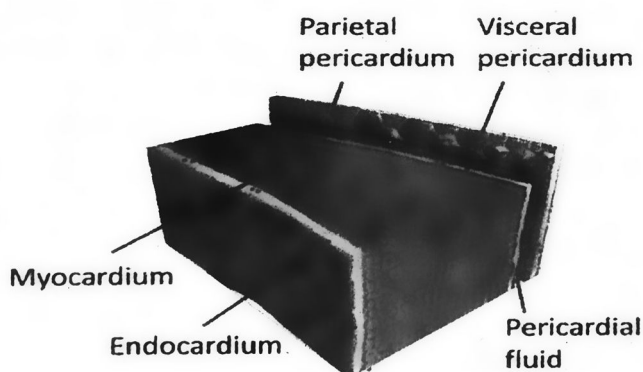
Q15. Describe the structure of heart wall.

Ans. The heart wall is composed of three layers.

Outer layer: The wall of heart is composed of three layers. The inner layer of pericardium i.e., **epicardium** makes the outer lining of heart wall.

Middle layer: Beneath epicardium, there is the thickest layer of heart wall i.e., myocardium. **Myocardium** is made of cardiac muscles.

Inner layer: Endocardium is present beneath myocardium. It is a single layer of epithelial cells and make the inner linings of heart chambers.



Q16. How many chambers are present in heart? State chambers and septa of heart.

Ans. Chambers of heart

There are four chambers of heart i.e., two upper thin-walled **atria** and two lower thick-walled **ventricles**. Atria receive blood from body and pass it to ventricles, which distribute blood to body.

Septa of heart

- **Atrioventricular septum:** Atria and ventricles are separated by **atrioventricular septum**.
- **Interatrial septum:** The left and right atria are separated from each other by an **interatrial septum**.
- **Interventricular septum:** The left and right ventricles are separated from each other by an **interventricular septum**. It is **much thicker** than the interatrial septum.

Q17. Human heart functions as a double pump. Justify?

Ans. Human heart functions as a **double pump** because its right side (Right atrium and Right ventricle) carries deoxygenated blood, and its left side (left atrium and left ventricle) carries oxygenated blood. It carries out **pulmonary circulation** (supply of blood to lungs) and **systemic circulation** (supply of blood to all organs of body – except lungs). Complete separation of deoxygenated (right side) and oxygenated (left side) blood is maintained in heart.

Q18. Trace the circulation of blood between heart, lungs and body.

Ans. Circulation of deoxygenated blood
The right atrium receives **deoxygenated blood from body** via two veins i.e., superior vena cava and inferior vena cava. Right atrium passes this blood to right ventricle via tricuspid valve. When right ventricle contracts, deoxygenated blood is passed to

pulmonary trunk via semilunar pulmonary valve. The pulmonary trunk divides into left and right pulmonary arteries which carry this blood to lungs.

Circulation of oxygenated blood

The oxygenated blood from lungs is brought to left atrium by four pulmonary veins. Left atrium passes this blood to left ventricle via bicuspid (or mitral) valve. When left ventricle contracts, oxygenated blood is passed to aorta via semilunar aortic valve. Aorta carries this blood to all parts of body (except lungs).

Q19. Define heartbeat.

Ans. Definition: "The rhythmic contractions and relaxations of the heart muscles, produce sound is called heartbeat".

Heart works in continuous cycles. Its chambers relax and are passively filled with blood from large veins. Then, its chambers contract and propel the blood throughout body.

Q20. Why left ventricle is thicker than right one?

Ans. The wall of left ventricle is thicker (about 3 times) than that of the right ventricle because it has to push/pump the blood to all over body, with greater force.

Q21. Differentiate between normal and abnormal heart sounds. How abnormal sounds can be caused?

Ans. Normal heart sounds: There are two normal heart sounds heard by stethoscope.

Lubb sound: When both ventricles contract simultaneously to pump the blood to pulmonary arteries and aorta, the tricuspid and bicuspid valves close and "lubb" sound is made.

Dubb sound: When ventricular systole ends and both ventricles relax simultaneously, the pulmonary and aortic semilunar valves close and "dubb" sound is made. Lubb-Dubb can be heard with the help of a stethoscope.

Abnormal heart sounds: If the valves are not closing fully, or if they open narrowly, turbulence is created within the heart. This turbulence can be heard; it is called **murmur**. A murmur sounds like a **hiss**.

Q22. Compare the morphology and physiology of SA-node and AV-node.

Ans.

SA-node	AV-node
• The sinoatrial node consists of a small cluster of cardiac muscle cells. • It is embedded in the upper wall of right atrium. • Heartbeat starts when SA-node sends electrical impulses to the walls of atria. • It causes both atria to contract simultaneously.	• AV-node is made of small cluster of cardiac muscle cells. • It is located at the lower portion of interatrial septum. • It sends impulses to ventricles through AV-bundle.

Q23. How nerve impulses are propagated from AV-node to ventricles?

Ans. From AV node, the impulses reach an **atrioventricular bundle** or **bundle of His**. It is a network of fibres present in

interventricular septum. AV bundle divides into left and right branches, which end at the **Purkinje fibres** in the walls of the ventricles. Stimulation of these fibres causes the ventricles to contract almost simultaneously.

Q24. What are consequences of blocked or weak impulse in heart? How it can be cured?

Ans. If there is some blockage in the flow of the electrical impulses, or if the impulses initiated by SA node are weak; it may delay the rhythmicity of heartbeat or stop it, which can lead to heart attack or cardiac failure, if not cured.

Cure of weak impulses: In such patients of weak SA node, **artificial pacemaker** is used. It is a battery- operated device that is surgically transplanted near the AV node. It emits electrical signals that trigger normal heartbeats.

Q25. Describe how heart rate is controlled in various physical conditions?

Ans. The heart of an average adult beats about **70 times per minute**. It pumps the entire blood volume (about 5 litres) every minute. The normal speed of heartbeat is

Q27. Compare PR segment with ST segment.

Ans.

PR segment	ST segment
• The flat line between the end of P-wave and start of QRS complex is called PR segment. • It shows the completion of atrial depolarization. • It is usually 0.12 to 0.20 seconds. • A prolonged PR indicates a first-degree heart block.	• It is a flat line between end of QRS complex and start of T-wave. • It shows the completion of depolarization of ventricles. • This segment ordinarily lasts about 0.08 second. • It can be depressed in ischemia (decreased flow of blood and oxygen to heart muscles) and elevated in myocardial infarction.

Q28. Brief about following components of ECG

a) P-wave

b) T-wave

Ans.

P-wave	T-wave
• It shows beginning of atrial depolarization, initiated by SA node. It causes atrial contraction. • Irregular or absent P waves may indicate arrhythmia (lack of rhythmicity).	• It represents the beginning of repolarization of ventricles. • T-wave abnormalities may indicate electrolyte disturbance. The hyper-acute T-wave shows the earliest findings of acute myocardial infarction.

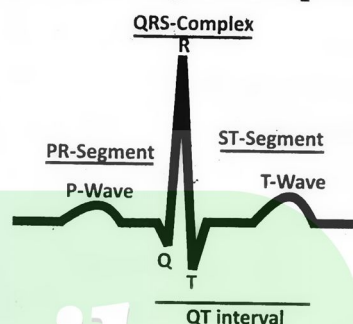
made and maintained by pacemaker and AV node. Brain also exerts some influence on heart rate.

During fever: During fever and exercise, the control centre in brain sends nerve signals to both the pacemaker and the AV node, making them to increase the heart rate. It is to cope with the situation.

During rest: In contrast, when we are asleep or at rest, the brain's control centre slows down the activity of pacemaker and AV node.

Q26. Draw the sketch of normal ECG wave form showing its component.

Ans.



Q29. Compare QRS complex and QT interval of a normal ECG.

Ans.

QRS	QT interval
- It shows the beginning of depolarization of ventricles. Atrial repolarization also occurs during this phase. Abnormalities in the QRS complex may indicate bundle branch block, ventricular tachycardia (faster rate of contraction), or other ventricular abnormalities.	- The QT interval is from the beginning of the QRS complex to the end of the T wave. A normal QT interval is usually about 0.40 seconds. Abnormalities of QT-interval can indicate dangerous heart rhythms and sudden cardiac death.

★Q30. What are blue babies? Describe its reasons.

Ans. It is a development defect in the cardiovascular system some newborns, in which the infants skin appears blue, these are called blue babies. The blueness of skin is called cyanosis, which is due to poorly oxygenated (mix blood) to the body (especially skin).

Causes

- Cyanosis results due to the failure of **interatrial foramen** to close, during

development, which is a temporary opening in the embryonic heart between right and left atria. Normally, it is closed during development.

- Cyanosis may also happen due to failure of **ductus arteriosus** to fully constrict, during development. Ductus arteriosus is a temporary channel between the embryonic pulmonary artery and aorta. Normally, it constricts during development.

Blood Vessels

Q31. Differentiate between arteries and veins.

Ans.

Arteries	Veins
- Arteries are the blood vessels which carry blood away from heart to different parts of body. - All arteries carry oxygenated blood, except pulmonary arteries. - The walls of arteries are made up of three layers. Tunica externa or adventitia: It is the outer layer of arteries made of connective and elastic tissue. Tunica media: It is the middle layer of arteries made of thick muscular tissue and elastic fibres. Tunica intima: It is the inner layer of arteries made of thin layer of endothelial cells.	- These blood vessels carry blood from different parts of the body towards heart. - All veins carry deoxygenated blood, except pulmonary veins. - The wall of veins has same three layers as are present in arteries. Tunica externa (adventitia): It is the outer layer of veins, made of connective and elastic tissue. Tunica media: It is the middle layer of veins, relatively thin and only slightly muscular, with few elastic fibres. Tunica intima: It is the inner layer of veins, made of thin layer of endothelial cells.

Q32. How capillaries are formed? Describe their composition and role.

Ans. Formation: These vessels are formed by the division of arterioles. Capillaries join to form venules. Capillaries penetrate all tissues and have approach to the cellular level.

Composition: The walls of capillaries are made of a single layer of **endothelial** cells. The internal diameter of a capillary is about 8 micrometers.

Role: Capillaries are the sites where materials are exchanged between blood and body tissues by diffusion or active transport.

★Q33. What do you know about the length of capillaries?

Ans. No cell of the body is more than 100 micrometres away from a capillary. Capillaries are so narrow that RBCs must pass through them in single line. It is estimated that the total length of capillaries in an adult human is over 80,600 kilometres, enough to encircle the global twice!

Q34. Define interstitial fluid. Describe its composition.

Ans. Definition: The pressure within capillaries causes a continuous leakage of fluid from the blood plasma into tissues. This fluid, known as **interstitial fluid**.

Composition: Interstitial fluid consists of water with dissolved nutrients, hormones, gases, wastes and small proteins.

Q36. Differentiate between pulmonary circulation from system circulation.

Ans.

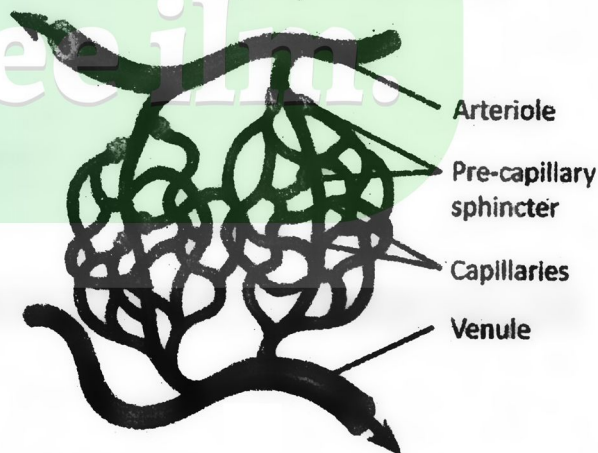
Pulmonary Circulation	System Circulation
• Circulation of blood from heart to the lungs and from lungs back to the heart is called pulmonary circulation. • Pulmonary circulation supplies deoxygenated blood to lungs and returns oxygenated blood to heart.	• Circulation of blood from heart to body (except lungs) and from body back to heart is called systemic circulation. • The systemic circulation supplies oxygenated blood to all the cells, tissues, and organs of the body (except lungs) and returns deoxygenated blood to heart.

Large proteins, RBCs and platelets remain within capillaries. But some WBCs can squeeze out through the intercellular spaces of capillary wall.

Q35. Describe the role of pre-capillary sphincters in maintaining blood flow in capillaries.

Ans.

- Some capillaries are connected to arterioles and venules through loops of other capillaries. The entry of each loop is guarded by a ring of muscles called a **pre-capillary sphincter**. These sphincters regulate the amount of blood flowing through capillaries.
- The amount of blood flowing in capillaries is controlled by constricting or dilating the capillaries. Nervous stimulation can constrict capillaries and certain chemicals such as **histamine** can dilate them.



Q37. Describe the blood supply of heart.

Ans. Arterial blood supply: The heart walls are supplied with blood through a small portion of the systemic circulation. **Two coronary arteries** i.e., the right and left coronary arteries, arise from the aorta, near its origin. These arteries divide into many smaller arteries, arterioles and then into capillaries.

Venous blood supply: After supplying oxygenated blood to heart muscles, the capillaries unite to form venules which make many **coronary veins**. The coronary veins join to form a **coronary sinus**, which opens in right atrium. Small coronary veins drain directly into right atrium.

Q38. Define hepatic-portal circulation. For what purpose it is build?

Ans. A portal system is a circulation in which **veins end in capillaries**. In hepatic portal system, a large **hepatic portal vein** collects blood from **spleen** and **alimentary canal** and takes it to the liver through hepatic portal vein. The blood from liver is taken to heart through **hepatic veins**. Hepatic portal system extends from the lower portion of oesophagus to the upper part of anal canal.

Purpose: The blood that comes from alimentary canal to liver contains substances that are absorbed from small intestine. These substances pass through liver before going to heart. Liver removes harmful substances from blood and absorbs nutrients for storage before sending this blood to heart.

Q39. Describe the renal circulation of blood.

Ans. Arterial circulation: The kidneys (renals) are supplied by left and right renal arteries. **Right and left renal arteries** carry oxygenated blood to the right and left kidneys. Inside the kidney, each renal artery

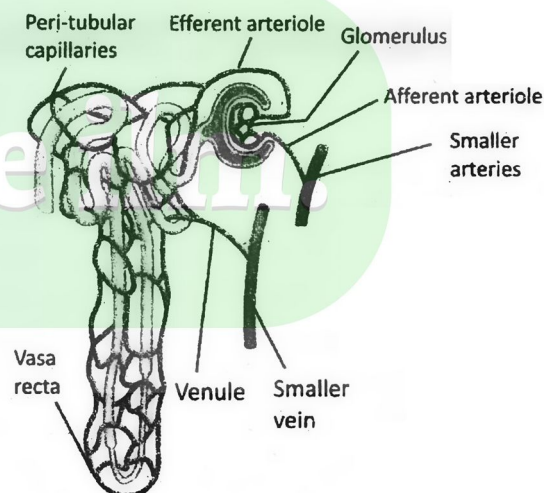
divides repeatedly to make **smaller arteries**. The smaller arteries branch into several **afferent arterioles**, which supply blood to nephrons (units of kidney).

- Each afferent arteriole divides to make the capillaries of **glomeruli**.

Venous circulation: The capillaries of glomeruli unite to make **efferent arteriole**, which divides to make two sets of capillaries i.e., (i) **peri-tubular capillaries** (around nephron tubule in cortical portion of kidney), and (ii) **vasa recta** (around nephron tubule in the medulla of kidney). These capillaries unite to form **venules** that converge and make smaller veins. The smaller veins unit to form a **renal vein**.

Q40. Sketch and label nephron.

Ans.

**Blood Pressure****Q41. Define blood pressure. Describe systolic and diastolic pressure. How it is measured?**

Ans. Blood pressure is the measure of force exerted by blood against the inner walls of blood vessels arteries. This force keeps blood flowing from heart to the entire capillary network in body.

Systolic pressure: When ventricles contract (ventricular systole), heart forces blood into pulmonary arteries and aorta. As a result, the pressure in these arteries rises sharply. The

maximum pressure during ventricular systole is called **systolic pressure**. Systolic pressure in a normal young adult is **120 mm Hg**.

Diastolic pressure: When ventricles relax (diastole), the arterial pressure drops. The lowest pressure that remains in arteries before the next ventricular contraction is called **diastolic pressure**. Diastolic pressure in a normal young adult is **80 mm Hg**.

- It is measured using **sphygmomanometer** and stethoscope.

Q42. Describe the long-term regulation of blood pressure. / Describe the hormonal mechanism of blood pressure regulation.

Ans. The long-term regulation of blood pressure is done through **hormones**. Certain hormones regulate the volume of blood by effecting the reabsorption of water and salt in kidneys.

Role of ADH in low blood pressure

When there is a decrease in blood volume and blood pressure, special receptors present in brain create thirst. They also stimulate posterior pituitary gland to secrete **antidiuretic hormone (ADH)**. ADH stimulates kidneys to retain more water in blood, excreting less in urine. It restores the blood volume and ultimately blood pressure. ADH also constricts arterioles, which raises arterial blood pressure.

Q43. Compare and contrast the roles of ADH and ANH in maintaining blood pressure.

Ans.

ADH	ANH
• ADH (Anti Diuretic Hormones) usually works to raise/increase blood pressure during low blood pressure. • ADH stimulates kidneys to retain more water in blood, excreting less in urine. It restores the blood volume and ultimately blood pressure. ADH also constricts arterioles, which raises arterial blood pressure.	• ANH (Arterial Natriuretic Hormones) works to decrease blood pressure during high blood pressure. • The walls of right atrium contain endocrine cells that secrete atrial natriuretic hormone (ANH). When there is stretching of the atrium by an increased blood volume, the right atrium secretes ANH. It speeds up the excretion of salts and water through urine, which lowers the blood volume and pressure.

Cardiovascular Disorders

Q44. Differentiate between atherosclerosis and arteriosclerosis.

Ans.

Atherosclerosis	Arteriosclerosis
Atherosclerosis means deposition within arteries. Various materials may accumulate in arteries e.g., fatty materials, abnormal amounts of smooth muscle cells, cholesterol, fibrin and cellular debris of various kinds. Atherosclerosis can lead to heart attacks, because it causes the narrowing of arteries	Arteriosclerosis means hardening of arterial walls. It occurs when calcium is deposited in arterial walls. The blood flow through these arteries is restricted and arteries cannot expand normally. This forces the heart to work harder. Severe atherosclerosis usually leads to arteriosclerosis.

and increases the risk of the formation of thrombus.

It is coexisting Atheroma and arteriosclerosis **Atheroma** is deposition of hard yellow plaque of lipoid material in the inner most layer of arteries which may be due to high level of cholesterol in the blood. **Arteriosclerosis** is degenerative arterial change associated with advancing age, primarily a thickening of middle layer of arteries.

Q45. Define thromboembolism and thrombosis. How it is formed?

Ans. Thromboembolism: Formation of thrombus in a blood vessel and then its carriage to any other location is called **thromboembolism**.

Thrombosis: Thrombosis is the formation of thrombus. Thrombus is a solid mass or plug of blood constituents (clot) in a blood vessel. This mass may block (wholly or only in part) the vessel.

Causes: Thrombus formation may be due to; (i) irritation or infection of lining of blood vessels, (ii) reduced rate of blood flow, due to long periods of inactivity, (iii) pneumonia, tuberculosis, emphysema etc.

Q46. What happens if thrombosis occurs in coronary arteries and brain vessels?

Ans. Thrombosis blocks the blood flow to organs. A **thrombosis in coronary arteries** causes heart attack which can be life threatening. Similarly, a **thrombus in the vessels of brain** causes **stroke** (which causes paralysis of the muscles). A thrombus may be dislodged and carried to some other locations in the circulatory system. Such a thrombus is called **embolus**.

Q47. What is angina pectoris? What does it indicate?

Ans.

- The pain felt in the regions of chest, shoulders, arms and jaws due to hypoxia

(low oxygen levels) to myocardium is called **angina pectoris**.

- It usually occurs due to blockage of coronary arteries is usually due to gradual build-up of lipids (especially **cholesterol**) in the inner wall of coronary artery.
- Angina indicates that oxygen demands are greater than its delivery and a heart attack may occur in future.

Q48. Define myocardial infarction. Is it possible to recover from heart attack?

Ans. Death of heart muscles due to insufficient supply of oxygen and nutrients; leading to death of cardiomyocytes is known as **myocardial infarction** also known as heart attack.

Causes: The major cause of heart attack is the blockage of coronary arteries.

Coronary arteries supply oxygen and nutrients to **cardiac muscles**. If blood flow is blocked in coronary arteries, it results in insufficient supply of blood to one or more parts of cardiac muscle.

Recovery from a heart attack is possible if the damaged portion of heart is small enough that the other blood vessels in heart can enlarge their capacity and **resupply** the damaged tissues.

Q49. Which procedure is used to examine blood vessels and chambers of heart? How it is performed?

Ans. Coronary angiography is the most appropriate method to examine blood vessels

and heart chambers. In this method X-rays are used to examine the blood vessels and heart chambers. In order to create the X-ray pictures, a physician guides a small tube-like device called catheter through the large arteries of body. When the tip of catheter reaches the opening of coronary arteries, a special fluid (called a contrast medium or dye) is injected in catheter. This fluid is visible in X-ray machine. Pictures (angiograms) of fluid in coronary artery are obtained.

Q50. What is open-heart surgery? How coronary bypass surgery is performed?

Ans.

- The **open heart surgery** is done when heart is still beating it includes bypass surgery valvular replacement etc.

Coronary Bypass Surgery

- It is one of the most common and effective procedures to compensate the blockage of blood to cardiac muscles. In this surgery, surgeon takes a healthy blood vessel from leg, arm, chest or abdomen of the patient. He attaches the ends of blood vessel above and below the blocked coronary artery. So, blood is bypassed around the damaged or blocked area.
- Coronary bypass surgery doesn't cure the underlying disease process i.e., atherosclerosis or coronary artery disease. Lifestyle changes especially smoking cessation are crucial to reduce the chance of future blockages and heart attacks, even after successful bypass surgery.

Q51. Describe the procedure of performing angioplasty and stenting.

Ans. Angioplasty: Angioplasty is a procedure that opens a blocked or narrowed artery. During an angioplasty, a small wire called a catheter, under X-ray guidance, is passed through the narrowed coronary artery.

A small sausage-shaped balloon is then advanced over the wire into the narrowed section of artery. The balloon is then inflated to dilate the narrowed section of the artery. Once the artery is dilated, a small amount of dye is injected to confirm the successful dilatation.

Stenting: Stenting may also be done during angioplasty. A stent is an expandable stainless steel mesh tube, mounted on a balloon catheter. When the stent/balloon is positioned within the narrowed artery, the balloon is inflated. The inflated balloon expands the stent and the artery. The balloon is removed and the stent remains in place. The stent supports the artery walls and keep the artery open and dilated.

Q52. Define hypertension. What are its causes?

Ans. A chronic (long lasting) elevation in blood pressure is called hypertension. It occurs when blood pressure consistently remains above **140/90 mm Hg**.

Causes

- Any abnormality in nervous or hormonal mechanisms of blood pressure regulation may cause hypertension.
- Stress, obesity, high salt intake, smoking, there may also be hereditary reasons of hypertension.

Q53. Illustrate the damages caused by hypertension. / What are the complications of hypertension?

Ans. Whenever blood pressure is chronically elevated, there is an increased chance of the rupture of blood vessels.

Effect on brain: When this occurs in brain, it is called **brain haemorrhage**. It damages the delicate structure of brain.

Effect on cardiac muscles: Hypertension also weakens cardiac muscles. If hypertension is prolonged, heart is unable to pump effectively and blood flow cannot

be maintained to meet needs of tissues. In such conditions, blood may be retained in heart and lungs. It is called **congestive heart failure**.

Effect on kidneys: Hypertension can also damage the nephrons of kidneys. It leads to further retention of salts and water in blood and therefore further hypertension.

Lymphatic system of human

Q54. Write the definition and composition of lymphatic system of human.

Ans. In human, in addition to the blood circulatory system, there is another system responsible for the transport of materials. It also returns the materials from tissues to blood. This system is called lymphatic system.

Composition: It consists of lymph vessels, lymphoid masses, lymph nodes and lymph-the fluid which flows in the system.

Q55. Define lacteals. Write their role.

Ans. The branches of lymph capillaries in villi, are called lacteals. Fatty acids and glycerol are absorbed into the epithelial cells of villi where they form triglycerides. The triglycerides are coated with proteins to form chylomicrons, which enter the lacteals of villi.

Q56. Write two important functions of lymphatic system.

Ans. Functions of lymphatic system

- Lymphatic system returns the excess fluid and dissolved proteins and other substances to blood. In an average person, about three litres more fluid leaves blood capillaries daily. But it is absorbed by lymphatic capillaries and returned to bloodstream, before the blood enters heart.

- Lymphatic system also helps to defend body against foreign invaders.
- Lymph nodes filter lymph. They have lymphocytes and macrophages that destroy bacteria and viruses present in lymph.

★Q57. Give the reason of swelling of lymph nodes.

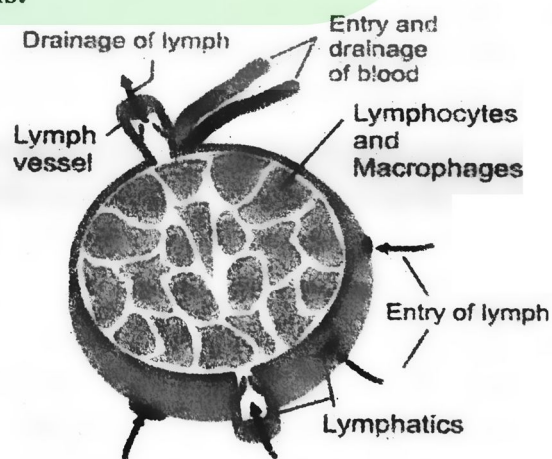
Ans. The painful swelling of lymph nodes in certain diseases (e.g., mumps) is largely a result of the accumulation of dead lymphocytes and macrophages.

Q58. Define lymph nodes. Where they are present in human body?

Ans. At certain spots, the lymph vessels have masses of connective tissue where lymphocytes are present. These are **lymph nodes**. Several afferent lymph vessels enter a lymph node and the lymph is drained by a single efferent lymph vessel. Lymph nodes are present in the neck region, axilla and groin areas of man.

Q59. Sketch and label a lymph node?

Ans.



Q60. Name some lymphoid masses. What do they produce?

Ans. The larger lymphoid masses are spleen, thymus, tonsils and adenoids. These produce lymphocytes and play a role in immunity.

LONG QUESTIONS (EXERCISE)

Q1. Describe the structure of the walls of heart and rationalize the thickness of the wall of each chamber.

Ans. See Q1. of theory.

Q2. Describe the flow of blood through heart as regulated by the valves.

Ans. See Q2. of theory.

Q3. Explain how a heartbeat is initiated and controlled.

Ans. See Q4. of theory.

Q4. Describe the detailed structure of arteries, veins and capillaries.

Ans. See Q6. of theory.

Q5. Describe the role of precapillary sphincters in regulating the flow of blood through capillaries.

Ans. See Q7. of theory.

Q6. Write the components of pulmonary circulation.

Ans. See Q9. of theory.

Q7. What are the main components of coronary, hepatic-portal and renal circulation?

Ans. See Q10. of theory.

Q8. Define blood pressure and explain systolic and diastolic pressure.

Ans. See Q11. of theory.

Q9. Identify the factors causing atherosclerosis and arteriosclerosis.

Ans. See Q13. of theory.

Q10. Write notes on Angina pectoris heart attack, and heart failure.

Ans. See Q15. of theory.

Q11. Outline the main principles of coronary bypass and angioplasty.

Ans. See Q16. of theory.

Q12. Define hypertension and describe the factors that regulate blood pressure and can lead to hypertension and hypotension.

Ans. See Q17. of theory.

Q13. List the changes in life styles than can protect man from hypertension and cardiac problems.

Ans. See Q15. of theory.

Q14. Describe the structure and role of lymph capillaries, lymph vessels and lymph ducts.

Ans. See Q18. of theory.

INQUISITIVE QUESTIONS

Q1. Why is the pressure in the pulmonary circulation lower than in the systemic circulation?

Ans. The pressure in the pulmonary circulation is significantly lower than is systemic circulation due to differences in vascular resistance, vascular structure and functional requirements. The pulmonary circulation is a **low pressure, high flow system** designed for efficient gaseous exchange, while systemic circulation is a **high pressure system** needed to supply all organs against resistance.

Q2. Why is it so important for the human heart to develop early and begin functioning within the developing embryo?

Ans. The early development and functioning of the human heart in the embryonic life are crucial for several reasons related to **oxygen supply, nutrients delivery, removal of metabolic waste** and for the **survival of embryo**. Embryo grows too fast, so diffusion alone

becomes insufficient to meet the requirements of rapid growth. As the metabolic rate of embryo is very high every. To form new organs, oxygen, nutrients supply and waste removal, without heart seems to be very difficult.

Q3. Justify how vasoconstriction or vasodilation is reflective of emotions.

Ans. Vasoconstriction and vasodilation are physiological responses that reflects emotional states due to relationship with autonomic nervous system and endocrine systems.

- **For example**, during fear stress & emergency situations sympathetic nervous system activates leading to **vasoconstriction** in gastro intestinal tract (GIT) and skin while **vasodilation** occurs improving blood flow to muscles and brain to prepare body for rapid actions (e.g., running or fighting). These vascular changes not only prepare the body for action or recovery, but also visibly manifest emotions (e.g., blushing, pallor) making them a physiological mirror of our inner feelings.

Q4. Justify in what way the blood circulatory system is dependent on the lymphatic system.

Ans. The blood circulatory system depends on the lymphatic system as about 3 litres more fluid leaves blood capillaries daily then is reabsorbed in an average adult, lymphatic system returns this excess fluid having dissolved proteins and other substances, back to blood circulatory system to maintain its **blood volume**, moreover it also **destroys the pathogens** which entered the tissues thus, helps defend the body against foreign invaders.

Q5. Interpret why the swelling of the lymph nodes is a cause of concern.

Ans. The swelling of lymph nodes also called **lymph adenopathy** can be caused by various factors, like **viral infections** (mumps), **bacterial infections** (cervical lymph adenopathy) or due to **cancer**. As the lymph nodes filter lymph bacteria or viruses present in lymph are destroyed by macrophages and lymphocytes of lymph nodes which often result in swelling, so that's why swelling of lymph nodes is a cause of concern it shall not be left unattended.

Q6. Trace the path of lymph until it is returned to the blood.

Ans. Lymph → lymph capillaries → lymphatic vessels → larger lymph ducts → main lymph duct (right lymphatic duct and thoracic duct) → subclavian veins (right and left).