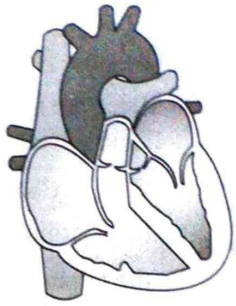
CHAPTER

# 15 Body Fluids and Circulation



## 15.1. Blood

**1.** A person with blood group A $Rh^-$ can receive the blood transfusion from which of the following types?

(I) B $Rh^-$ (II) AB $Rh^-$

(III) O $Rh^-$ (IV) A $Rh^-$

(V) A $Rh^+$

Choose the correct answer from the options given below:

(A) (IV) and (V) only

(B) (IV) only

(C) (I) and (II) only

(D) (III) and (IV) only **[Re-NEET 2024]**

**2.** Given below are two statements:

**Statement I:** Bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced.

**Statement II:** Both bone marrow and thymus provide micro environments for the development and maturation of T-lymphocytes.

In the light of the above statements, choose the most appropriate answer from the options given below:

(A) Both Statement I and Statement II are incorrect.

(B) Statement I is correct but Statement II incorrect.

(C) Statement I is incorrect but Statement II is correct.

(D) Both Statement I and Statement II are correct.

**[NEET 2024]**

**3.** In which blood corpuscles, the HIV undergoes replication and produces progeny viruses?

(A) Basophils (B) Eosinophils

(C) $T_H$ cells (D) B-lymphocytes

**[NEET 2023]**

**4.** Which of the following statements are correct?

(I) Basophils are most abundant cells of the total WBCs.

(II) Basophils secrete histamine, serotonin and heparin.

(III) Basophils are involved in inflammatory response.

(IV) Basophils have kidney shaped nucleus.

(V) Basophils are agranulocytes.

Choose the correct answer from the options given below:

(A) (II) and (III) only (B) (I) and (II) only

(C) (IV) and (V) only (D) (III) and (V) only

**[NEET 2023]**

**5.** Given below are two statements:

**Statement I:** The coagulum is formed of network of threads called thrombins.

**Statement II:** Spleen is the graveyard of erythrocytes.

In the light of the above statements, choose the most appropriate answer from the options given below:

(A) Both Statement I and Statement II are incorrect.

(B) Statement I is correct but Statement II is incorrect.

(C) Statement I is incorrect but Statement II is correct.

(D) Both Statement I and Statement II are correct.

**[NEET 2022]**

**6.** Which enzyme is responsible for the conversion of inactive fibrinogens to fibrins?

(A) Thrombin (B) Renin

(C) Epinephrine (D) Thrombokinase

**[NEET 2021]**

**7.** Which of the following conditions causes erythroblastosis foetalis?

(A) Mother Rh +ve and foetus Rh –ve

(B) Mother Rh –ve and foetus Rh +ve

(C) Both mother and foetus Rh –ve

(D) Both mother and foetus Rh +ve **[NEET Oct. 2020]**

**8.** Match the following columns.

| Column I | Column II |
|---|---|
| (a) Eosinophils | (i) Immune response |
| (b) Basophils | (ii) Phagocytosis |
| (c) Neutrophils | (iii) Release histamine, destructive enzymes |
| (d) Lymphocytes | (iv) Release granules containing histamine |

Select the correct option:

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | (iv) | (i) | (ii) | (iii) |
| (B) | (i) | (ii) | (iv) | (iii) |

(C) (ii) (i) (iii) (iv)

(D) (iii) (iv) (ii) (i) **[NEET Sept. 2020]**

**9.** Match the items given in Column I with those in Column II and select the correct option given below.

| Column I | Column II |
|---|---|
| (a) Fibrinogen | (i) Osmotic balance |
| (b) Globulin | (ii) Blood clotting |
| (c) Albumin | (iii) Defence mechanism |

Select the correct option from the following:

| | (a) | (b) | (c) |
|---|---|---|---|
| (A) | (i) | (iii) | (ii) |
| (B) | (i) | (ii) | (iii) |
| (C) | (iii) | (ii) | (i) |
| (D) | (ii) | (iii) | (i) |

**[NEET 2018]**

**10.** Adult human RBCs are enucleated. Which of the following statement(s) is/are most appropriate explanation for this feature?

(I) They do not need to reproduce.

(II) They are somatic cells.

(III) They do not metabolise.

(IV) All their internal space is available for oxygen transport.

Select the correct option:

(A) Only (IV) (B) Only (I)

(C) (I), (Ill) and (IV) (D) (II) and (III) **[NEET 2017]**

**11.** Name the blood cells, whose reduction in number can cause clotting disorder, leading to excessive loss of blood from the body.

(A) Erythrocytes (B) Leucocytes

(C) Neutrophils (D) Thrombocytes

**[NEET Phase-II 2016]**

**12.** Serum differs from blood in:

(A) lacking globulins

(B) lacking albumins

(C) lacking clotting factors

(D) lacking antibodies **[NEET Phase-II 2016]**

**13.** Erythropoiesis starts in:

(A) kidney (B) liver

(C) spleen (D) red bone marrow

**[AIPMT Cancelled 2015]**

**14.** Which one of the following is correct?

(A) Plasma = Blood - Lymphocytes

(B) Serum = Blood + Fibrinogen

(C) Lymph = Plasma + RBC + WBC

(D) Blood = Plasma + RBC + WBC + Platelets

**[AIPMT Cancelled 2015]**

**15.** The figure shows a human blood cell. Identify it and give its characteristics.

| | Blood cell | Characteristics |
|---|---|---|
| (A) | Basophil | Secretes serotonin, inflammatory response |
| (B) | B-lymphocyte cells | Forms about 20% of blood involved in immune response |
| (C) | Neutrophil | Most abundant blood cells, phagocytic |
| (D) | Monocyte | Life span of 3 days, produces antibodies |

**[NEET Karnataka 2013]**

**16.** Which one of the following human organs is often called the 'graveyard' of RBCs?

(A) Gall bladder (B) Kidney

(C) Spleen (D) Liver

**[AIPMT Mains 2012]**

**17.** A person with unknown blood group under ABO system, has suffered much blood loss in an accident and needs immediate blood transfusion. His one friend who has a valid certificate of his own blood type, offers for blood donation without delay. What would have been the type of blood group of the donor friend?

(A) Type AB (B) Type O

(C) Type A (D) Type B

**[AIPMT Screening 2011]**

**18.** Which one of the following plasma proteins is involved in the coagulation of blood?

(A) Serum amylase (B) A globulin

(C) Fibrinogen (D) An albumin

**[AIPMT Screening 2011]**

**19.** The haemoglobin content per 100 mL of blood of a normal healthy human adult is:

(A) 5-11 g (B) 25-30 g

(C) 17-20 g (D) 12-16 g

**[AIPMT Mains 2010]**

**20.** There is no DNA in:

(A) an enucleated ovum

(B) mature RBCs

(C) a mature spermatozoan

(D) hair root **[AIPMT Screening 2009]**

**21.** Globulins contained in human blood plasma are primarily involved in:

(A) defence mechanisms of body
(B) osmotic balance of body fluids
(C) oxygen transport in the blood
(D) clotting of blood **[AIPMT Screening 2009]**

**22.** Which type of white blood cells are concerned with the release of histamine and the natural anticoagulant heparin?
(A) Neutrophils (B) Basophils
(C) Eosinophils (D) Monocytes
**[AIPMT Screening 2009]**

**23.** The most active phagocytic white blood cells are:
(A) neutrophils and eosinophils
(B) lymphocytes and macrophages
(C) eosinophils and lymphocytes
(D) neutrophils and monocytes
**[AIPMT Screening 2008]**

**24.** A drop of each of the following, is placed separately on four slides. Which of them will not coagulate?
(A) Blood serum
(B) Sample from the thoracic duct of lymphatic system
(C) Whole blood from pulmonary vein
(D) Blood plasma **[AIPMT 2007]**

**25.** Which of the following substances, if introduced into the blood stream, would cause coagulation of blood at the site of its introduction?
(A) Prothrombin (B) Fibrinogen
(C) Thromboplastin (D) Heparin **[AIPMT 2005]**

**26.** You are required to draw blood from a patient and to keep it in a test tube for analysis of blood corpuscles and plasma. You are also provided with the following four types of test tubes. Which of these will you not use for the purpose?
(A) Test tube containing calcium bicarbonate
(B) Chilled test tube
(C) Test tube containing heparin
(D) Test tube containing sodium oxalate **[AIPMT 2004]**

**27.** Continuous bleeding from an injured part of the body is due to the deficiency of:
(A) vitamin A (B) vitamin B
(C) vitamin K (D) vitamin E **[AIPMT 2002]**

**28.** Which of the following is correct for blood group 'O'?
(A) No antigens but both A and B antibodies are present.
(B) A antigen and B antibody both are present.
(C) Antigen and antibody are both absent.
(D) A and B antigens and A, B antibodies are present.
**[AIPMT 2001, 1999]**

**29.** What is correct regarding leucocytes?
(A) These can squeeze out through (can cross) the capillary walls.
(B) These are enucleate.
(C) Sudden fall in their number indicates cancer.
(D) These are produced in thymus. **[AIPMT 2000]**

**30.** Which is the principal cation in the plasma of the blood?
(A) Magnesium (B) Sodium
(C) Potassium (D) Calcium **[AIPMT 1999]**

**31.** Which of the following is agranulocyte?
(A) Lymphocyte (B) Eosinophil
(C) Basophil (D) Neutrophil
**[AIPMT 1997]**

**32.** The life span of human WBC is approximately:
(A) less than 10 days (B) between 20-30 days
(C) between 2-3 months (D) more than 4 months
**[AIPMT 1997]**

**33.** Which one of the following vertebrate organs receives the oxygenated blood only?
(A) Gill (B) Lung
(C) Liver (D) Spleen **[AIPMT 1996]**

**34.** Antigens are present:
(A) inside the nucleus
(B) on cell surface
(C) inside the cytoplasm
(D) on nuclear membrane. **[AIPMT 1995]**

**35.** Vitamin K is required for:
(A) change of Prothrombin to Thrombin
(B) synthesis of Prothrombin
(C) change of Fibrogen to Fibrin
(D) formation of Thromboplastin **[AIPMT 1993]**

**36.** Cells formed in bone marrow include:
(A) RBC (B) RBC and leucocytes
(C) leucocytes (D) lymphocytes.
**[AIMPT 1993]**

**37.** Removal of calcium from freshly collected blood would:
(A) cause delayed clotting
(B) prevent clotting
(C) cause immediate clotting
(D) prevent destruction of haemoglobin.
**[AIPMT 1989]**

**38.** A person with blood group A requires blood. The blood group which can be given is:
(A) A and B (B) A and AB
(C) A and O (D) A, B, AB and O
**[AIPMT 1989]**

## 15.2. Lymph (Tissue Fluid)

**39.** Compared to blood our lymph has:

(A) no plasma

(B) plasma without proteins

(C) more WBCs and no RBCs

(D) more RBCs and less WBCs

**[AIPMT Screening 2009]**

**40.** Which of the following statement is true for lymph?

(A) WBC and serum

(B) All components of blood except RBCs and some proteins

(C) RBCs, WBCs and plasma

(D) RBCs, proteins and platelets **[AIPMT 2002]**

**41.** Which of the following is not the main function of lymph glands?

(A) Forming RBCs (B) Forming WBCs

(C) Forming antibodies (D) Destroying bacteria

**[AIPMT 1998]**

**42.** The lymph serves to:

(A) return the interstitial fluid to the blood.

(B) return the WBCs and RBCs to the lymph nodes.

(C) transport $CO_2$ to the lungs.

(D) transport $O_2$ to the brain. **[AIPMT 1995]**

**43.** Lymph differs from blood in possessing:

(A) only WBCs

(B) more RBCs and WBCs

(C) more RBCs and few WBCs

(D) more WBCs and few RBCs **[AIPMT 1989]**

## 15.3. Circulatory Pathways

**44.** 'Lub' sound of Heart is caused by the ..... .

(A) closure of the semilunar valves

(B) opening of tricuspid and bicuspid valves

(C) opening of the semilunar values

(D) closure of the tricuspid and bicuspid values

**[Re-NEET 2024]**

**45.** Following are the stages of pathway for conduction of an action potential through the heart:

(I) AV bundle (II) Purkinje fibres

(III) AV node (IV) Bundle branches

(V) SA node

Choose the correct sequence of pathway from the options given below:

(A) (I)-(V)-(III)-(II)-(IV) (B) (II)-(IV)-(V)-(III)-(I)

(C) (V)-(I)-(IV)-(II)-(III) (D) (V)-(III)-(I)-(IV)-(II)

**[NEET 2024]**

**46.** Match List I with List II:

| List I | List II |
|---|---|
| (a) P wave | (i) Heart muscles are electrically silent. |
| (b) QRS complex | (ii) Depolarisation of ventricles. |
| (c) T wave | (iii) Depolarisation of atria. |
| (d) T-P gap | (iv) Repolarisation of ventricles. |

Choose the correct answer from the options given below:

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | (iii) | (ii) | (iv) | (i) |
| (B) | (ii) | (iii) | (i) | (iv) |
| (C) | (iv) | (ii) | (i) | (iii) |
| (D) | (i) | (iii) | (iv) | (ii) |

**[NEET 2024]**

**47.** Match List I with List II.

| List I | List II |
|---|---|
| (a) P-wave | (i) Beginning of systole |
| (b) Q-wave | (ii) Repolarisation of ventricles |
| (c) QRS complex | (iii) Depolarisation of atria |
| (d) T-wave | (iv) Depolarisation of ventricles |

Choose the correct answer from the options given below:

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | (ii) | (iv) | (i) | (iii) |
| (B) | (i) | (ii) | (iii) | (iv) |
| (C) | (iii) | (i) | (iv) | (ii) |
| (D) | (iv) | (iii) | (ii) | (i) |

**[NEET 2023]**

**48.** Which one of the following statements is correct?

(A) The tricuspid and the bicuspid valves open due to the pressure exerted by the simultaneous contraction of the atria.

(B) Blood moves freely from atrium to the ventricle during joint diastole.

(C) Increased ventricular pressure causes closing of the semilunar valves.

(D) The atrio-ventricular node (AV Node) generates an action potential to stimulate atrial contraction.

**[NEET 2022]**

**49.** The QRS complex in a standard ECG represents:

(A) depolarisation of auricles

(B) depolarisation of ventricles

(C) repolarisation of ventricles

(D) repolarisation of auricles. **[NEET Sept. 2020]**

**50.** What would be the heart rate of a person if the cardiac output is 5 L, blood volume in the ventricles at the end of diastole is 100 mL and at the end of ventricular systole is 50 mL?

(A) 75 beats per minute (B) 100 beats per minute

(C) 125 beats per minute (D) 50 beats per minute

**[NEET National 2019]**

**51.** Match the following columns.

| Column I | Column II |
|---|---|
| (a) P-wave | (i) Depolarisation of ventricles |
| (b) QRS complex | (ii) Repolarisation of ventricles |
| (c) T-wave | (iii) Coronary ischemia |
| (d) Reduction in the size of T-wave | (iv) Depolarisation of atria |
| | (v) Repolarisation of atria |

Select the correct option.

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | (iv) | (i) | (ii) | (v) |
| (B) | (ii) | (i) | (v) | (iii) |
| (C) | (ii) | (iii) | (v) | (iv) |
| (D) | (iv) | (i) | (ii) | (iii) |

**[NEET National 2019]**

**52.** A specialised nodal tissue embedded in the lower corner of the right atrium, close to atrio-ventricular septum, delays the spreading of impulses to heart apex for about 0.1 sec. The delay allows:

(A) blood to enter aorta

(B) the ventricles to empty completely

(C) blood to enter pulmonary arteries

(D) the atria to empty completely. **[NEET Odisha 2019]**

**53.** Match the items given in Column I with those in Column II and select the correct option given below.

| Column I | Column II |
|---|---|
| (a) Tricuspid valve | (i) Between left atrium and left ventricle |
| (b) Bicuspid valve | (ii) Between right ventricle and pulmonary artery |
| (c) Semilunar valve | (iii) Between right atrium and right ventricle |

Select the correct option from the following.

| | (a) | (b) | (c) |
|---|---|---|---|
| (A) | (i) | (ii) | (iii) |
| (B) | (i) | (iii) | (ii) |
| (C) | (iii) | (i) | (ii) |
| (D) | (ii) | (iv) | (iii) |

**[NEET 2018]**

**54.** Blood pressure in the mammalian aorta is maximum during:

(A) systole of the left atrium

(B) diastole of the right ventricle

(C) systole of the left ventricle

(D) diastole of the right atrium

**[AIPMT Cancelled 2015]**

**55.** Doctors use stethoscope to hear the sounds produced during each cardiac cycle. The second sound is heard when:

(A) AV valves open up.

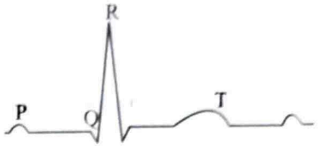
(B) ventricular walls vibrate due to gushing in of blood from atria.

(C) semilunar valves close down after the blood flows into vessels from ventricles.

(D) AV node receives signal from SA node.

**[AIPMT Latest July 2015]**

**56.** The diagram given here is the standard ECG of a normal person. The P-wave represents the:




(A) contraction of both the atria

(B) initiation of the ventricular contraction

(C) beginning of the systole

(D) end of systole. **[NEET 2013]**

**57.** If due to some injury the chordae tendineae of the tricuspid valve of the human heart is partially non-functional, what will be the immediate effect?

(A) The flow of blood into the aorta will be slowed down.

(B) The 'pacemaker' will stop working.

(C) The blood will tend to flow back into the left atrium.

(D) The flow of blood into the pulmonary artery will be reduced. **[AIPMT Screening 2010]**

**58.** In a standard ECG, which one of the following alphabets is the correct representation of the respective activity of the human heart?

(A) R-repolarisation of ventricles

(B) S-start of systole

(C) T-end of diastole

(D) P-depolarisation of the atria

**[AIPMT Screening 2009]**

**59.** In humans, blood passes from the postcaval to the diastolic right atrium of heart due to:

(A) pushing open of the venous valves

(B) suction pull

(C) stimulation of the sino auricular node

(D) pressure difference between the caval and atrium.

**[AIPMT Screening 2008]**

**60.** The cardiac pacemaker in a patient fails to function normally. The doctors find that an artificial pacemaker is to be grafted in him. It is likely that it will be grafted at the site of:

(A) atrioventricular bundle

(B) Purkinje system

(C) sinoatrial node

(D) atrioventricular node **[AIPMT 2004]**

**61.** Bundle of His is a network of:
(A) muscle fibres distributed throughout the heart walls.
(B) muscle fibres found only in the ventricle wall.
(C) nerve fibres distributed in ventricles.
(D) nerve fibres found throughout the heart.
**[AIPMT 2003]**

**62.** Systemic heart refers to:
(A) the heart that contracts under stimulation from nervous system.
(B) left auricle and left ventricle in higher vertebrates.
(C) entire heart in lower vertebrates.
(D) the two ventricles together in humans.
**[AIPMT 2003]**

**63.** Impulse of heart beat originates from:
(A) SA node (B) AV node
(C) vagus nerve (D) cardiac nerve.
**[AIPMT 2002]**

**64.** The correct route through which pulse-making impulse travels in the heart is:
(A) AV node → Bundle of His → SA node → Purkinje fibres → Heart muscles
(B) AV node → SA node → Purkinje fibres → Bundle of His → Heart muscles
(C) SA node → Purkinje fibres → Bundle of His →AV node → Heart muscles
(D) SA node → AV node → Bundle of His → Purkinje fibres → Heart muscles. **[AIPMT 1995]**

**65.** Neurogenic heart is the characteristic of:
(A) Humans (B) Arthropods
(C) Rat (D) Rabbit. **[AIPMT 1995]**

**66.** Dub sound is produced during closure of:
(A) semilunar valves (B) bicuspid value
(C) tricuspid value (D) Both (B) and (C).
**[AIPMT 1994]**

**67.** The pace setter in the heart is called as:
(A) Sino-atrial node (SAN)
(B) Atrio-ventricular node (AVN)
(C) Purkinje fibres
(D) Papillary muscles. **[AIPMT 1994]**

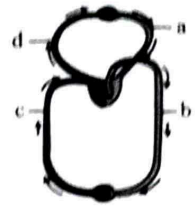
**68.** Tricuspid valve is found in between:
(A) sinus venosus and right auricle
(B) right auricle and right ventricle
(C) left ventricle and left auricle
(D) ventricle and aorta **[AIPMT 1989]**

## 15.4. Double Circulation

**69.** The hepatic portal vein drains blood to liver from:
(A) heart (B) stomach
(C) kidneys (D) intestine. **[NEET 2017]**

**70.** Blood pressure in the pulmonary artery is:
(A) more than that in the carotid.
(B) more than that in the pulmonary vein.
(C) less than that in the vena cava.
(D) same as that in the aorta. **[NEET Phase-I 2016]**

**71.** Figure shows schematic plan of blood circulation in human with labels a to d. Identify the label and give its function(s).




(A) a - pulmonary vein - takes impure blood from body parts, $pO_2$ = 60 mmHg
(B) b - pulmonary artery - takes blood from heart to lungs, $pO_2$ = 90 mmHg
(C) c - vena cava - takes blood from body parts to right auricle, $pCO_2$ = 45 mmHg
(D) d - dorsal aorta - takes blood from heart to body parts, $pO_2$ = 95 mmHg **[NEET 2013]**

**72.** Arteries are best defined as the vessels which:
(A) carry blood away from the heart to different organs.
(B) break up into capillaries which reunite to form a vein.
(C) carry blood from one visceral organ to another visceral organs.
(D) supply oxygenated blood to the different organs.
**[AIPMT Screening 2011]**

**73.** Fastest distribution of some injectible material or medicine and with no risk of any kind can be achieved by injecting it into the:
(A) muscles (B) arteries
(C) veins (D) lymph vessels.
**[AIPMT Mains 2010]**

**74.** Pulmonary artery is different from pulmonary vein because it has:
(A) larger lumen (B) thick muscular walls
(C) no endothelium (D) valves **[AIPMT 2000]**

**75.** In veins, valves are present to check backward flow of blood flowing at:
(A) Atmospheric pressure
(B) High pressure
(C) Low pressure
(D) All of the above **[AIPMT 1995]**

**76.** Wall of blood capillary is formed of:
(A) haemocytes (B) parietal cells
(C) endothelial cells (D) oxyntic cells
**[AIPMT 1993, 91]**

77. Splenic artery arises from:
(A) anterior mesenteric artery
(B) coeliac artery (or celiac artery)
(C) posterior mesenteric artery
(D) intestinal artery. **[AIPMT 1990]**

78. A vein possesses a large lumen because:
(A) tunica media and tunica externa form a single coat.
(B) tunica interna and tunica media form a single coat.
(C) tunica in terna, tunica media and tunica externa are thin.
(D) tunica media is a thin coat. **[AIPMT 1990]**

79. Arteries carry oxygenated blood except:
(A) pulmonary (B) cardiac
(C) hepatic (D) systemic **[AIMPT 1989]**

## 15.5. Regulation of Cardiac Activity

80. Which of the following is associated with decrease in cardiac output?
(A) Sympathetic nerves
(B) Parasympathetic neural signals
(C) Pneumotaxic centre
(D) Adrenal medullary hormones **[NEET Oct. 2020]**

## 15.6. Disorders of Circulatory System

81. Which one of the following statements is correct regarding blood pressure?
(A) 100/55 mm Hg is considered an ideal blood pressure.
(B) 105/50 mm Hg makes one very active.
(C) 190/110 mm Hg may harm vital organs like brain and kidney.
(D) 130/90 mm Hg is considered high and requires treatment. **[AIPMT Screening 2011]**

82. The thickening of walls of arteries is called:
(A) arteriosclerosis
(B) arthritis
(C) aneurysm
(D) both (B) and (C). **[AIPMT 1999]**

83. An adult human with average health has systolic and diastolic pressures as:
(A) 120 mm Hg and 80 mm Hg.
(B) 50 mm Hg and 80 mm Hg.
(C) 80 mm Hg and 80 mm Hg.
(D) 70 mm Hg and 120 mm Hg. **[AIPMT 1998]**

# SOLUTIONS

1. (D) For a person with blood group A $Rh^-$, the compatible blood types for transfusion are those that do not cause an immune response. $ORh^-$ is correct as $ORh^-$ is the universal donor for red blood cells and lacks both A, B, and Rh antigens, making it safe for any $Rh^-$ recipient. $ARh^-$ is correct as A $Rh^-$ is compatible as it has the A antigen and lacks the Rh antigen, matching the recipient's blood type.

   $BRh^-$ is incorrect as the presence of B antigens in the donor blood would trigger an immune response in a person with blood group A. $ABRh^-$ is incorrect as the presence of both A and B antigens in the donor blood would trigger an immune response in a person with blood group A. A $Rh^+$ is incorrect as the presence of the Rh antigen in $ARh^+$ blood would trigger an immune response in a person with $Rh^-$ blood.

2. (D) Bone marrow and thymus are primary lymphoid organs where immature lymphocytes differentiate into antigen-sensitive lymphocytes. The bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced. Both bonemarrow and thymus provide micro-environments for the development and maturation of T-lymphocytes.

3. (C) HIV (Human Immunodeficiency Virus) is a type of virus that attacks the immune system, specifically the $CD^{4+}$ T-helper ($T_H$) cells. These cells play a crucial role in helping the immune system fight infections. HIV infects and replicates inside these cells, which leads to a progressive decline in the number of $T_H$ cells in the body.

4. (A) Basophils are the least abundant of the total white blood cells (WBCs) and account for less than 1% of WBCs.

   Basophils have a bilobed or trilobed nucleus, not a kidney-shaped nucleus.

   Basophils are granulocytes, not agranulocytes.

5. (C) Blood exhibits coagulation or clotting in response to an injury. This is a mechanism to prevent excessive loss of blood from the body. A clot or a coagulum is formed mainly of a network of threads called fibrins in which dead and damaged formed elements of blood are trapped. Fibrins are formed by the conversion of inactive fibrinogens in the plasma by the enzyme thrombin.

6. (A) At the site of injury or bleeding, fibrinogens get converted into fibrins by the action of thrombin, which is a clotting enzyme.

### Related Theory

*An excessive clotting disorder, also known as a hypercoagulable disorder or thrombophilia, is the tendency of some people to develop blood clots in parts of the body, such as the deep veins in the legs (called venous thromboembolism or DVT) or the arteries of the heart (arterial thrombosis).*

**7.** (B) If fertilisation takes place between the gametes of Rh –ve female and Rh +ve male then the resulting foetus blood will be Rh +ve. This leads to a condition known as erythroblastosis foetalis. It is a case of Rh incompatibility in which mother is Rh –ve and the foetus is Rh +ve. The Rh +ve blood of the foetus stimulates the formation of anti –Rh antibodies in the mother's blood. During second pregnancy, Rh antibodies (formed in mother's body) can leak into the blood of the foetus (Rh +ve) and destroy the foetal RBCs. This could be fatal to the foetus or could cause severe anaemia and jaundice to the baby.

### Related Theory

*During the first pregnancy, when Rh -ve mother is carrying Rh +ve baby, there is an interaction of both blood during parturition. The mother's blood form Rh antibodies in response to that interaction. During the first pregnancy, the antibodies are produced in lower concentration and do not harm the foetus. During second pregnancy with Rh +ve baby, the concentration of antibodies against Rh factor will build up and attack the blood cells of the foetus and cause its death. This phenomenon is referred as erythroblastosis foetalis.*

**8.** (D) Eosinophils are associated with allergic reactions and release histamine and destructive enzymes. Basophils secrete histamine, serotonin, heparin *etc.*, and are involved in inflammatory reactions. Neutrophils are phagocytic cells. Both B and T-lymphocytes are responsible for immune responses of the body. Basophils, neutrophils, and eosinophils are granulocytes. Lymphocytes and monocytes, on the other hand, are agranulocytes. Monocytes are the phagocytes that engulf foreign pathogens and destroy them.

### Mnemonics

*Leucocytes are immune cells that protect the body from infection. There are several types of leucocytes. Simply look at this trick and learn their names with their composition.*

*Never Let Monkey Eat Bananas*

*Never* – *Neutrophils (60%)*
*Let* – *Lymphocytes (30%)*
*Monkey* – *Monocytes (6%)*
*Eat* – *Eosinophils (3%)*
*Bananas* – *Basophils (1%)*

**9.** (D) Fibrinogen is a soluble plasma protein that helps in the formation of blood clot by converting into insoluble fibrin. Globulins are simple proteins that form blood serum proteins, involved in defence mechanism. Albumin is a plasma protein, that helps in maintaining osmotic pressure, which prevents fluid leakage out into the tissues from the blood stream.

**10.** (A) The absence of nucleus in RBCs is an adaptation that allows RBCs to contain more haemoglobin and carry oxygen in the provided empty space. This also aids in efficient diffusion of oxygen.

RBCs are somatic cells, which do not reproduce and show any metabolic activity, as they lack nucleus. However, this do not explain the reason of its enucleate character.

### Related Theory

*Red blood cells, also called erythrocytes, are cellular component of blood, RBCs are red in colour due to the presence of haemoglobin. The mature human red blood cell is small, round, and biconcave. The lifespan of RBCs is 120 days.*

### Caution

*Students must remember that, RBCs are formed in bone marrow. They are enucleate, i.e., immature RBCs possess nucleus, but mature RBCs do not.*

**11.** (D) Thrombocytes, also called platelets are responsible for clotting of blood. If these cells are destroyed, then it would lead to excessive blood loss from the body at the site of injury. Erythrocytes are red blood cells, responsible to carry oxygen *via* haemoglobin. Leucocytes and neutrophils are white blood cells and are responsible for immune response of the body.

### Related Theory

*The clotting factors are factor I (fibrinogen), factor II (prothrombin), factor III (tissue thromboplastin or tissue factor), factor IV (ionised calcium), factor V (labile factor or proaccelerin), factor VII (stable factor or proconvertin), and factor VIII (anti-hemophilic factor). Additionally, the coagulation factors also include factor IX (plasma thromboplastin component or the Christmas factor), factor X (Stuart-Prower factor), factor XI (plasma thromboplastin antecedent), factor XII (Hageman factor), and factor XIII (fibrin-stabilising factor).*

### Caution

*Students usually get confused between the names of blood cells. They must remember their Greek meaning. As red blood cells, i.e., erythrocytes derived from Greek words, "erythros" as "red" and "cyte" as "cell". In leucocytes, "leucko" means white and "cyte" means "cell". The word thrombocyte also came from the Greek "thrombos" meaning a "thick drop" or clot, and "cyte" means "cell".*

**12.** (C) Serum is the plasma without the clotting factors and blood cells. It is usually abundant in antibodies.

### Related Theory

*A serum albumin test is a simple blood test that measures the amount of albumin in the blood. The normal range is 3.4 to 5.4 g/dL (34 to 54 g/L). Higher levels of albumin indicate dehydration or severe diarrhoea. Certain drugs, including steroids, insulin, and hormones, can raise albumin levels.*

**13.** (D) The production of red blood cells occurs during different stages in human: during early weeks of embryonic life it takes place in the mesodermal cells of the yolk sac; after 3–4 months it moves to the liver, along with spleen and lymph nodes; after 7 months and birth, red bone marrow takes over.

### Related Theory

*In children, erythropoiesis can occur in the bone marrow of most bones, However, in adults, it only occurs in the bone marrow of the vertebrae, ribs, sternum, sacrum, pelvis and proximal femur. When erythropoiesis is inadequate in the bone marrow, this can trigger extramedullary haematopoiesis i.e., haematopoiesis occurring outside the marrow. This is commonly seen in haemoglobulinopathies, in particular thalassaemia and myelofibrosis.*

**14.** (D) Plasma = Blood – (RBC + WBC + Platelets)

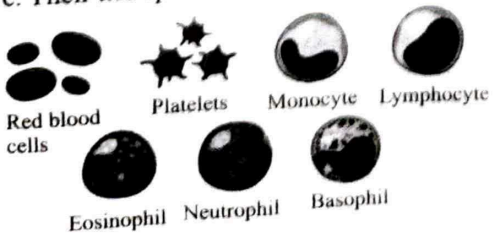
Serum = Plasma – Fibrinogen

Lymph = WBC + Plasma

### Related Theory

*Blood is composed of 55% plasma and 45% formed elements including red blood cells, white blood cells and platelets. Due to these living cells suspended in the plasma, blood is considered a fluid connective tissue (not a fluid). It is the only fluid tissue in the body.*

**15.** (A) Basophils have three lobed nucleus and a smaller number of coarse granules. They secrete histamine, serotonin, heparin, *etc.*, and are involved in inflammatory reactions. Lymphocytes are smaller in size having round nucleus. They are of two major types – B and T-lymphocytes. Both B and T-lymphocytes are responsible for immune responses of the body. Neutrophils are the most abundant cells and are phagocytic in nature. They destroy foreign organisms entering the body and are polymorphic and have multi-lobed nucleus. Monocytes are the largest of all WBCs. They are motile, phagocytic in nature. Their life span is about 10-20 hours.




*Types of Blood Cells*

### Related Theory

*There are two types of WBCs : granulocytes and agranulocytes. Neutrophils, eosinophils and basophils are different types of granulocytes, while lymphocytes and monocytes are the agranulocytes.*

**16.** (C) Spleen is called the graveyard of RBCs because it removes dead RBCs from the blood.

### Related Theory

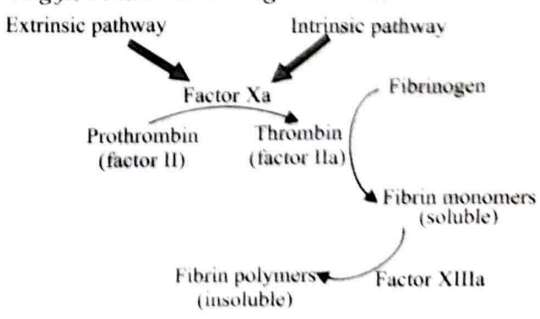
*The spleen is a large bean-shaped organ, mainly containing lymphocytes and phagocytes, which acts as a filter of the blood by trapping blood-borne microorganisms and has a large reservoir of erythrocytes. The lymph nodes are small solid structures located at different points along the lymphatic system. The average life span of human RBCs is 120 days. The aged RBCs attract auto antibodies after which they are attached by macrophages in liver and spleen. The process of destruction of RBCs is called haemolysis. About 2.5 million RBCs are destroyed every second in the body.*

**17.** (B) Blood group O negative is a universal donor, while Blood group AB positive is a universal acceptor. Blood group O negative have no antigens and hence, can be transfused to any patient, while blood group AB positive have antigen A, B and Rh, but no antibodies, and hence, can receive blood from any group type.

**18.** (C) During tissue and vascular injury, fibrinogen (factor I) is converted enzymatically by thrombin to fibrin and then to a fibrin-based blood clot. Fibrin clots function primarily to occlude blood vessels to stop bleeding. An amylase blood test measures the amount of amylase in a person's blood. Globulins function in liver function, blood clotting, and fighting infection. Albumin maintains the osmotic pressure of the blood compartment, provide nourishment to the tissues, and transport hormones, vitamins, drugs, and other substances, such as calcium throughout the body.

### Related Theory

*Following flowchart shows coagulation cascade:*




*Fibrin Formation*

**19.** (D) The normal range for haemoglobin: for men, 13.5 to 17.5 grams per decilitre, for women, 12.0 to 15.5 grams per decilitre.

**20.** (B) A mature RBC in all mammals does not contain DNA. An enucleated ovum is the one from which nucleus has been removed artificially. However, it contains DNA in the mitochondria. A mature spermatozoan contains DNA in the head region. Hair root or hair follicle is the living part of the hair that contains a group of cells that are nucleated and contain DNA.

**Related Theory**

*Platelets and erythrocytes comprise the major cellular components devoid of a cell nucleus. Human erythrocytes have a life span of approximately 120 days after which they are removed from the circulation.*

**Caution**

*Unlike other mammals, camels have nucleated, oval-shaped red blood cells, which help to continue blood flow during times when water is scarce.*

**21.** (A) Globulins participate in the immune system (*i.e.*, immunoglobulins) and also act as transport proteins.

**Related Theory**

*There are four main types of globulins- alpha 1, alpha 2, beta, and gamma. Alpha and beta globulins are transport proteins, serve as substrates upon which other substances are formed, and perform other diverse functions. Gamma globulins have a vital role in natural and acquired immunity to infection.*

**22.** (B) The main functions of basophils are as following:

(1) Releases histamine, which dilates the blood vessels around the injection site.

(2) Improves blood flow and promotes healing.

(3) Provides other immune cells better access to the infection site.

(4) Releases histamine in response to allergens, and bind with an antibody IgE and causes allergic reactions, such as itchy skin, hives, runny nose, and watering eyes.

(5) Releases heparin, which prevents blood clotting at the injection site.

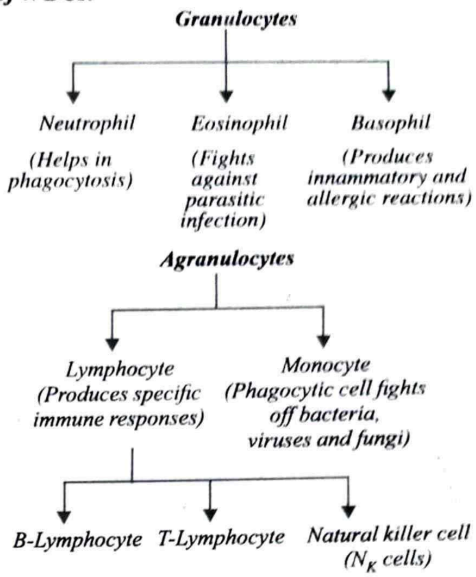
The primary function of neutrophils is phagocytosis of foreign or dead cells. Monocytes play a role in both the inflammatory and anti-inflammatory processes during an immune response. Eosinophils or acidophils are granular white blood cells, which are non-phagocytic cells, and their number increases with allergic reaction, such as asthma or hay fever.

**23.** (D) Neutrophils, monocytes and eosinophils are phagocytic cells. Neutrophils and monocytes are most active out of these three.

**Related Theory**

*Monocytes are largest of all leucocytes and generally change into macrophages after entering tissue spaces. Neutrophils are most numerous of all leucocytes, and have many lobed nucleus. Lymphocytes are non-motile and non-phagocytic in nature. They produce antibodies to destroy microbes. These are found as B and T-lymphocytes. T-lymphocytes either directly attack the antigens or stimulate B-lymphocytes to produce antibodies.*

***Types of WBCs:***




**24.** (A) Serum is the component of blood, which does not play a role in clotting. Serum includes all proteins not used in blood clotting; all electrolytes, antibodies, antigens, hormones; and any exogenous substances (*e.g.*, drugs or microorganisms).

Serum = Plasma – Clotting factors

**Caution**

*Students should remember that serum is the liquid that remains after the blood has clotted. Plasma is the liquid that remains when clotting is prevented with the addition of an anticoagulant.*

**25.** (C) Thrombin acts as an enzyme and catalyses conversion by an enzyme complex involving thromboplastin- fibrinogen (a soluble plasma protein) into an insoluble fibre like polymer, fibrin. These fibres form a dense network upon the wound and trap blood corpuscles (WBCs, RBCs and platelets) and thus, form a clot. Proteolytic cleavage of prothrombin generates thrombin, which converts fibrinogen into fibrin for clot formation. Fibrinogen is a protein produced by the liver, which helps stop bleeding by helping blood clots to form. Heparin is used to prevent blood clots from forming.

**Related Theory**

*Thromboplastin is released by the injured tissue. This reacts with $Ca^{2+}$ ions present in blood and forms a proteinaceous enzyme called prothrombinase. Later in the presence of $Ca^{2+}$, it inactivates heparin (anticoagulant) and catalyses prothrombin (inactive plasma protein) into an active thrombin protein.*

**26.** (A) Calcium bicarbonate causes clotting of blood. Chilled test tube decreases the rate of coagulation of blood. Chelating agents, like heparin, EDTA, sodium oxalate act as anti-coagulants.

**Related Theory**

*Vitamin K is a nutrient that the body requires to stay healthy. Anti-haemorrhagic factor, or phylloquinone, is another name for vitamin K. It functions as a coenzyme for vitamin K-dependent carboxylase, an enzyme required for protein synthesis and other diverse physiological functions in hemostasis (blood clotting) and bone metabolism.*

**36.** (B) Bone marrow is a soft, spongy tissue that produces blood components in order for the body to survive. Bone marrow can be found in the centre of most bones as well as at the ends of spongy bones in our bodies. Bone marrow and blood vessels fill bone cavities, storing fat and stem cells and producing blood cells.

Bone marrow is classified into two types based on its colour:

(1) Red bone marrow is responsible for the production of blood cells (Haematopoiesis). It produces red blood cells (RBCs), which carry oxygen, as well as white blood cells (WBCs) and platelets, which help to prevent infection.

(2) Yellow bone marrow stores fat in the body. Its cells store fat for energy production and also develop bone, cartilage, muscles, and fat cells for our body.

**37.** (B) Thromboplastin, a lipoprotein, aids in the formation of clots. Thromboplastin greatly helps in the formation of the enzyme prothrombinase. This enzyme deactivates heparin and converts the inactive plasma protein prothrombin into its active form, thrombin. Both transformations necessitate the presence of calcium ions. Thrombin converts fibrinogen molecules to insoluble fibrin. Fibrin monomers polymerize to form long, sticky fibres. The fibrin threads form a fine network over the wound and trap blood corpuscles (RBCs, WBCs, platelets) to form a crust, the clot. As a result, removing calcium from the blood prevents clotting.

**38.** (C) A person with blood group A is able to receive blood from people with blood groups A and O. A-antigens and anti-B antibodies are present in people with blood group A. As a result, it can receive blood from people of the same blood group as well as people of the O blood group, because people of the O blood group (universal donor) have no antigens in their body.

**39.** (C) Blood has RBCs, WBCs, platelets and a fluid called plasma, whereas lymph has WBCs and watery fluid, but lack RBCs.

**Related Theory**

*The lymphatic system (lymph, lymph nodes and lymph vessels) supports the circulatory system by draining excess fluids and proteins from tissues back into the bloodstream, thereby preventing tissue swelling.*

**40.** (B) Lymph is a clear-to-white fluid made of white blood cells, especially lymphocytes, and serum. Serum is plasma minus clotting factor. It does not contain RBCs and certain proteins like clotting factors.

**Related Theory**

*Serum is the portion of plasma remaining after coagulation of blood, during which the plasma protein fibrinogen is converted to fibrin and remains behind in the clot.*

**41.** (A) Lymph glands are the organs that are associated with lymph. These organs are linked to the development, maturation, and proliferation of lymphocytes (a type of WBC). They also serve as antigen-antibody reaction sites. This is accomplished by trapping pathogens such as bacteria, viruses, and others in the blood, which are then destroyed by the lymphocytes found in those organs. On the basis of function, lymphoid organs are classified into two types: Primary lymphoid organs and secondary lymphoid organs. Thus, it can be said that the lymph gland's primary functions are formation of WBCs and antibodies to destroy bacteria. It does not participate in the formation of RBCs.

**42.** (A) The colourless liquid found within the lymphatic system is lymph (also known as tissue fluid in the intercellular spaces). The return of interstitial fluid to the blood is an important function of lymph. The interstitial fluid is a filtered form of blood that contains no cellular components or plasma proteins. It is made up of water with dissolved materials. It receives $CO_2$, nitrogenous waste products, hormones, and other synthetic substances from the tissue cells and transports them to the lymph capillaries, where they are released into the blood.

**43.** (A) Lymph is a colourless fluid connective tissue. Lymph consists of WBCs and watery fluid. It differs from the blood in lacking red blood cells (RBCs), platelets and some plasma proteins.

**Related Theory**

*Lymphatic system plays a major role in protecting human body from illness and thereby it constitutes the immune system. The major function of the lymphatic system is to maintain the fluid balance in the body as well as to protect the body against infections. It builds immunity and produces antibodies to attack the disease-causing microbes with the help of special white blood cells called lymphocytes.*

**44.** (D) The "lub" sound of the heart, also known as the first heart sound (S1), is caused by the closure of the atrio-ventricular (AV) valves, *i.e.*, tricuspid valves (right AV) and bicuspid (mitral or left AV) valves, which marks the beginning of ventricular systole. Closure of the semilunar valves causes the "dub" sound.

**45.** (D) The correct sequence for the conduction of action potential through the heart is:

SA node → AV node → AV bundle → Bundle branches → Purkinje fibres.

The heart's electrical impulse originates at the SA node, the natural pacemaker, and travels to the AV node, where it is briefly delayed. It then proceeds through the AV bundle, and into the left and right bundle branches.

This pathway ensures the atria contract fully before the ventricles. The impulse finishes its journey through the Purkinje fibres, causing the ventricles to contract. This ensures that the heart's pumping action is efficient and synchronised.

**46.** (A) P-wave represents the electrical excitation (or depolarisation) of the atria, which leads to the contraction of both the atria. The QRS complex represents the depolarisation of the ventricles, which initiates the ventricular contraction. The T-wave represents the return of the ventricles from excited to normal state (repolarisation). T-P gap indicates that heart muscles are electrically silent.

**47.** (C) P-wave: Depolarisation of atria; P-wave is the first wave of the electrocardiograph (ECG), which represents the depolarisation of the atria.

Q-wave: Beginning of systole; Q-wave is the first negative deflection seen in the QRS complex of the ECG, which marks the beginning of ventricular depolarisation and the onset of systole.

QRS complex: Depolarisation of ventricles; QRS complex represents the depolarisation of the ventricles. It consists of three waves - Q, R, and S.

T-wave: Repolarisation of ventricles; T-wave represents the repolarisation of the ventricles after depolarisation. It is a positive wave in most leads of the ECG.

**48.** (B) The tricuspid and bicuspid valves open due to pressure exerted by blood present in atria and a decrease in pressure in ventricles during ventricular diastole.

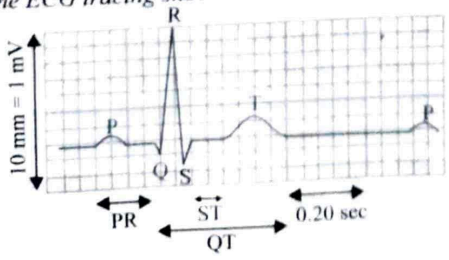
The decrease in ventricular pressure, *i.e.*, during ventricular diastole, causes the closure of semilunar valves.

The SA node generates an action potential to stimulate atrial contraction.

**49.** (B) In ECG, there are 5 consecutive waves: P, Q, R, S, and T. QRS complex represent depolarisation of ventricles. P-wave represents depolarisation of atria. T-wave represents repolarisation of ventricles.

### Related Theory

*Look at the ECG tracing shown here.*




*The different waves that comprise the ECG represent the sequence of depolarisation and repolarisation of the atria and ventricles. P-wave represents the wave of depolarisation of atria that spreads from the SA node throughout the atria. The PR interval is the time between the first deflection of the P-wave and the first deflection of the QRS complex. The three waves of the QRS complex represent ventricular depolarisation. The ST segment, which is also known as the ST interval, is the time between the end of the QRS complex and the start of the T-wave. It reflects the period of zero potential between ventricular depolarisation and repolarisation. T-waves represent ventricular repolarisation (atrial repolarisation is obscured by the large QRS complex).*

### Caution

*Students usually choose wrong option as they get confused between the different waves and their representation. Remember, during the cardiac impulse, firstly, the atria are contracted (P wave), which flows to the ventricular contraction (QRS complex), and last towards the relaxation of ventricles (T-wave).*

**50.** (B) Given output = 5 L = 5000 mL

Blood volume at the end of ventricular diastole = 100 mL

Blood volume at the end of ventricular systole = 50 mL

So, stroke volume = 100 – 50 = 50 mL

Cardiac output = stroke volume x heart rate

5000 mL = 50 mL x heart rate

Heart rate = 100 beats per minute

**51.** (D) P-wave represents the wave of depolarisation of atria that spreads from the SA node throughout the atria. The three waves of the QRS complex represent ventricular depolarisation. T-waves represent ventricular repolarisation (atrial repolarisation is obscured by the large QRS complex). Reduction in the size of T-wave signifies coronary ischemia, *i.e.*, when the heart muscles receive insufficient oxygen as in arteriosclerotic heart disease.

**52.** (D) AV node is present in the lower left corner of right atrium. When electrical signal generated by the SA node reaches AV node, they pass down through to the ventricles. The AV node slows the electrical current and this delay of 0.1 seconds ensures that the atria empties completely into the ventricles before the ventricles pump out the blood.

**53.** (C) The right atrio-ventricular opening is guarded by tricuspid valves, while the left atrio-ventricular opening is guarded by bicuspid valves (or mitral valve). Semilunar valve is present in the junction of right ventricle and pulmonary artery.

### Mnemonics

*The heart is a complex organ, which includes major four types of valves. A very simple trick to remember these names forever is:*

*Try Performing Better Always*
*Try* – *Tricuspid valve*
*Performing* – *Pulmonary valve*
*Better* – *Bicuspid valve*
*Always* – *Aortic valve*

**54.** (C) When blood enters left atrium from pulmonary vein, atrium contract and the blood enters left ventricle. Upon contraction, the blood moves to aorta under high pressure to all the parts of the body. This pressure in aorta is maximum which ensures the effective delivery of oxygen to the extreme parts of the body.

### Mnemonics

*To remember the cardiac blood flow, go through the trick below.*

| *For deoxygenated blood:* | *For oxygenated blood:* |
|---|---|
| *Real Rich People Lie* | *Life Love Age Body* |
| *R – Right atrium* | *L – Left atrium* |
| *R –Right ventricle* | *L – Left ventricle* |
| *P – Pulmonary artery* | *A – Aorta* |
| *L – Lungs* | *B – Body* |

**55.** (C) In healthy adults, there are two normal heart sounds: Lub and dub. The first sound is heard due to the closure of AV valves, while second sound is heard due to the closure of semilunar valves.

### Related Theory

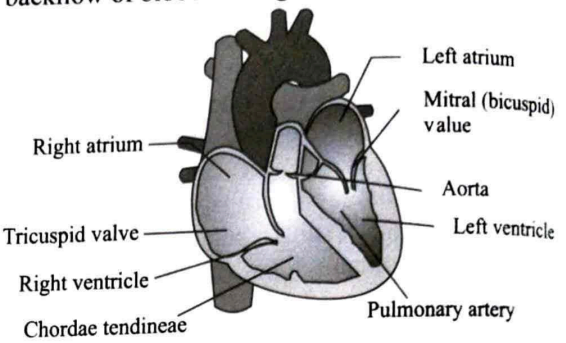
*The closure of the mitral and tricuspid valve at the beginning of ventricular systole causes the first part of the lub-dub sound made by the heart as it beats. Formally, this sound is termed as the first heart tone or S1. It is created by the vibration of the valves during the closure of mitral and tricuspid valve. The second part of the lub-dub sound is caused by the closure of the aortic and pulmonary valves at the end of ventricular systole. As the left ventricle empties, its pressure falls below pressure in the aorta, and the aortic valve closes. This sound is termed as S2.*

### Caution

*Students often misinterpret the duration and pitch of heart sounds. Always remember that, first heart sound, i.e., lub is longer, louder, duller, and lower-pitched. While, second heart sound, i.e., dub is of short duration and also high-pitched over the first one.*

**56.** (A) The P-wave represents the electrical excitation (or depolarisation) of the atria, which leads to the contraction of both the atria. The QRS complex represents the depolarisation of the ventricles, which initiates the ventricular contraction. The contraction starts shortly after Q and marks the beginning of the systole. The T-wave represents the return of the ventricles from excited to normal state (repolarisation). The end of the T-wave marks the end of systole.

**57.** (D) Tricuspid valve is present between the right atrium and right ventricle. It consists of three cusps that channel the flow of blood from the atrium to the ventricle. When the right ventricle contracts, forcing blood into the pulmonary artery, the tricuspid valve closes the aperture to the atrium, thereby preventing any backflow of blood. The valve reopens to allow blood to flow from the atrium into the ventricle. If the chordae tendineae of the tricuspid valve of human heart is partially non-functional, the flow of blood into the pulmonary artery is reduced due to backflow of blood into right atrium.




*Structure of Heart*

### Related Theory

*The function of chordae tendineae is to anchor the AV valves to ventricular papillary muscles and keep the AV valves in a closed position during ventricular systole to prevent the backflow of blood into the atria.*

**58.** (D) In ECG, there are 5 consecutive waves: P, Q, R, S, and T. QRS complex represents the depolarisation of ventricles. P-waves represent depolarisation of atria that spreads from the SA node throughout the atria. T-wave represents repolarisation of ventricles.

**59.** (D) The deoxygenated blood of the lower body is transported to the right atrium of the heart. This transport of blood is facilitated by the pressure difference that exists between the postcaval vein and the right atrium during diastole of the heart. Diastolic right atrium has less pressure and post caval has high pressure, and thus, blood moves from postcaval to right atrium.

### Related Theory

*Blood passes from the superior and inferior vena cava into the right atrium. During the start of diastole, the pressure drops in the right atrium, thereby forcing the blood from vena cava to enter the right atrium. During diastole as the atrium relaxes and enlarges in size, the pressure falls.*

**60.** (C) SA node is a specialised bundle of neurons located in the upper part of the right atrium of the heart and acts as a natural cardiac pacemaker from which the heart beat originates. If this system is damaged, it may send non-coordinated impulses to the heart chambers resulting in symptoms like irregular heart rate, tiredness, dizziness and loss of consciousness. As the pacemaker cells create this rhythmical impulse, an artificial pacemaker is implanted at the

site of SA node to mimic the actions of the node and conducting system and helps to regulate the heartbeat.

**Related Theory**

*The electrical impulse travels from the sinus node to the atrioventricular node (AV node). There, impulses are slowed down for a very short period, then continue down the conduction pathway via the bundle of His into the ventricles.*

**61.** (B) Bundle of His is a network of muscle fibres, found in the walls of ventricles. They originate from AV node and further give rise to Purkinje fibres. This helps in maintaining the rhythmic contraction of the ventricles.

**Related Theory**

*Bundle of His is a collection of specialised heart muscle cells for electrical conduction, while Purkinje fibres are thin filaments originating from the left posterior fascicles and left anterior fascicles that help in distributing impulses to the ventricular muscles.*

**62.** (B) Systemic circulation moves blood between the heart and the rest of the body. It sends oxygenated blood out to cells and returns deoxygenated blood to the heart. Systemic heart refers to the left auricle and left ventricle in higher vertebrates. In pulmonary circulation, deoxygenated blood pumped into the pulmonary artery is transferred to the lungs from where the oxygenated blood is carried by the pulmonary veins into the left atrium.

**Related Theory**

*Systemic circulation is ordered from the left ventricle to the aorta, through the structures of the body, to the superior or inferior vena cava, and re-enters the heart in the right atrium. The pulmonary circulation is a relatively low pressure system compared to the systemic circulation because the pulmonary arteries are not as muscularised as their systemic counterparts.*

**63.** (A) An electrical stimulus is generated by the sinoatrial node, or SA node. This is a small mass of specialised tissue located in the right atrium of the heart.

**Related Theory**

*The AV node gathers the electrical impulse from SA node and, after a brief delay, allows it to pass through to the ventricles. This brief delay in the transmission of the electrical signal through the AV node is critical to a normal heartbeat and also for the efficient functioning of the heart.*

**64.** (D) The correct route through which pulse-making impulse travels in the heart is:

SA node →AV node →Bundle of His → Purkinje fibres → Heart muscles.

Pulse-making impulse starts in the SA node and from there it travels to the AV node. Further, it is conducted to the Purkinje fibres through the bundle of His fibres. The Purkinje fibres situated in the lateral walls of the ventricles spread the impulse to the ventricles. Thus, the ventricular contraction is initiated.

**65.** (B) Lower invertebrates, such as arthropods and annelids have neurogenic hearts. The nerve from the brain initiates cardiac movement in the neurogenic heart. The ganglion located near the heart initiates the heartbeat. The nervous system generates the contraction impulse. They have a sac-like heart and no blood flow through the vessels. On the other hand, myogenic heart is found in molluscs and vertebrates, in which initiation of heart beat is under muscular control.

**Caution**

*Students generally do not know about this fact that when the neurogenic heart is removed from the body, it stops beating, whereas the myogenic heart continues to beat for some time.*

**66.** (A) Two distinct sounds, 'lub' and 'dub' can be heard during heart beat with the help of a stethoscope. Lub is the first sound with low pitch and is produced by the closure of tricuspid and bicuspid valves (collectively called atrio-ventricular valves) at the beginning of ventricular systole. Dub is the second sound with sharp and high pitch and is produced by closure of semilunar valves by the end of ventricular systole.

**67.** (B) The sino-atrial node, also known as the natural pacemaker, initiates the cardiac impulse. It then make its way to the atrio-ventricular node. From there, the Purkinje fibres lead to the ventricles. The atrio-ventricular node is primarily responsible for regulating heart rate rhythm. The delay in impulse conduction in this node alters the duration of contraction between the atria and ventricles. As a result, the AV node is referred to as the pace-setter.

**68.** (B) The tricuspid valve, which safeguards the opening between the right atrium and the right ventricle, is made up of three muscular flaps or cusps. An atrio-ventricular valve is another name for it. It prevents blood from flowing back into the right atrium. A bicuspid valve, on the other hand, guards the opening between the left atrium and the left ventricle.

**69.** (D) In hepatic portal system, the hepatic vein carries blood from intestine to liver, along with the nutrients absorbed in the intestine. Coronary artery and vein circulate blood in heart muscles. Renal artery and vein carries blood in and out of the renal system. Gastric vein carries blood from stomach to heart.

**Related Theory**

*The portal system is a system in which the veins start and end in capillaries. It delivers deoxygenated blood to the liver for purification before it is carried to the heart. The hepatic portal vein is the largest vein in the abdominal cavity. It drains blood*

*from the spleen and the gastrointestinal tract to the liver. The hepatic veins begin at the junction of splenic veins and superior mesenteric.*

**70.** (B) Arteries have thicker smooth muscles than the veins, to accommodate the high pressure of the blood.

The pulmonary arteries transport deoxygenated blood from the heart to the lungs for oxygenation. The right ventricle of the heart pumps blood through the pulmonary arteries.

The pulmonary veins return oxygenated blood from the lungs to the heart, where it enters the left atrium.

As the blood in the pulmonary arteries is pumped by the heart, they have a higher pressure than the pulmonary veins.

### Related Theory

*The blood pressure in different vessels can be seen as:*
*Artery > arteriole > capillary > venule > vein > vena cava.*

**71.** (C) (a) Pulmonary vein – takes oxygenated blood from lungs to heart; $pCO_2$ = 40 mm of Hg; $pO_2$ = 95 – 104 mm of Hg

(b) Dorsal aorta – takes oxygenated blood from heart to body parts; $pCO_2$ = 40 mm of Hg; $pO_2$ = 95 mm of Hg

(c) Vena cava – takes deoxygenated blood from body to heart; $pCO_2$ = 46 mm of Hg; $pO_2$ = 40 mm of Hg

(d) Pulmonary artery – takes deoxygenated blood from heart to lungs; $pCO_2$ = 46 mm of Hg; $pO_2$ = 40 mm of Hg

### Mnemonics

*It appears tough to recall how our body's blood circulates. Use this mnemonic to help you recall the blood circulation pathway.*
***In Some Really Trendy Resorts People Play Loud Perfect Lullabies Making Lads And Adults Sleep.***

| | | |
|---|---|---|
| *In* | – | *Inferior vena cava* |
| *Some* | – | *Superior vena cava* |
| *Really* | – | *Right atrium* |
| *Trendy* | – | *Tricuspid valve* |
| *Resorts* | – | *Right ventricle* |
| *People* | – | *Pulmonary valve* |
| *Play* | – | *Pulmonary artery* |
| *Loud* | – | *Lungs* |
| *Perfect* | – | *Pulmonary vein* |
| *Lullabies* | – | *Left atrium* |
| *Making* | – | *Mitral valve* |
| *Lads* | – | *Left ventricle* |
| *And* | – | *Aortic valve* |
| *Adults* | – | *Aorta* |

**72.** (A) Arteries are blood vessels that carry blood away from the heart towards different organs. They generally contain oxygenated blood (except pulmonary artery, which contains deoxygenated blood). Arteries break up into arterioles and then into capillaries in the tissue, which reunite to form vein.

### Related Theory

*Differences between arteries and veins:*

| *S. No.* | ***Arteries*** | ***Veins*** |
|---|---|---|
| *(1)* | *The blood vessels that arise from the heart and carry blood away from heart are called arteries.* | *The blood vessels that bring blood to the heart are called veins.* |
| *(2)* | *Arteries are thick-walled blood vessels, situated in deep layers in the body.* | *Veins are thin-walled blood vessels, situated superficially in the body.* |
| *(3)* | *Arteries do not have valves.* | *Veins have valves.* |
| *(4)* | *Tunica externa or adventitia, the outermost layer of arteries is thick and elastic.* | *Tunica externa, the outermost layer of veins is thin.* |
| *(5)* | *Tunica media is very thick and contain elastic fibres.* | *Tunica media is thin layer and contain involuntary muscle fibres.* |
| *(6)* | *Blood in the arteries show high blood pressure.* | *Blood in the veins show lesser blood pressure.* |

### Caution

*Students usually think that arteries carries oxygenated blood and veins carries deoxygenated blood. This is a wrong approach, because pulmonary artery carries deoxygenated blood and pulmonary vein carries oxygenated blood.*

**73.** (C) Intravenous injection is given for rapid distribution of drugs or substance. Intramuscular injection is given for producing local effect.

### Related Theory

***Types of injection:*** *Subcutaneous injections are injections that deliver medication into the layer of fat just under the skin.*

*(1)* ***Intramuscular injections*** *are injections into a muscle. Intravenous injections deliver medication directly into a vein.*

*(2)* ***Intradermal injection*** *are injections given in between the layers of the skin. Intraosseous injections are usually used in emergencies where medication or fluids need to get into the bloodstream quickly and venous access is difficult or impossible.*

**74.** (B) The pulmonary artery transports deoxygenated blood from the heart to the lungs, whereas the pulmonary vein transports oxygenated blood from the lungs to the heart. A pulmonary artery has a narrower lumen and thicker muscular walls than a pulmonary vein.

**75.** (C) Veins (except pulmonary veins) transport deoxygenated blood from tissues to the heart. These are blood vessels with thin walls through which blood flows at very low pressure. This low-pressure blood flow increases the possibility of blood flowing backwards. As a result, the presence of valves in the veins prevents low-pressure blood from flowing backwards.

**76.** (C) The plasma-endothelial interface, endothelium, basal lamina, and adventitia are the four layers that make up the blood capillary walls. The endothelium is a monolayer of metabolically active cells that mediates and monitors fluid exchange between plasma and interstitial fluid.

**77.** (B) The splenic artery is the blood vessel that supplies oxygenated blood to the spleen. It arises from the coeliac artery, and follows a course superior to the pancreas.

**78.** (D) Veins are blood vessels that transport deoxygenated blood from organs back to the heart. Vein walls have the same three layers (tunica externa, tunica media, and tunica interna) as arteries. Arteries have a thick middle layer that allows them to stretch in response to each heartbeat. In contrast to arteries, vein walls are not elastic. Tunica media (middle layer) is certainly less muscular, comparatively thin and has fewer elastic fibres. As a result, the lumen in veins is large.

**79.** (A) Except for the pulmonary arteries, which carry blood to the lungs for oxygenation, all other arteries carry oxygenated blood away from the heart to the tissues (usually veins carry deoxygenated blood to the heart but the pulmonary veins carry oxygenated blood as well). On the other hand, cardiac arteries, also known as coronary arteries, run along the coronary sulcus of the heart's myocardium. Their primary function is to deliver blood to the heart. The liver receives blood from two sources: the hepatic artery and the portal vein.

**80.** (B) Parasympathetic neural signals controls bodily functions when a person is at rest. Some of its activities include stimulating digestion, activating metabolism, and helping the body relax. It functions in decreasing the rate of heart beat, speed of conduction of action potential and thereby cardiac output.

### Related Theory

➥ *Sympathetic nervous system function in case of emergency or stress condition. The pneumotaxic centre is located in the pons region of the brainstem. It moderates the functions of the respiratory rhythm centre. It reduces the duration of inspiration and therefore, alters the respiratory rate. The adrenal medullary hormones initiate the flight or fight response. The main hormones secreted by the adrenal medulla include epinephrine (adrenaline) and nor-epinephrine (noradrenaline), which have similar functions.*

**81.** (C) 190/110 mm Hg of blood pressure represents hypertension, which leads to heart diseases and also affects vital organs like brain and kidney. 120/80 is the normal/ideal blood pressure in humans. Any value above this represents hypertension and value below this represent hypotension. 105/50 is a condition of hypotension. 130/90 is a condition of mild hypertension, and does not require treatments.

### Related Theory

➥ *Hypertension Classification:*

*(1) Normal BP: <130 mmHg (systolic [SBP]) and <85 mmHg (diastolic [DBP])*

*(2) High-normal: 130-139 mmHg SBP and/or 85-89 mmHg DBP.*

*(3) Grade 1 hypertension: 140-159 mmHg SBP and/or 90-99 mmHg DBP.*

*(4) Grade 2 hypertension: ≥ 160 mmHg SBP and/or ≥ 100 mmHg DBP.*

### Caution

➥ *Students need to know that reading 120 refers to the amount of pressure in the arteries during the contraction of your heart muscle (systolic pressure), while reading 80 refers to the blood pressure against arteries when heart muscle is between beats/ relaxes (diastolic pressure).*

**82.** (A) Arteriosclerosis is a condition of thickening and hardening of the arteries. Here, plaque builds up inside the arteries. Plaque is made of cholesterol, fatty substances, cellular waste products, calcium and fibrin (a clotting material in the blood).

**83.** (A) Blood pressure is the force exerted against the walls of blood vessels caused by the discharge of blood into them caused by left ventricle contraction. Systolic pressure is the temporary increase in blood pressure that occurs during heart contraction. Diastolic pressure is the temporary drop in blood pressure that occurs when the heart relaxes. In arteries near the heart, the average systolic/diastolic pressure for a healthy resting adult is 120/80 mm Hg.