

Body Fluids and Circulation

18.1 Blood

1. Match the following columns and select the correct option.

Column-I		Column - II	
(A) Eosinophils	(i) Immune response		
(B) Basophils	(ii) Phagocytosis		
(C) Neutrophils	(iii) Release histaminase, destructive enzymes		
(D) Lymphocytes	(iv) Release granules containing histamine		

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

(NEET 2020)

2. 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		

A	B	C
(a) (iii)	(ii)	(i)
(b) (i)	(ii)	(iii)
(c) (i)	(iii)	(ii)
(d) (ii)	(iii)	(i)

(NEET 2018)

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

- (1) They do not need to reproduce.
 (2) They are somatic cells.
 (3) They do not metabolise.
 (4) All their internal space is available for oxygen transport.
- (a) Only (1) (b) (1), (3) and (4)
 (c) (2) and (3) (d) Only (4) *(NEET 2017)*

4. 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-II 2016)

5. Serum differs from blood in

- (a) lacking globulins
 (b) lacking albumins
 (c) lacking clotting factors
 (d) lacking antibodies. *(NEET-II 2016)*

6. Erythropoiesis starts in

- (a) spleen (b) red bone marrow
 (c) kidney (d) liver. *(2015 Cancelled)*

7. Person with blood group AB is considered as universal recipient because he has

- (a) both A and B antigens on RBC but no antibodies in the plasma
 (b) both A and B antibodies in the plasma
 (c) no antigen on RBC and no antibody in the plasma
 (d) both A and B antigens in the plasma but no antibodies. *(2014)*

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



Blood cell

- (a) Basophil
 (b) B-lymphocyte
 (c) Neutrophil
 (d) Monocyte

Characteristics

Secretes serotonin, inflammatory response
 Forms about 20% of blood cells involved in immune response
 Most abundant blood cells, phagocytic
 Lifespan of 3 days, produces antibodies

(Karnataka NEET 2013)

9. A certain road accident patient with unknown blood group needs immediate blood transfusion. His one doctor friend at once offers his blood. What was the blood group of the donor?
 (a) Blood group B (b) Blood group AB
 (c) Blood group O (d) Blood group A (2012)
10. Which one of the following human organs is often called the "graveyard" of RBCs?
 (a) Gall bladder (b) Kidney
 (c) Spleen (d) Liver (Mains 2012)
11. Which one of the following plasma proteins is involved in the coagulation of blood?
 (a) Albumin (b) Serum amylase
 (c) Globulin (d) Fibrinogen (2011)
12. A person with unknown blood group under ABO system, has suffered much blood loss in an accident and needs immediate blood transfusion. His friend who has 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 B (b) Type AB
 (c) Type O (d) Type A (2011)
13. Which two of the following changes (i –iv) usually tend to occur in the plain dwellers when they move to high altitudes (3,500 m or more)?
 (i) Increase in red blood cell size
 (ii) Increase in red blood cell production
 (iii) Increased breathing rate
 (iv) Increase in thrombocyte count
 Changes occurring are
 (a) (ii) and (iii) (b) (iii) and (iv)
 (c) (i) and (iv) (d) (i) and (ii). (2010)
14. The haemoglobin content per 100 mL of blood of a normal healthy human adult is
 (a) 5 - 11 gm (b) 25 - 30 gm
 (c) 17 - 20 gm (d) 12 - 16 gm.
 (Mains 2010)
15. There is no DNA in
 (a) mature RBCs
 (b) a mature spermatozoan
 (c) hair root
 (d) an enucleated ovum (2009)
16. Globulins contained in human blood plasma are primarily involved in
 (a) osmotic balance of body fluids
 (b) oxygen transport in the blood
 (c) clotting of blood
 (d) defence mechanisms of body. (2009)
17. The most popularly known blood grouping is the ABO grouping. It is named ABO and not ABC, because "O" in it refers to having
 (a) overdominance of this type on the genes for A and B types
 (b) one antibody only - either anti - A or anti - B on the RBCs
 (c) no antigens A and B on RBCs
 (d) other antigens besides A and B on RBCs. (2009)
18. The most active phagocytic white blood cells are
 (a) eosinophils and lymphocytes
 (b) neutrophils and monocytes
 (c) neutrophils and eosinophils
 (d) lymphocytes and macrophages. (2008)
19. Which type of white blood cells are concerned with the release of histamine and the natural anticoagulant heparin?
 (a) Eosinophils (b) Monocytes
 (c) Neutrophils (d) Basophils (2008)
20. 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 (2007)
21. 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 you will 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 (2004)
22. In the ABO system of blood groups, if both antigens are present but no antibody, the blood group of the individual would be
 (a) B (b) O
 (c) AB (d) A. (2003)
23. What is correct for blood group O?
 (a) No antigens but both a and b antibodies are present.
 (b) A antigen and b antibody present.
 (c) Antigen and antibody both absent.
 (d) A and B antigens and a, b antibodies present. (2001)
24. Erythroblastosis fetalis is caused when fertilisation takes place between gametes of
 (a) Rh⁻ female and Rh⁺ male
 (b) Rh⁺ female and Rh⁻ male
 (c) Rh⁺ female and Rh⁺ male
 (d) Rh⁻ female and Rh⁻ male. (2000)

25. Which statement is true for WBC?
 (a) Non-nucleated
 (b) In deficiency, cancer is caused
 (c) Manufactured in thymus
 (d) Can squeeze through blood capillaries (2000)
26. Which is the principal cation in the plasma of the blood?
 (a) Potassium (b) Magnesium
 (c) Calcium (d) Sodium (1999)
27. The blood group, with antibody-A and antibody-B is
 (a) O (b) B
 (c) A (d) AB. (1999)
28. The problem, due to Rh⁻ factor arises when the blood of two (Rh⁺ and Rh⁻) mix up
 (a) during pregnancy (b) in a test tube
 (c) through transfusion (d) both (a) and (c). (1999)
29. Which of the following is agranulocyte?
 (a) Basophil (b) Neutrophil
 (c) Lymphocyte (d) Eosinophil (1997)
30. The life span of human WBC is approximately
 (a) between 2 to 3 months
 (b) more than 4 months
 (c) less than 10 days
 (d) between 20 to 30 days. (1997)
31. Vitamin K is required for
 (a) change of prothrombin into thrombin
 (b) synthesis of prothrombin
 (c) change of fibrinogen to fibrin
 (d) formation of thromboplastin. (1993)
32. Cells formed in bone marrow include
 (a) RBCs (b) RBCs and leucocytes
 (c) leucocytes (d) lymphocytes. (1992)
33. Component of blood responsible for producing antibodies is
 (a) thrombocytes (b) monocytes
 (c) erythrocytes (d) lymphocytes. (1992)
34. Blood group AB has
 (a) no antigen
 (b) no antibody
 (c) neither antigen nor antibody
 (d) both antigen and antibody. (1991)
35. Carbonic anhydrase occurs in
 (a) lymphocytes (b) blood plasma
 (c) RBCs (d) leucocytes. (1991)
36. Removal of calcium from freshly collected blood would
 (a) cause delayed clotting
 (b) prevent clotting
 (c) cause immediate clotting
 (d) prevent destruction of haemoglobin (1989)
37. 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. (1989)
38. Which one engulfs pathogens rapidly?
 (a) Acidophils (b) Monocytes
 (c) Basophils (d) Neutrophils (1989)
39. Child death may occur in the marriage of
 (a) Rh⁺ man and Rh⁺ woman
 (b) Rh⁺ man and Rh⁻ woman
 (c) Rh⁻ man and Rh⁻ woman
 (d) Rh⁻ man and Rh⁺ woman. (1988)
40. Breakdown product of haemoglobin is
 (a) bilirubin (b) iron
 (c) biliverdin (d) calcium. (1988)
41. RBCs do not occur in
 (a) frog (b) cow
 (c) camel (d) cockroach. (1988)

18.2 Lymph (Tissue Fluid)

42. Which one of the following is correct?
 (a) Lymph = Plasma + RBC + WBC
 (b) Blood = Plasma + RBC + WBC + Platelets
 (c) Plasma = Blood - Lymphocytes
 (d) Serum = Blood + Fibrinogen (2015 Cancelled)
43. Compared to blood our lymph has
 (a) plasma without proteins
 (b) more WBCs and no RBCs
 (c) more RBCs and less WBCs
 (d) no plasma. (2009)
44. Which of the following statements is true for lymph?
 (a) WBC + serum
 (b) Blood - RBCs and some proteins
 (c) RBCs + WBCs + plasma
 (d) RBCs + proteins + platelets (2002)
45. Which of the following is not the main function of lymph glands?
 (a) Forming RBCs (b) Destroying bacteria
 (c) Forming WBCs (d) Forming antibodies (1998)
46. The lymph serves to
 (a) return the interstitial fluid to the blood
 (b) return the WBCs and RBCs to the lymph nodes
 (c) transport CO₂ to the lungs
 (d) transport O₂ to the brain. (1995)
47. Lymph differs from blood in possessing
 (a) only WBC
 (b) more RBC and WBC
 (c) more RBC and few WBC
 (d) more WBC and few RBC. (1989)



18.3 Circulatory Pathways

48. The QRS complex in a standard ECG represents

- (a) repolarisation of auricles
- (b) depolarisation of auricles
- (c) depolarisation of ventricles
- (d) repolarisation of ventricles. (NEET 2020)

49. Match the column - I with column - II.

Column-I

Column-II

- | | |
|--------------------------------------|-----------------------------------|
| (A) P-wave | (i) Depolarisation of ventricles |
| (B) QRS complex | (ii) Repolarisation of ventricles |
| (C) T-wave | (iii) Coronary ischaemia |
| (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) (ii) | (iii) | (v) | (iv) |
| (b) (iv) | (i) | (ii) | (iii) |
| (c) (iv) | (i) | (ii) | (v) |
| (d) (ii) | (i) | (v) | (iii) (NEET 2019) |

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) 125 beats per minute
- (b) 50 beats per minute
- (c) 75 beats per minute
- (d) 100 beats per minute (NEET 2019)

51. 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 |

- | | | |
|-----------|-------|-------------------|
| A | B | C |
| (a) (iii) | (i) | (ii) |
| (b) (i) | (iii) | (ii) |
| (c) (i) | (ii) | (iii) |
| (d) (ii) | (i) | (iii) (NEET 2018) |

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

- (a) AV node receives signal from SA node
- (b) AV valves open up
- (c) Ventricular walls vibrate due to gushing in of blood from atria
- (d) Semilunar valves close down after the blood flows into vessels from ventricles. (2015)

53. Blood pressure in the mammalian aorta is maximum during

- (a) systole of the left ventricle
- (b) diastole of the right atrium
- (c) systole of the left atrium
- (d) diastole of the right ventricle. (2015 Cancelled)

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

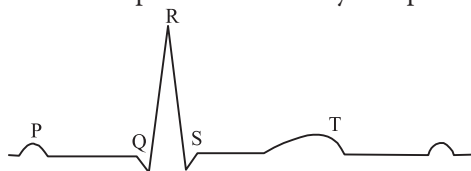


- (a) beginning of the systole
- (b) end of systole
- (c) contraction of both the atria
- (d) initiation of the ventricular contraction. (NEET 2013)

55. 'Bundle of His' is a part of which one of the following organs in humans?

- (a) Brain
- (b) Heart
- (c) Kidney
- (d) Pancreas (2011)

56. Given below is the ECG of a normal human. Which one of its components is correctly interpreted below?



- (a) Complex QRS - one complete pulse
- (b) Peak T - initiation of total cardiac contraction
- (c) Peak P and peak R together - systolic and diastolic blood pressures
- (d) Peak P- initiation of left atrial contraction only (Mains 2011)

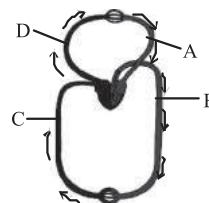
57. If due to some injury the chordae tendinae of the tricuspid valve of the human heart is partially non-functional, what will be the immediate effect?

- (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. (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) S - start of systole
 (b) T - end of diastole
 (c) P - depolarisation of the atria
 (d) R - repolarisation of ventricles (2009)
59. In humans, blood passes from the post caval to the diastolic right atrium of heart due to
 (a) stimulation of the sino auricular node
 (b) pressure difference between the post caval and atrium
 (c) pushing open of the venous valves
 (d) suction pull. (2008)
60. Which one of the following has an open circulatory system?
 (a) *Octopus* (b) *Pheretima*
 (c) *Periplaneta* (d) *Hirudinaria* (2006)
61. 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. (2003)
62. 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. (2003)
63. 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. (2003)
64. Impulse of heart beat originates from
 (a) SA node (b) AV node
 (c) vagus nerve (d) cardiac nerve. (2002)
65. Rate of heart beat is determined by
 (a) Purkinje fibres (b) papillary muscles
 (c) AV node (d) SA node. (1999)
66. The correct route through which pulse-making impulse travels in the heart is
 (a) SA node → Purkinje fibres → bundle of His → AV node → heart muscles
 (b) SA node → AV node → bundle of His → Purkinje fibres → heart muscles
 (c) AV node → bundle of His → SA node → Purkinje fibres → heart muscles
 (d) AV node → SA node → Purkinje fibres → bundle of His → heart muscles. (1995)
67. The neurogenic heart is the characteristic feature of
 (a) humans (b) arthropods
 (c) rabbits (d) rats. (1995)
68. The heart sound 'dup' is produced when
 (a) mitral valve is closed
 (b) semi-lunar valves at the base of aorta get closed
 (c) tricuspid valve is opened
 (d) mitral valve is opened. (1994)
69. The pacesetter in the heart is called
 (a) sino-atrial node (SAN)
 (b) atrio-ventricular node (AVN)
 (c) Purkinje fibres
 (d) papillary muscle. (1994)
70. 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. (1989)

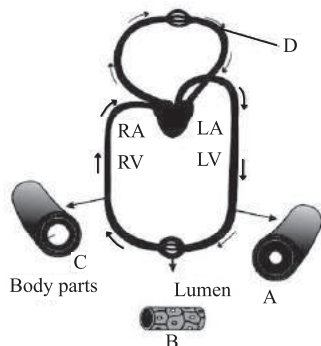
18.4 Double Circulation

71. The hepatic portal vein drains blood to liver from
 (a) stomach (b) kidneys
 (c) intestine (d) heart. (NEET 2017)
72. Blood pressure in the pulmonary artery is
 (a) more than that in the pulmonary vein
 (b) less than that in the venae cavae
 (c) same as that in the aorta
 (d) more than that in the carotid. (NEET-I 2016)
73. In mammals, which blood vessel would normally carry largest amount of urea?
 (a) Hepatic vein (b) Hepatic portal vein
 (c) Renal vein (d) Dorsal aorta (NEET-I 2016)
74. Which one of the following animals has two separate circulatory pathways?
 (a) Whale (b) Shark
 (c) Frog (d) Lizard (2015)
75. The given figure shows schematic plan of blood circulation in humans with labels A to D. Identify the label and give its functions.



- (a) C - Vena cava - Takes blood from body parts to right auricle, $p\text{CO}_2 = 45$ mm Hg
 (b) D - Dorsal aorta - Takes blood from heart to body parts, $p\text{O}_2 = 95$ mm Hg
 (c) A - Pulmonary vein - Takes impure blood from body parts, $p\text{O}_2 = 60$ mm Hg
 (d) B - Pulmonary artery - Takes blood from heart to lungs, $p\text{O}_2 = 90$ mm Hg (NEET 2013)

76. The figure shows blood circulation in humans with labels A to D. Select the option which gives correct identification of label and functions of the part.



- (a) B - Capillary-Thin without muscle layer and wall two cell layers thick
 (b) C - Vein-Thin walled and blood flows in jerks/spurts
 (c) D - Pulmonary vein-Takes oxygenated blood to heart, $p\text{O}_2 = 95$ mmHg
 (d) A - Artery-Thick walled and blood flows evenly (Karnataka NEET 2013)

77. Arteries are best defined as the vessels which
 (a) supply oxygenated blood to the different organs
 (b) carry blood away from the heart to different organs
 (c) break up into capillaries which reunite to form a vein
 (d) carry blood from one visceral organ to another visceral organ. (2011)

78. Fastest distribution of some injectible material/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. (Mains 2010)

79. Difference between pulmonary artery and pulmonary vein is that, the pulmonary artery has
 (a) no endothelium
 (b) valves
 (c) thicker walls
 (d) oxygenated blood. (2000)

80. In which point, pulmonary artery is different from pulmonary vein?

- (a) Its lumen is broad.
 (b) Its wall is thick.
 (c) It has valves.
 (d) It does not possess endothelium. (2000)

81. Which vertebrate organ receives only oxygenated blood?

- (a) Spleen (b) Liver
 (c) Gill (d) Lung (1996)

82. 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 these. (1995)

83. Blood capillaries are made of

- (a) endothelium, connective tissue and muscle fibres
 (b) endothelium and muscle fibres
 (c) endothelium and connective tissue
 (d) endothelium only. (1993)

84. Wall of blood capillary is formed of

- (a) haemocytes
 (b) parietal cells
 (c) endothelial cells
 (d) oxyntic cells. (1991)

85. Splenic artery arises from

- (a) anterior mesenteric artery
 (b) coeliac artery
 (c) posterior mesenteric artery
 (d) intestinal artery. (1991)

86. 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 interna, tunica media and tunica externa are thin
 (d) tunica media is a thin coat. (1990)

87. Arteries carry oxygenated blood except

- (a) pulmonary
 (b) cardiac
 (c) hepatic
 (d) systemic. (1989)

18.5 Regulation of Cardiac Activity

88. How do parasympathetic neural signals affect the working of the heart?

- (a) Reduce both heart rate and cardiac output.
 (b) Heart rate is increased without affecting the cardiac output.
 (c) Both heart rate and cardiac output increase.
 (d) Heart rate decreases but cardiac output increases. (2014)

18.6 Disorders of Circulatory System

89. Which one of the following statements is correct regarding blood pressure?
- 130/90 mm Hg is considered high and requires treatment.
 - 100/55 mm Hg is considered an ideal blood pressure.
 - 105/50 mm Hg makes one very active.
 - 190/110 mm Hg may harm vital organs like brain and kidney. (2011)
90. Given below are four statements (i-iv) regarding human blood circulatory system.
- Arteries are thick-walled and have narrow lumen as compared to veins.
 - Angina is acute chest pain when the blood circulation to the brain is reduced.
 - Persons with blood group AB can donate blood to any person with any blood group under ABO system.

(iv) Calcium ions play a very important role in blood clotting.

Which two of the above statements are correct?

- (i) and (iv)
- (i) and (ii)
- (ii) and (iii)
- (iii) and (iv)

(Mains 2010)

91. The thickening of walls of arteries is called
- arteriosclerosis
 - arthritis
 - aneurysm
 - both (b) and (c). (1999)
92. An adult human with average health has systolic and diastolic pressures as
- 120 mm Hg and 80 mm Hg
 - 50 mm Hg and 80 mm Hg
 - 80 mm Hg and 80 mm Hg
 - 70 mm Hg and 120 mm Hg. (1998)

ANSWER KEY

1. (a) 2. (d) 3. (d) 4. (d) 5. (c) 6. (b) 7. (a) 8. (a) 9. (c) 10. (c)
 11. (d) 12. (c) 13. (a) 14. (d) 15. (a) 16. (d) 17. (c) 18. (b) 19. (d) 20. (a)
 21. (a) 22. (c) 23. (a) 24. (a) 25. (d) 26. (d) 27. (a) 28. (d) 29. (c) 30. (c)
 31. (b) 32. (b) 33. (d) 34. (b) 35. (c) 36. (b) 37. (c) 38. (d) 39. (b) 40. (a,b)
 41. (d) 42. (b) 43. (b) 44. (b) 45. (a) 46. (a) 47. (a) 48. (c) 49. (b) 50. (d)
 51. (a) 52. (d) 53. (a) 54. (c) 55. (b) 56. (a) 57. (d) 58. (c) 59. (b) 60. (c)
 61. (*) 62. (b) 63. (b) 64. (a) 65. (d) 66. (b) 67. (b) 68. (b) 69. (b) 70. (b)
 71. (a,c) 72. (a) 73. (a) 74. (a) 75. (a) 76. (c) 77. (b) 78. (c) 79. (c) 80. (b)
 81. (a) 82. (c) 83. (d) 84. (c) 85. (b) 86. (d) 87. (a) 88. (a) 89. (d) 90. (a)
 91. (a) 92. (a)

*None of the options is correct.

Hints & Explanations

- (a)
- (d)
- (d) : Red blood cells of adult humans do not have cell organelles including nucleus, Golgi bodies, mitochondria, ribosomes, etc. It increases the surface area of RBCs and enables them to contain more haemoglobin (the oxygen carrying pigment).
- (d) : Thrombocytes are called blood platelets. They are minute disc-shaped cell fragments in mammalian blood. They are formed as fragments of larger cells found in red bone marrow; they have no nucleus. They play an important role in blood clotting and release thromboxane A_2 , serotonin and other chemicals, which cause a chain of

events leading to the formation of a plug at the site of the damage, thus preventing further blood loss. A reduction in their number can lead to clotting factors which will lead to excessive loss of blood from the body.

5. (c) : Serum is the fluid that separates from blood plasma on centrifugation. Serum is essentially similar in composition to plasma but lacks fibrinogen and other substances that are used in the coagulation process.

6. (b) : Erythropoiesis is the formation of red blood cells (erythrocytes) which occurs in the red bone marrow.

7. (a) : Individuals with AB blood group have both antigen A and B on their RBCs, and no antibodies for either of the antigen in their plasma. Type O individuals

are without A and B antigens on their RBCs, but have antibodies for both these antigens in their plasma. Individuals with blood group AB can receive blood of A, B or O group, while those with blood group O can donate blood to anyone.

8. (a) : Basophils have nucleus which is three-lobed and have less number of coarse granules. Their granules take basic stain and release heparin, histamine and serotonin.

9. (c) : The blood group was O. The person having O blood group is universal donor. It lacks both antigens 'A' and 'B' thus does not cause agglutination or clumping of blood cells when transfused into person with any of the four blood groups.

10. (c) : Spleen is a vertebrate organ, lying behind the stomach, that is basically a collection of lymphoid tissue. Its functions include producing lymphocytes and destroying foreign particles. It acts as a reservoir for RBCs and can regulate the number in circulation. It is also the site for the breakdown of worn out RBCs and thus is known as "graveyard" of RBCs.

11. (d) : Blood plasma is a faint yellow, slightly alkaline and somewhat viscous fluid. The plasma contains a number of proteins: serum albumin, serum globulins, properdin, prothrombin and fibrinogen. Prothrombin and fibrinogen play an important role in blood clotting.

12. (c) : The blood group was O. The person having O blood group is universal donor. It lacks both antigens 'A' and 'B' thus does not cause agglutination or clumping of blood cells when transfused into person with any of the four blood groups.

13. (a) : The body undergoes numerous changes at higher elevation in order to increase oxygen delivery to cells and improve efficiency of oxygen use. The early changes include increased breathing rate, increased heart rate and fluid shifts. The later changes includes increased red blood cell production, increased 2, 3 DPG production and increased number of capillaries.

14. (d)

15. (a)

16. (d) : Globulins in human blood plasma are primarily involved in defence mechanisms of body. Globulins like immunoglobulins act as antibodies that destroy bacteria, viruses and toxic substances that may enter into the blood from outside.

17. (c) : In ABO blood group, O refers to O blood group. It has no antigen (A and B) on RBCs.

18. (b) : Phagocytes are cells that are able to engulf and breakdown foreign particles, cell debris and disease producing microorganisms. Neutrophils and monocytes

(type of white blood cells) are the most active phagocytic cells.

19. (d) : Basophils have nucleus which is three-lobed and have less number of coarse granules. Their granules take basic stain and release heparin, histamine and serotonin.

20. (a) : Blood serum is blood plasma from which the fibrin and clotting factors have been removed by centrifugation or vigorous stirring, so that it cannot clot. Serum containing a specific antibody or antitoxin may be used in the treatment or prevention of certain infections. Such serum is generally derived from a non-human mammal (e.g., a horse).

21. (a)

22. (c) : Individuals with AB blood group have both antigen A and B on their RBCs, and no antibodies for either of the antigen in their plasma. Type O individuals are without A and B antigens on their RBCs, but have antibodies for both these antigens in their plasma. Individuals with blood group AB can receive blood of A, B or O group, while those with blood group O can donate blood to anyone.

23. (a) : Refer to answer 22.

24. (a) : If fertilisation takes place between gametes of Rh⁻ female and Rh⁺ male then the resulting fetus' blood is Rh⁺. The Rh⁺ blood of the fetus stimulates the formation of anti Rh factors in the mother's blood. In second pregnancy (with Rh⁺ fetus), the anti Rh factors of the mother's blood destroy the fetal red blood corpuscles. This is called erythroblastosis fetalis. New born may survive but it is often anaemic. The Rh⁻ child does not suffer.

25. (d) : WBCs are the colourless nucleated amoeboid cells that can squeeze through blood capillaries by a process known as diapedesis. The increase in their number causes leukemia, a cancer. WBCs are of two types, granulocytes (formed in bone marrow) and agranulocytes (formed in bone marrow and thymus).

26. (d) : Blood consists of a watery fluid called plasma. Plasma is a faint yellow, slightly alkaline, viscous fluid. It consists of 90% water, 1% inorganic salts, 7% or 8% proteins and 1% of other substances. The inorganic salts in plasma occur as ions. Sodium is the main cation of plasma and chloride, the main anion. Potassium, calcium and magnesium occur in small amount.

27. (a)

28. (d) : A protein named as Rhesus antigen, is present on the surface of red blood corpuscles. Persons having this Rhesus antigen (Rh factor) are called Rh positive (Rh⁺). Others who do not have this factor are known

as Rh negative (Rh^-). Both Rh^+ and Rh^- individuals are phenotypically normal. The problem arises during blood transfusion and pregnancy.

The first blood transfusion of Rh^+ blood to the person with Rh^- blood causes no harm because the Rh^- person develops anti Rh factors or antibodies in his/her blood. In second blood transfusion of Rh^+ blood to the Rh^- person, the latter's anti Rh factors attack and destroy the red blood corpuscles of the donor. If father's blood is Rh^+ , mother's blood is Rh^- and fetus' blood is Rh^+ . Then in second pregnancy (with Rh^+ fetus), the anti Rh factors of the mother's blood destroy the fetal red blood corpuscles.

29. (c) : Agranulocytes are leucocytes that lack granules in the cytoplasm. They are formed in spleen and lymph nodes and bone marrow. Since lymphocyte does not have granules in their cytoplasm so it is called agranulocyte. Lymphocytes are important in the body's defence and are responsible for immune reactions as the presence of antigens stimulates them to produce antibodies. Another type of agranulocyte is monocyte. The other three are granulocytes which are produced in red bone marrow.

30. (c) : WBCs (also called leucocytes) are rounded or irregular colourless cells with a nucleus. They can change their shape and are capable of amoeboid movement. Leucocytes, formed in lymph nodes and red bone marrow, can produce antibodies and move through the walls of vessels to migrate to the sites of injuries, where they surround and isolate dead tissue, foreign bodies and bacteria. They survive for a few days generally 3-4 days after which they die and get phagocytised in blood, liver and lymph nodes.

31. (b) : Vitamin K is essential for blood clotting as it is necessary for the synthesis of prothrombin in the liver.

32. (b) : In the embryo and foetal stage of vertebrates, RBCs and leucocytes are formed in the bone marrow, lymph nodes, yolk sac, liver, spleen and thymus but after birth they are formed in red bone marrow only.

33. (d) : Lymphocytes have a very large, rounded nucleus and scanty cytoplasm. They are nonmotile and nonphagocytic. They secrete antibodies to destroy microbes and their toxins, reject grafts and kill tumour cells. They also help in healing of injuries. Thrombocytes aid in clotting of blood. Monocytes are phagocytic in nature and erythrocytes (RBCs) transport gases in the body.

34. (b)

35. (c) : During transport of CO_2 in the blood, about 70% of CO_2 released by respiring tissue cells is transported as bicarbonate ions. It diffuses into the plasma and then into the RBCs. Here, CO_2 combines with water to form carbonic acid. This reaction is catalyzed by a zinc

containing enzyme carbonic anhydrase. Carbonic acid dissociates into bicarbonate and hydrogen ions. A small amount of bicarbonate ions is transported in the RBCs, whereas most of them diffuse into the plasma to be carried by it.

36. (b) : Thromboplastin, a lipoprotein, helps in clot formation. Thromboplastin helps in the formation of an enzyme prothrombinase. This enzyme inactivates heparin and it also converts the inactive plasma protein prothrombin into its active form, thrombin. Both the changes require calcium ions. Thrombin converts fibrinogen molecule to insoluble fibrin. The fibrin monomers polymerise 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. Thus, if calcium is removed from the blood, clotting process will not occur.

37. (c)

38. (d) : Neutrophils, are the most abundant type of white blood cells and form an integral part of the immune system. These phagocytes are normally found in the blood stream. However, during the acute phase of inflammation, particularly as a result of bacterial infection, neutrophils leave the vasculature and migrate toward the site of inflammation in a process called chemotaxis. They are the predominant cells in pus, accounting for its whitish/yellowish appearance. Neutrophils react within an hour of tissue injury and are the hallmark of acute inflammation. Monocytes are also phagocytes but take 7-8 hours to reach at the site of injury. Acidophils and basophils are not phagocytic in nature.

39. (b) : Rh factor plays a crucial role in child's birth born out of a marriage between Rh^- woman and a Rh^+ man. In such a case, the mother becomes sensitive while carrying a first Rh^+ child within her womb. The reason for such sensitivity is that some of the RBCs from the developing embryo get into the blood stream of the mother during development, causing her to produce anti-Rh antibodies. In fact, the first child of such parents is nearly normal and is delivered safely. However, if such a mother gets pregnant again, the subsequent Rh^+ foetuses will be exposed to the anti-Rh antibodies produced by the mother. As a result serious damage to the red blood cells of the developing embryo will occur causing haemolytic disease of the newborn (HDN) or erythroblastosis fetalis. This disease leads to the death of the developing embryo before birth or after parturition.

40. (a, b) : The haemoglobin is broken down into haem *i.e.*, iron and globin protein which is then converted into yellowish substance bilirubin which is extracted by the

liver cells from the blood and stored in the form of bile in gall bladder.

41. (d) : RBCs do not occur in the blood of cockroach. The circulatory system of cockroach is of open type. Viscera lie in the haemocoel immersed in blood called haemolymph. The latter consists of colourless plasma and irregular white corpuscles, the leucocytes. There are no blood vessels except aorta that carries blood from the heart to the haemocoel.

42. (b) : Lymph = Plasma + WBC
Plasma = Blood – Cellular components
Serum = Plasma – Clotting factors

43. (b)

44. (b)

45. (a) : Formation of WBCs, antibodies and destruction of bacteria occur in lymph glands while formation of RBCs occur in bone marrow. Lymph gland is a rounded mass of lymphatic tissue that is surrounded by a capsule of connective tissue. Lymph glands filter lymph (lymphatic fluid) and they store lymphocytes (white blood cells). They are located along lymphatic vessels. They are also called lymph node.

46. (a) : Lymph (also called tissue fluid in the intercellular spaces) is the colourless liquid found within the lymphatic system. An important function of lymph is to return interstitial fluid back to the blood. The interstitial fluid is the filtered form of the blood without the cellular components and plasma proteins. It consists of water containing dissolved materials. It receives CO₂, nitrogenous waste products, hormones and other synthetic substances from the tissue cells and enters the lymph capillaries to discharge them into blood.

47. (a)

48. (c) : The QRS complex represents the depolarisation of the ventricles, that initiates the ventricular contraction.

49. (b) : A normal electrocardiogram or ECG comprises of a P wave, a QRS wave complex and a T wave in which P wave represents depolarisation of the atria, QRS wave complex represents depolarisation of the ventricles and T wave represents ventricular repolarisation. Myocardial ischaemia can affect morphology of T-wave in a variety of ways, *i.e.*, T-wave may become tall, flattened, inverted or biphasic. Flattened T-waves is common in patient with myocardial ischaemia.

50. (d) : Stroke volume = End diastolic volume
– End systolic volume

$$= 100 - 50 = 50 \text{ mL}$$

Cardiac output = Heart beat \times Stroke volume

$$\therefore \text{Heart beat} = \text{Cardiac output} / \text{Stroke volume} \\ = 5000 / 50 = 100 \text{ beats per minute}$$

51. (a)

52. (d) : Second heart sound *i.e.*, *dup* is caused by the closure of the semilunar valves and marks the end of ventricular systole.

53. (a) : The temporary rise in blood pressure during the contraction of the heart is called systolic pressure and the temporary fall in blood pressure during relaxation of the heart is called diastolic pressure. Blood pressure is expressed as the ratio of the systolic pressure over the diastolic pressure. For a healthy resting adult person, the average systolic/diastolic pressures are 120/80 mmHg. Aorta is directly supplied by left ventricle thus, the blood pressure in aorta is highest during systole of left ventricle. During it, left ventricle contracts and pushes blood into aorta.

54. (c) : In the given diagram 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.

55. (b) : 'Bundle of His' is a part of heart. A bundle of nodal fibres, atrioventricular bundle (AV bundle), continues from the atrioventricular node (AVN) and passes through the atrioventricular septa. It emerges on the top of the interventricular septum and immediately divides into a right and left bundle, which give rise to minute fibres throughout the ventricular musculature of the respective sides called Purkinje fibres. These fibres along with right and left bundles are known as Bundle of His.

56. (a) : By counting the number of QRS complexes that occur in a given time period, one can determine the heart beat rate (pulse) of an individual. The QRS complex represents the depolarisation of the ventricles, which initiates the ventricular contraction.

57. (d) : Tricuspid valve is the valve in the heart 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. Thus, if tricuspid valve is partially non-functional the flow of blood into the pulmonary artery will be reduced.

58. (c) : Refer to answer 54.



59. (b) : Due to the pressure difference between the post caval and atrium, the blood passes from the post caval to the diastolic right atrium. Diastolic right atrium has less pressure and post caval has high pressure, thus blood moves from post caval to right atrium.

60. (c) : *Periplaneta* has open circulatory system, i.e., the blood does not flow in blood vessels but flows in a haemocoel (body cavity). The circulatory systems of all vertebrates, as well as of annelids (for example, earthworms) and cephalopods (squid and *Octopus*) are closed, in which the blood never leaves the system of blood vessels consisting of arteries, capillaries and veins.

61. None of the options is correct.

The artificial pacemaker is a small battery operated electrical stimulator planted beneath the skin under right clavicle while the string / cable is passed *via* superior vena cava, right atrium and allowed to rest against the tip of the right ventricle. It is an electrical device used for covering up any deficiency of myogenic functioning so as to make heart beat normally.

62. (b) : Bundle of His is a part of heart. A bundle of nodal fibres, atrioventricular bundle (AV bundle), continues from the atrioventricular node (AVN) and passes through the atrioventricular septa. It emerges on the top of the interventricular septum and immediately divides into a right and left bundle, which give rise to minute fibres throughout the ventricular musculature of the respective sides called Purkinje fibres. These fibres along with right and left bundles are known as Bundle of His.

63. (b)

64. (a) : SA (sinoatrial) node is a specialised bundle of neurons located in the upper part of the right atrium of the heart. SA node is the natural cardiac pacemaker from which the heart beat originates.

65. (d)

66. (b)

67. (b) : The neurogenic heart is a characteristic feature of most arthropods and some annelids. In this, the heart beat is initiated by a nerve impulse coming from a nerve ganglion situated near the heart. The myogenic heart is a characteristic feature of molluscs and vertebrates. In this, heart beat is initiated by a patch of modified heart muscle itself. So, humans, rabbits and rats have myogenic heart.

68. (b) : Refer to answer 52.

69. (b) : AV (atrioventricular) node is a mass of modified heart muscle situated in the lower middle part of the right atrium. It receives the impulse to contract from the SA node *via* the atria and transmits it through the atrioventricular bundles to the ventricles. AV node is

called the pacesetter. Here, the impulses are delayed for 0.1 second to ensure that the auricles will contract first and empty fully before the ventricles contract.

70. (b) : Refer to answer 57.

71. (a,c) : Blood enters the liver from two sources. From the hepatic artery, it gets oxygenated blood and from the hepatic portal vein, it receives deoxygenated blood. Blood in the hepatic artery comes from the aorta. Blood in the hepatic portal vein comes directly from the intestine containing newly absorbed nutrients, stomach, etc.

72. (a)

73. (a) : Hepatic vein carries largest amount of urea. Urea is produced in liver. Hepatic vein transports liver's deoxygenated blood to heart for oxygenation.

74. (a) : Whale is a mammal and in mammals, two separate circulatory pathways are found — systemic circulation and pulmonary circulation. Oxygenated and deoxygenated bloods received by the left and right atria respectively pass on to the left and right ventricles. Thus, oxygenated and deoxygenated bloods are not mixed. This is referred to as double circulation.

75. (a) : In the given figure, A is pulmonary vein which brings pure blood from lungs to left atrium, B is dorsal aorta which carries blood from heart to body parts, C is vena cava which carries impure blood from body parts to right auricle and D is pulmonary artery which takes impure blood from heart to lungs.

76. (c) : A - Artery : Carries blood from heart to different body parts. It is thick-walled and elastic. The flow of blood in it is intermittent.

B - Capillary : Nutrients, hormones, gases, etc., can diffuse into tissue cells through capillaries and *vice versa*. It is thin-walled and only one layer thick resting on basement membrane.

C - Vein : Brings blood from different body parts to the heart. It is thin-walled and acts as low-resistance conduct for blood flow.

D - Pulmonary vein : Two pulmonary veins from each lung transport the oxygenated blood to the left atrium.

77. (b) : Arteries and veins are main blood vessels. Arteries carry blood from the heart to different body parts. Veins bring blood from different body parts to the heart.

78. (c) : Intravenous injection is given for rapid distribution of drugs/substance. Intra-muscular injection is given for producing local effect.

79. (c) : An artery has thick and more elastic wall but its lumen is narrow as compared to vein. Pulmonary artery carries deoxygenated blood from the right ventricle

to the lungs for oxygenation. Pulmonary vein carries oxygenated blood from the lungs to the left auricle.

80. (b) : An artery has thick and more elastic wall but its lumen is narrow as compared to vein. Pulmonary artery carries deoxygenated blood from the right ventricle to the lungs for oxygenation. Pulmonary vein carries oxygenated blood from the lungs to the left auricle.

81. (a) : Spleen receives only oxygenated blood from the heart through splenic artery. The liver receives a blood supply from two sources. The first is the hepatic artery which delivers oxygenated blood from the general circulation. The second is the hepatic portal vein delivering deoxygenated blood from the small intestine containing nutrients. The blood flows through the liver tissue to the hepatic cells where many metabolic functions take place. The blood drains out of the liver *via* the hepatic vein. Gill and lung receive deoxygenated blood as these are the organs where oxygenation of blood takes place.

82. (c) : Veins carry blood at low pressure as compared to blood carried by arteries. Arteries carry blood from the heart whose function is to pump blood at high pressure so that blood can reach each and every part of the body. Veins carry blood from tissues to the heart, so they carry blood at low pressure. Valves are present in the veins to prevent backflow of blood due to force of gravity.

83. (d) : The wall of capillaries is very thin (usually less than one micron) and have numerous minute pores and made up of only endothelium. Exchange of material takes place between blood and tissue fluid across the endothelial membrane of capillaries through active diffusion.

84. (c) : Refer to answer 83.

85. (b) : The splenic artery is the blood vessel that supplies oxygenated blood to the spleen. It branches from the coeliac artery and follows a course superior to the pancreas. The coeliac artery is the first major branch of the abdominal aorta and branches from the aorta around the level of the T12 vertebra in humans. It is one of three anterior/ midline branches of the abdominal aorta.

86. (d) : Wall of a vein consists of tunica externa, tunica media and tunica interna. All these layers are also present in the wall of artery. However, in the wall of a vein, the elastic membrane of tunica interna is relatively thin, and muscle fibres and elastic fibres in tunica media are fewer.

Therefore, a vein has a thinner and less elastic wall but a wider cavity than an artery of the same diameter.

87. (a) : Pulmonary artery carries the blood from the right ventricle of the heart to the lungs for oxygenation so it carries deoxygenated blood.

88. (a) : A special neural centre in medulla oblongata can moderate the cardiac function through autonomic nervous system (ANS). Neural signals through the sympathetic nerves (part of ANS) can increase the rate of heart beat, the strength of ventricular contraction and thereby the cardiac output. Parasympathetic neural signals (component of ANS) decrease the rate of heart beat, speed of conduction of action potential and thereby the cardiac output.

89. (d) : If repeated checks of blood pressure of an individual is 140/90 mm Hg or higher, it shows hypertension or high blood pressure. It leads to heart diseases and also affects vital organs like brain and kidney.

90. (a) : The term angina means chest pain. In this disease, enough oxygen does not reach the heart muscles. The patient experiences heart pain usually in front of the chest.

AB blood group person have both antigens A and B, but do not have antibodies in the plasma. Due to the presence of both the antigens, AB blood group person cannot donate blood to anyone. However, the person can receive blood from any blood group as it has no antibodies. Thus, AB blood group is a universal recipient.

91. (a) : Arteriosclerosis is the hardening of arteries and arterioles due to thickening of the fibrous tissue, and the consequent loss of elasticity. In this disease, calcium salts precipitate with the cholesterol. This calcification ultimately makes the wall of arteries stiff and rigid.

92. (a) : The temporary rise in blood pressure during the contraction of the heart is called systolic pressure and the temporary fall in blood pressure during relaxation of the heart is called diastolic pressure. Blood pressure is expressed as the ratio of the systolic pressure over the diastolic pressure. For a healthy resting adult person, the average systolic/diastolic pressures are 120/80 mm Hg. Aorta is directly supplied by left ventricle thus, the blood pressure in aorta is highest during systole of left ventricle. During it, left ventricle contracts and pushes blood into aorta.

