16
Circulatory System

Answers and Explanations

I. Functions and Major Components of the Circulatory System

A. Multiple Choice Questions

1. (d) – The reproductive system does not function in maintaining homeostasis. As endocrine glands, however, the gonads do produce hormones that help to maintain body activities.
2. (d) – In a broad sense, the vessels that transport blood and those that transport lymph are part of the circulatory system. Likewise, lymph nodes are considered part of the circulatory system because they cleanse the lymph prior to its return to venous blood.
3. (a) – Capillaries are the functional units of the circulatory system, where exchange of materials between the blood and cells takes place.

B. True–False Questions

1. True – The extensive vascularity within the body is primarily due to the tremendous number of capillaries.
2. True – Hemoglobin molecules have an affinity for O_2.
3. False – Tissue fluid is the same as interstitial fluid. Both terms refer to the moist environment surrounding cells.

II. Blood

A. Multiple Choice Questions

1. (b) – Blood has a viscosity that ranges between 4.5 and 5.5.
2. (c) – The hematocrit is an indication of O_2 carrying capacity of the blood; a person with a low hematocrit is likely to be anemic.
3. (a) – A mature erythrocyte lacks a nucleus.
4. (a) – Neutrophils account for 54% to 62% of the leukocytes in a normal sample of blood.
5. (c) – The life span of platelets is from 5 to 9 days.
6. (c) – Produced by basophils, heparin thins the blood, helping to maintain it at a consistent viscosity.
7. (d) – Polycythemia, or an excessive number of erythrocytes, is symptomatic of several dysfunctions.
8. (e) – Low amounts of gamma globulins produced by lymphocytes cause a person to be susceptible to infectious diseases.
9. (a) – Serum is produced by removal of fibrinogen from blood plasma.

B. True–False Questions

1. True – Blood cells are so small that over 5.5 million of them are present in a drop (cubic millimeter) of blood.
2. True – Because an erythrocyte lacks a nucleus and mitochondria, some people refer to a red blood cell as a red blood corpuscle—not as a true cell.
3. True – Because each of the approximately 280 million hemoglobin molecules contained in an erythrocyte can combine with four molecules of O_2, each erythrocyte can carry over a billion molecules of O_2.
4. False – Fibrinogen is a plasma protein, not a cell.
5. False – None of the blood cells can mitotically divide.
6. False – Both alpha and beta globulins are produced in the liver and transport lipids and fat-soluble vitamins.

III. Heart

A. Multiple Choice Questions

1. (a) – The pericardial cavity is the space between the two layers of the pericardium surrounding the heart. The heart is contained within the mediastinum, and the mediastinum is located in the thoracic cavity.

2. (a) – Composed of cardiac muscle, the myocardium is the thickest layer of the heart.
3. (e) – Each of the four statements concerning the right atrium is correct.
4. (c) – Attached between the papillary muscles and the cusps of the atrioventricular valves, the chordae tendineae keep the valves from everting as the ventricles are contracted.
5. (d) – The two ventricles have the same cubic capacity. The auricles increase the size of the atria, so that they can hold greater volumes of blood.
6. (e) – The left atrioventricular valve is on the same side of the heart as the aortic valve, which lies at the base of the ascending aorta.
7. (c) – The walls of the ventricles are thicker than those of the atria in order to provide the forceful contraction necessary to pump blood throughout the body.
8. (a) – Blood from the right ventricle passes through the pulmonary vessels to and from the lungs, and the left atrium receives the oxygenated blood.
9. (c) – The right marginal artery serves the right side of the heart, and the left marginal artery serves the left side of the heart.
10. (d) – In a normal wave of depolarization through the conduction system of the heart, the activity of the nodal tissues can be monitored as an ECG.
11. (e) – Stimulation of the conduction myofibers causes the ventricles to contract and the pulmonary and aortic valves to open as blood is discharged from the heart.
12. (a) – The P wave is the first deflection of an ECG.
13. (a) – Diastole is ventricular relaxation that follows immediately after the QRS wave. It is exhibited by the P wave.
14. (a) – The louder lub sound of the lub-dub is caused by closing of the AV valves.
15. (b) – Ventricular contraction causes the AV valves to close and the pulmonary and aortic valves to open.
16. (b) – Heart murmurs are the sounds made by leaky valves.

B. True–False Questions
1. True – The parietal pericardium is the pericardial sac and the visceral pericardium is the epicardium.
2. False – The inner serous layer of the pericardium secretes pericardial fluid.
3. True – The endocardium is the innermost lining of the heart, surrounding the cavities of the atria and the ventricles. The endothelium is the innermost lining of blood vessels, surrounding the lumina. A capillary is composed of endothelial tissue only.
4. False – Chordae tendineae attach only to the atrioventricular valves.
5. True – The two pulmonary arteries arise from the pulmonary trunk, and the four branches of the pulmonary veins empty oxygenated blood from the lungs into the left atrium.
6. False – Equal amounts of blood flow through all four heart chambers.
7. False – Coronary circulation to the heart is part of the systemic circulation.
8. True – Located on the posterior portion of the heart, the coronary sinus collects all of the venous blood return from the myocardium of the heart, and then drains it into the right atrium.
9. False – A basic rate of depolarization through the conduction system of the heart is innate. Cardiac muscle fibers are myogenic.
10. True – Stimulation of the conduction myofibers causes ventricular contraction, which accounts for the QRS deflection of an ECG.
11. False – Depolarization of the AV node is necessary to relay the depolarization through the AV bundle to the conduction myofibers. Depolarization of the conduction myofibers causes systole.
12. False – The sound of the left atrioventricular valve is best heard with a stethoscope placed at the fifth intercostal space, just below the left breast on a female and just below the left nipple on a male.

IV. Blood Vessels

A. Multiple Choice Questions
1. (b) – The three tunicas of blood vessels from external to internal are the tunica externa, tunica media, and tunica interna. The innermost portion of the tunica interna, bordering the lumina of blood vessels, is the endothelium.
2. (a) – Because of the great number of veins and venules and their wide lumina, most of the blood within the body is found within these vessels at any given time.

3. (e) – All blood vessels contain an endothelium in contact with their lumina. Capillaries consist of just an endothelium of simple squamous epithelium.
4. (b) – There are precapillary sphincters, but not precapillary vessels.
5. (e) – Pulmonary veins do not transport oxygenated blood nor do they have valves. Other veins, such as the internal and external jugular veins, do not have valves.

B. True–False Questions
1. False – The endothelium consists of simple squamous epithelium.
2. True – The small diameter of capillaries forces the red blood cells through the lumina of these vessels in single file.
3. False – Continuous capillaries are typical of the blood-brain barrier.
4. True – For the most part, blood pressure is lost at the capillary level.

V. Principal Arteries of the Body

A. Multiple Choice Questions
1. (b) – The right subclavian artery arises from the brachiocephalic trunk.
2. (a) – The vertebral arteries pass through the transverse foramina of the cervical vertebrae to serve the brain.
3. (c) – The cerebral arterial circle ensures a continuous flow of blood to the brain.
4. (b) – The occipital and maxillary arteries do not serve the brain, but do serve the meninges covering the brain. Vasodilation of these vessels is usually the cause of headaches.
5. (d) – The axillary artery is the segment of the major vessel of the upper extremity as it passes through the axillary region.
6. (c) – The brachial artery can be compressed against the humerus, forming a pressure point in the brachial region.
7. (a) – The common hepatic artery is a branch of the celiac trunk.
8. (d) – The popliteal artery is the segment of the major artery of the lower extremity as it passes across the popliteal fossa.

B. True–False Questions
1. True – The right and left coronary arteries supply arterial blood to the myocardium of the heart.
2. False – Baroreceptors for monitoring blood pressure are found in the carotid sinus, and chemoreceptors within the carotid body respond to chemical changes in the blood.
3. True – The pituitary portal system is important for feedback mechanisms by which hormones are monitored within the blood.
4. True – Blood pressure can be determined by compressing the radial artery against the radius and detecting the pulsations of blood.
5. True – The splenic artery branches from the celiac trunk to supply blood to the spleen, pancreas, and portions of the stomach.
6. False – The celiac trunk and lumbar arteries are also unpaired vessels that arise from the abdominal portion of the aorta.
7. False – The femoral triangle is clinically important because it is an arterial pressure point and because it is a site where hernias frequently occur.
8. True – For example, the anterior and posterior humeral circumflex arteries encircle the proximal portion of the humerous.

VI. Principal Veins of the Body

A. Multiple Choice Questions
1. (a) – Like arteries, the walls of veins contain three tunicas.
2. (d) – The carotid sheath compartmentalizes and protects the common carotid artery, jugular vein, and vagus nerve as they pass through the neck.
3. (c) – The basilic and cephalic veins are superficial through the brachial region, and the brachial vein is deep.
4. (a) – The median cubital vein, located just beneath the skin in the cubital fossa, is the preferred site for venipuncture.
5. (a) – The azygos vein drains into the superior vena cava.

6. (d) – The common iliac vein drains blood from the lower extremity into the inferior vena cava.
7. (e) – The brachial vein parallels the brachial artery deep against the humerus in the brachial region.
8. (a) – Only the blood draining from the abdominal viscera (excluding the kidneys and adrenal glands) passes through the hepatic portal vein.

B. True–False Questions
1. True – Venous blood draining from the brain pools in the venous sinuses before draining through the jugular veins.
2. True – The two brachiocephalic veins converge to form the superior vena cava, and the brachiocephalic trunk bifurcates to give rise to the right common carotid and right subclavian arteries.
3. False – Blood drains from the deep thoracic region through the hemiazygos vein.
4. True – The great saphenous vein that drains the lower extremity is the longest vessel of the body.
5. True – The inferior vena cava that drains the lower part of the body is the largest vessel in diameter.
6. True – The hepatic portal system processes all of the blood draining from the abdominal viscera except that from the kidneys and adrenal glands.

VII. Fetal Circulation

A. Multiple Choice Questions
1. (c) – The umbilical vein transports oxygenated blood from the placenta to the fetal heart, and the two umbilical arteries transport deoxygenated blood from the fetus to the placenta.
2. (e) – Arising from the placenta, the umbilical vein is rich in O_2.
3. (c) – The foramen ovale in the fetal heart closes at birth with the first breath of inhaled air.
4. (a) – The round ligament of the liver, derived from the umbilical vein, helps to support the liver.

B. True–False Questions
1. True – Because of its capillary-exchange vascular network, the placenta can function as a selective barrier against certain substances.
2. False – A small amount of fetal blood flow passes through the pulmonary circulation to ensure development of the lungs and pulmonary vessels.
3. False – The umbilical arteries of the fetus arise from the internal iliac arteries.
4. False – The foramen ovale abruptly closes with the first inhalation of the newborn because the left heart pressure increases and the right heart pressure decreases. These changing pressure relationships cause the flap of the foramen ovale to be pushed to the closed position.

VIII. Lymphatic System

A. Multiple Choice Questions
1. (d) – Filtration of metabolic wastes is the function of the kidneys.
2. (c) – The thoracic duct drains lymph into the left subclavian vein; the right lymphatic duct drains lymph into the right subclavian vein.
3. (c) – The pancreas is a mixed gland that serves the digestive and endocrine systems.

B. True–False Questions
1. False – Edema is the accumulation, or retention of excess tissue fluid.
2. True – Interstitial fluid surrounds cells within tissues, and lymph is fluid within lymph vessels.
3. False – Lymph draining from the upper right quadrant drains through the right lymphatic duct into the right subclavian vein.
4. True – The spleen, thymus, and tonsils are lymphoid organs containing reticular connective tissue.

IX. Developmental Exposition of the Cardiovascular System

A. Multiple Choice Questions
1. (a) – Twenty-five days after conception, the embryonic heart is sufficiently developed to begin to contract and pump blood.
2. (b) – The foramen ovale shunts blood from the right atrium to the left atrium in the fetal heart, but it immediately closes upon birth of the baby.
3. (a) – The ductus arteriosus shunts blood from the pulmonary trunk to the arch of the aorta in the fetal circulatory system, but it closes within 6 weeks following the birth of the baby.

B. True–False Questions

1. True – The heart normally begins development from cardiogenic mesoderm at day 18 and is sufficiently developed by day 25 to pump blood through the developing embryo.
2. False – Congenital heart problems develop during the crucial 7-day period of heart formation between days 18 and 25.
3. True – All mammals have a single left aortic arch, all birds have a single right aortic arch, and all reptiles have a double aortic arch.

X. Clinical Considerations

A. Matching Questions

1. (b)
2. (g)
3. (i)
4. (f)
5. (e)
6. (h)
7. (d)
8. (a)
9. (c)

XI. Chapter Review

A. Completion Questions

1. hemoglobin/erythrocytes
2. cardiovascular/lymphatic
3. cardiogenic
4. foramen ovale
5. serous
6. epicardium
7. papillary muscles
8. left atrioventricular
9. pulmonary circulation
10. Systole, diastole
11. 80 mmHg
12. murmurs
13. aortic
14. sinoatrial node (SA node)
15. QRS
16. lub
17. baroreceptors/chemoreceptors
18. basilar
19. lacteals
20. reticular

B. Matching Questions

Set 1:

1. (c)
2. (b)
3. (g)
4. (h)
5. (i)
6. (j)
7. (a)
8. (d)
9. (e)
10. (f)

Set 2:

1. (g)
2. (d)
3. (a)
4. (j)
5. (b)
6. (i)
7. (h)
8. (c)
9. (f)
10. (e)

Set 3:

1. (h)
2. (e)
3. (c)
4. (g)
5. (a)
6. (i)
7. (j)
8. (d)
9. (b)
10. (f)