Answers to Questions for Comprehension

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Q1. The three main functions of the circulatory system are:

(a) The circulatory system transports gases (from the respiratory system), nutrient molecules (from the digestive system), and waste materials (from the excretory system).

(b) The circulatory system regulates internal temperature and transports hormones.

(c) The circulatory system protects against blood loss from injury and against disease-causing microbes or toxic substances introduced into the body.

Q2. The three components of the human circulatory system are:

(a) heart

(b) blood vessels

(c) blood

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Q3. The four chambers of the mammalian heart are:

(a) right atrium

(b) left atrium

(c) right ventricle

(d) left ventricle

Q4. The function of the heart valves is to ensure that blood flows in the correct direction. There are four valves.

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Q5. Arteries carry blood away from the heart.

Q6. Veins carry blood toward the heart.

Q7. Capillaries link arteries and veins.

Q8. (a) Arteries: An artery has highly elastic walls. This elasticity allows the artery to first expand as a wave of blood surges through it during the contraction of the ventricles, and then snap back again during the relaxation of the ventricles. This movement keeps the blood flowing in the right direction and provides an additional pumping motion to help force the blood through the blood vessels.

(b) Veins: The veins are not as elastic, and cannot contract to help the blood move back to the heart, so the contraction of muscles keeps the blood flowing toward the heart. Veins also have one-way valves that prevent the blood from flowing backwards.

(c) Capillaries: Capillaries are the smallest blood vessels. The capillary wall is a single layer of cells. Gas and nutrient exchange takes place at the capillary level.

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Q9. The **sinoatrial node**, or the SA node, is often referred to as the pacemaker because it is the place from which these stimuli originate during normal heart functions. This node generates an electrical signal that spreads over the two atria and makes them contract simultaneously. As the atria contract, the signal reaches another node called the **atrioventricular node**, or AV node. This node transmits the electrical signal through specialized cardiac muscle cells over the walls of the ventricles to start their contraction.

Q10. The change in voltage produced by these electrical signals can be measured using a device called an electrocardiogram (ECG). In a normal ECG reading, as shown here, the small voltage increase marked as P shows the electrical activity immediately prior to atrial contraction. The large spike at QRS shows the electrical activity immediately prior to ventricular contraction. As the ventricles recover from the contraction, the small spike at T shows the electrical activity as the ventricles recover, before the next stimulation by the S-A node.

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Q11. The "120" is the systolic pressure. Systolic pressure is the maximum pressure during ventricular contraction. The ventricles then relax and the pressure in the pulmonary arteries and the aorta drops.
The "80" is the diastolic pressure. Diastolic pressure is the lowest pressure before the ventricles contract again.

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Q12. The pulmonary pathway transports oxygen-poor blood to the lungs. When the blood reaches the lungs, oxygen and carbon dioxide are exchanged by diffusion between blood in the capillaries and air in the alveoli of the lungs through the actions of the respiratory system. Oxygen-rich blood returns to the left side of the heart by way of the pulmonary veins.
The systemic pathway moves oxygen-rich blood from the left ventricle of the heart to the body tissues. Oxygen and nutrients move into the tissue cells and waste products move out of the tissue cells into the blood.

Q13. The coronary pathway is dedicated to providing blood to the muscle tissue of the heart itself. The coronary arteries and cardiac veins spread throughout the muscle tissue of the heart. The coronary arteries bring oxygen and nutrients to heart cells, which do not receive any benefit from the blood moving through the interior of the heart.

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Q14. Blood is the only liquid tissue in the body. It is a mixture—if blood is transferred from a person's vein to a test tube and is prevented from clotting, it separates into two layers. The lower layer is formed elements (cells) and the upper layer is plasma. Mixtures can usually be separated into their component parts.

Q15. There are 4 to 6 million red blood cells per cubic millilitre of blood. Normal, mature red blood cells do not have a nucleus.

The same volume of blood contains 4000 to 11 000 white blood cells. All white blood cells have a nucleus.

Q16. Platelets are cell fragments. These formed elements initiate the process of blood clotting or coagulation.

responsible for maintaining a relatively constant internal body temperature.

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Q17. Blood, a vital tissue fluid, carries oxygen from the lungs and nutrients from the small intestines to the cells. It also takes carbon dioxide to the lungs and waste to the kidneys. Other functions of the blood include helping to fight infection, regulate body temperature, and transport hormones from endocrine glands to target organs.

Q18. A number of factors trigger vasomotor actions. Vasodilation in the skin occurs in response to an increase in blood (core) temperature, such as occurs during strenuous exercise. This response dissipates heat from the skin, which cools the internal temperature.

Localized vasoconstriction in the extremities occurs in response to a decrease in blood temperature. For example, the hands and fingers lose blood flow in the cold, due to vasoconstriction which limits heat loss, thereby maintaining core body temperature.

Other factors which cause vasomotor actions are changes in blood pressure. As blood pressure increases, vasodilation of arteries throughout the body tends to decrease it. As blood pressure decreases, vasoconstriction increases it. Certain drugs, such as nicotine and alcohol are vasodilators. Blushing from embarrassment is caused by rapid vasodilation of the blood vessels in the face in response to nervous stimulation.

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Q19. The cells of the body are constantly bathed in liquid, called interstitial fluid. Any material that is exchanged between the capillaries and the cells must pass through the interstitial fluid.

Q20. Capillaries are very important in maintaining homeostasis because an exchange of substances takes place across their thin walls. Oxygen and nutrients, such as glucose, diffuse out of a capillary into the tissue fluid that surrounds cells. Wastes, such as carbon dioxide, diffuse into the capillary. The relative constancy of tissue fluid is dependent upon capillary exchange. As well, opening and closing capillary beds near the surface of the body is an important homeostatic mechanism

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Q21. The lymphatic circulatory system is a network of vessels, with associated glands or nodes, which extends throughout the body. The lymphatic vessels collect a fluid, called lymph, which is made up of interstitial fluid. Lymph vessels are closely associated with the capillaries of the cardiovascular system. Fluid that escapes from the cardiovascular capillaries forms part of the interstitial fluid. Some of this fluid is collected in the lymphatic capillaries and is eventually returned to the blood.

Q22. The lymphatic system also works with the white blood cells to protect the body against infection. White blood cells called lymphocytes mature in the lymph nodes, the glands that are found throughout the lymphatic system. The lymph nodes also contain macrophages, which trap and destroy bacteria that are circulating within the body.

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Q23. The three lines of defence are:

- the skin – preventing the entry of pathogens (physical barriers)
- non-specific defences – cell-mediated immunity
- specific defences – antibody-mediated immunity

Q24. The specific immune system is primarily a function of the lymphocytes in the circulatory system. The lymphocytes are divided into two specialized groups, depending on where they mature. B lymphocytes, or **B cells**, mature in the bone marrow. T lymphocytes, or **T cells**, mature in the thymus gland, which is located near the heart.

Q25. Characteristics of B Cells:

- B cells mature in the bone marrow
- B cells give rise to plasma cells, which produce antibodies (antibodies combine with and neutralize a specific antigen)
- antibodies are secreted into blood, lymph, and other body fluids

Characteristics of T Cells:

- T cells are produced in bone marrow and mature in thymus
- these cells do not produce antibodies
- killer T cells directly attack cells that bear non-self antigens
- other T cells regulate the immune response

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Q26. The blood groups are named for the presence of A or B antigens on the surface of the red blood cells. Type A blood has A antigen, Type B has B antigen, Type AB has both and Type O has neither. Antibodies to these antigens are found in the plasma of persons who lack the corresponding antigens. The plasma of Type O blood contains both anti-A and anti-B antibodies. Type AB plasma contains neither antibody. Type A plasma contains anti-B antibodies and Type B plasma contains anti-A antibodies.

Q27. The Rh factor is an antigen found on the surface of red blood cells in many people, who are said to be Rh+.

Individuals without the Rh factor are said to be Rh- and will produce anti-Rh antibodies if they are exposed to the Rh factor on foreign red blood cells. This can happen if an Rh- woman is pregnant with an Rh+ child. If fetal red blood cells cross the placenta and enter the maternal blood (this will most certainly occur during birth), the woman will produce anti-Rh antibodies within a few hours. The presence of these antibodies will cause hemolytic disease in the children of subsequent pregnancies.