Q.2 i) How the interstitial fluid is formed?

Answer:

Interstitial fluid (tissue fluid, or intercellular fluid):

When blood passes through the arteries (with pressure), veins, and capillaries the water along with salts, some plasma proteins, etc. ooze out in tissue spaces. This fluid is called interstitial fluid.

Formation of tissue fluid:

Interstitial fluid is simply blood plasma minus most of the proteins. Interstitial fluid bathes the cell in the tissue space and substances in it can enter the cells by diffusion or active transport. Substances like carbon dioxide can diffuse out of the cells and into the interstitial fluid.

Q.2 ii) Why does the normal value of BP increase in old age? Explain your answer.

Answer:

The increase in blood pressure with age is mostly associated with structural changes in the arteries and especially with large artery stiffness which leads to atherosclerosis and arteriosclerosis. In elderly people, the most powerful predictor of risk is increased pulse pressure due to decreased diastolic and increased systolic blood pressure. Although blood pressure does increase with age, it is still clearly detrimental to cardiovascular health. There is a direct link between high blood pressure and the risk of stroke, heart failure, kidney failure, and coronary artery disease.

Q.2 iii) If the baroreceptors are removed from an artery what would be the effect?

Answer:

Baroreceptors are a type of nerve endings which are located in the blood vessels of the human body which detect the pressure of blood flowing through them and send messages to the central nervous system to increase or decrease total peripheral resistance and cardiac output. If these baroreceptors are removed from the artery, baroreflex failure occurs which results in the change of blood pressure with episodes of severe hypertension (high blood
pressure). There can be an increased heart rate during stress and hypotension (low blood pressure) with normal or reduced heart rate during rest.

**Symptoms:**
- Headache
- Excessive sweating
- Extremely high or volatile blood pressure and heart rate with spikes in blood pressure in response to stress, with periods of normal or even low blood pressure during rest
- The heart rate that does not respond to medications intended to improve it

Q.2 iv) **What changes occur in BP and cardiac output during a strenuous exercise?**

**Answer:**
- During exercise, the human body needs three or four times more than normal cardiac output, because body muscles need more oxygen.
- Exercising makes the heart pump more blood to the muscles. This will increase blood flow, which is beneficial for the brain so cardiac output increases.
- Most of the increase in cardiac output goes to the exercising muscles. There is an increase in blood flow to the skin (dissipation of heat) and the heart (increased work performed by the heart).
- In both skeletal and cardiac muscles, vasodilation is mediated by local metabolic factors
- Exercise also stimulates the growth of new blood vessels, causing blood pressure to decrease in fit people.
- Simultaneously with vasodilation in these three regions, vasoconstriction occurs in the kidneys and gastrointestinal organs, due to an increase in activity of sympathetic neurons supplying them.

Q.2 v) **If we don’t take water the whole day in June, what would be the effect on the volume of lymph?**

**Answer:**
If we don’t take water the whole day in June, dehydration occurs and the body will become water-deficient due to sweating or urination. This will lead to decreased blood volume, and less lymph will be secreted out into tissue spaces resulting in decreased lymph volume.

Lymph fluid is composed of 95% water and interacts with every cell in the body. It helps get nutrients to different parts of the body and cleanses internally continually to restore balance in cells. It also carries waste products and bacteria away for disposal, ensuring that the body processes stay in equilibrium. When it stops flowing properly, waste and bacteria get stuck, the immune system struggles to cope and the body becomes sick.
Notes for Biology Class 11 Long Question

Q.3 i) Describe the composition of blood. What are the main functions of blood cells?

Answer:

Blood: “Blood is a specialized bodily fluid in humans and other animals that delivers necessary substances such as nutrients and oxygen to the cells and transports metabolic waste products away from the same cells.”

Composition of blood:
Blood is composed of four main components:

- 1. Plasma
- 2. Red blood cells
- 3. White blood cells
- 4. Platelets

1. Plasma:
   The liquid component of blood is called plasma, a mixture of water, sugar, fat, protein, and salts.

Functions of blood plasma:
The main functions of the blood plasma are to transport blood cells throughout the human body along with nutrients, waste products, antibodies, clotting proteins, chemical messengers such as hormones, and proteins that help maintain the body’s fluid balance.

Blood cells:
These include red blood cells (Erythrocytes), white blood cells (leucocytes) and platelets.

2. Red blood cells (Erythrocytes):
   These are the most numerous of the cells in the blood. These cells, when formed, have a nucleus, but it is lost before they enter the circulatory fluid or blood. 95% of the cytoplasm of red blood cells in the red pigment, called haemoglobin, the remaining 5% consists of enzymes, salts and other proteins. The red cells once mature, do not divide. Red blood cells are formed principally in the red bone marrow of short bones, such as the sternum, ribs and vertebrae. In the embryonic life, they are formed in the liver and spleen. The average
The lifespan of red blood cells is about four months after which it breaks down and disintegrates in the liver and spleen partly by phagocytes by phagocytosis.

**Functions of red blood cells:**
The red blood cells help in the exchange of materials between blood and body tissues through blood capillaries via an interstitial fluid.

3) **White blood cells (Leucocytes):**

White blood cells are colourless, as they do not contain pigments. They are much larger than red blood cells. There are at least five different types which can be distinguished based on the shape of the nucleus and density of granules in the cytoplasm.

**Types of blood cells:**
They can be grouped into two main types:

i. **Granulocytes:**
Granulocytes include neutrophils, eosinophils and basophils. They are formed in the red bone marrow.

ii. **Agranulocytes:**
Agranulocytes are formed in lymphoid tissue, such as those of the lymph nodes, spleen, tonsils, adenoids and the thymus.

**Types of agranulocytes:**
Agranulocytes include monocytes and lymphocytes (B and T). Monocytes stay from 10-20 hours in the blood, then enter tissues and become tissue macrophages, performing a phagocytic function. Lymphocytes have life spans of months or even years, but this depends on the body’s need for these cells.

**Functions of white blood cells:**
- Leucocytes protect the body against foreign invaders and use a circulatory system to travel to the site of invasion.
- Monocytes and neutrophils travel through capillaries and reach the site of a wound where bacteria have gained entry.
- Macrophages and neutrophils feed on bacterial invaders or other foreign cells, including cancer cells. They typically die in the process, and their dead bodies accumulate and contribute to the white substance called pus, seen at infection sites.
- Basophils produce heparin, a substance that inhibits blood clotting. These also produce chemicals, such as histamine, that participate in allergic reactions and in responses to tissue damage and microbial invasion.
- Lymphocytes help to provide immunity against the disease.
Blood Platelets:
Blood platelets are not cells but are fragments of large cells called megakaryocytes. There is no nucleus in them. There is no pigment in them.

Functions of platelets:
Platelets help in the conversion of fibrinogen, a soluble plasma protein, into an insoluble form, fibrin. The fibrin threads enmesh red blood cells and other platelets in the area of damaged tissue, ultimately forming a blood clot. The clot serves as a temporary seal to prevent bleeding until the damaged tissue can be repaired.

Q.3 ii) How different blood groups are formed. What is their practical implication in a blood transfusion?

Answer:

Blood groups:
Blood is classified, according to the presence or absence of certain markers (antigens) found on red blood cells and in the plasma that allows the human body to recognize blood. If another blood type is introduced, the human immune system recognizes it as a foreign agent and attacks it, resulting in a transfusion reaction.

ABO blood type system:
The ABO system has four different phenotypes, which are distinct from each other based on specific antigens on the surface of RBC.

Antigens on the surface of RBC:
1. A person having antigen A has blood group A.
2. A person having antigen B has blood group B.
3. A person having both the antigens A and B has blood group AB.
4. A person having neither antigen A nor B would have blood group O.

**Antibodies in ABO blood group:**
The blood serum containing antibodies is called antiserum.

1. The blood serum of A phenotype contains anti-B antibodies. They will agglutinate or clump any RBC, which have B antigens on them.
2. B phenotype contains anti-A antibodies in the serum and agglutinates any RBC with antigen A.
3. Phenotype AB has neither anti-A nor anti-B antibodies in the serum.
4. The serum of O blood type contains both anti-A and anti-B antibodies.

**Blood transfusion and their practical implications:**
Any blood transfusion is ideally safe if it does not cause agglutination in the recipient. Agglutination leads to serious results because clumped cells cannot pass through fine capillaries. The blood samples of the donor and the recipient are cross-matched for compatibility before giving the transfusion. If incompatible blood is transfused, the dangerous hemolytic reaction occurs. Either the antibodies of the recipient destroy the RBC of the donor or the antibodies of the donor hemolyze the RBC of the recipient.

**Blood transfusion safety protocol:**

1. **Blood group A:**
   Blood group A can be transfused only into A and AB recipients because they do not have anti-A antibodies.

2. **Blood group B:**
   Blood group B can be transfused only into B and AB recipients as they do not have anti-B antibodies.

3. **Blood group AB:**
   Blood group AB can be transfused only into AB recipients because they have neither anti – A nor anti B antibodies.

4. **O blood group:**
   O blood group has neither A nor B antigen but it does have anti-A and anti-B antibodies. An O recipient can only be given transfusion from a donor O.

**Universal donor:**
Phenotype O can also be used as a donor for small transfusions to A, B and AB recipients because donor’s antibodies are quickly absorbed by other tissues or greatly diluted in the recipient’s bloodstream. O blood group individuals are called universal donors.

**Universal recipients:**
AB blood group individuals are called universal recipients because they can receive transfusions of blood from any of the four blood groups.
Q.3 iii) Draw the internal structure of a human heart and show the blood circulation with the help of arrows.

![Diagram of the human heart]

Q.3 iv) Name major arteries and veins and discuss the organs to which they target.

Answer:
Arteries:
The arteries are the blood vessels that deliver oxygen-rich blood from the heart to the tissues of the body.

**Major types of arteries:**

Systemic arteries are the arteries (including the peripheral arteries), of the systemic circulation, which is the part of the cardiovascular system that carries oxygenated blood away from the heart, to the body, and returns deoxygenated blood back to the heart.

1. **Aorta:**
   Aorta is the largest artery of the body which arises from left ventricles. Many arteries arise from the aorta.

2. **Coronary arteries:**
   The first arteries branching from the aorta are coronary arteries. These arteries supply the oxygenated blood and food to the heart itself. Aorta then forms an arch which, before descending, gives off three branches which supply blood to head, shoulders and arms.

   After it, aorta descends along with the vertebral column. Here, it is called the dorsal aorta. It gives off many arteries.

3. **Coeliac artery:**
   Coeliac artery supplies blood to stomach and spleen

4. **Mesenteric arteries:**
   Mesenteric arteries supply blood to the duodenum, pancreas, intestine, and rectum.

5. **Hepatic artery:**
   The hepatic artery supplies blood to the liver

6. **Renal artery:**
   A pair of renal arteries supply blood to kidneys.

7. **Iliac arteries:**
   The aorta then divides to form right and left iliac arteries which supply blood to right and left legs.

8. **Pulmonary artery:**
   The pulmonary artery originates from the right ventricle and carries deoxygenated blood to the lungs.

9. **Carotid artery:**
   The carotid arteries are major blood vessels in the neck that supply blood to the brain, neck, and face.

2. **Veins:**
Veins are blood vessels that carry blood toward the heart. Most veins carry deoxygenated blood from the tissues back to the heart; exceptions are the pulmonary and umbilical veins, both of which carry oxygenated blood to the heart.

**Major types of veins:**

1. **Vena cava:**
   - The deoxygenated blood is poured into the right atrium through two major veins superior vena cava and inferior vena cava.

2. **Superior vena cava:**
   - Superior vena cava is formed by the union of many pairs of veins from the head, shoulders, and arms.

3. **Inferior vena cava:**
   - The inferior vena cava is made of many veins from parts of the lower region. For example, two femoral veins from legs empty into inferior vena cava.

4. **Renal veins:**
   - Renal veins carry blood from the kidneys.

5. **Hepatic portal vein:**
   - The hepatic portal vein carries blood from the alimentary canal to the liver. From the liver, a hepatic vein carries blood to the inferior vena cava.

6. **Coronary veins:**
   - From heart walls, the deoxygenated blood returns to the right atrium through coronary veins.

7. **Pulmonary veins:**
   - Pulmonary veins originate from lungs and bring oxygenated blood to the left atrium.

**Q.3 v) Write short notes on the following.**

- **Leukemia**
- **Thalassaemia**

**Answer:**

1. **Leukemia:**
   - Leukaemia is a type of cancer that results in the body making too many abnormal white blood cells. This uncontrolled production results in an excessive amount of white blood cells that may be immature (acute leukaemia) or mature (chronic leukaemia). The leukemic cells may not function well to fight infection and may interfere with the production of red blood cells (which carry oxygen) and platelets (which control bleeding).

   Normally, white blood cells play an important role in the body’s natural defence system. They target and destroy foreign invaders like viruses and bacteria. White blood cells are
made in the marrow (the spongy core) of bones. Without healthy and functioning white blood cells, the body is at risk of developing severe and sometimes fatal infections.

**Causes:**
For most people with leukaemia, there’s no way to identify what causes it. In some cases, though, specific risk factors can be identified

- Previous chemotherapy or radiation therapy
- Exposure to high doses of radiation or benzene (found in unleaded gasoline, tobacco smoke, chemical production facilities)
- Family history; genetic abnormality, such as an abnormality on chromosome 22 (also known as the Philadelphia chromosome).
- Genetic disorders, such as Down syndrome

**Treatment:**
- Treatment for leukaemia depends on the type of leukaemia and other factors such as the patient’s age, white blood cell count and genetics of cancer.
- The main treatment is chemotherapy, which involves injecting a combination of drugs in the blood and sometimes in the spinal fluid.
- If a patient’s cancer comes back after chemotherapy, doctors may consider bone marrow transplantation.

**b) Thalassemia:**
Thalassemia is a blood disorder passed down through families (inherited) in which the body makes an abnormal form of haemoglobin. Haemoglobin is the protein in red blood cells that carries oxygen. The disorder results in large numbers of red blood cells being destroyed, which leads to anaemia.

**Causes:**
Haemoglobin is made of two proteins: Alpha globin and beta-globin. Thalassemia occurs when there is a defect in a gene that helps control the production of one of these proteins.

**Symptoms:**
- Children born with thalassemia major (Cooley’s anaemia) are normal at birth but develop severe anaemia during the first year of life.
- Bone deformities in the face
- Fatigue
- Stunted growth
- Shortness of breath
- Yellow skin (jaundice)

**Treatment:**
- Treatment for thalassemia major often involves regular blood transfusions and folate supplements.
- During the blood transfusions, the patient should not take iron supplements. Doing so can cause a high amount of iron to build up in the body, which can be harmful.
• Persons who receive a lot of blood transfusions need a treatment called chelation therapy. This is done to remove excess iron from the body.
• A bone marrow transplant may help treat the disease in some patients, especially children.