**Final Term Assignment (2020)**

**Course Title: Basic Physiology (DT– 2nd) Instructor: Dr. Irfan Ali Khan**

**Question Paper Time: 48 hours**

* **Class Code. \_\_\_\_\_\_\_\_\_\_\_\_\_\_DT\_\_\_\_\_\_\_\_\_\_\_\_ Name/Class Roll No: \_\_\_\_\_ Majid iqbal /15946\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Note:**

* **Attempt all questions from this section.**
* **Use Blue / Black Ink only. Do not use red.**
* **Tick or encircle only one option in each given question.**

*It’s an open book Conceptual Assignment paper. Time to Use your brain now.*

* **Briefly explain the process of hematopoiesis along with diagrammatic illustration. (Marks 10)**

**Hematopoiesis Process:**

Hematopoiesis is the process by which blood cells are created. The monophyletic theory on hematopoiesis, which is widely accepted, suggests that all of the hematopoietic cells are generated on the basis of pluripotent stem cells, which become unipotential ones and differentiate into precursor cells before going on to form mature blood cells.Hematopoiesis during the early stages of embryogenesis occurs in the yolk sac and subsequently in the liver. During the 3rd to 7th month of gestation it primarily occurs in the spleen and just before birth shifts to the marrow cavity and from birth onwards occurs primarily in the bone marrow.Pluripotent stem cells continuously produce more of themselves. Hematopoietic cells are constantly generated from pluripotent stem cells, where some of these pluripotent cells become unipotential stem cells. Subsequently, some of the cells of this unipotential population differentiate into precursor cells that, once differentiated, are in part committed to becoming one of the mature types of blood cells, which are erythrocytes, monocytes, lymphocytes, thrombocytes and granulocytes.Hematopoietic cells that are immature precursor cells evolve from cells that make a lot of protein to cells that make less protein and structural changes occur with this evolution. These cells have more clumped or condensed chromatin, since it is not being actively transcribed. In addition to this, these cells have fewer nucleoli, smaller Golgi apparatuses, and fewer ribosomes, thus, they exhibit less basophilic hematoxylin staining.

**Erythropoiesis**

Erythropoiesis is the process by which red blood cells, also known as erythrocytes, are made and are stimulated by decreased levels of oxygen in the blood, which sets into motion the secretion of erythropoietin, a hormone central to the formation of red blood cells. The process of red blood cell formation takes on average 2 days to be completed from unipotential hematopoietic cell to mature red blood cell. In our bodies, there 2 million erythrocytes are produced every second. Hematopoietic cells committed to becoming red blood cells usually get smaller and more condensed as they mature until there is eventually loss of their nuclei.The unipotential cell becomes what is known as a proerythroblast, which has a nucleus that is not condensed and takes up most of the cell with basophilic or blue cytoplasm. The cell then becomes a basophilic erythroblast, which is followed by a polychromatophilic erythroblast stage, where the nucleus is more condensed than the latter two stages and the cytoplasm becomes reduced. In the subsequent orthochromatophilic erythroblast stage, the nucleus is much smaller than that of the previous stages with a pinker cytoplasm. In the reticulocyte stage the red blood cell has no nucleus, but still stains somewhat blue due to the remnants of polyribosomes within the cell. Finally, the erythrocyte is the mature red blood cell, which has no nucleus and no polyribosome remnants and as a result stains pink.

**Granulopoiesis**

Granulopoiesis is the formation of granulocytes, which are white blood cells with multilobular nuclei and cytoplasmic granules. The unipotential hematopoietic cell that becomes a myeloblast is large and has a cytoplasm that stains blue with a large nucleus. This cell evolves into a promyelocyte that contains azurophilic granules, and then becomes a myelocyte, which has a non-indented still rather large nucleus. This cell then becomes a metamyelocyte, which is similar in size to a mature granulocyte and the nucleus begins to become indented. Following this stage is the band cell stage, where the nucleus has definitive indentation and resembles a horseshoe. Finally, there is the mature granulocyte, which has a lobed nucleus and cytoplasmic granules. The entire process happens over a period of 2 weeks.

**Monopoiesis, Lymphopoiesis and Thrombopoiesis**

Monopoiesis is the process by which monocytes are formed. The committed progenitor cell, the monoblast, is found only in the bone marrow and has a basophilic cytoplasm without granules. These evolve into promonocytes, which are smaller with nuclei that become slightly indented, before becoming monocytes, which have kidney-shaped nuclei and can develop into dendritic cells or macrophages.Lymphopoiesis is the formation of lymphocytes, which start from their first committed progenitor cells, lymphoblasts. These cells go on to mature into lymphocytes that are capable of differentiating into either B, T or natural killer cells. Thrombopoiesis is the formation of platelets, which come from extremely large cells within the bone marrow call megakaryocytes. The creation of individual platelets occurs when the plasma membranes of megakaryocytes are fragmented, thereby generating platelets containing many granules.



2.**What are the factors that influence the respiratory rate, explain in detail. (Marks 10)**

The eight environmental factors affecting the rate of respiration are: (1) Oxygen Content of the Atmosphere (2) Effect of Temperature (3) Effect of Light (4) Effect of Water Contents (5) Effect of Respirable Material (6) Effect of Carbon Dioxide Concentration (7) Protoplasmic Conditions and (8) Other Factors.

**1) Oxygen Content of the Atmosphere:**

The percentage of oxygen in the surrounding atmosphere greatly influences the rate of respiration. But reduction of the oxygen content of the air, however, causes no significant lowering in the respiratory rate until the percentage drops to about 10%. At 5% oxygen definite retardation of respiration occurs.with the increase of oxygen concentration in the atmosphere, the rate of respiration also increases, but this effect is not as accelerating as might be expected. This response of plants and their parts depends upon several factors. The plant tissues which ordinarily have low rates of respiration are not as seriously affected by low concentration of oxygen as those which have higher rates of respiration.In certain plants, like rice, on removal of oxygen the rate of respiration in terms of total carbon dioxide produced actually increases. This indicates that anaerobic respiration comes into action when oxygen is no longer available and that the plant, if it has to make up for the relative inefficiency of this system, has to respire faster.

**(2) Effect of Temperature:**

Like most chemical reactions, the rate of respiration is greatly influenced by temperature. Estimation of Q 10 of the process for a rise in temperature from 8° to 18 °C gives a Q 10 of 2, indicating a chemical reaction. If the rise is at a much higher starting temperature, say between 20° and 30°C, then the Q 10 may fall below 2. It should be borne in mind that different plants or plant parts may show considerable variation in regard to optimum temperature for respiration.In certain cases the rate of respiration increases at lower temperature. E. F. Hopkins (1925) reported that the rate of respiration in white potatoes increases if the temperature is lowered to just above freezing point. This increase in the rate of respiration is primarily due to an increase in the quantity of respirable materials (such as soluble carbohydrates) which tend to accumulate in Irish potatoes at temperature slightly above 0°C.At temperatures higher than the optimum for respiration, the rate of respiration (in terms of oxygen utilized and CO2 produced) falls due to inter-conversions of respirable materials. For instance, fats may be formed from carbohydrates by a reaction in which carbon dioxide is utilized and oxygen produced. At very high temperatures, the rate of respiration falls significantly and may even come to standstill because of protoplasmic injuries (Fig. 7.14).

**(3) Effect of Light:**

Light has indirect effects on the rate of respiration. With the increase in light intensity, the temperature of the surrounding atmosphere also increases thus affecting the rate of respiration. Secondly, the quantity of respirable material in the plant largely depends upon the rate of photosynthesis which is directly influenced by light and thirdly, stomata remain open during daylight and hence rapid exchange of gases takes place through them.

**(4) Effect of Water Contents:**

Over a certain range, water content of the plant tissue greatly influences its rate of respiration. In most of the storage able seeds the moisture content is kept below the point which allows a rapid respiration. With the increase in moisture content, the rate of respiration is likely to go up with the result a rapid loss of viability will occur and at the same time the temperature will also rise and the grain may be spoiled

Unlike most green tissues, xerophytes, lichens and leafy mosses (Sphagnum species) can be brought to an air-dry condition at low humidity without any apparent loss in their viability.

**(5) Effect of Respirable Material:**

Amount and kind of respirable material present in the cells greatly effect the rate and course of respiration. It has been shown that plants respire more rapidly after having been exposed to conditions favourable for photosynthesis during which carbohydrates are synthesized. Increase in respiration has also been observed to be associated with increase in soluble sugars.

**(6) Effect of Carbon Dioxide Concentration:**

The rate of respiration is normally not affected by increase of carbon dioxide concentration in the surrounding atmosphere up to 19%, but as the concentration increases from 10% to 80%, a progressive decrease in respiration occurs.Specific response to higher CO2 concentration varies with the particular kind of tissue and plant. The effect of CO2 concentration is more significant when the temperature and oxygen supply are low. At a very high concentration of CO2 the plant tissues are injured or even killed.

**(7) Protoplasmic Conditions:**

The young growing tissues which have greater amounts of protoplasm as compared to older tissues, show higher rates of respiration. Their higher rate of respiration supports the meristematic activities of the cells by supplying large amounts of energy. The degree of hydration of the protoplasm in the cells affects the rate, and mechanical injury to plant tissues will accelerate respiration.

**(8) Other Factors:**

Various chemicals, such as cyanides, azides and fluorides, have been reported to possess respiration retarding properties through their effect on respiratory enzymes. Respiration rate may likely be accelerated by low concentrations of the compounds like ethylene, carbon monoxide, chloroform and ether.Chlorides of various minerals, like sodium, potassium, calcium and magnesium have pronounced effects on the rate of respiration. Monovalent chlorides, like KCl and NaCl, increase the rate of respiration while the divalent chlorides, such as MgCl2 and CaCl2greatly decrease it. Steward and Preston (1941) found cations to depress respiration and photosynthesis.

**3. Enlist different layers of skin, write a detailed note on epidermis. (Marks 10)**

The skin is the largest organ of the body, with a total area of about 20 square feet. The skin protects us from microbes and the elements, helps regulate body temperature, and permits the sensations of touch, heat, and cold.

Skin has three layers:

* The epidermis, the outermost layer of skin, provides a waterproof barrier and creates our skin tone.
* The dermis, beneath the epidermis, contains tough connective tissue, hair follicles, and sweat glands.
* The deeper subcutaneous tissue (hypodermis) is made of fat and connective tissue.

The skin’s color is created by special cells called melanocytes, which produce the pigment melanin. Melanocytes are located in the epidermis.

**EPIDERMIS:**

The epidermis is the thin, outer layer of the skin that is visible to the eye and works to provide protection to the body. It does not contain any blood vessels and is, therefore, dependent on the dermis, the layer of the skin underneath it, to provide access to nutrients and dispose of waste.

**Types of Cells**

Keratinocytes are the most common type of cell in the epidermis and are responsible for the synthesis of the protein keratin. These cells exist in progressive stages of differentiation from the deepest to the superficial layers of cells. They originate from the basal layer, which is the deepest layer of the epidermis, and gradually move up to the outside layer of the epidermis. Here they are shed from the skin and replaced by new maturing cells.

Melanocytes are another type of cell in the epidermis, which are present throughout the basal layer of the epidermis. These cells are responsible for the production of melanin, which contributes to the color of the skin of the individual. It also helps to protect the body from ultraviolet radiation present in sunlight that can damage the DNA of the skin cells.

Langerhans cells produced in the bone marrow are also present in the epidermis and work to detect foreign substances and infections, as a part of the immune system of the skin. These cells are also thought to be involved in the development of skin allergies.

Merkel cells originate from neural crest cells and are responsible for the perception of gentle touch. They are present in the epidermis in specific areas of the skin, such as the nail beds and genitalia.

Structure

The epidermis consists of stratified, squamous epithelial cells. There are four layers of the epidermis, according to the maturation of the cells:

* Stratum germinativum
* Stratum spinosum
* Stratum granulosum
* Stratum corneum

The stratum germinativum is the innermost layer, which adjoins the dermal layer of skin, and where the keratinocyte cells originate. The stratum corneum is the outermost layer, which is relatively waterproof and prevents the entry of bacteria, viruses and other foreign substances into the body.

The thickness of the epidermis depends on the level of protection required by that area of the body. For example, the palms of the hands and the soles of the feet have a significantly thicker layer of keratin in the epidermis, up to 2.3 mm. This protects the body from the high impact to which these areas of the body are subject. In contrast, the thickness of the epidermis on the eyelids is approximately 0.05 mm thick.

**Function:**

All layers of the skin, including the epidermis, are responsible for the protection of the body, including internal organs, muscles, nerves, and blood vessels. Some roles of the epidermis include:

* Production of new skin cells
* Production of melanin to give color to the skin and reduce the absorption and impact of ultraviolet radiation
* Physical protection of the body
* Immune protection of the body

**Dependence on Dermis**

As there is no direct blood supply to the epidermis, it relies on the underlying layer of skin, the dermis, for the supply of nutrients and disposal of waste products. This occurs via a process of diffusion through the dermoepidermal junction, which lies just below the stratum germinativum of the epidermis.

**4. Define lymphatic system, what are different components of lymphatic system? (Marks 10)**

The tissues and organs that produce, store, and carry white blood cells that fight infections and other diseases. This system includes the bone marrow, spleen, thymus, lymph nodes, and lymphatic vessels (a network of thin tubes that carry lymph and white blood cells). Lymphatic vessels branch, like blood vessels, into all the tissues of the body. Also called lymph system.

Anatomy of the lymph system, showing the lymph vessels and lymph organs including lymph nodes, tonsils, thymus, spleen, and bone marrow. Lymph (clear fluid) and lymphocytes travel through the lymph vessels and into the lymph nodes where the lymphocytes destroy harmful substances. The lymph enters the blood through a large vein near the heart.

**Lymphatic System Structures**

The major components of the lymphatic system include lymph, lymphatic vessels, and lymphatic organs that contain lymphoid tissues.

* [**Lymphatic Vessels**](https://www.thoughtco.com/lymphatic-vessels-anatomy-373245)

Lymphatic vessels are structures that absorb fluid that diffuses from blood vessel capillaries into surrounding tissues. This fluid is directed toward lymph nodes to be filtered and ultimately re-enters blood circulation through veins located near the heart. The smallest lymphatic vessels are called lymph capillaries. Lymphatic capillaries come together to form larger lymphatic vessels. Lymphatic vessels from various regions of the body merge to form larger vessels called lymphatic trunks. Lymphatic trunks merge to form two larger lymphatic ducts. Lymphatic ducts return lymph to the blood circulation by draining lymph into the subclavian veins in the neck.

* [**Lymph Nodes**](https://www.thoughtco.com/lymph-nodes-anatomy-373244)

Lymphatic vessels transport lymph to lymph nodes. These structures filter lymph of pathogens, such as bacteria and viruses. Lymph nodes also filter cellular waste, dead cells, and cancerous cells. Lymph nodes house immune cells called lymphocytes. These cells are necessary for the development of humoral immunity (defense prior to cell infection) and cell-mediated immunity (defense after cell infection). Lymph enters a node through afferent lymphatic vessels, filters as it passes through channels in the node called sinuses, and leaves the node through an efferent lymphatic vessel.

* [**Thymus**](https://www.thoughtco.com/thymus-anatomy-373250)

The thymus gland is the main organ of the lymphatic system. Its primary function is to promote the development of specific cells of the immune system called T-lymphocytes. Once mature, these cells leave the thymus and are transported via blood vessels to the lymph nodes and spleen. T-lymphocytes are responsible for cell-mediated immunity, which is an immune response that involves the activation of certain immune cells to fight infection. In addition to immune function, the thymus also produces hormones that promote growth and maturation.

* [**Spleen**](https://www.thoughtco.com/spleen-anatomy-373248)

The spleen is the largest organ of the lymphatic system. Its primary function is to filter the blood of damaged cells, cellular debris, and pathogens. Like the thymus, the spleen houses and aids in the maturation of lymphocytes. Lymphocytes destroy pathogens and dead cells in the blood. The spleen is rich in blood supplied via the splenic artery. The spleen also contains efferent lymphatic vessels, which transport lymph away from the spleen and toward lymph nodes.

* **Tonsils**

Tonsils are arrays of lymphatic tissue located in the upper throat region. Tonsils house lymphocytes and other white blood cells called macrophages. These immune cells protect the digestive tract and lungs from disease-causing agents that enter the mouth or nose.

* [**Bone Marrow**](https://www.thoughtco.com/bone-marrow-anatomy-373236)

Bone marrow is the soft, flexible tissue found inside bone. Bone marrow is responsible for the production of blood cells: red blood cells, white blood cells, and platelets. Bone marrow stem cells play an important role in immunity as they generate lymphocytes. While some white blood cells mature in bone marrow, certain types of lymphocytes migrate to lymphatic organs, such as the spleen and thymus, to mature into fully functioning lymphocytes.

Lymphatic tissue can also be found in other areas of the body, such as the skin, stomach, and small intestines. Lymphatic system structures extend throughout most regions of the body. One notable exception is the [central nervous system](https://www.thoughtco.com/central-nervous-system-373578).

**Lymphatic System Summary**

The lymphatic system plays a vital role in the proper functioning of the body. One of the major roles of this organ system is to drain excess fluid surrounding tissues and organs and return it to the blood. Returning lymph to the blood helps to maintain normal blood volume and pressure. It also prevents edema, the excess accumulation of fluid around tissues. The lymphatic system is also a component of the [immune system](https://www.thoughtco.com/immune-system-372421). As such, one of its essential functions involves the development and circulation of immune cells, specifically lymphocytes. These cells destroy pathogens and protect the body from disease. In addition, the lymphatic system works in conjunction with the cardiovascular system to filter blood of pathogens, via the spleen, before returning it to circulation. The lymphatic system works closely with the digestive system as well to absorb and return lipid nutrients to the blood.

**5. What is blood pressure? How will you check and record blood pressure of a patient? (Marks 10)**

When your heart beats, it pumps blood round your body to give it the energy and oxygen it needs. As the blood moves, it pushes against the sides of the blood vessels. The strength of this pushing is your blood pressure. If your blood pressure is too high, it puts extra strain on your arteries (and your heart) and this may lead to heart attacks and strokes.When your heart beats, it pumps blood round your body to give it the energy and oxygen it needs. As the blood moves, it pushes against the sides of the blood vessels. The strength of this pushing is your blood pressure. If your blood pressure is too high, it puts extra strain on your arteries (and your heart) and this may lead to heart attacks and strokes.Even if you do not have high blood pressure at the moment, it is important to keep your blood pressure as low as you can. The higher your blood pressure, the higher your risk of health problems.

For example, a blood pressure of 135 over 85 may be “normal” but someone with this reading is twice as likely to have a heart attack or stroke as someone with a reading of 115 over 75.

* To begin blood pressure measurement, use a properly sized blood pressure cuff. The length of the cuff's bladder should be at least equal to 80% of the circumference of the upper arm.
* Wrap the cuff around the upper arm with the cuff's lower edge one inch above the antecubital fossa.
* Lightly press the stethoscope's bell over the brachial artery just below the cuff's edge. Some health care workers have difficulty using the bell in the antecubital fossa, so we suggest using the bell or the diaphragm to measure the blood pressure.
* Rapidly inflate the cuff to 180mmHg. Release air from the cuff at a moderate rate (3mm/sec).
* Listen with the stethoscope and simultaneously observe the sphygmomanometer. The first knocking sound (Korotkoff) is the subject's systolic pressure. When the knocking sound disappears, that is the diastolic pressure (such as 120/80).
* Record the pressure in both arms and note the difference; also record the subject's position (supine), which arm was used, and the cuff size (small, standard or large adult cuff).
* If the subject's pressure is elevated, **measure blood pressure** two additional times, waiting a few minutes between measurements.
* A BLOOD PRESSURE OF 180/120mmHg OR MORE REQUIRES IMMEDIATE ATTENTION!

**Stay home, stay Safe**