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**2ND Semester**

**Section B**

**Subject: PHYSIOLOGY**

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**Q1: *Write the functions and composition of Blood?***

**Ans:**

# **BLOOD:**

**Blood** is a **body** 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 those same cells. In vertebrates, it is composed of **blood** cells suspended in **blood** plasma.

Normal **Ph** of blood is **7.35-7.45**

Body contains about 6-8% of the body’s weight. According to a 70 kg person will have 5-6 litres of blood. Total blood vloume cannot circulate in the body because some blood deposited in organs such as liver and remaining blood circulates in the body.

Blood is formed by 4 Components

* Plasma
* Erythrocytes ( red blood cells , RBCs)
* Leukocytes ( white blood cells WBCs )
* Thrombocytes ( Platelets )



# **BLOOD COMPOSITION**

Liquid part of blood :

**PLASMA**

**92% water**

**Mineral ions**

**Glucose and nutrients**

**Hormones**

**CO2**

**Proteins**

**RBCs**

**Biconcave in shape**

**Diameter = 7.8 micrometer**

**Thickness = 2.5 micrometer**

**52,00,000/cubic millimeter of blood in males**

**47,00,000 in females**

**WBCs**

**7000 per microliter of blood – 6 types of WBC**

**Polymorphonuclear neutrophills 62% Polymorphonuclear eosinophills 2.3% Polumorphonuclear basophills 0.4% Monocytes 5.3% Lymphocytes 30%**

**PLATELETS**

**300,000 per microliter of blood**

Blood is the only fluid tissue in the body. It appears to be a thick,

homogeneous liquid, but the microscope reveals that blood has

both cellular and liquid components. Blood is a specialized type

of connective tissue in which living blood cells, called the

formed elements, are suspended in a nonliving fluid matrix

called plasma (plaz-

mah). The collagen and elastic fibers typical

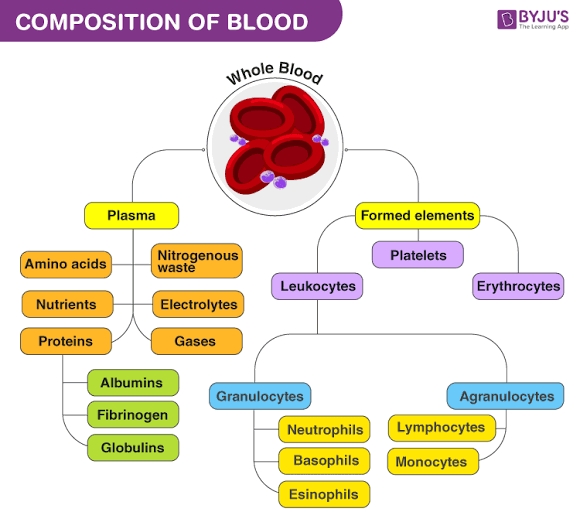
of other connective tissues are absent from blood, but dissolved

fibrous proteins become visible as fibrin strands during blood

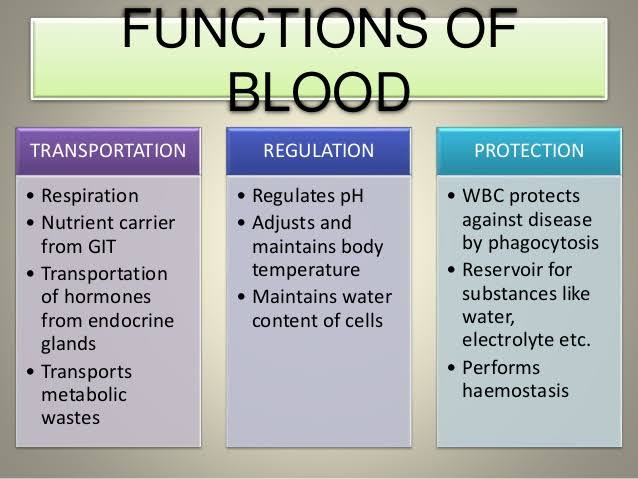
clotting.

Blood consists of

* Liquid Plasma ( volume 55-60% )
* Formed elements ( volume 40-45% )



# **FUNCTIONS OF BLOOD**



Blood has three main functions

* Transportation
* Protection
* Regulation

**TRANSPORT**

Blood transports following substances

* Gases, namely **Oxygen** (O2) and **Carbon dioxide** (CO2) between the lungs and rest of the body.
* **Nutrients** from the digestive tract and storage sites to the rest of the body.
* **Waste products** to be detoxified by the liver and kidneys.
* **Hormones** from the glands in which they are produced to their target cells.
* Heat to the skin so as to help **regulate body temperature.**

**PROTECTION**

Blood has several roles in inflammation.

* White blood cells ( Leukocytes ) destroy invading **microorganisms and cancer cells.**
* **Antibodies** and other proteins destroy pathogenic substances
* Platelet factors initiate **blood clotting** and help minimise blood loss.

**REGULATION**

Blood helps regulate

* Ph by interacting with **acids and bases**
* **Water balance** by transferring water to and from tissues

**Q2: *What is Erythrocyte , Erythropoiesis , Erythrocytosis and Erythropenia.***

**Ans:**

# **ERYTHROCYTES**

 A cell that contains **hemoglobin** and can carry oxygen to the body. Also called a red blood cell (RBC). The reddish color is due to the hemoglobin. **Erythrocytes** are biconcave in shape, which increases the cell's surface area and facilitates the diffusion of oxygen and carbon dioxide.

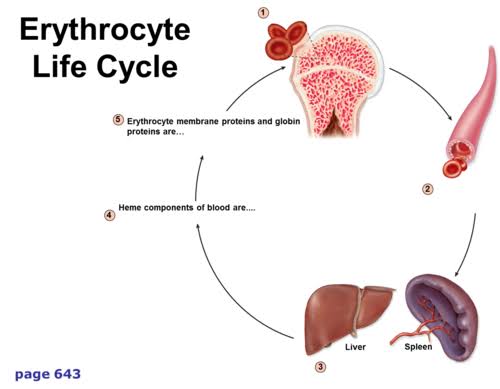
Approximately **2.4 million** new Erythrocytes produced per second.

A typical human Erythrocyte has a disk diameter of approximately **6.2-8.2 μm**

The average taken by human red blood cells is **28 seconds** to complete one cycle of circulation.

Major function is transportation of **haemoglobin**

RBCs contains **carbonic anhydrase** which catalysis reaction between carbon dioxide and water and perform function of transporting carbon dioxide frim tissues to lungs.



# **ERYTHROPOIESIS**

**Process of Formation of RBCs is called Erythropoiesis**

Erythropoiesis is the process which produces red blood cells, which is the development from erythropoietic stem cell to mature red blood cell.

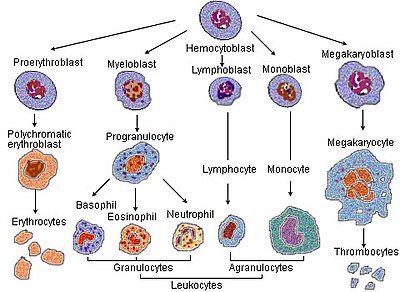
It is stimulated by decreased O2 in circulation, which is detected by the [**kidneys**](https://en.m.wikipedia.org/wiki/Kidney), which then secrete the hormone [**erythropoietin**](https://en.m.wikipedia.org/wiki/Erythropoietin). This hormone stimulates proliferation and differentiation of red cell precursors, which activates increased erythropoiesis in the [**hemopoietic**](https://en.m.wikipedia.org/wiki/Hemopoietic) tissues, ultimately producing [**red blood cells**](https://en.m.wikipedia.org/wiki/Red_blood_cells) (erythrocytes). In [**postnatal**](https://en.m.wikipedia.org/wiki/Postnatal) [**birds**](https://en.m.wikipedia.org/wiki/Bird) and [**mammals**](https://en.m.wikipedia.org/wiki/Mammal) (including [**humans**](https://en.m.wikipedia.org/wiki/Humans)), this usually occurs within the [**red bone marrow**](https://en.m.wikipedia.org/wiki/Red_bone_marrow). In the early [**fetus**](https://en.m.wikipedia.org/wiki/Fetus), erythropoiesis takes place in the mesodermal cells of the [**yolk sac**](https://en.m.wikipedia.org/wiki/Yolk_sac). By the third or fourth month, erythropoiesis moves to the liver. After seven months, erythropoiesis occurs in the bone marrow. Increased level of physical activity can cause an increase in erythropoiesis. However, in [**humans**](https://en.m.wikipedia.org/wiki/Humans) with certain [**diseases**](https://en.m.wikipedia.org/wiki/Diseases) and in some [**animals**](https://en.m.wikipedia.org/wiki/Animals), erythropoiesis also occurs outside the [**bone marrow**](https://en.m.wikipedia.org/wiki/Bone_marrow), within the [**spleen**](https://en.m.wikipedia.org/wiki/Spleen) or [**liver**](https://en.m.wikipedia.org/wiki/Liver).

**Erythropoiesis** takes place in the bone marrow, where **hemopoietic** stem cells differentiate and eventually shed their nuclei to become **reticulocytes**.

Erythropoiesis, the development of red blood cells, is a tightly regulated process for **maintaining sufficient oxygen** delivery to tissue.

In addition to **erythropoietin**, the erythropoietic machinery requires a constant supply of iron, vitamin B12, and folic acid.

**Erythropoietin** is the principal **hormone** that regulates **erythropoiesis** and its transcription is mediated by **hypoxia inducible factor-1 (HIF-1)**

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**Causes:**

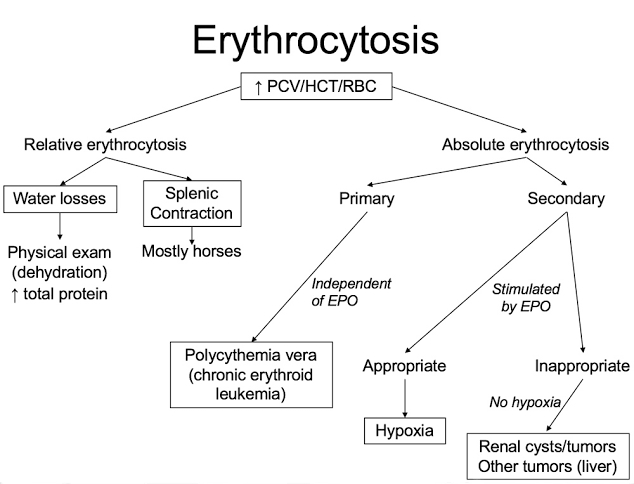
**Erythropoietin** is produced in the kidney and liver in response to low oxygen levels. In addition, **erythropoietin** is bound by circulating red blood cells; low circulating numbers lead to a relatively high level of unbound **erythropoietin**, **which stimulates** production in the bone marrow.

**Treatment:**

**Erythropoiesis**-stimulating agents (ESAs) continue to have an important role in the **treatment** of anemia in patients with CKD. ESA use in this group of patients has been shown to raise hemoglobin (Hgb) levels, decrease blood transfusion requirements, and improve the quality of life and symptoms related to anemia.

# **ERYTHROCYTOSIS**

**Increase in Red Blood Cell Mass**



**Erythrocytosis** is defined as an increase in red blood cell (RBC) mass, usually absolute, **erythrocytosis** and is also associated with an increased **hematocrit** (HCT) and hemoglobin concentration. Although some use the term **polycythemia** interchangeably with **erythrocytosis**, the two are not synonymous.

Relative **erythrocytosis** occurs due to **dehydration** or **endotoxemia** (hemoconcentration) or excitement/exercise (splenic contraction). ... Appropriate secondary **erythrocytosis** occurs in response to increased **erythropoietin** (EPO) levels resulting from sustained hypoxia.

**Secondary** is **erythrocytosis** that develops **secondary** to disorders that cause tissue hypoxia, inappropriately increase **erythropoietin production,** or increase sensitivity to erythropoietin. ... Any elevation of hemoglobin or **hematocrit** above normal values for age and sex is considered **erythrocytosis**.

**Causes:**

Smoking, a lack of oxygen, such as from lung diseases or being in high altitudes.

**Treatment:**

Any underlying disorder that is causing the oxygen deprivation and secondary **erythrocytosis** is **treated** as effectively as possible. In some people, phlebotomy (in which some of the person's blood is removed) is used to lower the number of red blood cells. It is rare that phlebotomy is needed in secondary **erythrocytosis**.

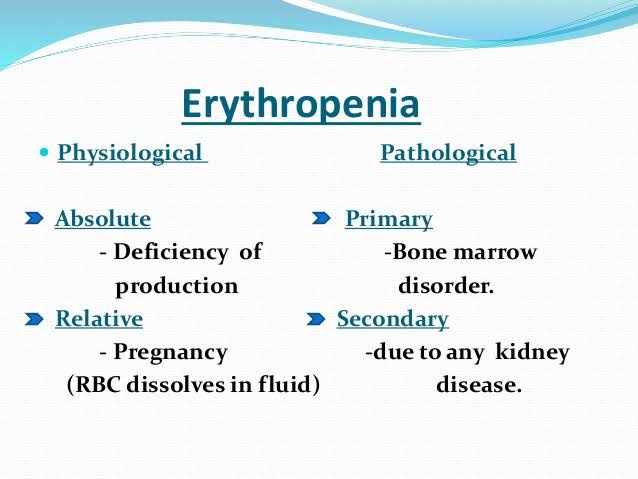
# **ERYTHROPENIA**

**A decrease in the number of erythrocytes, associated with anemia**

**Or**

**Deficiency of Red Blood Cells**

It is **caused** by a **mutation in genes** that control how many RBCs your bone marrow makes. When one of these genes is mutated, your bone marrow will produce extra RBCs, even when your body doesn't need them.

**Causes:** smoking.

a lack of oxygen, such as from lung diseases or being in high altitudes.

tumors.

medications such as steroids and diuretics.

**Treatment**

Any underlying disorder that is causing the oxygen deprivation and secondary **erythrocytosis** is **treated** as effectively as possible. In some people, phlebotomy (in which some of the person's blood is removed) is used to lower the number of red blood cells. It is rare that phlebotomy is needed in secondary **erythrocytosis**.

**Q3: *What is Platelets? and write about clotting mechanism and its all steps.***

**Ans:**

# **PLATELETS**

Platelets are tiny blood cells that help your body form **clots to stop bleeding.** If one of your blood vessels gets damaged, it sends out signals to the platelets. The platelets then rush to the site of damage. they form a plug (clot) to fix the damage.

Platelets are made in your **bone marrow** along with your white and red blood cells. Your bone marrow is the spongy center inside your bones. Another name for platelets is **THROMBOCYTES** Healthcare providers usually call a clot a thrombus. Once platelets are made and circulated into your bloodstream, they **live for 8 to 10** days.

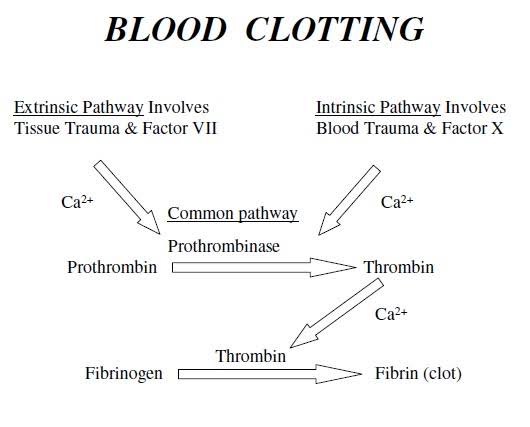
Under a **microscope**, a platelet looks like a **tiny plate**. Your healthcare provider may do a blood test called a complete blood count to find out if your bone marrow is making the right number of platelets:

A normal platelet count is **150,000 to 450,000** platelets per microliter of blood.

Your risk for bleeding develops if a platelet count falls below **10,000 to 20,000.** When the platelet count is less than **50,000**, bleeding is likely to be more serious if you're cut or bruised.

Some people make too many platelets. They can have platelet counts from 500,000 to more than 1 million.

# **MECHANISM**



Clotting Mechanism is broken into 2 Stages:

**Primary Hemostasis:**

Formation of a weak Platelet plug

**Secondary Hemostasis :**

Stabilizing the weak Platelet plug into a clot by the fibrin network.

The **mechanism** of **coagulation** involves **activation**, **adhesion** and **aggregation** of **platelets**, as well as deposition and maturation of fibrin. **Platelets** immediately form a plug at the site of injury; this is called primary hemostasis.

The second critical **step** in hemostasis, which follows **vasoconstriction**, is **platelet plug formation**.

There are three **steps** to **platelet plug formation** are:

**adherence**

**activation**

**aggregation**

**Q4: *Write a detail note on ABO System?***

**Ans:**

# **ABO System**

**ABO** blood group **system**, the classification of human blood based on the inherited properties of red blood cells (erythrocytes) as determined by the **presence or absence of the antigens A and B,** which are carried on the surface of the red cells. Persons may thus have type A, type B, type O, or type AB blood.

**NOMENCLATURE**

Number of ABO Blood group antigens are 4

ISBT Symbol: ABO

ISBT number: 001

Gene Symbol: ABO

Gene name: ABO blood group ( A transferase, α1,3-N-acetylgalactosaminyltransferase;B transferase, α1,3-galactosyltransferase ).

**ABO SYSTEM**

**BY DR. KARL LANDSTEINER 1900**

Received Nobel prize in Physiology or Medicine in 1930 for this discovery.

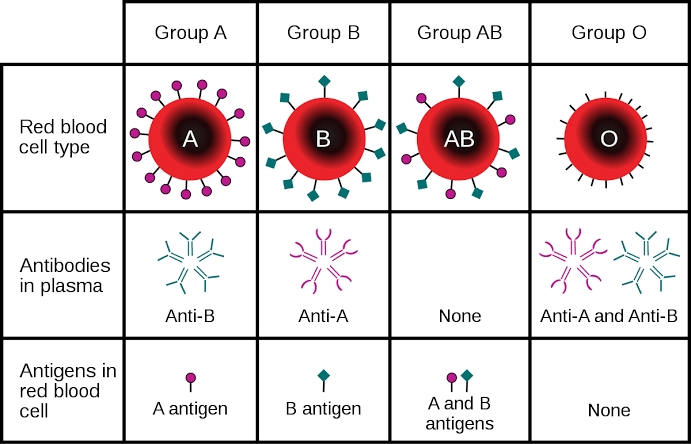
* He concluded that it is inherited from Parents.
* Based on A and B Antigens-Agglutinogems
* It may have

Neither of them

One of them

Both of them

The **ABO blood group system** is used to denote the presence of one, both, or neither of the A and B [**antigens**](https://en.m.wikipedia.org/wiki/Antigen) on [**erythrocytes**](https://en.m.wikipedia.org/wiki/Erythrocyte). In human [**blood transfusions**](https://en.m.wikipedia.org/wiki/Blood_transfusion) it is the most important of the 36 different [**blood type**](https://en.m.wikipedia.org/wiki/Blood_type) (or group) classification systems currently recognized. A mismatch (very rare in modern medicine) in this, or any other [**serotype**](https://en.m.wikipedia.org/wiki/Serotype), can cause a potentially fatal [**adverse reaction**](https://en.m.wikipedia.org/wiki/Blood_transfusion#Adverse_effects) after a transfusion, or an [**unwanted immune response**](https://en.m.wikipedia.org/wiki/Organ_rejection) to an organ transplant. The associated anti-A and anti-B [**antibodies**](https://en.m.wikipedia.org/wiki/Antibodies) are usually [**IgM**](https://en.m.wikipedia.org/wiki/IgM) antibodies, produced in the first years of life by sensitization to environmental substances such as food, bacteria, and viruses.

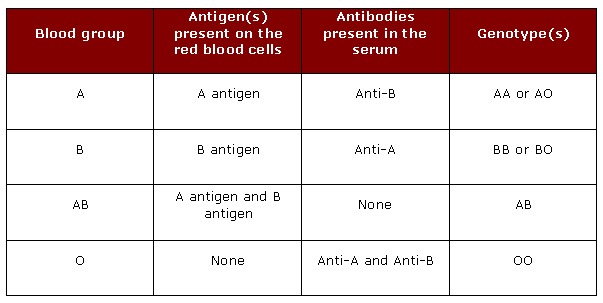
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### **ABO phenotypes**

The four basic ABO phenotypes are O, A, B, and AB. After it was found that blood group A RBCs reacted differently to a particular antibody (later called anti-A1), the blood group was divided into two phenotypes, A1 and A2. RBCs with the A1 phenotype react with anti-A1 and make up about 80% of blood type A. RBCs with the A2 phenotype do not react with anti-A1 and they make up about 20% of blood type A. A1 red cells express about 5 times more A antigen than A2 red cells, but both types of red cell react with anti-A, and as far as transfusion purposes are concerned, the A1 and A2 blood groups are interchangeable.

There are many other subgroups of blood group A in which RBCs tend to weakly express the A antigen, whereas weak variants of the blood group B phenotype are rare.

The immune system forms antibodies against whichever ABO blood group antigens are *not* found on the individual's RBCs. Thus, a group A individual will have anti-B antibodies and a group B individual will have anti-A antibodies. Blood group O is common, and individuals with this blood type will have both anti-A and anti-B in their serum. Blood group AB is the least common, and these individuals will have neither anti-A nor anti-B in their serum.



ABO antibodies in the serum are formed naturally. Their production is stimulated when the immune system encounters the "**missing**" ABO blood group antigens in foods or in micro-organisms. This happens at an early age because sugars that are identical to, or very similar to, the ABO blood group antigens are found throughout nature.

The ABO locus has three main **alleleic** forms: A, B, and O. The A allele encodes a glycosyltransferase that produces the A antigen (**N-acetylgalactosamine** is its **immunodominant sugar**), and the B allele encodes a glycosyltransferase that creates the B antigen (**D-galactose** is its immunodominant sugar).

**Function of the A and B antigens**

**functions of the ABO blood group** antigens are not known. Individuals who lack the A and B antigens are healthy, suggesting that any function the antigens have is not important, at least not in modern times.

**Diseases associated with ABO blood group antigens**

No diseases are known to result from the lack of expression of ABO blood group antigens, but the susceptibility to a number of diseases has been linked with a person's ABO phenotype. Such correlations remain controversial and include the observation that gastric cancer appears to be more common in group A individuals ,whereas gastric and duodenal ulcers occur more often in group O individuals.

**Clinical Significance of ABO Antibodies**

ABO Antibodies are of major clinical significance for two reasons:

**They are naturally occurring and are found universally**

**They are highly reactive**

**Indications for ABO grouping:**

ABO grouping is required for all of the following individuals:

**Blood Donors**

since it can be life threatening to give the wrong ABO group to the patient.

**Transfusion recipients**

since we need to know the donor blood is ABO compatible.

**Transplant Candidates and Donors**

ABO antigens are found in other tissues as well.  Therefore the transplant candidates and donors must be compatible.

**Prenatal Patients**

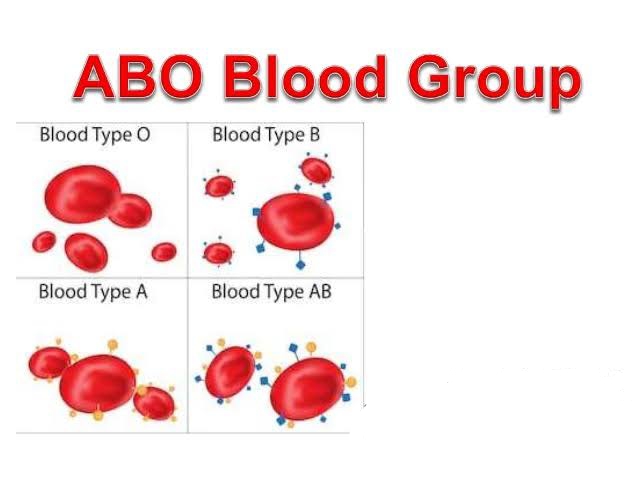
To determine whether the mothers may have babies who are suffering from ABO-HDN.  It is also beneficial to know the ABO group should she start hemorrhaging.

**Newborns**

 (sometimes) If the baby is demonstrating symptoms of Hemolytic Disease of the Newborn, the ABO group needs to be determined along with Rh and others.

**Paternity testing**

Since the inheritance of the ABO Blood Group System is very specific, this serves as one of the first methods to determine the likelihood that the accused father is the father or not.



**Q5:**

1. ***A person fell down from a tree and become unconscious, with bleeding from head, what will you do as a first aid?***

**Ans:**  First of all I’ll check that i and the casualty aren't in any danger, and, if possible, make the situation safe i’ll sanitize my hands and then wear surgical gloves to reduce the risk of any infection being passed on. Then i will apply piodine on the affected part nd then i will apply bandage. if bleeding continues through the pad, I’ll apply pressure to the wound  until the bleeding stops and then apply another pad over the top and bandage it in place. I will not remove the original pad or dressing, but continuously i will check that the bleeding has stopped or not.

1. ***You have to meet with your friend and you came to know he’s covid positive , what precautionary measures will you take?***

**Ans:** First of all i will advise him to be isolated separately in his home. Because now adays hospitals are not safe. They are killing corona patients. And I’ll advise him to take fresh juices , fruits , hot water , fresh vegetables and panadol. And I’ll also quarantine myself. Because I interacted with covid patient.

**Everyone should follow following precautionary measures**

Clean your hands often. Use soap and water, or an alcohol-based hand rub.

Maintain a safe distance from anyone who is coughing or sneezing.

Don’t touch your eyes, nose or mouth.

Cover your nose and mouth with your bent elbow or a tissue when you cough or sneeze.

Stay home if you feel unwell.

If you have a fever, cough and difficulty breathing, seek medical attention. Call in advance.

Follow the directions of your local health authority.

# **THE END**