

## Syllabus

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## 8.0 Introduction

## Q.1 Can you call?

## i. Definition of 'Respiration'.

**Ans:** Respiration : It is a biochemical process of oxidation of organic compounds in an orderly manner for the liberation of chemical energy in the form of ATP.

## ii. The types of cellular respiration.

**Ans:** The two types of cellular respiration are aerobic respiration and anaerobic respiration.

## iii. Why should we respire all the time?

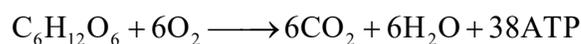
**Ans:** Living organisms obtain energy to carry out vital life processes through the process of respiration thus we need to respire all the time.

## Q.2 What is respiratory surface?

**Ans:** The site of gaseous exchange is called the respiratory surface.

## Q.3 Write the equation for cellular respiration.

**Ans:**



## Q.4 Use your brain power.

What would happen if respiration take place in one single step?

**Ans:** If respiration took place in one single step, the energy would be released at once. Since we would not be able to use so much energy, most of it would be lost in the form of light or heat energy.

## 8.1 Organs of Respiratory Exchange

## Intext Question

## Q.5 What are main features of respiratory surface?

**Ans:**

- i. Respiratory exchange is a simple physical process.
- ii. For efficient gaseous exchange, the respiratory surface should have the following features :
  - a. It should have a large surface area.
  - b. It should be thin, highly vascular and permeable to allow exchange of gases.
  - c. It should be moist.

## TEXTUAL QUESTION

## ★ Q.6 Identify the incorrect statement and correct it,

(A) A respiratory surface area should have a large surface area.

(B) A respiratory surface area should be kept dry.

(C) A respiratory surface area should be thin, may be 1mm or less.

**Ans:** (B) A respiratory surface area should be kept dry.

Correct statement - A respiratory surface should be moist in order to facilitate

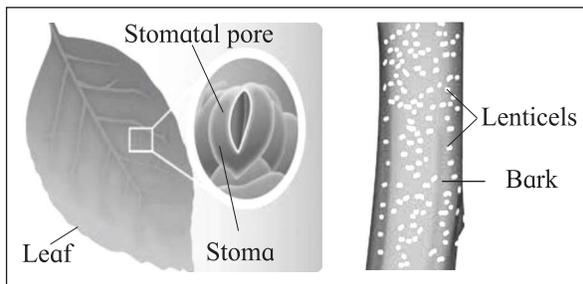
exchange of gases.

**Gaseous exchange in plants**

**Q.7 Explain the process of gaseous exchange in plants.**

**Ans:**

- i. The shape and structure of plants facilitate gaseous exchange by diffusion.
- ii. A terrestrial flowering plant has many air spaces between the cells of stem, leaf and root. These air spaces are continuous. Oxygen diffuses into the air space through stomata (the pores on leaves and young stems), carbon dioxide and water vapour diffuse out.
- iii. In the aerated soil, the oxygen dissolves in the film of moisture or water around the root tissue and enters it by diffusion.
- iv. Woody flowering plants (trees and shrubs) have an external impervious bark. Here, gaseous exchange occurs through small pores in the stem surface, called lenticels.



**INTEXT QUESTION**

**Q.8 Curiosity Box.**

**Which are the part of plant help in the process of gaseous exchange?**

**Ans:** Gaseous exchange in plants occurs through leaves (Stomata), stem (Lenticels), bark, and root hairs.

**Respiration in Animals**

**Q.9 Describe respiratory structures in various organisms along with their habitat in a tubular form.**

**Ans:**

| Organism  | Habitat               | Respiratory surface/ organ                         |
|---|-----------------------|--|
| Protists, Sponges and Coelenterates   | Aquatic               | Plasma membrane                                    |
| Flatworms like Planaria, Annelids (earthworm, nereis, leech), amphibians (frog) | Aquatic or semoquatic | Plasma membrane, general body surface (moist skin) |
| Insects   | Terrestrial           | Tracheal tubes and spiracles                       |
| Arachnids like spiders and scorpions  | Terrestrial           | Book lungs   |
| Limulus (Arthropod)   | Aquatic               | Book gills   |
| Amphibian tadpoles of frog, salamanders and newts                               | Aquatic               | External gills                                     |
| Fish  | Aquatic               | Internal gills                                     |
| Reptiles, Birds and Mammals   | Terrestrial           | Lungs  |
| Turtles   | Underwater            | cloaca   |

**Q.10 Match the Respiratory surface to the organism in which it is found.**

**Ans:**

|      | Respiratory surface |    | Organism   |
|------|---------------------|----|------------|
| i.   | Plasma membrane     | a. | Insect     |
| ii.  | Lungs               | b. | Salamander |
| iii. | External gills      | c. | Bird       |
| iv.  | Internal gills      | d. | Amoeba     |
| v.   | Trachea             | e. | Fish       |

**Q.11 Use your brain power.**

**Why large animals cannot carry out respiration without the help of circulatory system?**

**Ans:**

- i. In large animals, the respiratory system interacts with the circulatory system to transfer oxygen to red blood cells also for releasing carbon dioxide from the blood into the air in the lungs.
- ii. In simpler animals, exchange of gasses occurs through diffusion whereas in large animals due to their complex organization this is not possible.  
Thus large animals cannot carry out respiration without the help of circulatory system.

**TEXTUAL**

**★Q.12 Why the respiration in insect called direct respiration.**

**Ans:** In insects, Respiratory system is independent of its circulatory system and the tracheal tubes directly transports oxygen to the entire body. Therefore, respiration in insect is called direct respiration.

**8.2 Human Respiratory System**

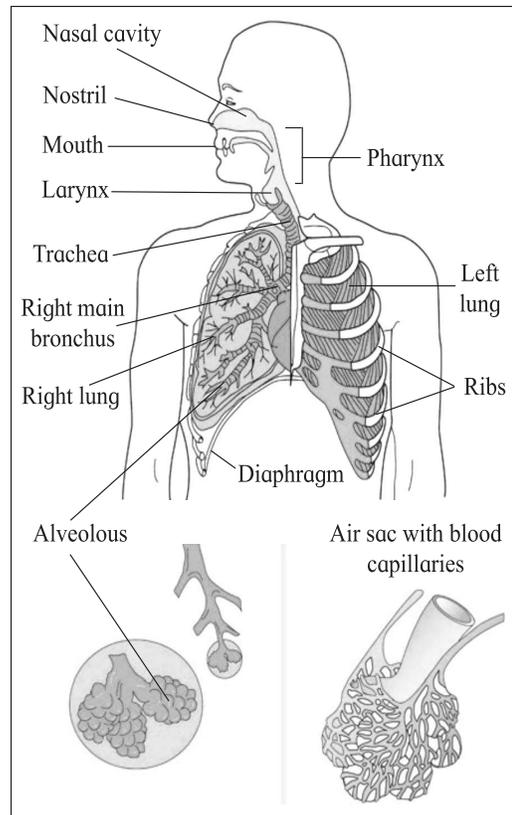
**Q.13 State the functions and parts of respiratory system.**

**Ans:**

- i. The respiratory system brings about inspiration, expiration and exchange of gases in the lungs.
- ii. These are then transported by blood from the lungs to the different tissues and parts of the body.
- iii. The respiratory system can be divided into an upper respiratory system having external nares, nasal cavities, internal nares, nasopharynx, nose, throat and associated structures.
- iv. The lower respiratory system refers to the larynx, trachea, bronchi, bronchioles and lungs.

**Q.14 Explain the parts of human respiratory system in detail.**

**Ans:** Following are the parts of human respiratory system.



**1. Nose:**

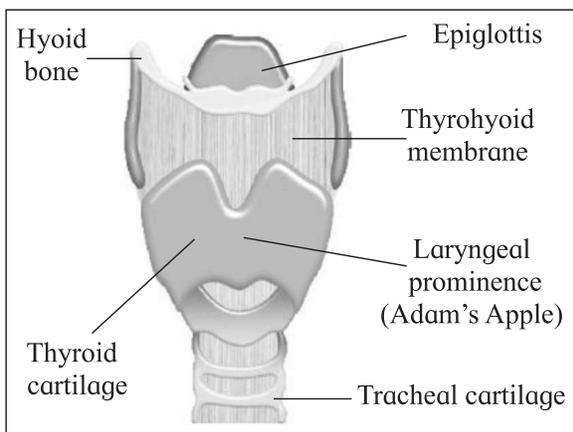
- i. The nose has a pair of slit like openings called external nares or nostrils for entry of air into the nasal cavity.
- ii. The nasal cavity is divisible into right and left nasal chambers by a mesethmoid cartilage.
- iii. Each nasal chamber is further divided into three regions.
  - a. **Vestibule** : It is the proximal part about the nostrils. Its skin has hair for filtering the air and trapping the dust and suspended particles in the inhaled air.
  - b. **Respiratory part (conditioner)** : The middle thin walled highly vascular part for warming and moistening the inhaled air.
  - c. **Olfactory or sensory chamber** : The uppermost part is lined by olfactory epithelium for detection of smell.

**2. Pharynx:**

- i. It is divisible into three parts.
- ii. The nasopharynx is the uppermost part from the nasal chamber it leads into **oropharynx** (common passage for food and air).
- iii. This continues below as the **laryngopharynx**.
- iv. Between the nasopharynx and oropharynx is the palate bone.
- v. The pharynx has a set of lymphoid organs called **tonsils**.

**3. Larynx:**

- i. It is called voice box. It is the part of the respiratory tract which contains vocal cords for producing sound.
- ii. The larynx extends from the laryngopharynx and the hyoid bone to the trachea.
- iii. It is a hollow, tubular structure. Its wall is made up of cartilage plates held by membranes and muscles.
- iv. Internally, it is lined by a pair of folds of elastic vocal cords (true vocal cords).
- v. Voice is produced by passage of air between the vocal cords and modulations created by tongue, teeth, lips and nasal cavity.
- vi. The larynx opens into the laryngopharynx through a slit like opening called glottis.
- vii. This opening of the trachea or wind pipe is guarded by a leaf like flap called **epiglottis**. It prevents the entry of food into trachea.



**4. Trachea (wind pipe):**

- i. It is a long tube 10 to 12 cm in length.
- ii. It runs through the neck in front of the

oesophagus and extends into and upto the middle of thoracic cavity.

- iii. It is supported by 'C' shaped 16 to 20 rings of cartilage which prevent the collapse of trachea.
- iv. It is lined internally with ciliated, pseudostratified epithelium and mucous glands that trap the unwanted particles preventing their entry into the lungs.

**5. Bronchi:**

- i. The trachea divides into right and left primary bronchi as it reaches the middle of the thoracic cavity.
- ii. The bronchi are supported internally by 'C' shaped incomplete rings of cartilage.
- iii. The primary bronchi divide to form secondary and tertiary bronchi which lead into terminal bronchioles ending into alveoli.

**6. Lungs:**

- i. These are the main respiratory organs of humans.
- ii. One pair of spongy and elastic lungs are present in the thoracic cavity.
- iii. Each lung is enclosed and protected by a double pleural membrane, outer parietal and inner visceral membrane.
- iv. Between the two pleura is a pleural cavity filled with a lubricating fluid called pleural fluid. It is secreted by the membranes.
- v. The right lung is larger and divided into 3 lobes, while the left lung is smaller and divided into 2 lobes.
- vi. Each lobe of the lung has the terminal bronchioles ending in a bunch of air sacs, each with 10 to 12 alveoli.

**7. Alveoli:**

- i. These are thin walled lobulated structures, like a bunch of grapes.
- ii. Each alveolus is surrounded by a network of capillaries of pulmonary arteries and veins.
- iii. These have highly elastic wall made up of a single layer of squamous epithelium resting on a basement membrane of connective tissue.

- iv. There are about 700 million alveoli in the lungs and they provide the surface area for exchange of gases.

**Q.15 What is a diaphragm?**

**Ans:**

- i. It is a muscular septum that separates the thoracic and abdominal cavity.
- ii. It is dome shaped and on contraction it becomes flattened.

**Intext**

**Q.16 Kavya underwent a surgical procedure called Rhinoplasty.**

**What could have been the reason for such a surgery? On which part of the body is it carried out?**

**Ans:**

- i. Rhinoplasty is performed on nose and can be called as nasal reconstruction. It is a plastic surgery procedure for altering and reconstructing the nose.
- ii. Kavya might have undergone this surgery for any of the following reasons,
  - a. Cosmetic reasons
  - b. To repair fractured nose.
  - c. Deviated nasal septum.
  - d. Treatment for disfigurement resulted from trauma of birth defects.

**Intext**

**Q.17 Do you know?**

- i. **Shreyas choked while eating dinner. How can you help him? What is the immediate help that can be given to him?**

**Ans:** It depends on the nature of the blockage if it is mild, Shreyas can be asked to cough the obstruction out. If it is severe we should immediately seek medical assistance.

- ii. **What is a role of epiglottis.**

**Ans:**

- i. The larynx opens into the laryngopharynx through a slit like opening called glottis.
- ii. This opening of the trachea or wind pipe is guarded by a leaf like flap called **epiglottis**. It prevents the entry of food into trachea.

**TEXTUAL**

**★Q.18 Why does trachea have 'C' shaped rings of cartilage?**

**Ans:** Trachea is composed of 'C' shaped rings of cartilage as they prevent trachea from collapsing.

**★Q.19 Name the organ which prevents the following the entry of food into the trachea while eating.**

**Ans:** **Epiglottis** is the organ which prevents the following the entry of food into the trachea while eating.

**Intext**

**Q.20 Find out**

**What is the role of tonsils in our body?**

**Ans:**

- i. Tonsils are small lymphatic nodules in pharyngeal region. They fight against inhaled and ingested foreign substances
- ii. They are involved in immunological reactions against foreign invaders.
- iii. Normally there are five tonsils strategically positioned to fight against inhaled and ingested foreign substances.
- iv. Humans have 2 pairs of tonsils (Palatine and Lingula tonsils) and a single tonsil (Pharyngeal tonsil).

**Intext**

**Q.21 Internet my friend.**

- i. **What is the importance of pleural fluid?**

**Ans:**

- i. The friction between the pleural membranes is reduced due to pleural fluid, allowing them to slide easily one over the other during breathing.
- ii. It also causes the two membranes to adhere to one another.

- ii. **Find the total surface covered by the alveoli.**

**Ans:** The total surface area covered by alveoli is 70 m<sup>2</sup>. i.e. about 750 ft.

**Q.22 Do you know?**

**What is a role of epiglottis?**

**Ans:** This opening of the trachea or wind pipe is

guarded by a leaf like flap called **epiglottis**. It prevents the entry of food into trachea.

### 8.3 Mechanism of Respiration

**Q.23 Explain in detail the process of respiration in human being.**

**Ans:** Respiration is a biological process involving exchange of gases between the atmosphere and the lungs and it results in the formation of ATP. It includes the following processes:

1. Breathing
2. External respiration
3. Internal respiration
4. Cellular respiration

**1. Breathing :**

- i. It is a physical process by which gaseous exchange takes place between the atmosphere and the lungs.
- ii. It involves inspiration and expiration. Both these steps involved parts of the thoracic cage, the ribs, sternum and the intercostal muscles and muscles of the diaphragm.

**iii. Inspiration :**

- a. During inspiration, the atmospheric air is taken in to the lungs.
- b. It occurs due to the pressure gradient formed between the lungs and the atmosphere.
- c. It is an active process in which the diaphragm becomes flat and goes downward, the external intercostal muscles contract so the ribs and sternum move upward and outward.
- d. This leads to an increase in the thoracic volume and a decrease in pressure of thorax and the lungs.
- e. To equalize the low pressure inside the lungs, air from the atmosphere rushes into lungs. This is inspiration.

**iv. Expiration :**

- a. During expiration, the thorax contracts causing air to be exhaled.
- b. The diaphragm relaxes and is pushed upwards.
- c. It becomes dome shaped.

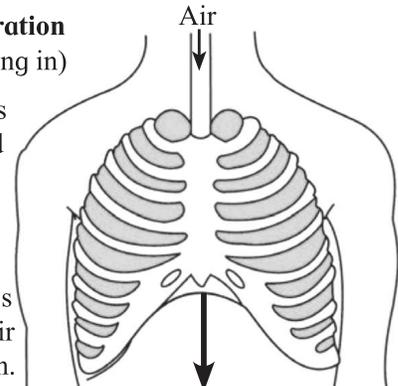
- d. The intercostal muscles also relax pulling the rib cage inward and downward.
  - e. This causes a decrease in thoracic volume and leads to increase in pressure in the thorax and the lungs as compared to the atmospheric pressure.
  - f. So air from the lungs rushes out. This is expiration.
- v. One inspiration and one expiration is one breath.

**a. Inspiration**  
(Breathing in)

Rib cage moves up and forward

Pressure in lungs decreases and air comes rushing in.

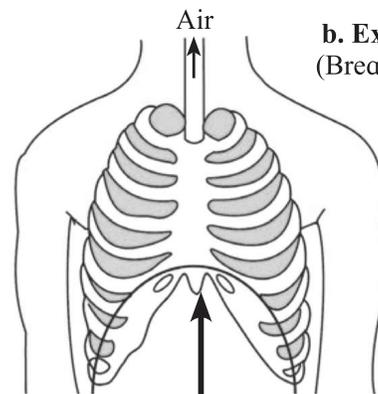
Diaphragm contracts and moves down



**b. Expiration**  
(Breathing out)

Rib cage moves down and inward

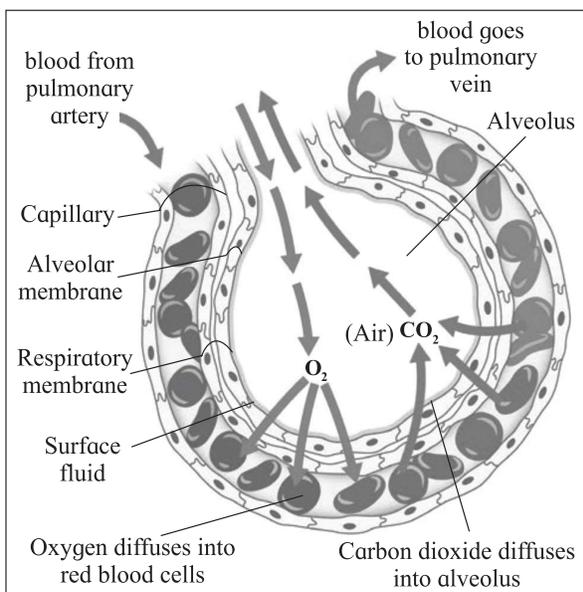
Diaphragm relaxes and moves up



**2. External respiration/ Exchange of gases at the alveolar level :**

- i. An alveolus consists of a layer of simple squamous epithelium resting on a basement membrane.
- ii. It is intimately associated with a dense network of capillaries.
- iii. The capillary wall is also made up of simple squamous epithelium resting on a thin

- basement membrane.
- iv. Both the layers have similar structure and are thin walled. Together they make up the respiratory membrane through which gaseous exchange occurs i.e. between the alveolar air and the blood.
  - v. Diffusion of gases will take place from an area of higher partial pressure to an area of lower partial pressure until the partial pressure in the two regions reaches equilibrium.
  - vi. The partial pressure of carbon-dioxide of blood entering the pulmonary capillaries is 45 mmHg while partial pressure of carbon dioxide in alveolar air is 40 mmHg.
  - vii. Due to this difference, carbon dioxide diffuses from the capillaries into the alveolus.
  - viii. Similarly, partial pressure of oxygen of blood in pulmonary capillaries is 40 mmHg while in alveolar blood it is 104 mmHg. Due to this difference oxygen diffuses from alveoli to the capillaries.



3. **Internal respiration :**
  - i. The two main components of blood involved in transport of the respiratory gases  $\text{CO}_2$  and  $\text{O}_2$ , are the RBCs and the plasma.
  - ii. **Transport of oxygen :**

- a. Of the total oxygen transported only 3% is transported in a dissolved state by the plasma.
- b. The remaining 97% is bound to the haemoglobin (Hb) present in the RBCs.
- iii. Haemoglobin acts as the respiratory carrier. It has a high affinity for  $\text{O}_2$  and combines with it to form oxyhaemoglobin.
- iv. Theoretically, one molecule of Hb has 4  $\text{Fe}^{++}$ , each of which can pick up a molecule of oxygen ( $\text{O}_2$ ).



- v. Oxyhaemoglobin is transported from lungs to the tissues where it readily dissociates to release  $\text{O}_2$ .



- vi. However, the degree of saturation of Hb with  $\text{O}_2$  depends upon the  $\text{O}_2$  tension i.e.  $\text{ppO}_2$ .
  - a. 100% saturation is rare.
  - b. Maximum saturation of 95 to 97% is at  $\text{ppO}_2$  in alveoli (100 mmHg).
  - c. Degree of saturation decreases with the drop in  $\text{ppO}_2$ . This begins the dissociation of  $\text{HbO}_2$ .
  - d. At 30 mmHg of  $\text{ppO}_2$ , only 50% saturation can be maintained.

- vii. The relationship between  $\text{HbO}_2$  saturation and oxygen tension ( $\text{ppO}_2$ ) is called **oxygen dissociation curve**.

- viii. This oxygen haemoglobin dissociation curve is a sigmoid curve and it shifts towards the right due to increase in  $\text{H}^+$  concentration, increase in  $\text{ppCO}_2$  and rise in temperature and rise in DPG (2, 3 diphosphoglycerate), formed in the RBCs during glycolysis. It lowers the affinity of haemoglobin for oxygen.

#### 4. Cellular Respiration :

- i. It is the last step taking place inside the cell where food is oxidized and ATP is generated. It can be shown by two steps:
- ii. **Oxidation :** Breaking down of complex organic molecules into simple inorganic molecules with release of heat energy.



- iii. **Phosphorylation** : It involves trapping the heat energy in the form of high energy bond of ATP molecule. ATP is used to carry out vital life processes and so is called as energy currency of the cell.



**TEXTUAL**

★ **Q.24 Why is it advantageous to breathe through the nose than through the mouth?**

**Ans:**

- i. Nose consists of hair in the nasal cavity which prevents the entry of microbes, dust and other impurities which may harm the lungs thus it filters and warms inhaled air
- ii. Mouth lacks any such structures for filtering and warming the air that is inhaled during inspiration
- Hence, it is advantageous to breathe through the nose than through the mouth.

**Q.25 Write a brief note on transport of O<sub>2</sub>.**

**Ans:**

- i. Of the total oxygen transported only 3% is transported in a dissolved state by the plasma.
- ii. The remaining 97% is bound to the haemoglobin (Hb) present in the RBCs.

**Q.26 Write a brief note on transport of CO<sub>2</sub>.**

**Ans:** Carbon dioxide is readily soluble in water and is transported by RBCs and plasma in three different forms.

- i. **By plasma in solution form (7%)** : Only 7% of CO<sub>2</sub> is transported in a dissolved form as carbonic acid (which can breakdown into CO<sub>2</sub> and H<sub>2</sub>O).



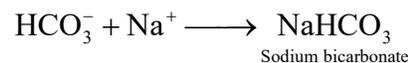
- ii. **By bicarbonate ions (70%)** :

- a. Nearly 70% of carbon dioxide released by the tissue cells diffuses into the plasma and then into the RBCs.
- b. In the RBCs, CO<sub>2</sub> combines with water in the presence of a Zn containing enzyme, carbonic anhydrase to form carbonic acid.
- c. Carbonic anhydrase enzyme is found in the RBCs and not in the plasma.

- d. The rate of formation of carbonic acid inside the RBC is very high as compared to its formation in the plasma.
- e. Carbonic acid being unstable almost immediately dissociates into HCO<sub>3</sub><sup>-</sup> and H<sup>+</sup> in the presence of the enzyme carbonic anhydrase (CA) leading to large accumulation of HCO<sub>3</sub><sup>-</sup> inside the RBCs.



- f. It thus moves out of the RBCs. This would bring about imbalance of the charge inside the RBCs. To maintain the ionic balance between the RBCs and the plasma, Cl<sup>-</sup> diffuses into the RBCs.
- g. This movement of chloride ions is known as chloride shift or Hamburger's phenomenon.
- h. HCO<sub>3</sub><sup>-</sup> that comes into the plasma joins to Na<sup>+</sup> / K<sup>+</sup> forming NaHCO<sub>3</sub> / KHCO<sub>3</sub> (to maintain pH of blood).



H<sup>+</sup> is taken up by protein (haemoglobin).



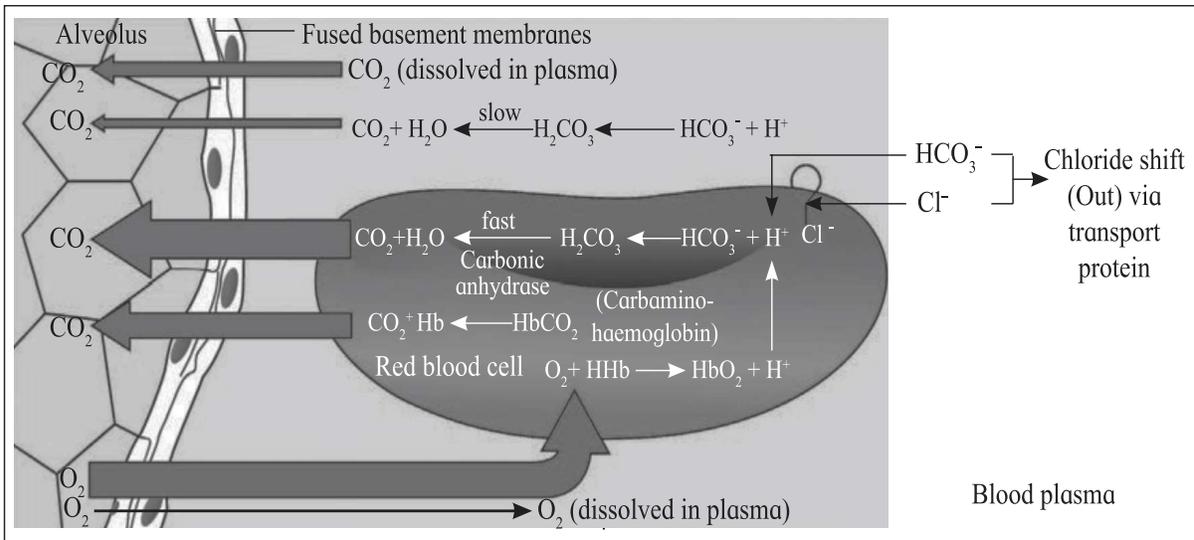
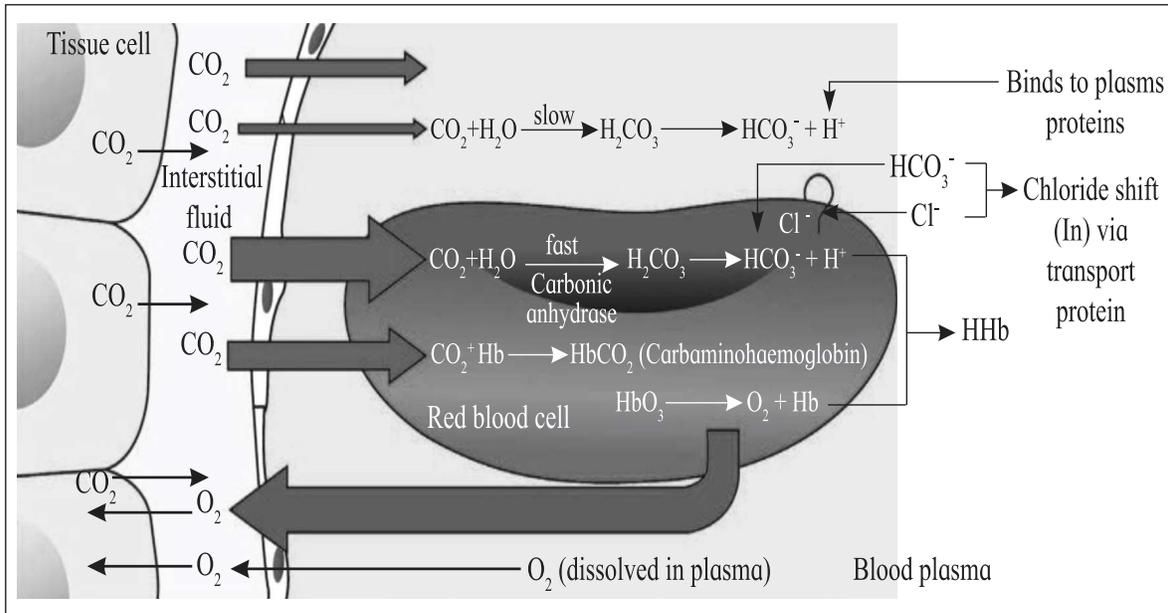
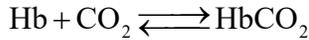
These H<sup>+</sup> ions might be expected to lower blood pH, but they are buffered by haemoglobin by the formation of deoxyhaemoglobin (reduced haemoglobin).

- i. At the level of the lungs in response to the low partial pressure of carbon dioxide (ppCO<sub>2</sub>) of the alveolar air, hydrogen ion and bicarbonate ions recombine to form carbonic acid and under the influence of carbonic anhydrase yields carbon dioxide and water.



- iii. By red blood cells (23%) : Carbon dioxide binds with the amino group of the haemoglobin and form a loosely bound compound carbaminohaemoglobin. This molecule readily decomposes in region where

the partial pressure of carbon dioxide (ppCO<sub>2</sub>) is low (alveolar region), releasing the carbon dioxide.



**Q.27 What is Bohre effect?**

**Ans: Bohr effect :** It is the shift of oxyhaemoglobin dissociation curve due to change in partial pressure of CO<sub>2</sub> in blood.

**Q.28 What is Haldane Effect?**

**Ans:** The amount of CO<sub>2</sub> that can be transported in the blood is influenced by the percent saturation of haemoglobin with oxygen. The lower the amount of oxyhaemoglobin (Hb-O<sub>2</sub>), the higher the CO<sub>2</sub>

carrying capacity of the blood, this relationship is known as the Haldane Effect.

**Q.29 Use your brain**

**i. What is the role of haemoglobin in the transport of oxygen in the blood.**

**Ans:**

- i. Of the total oxygen transported only 3% is transported in a dissolved state by the plasma.
- ii. The remaining 97% is bound to the haemoglobin (Hb) present in the RBCs.

**ii. Write a note on chloride shift.**

**Ans:**

- i. The rate of formation of carbonic acid inside the RBC is very high as compared to its formation in the plasma.
- ii. Carbonic acid being unstable almost immediately dissociates into  $\text{HCO}_3^-$  and  $\text{H}^+$  in the presence of the enzyme carbonic anhydrase (CA) leading to large accumulation of  $\text{HCO}_3^-$  inside the RBCs.



- iii. It thus moves out of the RBCs. This would bring about imbalance of the charge inside the RBCs. To maintain the ionic balance between the RBCs and the plasma,  $\text{Cl}^-$  diffuses into the RBCs.
- iv. This movement of chloride ions is known as chloride shift or Hamburger's phenomenon.

**Q.30 Try this.**

**Count the number of breaths you take in the following situations.**

- i. After a goodnight's sleep**
- ii. During a vigorous activity (running, climbing stairs etc.)**
- iii. After the vigorous activity.**

**Do you find any difference in the count?**

**Ans:**

- i. Number of breathes during sleep = 12
- ii. During rigorous activity = 80
- iii. After rigorous activity = 40

Yes, there is a difference in count as the number of breaths change depending upon the acativity, physical fitness or external stimuli.

**TEXTUAL**

**★ Q.31 Why is gas exchange very rapid at alveolar level?**

**Ans:** Alveoli are lined by layer of simple squamous epithelium which allows rapid exchange of gases in alveolar region.

**Q.32 Explain carbon monoxide poisoning.**

**Ans:**

- i. Affinity of haemoglobin for carbon monoxide is about 250 times more, than for oxygen.
- ii. In the presence of carbon monoxide, haemoglobin readily combines to form a stable compound carboxyhaemoglobin.
- iii. The haemoglobin is blocked by carbon monoxide, preventing oxygen from binding with haemoglobin.
- iv. Thus, less haemoglobin is available for oxygen transport depriving the cells of oxygen.
- v. This is carbon monoxide poisoning.

**Q.33 Use your brain power.**

**While working with the car engine in a closed garage, John suddenly left dizzy and fainted. What is the possible reason?**

**Ans:**

- i. John could have left dizzy due to excessive carbon monoxide present in the surrounding.
- ii. In a agarage, carbon monoxide gas is released from the car engine and is found in exhaust fumes from automobiles.
- iii. The elevated levels of this gas could also cause carbon monoxide poisoning.

**TEXTUAL**

**Q.34 Smita was working in a garage with the doors closed and automobiles engine running. After some time she felt breathless and fainted. What would be the reason? How can she be treated?**

**Ans:**

- i. Smita left breathless and fainted due to presence of excessive carbon monoxide in the surrounding.
- ii. Carbon monoxide can even be fatal and thus we can treat it by administering pure oxygen.

**Q.35 Write a note on different lung volumes.**

**Ans:**

i. **Lung Volumes :**

**Tidal volume (T.V.) :** It is the volume of air inspired or expired during normal breathing. It is 500 ml.

ii. **Inspiratory reserve volume (IRV) :** The maximum volume of air, or the extra volume of air, that is inspired during forced breathing in addition to T.V. Its value is 2000 to 3000ml.

iii. **Expiratory reserve volume (ERV) :** The maximum volume of air that is expired during forced breathing after normal expiration. Its value is 1000 to 1100ml.

iv. **Dead space (DS) :** The volume of air that is present in the respiratory tract (from nose to the terminal bronchioles), but not involved in gaseous exchange. It is 150 ml.

v. **Residual volume (RV) :** The volume of air that remains in the lungs and the dead space even after maximum expiration. It is 1100 to 1200ml.

**Q.36 Write a note on lung capacities.**

**Ans:**

i. **Total Lung capacity :** The maximum amount of air that the lungs can hold after a maximum forcefull inspiration (5200 to 5800ml).

ii. **Vital capacity (VC) :** The maximum amount of air that can be breathed out after a maximum inspiration. It is the some total of TV, IRV and ERV and is 4100 to 4600ml.

#### 8.4 Regulation of breathing.

**Q.37 Explain the process of regulation of respiration in detail.**

**Ans:**

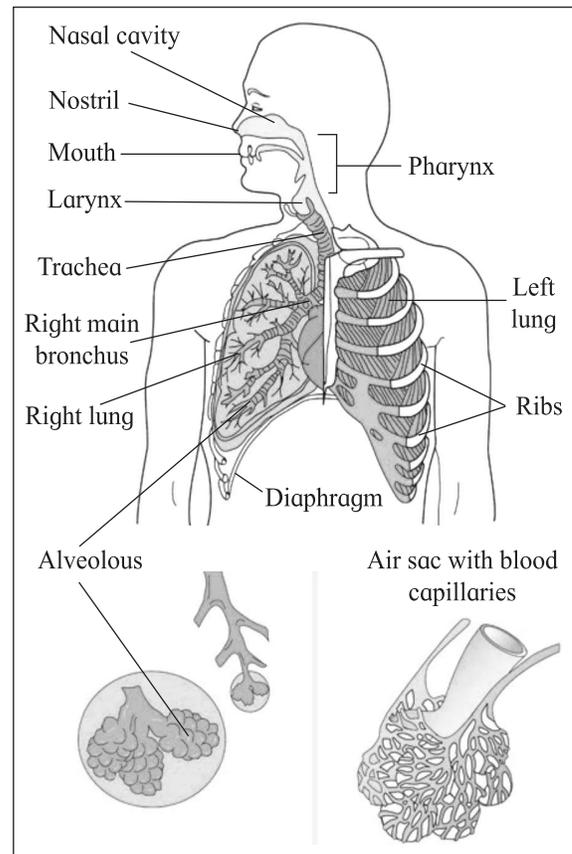
i. **Respiration is under dual control :** nervous and chemical.

ii. Human adults breathe about 12 times/minute while a new born about 44 times/ minute. Normal breathing is an involuntary process.

iii. Steady rate of respiration is controlled by neurons located in the **pons** and **medulla** and are known as the **respiratory centres**. It regulates the rate and depth of breathing.

iv. It is divided into three groups : dorsal group of neurons in the medulla (inspiratory center) ventro lateral group of neurons in medulla (inspiratory and expiratory center) and pneumotaxic center located in pons (primarily limits inspiration, slow wave sleep and rapid eye movement sleep).

v. Apneustic center in the medulla is antagonistic to the neumotaxic center. It controls non rapid eye movement sleep and wakefulness.



vi. During inspiration when the lungs expand to a critical point, the stretch receptors are stimulated and impulses are sent along the vagus nerves to the expiratory centre. It then sends out inhibitory impulses to the inspiratory center.

vii. The inspiratory muscles relax and expiration follows. As air leaves the lungs during expiration, the lungs are deflated and the

stretch receptors are no longer stimulated. Thus, the inspiratory centre is no longer inhibited and a new respiration begins. These events are called the **Hering-Breuer reflex**.

- viii. The **Hering-Breuer reflex** controls the depth and rhythm of respiration. It also prevents the lungs from inflating to the point of bursting.
- ix. The respiratory centre has connections with the cerebral cortex which means we can voluntarily change our pattern of breathing.
- x. Voluntary control is protective because it enables us to prevent water or irritating gases from entering the lungs. But the ability to stop breathing is also limited by the build up of carbon dioxide in the blood.

**Q.38 State the normal breathing rate in adults and new born?**

**Ans:** Human adults breathe about 12 times/minute while a new born about 44 times/ minute. Normal breathing is an involuntary process.

**8.5 Modified Respiratory Movements.**

**Q.39 What are modified respiratory movements?**

**Ans:**

- i. Some respiratory movements are different from the normal movements and help express emotion or clear the air passage.
- ii. Of these movements some may be reflexes, but others can be initiated voluntarily e.g. coughing and yawning.

**Q.40 Given below are the characteristics of some modified respiratory movement. Identify them.**

- i. **Spasmodic contraction of muscles of expiration and forceful expulsion of air through nose and mouth.**
- ii. **An inspiration followed by many short convulsive expiration accompanied by facial expression.**

**Ans:**

- i. Sneezing:
- ii. Crying

**Q.41 Internet my friend**

**i. Find out information about the various modified respiratory movements and write it in a tabular form.**

| Movement   | Type of movement | Description   |
|------------|------------------|---|
| Coughing   | Reflex           | The stimulus for this act may be a foreign body lodged in the larynx, trachea, or epiglottis.   |
| Hiccupping | Reflex           | Spasmodic contraction of the diaphragm followed by a spasmodic closure of the rima glottidis, which produces a sharp sound on inhalation. |
| Yawning    | Reflex           | The mouth is opened wide air is inhaled producing depression of mandible.   |

**Ans:**

**ii. What is the significance of such movements?**

**Ans:** Expression of emotious and also indication. of mental state is allowed by modified respiratory movements.

**8.6 Common Disorders of Respiratory System.**  
**Inext**

**Q.42**

**i. Write a breif note on common disorders of respiratory system.**

**Ans:** Following are the common discorders of respiratory system.

**1. Emphysema**

- a. Symptoms are Breakdown of alveoli, shortness of breath.
- b. It can be caused due to smoking, air pollution.
- c. Treatment includes quit smoking, avoid polluted air, administer oxygen to relieve

- symptoms
2. **Chronic bronchitis**
    - a. Symptoms are coughing, shortness of breath
    - b. It can be caused due to smoking, air pollution
    - c. Treatment includes quit smoking, avoid polluted air, if possible move to warmer, drier climate
  3. **Acute bronchitis**
    - a. Symptoms are inflammation of bronchi, shortness of breath, yellow mucous coughed up.
    - b. It can be caused due to viruses and bacteria
    - c. Treatment includes if bacterial, take antibiotics, cough medicine, use vaporizer
  4. **Sinusitis**
    - a. Symptoms are inflammation of the sinuses, mucous discharge
    - b. It can be caused due to viruses and bacteria
    - c. Treatment includes if bacterial, take antibiotics and decongestants, use vaporizer
  5. **Laryngitis**
    - a. Symptoms are inflammation of larynx, vocal cords, sore throat, hoarseness of voice, mucous build up and cough
    - b. It can be caused due to viruses and bacteria
    - c. Treatment includes if bacterial, take antibiotics, cough medicines, voice rest, avoid irritants like smoke
  6. **Pneumonia**
    - a. Symptoms are inflammation of lungs ranging from mild to severe, cough and fever, shortness of breath, chills, sweating, chest pain, blood in mucous
    - b. It can be caused due to bacteria, viruses
    - c. Treatment includes consult physician immediately, antibiotics, cough medicines, stay warm
  7. **Asthma**
    - a. Symptoms are constriction of bronchioles, mucus build up in bronchioles, periodic wheezing, difficulty in breathing.
    - b. It can be caused due to allergy to pollen, some foods, food additives, pet hair, etc.

- c. Treatment includes use of inhalants to open passage ways, avoid irritants
8. **Occupation Respirator Disorders silicosis, asbestosis**
  - a. Symptoms are inflammation fibrosis, lung damage.
  - b. It can be caused due to long term exposure to dust particles silica and asbestos, particles during occupation
  - c. Protective mask and gear during work.
- ii. **Shreyas went to a garden on a wintry morning. When he came back, he found it difficult to breath and started wheezing. What could be the possible condition and how can be treated?**

**Ans:** a. The symptoms - difficulty in breathing, wheezing indicate that Shreyas could be suffering from asthma.  
b. Inhalers which open air passage ways are used to treat asthma.

- iii. **Why is it difficult to hold one's breathe beyond a limit?**

**Ans:** a. After breathing in air, one can hold breath as plenty of oxygen is available. Over the time, body runs out of oxygen and the level of CO<sub>2</sub> rises.  
b. When the level of carbon dioxide becomes too high, painful contractions begin in the ribs and in the diaphragm. The pain is a signal that the person needs to exhale. The body and brain start to suffer from a lack of oxygen. Therefore, it is difficult to hold one's breathe beyond a limit.

- Q.43 Explain artificial ventilation.**

**Ans:**

- i. **Artificial ventilation :** It is also called artificial respiration.
- ii. It is the method of inducing breathing in a person when natural respiration has ceased or is faltering.
- iii. If used properly and quickly, it can prevent death due to drowning, choking, suffocation, electric shock, etc.
- iv. The process involves two main steps: establishing and maintaining an open air

passage from the upper respiratory tract to the lungs and force inspiration and expiration as in mouth to mouth respiration or by mechanical means like ventilator.

**Q.44 Write a note on ventilator and its functions.**

- Ans:**
- i. A ventilator is a machine that supports breathing and is used during surgery, treatment for serious lung diseases or other conditions when normal breathing fails.
  - ii. It is mainly used in hospitals as part of life support system. Ventilators do the following,
    - a. Get oxygen into the lungs.
    - b. Remove carbon dioxide from the lungs.
    - c. Help the patient breathe.

**8.7 Transportation in Living Organisms**

**Q.45 Explain the transportation in living organisms in detail.**

**Ans:**

- i. All living organisms, whether unicellular or multicellular show an important property of exchange of material with their surrounding as well as between various parts of the their cell or body.
- ii. Organisms take up oxygen and nutrients from the surrounding, these are circulated within the body for various metabolic activities. The wastes generated within are given out into the surrounding.
- iii. Transportation in organisms and animals occurs by **diffusion** and by **active transport** between the cells.
- iv. This mechanism is suitable where the surface area of body is large and the distance between parts of the body in the organism is extremely small.
- v. **Cyclosis** is the streaming movement of the cytoplasm shown by almost all living organisms e.g. Paramecium, Amoeba, root hair cells of many plants and WBCs in animals.
- vi. It is for transportation within the cell or **intracellular transport**.

- vii. In sponges and coelenterates the surrounding water is circulated through the body cavities.
- viii. In flat worms there is parenchymal circulation.
- ix. In round worms there are no blood vessels and the body fluid is moved around the viscera by contraction of body wall and muscles. This is **extracellular transport**.

**#Q.46**

- i. Observe and discuss. Observe the diagram and discuss the process with your friends.**

**Ans:**

- i. The given diagram demonstrates that the respiratory, digestive, circulatory systems work together.
- ii. The respiratory system is responsible for taking in and circulating oxygen into our bloodstream making them available for body. Circulatory system is also responsible for picking up carbon dioxide and helps us exhale these wastes.
- iii. Digestive system breaks carbohydrates into simple sugars like glucose. The bloodstream absorbs glucose, which our circulatory system distributes throughout the body.
- iv. The interstitial fluid provides nutrients and oxygen to the cells and collects waste products discharged from cells after metabolism.
- v. The urinary and circulatory systems work together mainly in the unit of the kidneys. The kidneys are a part of the urinary system, but they are also able to help regulate the circulatory system by filtering the blood allowing it to become more regulated. The kidneys reabsorb nutrients such as glucose and electrolytes, while allowing waste products such as salts, some amino acids, ammonia and by-products of bile to be excreted from the body as urine.
- vi. The large intestine of the digestive system absorbs water from the remaining indigestible food matter and transmits the useless waste material from the body.
- vii. The lungs, part of the respiratory system expel

carbon dioxide from the body as waste by-product of respiration.

**ii. Internet my friend.**

**Enlist organisms without a proper transport system.**

**Ans:** Sponges, rotifers, cnidarians, ctenophores, ctenophores, platyhelminthes, aschelminthes, etc. are the organisms that lack proper transport system.

**iii. Use your brain power.**

**What is the co-relationship between activeness of organism and complexity of transport system?**

**Ans:**

- i. An organism to remain active requires energy.
- ii. Depending upon the degree of organism's activity, the requirement of energy varies.
- iii. More the activeness and complexity of an organism more is the requirement of energy. This energy is provided to organisms through respiration.
- iv. In higher organisms, oxygen and other nutrients play significant role in respiration and needs to be transported to various organ systems. If oxygen and nutrients are not sufficiently provided, the activity of an organism would be affected due to lack of energy.
- v. Also, the waste products generated in the body need to be transported to excretory organs to expel them out of the body.
- vi. Also, the waste products accumulate in the body, then they will damage the various organs affecting the individual's overall body activities.  
Hence, for an organism to remain active its transport system must be efficiency working.

**8.8 Circulation in Animals.**

**Q.47 How does circulation occur in higher animals?**

**Ans:**

- i. In higher animals the circulation is carried out by special fluids blood and lymph.

- ii. Higher animals from Annelida to chordata have a special circulating fluid, the blood which is pumped to the tissues by the heart through the blood vessels.

**Q.48 Describe the types of blood vascular system.**

**Ans:** Types of blood vascular system are as follows:

**1. Open circulation:**

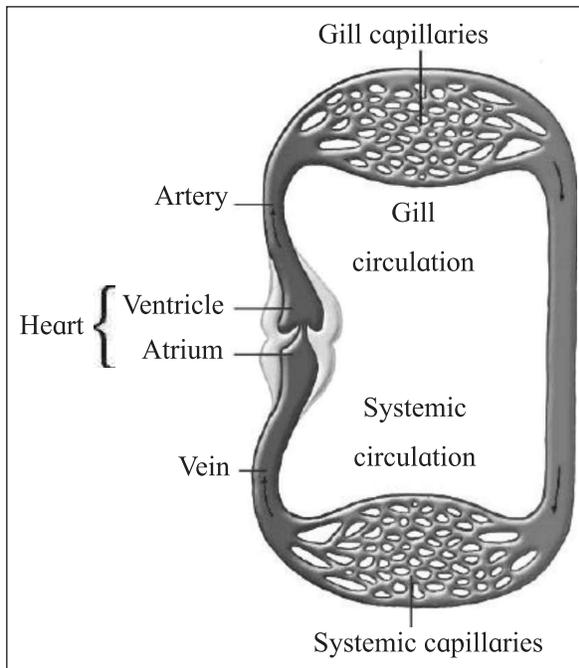
- i. In animals having an open circulation, blood is circulated through the body cavities (haemocoels).
- ii. The visceral organs lie in the blood filled body cavity. Exchange of material takes place directly between blood and cells or tissues of the body. The blood flows with low pressure and usually does not contain any respiratory pigment like haemoglobin, so it does not transport respiratory gases. e.g. Arthropods (cockroach, studied in 11th std.) and Molluscs.

**2. Closed circulation :**

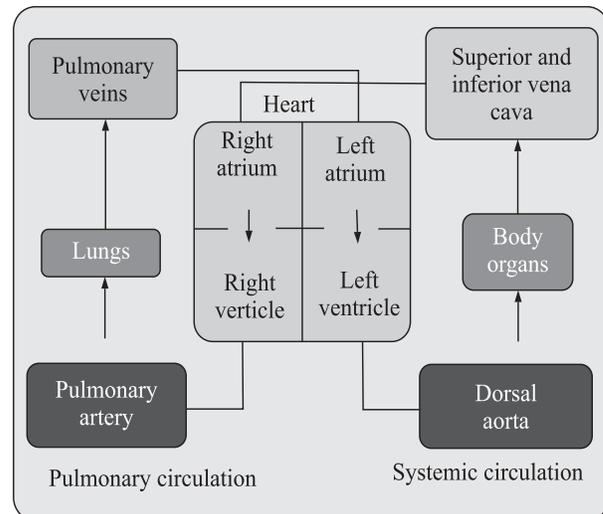
- i. In all the vertebrates, higher molluscs and annelids, blood is circulated all over the body through a network of blood vessels.
- ii. In this type of circulation, blood flows within the blood vessels and does not come in direct contact with cells and body tissues.
- iii. Exchange of material between blood and body tissues is through an intermediate fluid called lymph.
- iv. Blood flows with high pressure and contains respiratory pigments like haemoglobin for transportation of respiratory gases.
- v. The closed circulation can be divided into two main types : single and double circulation.
- vi. **Single circulation :**
  - a. In single circulation, the blood passes through heart only once during each cycle as in fishes.
  - b. Deoxygenated blood is pumped from heart towards gills, where it undergoes oxygenation.
  - c. This oxygenated blood moves towards

various body parts, gets deoxygenated and returns back to heart for next cycle.

d. Since, the heart of fish carries only deoxygenated blood, it also called 'venous heart'.



- vii. **Double circulation :**
- In double circulation, blood passes through heart twice during each cycle; it occurs in birds and mammals.
  - In these animals, heart pumps deoxygenated blood to lungs for oxygenation and it returns to heart as oxygenated blood.
  - This is 'pulmonary circulation'.
  - The oxygenated blood is pumped from the heart towards various body parts (except lungs) and returns back to the heart as deoxygenated blood.
  - This is 'systemic circulation'. Human heart shows double circulation.



**TEXTUAL**

★Q.49 Distinguish between open and closed circulation.

Ans:

| No.  | Open Circulation   | Closed circulation.   |
|------|--|---|
| i.   | Blood is circulated through the body cavities (haemocods), in open circulation.                      | Blood circulates the blood vessels and does not come in direct contact with cells and body tissues in closed circulation. |
| ii.  | The blood flows with low pressure.   | The blood flows with high pressure.   |
| iii. | Exchange of material takes place directly between blood and cells or tissues of the body.            | Exchange of material between blood and body tissues is through intermediate fluid called lymph.                           |
| iv.  | It is devoid of any respiratory pigment like haemoglobin so it does not transport respiratory gases. | It contains respiratory pigments like haemoglobin for transportation of respiratory gases.                                |
|      | e.g. Arthropods and molluses   | e.g. All vertebrates, higher molluscs and annelids.   |

**Q.50** Draw neat labelled diagram of double circulation.

**Ans:** Refer Q.48. 2.vii.

**#Q.51**

**i. Give scientific reason.**  
**Closed circulation is more efficient than open circulation.**

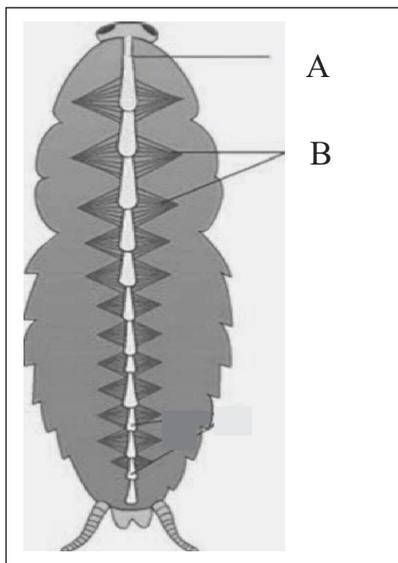
**Ans:**

**i.** In open circulation, blood is not enclosed in blood vessels but pumped directly into the cavity called haemocoel whereas in closed type of circulation, blood flows within the blood vessels and does not come in direct contact with cells and body tissues.

**ii.** Therefore, in closed blood circulation blood flows under high pressure and allows the blood to pass faster and achieve a high level of distribution within the body.

Thus, closed circulation is more efficient than open circulation.

**ii. Observe and discuss.**  
**Observe the diagram and give appropriate labes.**



**A.** Anterior aorta

**B.** Alary muscles

**iii. Can you recall?**

**Which type of circulation is present in cockroach? How is different from that of humans?**

**Ans:**

**i.** In cockroach, open type circulation is present and in humans closed type.

**ii.** The circulatory system in cockroach is different from the circulatory system of humans as the circulatory fluid flows freely through cavities because there are no blood vessels to conduct the circulatory fluid.

**iii.**

**iv. Internet my friend.**

**Which is type of circulation present in amphibians and reptiles?**

**Ans:** Incomplete double circulation is present and in humans closed type.

### 8.9 Circulatory System in Human.

**Q.52** Explain human circulatory system in detail.

**Ans:** Human circulatory system consists of

1. Blood vascular system.
2. Lymphatic System.

**1. Blood vascular system:**

In human beings it consists of blood, heart and blood vessels. It is responsible for various functions like transport, homeostasis and protection.

**i. Blood:**

- a. An average adult has about 4 to 6 liters of blood.
- b. It is a red coloured fluid connective tissue derived from embryonic mesoderm.
- c. It is slightly alkaline (pH 7.4), salty and viscous fluid.
- d. It is heavier than water.
- e. It has two main components the fluid plasma (55%) and the formed elements i.e. blood cells (44%). These can be separated by centrifugation.

**ii. Heart:**

- a. Heart is the main pumping organ of the circulatory system.
- b. It is reddish brown in colour, hollow, muscular organ, roughly the size of one's fist.
- c. Its average weight is about 300gm in males and 250gm in females.
- d. It is conical in shape and lies in mediastinum i.e. the space between two lungs.
- e. It is broader at upper end (base) and conical at lower end (apex). Conical end

is slightly tilted to left side and rests above the diaphragm.

iii. **Blood vessels:**

- a. There are three main types of blood vessels in the human circulatory system viz, arteries, veins and capillaries.
- b. **Arteries :** These blood vessels carry blood from heart to various parts/organs of the body, there they branch into arterioles and further into fine capillaries.
- c. **Veins** are thin walled, mostly superficial vessels which carry blood from the organs towards the heart.
- d. These are a network of minute blood vessels. They are thin walled having a single layer of flat squamous epithelium resting on a single basement membrane. They are mainly involved in exchange of materials.

2. **Lymphatic system:**

- i. Lymphatic system consists of lymph, lymphatic vessels, some organs and tissues.
- ii. The word 'lymph' means 'clear water' and it is a fluid connective tissue with almost similar composition to the blood except RBCs, platelets and some proteins.
- iii. Fluid from intercellular spaces of the body tissue enters into the lymphatic vessels, from here it is discharged into the blood vessels (veins) through the thoracic duct and the right lymphatic duct.

**Q.53 What is haematology?**

**Ans:** Study of blood is called haematology.

**Q.54 Centrifugation is used for what purpose with respect to blood?**

**Ans:** Centrifugation technique is used to separate the components of blood.

**Q.55 Write a note on blood composition and coagulation.**

**Ans:**

- i. Study of blood is called haematology.
- ii. An average adult has about 4 to 6 liters of blood. It is a red coloured fluid connective

tissue derived from embryonic mesoderm.

- iii. It is slightly alkaline (pH 7.4), salty and viscous fluid. It is heavier than water.
- iv. It has two main components the fluid plasma (55%) and the formed elements i.e. blood cells (44%). These can be separated by centrifugation.
- v. **Plasma :** It constitutes 55% of the blood. It is a straw-coloured, slightly alkaline, viscous fluid and consists of 90% water, 7 to 8% Proteins (albumen, globulin, properdin, prothrombin, fibrinogen), 1% Inorganic salts (Na, K, Mg, Ca, Fe, Mn and  $\text{Cl}^-$ ,  $\text{HCO}_3^-$ , and  $\text{PO}_4^{3-}$ ) and 1 to 2% of other components such as Food (glucose, amino acids, fatty acids, triglycerids), wastes (urea, uric acid and creatinine), Regulators (hormones, enzymes, vitamins), Anticoagulants (heparin), Cholesterol and antibodies, Dissolved gases ( $\text{O}_2$ ,  $\text{CO}_2$ ,  $\text{N}_2$ )

**TEXTUAL**

**★ Q.56 Write a note on blood plasma**

**Ans:** **Plasma :** It constitutes 55% of the blood. It is a straw-coloured, slightly alkaline, viscous fluid and consists of 90% water, 7 to 8% Proteins (albumen, globulin, properdin, prothrombin, fibrinogen), 1% Inorganic salts (Na, K, Mg, Ca, Fe, Mn and  $\text{Cl}^-$ ,  $\text{HCO}_3^-$ , and  $\text{PO}_4^{3-}$ ) and 1 to 2% of other components such as Food (glucose, amino acids, fatty acids, triglycerids), wastes (urea, uric acid and creatinine), Regulators (hormones, enzymes, vitamins), Anticoagulants (heparin), Cholesterol and antibodies, Dissolved gases ( $\text{O}_2$ ,  $\text{CO}_2$ ,  $\text{N}_2$ )

**8.10 Red blood corpuscles / Erythrocytes.**

**Q.57 Write a detailed note on Red blood corpuscles / Erythrocytes.**

**Ans:**

- i. Erythrocytes are the most abundant cells in the human body.
- ii. They are circular, biconcave and enucleated (in camel and llama they are nucleated).
- iii. The red colour of RBCs is due to an oxygen

- carrying pigment, the haemoglobin, in their cytoplasm.
- iv. In males, their average number is about 5.1-5.8 million/mm<sup>3</sup> (per  $\mu\text{L}$ ) and in females about 4.3-5.2 million/mm<sup>3</sup>.
  - v. This is called total RBC count. The average life span of RBCs is 120 days.
  - vi. The process of formation of RBCs is called **erythropoiesis**.
  - vii. RBCs are produced from haemocytoblasts/reticulocytes.
  - viii. The erythropoietic organ of the foetus is the liver and spleen and in the adult, it is mainly the red bone marrow.
  - ix. Vitamin B<sub>12</sub>, folic acid and heme protein are required for production of RBCs. The old and worn out RBCs are destroyed in the liver and spleen (graveyard of RBCs).
  - x. Condition with increase in the number of RBCs is called **polycythemia** and with decrease in number of RBCs is called as **erythrocytopenia**.
  - xi. The hormone erythropoietin produced by the kidney cells stimulates the bone marrow for production of RBCs.
  - xii. Mature erythrocyte is devoid of nucleus, mitochondria or other membrane bound cell organelles.
  - xiii. Its cytoplasm (stroma) is rich in haemoglobin and O<sub>2</sub> carrying proteinaceous pigment that gives red colour to the RBCs and blood.
  - xiv. It also contains an enzyme, carbonic anhydrase.
  - xv. Erythrocytes are responsible for the transport of respiratory gases O<sub>2</sub> and CO<sub>2</sub>, maintaining pH and viscosity of blood.
  - xvi. They also contribute in the process of blood clotting. The hematocrit is ratio of the volume of RBCs to total blood volume of blood.
  - xvii. It is different for men and women.

**Q.58 Write a detailed note on content and structure of haemoglobin.**

**Ans:**

- i. Each erythrocyte approximately contains 270

- million molecules of haemoglobin.
- ii. Normal content of haemoglobin in blood of men is about 14 – 17 gm% and in women it is about 13 – 15 gm%.
- iii. Condition with less number of RBCs or less amount of haemoglobin or both is called as anaemia.
- iv. Each molecule of haemoglobin is a protein-iron complex.
- v. It consists of four polypeptide (globin) chains 2 alpha and 2 beta chains.
- vi. An iron – porphyrin (haem) group is attached to each chain and all four chains are bound together.
- vii. Each haem group can carry one O<sub>2</sub> molecule and thus one haemoglobin molecule can carry four O<sub>2</sub> forming oxyhaemoglobin. CO<sub>2</sub> interacts with amino acid residues of globin chains and forms carbaminohaemoglobin.
- viii. After haemolysis, haemoglobin is broken down. Its globin part is broken to recycle the amino acids.
- ix. Iron of heme group is stored as ferritin in the liver and porphyrin group of heme is converted into green pigment biliverdin and then into red-orange coloured bilirubin.
- x. These pigments (mainly bilirubin) are added to bile and finally removed out of body along with faeces.

**Q.59 Internet my friend.**

**i. Compare between myoglobin and haemoglobin.**

**Ans:**

- a. Myoglobin and haemoglobin are heme proteins but the capability of binding oxygen molecules makes them different molecules. Haemoglobin is a tetrameric protein (quaternary structure of four sub-units) whereas myoglobin is monomeric protein.
- b. Haemoglobin is found in RBCs and myoglobin found in muscle tissues.

**ii. In the erythrocytes, nucleus and mitochondria are absent. Explain?**

**Ans:**

- a. Mature erythrocytes have no nucleus so that their internal space is available for oxygen transport.
- b. RBCs lack mitochondria as they respire anaerobically (without oxygen) and do not use up any of the oxygen they transport.

**Q.60 Internert my friend.**

- i. **Find out the percentage and functions of different blood proteins.**

**Ans:**

| Blood proteins | Percentage | Functions  |
|----------------|------------|--|
| Albumins       | 54%        | Transport proteins for several steroid hormones and for fatty acids, it acts as modulator plasma colloid osmotic pressure.               |
| Globulins      | 38%        | Antibodies (immunoglobulins) help attack viruses and bacteria. Alpha and beta globulins transport iron, lipids, and fat-soluble vitamins |
| Fibrinogens    | 7%         | Plays essential role in blood clotting.  |

- ii. **What is the clinical importance of haematocrit value?**

**Ans:**

- a. It is used as a screening test for anaemia.
- b. It is used to evaluate red blood cell count and haemoglobin.
- c. Lower haematocrit values in women of reproductive ages indicate excessive blood loss during menstruation.
- d. A significant drop in haematocrit value

indicates anaemia.

- e. Haematocrit may be 65% or higher which indicates polycythemia.

**iii. Differentiate between plasma and serum.**

**Ans:**

| No. | Plasma  | Serum  |
|-----|---|--|
| a.  | Plasma contains 90% water and 6 - 8% proteins.  | Serum is similar in composition with plasma excluding clotting factors.  |
| b.  | Plasma is the liquid component of blood in which blood cells are suspended.   | Serum does not contain blood cells.  |
| c.  | Plasma contains clotting factors.   | Serum lacks clotting factors.  |
| d.  | Plasma is extracted by spinning a blood sample in a centrifuge, wherein heavier blood cells settle at the bottom, and blood plasma is collected from the upper layer using a pipette. | Serum is isolated by allowing the blood sample to clot. After clotting is complete, the sample is ringed i.e., liquid is extracted using an applicator stick. The liquid is further centrifuged to remove any traces of cells or clot. |

**Q.61 What is anaemia?**

**Ans:** Condition with less number of RBCs or less amount of haemoglobin or both is called as anaemia.

**8.11 White blood corpuscles / Leucocytes.**

**Q.62 Write a note on white blood corpuscles or Leucocyte.**

**Ans:**

- i. Leucocytes are colourless, nucleated and amoeboid cells larger than RBCs.
- ii. Due to their amoeboid movement they can move out of the capillary walls by a process called diapedesis.
- iii. A normal adult has on an average, 5000-11000 WBCs per mm<sup>3</sup> of blood. Decrease in number of WBCs (<4000) is called leucopenia (common in HIV, AIDS and TB patients or

- those exposed to radiations, shock, etc).
- iv. Temporary increase in number of WBCs is called as leucocytosis.
  - v. It is due to infection. It also occurs during pregnancy and in newborn babies.
  - vi. Uncontrolled increase in number of WBCs is a type of blood cancer called **leukemia**.
  - vii. WBCs are mainly concerned with defense mechanism i.e. protection.

**Q.63 Explain the types of WBCs,**

**Ans:** These are colourless, irregular nucleated cells and show polymorphism (exist in variable forms). They can be classified into two main types such as granulocytes and agranulocytes.

**1. Granulocytes :**

- i. These are WBCs with a **granular cytoplasm**, also called **Polymorpho nuclear leucocyte (PMN)** cells.
- ii. They have lobulated nuclei in different shapes.
- iii. Granulocytes are formed from myeloid stem cells and once formed, do not divide.
- iv. Granulocytes constitute about 72% of total WBCs. Granules are actually secretory vesicles which contain various secretions, enzymes, etc.
- v. Depending upon staining property of the granules, these granulocytes are classified into three types as neutrophils, basophils and acidophills.

**vi. Neutrophils :**

- a. Granules are very fine, large in number, evenly distributed and stained with neutral stains (dyes).
- b. Neutrophils are about 70% of total WBCs.
- c. These cells are spherical and nucleus is several lobed (2-7).
- d. These are able to perform amoeboid movements and phagocytosis.
- e. They are responsible for destroying pathogens by the process of **phagocytosis**.
- f. 'Pus' is mixture of dead neutrophils, damaged tissues and dead microbes.

**vii. Basophils / Cyanophils :**

- a. These cells have very few granules of large size, and stain with basic stains like methylene blue.
- b. Basophils are non-phagocytic, small, spherical cells and are about 0.5-1% of total WBCs.
- c. Nucleus is twisted. They are present in infected and allergic conditions only.
- d. Basophils secrete heparin, histamine and serotonin.

**viii. Eosinophils / Acidophills :**

- a. Acidophills contain lysosomal granules that are stained to red colour with acidic stains like eosin.
- b. Eosinophils are about 1 – 3 % of total WBCs. Nucleus is bilobed.
- c. They destroy antigenantibody complex by phagocytosis.
- d. Their number increases in allergic condition and they show antihistaminic property.
- e. They are also responsible for detoxification as they produce antitoxins.

**2. Agranulocytes :**

- i. Agranulocytes are about 28% of total WBCs.
- ii. Cytoplasm of these leucocytes is without granules.
- iii. They are formed from lymphoid stem cells and can divide by mitosis.
- iv. Nuclei of agranulocytes are large in size but are not lobulated like the granulocytes.
- v. There are two types of agranulocytes - Lymphocytes and Monocytes.

**vi. Lymphocytes :**

- a. Lymphocytes are the smallest of all WBCs and have a large spherical nucleus.
- b. They constitute about 25-30% of total WBCs.
- c. Depending upon function, two types of lymphocytes are present as B-lymphocytes and T-lymphocytes.
- d. B-lymphocytes mature in bone marrow and are responsible for antibody

production/humoral immunity.

e. It is a highly specific antigen, antibody immunity T-lymphocytes mature in thymus and are responsible for cell-mediated immunity.

f. Helper T-cells, killer T-cell, memory T-cells and suppressor T-cells are four main subtypes of T-lymphocytes.

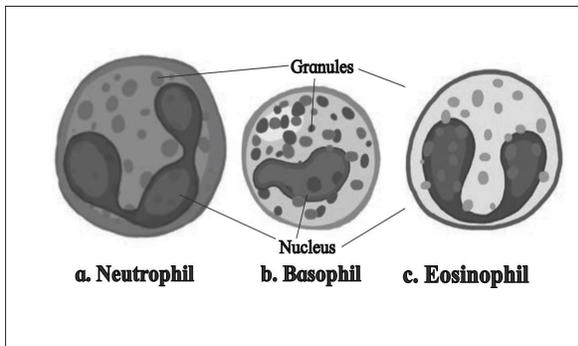
vii. **Monocytes :**

a. Monocytes are the largest of all the WBCs.

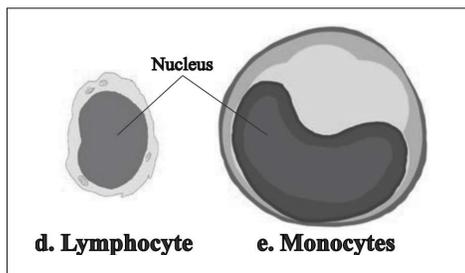
b. Its nucleus is large and bean or kidney shaped.

c. They form 3-5% of WBCs. Monocytes are actively motile and give rise to macrophages.

d. They are mainly phagocytic and destroy the bacteria and dead or damaged tissue by phagocytosis.



a. Neutrophil      b. Basophil      c. Eosinophil



d. Lymphocyte      e. Monocytes

**Q.64 Think about it.**  
**Why and when do the leucocytes perform diapedesis?**

**Ans:** Leucocytes perform diapedesis to fight infection or when a tissue is injured.

**Q.65 What are the granules in granulocytes?**

**Ans:** Granules in the granulocytes are proteins that are responsible for helping the immune system

to fight off infections.

**Q.66 Curiosity.**

**i. How do monocytes perform amoeboid movement and phagocytosis?**

**Ans:** Monocytes kill microorganisms by ingesting them through phagocytosis. In phagocytosis, lobes of the cytoplasm extend outward and surround foreign particles. Monocytes perform amoeboid movement due to the pressure developed in the cell cortex in the middle and posterior parts of the moving cell, actin and myosin like proteins.

**ii. How do monocytes modify into macrophages?**

**Ans:** Monocytes migrate to the infected area. During this migration, the monocytes enlarge and differentiate into wandering macrophages.

**Q.67 Internet my friend.**

**i. What are the reasons for changes in number of neutrophils and the importance of complete blood count (CBC)?**

**Ans:**

a. The neutrophil count rises due to bacterial infection, burn, stress and inflammation and it may fall due to drug toxicity, vitamin B<sub>12</sub> deficiency and systemic lupus erythematosus (SLE).

b. Complete blood count: It screens for anaemia and various infections. It evaluates the number of cells in blood especially WBCs, RBCs and platelets. It also measures the amount of haemoglobin in blood.

**ii. Why and when are heparin, histamine and serotonin secreted? Are these biomolecules secreted by any other cell / organ in our body?**

**Ans:**

a. Basophils release heparin, histamine and serotonin, at the site of inflammation. These substances intensify inflammatory reactions and are involved in hypersensitivity (allergic) reactions.

b. Mast cells also release substance - heparin and histamine involved in inflammation.

**8.12 Thrombocytes / Platelets.**

**Q.68 Write a detailed note on thrombocytes or platelets.**

**Ans:**

i. Thrombocytes are cellular fragments formed from the large cells called megakaryocytes.

- ii. These are produced in bone marrow. They are very small, oval shaped cell fragments without nucleus.
- iii. Normal count of thrombocytes in human blood is about 2.5 – 4.5 lakh / mm<sup>3</sup> of blood.
- iv. If number of thrombocytes decreases than normal, condition is called as **thrombocytopenia**. This condition causes internal bleeding (haemorrhage).
- v. Platelets secrete platelet factors which are essential in blood clotting.
- vi. They also seal the ruptured blood vessels by formation of **platelet plug/ thrombus**.
- vii. They secrete serotonin a local **vasoconstrictor**.

**Q.69 Write a detailed note on thrombocytes or platelets.**

**OR**

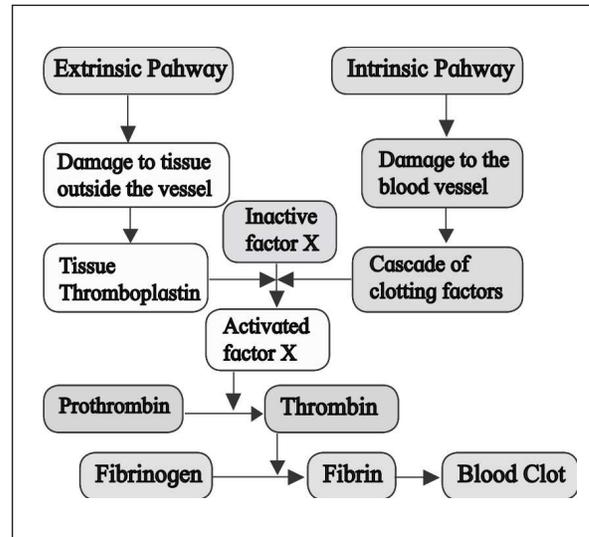
**★ Explain blood clotting factor or cogulation of blood.**

**Ans:**

- i. Clotting or coagulation is the process of converting the liquid blood into a solid form.
- ii. This process may be initiated by contact of blood with any foreign surface (intrinsic process) or with damaged tissue (extrinsic process).
- iii. Intrinsic and extrinsic processes involve interaction of various substances called **clotting factors** by a step wise or cascade mechanism.
- iv. There are in all twelve clotting factors numbered as I to XIII (factor VI is not in active use).
- v. Interaction of these factors in a cascade manner leads to formation of the enzyme thrombin.
- vi. Thromboplastin, helps in the formation of enzyme prothrombinase.
- vii. This enzyme inactivates heparin and it also converts inactive prothrombin into its active thrombin.
- viii. Thrombin converts soluble blood

proteinfibrinogen into insoluble fibrin.

- ix. Fibrin forms a mesh in which platelets and other blood cells are trapped to form the clot.
- x. Blood clotting occurs as shown in the following flowchart.



**★ Q.70 Distinguish between intrinsic pathway and extrinsic pathway.**

**Ans:**

| No.  | Intrinsic pathway  | Extrinsic pathway   |
|------|--|---|
| i.   | It is stimulated by damage to blood vessel.                      | It is stimulated by damage to tissue outside the vessel.                  |
| ii.  | It is more complex and takes more time than extrinsic pathway    | It occurs rapidly as it has fewer steps as compared to intrinsic pathway. |
| iii. | Tissue factor is not involved in activation of intrinsic pathway | Tissue factor also known as thromboplastin activates extrinsic pathway.   |
| iv.  | It involves factor VIII, IX, XI and XII.                         | It involves factors VII, X and V.   |

★ Q.71 Curiosity.

i. **What is blood clotting? How and when does it occur?**

Ans: (Refer Q.69 and Q.72)

ii. **What is immunity? Name its types.**

Ans:

- Immunity is the ability of body to recognize, neutralize / destroy and eliminate foreign substances or resist a particular infection or disease.
- The types of immunity are innate immunity and acquired immunity.
- Acquired immunity is further divided as acquired active immunity and acquired passive immunity.
- Types of acquired active immunity: natural acquired active immunity and artificial acquired active immunity.
- Types of acquired passive immunity: natural acquired passive immunity and artificial acquired passive immunity.

iii. **Why does our immune system fail against pathogens like *Trypanosoma* and *Plasmodium***

Ans:

- Plasmodium* species employ various immune

evasion strategies during different life cycle stages. It has evolved a range of biomolecular strategies in order to escape the immune response and to ensure the survival within the host.

- Plasmodium* requires two hosts- the mosquito vector and the vertebrate host, to complete its life cycle.
- In humans, it undergoes two stages - asymptomatic and a symptomatic. *Plasmodium*, employs several mechanisms like immune evasion, immune exploitation and molecular piracy to promote their survival in the host.
- Majority of the parasites that survived after immunological attack in liver, replicate within hepatocytes. They multiply exponentially forming about hundreds and thousands of merozoites.
- Despite the innate immunity manages to destroy majority of the sporozoites, some of them manage to successfully infect at low numbers. They have evolved to overcome this barrier by various mechanical strategies such as motility and cell transversal. Hence, our immune system fails against pathogens like *Trypanosoma* and *Plasmodium*.

**Q.72 Observe and Discuss.**

**Observe the flow chart and discuss the process with your friends.**

Ans:

- The given flowchart depicts the process of coagulation of blood.
- Extrinsic pathway is stimulated by damage to tissue outside the vessel whereas intrinsic pathway is stimulated by damage to blood vessel.
- Extrinsic pathway occurs rapidly as it has fewer steps as compared to intrinsic pathway.
- It is initiated when thromboplastin (complex mixture of lipoproteins and phospholipids) leaks into blood from damaged cells outside blood vessels. This initiates the formation of prothrombinase.
- Thromboplastin initiates activation of clotting factor X which combines with factor V in the presence of  $Ca_2$  to form the active enzyme prothrombinase. Prothrombin is converted into thrombin by prothrombinase. Thrombin then converts fibrinogen into fibrin, which in combination with blood platelets forms clot

- thereby completing the extrinsic pathway.
- vi. Intrinsic pathway is more complex and takes more time than extrinsic pathway.
  - vii. The activators of this pathway are in direct contact with blood or contained in blood thus, for triggering this pathway outside tissue damage is not required.
  - viii. If endothelial cells become roughened or damaged, blood can come in contact with collagen fibers in the connective tissue around the endothelium of the blood vessels. Also, trauma to endothelial cells causes damage to platelets, resulting in the release of phospholipids by the platelets. Contact with collagen fibers activates clotting factor XII which initiates a sequence of reactions that eventually activates clotting factor X.
  - ix. On activation of factor X it combines with factor V to form the active enzyme prothrombinase (just as occurs in the extrinsic pathway), completing the intrinsic pathway.

★ **Q.73 Describe human blood and give its function.**

**Ans:**

- i. In human beings it consists of blood, heart and blood vessels. It is responsible for various functions like transport, homeostasis and protection.
- ii. **Plasma :** It constitutes 55% of the blood. It is a straw-coloured, slightly alkaline, viscous fluid and consists of 90% water, 7 to 8% Proteins (albumen, globulin, properdin, prothrombin, fibrinogen), 1% Inorganic salts (Na, K, Mg, Ca, Fe, Mn and Cl<sup>-</sup>, HCO<sub>3</sub><sup>-</sup>, and PO<sub>4</sub><sup>3-</sup>) and 1 to 2% of other components such as Food (glucose, amino acids, fatty acids, triglycerids), wastes (urea, uric acid and creatinine), Regulators (hormones, enzymes, vitamins), Anticoagulants (heparin), Cholesterol and antibodies, Dissolved gases (O<sub>2</sub>, CO<sub>2</sub>, N<sub>2</sub>)
- iii. **Red Blood Corpuscles:**
  - a. Erythrocytes are the most abundant cells in the human body.
  - b. They are circular, biconcave and enucleated (in camel and llama they are nucleated).
  - c. The red colour of RBCs is due to an

- oxygen carrying pigment, the haemoglobin, in their cytoplasm.
- d. In males, their average number is about 5.1-5.8 million/mm<sup>3</sup> (per μL) and in females about 4.3-5.2 million/mm<sup>3</sup>.
- e. This is called total RBC count. The average life span of RBCs is 120 days.
- f. The process of formation of RBCs is called **erythropoiesis**.
- g. RBCs are produced from haemocytoblasts/reticulocytes.
- h. The erythropoietic organ of the foetus is the liver and spleen and in the adult, it is mainly the red bone marrow.
- ix. Vitamin B<sub>12</sub>, folic acid and heme protein are required for production of RBCs The old and worn out RBCs are destroyed in the liver and spleen (graveyard of RBCs).
  - i. Condition with increase in the number of RBCs is called **polycythemia** and with decrease in number of RBCs is called as **erythrocytopenia**.
  - j. The hormone erythropoietin produced by the kidney cells stimulates the bone marrow for production of RBCs.
  - k. Mature erythrocyte is devoid of nucleus, mitochondria or other membrane bound cell organelles.
  - l. Its cytoplasm (stroma) is rich in haemoglobin and O<sub>2</sub> carrying proteinaceous pigment that gives red colour to the RBCs and blood.
  - m. It also contains an enzyme, carbonic anhydrase.
  - n. Erythrocytes are responsible for the transport of respiratory gases O<sub>2</sub> and CO<sub>2</sub>, maintaining pH and viscosity of blood.
  - o. They also contribute in the process of blood clotting. The hematocrit is ratio of the volume of RBCs to total blood volume of blood.
  - p. It is different for men and women.
- iv. **White Blood Corpuscles:**
  - a. Leucocytes are colourless, nucleated and

- amoeboid cells larger than RBCs.
- b. Due to their amoeboid movement they can move out of the capillary walls by a process called diapedesis.
  - c. A normal adult has on an average, 5000-11000 WBCs per mm<sup>3</sup> of blood. Decrease in number of WBCs (<4000) is called leucopenia (common in HIV, AIDS and TB patients or those exposed to radiations, shock, etc).
  - d. Temporary increase in number of WBCs is called as leucocytosis.
  - e. It is due to infection. It also occurs during pregnancy and in newborn babies.
  - f. Uncontrolled increase in number of WBCs is a type of blood cancer called **leukemia**.
  - g. WBCs are mainly concerned with defense mechanism i.e. protection.
- v. **Thrombocytes:**
- a. Thrombocytes are cellular fragments formed from the large cells called megakaryocytes.
  - b. These are produced in bone marrow. They are very small, oval shaped cell fragments without nucleus.
  - c. Normal count of thrombocytes in human blood is about 2.5 – 4.5 lakh / mm<sup>3</sup> of blood.
  - d. If number of thrombocytes decreases than normal, condition is called as **thrombocytopenia**. This condition causes internal bleeding (haemorrhage).
  - e. Platelets secrete platelet factors which are essential in blood clotting.
  - f. They also seal the ruptured blood vessels by formation of **platelet plug/ thrombus**.
  - g. They secrete serotonin a local **vasoconstrictor**.

### 8.13 Heart

**Q.74 Give a detailed description of heart and pericardium.**

**Ans:**

- i. Heart is the main pumping organ of the

- circulatory system.
- ii. It is reddish brown in colour, hollow, muscular organ, roughly the size of one's fist.
- iii. Its average weight is about 300gm in males and 250gm in females.
- iv. It is conical in shape and lies in **mediastenum**- i.e. the space between two lungs.
- v. It is broader at upper end (base) and conical at lower end (apex).
- vi. Conical end is slightly tilted to left side and rests above the diaphragm.
- vii. Heart is enclosed in a membranous sac called pericardium.
- viii. Pericardium is formed of two main layers - outer **fibrous** and inner **serous pericardium**.
- ix. Serous pericardium is soft, moist and elastic.
- x. It is formed of squamous epithelium and is further divisible into two layers as **parietal** and **visceral layer**.
- xi. Parietal and visceral layers of serous pericardium are separated by a pericardial space.
- xii. This space is filled with **pericardial fluid** (about 50ml) which acts as a shock absorber and protects the heart from mechanical injuries.
- xiii. It also keeps the heart moist and acts as lubricant.

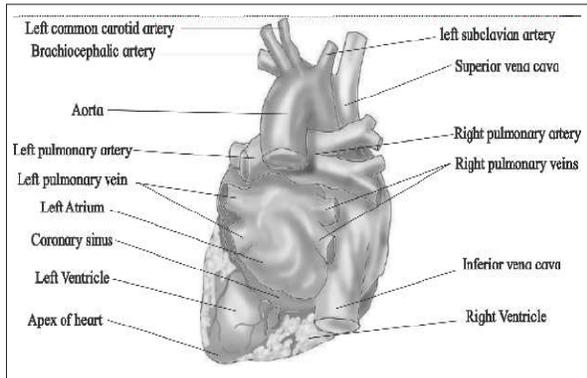
**Q.75 Describe the structure of heart wall.**

**Ans:**

- i. The heart is mesodermal in origin. Its wall is formed of three layers, outer **epicardium**, middle **myocardium** and inner **endocardium**.
- ii. Epicardium is thin and formed of a single layer of flat squamous epithelium resting on basement membrane.
- iii. Myocardium is the middle thick layer formed of cardiac muscles. Endocardium is a single thin layer formed of squamous epithelium.
- iv. The epicardium and endocardium are protective in function whereas myocardium is responsible for contraction and relaxation of heart.

**Q.76 Explain the external structure of human heart.**

**Ans:**



- i. The human heart is four chambered.
- ii. The two superior chambers are called **atria** (auricles) and inferior two are called **ventricles**.
- iii. Externally, the atria are separated from ventricles by a transverse groove called **coronary sulcus** or **atrioventricular groove**.
- iv. The two ventricles are externally separated from each other by two grooves, the anterior and posterior **inter-ventricular sulci**.
- v. Coronary arteries and coronary veins run through these sulci.
- vi. Pulmonary trunk arising from right ventricle and aorta from left ventricle are present on anterior surface of heart.
- vii. The pulmonary trunk bifurcates into right and left pulmonary arteries.
- viii. Aorta (systemic aorta) is divisible into three regions as ascending aorta, systemic arch/aortic arch and descending aorta.
- ix. The **Ligamentum arteriosum** joins pulmonary trunk and aortic arch. It is the remnant of an embryonic duct called **ductus arteriosus**.
- x. The aortic arch gives out three arteries viz. brachiocephalic (innominate) artery, left common carotid and left subclavian.
- xi. The right atrium receives **superior** and **inferior vena cava** along its dorsal surface.
- xii. **Pulmonary veins** open into left atrium along

the dorsal surface of heart.

**★ Q.77 Describe pericardium.**

**Ans:**

- i. Heart is enclosed in a membranous sac called pericardium.
- ii. Pericardium is formed of two main layers - outer **fibrous** and inner **serous pericardium**.
- iii. Serous pericardium is soft, moist and elastic.
- iv. It is formed of squamous epithelium and is further divisible into two layers as **parietal** and **visceral layer**.
- v. Parietal and visceral layers of serous pericardium are separated by a pericardial space.
- vi. This space is filled with **pericardial fluid** (about 50ml) which acts as a shock absorber and protects the heart from mechanical injuries.
- vii. It also keeps the heart moist and acts as lubricant.

**Q.78 Explain internal structure of heart**

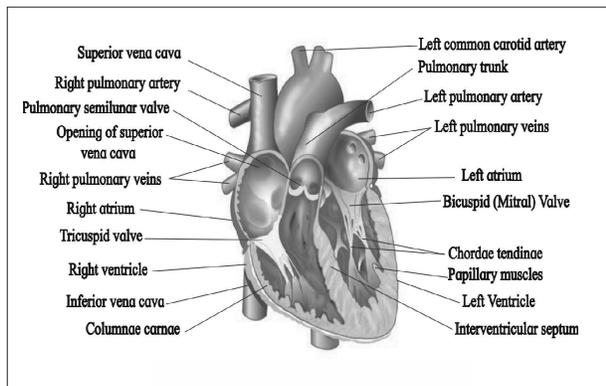
**Ans:**

**1. Atria :**

- i. These are the thin-walled receiving chambers of heart.
- ii. They are separated from each other by inter-auricular septum.
- iii. Interauricular septum has an oval depression called **fossa ovalis**.
- iv. It is a remnant of the embryonic aperture called **foramen ovalis**.
- v. Superior vena cava (precaval), inferior vena cava (postcaval) and coronary sinus open into the right atrium.
- vi. Opening of the postcaval is guarded by a **Eustachian valve** while the **Thebesian valve** guards the opening of coronary sinus into right atrium.
- vii. Four pulmonary veins open into the left atrium. These openings are without valves.
- viii. Both the atria open into the ventricles of their respective sides by atrioventricular apertures.
- ix. These openings are guarded by cuspid valves.

The **tricuspid valve** is present in the right AV aperture and **bicuspid valve** (mitral valve) is present in the left AV aperture.

- x. All these heart valves help in maintaining a unidirectional flow of blood. They also avoid back flow of blood.
- 2. Ventricles :**
- These are inferior, thick-walled pumping chambers of the heart.
  - The right and left ventricles are separated by an interventricular septum.
  - Wall of the left ventricle is more muscular and about 3-times thicker than the right ventricle. Inner surface of the ventricles shows several ridges called **columnae carnae** or **trabeculae carnae** which divide the lumen of ventricle into small pockets or fissures.
  - The lumen of ventricles also shows inelastic fibers called **chordae tendinae**.
  - These attach the bicuspid and tricuspid valves to the ventricular wall (papillary muscles) and regulate their opening and closing.
  - The right ventricle opens into the **pulmonary aorta** and left ventricle opens into the **aorta**.
  - These openings are guarded by three semilunar valves each. These valves prevent the backward flow of blood into the ventricles.



**TEXTUAL**

★Q.79 What is role of papillary muscles and chordae tendinae in human heart?

Ans:

- Papillary muscles present on ventricular wall which are connected to chordae tendinae which are connected to chordae tendinae which in turn is connected to bicuspid and tricuspid valves.
- Opening and closing of valves is regulated by chordae tendinae and papillary muscles.

**Q.80 Give scientific reason.**

**Left ventricle is thick than all other chambers of heart.**

Ans:

- The thickness of the myocardium of the four chambers varies according to functions of each chamber.
- The thin walled atria deliver blood into adjacent respective ventricles.
- As compared to right ventricle, left ventricle pumps blood at great distances to all other parts of the body at higher pressure and resistance to blood flow is larger. Therefore, the left ventricle is thick as it requires strength to withstand the high pressure.

**Q.81 Describe valves of human heart.**

Ans:

Both the atria open into ventricles of their respective sides by atrio-ventricular apertures. The atrioventricular apertures are guarded by cuspid valves.

- Cuspid valves:** These are bicuspid and tricuspid valves. Bicuspid valve also known as mitral valve is present in the left atrio-ventricular aperture. Tricuspid valve is present in the right AV aperture.
- Eustachian valve:** It is present on the opening of post-caval vein (inferior vena cava).
- Thebesian valve:** It guards the opening of coronary sinus into right atrium.
- Semilunar valves:** These three valves guard the opening between right ventricle and pulmonary artery and left ventricle and aorta.

**Q.82 Explain the pumping action of heart.**

Ans:

- The heart acts as the main pumping organ of the circulatory system.

- ii. The pumping action is brought about by a rhythmic contraction and relaxation of the cardiac muscles or heart muscles.
- iii. Contraction of heart muscles is **systole** and relaxation of heart muscles is **diastole**.
- iv. A single systole followed by diastole makes one **heart beat**.
- v. The heart beats 70 to 72 times per minute. This is called **heart rate**.
- vi. During each heart beat ventricles pump about 70 ml of blood this is called **stroke volume**.
- vii. It means heart pumps about  $72 \text{ (heart rate)} \times 70 \text{ ml (stroke volume)} = 5040 \text{ ml}$ . 5 liters of blood per minute this is called cardiac output.

**diagram**

**Q.83 Write a note on conducting tissue of heart.**

**Ans:**

- i. The human heart is **myogenic** i.e. the heart is capable of generating a cardiac contraction independent of nervous input.
- ii. It also shows auto rhythmicity i.e. it can generate its own rhythm by specialized muscles.
- iii. A specialized cardiac musculature called the nodal tissue is distributed in the heart.
- iv. A part of this nodal tissue is present in the upper right corner of the right atrium.
- v. It is called **SA Node** or **Sinoatrial node**.
- vi. It lies at the base of opening of superior vena cava.
- vii. Another mass of nodal tissue, the modified muscular fibers also called autorhythmic fibers (conducting tissue) control the beating rate of heart.
- viii. Conducting (nodal) tissue consists of SA node, AV node, bundle of His and Purkinje fibers.

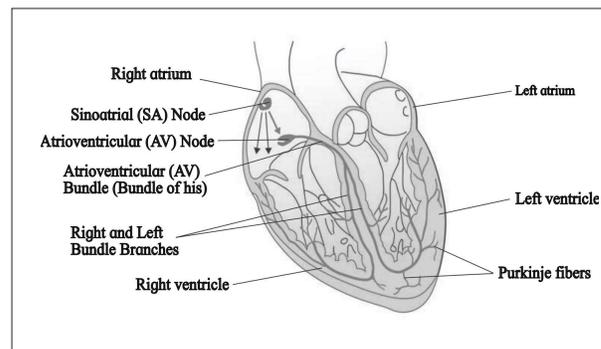
**Q.84 Explain conducting system of the heart**

**Ans:**

- i. SA node (sinu-atrial node) is present in the right atrium.
- ii. It acts as pacemaker of heart because it has the power of generating a new wave of contraction and making the pace of

contraction.

- iii. SA node passes the contraction to the left ventricle and also to the AV node.
- iv. AV node (atrio-ventricular node) is present in the right atrial wall near the base of interatrial septum. It acts as pace setter of heart.
- v. **Bundle of His/ Tawara** branches start from AV node and pass through interventricular septum.
- vi. Bundle of His forms two branches, the right and left bundles, one for each ventricle.
- vii. These branches form network in ventricular walls and these are called Purkinje fibers.
- viii. Bundle of His and Purkinje fibers spread impulses in ventricles. As a result both the ventricles contract simultaneously.



**TEXTUAL**

**★ Q.85 Give scientific reason.**

**Human heart is called as myogenic and autorhythmic.**

**Ans:**

- i. Human heart is capable of generating a cardiac contraction independent of nervous system. It can generate its own rhythm due to presence of nodal tissues.
- ii. The nodal tissue SA node (Sinoatrial node is capable) of generating the wave of contraction and making the pace of contraction. Thus, human heart is myogenic and autorhythmic.

**8.14 Working mechanism of human heart**

**Q.86 Explain the working mechanism of human**

heart.

Ans:

- i. Human heart alternately contracts and relaxes. Contraction is called systole and relaxation is called diastole. Atria and ventricles contract alternately.
- ii. Consecutive systole and diastole constitutes a single heartbeat or cardiac cycle. It is completed in 0.8 sec. On an average, 72 beats are completed in one minute in an adult, at rest.

**1. Atrial systole (AS):**

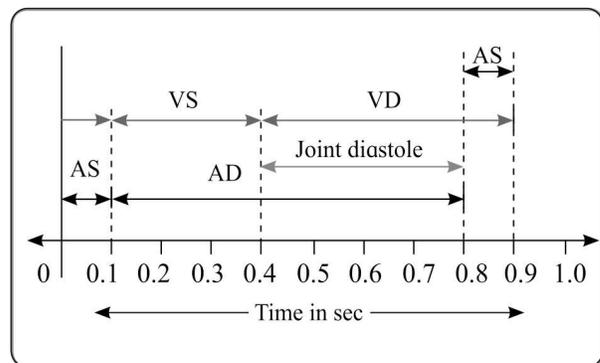
- i. Right atrium receives deoxygenated blood and left atrium receives oxygenated blood.
- ii. When both the atria are completely filled with blood, pressure is exerted on the wall.
- iii. In response to this pressure, SA node gets excited and generates cardiac impulse.
- iv. Due to this, cardiac muscles in the atrial wall contract causing atrial systole.
- v. During atrial systole, blood is pumped into ventricles.
- vi. Blood is prevented from going back to the veins and coronary sinus by Eustachian and Thebesian valve respectively.
- vii. After completing systole the atria go into diastole.
- viii. In normal conditions, atrial systole is for 0.1 sec. and atrial diastole (AD) is for 0.7 sec.

**2. Ventricular systole (VS):**

- i. The impulse which started from SA node now reaches the AV node and it gets excited.
- ii. AV node sends impulses to bundle of His and from bundle of His to Purkinje fibers.
- iii. Purkinje fibers spread impulses all over the wall of ventricles.
- vi. Due to this, ventricular wall contracts causing ventricular systole. During ventricular systole, right ventricle pumps

deoxygenated blood into pulmonary trunk and left ventricle pumps oxygenated blood into aorta.

- v. During ventricular systole the cuspid valves close both the atrioventricular apertures preventing blood flow into atria (lubb sound is heard).
- vi. In normal conditions, ventricular systole lasts for 0.3 sec. and ventricular diastole (VD) lasts for 0.5 sec.
- vii. During ventricular diastole, semilunar valves are closed, preventing backflow of blood from pulmonary trunk and systemic aorta into ventricles (dub sound is heard).
- viii. For about 0.4 second, both atria and ventricles are in diastole. When all the chambers of heart are in diastole, this condition is called **joint diastole** or **complete diastole**. Thus, duration of one cardiac cycle is 0.8 sec.
- ix. Right side of heart contains deoxygenated and left contains oxygenated blood.
- x. Total volume of blood pumped during one ventricular systole is called stroke volume (SV) and it is approximately 70 ml.



**TEXTUAL**

**\*Q.87 If the duration of the atrial systole is 0.1 sec and that of complete diastole is 0.4 sec, then how does one cardiac cycle complete in 0.8 sec?**

Ans:

- i. One cardiac cycle includes atrial systole, ventricular systole and joint/ complete diastole.
- ii. The duration for atrial systole is 0.1 sec, duration for complete diastole is 0.4 sec, which means if one cardiac completes in 0.8 sec then duration for ventricular systole is 0.3 sec.
- iii. Therefore, the duration of one cardiac cycle = Atrial systole + Ventricular systole + Complete diastole  
= 0.1 sec + 0.3 sec + 0.4 sec  
= 0.8 sec
- iv. Also the relaxation period shortens as the heart beats faster whereas the durations of atrial systole and diastole shortens slightly. Hence one cardiac cycle completes in 0.8 sec.

**Q.88 What is cardiac output**

**Ans: Cardiac output (CO):**

It is the volume of blood pumped out per min. For a normal adult human being it is calculated as follows :

$$(CO) = SV \times HR = 70 \times 72 = 5040 \text{ ml/min}$$

**★ Q.89 A man's pulse rate is 68 and cardiac output is 5500 cm<sup>3</sup>. Find the stroke volume.**

**Ans:** Cardiac output = Stroke volume × Heart Rate  
5500 = Stroke volume × 68  
Stroke volume = 5500 / 68  
= 80.880 ≈ 80.88 mL

**Q.90 Explain the process of regulation of cardiac activity.**

**Ans:**

- i. Though human heart is myogenic, it is also under dual control, the nervous as well as hormonal.
- ii. The nervous control includes the part of autonomic nervous system.
- iii. Sympathetic system (with hormone epinephrine as neurotransmitter) increase the rate of heartbeat during emergency. Parasympathetic system (with acetylcholine as neurotransmitter) reduces rate of heartbeat.
- iv. Nervous control includes the part of the autonomous nervous system its cardiovascular center lies in the medulla oblongata.

- v. It controls rate of heart beat in response to inputs from various receptors like proprio-receptors (which monitor the position of limbs and muscles), chemoreceptors (monitoring chemical changes in blood) and baroreceptors (monitoring the stretching of main arteries and veins).
- vi. Chemical control of the heart rate includes the conditions like hypoxia, acidosis, alkalosis causing decreased cardiac activity, hormones like epinephrine and norepinephrine enhance the cardiac activity.
- vii. Besides, concentration of cations like K<sup>+</sup>, Ca<sup>++</sup> and Na<sup>+</sup> have major effect on cardiac activity.
- viii. Cardiac activity decreases with the elevated blood level of K<sup>+</sup> and Na<sup>+</sup>.

**8.15 Blood vessels.**

**Q.91 What are the types of blood vessels.**

**Ans:** There are three main types of blood vessels in the human circulatory system viz, arteries, veins and capillaries.

**Q.92 Write a short note on Arteries.**

**Ans:**

- i. These blood vessels carry blood from heart to various parts/organs of the body, there they branch into arterioles and further into fine capillaries.
- ii. They normally carry oxygenated blood to all parts of the body (except the pulmonary artery which carries deoxygenated blood).
- iii. They are usually situated deep in the body except a few like the radial, brachial, femoral, etc. which are superficially located.

**Q.93 Write a short note on Veins.**

**Ans:**

- i. Veins are thin walled, mostly superficial vessels which carry blood from the organs towards the heart.
- ii. The capillaries around the various organs join to form the veins.
- iii. Except for the pulmonary veins or other veins of the body carry deoxygenated blood towards the heart.

**Q.94 Explain portal vein.**

**Ans:**

- i. A portal vein e.g. hepatic portal vein, differs from the other normal veins in that its starts as capillaries from one organ and capillarises in some intermediate organ e.g. liver, before taking the blood towards the heart.
- ii. Histologically, the veins also show the three layers like in the arteries.
- iii. The tunica externa, tunica media and tunica interna.
- iv. However, the tunica media is comparatively thinner and their lumen is wide and narrow.
- v. Internal valves at regular intervals can be seen.
- vi. Blood flows with flow pressure and the valves prevent backflow of blood.

**Q.95 Use your brain power.**

**Why do the veins have valves?**

**Ans:**

- i. Veins carry blood from the organs towards the heart.
- ii. Blood flows in veins under low pressure. Thus, to prevent the backflow of blood, veins have valves.

**Q.96 Give scientific reasons.**

**Arteries are thicker than veins.**

**Ans:**

- i. Arteries carry oxygenated blood away from the heart to the body.
- ii. The blood pumped out by the heart is under high pressure and to withstand this pressure arteries are thick walled.
- iii. Veins carry deoxygenated blood from the body back to the heart.
- iv. They are thin walled as the blood that flows through veins in under low pressure. Hence, arteries are thicker than veins.

**Q.97 Distainguish between Arteries and Veins.**

**Ans:**

| No.   | Arteries   | Veins   |
|-------|--|---|
| i.    | They carry blood away from the heart to various parts/organs of the body.  | The carry blood towards the heart from various parts/organs of the body.          |
| ii.   | Blood flows under great pressure.  | Blood flows under less pressure.  |
| iii.  | They are thick walled.   | They are thin walled.   |
| iv.   | Arteries branch into arterioles and further into fine capillaries.   | Venules are small vessels that continue from capillaries and merge to form veins. |
| v.    | These are deeply situated except a few like the radial, brachial, femoral, etc. which are superficially located. | Mostly sperficial in location.  |
| vi.   | They carry oxygenated blood, except pulmonary artery.  | They carry deoxygenated blood, from the body back to the heart.                   |
| vii.  | Tunica media is comparatively thicker.   | Tunica media is comparatively thinner.  |
| viii. | They do not have valves  | They have valves to prevent the backflow of the blood.                            |

**Q.98 Write a short note on Capillaries.**

**Ans:**

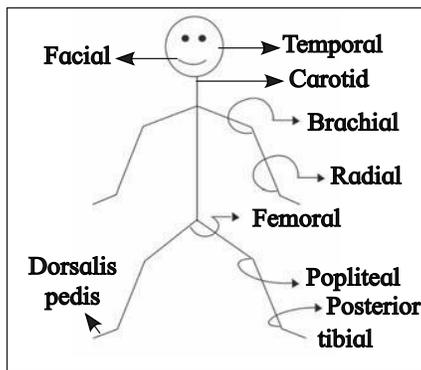
- i. These are a network of minute blood vessels.
- ii. They are thin walled having a single layer of flat squamous epithelium resting on a single basement membrane.
- iii. They are mainly involved in exchange of materials.
- iv. Wall of capillaries is formed of single layer of squamous epithelium and it is stretchable.
- v. Blood flows through the capillaries under high pressure.
- vi. Wall of capillaries bear small endothelial pores or fenestrae through which body cells

(WBCs) can escape by the process called as diapedesis.

**Q.99 Explain the term ‘Pulse’?**

**Ans:**

- i. It is a series of pressure waves that travel through the arteries due to ventricular systole.
- ii. It is the strongest in arteries closer to the heart and gradually becomes weak in arteries away from heart.
- iii. It can be felt easily in the superficial arteries like radial artery in the wrist and carotid artery in the neck.
- iv. The pulse can be felt at particular points on the body.
- v. All locations where the pulse can be felt are shown in figure



**Q.100 Define pulse rate?**

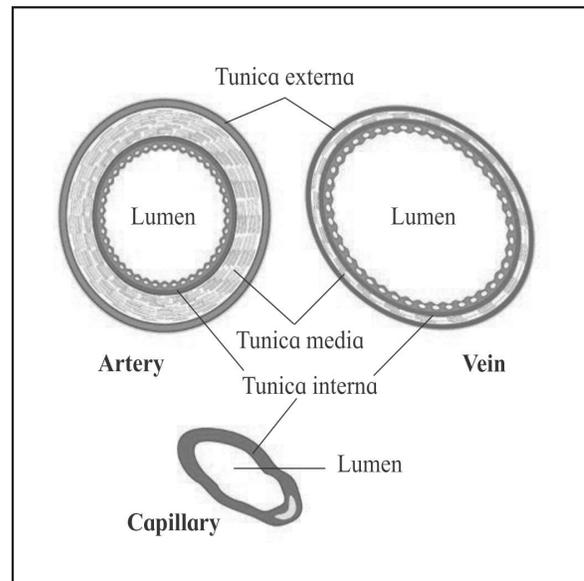
**Ans:** Pulse rate is equal to heart rate. Pulse rate sleep, emotions, exercise, anxiety, etc. higher than normal (above 100 beats/min) is called tachycardia and slower pulse rate (below 60 beats/min) than normal is called bradycardia.

**★Q.101 Describe histological structure of artery, vein and capillary.**

**Ans:**

- i. In a T. S. of artery, its wall shows three layers. Tunica externa or tunica adventitia, Tunica media Tunica interna or intima.
- ii. The outermost tunica externa is a thick, tough layer of collagen fibers.
- iii. The tunica media is made up of smooth muscles and elastic fibres.
- iv. This thick muscular and elastic layer makes the arterial wall pulsatile.

- v. The innermost tunica interna is a single layer of flat compact endothelial cells surrounding the lumen.
- vi. The angular margin around the lumen shows **tesselations**.
- vii. Arterial lumen is devoid of valves and blood flows through it rapidly and with high pressure.



**Q.102 Use your brain power.**

**Why do the veins have valves?**

**Ans:**

- i. Veins carry blood from the organs towards the heart.
- ii. Blood flows in veins under low pressure. Thus, to prevent the backflow of blood, veins have valves.

**Q.103 Give scientific reasons.**

**Arteries are thicker than veins.**

**Ans:**

- i. Arteries carry oxygenated blood away from the heart to the body.
- ii. The blood pumped out by the heart is under high pressure and to withstand this pressure arteries are thick walled.
- iii. Veins carry deoxygenated blood from the body back to the heart.

- iv. They are thin walled as the blood that flows through veins is under low pressure.  
Hence, arteries are thicker than veins.

**Q.104 Distinguish between Arteries and Veins.**

**Ans:**

| No.   | Arteries   | Veins   |
|-------|--|---|
| i.    | They carry blood away from the heart to various parts / organs of the body.                                      | The carry blood towards the heart from various parts/ organs of the body.         |
| ii.   | Blood flows under great pressure.  | Blood flows under less pressure.  |
| iii.  | They are thick walled.   | They are thin walled.   |
| iv.   | Arteries branch into arterioles and further into fine capillaries  | Venules are small vessels that continue from capillaries and merge to form veins. |
| v.    | These are deeply situated except a few like the radial, brachial, femoral, etc. which are superficially located. | Mostly superficial in location.   |
| vi.   | They carry oxygenated blood, except pulmonary artery.  | They carry deoxygenated blood, except pulmonary vein.                             |
| vii.  | Tunica media is comparatively thicker.   | Tunica media is comparatively thinner.  |
| viii. | They do not have valves.   | They have valves to prevent the backflow of the blood.                            |

**Q.105 Why can you feel a pulse when you keep a finger on the wrist or neck but not when you keep them on a vein?**

**Ans:**

- i. Pulse is the series of pressure waves that travel through arteries due to ventricular systole.

- ii. It is strongest in the arteries closer to the heart and gradually becomes weak in arteries away from the heart and will be the weakest till it reaches the vein.
- iii. When we keep a finger on the wrist or neck the superficial arteries like radial artery in the wrist and carotid artery in the neck can be felt but it cannot be felt in the veins.

**Q.106 Which blood vessel of the heart will have the maximum content of oxygen and why?**

**Ans:**

- i. Pulmonary vein carries maximum content of oxygen.
- ii. Pulmonary circulation moves deoxygenated blood from the heart to the lungs for oxygenation and it returns to heart as oxygenated blood. Systemic circulation pushes the oxygenated blood from the heart towards various body parts (except lungs) and returns back to the heart as deoxygenated blood.
- iii. Pulmonary vein is the only blood vessel that carries freshly oxygenated blood from the lungs to the heart for distribution to the body.

**Q.107 How blood is kept moving in the large veins of the legs?**

**Ans:**

- i. The blood in the large veins of legs is kept moving by the means of azygos system (located on either side of the vertebral column and drains the viscera within the mediastinum, as well as the back and thoraco-abdominal walls).
- ii. It serves as a bypass for the inferior vena cava that drains blood from the lower body.
- iii. Several small veins link the azygos system directly with inferior vena cava. Large veins drain the lower limbs and abdomen, conduct blood into the azygos system.
- iv. If the inferior vena cava or hepatic portal vein becomes obstructed, the azygos system returns blood from the lower body to the superior vena cava.

**8.16 Blood Pressure (B.P.)**

**Q.108 Define blood pressure and how it is measured?**

**Ans:**

- i. The pressure exerted by blood on the wall of the blood vessels is called blood pressure.

- ii. It is measured by the sphygmomanometer. It is usually measured from the arteries.

**Q.109 Write a note on arterial blood pressure.**

**Ans:**

- i. Pressure exerted by blood on the wall of artery is arterial blood pressure.
- ii. Pressure on arterial wall during ventricular contraction (systole) is systolic pressure (SP).
- iii. For a normal healthy adult the average value is 120 mmHg.
- iv. Pressure on arterial wall during relaxation of ventricles is diastolic pressure (DP). For a normal healthy adult it is 80 mmHg.  

$$BP = SP / DP$$

$$= 120/80 \text{ mmHg}$$
- v. Blood pressure is normally written as 120/80 mmHg. Difference between systolic and diastolic pressure is called **pulse pressure**. Normally, it is 40 mmHg.
- vi. Deviations from normal blood pressure value indicate malfunctioning of heart.
- vii. It may be due to high or low blood volume, arterial inelasticity or hardening of arteries (arteriosclerosis), deposition of fats like cholesterol in the arteries (atherosclerosis), renal diseases and emotion induced hormonal changes, obesity, etc.
- viii. Blood pressure lower than normal i.e. below 90/60 mmHg is called hypotension and blood pressure higher than normal i.e. above 140/90 mmHg is hypertension.

**★ Q.110 Explain in brief the factors affecting blood pressure.**

**Ans:**

- i. Normal cardiac output is 5 lit/min. Increase in cardiac output increases systolic pressure.
- ii. Peripheral resistance depends upon the diameter of blood vessels.
- iii. Decrease in diameter of arterioles and capillaries under the effect of vasoconstrictors like vasopressin or ADH cause increase in peripheral resistance and thereby increase in blood pressure.
- iv. Blood loss in accidents decreases blood

volume and thus the blood pressure.

- v. Blood pressure is directly proportional to Viscosity of blood.
- vi. Blood pressure increases with age due to increase in inelasticity of blood vessels.
- vii. Amount of blood brought to the heart via the veins per unit time is called the venous return and it is directly proportional to blood pressure.
- viii. Blood pressure is also directly proportional to the total length of the blood vessel.
- ix. Blood pressure can also be affected by vaso constriction or vaso dilation.
- x. Females have slightly lower BP than males her age before menopause.
- xi. However, the risk of high B.P. increases in the females after menopause sets in.

**★ Q.111 What is blood pressure? how is it measured? Explain factors affecting blood pressure.**

**Ans:** Refer Q.108 and Q.110

**Q.112 Think about it.**

**Why do obese persons are prone to hypertension?**

**Ans:**

- i. As a person gains weight, the amount of adipose tissue increases and new blood vessels as compared to a lean person.
- ii. The additional blood vessels in adipose tissue increase the total blood vessel length and blood pressure is directly proportional to total length of blood vessel.
- iii. An increase in total blood vessel length increases the blood pressure thus, obese people are prone to hypertension.

**Q.113 Internet my friend.**

**Surf the internet for video-clips of angiography, angioplasty and by-pass surgery. Gather more information about these medical procedures.**

**Ans:**

**Q.114 Think about it.**

**Why the heart-recipient has to rely upon life-time supply of immunosuppressants?**

OR

**Person who has undergone heart beats at higher rate than normal?**

Ans:

- i. Immunosuppressants are the drugs that reduce the level of immune activity and the risk of rejection of foreign bodies such as transplant organs.
- ii. After transplantation, there is a risk of graft rejection as the body may recognize the transplanted organ / tissue as foreign and may trigger immune response thereby damaging the transplanted organ.  
Therefore, the heart recipient has to rely upon life-time supply of immunosuppressants.

**Q.115 Write a note on use of sphygmomanometer for measuring blood pressure.**

Ans:



- i. Blood pressure is measured with the help of an instrument called **sphygmomanometer**.
- ii. This instrument consists of inflatable rubber bag cuff covered by a cotton cloth.
- iii. It is connected with the help of tubes to a

mercury manometer on one side and a rubber bulb on the other side.

- iv. During measurement, the person is asked to lie in a sleeping position.
- v. The instrument is placed at the level of heart and the cuff is tightly wrapped around upper arm.
- vi. The cuff is inflated till the brachial artery is blocked due to external pressure.
- vii. Then pressure in the cuff is slowly lowered till the first pulsatile sound is heard.
- viii. At this moment, pressure indicated in manometer is systolic pressure.
- ix. Sounds heard during measurement of blood pressure are called as Korotkoff sounds.
- x. Pressure in the cuff is further lowered till any pulsatile sound cannot be heard due to smooth blood flow.
- xi. At this moment, pressure indicated in manometer is diastolic pressure.
- xii. An optimal blood pressure (normal) level reads 120/80 mmHg.

**Q.116 Write a short note on Hypertension.**

Ans:

- i. Persistently raised blood pressure higher than the normal is called hypertension.
- ii. 140/90 mmHg is called as threshold of hypertension and the 180/120 mmHg and higher readings are dangerous to the health.
- iii. It may damage the heart, brain and kidneys.
- iv. Under the condition of hypertension, heart uses more energy for pumping which causes angina pectoris- the chest pains due to lowered blood supply to cardiac muscles and may lead to myocardial infarction.
- v. There are more chances of brain hemorrhage due to hypertension as arteries in brain are less protected by surrounding tissues as compared to other organs.
- vi. In kidney, hypertension may cause kidney failure.

**Q.117 What is CAD?**

Ans:

- i. **Coronary Artery Disease (CAD):** It is also

known as atherosclerosis.

- ii. In this, calcium, fat cholesterol and fibrous tissues gets deposited in blood vessels supplying blood to the heart muscles making the lumen narrow.

**Q.118 Write a short note on angina pectoris.**

**Ans:**

- i. It is the pain in the chest resulting from a reduction in the blood supply to the cardiac muscles because of atherosclerosis or arteriosclerosis.
- ii. It is characterized by severe pain and heaviness in the chest.
- iii. The pain may spread to the neck, lower jaw, left arm and left shoulder.
- iv. The pain usually results from exertion, when there is more demand of oxygen by the heart, but the supply does not meet the requirement.

**Q.119 What is angiography? write a note on remedial procedures for blockages.**

**Ans:**

- i. X-ray imaging of the cardiac blood vessels to locate the position of blockages is called angiography.
- ii. Depending upon the degree of blockage, remedial procedures like angioplasty or by-pass surgery are performed.
- iii. In angioplasty, a stent is inserted at the site of blockage to restore the blood supply.
- iv. In by-pass surgery, the atherosclerotic region is by-passed with part of vein or artery taken from any other suitable part of the body, like hands or legs.

**Q.120 Write a short note on heart transplant.**

**Ans:**

- i. Replacement of severely damaged heart by normal heart from brain-dead or recently dead donor is called heart transplant.
- ii. Heart transplant is necessary in case of patients with end-stage heart failure and severe coronary arterial disease.

**Q.121 What do you mean by a Silent Heart Attack?**

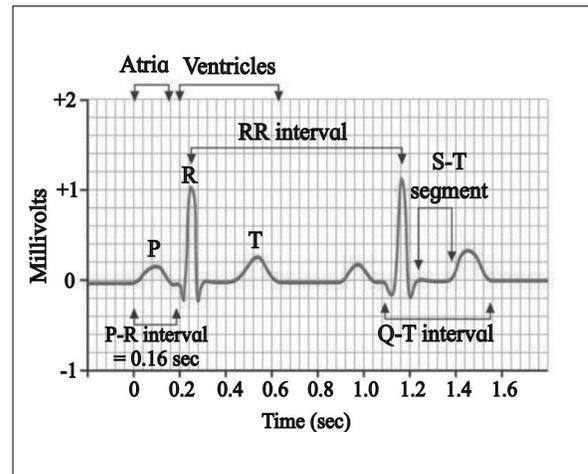
**Ans:**

- i. Silent heart attack, also known as silent myocardial infarction is a type of heart attack that lacks the general symptoms of classic heart attack like extreme chest pain, hypertension, shortness of breath, sweating and dizziness.
- ii. Symptoms of silent heart attack are so mild that a person often confuses it for regular discomfort and thereby ignores it.
- iii. It has been studied that men are more affected by silent heart attack than women.

**8.17 Electrocardiogram**

**Q.122 Explain different segment of a normal ECG.**

**Ans:**



- i. Graphical recording of electrical variations detected at the surface of body during their propagation through the wall of heart is **electrocardiogram (ECG)**.
- ii. This recording may be in the form of printout or onscreen display.
- iii. The instrument used for this recording is the **ECG machine** or **electrocardiograph**.
- iv. This instrument detects and amplifies the signals.
- v. Various electrodes are used for recording of signals.
- vi. Four electrodes are positioned on limbs; two on arms and two on legs.

- vii. These are limb electrodes. Six electrodes are positioned on chest. These are chest electrodes.
- viii. In a normal record, three different waves are recognized as P-wave, QRS complex and T-wave. P-wave is a small upward deflection from baseline of graph. It represents the atrial depolarization.
- ix. The QRS complex starts as a slight downward deflection from baseline, continues as sharp and large upright wave and ends as a downward wave.
- x. QRS complex represents the ventricular depolarization.
- xi. T-wave is small, wide and upwardly elevated wave. It represents the ventricular repolarization.

**Q.123 State the uses of ECG.**

**Ans:**

- i. ECG helps to diagnose the abnormality in conducting pathway, enlargement of heart chambers, damages to cardiac muscles, reduced blood supply to cardiac muscles and causes of chest pain.
- ii. A physician can find out the defect in the heart by examining the wave pattern and the time interval between them.

**Q.124 Curiosity.**

**i. What is depolarization and repolarization?**

**Ans:**

- a. Depolarization is a change within a cell, during which the cell undergoes a shift in electric charge distribution, resulting in less negative charge inside the cell.
- b. Repolarization is the process by which the membrane, cell or fibre after depolarization is polarized again with positive charge on the outer and negative charge on the inner surface.

**ii. What is the correlation between depolarization and repolarization as well as contraction and relaxation of the heart?**

**Ans:**

- a. Depolarization of cardiac myocytes generates

action potential which causes contraction of heart.

- b. Repolarization restores the original electrical conditions of the heart and results in relaxation.

**iii. How are the signals detected and amplified by electrocardiography?**

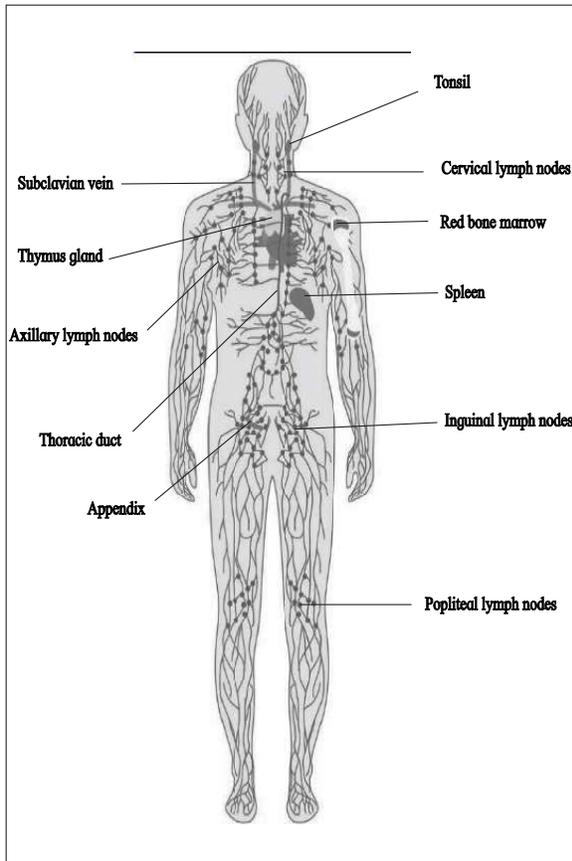
**Ans:** The electrical signals from various points are detected by electrodes and a bio-potential amplifier amplifies these electrical signals.

**8.18 Lymphatic System**

**Q.125 Write a short note on Lymphatic System.**

**Ans:**

- i. Lymphatic system consists of lymph, lymphatic vessels, some organs and tissues.
- ii. The word 'lymph' means 'clear water' and it is a fluid connective tissue with almost similar composition to the blood except RBCs, platelets and some proteins.
- iii. Fluid from intercellular spaces of the body tissue enters into the lymphatic vessels, from here it is discharged into the blood vessels (veins) through the thoracic duct and the right lymphatic duct.



**Q.126 Distinguish between.**

- i. **Blood and Lymph.**
- ii. **Blood capillary and lymph capillary.**

**Ans:**

| No. | Blood  | Lymph  |
|-----|--|--|
| a.  | It is reddish in colour.                           | It is pale yellow in colour.   |
| b.  | It has two main components -                       | It has almost similar composition to the blood except RBCs, platelets and some proteins. |
| c.  | It flows through blood vessels.                    | It flows through lymph vessels.  |
| d.  | It transports materials from one organ to another. | It transports material from tissues cells to blood and vice-versa.                       |

i.

| No | Blood capillary   | Lymph capillary                                      |
|----|---|--|
| a. | Its diameter is smaller than lymph capillary.                         | Its diameter is larger than blood capillary.         |
| b. | It contains blood.  | It contains lymph.                                   |
| c. | It is less permeable than lymph.                                      | It is more permeable than blood capillary.           |
| d. | Blood capillaries provide oxygen and other substances to the tissues. | Lymph capillaries absorb the excess of tissue fluid. |

ii.

**Q.127 Internet my friend.**

**Location of lymph nodes in human body.**

**Ans:** Lymph nodes are located throughout the body. They are found in neck, chin, armpits, mammary glands, groin, etc.

**Q.128 Write a note on tonsillitis.**

**Ans:**

- i. Tonsils are small lymphatic nodules in pharyngeal region.

- ii. Normally there are five tonsils strategically positioned to fight against inhaled and ingested foreign substances.
- iii. Inflammation of tonsils is called as tonsillitis.
- iv. It is caused due to viral or bacterial infection.
- v. Symptoms include sore throat, fever, swollen lymph nodes, nasal congestion, difficulty in swallowing, headache, etc.
- vi. Viral tonsillitis cures naturally but bacterial tonsillitis needs antibiotic treatment.
- vii. Tonsillectomy is performed in some patients who do not respond to the treatment.