

## UNIT I-HUMAN ANATOMY AND PHYSIOLOGY

### IA-- DIGESTION AND ABSORPTION

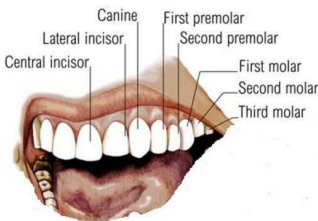
#### Very Short Answer Questions

1. Give the dental formula of adult human being?

A. Dental formula represents the arrangement of various types of teeth in each half of both the jaws of man in the order Incisors, Canines, Premolars and Molars.

In adult man, it is ....  $\frac{2123}{2123} = 32$ .

Dental formula of milk dentition is  $2/2, 1/1, 0/0, 2/2 = 20$



I = Incisors teeth

C = Canines teeth

P = Premolars teeth

M = Molars teeth

For an adult man with 32 teeth, the formula is written as:

I - 2/2 C - 1/1 P - 2/2 M - 3/3

The total number of teeth on **one side** of the mouth is **16**, thus the total number of teeth in the mouth equals  $16 \times 2 = 32$ .

2. Bile juice contains no digestive enzymes, yet it is important for digestion. How?

A. Bile juice secreted by liver doesn't contain enzymes, but it has bile salts like sodium/potassium glycocholates and taurocholates, which help in digestion and absorption of fats. Bile salts emulsify fats.

Bile activates the lipases of pancreatic and intestinal juice. They act on emulsified fats and convert them into fatty acids and glycerol.

3. Describe the role of chymotrypsin. Name two other digestive enzymes of the same category secreted by the same gland?

A. Chymotrypsin of pancreatic juice helps in the digestion of proteins, proteoses and peptones and converts them into Tripeptides and dipeptides.

Trypsin and carboxy peptidases are the other digestive enzymes produced by the pancreas.

4. What would happen if HCl were not secreted in the stomach?

A. HCl is secreted by oxyntic cells of fundic glands present in the wall of stomach.

It provides acidic pH which is optimal for the action of pepsin.

HCl activates the pro enzyme **pepsinogen** into **pepsin**.

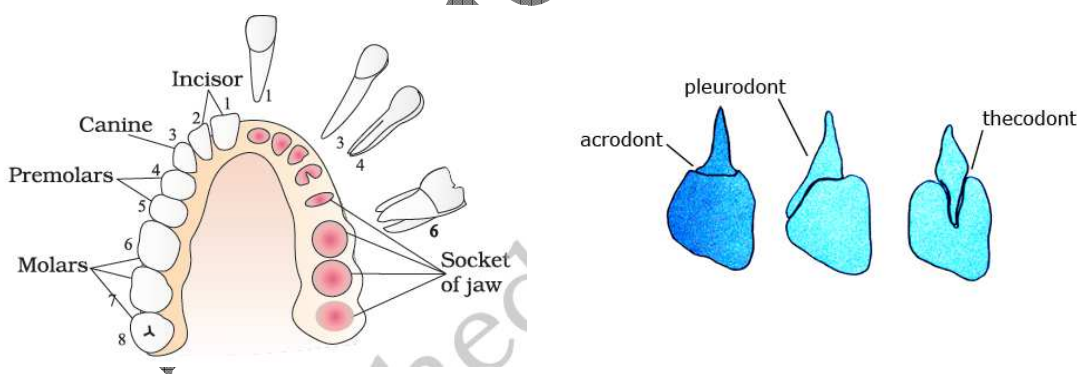
Pepsin plays an important role in digestion of proteins.

If HCl were not secreted in the stomach, then pepsin would not be activated. It would effect on digestion of proteins.

5. Explain the terms thecodont and diphyodont dentitions?

A. **Thecodont:** Arrangement of teeth in the sockets of the jaw bones is called thecodont dentition.

**Diphyodont:** formation of two sets of teeth during the life time, a set of temporary/milk teeth/deciduous teeth replaced by a set of permanent teeth is known as diphyodont dentition.



6. What is autocatalysis? Give two examples?

A. Autocatalysis is the catalysis of a reaction in which the catalyst is one of the products of the reaction (or) catalysis caused by a catalytic agent formed during a chemical reaction.

E.g.: **Trypsinogen**  $\xrightarrow{\text{Trypsin}}$  **Trypsin (Autocatalysis)**

**7. What is chyme?**

A. Semi fluid mass of partly digested acidic food formed in the stomach is called chyme.

**8. Name the different types of salivary glands of man and their locations in the human body?**

A. Three pairs of salivary glands are present in man. They are....

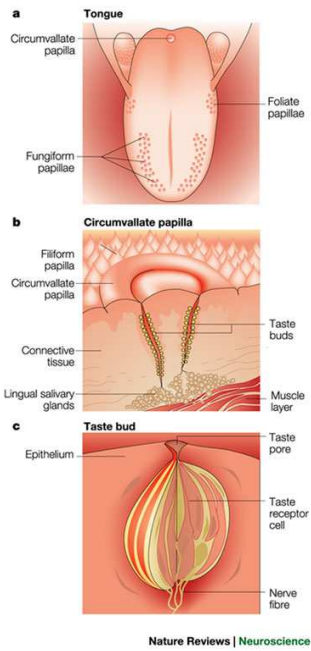
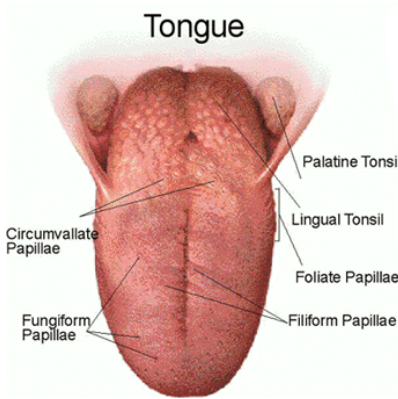
1. **Parotid Glands** – present below the pinna / inner surface of the cheeks
2. **Sub maxillary (or) Sub mandibular glands** – located at the angles of lower jaw
3. **Sublingual glands** – present below the tongue



**9. Name different types of papillae present on the tongue of man?**

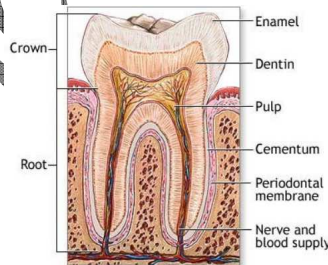
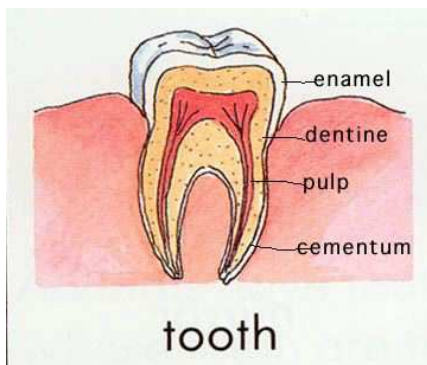
A. The upper surface of the tongue has small projections called papillae, representative of taste buds. In humans, the tongue bears 3 (three) types of papillae namely:

- i) Fungi form papillae – present on tip and margins of tongue.
- ii) Filiform papillae -- present on surface of tongue.
- iii) Circumvallate papillae – present on posterior part / base of tongue.



10. What is the hardest substance in the human body? What is its origin?

- A. Enamel of tooth is the hardest substance in the human body. It covers the crown of tooth. Enamel is secreted by ameloblasts of ectodermal origin.



11. Name the structure of gut which is vestigial in human beings, but well developed in herbivores. And mention the type of tissue with which it is mostly formed?

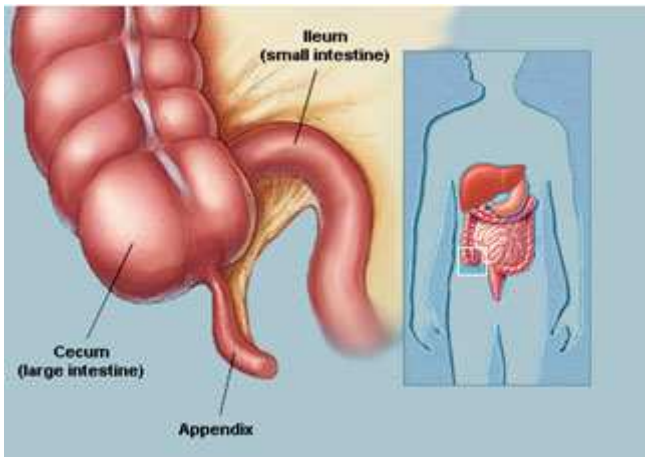
- A. **Appendix** is the vestigial part in human beings.

It is a narrow finger like tubular projection, arises from the **caecum**.

In herbivores it is a functional part and useful in the digestion of cellulose.

Appendix contains a high concentration of lymphoid tissues.

Appendix is known as **abdominal tonsil**.



**12. Distinguish between deglutition and mastication?**

A. **Deglutition:** Deglutition is the swallowing of food.

**Mastication:** The mastication process includes the biting and tearing of food into pieces.

It is involved by using the incisors and canines.

The grinding of food is usually performed by the molars and premolars.

During this process, food is moistened and mixed with saliva.

**13. Distinguish between diarrhea and constipation?**

A. **Diarrhea:** The abnormal frequency of bowel movement and increased liquidity of the faecal discharge. It reduces the absorption of food and results in loss of water (dehydration).

**Constipation:** The condition in which the faeces are retained within the rectum as it is hard due to low content of water and the movement of bowel occurs irregularly.

**14. Name two hormones secreted by the duodenal mucosa?**

A. The hormones secreted by epithelium of duodenal mucosa are **secretin** and **cholecystokinin** (cck)/cholecystokinin pancreozymin.

**15. Distinguish between absorption and assimilation?**

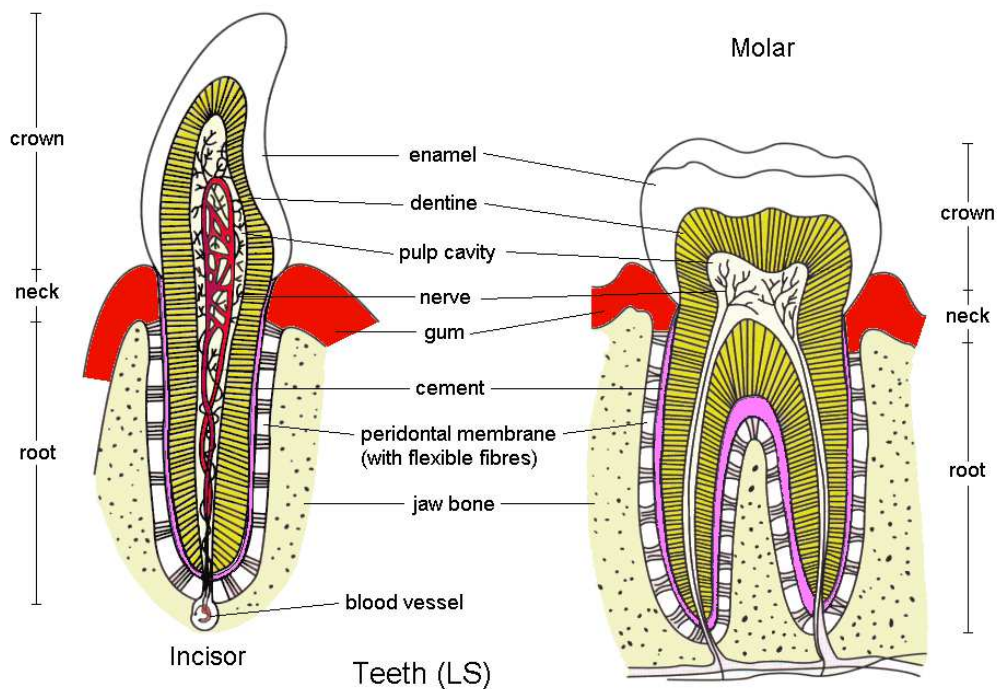
A. **Absorption:** Absorption is the process by which the end products of digestion pass through the intestinal mucosa into blood (or) lymph. It is carried out by passive, active (or) facilitated transport mechanisms.



**Assimilation:** The absorbed substances finally reach the tissues, where food materials become integral components of the living protoplasm and used for the production of energy, growth and repair. This process is called assimilation.

### Short Answer Questions

1. Draw a neat labelled diagram of L.S. of teeth?



2. Describe the process of digestion of proteins in the stomach?

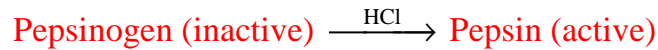
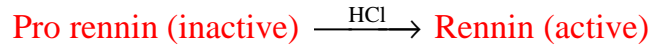
A. Digestion of proteins begins in the stomach. The food enters into the stomach is mixed thoroughly with the gastric juice of the stomach by the churning movements of its muscular wall and the product is called chyme.

The main components of gastric juice are protein digestive enzymes, hydrochloric acid and mucus.

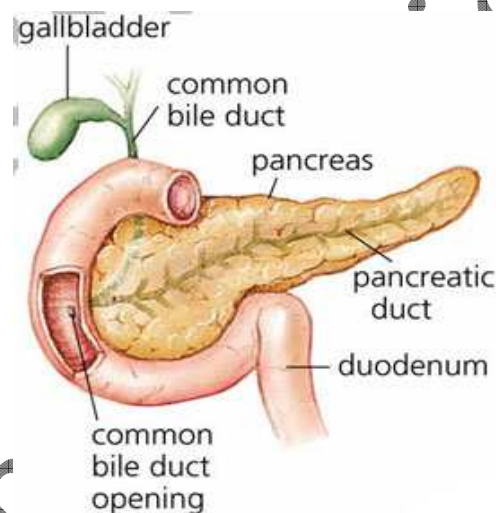
HCl provides the acidic pH (0.9 to 1.8) which is optimal for the action of pepsin. The pro-enzymes of gastric juice, the pepsinogen and pro-rennin are converted into the active enzymes, **pepsin and rennin** respectively by the action of Hydrochloric acid.

Pepsin converts proteins into proteoses and peptones.

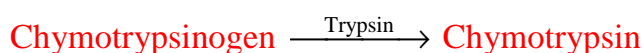
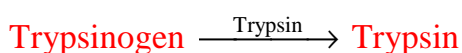
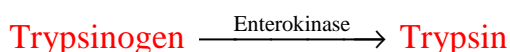
Rennin is a proteolytic enzyme found in the gastric juice of infants. It acts on the milk protein, the casein in the presence of calcium ions and converts it into calcium paracaseinate and proteoses. Pepsin acts on calcium paracaseinate and converts it into peptones. The entire process of protein digestion in the stomach takes about 4 hours.



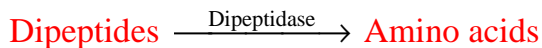
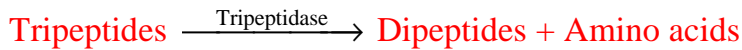
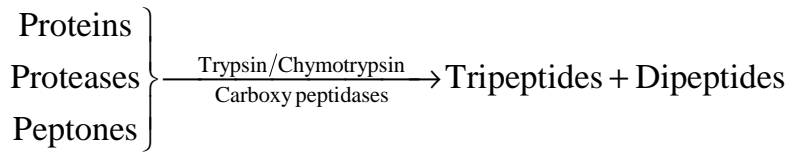
3. Explain the role of pancreatic juice in the digestion of proteins?



A. Pancreatic juice is secreted by the pancreas and it plays an important role in protein digestion. Pancreatic juice contains protein hydrolyzing enzymes like trypsinogen, chymotrypsinogen and pro carboxy peptidase but in inactive form. Enzyme activator, enterokinase of intestinal juice activates Trypsinogen active **trypsin**, which in turn activates the other enzymes in the pancreatic juice.



Chymotrypsin, trypsin and carboxy peptidase of pancreatic juice act upon proteins, proteoses and peptones in the chyme, results in the formation of tri and dipeptides which in turn hydrolyzed into amino acids by the action of tri and dipeptidases.



#### 4. How are polysaccharides and disaccharides digested?

A. Carbohydrates of food principally consist of polysaccharides, Starch and glycogen. It contains disaccharides and small amounts of monosaccharide.

**Digestion in Mouth:** Digestion of carbohydrates starts in the mouth, where they come in contact with saliva. Saliva contains carbohydrase called salivary amylase (ptyalin). It hydrolyses the starch into disaccharides (maltose).

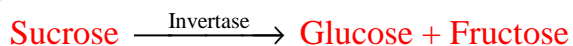
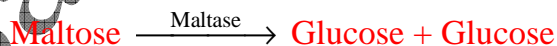
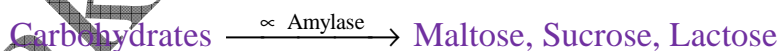


**Digestion in Stomach:** Ptyalin action stops in stomach when pH falls to 3.0. No carbohydrate splitting enzymes are available in gastric juice.

**Digestion in small intestine:** Chyme reaches the duodenum where it is mixes with pancreatic juice and intestinal juice.

Carbohydrates in the chyme are hydrolysed by the pancreatic amylase into disaccharides.

Intestinal disaccharidases act on the disaccharides and convert them into monosaccharide.





5. **If you take butter in your food how does it get digested and absorbed in the body? Explain?**

A. Butter contains fat. Fats are partially digested in stomach.

**Digestion of fat in the small intestine:** The major site of fat digestion is the small intestine. It is due to the presence of lipase / (steapsin) in the pancreatic juice and bile juice. Bile juice contains bile salts such as Sodium / Potassium glycocholates and taurocholates which helps in the emulsification of fat i.e., breakdown of fats into very small micelles. Bile also activates lipases of pancreatic juice (steapsin) and intestinal lipases. These lipases act on emulsified fats and convert them into fatty acids and glycerols.

Fats  $\xrightarrow{\text{Bile salts}}$  Emulsified fats

Emulsified fats  $\xrightarrow{\text{Lipases}}$  Monoglycerides

Monoglycerides  $\xrightarrow{\text{Lipases}}$  Fatty acids + Glycerol

**Absorption:** Fatty acid and glycerol being insoluble in water cannot be absorbed into the blood directly. They are first modified into small droplets called **micelles**, which move into intestinal mucosal cells. They are reformed into very small protein coated fat globules called **Chylomicrons** which are transported into the lymph capillaries in the villi by exocytosis. They are released into blood stream through left subclavian vein via the thoracic duct. These chylomicrons are broken down to fatty acids and glycerol by the action of an enzyme **lipoprotein lipase** and they diffuse into the adipocytes of the adipose tissue and liver for storage as neutral fat or tissue fat.

6. **What are the functions of liver?**

A. Liver performs a variety of functions like synthesis, storage and secretion of various substances.

1. Liver secretes the bile juice, which contains bile salts such as **glycocholate and taurocholate** of sodium and potassium which help in digestion and absorption of lipids.

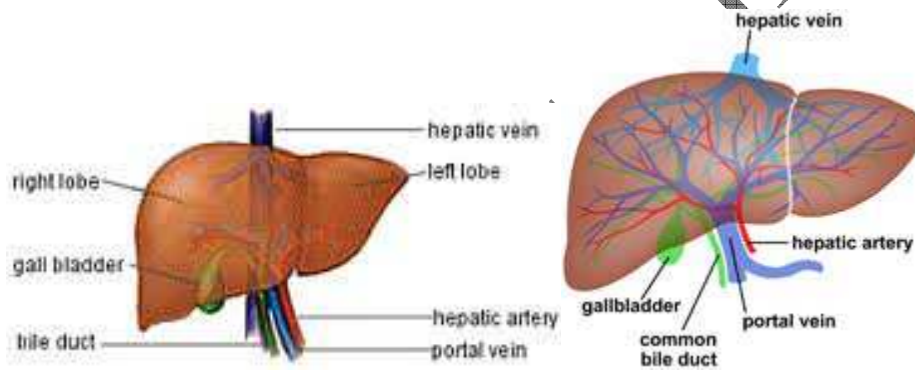
2. Liver plays the key role in carbohydrate metabolism.

a) **Glycogenesis:** Formation of glycogen from glucose

b) **Glycogenolysis:** Breakdown of glycogen into glucose

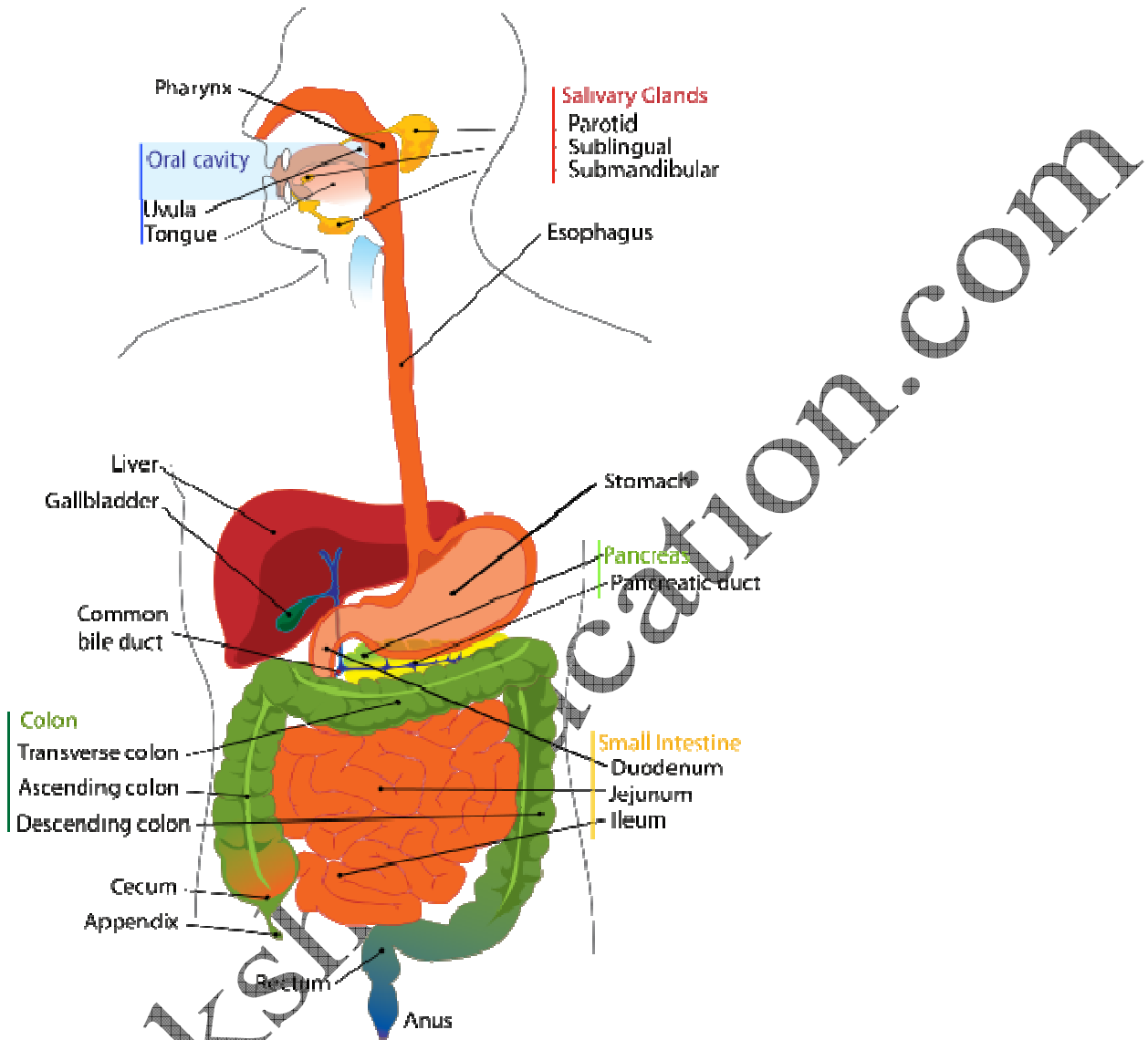
c) **Gluconeogenesis:** Synthesis of glucose from certain amino acids or other than carbohydrates.

3. Liver plays an important role in synthesis of cholesterol and production of triglycerides.
4. Deamination of proteins occurs in the liver.
5. Liver is the chief organ of detoxification of toxic substances that enter the gut along with food.
6. Liver acts as thermoregulatory organ.
7. Liver acts as a haemopoietic organ in the foetus and erythroclastic organ in the adult.
8. Liver synthesizes the plasma proteins such as albumin, globulins, blood clotting factors such as fibrinogen / prothrombin, etc., and the anticoagulant called **heparin**.
9. The lactic acid formed during anaerobic muscle contraction is converted into glycogen (gluconeogenesis) in the liver by Cori cycle.
10. Kupffer cells are the largest phagocytic cells which remove unwanted substances and microbes by Phagocytosis. Kupffer cells are known as hepatocytic macrophages.



## Long Answer Questions

1. Explain the digestive system of man with neat labeled diagrams?



Human digestive system consists of alimentary canal and the associated glands.

### 1. Digestive Tract/Alimentary Canal:

It starts with mouth and ends with anus. It consists, the parts like buccal cavity, pharynx, oesophagus, stomach, small intestine and large intestine.

#### a) Mouth and Buccal Cavity:

- \* Mouth leads into buccal or oral cavity.
- \* Palate separates the ventral buccal cavity from dorsal nasal chamber.

\* Anterior hard palate is bony and lined by palatine rugae. Posterior soft palate hangs down into the pharynx as Uvula.

\* Jaw bones have 4 kinds of teeth and a tongue.

\* Teeth are ecto-mesoderm in origin. Teeth are thecodont, heterodont, diphyodont.

\* Dental formula of adult man is ....  $\frac{2123}{2123} = 32$ .

\* Dental formula of milk dentition is  $2/2, 1/1, 0/0, 2/2 = 20$ .

\* Tongue attaches with floor of buccal cavity by frenulum. Upper surface of tongue has papillae with taste buds. They are:

a) Fungiform – anterior margin and tip.

b) Filiform – on surface    c) Circumvallate – on posterior surface.

### b) Pharynx:

\* Pharynx is divided into nasopharynx, oropharynx and laryngopharynx by soft palate.

\* Epiglottis prevents the entry of food into glottis during swallowing.

\* Pharyngeal tonsils/adenoids, palatine tonsils and lingual tonsils are present as lymphoid tissues.

### c) Oesophagus:

\* It is a thin long tube extends through neck, thorax and diaphragm and finally leads into stomach.

\* Cardiac sphincter/gastro esophageal sphincter regulates the opening of esophagus into stomach.

### d) Stomach:

\* It is a wide J shaped muscular part present in upper left portion of abdominal cavity. It has three major parts like...

Anterior cardiac stomach middle large fundic stomach and posterior pyloric stomach.

\* Pyloric stomach opens into duodenum of small intestine through pylorus which is guarded by pyloric sphincter.

### e) Small Intestine:

\* It is the longest part of alimentary canal.

\* It has three regions like proximal duodenum, middle long coiled jejunum and distal highly coiled ileum.

\* Duodenum receives hepatopancreatic duct through the opening which is guarded by **sphincter of Oddi**.

\* Ileum opens into large intestine.

**f) Large Intestine:**

\* It consists of caecum, colon and rectum.

\* Caecum is a small blind sac which accommodates symbiotic microorganisms.

\* A narrow finger like vermiform appendix (abdominal tonsil) arises from caecum.

\* Caecum opens into colon which has 4 regions like ... ascending, transverse, descending and sigmoid parts.

\* Colon shows external bulged out pouches known as haustra.

\* Rectum is a small dilated sac that leads into anal canal.

\* Anal canal opens out through the anus. It is guarded by an internal anal sphincter with smooth muscle and external anal sphincter with voluntary/striped muscles.

**Digestive Glands:**

- Digestive glands are salivary glands, gastric glands, intestinal glands, liver and pancreas.
- 3 pairs of salivary glands are present in man.. Parotid, sub-maxillary and sublingual glands.
- Gastric glands are present in the wall of stomach in the form of cardiac, fundic and pyloric glands.
- Liver is the largest gland in the body. It secretes bile juice.
- Pancreas is the second largest gland. It is mixed gland with both exocrine and endocrine parts.

S.No	Digestive Juice	Secreted by	pH & Nature	Components
1.	Saliva	Salivary glands	6.8, slightly acidic	Water, salts, mucin, Ptyalin ( $\alpha$ – amylase), lysozyme
2.	Gastric juice	Gastric glands	0.9 to 1.8 Acidic	Proenzymes, Pepsinogen, prorennin, Hcl, Castle’s intrinsic factor, gastric lipase.
3.	Intestinal juice (succus entericus)	Brunner’s glands of duodenum and crypts of Lieberkuhn	7.5 to 8.0, Alkaline	Tripeptidases, dipeptidases, aminopeptidases, disaccharidases, Intestinal lipase, enzyme activator, Enterokinase, lysozyme
4.	Bile juice	Liver	Alkaline	Bile salts, sodium bicarbonate, bile pigments.

5.	Pancreatic juice	Pancreas	8.4, alkaline	Sodium bicarbonate, trypsinogen, Chymotrypsinogen, carboxypeptidases, lipase (Steapsin), amylase, nucleases like DNAase and RNA ase.
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