1. **What is digestion? (1 mark)**
   - *Extracellular process in the alimentary canal which includes all the physical and chemical processes that reduce food small, soluble molecules that can be absorbed by cells.*

2. **What is the difference between digestion and absorption? (1 mark)**
   - *Absorption takes place across the membranes of cells of the small intestine, whereas digestion is purely extracellular. Absorption occurs only after digestion has first broken food into soluble molecules small enough to be absorbed.*

3. **Compare the composition of the food we eat with the molecules that our cells actually use.**
   - *Food is a mixture of large macromolecules of proteins, fats, nucleic acids, and polysaccharides. Our cells actually only use the small molecules which make up these macromolecules (amino acids, glucose, nucleic acids, glycerol, fatty acids).* (1 mark)

4. **How many teeth do adults have? What are the four types of teeth and their function? (2 marks)**

<table>
<thead>
<tr>
<th>Name of Tooth</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incisors (8)</td>
<td>Biting</td>
</tr>
<tr>
<td>Canines (4)</td>
<td>Tearing</td>
</tr>
<tr>
<td>Premolars (8)</td>
<td>Grinding</td>
</tr>
<tr>
<td>Molars (12)</td>
<td>Crushing</td>
</tr>
</tbody>
</table>

5. **Use your tongue to locate at least one of the salivary enzymes on the inside of your mouth.**
   - *Weird to find them, wasn’t it?*

6. **What is a hydrolytic enzyme? What is the enzyme in saliva? What reaction does it catalyze?**
   - *An enzyme that reacts water with a substrate to break it down. The enzyme in saliva is SALIVARY AMYLASE. It breaks starch down into the disaccharide MALTOSE.* (1 mark)

7. **Using a labelled diagram, explain why when you swallow food or liquid, it doesn’t usually go up your nose and down your windpipe.**
   - *See text for diagram.* (1 mark)
   - *Reason it doesn’t go up your nose or down windpipe. Structures in passages cause air passages to be blocked: (1 mark)*
   - *Soft palate moves back to cover nasopharyngeal openings (so food doesn’t go up your nose)*
   - *Opening to larynx is called glottis. Flap of tissue called epiglottis sits at top of trachea. When you swallow, trachea moves up under the epiglottis, blocking trachea.*

8. **Describe the process of peristalsis in the esophagus. How can a combination of circular and longitudinal muscles cause this action?**
   - *See diagram in text. Circular muscles squeeze tubes, longitudinal muscles contract tubes to move food bolus along in a sequential fashion.* (1 mark)

9. **What is the function of the stomach?**
   - *Receives and temporarily stores food to be digested. Churns food to mechanically break it down, and produces pepsin which breaks proteins into peptides.* (1 mark)

10. **What is gastric juice? Where is it produced? What is it composed of? What does it do?**
    - *A digestive juice containing enzymes, and which is produced by glands in the stomach mucosal lining.* (1/2 mark)
    - *Contains pepsinogen and HCl.* (1/2 mark)
    - *Pepsinogen and HCl combine to produce Pepsin, a hydrolytic enzyme that breaks proteins into peptides.* (1 mark)

11. **How is the structure of the stomach related to its function? (any 4 of these reason = 1/2 mark each, for a total of 2 marks)**
    - *Muscular and flexible so that it expands so it can store food.*
    - *Three layers of muscles serve to churn the food.*
    - *Glands produce gastric juice for breaking down proteins.*
• Mucus lining to protect it from its own juices.
• Sphincter to empty contents into small intestine.

12. Give a one sentence description, using your own words, of the function of the following digestive components: (3 marks, 1/2 mark each)

<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>mouth</td>
<td>receive and chew food, moisten with saliva, and start to digest starch.</td>
</tr>
<tr>
<td>pharynx</td>
<td>Passageway for both air and food, leads to esophagus.</td>
</tr>
<tr>
<td>epiglottis</td>
<td>Cover opening to larynx when swallowing.</td>
</tr>
<tr>
<td>cardiac sphinctor</td>
<td>Muscle that encircles the esophagus at the stomach junction. Allows food into stomach, and also prevents constant vomiting.</td>
</tr>
<tr>
<td>esophagus</td>
<td>Moves food from mouth to stomach through peristaltic action.</td>
</tr>
<tr>
<td>pepsinogen</td>
<td>Protein precursor to pepsin, reacts with HCl to form pepsin.</td>
</tr>
</tbody>
</table>

13. How come, if your stomach is full of acid and protein-digesting enzymes, doesn't it digest itself? (1 mark)
• Thick mucus layer secreted by stomach wall protects it.

14. What is an ulcer, and what causes them?
• A sore in the stomach wall caused by the gradual disintegration of tissues. Once thought to be caused mostly by the oversecretion of gastric juices due to stress, most ulcers are now thought to be caused by bacterial infections. (1 mark)

1. Majority of digestion takes place in this organ
   SMALL INTESTINE

2. Length of this organ
   6 - 7 meters

3. Three parts of this organ are called:
   1. Duodenum
   2. Jejunum
   3. Ilium

4. How long is duodenum?
   ~25 CM

5. What controls flow of material into duodenum?
   PYLORIC SPHINCTER

6. What is this material that enters the duodenum called?
   ACID CHYME

7. What is main role of duodenum in digestion?
   Most of the enzymatic hydrolysis of macromolecules takes place here. Most absorption also takes place here.

8. What two organs produce secretions that end up in duodenum?
   1. Liver (bile)
   2. Pancreas (numerous secretions collectively called pancreatic juice)

9. Liver produces what?
   Bile

10. Why is it greenish in colour?
    Contains pigments from the breakdown of hemoglobin (another liver function)

11. Where is this substance stored?
    Gall Bladder

12. What does an emulsifying agent do?
    Breaks big molecules into small molecules and keeps them from coming back together (e.g., bile salts do this to fat)

13. What do bile salts do?
    Break fat into fat droplets

14. What sodium compound does pancreatic juice contain?
    NaHCO₃ (sodium bicarbonate)

15. What does this substance do?
    Neutralizes acid chyme, makes pH of small intestine alkaline.

16. What 3 important enzymes does pancreatic juice contain?
    Name: Pancreatic amylase
    Function: Breaks starch to maltose
    Name: Trypsin
    Function: Breaks protein to peptides
    Name: Lipase
    Function: Digests fat droplets to glycerol and fatty acids.

17. What produces the intestinal juices in the small intestine?
    Intestinal glands

18. Where are these glands located?
    In wall of small intestine

19. Two important intestinal juice enzymes and their functions are:
    Name: Peptidases
    Function: Digest peptides to amino acids
20. **Name: Maltase, sucrase, lactase etc.** Function: Digest disacch. to monosacch. e.g. maltose to glucose

21. Where does absorption take place?
   Across the walls of the villi lining s.i.

22. Is this absorption passive? What does it require?
   NO. It is active – requires energy.

23. Where do sugars and amino acids go?
   Into blood vessels

24. Where do glycerol and fatty acids go?
   Into lacteals (small lymph vessels)

25. What is the function of the hepatic portal vein?
   Carries food-rich blood from s.i. to liver for processing.

26. In your own words, list 6 functions of the liver.
   1. Removes poisons from the blood
   2. Destroys old red blood cells
   3. Produces bile
   4. Stores glucose as glycogen, breaks down glycogen to maintain blood glucose levels.
   5. Makes blood proteins
   6. Produces urea from the breakdown of amino acids.

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1. List 3 disorders of the liver, and describe their causes and effects.
   - **Jaundice:**
     - gives yellowish tint to skin
     - due to build up of bilirubin (from breakdown of RBC) in blood, caused by liverdamage or blockage of bile duct (obstructive jaundice). Obstructive jaundice also causes GALLSTONES (made of cholesterol and CaCO₂). Can block bile ducts. Removal of gall bladder often necessary.
   - **Viral Hepatitis:**
     - causes liver damage and jaundice. Two types.
     - Type A: infectious hepatitis -- caused by unsanitary food, polluted shellfish.
     - Type B: serum hepatitis: spread through blood contact (e.g. transfusions)
   - **Cirrhosis:**
     - usually caused by chronic over-consumption of alcohol.
     - Liver fills up with fat deposits and scar tissue
     - Kills thousands of alcoholics per year

2. Explain how the large intestine is **structurally and functionally** different from the small intestine. What is the composition of **feces**?

   - Large intestine has a larger diameter but is much shorter (i.e. about 1.5 to 2 m in length) compared to the small intestine. Structure of the walls of large intestine is roughly similar to the small intestine. Moves material through peristalsis. L.I. contains billions of bacteria such as *E. coli*.
   - Functionally, L.I. is only concerned with the expulsion of undigestable material, reabsorption of water, and the absorption of vitamins (e.g. vitamin K).

3. What is the name of the **main bacteria** present in the large intestine? What is its **function**?

   *Escherichia coli*. It feeds on undigestable material, producing gases like methane in the process (it is largely responsible for flatulence!). It produces some traces of vitamins. It prevents pathogenic bacteria from overcolonizing the small intestine.

4. **Make a table** that very briefly and concisely lists the **Name, Symptoms, and Corrective Measures** for the following disorders: Use the following as a template.

<table>
<thead>
<tr>
<th>Name of Disorder</th>
<th>Cause(s)</th>
<th>Symptoms</th>
<th>Corrective Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. gall stones</td>
<td>excess cholesterol in diet a primary cause, metabolic dysfunction.</td>
<td>small &quot;stones&quot; of cholesterol and salts in gall bladder</td>
<td>surgical removal of gall bladder, some medicines can dissolve gallstones, sound waves can break small ones up</td>
</tr>
<tr>
<td>ii. &quot;heartburn&quot;</td>
<td>excessive acidity in stomach, stomach contents going up esophagus past cardiac sphincter.</td>
<td>burning in stomach/chest</td>
<td>antacids, diet changes</td>
</tr>
<tr>
<td>iii. periodontitis</td>
<td>&quot;Tooth Decay&quot; due to bacteria feeding on teeth.</td>
<td>progression of gingivitis to the point of supporting bone has begun. Primary cause of tooth loss in adults. Teeth loosen, gums recede.</td>
<td>Prevention through good dental hygiene. Surgery, removal of teeth often necessary.</td>
</tr>
<tr>
<td>iv. constipation</td>
<td>Diets low in fiber, high in fat is the primary cause.</td>
<td>Slow peristalsis of large intestine causes the large intestine to reabsorb too much water. Feces is hard, dry, and difficult to pass.</td>
<td>High fiber diet, laxatives.</td>
</tr>
<tr>
<td>v. hernia</td>
<td>Can be genetic. Some hernias cause by combination of excessive muscle strain and genetic factors.</td>
<td>Hiatus Hernia: protusion of the stomach above the diaphragm.</td>
<td>Surgical treatment is necessary only for large hernias.</td>
</tr>
</tbody>
</table>
anocobalamin (vitamin B12),

vi. mumps an acute, contagious, generalized viral disease, usually spread by contact with saliva of infected person

vii. hemorrhoids inflamed veins of rectum, often caused by excessive strain during defecation which damages vein valves.

viii. diarrhea infection of large intestine (bacterial or viral) hindering reabsorption of water.

ix. appendicitis inflammation of appendix, usually due to bacterial infection.

Symptomatic (treat symptoms). Vaccine is available.

topical ointments like Preparation H, surgery in extreme causes.

watery feces, dehydration.

drugs can control it. Glucose/salt mixture can osmotically "trick" the body into reabsorbing water.

severe pain in affected area, fever. If infection untreated, could cause appendix to burst, which spreads the infection and can lead to death.

surgery to remove appendix is most effective treatment.

Hormone Released by What Part, and in response to what? Acts on What Part? What does it do?

GASTRIN upper part of stomach/in response to protein in the stomach Gastic juice secreting cells at top of stomach Causes secretion of gastric juices

SECRETIN Small intestine/Acid chyme in stomach Pancreas Causes pancreas to release NaHCO3 and pancreatic enzymes

CHOLECYSTOKININ Small intestine/Acid chyme in stomach Pancreas and Liver (gall bladder) Causes liver to secrete bile and pancreas to secrete pancreatic juice.

GIP Small intestine/acid chyme rich in fats enter duodenum Stomach Inhibits stomach peristalsis and acid secretion (i.e. opposes the action of gastrin)

Molecule Type Where Digested Broken Down Into

Carbohydrates mouth, small intestine monosaccharides e.g. glucose

Fats small intestine glycerol & fatty acids

Proteins stomach, small intestine amino acids

Enzyme Secreted by: Site of secretion Optimum pH Reactants Product

Salivary Amylase saliva glands mouth neutral starch maltose

Maltase small intestine duodenum alkaline maltose glucose

Pepsin stomach stomach acid protein polypeptides

Pancreatic Amylase pancreas duodenum alkaline starch maltose

Nuclease pancreas duodenum alkaline DNA, RNA nucleotides

Trypsin pancreas duodenum alkaline certain polypeptides smaller polypeptides

Lipase pancreas duodenum alkaline small fat droplets glycerol and fatty acids

a. carbohydrates

b. proteins

c. fats

d. vitamins

e. minerals

9. List 4 fat soluble vitamins. Why is it not a good idea to ingest too much of these vitamins?

10. List 11 water soluble vitamins. Why are vitamins only needed in small amounts?

11. List 4 mineral micronutrients. Why are they called micronutrients?

12. List 13 mineral micronutrients. Why are they called micronutrients?

13. What is wrong with a diet that has high in fat? Detail at least 5 things.

Stress, saturated fats, artery damage, heart disease, high blood pressure, high cholesterol, diabetes.

Fats have high levels of pesticides, hormones, antibiotics, compared to plant foods.

High fat, high protein diets also linked to degenerative diseases such as osteoporosis, kidney disease.

Raising animals for meat is the most wasteful and destructive way to produce food in terms of damage to the environment and depletion of natural resources.

Following is an abbreviated list of diseases which are closely linked to high-fat diets, and which can be often improved, prevented, and even occasionally cured by the adoption of a vegetarian diet (5):

- Strokes
- Heart Disease
- Osteoporosis
- Kidney Disease
- Breast Cancer
- Colon Cancer
- Prostate Cancer
- Pancreatic Cancer
- Ovarian Cancer
• Cervical Cancer • Stomach Cancer • Endometrial Cancer
• Diabetes • Hypoglycemia • Kidney Disease
• Peptic Ulcers • Constipation • Hemorrhoids
• Hiatal hernias • Diverticulosis • Obesity
• Gallstones • Hypertension • Asthma
• Salmonellosis • Trichinosis

- This is only a partial list, and that there are many more illnesses and health problems directly connected to the consumption of animal foods, including eggs and dairy products.
- Women who eat 3 or more eggs per week, for example, have 3 times the risk of developing fatal ovarian cancer.
- Women who eat butter and cheese 2-4 times per week have a 3.2 higher risk of developing breast cancer than those who have them once or less.
- The average measurable bone loss (i.e. amount of osteoporosis) in 65 year old meat-eating females is 35%, compared to half that for female vegetarians the same age.
- Every country in the world that has high rates of colon cancer, prostate cancer, breast cancer, strokes, and heart disease also has corresponding high rates of meat intake.
- Overall, there can be no question anymore, in light of the growing library of scientific evidence, that a vegetarian diet is better suited to human physiology, and is healthier, than a meat-based diet. And that is under the best of circumstances. As it turns out, animal products today are much more dangerous than they were as little as ago as 50 years ago.