Unit 17 · Digestive System

ANSWER KEY · FOR TEACHERS

Full marks 32

Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Key words

1. thecodont
2. epiglottis
3. Kupffer cells
4. Stensen's duct
5. enterokinase
6. micelles
7. chylomicrons
8. lacteal

K · 4

Each carries 0.5 mark.

2 Label the diagram

1. serosa
2. longitudinal muscle
3. Auerbach's plexus
4. circular muscle
5. submucosa
6. muscularis mucosae

K · 3

Each carries 0.5 mark.

3 Multiple choice

i. **b.** accessory pancreatic duct — K · 1

The **accessory pancreatic duct** is the duct of Santorini; the main pancreatic duct is the duct of **Wirsung**.

ii. **c.** filiform — K · 1

Filiform papillae are the smallest and most numerous, but they have no taste buds: they make the tongue rough so it can grip food. Circumvallate papillae carry many taste buds, fungiform a few each.

iii. **b.** blood flows in to the central vein; bile flows out to the bile ducts at the corners — U · 1

Blood from the portal vein and hepatic artery enters at the **corners** and flows **inwards** along the sinusoids to the central vein. Bile, made by the same cells, flows **outwards** in the canaliculi to the bile ducts at the corners. The two never mix.

iv. **c.** cholecystokinin — A · 1

Cholecystokinin (CCK; the name means "gall-bladder mover") is released by the duodenum when fats and proteins arrive; it makes the gall bladder contract and the pancreas secrete its enzymes.

v. **c.** large intestine — A · 1

The **large intestine** absorbs most of the water left after the small intestine, about 1.3 liters a day, and forms solid feces. (The **small intestine** absorbs more water in all, about 7 liters a day, but what reaches the large intestine is still liquid. So if a question asks which part absorbs the *most* water, the answer is the small intestine.)

4 Short answers

a. MARKING SCHEME — K · 2

- ✓ Both formulas correct (2123/2123 = 32; 2102/2102 = 20).
- ✓ The milk molars are replaced by the permanent premolars.

b. MARKING SCHEME — U · 2

- ✓ Active enzymes would digest the gland's own cells and ducts.
- ✓ They are activated only in the duodenum (enterokinase, then trypsin).

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c. MARKING SCHEME A · 2

✓ Fats.
✓ Without the store of bile, less bile reaches a fatty meal, so less emulsification and less lipase action.

d. MARKING SCHEME U · 3

✓ Six-sided lobule with a central vein and radiating cords of hepatocytes.
✓ Sinusoids with Kupffer cells between the cords; bile canaliculi between the cells.
✓ Portal triads at the corners: portal vein, hepatic artery, bile duct.

5 Long answers

a. ANSWER U · 4

- **Mouth:** no protein digestion; chewing only breaks the food up.
- **Stomach:** HCl turns pepsinogen into **pepsin** (pepsin then activates more). Proteins → **peptones and proteoses** (pepsin, pH 1.5–2.5). In young mammals, prorennin → **rennin**, which turns casein into paracasein, curdled by Ca^{2+}.
- **Duodenum: enterokinase** turns trypsinogen into **trypsin**, which activates chymotrypsinogen, procarboxypeptidase and proelastase. Proteins and peptones → polypeptides and peptides (**trypsin, chymotrypsin, elastase**); peptides → shorter peptides and amino acids (**carboxypeptidase**).
- **Brush border:** peptides → **amino acids** (**aminopeptidase, dipeptidase**), absorbed by active transport into the blood capillaries.

MARKING SCHEME

✓ No protein digestion in the mouth; in the stomach pepsinogen activated by HCl, proteins to peptones by pepsin.
✓ Enterokinase activates trypsinogen; trypsin activates the other proenzymes.
✓ Trypsin, chymotrypsin, elastase and carboxypeptidase give peptides and amino acids.
✓ Aminopeptidase and dipeptidase finish to amino acids.

b. ANSWER A · 4

Absorption, about 90% of it in the **small intestine** through its villi and microvilli:

- **Carbohydrates:** glucose and galactose by **active transport** with Na^+; fructose by **facilitated diffusion**; into the blood capillaries and to the liver by the **hepatic portal vein**.
- **Proteins:** amino acids (and short peptides) by **active transport**, mostly with Na^+, into the blood capillaries.
- **Fats:** fatty acids and monoglycerides reach the cells in **micelles** with bile salts and **diffuse** in; in the smooth ER they are rebuilt into fats and packed into **chylomicrons**.
- Chylomicrons, too big for the blood capillaries, enter the **lacteals**, and reach the blood through the **thoracic duct** at the left subclavian vein.

MARKING SCHEME

✓ Glucose and galactose by active transport with Na^+, fructose by facilitated diffusion, into the blood.
✓ Amino acids by active transport into the blood capillaries (to the liver by the portal vein).
✓ Fats: micelles, diffusion into the cells, rebuilt into chylomicrons.
✓ Chylomicrons enter the lacteals and reach the blood through the thoracic duct.

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6 Think

ANSWER HA · 3

In the small intestine **glucose and sodium are absorbed together** by one carrier, which keeps working even in cholera.
As glucose and Na^+ enter the cells, **water follows by osmosis**, so the drink replaces the water and salt being lost.
Too much sugar or salt makes the gut's contents **more concentrated** than the cells, so water is drawn **into the gut** by osmosis, and the diarrhea gets worse.

MARKING SCHEME

- ✓ Glucose and Na^+ are absorbed together by a carrier that still works in cholera.
- ✓ Water follows them by osmosis, replacing what is lost.
- ✓ Too concentrated a drink draws water into the gut by osmosis, worsening the diarrhea.

7 Activity: Bread that turns sweet

(not marked)

WHAT STUDENTS SHOULD FIND

The bread or rice tastes of **little at first**, then slowly turns **sweet**. **Salivary amylase** (ptyalin) is splitting its **starch** into **maltose** (with isomaltose and dextrins), which the tongue can taste as sweet.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	11	10	8	3	**32**

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