Chapter test

7 Nutrition in humans

Name: _____ ( ) Class: _____ Date: _____

Total marks: 40 marks
Time allowed: 40 minutes
Answer ALL questions.

Score: / 40

A. Concept checking (10 marks, 1 mark each)

1. The process of nutrition does not include the

   A. intake of food.
   B. use of food molecules for metabolism.
   C. removal of metabolic wastes.
   D. breakdown of food substances into simple molecules. ☐

★ 2. Which of the following structure does not produce digestive juice?

   A. Pancreas
   B. Small intestine
   C. Gall bladder
   D. Stomach ☐

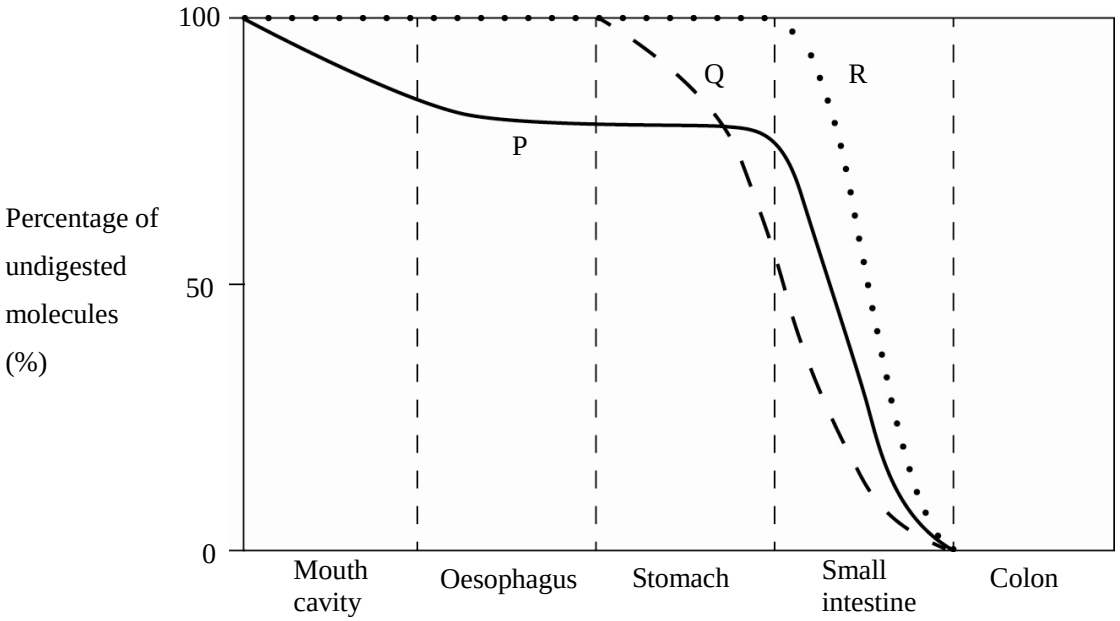
3. The dental formula of an animal is $i\ \frac{2}{2}, c\ \frac{1}{1}, pm\ \frac{2}{2}, p\ \frac{2}{2}$. How many teeth does this animal have?

   A. 7
   B. 14
   C. 28
   D. 32 ☐

4. Which of the following statements about physical digestion and chemical digestion is correct?

   A. Bile involves in both physical and chemical digestion.
   B. In the mouth cavity, carbohydrates undergo physical digestion only.
   C. In both types of digestion, food substances are broken down into simpler molecules.
   D. Physical digestion can enhance the efficiency of chemical digestion. ☐

Direction: Questions 5 to 7 refer to the graph below, which shows the percentage of undigested molecules (P, Q and R) present along the alimentary canal.



★ 5. Which of the following statements correctly interprets the graph above?

A. No digestion occurs in the mouth cavity.
B. The rate of digestion is the fastest in the stomach.
C. The digestion of R is completed in the small intestine.
D. All molecules are absorbed in colon. ☐

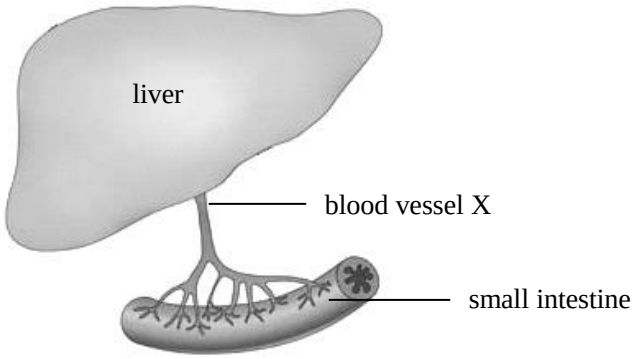
★ 6. Which of the following correctly identifies the three food substances?

	P	***Q***	***R***
A.	starch	protein	lipid
B.	protein	lipid	starch
C.	lipid	starch	protein
D.	starch	lipid	protein ☐

★ 7. Most water is absorbed in the small intestine. Based on the graph above, this is because

A. the small intestine has many villi to increase the surface area for water absorption.
B. most of the food substances are absorbed in the small intestine, the water potential of blood in the small intestine decreases.
C. the alkaline intestinal juice favours the absorption of water in the small intestine.
D. the rate of digestion is the highest in the small intestine. ☐

★ 8. The diagram below shows a part of the alimentary canal. Blood vessel X connects the small intestine and the liver.



Which of the following descriptions about blood vessel X is correct?

A. It carries oxygenated blood to the liver.
B. The water potential of the blood inside blood vessel X is low.
C. It is an artery because the blood inside flows towards an organ.
D. It transports vitamin A to the liver. ☐

★ 9. Lipids absorbed in the small intestine are first transported to the

A. liver.
B. gall bladder.
C. large intestine.
D. heart. ☐

★ 10. Which of the following is ***not*** an excretory waste produced by the liver?

A. carbon dioxide
B. urea
C. bile pigment
D. bile salt ☐

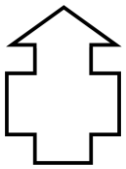
Question	1	2	3	4	5	6	7	8	9	10
Related section	7.1	7.5	7.2	7.5	7.5	7.5	7.5	7.7	7.7	7.7

B. Problem solving (18 marks)

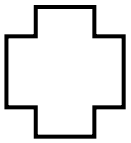
★ 11. Peter has obesity. His doctor suggested him to take drug X to treat obesity. Drug X is effective in inhibiting the action of pancreatic lipase.

$$\text{lipids} \xrightarrow{\text{lipase}} \text{fatty acids + glycerol}$$

The diagrams below show the shapes of a lipid molecule and the active part of drug X.



the shape of a lipid molecule



active part of drug X

(a) After taking drug X, Peter found that his faeces became oily. Based on the diagrams above, suggest the mechanism of drug X, which lead to the egestion of oily faeces. (3 marks)

(b) Peter's doctor suggested him to take vitamin supplements during the treatment. Suggest what type of vitamins he should take and explain why. (2 marks)

(Total: 5 marks)

★ 12. A student studied the digestion of proteins in humans. He added some hydrochloric acid into milk and stirred it with a glass rod. The milk became coagulated.

(a) What action of the stomach is simulated by the stirring action of the glass rod? (1 mark)

(b) Suggest why the digestion of milk protein can be facilitated by coagulation. (2 marks)

(c) The student then added some proteases into the coagulated milk. However, he mistakenly added pancreatic proteases instead of proteases secreted by the stomach. He found that no digestion occurs. Suggest why. (2 marks)

(Total: 5 marks)

★★ 13. The table below shows the relative amount of fatty acids and amino acids along the alimentary canal after a meal.

Region of the alimentary canal	**Fatty acids**	**Amino acids**
oesophagus	low	low
stomach	low	increase
duodenum	_____	_____
ileum	_____	_____
colon	low	low

(a) Name the action that helps moving food along the alimentary canal. (1 mark)

(b) Complete the table to show the changes in the amounts of fatty acids and amino acids (increase or decrease) in the duodenum and the ileum. (2 marks)

(c) Explain the changes in the amounts of fatty acids in the

(i) duodenum. (2 marks)

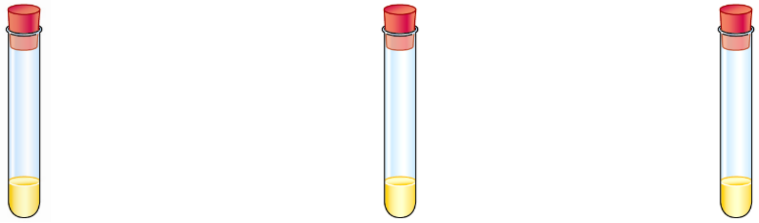
(ii) ileum. (2 marks)

(d) Explain why a high-protein diet will lead to a high concentration of urea in the blood in the hepatic vein? (1 mark)

(Total: 8 marks)

C. Exam challenge (12 marks)

★★ 14. An investigation was carried out to study the effect of bile salt on the digestion of lipids. The experiment was carried out at 37 °C. The diagram below shows the set-up.



Tube A	Tube B	Tube C
5 cm^3 full-cream milk + 2 cm^3 3% lipase solution + phenolphthalein	5 cm^3 full-cream milk + 2 cm^3 3% lipase solution + 2 cm^3 bile salt + phenolphthalein	5 cm^3 full-cream milk + 2 cm^3 3% boiled lipase solution + 2 cm^3 bile salt + phenolphthalein

Phenolphthalein is a pH indicator. The table below shows the colour change of phenolphthalein solution:

	pH > 10	**pH < 8**
Colour of phenolphthalein	pink	colourless

The results of the investigation are shown below.

	Tube A	**Tube B**	**Tube C**
Initial colour	pink	pink	pink
Colour of indicator after 5 minutes	pink	colourless	pink
Colour of indicator after 10 minutes	pink	colourless	pink
Colour of indicator after 15 minutes	colourless	colourless	pink

(a) (i) Explain the result of Tube A. (2 marks)

(ii) Explain the differences in the results of Tube A and Tube B. (3 marks)

(iii) Explain the result of Tube C. (2 marks)

(b) Based on the result of the above experiment and your biological knowledge, predict how the digestion of lipids would be affected if a person has high-fat meals after his gall bladder is removed. (3 marks)

(c) Draw a flow chart to show how the digested lipid molecules are transported from the small intestine to other parts of the body (including the organs and vessels involved). (2 marks)

(Total: 12 marks)

Marking scheme

A. Concept checking (10 marks, 1 mark each)

1.	C	2.	C	3.	C	4.	D	5.	C
6.	A	7.	B	8.	B	9.	D	10.	D

(1 mark each)

B. Problem solving (18 marks)

11. (a) The shape of drug X is similar to the shape of a lipid molecule. (1)
Drug X occupies the active site of pancreatic lipase and prevents lipids from binding to the enzyme. (1)
The digestion of lipids is hindered and the undigested lipids are egested in faeces. (1)
(b) Fat-soluble vitamins (1)
Fat-soluble vitamins have to dissolve in lipids before absorption. (1)
Less fat-soluble vitamin can be absorbed together with lipids when taking drug X.

(Total: 5 marks)

12. (a) (i) Churning (1)
(ii) Milk proteins become semi-solid and therefore they stay in the stomach for a longer time (1)
and to be digested by proteases. (1)
(b) Pancreatic proteases work best in alkaline medium. (1)
Pancreatic proteases are denatured in acidic medium. (1)

(Total: 5 marks)

13. (a) Peristalsis (1)
(b)

Region of the alimentary canal	Fatty acids	Amino acids
Duodenum	increase	increase
Ileum	decrease	decrease

(0.5 mark for each correct answer)

(c) (i) Any ***two*** of the following: (2)
- receive bile (1)
- lipids are emulsified by bile salts (1)
- receive lipases from the pancreas / intestinal cells (1)
- lipases digest lipids (1)
- lipids are digested to form fatty acids (1)

(ii) Any ***two*** of the following: (2)
- absorption / diffusion of fatty acids (1)
- into lacteals of villi (1)
- into lymph / lymph vessels (1)

(d) Liver breaks down excess amino acids to urea which is transported away through hepatic vein. (1)

(Total: 8 marks)

C. Exam challenge (12 marks)

14. (a) (i) Any ***two*** of the following: (2)
- hydrolysis of lipids (1)
- produces fatty acids (1)
- leads to a decrease in pH value (1)

(ii) Any ***two*** of the following: (3)
- tube B has bile salts while tube A does not (1)
- bile salts emulsify the lipids in the full-cream milk (1)
- to increase the surface area for the action of lipase (1)
- fatty acids are produced at a faster rate (1)

(iii) Lipase is denatured after boiling. (1)
No hydrolysis of lipids / production of fatty acids occur. (1)

(b) Gall bladder temporarily stores bile. It can regulate the amount of bile released. (1)
After the gall bladder is removed, the liver continues to produce bile, however the amount of release cannot be regulated. (1)
The rate of the lipid digestion decreases as the amount of bile available is not enough to emulsify all the fat. (1)

(c) Name 4 correct organs and vessel (1); link all the organs and vessels (1)
small intestine → lacteal → lymph vessel → vena cava → heart → aorta → various parts of the body (2)

(Total: 12 marks)