Name:_____

Questions on Digestion

Directions: The following questions are taken from previous IB Final Papers on Topic 6.1 (Digestion). Answer all questions. This will serve as a study guide for the next quiz.

Due Date: Thursday March 15

1. What is absorption?

A. Food entering the mouth and being chewed

B. Food entering the stomach for digestion

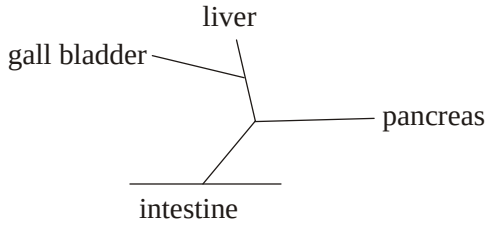
C. Taking digested food into the blood stream

D. Making complex organic molecules in cells using digested foods

(Total 1 mark)

2. Ducts connect the liver, gall bladder and pancreas to the alimentary canal. Which diagram shows the correct pattern of duct connections?

A.



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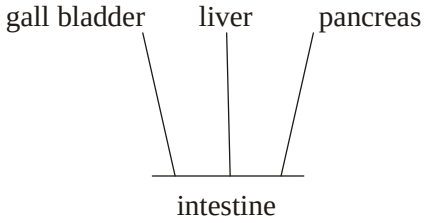

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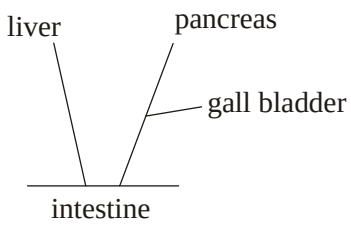

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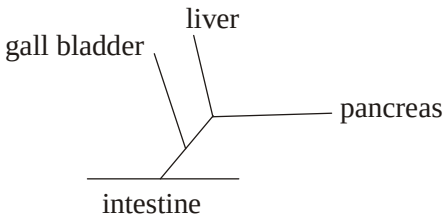


(Total 1 mark)

3. What sequence of organs do substances pass through, as they move through the human digestive system?

A. Mouth → stomach → pancreas → small intestine → liver → large intestine → anus

B. Mouth → stomach → small intestine → pancreas → liver → large intestine → anus

C. Mouth → esophagus → stomach → small intestine → large intestine → anus

D. Mouth → esophagus → stomach → large intestine → small intestine → anus

(Total 1 mark)

4. Why is most food digested?

A. Digestive enzymes require a variety of substrates.

B. It ensures that the diet is balanced.

C. Most ingested food molecules are large.

D. To prevent disorders of the intestine.

(Total 1 mark)

5. Two cellular activities that support human life are absorption and assimilation. What is needed for assimilation but **not** for absorption?

A. Enzymes to synthesize new molecules

B. Blood capillaries

C. Dissolved nutrients

D. Microvilli

(Total 1 mark)

6. Describe the role of enzymes in digestion with reference to two named examples.

(Total 5 marks)

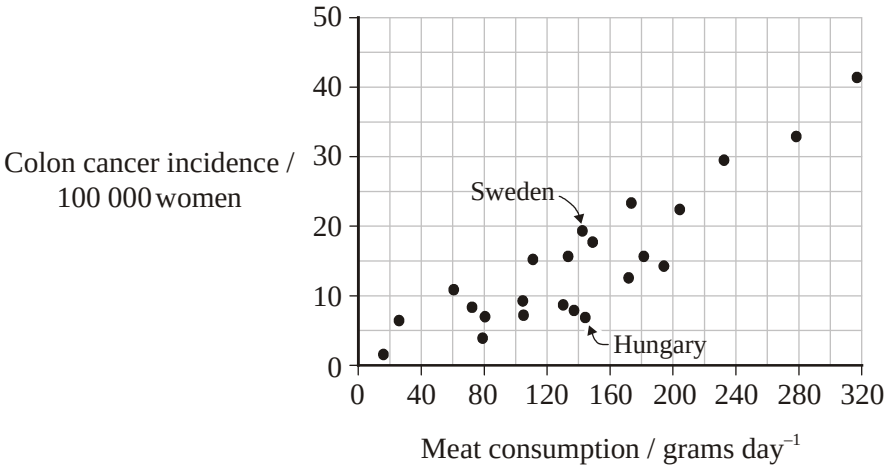
7. Draw a labelled diagram of the digestive system.

(Total 5 marks)

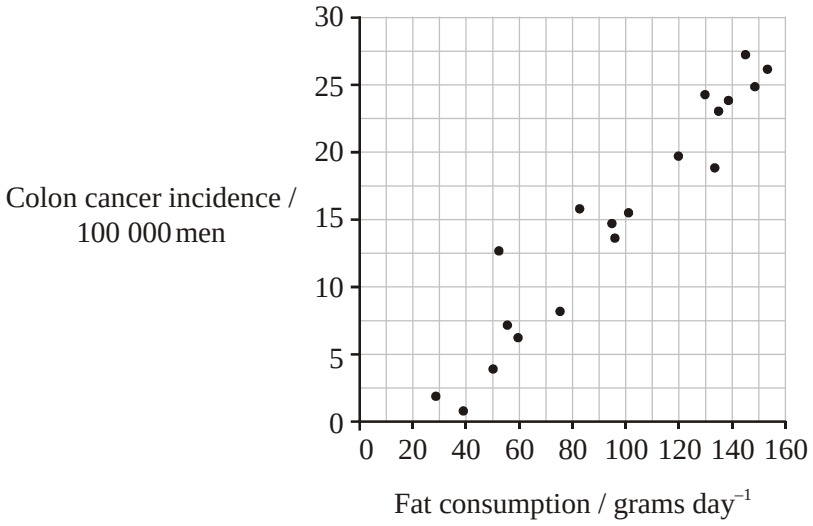
8. State the sources, substrate, product, and optimum pH conditions for the enzyme amylase.

(Total 4 marks)

9. Dietary factors are known to influence the incidence of colon cancer. The graphs below show the correlation between meat consumption (eating meat) and colon cancer in sample countries and the correlation between fat consumption and colon cancer.



[Source: B Armstrong and R Doll, Environmental factors and cancer incidence and mortality in different countries, with special reference to dietary practices, (1975), International J Cancer, **15**, pp 617–631]



[Source: http:members.aol.com/wantnomeat/page]

(a) (i) State the relationship between daily meat consumption and the incidence of colon cancer in women.

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(1)

(ii) Using the data in the two graphs opposite, suggest reasons for the relationship between daily meat consumption and the incidence of colon cancer in women.

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(2)

(b) (i) Calculate the difference in colon cancer incidence between Hungarian women and Swedish women.

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(1)

(ii) Discuss whether meat consumption causes colon cancer in Sweden and Hungary.

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(3)
(Total 7 marks)

10. Draw a diagram of a villus in vertical section.

(Total 5 marks)

11. (a) State **two** sources of disaccharides in the diet.

1. .....

2. .....

(1)

(b) Outline the use of absorbed carbohydrates.

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(3)

(c) Discuss the relationship between high levels of saturated lipids in the diet and health of the individual.

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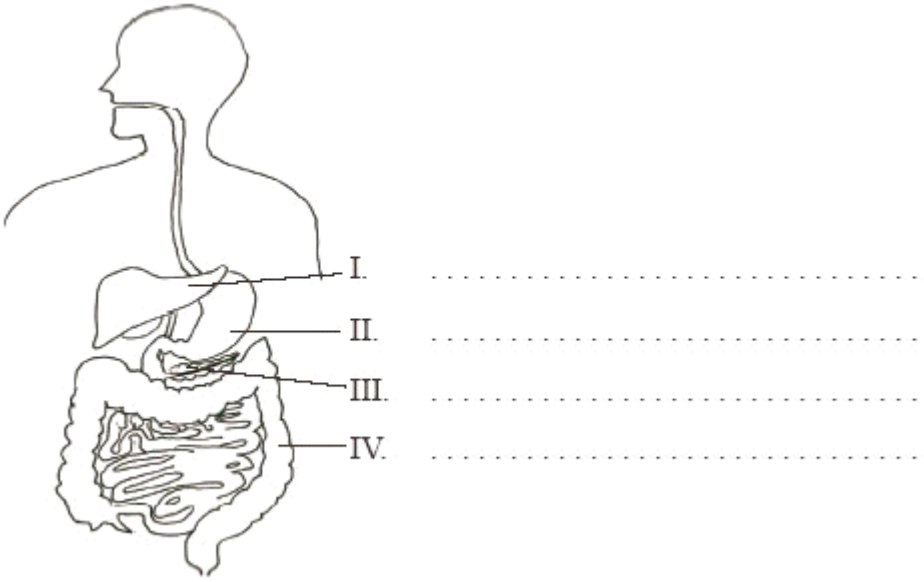
(4)
(Total 8 marks)

12. (a) Identify the parts of the human digestive system indicated below.



(2)

(b) In the space below draw the structure of an amino acid.

(2)

(c) The enzyme pepsin, involved in protein digestion in the stomach, requires an acid pH to work properly. Explain the effect of pH on enzyme activity.

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(2)

(d) Explain how **three** structures of the villus are related to the role of the villus in absorption.

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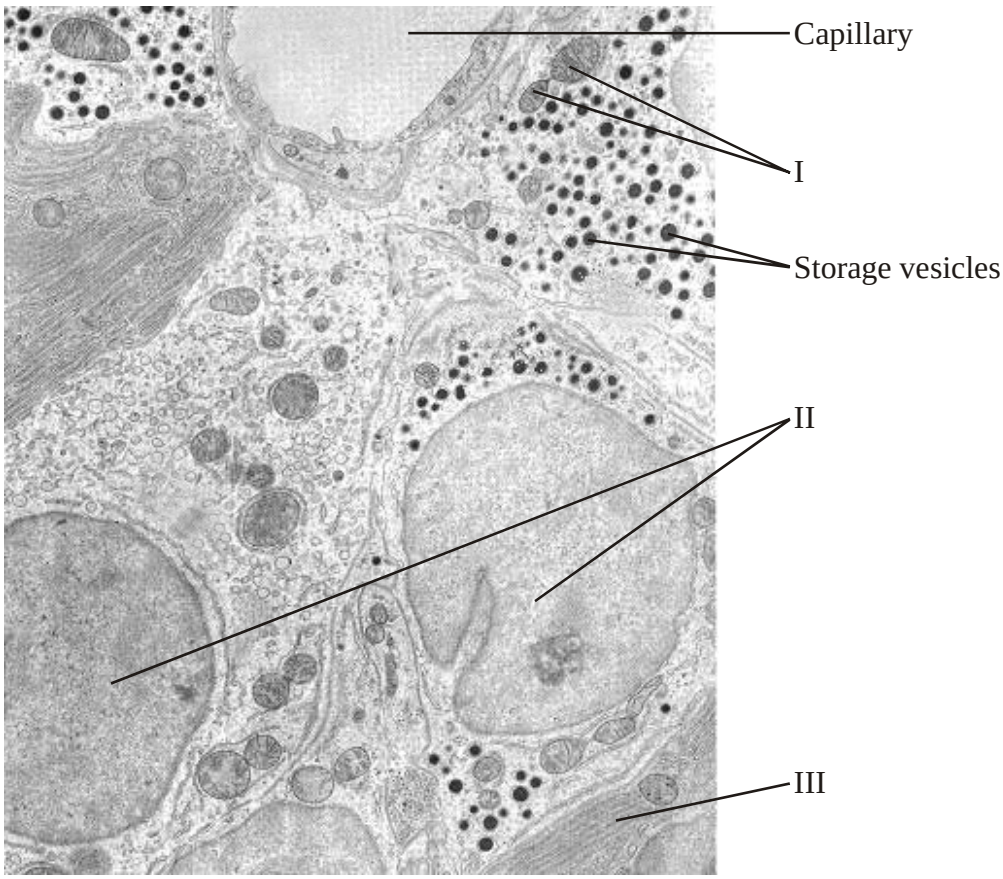
(3)
(Total 9 marks)

13. The electron micrograph below shows part of several pancreatic islet cells.



(a) Identify the structures labelled I, II and III in the micrograph above and give a role for each one.

	Structure	Role
A.		
B.		
C.		
D.		

(3)

(b) (i) Using the letter A, identify **one** location on the micrograph where transcription takes place.

(1)

(ii) Using the letter B, identify **one** location on the micrograph where chemiosmosis occurs.

(1)

The large, black vesicles store products of the cells that are released into the capillaries of the pancreas.

(c) (i) Suggest what product each cell is likely to be making.

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(1)

(ii) Explain how the products are transported from the site of production and released from the islet cells.

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(3)

(Total 9 marks)

14. Enzymes are used by living organisms to catalyse reactions. Some of these reactions occur in the cytoplasm of cells. Other reactions take place outside cells, for example the digestion of foods in the human gut.

(a) State the name used by biochemists for the chains and cycles of reactions that occur **inside cells**.

.....

(1)

(b) Enzymes of digestion in humans are secreted by glands. They have a pH optimum which allows them to work efficiently in the part of the gut into which they are secreted.

(i) In the table below, identify the missing enzyme, the two glands, and the pH optimum

Name of enzyme	Gland secreting the enzyme	Substrate	Products	pH optimum
amylase		starch	maltose	
		triglycerides	fatty acids and glycerol	7

(4)

(ii) Outline the effect of pH values above and below the optimum on enzyme structure.

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(2)

(c) Enzymes that work inside cells are sometimes affected by non-competitive inhibitors. Explain how a non-competitive inhibitor affects the activity of an enzyme.

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(3)
(Total 10 marks)

15. (a) Outline the role of the liver in the storage of nutrients.

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(2)

(b) Explain how the body overcomes the problem of lipid digestion in the alimentary canal.

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(2)
(Total 4 marks)

16. (a) List **two** glands that secrete digestive juices into the alimentary canal.

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(1)

(b) Describe the process of erythrocyte and hemoglobin breakdown in the liver.

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(4)
(Total 5 marks)

1. C

[1]

2. A

[1]

3. C

[1]

4. C

[1]

5. A

[1]

6. large food molecules must be broken down;
such as carbohydrates / proteins, *etc*;
by hydrolysis of bonds / to form monomers;
in preparation for absorption;
rate of reaction at body temperature too slow;
enzymes increase the rate of breakdown / act as catalysts;
first enzyme example – name, substrate and product;
second enzyme example – name, substrate and product;
*Award **[3 max]** if no examples given.*

[5]

7. *Award **[1]** for each two of the following structures clearly drawn and correctly labelled. Connections between organs must be correct for full marks.*

mouth / teeth / tongue;
esophagus;
stomach;
small intestine;
large intestine / colon;
anus;
pancreas;
liver;
gall bladder;
rectum;
salivary glands;
sphincters;

[5]

8. *source:* salivary glands;
pancreas;
substrate: starch / glycogen; *(do not accept carbohydrate)*
product: maltose / disaccharide;
optimum pH: 7–8 / neutral–slightly alkaline;

[4]

9. (a) (i) positive correlation / higher incidence with higher meat consumption 1

(ii) fat consumption is correlated with / causes colon cancer;
meat contains (high levels of) fat; 2

(b) (i) 12(±1) deaths per 100000 women 1

(ii) same meat consumption but higher colon cancer rate in Sweden;
other factors cause colon cancer (in Sweden) / *eg* genetic factors, lack of fibre;
only some types of meat may cause colon cancer;
meat may contain more fat in Sweden / other chemical differences;
other foods may protect against cancer (in Hungary); 3 max

[7]

10. *(Award **[1]** for each of the following structures clearly drawn **and** labelled correctly.)*
lymph vessel;
arteriole;
venule;
(central) lacteal;
capillary network;
epithelial layer / lining / epithelium;
microvilli;
goblet cells;

[5]

11. (a) *Award **[1 max]** for any two of the following.*
cane sugar / honey / onion / milk / maple syrup / fruit / soft drinks / other answers 1

(b) provide energy / cell respiration;
excess carbohydrate (glucose) can be converted into fat / glycogen for storage;
synthesis of glycoproteins / combine with proteins to form glycoproteins;
components of nucleic acids *eg* ribose in mRNA / deoxyribose in DNA;
required for the synthesis of some amino acids;
constituent of connective tissue; 3 max

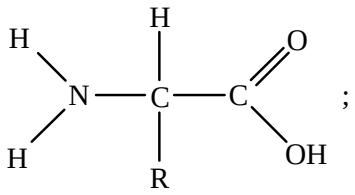
(c) diets high in saturated lipids increase risk of heart disease / atherosclerosis;
diets high in saturated lipids increase risk of obesity;
obesity linked to a variety of health problems *eg* diabetes;
atherosclerosis is narrowing of artery lumen;
atherosclerosis leads to high blood pressure / increased risk of coronary thrombosis / stroke;
smoking / lack of exercise in combination with diet high in saturated lipids compounds risk of heart disease;
relationship may be affected by genetic factors; 4 max

[8]

12. (a) I: liver;
II: stomach;
III: pancreas;
IV: large intestine / (descending) colon; 2 max

*Award **[1]** for every two correct, up to **[2 max]**.*

(b) amino group properly drawn;
acid group properly drawn;
C with H and R group attached; (*no labels are required*)
eg 2



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*Award **[2]** if three are correct, **[1 max]** if two are correct and **[0]** if one is correct.*

N.B . A condensed formula is acceptable which shows H_2N- and -COOH instead of the expanded amino group and carboxyl group attached to the central carbon atom; N atom of amino group must be joined to central C atom.

(c) each enzyme has an optimum pH where enzyme functions best / drawing of bell curve with optimal pH labelled;
changes in pH (from optimum pH) decrease activity / effectiveness;
pH slightly changes the shape of the active site / tertiary structure of protein changed / enzyme denatured;
more difficult to form enzyme-substrate complex; 2 max

***N.B** . Accept above marking points if given through a specific example such a s pepsinogen conversion to pepsin when pH is lowered.*

(d) microvilli increase surface area of absorption;
epithelium / one layer of cells provides a thin layer to enhance absorption / small distance for diffusion;
protein channels (in membrane of microvilli) allow facilitated diffusion;
mitochondria (for energy) present for active transport;
blood capillaries close to epithelium / surface membrane reduce distance / increase speed for diffusion;
blood capillaries carry away glucose / amino acids / nutrients;
lacteal carry away fats / fatty acids / glycerol; 3 max

Accept any of the above points in a clearly drawn annotated diagram.

[9]

13. (a) *Award **[1]** for each correct structure **and** its role.*

	Structure	Role
I:	mitochondria	produce ATP / site of (aerobic) respiration;
II:	nucleus	contains genetic information / produces RNA / site of replication;
III:	(rough) endoplasmic reticulum	(site of) translation / protein production / protein transport;

3

(b) (i) A in nucleus / A in mitochondria 1

(ii) B in a mitochondrion 1

(c) (i) insulin / glucagon 1

Do not accept proteins.

(ii) vesicles formed at / bud off from RER;
product carried to Golgi apparatus (and modified there);
vesicles carry product to plasma membrane;
fuse with membrane;
release product (to lumen) / exocytosis;
ATP used / energy required; 3 max

[9]

14. (a) metabolic pathways / metabolic reactions / metabolism / anabolism <u>and</u> catabolism 1

(b) (i) salivary gland / pancreas;
pH 7.5 (± 0.5);
lipase; (*accept lipidase)*
pancreas; 4

(ii) ionic bonds / polar bonds broken / disrupted / charge distribution altered;
ionization of amino / carboxyl groups altered;
conformation / shape of enzyme / active site altered / tertiary structure altered;
enzyme denatured; 2 max

(c) inhibitor binds (to the enzyme) away from the active site /
at allosteric site;
shape / (intramolecular) bonding / conformation of the protein /
enzyme is altered;
shape / properties of active site altered;
substrate no longer fits the active site /
no enzyme-substrate / ES complex formed;
no enzyme activity /
works more slowly (until the inhibitor dissociates); 3 max

*Award **[1 max]** if competitive inhibition is described.*

[10]

15. (a) liver stores excess glucose as glycogen / releases glucose from glycogen (as levels drop);
liver breaks down red blood cells / hemoglobin and stores iron;
liver stores fat soluble vitamins / vitamin A / vitamin D / vitamin B12 / folic acid; 2 max

(b) lipids are hydrophobic / not water soluble;
bile helps to break up lipid droplets / bile emulsifies fats / increases surface area of lipid droplets for lipase attack;
lipids more accessible to lipase / lipase breaks down lipids;
pancreatic juices brings up pH as optimal pH for lipase is alkaline / pH8; 2 max

[4]

(c) inhibitor binds (to the enzyme) away from the active site /
at allosteric site;
shape / (intramolecular) bonding / conformation of the protein /
enzyme is altered;
shape / properties of active site altered;
substrate no longer fits the active site /
no enzyme-substrate / ES complex formed;
no enzyme activity /
works more slowly (until the inhibitor dissociates); 3 max

*Award **[1 max]** if competitive inhibition is described.*

[10]

16. (a) *Two of the following needed for **[1]**.*
pancreatic;
salivary;
gastric pits / gastric glands;
glands in intestinal wall / krypts / Brunner's gland;
liver 1 max

(b) erythrocytes rupture when they reach the end of their life span / after 120 days;
absorbed by phagocytosis / Kupffer cells in liver from blood;
hemoglobin split into globin and heme groups;
iron removed from heme leaving bile pigment / bilirubin;
bilirubin released into alimentary canal;
digestion of globin to produce amino acids; 4 max

[5]