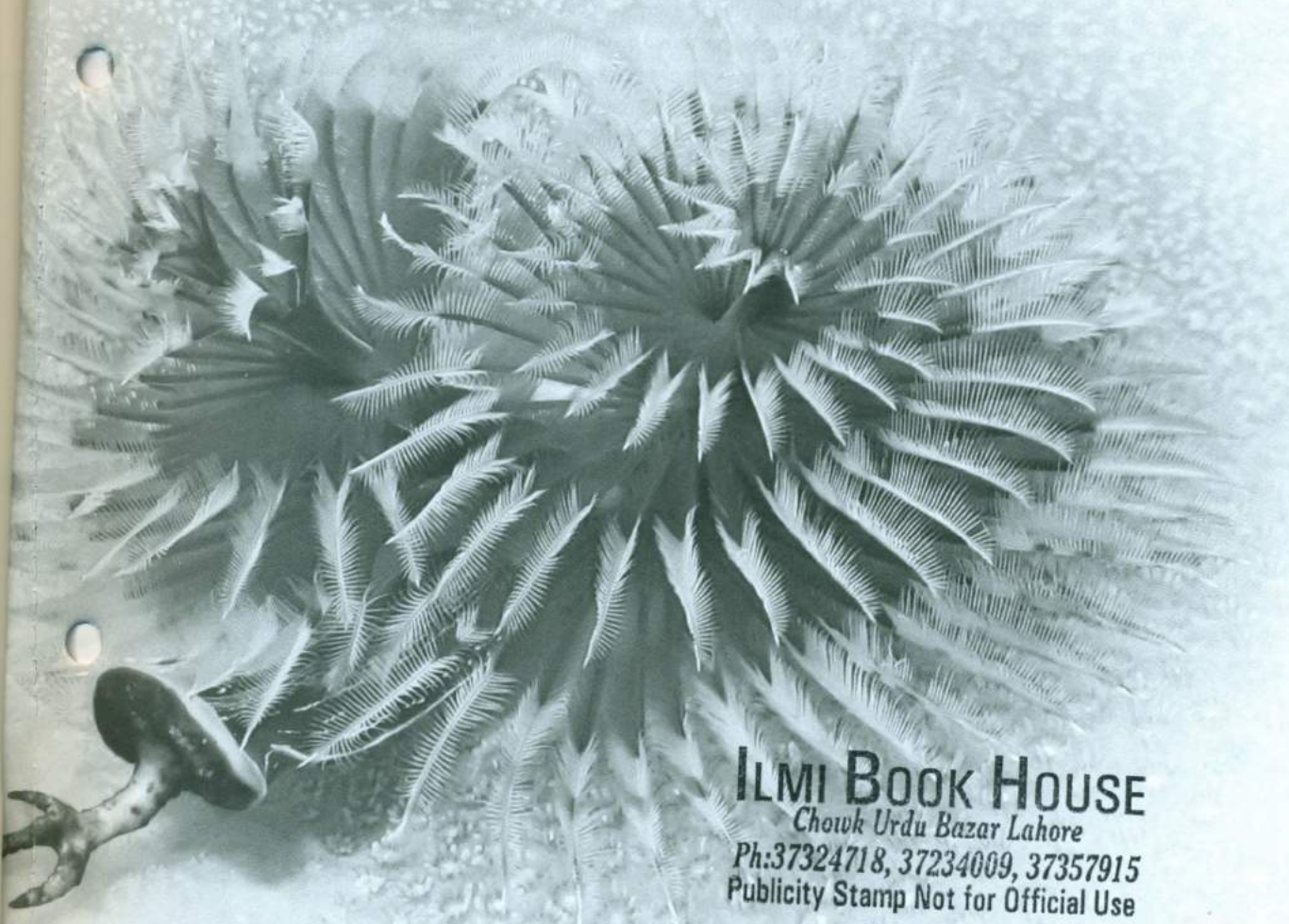


BIOLOGY

MATTERS

GCE 'O' LEVEL
2nd Edition

Workbook



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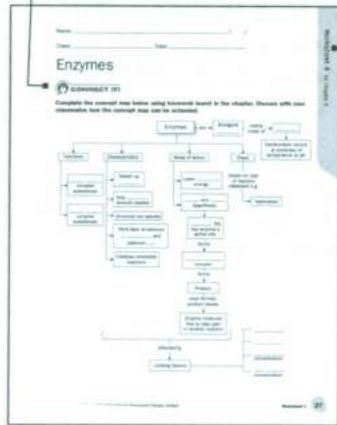
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Preface

This Workbook is written specially for students taking the GCE 'O' Level Biology examination. To enhance learning and reinforcement, the topics in the Workbook follow the same sequence as the Textbook.

Connect It!

Students fill in a concept map using keywords from a chapter in order to strengthen key concepts taught in that chapter



Link to the textbook chapter for easy reference.

Work On It!

This section helps students monitor their progress in learning. Questions are categorised based on the learning outcomes in the textbook. Students are asked to circle the questions they have answered incorrectly, and refer to the relevant section in the textbook for further revision.

WORK ON IT!

Mark the questions you have answered incorrectly. Then, circle the correct answers in the Workbook to monitor your understanding of the key concepts.

Learning Outcome	Number of Questions	Number Answered Correctly	Number Answered Incorrectly
LO 1: Describe the structure of a globular protein, including the primary, secondary, tertiary and quaternary structures.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100		
LO 2: Describe the structure of a fibrous protein, including the primary, secondary, tertiary and quaternary structures.			
LO 3: Describe the structure of a membrane protein, including the primary, secondary, tertiary and quaternary structures.			
LO 4: Describe the structure of a channel protein, including the primary, secondary, tertiary and quaternary structures.			
LO 5: Describe the structure of a carrier protein, including the primary, secondary, tertiary and quaternary structures.			
LO 6: Describe the structure of a receptor protein, including the primary, secondary, tertiary and quaternary structures.			
LO 7: Describe the structure of a cell-surface receptor protein, including the primary, secondary, tertiary and quaternary structures.			
LO 8: Describe the structure of a transport protein, including the primary, secondary, tertiary and quaternary structures.			
LO 9: Describe the structure of an enzyme, including the primary, secondary, tertiary and quaternary structures.			
LO 10: Describe the structure of a hormone, including the primary, secondary, tertiary and quaternary structures.			

Test It!

A variety of questions, with different difficulty levels, is provided.

TEST IT!

Section A: Multiple-Choice Questions

Answer the correct options and write the letter in the brackets provided.

- Enzymes are:
 - proteins that are used as chemical reactions.
 - enzymes that catalyse chemical reactions at low temperatures.
 - enzymes that catalyse chemical reactions in living organisms.
 - enzymes that speed up the rate of chemical reactions in living organisms.
- Apply the lock-and-key model of an enzyme. Which substrate fits best with the enzyme?
 - Substrate A
 - Substrate B
 - Substrate C
 - Substrate D
- The graph of a reaction is shown below. The graph shows the reaction occurring with and without an enzyme.

Which option, A, B, C, or D, represents the energy level in the reaction to using an enzyme?

 - Activation energy
 - Free energy
 - Free energy change
 - Free energy level

Learn & Apply

A worked example and related practice questions show students how to answer essay-type and structured questions.

LEARN & APPLY

Use the worked example below to answer the Practice Questions.

Worked Example

Explain, with reasons and examples, why the biological activity of an enzyme may be affected by substrate concentration.

Thought Process

The diagram will give understanding of the reaction of living systems. It explains a laboratory that works with an enzyme. It is used to answer the question. Use the graph that illustrates the relationship between the rate of reaction and substrate concentration. Describe the effect of substrate concentration, high substrate concentration and enzyme concentration on enzyme activity.

Answer

Point to note:

- Increasing substrate concentration will increase the rate of enzyme reaction, as there are more molecules to react with the enzyme.
- In the substrate concentration, every other value of enzyme are the same. Increasing substrate concentration will increase the rate of reaction.
- As more substrate is added, the rate of reaction will increase.
- The reaction rate of reaction is affected.
- After time is reached, substrate at higher rates are accepted. Thus, increasing substrate concentration will not change the rate of reaction.

Data-based questions are provided to prepare students for the current examination format. The questions involve various kinds of data, to provide practice in interpreting and manipulating different kinds of data.

Section B: Structured Questions

Answer the following questions in the spaces provided.

- The diagram illustrates the energy changes in a reaction with and without an enzyme.
 - Define activation energy.
 - Using the diagram, explain why the reaction rate is higher when an enzyme is used.
 - Using your knowledge of activation energy, explain how a reaction rate is affected by temperature.
 - Draw an example of a reaction that involves an exothermic change. State the substrate and the product formed.

The Worksheets emphasise contextual learning, information handling and problem-solving skills. It is hoped that these emphases will stimulate students' interest in Biology and in the application of the subject to everyday life.

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Terms Used in Examination Questions

Below is a list of terms that are used in examination questions. It is important that you familiarise yourself with these terms and what is expected in your answers when such terms are encountered.

Term	What is expected in your answer
Analyse	Interpret data to reach conclusions.
Annotate	Add brief notes to a diagram, drawing or graph.
Apply	Use an idea, equation, principle, theory or law in a new situation.
Calculate	Find an answer using mathematical methods (show working unless instructed otherwise).
Compare	Give an account of similarities and differences between two (or more) items, referring to both (or all) of them throughout your account.
Construct	Represent or develop information in a graphical form (include a legend or key).
Deduce	Reach a conclusion from the information given.
Define	Give the precise meaning of a word or phrase as concisely as possible.
Derive	Manipulate a mathematical equation to give a new equation or result.
Describe	Give a detailed step-by-step account, including all relevant information.
Design	Produce a plan, model or simulation.
Determine	Find the only possible answer.
Discuss	Give an account including, where possible, a range of arguments, assessments of the relative importance of various factors or comparisons of alternative hypotheses.
Distinguish	Give the differences between two or more different items or concepts.
Draw	Illustrate by means of pencil lines (add labels unless told otherwise).
Estimate	Find an approximate value for an unknown quantity, based on the information provided and prior scientific knowledge.
Evaluate	Assess the consequences and limitations.
Explain	Give a clear account including causes, reasons or mechanisms.
Identify	Find an answer from a number of possibilities.
List	Give a sequence of names or other brief answers, with no elaboration. Each point in your sequence should be clearly separated from the rest.
Measure	Find a value for a quantity (include units as well).
Outline	Give a brief account or summary (include essential information only).
Predict	Give an expected result.
Solve	Obtain an answer using algebraic and/or other numerical methods (show working unless instructed otherwise).
State	Give a specific name, value or other brief answers (no supporting argument or calculation is necessary).
Suggest	Propose a hypothesis or an alternative answer.

A Guide to Essay Writing

Essay questions are designed to test your ability to describe and explain biological processes, principles and concepts. Marks will be awarded according to the points presented.

It is important to read the essay question carefully before attempting to answer it. Do highlight key terms and words in the question. Many students misunderstand the question and as a result, their essays are inappropriate. Sometimes an essay question consists of two or more parts. Ensure that you have answered every part.

Before starting to write, plan the essay. Here is how an essay may be planned:

1. Note the topics involved.
2. Write down all the relevant points and ideas.
3. Organise these points and ideas so that a logical sequence is formed.
4. Develop an introduction, followed by the sequence of points and a conclusion.

While writing, keep referring to the essay plan to stay on track. Avoid using long sentences in your essay.

A few examples are given below to illustrate some key points that should be taken note of while writing your essay.

Example 1

Describe clearly the synthesis of human insulin through the recombinant gene technique. Discuss the advantages and disadvantages of using such a technique. [8]

The topics involved are DNA, genetic engineering, microbiology and biotechnology. There are two parts to this question.

The term 'describe' used in the first part of the question means that a detailed, step-by-step account that includes all relevant information is required in the essay. Your answer should provide details of the recombinant gene technique (e.g. the use of enzymes, bacteria, plasmids and the human insulin gene).

The second part of the question requires a discussion of the advantages and disadvantages of recombinant technology. The term 'discuss' is used. This means an account that includes a range of arguments is required. As a general guide, at least two advantages and two disadvantages should be given.

A possible distribution of marks in this question is four marks for the description of the production of human insulin and four marks for the discussion on the advantages and disadvantages of the recombinant gene technique.

Example 2

Describe the functions of each of the following in the nutrition of a mammal:	
a) hydrochloric acid	[2]
b) liver	[3]

This is considered a 'recall' or 'knowledge' question. Note that the question requires a description of functions that relate to nutrition in a mammal. Care must be taken when writing so that the essay does not include items that are out of point. This is especially true for the functions of the liver. There are six functions of the liver listed in the textbook. The essay must only mention the functions that relate to nutrition in mammals.

Example 3

Compare nutrition in mammals with nutrition in green plants.	[5]
--	-----

A common mistake which students make is to state only the differences. An appropriate answer requires both similarities and differences to be stated.

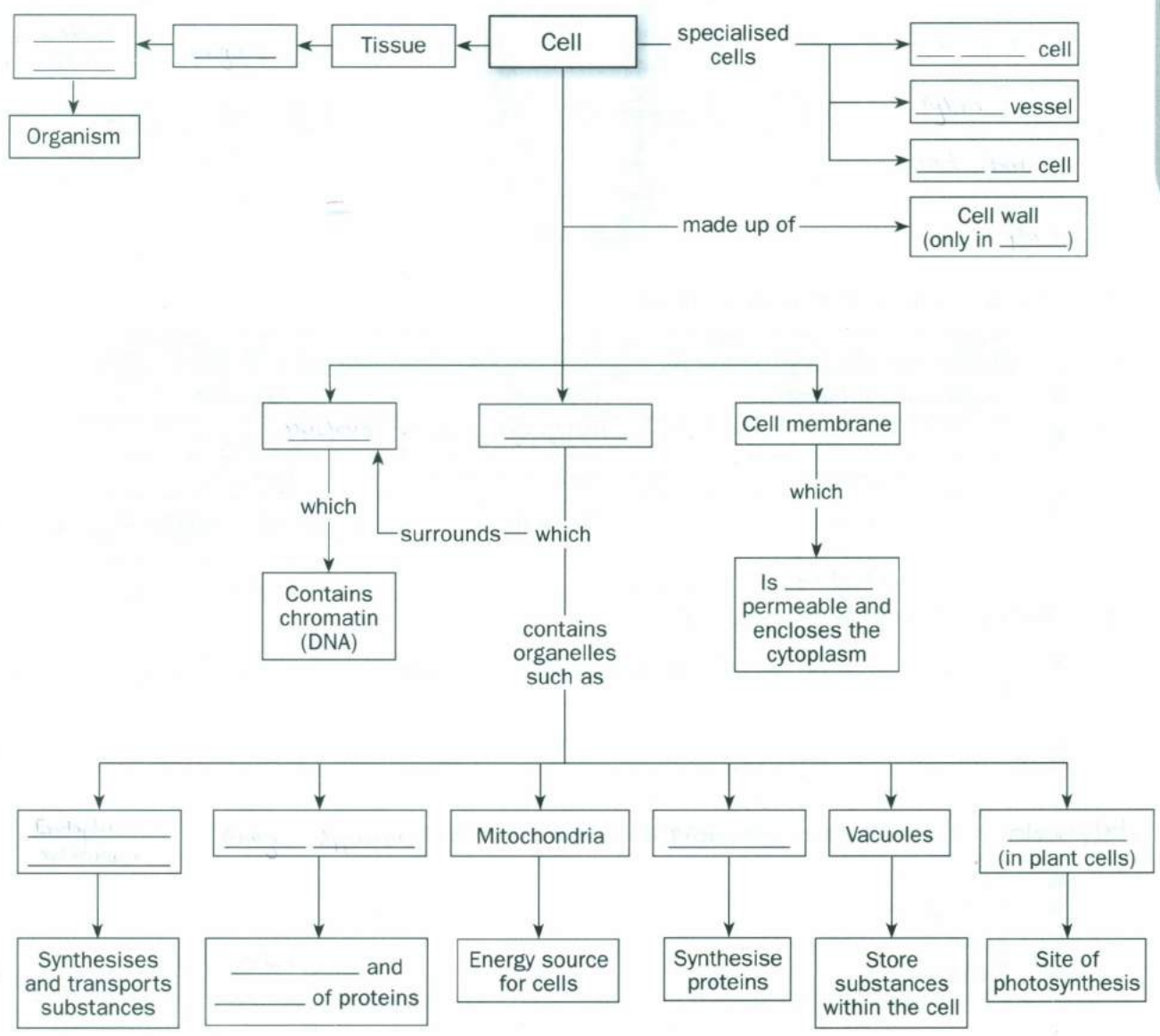
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Cells



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.

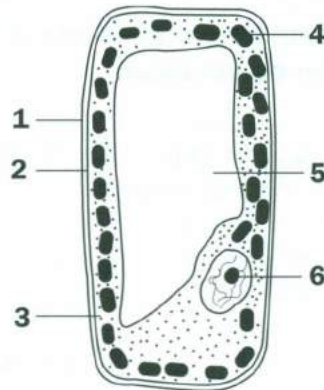


TEST IT!

Section A: Multiple-Choice Questions

Choose the correct answer, and write its letter in the brackets provided.

For questions 1, 2 and 3, refer to the diagram shown below.



1. What are the numbered parts of the cell?

	1	2	3
A	Cell surface membrane	Cell wall	Cytoplasm
B	Cell wall	Cell surface membrane	Cytoplasm
C	Cytoplasm	Cell surface membrane	Cell wall
D	Cytoplasm	Cell wall	Cell surface membrane

()

2. Which structure traps light energy?

- A 3
- B 4
- C 5
- D 6

()

3. Which structures are found in both plant and animal cells?

- A 1 and 2
- B 1 and 3
- C 2 and 3
- D 2 and 4

()

4. The electron micrograph of a section of a liver cell taken from an animal is shown below.



What are the identity of **X** and the function of **Y**?

	Identity of X	Function of Y
A	Endoplasmic reticulum	Production of energy
B	Golgi apparatus	Formation of vesicles
C	Mitochondrion	Release of energy
D	Vacuole	Production of proteins

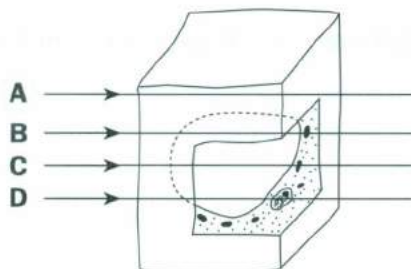
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5. An animal cell had its nucleus removed by means of a fine glass tube. The cell was not otherwise damaged. It was put in a solution that induces cell division. It continued to survive for a day, but did not undergo cell division. An intact cell, used as a control, divided twice in that time. What can you conclude from this experiment about the role of the nucleus in the cell?

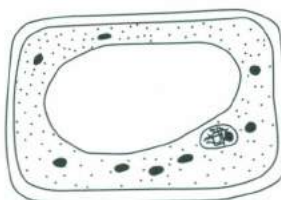
- A The nucleus controls the normal activity of the cell.
 B The nucleus is essential for cell division.
 C The nucleus is essential for life.
 D The nucleus is the only part of the cell that contains DNA.

()

6. The diagram below shows a **three-dimensional view** of a plant cell with some of its internal structures revealed.

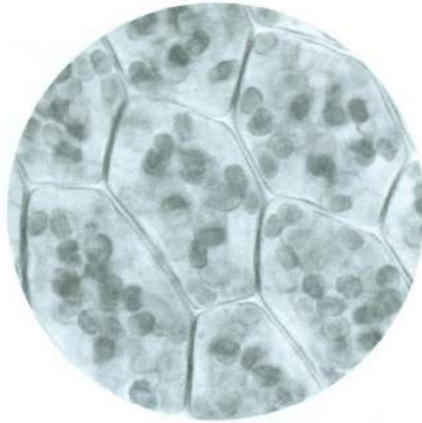


The diagram below shows a section of the cell (viewed from above) after it has been sliced along a plane. At which plane, **A**, **B**, **C** or **D**, has the cell been sliced?



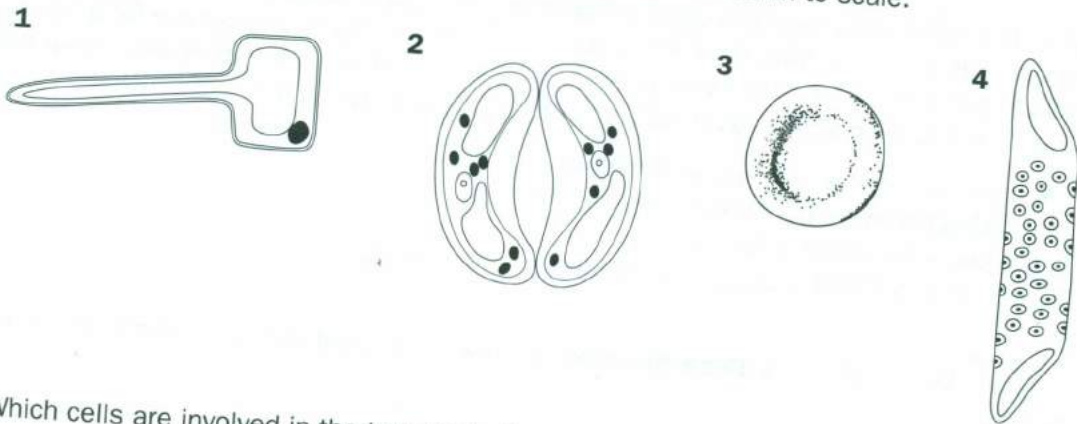
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7. The diagram below shows an electron micrograph of plant cells.



What is the likely function of these plant cells?

- A Carry out photosynthesis
 - B Carry out respiration
 - C Provide support to the plant
 - D Transport water in the plant
8. The diagram below shows four types of cells that are not drawn to scale.



Which cells are involved in the transport of substances in a living organism?

- A 1 and 2
- B 1 and 4
- C 2 and 3
- D 3 and 4

9. Which of the following correctly relates these specialised cells to their functions?

	Absorption of water and mineral salts	Conduction and support	Transport of oxygen
A	Red blood cell	Xylem	Root hair cell
B	Root hair cell	Xylem	Red blood cell
C	Xylem	Red blood cell	Root hair cell
D	Xylem	Root hair cell	Red blood cell

()

10. The stomach is considered as an organ, because _____.

- A it consists of a group of cells working together to digest food
- B it consists of different tissues working together to digest food
- C it is a basic unit of life
- D it produces digestive enzymes to digest food

()

11. Which of the following correctly lists the organs in flowering plants?

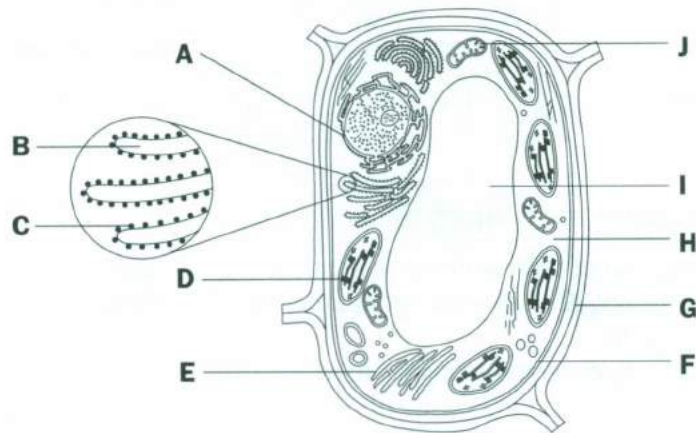
- A Flower, leaf, stem, root
- B Flower, leaf, stem, root hair cell
- C Leaf, stem, root, root hair cell
- D Stem, root, root hair cell

()

Section B: Structured Questions

Answer the following questions in the spaces provided.

1. The diagram below shows the structures visible in a plant cell when it is examined under an electron microscope.



- (a) Identify the parts labelled **A** to **J**.

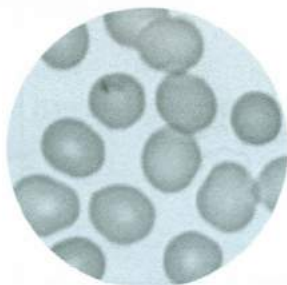
A: _____	F: _____
B: _____	G: _____
C: _____	H: _____
D: _____	I: _____
E: _____	J: _____

- (b) State one function each for **A**, **B**, **E**, **I** and **J**.

- (c) What feature(s) in this cell indicate(s) that it can photosynthesise?

- (d) State one structural difference between structures **F** and **G**.

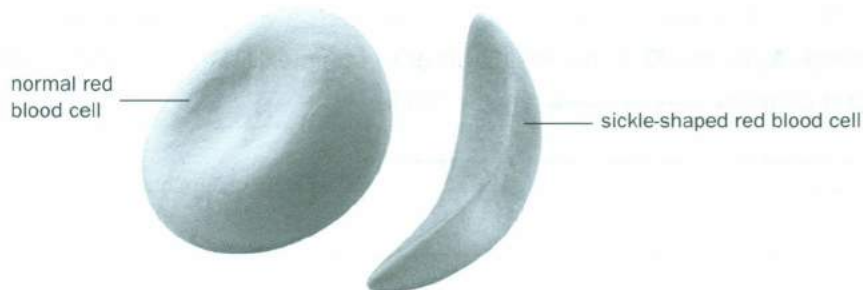
2. The diagram below shows some normal blood cells when they are viewed under a microscope.



(a) Name the type of blood cells shown, and state the function of these cells.




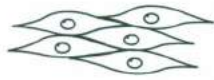
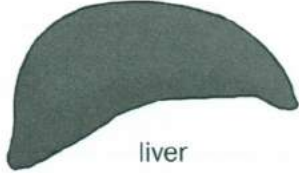
(b) Explain how the red blood cell is adapted for its function.

(c) Some people suffer from a genetic disease known as sickle cell anaemia. These sufferers of sickle cell anaemia have red blood cells that are sickle-shaped.



Explain why a patient suffering from sickle cell anaemia feels tired easily.

3. (a) Complete the table below.

<p>A _____</p>		
<p>B _____</p>	 endothelial layer	 muscle
<p>C _____</p>	 liver	

(b) Arrange **A**, **B**, and **C** in increasing order of complexity.

Least complex \longrightarrow Most complex

_____ \longrightarrow _____ \longrightarrow _____

Section C: Free-Response Questions

Answer the following questions.

1. Explain how the structure of the root hair cell is adapted for its functions.

2. Compare the structural differences between a typical animal cell and a typical plant cell.

3. The human skin is composed of many structures such as blood vessels, epidermal cells, nerves and sweat glands. Explain whether we should classify the skin as a tissue or an organ.


WORK ON IT!

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) Identify cell structures in diagrams or micrographs, and state the functions of organelles and membrane systems	1, 2, 3, 4, 5, 6	1	-	2.1
(b) State the relationship between cell structure and function	8, 9	2	1	2.2
(c) Compare the structures of typical animal and plant cells	-	-	2	2.1
(d) Differentiate between cell, tissue, organ and organ system	10, 11	3	3	2.2
(e) Examine and identify typical plant and animal cells under a microscope	7	-	-	2.1

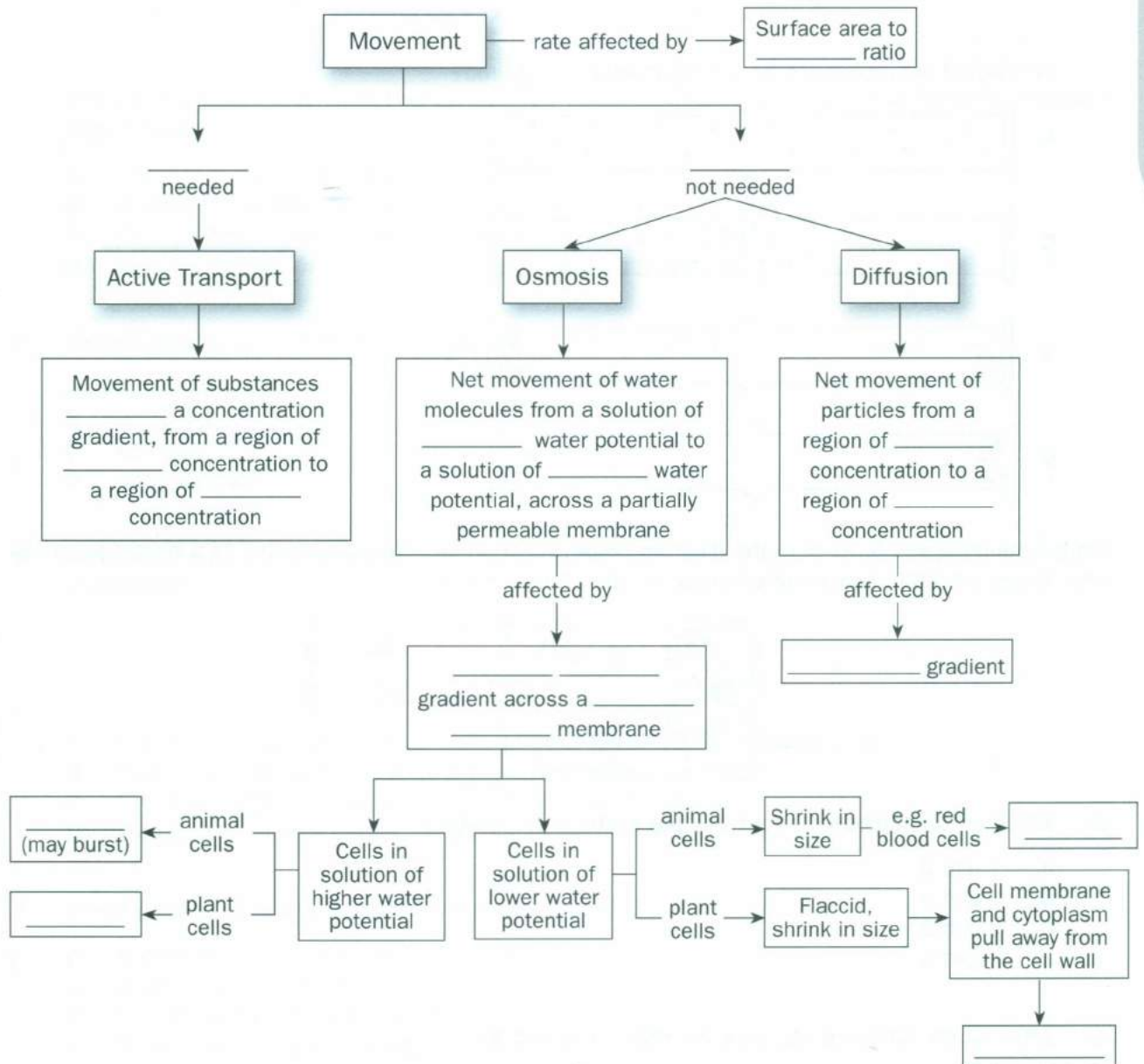
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Movement of Substances



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.

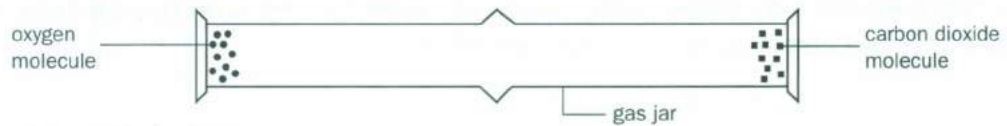


TEST IT!

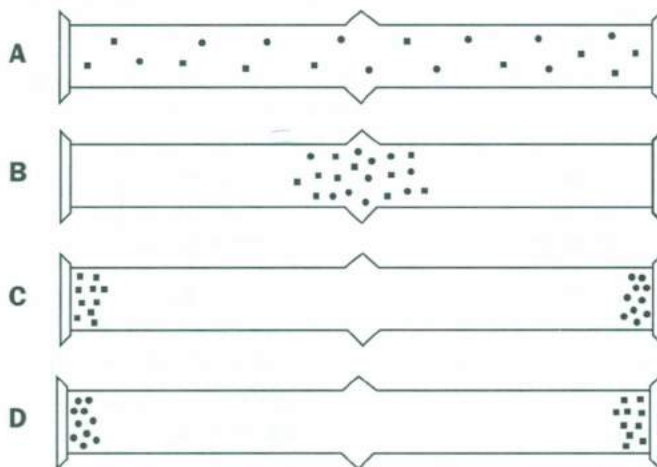
Section A: Multiple-Choice Questions

Choose the correct answer, and write its letter in the brackets provided.

1. The two gas jars shown below were left for a long time to let oxygen and carbon dioxide molecules diffuse through them.

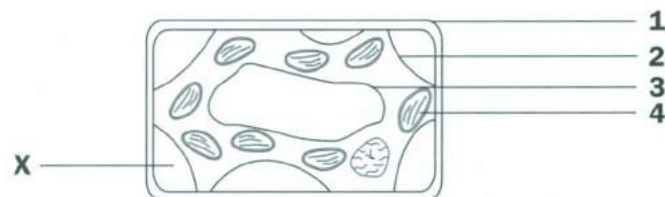


How would the molecules be arranged after a long time?



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For questions 2 and 3, refer to the diagram below, which shows the appearance of a typical plant cell after it was placed in concentrated sugar solution for 15 minutes.



2. Which of the numbered structures are partially permeable?

- A 1 and 2
- B 1 and 4
- C 2 and 3
- D 2 and 4

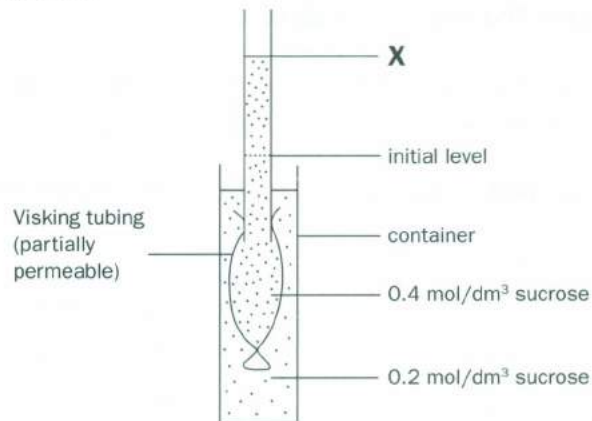
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3. Which of the following occupies the region labelled X?

- A Air
- B Cell sap
- C Sugar solution
- D Water

()

4. The diagram shows the results of an experiment after 3 hours. The liquid in the glass tube rose to point **X** from its initial level.



In a second experiment, what change could be made to cause the liquid to rise higher than point **X** after 3 hours?

- A** A larger container with the same volume of liquid
B A smaller container with the same volume of liquid
C Change the sucrose solution in the Visking tubing to water
D Change the sucrose solution in the container to water ()
5. The process by which water enters the root hair cell is called _____.
- A** active transport
B diffusion
C osmosis
D phagocytosis ()
6. Which of the following statements is true of these cells, assuming that both cells have the same thickness?



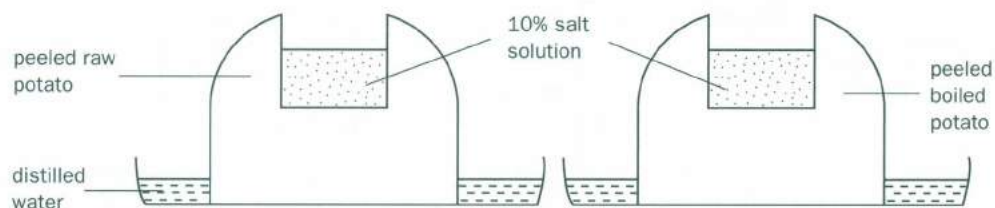
- A** Cell X is specially adapted for active transport, and Y for diffusion.
B Cell X has a greater surface area to volume ratio than Y.
C Cell Y is modified for absorbing materials into the cell.
D Diffusion of oxygen into cell Y occurs at a higher rate than X. ()
7. Which statement is true of active transport in plants?
- A** It depends on the availability of energy.
B It eventually achieves equilibrium.
C It involves the random movement of molecules.
D It relies on the kinetic energy of molecules. ()

Section B: Structured Questions

Answer the following questions in the spaces provided.

1. In an experiment, a peeled potato was cut into half, and wells were created as shown in the diagram below. One potato half was boiled before the experiment.

Both potato halves were soaked in 10 cm^3 of distilled water, before their wells were filled with 5 cm^3 of 10% salt solution.



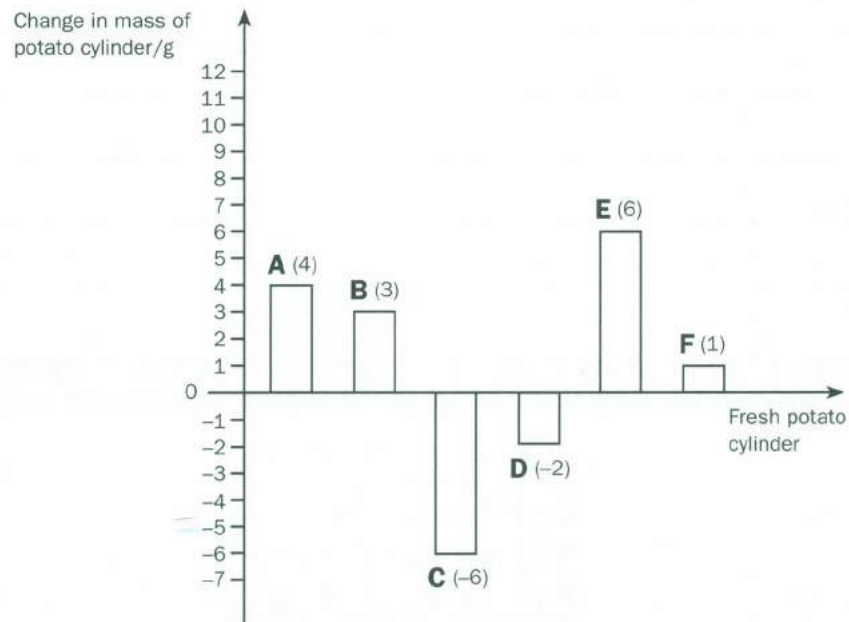
- (a) Predict what will happen to

- (i) the levels of the solution in the well of the peeled raw potato and distilled water in the dish after 24 hours.

- (ii) the levels of the solution in the well of the peeled boiled potato and distilled water in the dish after 24 hours.

- (b) Explain your answers in (a)(i) using your knowledge of diffusion and osmosis.

2. Six identical cylinders of fresh potato (**A** to **F**), each weighing 10 g, were immersed in salt solutions of different concentrations for two hours. They were removed and reweighed. The change in mass of each cylinder was recorded in a bar graph as shown.



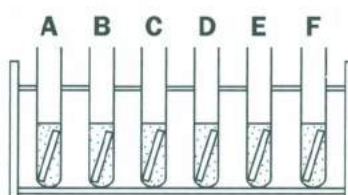
- (a) Which cylinder has been immersed in salt solution with:
- the highest concentration? _____.
 - the lowest concentration? _____.
 - a concentration closest to that of the potato cells? _____.

- (b) Explain the changes in the cells of potato cylinder **D**.

- (c) Calculate the percentage increase in mass shown by potato cylinder **A**.

(d) Suggest how the experiment can be extended to find the concentration of the potato cells.

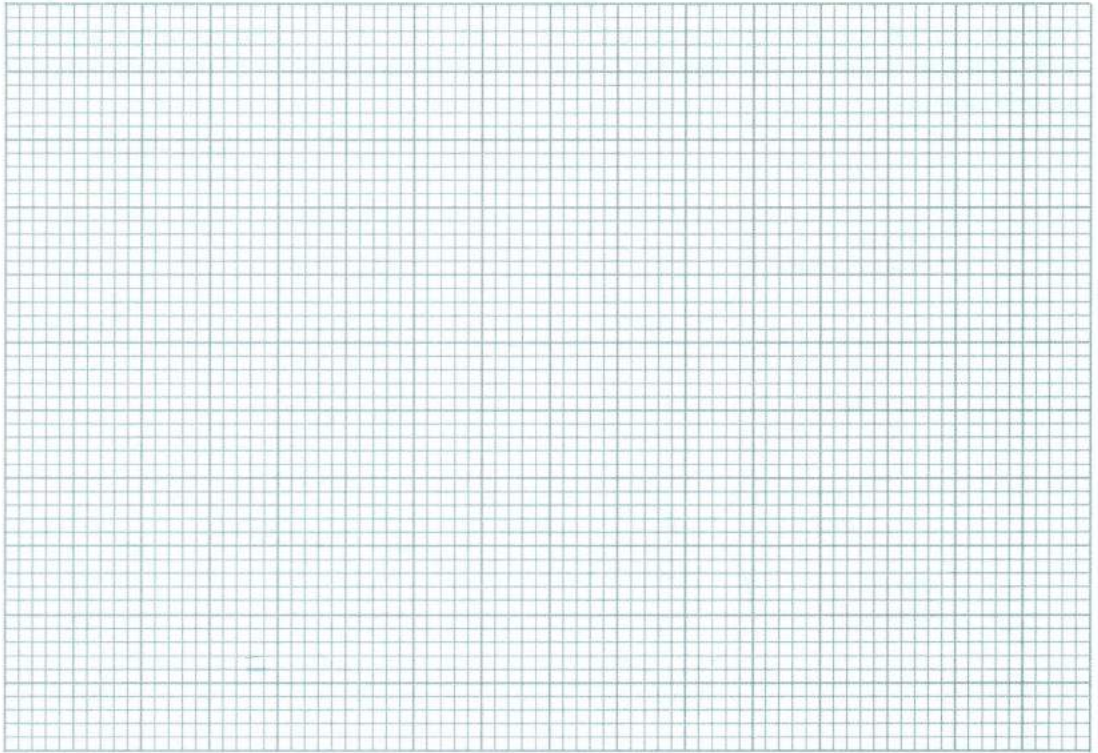
3. In an experiment, six potato strips of equal mass were cut and placed in separate test tubes as shown in the diagram below. Each test tube contained sugar solution of a different concentration.



After six hours, the potato strips were removed from the test tubes and dried carefully using a paper towel. They were then weighed again. Some of the potato strips had gained in mass, while some had lost in mass. The changes in mass are shown in the table below.

Test tube	Amount of sugar in g in 100 cm ³ of solution	Change in mass in g, increase (+) or decrease (-)
A	18	- 0.40
B	14	- 0.02
C	12	+ 0.20
D	10	+ 0.30
E	6	+ 0.60
F	2	+ 0.90

(a) Draw a graph to show the results of the experiment.



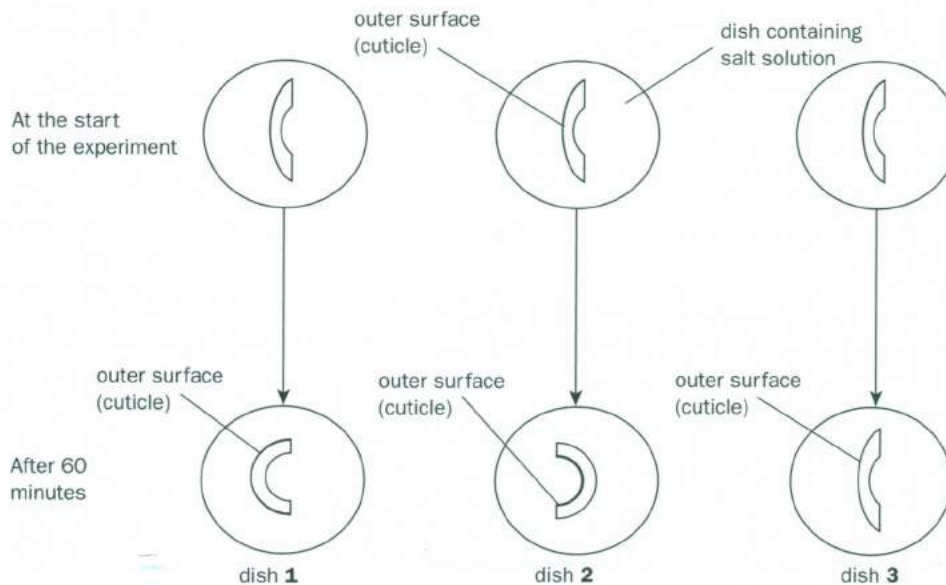
(b) Which test tube contains sugar solution with the highest concentration? Explain your answer.

(c) Use the graph to estimate a value for the sugar concentration in the potato cells.

(d) Explain why the potato strip in test tube **F** had increased in mass.

(e) Suggest **two** ways to increase the accuracy and reliability of this experiment.

4. A student carried out an experiment to find out the effect of sugar concentration on chilli strips. Three chilli strips of equal length were cut and placed in Petri dishes labelled **1**, **2** and **3**. Each Petri dish contained different concentrations of salt solution — 1% salt solution, 0.5% salt solution and 0.1% salt solution. The diagram below shows the appearance of the chilli strips initially and after 60 minutes.



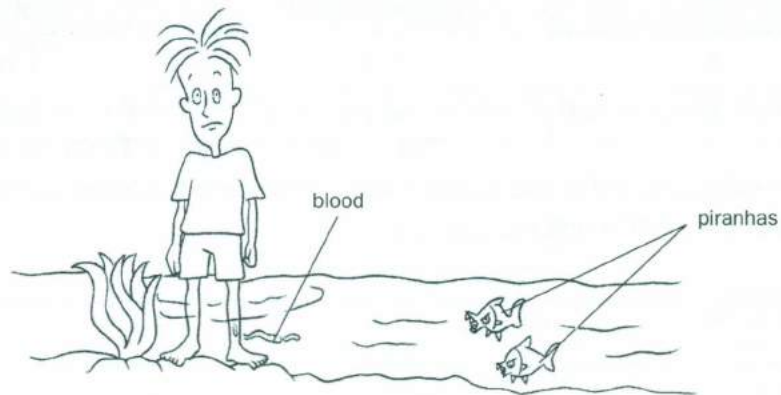
- (a) Based on the appearance of the strips after 60 minutes, deduce the concentration of the salt solution in each of the Petri dishes.

- (b) Explain how the change in the chilli strip in dish **2** was brought about.

Section C: Free-Response Questions

Answer the following questions.

1. Write a short paragraph to explain why the child, with a bleeding leg wound, shown in the diagram, is in danger of being bitten by the piranhas.



2. A scientist performed an experiment to measure the uptake of two types of sugar, Sugar **A** and Sugar **B**, by the cells of the small intestine in the presence and absence of oxygen. The table below shows the amount of sugar absorbed by the cells of the small intestine under the different conditions.

Sugar	Amount absorbed in the presence of oxygen/ arbitrary units	Amount absorbed in the absence of oxygen/ arbitrary units
A	8.0	1.8
B	6.4	6.2

Discuss the results obtained by this scientist with reference to the movement of Sugar **A** and Sugar **B** into the cells of the small intestine.

 **WORK ON IT!**

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) Define diffusion, and state its importance in nutrient uptake and gas exchange in organisms	1, 6	1	1, 2	3.1
(b) Define osmosis, and describe the effects of osmosis in plant and animal tissues	2, 3, 4, 5	1, 2, 3, 4		3.2
(c) Define active transport	7		2	3.4
(d) Discuss the importance of active transport as an energy-consuming process by which substances are transported against a concentration gradient			2	3.4

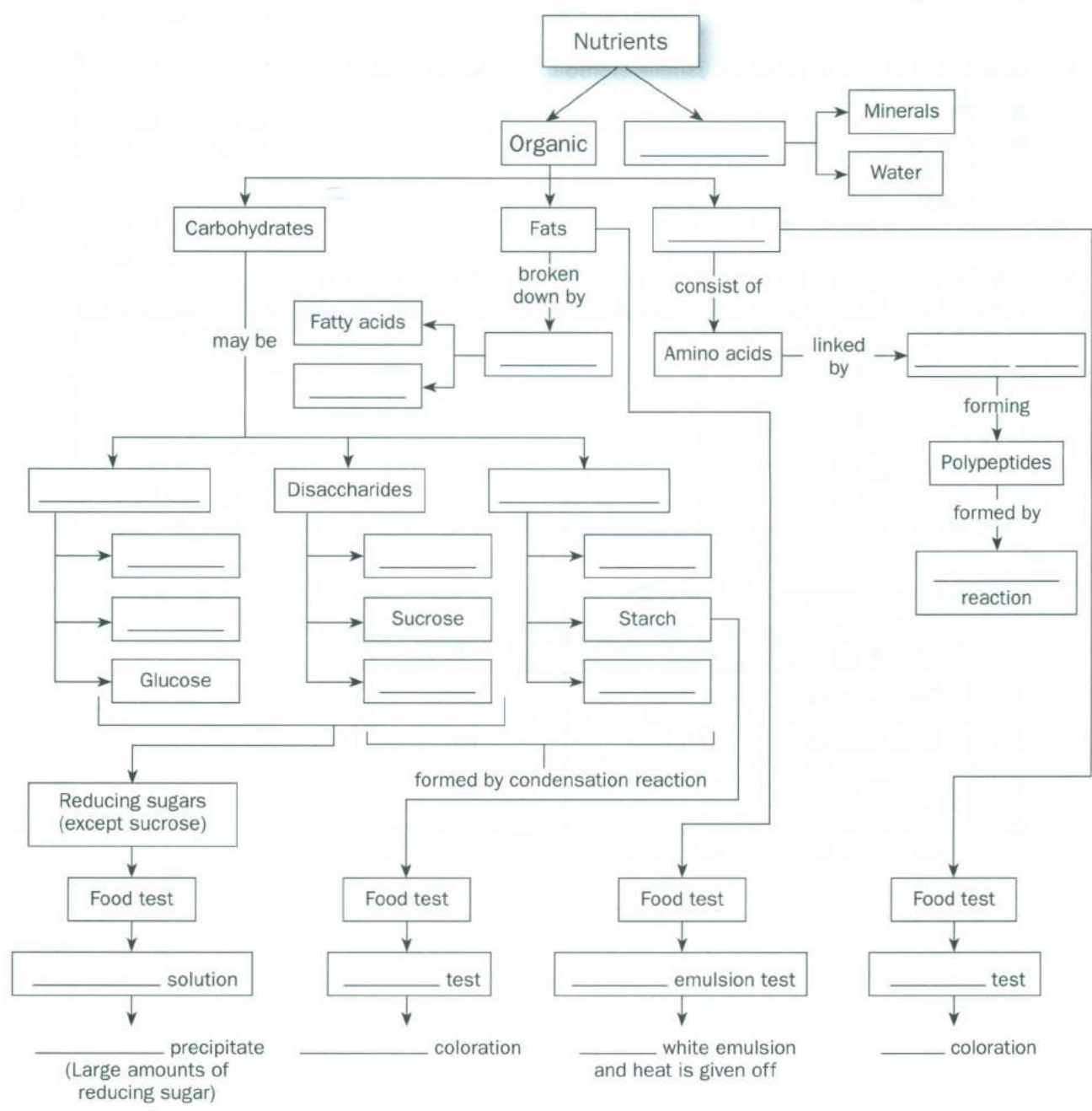
Name: _____ ()

Class: _____ Date: _____

Nutrients



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.



TEST IT!

Section A: Multiple-Choice Questions

Choose the correct answer, and write its letter in the brackets provided.

1. Which statement correctly describes one of the roles of water in the human body?

- A As a solvent to dissolve some substances
- B As a source of energy
- C As an insulating layer for the body
- D As material for the build-up of muscles

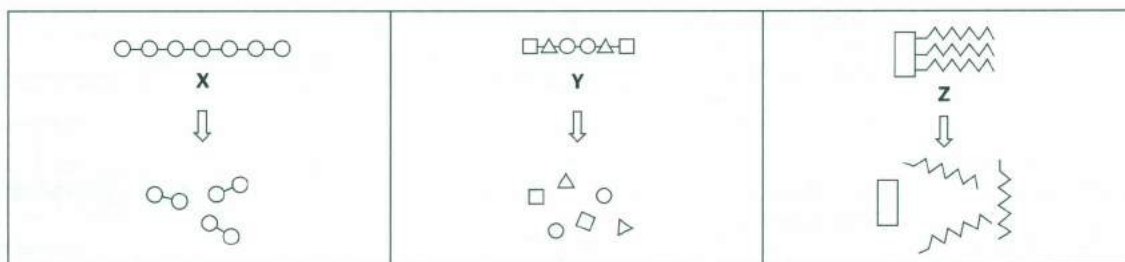
()

2. Which form of carbohydrate is usually stored in the human body?

- A Glucose
- B Glycogen
- C Glycerol
- D Starch

()

3. The diagram below shows the breakdown of three types of organic molecules.



What are the identities of X, Y, and Z?

	X	Y	Z
A	Carbohydrate	Fat	Protein
B	Carbohydrate	Protein	Fat
C	Protein	Carbohydrate	Fat
D	Protein	Fat	Carbohydrate

()

4. A student was given three test tubes, each containing two food substances. The student was asked to identify the food substances present in each test tube. The table below shows the results of the student's tests.

Test tube	Reagent added		
	Biuret solution	Benedict's solution	Iodine solution
X	Solution remains blue	Orange-red precipitate formed	Blue-black colour observed
Y	Violet colour observed	Orange-red precipitate formed	Solution remains brown
Z	Violet colour observed	Solution remains blue	Blue-black colour observed

Which conclusion is consistent with the results?

- A Egg white and maltose are present in test tube X.
 B Egg white and starch are present in test tube X.
 C Egg white and starch are present in test tube Z.
 D Starch and maltose are present in test tube Y. ()
5. Food tests are carried out on four solutions. Which solution contains only glucose and proteins? (✓ indicates a positive reaction; X indicates negative result.)

Solution	Benedict's test	Biuret test	Ethanol emulsion test
A	✓	X	✓
B	✓	✓	✓
C	✓	✓	X
D	X	✓	✓

()

Section B: Structured Questions

Answer the following questions in the spaces provided.

1. A student conducted food tests on a solution given to him. Complete the table to show the conclusions which can be drawn from the tests.

Food test	Observation	Conclusion
Sample mixed with Benedict's solution and boiled	Orange-red precipitate formed	
Sample mixed with sodium hydroxide and 1% copper sulfate, drop by drop	Violet colour observed	
Sample mixed with iodine solution	Blue-black colour observed	
Sample mixed with ethanol and then water	White emulsion formed	

2. (a) Name the type of reaction by which amino acids are linked together.

- (b) Name the product formed when many amino acids are linked together.

- (c) How does the sequence of amino acids affect the structure and function of proteins?

Section C: Free-Response Questions

Answer the following questions.

1. David is given a slice of cucumber and a slice of tomato. He is curious to find out if the food samples contain reducing sugars, proteins or fats. Outline the experiments that he should conduct to test the food samples for reducing sugars, proteins and fats.

2. Describe the structure and function(s) of carbohydrates, proteins and fats.

3. (a) Sally wants to lose weight by only eating plain rice for all her meals. Explain why it is not advisable for her to do so for a prolonged period of time.

- (b) The forms of carbohydrates stored in humans and plants are glycogen and starch respectively. Explain why glucose is not used to store carbohydrates.

 **WORK ON IT!**

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) Explain the importance of water in living organisms	1			4.2
(b) Describe how glycogen is formed from simpler glucose molecules	2, 3		2, 3	4.3
(c) Describe how fats are formed from glycerol and fatty acids	3		2, 3	4.4
(d) Describe how proteins and polypeptides are formed from amino acids	3	2	2, 3	4.5
(e) Carry out experiments to test for the presence of reducing sugars, starch, fats and proteins	4, 5	1	1	4.3, 4.4, 4.5

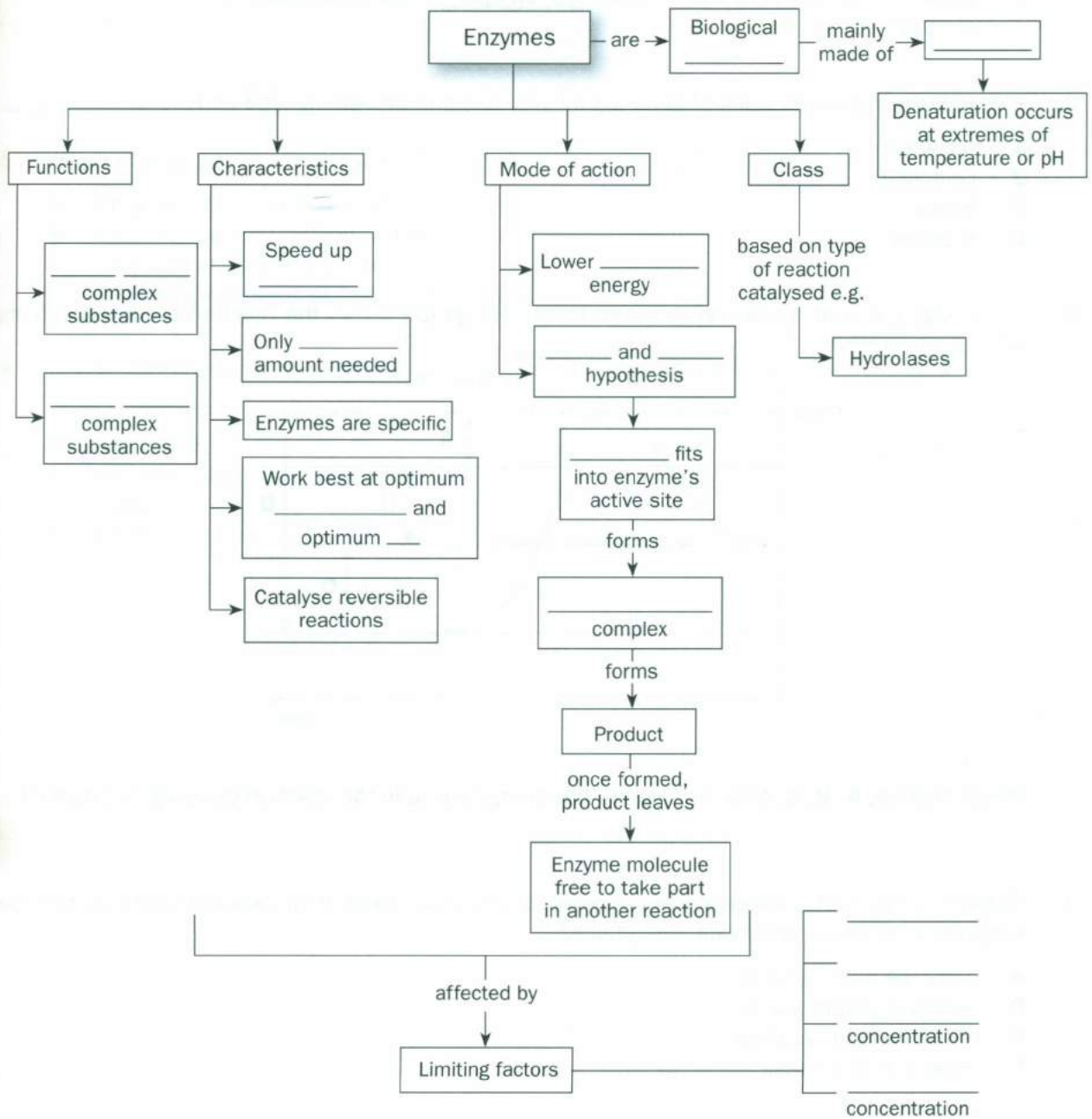
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Class: _____ Date: _____

Enzymes



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.

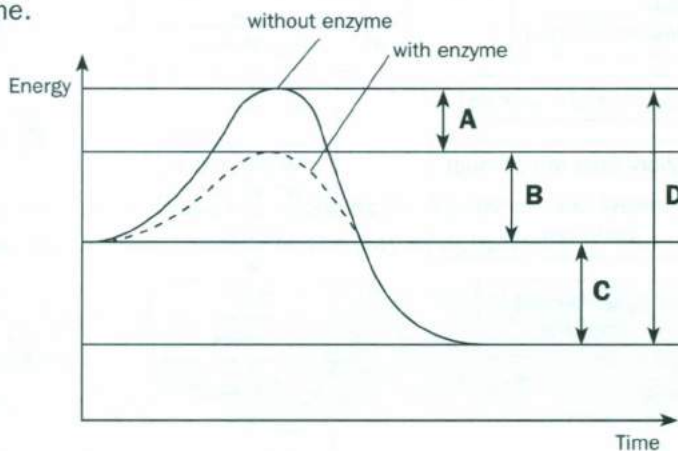


TEST IT!

Section A: Multiple-Choice Questions

Choose the correct answer, and write its letter in the brackets provided.

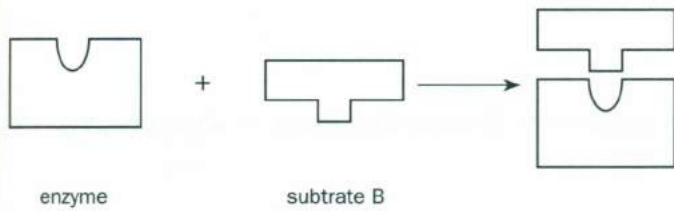
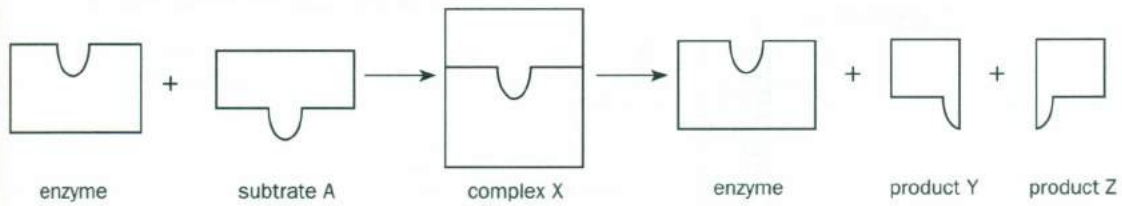
- Enzymes are _____.
 A proteins that are used up in chemical reactions
 B proteins that catalyse chemical reactions at any temperature
 C proteins that catalyse chemical reactions in living organisms
 D proteins that speed up the breakdown of complex compounds into simpler substances ()
- To digest the xylem cell walls of dead plant cells, bacteria secrete lignase and _____.
 A amylase
 B cellulase
 C lipase
 D sucrase ()
- The energy graph of a reaction is shown below. The graph shows the reaction occurring with and without an enzyme.



Which interval, **A**, **B**, **C**, or **D**, represents the energy saved in the reaction by using an enzyme? ()

- Enzymes are added to biological washing powders to remove stains. Which would be the most effective enzymes in removing chocolate milk stains?
 A Amylase and catalase
 B Amylase and maltase
 C Protease and catalase
 D Protease and lipase ()

For questions **5** and **6**, refer to the diagram below.



5. Which characteristic of enzymes is the diagram above trying to illustrate?

- A** Enzymes are specific in nature.
- B** Enzymes speed up chemical reactions.
- C** Enzymes work best at optimum pH.
- D** Enzymes work best at optimum temperature.

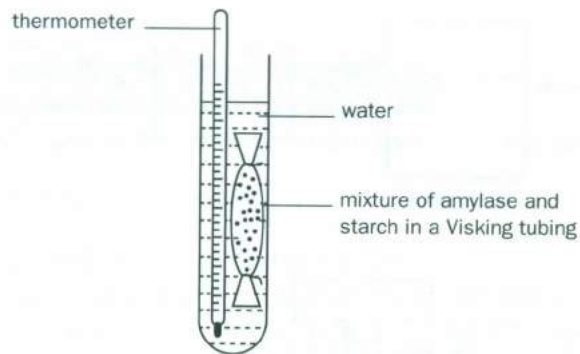
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6. The reaction between substrate **A** and the enzyme to produce **Y** and **Z** is an example of

- A** anabolism
- B** condensation
- C** hydrolysis
- D** photosynthesis

()

7. The diagram shows an experiment that was carried out with water at different temperatures.

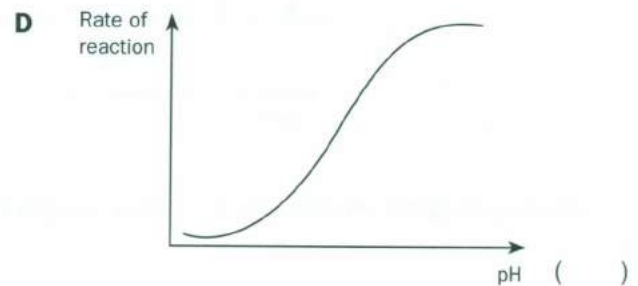
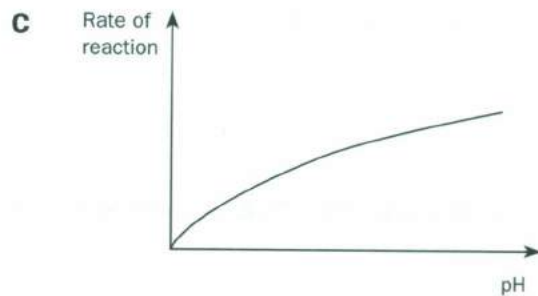
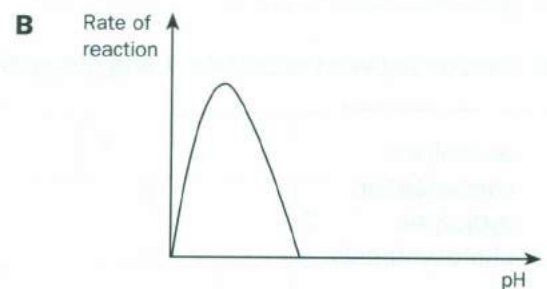
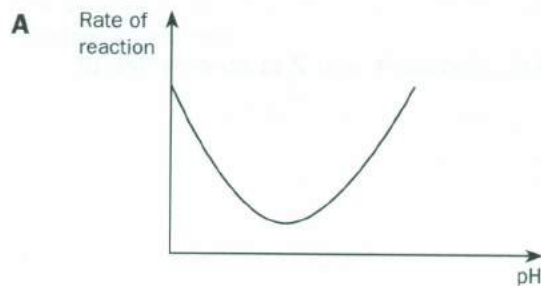


The water was tested for the presence of reducing sugar at 30-second intervals. At which temperature would reducing sugar be detected most rapidly?

- A 10°C
- B 20°C
- C 40°C
- D 100°C

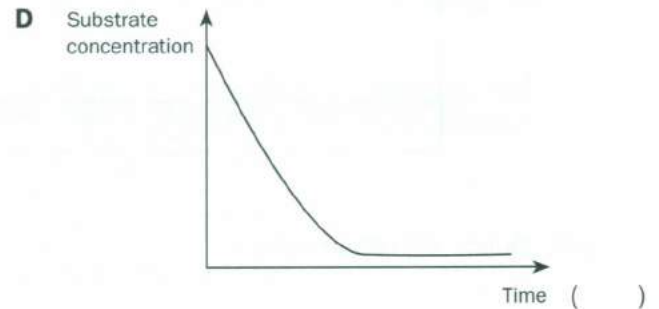
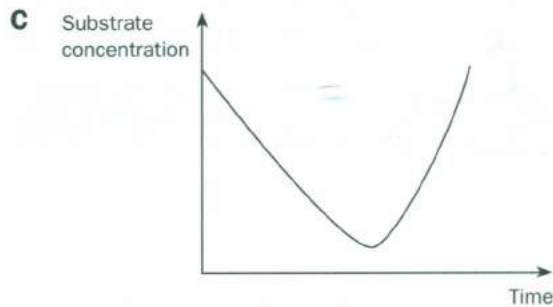
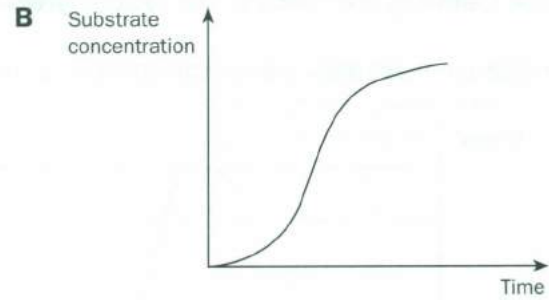
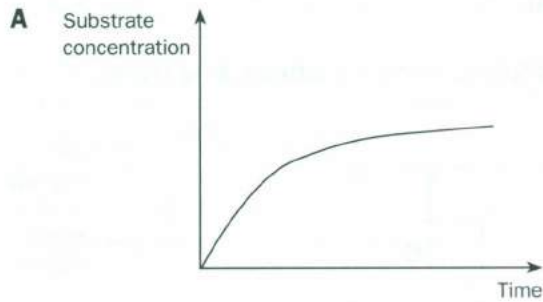
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8. Which graph correctly shows the effect of pH on the rate of reaction of an enzyme-catalysed reaction?

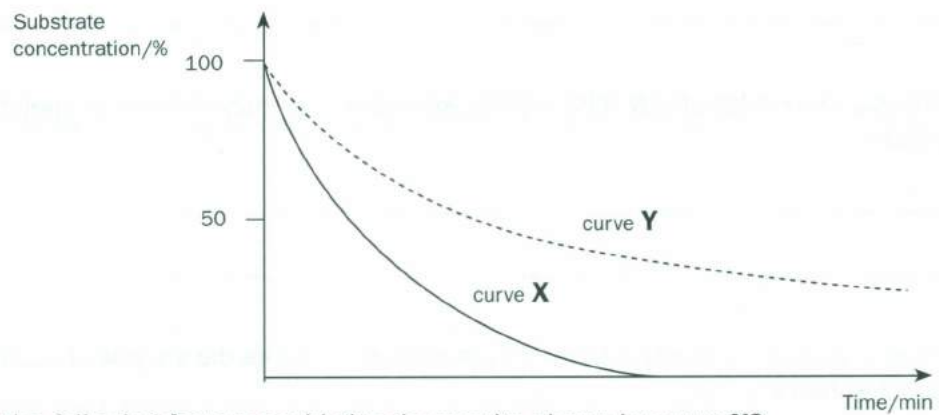


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9. Which graph correctly represents the changes in substrate concentration in an enzyme-catalysed reaction given a fixed temperature and a fixed pH?



10. Curve **X** represents an enzyme-catalysed reaction under optimum conditions. Curve **Y** shows the action of the same enzyme on the same substrate, but with one alteration to the reaction condition.



Which of the following factors could give the results shown by curve **Y**?

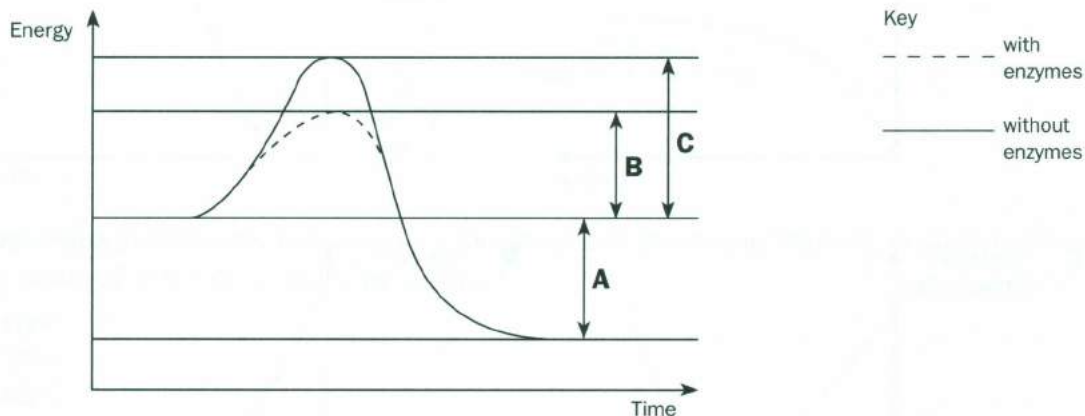
- A** A 10°C decrease in temperature
- B** A decreased substrate concentration
- C** An increased enzyme concentration
- D** An increased substrate concentration

()

Section B: Structured Questions

Answer the following questions in the spaces provided.

1. The diagram illustrates the energy changes in a reaction, with and without an enzyme.



- (a) Define *activation energy*.

- (b) Using the intervals **B** and **C**, how would you describe the lowering of activation energy caused by an enzyme?

- (c) Using your knowledge of activation energy, explain how an enzyme helps to speed up a chemical reaction.

- (d) Give an example of a reaction that involves an enzyme. State the enzyme, its substrate and the product(s) formed.

2. **X** is an unknown substance extracted from a living organism. A student was required to investigate the ability of **X** to bring about the hydrolysis of starch. She set up two water baths, one containing boiling water (100°C) and the other containing water at 36°C.

The student used the water baths and set up the reaction mixtures as follows:

- Test tube **1**: 1 cm³ of **X** (pre-treated at 100°C for 1 minute) + 9 cm³ of distilled water
- Test tube **2**: 1 cm³ of **X** (pre-treated at 36°C for 1 minute) + 9 cm³ of distilled water
- Test tube **3**: 1 cm³ of **X** (pre-treated at 100°C for 1 minute) + 9 cm³ of starch
- Test tube **4**: 1 cm³ of **X** (pre-treated at 36°C for 1 minute) + 9 cm³ of starch
- Test tube **5**: 1 cm³ of distilled water + 9 cm³ of starch

The reaction mixtures were placed in the water bath that contained water at 36°C. After 15 minutes, the student tested the mixture in each test tube for the presence of reducing sugar using Benedict's test. Her observations were as follows:

Test tube	Observation for Benedict's test
1	Mixture remained blue
2	Mixture remained blue
3	Mixture remained blue
4	Mixture turned from blue to orange-red
5	Mixture remained blue

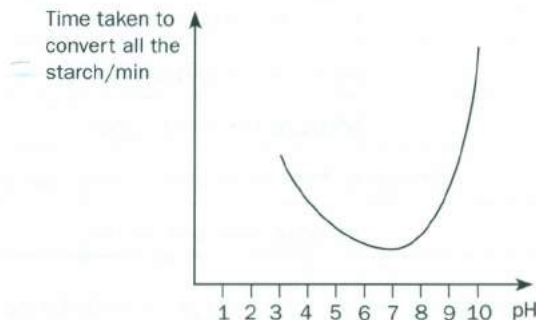
- (a) Based on the student's observations, what is the action of substance **X** on starch?

- (b) What evidence supports that substance **X** contains an enzyme?

- (c) Suggest **two** experiments that the student could perform to find out if substance **X** contains an enzyme.

(d) What is the purpose of including test tubes **1** and **2**? Why are they necessary?

3. An experiment was conducted to investigate the action of the enzyme amylase in solutions of different pH. Eight test tubes were set up, each filled with 5 cm³ of buffered solutions of pH 3, 4, 5, 6, 7, 8, 9 and 10 respectively. 5 cm³ of amylase and 30 cm³ of starch were then added to each test tube, in sequence. 1 cm³ of the mixture was taken out every 30 seconds, and tested for starch using the iodine test, until it gave a negative starch test. The time taken to digest all the starch was recorded. The results were represented in the graph below.

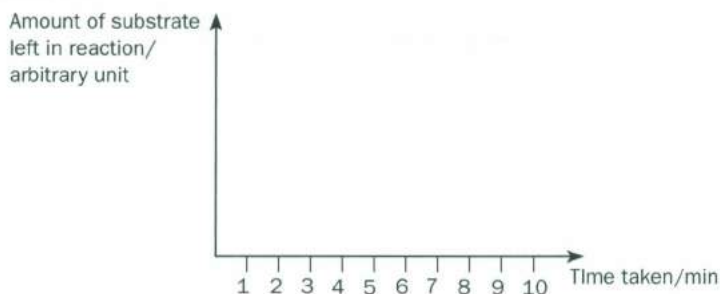


(a) What variable (factor) was being tested in this experiment?

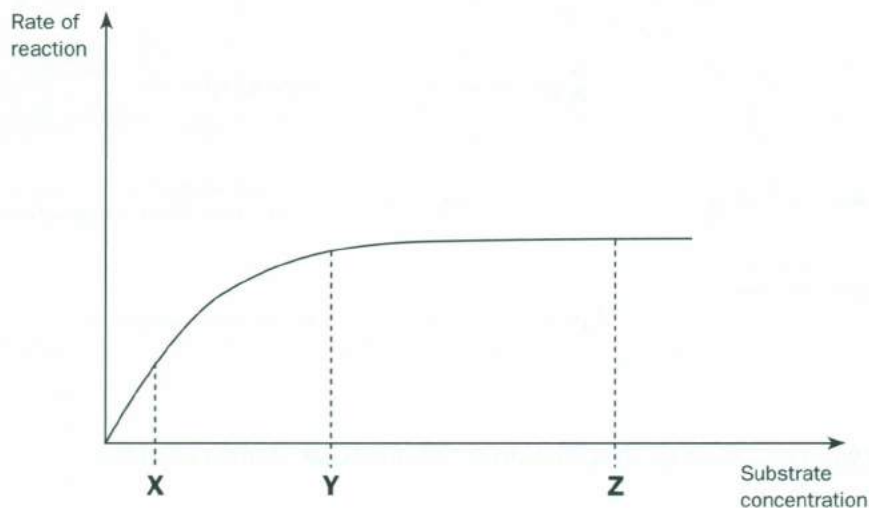
(b) Name **two** conditions that had to be kept constant.

(c) From the results, what is the optimum pH of amylase? Explain your answer.

(d) Sketch on the diagram below, how the amount of substrate varies during the reaction at optimum conditions.



4. The graph below shows the rate of an enzyme-catalysed reaction with increasing substrate concentration.



- (a) Describe how substrate concentration affects the rate of reaction at the following points:

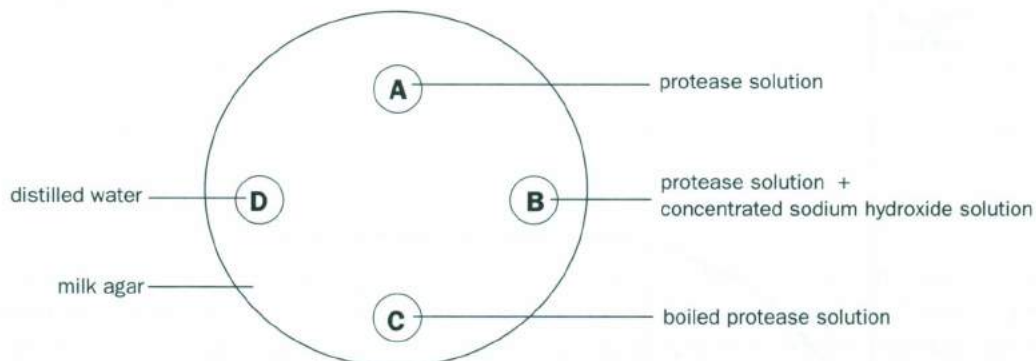
(i) Point X;

(ii) Point Y; and

(iii) Point Z.

- (b) Suggest a limiting factor between points Y and Z.

5. A dish is filled with milk agar made by mixing milk with agar powder. Four holes are cut in the milk agar, and each hole is filled with the substances shown.



- (a) Write a word equation to show the effect of protease on milk proteins.

- (b) After one day of incubation at 37°C, the agar plate is put under a light box to observe for clear zones around the holes.

- (i) Why should one look for clear zones around the holes?

- (ii) State what you would observe in each hole.

Hole A: _____

Hole B: _____

Hole C: _____

Hole D: _____

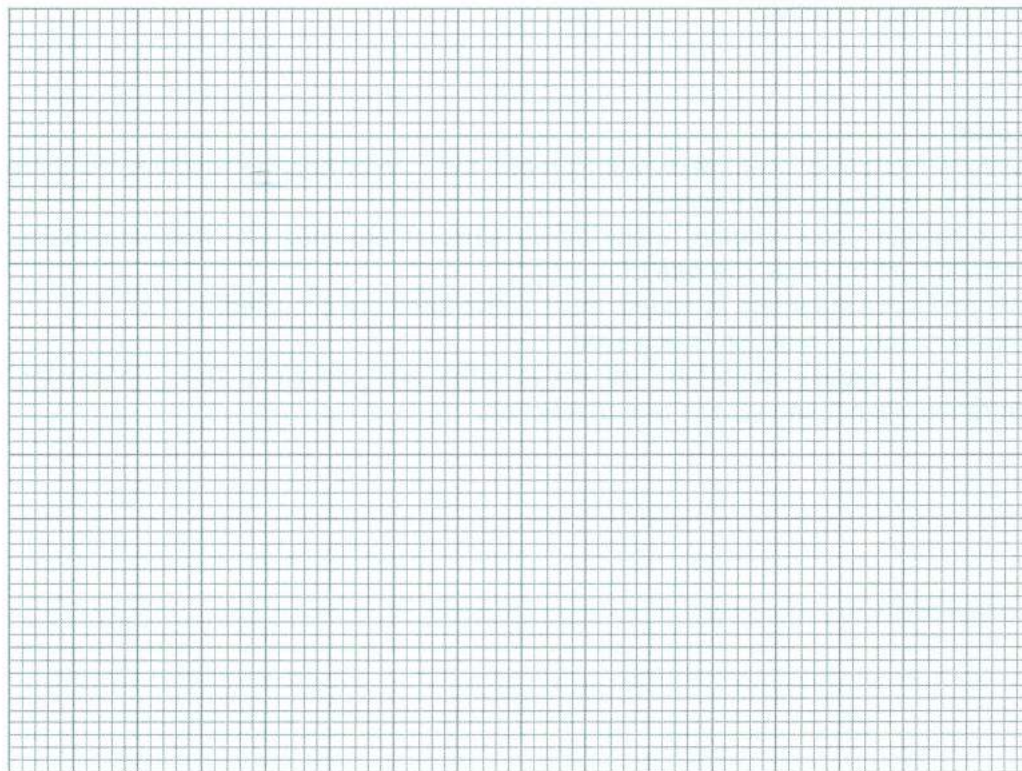
- (c) Explain the purpose of distilled water in hole D.

6. The enzyme catalase catalyses the breakdown of hydrogen peroxide to water and oxygen. An experiment was set up to find the initial rate of reaction of catalase. The volume of oxygen is measured at every 30-second interval. The results are shown below.

Time/s	30	60	90	120	150	180	210	240	270	300
Gas volume collected/cm ³	6	12	16	19	22	23	24	25	25.5	26

- (a) Explain the meaning of 'catalyse'.

- (b) Plot a graph of the results obtained.



- (c) From the graph, calculate the initial rate of reaction. Show your working clearly.

- (d) Name **two** conditions or factors that had to be kept constant in this experiment.

LEARN & APPLY

Go through the worked example below, then try to answer the Free-Response Questions.

Worked Example

Explain, with reasons and examples, why the biological activity of an enzyme may be affected by substrate concentration.

Thought Process

This question tests your understanding of the concept of limiting factors. A substrate is a substance that reacts with an enzyme. As an aid to answer this question, bear in mind the graph that illustrates the relationship between the rate of reaction and substrate concentration.

Describe the effects of low substrate concentration, high substrate concentration and excess substrate concentration on enzyme activity.

Answer

Points to cover

1. Increasing substrate concentration will increase the rate of enzyme reaction, as there are more molecules to react with the enzymes.
2. At low substrate concentration, many active sites of enzymes are free. Increasing substrate concentration will increase the rate of reaction.
3. As more and more substrate is added, more active sites are occupied.
4. The maximum rate of reaction is achieved.
5. When there is excess substrate, all active sites are occupied. Thus, increasing substrate concentration will not change the rate of reaction.

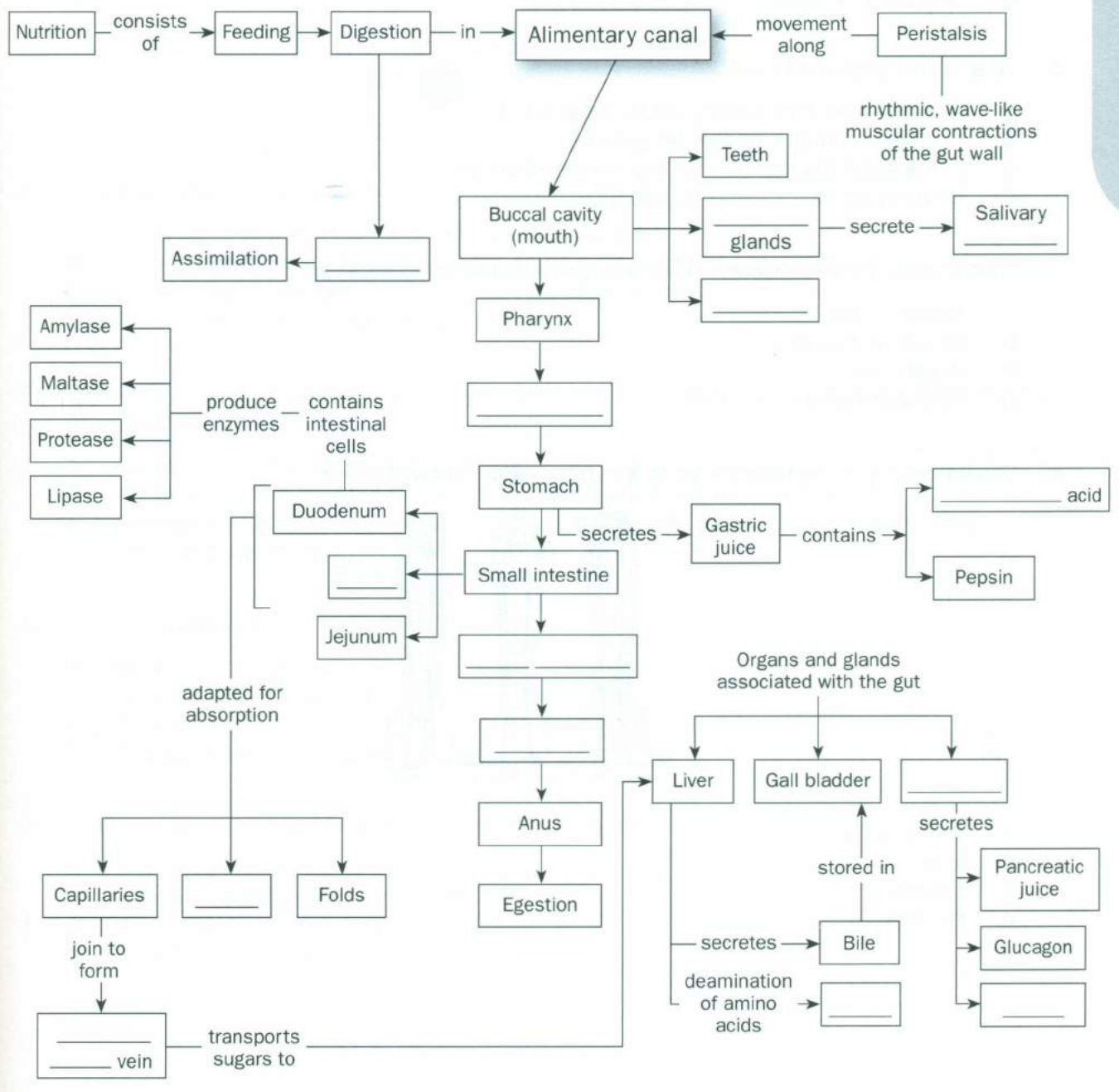
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Nutrition in Humans



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.



TEST IT!

Section A: Multiple-Choice Questions

Choose the correct answer, and write its letter in the brackets provided.

1. Carbohydrate digestion occurs mainly in the _____.

- A mouth and duodenum
- B mouth and stomach
- C stomach and duodenum
- D stomach and ileum

()

2. What is the function of bile?

- A To break down fat into fatty acids and glycerol
- B To emulsify fat into smaller fat globules
- C To transport the digested fat into the bloodstream
- D To transport the digested fat into the lacteals

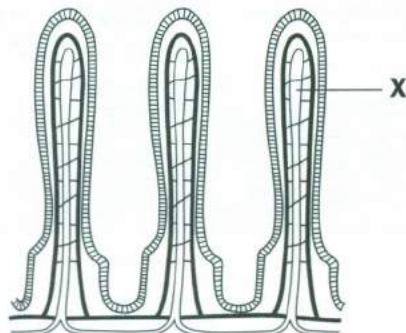
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3. Which blood vessel transports absorbed food substances to the liver?

- A Hepatic artery
- B Hepatic portal vein
- C Hepatic vein
- D Pulmonary artery

()

4. What substances are transported in **X** in the diagram shown below?

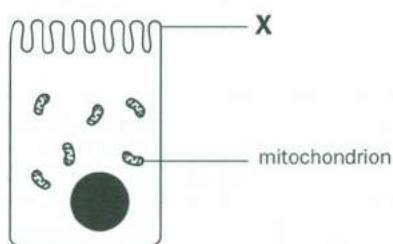


- A Amino acids
- B Fats
- C Glucose
- D Glycerol

()

5. Excess amino acids are toxic to the human body, and must be deaminated. Excess amino acids are deaminated in the _____.
- A ileum
 - B large intestine
 - C liver
 - D stomach
- ()

For questions 6 and 7, refer to the diagram below which shows an epithelial cell from a villus.



6. How does structure **X** aid in the absorption of digested food?
- A By active transport of the digested food into the villus
 - B By increasing the surface area to volume ratio for absorption of digested food
 - C By secreting enzymes to digest and absorb digested food
 - D By sweeping the food particles into the villus
- ()
7. There are many mitochondria in the epithelial cell of a villus. What is the function of these mitochondria?
- A Control the activity of the epithelial cell
 - B Increase surface area to volume ratio for diffusion of digested food particles
 - C Release energy required for active transport of digested food particles into the villus
 - D Produce enzymes that digest food particles
- ()
8. Which of the following is **not** a function of the liver?
- A Breakdown of haemoglobin
 - B Deamination of excess amino acids
 - C Produce insulin
 - D Site for conversion of glucose into glycogen for storage
- ()
9. What happens to alcohol after it enters the human body?
- A Alcohol is absorbed by the stomach.
 - B Alcohol is deaminated by the liver.
 - C Alcohol is detoxified by the liver.
 - D Alcohol is passed out as urine.
- ()

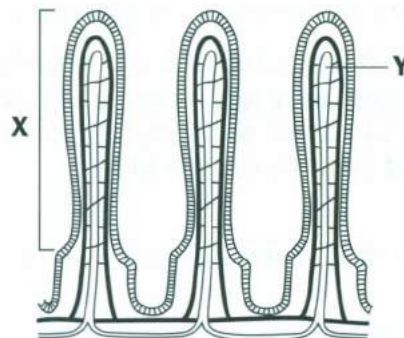
Section B: Structured Questions

Answer the following questions in the spaces provided.

1. Complete the table below, which illustrates the digestive process.

Region of digestion	Active enzyme	Substrate	Product(s)
Mouth	Amylase		
Stomach		Proteins	
Duodenum			Glucose
		Polypeptides	
		Fats	

2. The diagram below shows structures from a part of the alimentary canal.



- (a) In which part of the alimentary canal are these structures found?

- (b) Identify X and Y.

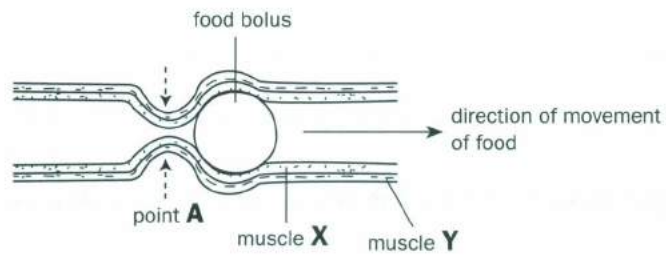
X: _____

Y: _____

- (c) X is structurally adapted to absorb digested food. Suggest **two** such adaptations.

- (d) Identify a substance that can be found in **Y**, and state the function of **Y**.

3. The diagram below shows structures from a part of the alimentary canal.



- (a) Food moves along the alimentary canal through the contraction and relaxation of muscles. What is this process known as?

- (b) Identify muscle **X** and muscle **Y**.

- (c) Describe the action of muscles **X** and **Y** at point **A**.

Section C: Free-Response Questions

Answer the following questions.

1. Coeliac disease is a human gastrointestinal disease that is characterised by the destruction of villi in the small intestine.

(a) Explain the effect of the destruction of villi on absorption.

(b) Suggest and account for the signs and symptoms that may arise as a result of coeliac disease.

2. A patient suffering from gall bladder disease has his gall bladder removed. Suggest and explain the type of diet and lifestyle that he should adopt after his gall bladder was removed.


WORK ON IT!

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) Describe the functions of the main regions of the alimentary canal and the associated organs, in relation to ingestion, digestion, absorption, assimilation and egestion of food	1		2	6.1
(b) Describe peristalsis, and explain its function in mixing and propelling the contents of the alimentary canal		3		6.1
(c) Describe the functions of enzymes such as amylase, maltase, protease and lipase in digestion, listing the substrates and end-products		1		6.2
(d) Describe the structure of a villus and its role, including the role of capillaries and lacteals in absorption	4, 6, 7	2	1	6.3
(e) State the function of the hepatic portal vein	3			6.4
(f) State the role that the liver plays in human nutrition	2, 5, 8		3	6.5
(g) Describe the effects of excessive consumption of alcohol	9			6.5

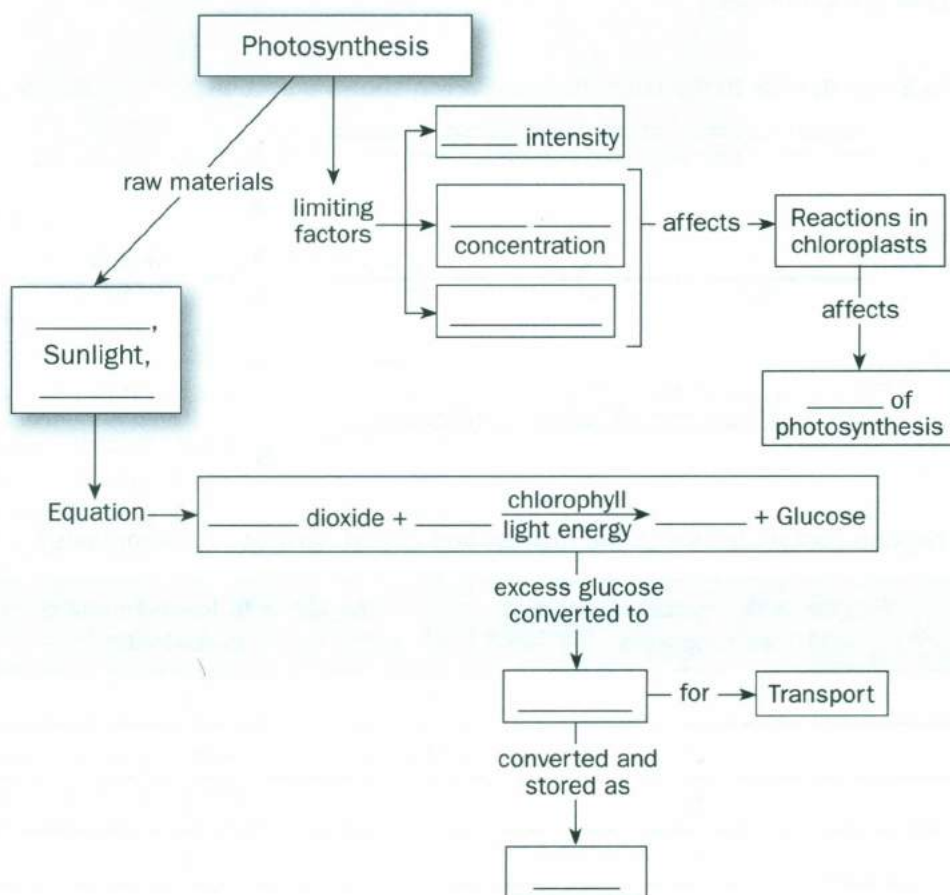
Name: _____ ()

Class: _____ Date: _____

Nutrition in Plants



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.



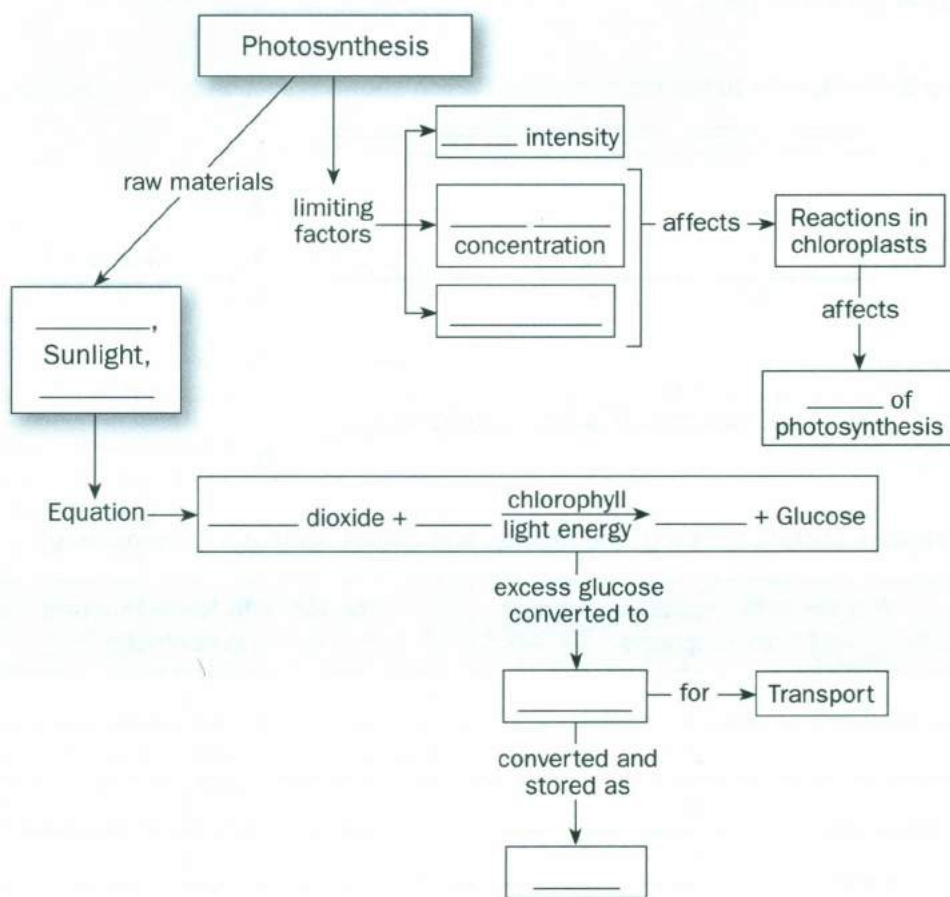
Name: _____ ()

Class: _____ Date: _____

Nutrition in Plants



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.



TEST IT!

Section A: Multiple-Choice Questions

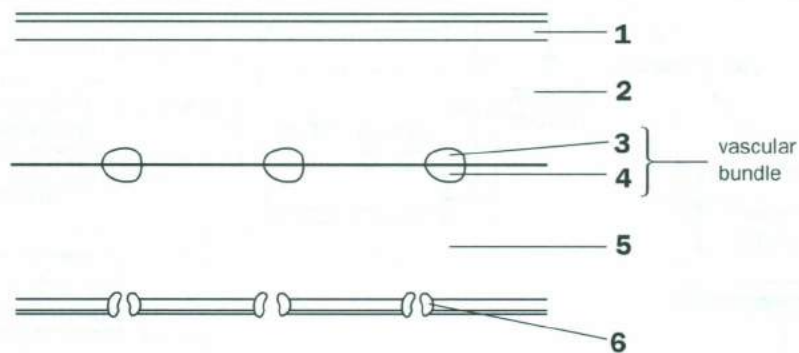
Choose the correct answer, and write its letter in the brackets provided.

1. Which of the following leaf cells do **not** contain chloroplasts?

- A Guard cells
- B Palisade mesophyll cells
- C Spongy mesophyll cells
- D Upper epidermal cells

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For questions 2 and 3, refer to the diagram below which shows a section from the leaf of a green plant.



2. Which regions contain cells with the highest and lowest number of chloroplasts?

	Region with highest number of chloroplasts	Region with lowest number of chloroplasts
A	1	2
B	2	6
C	5	2
D	6	1

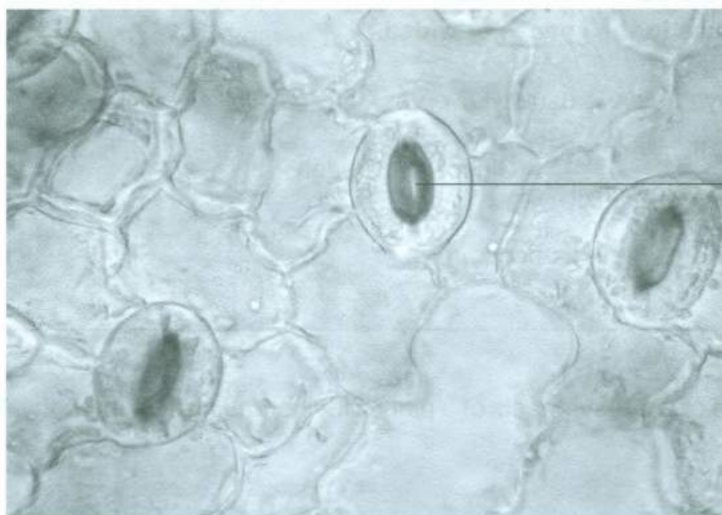
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3. After a period of bright light, which regions contain the most starch?

- A 1 and 6
- B 2 and 4
- C 2 and 5
- D 3 and 5

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4. The photo below shows part of a green plant. What is **X**?



- A** Guard cell
B Palisade mesophyll
C Spongy mesophyll
D Stoma ()
5. How does most of the carbon dioxide enter the photosynthesising cells of a leaf?
A Diffusion through the epidermis of the leaf
B Diffusion through the phloem of the leaf
C Diffusion through the stomata of the leaf
D Diffusion through the xylem of the leaf ()
6. The first step in the test for starch in a leaf, is to place the leaf in boiling water for about 5 minutes. What is the rationale for this step?
A To denature all enzymes in the leaf
B To make the leaf softer so that it is easier to test for starch
C To remove air in the leaf
D To remove chlorophyll from the leaf ()
7. Glucose, that is manufactured by green leaves during photosynthesis, may be converted into a storage form or be transported to parts of the plant that need glucose. In what form is glucose being stored and transported within the plant?

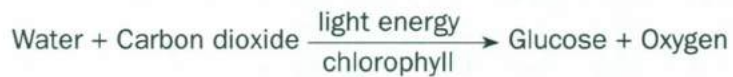
	Storage form of glucose	Transported form of glucose
A	Glycogen	Glucose
B	Glycogen	Sucrose
C	Starch	Glucose
D	Starch	Sucrose

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Section B: Structured Questions

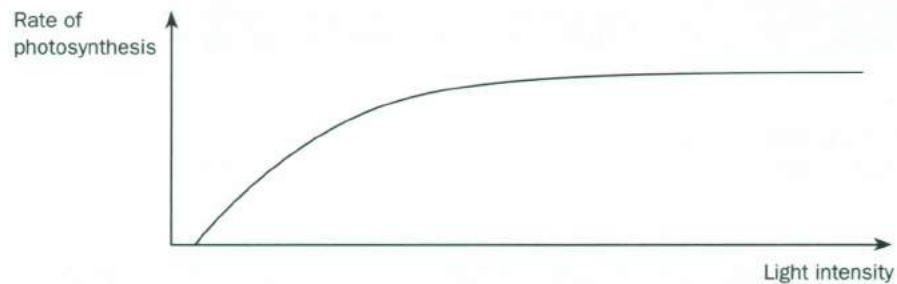
Answer the following questions in the spaces provided.

1. The equation for photosynthesis is usually given as:



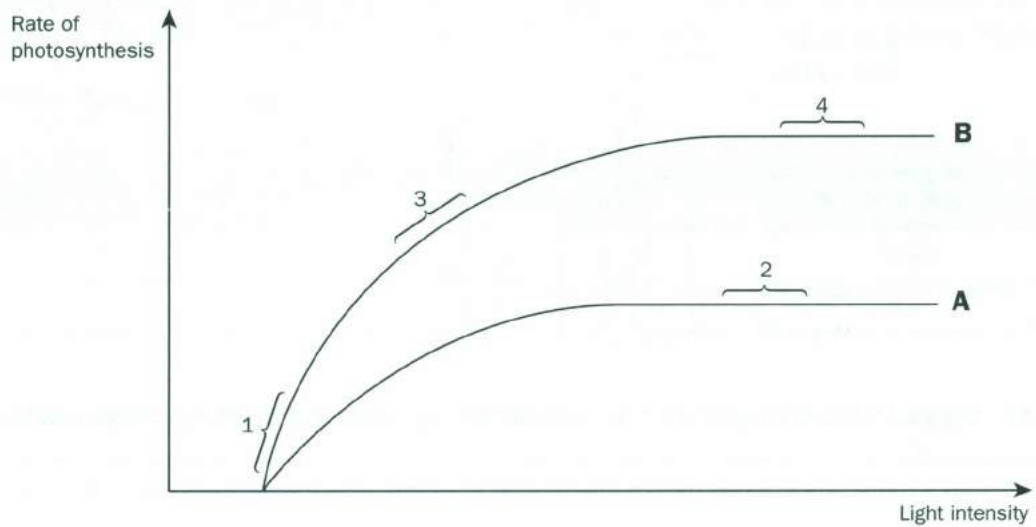
Which organelle does photosynthesis occur in?

2. The graph shows the rate of photosynthesis of a plant with increasing light intensity. The temperature was kept at 20°C.



- (a) Mark the section of the graph where light intensity is the major limiting factor. Label this section as **X**.
- (b) Mark the section of the graph where a factor other than light intensity is limiting the rate of photosynthesis. Label this section as **Y**.
- (c) Suggest a possible limiting factor at section **Y**.
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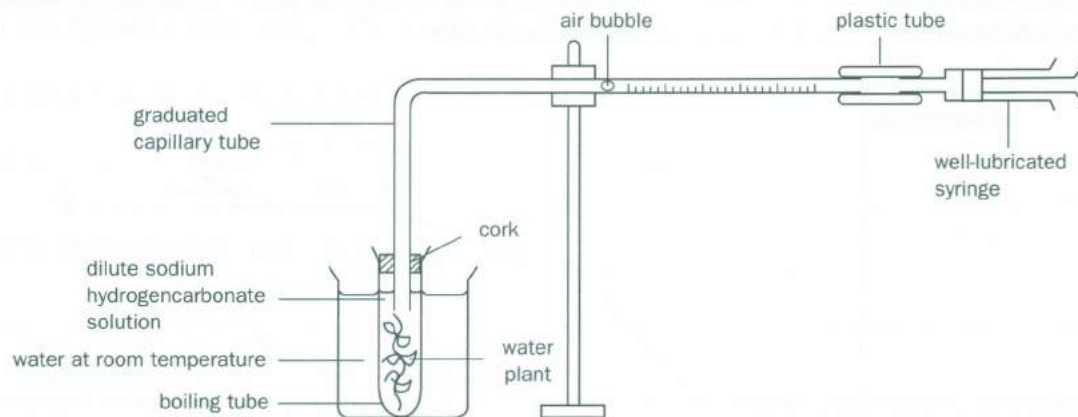
3. The graph below shows the effect of light intensity on a plant's rate of photosynthesis at two different temperatures. Curve **A** was obtained from a plant kept at lower temperature, while curve **B** was obtained from a plant kept at a higher temperature.



- (a) What factor(s) was (were) affecting the rate of photosynthesis at each of the regions, 1, 2 and 3, on the graph? Give reasons for your answers.

- (b) Suggest **two** factors that might have been limiting the rate of photosynthesis at region 4 on curve **B**.

4. The apparatus below can be used to investigate the rate of photosynthesis.



(a) Suggest what is measured in this experiment to show that photosynthesis has occurred.

(b) Describe how this apparatus can be used to measure the effect of light intensity on the rate of photosynthesis.

(c) State **three** steps that need to be taken during the experiment described in (b) to minimise sources of errors.

5. A shoot of *Hydrilla* was placed in a boiling tube containing pond water. A bench lamp with a 60 W bulb shining at the boiling tube, was placed 25 cm away. An oxygen probe was put into the boiling tube, and the oxygen concentration was recorded by a data logger. The oxygen concentration was recorded after 5 minutes and again 10 minutes later. The experiment was then repeated using the same *Hydrilla* in the same boiling tube, but with the lamp placed 5 cm away from the boiling tube.

The results are given in the table below.

Distance of lamp/cm	Oxygen concentration after 5 mins/% saturation	Oxygen concentration after 10 mins/% saturation
25	60	65
5	64	84

- (a) Draw the experimental set-up as described above.



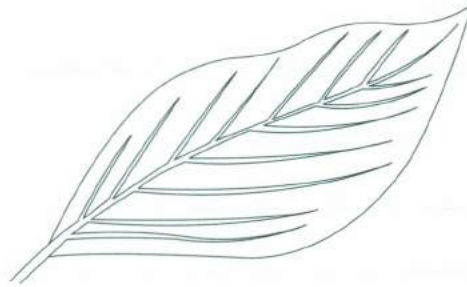
(b) Based on the results of this experiment, explain the effect of light intensity on oxygen production.

(c) (i) What process are we trying to investigate when we measure the oxygen concentration in this experiment?

(ii) Why is the measurement of oxygen concentration considered an inaccurate measurement of the rate of the process stated in (c)(i)?

(d) State one environmental condition that would need to be kept constant during this experiment. Describe how this condition can be kept constant.

6. Photosynthesis takes place mostly in the leaves of plants. The laminae of most leaves are wide and thin, as shown in the diagram below.



- (a) Name the cells in the leaf where most photosynthesis takes place.

- (b) Which tissue in the leaf supplies water to the cells for photosynthesis?

- (c) Explain how having a wide lamina helps a leaf to photosynthesise.

- (d) Explain how having a thin lamina helps a leaf to photosynthesise.

- (e) Most leaves are covered with a transparent, waterproof cuticle. How does this feature aid in photosynthesis?

Section C: Free-Response Questions

Answer the following questions.

- 1. Discuss the major adaptations of the leaf for photosynthesis.


WORK ON IT!

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) State that chlorophyll traps light energy, and converts it into chemical energy for the formation of carbohydrates	7	1		7.1
(b) State the equation, in words and symbols, for photosynthesis		1		7.1
(c) Investigate and discuss the factors affecting the rate of photosynthesis		3, 4, 5	2	7.1
(d) Discuss limiting factors that can affect the rate of photosynthesis		2, 3	2	7.1
(e) Identify and label the various cellular and tissue structures of a dicotyledonous leaf as seen under the microscope	4, 5			7.2
(f) Relate how the structure of the leaf is adapted to its functions	1, 2, 3, 6	1, 6	1	7.2
(g) Describe the intake of carbon dioxide and water by plants	5			7.2

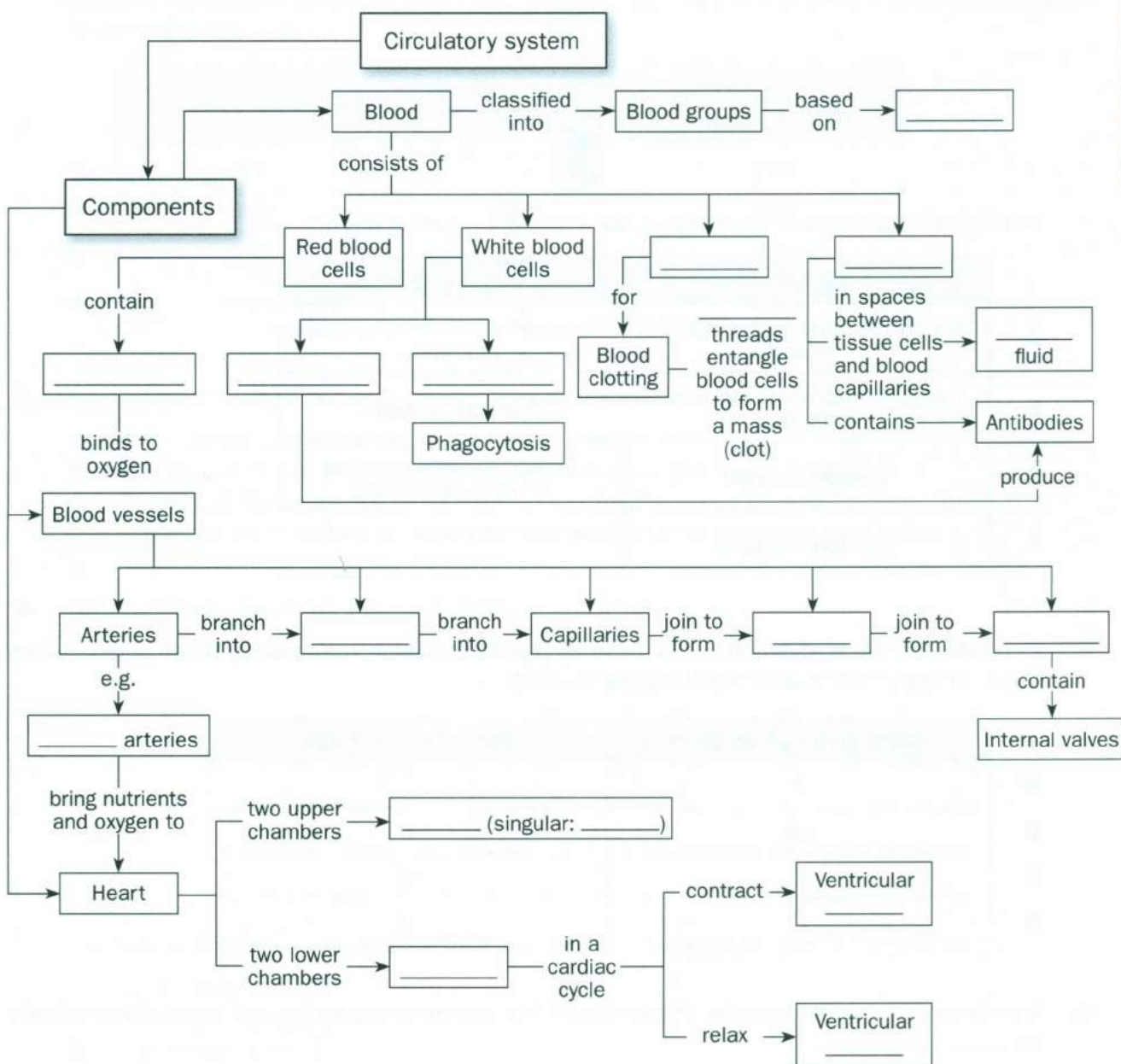
Name: _____ ()

Class: _____ Date: _____

Transport in Humans



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.

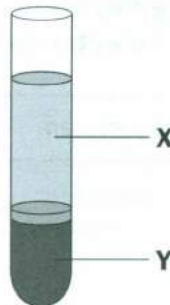


TEST IT!

Section A: Multiple-Choice Questions

Choose the correct answer, and write its letter in the brackets provided.

1. After centrifugation, blood separates into three layers as shown in the diagram below. Layer **X** is the topmost layer and is yellowish and translucent. Layer **Y** is the bottom layer and is dark red in colour.



What are the functions of the components of blood in layers **X** and **Y**?

	Layer X	Layer Y
A	Defend the body against foreign substances	Transport nutrients and waste materials
B	Transport nutrients and waste materials	Transport oxygen
C	Transport oxygen	Defend the body against foreign substances
D	Transport oxygen	Transport nutrients and waste materials

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2. Four individuals **A**, **B**, **C**, and **D** each received a blood transfusion in a hospital. Which person will be at risk of agglutination after the blood transfusion?

	Blood group of recipient	Blood type of donor
A	A	O
B	AB	B
C	B	AB
D	O	O

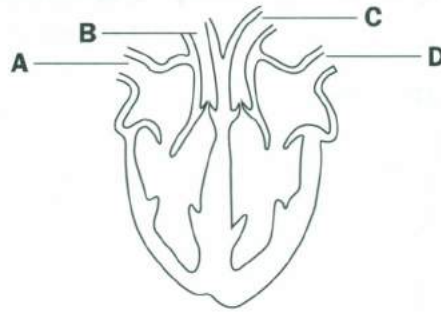
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3. A person living at a high altitude, where there is low oxygen concentration, will adapt physiologically by _____.

- A** decreasing the number of red blood cells
- B** feeling dizzy and nauseous
- C** increasing his breathing rate
- D** increasing the number of red blood cells

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4. The diagram below shows a section of the human heart.



Which of the options below correctly describes the properties of the blood flowing through blood vessels **C**?

	Relative pressure	Relative carbon dioxide concentration	Relative oxygen concentration
A	Low	Low	High
B	High	High	High
C	High	Low	High
D	High	Low	Low

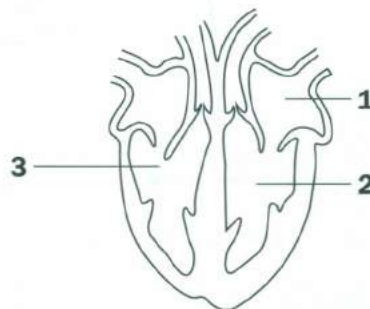
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5. What causes the 'lub' and 'dub' sounds of a heartbeat?

- A** The backflow of blood hitting the heart muscles
- B** The closure of the semi-lunar valves, bicuspid valve and tricuspid valve
- C** The flow of blood into the pulmonary vein and aorta
- D** The return of blood into the heart from the venae cavae and pulmonary artery

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6. The diagram below shows a section of the human heart.

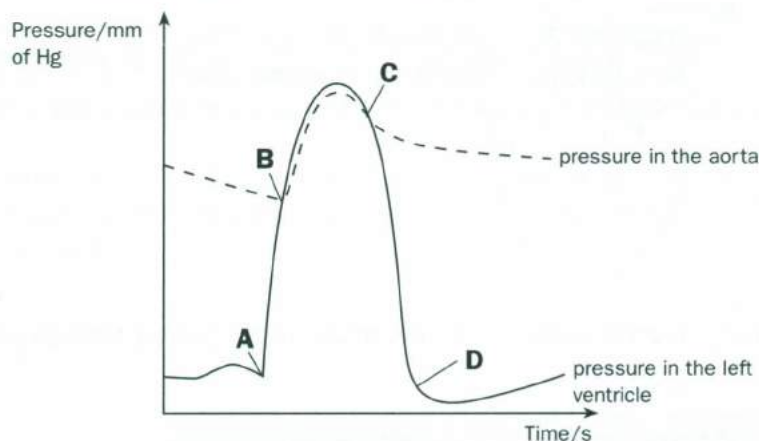


What is the relative blood pressure at **2** compared to that at **1** and **3**?

- A** Higher than **1** and **3**
- B** Higher than **1**, but lower than **3**
- C** Lower than **1** and **3**
- D** Lower than **1**, but higher than **3**

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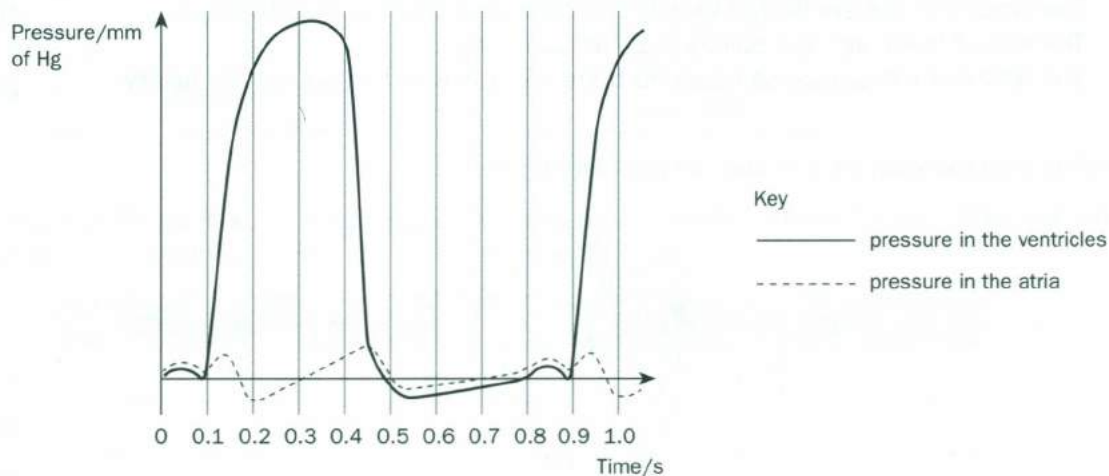
7. The diagram below shows the blood pressure in the aorta and left ventricle, during the cardiac cycle. At which point does the semi-lunar valve of the aorta start to close?



8. After a patient underwent heart surgery, there was an increase in the number of white blood cells in his body. What could be a possible reason for this increase?

- A The patient might have developed an infection after the surgery.
- B The patient might need more nutrients to be transported around his body.
- C The patient might need more oxygen to help him recover faster.
- D The patient might need to accelerate the clotting of his blood to prevent excessive blood loss from the surgery.

9. The diagram shows the pressure changes in the left side of a human heart.



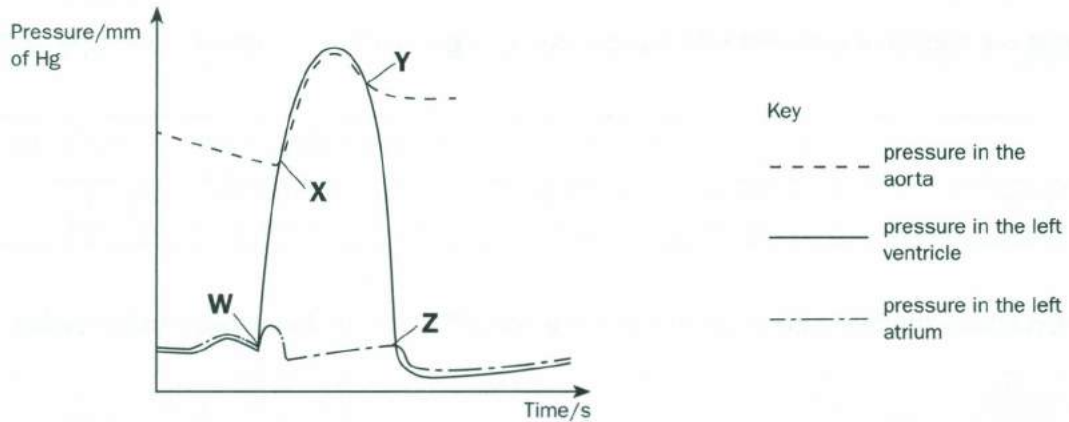
What is the ratio of the timing of ventricular systole to ventricular diastole?

- A 1:3
- B 1:7
- C 1:8
- D 7:8

Section B: Structured Questions

Answer the following questions in the spaces provided.

1. The graph below shows pressure changes in the left side of the heart during the cardiac cycle.



- (a) State whether the semi-lunar valve and the bicuspid valve are open or closed at points **W**, **X**, **Y** and **Z**.

- (b) State what happens when the pressure in the atrium is higher than the pressure in the ventricle.

2. A person's blood group can be identified by mixing his or her blood with serum containing antibodies onto a test panel like the one below.

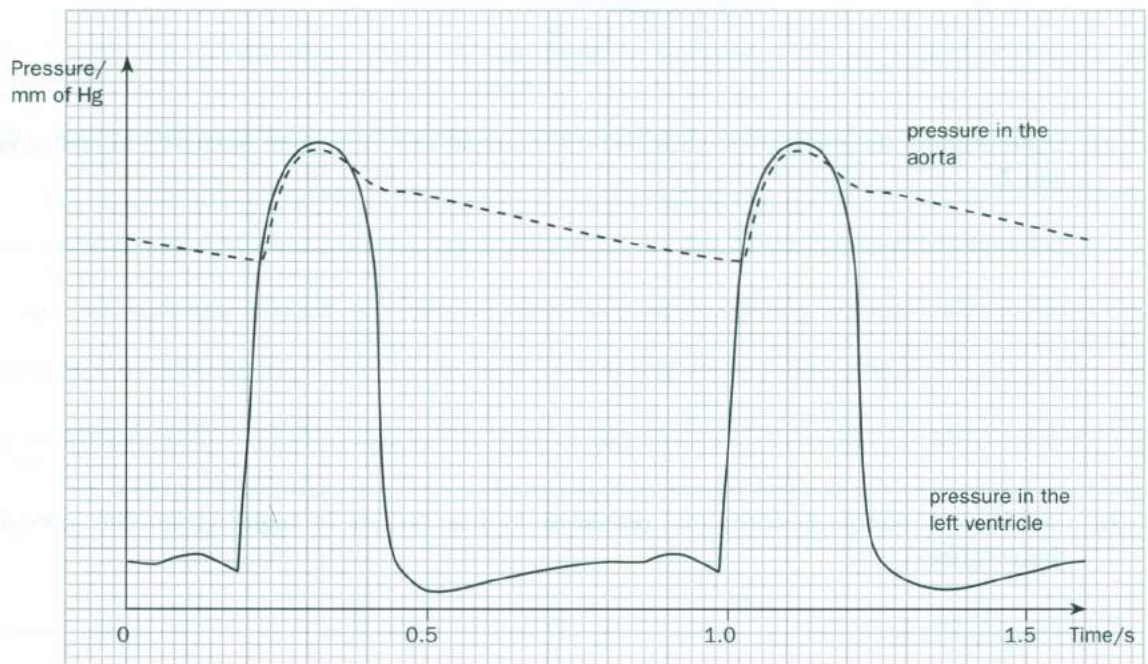
- (a) Complete the table using a (✓) if agglutination occurs, and a (x) if agglutination does not occur.

Blood group	Test panel (serum)		
	Anti-A antibody	Anti-B antibody	Control (no antibody)
A			
B			
AB			
O			

(b) Why is the control needed?

(c) What will happen if a patient with blood group O is given a transfusion of blood type AB?

3. The graph shows the blood pressure in the aorta and left ventricle during two cardiac cycles.

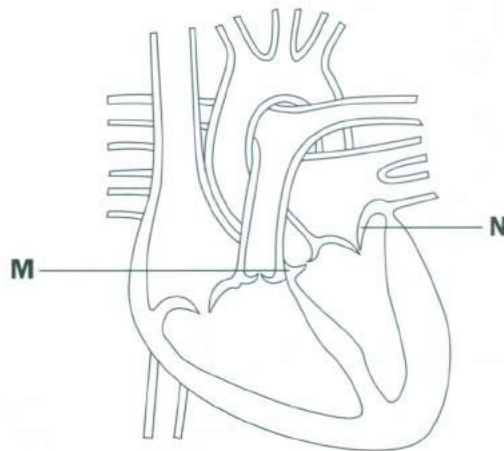


(a) How long is a cardiac cycle?

(b) State the duration in each cardiac cycle when the aortic valve (semi-lunar valve) is closed. Explain how you arrived at your answer.

- (c) If a line indicating pressure in the right ventricle is drawn on this graph, state one similarity and one difference it would have with the existing line indicating pressure in the left ventricle.

4. (a) Complete the diagram by drawing in the path of blood into and out of the heart.
- (i) Use a black/blue pen to show the path of deoxygenated blood into and out of the heart.
- (ii) Use a red pen to show the path of oxygenated blood into and out of the heart.



- (b) Name valves **M** and **N**.

M: _____

N: _____

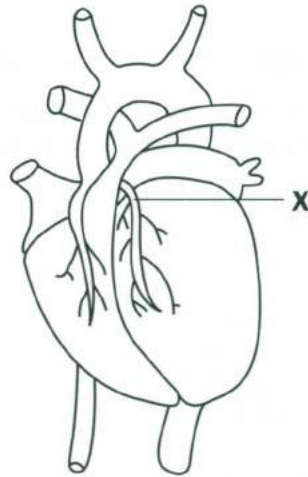
- (c) State what would happen to valves **M** and **N** during ventricular systole.

- (d) Some babies are born with a disorder known as *patent ductus arteriosus*. This disorder results in a condition in which the hole between the aorta and the pulmonary artery fails to close after birth. This causes the baby to have poor growth and shortness of breath.

- (i) Predict how the blood circulation of a baby with this disorder will be affected.

- (ii) Explain why babies with this disorder may have poor growth.

5. The diagram shows the **external view** of a person's heart.



- (a) If there is a blockage at **X**, state what will happen to this person.

- (b) Suggest **two** causes of such a blockage.

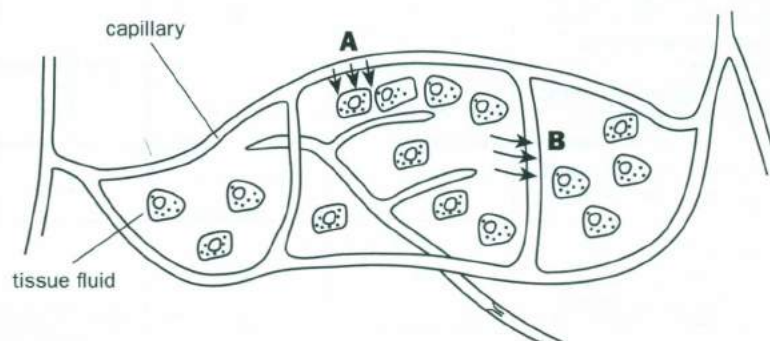
- (c) State **two** ways in which a person can prevent a blockage at **X**.

Section C: Free-Response Questions

Answer the following questions.

1. Arteries and veins are two different types of blood vessels found in the human body. Compare and contrast the structures of arteries and veins with reference to their functions.

2. The diagram below illustrates the transfer of materials between capillaries and tissue fluid. Describe what happens at points **A** and **B**.



3. Describe the route taken by the blood from the intestine to the kidney. List all the major blood vessels and organs involved.

 **WORK ON IT!**

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) State the components of blood and their roles in transport and defence	1, 3, 8			8.1, 8.2, 8.4
(b) List the different ABO blood groups and all possible combinations for the donor and recipient in blood transfusions	2	2		8.3
(c) Relate the structures of arteries, veins and capillaries to their functions	4, 6		1, 2	8.5
(d) Identify the main blood vessels to and from the heart, lungs, liver and kidneys			1, 3	8.6
(e) Describe the structure and function of the heart in terms of muscular contraction and the working of valves	5	3, 4		8.6
(f) Outline the cardiac cycle in terms of what happens during systole and diastole	7, 9	1, 3, 4		8.6
(g) Describe coronary heart disease in terms of the occlusion of coronary arteries, and list the possible causes, such as diet, stress and smoking, stating the possible preventive measures		5		8.7

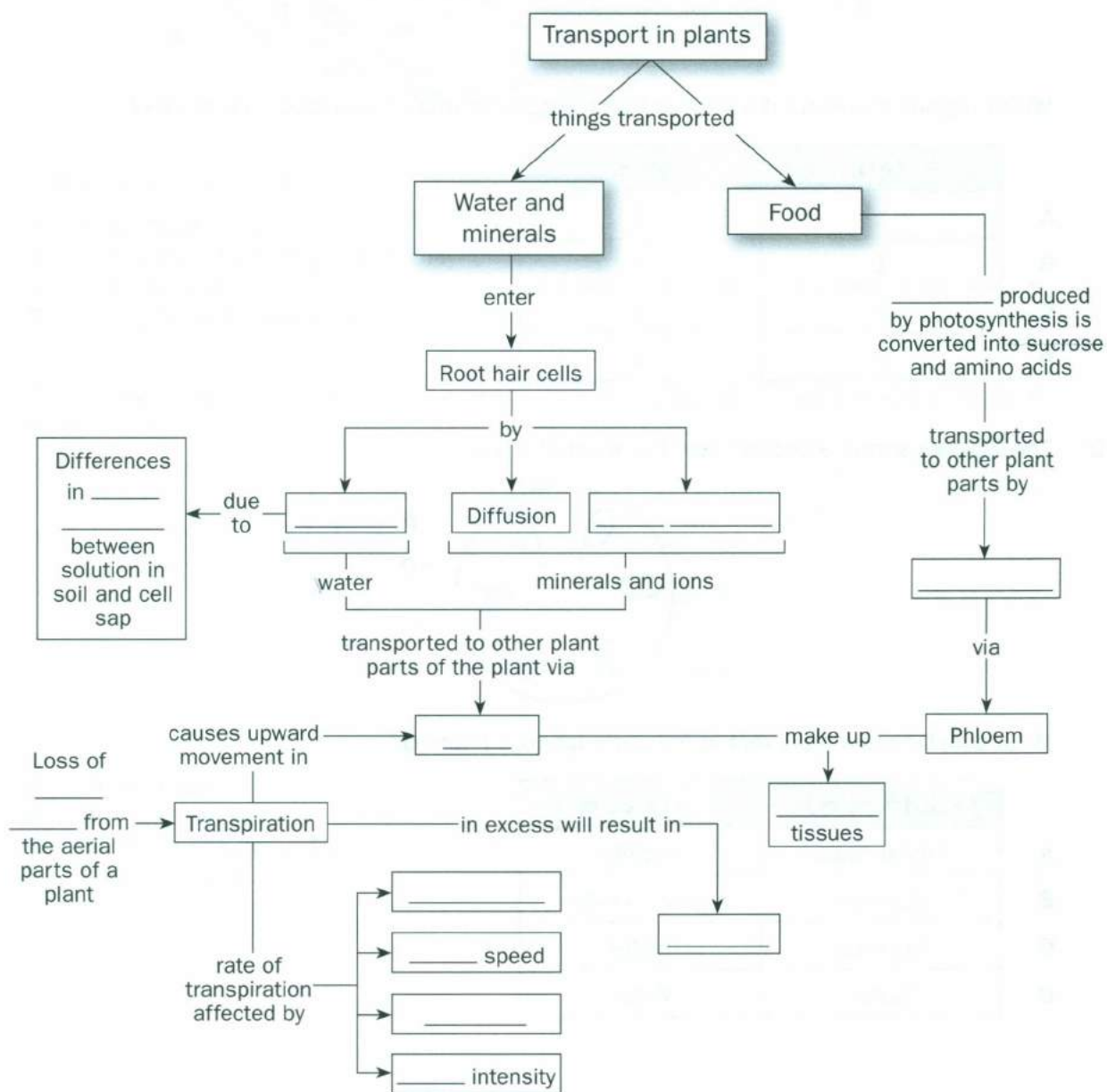
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Class: _____ Date: _____

Transport in Plants



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.

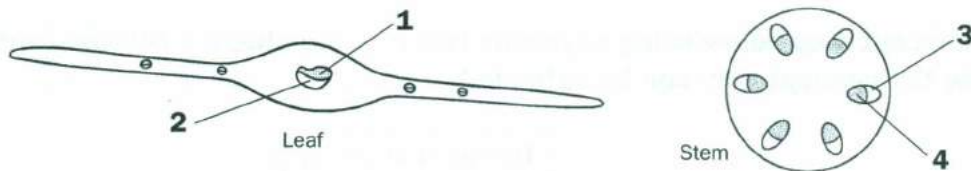


TEST IT!

Section A: Multiple-Choice Questions

Choose the correct answer, and write its letter in the brackets provided.

1. The diagram shows sections of a leaf and of the stem of a plant.

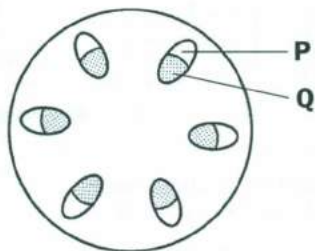


Which regions represent the tissues that transport manufactured food substances?

	Leaf	Stem
A	1	3
B	1	4
C	2	3
D	2	4

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2. The diagram shows a section from the stem of a plant.

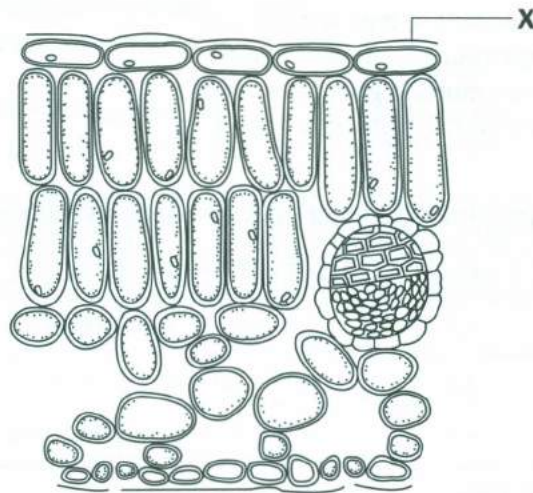


What substances are present in the parts labelled P and Q?

	Substance in P	Substance in Q
A	Amino acids	Sucrose
B	Sucrose	Amino acids
C	Sucrose	Water
D	Water	Water

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3. The diagram shows a section from the leaf of a plant.

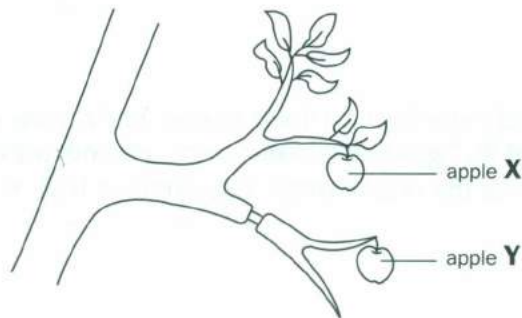


The structure labelled **X** _____.

- A** absorbs green light
- B** is capable of carrying out photosynthesis
- C** prevents sugar loss
- D** prevents excessive water loss

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4. Part of the branch, in the diagram below, has been 'ringed'. What will happen to apple **Y** after some time?



- A** Grows bigger
- B** Remains the same
- C** Same size as apple **X** at the end of the experiment
- D** Shrinks in size

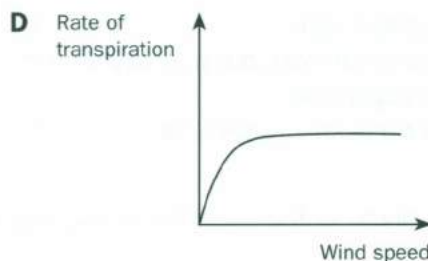
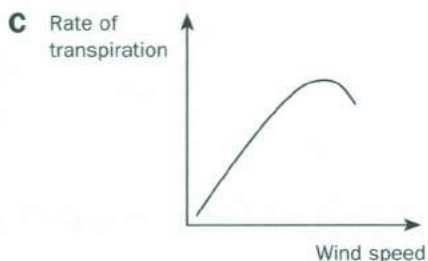
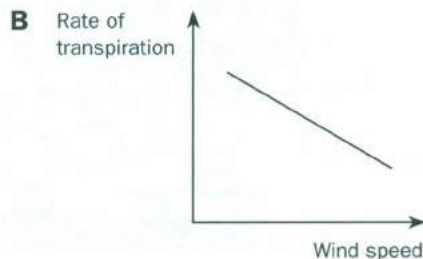
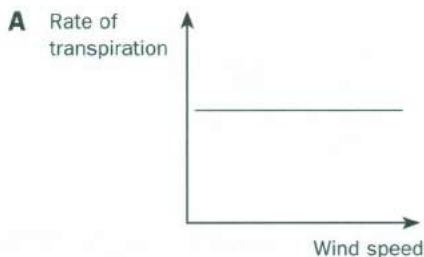
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5. Which conditions would cause a plant to wilt most rapidly?

- A High humidity, high temperature, high wind speed
- B High humidity, low temperature, high wind speed
- C Low humidity, high temperature, high wind speed
- D Low humidity, low temperature, high wind speed

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6. Which graph shows the effect of air movement (wind speed) on the transpiration rate of a plant?



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7. A leafy shoot, with the beaker of water in which it was placed, had a mass of 315 g. Three hours later, it was found to have a mass of 297 g. A similar beaker of water, but without the shoot, lost only 3 g over the same period. What was the rate of water loss from the leafy shoot?

- A 3 g/hour
- B 4 g/hour
- C 5 g/hour
- D 6 g/hour

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Section B: Structured Questions

Answer the following questions in the spaces provided.

1. A group of students tested leaves from two different plants, thyme and mint, in order to find out which leaf surface had more stomata. The thyme plant had fewer leaves compared to the mint plant.

	Average weight loss/%	
	Mint	Thyme
Petroleum jelly on both leaf surfaces	14	13
Petroleum jelly on lower leaf surface only	41	20
Petroleum jelly on upper leaf surface only	44	30

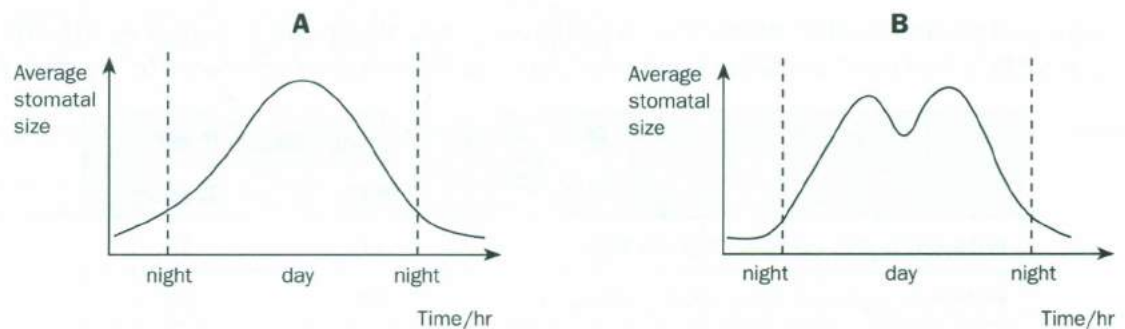
- (a) From which surface did the mint leaf lose the most water? Explain your answer.

- (b) Which surface of the thyme leaf has more stomata? Explain your answer.

- (c) Explain the differences in the results for the two types of leaves.

- (d) Based on the experimental results, which plant would be better adapted to hotter, drier conditions? Give a reason for your answer.

2. The following graphs show the average size of the stomata on the leaves of two plants during a 24-hour period. One plant was kept in a moist environment, while the other was kept in a hot and dry environment.



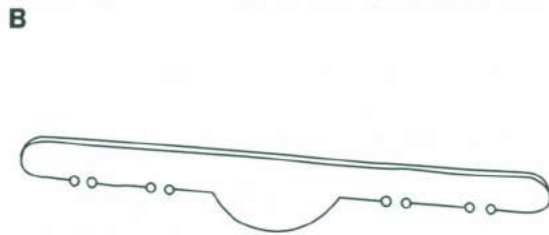
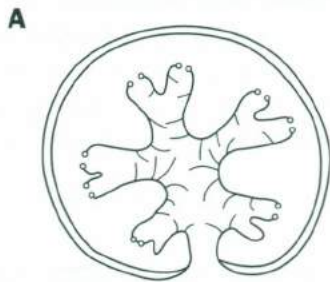
- (a) (i) Which graph best represents the plant in a hot and dry environment?

- (ii) Explain the reason for your answer in (a)(i).

- (iii) Explain why the average stomatal size at night is smaller than that during the day.

- (b) Predict **two** structural features that the plant in the hot and dry environment will have that allows it to survive or adapt well in hot and dry conditions.

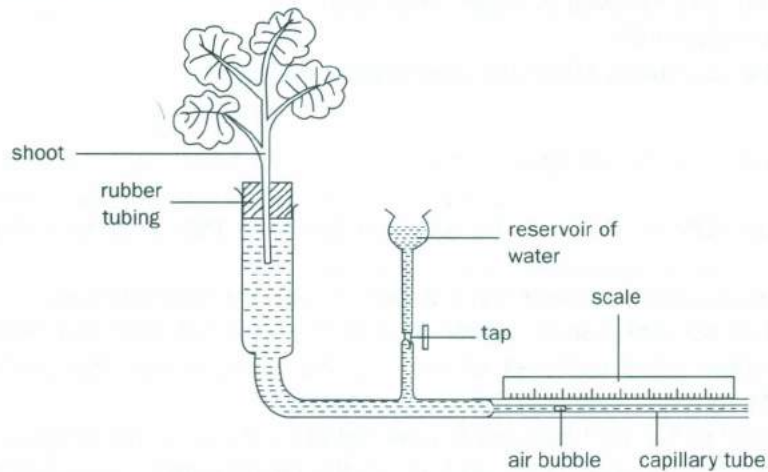
3. The following diagrams show the **transverse sections** of the leaves of two different plants.



(a) Which plant, **A** or **B**, is from a dry environment?

(b) Name and describe **two** observable features of the plant in (a) which help it to adapt to the dry environment.

4. The diagram below shows a potometer.



(a) Name the process by which water is lost from the shoot.

(b) What does the potometer directly measure?

- (c) Suggest **two** reasons why the measurement in (b) is not necessarily the same as the rate of the process stated in (a).

- (d) State **two** factors that might affect the shoot's rate of water loss.



LEARN & APPLY

Go through the worked example below, then try to answer the Free-Response Questions.

Worked Example

Explain how a plant absorbs water.

Thought Process

This question needs to be answered in several parts. The answer should consist of the following points:

- Which parts of plants are involved in water absorption?
- What processes are involved?
- What environmental conditions affect the absorption of water?

Answer

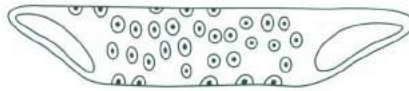
Points to cover

1. Water absorption occurs mainly at the root hair cells, as they provide a large surface area for absorption.
2. The cell sap of root hairs has lower water potential than the soil solution.
3. Water potential in soil solution is higher than in the root hair cell sap. Water moves from the soil, across the permeable cell wall of the root hair cell, across the partially permeable cell membrane of the root hair cell, into the cell by osmosis.
4. The water potential of the root hair cell is now higher than that of the neighbouring cells.
5. Water thus leaves the root hair cells, and enters the neighbouring cells by osmosis.
6. When the water potential of the soil solution is low, for example, during the dry season, the root hair cells use active transport to absorb dissolved mineral salts. As the mineral salts are dissolved in water, their movement into the plant cells will lower the water potential, and bring water into the cells by osmosis.

Section C: Free-Response Questions

Answer the following questions.

1. The diagram below shows a xylem vessel.



- (a) Are xylem vessels living or dead structures? Give one reason for your answer.

- (b) What are the main functions of xylem vessels? State **three** ways in which xylem vessels are adapted to their functions.

2. (a) Describe how the adaptation of plant root is similar to the adaptation of lining of the small intestine in humans for the absorption of nutrients.

- (b) Systemic pesticides are pesticides that are absorbed and transported to all parts of the plant. Describe how spraying systemic pesticides directly on the leaves of plants, kills insects such as aphids, which feed on shoots that have grown after the spraying.

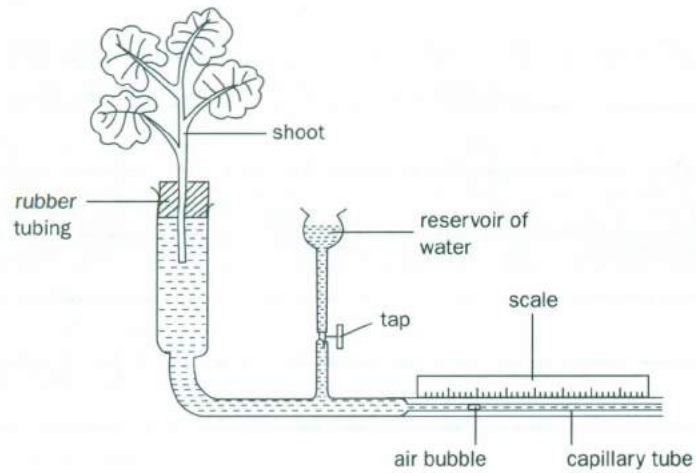
3. Products of photosynthesis, such as sucrose, are translocated via the phloem from sites of production in green leaves to places where they are utilised, such as seeds, fruits, roots and new leaves. These places are known as 'sinks'.

(a) Describe a pathway by which a sucrose molecule is transported from the leaf to a sink such as a fruit.

(b) Describe an experiment that can demonstrate the process described in (a).

(c) Suggest and provide one reason why a sucrose molecule may be transported to a particular sink and not to other sinks.

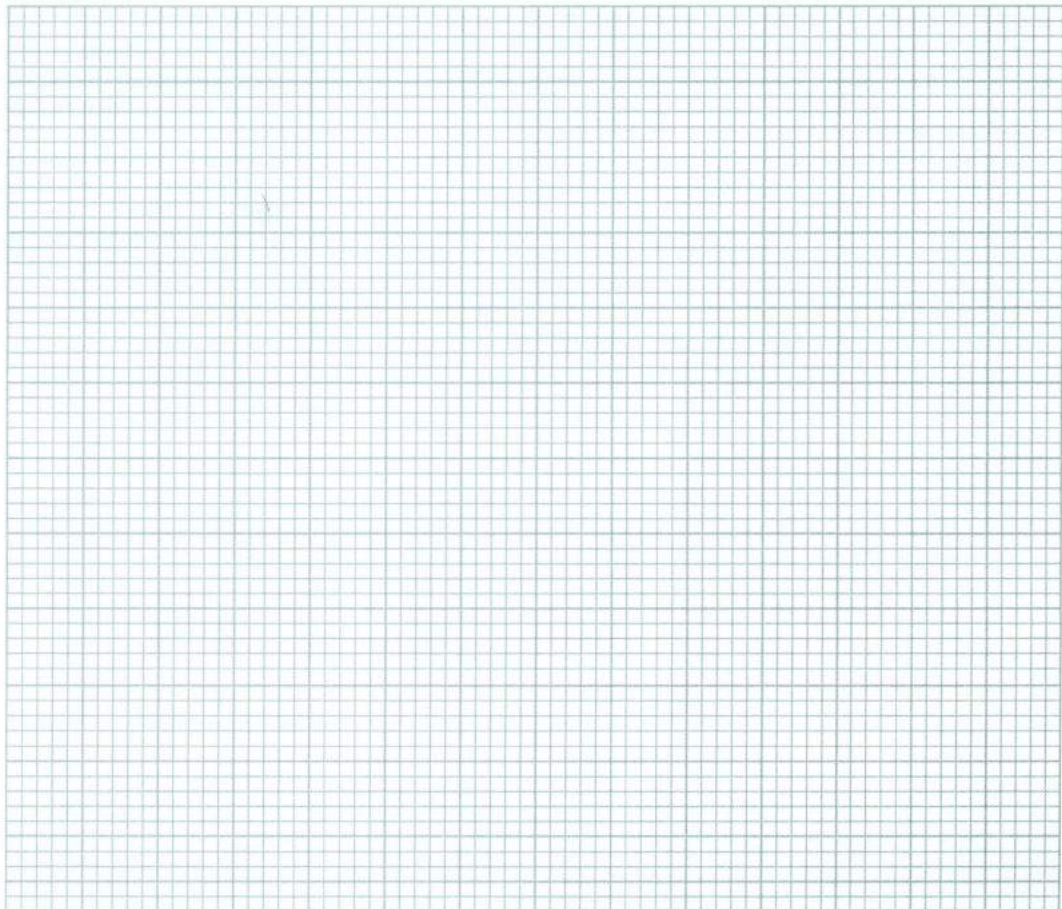
4. A student set up a potometer to investigate the amount of water taken up by a leafy shoot.

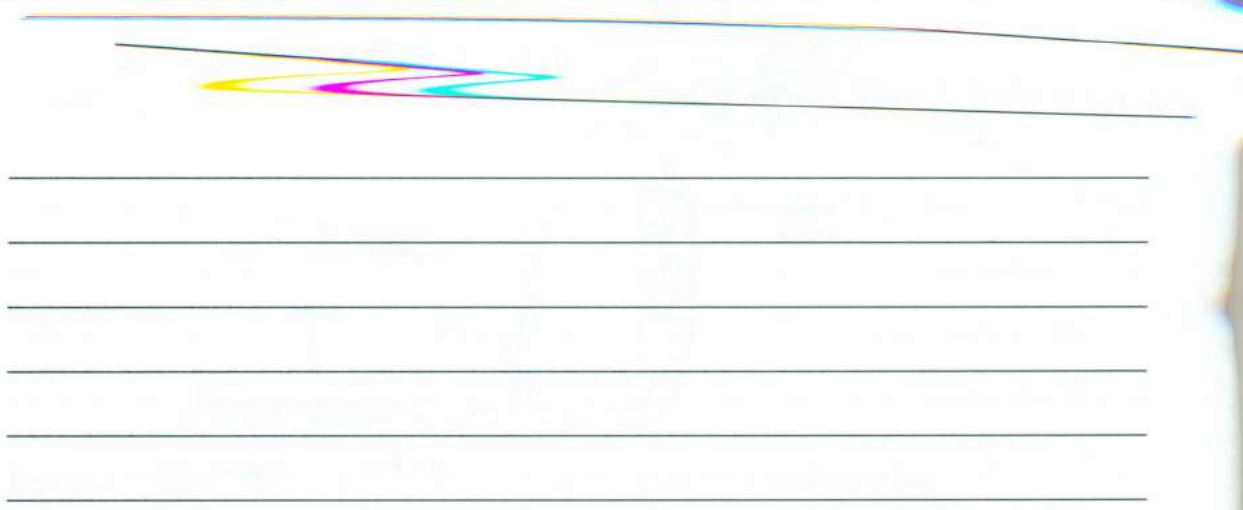


The distance that the air bubble travelled along the capillary tube, was measured every two minutes. The results of the experiment are shown in the table below.

Time/minutes	0	2	4	6	8	10	12	14	16	18	20
Distance travelled/mm	0	7	20	33	45	57	72	85	99	108	122

- (a) Draw a graph to show the results.





(c) Describe how water from the capillary tube enters the shoot to reach one of the leaves.


WORK ON IT!

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) Identify the positions, and explain the functions of xylem vessels and phloem in sections of a herbaceous dicotyledonous leaf and stem under the light microscope	1, 2			9.1
(b) Outline the pathway by which water is transported from the roots to the leaves through the xylem vessels			1	9.2
(c) Define translocation, and illustrate the process through translocation studies	4		3	9.2
(d) Relate the structure and function of root hairs to their surface area, and to water and ion uptake			2	9.3
(e) Explain the movement of water between plant cells, and between plant cells and their environment, in terms of water potential	2			9.3, 9.4
(f) Define transpiration, and explain that transpiration is a consequence of gas exchange in plants	3, 7	1, 4	4	9.4
(g) Describe and explain the effects of variation of air movement, temperature, humidity and light intensity on transpiration rate, and explain how wilting occurs	5, 6	2, 3, 4	4	9.4

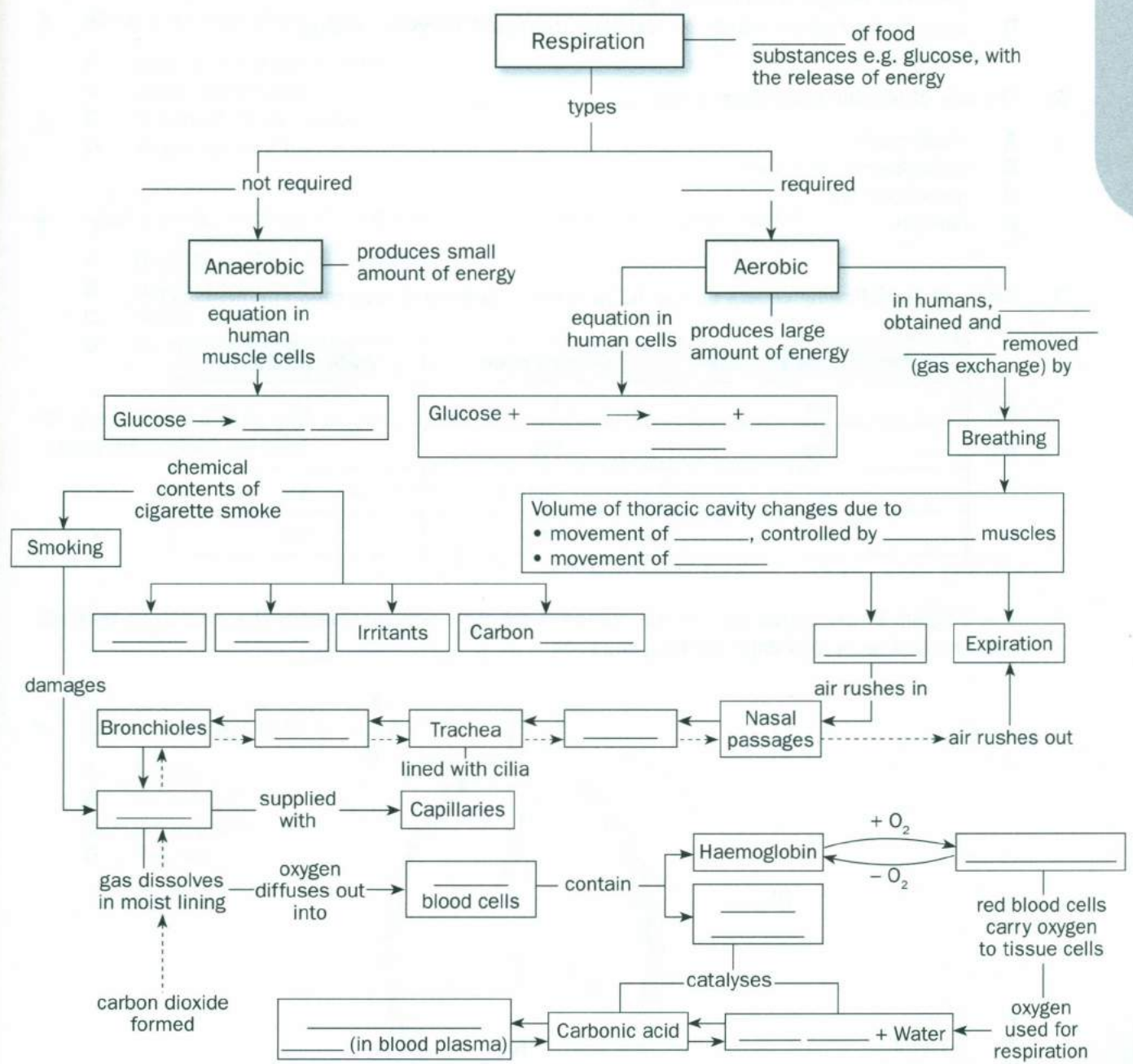
Name: _____ ()

Class: _____ Date: _____

Respiration in Humans



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.



TEST IT!

Section A: Multiple-Choice Questions

Choose the correct answer, and write its letter in the brackets provided.

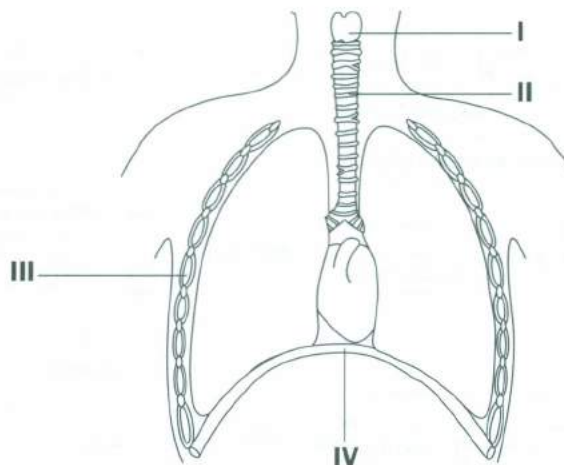
- Cellular respiration is best described as _____.
 - A a process by which carbon dioxide is inhaled, and oxygen is exhaled
 - B a process by which oxygen is inhaled, and carbon dioxide is exhaled
 - C a process by which sugar is produced from carbon dioxide and water in the presence of light and chloroplasts
 - D a process by which sugars are oxidised to release chemical energy ()

- The site of aerobic respiration is the _____.
 - A chloroplast
 - B endoplasmic reticulum
 - C mitochondrion
 - D nucleus ()

3. Which of the following occurs during the process of anaerobic respiration in muscles?

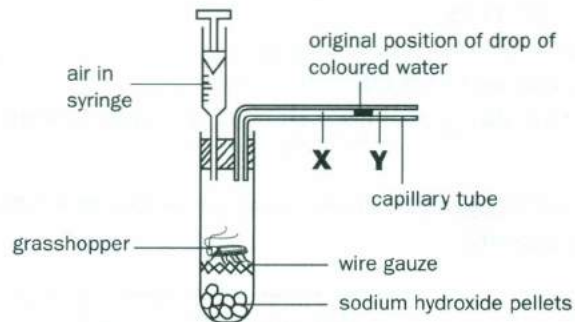
	Carbon dioxide produced	Oxygen used	Water produced	
A	No	No	No	
B	Yes	Yes	Yes	
C	No	No	Yes	
D	No	Yes	No	()

4. The diagram below shows part of the human respiratory system. Identify the structures that will contract and relax to change the lung capacity.



- A I only
- B II and III
- C III and IV
- D III only ()

For questions **5** and **6**, refer to the experimental set-up shown below.



5. What is the role of the sodium hydroxide pellets?

- A** To absorb carbon dioxide
- B** To absorb oxygen
- C** To absorb water vapour
- D** To act as food for the grasshopper

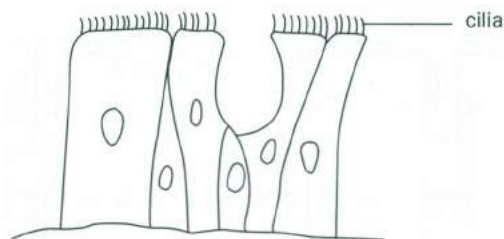
()

6. After a while, what would be the position of the drop of coloured water?

- A** Disappears from the capillary tube
- B** Nearer position **X**
- C** Nearer position **Y**
- D** No change in position

()

For questions **7** and **8**, refer to the diagram shown below. The cells in the diagram can be found in the human respiratory system.

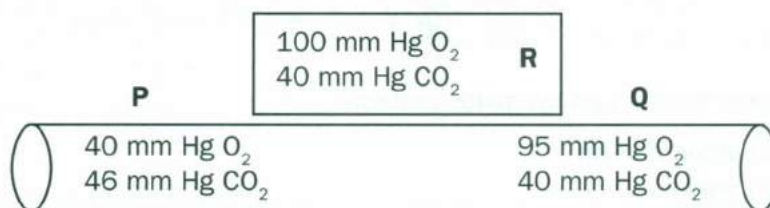


7. Where can these cells be found?

- A** Alveoli
- B** Diaphragm
- C** Bronchioles
- D** Trachea

()

8. What is the function of the cilia on these cells?
- A To absorb oxygen into cells
 - B To increase surface area for gas exchange
 - C To produce mucus so as to trap dust particles
 - D To sweep the mucus, along with trapped dust particles, towards the pharynx ()
9. Which of the following correctly describes the diagram below, which depicts the exchange of gases in the human circulatory system?

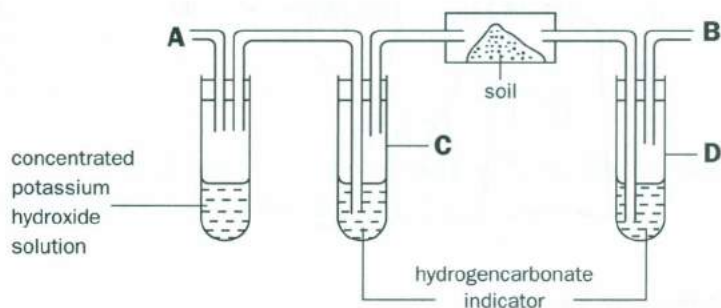


- A R is a blood capillary, and blood flow is from P to Q.
- B R is a blood capillary, and blood flow is from Q to P.
- C R is an alveolus, and blood flow is from P to Q.
- D R is an alveolus, and blood flow is from Q to P. ()

Section B: Structured Questions

Answer the following questions in the spaces provided.

1. The following experiment was performed to demonstrate that microorganisms in the soil respire.



- (a) What is the error in the experimental set-up? How should this error be corrected?

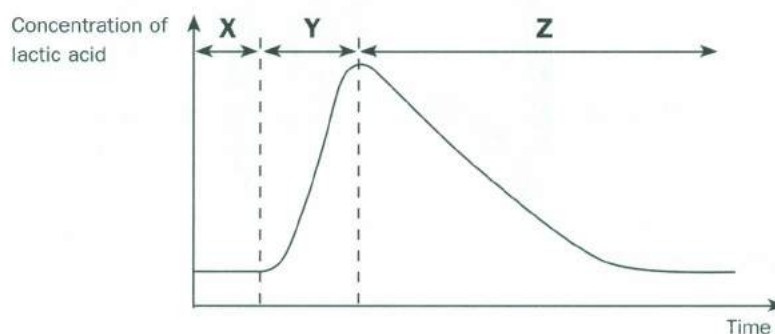
(b) Assuming that the error has been corrected, how should the pump draw air through the apparatus? Should it be from **A** to **B** or from **B** to **A**?

(c) In which test tube, **C** or **D**, would the hydrogencarbonate indicator solution change in colour?

(d) What causes the change in colour of the hydrogencarbonate indicator solution?

(e) Write a chemical equation to illustrate aerobic respiration in soil microorganisms.

2. The graph below shows the concentration of lactic acid in the blood of a person performing vigorous exercise.



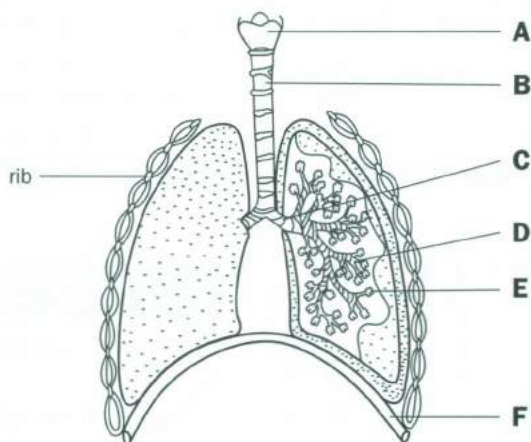
(a) In which region, **X**, **Y** or **Z**, is the person actually exercising?

(b) Write a word equation to show how lactic acid is formed during vigorous exercise.

(c) Describe the effects of an increasing lactic acid concentration on the muscles during **Y**.

(d) Explain why there is a gradual decrease in lactic acid concentration in region **Z**.

3. The figure below shows the human respiratory system.



(a) Identify structures **A** to **F**.

A: _____

B: _____

C: _____

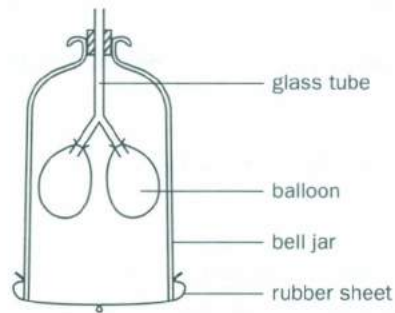
D: _____

E: _____

F: _____

(b) How does structure **F** help in breathing?

4. The diagram below shows a model that represents the human respiratory system.



(a) Which part of the human respiratory system is represented by:

(i) the glass tube;

(ii) the balloon; and

(iii) the rubber sheet?

(b) Suggest **two** reasons why this model is not considered as an accurate representation of the human respiratory system.

(c) What will happen to the balloons when the rubber sheet is pulled down? Explain your answer.

(d) If a hole is created in the wall of the bell jar, what would happen to the balloons when the rubber sheet is pulled down?

LEARN & APPLY

Go through the worked example below, then try to answer the Free-Response Questions.

Worked Example

Describe the movement of carbon dioxide from the body cells to the air spaces in the lungs.

Thought Process

You need to state how carbon dioxide is produced in body cells, as well as, how carbon dioxide is transported from the cells to the lungs. Think about the process and reactions involved.

Answer

Points to cover

1. Carbon dioxide, which is produced in cells during cellular respiration, diffuses out into the tissue fluid before diffusing into the capillary network.
2. This carbon dioxide will diffuse into blood in the capillaries due to a concentration gradient of carbon dioxide between the cells and the blood.
3. Carbon dioxide diffuses into red blood cells and is converted into hydrogencarbonate ions by carbonic anhydrase found in red blood cells.
4. Hydrocarbonate ions then diffuse into blood plasma and are carried to the lungs.
5. In the lungs, the hydrogencarbonate ions diffuse into red blood cells and are converted into carbon dioxide by carbonic anhydrase.
6. Carbon dioxide then diffuses across the blood capillaries into the air spaces in the alveoli of the lungs, due to the concentration gradient of carbon dioxide between the red blood cells and the air spaces in the lungs.

Section C: Free-Response Questions

Answer the following questions.

1. Describe **three** ways in which smoking damages the lungs.

2. The diagram below shows a section of an alveolus and a blood capillary near it. Annotate the diagram to describe the movement of oxygen when it enters the lungs.




WORK ON IT!

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) Identify parts of the human respiratory system in diagrams	4	3		10.3
(b) State the characteristics of the exchange surface of alveoli, and describe the role it plays in gas exchange	9		2	10.3
(c) Describe how carbon dioxide is removed from the lungs, with reference to the carbonic anhydrase enzyme	Refer to 'Learn and Apply'			10.3
(d) Describe the role of cilia, diaphragm, ribs and intercostal muscles in regulating breathing	7, 8	3, 4		10.4
(e) Describe the effects of tobacco smoke on our health			1	10.5
(f) Define and state the equation (in words and symbols) for aerobic respiration in humans	1, 2, 5, 6	1		10.1
(g) Define and state the equation (in words only) for anaerobic respiration in humans	3	2		10.1
(h) Describe the effect of lactic acid in muscles during exercise		2		10.1

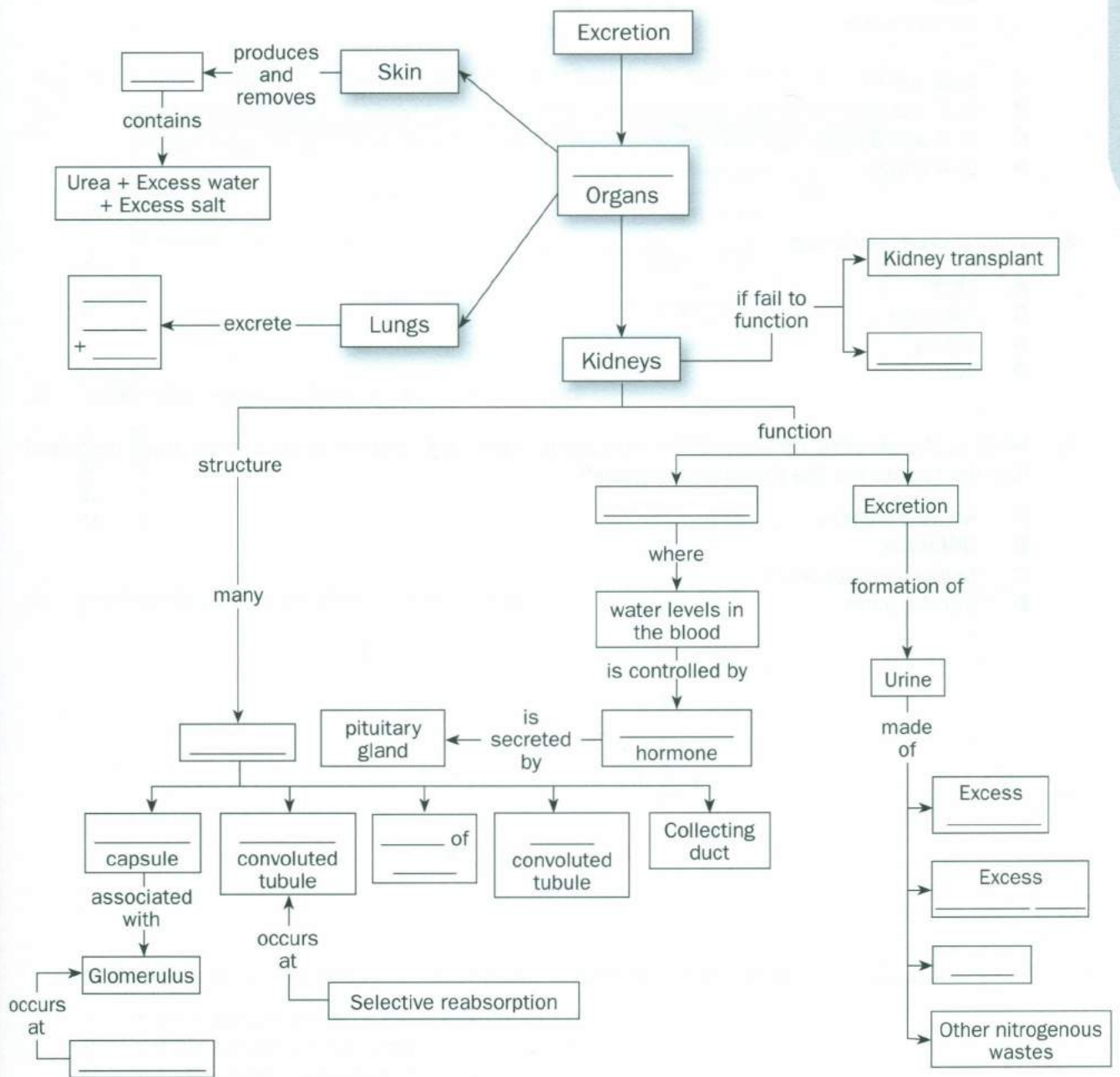
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Class: _____ Date: _____

Excretion in Humans



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.



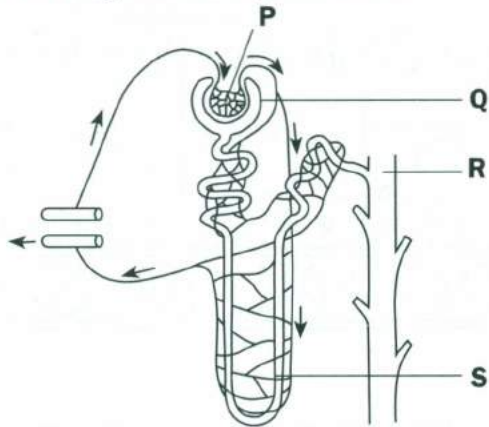
 **TEST IT!**

Section A: Multiple-Choice Questions

Choose the correct answer, and write its letter in the brackets provided.

1. Which of the following correctly lists the excretory products of the human body?
- 1 Amino acids
 - 2 Carbon dioxide
 - 3 Glucose
 - 4 Urea
 - 5 Excess water
- A** 1, 3 and 4
B 1, 2 and 4
C 2, 3 and 4
D 2, 4 and 5 ()
2. Urea is produced in the _____.
- A** blood
B intestine
C kidney
D liver ()
3. What is the process whereby small molecules, such as glucose and urea, pass from the blood into the nephron at the Bowman's capsule?
- A** Active transport
B Diffusion
C Selective reabsorption
D Ultrafiltration ()

For questions 4 and 5, refer to the diagram of a nephron below.



4. Which of the following correctly relates the structure to its respective function?

	Structure	Function
A	P	Selective reabsorption
B	Q	Ultrafiltration
C	R	Ultrafiltration
D	S	Secretion of ADH

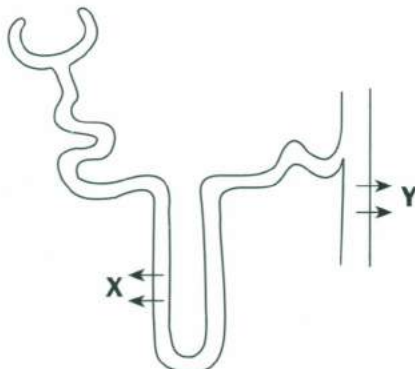
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5. Antidiuretic hormone (ADH) acts primarily at part _____.

- A P
- B Q
- C R
- D S

()

6. The following diagram shows a human nephron.

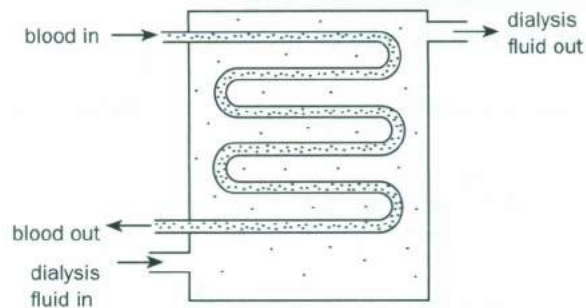


An increase in the movement of water would occur in the direction of _____.

- A X if the person drinks a large amount of water
- B Y if the person drinks a large amount of water
- C Y if less ADH is secreted by the person
- D Y if more ADH is secreted by the person

()

2. The diagram below represents a dialysis machine.



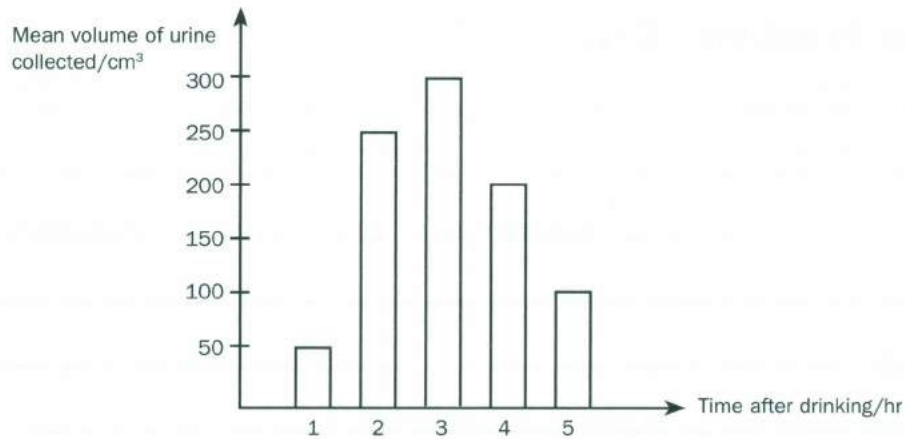
(a) State **two** components in dialysis fluid that must be at a lower concentration than that in the blood.

(b) State one characteristic property of the dialysis tubing. Why is this property important?

(c) What temperature should the dialysis fluid be maintained at?

(d) Dialysis machines are used to treat people with kidney failure. The ideal treatment for a person with kidney failure would be for the person to undergo a kidney transplant. Suggest the advantages of a kidney transplant over prolonged dialysis.

3. A group of healthy people were selected to participate in a study on urine output. Each person was made to drink 1 litre of pure water. The volume of urine each person produced hourly was measured for the next 5 hours.



- (a) Outline the physiological process that results in the increase, in urine volume over the first 3 hours.

- (b) Why did the volume of urine collected decrease during the fourth and fifth hours?

- (c) Suggest one reason why the people in the study need to avoid exercise during the duration of the study.

Section C: Free-Response Questions

Answer the following questions.

1. Describe how the body removes urea.

2. (a) Explain what happens to the components of urine after a person eats a high-protein meal.

(b) Explain what happens to urine volume

(i) when a person exercises vigorously; and

(ii) when a person eats a meal with a high salt content.

 **WORK ON IT!**

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) Define excretion, and explain the importance of removing nitrogenous and other compounds from the body	1		1	11.1
(b) Outline the function of the nephron in relation to ultra-filtration and selective reabsorption in the production of urine, and the function of other parts of the kidney in excretion	2, 3, 4, 6, 7	1, 3	1, 2	11.2, 11.3
(c) Outline the role of the antidiuretic hormone (ADH) in osmoregulation	5	3		11.4
(d) Outline the mechanism of dialysis in the context of kidney failure	8	2		11.5

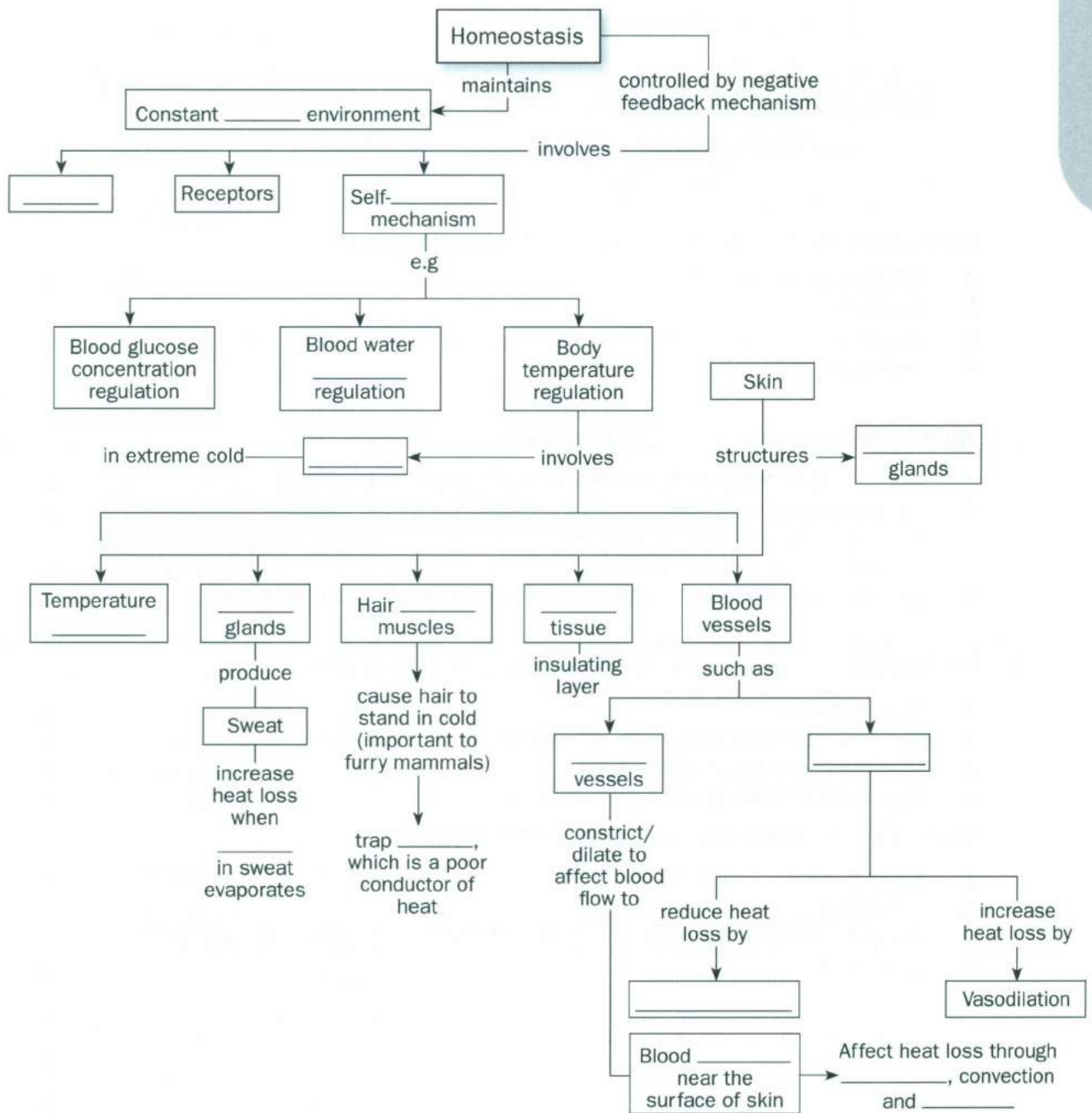
Name: _____ ()

Class: _____ Date: _____

Homeostasis



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.

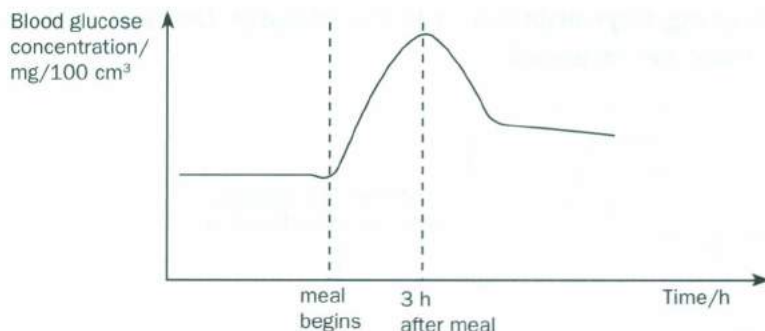


TEST IT!

Section A: Multiple-Choice Questions

Choose the correct answer, and write its letter in the brackets provided.

1. The following graph shows the blood glucose concentration in a healthy person before, during and after a meal.



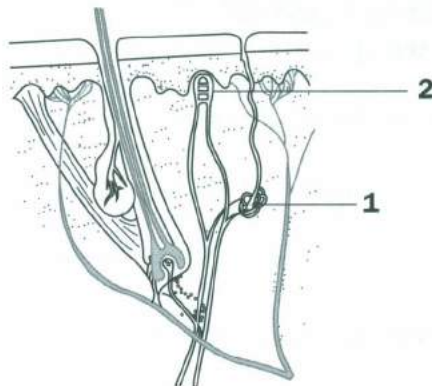
What causes the decrease in glucose level 3 hours after the meal?

- A Antidiuretic hormone
 - B Glucagon
 - C Insulin
 - D Oestrogen ()
2. Which of the following is a correct example of homeostasis?
- A Glucagon is secreted to reduce the level of glucose in the blood.
 - B Increased ventilation rate reduces the oxygen content of blood.
 - C More antidiuretic hormone (ADH) is produced to increase the reabsorption of water by the collecting duct in the kidney.
 - D Vasodilation decreases blood flow to the skin in order to conserve heat. ()
3. The following are some processes that happen in the human body.
- 1 Digestion of fat
 - 2 Regulation of water and solute concentrations in the blood
 - 3 Maintenance of body temperature
 - 4 Regulation of blood glucose concentration

Which of the processes are controlled by homeostasis?

- A 1 and 2
- B 1, 2 and 4
- C 2 and 4
- D 2, 3 and 4 ()

4. The diagram below shows a section through the skin of a person.



Which of the following correctly describes the function of structures **1** and **2**?

	Function of 1	Function of 2
A	Secretes sweat to increase heat loss from the body	Traps air to reduce heat loss from the body
B	Secretes sweat to increase heat loss from the body	Vasoconstricts to reduce heat loss from the body
C	Traps air to reduce heat loss from the body	Secretes sweat to increase heat loss from the body
D	Vasoconstricts to reduce heat loss from the body	Traps air to reduce heat loss from the body

()

5. The increase in blood flow to the skin during exercise causes _____.

- A carbon dioxide to be lost
- B heat to be lost
- C oxygen to be gained
- D water to be lost

()

6. When a person is exposed to cold air, his skin temperature decreases. What causes the decrease in his skin temperature?

- A Less blood flowing to the heart and lungs
- B Less blood flowing to the skin
- C More blood flowing below the skin
- D More blood flowing to the heart and lungs

()

7. Which combination of factors helps to increase the loss of heat from the body?

	Arterioles leading to surface blood vessels	Sweat secretion
A	Constricted	Maximised
B	Constricted	Minimised
C	Dilated	Maximised
D	Dilated	Minimised

()

Section B: Structured Questions

Answer the following questions in the spaces provided.

1. (a) (i) Explain what is meant by 'homeostasis'.

- (ii) Explain what is meant by 'negative feedback'.

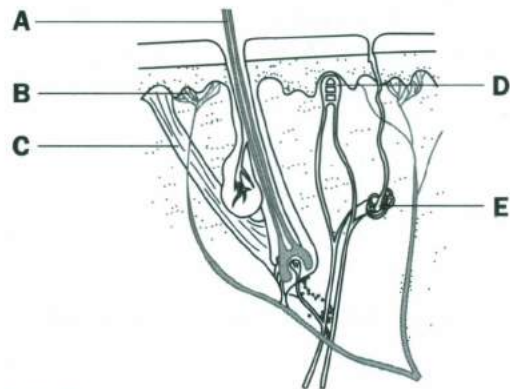
- (b) The diagram below shows part of a generalised feedback system.

Input → Detector → Control centre → X → Output

With reference to the diagram, state what part of the feedback system X represents.

- (c) Give an example of a homeostatic action in the human body.

2. The diagram below shows a section of the skin of a mammal.



(a) Identify structures **A** to **E**.

A: _____

B: _____

C: _____

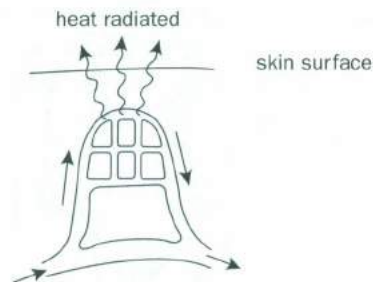
D: _____

E: _____

(b) Describe how structure **E** will respond when there is an increase in the body temperature of a mammal.

(c) Explain how a change to structure **C** will help a furry mammal.

3. (a) The diagram shows the capillaries of the skin on a hot day.

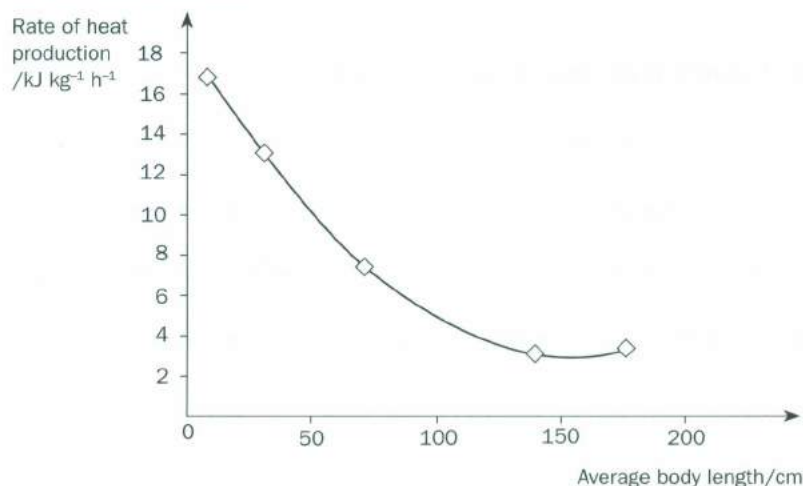


- (i) What causes the increase in blood flow to the capillaries?

- (ii) How does an increase in blood flow help to regulate temperature?

- (b) Other than blood vessels, which part of the skin plays an important role in reducing body temperature?

4. The graph below shows the relationship between the rate of heat production and the average body length of mammals.



- (a) Describe the relationship between the average body length and the rate of heat production.

- (b) Name a process that releases heat energy in the body.

(c) A mammal with a body mass of 100 kg was kept in a hot desert environment for eight hours. The average percentage of body mass lost per hour was 1.2%.

(i) Calculate the loss of body mass of the mammal over the first two hours.

(ii) In what form is most of the body mass lost as?

(ii) Explain how this loss helps the mammal to survive in the hot desert environment.

Section C: Free-Response Questions

Answer the following questions.

1. Describe how our body temperature returns to normal after strenuous exercise.

2. Explain the following using your knowledge of homeostasis.

(a) A boy who fell into ice-cold water had to quickly remove his clothes and dry himself after he was rescued from the water.

(b) An athlete's face appears red after running a race.

(c) A sailor stranded on an island should not drink seawater to quench his thirst.

 **WORK ON IT!**

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) Define homeostasis		1(a)		12.1
(b) Explain the basic principles of homeostasis using the following key concepts: stimulus, corrective mechanism and negative feedback	1, 2, 3	1(b), 1(c)	2	12.1
(c) Identify structures involved in homeostasis on a diagram of the skin		2(a)		12.2
(d) Relate structures involved in homeostasis to their respective functions	4	2(b), 3(b), 3(c)		12.2
(e) Understand and describe how the body maintains a constant temperature in different environmental conditions	5, 6, 7	2(c), 3(a), 4	1	12.3

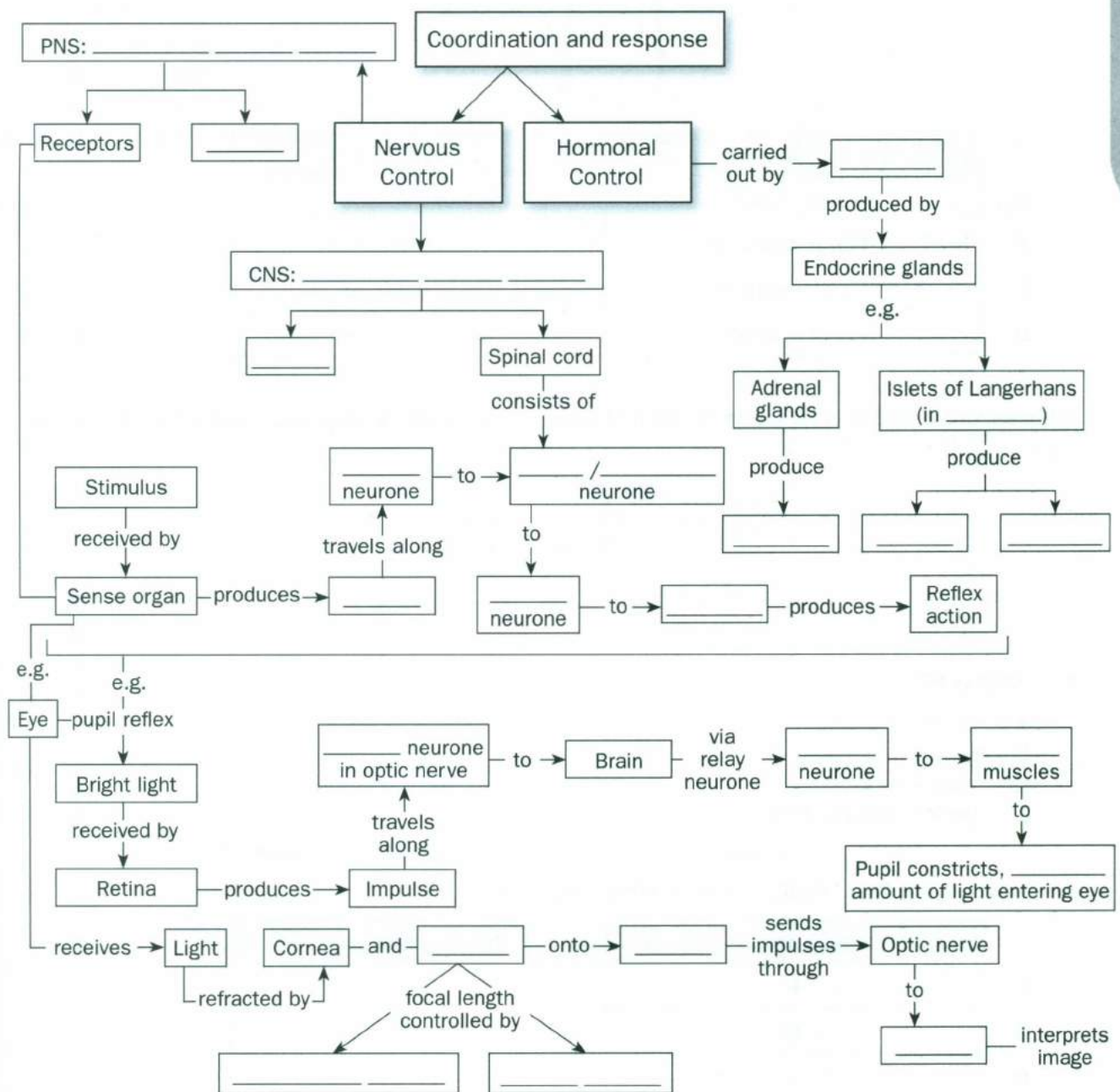
Name: _____ ()

Class: _____ Date: _____

Coordination and Response



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.

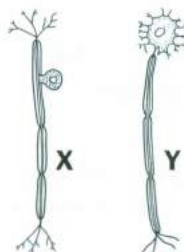


TEST IT!

Section A: Multiple-Choice Questions

Choose the correct answer, and write its letter in the brackets provided.

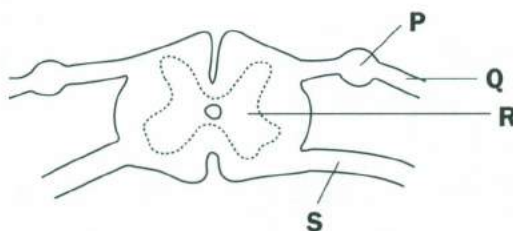
1. Which of the following correctly identifies X and Y?



	X	Y
A	Motor neurone	Motor neurone
B	Motor neurone	Sensory neurone
C	Motor neurone	Relay neurone
D	Sensory neurone	Motor neurone

()

For questions 2 and 3, refer to the diagram of a section from the human spinal cord as shown below.



2. What is P?

- A Dorsal root
- B Dorsal root ganglion
- C Ventral root
- D Ventral root ganglion

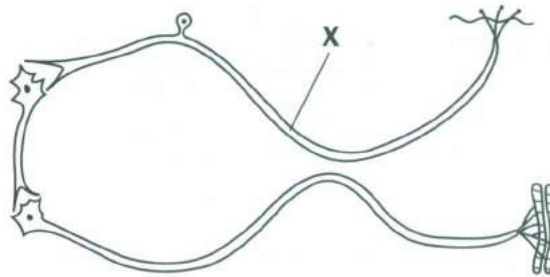
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3. Where can a motor neurone and a sensory neurone be found?

	Motor neurone	Sensory neurone
A	P	R
B	Q	S
C	R	P
D	S	Q

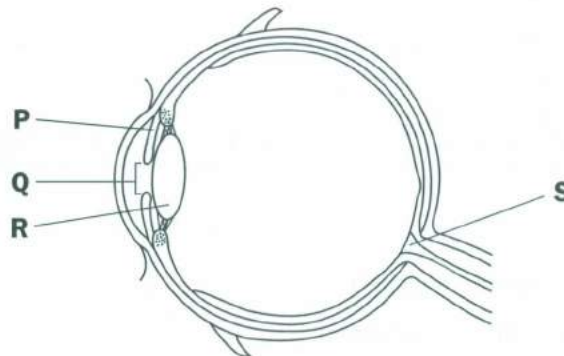
()

4. A nerve impulse is transmitted along three neurones as shown below.



If a cut is made at X, what would the response of a person be when he touches a hot iron?

- A** He experiences pain and withdraws his hand from the hot iron involuntarily.
B He experiences pain, but does not withdraw his hand from the hot iron.
C He does not experience pain and does not withdraw his hand from the hot iron.
D He does not experience pain, but withdraws his hand from the hot iron involuntarily. ()
5. Cataract is a medical condition in which patients experience blurred/cloudy vision due to difficulties in focusing light rays onto the retina. Which part of the eye is affected in this condition?



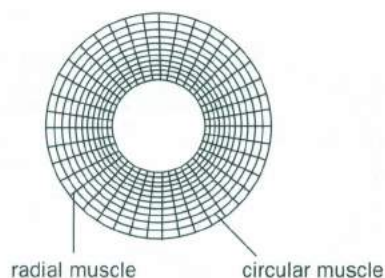
- A** P
B Q
C R
D S ()

6. Which of the following correctly describes the changes that take place when a person looks at a distant object?

	Ciliary muscle	Suspensory ligament	Shape of lens
A	Contracts	Becomes less taut	Becomes more convex
B	Contracts	Becomes taut	Becomes less convex
C	Relaxes	Becomes less taut	Becomes less convex
D	Relaxes	Becomes taut	Becomes less convex

()

7. The diagram shows the **front view** of the pupil of a person in a bright room.



What happens when the light in the room is switched off?

	Radial muscle	Circular muscle	Pupil size
A	Contracts	Relaxes	Decreases
B	Contracts	Relaxes	Increases
C	Relaxes	Contracts	Decreases
D	Relaxes	Contracts	Increases

()

8. Hormones are destroyed in the _____.

- A kidney
- B liver
- C pancreas
- D stomach

()

9. The function of the hormone insulin is to _____.

- A allow glucose to enter the bloodstream
- B break down glucose
- C prevent glucose from being excreted by the kidney
- D trigger the conversion of glucose into glycogen

()

For questions 10 and 11, refer to the diagram shown below.



10. Which gland will secrete hormone X, and when will it be secreted?

	Gland secreting hormone X	When
A	Islets of Langerhans	After a meal
B	Islets of Langerhans	During exercise
C	Liver	After a meal
D	Liver	Before a meal

()

11. What is the identity of hormones X and Y?

	Hormone X	Hormone Y
A	Adrenaline	Insulin
B	Glucagon	Glycogen
C	Glycogen	Adrenaline
D	Insulin	Glucagon

()

12. A person had a heavy meal, and after a few hours, his blood glucose level increases. Identify the stimulus, and the effector and target organ involved in his body, in response to a heavy meal.

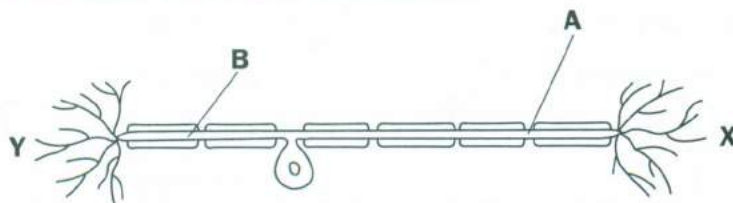
	Stimulus	Effector	Target organ
A	Increased amount of food in stomach	Islets of Langerhans	Pancreas
B	Increased amount of food in small intestine	Liver	Islets of Langerhans
C	Increased blood glucose level	Islets of Langerhans	Liver
D	Increased blood glucose level	Liver	Islets of Langerhans

()

Section B: Structured Questions

Answer the following questions in the spaces provided.

1.



(a) Name the type of neurone shown.

(b) Part X is connected to a receptor. Give one example of such a receptor.

(c) What does part Y connect to?

(d) (i) Suggest the identity of nerve fibres located at A and B.

A: _____

B: _____

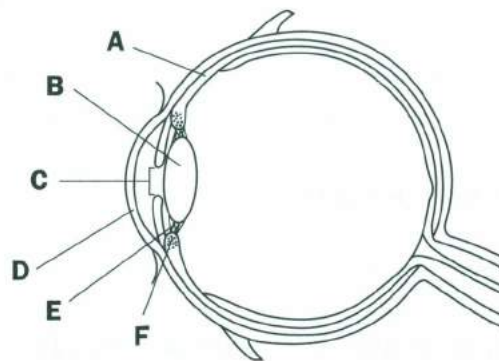
(ii) Explain how the identity of A and B was established in (i).

2. A person moved from a brightly-lit room to a dark room. He was unable to see for the first few minutes. Gradually, he was able to see fairly well in the dark room.

(a) Explain how the pupils of eyes in a brightly-lit room differ from those in a dark room.

(b) Explain why the person was not able to see when he first stepped into the dark room.

3. The diagram shows a **vertical section** of the human eye.



(a) Identify structures **A** to **F**.

A: _____

B: _____

C: _____

D: _____

E: _____

F: _____

(b) Explain how structures **B**, **E** and **F** help to focus light rays onto the retina.

(c) Suggest why it will be dangerous if structure **D** is cut in an accident.

4. (a) What are endocrine glands?

(b) Give an example of an endocrine gland.

(c) Using the secretion of adrenaline as an example, describe how the endocrine and nervous systems work together to coordinate a response in the human body.

5. When the blood glucose level in the body decreases, the hormone glucagon is released to restore the blood glucose level.

(a) Suggest a scenario where the blood glucose level decreases below the normal level.

(b) Explain how glucagon helps to restore the blood glucose level.

(c) Where is glucagon secreted from?

(d) Hypoglycemia is a medical condition in which blood glucose levels are lower than normal. Based on your understanding of how blood glucose levels are regulated, suggest what might cause the low blood glucose levels in hypoglycemic patients.

LEARN & APPLY

Go through the worked example below, then try to answer the Free-Response Questions.

Worked Example

Compare and contrast nervous control and hormonal control.

Thought Process

In the answer, both similarities and differences between nervous control and hormonal control are required. Think about the functions of these controls, their effects and their speed of action.

Answer

Points to cover

1. Both nervous and hormonal controls are used to control processes in the body to maintain a constant internal environment (homeostasis).
2. Both require a stimulus to cause the transmission of a message to target organ.
3. Nervous control involves nervous impulses (electric signals), while hormonal control involves hormones (chemical substances).
4. The response in nervous control is quick, while that in hormonal control is relatively slower.
5. The response in nervous control is short-lived, while the response in hormonal control may either be short-lived or long-lived.
6. Nervous control may be voluntary or involuntary, while hormonal control is always involuntary.
7. The effect of nervous control is usually localised, while in hormonal control, more than one target organ may be affected.

Section C: Free-Response Questions

Answer the following questions.

1. Describe the general structure of the nervous system using the following terms: central nervous system, effector, motor neurone, peripheral nervous system, and sensory neurone.

2. Explain the nervous pathway involved in the following scenarios:

(a) A person who touches a hot iron will quickly withdraw his hand from it.

(b) The pupils of a person's eyes change when the person moves from a dark room to a bright room.

- (c) The lenses of a person's eyes change shape when the person focuses on a distant object.

 **WORK ON IT!**

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) Understand how components of the nervous system, such as the brain, spinal cord and nerves, co-ordinate and regulate bodily functions	2, 4	1	1, 2(a)	13.2, 13.3
(b) Identify sensory neurones, relay neurones and motor neurones; and outline their functions	1, 3	1		13.2
(c) Identify structures of the eye as seen in the front view and horizontal section		3		14.1
(d) State how the main components of the eye work to produce a focused image of near and distant objects, and how they respond when exposed to different light intensities	5, 6, 7	2	2(b), 2(c)	14.1, 14.2
(e) Explain what is meant by an endocrine gland		4		15.1, 15.2
(f) Define hormones (with reference to certain examples), identify their mode of action; and state the organ which they are destroyed in	8, 9	4		15.1, 15.2, 15.3
(g) Explain how insulin and glucagon regulate blood glucose levels	10, 11, 12	5		15.3

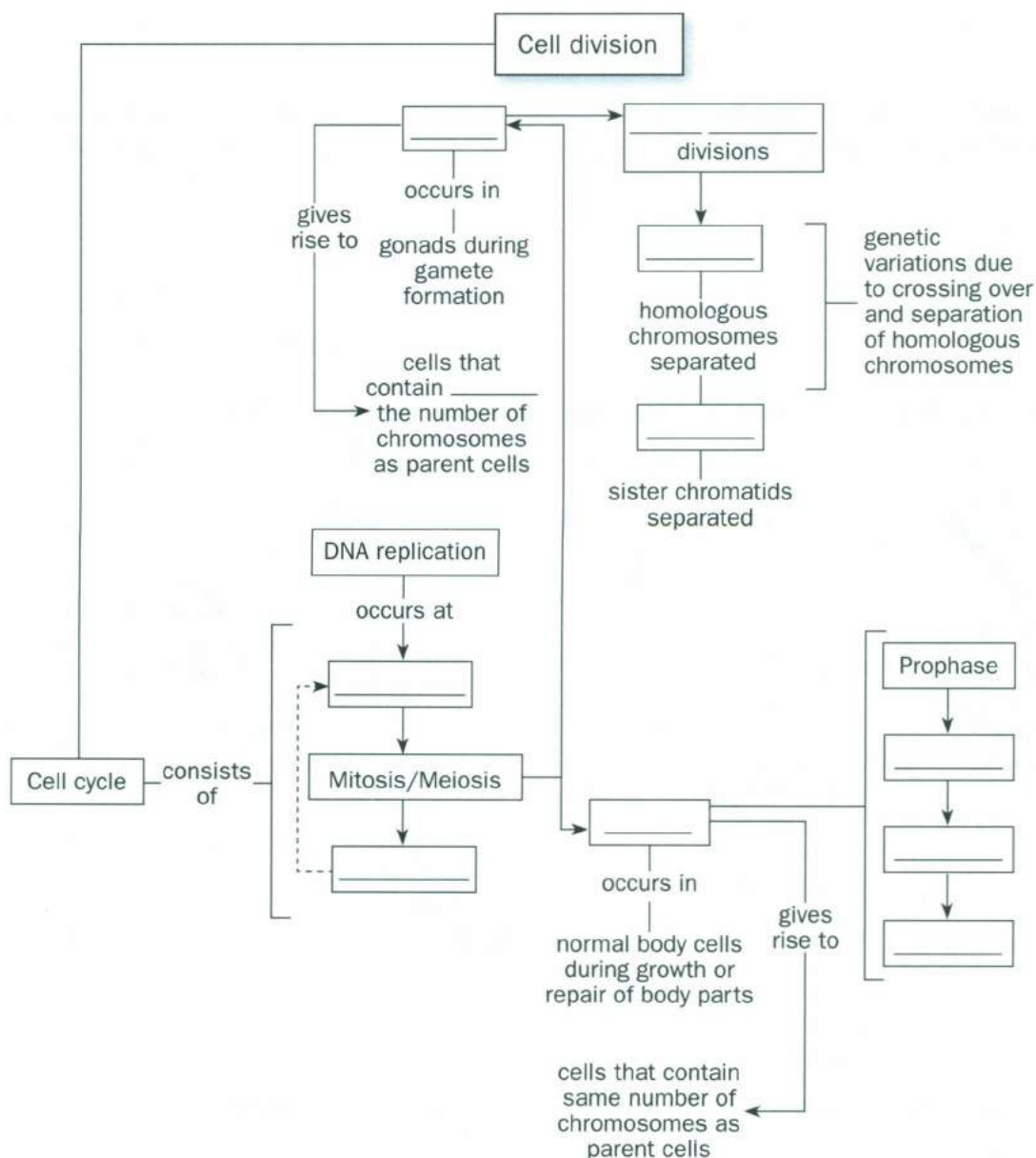
Name: _____ ()

Class: _____ Date: _____

Cell Division



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.



TEST IT!

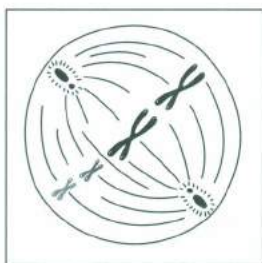
Section A: Multiple-Choice Questions

Choose the correct answer, and write its letter in the brackets provided.

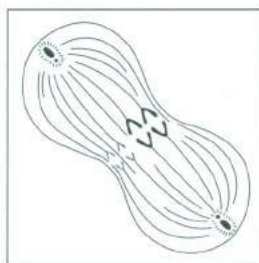
1. The diploid number of the mouse is 40. The number of chromosomes present in a body cell of a mouse is _____.
- A 10
 B 20
 C 40
 D 80
- ()

2. Mitosis occurs during the growth of human tissues. The number of chromosomes present in each parent cell before, and each daughter cell after mitosis is best represented by _____.
- A $n \rightarrow n$
 B $n \rightarrow 2n$
 C $2n \rightarrow n$
 D $2n \rightarrow 2n$
- ()

3. The diagrams below show mitosis at various stages.



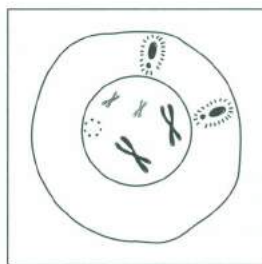
Stage P



Stage Q



Stage R



Stage S



Stage T

Which of the following lists the correct order for the various stages of mitosis?

- A P, Q, R, S, T
 B Q, R, P, T, S
 C R, Q, T, S, P
 D T, S, P, Q, R
- ()

4. How many chromosomes will be found in a body cell and sperm cell of a fruitfly?

	Number of chromosomes in a body cell	Number of chromosomes in a sperm cell
A	4	3
B	4	4
C	4	8
D	8	4

()

5. Meiosis occurs during the production of human gametes. The number of chromosomes present in each cell before and after meiosis is best represented by _____.

- A $n \rightarrow n$
- B $n \rightarrow 2n$
- C $2n \rightarrow n$
- D $2n \rightarrow 2n$

()

6. What happens to the chromatin in prophase I of meiosis?

- A They are pulled towards opposite poles.
- B They attach to spindle fibres.
- C They decondense and become threadlike.
- D They shorten and become visible.

()

7. Homologous chromosomes _____.

- A are identical for all members of a species
- B are in pairs in gametes
- C have identical alleles
- D have identical gene loci

()

8. The formation of gametes involves different stages of meiosis. Which of these combinations of stages gives rise to increased genetic variation in the zygote?

- A Metaphase I and Metaphase II
- B Prophase I and Metaphase I
- C Prophase I and Prophase II
- D Prophase I, Prophase II and Metaphase I

()

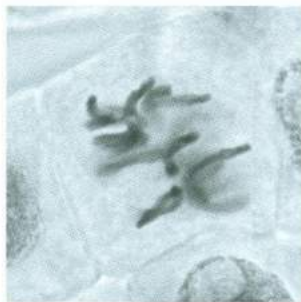
Section B: Structured Questions

Answer the following questions in the spaces provided.

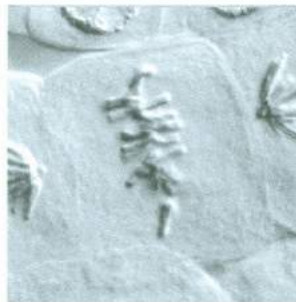
1. The following table compares mitosis and meiosis. Put a tick (✓) if the statement is correct and a cross (✗) if the statement is incorrect.

Characteristics	Mitosis	Meiosis
Chromosomes replicate		
Involves two nuclear divisions		
Crossing over takes place between the chromatids		
Homologous chromosomes pair up		
Sister chromatids separate		
Daughter cells are identical to the parent cell		
Occurs during gamete formation		

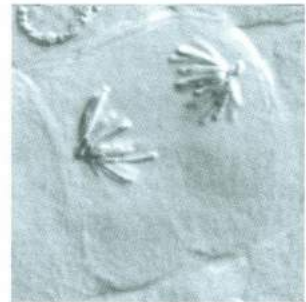
2. Figures **A**, **B** and **C** are photomicrographs of stages of nuclear division in the root hair cells of a plant.



A



B



C

- (a) Name the type of division shown in the photomicrographs.

- (b) Name the stage of division shown in each photomicrograph.

A Stage: _____

B Stage: _____

C Stage: _____

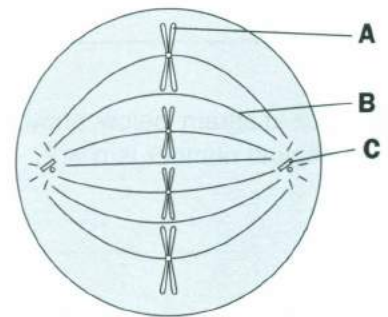
3. The diagram shows an animal cell at a phase in meiosis II division.

(a) Identify the structures **A**, **B** and **C**.

A: _____

B: _____

C: _____

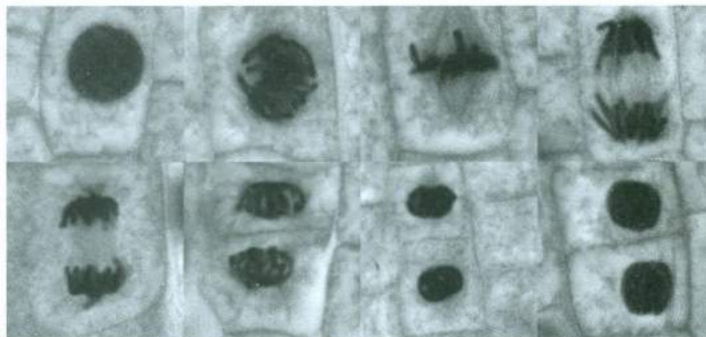


(b) (i) What stage of meiosis II does the diagram show?

(ii) What is the number of chromosomes present in the parent cell during prophase I?

(c) Down's syndrome is a medical condition in which a person's body cell consists of 47 chromosomes, with an additional copy of chromosome 21. At which stage(s) of meiosis might the mistake of having an additional chromosome had happened to cause Down's syndrome?

4. The figure below shows a photomicrograph of cells from a root tip of a plant. The cells are in various stages of mitosis.



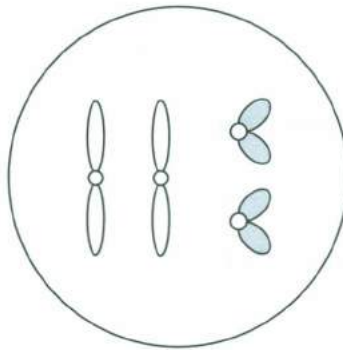
(a) Identify and label on the diagram, cells that are undergoing the following stages of mitosis:

(i) Prophase; (ii) Metaphase;

(iii) Anaphase; and (iv) Telophase.

(b) Suggest what would happen to the root tip as a result of mitosis.

5. The diagram below shows the nucleus and its contents in a known diploid animal cell whose haploid number is $n = 2$.



(a) State the total number of chromosomes that are present in the diploid cells of this animal.

(b) Draw the contents of the cell at prophase I if this cell were to undergo meiosis.

(c) Draw one of the products formed at the end of meiosis.

Section C: Free-Response Questions

Answer the following questions.

1. (a) Explain the meaning of the following terms:

(i) gene;

(ii) chromosome; and

(iii) homologous chromosome.

(b) Explain the relationship between genes, chromosomes and homologous chromosomes.

2. Describe the role of mitosis in maintaining genetic stability. (Hint: *genetic stability* refers to maintenance of DNA sequence, and number and structure of chromosomes.)

3. (a) What is meiosis and where does it occur in the human body?

(b) Explain why meiosis is essential for humans.

 **WORK ON IT!**

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) Understand what occurs during the two processes of cell division, mitosis and meiosis	2, 5, 6	1, 3, 4(b), 5(b), 5(c)	3(a)	16.2, 16.3
(b) Identify the main stages of mitosis and meiosis with the help of diagrams	3	2, 3, 4(a)		16.2, 16.3
(c) Explain why it is important to produce genetically identical cells			2	16.2
(d) Understand the term "homologous" in the context of chromosomes	7		1	16.3
(e) Understand what is meant by "haploid" and "diploid"	1, 4	5(a)		16.3
(f) Explain the need for a reduction division process prior to fertilisation in sexual reproduction			3(a), 3(b)	16.3
(g) State how meiosis and fertilisation results in variation	8		3(b)	16.3

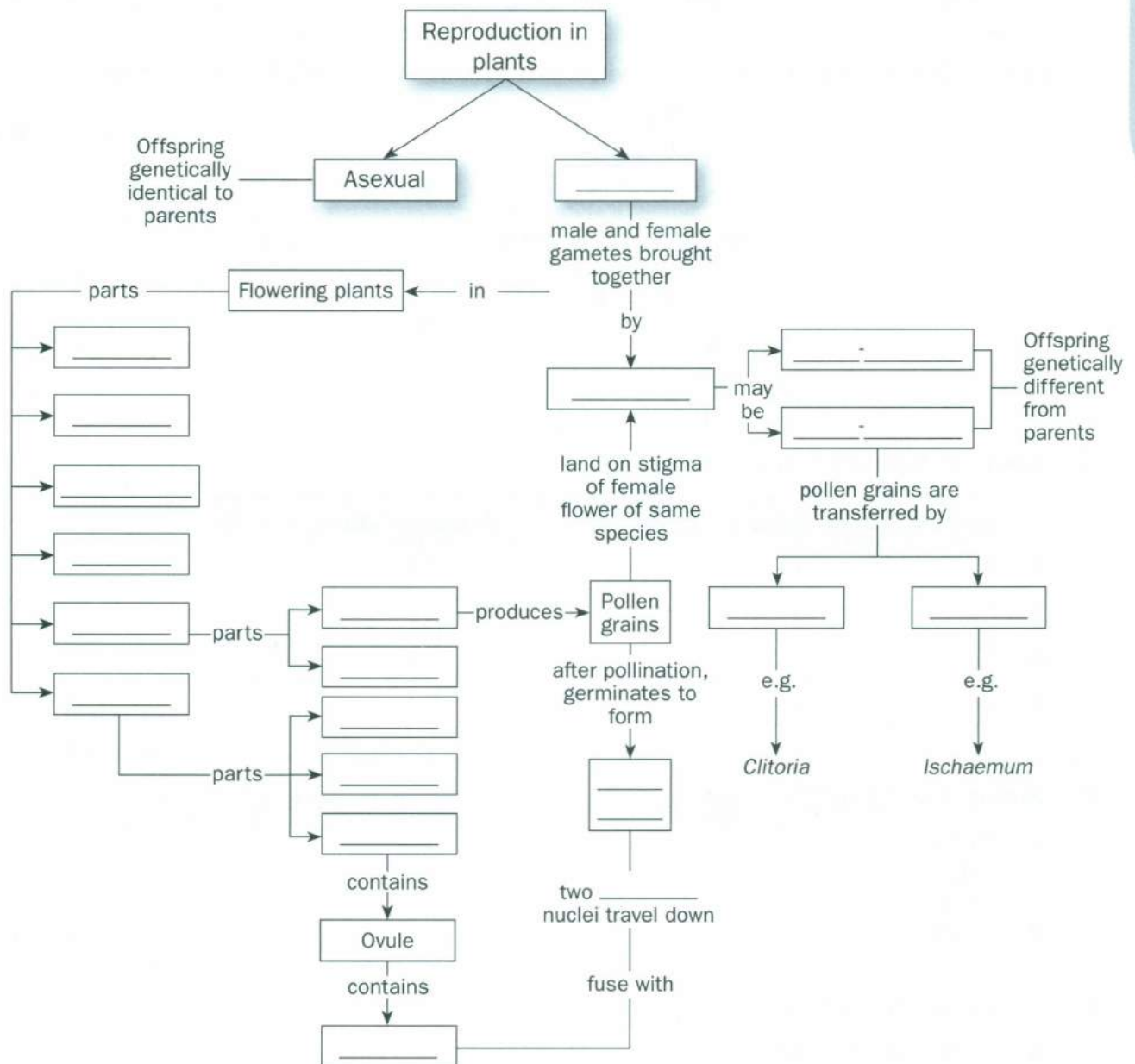
Name: _____ ()

Class: _____ Date: _____

Reproduction in Plants



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.



TEST IT!

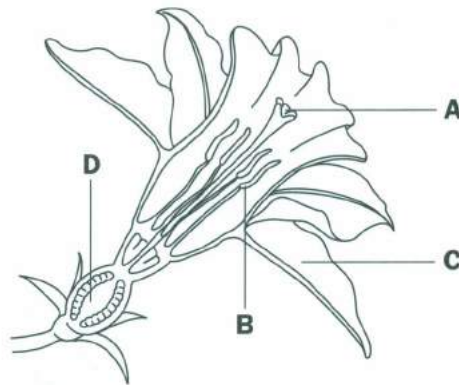
Section A: Multiple-Choice Questions

Choose the correct answer, and write its letter in the brackets provided.

1. One of the advantages of asexual reproduction is that _____.
- A all the beneficial characteristics of the parent are passed on to the offspring
 - B less offspring are produced
 - C more offspring are produced
 - D there is more genetic variation in the offspring

()

For questions 2 and 3, refer to the diagram below, which shows the general section of a flower.



2. Where can male and female gametes be found?

	Male gamete	Female gamete
A	A	B
B	A	C
C	B	A
D	B	D

()

3. What is structure A?

- A Ovary
- B Petal
- C Sepal
- D Stigma

()

4. The carpel consists of _____.

- A anthers and filaments
- B anthers, stigma and style
- C petals, sepals and stamens
- D stigma, style and ovary

()

5. Pollination is _____.

- A the fusion of male gametes with the female gametes in the ovary
- B the fusion of pollen grains with the female gametes in the ovary
- C the transfer of female gametes to the stigma
- D the transfer of pollen grains to the stigma of a flower

()

6. Self-pollination refers to the _____.

- A fusion of pollen grains from a flower with the ovum of a different flower on another plant
- B fusion of pollen grains from a flower with the ovum of the same flower on the same plant
- C transfer of pollen grains from the anthers of a flower to the stigma of a different flower on another plant
- D transfer of pollen grains from the anthers of a flower to the stigma of the same flower on the same plant

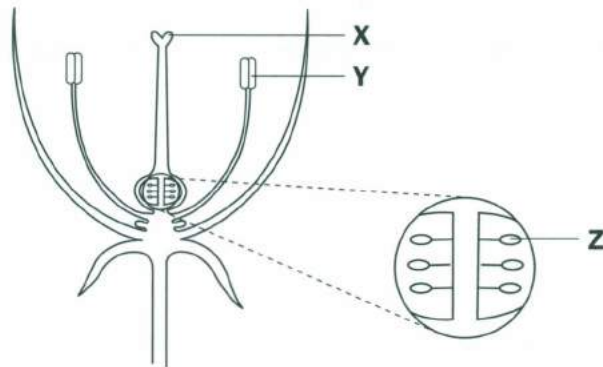
()

7. Most insect-pollinated flowers have _____.

- A bright conspicuous petals and compact stigmas
- B bright conspicuous petals and long protruding stigmas
- C compact stigmas and stamens hanging outside the flower
- D feathery stigmas and pendulous stamens

()

8. The diagram below shows the structure of a generalised flower.



Where do pollination and fertilisation take place?

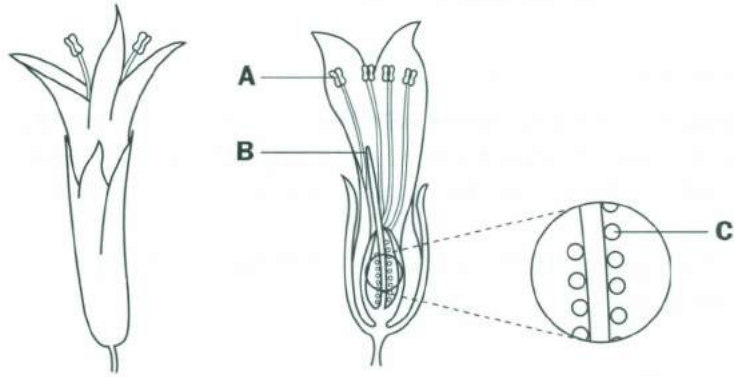
	Pollination	Fertilisation
A	X	Y
B	X	Z
C	Y	X
D	Y	Z

()

Section B: Structured Questions

Answer the following questions in the spaces provided.

1. The diagrams below show a complete flower and a section of a flower of the *Kalanchoe* plant.



- (a) Identify structures **A** to **C**.

A: _____

B: _____

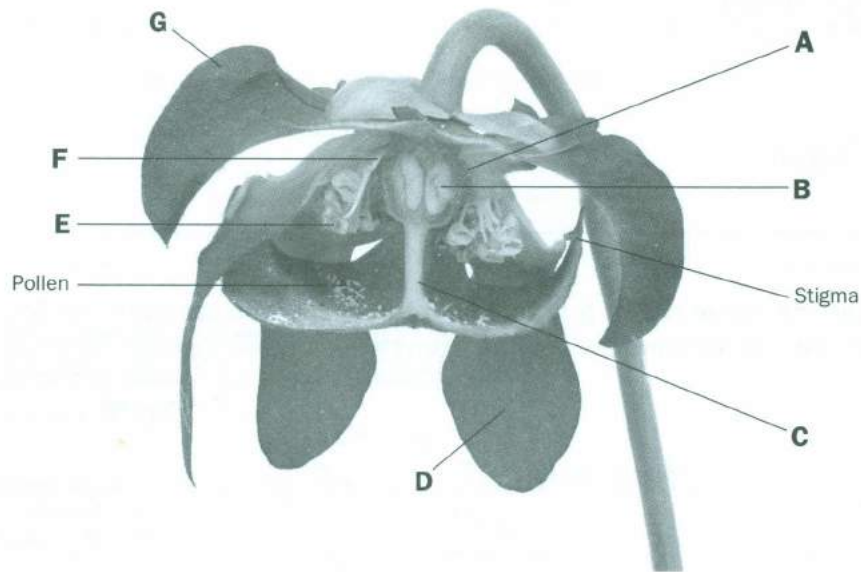
C: _____

- (b) State **two** features shown in the diagrams that show that this flower is adapted for insect-pollination.

- (c) This flower is adapted for self-pollination. State one characteristic of flowers adapted for self-pollination that is **not** shown in the diagram.

- (d) From what you can see in the diagram, what feature of the flower suggests that the fruit of this flower is likely to contain more than one seed?

2. The diagram below shows a section of a *Sarracenia* flower (North American Pitcher Plant).



(a) Identify structures **A** to **G**.

A: _____

E: _____

B: _____

F: _____

C: _____

G: _____

D: _____

(b) State whether this flower is adapted for insect-pollination or wind-pollination.

(c) State **two** features shown in the diagram that show that this flower is adapted for the type of pollination suggested in (b).

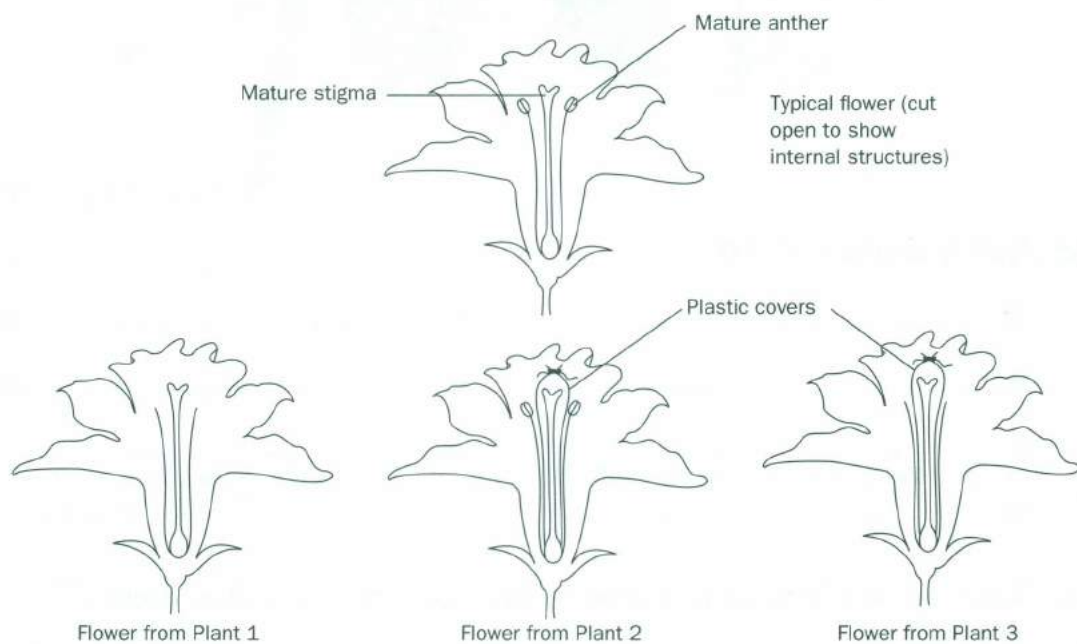
(d) Which of the structures **A** to **G** is directly involved in pollination?

(e) After fertilisation, state which structure will develop into

(i) a fruit; and

(ii) a seed.

3. The first picture below shows a typical flower from a particular plant. All flowers of Plants 1, 2 and 3 were treated as shown below. The plants are left in the open.



(a) State the difference between the flowers from Plant 1 and Plant 2.

(b) Explain why only flowers from Plant 1 are able to produce seeds, but not those from Plants 2 and 3.

- (c) A student suggested that the seeds from Plant 1 have increased genetic variability as compared to those plants without the stamens being removed from their flowers. How does removing the stamens from the flowers from Plant 1 increase the genetic variability of the offspring?

Section C: Free-Response Questions

Answer the following questions.

1. (a) Distinguish between asexual reproduction and sexual reproduction.

- (b) Discuss the advantages and disadvantages of asexual reproduction.

- (c) What are some special features of plants that enable them to carry out sexual reproduction?

2. (a) Distinguish between pollination and fertilisation in flowering plants.

(b) Outline the growth of the pollen tube and its entry into the ovule.

(c) Describe fertilisation in flowering plants.


WORK ON IT!

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) Define sexual and asexual reproduction, and differentiate between the two processes	1		1	17.1
(b) Identify the main parts of a flower in diagrams/photos	2, 3, 4	1, 2		17.2
(c) State the functions of the sepals, petals, anthers and carpels		3		17.2
(d) Outline the process of pollination, and distinguish between self-pollination and cross-pollination	5, 6, 8	1	2	17.3
(e) State the characteristics of insect-pollinated and wind-pollinated flowers, and distinguish between the two types of flowers	7	1, 2		17.3
(f) Describe the growth of the pollen tube and the process of fertilisation in flowering plants		2	2	17.4

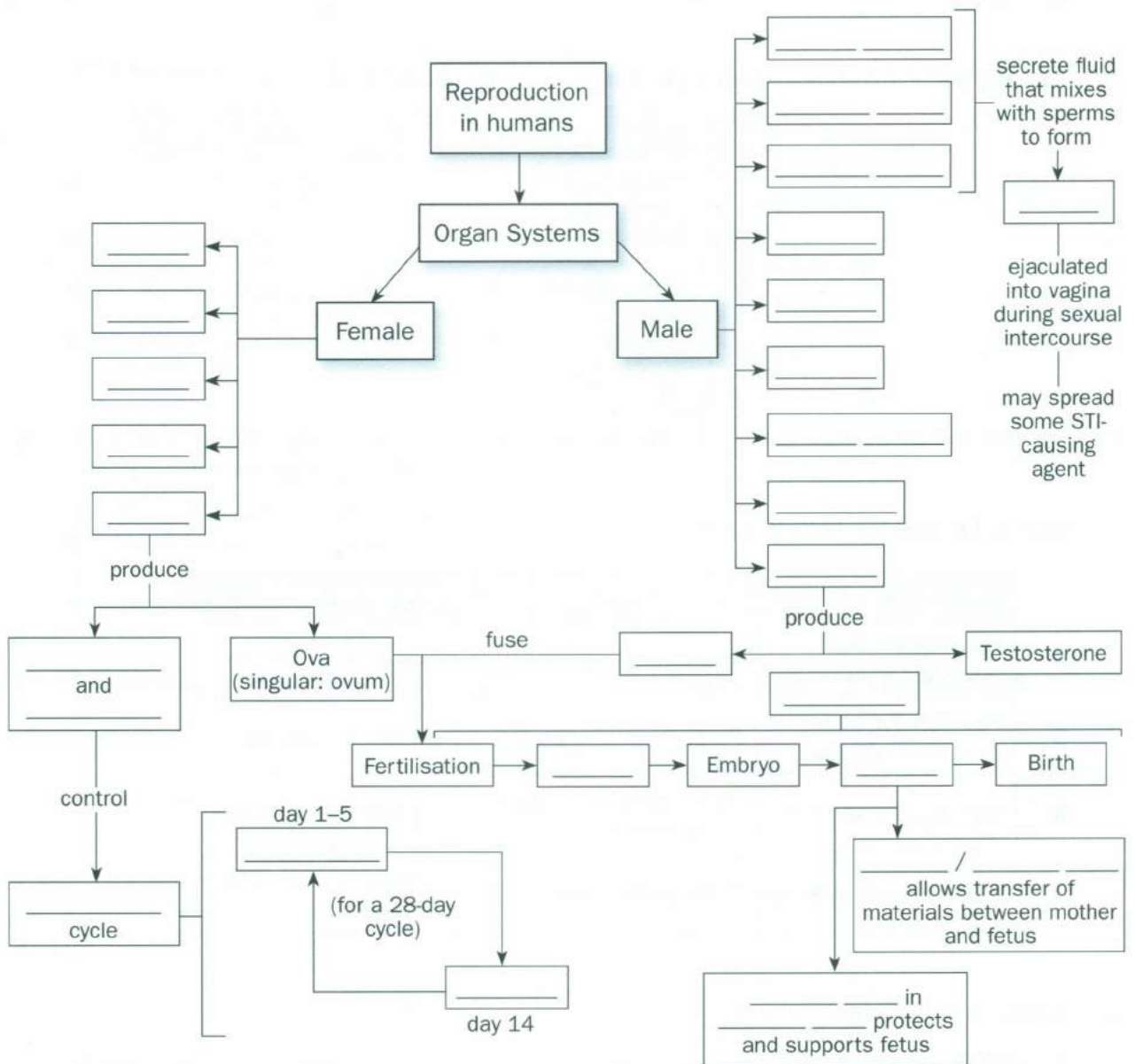
Name: _____ ()

Class: _____ Date: _____

Reproduction in Humans



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.



TEST IT!

Section A: Multiple-Choice Questions

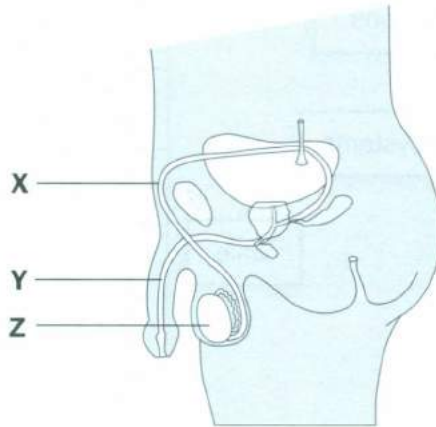
Choose the correct answer, and write its letter in the brackets provided.

1. Sperms are produced in the _____.

- A epididymis
- B penis
- C sperm duct
- D testes

()

2. The diagram below shows a **side view** of the male reproductive system.



What is the function of **X**, **Y** and **Z**?

	X	Y	Z
A	Passage for both urine and sperms	Passage for sperms	Production of sperms
B	Passage for both urine and sperms	Production of sperms	Passage for sperms
C	Passage for sperms	Passage for both urine and sperms	Production of sperms
D	Production of sperms	Passage for sperms	Passage for both urine and sperms

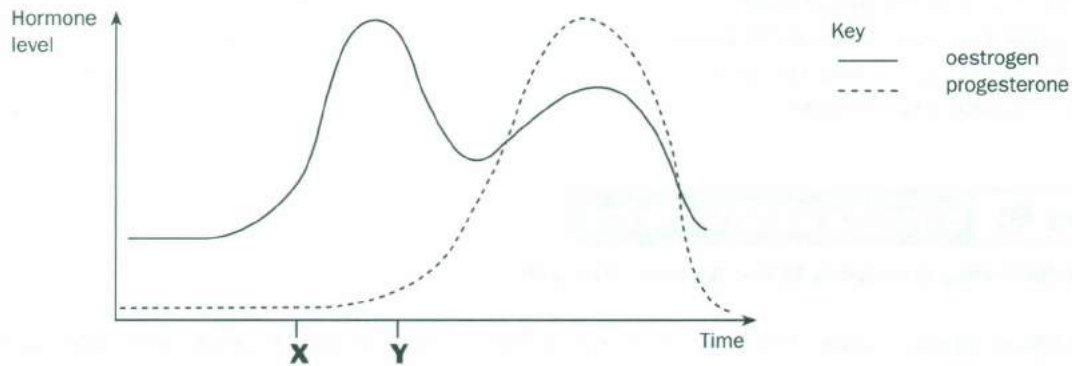
()

3. Where does fertilisation occur?

- A Cervix
- B Ovary
- C Oviduct
- D Uterus

()

4. The following diagram shows the concentration of female sex hormones in the blood over time.



What happens at point X and point Y?

	X	Y
A	Menstruation	Ovulation
B	Menstruation	Repair of uterus wall lining
C	Repair of uterus wall lining	Menstruation
D	Repair of uterus wall lining	Ovulation

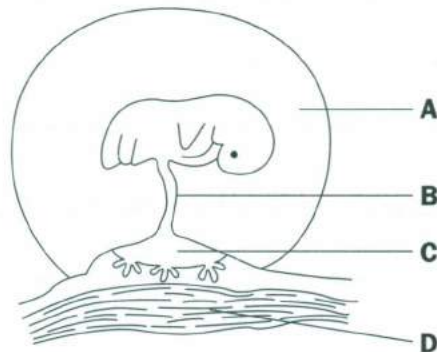
()

5. Which of the following correctly lists some of the substances transferred from mother to fetus via the umbilical cord during pregnancy?

- A Carbon dioxide, amino acids and antibodies
- B Glucose, amino acids and antibodies
- C Glucose, amino acids and carbon dioxide
- D Glucose, carbon dioxide and antibodies

()

6. The following diagram shows a developing mammalian fetus and part of the uterine wall.



Where does the exchange of dissolved nutrients, gases and excretory products between mother and fetus take place?

()

7. Risk of Human Immunodeficiency Virus (HIV) infection is best reduced by _____.

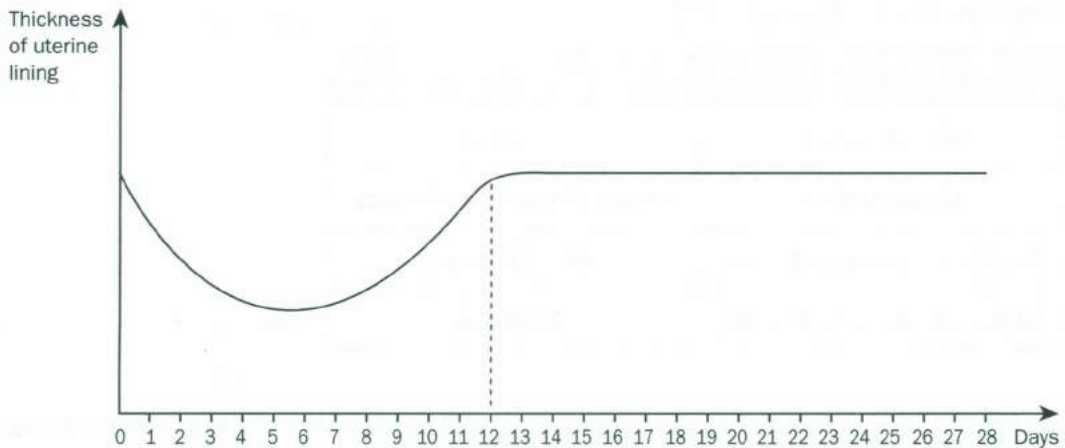
- A not having blood transfusions
- B regular exercise and a healthy diet
- C keeping to one sexual partner
- D taking anti-viral medications

()

Section B: Structured Questions

Answer the following questions in the spaces provided.

1. The diagram below shows how the thickness of the uterine lining changes over time during a menstrual cycle lasting 28 days.

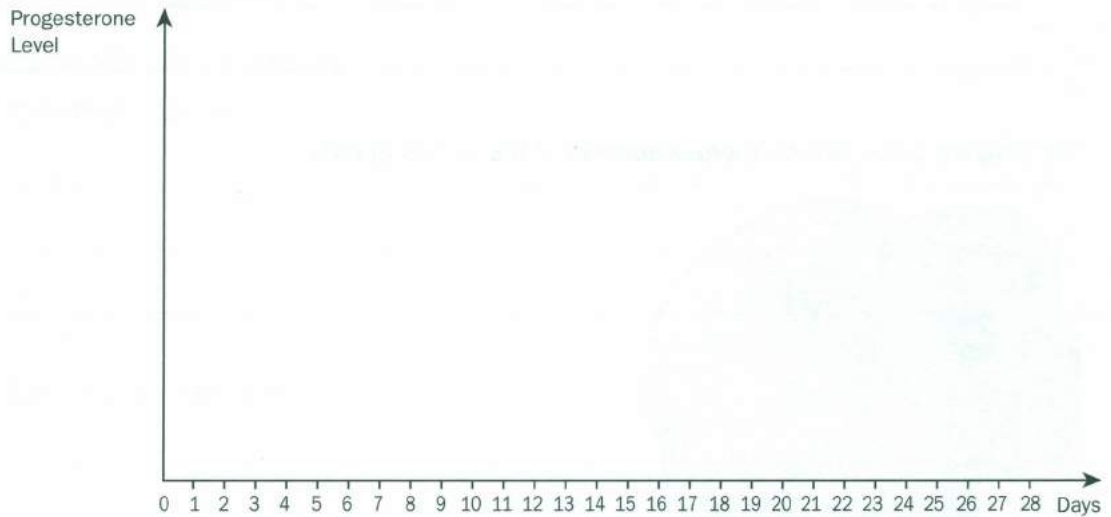


(a) On which day(s) is the woman most fertile?

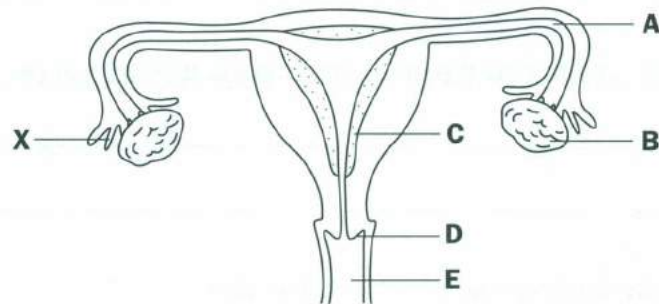
(b) What causes the decrease in the thickness of the uterine lining from day 0 to day 5?

(c) If the woman is pregnant, what will happen to the thickness of the uterine lining after day 28?

- (d) On the diagram below, draw a graph to show how the level of progesterone changes over the course of the menstrual cycle, assuming that the woman is not pregnant.



2. The diagram below shows the **front view** of the female reproductive system.



- (a) Identify structures **A** to **E**.

A: _____

B: _____

C: _____

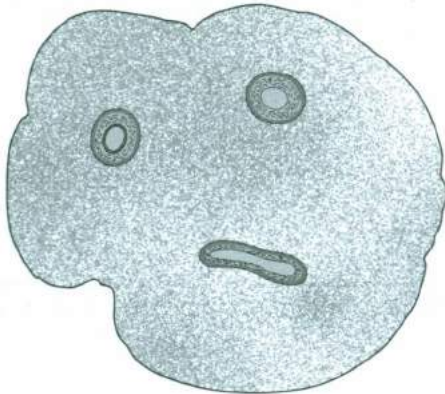
D: _____

E: _____

- (b) State the functions of structures **A** to **C**.

(c) How does the shape of structure **A** at point **X** help its function?

3. The diagram below shows a **cross-section** of the umbilical cord.



(a) Label the umbilical artery and the umbilical vein in the diagram.

(b) Using the diagram, state how the umbilical artery is identified in (a).

(c) Describe the path of blood flow in the umbilical vein.

(d) List **two** substances that will be transferred from the fetus to its mother.

(e) How do the substances listed in (d) move into the mother's blood?

(f) The capillaries at the site of exchange between fetus and mother are located in finger-like villi. What is the advantage of this?

Section C: Free-Response Questions

Answer the following questions.

1. Distinguish between the following terms:

(a) semen and sperm;

(b) ovary and oviduct; and

2. Describe how a human embryo is protected and nourished inside its mother.

3. Compare and contrast the fertilisation process in flowering plants and in humans.

4. The table below shows the number of reported HIV/AIDS (Acquired Immune Deficiency Syndrome) cases in Singapore from year 2000 to 2010.

Year	Total number of HIV/AIDS cases
2000	226
2001	237
2002	234
2003	242
2004	311
2005	317
2006	359
2007	423
2008	456
2009	463
2010	441

(Source: Ministry of Health, Singapore 2011)

- (a) Describe the general trend observed for the number of HIV/AIDS cases in Singapore over the last 10-year period.

- (b) Explain how HIV/AIDS can be transmitted.

- (c) Describe ways in which the number of HIV/AIDS cases can be reduced.


WORK ON IT!

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) Identify on diagrams, structures in the male and female reproductive systems, and state their respective functions	1, 2	2	1(a), 1(b)	18.1, 18.2
(b) Describe stages in the menstrual cycle with reference to the effect of hormones	4	1	1(c)	18.3
(c) Describe fertilisation and the process of early development of the zygote	3		3	18.4
(d) State the function of the amniotic sac and the amniotic fluid		3	2	18.4
(e) Describe the function of the placenta and umbilical cord, with reference to the exchange of materials between the mother and the fetus	5, 6	4	2	18.4
(f) Understand how the human immunodeficiency virus (HIV) can be transmitted between individuals, and suggest methods to control the spread of the disease	7		4	18.5

TEST IT!

Section A: Multiple-Choice Questions

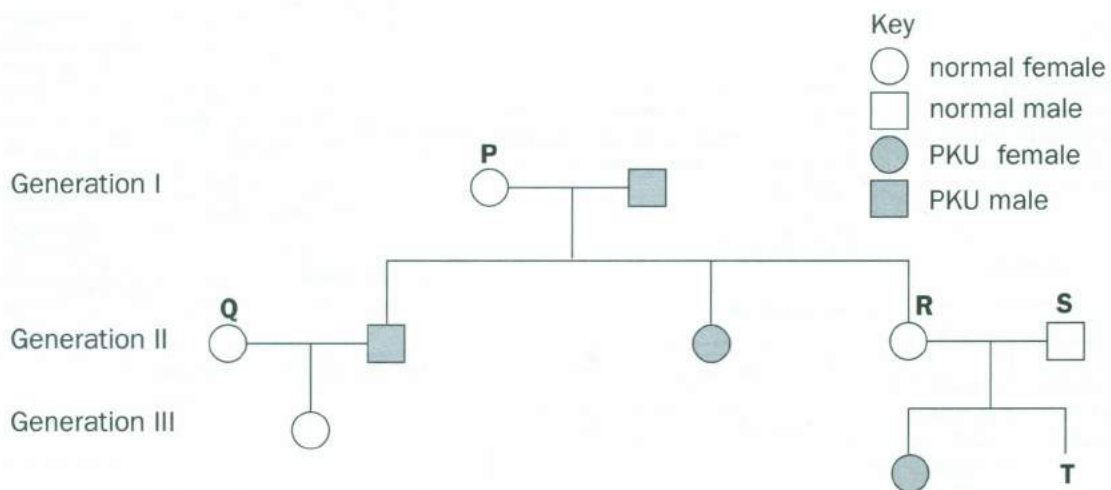
Choose the correct answer, and write its letter in the brackets provided.

1. Phenotype is determined by _____.

- A environmental factors only
- B genotype and environmental factors
- C genotype only
- D mutation only

()

For questions 2 and 3, refer to the following diagram showing the family tree of a family with phenylketonuria (PKU). PKU is a disease that is expressed in homozygous recessive individuals. PKU patients are not able to break down an amino acid called phenylalanine.



2. Which of the following best describes the genotype of individuals in the family tree?

- A P and Q are homozygous dominant.
- B P and Q are heterozygous.
- C R and S are homozygous dominant.
- D R is homozygous dominant, and S is heterozygous.

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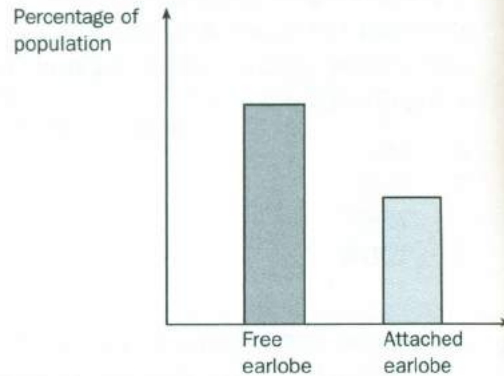
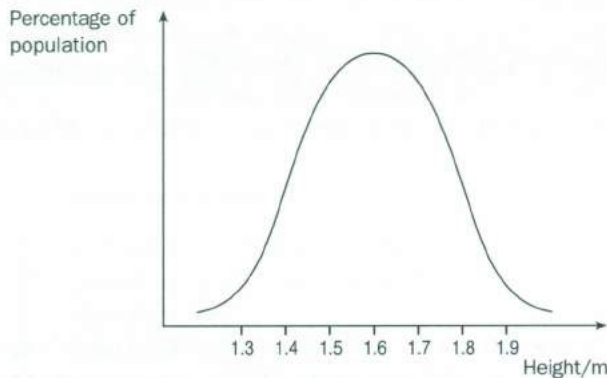
3. What is the chance that T will be normal?

- A 25%
- B 50%
- C 75%
- D 100%

()

4. The Rhesus blood group system is a human blood group system. It is the most clinically important blood group system after ABO. In humans, the allele for the Rhesus-positive trait (H) is dominant to the allele for the Rhesus-negative trait (h). If a homozygous Rhesus-positive woman and a homozygous Rhesus-negative man have children, what is the probability of their first child being Rhesus-positive?
- A 0%
 B 25%
 C 75%
 D 100% ()
5. The human ABO blood group is determined by one gene with three different alleles. A father with blood group O and a mother with blood group AB have a child. How many ABO blood group genotypes and phenotypes are possible in the child?
- A 2 genotypes and 1 phenotypes
 B 2 genotypes and 2 phenotypes
 C 3 genotypes and 3 phenotypes
 D 4 genotypes and 4 phenotypes ()
6. A child has blood group AB. Her father's blood group is B. Which blood group(s) can her mother have?
- A O
 B A or AB
 C B
 D B or O ()
7. The nucleus of the human female gamete contains _____.
- A 22 chromosomes and one X chromosome
 B 22 chromosomes and one X or Y chromosome
 C 23 chromosomes and one X chromosome
 D 23 chromosomes and one X or Y chromosome ()
8. Sickle-cell anaemia is an example of a _____.
- A bacterial infection
 B chromosomal mutation
 C dietary deficiency disease
 D gene mutation ()

9. The graphs below show the distributions, within a human population, for height and for earlobe type.



Which type of variation does each characteristic exhibit?

	Height	Type of earlobe
A	Continuous	Continuous
B	Continuous	Discontinuous
C	Discontinuous	Continuous
D	Discontinuous	Discontinuous

()

10. Which of the following two characteristics are examples of continuous variation?

- A Ability to roll tongue and height
- B Blood type and ability to roll tongue
- C Gender and weight
- D Length of feet and weight

()

11. Which of the following describes natural selection?

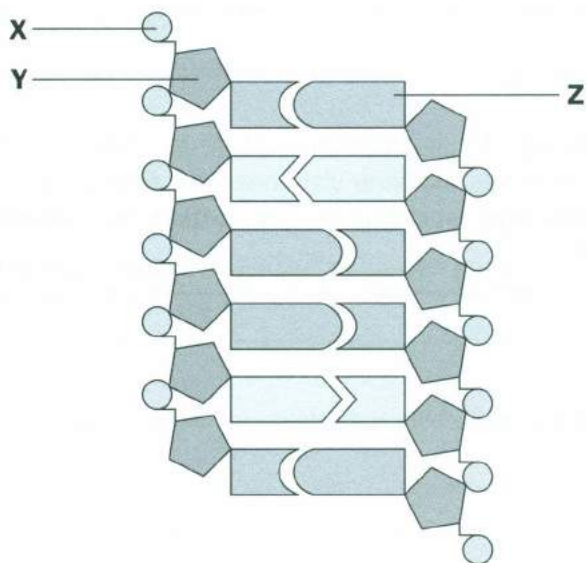
- A A process by which careful selection of parents are made to produce a new generation with desirable characteristics.
- B A process by which human beings selectively breed animals for a purpose.
- C A process by which individuals possessing advantageous characteristics survive, breed and pass on their characteristics to the next generation.
- D A process by which there is a rapid change in the gene pool such that new, desirable characteristics are observed.

()

e type.

12. Farmers have noticed that, over the years, the amount of pesticide required to act against caterpillars increases. The best explanation for this observation is that _____.
- A most of the caterpillars become more resistant due to repeated exposure to the pesticide
 - B most of the caterpillars mutate at every generation and become resistant
 - C some of the caterpillars that are already resistant survive, and are able to reproduce and pass this resistance trait to the next generation
 - D the allele that gives rise to resistance become dominant over the years due to selection pressure
- ()

13. The following diagram shows part of a DNA molecule.



Identify X, Y and Z.

	X	Y	Z
A	Deoxyribose sugar	Nitrogenous base	Phosphate group
B	Nitrogenous base	Deoxyribose sugar	Phosphate group
C	Phosphate group	Deoxyribose sugar	Nitrogenous base
D	Phosphate group	Nitrogenous base	Deoxyribose sugar

()

14. Which of the following correctly lists all the nitrogenous bases in DNA?

- A Adenine, cytosine, guanine, thymine
- B Adenine, cytosine, guanine, uracil
- C Alanine, cytosine, guanine, thymine
- D Alanine, cytosine, guanine, uracil

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Section B: Structured Questions

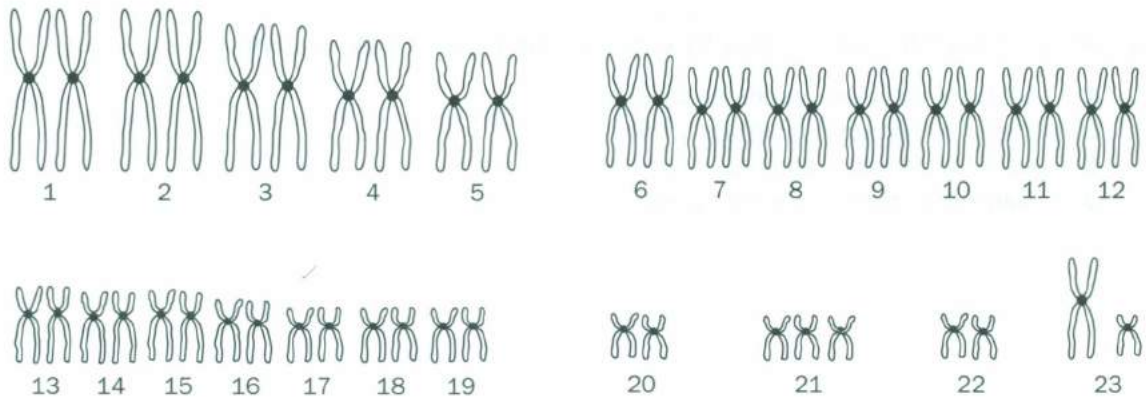
Answer the following questions in the spaces provided.

1. The sex of a person is determined by the combination of X and Y chromosomes present. Female cells have two X chromosomes, while male cells have one X and one Y chromosome.

- (a) State whether the male or the female gamete determines the sex of a child. Explain your answer.

- (b) In the space below, draw a genetic diagram to show that there is an equal chance that a baby can be a boy or a girl.

- (c) The following diagram shows all the chromosomes (the karyotype) of a person.



- (i) Identify the sex of the person from which the chromosomes were taken. Explain your answer.

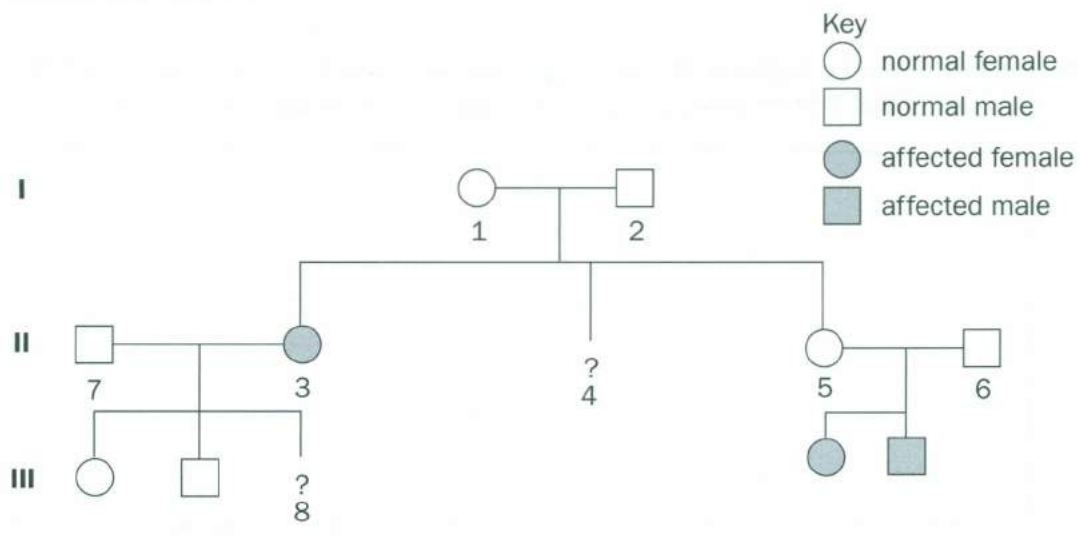
- (ii) Suggest, with a reason, what condition will be present in this person.

2. Sickle-cell anaemia is a condition in which red blood cells contain abnormal haemoglobin. People who inherit two sickle-cell alleles, are seriously anaemic and usually die young. Those who are heterozygous are only mildly affected.

- (a) State the process that brought about the sickle-cell gene.

- (b) Suggest, with a reason, whether the allele that gives rise to sickle-cell anaemia is dominant or recessive.

- (c) The diagram below shows a family tree with some members of a family being affected by sickle-cell anaemia.



Using 'N' to represent the normal allele, and 'n' to represent the sickle-cell allele,

- (i) State the genotype(s) of persons 1 and 2. Explain your answer.

- (ii) Predict all possible genotypes and phenotypes of person 8, using genetic diagrams.

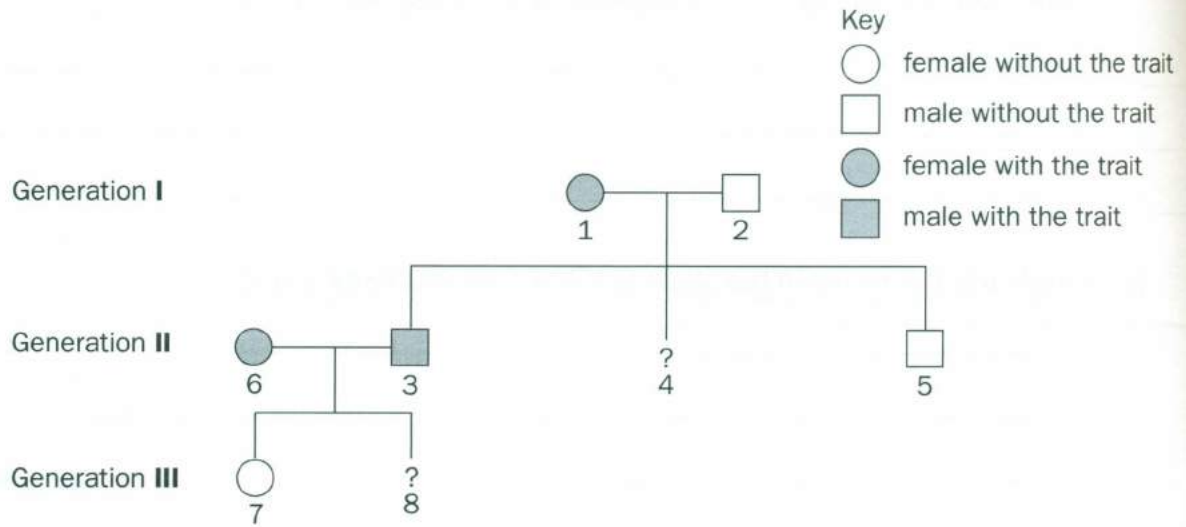
- (iii) Person 4 often complains of becoming tired easily. He had his blood tested. What is the probability that he has sickle-cell anaemia? Use a genetic diagram to show this.

(d) People with sickle-cell anaemia are less affected by malaria. Explain why, in regions where malaria is prevalent, there are many people with the sickle-cell allele.

(e) Explain why a person with two sickle-cell alleles will usually die young.

3. A scientist analysed a double stranded DNA sample, and found that 15% of its nitrogenous bases were adenine. Calculate the percentage of the other nitrogenous bases in the DNA sample. Explain your answer.

4. The inheritance of a particular trait is shown below.



(a) Explain, using the information provided in the diagram above, the genotypes of those expressing the trait.

(b) Predict and explain what is the probability that person 8 will be heterozygous.

Section C: Free-Response Questions

Answer the following questions.

1. The inheritance of ABO blood groups is controlled by three alleles, I^A , I^B and I^O . Both I^A and I^B are dominant to the allele I^O .

(a) Explain what is meant by an allele.

(b) State all the possible genotypes for each blood group.

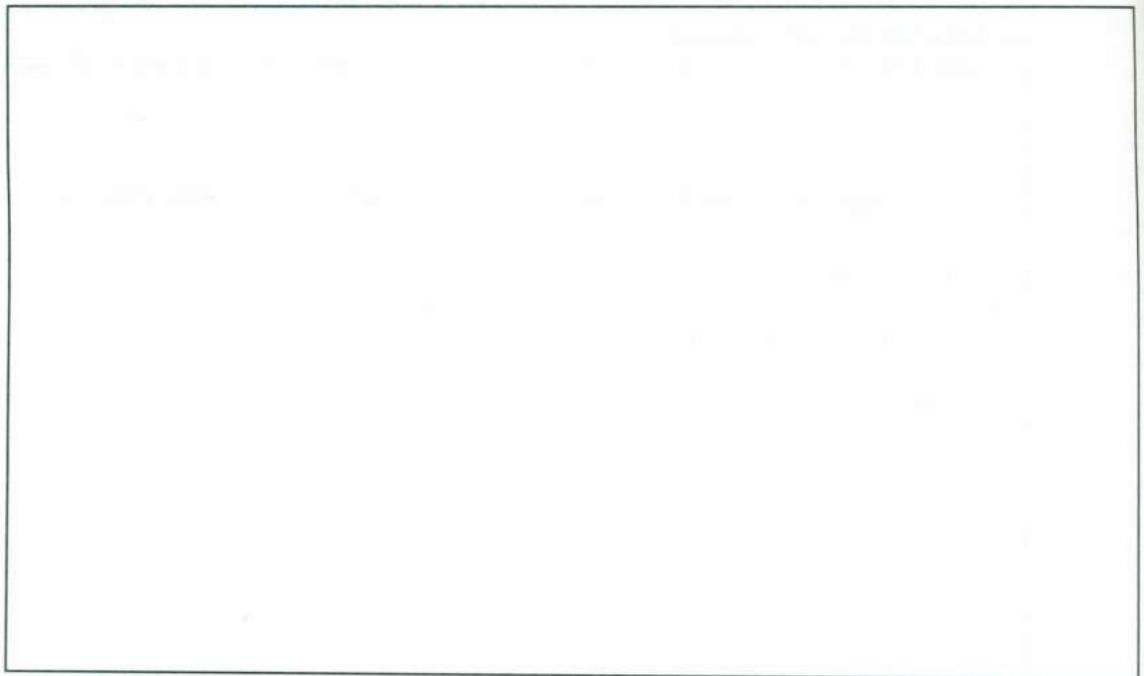
(c) A father with blood group A, and a mother with blood group B had children of blood groups A and O. Using full genetic diagrams, show all the possible ABO blood group phenotypes for the children of these parents.

2. (a) Distinguish between

(i) a gene and an allele; and

(ii) genotype and phenotype.

(b) Draw a genetic diagram to show the inheritance of height in pea plants when two heterozygous tall pea plants cross. The tall allele is the dominant allele.



3. (a) Distinguish between the processes of

(i) continuous variation and discontinuous variation; and

(ii) natural selection and artificial selection.

(b) Discuss the possible causes of mutation, and give an example where a mutation is advantageous to an organism.

4. (a) Using your knowledge of genetic engineering, describe how a scientist can transfer a gene, that gives rise to the production of a toxin that kills insects, into bacteria and eventually collect the toxin from the bacteria.

- (b) People have opposed the use of genetic engineering as described above to improve crop yield. Give **three** biologically valid reasons that can be used as arguments against this type of genetic engineering.


WORK ON IT!

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) Distinguish between "gene" and "allele"			2	19.2
(b) Understand and explain commonly used terms in the study of heredity, such as "dominant", "recessive", "homozygous", "heterozygous", "phenotype" and "genotype"	1, 2			19.2
(c) Solve problems, and predict results of monohybrid inheritance using genetic diagrams	3, 4	1, 2, 4		19.2, 19.3
(d) Explain codominance with reference to the inheritance of the ABO blood group phenotypes	5, 6		1	19.4
(e) Describe the determination of sex in humans with reference to the XX and XY chromosomes	7	1		19.3
(f) Differentiate between discontinuous and continuous variation	9, 10		3	19.5
(g) Describe different types of mutation and their causes	8	2		19.6
(h) Relate variation and competition to natural selection and eventually evolution	11, 12		3	19.7
(i) State the composition of DNA and its structure	13, 14	3		20.1
(j) Understand and apply the rules of base pairing		3		20.1
(k) Understand that genes can be transferred			4(a)	20.2, 20.3
(l) Outline the application of genetic engineering in the production of insulin			4(a)	20.3
(m) Discuss the various issues arising from genetic engineering			4(b)	20.4

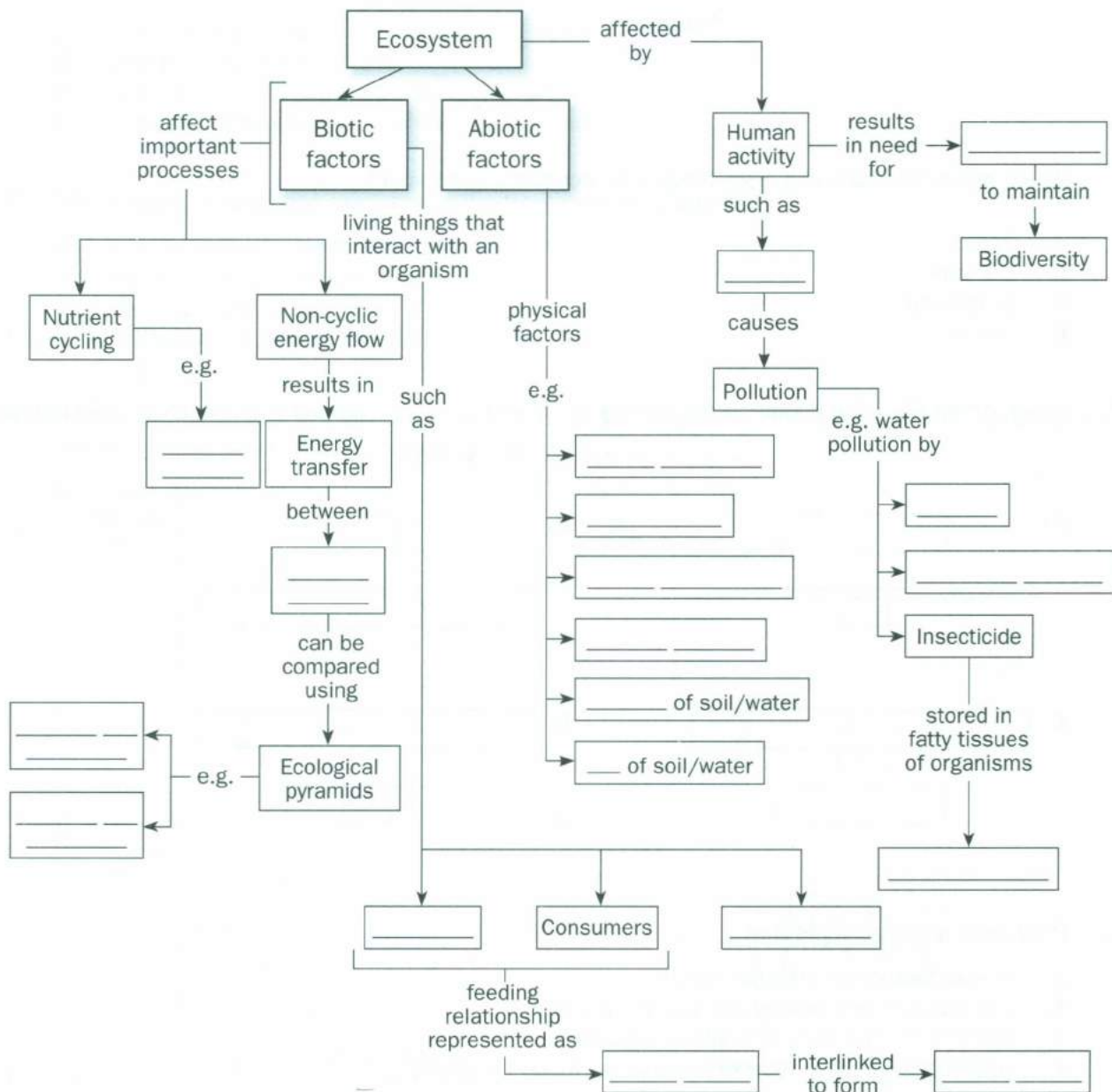
Name: _____ ()

Class: _____ Date: _____

Ecology and Our Impact on the Ecosystem



Complete the concept map below using keywords learnt in the chapter. Discuss with your classmates how the concept map can be extended.

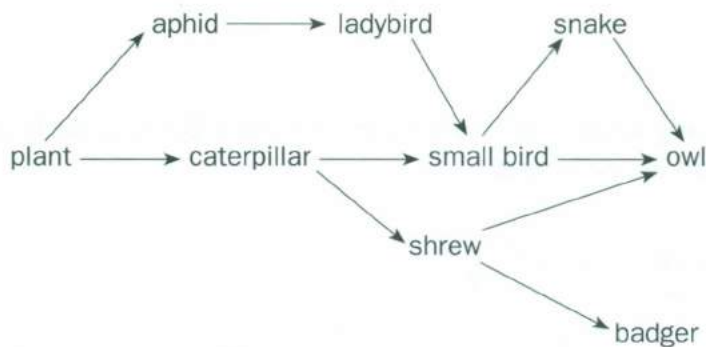


TEST IT!

Section A: Multiple-Choice Questions

Choose the correct answer and write its letter in the brackets provided.

1. The diagram below shows a food web.

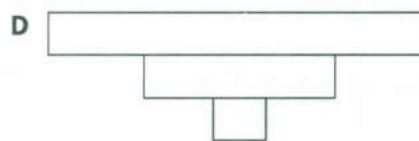
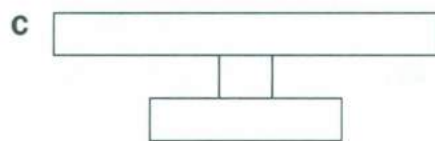
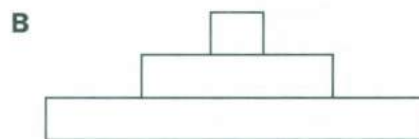


Which one of the following organisms is a secondary consumer?

- A Aphid
- B Caterpillar
- C Small bird
- D Snake

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2. Which of the following pyramids represents the biomass of the organisms in the food chain below?



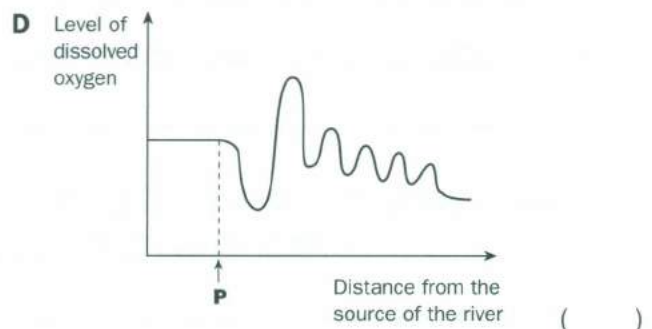
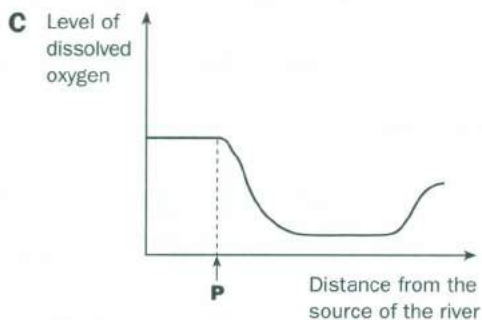
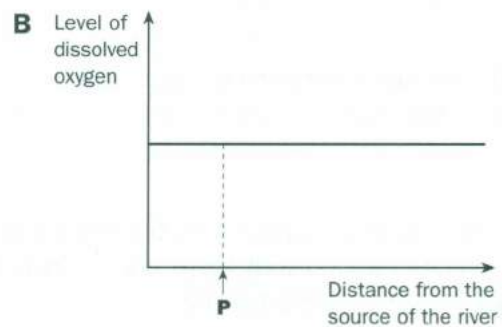
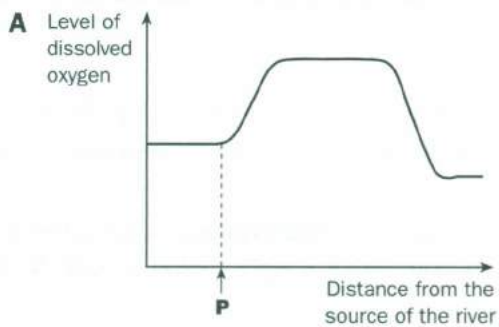
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3. Producers are organisms that _____.

- A break down dead organic matter
- B can convert light energy into chemical energy
- C live on or in the body of another organism
- D obtain energy from other organisms on which they feed

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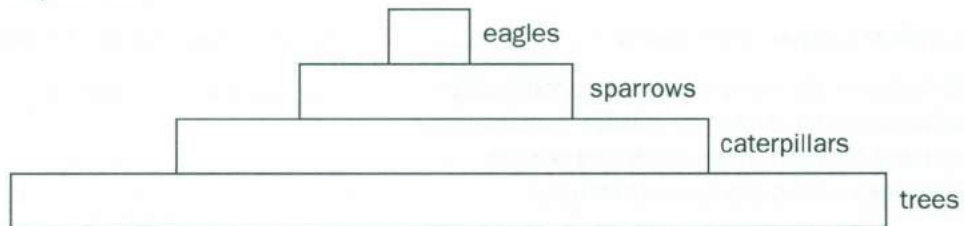
4. Carbon dioxide is removed from the atmosphere by _____.
- A combustion
 - B decomposition
 - C photosynthesis
 - D respiration
- ()
5. Sewage pollutes water and causes a _____.
- A decrease in the carbon dioxide concentration
 - B decrease in the dissolved nitrate concentration
 - C decrease in the number of decomposers
 - D decrease in the oxygen concentration
- ()
6. Bioaccumulation refers to the build-up of _____.
- A biodegradable chemicals along a food chain
 - B energy along a food chain
 - C living organisms along a food chain
 - D non-biodegradable chemicals in an organism
- ()
7. Which types of microbes are used in the treatment of sewage?
- A Aerobic bacteria, anaerobic bacteria and fungi
 - B Aerobic bacteria and anaerobic bacteria
 - C Aerobic bacteria and fungi
 - D Anaerobic bacteria and fungi
- ()
8. A factory discharges sewage into a river at point **P**. Which of the following graphs illustrates the changes in the level of dissolved oxygen along the river?



Section B: Structured Questions

Answer the following questions in the spaces provided.

1. The pyramid of biomass for a forest is shown below. The width of each band represents the biomass of each trophic level.



- (a) What is the correct unit used to record biomass?

- (b) Why are pyramids of biomass more useful when studying a particular ecosystem than pyramids of numbers?

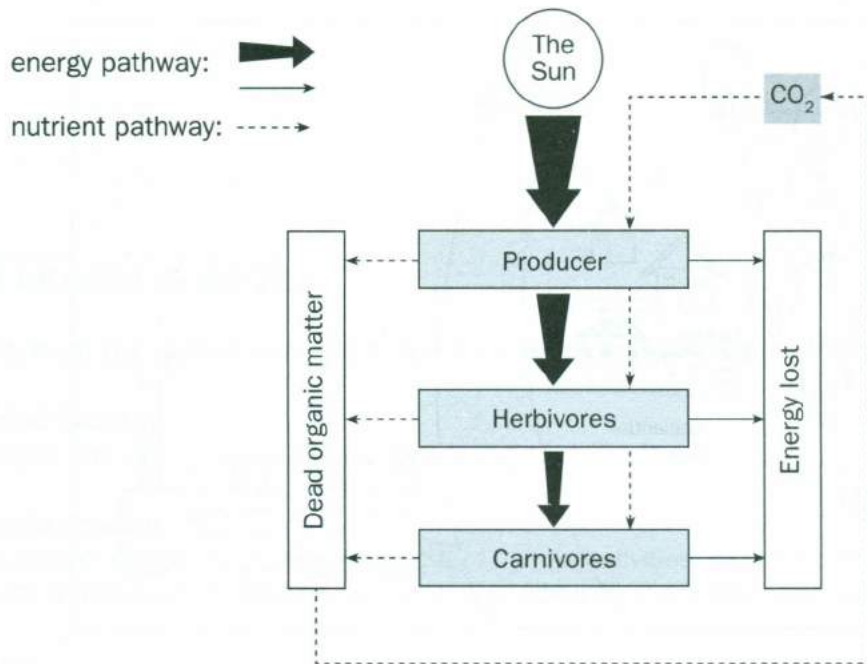
- (c) From the pyramid of biomass, identify

- (i) the producer; and

- (ii) the secondary consumer.

- (d) Insecticide was sprayed onto the trees to control the number of caterpillars. After a few years, scientists noticed that there was a decline in the number of eagles in the forest. Suggest **two** reasons for the decline.

2. The diagram shows the energy pathway and nutrient pathway in a food chain.



(a) What nutrient is illustrated in the nutrient pathway?

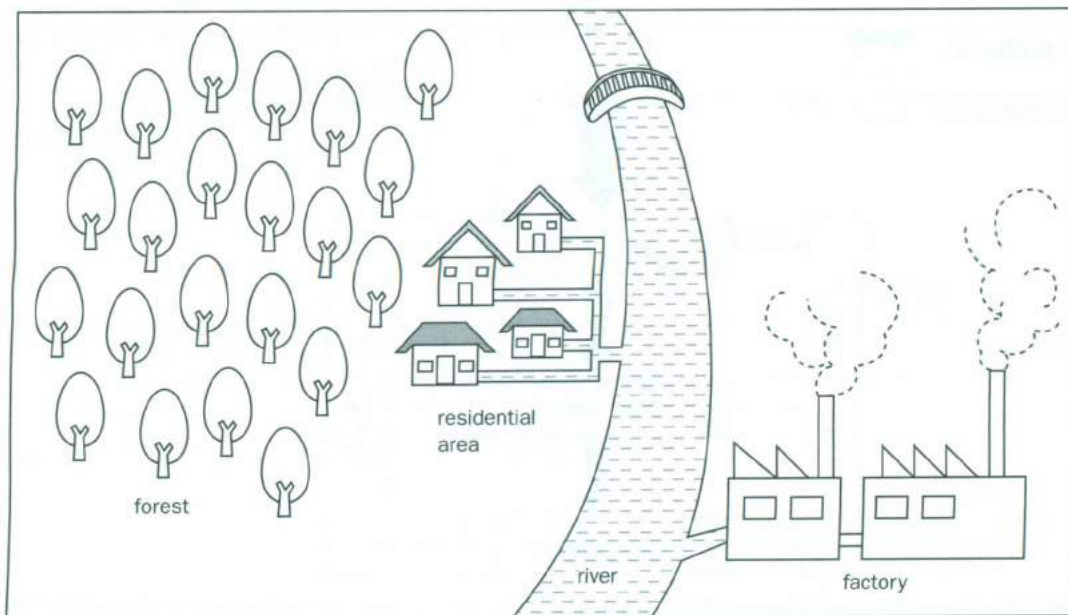
(b) How does the producer take in energy from the Sun?

(c) Why do the arrows representing the energy pathway decrease in size from the Sun to the carnivores?

(d) From the diagram, state one difference between the energy pathway and nutrient pathway.

(e) A carbon sink is an area that stores carbon compounds for an indefinite period. Name **two** natural places on Earth that can be considered as carbon sinks.

3. The diagram below shows the effects of human activities in a town.



(a) Organic matter is discharged from the residential area.

(i) State the effects of the discharge of this organic matter on the organisms in the river.

(ii) How would the concentration of dissolved oxygen change as water flows downstream from the residential area?

(b) The factory discharges high-temperature waste into the river. How would this discharge affect the organisms in the river?

(c) Suggest **two** ways to improve the quality of water in the river.



LEARN & APPLY

Go through the worked example below, then try to answer the Free-Response Questions.

Worked Example

Describe how humans cause water pollution.

Thought Process

Your answer should focus on the effects of human activities, and not on natural disasters. You should include a definition of pollution, the source of pollutants, and the effects of these pollutants on water.

Answer

Points to cover

1. Pollution is the addition of substances to the environment that damages it, making it undesirable or unfit for life.
2. Most of the time, pollution is brought about by human activities as the human population increases, and industrialisation and urbanisation becomes more prevalent. Waste materials from factories, and untreated sewage dumped into rivers and streams, pollute the water (sources of pollutants).
3. Waste materials from factories may include poisonous chemicals or metals such as mercury, lead, zinc and arsenic. They make the water unsafe to drink. It is also unsafe to consume fish living in such polluted water.
4. Untreated sewage, especially with high nitrate content, is a good source of food for bacteria. Bacteria grow and multiply rapidly, using up the oxygen in water.
5. Other organisms in the water such as fishes and plants die due to a lack of oxygen in the water (the bacteria also cause diseases such as cholera and typhoid — making the water unsafe to drink).
6. Nitrates present in fertilisers that are leached into the river, may promote growth of algae (algal bloom). The algae will block sunlight for photosynthesis of underwater plants. As plants die and decompose, the level of oxygen decreases, and organisms such as fishes die.

Section C: Free-Response Questions

Answer the following questions.

Discuss the importance of

1. conserving species to maintain biodiversity;

2. proper treatment of sewage before discharge; and

3. controlling the use of pesticides.


WORK ON IT!

Circle the question(s) you have answered incorrectly. Then, revisit the relevant section(s) in the textbook to strengthen your understanding of the key concept(s).

Learning objectives	Questions			Textbook section(s)
	Multiple-Choice	Structured	Free-Response	
(a) Describe the non-cyclical nature of energy flow		2		21.4, 21.5
(b) Understand and explain terms such as "producers", "consumers" and "trophic level", in the context of food chains and food webs	1, 3			21.4
(c) Explain how energy losses occur along food chains, and the efficiency of energy transfer between trophic levels		2		21.5
(d) Interpret pyramids of numbers and biomass	2	1		21.5
(e) Describe the carbon cycle and the role of carbon sinks	4	2		21.6, 21.7
(f) Describe and evaluate the effects of water pollution by sewage, inorganic waste and insecticides	5, 6, 8	1, 3	2, 3	22.1
(g) Outline the role of microorganisms in sewage treatment	7			22.1
(h) Discuss reasons for conservation of species			1	22.2

Name: _____ ()

Class: _____ Date: _____

Section A: Multiple-Choice Questions

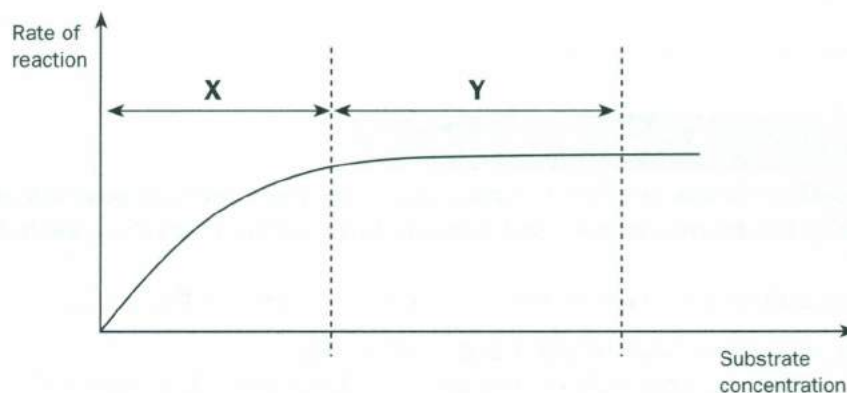
Answer ALL the questions in this section. For each question, there are four possible answers, A, B, C and D. Choose the correct answer and write its letter in the brackets provided.

1. When comparing a plant cell to an animal cell, one would expect to find _____.
- A a cellulose cell wall in both the plant and animal cells
 B a nucleus containing a nucleolus in the animal cell, but not in the plant cell
 C endoplasmic reticulum in both the plant and animal cells
 D ribosomes in the animal cell, but not in the plant cell ()
2. The formation of proteins from amino acids is carried out by the _____.
- A chloroplasts
 B mitochondria
 C nuclear membrane
 D ribosomes ()
3. Which region of the alimentary canal has the greatest internal surface area?
- A Colon
 B Ileum
 C Oesophagus
 D Stomach ()
4. Which of the following correctly matches the substance with the process of entry into an epithelial cell of the small intestine after a heavy meal?

	Substance	Process
A	Amino acids	Osmosis
B	Fats	Active transport
C	Glucose	Diffusion
D	Water	Diffusion

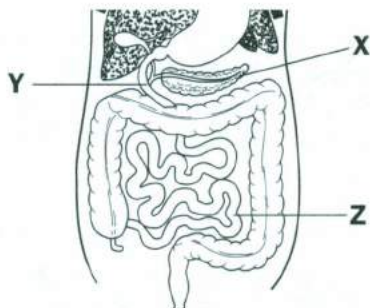
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For questions 5 and 6, refer to the graph of an enzyme-catalysed reaction shown below.



5. Which of the following best describes what happens during interval **X**?
- A Product formation has stopped.
 - B Some of the active sites are unoccupied.
 - C The amount of product being formed is equal to the amount of product being broken down.
 - D The product is being formed at a constant rate. ()
6. Which of the following best describes what happens during interval **Y**?
- A Product formation has stopped.
 - B Some of the active sites are unoccupied.
 - C The amount of product being formed equals the amount of product being broken down.
 - D The product is being formed at a constant rate. ()
7. An experiment was conducted to trace the path taken by carbohydrate molecules from a plant after a herbivore had consumed the plant. The carbohydrate molecules were labelled with radioactive carbon. Special equipment were then used to detect these radioactively labelled molecules. Which of the following paths is correct?
- | | In the plant | | In the herbivore | |
|---|---------------------|---|------------------------------|-----|
| A | glucose → starch | → | glucose → maltose → starch | |
| B | glucose → starch | → | maltose → glucose → glycogen | |
| C | glucose → maltose | → | glucose → maltose → starch | |
| D | glucose → maltose | → | starch → glucose → glycogen | () |
8. A patient had his gall bladder removed, and needs to be put on a special diet. Which menu would be most suitable for this patient?
- A Boiled chicken meat (without skin) and a fresh orange
 - B Chicken sausages and cream cake
 - C Fried fish fillet and boiled potato
 - D Pan-fried fish fillet in cheese sauce and green salad ()

9. The diagram below shows part of the digestive system.



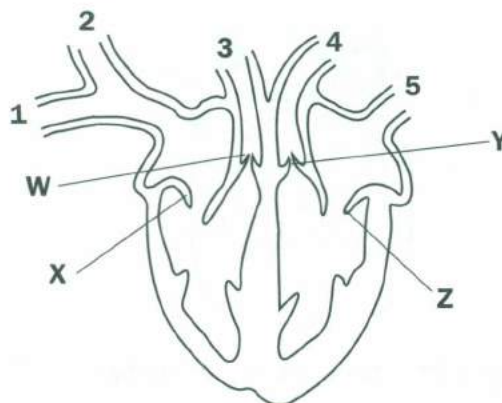
Which structures produce substances involved in fat digestion?

- A** X only
B Y only
C X and Y only
D X, Y and Z ()
10. Water loss from the aerial parts of a plant is most rapid when conditions are _____.
- A** dry, still and warm
B dry, windy and warm
C wet, windy and cold
D wet, windy and warm ()
11. A plant was placed in a bell-jar in a warm and brightly-lit environment. The air in the jar contains carbon dioxide where carbon exists as a radioactive isotope.



- After six hours, which of the following regions are likely to have high levels of radioactivity?
- A** 1 and 2
B 1 and 3
C 2 and 3
D 1, 2 and 3 ()
12. Cellular respiration is a series of enzymatic reactions that _____.
- A** is important in the maintenance of body temperature in mammals
B is like photosynthesis, and occurs only in animal cells
C is like photosynthesis, and requires oxygen
D occurs in animal cells, but not in plant cells ()

For questions 13 and 14, refer to the diagram below, which shows a **vertical section** of the human heart.



13. Which of the following blood vessels contains blood with the highest oxygen concentration?

- A 1
- B 2
- C 3
- D 5

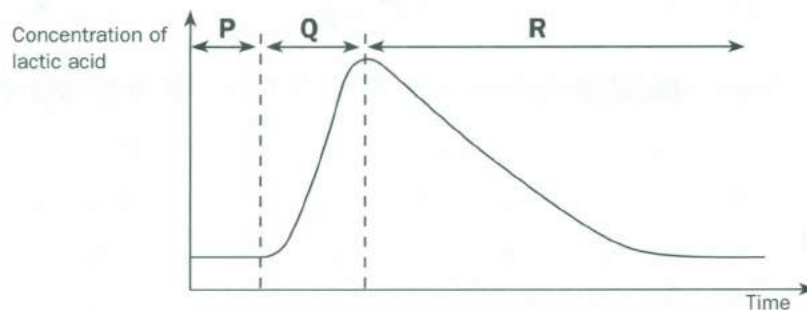
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14. Heart sounds are produced by _____.

- A closing of valves W and X
- B closing of valves W, X, Y and Z
- C opening of valves Y and Z
- D opening of valves W, Y and Z

()

15. The graph below shows the concentration of lactic acid in the blood of an athlete. During which time **period** is oxygen debt incurred and repaid?



	Oxygen debt incurred	Oxygen debt repaid
A	P	Q and R
B	Q	R
C	P and Q	R
D	Q and R	P

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16. Which of the following correctly describes the processes occurring in a person's skin when he takes a cold shower?

- A The arterioles constrict, and sweat glands are more active.
- B The arterioles constrict, and sweat glands are less active.
- C The arterioles dilate, and sweat glands are more active.
- D The arterioles dilate, and sweat glands are less active.

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For questions 17 and 18, refer to the table shown below.

Substance	Glomerular filtrate (g)	Urine (g)
Proteins	0	0
Salt	10 000	9500
Glucose	150	0
Urea	65	50
Water	200 000	2000

17. Using the information in the table, it is likely that _____.

- A glucose has been excreted
- B the salt concentration in the filtrate and urine are in equilibrium
- C proteins have been reabsorbed
- D water has been reabsorbed from the filtrate

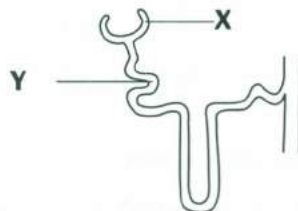
()

18. Energy would be required for the reabsorption of _____ at the proximal convoluted tubule.

- A glucose
- B salt
- C urea
- D water

()

19. The diagram below shows a kidney nephron. Which of the following describes the processes that happen at X and at Y?



	X	Y
A	Diffusion	Selective reabsorption
B	Selective reabsorption	Diffusion
C	Selective reabsorption	Ultrafiltration
D	Ultrafiltration	Selective reabsorption

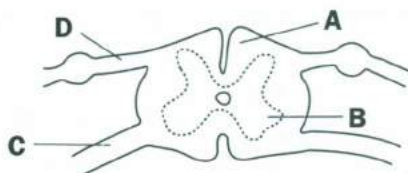
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20. Diabetes insipidus is a disease caused by a deficiency in the antidiuretic hormone (ADH). Which of the following correctly matches the kidney site affected with the symptom associated with the disease?

	Site	Symptom
A	Collecting duct	Excessive urine
B	Glomerulus	Little or no urine
C	Loop of Henlé	Little or no urine
D	Proximal convoluted tubule	Excessive urine

()

21. The diagram below shows a section of part of the spinal cord.



Which of the labelled parts **A, B, C** or **D** contains the cell bodies of neurones? ()

22. A boy walked into a room that was dimly-lit. He then switched on all the lights in the room. Which of the following correctly describes the shape and size of the iris and pupil of his eye, and the condition of the circular muscles in his iris in the brightly-lit room?

	Front view of iris and pupil	Condition of circular muscles in iris
A		Contracted
B		Contracted
C		Relaxed
D		Relaxed

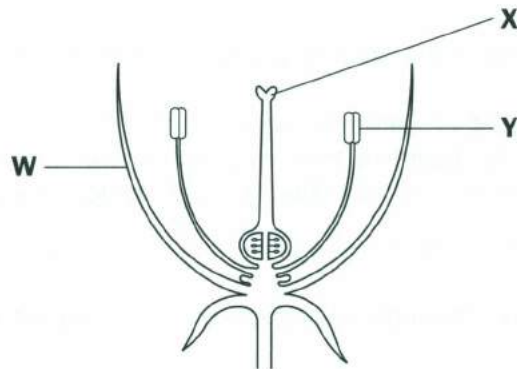
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23. The following are examples of reflex actions, **except** _____.

- A blinking an eyelid, when your eye is approached by a moving object
- B picking up a pen to write your name
- C pulling your hand away from a hot stove
- D sneezing, when your nose is tickled

()

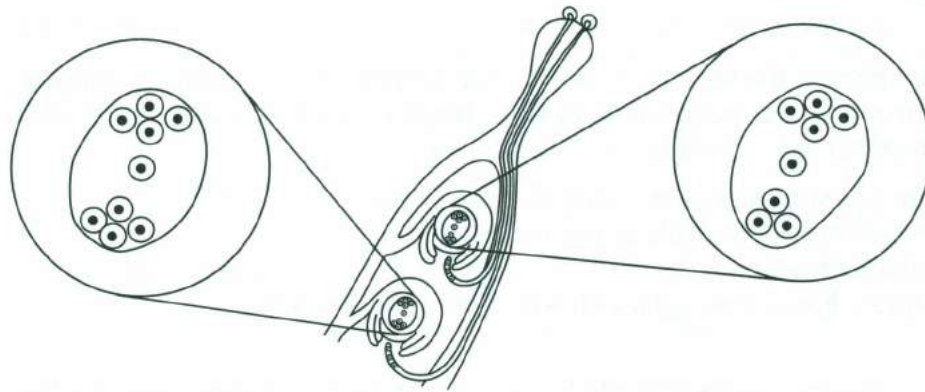
24. The diagram below shows the structure of a flower.



How would the features of this flower be different in a wind-pollinated flower?

	Size of W	Positions of X and Y
A	Greatly reduced	Protrude out of corolla
B	Greatly reduced	Within corolla
C	Very big	Protrude out of corolla
D	Very big	Within corolla

25. The diagram below shows a **longitudinal section** of a carpel with pollen grains germinating in it.



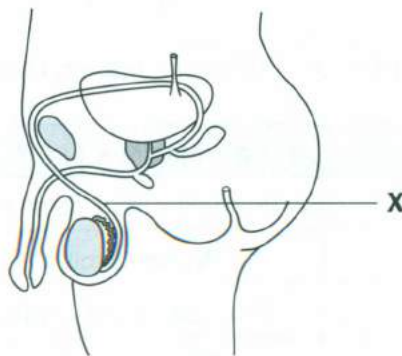
If the male gametes successfully fertilise the female gametes, and a fruit is formed, how many seed(s) would the fruit have?

- A 1
- B 2
- C 7
- D 14

26. What is the role of the prostate gland, Cowper's gland and seminal vesicles in the male reproductive system?

- A To produce male sex hormones that are responsible for the development of male sexual characteristics
 - B To secrete a fluid that activates the eggs in females
 - C To secrete a fluid that contains enzymes, which break down the egg membrane
 - D To secrete a fluid that contains nutrients and enzymes, which nourish and activate sperms
- ()

27. The diagram below shows the male reproductive and urinary system. What is the tube labelled X?



- A Epididymis
 - B Seminal vesicle
 - C Sperm duct (vas deferens)
 - D Ureter
- ()

28. A medical officer in the Ministry of Health needs to introduce a publicity campaign to reduce the spread of the Human Immunodeficiency Virus (HIV) that causes Acquired Immunodeficiency Disease Syndrome (AIDS). What advice should be included?

- A Do not use soap and towels used by other people.
 - B Have safe and responsible sexual behavior.
 - C Use the birth-control pill.
 - D Wash your hands thoroughly with soap after using the toilet.
- ()

29. A particular characteristic is controlled by a dominant allele, R, and a recessive allele, r. Which of the crosses will give a 1:1 ratio of the two phenotypes among the offspring?

- A $RR \times rr$
 - B $Rr \times RR$
 - C $Rr \times Rr$
 - D $Rr \times rr$
- ()

30. How many sex chromosomes does a normal human female inherit from her mother?

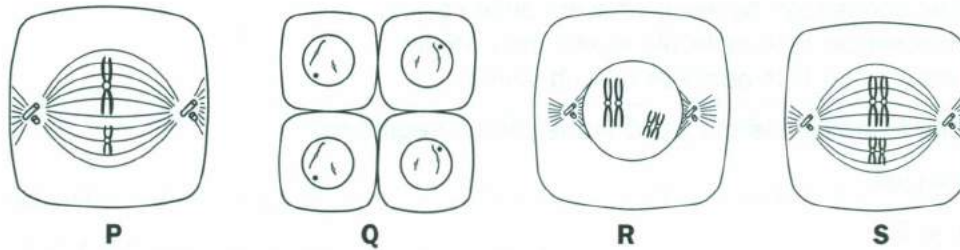
- A 1
 - B 2
 - C 23
 - D 46
- ()

31. A woman has blood group O. Her child also has blood group O. Which blood group **cannot** be the blood group of the father of the child?

- A A
- B AB
- C B
- D O

()

32. Some stages of meiosis are represented in the diagrams shown below.



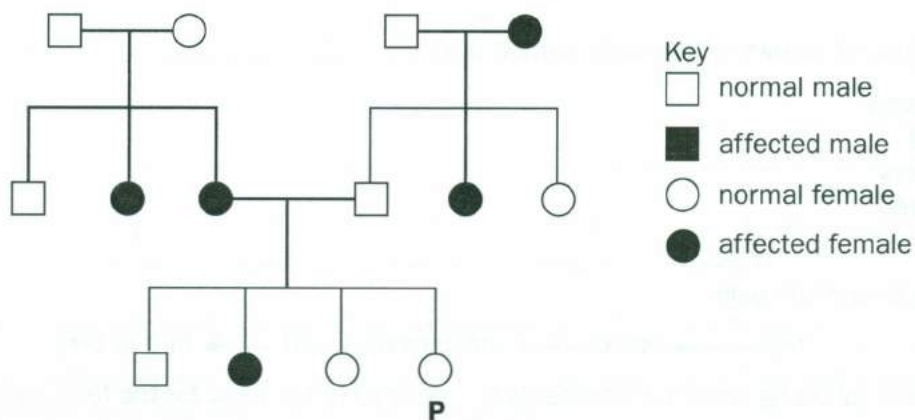
Which of the following has the stages of meiosis in the correct sequence?

First → Last

- A P, S, Q, R
- B Q, R, P, S
- C R, S, P, Q
- D S, R, Q, P

()

33. The following family tree shows the inheritance pattern of an inheritable disease.



Key
 □ normal male
 ■ affected male
 ○ normal female
 ● affected female

What is/are the possible genotype(s) of **P** who is normal (B represents the normal allele and b represents the allele for the disease)?

- A BB
- B bb
- C Bb
- D BB, Bb

()

34. The rule of complementary base pairing in DNA states that _____.

- A adenine pairs with cytosine, while guanine pairs with thymine
- B adenine pairs with guanine, while cytosine pairs with thymine
- C adenine pairs with thymine, while guanine pairs with cytosine
- D adenine pairs with thymine, while guanine pairs with thymine

()

35. The following steps occur in the production of a protein from DNA.

1. The base sequence is transcribed.
2. Peptide bonds form between adjacent amino acids.
3. The messenger RNA molecule leaves the nucleus.
4. The messenger RNA attaches to a ribosome.

Which of the following has the steps in the correct sequence?

First → Last

- A 1, 3, 4, 2
- B 1, 4, 2, 3
- C 2, 3, 1, 4
- D 3, 4, 2, 1

()

36. DNA molecules, isolated from a rat cell and a human cell, are found to differ in the sequence of their _____.

- A bases
- B sugars
- C phosphates
- D bases, sugars and phosphates

()

37. Fermentation of sugars to alcohol is carried out by _____.

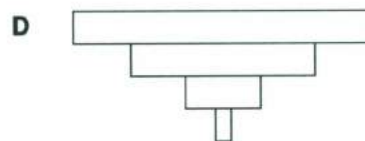
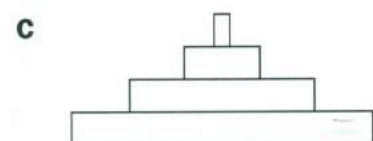
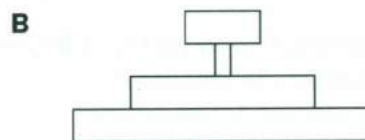
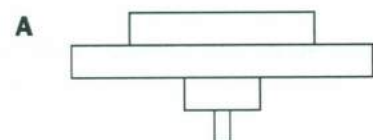
- A bacteria
- B fungi
- C vectors
- D viruses

()

38. Study the food chain below.

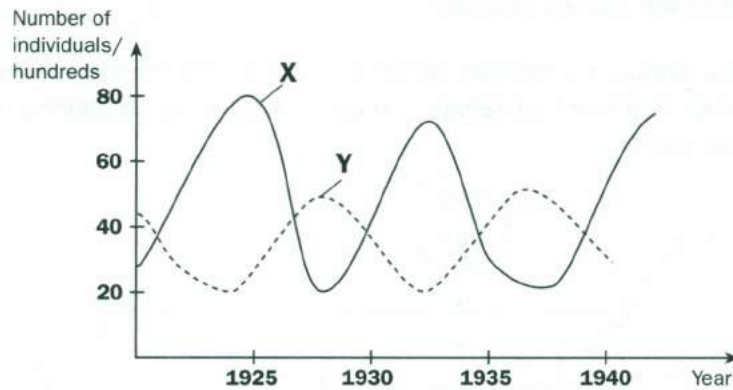
tree → aphid → insectivorous bird → bird of prey

Which of the following correctly represents the pyramid of biomass for the food chain?



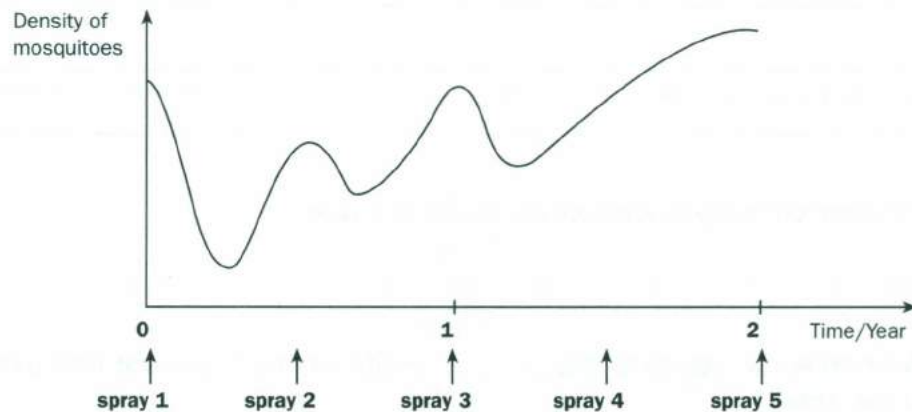
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39. The graph shows the populations of animal **X** and animal **Y** in the same habitat from 1920 to 1940.



What biological relationship between animal **X** and animal **Y** is shown in the graph?

- A X and Y compete for the same, limited resource.
 - B X and Y interact such that one depends on the other for survival.
 - C X and Y interact such that one is the predator, and the other is the prey.
 - D X and Y interact such that both benefit.
- ()
40. The graph shows the density of mosquitoes in an area that had been sprayed with a non-biodegradable insecticide once every half a year, successively for five sprays.



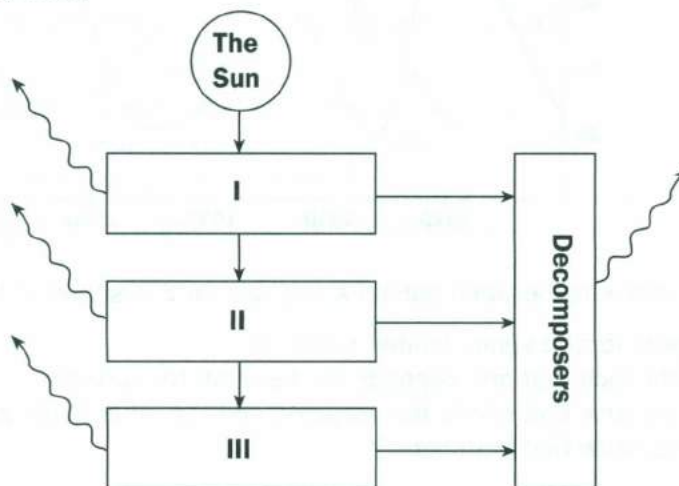
Explain why the insecticide did **not** kill most mosquitoes after the fifth spray.

- A Mosquitoes acquired resistance to the insecticide after some time and survived, forming a population that was resistant to the insecticide.
 - B Mosquitoes with resistance to the insecticide survived and produced a population that was resistant to the insecticide.
 - C The insecticide broke down after some time and could not kill the mosquitoes.
 - D The insecticide is not effective in killing the mosquitoes, because it is non-biodegradable.
- ()

Section B: Structured Questions

Answer ALL questions in the spaces provided.

1. The diagram below shows a simplified representation of the transfer of energy in a generalised ecosystem. Each box represents a category of organisms, grouped together based on their trophic position in the ecosystem.



- (a) State the trophic levels of the organisms in boxes I, II and III. [3]

- (b) State the form of energy that enters organisms in box III. [1]

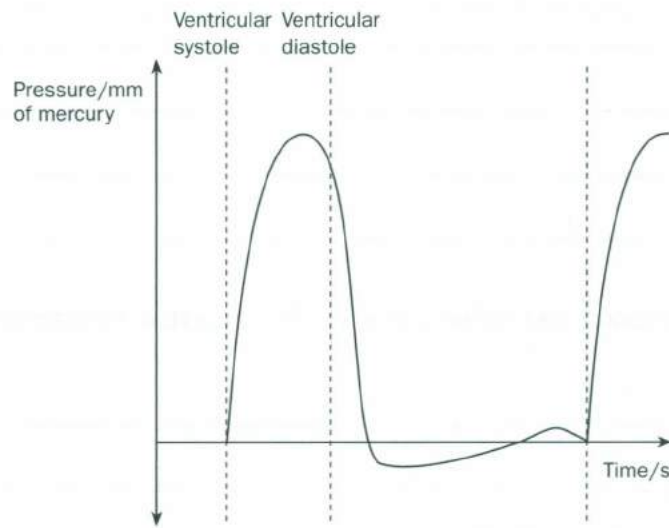
- (c) Identify which arrow represents the greatest transfer of energy per unit time (add a large 'X' next to the arrow). [1]

- (d) Explain what the wavy arrows leaving each box represents. [3]

- (e) Explain why there are usually **not** many trophic levels in a food chain. [2]

[Total: 10 marks]

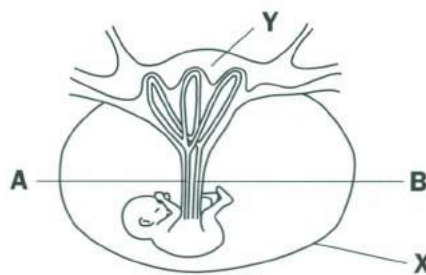
2. The diagram below shows the blood pressure in the left side of the heart during the cardiac cycle.



- (a) On the diagram, sketch and label the shape of the curve expected for the right ventricle. [2]
 (b) Mark an 'X' on the curve where ventricular diastole begins for the left ventricle. [1]
 (c) Define atrial systole. [1]

[Total: 4 marks]

3. The diagram below shows the structure of a developing human fetus and part of the uterine wall.



- | | |
|--|--|
| Content in A (arbitrary units) | Content in B (arbitrary units) |
| • 20 units of oxygen | • 50 units of oxygen |
| • 40 units of carbon dioxide in the form of hydrogencarbonate ions | • 25 units of carbon dioxide in the form of hydrogencarbonate ions |
| • 36 units of glucose | • 78 units of glucose |
| • 32 units of urea | • 12 units of urea |

- (a) Identify vessels **A** and **B**. [1]

(b) State the reasons for your answer in (a). [2]

(c) The function of **X** is to support and protect the fetus. Describe how **X** performs its functions. [2]

(d) A woman with blood group O marries a man with blood group AB.

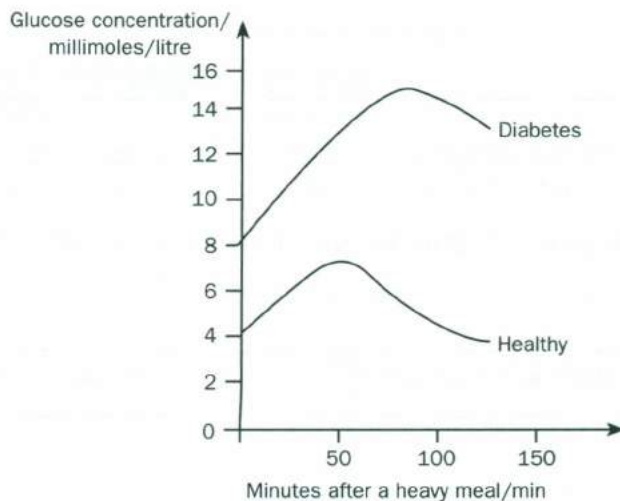
(i) Construct a genetic diagram to illustrate all the possible blood types of their children. Use I^A , I^B and I^O to represent the alleles responsible for blood group. [5]



(ii) Describe what will happen if the blood of the mother is mixed with that of the fetus at **Y** if there is no membrane to separate them. [2]

[Total: 12 marks]

4. The graph below shows the blood glucose level, measured in a person with diabetes and a healthy person, after a heavy meal consisting of plenty of carbohydrates.



- (a) State the difference in the blood glucose level between a healthy person and a person with diabetes. [1]

- (b) Explain why the blood glucose level in a person increases after a heavy meal. [2]

- (c) How long did it take for the blood glucose level of a healthy person to return to normal after a heavy meal? [1]

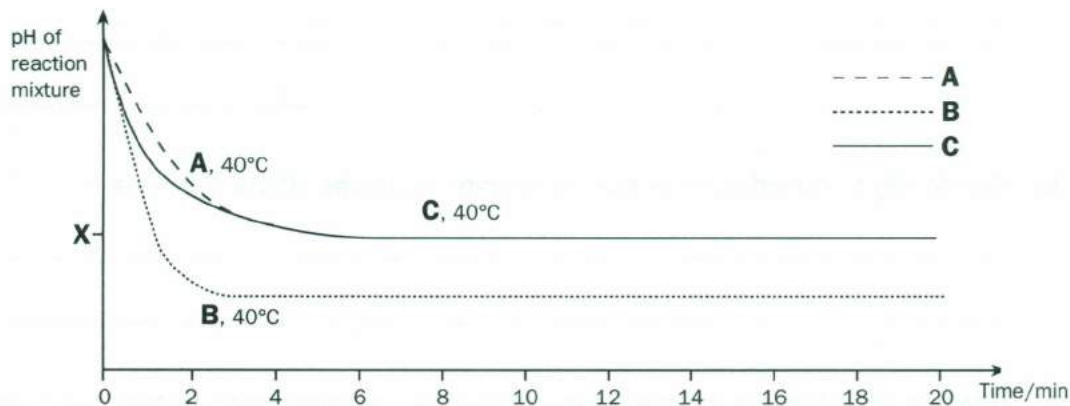
- (d) Explain why the blood glucose level of the healthy person returned to normal some time after a heavy meal. [3]

- (e) State two possible reasons why the person with diabetes had a high blood glucose level long after a heavy meal. [2]

- (f) Suggest one treatment for a person with diabetes, so that the high blood glucose level can be reduced. [1]

[Total: 10 marks]

5. The action of lipase on fats in three different milk solutions, **A**, **B** and **C**, was investigated. The volumes of enzyme and milk solutions were kept constant. Lipase breaks down fats into fatty acids and glycerol. The amount of fatty acids formed can be deduced by measuring the pH of the mixture. The graph below illustrates the results obtained.



- (a) State the time taken for the reaction to be completed in milk sample **C**. [1]

- (b) Comparing **B** and **C**, suggest a factor that could have affected the rate of reaction between 0 minute to 2 minutes. [1]

- (c) Suggest why the graphs labelled **A** and **C** became level at the same height, **X**. [1]

- (d) On the graph given, draw and label the graph that would be obtained if the same volume of lipase was added to the same volume of sample **A**, with the reaction carried out at a temperature of 30°C. [1]

[Total: 4 marks]

Section C: Free-Response Questions

Answer ALL questions. Write your answers on the writing paper provided. Label your answers prominently and neatly. Use a fresh sheet of paper for each question. Hand in Section C separately from Section B.

1. Table 1 shows the rate of water loss in a leafy shoot over a 24-hour period.

Time/hours	Rate of water loss/g per hour
0000	5
0400	2
0800	8
1200	25
1600	20
2000	10
2400	8

Table 2 shows the rate of water uptake in the same leafy shoot over a 24-hour period.

Time/hours	Rate of water uptake/g per hour
0000	8
0400	5
0800	8
1200	20
1600	22
2000	13
2400	10

- (a) Plot the data in Table 1 and Table 2 on the same axes. Label each graph. [6]
- (b) With reference to the graph, describe the relationship between water loss and the time of the day. [2]
- (c) Explain why it is not advisable for water loss to be greater than water uptake for a long period of time. [1]
- (d) Suggest why gardeners usually advise the transplanting of young seedlings in the early morning or evening. [1]

[Total: 10 marks]

2. (a) (i) Define aerobic respiration and photosynthesis.
(ii) Explain the relationship between these two processes, and their importance to living organisms. [5]
- (b) Gas exchange occurs at the surface of both mesophyll cells in the leaf and at the alveoli in the lungs. In what ways are the structures and functions of these surfaces similar for gas exchange? [3]
- (c) Phytoplankton are microscopic food producers. Only a small percentage of sunlight reaching a pond is used by phytoplankton for photosynthesis. Suggest **two** reasons for this. [2]
- [Total: 10 marks]

Either

3. (a) Describe the production of insulin by the genetic recombinant method. State clearly the conditions and/or considerations that a scientist must take into account before using this method. [7]
- (b) State the functions of insulin. Explain why it is advantageous to produce insulin using the genetic engineering (recombinant) method. [3]

or

3. Draw a labelled diagram of a cross-section of a dicotyledonous leaf, and use your diagram to describe the movement of water inside a leaf. [10]
- [Total: 10 marks]