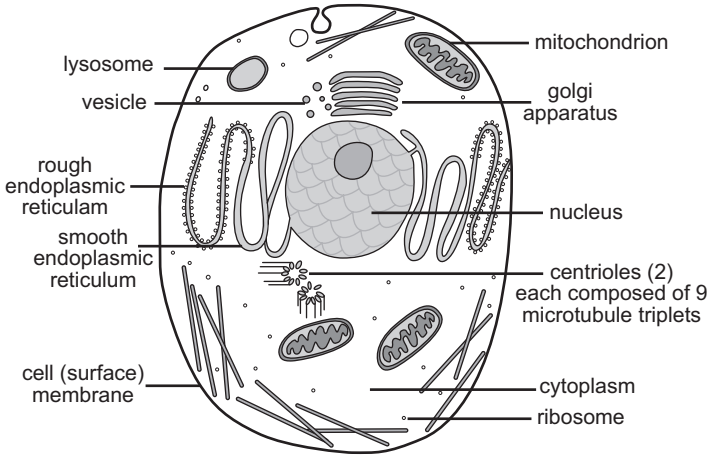
CONTENTS

'O' LEVEL BIOLOGY

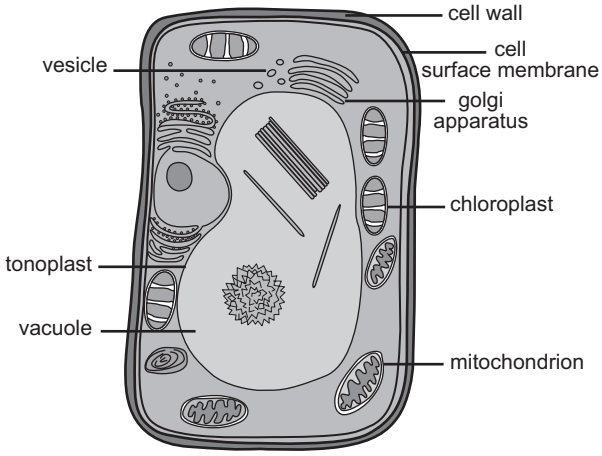
Unit 1 CELLS

Notes

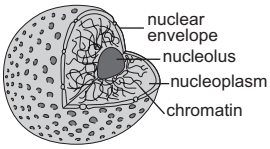
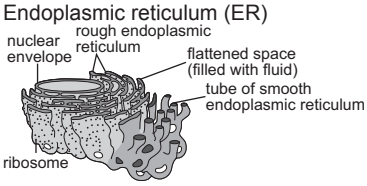
Cells are the building blocks of life. They are the simplest units that have all the characteristics of life. What does a cell consists of?



Parts of an animal cell

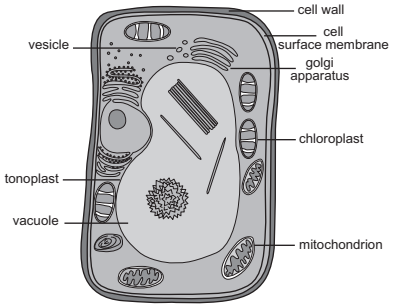
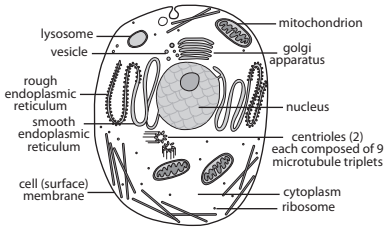


Parts of a plant cell

Part of a cell	Function
Cellulose cell wall (plant cell)	■ Non-living, thick, rigid layer around the cell membrane ■ Helps the plant to support itself ■ Vary the shape of the cell – angular, rectangular or rounded ■ Permeable – allows all substances to move in and out of the cell
Cell surface membrane	■ Surrounds the cytoplasm – keeping cells separate from one another ■ Made up of layers of lipid and protein – 0.00001 mm thick ■ Semi-permeable – allows only some substances to move in or out of the cell
Nucleus  Parts of a nucleus	■ Controls all activities of the cell ■ Round and surrounded by two membranes which together form the nuclear membrane (Note: Nuclear membrance has several nuclear pores to allow nuclear material to pass through.) ■ Contains chromosomes and nucleolus **Chromosomes** ■ Made up of chemical DNA – provides information for the formation of proteins in cells **Nucleolus** ■ Spherical structure involved in cell division ■ Produces RNA – takes information from the DNA out of the nucleus to make proteins in the cytoplasm
Centrioles	■ Paired cylindrical organelles near the nucleus ■ Composed of nine tubes – each with three tubules ■ Involved in cellular division
Cytoplasm	■ Made up of 75% water and 25% structures ■ Structures can be inclusions or organelles **Inclusions** ■ Substances that are stored temporarily in the cell which includes fat globules and starch grains **Organelles** ■ Permanent structures that are important for life of the cell ■ Help to carry out all its activities ■ Make useful substances that can be exported to other cells
Mitochondrion	■ Also known as the 'power house' of the cell ■ Generates energy that is needed to keep the cell's essential living processes going ■ Energy is produced on the folded inner membrane by a process called internal or cellular respiration ■ Quantity present in the cell depends on the cell's activities – muscle cells contain more mitochondria than other parts of the body
Endoplasmic reticulum (ER)  Parts of an endoplasmic reticulum	**Rough ER** ■ Contains ribosomes attached to its surface **Smooth ER** ■ No ribosomes attached; connected to rough ER and more tubular than rough ER ■ Synthesises substances such as fats and steroids ■ Converts harmful substances into harmless materials – detoxification

Part of a cell	Function
Ribosome	■ Builds proteins such as digestive enzymes or hormones **Ribosomes attached to ER** ■ Make proteins that are usually transported out of the cell **Free ribosomes – found in the cytoplasm** ■ Make proteins that are used within the cytoplasm of that cell
Golgi apparatus	■ Stores and modifies substances made by the ER ■ Packs these substances made for secretion out of the cell
Vacuole	■ Fluid-filled spaces surrounded by a membrane ■ Contains dissolved food substances and waste products **In plants** ■ One large vacuole containing cell sap – keeps the cell rigid ■ Cell sap contains dissolved substances such as sugars, mineral salts and amino acids ■ Enclosed by a membrane known as tonoplast **In animals** ■ Smaller and numerous – sometimes known as vesicles ■ Contains water and food substances
Chloroplast (plant cell)	■ Green discs containing the green pigment, chlorophyll – used by plants to convert carbon dioxide and water into sugars

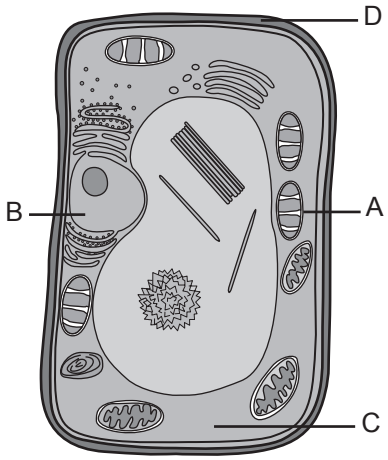
Difference between plant and animal cells

Plant cell	Animal cell
	
Cell wall present	Cell wall absent
Chloroplast present	Chloroplast absent
One large central vacuole	Vacuoles are small and numerous

Multiple Choice Questions

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

Study the diagram below and use it to answer questions 1 to 3.



1. Which of the labelled parts contain cellulose?

[ ]

2. Which of the labelled parts is concerned with the intake of water by osmosis?

[ ]

3. In which of the labelled parts is starch made?

[ ]

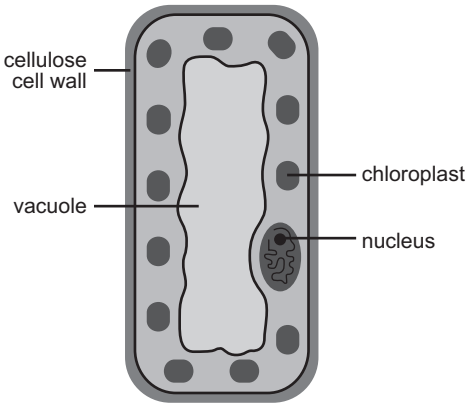
4. Two similar amoeba were isolated for an experiment. Using a fine glass tube, the nucleus of one of the amoebae was carefully removed, without causing any damage to the organism. It was observed that the amoeba continued to move and feed for several days. However, during those days, it did not reproduce. On the other hand, the other amoeba reproduced twice for the same period of time.

Which of the following can you conclude about the role of the nucleus in the amoeba?

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

[ ]

5. Study the diagram below. It shows a typical plant cell.

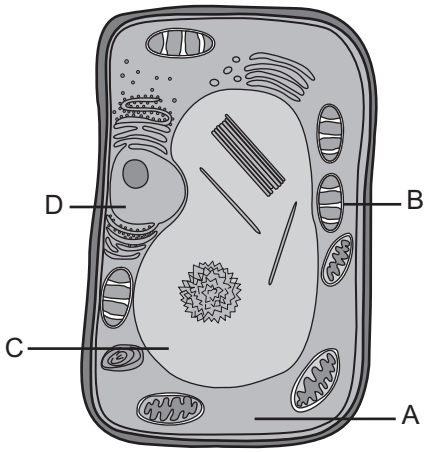


Which of the following correctly identifies the cell and where it can be found in a plant?

A Epidermal cell of a leaf
B Mesophyll cell of a leaf
C Root cortex cell
D Root hair cell

[ ]

6. Which of the following labelled structures contains chromosomes?



[ ]

7. Which of the following structures are found in both animal cell and plant cell?

A Cellulose cell wall
B Cell membrane
C Chloroplast
D Vacuole containing sap **[ ]**

8. What is the major advantage of using a light microscope instead of an electron microscope?

A It is able to observe structures of up to 1 nm.
B It is able to observe living matter.
C It has a constant depth of focus.
D It has a superior resolution. **[ ]**

9. Which of the following is a characteristic of the mitochondria?

A They provide sites for anaerobic respiration.
B They produce cellular secretion.
C They release energy.
D They store enzymes.

[ ]

10. Which of the following contains the highest concentration of RNA?

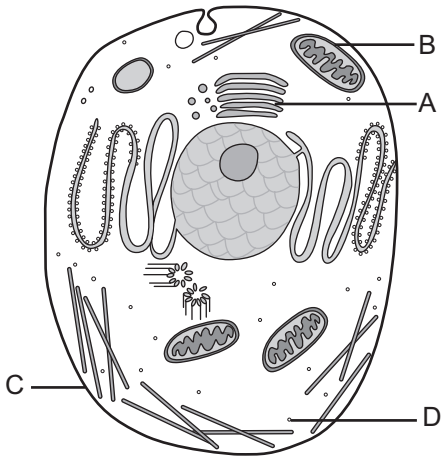
A Centriole
B Golgi apparatus
C Chromosome
D Nucleolus

[ ]

Structured Questions

Write your answers in the spaces provided.

1. The diagram below shows a typical animal cell as seen through an electron microscope.



(a) Name the structures labelled A – D in the diagram.

_____

_____

(b) Identify the part of the cell that is responsible for each of the following:

(i) stores all genetic information

_____

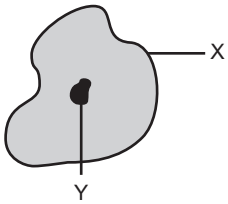
(ii) generation of ATP from the breakdown of glucose

_____

(iii) reproduction of proteins from amino acids

_____

2. The diagram below shows a cheek cell.



(a) Identify the parts labelled X and Y.

_____

_____

(b) Draw and label three extra structures that would change this animal cell into a plant cell.

(c) (i) Name the process in which green plants produce a store of energy.

_____

(ii) Where does the energy for the process in (i) come from?

_____

(iii) In what form is the energy stored?

_____

Essay Questions

Write your answers in the spaces provided.

1. Explain how the limitation of the light microscope, in revealing fine cellular details, is overcome by the electron microscope.

2. (a) Describe the structure and function of the endoplasmic reticulum.

(b) Explain the role of the golgi apparatus.

Answers

Multiple Choice Questions

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

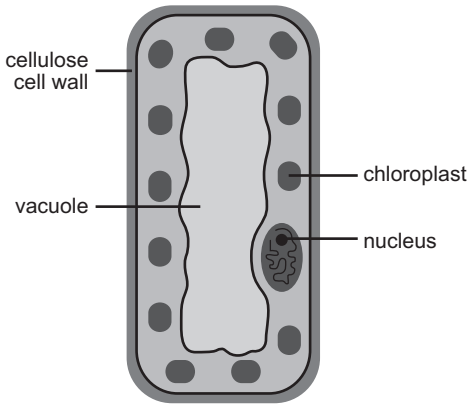
Structured Questions

1. (a) A – golgi apparatus
B – mitochondrion
C – cell membrane
D – ribosome

(b) (i) nucleus
(ii) mitochondria
(iii) ribosomes

2. (a) X – cell surface membrane
Y – nucleus

(b)



(c) (i) Photosynthesis
(ii) The Sun
(iii) Starch

Essay Questions

1. The light microscope has a limit of resolution of about 200 nm (0.2 μm). This limit is due to the wavelength of light (0.4-0.7 μm). Cells observed under a light microscope can be alive, or fixed and stained. The electron microscope has a limit of resolution of about 2nm. This is due to limitations of the lens used to focus electrons onto the sample. An electron microscope looks at replicas of dead cells, after fixation and heavy metal ion staining. Electrons are scattered as they pass through a thin section of the specimen, and then detected and projected onto an image on a fluorescent screen.

2. (a) The endoplasmic reticulum (ER) is a complex network of membranes which is present throughout the cell. There are two types of ER – rough endoplasmic reticulum which has a sheet-like structure with ribosomes attached to the membrane surface; and smooth endoplasmic reticulum, which has a tubular structure and no ribosomes attached to the membrane surface. The ribosomes attached to the membrane surface of the rough ER carry out protein synthesis. In addition to this function, rough ER carries out a number of other important roles within a cell. These include providing an internal structural skeleton to support the cell's shape, storage of the synthesised materials and minerals, forming an internal network through which materials can be transported and providing a large surface area on which chemical reactions can occur. The smooth ER has functions in several metabolic processes, including synthesis of lipids and steroids, metabolism of carbohydrates, regulation of calcium concentration, drug detoxification, attachment of receptors on cell membrane proteins and steroid metabolism.

(b) The golgi apparatus functions as a factory in which proteins received from the ER are further processed and sorted for transport to their eventual destinations: lysosomes, the plasma membrane or secretion. In plant cells, the golgi apparatus further serves as the site at which the complex polysaccharides of the cell wall are synthesised.

Unit 2 MOVEMENT OF SUBSTANCES

Notes

1. Diffusion

- It is the movement of molecules from a region of higher concentration to a region of lower concentration i.e. down a concentration gradient where this eventually leads to an equal distribution of the molecules.
- It is a physical, passive process where no energy from respiration is needed.
- Mineral salts, oxygen and carbon dioxide molecules can diffuse through the cell membrane.
- Molecules diffuse at different speeds depending on their own diffusion gradient.

2. Rate of diffusion

- State of matter – diffusion is slow in solids, faster in liquids and fastest in gases.
- Molecule size – smaller molecules diffues faster.
- Concentration gradient – a greater concentration gradient would increase the rate of diffusion.
- Temperature – the presence of heat increases the rate of diffusion of substances.

3. Importance of diffusion

- Ensures a constant supply of oxygen to living things in the water and soil.
- Ensures that carbon dioxide diffuses into green leaves when plants carry out photosynthesis.
- Ensures that dissolved mineral salts diffuse into the roots from the soil.
- Enables animals to detect food by the smell.
- Ensures that digested food diffuses into the blood through the walls of the small intestine.

4. Osmosis

- It is defined as the passage of water molecules from a region with higher concentration of water to a region of lower concentration of water through a partially-permeable membrane.

5. Concentration of solution determines the direction of osmosis in animal cells

- A dilute solution contains more water molecules. Hence it has a higher water potential than a concentrated solution. Water will then move from a region of higher water potential to a region of lower water potential.
- Hypertonic solution – animal cells shrink as the solution is more concentrated or has a lower water potential than the cell (water moves out of the cell).
- Hypotonic solution – animal cells swells then burst as the solution is more dilute or has a higher water potential than the cell (water moves into the cell).
- Isotonic solution – animal cells remain unchanged as there is no water potential gradient, hence no net movement of water molecules in any one direction.

6. Concentration of solution determines the direction of osmosis in plant cells

- Hypotonic solution – cell walls in plants prevent the cells from swelling and bursting and the pressure exerted by water on the cell wall is known as turgor pressure. This is required for support by non-woody plants.
- Hypertonic solution – the protoplasm of a plant cell shrinks away from its cell wall as water level leaves the cell by osmosis. This process is known as plasmolysis. It causes land plants to wilt.

7. Active transport

- It is a process by which substances are transported from a region of lower concentration to a region of higher concentration against a concentration gradient. Here, energy is needed as substances are moved against a concentration gradient.
- Examples of active transport include
  1. exchange of sodium and potassium ions in nerve cells.
  2. intake of amino acids and glucose molecules in the small intestine.
  3. accumulation of iodine by marine organisms.
  4. absorption of mineral salts by root hairs.

Multiple Choice Questions

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

1. Which of the following causes juice to ooze out when sugar is sprinkled in peeled kiwi?

A Osmosis
B Diffusion
C Active transport
D Saturation **[ ]**

2. Study the diagrams below.

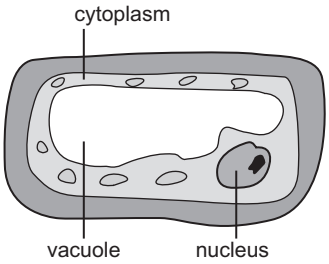


Fig. 1

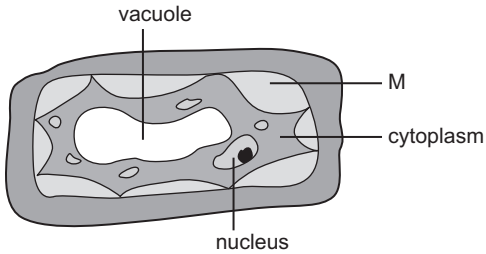


Fig. 2

Fig. 1 shows a plant cell at the start of an experiment. Fig. 2 shows the plant cell after it has been immersed in concentrated sugar solution.

Which of the following occupies the region labelled M?

A Air
B Sugar solution
C Cell sap
D Cytoplasm **[ ]**

3. Which of the following best describes osmosis in living organisms?

A It is a net movement across a semi-permeable membrane of solute molecules from a weak solution to a strong solution.
B It is a net movement across a semi-permeable membrane of solute molecules from a strong solution to a weak solution.
C It is a net movement across a semi-permeable membrane of water molecules from a weak solution to a strong solution.
D It is a net movement across a semi-permeable membrane of water molecules from a strong solution to a weak solution. **[ ]**

4. Which of the following can be done to a wilted celery stalk to make it firm and crispy again?

A Submerge the celery stalk in water
B Submerge the celery stalk in dilute salt solution
C Submerge the celery stalk in 20% sugar solution
D Submerge the celery stalk in 100% sugar solution **[ ]**

5. Which of the following would happen to a plant cell when it was submerged in 20% salt solution?

A Undergoes haemolysis
B Undergoes plasmolysis
C Shrinks
D Bursts **[ ]**

6. When a drop of blood is added to water, red blood cells undergo changes. Which of the following change cannot be observed?

A They increase in size.
B They undergo haemolysis.
C They decrease in size.
D They turn red. **[ ]**

7. Narrow strips of equal sizes were cut from a peeled raw potato. A few pieces were placed in sugar solution and the others were placed in distilled water. Which of the following takes place after some time?

A The potato strips placed in the sugar solution and the distilled water increased in length
B The potato strips placed in the sugar solution and the distilled water decreased in length
C The potato strips placed in the sugar solution decreased in length while those placed in the distilled water increased in length
D The potato strips placed in the sugar solution increased in length while those placed in the distilled water decreased in length **[ ]**

8. The _____ enters plant cells by active transport.

A water
B oxygen
C carbon dioxide
D nitrate ions **[ ]**

9. Which of the following processes can take place in a root hair cell when oxygen is not available?

A Active transport only
B Active transport and osmosis
C Diffusion and osmosis
D Diffusion only **[ ]**

10. How do nitrate ions, oxygen and water enter root hair cells?

	Nitrate ions	Oxygen	Water
A	active transport	diffusion	osmosis
B	diffusion	osmosis	active transport
C	active transport	osmosis	diffusion
D	osmosis	active transport	diffusion

[ ]

Structured Questions

Write your answers in the spaces provided.

1.

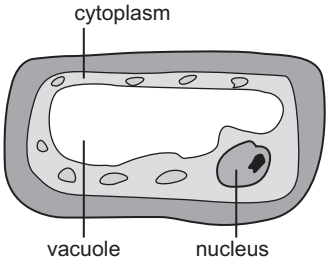


Fig. 3

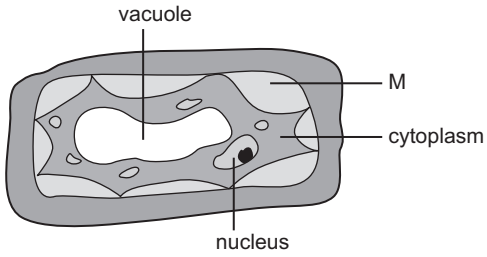


Fig. 4

Fig. 3 shows a plant cell at the start of an experiment. Fig. 4 shows the plant cell after a few minutes.

(a) (i) Identify the change that takes place.

_____

(ii) Give an account of what had taken place to cause the change above.

_____

_____

_____

(b) (i) What liquid surrounds the cell during the experiment?

_____

(ii) What condition is shown by the cell in Fig. 4?

_____

2. (a) Define *diffusion*.

_____

_____

(b) (i) Identify the process whereby plants take in ions from the soil.

_____

_____

(ii) Define the process named in (i).

_____

_____

_____

(iii) The process in (i) occurs only in living cells. Explain.

_____

_____

3. (a) Compare diffusion and osmosis.

Diffusion	Osmosis

(b) Describe and explain the effects of the following when placed in pure water.

(i) a plant cell; and

_____

_____

(ii) an animal cell.

_____

_____

4. (a) What is plasmolysis?

_____

(b) How to restore a plasmolysed cell?

_____

5. (a) What is turgor pressure?

_____

(b) Explain the role of turgor pressure.

_____

Essay Questions

Write your answers in the spaces provided.

1. Explain why when the hands are placed in fresh water, the fingertips become wrinkled after sometime but these do not happen when the hands are placed in salt water.

2. Explain why diffusion is important in all living organisms.

3. Explain the route water takes when it enters the plant from the soil.

Answers

Multiple Choice Questions

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

Structured Questions

1. (a) (i) Plasmolysis

(ii) The plant cell was placed in a hypertonic solution. Hence water molecules moved out of the cell sap and into the surrounding solution by osmosis. This caused the cytoplasm and the vacuole to shrink, and the cell membrane to begin to pull away from the cell wall.

(b) (i) Hypertonic solution

(ii) Turgidity

2. (a) Diffusion is the net movement of particles from a region where they are of higher concentration to a region where they are of lower concentration, i.e. across a concentration gradient.

(b) (i) Active transport

(ii) Active transport is the process in which energy is used to move the particles of a substance against a concentration gradient, i.e. from a region where they are of lower conce.ntration to a region where they are of higher concentration.

(iii) Active transport occurs only in living cells because living cells respire. It is during respiration that energy is set free and part of this energy is used in active transport.

3. (a)

Diffusion	Osmosis
Involves solids, liquids and gases	Involves water molecules only
Does not involve any membrane	Requires a semi-permeable membrane

(b) (i) When a plant cell is placed in a solution of higher water potential, water enters the cell by osmosis. As water enters the cell, the vacuole increases in size and pushes the cell contents against the cell wall. As the cell wall is strong and relatively elastic, it prevents over-expansion of the cell by exerting an opposing pressure as water enters the cell. This prevents entry of more water.

(ii) When an animal cell is placed in a solution of higher water potential, water enters the cell by osmosis. As water enters the cell, it swells and may even burst in a solution of high water potential. The cell bursts as there is no cell wall to protect it.

4. (a) Plasmolysis is the shrinkage of cytoplasm and cell membrane away from the cell wall.

(b) A plasmolysed cell can be restored to its original state by placing it in water or in a solution with high water potential.

5. (a) Turgor pressure is the pressure exerted outwards on the plant cell wall due to the water in the cell.

(b) Turgor pressure gives the cell its firmness or turgidity and helps to supprt the soft tissues in plants.

Essay Questions

1. In fresh water, the concentrations of the two fluids i.e. the fluid in the cells and the water are different. This results in water moving into the epidermal cells of the skin by osmosis. As the epidermal cells become stretched, the surface area of this layer increases. However, the inner layer of cells do not absorb any water. Hence the horny layer appears wrinkled. In salt water, the concentration of the salt water and that of the fluid in the cells are somewhat similar. Hence osmosis does not take place. Therefore, there is no stretching of the epidermis and the skin does not appear wrinkled.

2. Diffusion allows small molecules such as oxygen, carbon dioxide and water to move freely in and out of the cell membrane. The cell membrane does not act as a barrier, it is freely permeable to the small molecules. This movement of molecules into a cell is maintained because as the oxygen diffuses into the tissues, it will be used immediately by the cell for respiration, releasing energy. Therefore there is a constant demand for oxygen and the concentration gradient is maintained.

3. Water in the soil is drawn into the roots by osmosis. The water around the soil particles will pass from a higher concentration of water molecules into the root where there is a lower concentration of water molecules. The water passes into the root hair cell. This will increase the number of water molecules

inside this cell compared with the neighbouring cells of the root cortex. Therefore water passes by osmosis into the neighbouring cell. This cell will now contain a greater number of water molecules than the cell next to it. Water will pass into this cell.

Water may then be transported by three different pathways – most of it flows along the cellulose cell walls. Some water travels in the cytoplasm of the cells, and the rest passes from vacuole to vacuole. Eventually water reaches the xylem cells and then transported from the roots upwards into the stem.

Unit 3 NUTRIENTS

Notes

1. The process of making or obtaining food in plants or animals is known as nutrition. These molecules are called nutrients and are contained in the cell's protoplasm. The types of molecules found in the protoplasm are:

   - Carbohydrates
   - Fats
   - Proteins
   - Water

2. In all plants and animals food is used as follows:

   - As an energy source
   - For growth and repair
   - For metabolism

Carbohydrates

- Made up of carbon, hydrogen and oxygen
- H : O = 2 : 1
- General formula: $C_nH_{2m}O_m$
- Comes mainly from plants
- Good source of energy for the body
- Three main groups: Monosaccharide (single sugars), Disaccharide (double sugars), Polysaccharide (complex carbohydrates)

Monosaccharides (Single sugars)		
	Source	**Use**
Glucose	Fruit	Main carbohydrates used to release energy
Fructose	Fruit and honey	Basic food made during photosynthesis
Disaccharide (Double sugars)		
Sucrose	Sugarcane and beet	Broken down into glucose and fructose to release energy
Lactose	Milk	Broken down into glucose to release energy
Polysaccharide (Complex carbohydrates)		
Starch	Starch grains in potatoes, cereal, rice and other plants	Storage in plants, used for energy
Glycogen	Muscles and liver of animals	Animal starch is the storage carbohydrates
Cellulose	Cell walls of plants	Roughage in humans; source of energy in herbivores; structural materials for cell wall

<table>
<tr><td></td><td>■ Functions of carbohydrates
- as a substrate for respiration; provide energy for cell activities
- to form supporting structures
- to be converted into other organic compounds
- for the formation of nucleic acids
- to synthesise lubricants</td></tr>
<tr><td>Fats</td><td>■ Made up of carbon, hydrogen and oxygen (less oxygen than in carbohydrate)
■ Contain fatty acids (important dietary molecules) and glycerol joined together
■ Fatty acids – saturated or unsaturated
<table>
<tr><th>Saturated Fats</th><th>Unsaturated Fats</th></tr>
<tr><td>Found mainly in animals
Forms straight chains
Most saturated fats are solid at room temperature</td><td>Found mainly in vegetables
Forms bent structures
Most unsaturated fats are liquid at room temperature</td></tr>
</table>
■ Functions of fats
- food reserves
- energy supply
- protection
- insulation
- fat-soluble vitamins
- water source</td></tr>
<tr><td>Proteins</td><td>■ Made up of carbon, hydrogen and oxygen, also nitrogen and sometimes sulphur and phosphorus
■ Large complex molecules which when digested are broken down into smaller molecules known as amino acids
■ Types of proteins
- contains all the essential amino acids needed for growth: these proteins can be found in lean meat, fish, cheese and soya beans
- lacks the essential amino acids: these proteins can be found in flour, rice, oatmeal and cabbage
■ Functions of proteins
- growth and repair of cells and tissues
- formation of enzymes
- formation of hormones
- energy supply</td></tr>
<tr><td>Water</td><td>■ Functions of water
- an essential part of the cytoplasm which is the medium in which all chemical reactions occur
- blood is 55% plasma (liquid): carries many substances around the body
- digestion of food takes place in a watery medium
- acts as lubricant in joints</td></tr>
</table>

Multiple Choice Questions

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

1. Which of the following elements are commonly found in carbohydrates, fats and proteins?

A Carbon, hydrogen, oxygen
B Carbon, sulphur, oxygen
C Carbon, nitrogen, oxygen
D Carbon, chlorine, oxygen **[ ]**

2. The table below shows the observations made during tests carried out on samples of food.

Test	Observation
Biuret test	Lilac
Benedict's solution	Pale blue
Iodine solution	Blue-black

Based on these results, which of the following conclusions about the samples of food is correct?

	Proteins	Reducing sugars	Starch
A	absent	absent	absent
B	absent	absent	present
C	absent	present	absent
D	present	absent	present

[ ]

3. Food sample X was mixed with water and then tested to find out its contents. The results are tabulated below.

Test	Results
Iodine solution added	Yellow
Benedict's solution added and the mixture is heated to boil	Brick red precipitate
Shaken with ethanol	White emulsion
Sodium hydroxide solution added and then a few drops of copper sulphate solution	Blue

Which of the following was present in food sample X?

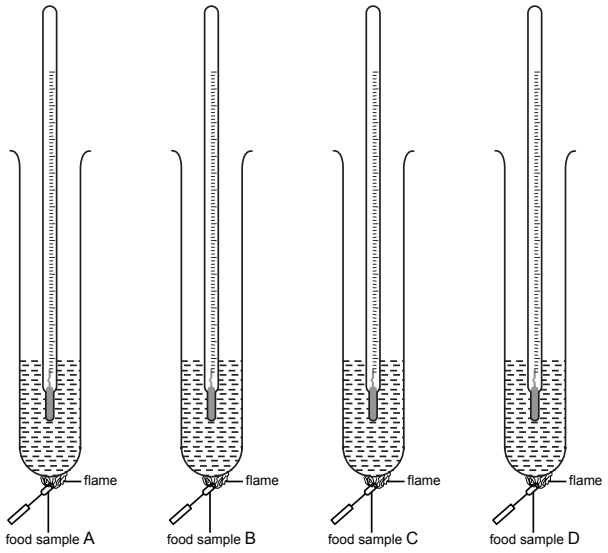
A Proteins only
B Reducing sugars only
C Fats and starch
D Fats and reducing sugars **[ ]**

4. In the manufacture of proteins, plants use some chemicals absorbed from the soil as well as other chemicals present within the plant. Which of the following combinations of chemicals is needed for the manufacture of proteins?

	Chemicals absorbed from the soil	Chemicals present within the plant
A	nitrates	carbohydrates
B	amino acids	fats
C	fats	nitrates
D	carbohydrates	amino acids

[ ]

5. Four equal masses of different types of foods were burnt as shown in the diagram below.



Which of the following food sample is likely to contain the most fat?

Food sample	Temperature of water at the start of the experiment (°C)	Temperature of water at the end of the experiment (°C)
A	17	27
B	17	85
C	18	77
D	19	32

[ ]

6. Some sample of egg albumen was tested using the biuret test. Which of the following shows the result of the test and the deduction which can be made?

	Result	Deduction
A	blue-black	protein present
B	blue-black	starch present
C	purple	protein present
D	purple	reducing sugars present

[ ]

7. Which of the following food contains the highest concentration of proteins?

A Bread
B Citrus fruits
C Fresh vegetables
D Meat **[ ]**

8. Marathon runners often eat bananas during the competition. Which of the following nutrients in a banana is important during the match?

A Fibre
B Protein
C Vitamin C
D Carbohydrates **[ ]**

Structured Questions

Write your answers in the spaces provided.

1. (a) How would you carry out a test on a breakfast cereal to show it contained sugar?

_____

_____

(b) What colour change would you expect during the test if sugar is present?

_____

(c) State one precaution that must be taken to carry out the test safely.

_____

2. An experiment was carried out where a peanut is burnt under a test tube of water. After sometime, the water in the test tube heats up.

(a) What is being measured in this experiment?

_____

(b) The temperature of the water needs to be measured before and after the peanut is burnt under the test tube. Explain.

_____

_____

(c) State two ways in which the result of the experiment may be inaccurate.

_____

3. The table below shows the food energy value of a lunch meal in school.

Food consumed	Protein (g)	Carbohydrates (g)	Fat (g)
Sausages	9	5	24
Chips	8	70	20
Baked beans	10	20	1
Apple pie	5	60	25
Ice cream	2	20	12
Softdrink	0	30	0

(i) In this meal, which food is the best source of protein?

_____

(ii) Suggest one other food, not consumed here, that is rich in protein.

_____

(iii) Why is protein essential in any diet?

_____

Essay Questions

Write your answers in the spaces provided.

1. (a) (i) What do the chemical structures of carbohydrates and fats have in common?

(ii) How do their chemical structures differ?

(b) Describe the roles of fatty acids in the human body.

2. (a) What are the components of a balanced diet?

(b) Describe, with the help of examples, how each of these components is important in the functioning of the human body?

Answers

Multiple Choice Questions

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

Structured Questions

1. (a) Mix the breakfast cereal thoroughly with water. Add Benedict's reagent and heat the mixture to boil.

(b) If sugar was present, after the mixture is put to boil, it will turn brick red/yellow.

(c) Caution must always be taken into account when heating the mixture.

2. (a) The amount of energy contained in the peanut.

(b) The objective of taking the reading is to find the temperature difference. This temperature difference would then indicate if there is an increase in the temperature of the water in the test tube as it is being heated.

(c) Heat may be lost to the surroundings and to the test tube.

3. (i) Baked beans are the best source of proteins.

(ii) Cheese, etc.

(iii) Protein is essential for growth and repair.

Essay Questions

1. (a) (i) Carbohydrates and fats are both made up of the elements carbon, hydrogen and oxygen.

(ii) In carbohydrates, the ratio of hydrogen to oxygen is 2 : 1 with a general formula: $C_nH_{2m}O_m$. However in fats, one molecule of fat is made up of one molecule of glycerol and three molecules of fatty acids.

(b) Fatty acids are the building blocks of fat in the body and in food. They are a source of energy and constituents of cellular membranes. The fatty acid molecule contains a fatty carbon chain as well as a weak organic acid that can either be saturated or unsaturated. Fatty acids can either be saturated or unsaturated where fewer hydrogen atoms in the structure results in less saturation.

Saturated fatty acids are normally solids at room temperature, and are mostly of animal origin. These saturated fatty acids, especially the long chained ones, are the ones that cause elevated cholesterol and low-density lipoproteins (LDL).

2. (a) A balanced diet is one that provides an adequate intake of energy and nutrients for maintenance of the body and therefore good health. A diet can easily be adequate for normal functioning of the body, yet may not be a balanced diet. An ideal diet in humans must contain fats, proteins, carbohydrates, vitamins, minerals, water and fibre. These however must be taken in the correct proportion. These proportions vary for each individual because everyone has different metabolic rates and levels of activity. Energy is provided by carbohydrates, fats and proteins. Proteins are a provider of energy in an emergency, but are primarily used as building blocks for growth and repair of many body tissues. These energy providing compounds are needed in large quantities in our diet.

(b) Carbohydrates are a rapid source of energy – they are the body's fuel. The bulk of a balanced diet should be made from carbohydrates. If eaten in an excess of the dietary requirements, carbohydrates are easily stored as fats in the cells, although carbohydrate is the first source of energy in the body. Carbohydrates are used principally to be oxidised to release energy for active transport, macromolecule synthesis, cell division and muscle contraction.

Fats are a rich source of energy in the diet. They can be greatly reduced in metabolic reactions and therefore release much energy. They are easily stored in the body and can form a layer beneath the skin of adipose tissue. As lipids are a rich source of energy, they are often not needed for respiration if there are adequate quantities of carbohydrate to provide energy that the body requires.

Protein is not a direct source of energy in the body, it is used primarily for growth and repair of body tissues although these can be used as an energy source as a last resort. Proteins fulfil a wide variety of roles in the body.

Vitamins cannot be synthesised by the body so must be supplied by diet. Vitamins have no common structure or function but are essential in small amounts for the body to be able to utilise other dietary components efficiently.

Unit 4 ENZYMES

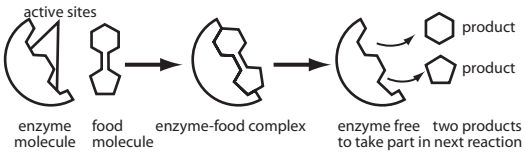
Notes

1. What are enzymes?

- Enzymes are biological catalysts made up mainly of proteins.
- They alter the rate of chemical reactions in living organisms but does not get used up in the reaction.
- Enzymes are capable of working in two ways.
  - By joining smaller molecules to form larger molecules
  - By splitting larger molecules into smaller molecules
- Enzymes control a specific chemical reaction.
- They lower the activation energy needed to start a chemical reaction.
- How enzymes work can be explained using the lock and key hypothesis.
  - The substrate fits into the active site on the enzyme molecule to form a temporary enzyme-substrate complex.
- Enzymes are named after their substrate or the type of reaction they catalyse
  - protease (enzyme) acts on proteins
  - lipase (enzyme) acts on lipids
  - sucrase (enzyme) acts on sucrose
  - amylase (enzyme) acts on starch
  - maltase (enzyme) acts on maltose
- Enzyme-catalysed reactions can be stopped or slowed down by inhibitors such as mercury, lead and arsenide

2. Characteristics of enzymes

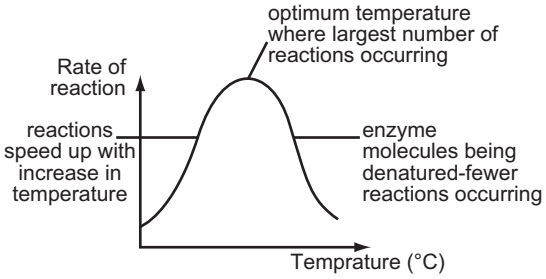
- Enzymes are specific in their actions — one type of enzyme acts on one specific substrate molecule or catalyse a specific reaction.
- Enzymes are not altered at the end of the reaction.
- Enzymes speed up a chemical reaction even at low enzyme concentration.
- Enzyme catalysed reaction are reversible where the forward and reversed reactions are catalysed by the same enzyme. However reactions usually proceed from left to right because the products are not allowed to build up.



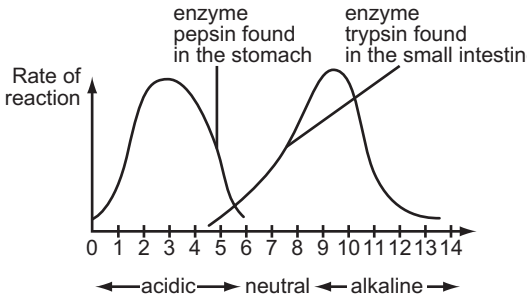
- Some enzymes require co-enzymes or co-factors in order to carry out their catalytic functions.
- Rate of enzyme - catalysed reaction is affected by
  - Temperature
  - pH
  - Substrate concentration
  - Enzyme concentration

3. Effects of temperature on enzyme-catalysed reaction

- An increase in temperature increase the rate of enzyme activity.
- Heat increases the kinetic energy of the enzyme and substrate molecules. This increases the rate of molecular collisions between the enzyme and its substrate.
- Most enzymes function at an optimum temperature of 40°C.
  - Above 40°C rate of enzyme-catalysed reaction decreases.
  - At 60°C enzyme-catalysed reaction ceases. Enzymes become denatured and are unable to function because they change shape, become less soluble and become coagulated.
- Low temperatures decreases the rate of enzyme-catalysed reactions.



Graph to show the effect of temperature on enzyme



Graph to show the effect of pH on enzyme

4. Effects of pH on enzyme-catalysed reaction

- Extreme change in pH caused enzymes to be denatured.
- When enzymes are denatured, they become inactivated.

5. Some roles of enzymes

- Amylase catalyses the hydrolysis of starch to maltose.
- Maltase catalyses the hydrolysis of maltose to glucose.
- Starch $\xrightarrow{\text{amylase}}$ maltose $\xrightarrow{\text{maltase}}$ glucose
- Protease catalyses the hydrolysis of protein to amino acids.
- Protein $\xrightarrow[\text{(stomach)}]{\text{pepsin}}$ Polypeptides $\xrightarrow[\text{(duodenum)}]{\text{trypsim}}$ peptone $\xrightarrow[\text{(ileum)}]{\text{erepsin}}$ amino acid
  (trypsin is found in pancreatic juice)
- Lipase catalyses the hydrolysis of fats to form glycerol and fatty acids.
- Lipid $\xrightarrow{\text{lipase}}$ glycerol + fatty acids

Multiple Choice Questions

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

1. Which of the following is not a characteristic of enzymes?

A pH sensitive
B Required in large quantities
C Heat sensitive
D Irreversibly damaged by the cold [ ]

2. At which of the following temperatures does most enzymes function?

A 5°C
B 20°C
C 40°C
D 55°C [ ]

3. How does extreme acidity affect the activity of amylase?

A Does not affect the activity of the enzyme
B Ceases the activity of the enzyme
C Decreases the rate of reaction
D Increases the rate of reaction [ ]

4. Which of the following will not occur as a result of high temperature on enzymes?

A Enzyme becomes more effective
B Enzyme loses solubility
C Enzyme changes shape
D Enzyme coagulates [ ]

5. Which of the following enzymes works best at a pH in the range 2–3?

A Amylase
B Lipase
C Maltase
D Pepsin [ ]

6. A solution of human saliva was mixed in a test tube with an equal amount of starch solution. The test tube was left to stand for 30 minutes and then several drops of iodine solution were added. Which of the following colour change would you expect to see?

A White
B Brown
C Green
D Blue-black [ ]

7. Amylase catalyses the hydrolysis of starch to maltose. Under which of the following conditions would the reaction take place most quickly?

	pH	Temperature
A	acidic	20°C
B	acidic	40°C
C	neutral	40°C
D	neutral	60°C

[ ]

8. Which of the following best identifies the enzymes in the reaction below?

starch $\xrightarrow{\text{I}}$ maltose $\xrightarrow{\text{II}}$ glucose

	I	II
A	amylase	lipase
B	amylase	maltase
C	lipase	pepsin
D	maltase	pepsin

[ ]

9. Which of the following enzymes is secreted by the pancreas?

A Insulin
B Lipase
C Maltase
D Pepsin

[ ]

10. Which of the following enzymes breaks down molecules of fat into fatty acids and glycerol?

A Protease
B Amylase
C Lipase
D Maltase

[ ]

Structured Questions

Write your answers in the spaces provided.

1. (a) Describe the functions of enzymes.

_____

_____

(b) List the factors that affect the rate of activity of an enzyme.

_____

_____

(c) Why must proteins be digested? Explain how this is carried out.

_____

_____

_____

_____

_____

_____

2. In an investigation to study the effect of temperature on the activity of an enzyme, six identical sets of apparatus were set up. Each set was kept at different temperatures. After five minutes, the enzymes were added to the egg white, the tube shaken and returned to the same water bath. The solutions were cloudy at first due to the presence of egg white protein. The time taken for the cloudiness to disappear was recorded in the table below.

Temperature (°C)	5	15	25	40	50	60
Time taken for cloudiness to disappear (min)	16	10	5	1	7	Still cloudy

(a) Plot a line graph to show the results.

(b) At which temperature did the enzyme react most rapidly?

_____

(c) Why were the enzyme and egg white kept separately for five minutes before being mixed?

_____

(d) The mixture at 60°C remained cloudy. Can this mixture then be re-used in a similar experiment? Explain.

_____

_____

(e) Explain the results at 5°C.

_____

3. Joe set up an experiment to investigate the digestion of a *sugar-free* biscuit by saliva. He set up three test tubes of identical quantities of substances in the following combination.

Test tube I: Ground biscuit and boiled saliva at 37°C.

Test tube II: Ground biscuit and saliva at 37°C.

Test tube III: Ground biscuit and water at 37°C.

Joe tested the contents using Benedict's solution. After boiling the contens with the reagent, a brick-red precipitate was obtained only in test tube II.

(a) Explain why a *sugar-free* biscuit was used.

_____

_____

_____

(b) State a conclusion Joe could draw from his experiment.

_____

(c) Suggest substances to be used in a fourth test tube which would improve the design of the experiment.

_____

(d) State additional information you are trying to find in (c).

_____

4. In a test tube kept in a water bath, 0.25 cm^3 of a plant enzyme was added to 5.0 cm^3 of starch suspension. Drops of this mixture were removed and tested with iodine solution to determine when all the starch had been digested. The experiment was repeated at each of eight different temperatures and the results were as follows:

Temperature (°C)	18	29	37	44	51	56	62	65
Time taken for digestion (min)	17	13	9	6	4	3	13	19

(a) Describe how you would test the contents of the tube to show that starch has been digested to a simple reducing sugar.

_____

_____

_____

(b) Deduce from the data, the temperature at which the reaction works the quickest.

_____

_____

(c) At which of the above temperatures would be the optimum temperature for the human enzyme?

_____

Essay Questions

Write your answers in the spaces provided.

1. Write an essay on enzymes, their properties and roles in animals and plants.

2. Describe the process of starch digestion in the small intestine.

Multiple Choice Questions

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

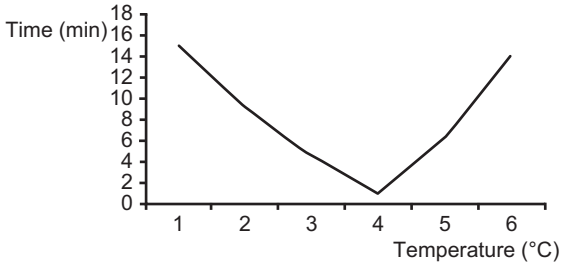
Structured Questions

1. (a) Enzymes speed up the rate of biochemical reactions such as hydrolysis, oxidation and reduction that occur in living organisms.

(b) The factors that affect the rate of activity of enzymes are pH and temperature of the environment in which the enzyme works in. Also the presence of enzyme inhibitors/ activators and the concentration of the substrate affects the rate of enzyme activity.

(c) Proteins are large molecules that cannot pass through the semi-permeable membranes of the cells in the body for immediate use. Hence digestion of these proteins must take place to break the proteins down into their simplest forms to be absorbed by the body.
Proteins are first digested in the stomach. The hydrochloric acid secreted by the stomach walls provides the right environment for pepsin (enzyme) to work in. Pepsin breaks down proteins to polypeptides. Protein digestion continues in the duodenum. Here, trypsin (enzyme) from the pancreatic juice breaks down undigested protein into peptones. The peptones produced are then converted to amino acids by erepsin (enzyme) present in the ileum which is the last phase in protein digestion. The end products of protein digestion are amino acids.

2. (a)



(b) 40°C

(c) This allows them to reach the temperature of the bath first before the reaction.

(d) Yes, provided it was cooled down and fresh enzyme was added to replenish the enzyme that had been denatured.

(e) The rate of reaction of enzyme is slow at lower temperatures.

3. (a) This was to ensure that the Benedict's test for reducing sugar conducted at the end of the experiment would turn positive not because of the presence of the simple sugar at the start of the experiment.

(b) Ground biscuit is digested by saliva at 37°C.

(c) Test tube IV: Water and saliva at 37°C.

(d) To show that saliva does not break down at 37°C to produce a reducing sugar.

4. (a) Test for reducing sugar on the samples. Heat Benedict's solution until it reaches boiling point. Add the test solution and re-heat. Allow the mixture to cool and observe. A colour change to orange/brick-red would show that reducing sugar was present.

(b) The fastest rate of reaction is shown by the fastest rate of digestion. Hence 56°C is the best temperature.

(c) 37°C

Essay Questions

1. Enzymes are biological catalysts made up mainly of proteins. They speed up the rate of chemical reaction without themselves being changed/altered during or at the end of the reaction. A small amount of enzyme can be used to bring about a large chemical reaction.
Enzymes are highly specific in their action i.e. they are highly substrate specific, for example, amylase aids in the hydrolysis of starch to give simple sugars (glucose) and it does not react with anything else.
Enzymes are sensitive to temperature changes and have an optimum temperature at which they function most efficiently. Having a lower temperature than their optimum temperature would cause enzyme activity to decrease. In cases where there are extreme temperatures, enzymes are said to be inactivated due to their protein structured nature.
Enzymes are also affected by the acidity or alkalinity of its environment. In most cases, the optimum pH for an enzyme to work is pH 7. However, digestive enzymes work most actively in alkaline or acidic medium. For example, in the stomach, the optimum pH in which enzymes works best in is pH 4 – the slightly acidic environment which is provided by the presence of hydrochloric acid while amylase works best in a slightly alkaline environment. Enzymes,

on the other hand, would be destroyed in extreme changes of acidity or alkalinity.

Enzymes play a very important role in plants and animals. In animals, they aid in digestion – breaking food substances into simple diffusible substances, in respiration to produce energy and in the breaking down of hydrogen peroxide in the liver. Enzymes are also needed in the conversion of ADT to ATP and in the build up of proteins from amino acids.

In green plants, enzymes are needed in photosynthesis, in the breaking up of food substances in the seed to be used for germination, in respiration and in growth. In non-green plants, enzymes are used to decompose dead organic matter which can then be absorbed by the plant.

2. When carbohydrates enter the small intestine, the remaining starch is converted by the enzymes amylopsin to maltose. The enzymes maltase, lactase and sucrase then take over. These enzymes convert maltose to glucose, lactose to glucose and galactose and sucrose to glucose and frustose respectively. Hence the end products of starch digestion in the small intestine are simple sugars.

Unit 5 NUTRITION IN HUMANS

1. Elements in classes of food

Classes of food	Elements
Carbohydrates	Carbon, hydrogen and oxygen
Fats	Carbon, hydrogen and oxygen
Proteins	Carbon, hydrogen, oxygen, nitrogen and sometimes sulphur

2. Principal sources for food

Classes of food	Source
Carbohydrates/starch	Wheat, rice, noodles
Protein	Milk, meat
Fat	Red meat, oil
Vitamin D	Milk, exposure to sunlight
Vitamin C	Citrus fruits
Iron	Liver
Calcium	Milk, cheese, eggs
Fibre	Fruits and vegetables

3. Dietary importance

Classes of food	Importance
Carbohydrates/starch	Main source of energy
Protein	Synthesis of protoplasm for growth and repair of worn out tissues Synthesis of enzymes and hormones Formation of antibodies
Fat	Synthesis of membranes Solvent for fat soluble vitamins Storage of energy Insulating material
Vitamin D	Promote absorption of calcium
Vitamin C	Needed for formation of intercellular substances to hold cells together Maintain healthy epithelial tissues

Classes of food	Importance
Iron	Component of haemoglobin
Calcium	Needed for building bones, normal functioning of muscles and blood clotting process
Fibre	Provide bulk to undigested matter and promote peristalsis
Water	Medium for various enzymatic reactions. Main component of blood plasma

4. Deficiency diseases

Nutrient	Deficiency disease	Symptoms
Vitamin C	Scurvy	Swollen bleeding gums, loosening of teeth
Vitamin D	Rickets	Poor teeth and bone formation. Deformities such as bowed legs in children. Soft bones
Calcium	Rickets	Poor teeth and bone formation. Deformities such as bowed legs in children. Soft bones
Iron	Anaemia	Low haemoglobin level in blood. Less red blood cells. Easily tired and breathlessness

5. A balanced diet consists of the right amounts of carbohydrates, proteins, fats, vitamins, minerals, fibre and water.

6. Energy intake

- Sources of energy food include carbohydrates (main), fats and proteins.
- Larger body size require more energy.
- Children require more energy for growth than adults.
- Man have less fatty tissue in their bodies and need more energy for heat production.
- People who are more active and perform hard labour need more energy.
- People living in cold climate need more energy.
- Pregnant or breast-feeding females require more energy.

7. Effects of malnutrition

- Due to dietary imbalance.
- Excessive intake of nutrients or deficient intake.

Starvation

- Lack of energy intake.
- Body uses energy stores such as fats and glycogen.
- When these are gone, body uses proteins.
- Lead to loss in body mass.

- Loss in muscles (muscles mostly made of proteins).
- Weakening of heart.

Obesity

- Over consumption of carbohydrates and fats.
- Excess carbohydrates converted into fats.
- Fatty deposits in organs and arteries.
- May lead to coronary heart diseases.

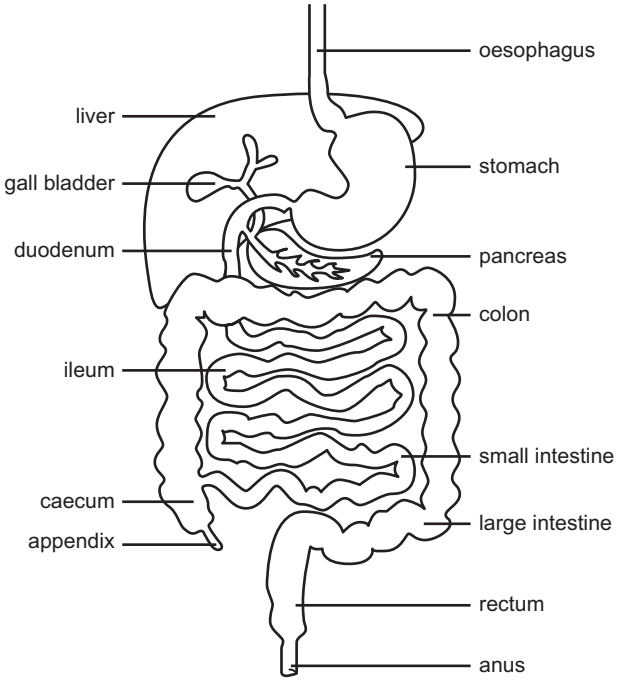
Heart Disease

- Over consumption of saturated fats (e.g. cholesterol).
- Increase risk of coronary heart disease.
- Where coronary arteries become narrow due to fatty deposits (formation of atheroma).
- Increase risk of stroke and heart attack.

Constipation

- Lack of fibre in diet.
- Undigested matter lack bulk.
- Poor peristalsis.
- Food stays too long in large intestine.
- Lots of water absorbed by large intestine.
- Dry hard stools.

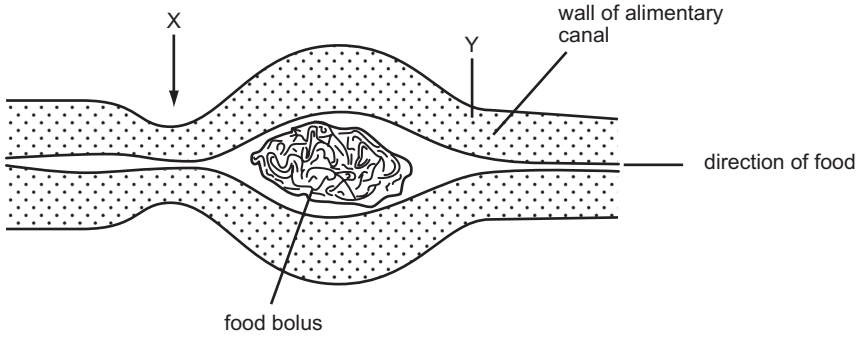
8. Human alimentary canal



Process	Description	Associated Parts
Ingestion	Food is taken into the body.	Mouth
Digestion	Large food molecules are broken down into simple diffusible substances.	Mouth, stomach, duodenum, ileum, liver, gall bladder, pancreas
Absorption	Digested food molecules diffuses through the villi into the blood.	Ileum
Assimilation	Absorbed food is converted into other substances needed by the body or used to make new cells or used for energy.	Liver
Egestion	Undigested food exits the body.	Rectum, anus

9. Peristalsis

- Occurs along the entire digestive canal
  E.g. oesophagus, stomach, small intestine, large intestine
- Contraction of muscles in the walls of the digestive canal
- Brings about movement of food
- Poor peristalsis leads to constipation



- At X, circular muscles contract and longitudinal muscles relax.
- At Y, circular muscles relax and longitudinal muscles contract.

10. Digestion

Starch

- Starch in the mouth is broken down by amylase into maltose.
- Undigested starch is broken down by amylase secreted by the pancreas in the small intestine.
- Maltose is broken down by maltase secreted by the intestinal juice into glucose.

Protein

- Protein digestion begins in the stomach.
- Gastric juice secreted by the stomach contains protease.

- Protease breaks down protein into peptones.
- In the small intestine, undigested protein is broken down into peptones by protease which is secreted by the pancreas.
- Peptones are broken down into amino acids by peptidases in intestinal juice.

Fats or Lipids

- Bile is produced in the liver and stored in the gall bladder.
- Bile released into the duodenum causes fats to become **emulsified.**
- The fats separate into smaller globules and this increases their surface area for enzymes to act on.
- Lipase from pancreatic and intestinal juice break down fats into fatty acids and glycerol.

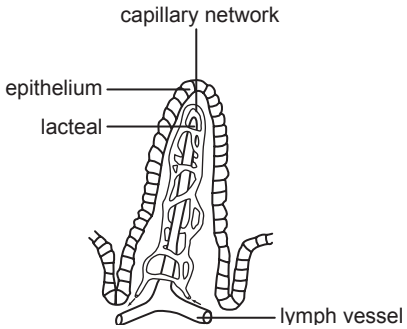
Digestive Juice	Organ	Enzymes
Saliva	Mouth	Amylase
Gastric juice	Stomach	Protease
Pancreatic juice	Pancreas	Amylase, protease, lipase
Intestinal juice	Small intestine	Peptidase, maltose, lipase
Bile	Liver, stored in gall bladder	Nil

11. Adaptation of ileum for absorption

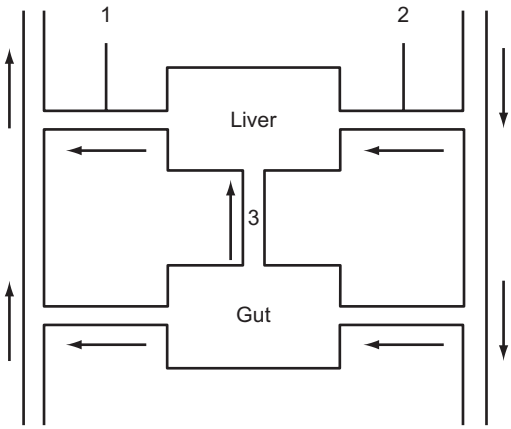
Adaptation	Structures
Increases surface area	Inner walls of small intestine have many folds. Villi and microvilli.
Increases time for absorption	Very long ileum
Increases rate of diffusion	Villi walls are made of a single epithelial layer. Movement of vili.
Maintain diffusion gradient	Ileum rich in blood vessels that carry away absorbed food quickly

12. Structure of villus

Structure	Function
A – blood capillaries	Absorb glucose and Amino acids
B – lacteal	Absorb fatty acids and glycerol
C – villus	Thin wall that allow easy diffusion



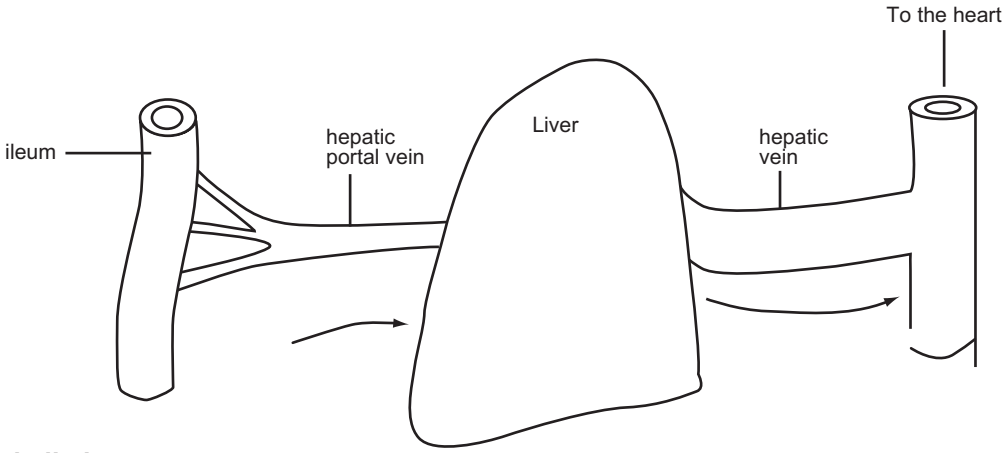
13. Hepatic portal vein



1– hepatic vein 2– hepatic artery
3– hepatic portal vein

Hepatic portal vein brings absorbed glucose and amino acids from the ileum directly to the liver.

14. Liver



Assimilation

- Glucose is used by cells in tissue respiration to release energy.
- Excess glucose is converted into glycogen and stored in the liver.
- Conversion of glucose to glycogen is induced by the release of insulin by the pancreas.
- Amino acid is used by cells to make proteins; enzymes, hormones, new protoplasm.
- **Excess** amino acids are **deaminated** (removal of amino group) in the liver to produce urea as excretory product.
- The amino group is removed and converted into urea.
- The remaining part of the protein is converted into glucose.
- Urea is non-toxic and will be excreted in urine.
- Excess glucose will be stored as glycogen in the liver and muscles.

Removal of Toxins

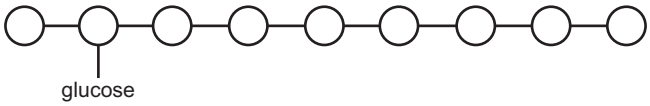
- Harmful substances like alcohol are broken down in the liver.

15. Assimilation of fats

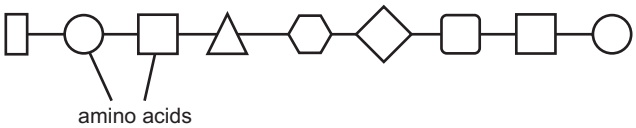
- Excess fats are stored in the adipose tissues beneath the skin, around the heart, kidneys and intestines.
- They are oxidised only when there is a lack of glucose.
- They also act as an insulating layer against heat loss.

16. Synthesis of large molecules in the body

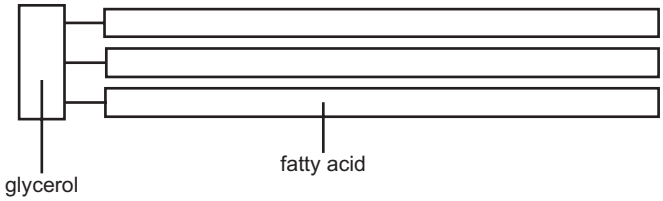
Glycogens are made by joining small glucose units.



Proteins are made by joining amino acid units.



Fats are made from one molecule of glycerol and three molecules of fatty acids.



Multiple Choice Questions

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

1. In which of the following parts of the digestive system is hydrochloric acid produced?

A Gall bladder
B Pancreas
C Liver
D Stomach **[ ]**

2. Which of the following enzymes is responsible for the production of fatty acids and glycerol?

A Amylase
B Lipase
C Protease
D Peptidase **[ ]**

3. In which of the following parts of the digestive system is amylase found?

A Saliva
B Pancreas
C Liver
D Stomach [ ]

4. Which of the following best explains the role of the digestive enzymes in gastric juice?

A To coagulate the liquid milk protein into casein
B To react on protein to break it down into amino acids
C To react on starch to break it down into glucose
D To prepare and form acidic medium [ ]

5. Which of the following best describes the villi?

I Has a lot of blood capillaries.
II Increases the surface area of the small intestine.
III Enhances the absorption of the end products of digestion.

A I and II only
B I and III only
C II and III only
D I, II and III [ ]

6. Study the information below about Substance X.

- It emulsifies oils and fats into smaller droplets.
- It neutralises the acid produced by the stomach wall.

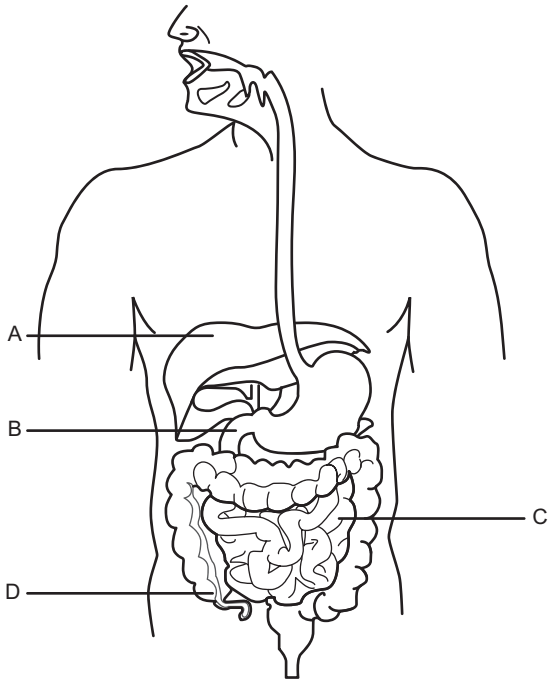
Which of the following best represents Substance X?

A Gastric juice
B Pancreatic juice
C Bile
D Gall bladder [ ]

7. Which of the following best describes the main function of the colon?

A To absorb water
B To absorb digested food materials
C To remove undigested food materials
D To produce enzymes to digest any remaining food [ ]

Study the diagram below and use it to answers Questions 8 to 10.



8. In which of the labelled parts is most of the glycerol absorbed into the lymphatic system?

A Liver
B Duodenum
C Jejunum
D Caecum
[ ]

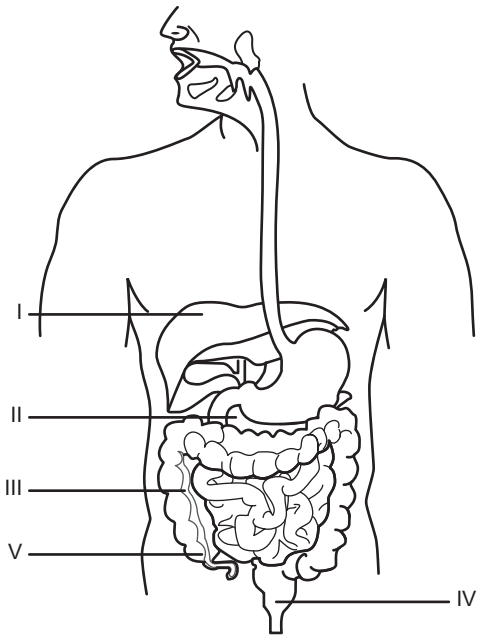
9. Which of the labelled parts synthesizes a secretion which help to speed fat digestion but does not contain any enzymes?

A Liver
B Duodenum
C Jejunum
D Caecum
[ ]

10. Which of the following statements about the part labelled D is correct?

A Its role is to remove most of the water and mineral salts from its contents.
B Its peristaltic movements help to move the contents along.
C It is surrounded by very few blood capillaries.
D It does not have any villi.
[ ]

Study the diagram below and use it to answer Questions 11 and 12.



11. Which of the following identifies the labelled part correctly?

	III	IV	V
A	rectum	caecum	ileum
B	colon	anus	large intestine
C	caecum	rectum	ileum
D	colon	rectum	caecum

[ ]

12. Which of the following identifies the roles of organs I and II in the metabolism of glucose?

	I	II
A	Stores glucose as glycogen	Secretes insulin which speeds up the conversion of glucose to glycogen
B	Converts glycogen into glucose	Secretes amylase which speeds up the hydrolysis of starch
C	Deamination of excess protein	Secretes trypsin which speeds up the hydrolysis of proteins
D	Synthesis of glycogen	Secretes amylase which speeds up the hydrolysis of glycogen

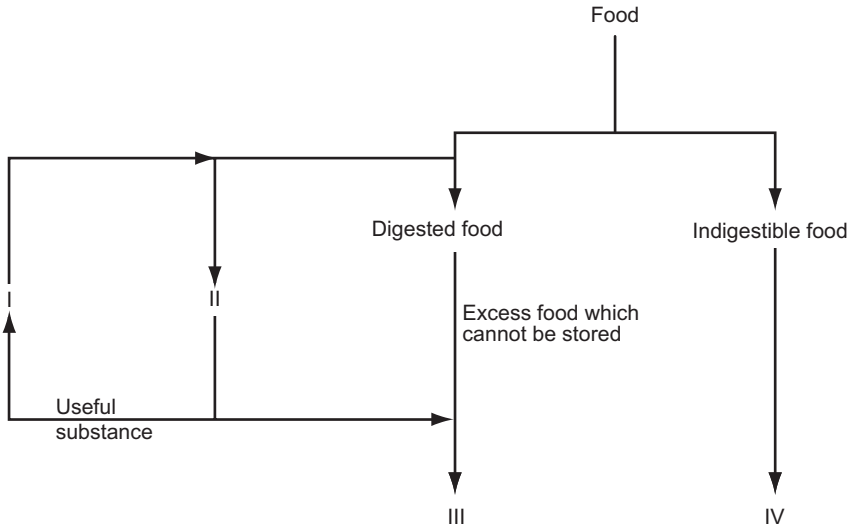
[ ]

13. The secretion that emulsifies fats in the duodenum is made in the _____.

A bile duct
B gall bladder
C liver
D pancreas

[ ]

14. Study the following classification chart which shows what happens to the food that is consumed.



Which of the following correctly identifies the processes labelled I, II, III and IV?

	I	II	III	IV
A	metabolism	secretion	defaecation	excretion
B	secretion	metabolism	excretion	defaecation
C	excretion	defaecation	secretion	metabolism
D	defaecation	excretion	metabolism	secretion

[ ]

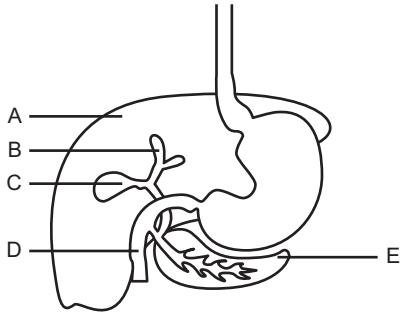
15. Intestinal juice contains enzymes which speeds up the rate of hydrolysis of _____.

A maltose, glucose, fats and peptones
B maltose, lactose, sucrose and fats
C lactose, sucrose, peptones and fats
D starch, lactose, fats and peptones [ ]

Structured Questions

Write your answers in the spaces provided.

1. The diagram below shows part of the alimentary canal.



(a) Label the parts A, B, C, D and E.

(b) (i) Name the liquid contained in the part labelled D.

_____

(ii) What is the main function of the liquid in (i)?

_____

(c) (i) Name the secretion produced by the exocrine gland in the structure labelled E.

_____

(ii) Describe the role of the secretion in (i) in the digestion of fats.

_____

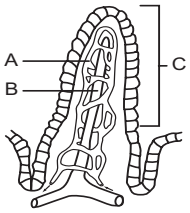
(d) (i) Name the secretion produced by the endocrine gland in the structure labelled E.

_____

(ii) Describe the role of the secretion in (i) in the digestion of carbohydrates.

_____

2. The diagram below shows the structure of a single villus.



(a) Where would you expect to find this structure in the oesophagus?

_____

(b) Name two chemicals passing through the part labelled C after a meal.

_____

(c) (i) Identify the part labelled B.

_____

(ii) Explain the role of the part labelled B in the villus.

_____

(d) Name the blood vessel connected to the part labelled C to the liver.

_____

(e) Suggest one advantage of blood going to the liver from the villus before going to the whole body.

_____

3. The three main classes of foodstuff are present in a slice of bread and butter. These are digested as they pass along the alimentary canal. Use this information to complete the table below.

(a)

Food	Food class	Where digestion begins	Product of digestion
Bread		stomach	glucose
Butter			

(b) Define *digestion*.

_____

(c) Identify the secretion produced by the alimentary canal that does not contain enzymes but assist in the digestion of fats.

_____

(d) Identify the region in the alimentary canal where digested food is absorbed.

_____

4. (a) (i) Identify the substance that is stored in the main food reserve in the liver of a mammal.

_____

(ii) Identify the hormone that controls the process of carbohydrates storage.

_____

(iii) Identify the blood vessel that carries most of the digested carbohydrate to the liver.

_____

(b) Describe briefly the excretory function of the liver.

_____

_____

(c) Identify the digestive juice which is produced by the liver and explain its function during digestion.

_____

_____

Essay Questions

1. Explain each of the following statements.

(a) People can go without food for weeks but they cannot survive without water for less than two days.

(b) Food that enters the mouth is not absorbed by the body.

2. (a) Describe how a molecule of digested food from the oesophagus enter the bloodstream?

(b) How does a diet rich in fat lead to heart disease?

Multiple Choice Questions

1. D	**2.** B	**3.** A	**4.** D	**5.** D
6. B	**7.** A	**8.** C	**9.** A	**10.** A
11. D	**12.** A	**13.** B	**14.** B	**15.** B

Structured Questions

1. (a) A – liver; B – bile duct; C – gall bladder; D – duodenum; E – pancreas
(b) (i) Bile
(ii) It emulsifies fats.
(c) (i) Pancreatic juice
(ii) Pancreatic juice contains lipase to increase the rate of hydrolysis of emulsified fats.
(d) (i) Insulin
(ii) Insulin converts excess glucose into glycogen to be stored in the body.

2. (a) It is found along the inner wall of the small intestine, ileum and duodenum.
(b) Carbohydrates and proteins
(c) (i) Blood capillaries
(ii) It creates a large surface area for the absorption of food from the inside of the oesophagus
(d) Hepatic portal vein
(e) The liver will control the level of food substances such as sugar.

3. (a)

Food	Food class	Where digestion begins	Product of digestion
Bread	carbohydrates proteins	stomach	glucose polypeptides
Butter	fats	duodenum	fatty acids and glycerol

(b) Digestion is a process whereby food substances are converted into soluble and diffusible forms by the action of enzymes.
(c) Bile
(d) Ileum

4. (a) (i) Glycogen
(ii) Insulin
(iii) Lymphatic nodes
(b) In the liver, excess sugar is converted into glycogen and stored. Glucose in the blood leaving the liver is used by cells for energy production. When more glucose is needed, glycogen in the liver is converted back to glucose.
(c) It produces bile to ensure that the blood glucose level is constant and to deaminate excess amino acids.

Essay Questions

1. (a) Food that is consumed will not be used up immediately during respiration.
Excess glucose will be stored as glycogen in the liver while excess fats will be stored in adipose tissues at various sites. These stores of energy-rich foods can be converted to glucose when the level of glucose in the blood falls. If a person cuts down on his physical activities while fasting, then the stores of fat and glycogen should be enough to last him for at least a month. Water is a major constituent of cytoplasm, blood, enzymes and various secretions. It is constantly lost from the body with expired air and as sweat. If the water that is lost is not replaced, the composition of the blood and cells will be affected and death will result.
(b) The digestive tract is a tube that starts from the mouth and ends at the anus. Hence the contents of the tract are outside the cells of the body. Food must be digested into the simplest forms before they can be absorbed into the bloodstream. Only when the food is in the blood can it be considered to have entered the body. Whatever is left in the digestive tract will be mainly roughage or plant fibre.

2. (a) A molecule of digested food such as glucose which is broken down from carbohydrates in the mouth and stomach passes along the oesophagus by peristalsis until it reaches the small intestine. Here, the walls of the small intestine are made up of numerous finger-like projections called villi which project into the intestinal cavity. The villi has a rich supply of blood and lymphatic vessels to carry away food substances. The glucose molecule is absorbed by the villi and the glucose passes across the walls of he blood vessels and into the bloodstream.
(b) Fats are absorbed by the lacteals in the small intestine and are brought to the liver where they can be oxidised or stored. A diet which is rich in fat will cause excess fat to be stored in the adipose tissues which occur mainly around the heart. Besides this, they form a thick lining inside the walls of the arteries near the heart causing the flow of blood to slow down, thus causing heart diseases.

Unit 6 NUTRITION IN PLANTS

Notes

Photosynthesis

1. Plants carry out photosynthesis

- Green plants produce carbohydrates from simple raw materials.
- Plants need carbon dioxide, water, light and chlorophyll to produce starch, oxygen and water during photosynthesis.
- During photosynthesis, chlorophyll absorbs light energy and becomes activated.
- Light energy is used to split the water molecules to produce hydrogen which reduces carbon dioxide to form glucose.
- Glucose, water and oxygen are formed during photosynthesis.
- Photosynthesis can be represented as follows:

$$\text{carbon dioxide} + \text{water} \xrightarrow[\text{light}]{\text{chlorophyll}} \text{glucose} + \text{water} + \text{oxygen}$$

$$6CO_2 + 12H_2O \longrightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$$

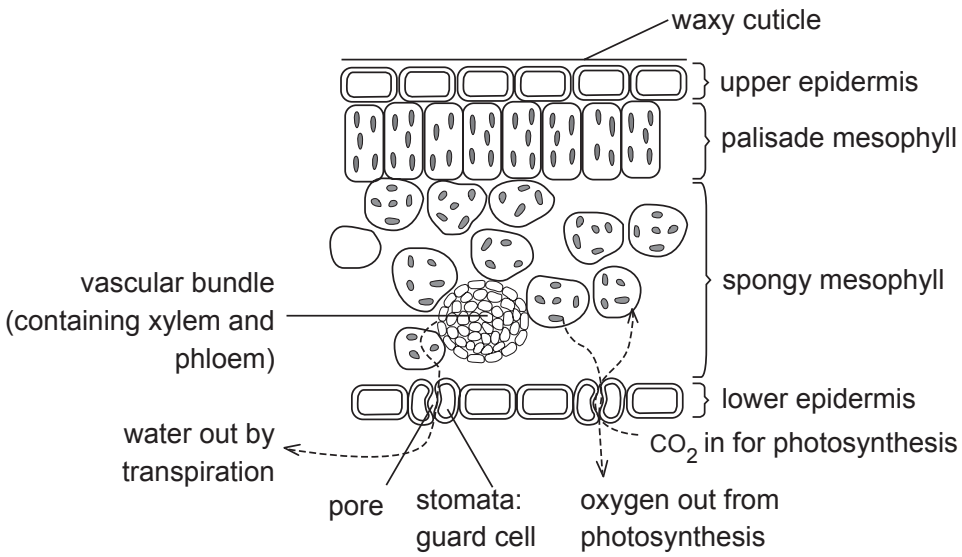
2. Factors that affect the rate of photosynthesis

- Light intensity
  - The higher the light intensity, the faster the rate of photosynthesis – when other conditions are favourable.
  - Low concentration of carbon dioxide limits the rate of photosynthesis.
  - When the concentration of carbon dioxide is higher, the rate of photosynthesis increases.
  - Rate of photosynthesis can be increased with a higher temperature.
- Concentration of carbon dioxide
  - Increasing the concentration of carbon dioxide present in the air (>0.1%), increases the rate of photosynthesis.
  - Greater than 0.1%, carbon dioxide does not increase the rate of photosynthesis because light intensity becomes the limiting factor.
- Temperature
  - For temperatures below 40°C, as the temperature increases, the rate of photosynthesis increases.
  - At 40°C, photosynthesis begins to decrease.
  - As the temperature rises above 40°C, photosynthesis ceases as enzymes are denatured due to exposure to heat.

3. Importance of photosynthesis

- Makes light energy from the Sun available to animals and plants as chemical energy in the form of glucose.
- In the day, the leaf produces more glucose than can be removed – excess glucose will then be converted into starch and stored in the leaf.
- At night, starch stored in the leaf is converted to glucose.
- Excess glucose is converted to sucrose before being transported out of the leaf for use by other parts of the plant, or for storage in the various storage organs.
- Nitrates and other mineral salts absorbed by the plant are used to form amino acids and proteins – these will either be stored or used in making new protoplasm.
- Fats can be formed from glucose and either stored, used to form protoplasm or in cellular respiration.
- Hence plants provide animals with food, either directly or indirectly.
- Chemical energy present in fossil fuels is released when the fuel is burnt.
- Photosynthesis ensures that living things have a constant supply of oxygen.

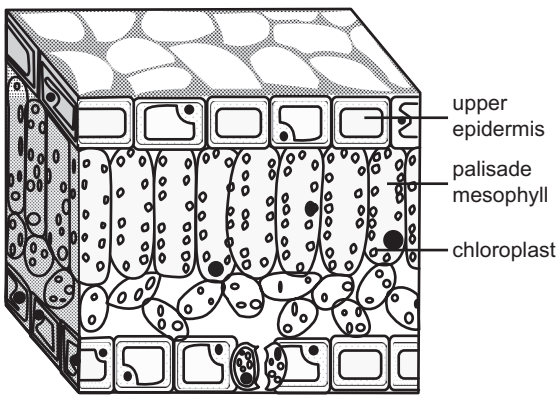
Leaf Structure



1. Internal structure of the lamina
   The leaf consists of three types of tissues:
   - Upper epidermis
     - made up of a single layer of closely-packed cells with a thick cuticle.
     - cuticle protects the leaf and prevents excessive evaporation of water.
     - transparent to allow sunlight to pass through.
   - Mesophyll – palisade or spongy
     - lies between the upper and lower epidermis.
     - palisade mesophyll
       - consists of one or two layers of closely-packed, long and cylindrical cells containing chloroplasts.

- ✧ spongy mesophyll
  - cells are irregular in shape—causing large intercellular air spaces among them to allow for rapid diffusion of gases.
  - contain fewer chloroplasts.
  - cells are covered with a thin film of moisture so that carbon dioxide can dissolve in it.
  - xylem and phloem are present here.
- ❖ Lower epidermis
  - ✧ consists of a single layer of closely-packed cells covered by an outer layer of cuticle which reduces water loss.

2. Distribution of chloroplasts in leaves to enable photosynthesis



- ❖ palisade mesophyll cells contain numerous chloroplasts to allow maximum absorption of light.
- ❖ chloroplasts arranged alongside the cell wall are most abundant on the side facing the sunlight.
- ❖ position of the chloroplasts changes to ensure efficient absorption of sunlight.
- ❖ thin leaf to allow light to reach more cells.
- ❖ a large flat surface increases the exposed surface area to light.

3. Gaseous exchange in leaves

- ❖ gaseous exchange takes place in the leaf through the stomata.
- ❖ all stoma are capable of opening and closing where these movements are affected by the intensity of light and the rate of evaporation of water.
- ❖ stoma usually open by day and close at night.
- ❖ carbon dioxide supply by diffusion is very efficient because of the large number of stomata and the large surface area of the leaf.
- ❖ once inside the leaf, carbon dioxide passes to the mesophyll cells by diffusing through the intercellular spaces.
- ❖ cells of the spongy mesophyll layer are loosely arranged to facilitate the diffusion of gases.
- ❖ carbon dioxide dissolves in the water surrounding the cells lining the air spaces and then diffuses through the cell walls into the cytoplasm.
- ❖ carbon dioxide is used by the chloroplasts during photosynthesis.
- ❖ oxygen molecules produced will then diffuse from the mesophyll cells into the intercellular spaces and out through the stomata.

Multiple Choice Questions

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

1. Which of the following structures in a palisade mesophyll cell absorbs light energy during photosynthesis?

A Ribosomes
B Chloroplasts
C Mitochondria
D Leucoplasts [ ]

2. Which of the following best describes the role of light energy trapped during photosynthesis?

A It is converted to chemical energy by oxygen molecules.
B It splits water molecules to produce hydrogen.
C It synthesizes proteins from amino acids.
D It is stored as heat energy in starch grains. [ ]

3. Which of the following are major sources of carbon to plants?

A Glucose
B Starch
C Proteins
D Carbon dioxide [ ]

4. In which of the following processes is carbon dioxide in air converted into carbohydrates?

A Combustion
B Respiration
C Photosynthesis
D Active transport [ ]

5. Which of the following elements, found in all organisms, is not normally obtained by plants from the soil?

A Nitrogen
B Calcium
C Magnesium
D Carbon [ ]

6. Which of the following best explains why during the day plants gives off oxygen and takes in carbon dioxide?

A Its rate of respiration is faster than its rate of photosynthesis.
B Its rate of photosynthesis is faster than its rate of respiration.
C It is respiring and not carrying out photosynthesis.
D It is carrying out photosynthesis but not respiring. [ ]

7. Which of the following structures help plants to carry out the maximum photosynthesis?

A Broad and flat leaves
B Shiny-surfaced leaves
C Spiky leaves
D Thick-skinned leaves [ ]

8. In which of the following ways does oxygen pass out through the stomata of the leaves?

A Diffusion
B Osmosis
C Evaporation
D Transpiration [ ]

9. Which of the following helps a plant to absorb carbon dioxide rapidly?

A Its green colour
B Arrangement of leaves on the stem
C Large surface area
D Thick section through the leaf [ ]

10. Which of the following traps light energy to allow for photosynthesis to take place?

A Carbon dioxide
B Chloroplast
C Cellulose
D Glucose [ ]

Structured Questions

Write your answers in the spaces provided.

1. A well watered plant had one of its leaves covered with tinfoil. After three days, the leaf was removed, decolourised with ethanol and treated with iodine solution.

(a) (i) What was the purpose of the tinfoil in the experiment?

_____

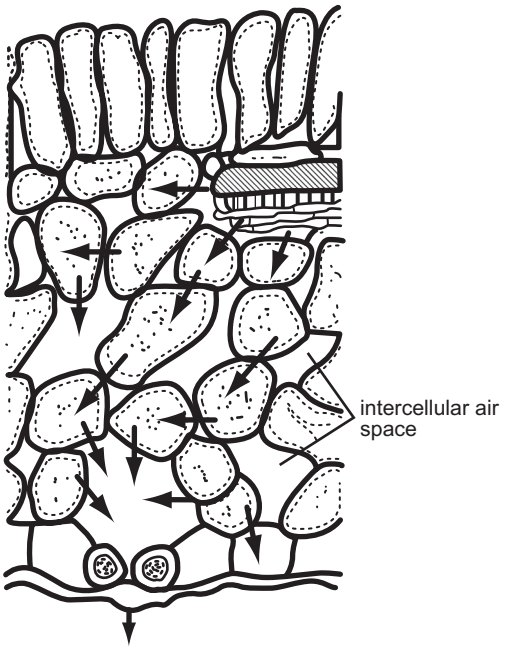
(ii) Some areas of the leaf was stained black with iodine. Name the substance that had caused this black stains.

_____

(b) Name the coloured substance removed by ethanol.

_____

2. The diagram below shows part of a vertical section through a green leaf.



(a) In the diagram

(i) Label a guard cell and a palisade mesophyll cell.

(ii) Circle the cells that contain chloroplast.

(b) The by-product of photosynthesis is sugar. State one use of this sugar to

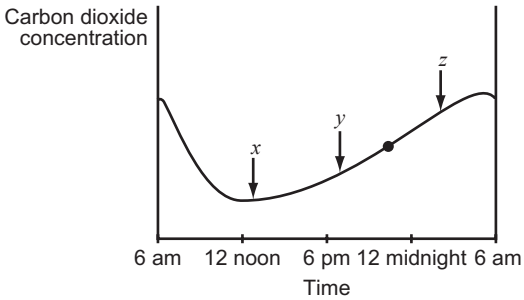
(i) the plant itself; and

_____

(ii) humans.

_____

3. The graph shows the concentration of carbon dioxide in air samples taken from around the foliage of a group of plants growing in a greenhouse. The samples were taken at intervals during the 24 hours.



Explain

(a) the low concentration of carbon dioxide at X;

_____

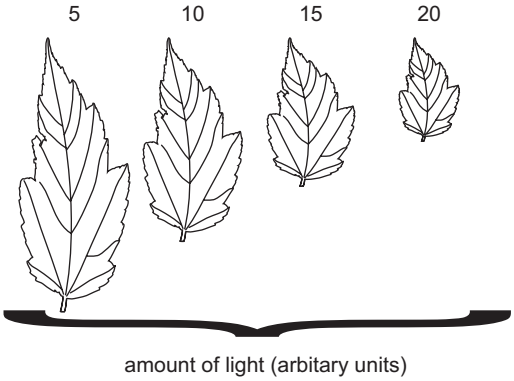
(b) increase in concentration at Y; and

_____

(c) high concentration of carbon dioxide at Z.

_____

4. The diagram below shows leaves taken from plants of the same species. The plants were grown under identical conditions except for light. The amount of light received by each leaf is shown below.



(a) Measure each leaf blade and plot a graph to show how the length of the leaf changes with the amount of light.

(b) What is the relationship between the length of the leaf and the amount of light?

_____

(c) Why is the relationship described in (b) an advantage to the plant?

_____

Essay Questions

Write your answers in the spaces provided.

1. (a) Describe briefly the process of photosynthesis.

(b) How are each of the following organisms dependent on photosynthesis?

(i) Bracket fungus

(ii) Caterpillar feeding on a leaf.

2. Write an essay on the structure of the leaf and its adaptation for photosynthesis.

Answers

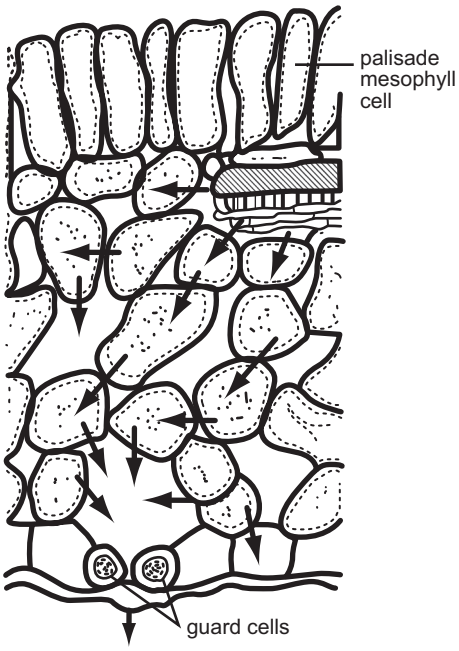
Multiple Choice Questions

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

Structured Questions

1. (a) (i) It stops some sunlight from reaching some parts of the leaf.
(ii) Starch
(b) Chlorophyll

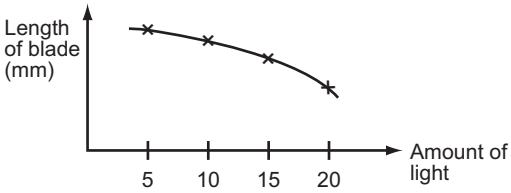
2. (a) (i)



(ii) Circle in palisade cells, spongy mesophyll cell and guard cells.
(b) (i) Sugar may be used for respiration.
(ii) Humans use sugar in/for food.

3. (a) X is the highest rate of photosynthesis using up more carbon dioxide.
(b) Light intensity drops so photosynthesis slows down, less carbon dioxide used.
(c) No photosynthesis – respiration produces carbon dioxide

4. (a)



(b) Decrease in light intensity (or the amount of light) results in growth of larger leaves.
(c) Larger leaf surface allows photosynthesis to continue at low light intensity.

Essay Questions

1. (a) The process of photosynthesis is where green plants absorb light energy to make food. The light energy is absorbed with the aid of chlorophyll and is then transformed into chemical energy. This energy is then used in the synthesis of carbohydrates from water and carbon dioxide. Oxygen is thus liberated in the process. The energy is used for splitting water into hydrogen and oxygen to simple carbohydrates. The glucose manufactured is converted to starch for storage until it is needed. It is then translocated to other parts.
(b) (i) A bracket fungus is not able to carry out photosynthesis because of the absence of the chlorophyll pigment. Bracket fungus feeds on decayed matter. For example, when plants die, the food in their cells which were manufactured by photosynthesis is decayed by the extracellular enzymes secreted by the bracket fungus present.
(ii) A caterpillar is a primary consumer that feeds on plant matter. Food obtained from the plant is formed by photosynthesis. Hence the caterpillar will be deprived of food if photosynthesis does not take place.

2. Generally, a green leaf consists of a leaf blade (lamina), a petiole (stalk) and the leaf base. The leaf is attached firmly to the stem by the leaf base. Another function of the leaf base is to protect the axillary bud from any physical damage. The stalk holds the lamina away from the stem so that the maximum amount of light can be absorbed by the leaf to carry out photosynthesis. However, there are leaves which do not possess any petioles. In such cases, the loss is compensated by the presence of a longer lamina.
The lamina itself has a certain useful characteristics which aid in the process of photosynthesis. Firstly, lamina has a very flat, large surface as compared to its volume. This ensures that maximum sunlight reaches the leaf surface.
The system of veins that exist in the leaf carry water and mineral salts to the cells from the roots and

carries the manufactured food to other parts of the plant. It consists of a main vein and branching veins forming a network.

The internal structure of the lamina is as follows:

- Upper epidermis
  - made up of a single layer of closely-packed cells with a thick cuticle.
  - cuticle protects the leaf and prevents excessive evaporation of water.
  - transparent to allow sunlight to pass through.
- Mesophyll – palisade or spongy
  - lies between the upper and lower epidermis.
  - palisade mesophyll
    - consists of one or two layers of closely-packed, long and cylindrical cells containing chloroplasts.
  - spongy mesophyll
    - cells are irregular in shape – causing large intercellular air spaces among them to allow for rapid diffusion of gases.
    - contain fewer chloroplasts.
    - cells are covered with a thin film of moisture so that carbon dioxide can dissolve in it.
    - xylem and phloem are present here.
- Lower epidermis
  - consists of a single layer of closely-packed cells covered by an outer layer of cuticle which reduces water loss.
  - it is made up of stomata to control the amount of water vapour leaving the leaf.
  - contains chloroplasts to carry out photosynthesis.

Unit 7 TRANSPORT IN HUMANS

Notes

1. In large animals, diffusion is too slow for the efficient exchange of materials needed for survival. Hence the transport system helps to transport materials from one part of the body to another. It consists of the blood system and the lymphatic system.

Composition of Blood

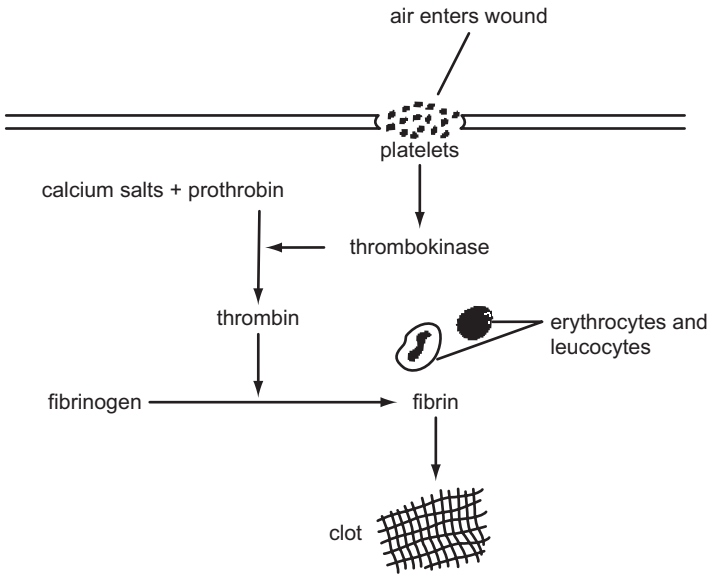
2. Blood consists of the following:

- Red blood cells
  - minute, circular, biconcave and do not have a nucleus.
  - their shape increases the surface area, allowing efficient diffusion of gases across the surface.
  - can change their shape as they squeeze through the narrow blood capillaries.
  - haemoglobin in the cytoplasm readily forms oxyhaemoglobin with oxygen and readily releases oxygen in regions of low oxygen concentration.
  - produced in the bone marrow.
  - have a life-span of 120 days.
  - are destroyed in the spleen, lymph nodes, bone marrow and liver.
- White blood cells
  - larger than red blood cells but fewer in number.
  - all have nuclei.
  - all can move by a crawling movement, enabling them to squeeze out of the capillaries into the tissues.
  - short life-span of between two to three days.
- Platelets
  - irregularly shaped and are about one-quarter the size of red blood cells.
  - cell fragments enclosed by a membrane.
  - are formed from special bone marrow cells.
  - no nucleus.
  - life-span of between five to nine days.
- Plasma
  - yellowish-liquid containing.
    - 90% water.
    - soluble proteins: fibrinogen, prothrombin, antibodies.
    - dissolved mineral salts as ions: potassium, sodium and calcium.
    - variables: products of digestion, vitamins, excretory products, hormones.

Functions of Blood

3. Blood plays an important role in the functioning of processes in the body.

- For transport
  - oxygen – from the lungs to the tissues as oxy-haemoglobin.
  - carbon dioxide – from the tissues to the lungs and is mainly carried in the plasma as the hydrogen carbonate ion.
  - digested food and minerals salts – from the digestive tract (small intestine) to the liver where amino acids and sugar levels are balanced and then these are released into general circulation.
  - excretory waste products such as urea – from the tissues to the lungs, skin and kidneys, and toxic wastes is carried in the plasma.
  - hormones – from the endocrine glands in the blood plasma to the parts of the body which require them.
  - heat produced by the muscles and various organs is carried around the body.
- For protection
  - Clotting



    - brought about by a series of reactions.
    - platelets and damaged blood vessels at the wound release an enzyme (thrombokinase) which results in the production of thrombin.
    - thrombin acts on the plasma protein – fibrinogen.
    - fibrinogen is converted into fibrin which forms a network of fibres like sieve.
    - these become clogged with red blood cells.
    - stops further blood loss and stop harmful germs entering the body.
- For immunity
  - removal of pathogens and dead cells by phagocytosis
    - bacteria and various foreign bodies are ingested by the white blood cells.
  - production of antibodies.
    - by white blood cells when they sense the presence of foreign bodies

- antibodies could neutralise the poisonous effect of toxins in the blood, kill the bacteria or cause the bacteria to clump together, making it easier for them to be ingested.
- antibodies persisting in the body after a person has recovered from an infection make that person immune to the pathogen.

✧ production of antibodies and tissue rejection
- to reduce tissue rejection during organ transplant.

❖ match the tissue of the donor with that of the recipient as closely as possible.
❖ use drugs to inhibit the activity of the immune system of the recipient.
❖ expose bone marrow and lymph tissues of the recipient to x-ray radiation, to inhibit production of white blood cells, hence slowing down the rejection process.

4. There are four blood groups – A, B, AB and O. Each blood group is named after the antigen present.
   ❖ antigens are represented by capital letters A and B
   ❖ antibodies may be represented by small letters a and b
   ❖ the table below shows the antigens and antibodies present in the different blood groups

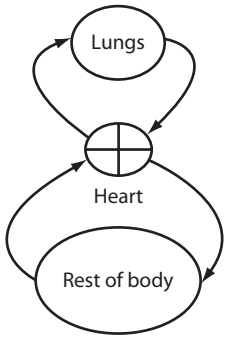
Blood group	Antigen on red blood cell	Antibody in serum
A	antigen A	antibody b
B	antigen B	antibody a
AB	antigen A and B	no antibodies
O	no antigen	antibodies a and b

The Circulatory System

5. The circulatory system consists of a network of blood vessels connected to the heart.

6. As blood remains in the blood vessels, it is a closed circulatory system.

7. The heart is a double pump that gives rise to double circulation – the blood passes through the heart twice in one complete circulation.



(a) Double circulation

- pulmonary circulation (low pressure circulation to the lungs) – the right side of the heart received deoxygenated blood from the body and pumps it to the lungs
- systemic circulation (high pressure circulation to the body tissues) – the left side of the heart receives oxygenated blood from the lungs and pumps it to other parts of the body

8. Valves in the heart and veins ensure that blood flow is in one direction.

Blood Vessels in the Circulatory System

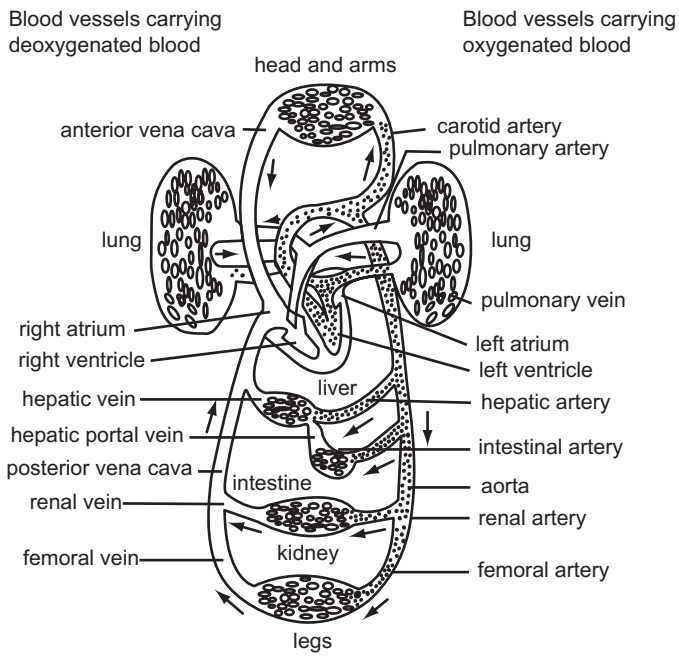
9. Blood flows from the heart into the arteries, which branch into smaller arterioles.

10. The arterioles branch into networks of blood capillaries found between the cells of tissues.

11. Exchange of materials between the blood and tissue fluids occur in the capillaries.
    - rate of blood flow in capillaries is slow, allowing more time for gaseous exchange
    - large surface area presented by the capillaries ensures that no cells are very far from the blood
    - capillary walls are one-cell thick to allow easy movement of substances across it

12. From blood capillaries, blood flows back into venules and then into veins, which carry the blood back to the heart.

13. Blood circulation is summarised below.



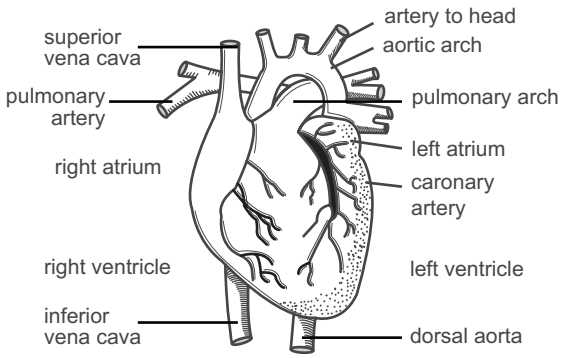
General plan of the human blood circulatory system

14. Valves in the circulatory system ensure a one-way flow of blood.
    - semi-lunar valves – present at the entrance to the pulmonary artery and the aortic arch prevent the backflow of blood when the ventricles relax
    - tricuspid valve in the right side of the heart – ensures a one-way blood flow from the right atrium into the right ventricle
    - bicuspid valve in the left side of the heart – ensures a one-way flow of blood from the left atrium into the left ventricle

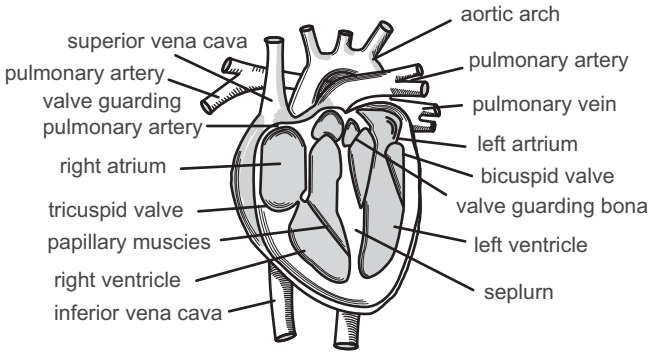
15. The table below summarises the comparison between the three types of blood vessels — arteries, veins and capillaries.

Feature	Artery	Capillary	Vein
Direction of blood flow	From heart to the capillaries	From arterioles to venules	From capillaries to the heart
Pressure	High	Low	Low
Pulse to be found	Present and can be felt when an artery is close to the surface	None	Absent
Valves	Absent	None	Present
Position in the body	Usually deep inside the body	Everywhere	Close to the surface
Thickness of the wall	Thick wall, small lumen	One-cell thick	Thin wall, large lumen
Oxygen carriage	Carry oxygenated blood except for the pulmonary artery	Average oxygen content	Carry deoxygenated blood except the pulmonary vein
If cut	Blood spurts out	Blood trickles out	Blood trickles out

Structure of the heart



(a) External view



(b) Internal view

16. The heart is a muscular organ which contracts to pump blood around the body. It consists of four chambers – two upper chambers (atria) and two lower chambers (ventricles). Both ventricles have thicker walls than that of the atrium.

17. The following happens when the heart pumps blood.

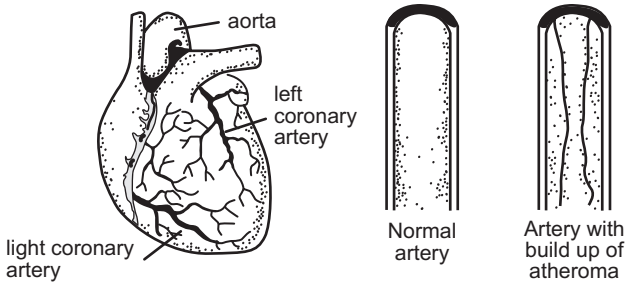
    - right atrium – receives deoxygenated blood from the body, then contracts and pushes it into the right ventricle
    - at the same time, the left atrium receives the oxygenated blood from the lungs and pushes it into the left ventricle
    - rings of muscles around the vena cava and pulmonary veins at the point where they enter the heart – contract, and this prevents blood flowing back into the veins

18. When the ventricles contract, blood from the right ventricle is pumped out to the lungs through which blood from the left ventricle is pumped to all parts of the body.

Coronary Heart Disease

19. Arteriosclerosis is a condition in which arterial walls become hard — less blood passed through the hardened arteries as the walls thicken and the lumen narrows.

20. Antherosclerosis — a form of arteriosclerosis that is caused by the deposition of fatty masses especially cholesterol on the walls of the arteries. This restricts the flow of blood as well as increases the risk of blood clot being trapped in it.



21. Foods high in saturated fats may cause the build up of more cholesterol – increasing the chance of developing antherosclerosis.

22. Coronary heart diseases occur when the coronary arteries become clogged.

23. A heart attack can occur if the heart muscle does not receive enough blood and that part of the heart muscle may die.

24. Smokers have a high risk of dying from heart disease as nicotine causes the heart to beat faster and increases blood pressure while carbon monoxide decreases oxygen supply to the blood.

25. Coronary heart disease can be prevented by
    - regular exercise;
    - healthy eating habits;
    - reduce or avoid stress; and
    - stop smoking.

Multiple Choice Questions

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

1. Which of the following carries carbon dioxide in the blood?

A Red blood cells
B Platelets
C White blood cells
D Plasma [ ]

2. The _____ carries oxygenated blood directly to the liver.

A aorta
B hepatic vein
C hepatic artery
D inferior vena cava [ ]

3. The _____ contains blood with the lowest concentration of oxygen.

A pulmonary artery
B hepatic artery
C renal artery
D aorta [ ]

4. Which of the following substances can be found both in the blood and urine of a healthy person?

A Glucose
B Red blood cells
C Dead white blood cells
D Urea [ ]

5. A red blood cell passes through the heart _____ on a journey from the renal artery to the aorta.

A once
B twice
C four times
D many times [ ]

6. Which of the following is absent in the blood plasma?

A Amino acids
B Glucose
C Cellulose
D Urea [ ]

7. Which of the following statements about the hepatic vein is false?

A It supplies the rest of the body with nutrients from digestion.
B It carries excess amino acids and glucose to storage sites.
C It contains blood at a high temperature.
D It carries blood away from the liver. [ ]

8. Which of the following brings about blood clotting of a wound?

A Red blood cells and components of the plasma
B Platelets and components of the plasma
C Red blood cells and the platelets
D Platelets only [ ]

9. Study the information below.

- Blood flow is fast and at a high pressure.
- The wall is very thin.
- Does not contain valves.

Which of the following vessels is described above?

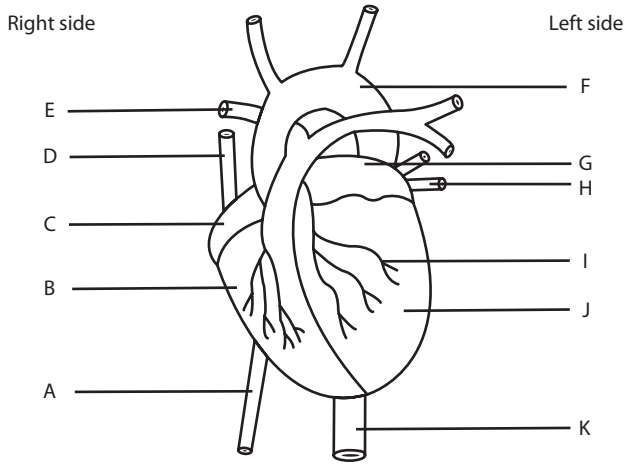
A Artery
B Vein
C Capillary
D Capillary and vein [ ]

10. The _____ transports blood from the ileum to the liver.

A hepatic vein
B hepatic portal vein
C hepatic artery
D inferior vena cava [ ]

Structured Questions

Write your answers in the spaces provided.



1. The diagram, labelled A to K shows a vertical view of a mammalian heart and blood vessels.

(a) State where the blood in the parts labelled D and E would go to next.

_____

_____

(b) Which of the labelled parts contracts to send blood to the brain?

_____

_____

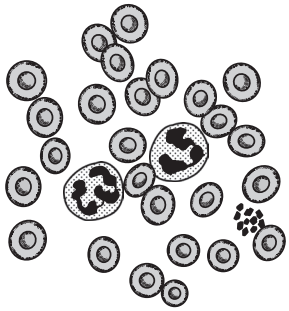
(c) (i) What effect does heavy smoking has on the part labelled J?

_____

(ii) How may the effect in (i) affect the general being of the heart?

_____

2. The diagram below shows the blood of a mammal.



(a) State three ways in which the white blood cells differ from the red blood cells.

_____

_____

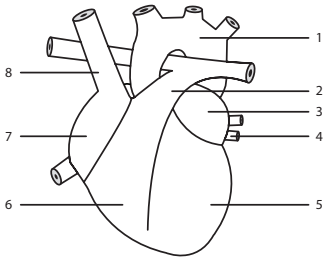
(b) Draw a different view of a red blood cell from one given above.

(c) When a drop of blood is added to distilled water, the red blood cell eventually swells and bursts. Explain.

_____

_____

3. (a) Name the parts of the heart below



(b) In which blood vessel is blood at the greatest pressure?

_____

(c) Name two blood vessels shown in the diagram which carry oxygenated blood.

_____

(d) Name the part of the heart which is the most muscular.

_____

(e) Name the part where red blood cells are produced.

_____

Essay Questions

Write your answers in the spaces provided.

1. (a) What is meant by *double circulation*?

(b) State two features of the heart that enables it to perform its functions.

2. (a) Describe the part played by the blood vessels in maintaining the circulation of the blood.

(b) Outline the functions of the circulatory system.

Multiple Choice Questions

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

Structured Questions

1. (a) D – The blood goes to the right atrium.
E – The blood goes to the right lung.

(b) F would contract forcing the blood out of the heart to the brain.

(c) (i) Smoking may cause damage or blockage may occur.

(ii) It would reduce the amount of oxygen reaching the muscles of the heart and so cause a heart attack.

2. (a) White blood cells are larger; are irregularly shaped cells; contain a nucleus which is irregular in shape.

(b)

(c) Water passes into the cells due to osmosis. Cell membrane is under increasing pressure and eventually ruptures.

3. (a) 1 – aorta 2 – pulmonary artery
3 – left atrium 4 – pulmonary vein
5 – left ventricle 6 – right ventricle
7 – right atrium 8 – superior vena cava

(b) Pulmonary artery

(c) Pulmonary vein, aorta

(d) Septum

(e) Bone marrow

Essay Questions

1. (a) In mammals, blood is circulated through the heart twice. Firstly, deoxygenated blood is brought to the heart from all parts of the body. This blood is then pumped or circulated to the lungs. The now oxygenated blood is then sent back to the heart via a different route and into a different chamber. This blood is circulated to all parts of the body. The system where blood which is brought to and from the lungs is called pulmonary circulation while the system which brings about to and from the body tissues is called systemic circulation.

(b) The double circulation of the mammal enables the blood that is pumped by the heart to be brought to all parts of the body (the tissues) in a short space of time (more effectively). The muscular walls of the heart provide the pressure for the speedy transportation of the blood.

2. (a) There is a massive structure of blood vessels throughout the body. Blood at high pressure from the heart passes through the arteries which has characteristics to withstand this pressure. This blood is then transported through capillaries so that useful constituents of blood can enter the cells of tissues while excretory products can leave the cells into the blood. The blood is then transported to the veins back to the heart. The veins have valves in them to prevent backflow of blood. These vessels do not collapse as blood can flow continuously. Thus blood vessels help to transport blood throughout the body.

(b) The circulatory system is made up of the heart and blood vessels. The arteries conduct oxygenated blood from the heart to all parts of the body. The blood contains dissolved food substances and oxygen which is required by the body for respiration. They also contain hormones which are essential for certain bodily processes. The blood of the arteries are passed through one-cell walled capillaries so that these substances can diffuse out. At the same time the unwanted substances from the cells are conducted to excretory organs. Also, excess food substances are sent from the intestines to the liver to be stored or destroyed. The veins to which the capillaries open into, conduct the blood back to the heart to be sent to the lungs and oxygenated. From the lungs, the blood is conducted back to the heart to be pumped throughout the body.

Unit 8 TRANSPORT IN PLANTS

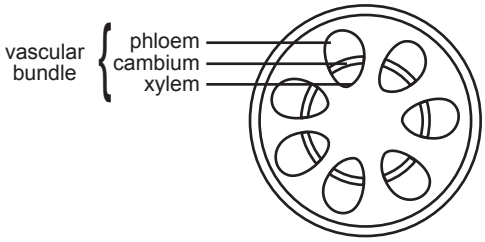
Notes

Transport Structures

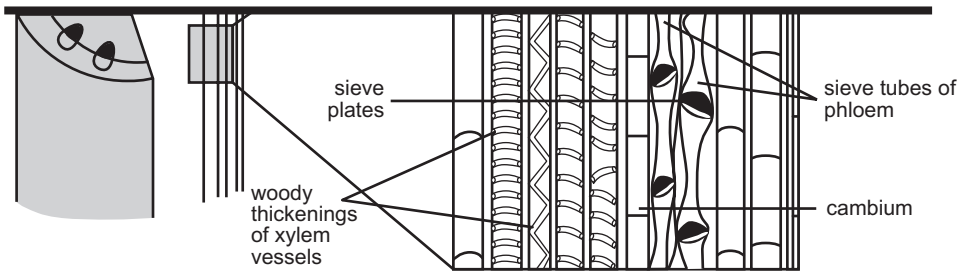
1. Flowering plants have a system of vessels that runs up and down the plants carrying materials. These vessels are called vascular tissues which are made up of

   - Xylem – long hollow tube stretching from the root to the leaf and made up of many dead cells
     - conducts water and dissolved mineral salts from the roots to the stems and leaves
     - provide mechanical support for the plant
     - inner walls of the xylem vessels are strengthened by deposits of a substance called lignin – deposited in the form of rings or spirals
   - Phloem – consists mainly of sieve tubes and companion cells
     - conducts manufactured food (sucrose and amino acids) from the green parts of the plant to other parts of the plant
     - sieve tubes have degenerated protoplasm that is connected between sieve tube cells which are kept alive by companion cells

2. Organisation of the vascular tissues in the stems are shown below:

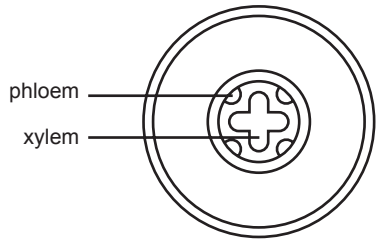


Transverse section of a dicotyledonous stem



Longitudinal section through a dicotyledon stem

3. Organisation of the vascular tissues in the roots are shown below:



Transverse section of a dicotyledonous root

Water and Ion Uptake

4. The absorption of water occurs mainly through root hairs.

5. Root hairs only exist in the root hair zone immediately behind the root cap.

6. As the root grows, new root hairs are produced. Old root hairs degenerate and die. Absorption of water and mineral salts occur in new areas of the root.

7. Each root hair is a projection of an epidermal cell, which will live for only a few days.

8. Root hairs are adapted for the absorption of water and minerals because
   - the total surface area for absorption is large and there are a large number of root hairs each of which is long, fine and narrow;
   - the cell sap is more concentrated than the soil water; and
   - since root hairs are living, they can respire and provide the energy for active transport.

9. Ions uptake occurs mainly by active transport.

Transpiration and Translocation

10. Transpiration is the loss of water vapour from the internal tissues of living plants through the lenticels and stomata.

11. Water evaporates from cells surrounding the intercellular spaces.

12. Water vapour collects in the intercellular spaces before they escape into the atmosphere, through the stomata and lenticels.

13. Factors which affect transpiration:

- Light intensity – transpiration is greater in light than in darkness
- Atmospheric pressure – as temperature increases, the rate of transpiration also increases
- Humidity of the atmosphere – transpiration is low when the level of humidity is high

14. Translocation is the movement of dissolved substances through the vascular tissues of plants.

15. Dissolved substances are translocated from the site of synthesis in the leaves or the site of absorption in the roots to other parts of the plant which need them.

16. Movement of water through the stem

- water enters the root from the soil via osmosis
- as water pressure in the cells of the cortex increases, water is forced to enter the xylem tissues of the root
- continual movement of water into the root causes the water to rise up the xylem tissues into the stem – root pressure
- water rise up the xylem vessels due to capillary action
- transpiration pull is the main force that draws water and minerals up the plant
- water from the xylem vessels will leave the vessels for the mesophyll cells

Multiple Choice Questions

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

1. Which of the following processes move glucose from the mesophyll cells into the phloem tissues of a green leaf?

A Diffusion
B Osmosis
C Absorption
D Active transport [ ]

2. Which of the following best describes transpiration?

A It is the exchange of gases between the leaves and the atmosphere.
B It is the passage of water through the stomata of the leaves.
C It is the loss of water vapour from the leaves to the stem.
D It is the passage of water from the roots to the leaves. [ ]

3. The _____ is important to cause the uptake of water by root hair cells.

A contractile fibres
B large surface area
C thick outer wall
D vacuole [ ]

4. The _____ in a green plant transports increased amounts of water on a warm, sunny and windy day.

A guard cell
B mesophyll
C phloem
D xylem [ ]

5. Which of the following best describes the functions of phloem and xylem in a green plant?

	Xylem	Phloem
A	support and transport of sugars	transport of water
B	support and transport of water	transport of sugars
C	transport of sugars	support and transport of water
D	transport of water	support and transport of sugars

[ ]

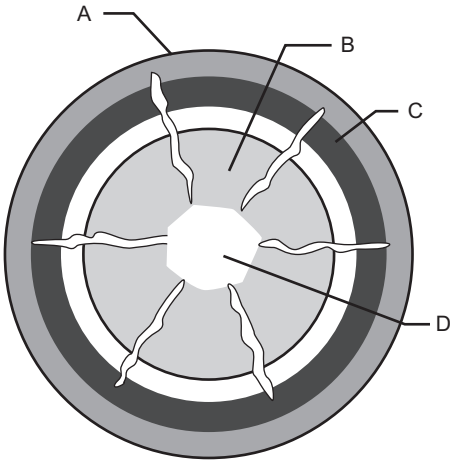
6. Transpiration increases when conditions become_____.

A more humid and more windy
B more humid and less windy
C drier and more windy
D drier and less windy [ ]

7. Which of the following substances is most easily transported in plant cells?

A Starch
B Glucose
C Cellulose
D Fat [ ]

8. The diagram shows a section through the stem of a green plant.



Which of the following labelled parts transports sugars to different parts of the plant? **[ ]**

9. The movement of sugars from leaf cells into phloem tissues is known as _____.

A diffusion
B osmosis
C absorption
D active transport **[ ]**

Structured Questions

Write your answers in the spaces provided.

1. What happens to substances that are carried through the xylem and phloem?

_____

_____

_____

_____

_____

2. (a) (i) Name the process by which water enters the vacuole of a root hair cell.

_____

(ii) State two conditions which must exist so that this process will occur.

_____

_____

(b) State two advantages of having a large number of root hairs in plants.

_____

_____

(c) (i) What are the two elements commonly supplied to plants by means of inorganic fertilisers?

_____

(ii) In what forms are each of the elements in (i) usually absorbed?

_____

(d) (i) Name the tissue in a plant through which water ascends from root to leaf.

_____

(ii) What is this upward flow of water called?

_____

(iii) Identify the process by which most of the water that rises up a plant in this way escapes to the atmosphere.

_____

Essay Questions

Write your answers in the spaces provided.

1. Explain the difference between the following pair of terms.

(a) translocation and transpiration

(b) phloem and xylem

(c) active transport and osmosis

2. (a) Why do plants need water?

(b) (i) Explain why a high concentration of salts in the soil tends to reduce transpiration.

(ii) Explain why seedlings have a better chance of survival when transplanted in the evening.

Answers

Multiple Choice Questions

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

Structured Questions

1. The xylem is a plant vessel which transports water and mineral salts from the roots to the leaves via the stems of the plant. The roots absorb water and mineral salts from the soil by way of osmosis and diffusion. The phloem consists mainly of sieve tubes and companion cells and it conducts manufactured food from the leaves to other parts of the plant e.g. storage organs. Glucose and amino acids are also carried by the phloem from the storage organs to the growing parts of the plant.

2. (a) (i) Osmosis
(ii) The concentration of soil water must be more diluted than the cell sap. A semi-permeable cell membrane must be present.

(b) It increases the surface area for osmosis and the uptake of water by the roots of the plant. They anchor the plant firmly in the soil by sticking to the soil particles between which they grow.

(c) (i) They are nitrogen and potassium.
(ii) They are absorbed as nitrate ions and potassium ions dissolved in water.

(d) (i) Xylem
(ii) Transpiration stream
(iii) Transpiration

Essay Questions

1. (a) Translocation is the movement of manufactured food substances, water and minerals salts through the phloem and xylem of the plant. Transpiration is the means by which water from the plant cells is lost to the atmosphere. It takes place mostly through the stomata of the leaves or through the lenticels in the stem.

(b) Phloem vessels still possess some cytoplasm. The vessels are separated by sieve plates and have companion cells next to them. Xylem vessels are no longer living. They join up to form hollow tubes connecting the roots to the leaves. Deposits of lignin support the walls of the xylem vessels thus enabling the vessels to provide mechanical support for the whole plant.

(c) Active transport involves the expenditure of energy as salts are moved against a concentration gradient. Osmosis is a special kind of diffusion involving the movement of water molecules across a semi-permeable membrane, from a region of higher water potential to a region of lower water potential.

2. (a) It is needed as a medium for translocation of manufactured food through the phloem in solution. It is needed for photosynthesis as a raw material which provides the hydrogen required to reduce carbon dioxide to simple carbohydrates. It is also needed to maintain cell turgidity.

(b) (i) The above means that the cell sap of the root hairs are more dilute than the soil water. This would cause water to move out of the cell of the root hair into the external surroundings of the plant by osmosis. Thus, less water would now reach the other parts of the plant especially the leaves. In time, less water would be available to be lost by transpiration and this the reduction in transpiration.

(ii) During the process of transplanting, root hairs of the seedling get damaged easily. When they are planted in the evening, they are less likely to lose water as transpiration does not take place in the dark. But if it (planting)n takes place during the day, the water lost through transpiration will not be replaced due to the damaged root hairs and thus will wither easily.

Unit 9 RESPIRATION

Notes

1. Respiration is the release of energy from food substances in living cells and it takes place in all living cells.

2. Energy liberated is made available for the energy-using processes of the organism.

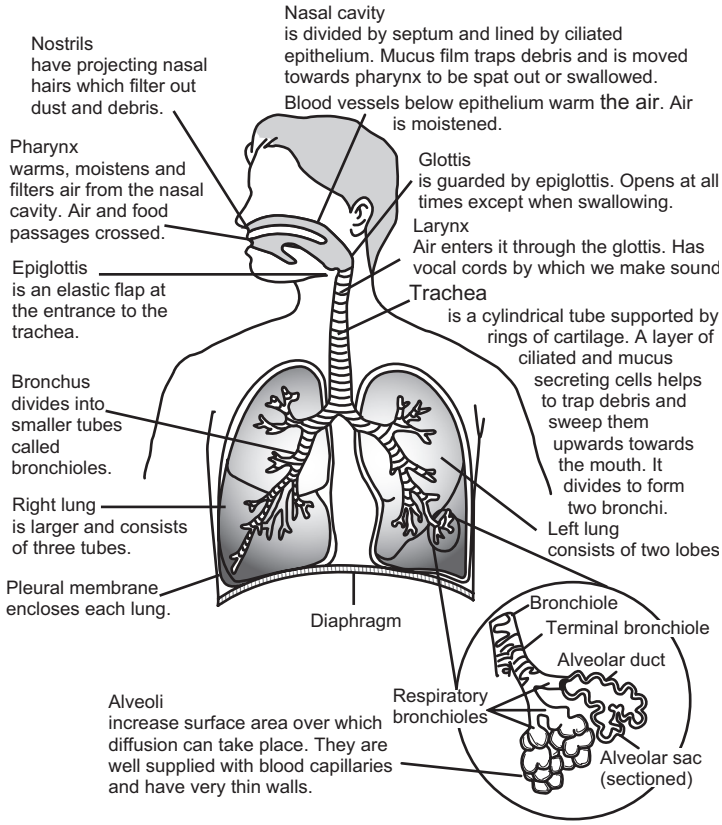
3. There are two types of respiration:
   - Aerobic respiration
     - the release of relatively large amount of energy by the breakdown of food substances in the **presence of oxygen**
     - glucose + oxygen → carbon dioxide + water + ATP (energy)
     - energy produced is stored in adenosine triphosphate (ATP)
     - main sites for aerobic respiration: mitochondria
   - Anaerobic respiration
     - the release of a relatively small amount of energy by the breakdown of food substances in the **absence of oxygen**
     - In plants
       glucose → ethanol + carbon dioxide + ATP
       In animals
       glucose → lactic acid + ATP
       In muscles
       - muscles usually respire aerobically
       - they require more energy than other parts of the body
       - during vigorous exercise, the demand for oxygen exceeds supply
       - occurs when oxygen is insufficient or absent

4. Plants and animals need energy for
   - Muscle contraction – large quantities of energy is needed for contraction of smooth muscles, cardiac muscles and skeletal muscles
   - Protein synthesis
   - Cell division – energy is required for cell division in new organelles, cytoplasm and DNA molecules
   - Active transport – for active transport to occur there has to be a concentration gradient and oxygen needs to be present
   - Growth – energy is used up at every stage of growth
   - Passage of nerve impulses
   - Maintenance of constant body temperature – heat energy is needed to maintain a base temperature at which the cells of the body can work well

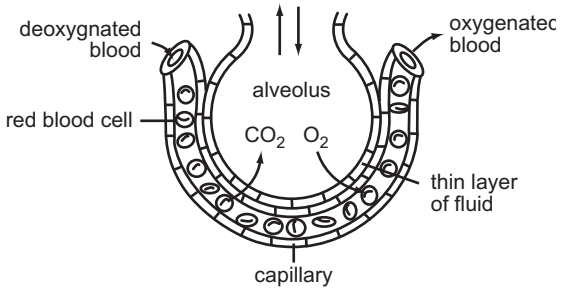
Gaseous Exchange in Man

5. Gaseous exchange is the exchange of gases between an organism and the environment.

6. Respiratory system in man is represented as follows:

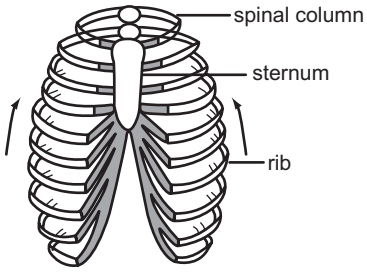
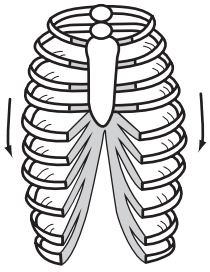
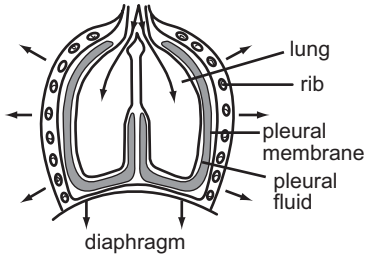
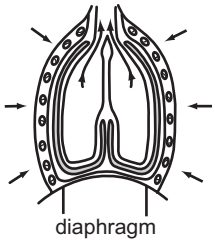


7. Gaseous exchange in the alveolus



- alveolus is well supplied with a network of blood vessels
- gaseous exchange takes place across a thin membrane
- air in the alveolus: more oxygen, less carbon dioxide than blood entering the capillaries
- oxygen diffuses from the alveoli into the blood and carbon dioxide diffuses from the blood into the alveoli

8. Breathing mechanism

Inhalation process	Exhalation process
 (a) Inhaling (a) Contraction of the outer intercostal muscles cause the ribs to move.	 (b) Exhaling (a) Relaxation of the outer intercostal muscles cause the ribs to move.
 (b) The diaphragm contracts and moves downwards to become flat.	 (b) The diaphragm relaxes and bends upwards.
The above actions causes the volume of the thoracic cavity to increase. Therefore, the air pressure in the thoracic cavity decreases.	The above actions causes the volume of the thoracic cavity to decrease. Therefore, the air pressure in the thoracic cavity increases.
The air pressure in the atmosphere is higher than in the thoracic cavity. Air moves from a place with a higher pressure to a place with a lower pressure. Therefore, air is pushed into the thoracic cavity.	The air pressure inside the thoracic cavity is higher than the atmospheric pressure. Therefore, air is pushed out of the thoracic cavity.

Multiple Choice Questions

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

1. Which of the following would usually take place during respiration?

A Muscle contraction
B Lung ventilation
C Energy release
D Rib movement [ ]

2. Which of the following are the products of anaerobic respiration in yeast?

A Carbon dioxide and lactic acid
B Carbon dioxide and ethanol
C Carbon dioxide and water
D Ethanol and lactic acid [ ]

3. Which of the following food substances would release the most energy if it is used up completely in respiration?

A Fat
B Starch
C Protein
D Sugar [ ]

4. _____ is/are the products of respiration in green plants.

A Oxygen
B Oxygen and water
C Carbon dioxide
D Carbon dioxide and water [ ]

5. Which of the following best describe the main function of the alveoli in the lungs?

A To provide a large surface area for gaseous exchange
B To provide an adequate supply of mucus
C To ensure that the lungs do not collapse
D To make the lungs elastic [ ]

6. When the diaphragm muscles are relaxed, the central region of the mammalian diaphragm is _____.

A curved ventrally towards the thorax, and dorsally towards the abdomen
B curved towards the abdomen
C curved towards the thorax
D approximately flat [ ]

7. Oxygen debt develops because _____.

A oxygen demands exceeds oxygen supply
B carbon dioxide levels in the blood rise
C breathing becomes very rapid
D the heartbeat increases [ ]

8. Which of the following processed do not require energy?

A Transmission of nerve impulses
B Contraction of muscles
C Synthesis of proteins
D Tissue respiration

[ ]

9. Which of the following gives the approximate oxygen content of expired air?

A 0%
B 4%
C 16%
D 20%

[ ]

10. The _____ can be measured to show that respiration had taken place in green leaves.

A conversion of starch into sugar
B release of carbon dioxide
C widening of the stomata
D loss of water vapour

[ ]

Structured Questions

Write your answers in the spaces provided.

1. Define the term *respiration*.

_____

_____

_____

_____

_____

_____

2. Explain why on a frosty morning, exhaled breath is visible.

_____

_____

_____

_____

Essay Questions

Write your answers in the spaces provided.

1. Describe how the alveolus enable the lung to carry out its functions efficiently.

2. (a) Define *aerobic* respiration.

(b) Explain the importance of respiration in the human body.

Multiple Choice Questions

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

Structured Questions

1. Respiration is the process whereby energy-rich food substances are oxidised by organisms which results in the release of energy for the vital activities of the organisms. Hence this process occurs inside every living cell of plants and animals. Respiration consists of both tissue respiration and external respiration. In addition to the release of energy during respiration, carbon dioxide and water are released as well as waste products.

2. Exhaled air contains more water vapour and is also warmer than atmospheric air. Hence when the warm water vapour comes into contact with the atmospheric air, it condenses making larger water droplets which are visible.

Essay Questions

1. An alveolus possesses a thin (one-celled) wall. This provides a suitable surface for easy diffusion. A dense network of capillaries surround each alveolus. These are branches of the pulmonary artery and they increase the surface area for exchange of carbon dioxide between the alveolus and the blood. The rate of gaseous exchange is increased by the large surface area provided by the unique structure of the alveolus. Thirdly, the mucus lining of the alveolus wall provides a medium for the oxygen to be dissolved in before diffusing in the blood. Red blood cells in the capillaries absorb the oxygen and transport it to all the tissues in the body. Carbon dioxide diffuses into the alveolus from the plasma down a concentration gradient.

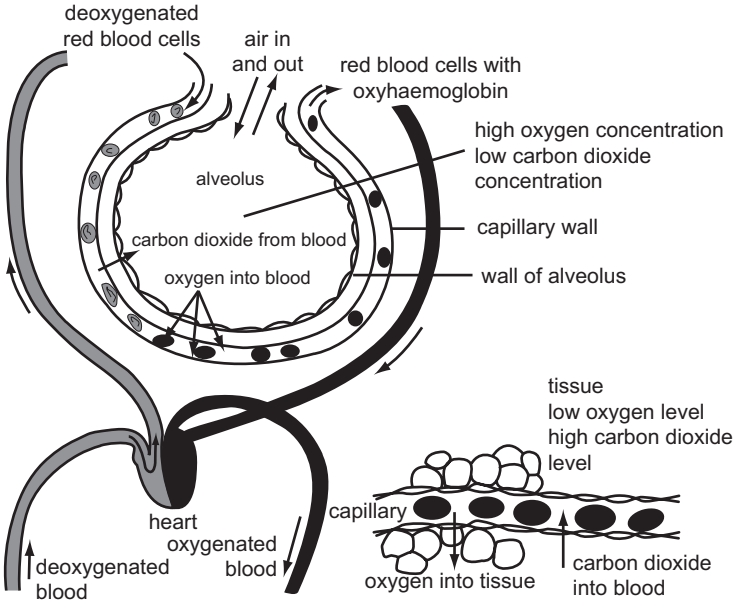
2. (a) Aerobic respiration is the oxidation of food substances to release energy. Here, full oxidation takes place in the presence of oxygen. Water and carbon dioxide are the by-products.

(b) Respiration releases energy which is essential for the carrying out of various body activities. For example, during exercise, the contraction of muscles requires energy. Energy is also needed in conveying nerve impulses through the body. The process of cell division for growth and reproduction requires energy. Responses of the body to stimulus need energy. The heart needs energy to pump blood and the brain cells need it in thinking. The process of breathing itself requires energy. Lots of energy are also needed in digestion and the processes of excretion.

Unit 10 EXCRETION

Notes

1. Excretion is the process by which metabolic waste products and toxic materials are removed from an organism's body.
2. Major excretory products in animals:
   - nitrogenous compounds from the breakdown of excess amino acids
   - carbon dioxide from cell respiration
   - bile pigments from the breakdown of haemoglobin of red blood cells
3. Main organs of excretion
   - lungs – remove carbon dioxide, some water and heat
   - kidneys – remove nitrogenous wastes from the blood such as urea and water
   - liver – deaminates and detoxifies nitrogenous wastes as well as breaks down haemoglobin into bile salts, excreted via the duodenum
   - skin – removes some urea and other salts in the sweat; gives off heat and water
4. Excretory products include
   - carbon dioxide and
   - urea
5. Removal of carbon dioxide from the lungs

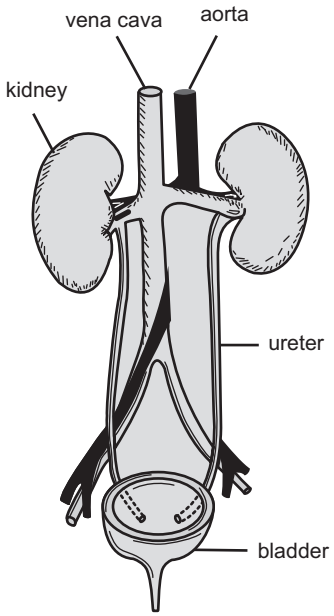


Gaseous exchange in the lungs and the tissues

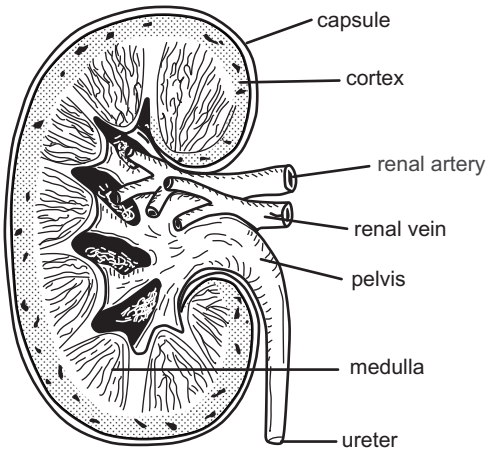
- carbon dioxide produced by cells and tissues is transported by the blood to the lungs
- gaseous exchange in the alveoli occurs by diffusion – concentration of carbon dioxide in the air is lower than the that in the blood being brought into the lungs

6. Cleansers of the blood – kidneys

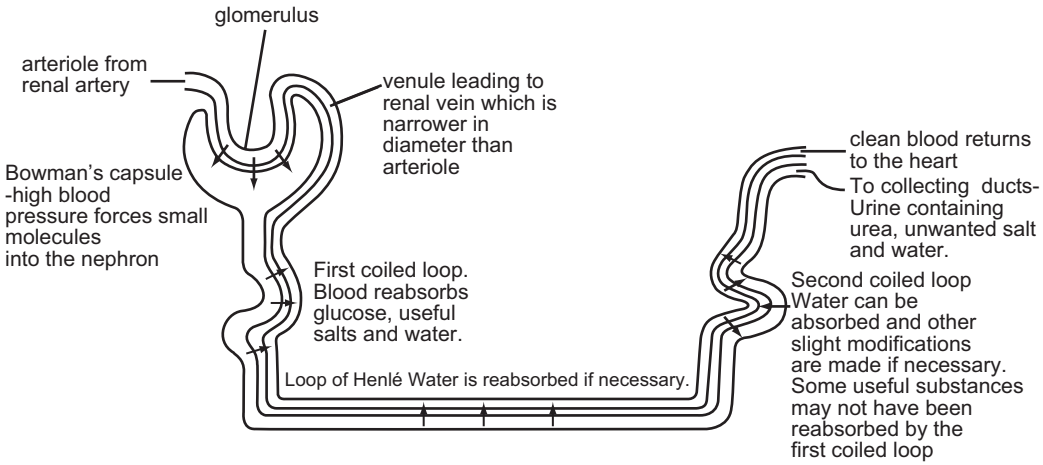
- urinary system is made up of kidneys, ureters, urinary bladder and urethra
- kidneys
  - remove nitrogenous wastes from the blood such as urea and water
  - help to regulate the water content and the chemical composition of body fluids
- blood entering the kidney is filtered – water and small solute molecules such as glucose, amino acids, urea and mineral salts are forced out of the kidney tubules but red blood cells, platelets and blood proteins are retained
- most of the water is reabsorbed by osmosis while the solutes which are required by the body are reabsorbed by the body via active transport
- urine enters the ureters
- urine is made up of water, mineral salts and waste substances such as urea
- urine slowly flows from the ureters to the urinary bladder
- walls of the urinary bladder expands as it fills with urine
- muscle contraction will act on the bladder when the bladder wall is stretched to a certain point
- urine from the urinary bladder flows into the urethra which leads to the outside of the body



Position of the kidneys



Structure of the kidney



Structure and function of a nephron

7. Compare the levels of substances in the blood before entering and after leaving the kidneys

Renal artery	Renal vein
oxygenated	deoxygenated
high levels of urea present	very little urea present
water levels inbalanced	water levels balanced
excess salts	balanced level of salts
may carry toxic substances such as alcohol	balanced levels of toxic substances

8. When both kidneys fail

- metabolic wastes can no longer be removed from the body
- the person must undergo regular haemodialysis
- what happens during haemodialysis
  - blood from an artery in the patient's arm flows into a long coil of tubing
  - the tubing provides a large surface area for the exchange of materials and is partially permeable – allowing small molecules such as urea and other wastes products to diffuse into the surrounding dialysis fluid
  - large molecules such as proteins and red blood cells remain in the blood
  - anticoagulant is added to prevent blood clotting in the tubes
  - fluid surrounding the tubing consists of water, at the correct temperature, the correct concentrations of chemicals such as glucose, various salts, bicarbonates and amino acids
  - eventually the blood with most of its nitrogenous wastes removed is returned to a vein in the patient's arm

Multiple Choice Questions

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

1. Which of the following is excreted from the body?

I Faeces
II Soluble minerals
III Bile salts
IV Metabolic wastes

A I and II only
B II and III only
C III and IV only
D I, III and IV only [ ]

2. Which of the following is an example of excretion?

A Oxygen, produced by photosynthesis, passing out of the leaf.
B Glucose present in urine passing out through the urethra.
C Water vapour passing out of the stoma of the leaf.
D Water present in the faeces passing out of the gut. [ ]

3. Which of the following is one of the major functions of the kidneys?

A To regulate elimination of material from the digestive tract
B To excrete the substances used in the digestive processes
C To regulate secretion of all substances from the liver
D To control the concentration of the body fluids [ ]

4. Which of the following processes involves the separation of waste products and mineral salts from blood through a membrane in a kidney machine?

A Osmosis
B Dialysis
C Ultra-filtration
D Active transport

[ ]

5. From which of the following organs is most carbon dioxide excreted?

A Lungs
B Kidney
C Liver
D Skin [ ]

6. From which of the following is nitrogen excreted from the body as urea?

A Mineral salts
B Vitamins
C Amino acids
D Carbohydrates [ ]

7. Which of the following is an organ for the excretion of a carbon compound produced by respiration in a mammal?

A Kidney
B Liver
C Rectum
D Lung [ ]

8. Which of the following substances are dissolved in the liquid which passes along the ureter to the bladder of a healthy person?

	Glucose	Proteins	Salts	Urea
A				√
B			√	√
C	√		√	√
D	√	√		

[ ]

9. Which of the following blood vessels carries blood with the lowest concentration of urea?

A Renal vein
B Renal artery
C Hepatic portal vein
D Vena cava

[ ]

10. Which of the following substances, when present in the urine, shows that a person is diabetic?

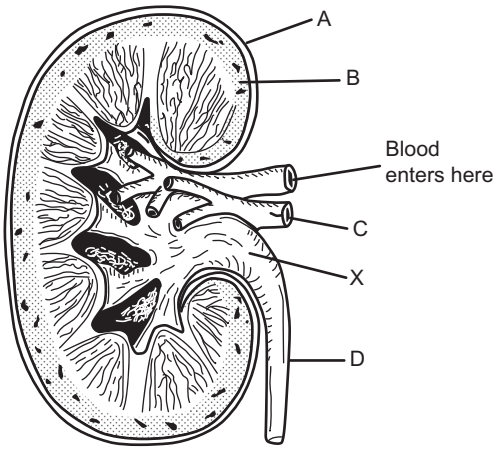
A Glucose
B Urea
C Mineral salts
D Sodium chloride

[ ]

Structured Questions

Write your answers in the spaces provided.

1.



(a) Identify the parts labelled A to D.

_____

_____

(b) State two different functions of this organ.

_____

(c) State what you would expect the part labelled X to contain in the complete organ.

_____

(d) State three differences in the composition of the blood entering and leaving this organ.

_____

_____

_____

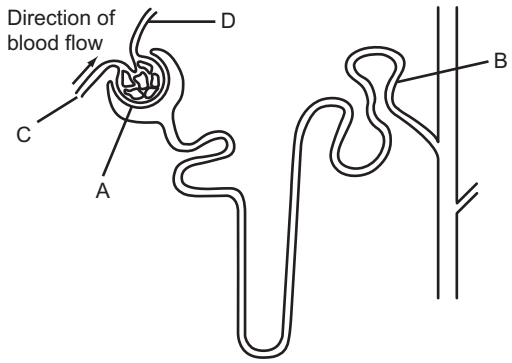
(e) Identify the structure to which the part labelled D leads to.

_____

(f) Name two main substances which can be found in the liquid passing through the part labelled D.

_____

2. The diagram below shows part of the kidney.



(a) Name structures A and B.

_____

(b) What substance is found in a higher proportion in

(i) C than in B; and

_____

(ii) B than in D.

_____

(c) What is the importance of the difference in diameter between C and D in the functioning of the kidneys?

_____

_____

3. Urea is one of the main waste products formed in the bodies of mammals.

(a) Identify the source of this urea.

_____

(b) In which organ is urea produced?

_____

(c) Name the organ that extracts urea from the blood.

_____

(d) Outline the route taken by the urea after extraction from the blood until it leaves the body.

_____

_____

_____

(e) Name two substances excreted by the lungs.

_____

4. (a) Define *excretion*.

_____

_____

(b) Describe the functions of the liver and kidneys. Give an example.

_____

_____

_____

_____

Essay Questions

Write your answers in the spaces provided.

1. Describe how lungs are involved in excretion.

2. Suggest three components of urine and for each, explain why they need to be excreted.

Multiple Choice Questions

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

Structured Questions

1. (a) A – kidney capsule
B – cortex
C – renal vein
D – ureter
(b) Excretion and osmo-regulation
(c) Urine would be present at the part labelled X
(d) (Any three from the following table)

Renal artery	Renal vein
oxygenated	deoxygenated
high levels of urea present	very little urea present
water levels inbalanced	water levels balanced
excess salts	balanced level of salts
may carry toxic substances such as alcohol	balanced levels of toxic substances

(e) The part labelled D leads to the bladder
(f) Water and urea

2. (a) A – glomerulus
B – second (distal) convoluted tubule
(b) (i) high level of oxygen
(ii) high level of urea
(c) Smaller diameter of the blood vessels D creates a high blood pressure in the glomerulus aiding ultra-filtration

3. (a) Food containing proteins
(b) Small intestine
(c) Kidney
(d) Urea is first transported to the kidneys by the blood. It is then absorbed by the kidneys and is brought to the bladder via the ureters and discharged to the outside of the body through the urethra
(e) Carbon dioxide and water

4. (a) Excretion is the process whereby metabolic waste products such as urea and carbon dioxide are removed from the body of the organism.
(b) The liver and kidneys are organs which help to excrete nitrogenous wastes such as urea. For example, excess amino acids obtained from digestion are brought to the liver where they are deaminated. Hence, urea is formed and it is transported to the kidneys by the blood.

Essay Questions

1. Waste products such as carbon dioxide and water are excreted by the lungs through exhaled air. Deoxygenated blood passing through the capillaries surrounding the alveoli carry the substances which diffuse into the alveolar air and excreted into the atmosphere through exhalation.

2. The three main components are urea, water and mineral salts such as sodium chloride.
Urea is formed due to the deamination of amino acids by the liver. Such nitrogenous products are poisonous and they need to be removed from the blood.
Water needs to be removed from the blood in order to maintain the osmotic pressure of the blood. For example, if the concentration of water in the blood is too high, the blood cells would absorb the water by osmosis and burst. Thus water is the main constituent of urine.
Finally, a high concentration of sodium chloride in the blood plasma will change the osmotic pressure of the blood and thus, upset the concentration of bodily fluids. Hence it has to be excreted as a component of urine by the kidneys.

Unit 11 HOMEOSTASIS

Notes

1. Homeostasis is defined as the maintenance of a constant internal environment – the immediate surroundings (spaces filled with intercellular fluid or tissue fluid) of the cells that form the body.

2. Tissue fluid provides the cells with the medium in which cells live. This medium represents the internal environment of the organisms.

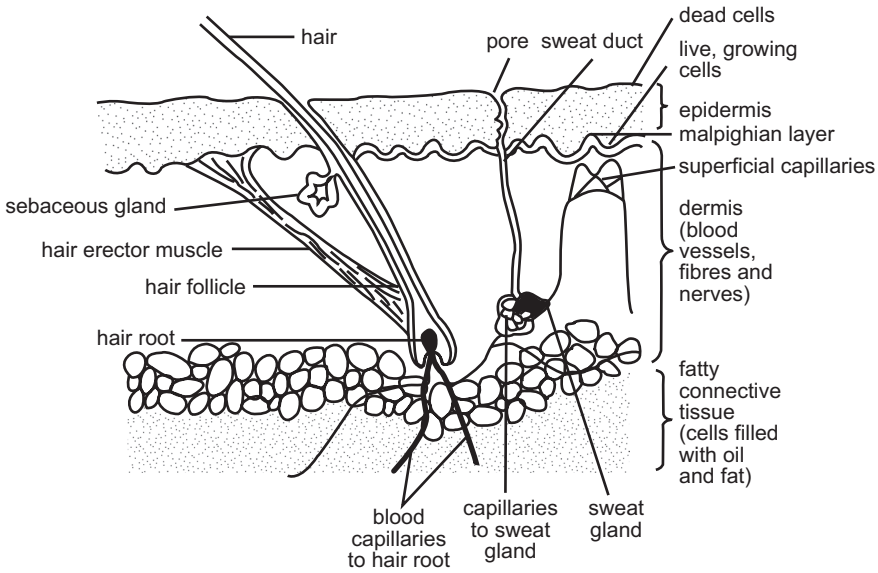
3. Controlling body temperature
   - a constant body temperature allows mammals to be active at any time
   - the skin plays a very important role in maintaining the body temperature

4. Controlling water levels
   - water level in the body is very carefully controlled by the kidneys
   - if the body keeps too much water, the tissue fluids become diluted – the cells in the body would then take up too much water from the tissue fluid by osmosis and the tissue becomes swollen
   - if the tissue fluid becomes too concentrated, water is withdrawn from the cells

5. Controlling glucose levels
   - this level is very delicately balanced in the bloodstream
   - the liver stores excess glucose as glycogen or converts glycogen back to glucose
   - the body is very sensitive to changes in the glucose level – if the glucose level drops too low, the person can become unconscious
   - the liver regulates the glucose levels in the blood – but the hormone, insulin, produced by the pancreas controls these reactions

6. The skin
   - forms the body's largest organ
   - made up of tough, flexible layer
   - functions:
     - protect the tissues from injury, sunlight, disease and loss of water
     - as a sense organ – detecting pressure, pain and changes in temperature
     - temperature regulation – maintaining a constant body temperature

7. Structure of the skin



Structure of the skin

- made up of two main layers
  - epidermis (thinner, outer layer)
  - dermis (thicker and more complex)
- epidermis
  - made up of several layers – malpighian layer, granular layer and cornified layer
  - malpighian layer
    - lowest layer which is alive and growing
    - contains the skin pigment melanine – gives the skin its colour; helps to protect the skin from damage caused by the sun's ultra-violet light
  - granular layer
    - no blood vessels here to bring nutrients or carry away wastes
    - this layer dies off giving rise to the cornified layer
  - cornified layer
    - topmost layer of the epidermis
    - consists of flat, dead cells which are continuously flaking off
- dermis
  - has hair follicles – form a protective layer which is highly sensitive to physical changes
  - contains sebaceous glands – produce an oily liquid, sebum that lubricates the hair and skin, and keeps the skin free of dust and bacteria
  - contains sweat glands – vital in regulation of temperature where water, salts and traces or urea is secreted from the coiled swear glands
  - has blood capillaries for bringing food and oxygen to the growing skin and regulating heat loss from the body
  - has nerve sensory cells – to detect touch, temperature, pain and pressure
  - beneath the dermis is a layer of subcutaneous fat that acts as an insulatory layer and also as a source of stored food

8. Heat production and heat loss

- heat is produced as a result of metabolic activities such as tissue respiration as well as eating hot food, exercising, radiation from the sun
- heat is lost
  - through your skin by radiation, convection and, to a limited extent, by conduction;
  - by evaporation of sweat from the surface of your skin;
  - in the faeces and urine; and
  - in air that is exhaled

Multiple Choice Questions

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

1. In which of the following ways is heat lost from the skin of man on a hot day?

A Relaxation of arterioles so that the skin capillaries carry more blood
B Movement of the skin capillaries nearer to the surface
C Evaporation of water from the sebaceous glands
D Opening of the pores of all the sweat glands **[ ]**

2. Which of the following is the function of the cornified layer of the epidermis of the human skin?

A Perception of sensation of temperature, pain and pressure
B Temperature regulation through sweating
C Prevention of uncontrolled water loss by evaporation
D Synthesis of vitamin D **[ ]**

3. How does the human body respond to a sudden fall in body temperature?

A Increase sweating
B Increase vasodilation
C Increase heat production
D Increase urine excretion **[ ]**

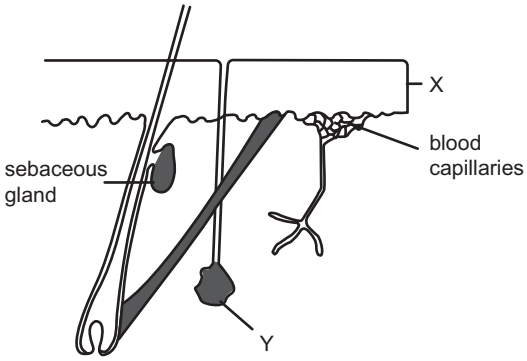
4. The most important function of sweat is to remove from the body excess _____.

A heat
B salts
C water
D urea **[ ]**

5. Which of the following must take place continuously in a mammal to maintain a body temperature above that of the surroundings?

A Digestion
B Respiration
C Shivering
D Sweating **[ ]**

6. The diagram shows a section of a human skin.



Which of the following is an important function of the layer labelled X?

A Insulation against the cold
B Manufacture of vitamin D
C Manufacture of pigment
D Reduction of water loss **[ ]**

7. With reference to the diagram in question 6, which of the following is the function of the structure labelled Y?

   A To detect temperature change
   B Excretion of carbon dioxide
   C To detect pressure change
   D Secretion of watery fluid **[ ]**

8. Which of the following features contributes most to conserving heat in nearly all mammals?

   A Hair covering the skin
   B High body temperature
   C Large body surface area
   D Numerous sweat glands **[ ]**

9. Which of the following contributes to an increase in body temperature?

   A The narrowing of the blood vessels in the skin.
   B An increase in blood flow to the skin.
   C The raising of the hairs on the skin.
   D A decrease in sweat production. **[ ]**

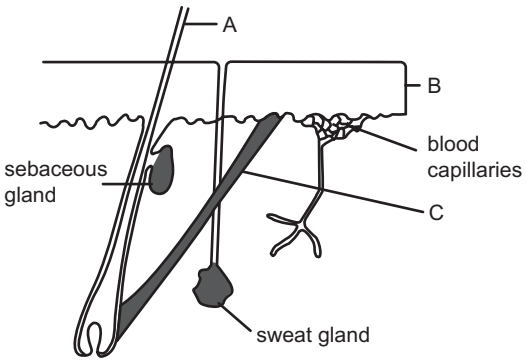
10. Which of the following helps to restore the body temperature when there is a sudden rise in the body temperature?

   A Contraction of the hair erector muscles
   B Reduced blood supply to the skin
   C Increased metabolic rate
   D Sweating **[ ]**

Structured Questions

Write your answers in the spaces provided.

1. The diagram shows the vertical section of a human skin.



(a) Label the parts A, B and C.

_____

_____

(b) After running for a marathon, your skin is wet and your face is hot.

(i) Why is your skin wet and how does this help to cool your body?

_____

_____

(ii) Why is your face hot and how does this help to cool your body?

_____

_____

(c) How do you think the sebaceous glands help to keep the hair and skin healthy?

_____

_____

2. The temperature of the wrist is higher than that of the forearm.

(a) Suggest two reasons for the temperature difference in the two body parts.

_____

_____

(b) The hand was then immersed in water at 40°C for a few minutes. As a result the temperature at the fingertips rose to 36°C. Suggest why this temperature did not reach 40°C.

_____

_____

(c) Which organ of the body produces the greatest amount of heat?

_____

_____

Essay Questions

Write your answers in the spaces provided.

1. (a) How does the skin of mammals help them to maintain a constant body temperature in cold conditions?

(b) Suggest some advantages of having a constant body temperature.

2. (a) How does your body gain heat?

(b) How does your body lose heat?

Multiple Choice Questions

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

Structured Questions

1. (a) A – hair
B – epidermis
C – erector muscle for the hair

(b) (i) As soon as your body temperature rises the sweating occurs. Evaporation of sweat cools the body down.

(ii) The blood vessels in the face dilate bringing more blood closer to the surface to aid cooling.

(c) Sebaceous glands produce an oily substance which lubricates the hair and skin. It also keeps it free from dust and bacteria.

2. (a) The wrist possesses more blood vessels that are closer to the surface of the skin. Thus more heat is brought to the wrist therefore making the temperature higher. Also the wrist is unable to contain heat as it possesses less hair than the forearm thus making the temperature higher.

(b) The heat absorbed by the fingertips was transported by the blood to other parts of the body to regulate the body temperature.

(c) The liver

Essay Questions

1. (a) The skin consists of many layers which possess blood capillaries which are quite close to the skin surface. On a cold day, the body tends to lose more heat to the surroundings thus the skin will regulate its various reaction to minimise heat loss. Firstly, the low external temperature will bring about a reflex constriction of blood vessels, causing less blood to flow to the skin and thereby less heat is lost through conduction, convection and radiation.

Secondly, sweat glands become inactive and so latent heat is not lost from the body. The hair or fur present on the skin will stand due to the contraction of hair muscles. In this way, a thicker layer of air is trapped in the hairs causing the heat to travel more slowly. Lastly, the body will shiver to generate heat.

(b) A constant warm body temperature ensures efficient body functions. Regardless of the external temperature, mammals can be active. Also, because biochemical reactions concerned with enzymes are efficient only over a very narrow range, a constant temperature is crucial for efficiency. Too high a temperature would destroy the enzymes and too low a temperature would render them inactive. Hence, mammals can remain active metabolically regardless of the surrounding temperature.

2. (a) Heat is produced as a result of metabolic activities such as tissue respiration. A lot of tissue respiration takes place in the muscles and in the liver. Hence, large amounts of heat are set free in these organs. Heat is distributed to all parts of the body by the blood.

The body also gains heat by eating hot food, exercising, due to radiation from the Sun or from the warm air on very hot days.

(b) The body is able to lose heat through the skin by radiation, convection and to a limited extent, by conduction. Heat is also lost by evaporation of sweat from the surface of the skin, in the faeces and urine, and in the air that is exhaled.

Unit 12 THE NERVOUS SYSTEM

Notes

1. A stimulus is a change in the environment that causes an organism to react. This reaction is known as a response.

2. Sensitivity or irritability is the ability of an organism to respond to a stimulus.

3. The human nervous system is made up of
   - the **central nervous system** (CNS)
     - brain
     - spinal cord
   - the **peripheral nervous system** (PNS) consisting of
     - cranial nerves
     - spinal nerves

4. The brain and spinal cord consist of two distinct regions:
   - grey matter – consists mainly of the cell bodies of the neurones, and forms the outer layers of the brain and the central parts of the spinal cord
   - white matter – consists mainly of nerve fibres, and forms the central parts of the brain and outer layers of the spinal cord

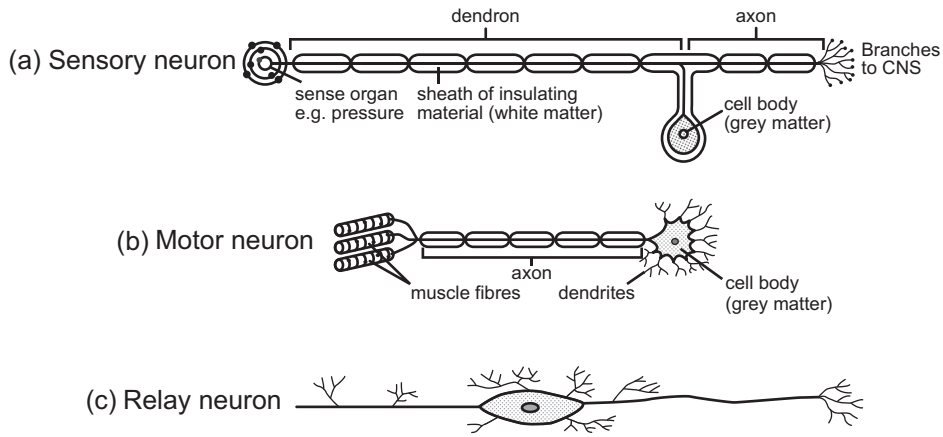
5. Structure of spinal cord
   - consists of grey and white matter – grey matter is inside surrounded by white matter on the outside
   - grey matter has the shape of the letter 'H'
   - a narrow central canal runs through the middle of the spinal cord
   - this canal contains fluid known as cerebrospinal fluid that brings nutrients to the spinal cord

6. Structure of spinal nerves
   - spinal nerve divides into two roots – dorsal root and the ventral root
     - dorsal root
       - joins the dorsal part of the spinal cord
       - contains sensory neurones
       - cell bodies of sensory neurones are clustered together in a small swelling known as the dorsal root ganglion
       - axons of the sensory neurones end in the grey matter of the spinal cord whereas their dendrons are located in the dorsal root and spinal nerves

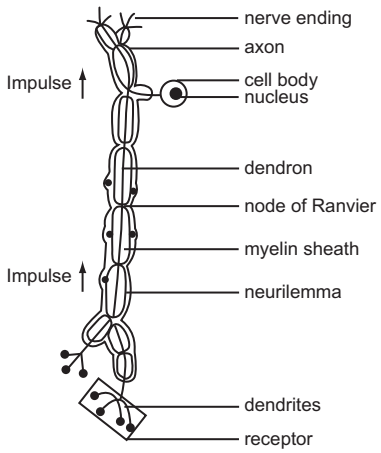
- ventral root
  - joins the ventral part of the spinal cord
  - contains motor neurones
  - cell bodies and dendrons of the motor neurones lie in the grey matter of the spinal cord to enter the ventral root and spinal nerve
  - spinal nerve contains nerve fibres from both the dorsal root (sensory neurones) and the ventral root (motor neurones)
  - as the spinal nerve leaves the spinal cord, it progressively subdivides into branches supplying nerve fibres to various parts of the body

7. Nervous tissues

- made up of nerve cell called neurones – basic units of the nervous systems
- three types of neurones
  - sensory neurone
  - motor neurone
  - relay neurone



8. Structure of the neurone



Sensory neurone

- has a cell body and cytoplasmic processes or nerve fibres extending from it
- axon – long fibre that transmits impulses **away** from the cell body
- dendron – fibre that transmits impulses towards the cell body
- dendrite – branch that is formed at the free ends of either axon or dendron
- myelin sheath – fatty layer that insulates the nerve fibres
- neurilemma – thin membrane that encloses the myelin sheath
- nodes of Ranvier – places where myelin sheath is incomplete

9. Functions of neurones

- transfer of nerve impulses from one neurone to another across the synapse – space between two neurones or a junction between a neurone and an effector such as muscles or glands
- when the sensory receptors are stimulated, a nerve impulse is produced and carried by the sensory neurone
- nerve impulse is transmitted to the relay neurone located in the spinal cord or the brain
- the cell body of the motor neurone receives the information from the relay neurone
- the axon of the motor neurone carries the nerve impulse to an effector organ – located outside the brain or spinal cord

10. Reflex action is an immediate response to a specific stimulus without conscious control. These are controlled by two reflex centres – the brain and spinal cord.

11. There are two types of reflexes

- spinal reflexes – controlled by the spinal cord e.g. knee jerk reflex
- cranial reflexes – controlled by the brain e.g. salivation

12. Some examples of reflex actions

Reflex	Stimulus	Receptor	Effector	Response
Blinking	bright light or dust	retina of the eye or touch receptor	eyelid muscle	eyelid closes
Knee jerking	sharp blow below the kneecap	stretch receptor on tendon	thigh muscle	lower leg jerks upwards
Yawning	high carbon dioxide levels	receptors in blood vessels	jaw, chest diaphragm muscles	mouth opens and deep breathing occurs
Coughing	dust in trachea	receptors in trachea	diaphragm and chest muscles	forces dust out
Secretion	smell, sight and thought of food	receptor cells in nose and eyes	salivary glands	increased production of saliva

Multiple Choice Questions

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

1. Which of the following relays information via the cranial and peripheral nervous systems?

A Motor neurone
B Sensory neurone
C Relay neurone
D Dendrite **[ ]**

2. Which of the following connects the sensory neurone?

A It connects sense organs to the brain and spinal cord.
B It connects the brain and spinal cord to the muscles.
C It connects one sense organ to another sense organ.
D It connects the sense organs to the muscles. **[ ]**

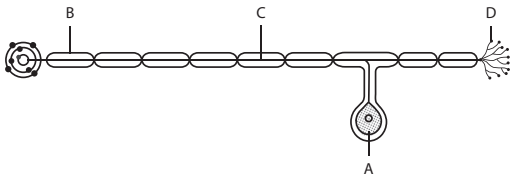
3. Which of the following is a conditioned reflex response?

A A cat is tickled at the bottom edge of its ribcage and it tries to scratch the spot with its hind leg.
B A sleeping dog hears a sudden bangs and immediately barks.
C A dog salivates when a bone is held between its jaws.
D A dog salivates when its master waves a bone. **[ ]**

4. In which of the following regions of the spinal cord and spinal nerves are synapses found?

A Central canal
B Dorsal root ganglion
C Grey matter
D White matter **[ ]**

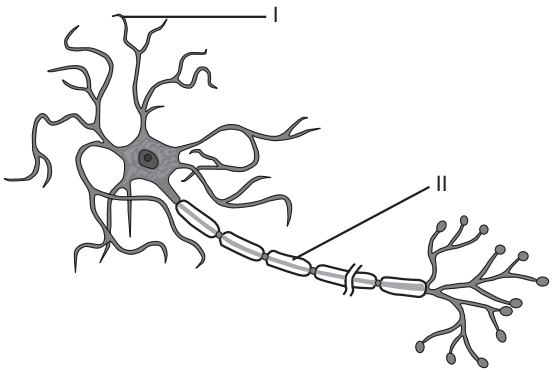
Use the diagram below to answer questions 5 and 6.



5. Which of the labelled parts, A, B, C or D, conveys impulses to the effector organs? **[ ]**

6. Which of the labelled parts, A, B, C or D, represents the cell body? **[ ]**

7. Which of the following pairs are labelled correctly?



	I	II
A	cell body	axon
B	axon	dendrite
C	dendrite	myelin sheath
D	synapse	dendrite

[ ]

8. Which of the following statements about conditioned reflex is true?

A A conditioned reflex has been modified by past experiences but unconditioned reflex is involuntary.
B A conditioned reflex does not involve the brain but the conditioned reflex does.
C A conditioned reflex does not involve nerves unlike unconditioned reflex.
D A conditioned reflex is faster than an unconditioned reflex. [ ]

9. Which of the following shows the pathway taken by a nerve to transmit a message when a person accidentally touchs fire?

A motor neurone ⟶ sensory neurone ⟶ relay neurone
B motor neurone ⟶ relay neurone ⟶ sensory neurone
C sensory neurone ⟶ motor neurone ⟶ relay neurone
D sensory neurone ⟶ relay neurone ⟶ motor neurone [ ]

10. Which of the following shows correctly the direction of an impulse through a reflex arc?

A muscles ⟶ sensory neurone ⟶ motor neurone ⟶ receptors
B receptor ⟶ sensory neurone ⟶ motor neurone ⟶ muscles
C glands ⟶ motor neurone ⟶ sensory neurone ⟶ receptors
D receptor ⟶ motor neurone ⟶ sensory neurone ⟶ glands [ ]

Structured Questions

Write your answers in the spaces provided.

1. (a) Draw the structure of a sensory neurone and a motor neurone.

(b) Describe a reflex action.

_____

_____

_____

_____

_____

2. Describe where each of the following is situated and describe its function.

(i) a sensory neurone; and

_____

_____

_____

(ii) a synapse.

_____

_____

_____

Essay Questions

Write your answers in the spaces provided.

1. (a) What is a reflex action?

(b) Describe the pathway the nerves takes to send a message to the brain when a person touches fire.

(c) What is the advantage of a reflex action?

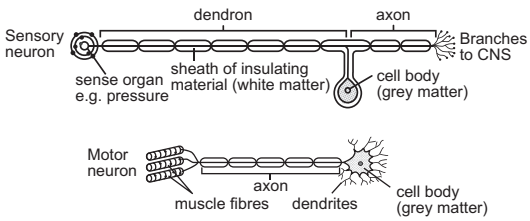
2. Describe how the nervous system process information.

Multiple Choice Questions

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

Structured Questions

1. (a)



(b) A reflex action consists of a receptor which receives the stimulus. This is then converted into a sensory impulse which is transmitted to the central nervous system by a sensory neurone. The motor neurone then transmits the motor impulse to the affector for the appropriate response.

2. (i) Sensory neurone is located in places between the brain and the spinal cord where it connects the sense organs to the central nervous system. The sensory neurone consists of an axon which enables impulses to be carried from the receptors to the brain and spinal cord.

(ii) A synapse bridges the gap between two neurones or a junction between two neurone and an effector such as a muscle or a gland. It enables impulses to be transmitted from the axon of one neurone to the dendron of another neurone across a tiny space.

Essay Questions

1. (a) Reflex action is a rapid automatic response to a stimulus and does not involve prior thought or planning.

(b) The heat from the fire stimulates the touch receptors at the tip of the fingers. The receptors produce nerve impulses which travel to the spinal cord, along the sensory neurone. In the spinal cord, the impulses are transmitted across synapses to the relay neurones and then to the motor neurones. Impulses leave the spinal cord and reach the muscles of the arm, hand and the fingers. The rapid withdrawal of the fingers from the fire is a reflex action in response to the stimulus.

(c) Reflex action allows the body to respond very quickly without having to think about it first.

2. Information is first gathered by receptors. Some receptors such as the eyes are located on the body while others are located inside the body. For example, the receptors in blood vessels in the neck that measure the concentration of carbon dioxide in the blood. Secondly, the information gathered by the receptors is converted into electrical signals called nerve impulses. The nerve impulses are then transmitted by the peripheral nerves to the central nervous system that is the brain and spinal cord. The brain then interprets the pattern of nerve impulses and 'decides' the action to take. Finally, the brain initiates nerve impulses that are transmitted to the effectors which will then carry out the intended actions.

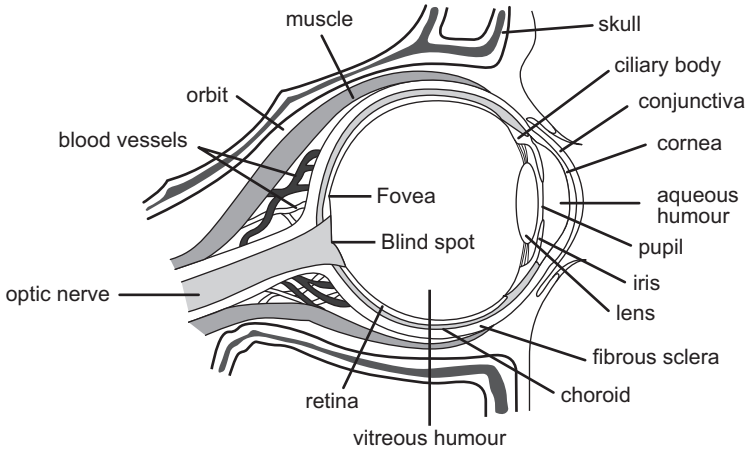
Unit 13 THE HUMAN EYE

Notes

1. Man responds to external stimuli such as light, temperature, sound and chemical changes. The eye is a sensory organ that is sensitive to light.

2. The eye is a receptor that is able to react to stimuli and responds accordingly.

3. Structure of the human eye.



- each eye consists of an eyeball held by muscles in a socket in the skull
- the eye is made up of the following:
  - sclera – the outermost coat of the eye
  - choroid – the middle coat
  - retina – innermost layer of the eye
  - lens – a flexible biconcave crystalline structure just behind the iris

4. Functions of parts of the eye

Part	Structure	Function
Sclera	White-coloured layer Strong and rigid	Maintains the shape of the eye Protects the eye
Cornea	At the front of the eye A transparent layer of sclera	Allows light to enter the eye Focuses light onto the retina Refracts light rays entering the eye

Part	Structure	Function
Choroid	A dark layer (middle part) Has many blood capillaries	Supplies oxygen and nutrients to the eye Absorbs light Prevents light reflection in the eye
Conjunctiva	Front layer of the eye Thin epithelium tissue	Protects the cornea
Iris	The coloured front of the eye Extension from the choroids layer (dark layer)	Controls the size of the pupil therefore the amount of light entering the eye Gives colour to the eye
Pupil	At the front of the eye A narrow opening that is surrounded by the iris	Controls and enables light to enter the eye
Lens	Elastic Transparent Convex lens	Refracts the entering light Focuses light in the retina
Ciliary muscles	Extend from the choroid	Change the thickness of the lens when seeing near or far objects Lens become thick when looking at near objects Lens become thin when looking at far objects
Suspensory ligaments	Made up of collagen fibres Strong structure	Support the lens Hold the lens in its position
Vitreous humour	Occupies the space behind the lens A jelly-like transparent substance	Supports the shape of the eye Disperses the light Focuses image onto the retina Protects the eye by absorbing the vibrations
Aqueous humour	A watery transparent liquid that occupies the space between the cornea and the lens	Maintain the shape and pressure of the eye Focuses light on the retina
Retina (a) Yellow spot (b) Blind spot	A layer of cells that are sensitive to light A point of the retina that is in straight line with the pupil Rich with photoreceptors (rods and cones that are sensitive to light) A spot where the optic nerves leave the retina Does not have cells that are sensitive to light	Detects the stimulus of light Changes it into impulses Part of the retina that is most sensitive to light Image of an object will be focused on this spot Part that is not sensitive to light Image of an object cannot be detected
Optic nerves	The connecting nerve from the retina to the brain	Send impulses from the retina to the brain where it interprets the impulses as sight

5. How does the eye focus

- as light rays travel through the cornea, aqueous humour, lens and vitreous humour, they are bent so that they can focus on the retina
- image formed on the retina
  - inverted, smaller than the actual size of the object
  - various photoreceptor cells are stimulated
  - nerve impulses produced are relayed to the visual area of the brain
  - messages are interpreted by the brain and the person becomes aware of the object
- when the eye is viewing a distant object
  - the ciliary muscles relax so that the suspensory ligaments become taut and pull on the elastic lens
  - the lens become thin and stretched
- when the eye is viewing a near object
  - the eye makes adjustments to maintain focus
  - the ciliary muscles contract, reducing the tension in the suspensory ligament and causing the lens to become more convex
- the eye is able to make adjustments
  - to the focal length of the lens so that objects at different distances can be seen clearly – known as accomodation

6. Pupil reflex

- the size of the pupil controls the amount of light that enters the eye
- the muscles of the iris control the size of the pupil
- this is a reflex action known as pupil reflex

Parts of the eye	Bright light	Dim light
Pupil size	Decreasing	Increasing
Iris circular muscles radial muscles	 contract relax	 relax contract

Multiple Choice Questions

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

1. A person who was reading a book suddenly looked up at the bright sky. Which of the following shows how the eye responded?

	Iris	Pupil
A	Circular muscles relax	enlarges
B	Circular muscles relax	becomes smaller
C	Circular muscles contract	becomes smaller
D	Circular muscles relax	enlarges

[ ]

2. Which of the following prevents the internal reflection of the eye?

A Cornea
B Choroid
C Sclerotic coat
D Conjunctiva

[ ]

3. Which of the following controls the amount of light entering the eye?

A Iris
B Cornea
C Ciliary body
D Lens

[ ]

4. Which of the following defines the term accomodation of the eye?

A Distinguishing between different colours
B Adapting to different light intensities
C Altering the focal length of the lens
D Judging distance

[ ]

5. Which of the following occurs when accomodation takes place in the eye?

A The external eye muscles move the eyes in their sockets to give a three-dimensional picture.
B The focal length of the lens changes so that light rays are focused on the retina.
C The pupil constricts so that less light enters.
D The pupil opens to allow more light to enter.

[ ]

6. Which of the following parts of the eye causes the greatest refraction of light?

A Aqueous humour
B Lens
C Cornea
D Vitreous humour

[ ]

7. Joe was reading a book in the garden when he looks up into the sky to watch the aeroplane passing by. In which of the following ways do his eyes accomodate as he looks up?

	Ciliary muscles	Suspensory ligaments
A	relaxed	stretched
B	relaxed	slackened
C	contracted	slackened
D	contracted	stretched

[ ]

8. Which of the following form the layer of light-sensitive cells in the eye?

A Choroid
B Cornea
C Retina
D Sclera

[ ]

9. Which of the following conditions causes the pupils to dilate?

A A decrease in light intensity
B An increase in light intensity
C Focusing on a distant object
D Focusing on a near object

[ ]

10. The ciliary muscle stretch from the _____.

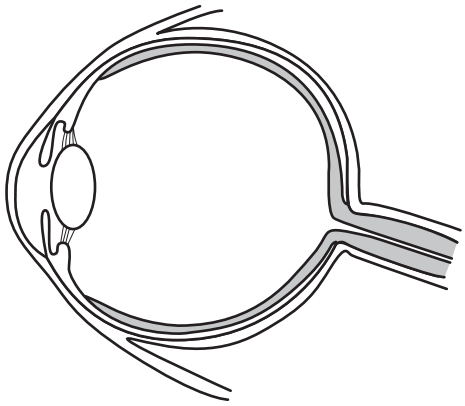
A Sclera
B Choroids
C Iris
D Vitreous humour

[ ]

Structured Questions

Write your answers in the spaces provided.

1. Study the diagram below which shows a section through the eye.



Supposed that Rose is looking at a fly on a book that she is reading.

(a) Label with the letter X, the part of the eye that contains muscles that focus light from the fly.

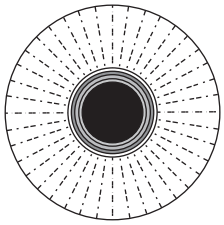
(b) Indicate the position of the image of the fly.

(c) Assume that the fly now flew off and landed on a wall and that Rose continues to watch it.

(i) Draw on the diagram, the shape of the lens when focused on the fly on the wall.

(ii) What brings about the change in the shape of the lens in (i)?

(d) (i) Label the iris.



(ii) Explain the effect of bright light on the iris of the eye.

2. (i) On the outline diagram of the iris below, draw and label the antagonistic muscles.

iris
(front view)

(ii) How does the iris control the amount of light entering the eyes?

Essay Questions

Write your answers in the spaces provided.

1. The retina is the innermost layer of the eyeball that contains photoreceptors. Photoreceptors consists of cones and rods. Explain briefly the functions of the cones and rods.

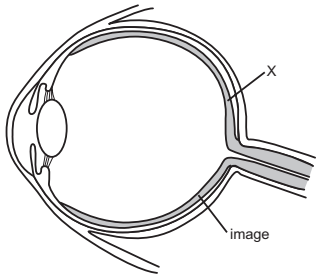
2. Using a pathway diagram, explain what the pupil reflex is.

Multiple Choice Questions

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

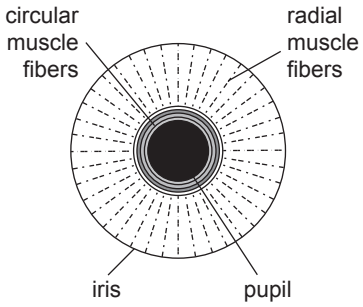
Structured Questions

1. (a) & (b)



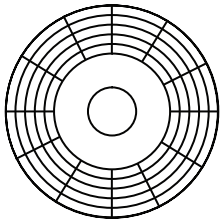
(c) (i) thinner lens now drawn
(ii) ciliary muscles have relaxed

(d) (i)



(ii) Circular muscles contract, radial muscles relax and this cut down the diameter of the iris.

2. (i)



(ii) The size of the pupils determines the amount of light entering the eye. This is then controlled by the antagonistic muscles – circular and radial, found in the iris. When the circular muscles of the iris contract, the radial muscles relax causing the pupil to decrease in size and thus reducing the amount of light entering the eye. This happens when the eye is exposed to bright light. On the contrary, when in dim light, the radial muscles contract, the circular muscle relaz causing the pupil to increase in size and thus increasing the amount of light entering the eye.

Essay Questions

1. Cones enable us to see colours in bright light and does not work well in dim light. There are three types of cones – red, blue and green. Each cones contains a different pigment to absorb light of different wavelengths and all these cones together enable us to see a wide variety of colours.
Rods are more sensitive to light such that they enable us to see in dim light – but only in black and white. Rods are sensitive to dim light as they contain a pigment called visual purple, which is bleached when the eye is exposed to bright light. As such, nerve impulses cannot be sent to the brain from the rods, hence a person will not be able to see anything. Visual purple must be reformed for a person to see in the dark.

2. stimulus → receptor → sensory → brain → motor → effector

(change in light intensity) (retina) neurone in optic nerve (iris)

The pupil reflex is a type of reflex action. Like in any type of reflex action, there is a receptor and an effector. Here, as seen from the pathway, the receptor is the retina and the effector is the iris. The size of the pupil changes as a result of changes in light intensity. For example the pupil usually becomes larger when the surrounding light intensity is low and it becomes smaller when the light intensity is high. However when light intensity becomes unbearable, and decreasing the size of the pupils does not help, the eyelids will then come closer together to screen off excessive amount of light from entering the eye.

Unit 14 HORMONES

Notes

1. A hormone is a chemical substance produced in minute quantities by an endocrine gland. It is transported in the bloodstream to alter the activities of one or more specific target organ(s).

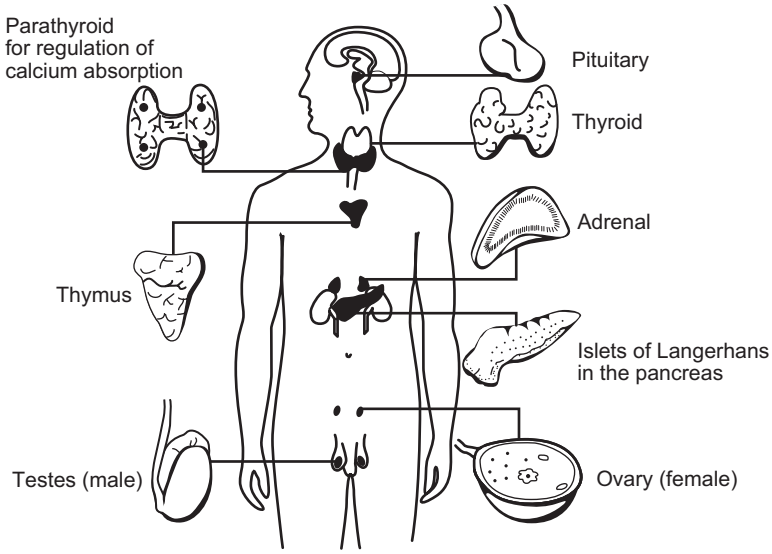
2. Endocrine glands are ductless glands which produce and release hormones directly into the blood. Exocrine glands produce secretions which leave the glands through a duct to target organ(s).

3. Hormone production must be balanced to ensure that the body functions normally.

4. However, these hormones are destroyed by the liver after it has completed its function and excreted by the kidneys.

5. Adrenaline
   - produced by the adrenal gland (medulla)
   - mobilises the entire body for unusual excretion due to stress, anxiety or fear
   - these series of short term responses prepares the body for fight or flight by
     - increasing the heartbeat rate so that oxygen and glucose takes a shorter time to reach the muscles
     - increasing blood supply to skeletal muscles
     - diverting blood from less important organs to the muscles
     - increasing metabolic rate so that more energy is available
     - increasing oxygen and glucose supply to the body

6. Other types of glands and their secretions



Gland	Hormone	Function
Pituitary	Growth hormone	Controls the rate of bone growth
	Gonadotrophic	Controls the output of the sex hormones
	Thyrptrophic	Controls the output of thyroxine
	Oxytocin	Causes contractions of the uterus during childbirth
	Anti-diuretic hormone (ADH)	Controls water content in the urine
Ovaries (in females)	Oestrogen	Controls ovulation and secondary sexual characteristics
	Progesterone	Prepares the lining of the uterus after ovulation
Testes (in males)	Testosterone	Controls sperm production and secondary sexual characteristics
Thyroid	Thyroxine	Controls respiration and other metabolic processes
		Controls mental and physical growth
Pancreas (islets of Langerhans)	Insulin	Regulates the amount of sugar in the blood

7. Diabetes mellitus

- increase in blood glucose level when the pancreas fail to produce enough insulin
- as the blood glucose level increases above normal, the kidneys excrete glucose and glucose appears in the urine
- as glucose reserves are rapidly depleted in diabetic patients, protein reserves are being utilised

- oxidation of fats to provide energy results in accumulation of toxic substances which could result in diabetic coma
- treatment:
  - restricted intake of carbohydrates
  - oral administration of insulin (for mild cases)
  - insulin injected hypodermically

8. Comparing hormonal and nervous systems

Nervous system	Hormonal system
Nerve impulses (electrical signals) are involved.	Hormones (chemical substances) are involved.
Impulses are transmitted by neurones.	Hormones are transported by the blood.
Responses are usually quick and short-lived.	Responses are usually slow but may be short-lived or long-lived.
Transmission may be voluntary or involuntary.	Production are always involuntary.
Effect is usually localised.	Effect tends to affect more than one target organ.
Stimulus ↓ Receptors ↓ Sensory neurone ↓ Central nervous system ↓ Motor neurone ↓ Effectors (muscles and glands)	Stimulus ↓ Endocrine glands ↓ Secreted hormone ↓ Hormones carried in the blood ↓ Hormone sensitive tissue e.g. heart, blood vessels, liver, sex organs

Multiple Choice Questions

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

1. Which of the following situations causes an increase in the secretion of insulin?

A Just before the release of sperms during sexual intercourse
B When a person is angry
C At the onset of puberty
D After eating a donut **[ ]**

2. Which of the following occurs when there is a decrease in the activity of the thyroid gland?

A A decrease in the glucose levels in the blood
B An increase in the glucose levels in the urine
C A decrease in the body's metabolic rate
D An increase in blood pressure **[ ]**

3. Which of the following decreases due to adrenaline secretion?

A Heart rate
B Digestive activity
C Blood sugar level
D Size of the pupils **[ ]**

4. Which of the following will contain in the urine of a person suffering from *diabetes mellitus*?

A Amino acids
B Fatty acids
C Glucose
D Starch **[ ]**

5. In which of the following organs are hormones destroyed?

A Adrenal glands
B Liver
C Kidneys
D Muscle cells **[ ]**

6. Which of the following types of cells triggers the release of adrenaline?

A Motor nerve cell
B Muscle cell
C Pancreatic cell
D Red blood cell **[ ]**

7. Which of the following enters the blood as it passes through the ovaries?

A Adrenaline
B Testosterone
C Insulin
D Oestrogen

[ ]

8. Which of the following gives the function of the adrenaline?

A It stimulates the cells of the liver to take up glucose.
B It causes more blood to flow through the skin.
C It converts glycogen into glucose.
D It decreases the breathing rate. **[ ]**

9. How does hormones travel round the body?

A Via the white blood cells
B Via the blood plasma
C Via the glands
D Via the nerves **[ ]**

10. Which of the following enters the blood as it passes through the thyroid?

A Adrenaline
B Insulin
C Glycogen
D Thyroxine **[ ]**

Structured Questions

Write your answers in the spaces provided.

1. (a) Compare between adrenal gland and salivary gland.

_____

_____

_____

(b) What effect does adrenaline have on the

(i) circulatory system, and

_____

_____

_____

(ii) skeletal muscles?

_____

_____

_____

(c) Compare between insulin and adrenaline.

_____

_____

_____

_____

_____

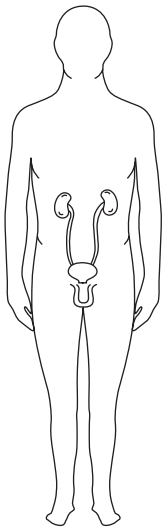
2. (a) What is a hormone?

_____

_____

_____

(b) How are hormones distributed around the whole body? Show them in the given figure below.



_____

_____

_____

3. Complete the following table.

Hormone	Destination	Effects
Insulin		
Adrenaline		
Thyroxine		

Essay Questions

Write your answers in the spaces provided.

1. Describe when the hormone adrenaline is secreted and its effects on the body.

2. (a) What are the signs and symptoms of *diabetes mellitus*?

(b) (i) What causes the signs and symptoms mentioned in (a)?

(ii) How can *diabetes mellitus* be treated?

Multiple Choice Questions

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

Structured Questions

1. (a) Adrenaline from the adrenal gland does not pass through a duct but enters directly into the bloodstream to be carried to the target organ. The saliva is poured out of a duct into the mouth and contains enzyme and water.

(b) (i) It makes the heart beat faster, moves the blood at a faster speed round the body and diverts more blood to the lungs and skeletal muscles.

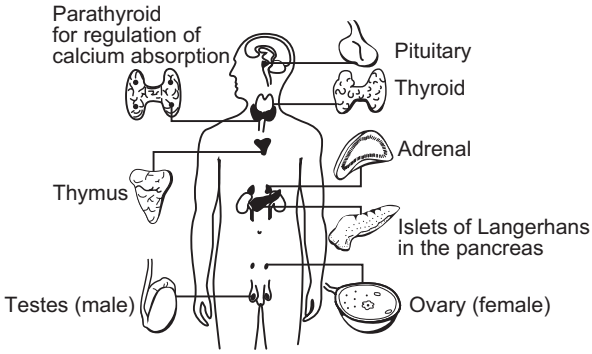
(ii) It delivers more blood, with higher concentrations of oxygen and glucose, to the muscles and because the rate of blood flow through the muscles is much faster, the muscles will be able to increase their rate of energy production at a very short notice. Any wastes of cellular respiration can also be removed very fast.

(c)

	Adrenaline	Insulin
Produced by	Adrenal glands	Pancreas
Organ(s) affected	Heart, lungs, liver, brain	Liver
Relationship with glucose	Stimulates conversion of glycogen in the liver to glucose	Controls the conversion of excess glucose into glycogen in the liver

2. (a) A hormone is a chemical substance produced in minute quantities by an endocrine gland. It is transported in the bloodstream to alter the activities of one or more specific target organ(s).

(b) Hormones are distributed throughout the whole body as follows:



3.

Hormone	Destination	Effects
Insulin	Liver and muscles	Decreases the level of sugar in the blood to a suitable level
Adrenaline	Liver and heart muscles	Increases the heart beat rate
Thyroxine	All over the body	Regulates the metabolic rate and the development of the body of the animal

Essay Questions

1. Adrenaline is secreted by the adrenal gland when the animal is in fear, anger and anxiety. The secretion of adrenaline increases the rate of the heartbeat and blood sugar level. There is also a rise of blood pressure. The pupil and coronary dilation are also observed. This results in increased blood supply to the heart, muscles and limb muscles. Blood vessels in the skin and gut are constricted. The result is that the animal concerned gets extra energy and thus, the ability to react in such conditions.

2. (a) In *diabetes mellitus*, blood concentration of glucose is increased. Some of the glucose is lost in the urine. Ketone, a poisonous by-product is also found in the urine. The presence of ketones give the breath a characteristic sweet odour. Other symptoms of *diabetes mellitus* include body weakness, continuous weight loss and even death.

(b) (i) The liver is responsible for the regulation of glucose levels. As blood passes through the liver, excess glucose is converted to glycogen and stored in the liver and muscles. The conversion of glucose to glycogen is under the control of the hormone insulin, secreted by the islets of Langerhans in the pancreas. Insulin also enables tissue cells to oxidise glucose to produce energy in tissue respiration.

Diabetes mellitus is the result of a lack of secretion of insulin. When there is a lack of insulin, glucose cannot be stored or utilised by tissue cells, so blood glucose concentration rises and some is subsequently lost in the urine.

Since muscle cells have no reserve of glycogen, body weakness follows, and there is a continuous weight loss. The body oxidises fat instead of glucose to produce energy. This results in the production of ketones which are secreted in the urine

(ii) *Diabetes mellitus* is of two types, Type I and Type II.

Type I can be treated by injecting insulin directly into the bloodstream.

Type II can be carefully controlled by regulating the carbohydrates intake and also by taking medicine orally.

Unit 15 REPRODUCTION IN PLANTS

Notes

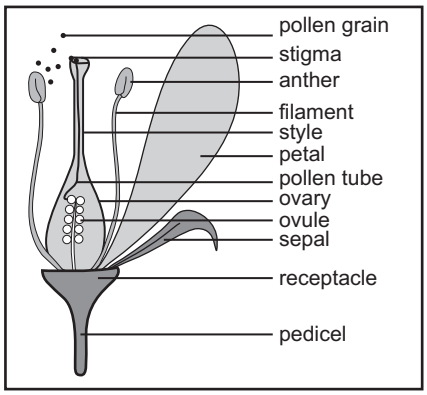
1. Reproduction is the production of new living individuals or offsprings to ensure the survival of the species.

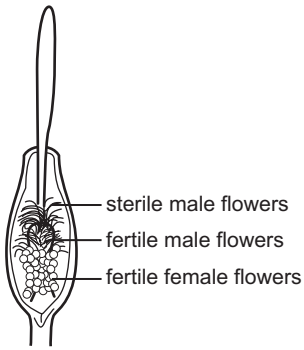
2. Two basic forms of reproduction

   - Asexual
     - involves one parent and results in the production of genetically identical offspring
     - characteristics of asexual reproduction
       - no fusion of gametes
       - only one individual is needed for this to take place
       - offsprings are exact copies of the parent
     - types of asexual reproduction
       - spore formation (ferns and fungus)
       - budding (yeast)
       - vegetative reproduction (grapes and potato)
     - commercial applications
       - natural vegetative propagation – to increase global food production
       - artificial vegetative propagation – to increase food supply by growing high yielding crop plants on a large scale and to ensure new plants have some particular feature of the parent
   - Sexual
     - involves the fusion of nuclei from two different parents to form a zygote and the production of dissimilar offsprings
     - involves a male and a female
     - the male gamete fuses with the female gamete to form a zygote which grows and develops into a multicellular individual

3. In flowering plants, flowers are the main reproductive organs.

4. Flowers may be bisexual or unisexual.





5. The male sex organ is called the stamen – produces pollen grains.

6. The female sex organ is called the carpel – consisting of an ovary, a style and one or more stigma.

7. The female gametes are contained in the ovules produced by the ovary.

8. Pollination is the transfer of pollen grains from the stamen to the stigma of the same or different flower of the same species.

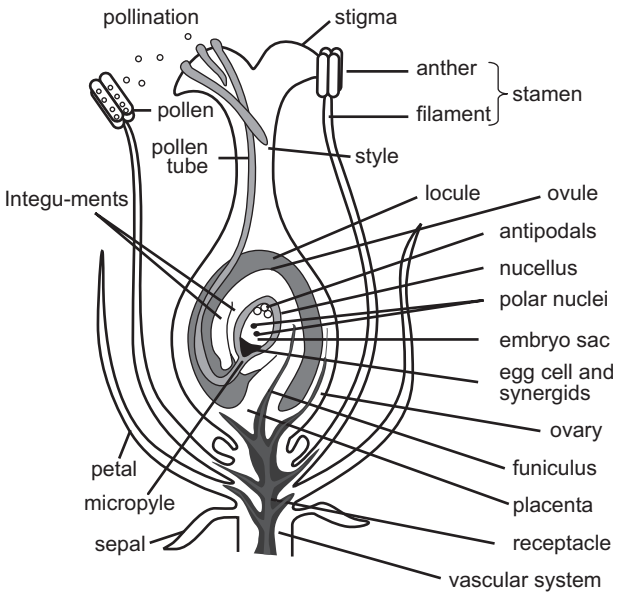
9. Fertilisation occurs when the male gamete fuses with the female gamete of the same flower or another flower of the same species.

10. Structure of a flower

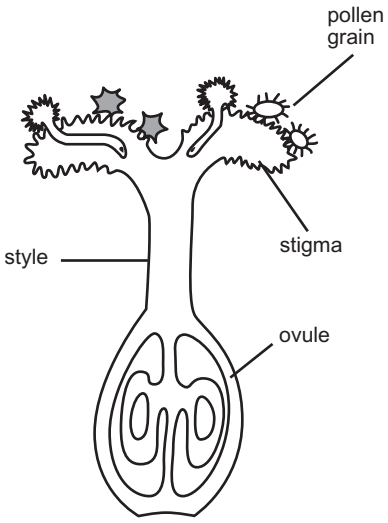
- floral parts of a flower are arranged in four whorls on the receptacle
- the floral parts consists of:
  - calyx
    - forms the outermost whorl
    - made of green and leaf-like structures called sepal which enclose and protect the floral parts during the bud stage
    - epicalyx forms an extra whorl outside the calyx in some flowers such as the hibiscus
  - corolla
    - forms the second whorl of the flower
    - components are called petals
    - most conspicuous part of the flower – colourful and serve to attract insects to the flower; protect the stamen and the carpels
  - androecium
    - forms the third whorl of the floral parts
    - male organ of the flower comprises many stamens
    - each stamen is made up of an anther attached to a filament
    - the number of stamens varies
    - the anther is bilobed, each containing two pollen sacs
    - pollen grains differ in shape and size depending on the species

- ✧ gynoecium
  - forms the fourth and innermost whorl of the floral parts
  - female sex organ comprises an ovary (may contains ovules), a style and a stigma
  - style is a slender prolongation on the top of the ovary
  - the stigma is the apical portion of the style which receives the pollen grains

11. Structure of insect-pollinated flower



12. Structure of wind-pollinated flower



13. Comparing insect-pollinated and wind-pollinated flowers

Wind-pollinated flowers	Insect-pollinated flowers
small	large
no petals or dull-coloured petals	brightly-coloured petals, large, often scented
no nectar	has nectar
stamens with long slender filaments	stamens not pendulous
large pollen grains produced	few pollen grains
pollen grains are small, light and with smooth surfaces	pollen grains are larger, heavier and have spikes on the surface
feathery stigma with large surface area to trap pollen grains in the wind	stigma has a sticky surface, usually compact – does not protrude
stamen and stigma hang out of the whorl of petals	stamen and stigma within the whorl of petals

14. Pollination

- the transfer of pollen grains from the anther to the stigma
- pollen grains develop inside the anther
- when the anthers are matured, they split open and the pollen grains are released
- pollen grains may be carried to the stigma by wind, insects or water

15. There are two kinds of pollination:

- self-pollination – transfer of pollen grains from the anther of a flower to the stigma of the same flower or another flower of the same plant
- cross-pollination – transfer of pollen grains from the anther of a flower to the stigma of another flower of a different plant of the same species

16. Fertilisation

Stage I: Pollen settles on a mature stigma. Stigma secretes a sugary fluid.

Stage II: Pollen grain produces a pollen tube.

Stage III: Pollen tube grows downwards towards the ovule, enters the ovule and releases two male gametes.

Stage IV: One male gamete fuses with the ovum to form a zygote. The other male gamete fuses with the definitive nucleus to form the endosperm nucleus.

Multiple Choice Questions

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

1. Pollination occurs when pollen grains are transferred to _____.

A anther
B sepal
C ovule
D stigma [ ]

2. Which of the following would likely be the characteristics of wind-pollinated flowers?

A Anthers with short filaments.
B Small, smooth pollen grains.
C Short, unbranched stigmas.
D Brightly-coloured petals. [ ]

3. Which part of the tomato flower swells to form the fleshy layer of the fruit?

A Ovary wall
B Sepals
C Ovule
D Stigma [ ]

4. Which of the following best describes asexual reproduction?

A The formation of individuals resulting from the splitting of a single nucleus.
B The production of genetically dissimilar organisms from one parent.
C The formation of genetically identical offspring from two parents.
D The production of genetically identical offspring from one parent. [ ]

5. What is the structure that develops from an ovule after fertilisation?

A Fruit
B Seed
C Gamete
D Spore [ ]

6. Many wind-pollinated flowers have _____.

A feathery stigmas and sticky pollen
B feathery stigmas and light pollen
C short stigmas and sticky pollen
D short stigmas and light pollen [ ]

7. Which of the following route is taken by a pollen tube after pollination of the flower?

A Ovule ⟶ style ⟶ stigma
B Style ⟶ ovule ⟶ stigma
C Stigma ⟶ style ⟶ ovule
D Stigma ⟶ filament ⟶ ovule [ ]

8. What is the structure that develops from the ovary after fertilisation?

A Fruit
B Seed
C Gamete
D Spore [ ]

9. Most wind-pollinated flowers have _____.

A brightly-coloured petals
B long projecting stigmas
C large nectars
D a strong scent [ ]

10. Which of the following structures develop into a seed after fertilisation?

A Anther
B Sepal
C Ovule
D Stigma [ ]

Structured Questions

Write your answers in the spaces provided.

1. (a) Why do insects visit flowers?

_____

(b) How do the insect's visit help flowering plants?

_____

_____

_____

(c) Describe briefly how the male and female gametes are brought together in a flower.

_____

_____

2. For insect-pollinated flower, describe the functions of

(i) the sepals

(ii) the petals

(iii) the anthers

(iv) the carpels

Essay Questions

Write your answers in the spaces provided.

1. Distinguish between

(a) ovary and ovule; and

(b) fertilisation and pollination.

2. Describe the male gamete of a flowering plant and how it reaches the female gamete after pollination.

Answers

Multiple Choice Questions

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

Structured Questions

1. (a) It is to get nectar and pollen from the flowers as part of their nutrition.

(b) The insects help in the cross-pollination of flowers. This happens when pollen grains of the flower get stuck onto the insect's hairy body and legs. When the insect visits another flower, the pollen grains will fall onto the stigma of this flower. Fertilisation can then take place.

(c) A pollen lands on the stigma forms a pollen tube which grows down to the style to the ovule, carrying the male gamete. It then fuses with the female gamete.

2. (i) The sepals protect the petals when the flower is in its bud stage.

(ii) The petals attract insects to the flower.

(iii) The anthers hold big sticky pollen grains that can stick to the bodies of insects.

(iv) The carpels hold the ovary, style and stigma together, and allows for pollination and fertilisation to take place.

Essay Questions

1. (a) The ovary is part of the gynoecium or pistil, which contains the ovules. After fertilisation, the ovary wall becomes the fruit wall. The ovules contain the female gametes and become the seeds after fertilisation.

(b) Fertilisation occurs when the male gamete fuses with the female gamete to produce the embryo. It takes place in all living things that reproduce by sexual reproduction. Pollination occurs when the pollen from the anther lands either on the stigma of the same flower or on the stigma of a flower of the same species.

2. The male gamete is the haploid cell and is found in a pollen grain. On pollination, the pollen grain will grow a pollen tube through the style and to an ovule. It enters the ovule through the microphyle. In the ovule, the tube burst releasing the male gamete that travels down it. This male gamete then fuses with the female gamete in the ovule.

Unit 16 REPRODUCTION IN ANIMALS

Notes

Male Reproductive System

1. Testes
   - oval in shape
   - are suspended in the scrotum outside the body cavity so that they are kept 2–3°C cooler than the rest of the body where sperm production is optimum at this temperature
   - function
     - produce male gametes known as sperms
     - produce male sex hormones called testosterone

2. Scrotum
   - sac formed by the skin to enclose the testes
   - function
     - protect the testes

3. Sperm duct
   - connects the storage duct also known as epididymis with the urethra during copulation

4. Male reproductive glands
   - prostrate gland – a single gland located at the part of the urethra where the two sperm ducts join
   - seminal vesicles – pair of glands which open directly into the sperm ducts
   - cowper's glands – open directly into the urethra
   - function
     - produce fluid which keeps the sperm alive and helps them to swim vigorously
     - together with the sperm, the fluid forms the semen

5. Urethra
   - passes through the penis
   - function
     - a tube which carries urine and semen at different times through the penis

6. Penis
   - an erectile organ
   - function

- ✧ carries urine and semen out of the body
- ✧ becomes stiff and erect so that copulation may occur and release the sperm into the vagina

Female Reproductive System

7. Ovaries

- ❖ oval in shape
- ❖ attached to the dorsal body wall below the left and right kidneys
- ❖ function
  - ✧ releases an egg or ovum every 28 days into the oviduct or fallopian tube
  - ✧ produce female sex hormones – oestrogen and progesterone

8. Oviduct

- ❖ also called the fallopian tube
- ❖ a narrow tube with a funnel-shaped opening lying close to the ovary
- ❖ function
  - ✧ contraction of the muscle wall aids the ovum to move towards the uterus
  - ✧ fertilisation of the egg usually occurs here

9. Uterus or womb

- ❖ has a central cavity surrounded by thick muscular walls
- ❖ function
  - ✧ adapted for the implantation of the embryo and its development into a foetus

10. Cervix

- ❖ a ring of muscles at the lower end of the uterus
- ❖ function
  - ✧ helps keep the foetus until it is ready to be born

11. Vagina

- ❖ cervix opens into the vagina
- ❖ a tube with thinner walls
- ❖ opens to the outside through the vulva
- ❖ function
  - ✧ serves as an opening for the entry of the penis during copulation
  - ✧ also serves as an outlet for the birth of baby

The Sperm and the Egg

12. Sperm

- ❖ extremely small
- ❖ consists of the head containing the chromosomes which carry the genes responsible for passing on the characteristics of the father, a middle piece and a tail, which helps it to swim

13. Egg (Ovum)

- larger than the sperm
- spherical in shape and consists of the nucleus containing chromosomes which carry genes responsible for passing on the characteristics of the mother, surrounded by cytoplasm and enclosed by a thin membrane with a jelly coat

14. Menstrual cycle

- begins only when a female reaches puberty and stops when menopause begin
- cycle starts with menstruation – characterised by bleeding from the vagina caused by the breaking down of the lining of the uterus or womb
- menstrual periods take place fairly regularly at intervals of about 28 days
- menstruation goes on for about five days
- on the 14th day of the menstrual cycle, one of the ovaries releases an ovum into the fallopian tube towards the uterus
- if ovum is fertilised with a sperm, it attaches itself to the walls of the uterus from which food and oxygen are obtained
- if the ovum is not fertilised, the ovum eventually disintegrates and the lining of the uterus wall breaks down
- uterine lining and blood flows out through the vagina 14 days after ovulation and this signals the start of the next menstrual cycle

15. Fertile and infertile phases of the menstrual cycle

- an ovum can live for 24 to 36 hours after ovulation
- a sperm cell remains active for two to three days after being released into the female reproductive system
- the fertile phase of the menstrual cycle is the time from day 11 to day 17 of the menstrual cycle
- if the sperm is released into the female reproductive system on day 12, the ovum can be fertilised and pregnancy results
- the infertile periods are from day 1 to day 10 when the uterus lining breaks down and then gets repaired slowly again, and from day 18 to day 28 when the cells in the uterus wall begin to die

16. Fertilisation

- during mating or sexual intercourse, a male's penis enters the vagina of a female – semen is ejaculated into the vagina during sexual intercourse
- the sperms swim up the oviducts of the woman – if the sperm meets an egg, fertilisation occurs
- acrosome of the sperm releases an enzyme that disperses the follicle cells surrounding the egg and breaks down part of the egg membranes
- the haploid sperm nucleus fuses with the haploid egg nucleus, forming a diploid zygote

17. Development of the zygote

- after fertilisation, the zygote passes along the oviduct to the uterus – zygote divides by mitosis to form the embryo
- the embryo implants itself in the uterine lining
- the amnion encloses the embryo in the amniotic cavity containing amniotic fluid
- villi containing the blood capillaries of the embryo grow from the embryo into the uterine wall

18. The placenta

- allows the diffusion of oxygen, food substances and antibodies from the mother's blood into the foetus' blood
- embryo is attached to the placenta by the umbilical cord – transports deoxygenated blood and food from the foetus to the placenta via the umbilical arteries, and oxygenated blood and food substances form the placenta to the foetus via the umbilical vein

Sexually Transmitted Diseases

19. Sexually transmitted diseases are diseases that are passed from an infected person to a healthy person during sexual intercourse.

20. Sexually transmitted diseases such as gonorrhoea and syphilis are caused by bacteria which live and reproduce in the male and female reproductive systems.

21. Symptoms of gonorrhoea

- burning sensation during urinating due to the inflammation of the urethra
- thick greenish-yellowish discharge from the tip of the penis or the vagina
- joints are swollen and painful
- results in sterility
- newborn baby may be infected as it passes through the vagina

22. Symptoms of syphilis

- painless sore appears on or near the genital organs usually just inside the vagina or on the end of the penis
- mild fever occurs when the bacteria infect other parts of the body
- lymph nodes swell
- non-itchy rash appears on the body
- blindness, insanity and paralysis may occur when the bacteria attack the brain

23. Detection and treatment of gonorrhoea

- with blood and urine tests to detect the presence of the bacteria
- both can be cured with antibiotics such as penicillin at an early stage of the infection

24. Acquired Immuno Deficiency Syndrome (AIDS)

- caused by a virus
- spread through

- intimate sexual contact
- blood transfusions using blood from an infected donor
- sharing the same hypodermic needle with drug abusers who are AIDS patients
- mothers who are AIDS patients, spreading the virus to their unborn babies
- drug addicts

- cannot spread through social contact
- more likely to be spread by the following groups
  - prostitutes
  - homosexuals with multiple sex partners
  - heterosexuals with multiple sex partners
  - mothers who are AIDS patients, spreading the virus to their unborn babies
  - drug addicts

25. Detection of AIDS

    - blood test

26. Methods of control

    - take precaution e.g. using condom
    - avoid having multiple sex partners
    - ensure that instruments used for ear piercing, acupuncture, tattooing and injection are sterilised or disposable
    - avoid sharing instruments that are likely to break the skin and be contaminated with blood

Multiple Choice Questions

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

1. Which of the following are symptoms of gonorrhoea?

A Paralysis
B Insanity
C Blindness
D Greenish-yellowish discharge **[ ]**

2. The sex of a baby is determined _____.

A when the embryo is implanted in the uterus wall
B between ovulation and fertilisation
C at the moment of fertilisation
D before ovulation **[ ]**

3. In which of the following does fertilisation takes place?

A Sperms deposited in a female animal during copulation meeting the cells of the uterus wall
B The nucleus in the pollen tube meeting and fusing with the nucleus in the ovule.
C Pollen grains landing and germinating on the stigma of a flower.
D A fungus developing spores. **[ ]**

4. Implantation of the human embryo usually occurs in the _____.

A cervix
B ovary
C oviduct
D uterus **[ ]**

5. Which of the following substances does the umbilical cord carries?

A Oxygen and digested food from the foetus to the mother
B Oxygen and digested food to the foetus from the mother
C Urea and carbon dioxide from the foetus to the mother
D Oxygen and urea to the foetus from the mother **[ ]**

6. Which of the following shows the number of chromosomes and sex chromosomes in a human sperm?

	Number of chromosomes	Sex chromosomes
A	23	X or Y
B	23	X and Y
C	22	X or Y
D	46	X and Y

[ ]

7. Which of the following statements about the placenta is true?

A It allows the transfer of mother's blood carrying dissolved food substances and oxygen to the foetus.
B It releases hormones which make the person more feminine.
C Movement across the placenta is by diffusion.
D It is made of maternal tissue only.

[ ]

8. In which of the following does fertilisation usually takes place?

A Ovary
B Uterus
C Oviduct
D Vagina

[ ]

9. Which of the following statements about the placenta is true?

A It provides the pathway for excretion by the fetus.
B It is connected to the fetus by the umbilical cord.
C It transfers the blood of the mother to the fetus.
D It releases hormones during pregnancy.

[ ]

10. In which of the following is syphilis transmitted?

A Insect bites
B Contaminated food
C Sexual contact
D Droplet infection

[ ]

Structured Questions

Write your answers in the spaces provided.

1. Define the term *sexual* reproduction.

_____

_____

2. Draw and label clearly the reproductive system of a female mammal.

Essay Questions

Write your answers in the spaces provided.

1. Distinguish between

(a) ureter and urethra; and

(b) testa and testis.

2. (a) What are the chief signs and symptoms of gonorrhoea in men and women?

(b) What steps can be taken to control the spread of gonorrhoea?

(c) Explain why a person can catch either syphilis or gonorrhoea only through sexual intercourse.

Answers

Multiple Choice Questions

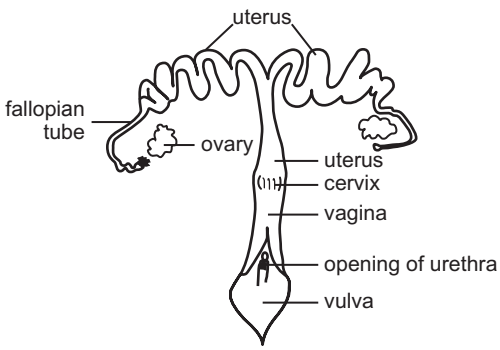
1. D **2.** C **3.** B **4.** D **5.** B

6. A **7.** C **8.** C **9.** C **10.** C

Structured Questions

1. Sexual reproduction involves the fusion of two reproductive cells called gametes which results in the formation of a zygote and eventually the development into an offspring.

2.



Essay Questions

1. (a) The ureter carries urine from the kidney to the bladder. The urethra carries urine from the bladder to the outside. In the male, the urethra carries both urine from the bladder and semen from the testes, although at different times.

(b) The testa is the outer coat of the seed, which protects both the embryo and the cotyledons. The testis is the male sex organ, which produces the sperms.

2. (a) The signs and symptoms include itching or pain when passing urine, thick pus-like discharge from the penis or vagina and later the swelling of the joints, which can become painful. It may also result in sterility.

(b) Some steps that can be taken are by refraining from having multiple sex partners, using condoms and educating the public about sexually transmitted diseases.

(c) The membranes of the vagina and the tip of the penis are thin and easily damaged. Hence it is easy for gonorrhoea bacteria to penetrate and enter the blood stream via these two points.

Unit 17 CELL DIVISION

Notes

1. Growth is a characteristic of all living things. It is a permanent increase in size. It is accompanied by cell division and differentiation to form tissues and organs.

2. Mitosis

   - cell division that takes place during the growth of an organism
   - is a nuclear division such that the daughter nuclei produced contain the same number of chromosomes as the parent nucleus
   - important for repair of worn-out parts of the body and for asexual reproduction in plants

3. Stages in mitosis

   - prophase – chromosomes have condensed and are now visible under the microscope, in the late prophase, spindle fibres form and the nuclear envelope disappears
   - metaphase
   - anaphase – chromatids are pulled apart to opposite poles of the cell
   - telophase – the spindle fibres break down, the nuclear envelope and nucleolus reform
   - cytokinesis – cytoplasm is divided between the two identical daughter cells

4. Interphase

   - the non-dividing period of a cell i.e. a stage before a cell divides
   - activities such as absorbing nutrients and building up protoplasm still occur at this stage
   - at this stage, chromosomes appear as long thin threads called chromatin
   - DNA replication and centriole division take place

5. Cell cycle consists of

   - interphase or resting stage
   - mitosis – nuclear division
   - cell division – division of the cytoplasm

6. Meiosis

   - a form of nuclear division such that the daughter nuclei produced (haploid reproductive cells) contain half the number of chromosomes as the parent nucleus (diploid cell)
   - produces four genetically varied haploid daughter cells

- crossing over during meiosis combined with random fertilisation allows different combinations of genes into a population
- both crossing over and random fertilisation cause genetic variation and increase the chances of survival of an individual during environmental changes

7. Meiosis consists of meiosis I and II and meiosis I stages are made up as follows:
   - prophase – homologous chromosomes pair up and crossing over occurs
     - crossing over is the process during which chromatids of homologous chromosomes cross each other (chiasmata) and exchange parts
   - metaphase
   - anaphase – separates homologous chromosomes
   - telophase – produces two daughter cells that have haploid number of chromosomes

8. Meiosis II stages are as follows:
   - anaphase – separates chromatids
   - telophase – the cleavage of the cytoplasm results in four daughter cells, each with a haploid number of chromosomes

9. Comparing mitosis and meiosis

Mitosis	Meiosis
same number of chromosomes in daughter and parent cells	daughter cells contain half the number of chromosomes as that of parent cell
no pairing of homologous chromosomes	pairing of homologous chromosomes at prophase I
no crossing over	crossing over may occur
daughter cells are identical to parent cell	variations occur in the daughter cells
two daughter cells produced from one parent cell	four daughter cells are produced from one cell
involves only one nuclear division	involves two nuclear divisions
occurs in normal body cells during growth or repair of body parts	occurs in the gonads during gamete formations

Multiple Choice Questions

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

1. Which of the following is a major difference between meiosis and mitosis?

A Homologous chromosomes associated only in meiosis
B Daughter chromatids separate only in meiosis
C DNA replication only occurs in mitosis
D Interphase present only in mitosis **[ ]**

2. Mitosis ensures _____.

A a reduction in the number of chromosomes
B equal division of nuclear materials
C changes in the nature of genes
D an increase in the size of cells **[ ]**

3. Meiosis takes place in the _____ of a flowering plant.

A anthers
B stigma
C pollen tube
D germinating seeds **[ ]**

4. The _____ contain haploid nuclei.

A epidermal cells
B pollen grains
C sieve tubes
D xylem vessels **[ ]**

5. What is the importance of meiosis occurring during the formation of gametes?

A It produces haploid sex cells in preparation for fertilisation.
B It prevents asexual reproduction occurring in the life cycle.
C It allows the number of the sex cells to be doubled.
D It prevents variations appearing in the phenotype. **[ ]**

6. A/An _____ contains the haploid number of chromosomes.

A actively dividing cell from the malphigian layer of the skin
B nerve cell in the brain
C red blood cell
D sperm cell **[ ]**

7. In which of the following parts of a flower does meiosis occur?

A Anther
B Petal
C Receptacle
D Sepal **[ ]**

8. Which of the following plant structures contain haploid nuclei?

A Epidermal cells
B Pollen grains
C Sieve tubes
D Xylem vessels **[ ]**

Structured Questions

Write your answers in the spaces provided.

1. (a) Explain how meiosis leads to the formation of four haploid nuclei.

_____

_____

_____

_____

_____

_____

(b) List three difference between mitosis and meiosis.

_____

_____

_____

_____

_____

_____

Essay Questions

Write your answers in the spaces provided.

1. (a) Describe the behaviour of homologous chromosomes.

(b) Explain the similarities and differences between non-homologous chromosomes.

2. (a) Explain how mitosis and meiosis provides for genetic stability and growth.

(b) Discuss the role of meiosis in

(i) sexual reproduction; and

(ii) promoting genetic variation.

Answers

Multiple Choice Questions

1. A	**2.** B	**3.** A	**4.** B
5. A	**6.** D	**7.** A	**8.** B

Structured Questions

1. (a) In meiosis, the nucleus of a cell divides twice. A single cell produces four cells by the end of meiosis. In sexually reproducing diploid animals (having two sets of chromosomes per cell), meiosis occurs during formation of the gametes (sex cells), so that the gametes are haploid (having only one set of chromosomes - half the number of chromosomes of the parent cell). When the gametes unite during fertilization, the diploid condition is restored.

(b) (Any three of the difference listed below.)

Mitosis	Meiosis
same number of chromosomes in daughter and parent cells	daughter cells contain half the number of chromosomes as that of parent cell
no pairing of homologous chromosomes	pairing of homologous chromosomes at prophase I
no crossing over	crossing over may occur
daughter cells are identical to parent cell	variations occur in the daughter cells
two daughter cells produced from one parent cell	four daughter cells are produced from one cell
involves only one nuclear division	involves two nuclear divisions
occurs in normal body cells during growth or repair of body parts	occurs in the gonads during gamete formations

Essay Questions

1. (i) Homologous chromosomes are chromosomes in a biological cell that pair (synapse) during meiosis, or alternatively, non-identical chromosomes that contain information for the same biological features and contain the same genes at the same loci but possibly different genetic information, called alleles, at those genes. For example, two chromosomes may have genes encoding eye color, but one may code for brown eyes, the other for blue. Homologous chromosomes are similar in length, except for sex chromosomes in several taxa, where the X chromosome is considerably larger than the Y chromosome. These chromosomes share only small regions of homology.

(ii) Non-homologous chromosomes representing all the biological features of an organism form a set, and the number of sets in a cell is called ploidy. In diploid organisms (most plants and animals), each homologous chromosome is inherited from a different parent. But polyploid organisms have more than two homologous chromosomes.

2. (a) The growth and division of cells (mitosis) and the formation of sperm and eggs (meiosis) are important for almost all organisms, including humans. We all began as a single cell that resulted from our father's sperm fertilizing our mother's egg. This single cell then divided by mitosis into two cells (daughter cells) which then grew and divided into four cells. This process of mitosis continued until we were born. It then continued again until we were "grown up". It is still happening right now as some of our cells use mitosis to replace old dead cells, such as skin cells. Meiosis, on the other hand, is a special form of mitosis that occurs only in a special subset of our cells to form eggs and sperm. In meiosis, one cell divides twice in a row to form four daughter cells from one cell. Those cells are then modified to become eggs or sperm. Mitosis and meiosis, then, are similar processes, but result in very different types of cells.

(b) (i) Sexual reproduction requires meiosis, a process in which a parent cell divides into four haploid cells, each with half the genetic material of the parent. A diploid parent cell, for example, divides to make four haploid cells. In sexual reproduction, haploid gametes from two individuals combine to produce a diploid zygote. An offspring resulting from sexual reproduction is genetically different from both parents.

(ii) The reason each offspring, and more generally, each individual has their own unique genetic code is due to genetic variation. First, there is independent assortment. This occurs when homologous chromosome pairs line up during Metaphase I of Meiosis. There is a fifty-fifty chance of each daughter cell getting one the of two chromosomes from the pair. Therefore, there are two options for each chromosome, a total of 2n options. Humans have a total of 23 chromosomes, creating a total of 8 million different gametes arising from a single germ line cell.

Unit 18 HEREDITY

Notes

1. Hereditary traits are traits that can be passed on from one generation to the next.

2. Genetics is the scientific study of heredity

   - the study of how traits are passed on from parents to their offspring
   - scientist who study heredity are called geneticists

Basic Definitions of Studying Heredity

3. Chromosome

   - a rod like structure visible in the nucleus during cell division
   - made up of deoxyribonucleic acid (DNA)
   - carry the information for making new animal or plant bodies
   - each chromosome may carry many genes along its length

4. Allele

   - different from genes
   - they occupy the same relative positions on a pair of homologous chromosomes
   - represented by letters
   - can be:
     - dominant – expresses itself and gives the same phenotype in both the homozygous and heterozygous conditions
     - recessive – does not express itself in the heterozygous condition but only in the homozygous conditions

5. Homologous chromosomes

   - exist in pairs – one from the male and the other from the female parent
   - are similar in shape and size
   - have exactly the same order or sequence of gene loci – alleles of gene loci may not be the same

6. Phenotype

   - refers to a trait that can be seen
   - the characteristic is expressed in the individual

7. Genotype

- genetic make-up of an organism – the combination of genes in an organism
- an organism is said to be homozygous for a trait if the two alleles controlling the trait are the same
- an organism is said to be heterozygous for a trait if the two alleles controlling the trait are different

Monohybrid Inheritance

8. Monohybrid inheritance refers to the inheritance of one characteristic.

9. The following are rules of genetics discovered by Mendel

- genes carry the characteristic from one generation to the next
- genes exist in pairs, one of which may be dominant
- in a gamete, only one gene from a pair is present
- when both the dominant and the recessive alleles are present, the dominant allele expresses itself

10. Co-dominance

- the inheritance of blood group in Man is an example of co-dominance in which both the genes for blood groups produce an effect when present together
- co-dominance is shown below

Blood groups	Genotype
A	I^AI^A, I^Ai^O
B	I^BI^B, I^Bi^O
AB	I^AI^B
O	i^Oi^O

- there are three genes which determine the blood group A, B and O
- an individual can have only two of the genes
- when a man of blood group A marries a woman of blood group O, and they have a son, the blood group of the son may be of blood group A or O depending on whether the man is homozygous or heterozygous

11. Sex determination in Man

- each cell has one pair of chromosomes that determine the sex of the animal
- males have an X and a Y chromosome
- females have two X chromosomes
- the sperm has either an X or a Y chromosome
- each ovum has an X chromosome
- fertilisation causes a zygote to form which grows into a male or a female

Mutations

12. Mutation

- the sudden change in the structure of the gene or the number of chromosomes in an organism
- can occur in body cells and this may lead to cancer
- can also occur in gametes resulting in genetic disorders in the off spring
- a mutant – an individual having characteristics altered by mutation

13. Gene mutation

- involves change to the structure of the gene
  - sickle cell anaemia – the structure of the gene which controls the production of one amino acid in the haemoglobin molecule of the red blood cell is altered
- caused by
  - exposure to atomic radiation such as alpha, beta, gamma, X-rays and cosmic rays
  - chemicals such as cyclamates (artificial sweetening agents) and mustard gas

14. Chromosome mutation

- involves a change in the number of chromosomes
- the number of chromosomes may be more or less than 46
  - down's syndrome and mongolism – caused by an extra chromosome in each body cell
- caused by
  - abnormality during gamete formation
  - the number of chromosomes may be less or more than 46
  - part of a chromosome may be lost
  - an additional part of a chromosome may be added
  - the arrangement of the genes may be reversed

Variation

15. Variation refers to the differences existing between individuals of the same species.

16. There are two type of variations:

- continuous variation – is a variation among individuals where there is a gradual transition between two extremes
  - examples: weight, height, size of foot, skin colour, etc
  - it is a result of both inheritance and environmental factors
- discontinuous variation – is a variation where the differences are distinct and do not show a gradual transition between the two extremes
  - examples: ABO blood groups, albinism, free or attached ear lobes, haemophilia
  - it is a result of inheritance or mutations and environmental factors do not affect it

17. Variation may be attributed to the following:

- random assortment – during cell division leading to the formation of gametes, the chromosomes, together with its genes, randomly group together
- crossing-over – during cell division, parts of the chromosomes may become detached and then be reattached at a different location or in a different sequence
- random combinations during fertilisation – different gametes possess different assortment of genes and there are many possible combinations of gametes during sexual fertilisation
- chromosome mutation
- gene mutation
- environmental factors – food supply, the availability of water, soil pH, minerals, oxygen supply, carbon dioxide concentration, temperature or light intensity are factors which can cause variation

Selection

18. Natural

- it is a process which results in the best adapted organisms in a population surviving to reproduce
- these organisms pass on more of their genes to the next generation

19. Artificial

- humans select the varieties of organisms that suit their needs
- varieties are produced by selective breeding

20. Comparing natural selection and artificial selection

Natural selection	Artificial selection
selection occurs when natural environmental conditions change	humans select the varieties or organisms that suit their needs
varieties are produced by mutations	varieties are produced by selective breeding

Multiple Choice Questions

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

1. Changes in the number of chromosomes can cause _____.

A colour blindness
B down's syndrome
C haemophilia
D sickle cell anaemia [ ]

2. Which of the following causes albinism?

A A change in chromosome number
B A mutation of the gene
C A hormone deficiency
D A virus infection [ ]

3. The gene for normal pigmentation changes to its albino allele in approximately 28 out of each million gametes. Which of the following best describes this change?

A Evolution
B Mutation
C Natural selection
D Melanism [ ]

4. Mutation can be caused by _____.

A exposure to atomic radiation
B infection by virulent pathogen
C inhalation of exhaust fumes
D consumption of alcohol [ ]

5. Which of the following statements about dominant gene is true?

A It gives the same phenotype on heterozygotes and homozygotes.
B It gives a greater chance of survival than a recessive gene.
C It is responsible for the male characteristics.
D It does not undergo mutation. [ ]

6. Alleles are _____.

A genes occupying the same relative position on a pair of homologous chromosomes
B a pair of homologous chromosomes alike in shape and size
C adjacent genes on one chromosome
D all the genes on one chromosome [ ]

Use the table below to answer questions 7 and 8.

	Father	Mother	Son	Daughter
Blood group	A	B	O	

7. Which of the following blood group genotypes cannot be that of the daughter?

A I^AI^O
B I^BI^O
C I^AI^A
D I^AI^B [ ]

8. If both parents are homozygous, the blood group of both son and daughter is _____.

A I^AI^A **C** I^AI^B
B I^BI^B **D** I^AI^O **[ ]**

9. Which of the following causes sickle cell anaemia?

A Bacterial infection **C** Dietary deficiency
B Gene mutation **D** Changes in chromosome number **[ ]**

10. _____ is a result of natural selection.

A Beef cattle **C** Disease-resistant crop
B Insecticide-resistant mosquitoes **D** Seedless oranges **[ ]**

Structured Questions

Write your answers in the spaces provided.

1. (a) Define the term *variation*, in living organims.

_____

_____

_____

(b) Give two examples of genetic variation in humans.

_____

_____

2. (a) State the term used to apply a change in a gene or a chromosome?

_____

_____

(b) How does the change in (a) affect future generations of a species?

_____

_____

(c) The appearance of the members of that species in (a) and (b) may change over several generations as a result of processes named in (a). State the term used to identify this process of change.

_____

_____

Essay Questions

Write your answers in the spaces provided.

1. (a) Distinguish between genes and alleles.

(b) What causes gene mutation?

(c) Explain how a man and a woman with normal red blood cells can have a child with sickle cell anaemia.

2. Distinguish between continuous and discontinuous variation, using examples where appropriate.

Answers

Multiple Choice Questions

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

Structured Questions

1. (a) Variation is the degree of difference between a set of parents and offsprings. These variations could be inherited or due to the external factors e.g. temperature, light, moisture which affect the development of the organism.

(b) Eye-colour and fingerprint

2. (a) Mutation

(b) When meiosis occurs to produce gametes, the changes allele will be transmitted to a gamete resulting in specific variations, in the offsprings.

(c) Evolution

Essay Questions

1. (a) Genes are units of inheritance passed on from parents to offspring during sexual reproduction. Alleles are a pair of genes that occupy the same position on a homologous pair of chromosomes. Genes determine the characteristics of a person. Alleles determine the forms of a particular characteristic. A person who is heterozygous has two alleles which are different i.e. a dominant allele and a recessive allele.

(b) Gene mutation involves changes to the structure of the gene. It is caused by exposure to atomic radiation such as gamma, X-rays and cosmic rays and, chemical or carcinogens such as cyclamates (used in artificial sweeteners) and mustard gas.

(c) A person with sickle cell anaemia is homozygous with genotype, Ss. A sickle cell anaemic person has inherited two recessive alleles from both parents. If the parents are heterozygous, Ss, and have normal haemoglobin, 25% of the children will have sickle cell anaemia.

2. Discontinuous variation produces individuals howing clear-cut and distinct differences with no intermediates between them. For example, the blood groups in Man (A, AB, B and O), the wing length in the mosquito and the sex in animals and plants (male or female). Continuous variation is characteristics in a population that show a complete gradation from one extreme to the other without any break. Examples are the different heights in a population and the different pigmentation (skin colour) in man.

Unit 19 MOLECULAR GENETICS

Notes

1. Deoxyribonucleuic acid (DNA) is a molecule that carries genetic information and a gene is a small segment of DNA that contains information used to make a single protein.

2. Organisation of DNA inside cells

   - each DNA molecule consists of two parallel strands twisted around each other to form a double helix (coiled structure)
   - a molecule of DNA is wrapped around proteins to form a single chromatin thread
   - during cell division, chromatin threads coil tightly into structures called chromosomes inside the cell nucleus

3. Basic unit that make up the DNA structure is known as nucleotide and each nucleotide is made up of:

   - deoxyribose – a sugar
   - a phosphate group
   - a nitrogen-containing base, all joined together

4. Nucleotides are building blocks of DNA and they can be joined together to form long chains called polynucleotides.

5. The rule of base pairing states the base of one chain bonded to those of the opposite chains and hence adenine (A) always bonds with thymine (T), and cytosine (C) always bonds with guanine (G).

6. Adenine and thymine are complementary bases. Cytosine and guanine are also complementary bases.

7. Each gene

   - is a small segment of DNA which controls the formation of a single protein such as an enzyme
   - stores a message (genetic code) that determines how an enzyme or protein should be made in the cell
   - consists of two polynucelotide chains
     - template – contains a sequence of nucleotides or bases

8. A cell cannot directly use the DNA template to make proteins and this is done through a two-step process
   - transcription
     - occurs in the nucleus
     - a process where the message stored in template DNA is copied to an mRNA molecule
   - translation
     - occurs in the cytoplasm
     - involves the ribosomes
     - uses the message stored in the mRNA to make a protein molecule

9. Genetic engineering is the technique used to transfer DNA from one organism to another organism from the same species or an organism from a different species.
   - The transfer of DNA involves inserting the genes of interest into a vector. The vector carries these genes into another organism.
   - Organism which have genes other than their own (foreign genes) inserted into them are called transgenic organisms.
   - Large scale commercial production of human insulin uses genetically engineered bacteria which are grown under optimal conditions.

10. Genetic engineering has several advantages over selective breeding.

Selective breeding	Genetic engineering
plants and animals used for breeding must be closely related or belong to the same species	genes from any plant or animal can be inserted into non-related species or different species
defective genes may be transmitted along with the healthy genes to the offspring	genes are carefully selected before transfer into an organism to reduce the risk of genetic defects being passed on to the offspring
selective breeding is a slow process that involves breeding over several generations and these requires large amounts of land	uses individual cells which reproduce rapidly in a small container in the laboratory
less efficient	more efficient

11. Some applications of genetic engineering have their benefits to society.

Applications	Benefits
low-cost production of medicine	important drugs such as human insulin are now more affordable to patients
production of crops that grow in extreme conditions	– drought-resistant crops – salt-tolerant crops – crops that make more efficient use of nitrogen and other nutrients
development of – crops that produce toxins that kill insect pests – pesticide-resistant crops	use of costly pesticides is reduced
development of foods designed to meet specific nutritional goals	improved nutritional quality of food

Multiple Choice Questions

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

1. Which of the following sets of offspring are genetically different from each other?

A Daughter amoeba produced by binary fusion
B Fungal spores from a single sprorangium
C Cuts shoots from a single plant
D Seeds from the same fruit

[ ]

2. The skin of an animal contains 8 chromosomes. How many chromosomes will be present in each of the gametes produced by this animal?

A An allele
B A gene
C A chromosome
D A nucleus

[ ]

3. Which of the following processes gives rise to organisms which are genetically different from each other?

A Binary fission in amoeba
B Production of spores by a mould fungus
C Production of seeds by a flowering plant
D Separation of small, fully-formed plants from a parent plant

[ ]

4. Which of the following bases is never found in RNA?

A Adenine
B Cytosine
C Gunine
D Thymine

[ ]

5. What is a codon?

A A length of DNA which codes for a particular protein.
B A part of the transfer RNA molecule to which a specific amino acid is attached.
C A part of the transfer of RNA molecule which recognises the triplet code on the messenger RNA.
D A part of the messenger RNA molecule that has a sequence of bases coding for an amino acid.

[ ]

6. Which of the following statements about the strands of a newly replicated DNA molecule is correct?

A Both strands are made up of newly assembled nucleotides.
B One strand is new and the other is part of the original molecule.
C Both strands contain some nucleotides form the original molecule.
D The sugar-phosphate chains are conserved and new bases are inserted between them.

[ ]

7. Which of the following is present in DNA but not in RNA?

A Adenine
B Cytosine
C Guanine
D Uracil **[ ]**

8. Which of the following statements describes base pairing in nucleic acids?

A Adenine cannot pair with either uracil or thymine.
B Guanine is paired with adenine.
C Hydrogen bonding can only occur between pyrimidine bases.
D Purine bases can only pair with pyrimidine bases. **[ ]**

Structured Questions

Write your answers in the spaces provided.

1. Explain the term *template*.

_____

_____

_____

_____

2. Explain how genes are arranged on a chromosome.

_____

_____

_____

_____

Essay Questions

Write your answers in the spaces provided.

1. (a) Describe the structure of DNA.

(b) Explain how human insulin can be synthesised by bacteria.

Answers

Multiple Choice Questions

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

Structured Questions

1. The term template strand refers to the sequence of DNA that is copied during the synthesis of mRNA. The opposite strand (that is, the strand with a base sequence directly corresponding to the mRNA sequence) is called the coding strand or the mRNA-like strand because the sequence corresponds to the codons that are translated into protein.

2. Many genes are arranged along the chromosomes in groups of related genes. These groups are called gene clusters. Related genes may be arranged in more than one physical cluster and a whole set of related genes is called a gene family. Gene clusters and gene families vary in importance in different taxonomic groups; they seem to be much rarer, for example, in insects than in mammals.

Essay Questions

1. (a) DNA is a polymer. The monomer units of DNA are nucleotides, and the polymer is known as a "polynucleotide." Each nucleotide consists of a 5-carbon sugar (deoxyribose), a nitrogen-containing base attached to the sugar, and a phosphate group. There are four different types of nucleotides found in DNA, differing only in the nitrogenous base. The four nucleotides are given one letter abbreviations as shorthand for the four bases. DNA is a normally double stranded macromolecule. Two polynucleotide chains, held together by weak thermodynamic forces, form a DNA molecule.

(b) Human recombinant insulin is produced by inserting the insulin gene into a suitable vector. The most readily available is a non-pathogenic weakened strain of the common bacterium *Escherichia coli*. The bacteria produce insulin that is chemically identical to its naturally produced counterpart.

Human insulin is the only animal protein to be made in bacteria in such a way that its structure is absolutely identical to that of the natural molecule. This reduces the possibility of complications resulting from antibody production.

In chemical and pharmacological studies, commercially available rDNA human insulin has proven indistinguishable from pancreatic human insulin. Initially the major difficulty encountered was the contamination of the final product by the host cells, increasing the risk of contamination in the fermentation broth. This danger was eradicated by the introduction of purification processes.

The entire procedure can now be performed using yeast cells as an alternative growth medium, as they secrete an almost complete human insulin molecule with perfect three-dimensional structure. This minimises complex and costly purification procedures.

Unit 20 ECOLOGY

Notes

1. Organisms continually interact with one another, as well as with their surroundings.

2. Ecology is the study of these interactions and scientists who study these interactions are called ecologists.

3. Ecologists study both the

   - living environment or biotic environment which consists of all the living things that an organism interacts with; and
     - Physical features affect the types of organisms living in it
     - Organisms living in an environment are adapted to its physical features
     - Populations of various species in an environment may live interdependently, forming ecological community
   - non-living environment or abiotic environment consists of the following physical factors.
     - light intensity – affects the distribution and growth of both plants and animals
     - temperature – affects the rate of reaction of enzymes, which control metabolic or physiological activities of plants and animals
     - amount of water available – as organisms cannot live without water, the amount of water available is one of the major factors affecting the number and location of plants and animals in a region
     - oxygen content – as most organisms are aerobic, they require oxygen for respiration and hence they cannot survive in environments of low oxygen content
     - salinity (salt concentration) of soil or water – an important factor that affect aquatic organism
     - pH of soil or water – affects the types of organisms that can live in such environments

4. Habitat is a place where an organism lives.

5. Population refers to a group of organisms of the same species living in a particular habitat.

6. All the populations of organisms living and interacting with one another in a particular habitat make up a community.

Ecosystem

7. An ecosystem is an ecological system formed by the interaction of living organisms and their non-living environment.

8. The living organisms in an ecosystem is made up of
   - producers (autotroph)
     - mainly green plants or chemosynthetic bacteria that can manufacture food by photosynthesis (converting light energy into chemical energy)
   - consumers – obtain their energy and nutrients from the organisms they feed on
     - herbivores – feed on green plants
     - carnivores – feed on animals
     - omnivores – feed on both animals and plants
   - decomposers – break down dead organisms and waste matter, taking in some of the energy and releasing the rest into the environment

9. A food chain is a linear series of organisms through which energy is transferred in the form of food.

10. A food web is made up of two or more food chains linked together. Here, an animal may eat more than one kind of food and may be eaten by a number of different consumers.

11. Pyramid of numbers allows for the comparison of the number of organisms present in each trophic level at a particular time.

12. Pyramid of biomass allows for the comparison of the mass of organisms present in each trophic level at a particular time.
    - biomass is the total weight of living mass
    - biomass decreases with each successive level in the food chain
    - biomass decreases as the trophic level increases
    - producers are present in the largest quantity of biomass

13. Pyramid of energy represents the total energy in the various trophic levels of a food chain.
    - producers occupy the first trophic level at the base of the pyramid – having the largest amount of energy
    - the quantity of energy which is available to the next trophic level decreases

14. The table below compares the pyramid of biomass and the pyramid of energy.

Pyramid of biomass	Pyramid of energy
related to the biomass of organisms	related to the energy content of organisms
constructed based on the biomass at any given time	constructed based on energy content over a period of time
does not consider the rate of reproduction of organisms	takes into consideration the rate of reproduction of organisms

The Carbon Cycle

15. Carbon is an element which is a component of a large number of substances.

16. Organic compounds containing carbon include carbohydrates, protein, fats and hydrocarbons.

17. Inorganic compounds include carbon dioxide, limestone and carbonates.

18. Carbon dioxide is taken out of the atmosphere during photosynthesis and returned to the atmosphere during respiration and decay. This is known as the carbon cycle.

19. Release of carbon dioxide into the atmosphere via:

    - respiration – oxidation of food substances such as carbohydrates, proteins and fats release carbon dioxide into the atmosphere
    - decay – during decomposition, carbon dioxide is released into the atmosphere
    - combustion – burning of fossil fuels such as coal, oil and natural gas produce carbon dioxide which is released into the atmosphere
    - volcanic eruption – carbon dioxide is released from the materials deep in the earth
    - limestone – the action of acid rain on limestone hills causes carbon dioxide to be released

20. Removal of carbon dioxide from the atmosphere via:

    - photosynthesis – carbon dioxide is absorbed by green plants to form carbohydrates, fats and proteins
    - chemosynthesis – carbon dioxide is converted by chemosynthetic bacteria to form carbohydrates
    - dissolution of carbon dioxide in sea water to form carbonates which are absorbed by animals to form shells

Multiple Choice Questions

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

1. The _____ is a producer.

A plant plankton
B animal plankton
C small fish
D heron
[ ]

2. Which of the following refers to green plants?

A Producer
B Consumer
C Herbivore
D Carnivore
[ ]

3. Which of the following best describes a boy when he is eating chicken wings?

A Decomposer
B Secondary consumer
C Primary consumer
D Tertiary consumer
[ ]

4. At the base of every food chain is an organism which _____.

A makes organic compounds from inorganic materials
B lives and feed on another organism
C feeds on dead or decaying matter
D eats plants
[ ]

5. The _____ converts urea to ammonia.

A decomposing bacteria
B denitrifying bacteria
C nitrifying bacteria
D nitrogen-fixing bacteria
[ ]

6. Which of the following best describes the organisms at the beginning of every food chain?

A They eat plants.
B They feed on dead or decaying matters.
C They make organic compounds from inorganic materials.
D They obtain energy by breaking down inorganic materials.
[ ]

7. Which of the following is a decomposer?

A Grass
B Bacteria
C Insects
D Small animals
[ ]

8. _____ is a chemical element found in all organisms that is not normally obtained by plants from the soil.

A Carbon
B Nitrogen
C Hydrogen
D Phosphorus
[ ]

9. In the carbon cycle, which of the following is important?

A Lightning
B Respiration of soil organism
C Absorption of mineral salts by roots
D Nutrition of the root nodules of leguminous plants **[ ]**

10. In a food web, the _____ is are the decomposers.

A bacteria
B hydra
C water fleas
D unicellular animals **[ ]**

Structured Questions

Write your answers in the spaces provided.

1. Study the food chain below.

tree → caterpillar → small bird → hawk

(a) Identify the

(i) the primary consumer;

_____

(ii) the producer; and

_____

(iii) the herbivore.

_____

(b) Name the process by which carbon dioxide is incorporated into the leaf.

_____

(c) Besides chemical substances, what else is passed along such a food chain?

_____

_____

2. (a) What are decomposers?

_____

_____

(b) Describe the importance of decomposers.

_____

_____

_____

Essay Questions

Write your answers in the spaces provided.

1. (a) (i) What is a food chain?

(ii) Give an example of a food chain involving four trophic levels.

(b) How is energy passed in a food chain?

(c) Explain why it is considered inefficient for man to consume meat.

2. Define *producer* and how the activities if producers affect the lives of the other organisms.

Answers

Multiple Choice Questions

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

Structured Questions

1. (a) (i) caterpillar
(ii) tree
(iii) caterpillar
(b) Photosynthesis
(c) It is energy (light energy) which originates from the sun.

2. (a) A decomposer feeds on dead or decaying matter. It obtains its food by secreting enzymes to digest the food before absorbing it.
(b) The role of the decomposer is to decay plant and animal matter. The decayed substances usually contain nitrogen which is returned to the earth so that it can be used by plants for growth and development.

Essay Questions

1. (a) (i) A food chain is a linear series of organisms through which energy is transferred.
(ii) grass $\rightarrow$ grasshopper $\rightarrow$ frog $\rightarrow$ snake
(b) Energy flows in one direction. It is non-cyclical. Light energy from the sun is absorbed by green plants to produce carbohydrates during photosynthesis. This light energy is then converted to chemical energy and stored in organic compounds. Herbivores feed on the plants. This energy is used by the herbivore to grow. Carnivores obtain their energy when they feed on herbivores.
(c) At each stage of the food chain, energy is progressively lost to the environment. This energy lost is due to heat during respiration. Only 10% of the energy in the food is used for growth. 90% is lost as heat energy or remains unutilised in the form of undigested food in the faeces. The longer the food chain, the less of the original energy trapped by the sun, is passed on. Man get less energy form eating meat, compared to eating the same amount of plant protein.

2. It is a living thing that can manufacture organic (food) substances form inorganic matter. Green plants are the only living things to be considered as producers as they manufacture glucose form inorganic materials such as carbon dioxide, water and light. Other organisms are very dependent on plants as they are the only food source. They obtain their food either directly or indirectly from the plants. For instance, the caterpillar obtains its food from the leafy plant. In turn, a bird would prey on the caterpillar, thus indicating that it is still indirectly dependent on plants for their food. Hence a food chain has been established. If supposing the number of green plants decrease considerably, this would lead to the death of the other animals as well and eventually extinction of some of the species.

Unit 21 OUR IMPACT ON THE ECOSYSTEM

Notes

1. Natural resources are resources supplied by nature that are used by humans and these can be:
   - renewable – can be replaced by natural cycles
   - non-renewable – cannot be replaced once they are used

2. Deforestation is the clearing of forests and this give rise to:
   - soil erosion
   - flooding
   - desertification
   - climate changes

3. Pollution is the process in which potentially harmful substances are released into the environment.
   - water pollution by sewage
     - sewage is waste water
     - effects of untreated sewage discharge in the ecosystem
       - organic waste such as urine and faeces contain bacteria which causes diseases to spread
       - sewage is a rich source of nutrients for bacteria and algae to multiply – they strive very wells
   - water pollution by inorganic wastes
     - inorganic wastes are discharged by industries into rivers and seas e.g.
       - phosphate ions form phosphate detergents
       - fertilisers not absorbed by the soil
       - many industrial wastes are non-biodegradable e.g. mercury, cadmium, nickel and chromium
     - effects of inorganic wastes on the ecosystem
       - mercury released into the water is absorbed by primary consumers and becomes more concentrated from one trophic level to the next trophic level in a food chain
       - phosphate detergents and inorganic fertilisers decrease the amount of oxygen that is dissolved in the water and encourage the growth of bacteria and algae – fishes die due to lack of oxygen
   - air pollution by sulphur dioxide
     - released into the atmosphere by industries and car exhausts
     - sulphur dioxide combines with moisture in the air to form acids and resulting in acid rain
     - effects

        - sulphur dioxide gas penetrates the leaves and stems resulting in the destruction of plant tissues
        - gases cause respiratory diseases such as bronchitis and lung cancer
        - acid rain decreases the pH of lakes and ponds, causing fishes and other pond animals to die and other animals in the food chain are also affected
        - acid rain causes skin irritation
        - corrodes stone or cement buildings as well as metal structures such as zinc roofs and bridges
    - pollution due to insecticides
        - insecticides are frequently used to kill the pests which attack and damage crops
        - chemical insecticides such as DDT are used on a large scale to kill pets which attack vegetables and fruit trees
            - insecticides such as DDT are non-biodegradable – they are not chemically broken down into simpler, harmless, inactive substances
            - DDT is very persistent – it accumulates in the fatty tissues of organisms and its toxicity accumulates along the food chain
            - DDT is non-specific – kills both target and non-target animals

4. Conservation is the protection of the natural environment.

5. Conservation include ways of:

    - protecting wildlife
    - keeping the environment clean
    - saving the natural resources so that the natural balance of nature can be maintained

6. Conservation of species are done for various reasons such as:

    - ecological value
        - each specie of plant and animal is part of the ecosystem
        - extinction of one or more species will upset the natural balance of nature in the ecosystem
    - economic value
        - forest is the source of many useful products such as rubber, fibres
        - products from the forest provide raw materials for industries
        - chemicals are extracted from plants
    - scientific value
        - plants and animals serve as a source of
            - genetic materials
            - natural drugs and antibiotics

7. Recycling

    - many of our natural resources are non-renewable
    - recycling helps to conserve resources
    - reasons for recycling
        - reduces wastes
            - garbage can be burnt or buried in landfills
            - whether burnt or buried, toxic gases are released

- toxic gases pollute the surrounding ecosystem
- recycling technology and systematic garbage collection reduces waste pollution

✧ saves energy
- recycling paper uses up to 64% less energy than making new ones

✧ conserves natural resources
- recycled water from sewage can be used in industries, flushing toilets and watering of plants
- recycled paper can be used for printing and manufacture of paper bags

Multiple Choice Questions

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

1. Which of the following would help keep environmental pollution caused by the insecticides at the lowest level?

A Easily washed into lakes and rivers
B Broken down by soil bacteria
C Taken up by plant roots
D Extremely poisonous **[ ]**

2. Which of the following would cause acid rain to be acidic?

A Smoke
B Dust particles
C Lead compounds
D Sulphur dioxide **[ ]**

3. Which of the following would be the long term effect of cutting down large areas of the rainforest?

A Decreased carbon dioxide content in the air
B Decreased flooding of low-lying land
C Increased rainfall in these areas
D Increased rate of soil erosion **[ ]**

4. Which of the following causes the decrease in oxygen concentration in a lake polluted by sewage?

A A decrease in dissolved nitrate concentration
B A decrease in the number of consumers
C An increase in the number of decomposers
D An increase in the number of green plants **[ ]**

5. Which of the following explains why DDT has been largely replaced by other compounds as a pesticide?

A It becomes more concentrated at each stage in the food chain.
B It destroys one particular pests only.
C It breaks down readily in the soil.
D It is difficult to apply. **[ ]**

6. Which of the following is the result of deforestation on the environment?

A More water drains away
B Fewer flowering plants
C More ground cover
D Fewer trees **[ ]**

7. Which of the following air pollutants could cause rain to be acidic?

A Sulphur dioxide from coal-fired power stations
B Dust particles from cement factories
C Lead compounds from car exhaust
D Smoke from wood fires

[ ]

8. A lake polluted with sewage will have _____.

A more nitrogen compounds
B more oxygen
C fewer bacteria
D more fish

[ ]

9. Which of the following is the effect of deforestation on the environment?

A Reduced carbon dioxide in the air
B Increased humidity of air
C Wind removes soil
D Soil washed away

[ ]

10. Which of the following is an undesirable feature in a pesticide?

A It becomes more concentrated at each stage in the food web.
B It destroys the immature forms of the pest.
C It breaks down within a few months.
D It destroys one particular pests only.

[ ]

Structured Questions

Write your answers in the spaces provided.

1. (a) Why are forests cleared?

_____

_____

_____

(b) List the effects of deforestation.

_____

_____

_____

_____

2. What is the importance of maintaining biodiversity?

_____

_____

_____

_____

_____

Essay Questions

Write your answers in the spaces provided.

1. (a) Define the term *pollution*.

(b) What are the major causes of air pollution?

(c) Describe the effects of air pollution on the natural ecosystem.

2. (a) Explain why it is important to conserve living organisms for the benefit of

(i) the human population; and

(ii) the natural environment.

(b) Explain why we need to recycle manufactured materials.

Answers

Multiple Choice Questions

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

Structured Questions

1. (a) Forests are cleared to meet the increasing demands for land and materials such as wood.

(b) Deforestation causes soil erosion, flooding, desertification and climate changes.

2. It is important to maintain biodiversity to ensure that the ecosystem is balanced. Organisms are in a way interdependent of one another and thus the protection and preservation of natural resources in the environment is important.

Essay Questions

1. (a) Pollution is any process which leads to the harmful increase in the amount of chemical substances, sound or radiation in the environment.

(b) The major causes of air pollution are
- combustion of fossil fuels which releases sulphur dioxide, nitrogen oxides, carbon monoxide and carbon dioxide
- aerosol cans and refrigerators release chlorofluorocarbons
- smoke from industries release various poisonous gases and particulate matter
- nuclear tests, and nuclear power stations release radioactive substances

(c) Effects of air pollution on the natural ecosystem
- sulphur dioxide reacts with oxygen and water in the air to form sulphuric acid which, when breathed in, will irritate the lining of the airways of man and other animals – the acid dissolves in the rain and falls as acid rain, which changes the pH of the environment and this could lead to the death of both plants and animals in that environment
- poisonous gases in smoke may retard the growth of trees in the forests
- formation of smog which consists of smoke and fog can cause the death of humans and animals
- corrosion of stone buildings occur in regions with acid rain and acidic gases

2. (a) (i) The conservation of the living organisms provides several benefits for the human population.
- Forests are a major source of oxygen for all living organisms
- Tropical plants possess medicinal properties
- Marine fisheries are a major source of human food
- There is scientific value in certain living organisms. The study of wildlife provides information for man's survival
- Natural resources should be maintained for outdoor recreational activities such as fishing, hiking and skiing
- Conservation preserves the natural scenery and wildlife for people to appreciate

(ii) The conservation of living organisms is important for the preservation of the natural environment. Forests help to moderate the weather, providing shade which prevents the soil from being heated up by the sun. The forest houses a large number of organisms. Each organism has a role to play in maintaining the balance of nature in the ecosystem. The forests also reduce the rate of evaporation of water from the soil to prevent excessive soil erosion as the roots bind the soil particles together.

(b) Recycling is one of the methods for conserving resources. Instead of dumping manufactured materials as rubbish after use, some of these are valuable materials which could be recycled and used again. Recycling also saves money and energy.