CYTOLOGY
AND
BIOCHEMISTRY

Question 1

Give two (2) functions of each of the following cellular organelle.

i) Nucleus
ii) Endoplasmic reticulum
iii) Lysosomes
iv) Golgi bodies

Question 2

State five (5) functions of membranes within cells

Question 3

The endosymbiotic hypothesis states that certain organelles of the eukaryotic cell arose as prokaryotic invaders of eukaryotes. What organelles would you suggest are included in this hypothesis? Explain your answer

Question 4

Describe four advantages of an organism to be multicellular.

Question 5

Name five non – membranous structure (organelles)

Question 6

Lysosomes are sometimes known as “suicide bags”. Give reason to support this statement

Question 7

What is meant by the term Lysosomes?

Question 8

Discuss the role played by the Golgi apparatus as cell’s post office.

Question 9

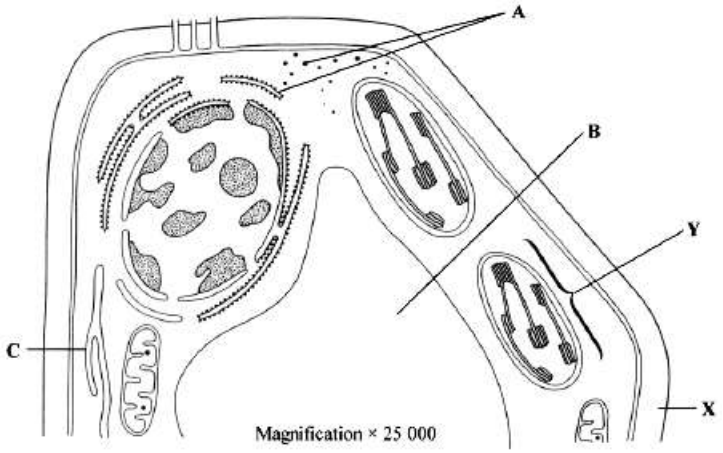
Draw a large and neat diagram of a chloroplast and label the parts involved in the process it undertakes

Question 10

What advantages does a eukaryotic cell gain by having internal membrane bound organelle?

Question 11

The diagram below shows part of a plant cell as seen through an electron microscope.



a) Name organelles, A, B and C
b) Give the function of;
   i) Structure X:
   ii) Structure Y:

Question 12

Outline the main ideas of the cell theory

Question 13

Why is it advantageous for cells to be small?

Question 14

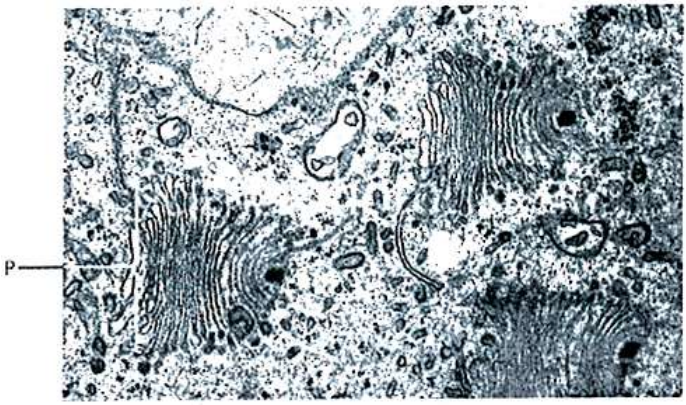
Why are mitochondria and chloroplasts said to be cells within a cell?

Question 15

How is the chloroplast adapted to its function?

Question 16

The electron micrograph below is a section through part of a cell showing a group of organelles.



Magnification ×16 000

a) Name the organelle labeled P
b) The electron micrograph below is a section through part of a cell showing mitochondria.

Magnification ×10000

i) Using information from these electron micrographs and your own knowledge, compare the structure of mitochondrion with the structure of the organelle labeled P

ii) Explain why the presence of these two organelles indicates the cell is eukaryotic

Question 17

a) Define eukaryotic cell.
b) Name a structure found in the cytoplasm of both eukaryotic and prokaryotic cells

Question 18

The fluid mosaic model of membranes is described as dynamic. What does the word dynamic imply in this context?

Question 19

What are the differences between Danielle Davson model and fluid Mosaic model?

Question 20

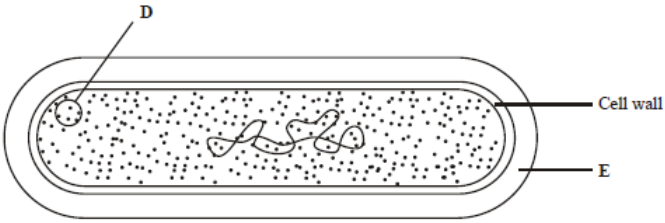
What is the difference between a "lipid bilayer" and a "double membrane"?

Question 21

What is the composition of the non – polar tail of a phospholipid?

Question 22

The diagram below shows a bacterial cell.



i) Name the parts labeled D and E
ii) State one function for each of the labeled part

Question 23

Complete each box in the table below which compares a prokaryotic and an eukaryotic cell, with a tick if a statement is correct or a cross if it is incorrect.

	Prokaryotic cell	**Eukaryotic cell**
Contains ribosomes attached to the endoplasmic reticulum		
Genetic material consists of linear chromosomes		
Diameter of the cell is 1μm		

Question 24

a) What are lysosomes?
b) One of the functions of lysosomes is autolysis
   i) What is meant by the term "autolysis"?
   ii) Mention the other functions of lysosomes.

Question 25

The table below refers to three organelles commonly found in eukaryotic cells. Complete the table by writing the name of the organelle, its description or one function, as appropriate, in each of the five boxes provided.

Name of Organelle	**Description**	**One function**
Golgi apparatus		

	Cylindrical organelles made up of microtubules	Involved in spindle organization during cell division in animal cells
	Rod – shaped structures with a double membrane, the inner one folded to form cristae	

Question 26

The cell surface membrane is composed of a phospholipid bilayer. Explain why the phospholipids in the bilayer are arranged with fatty acids pointing inwards and the phosphate heads outwards.

Question 27

a) What is unsaturated fatty acid?
b) Explain how unsaturated fatty acids increase the membrane fluidity and state why organisms living at low temperature have high proportions of unsaturated fatty acids in their membranes.

Question 28

Make a labeled diagram of a prokaryotic cell

Question 29

Give the functions of the mesosomes, pilus and plasmid in bacteria.

Question 30

Define prokaryotic cell.

Question 31

State five (5) differences between prokaryotic and eukaryotic cells.

Question 32

Draw a large diagram of a typical plant cell as seen under the electron microscope showing the cellular structures concerned with;

i) Protein synthesis
ii) Cellular respiration
iii) Control of cell division
iv) Photosynthesis
v) Transport of substances between two neighboring cells.

Question 33

Differentiate the following

i) Nucleus from nucleolus
ii) Plant vacuoles and animal vacuoles

Question 34

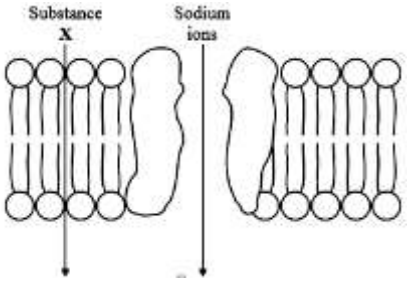
Draw a simplified structure of the plasma membrane according to the fluid mosaic model.

Question 35

Point out the differences between cell wall and cell membrane.

Question 36

The diagram below shows part of a plasma membrane. The arrows shows the path taken by sodium ions and by substance X when they diffuse through the membrane into a cell



i) Give two properties of the molecules of substance X which allows them to diffuse through the membrane of position shown

ii) What name is given to the type of transport protein through which sodium ions diffuse?

Question 37

A number of factors influence the rate of diffusion.

$$\text{Rate of diffusion} \propto \frac{\text{surface area X difference in concentration}}{\text{Thickness of exchange surface}}$$

Complete the table below showing which factors are high and which are low when there is rapid rate of diffusion.

Factor	Value of factor which producing a rapid rate of diffusion (high or low)
Surface area	
Difference in concentration	
Thickness of exchange surface	

Question 38

Distinguish between rough and smooth endoplasmic reticulum

Question 39

i) What is the major function of cell membrane that cannot be performed by the cell wall?
ii) What is the biological significance of microbodies?

Question 40

Explain what is meant by the term facilitated diffusion.

Question 41

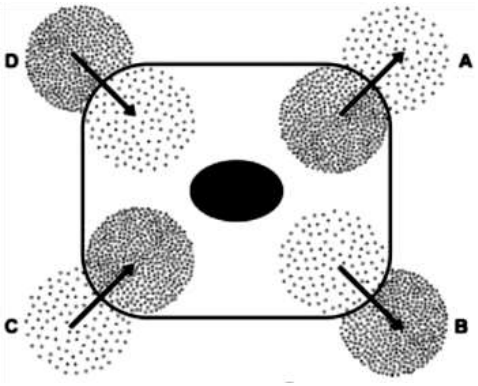
State two ways in which active transport differs from facilitated diffusion.

Question 42

Define the term osmosis.

Question 43

The diagram below shows four ways in which molecules may move into or out of a cell. The dots show the concentration of molecules.



The cell is respiring aerobically
Write the correct letter A, B, C or D next to each process.

Process	Arrow A, B, C or D
The movement of oxygen molecules	
The movement of carbon dioxide molecules	
The active uptake of glucose molecules	

Question 44

Explain why the structure of the cell membrane is called fluid mosaic

Question 45

What is the role of the following structures in the cell membrane?

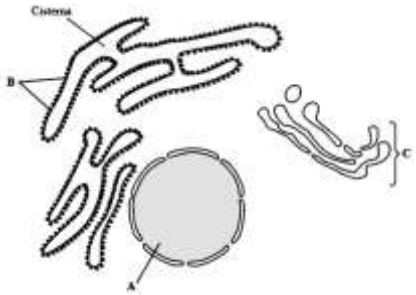
i) Glycoprotein
ii) Cholesterol
iii) Carrier protein
iv) Channel protein
v) Glycolipids

Question 46

Outline the types of membrane proteins.

Question 47

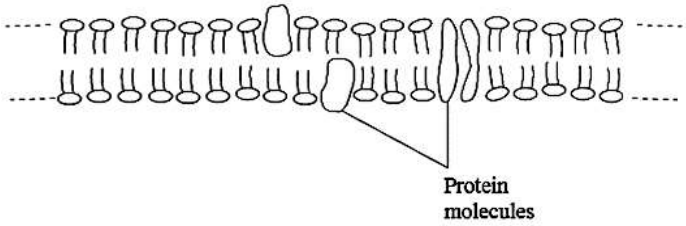
The diagram below shows a section through part of a cell as it would appear when seen with an electron microscope



This cell produces and secretes a protein. Describe the part played by organelles A, B and C in producing and secreting this protein

Question 48

The diagram below shows the fluid mosaic model of cell membrane structure.



a) Give two functions of the protein molecules in the cell membrane.
b) Explain how hydrophobic areas in the membrane are important to its function.

Question 49

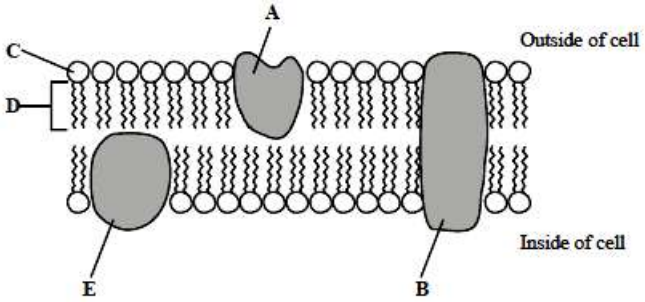
A student was asked to describe the structure of two organelles which were present on an electron micrograph. From the description below identify the organelles, and in each case, name the internal structure bolded.

a) These organelles were disc shaped and had an outer envelope of two membranes. Within it was **a series of further membrane which crossed the organelle like railways tracks**. At intervals the membranes appeared to repeatedly double back on themselves to form stack like structures. In the spaces between the membranes was a granular material.

b) This organelle had a round shape and had an outer envelope of two membranes, which was perforated in places. Within it were thin strands which did not appear to have the width or organization of membranes
One large round structure was visible internally.

Question 50

The diagram below shows part of cell surface membrane



a) Complete the table by writing the letter from the diagram which refers to each part of the membrane

Part of membrane	**Letter**
Transmembrane protein	

Contain only the elements carbon and hydrogen	

b) Explain why the structure of a membrane is described as being fluid mosaic?

Question 51

Name the following structures found in bacterial cells:

i) A long whip – like filament used in movement
ii) An organelle where proteins are synthesized
iii) A small circular piece of DNA which carry genes additional to those on the main loop of DNA

Question 52

State four (4) ways in which mitochondria and chloroplasts are similar to bacterial cells.

Question 53

Draw a well labeled diagram of a mitochondrion as seen under the electron microscope.

Question 54

Explain how the mitochondrion is adapted to the function it performs

Question 55

What is the functional relationship between the Golgi apparatus, nucleus, lysosomes and endoplasmic reticulum?

Question 56

List two places where cilia are found, and state the functions in each situation.

Question 57

Distinguish bacterial cells from frog's cells on the basis of the following features;

i) Size of the cells
ii) Outer boundary materials
iii) Types of hereditary materials and their location
iv) Organelle for respiration
v) Organelle for synthesis of protein
vi) Organelle for transport of lipids and proteins.

Question 58

Draw a large well labeled diagram of a typical plant cell as seen under electron microscope.

Question 59

Describe a chemical test you could carry out to show that a piece of coconut contains lipids.

Question 60

The table below refers to chemical tests for biological molecules. Complete the table:

		Observation if biological molecule is	
Method	Biological molecule tested for	Present	absent
Add a few drops of iodine solution			
Add alcohol and shake; pour into water			

Question 61

Briefly describe the biuret test.

Question 62

A student was carrying out some tests to identify substances present in a solution. It was known that there were two different food substances in the solution. Three different tests were carried out, each one on a separate $10cm^3$ sample. The tests that were carried out and the results are shown in the table below

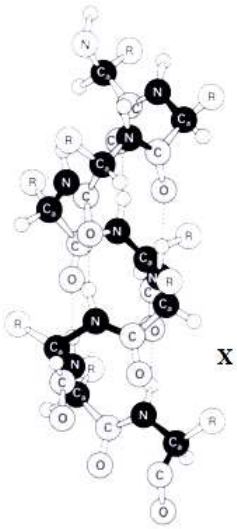
Test	**Result**
The biuret test was carried out	A purple colour was observed
The benedict's test was carried	The blue colour of the reagent did not change on heating

Dilute hydrochloric acid was added and the mixture was boiled, it was allowed to cool, neutralized and then test 2 was carried out	The blue colour of the reagent changed to a brick – red precipitate on heating

State the two food substances present in the student's solution

Question 63

The figure below shows a diagram of part of a polypeptide chain. This type of twisted structure is commonly found in proteins of many different types



X

a)

i) Name the repeating unit of a polypeptide chain.

ii) State the name given to the twisted structure shown in the figure.

iii) Identify the type of bond in the structure labeled by the letter X.

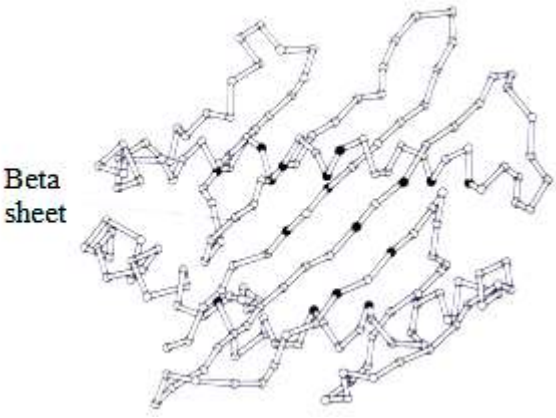
iv) Explain briefly what would happen to the polypeptide chain if it were heated to about 70ºC.

v) The twisted arrangement seen in the figure above is referred to as a secondary structure. Explain what is meant the term secondary structure.

b) Another common secondary structure is known as the beta sheet. State one difference between the beta sheet and the structure shown in the figure above.

Question 64

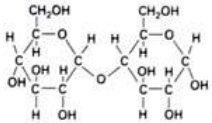
a) Proteins can be classified as fibrous or globular. Name one example of each type of protein. Globular proteins such as that shown in the figure below are often described as tertiary structures. However, as indicated in the diagram, many globular proteins may also have sections of secondary structures.

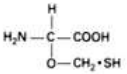


b) Explain what is meant by the term tertiary structure.

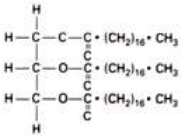
Question 65

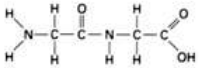
The diagrams below represent organic molecules. Using only the letters adjacent to the diagram indicate:

A 

B 

C 

D 

E 

a) Which structure contains a peptide bond?

b) Which structure contains a glycosidic bond?

c) Which structure is an amino acid?

d) Which structure is characterized by its solubility in organic solvents?

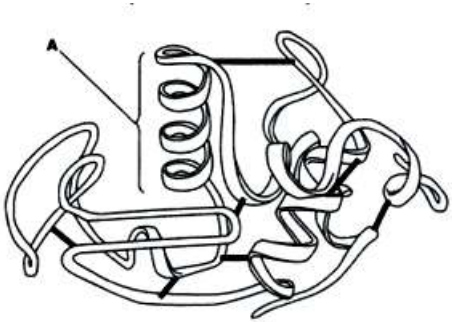
e) Which structure is a monosaccharide?

f) Which structures has been made as a result of a condensation reaction.

g) Which structure would require 3 water molecules for complete hydrolysis?

Question 66

Lipase is an enzyme that catalyses the hydrolysis of triglycerides. It is a soluble globular protein. The function of an enzyme depends upon the precise nature of its tertiary structure. The figure represents the structure of an enzyme. The black strips represent the disulphide bonds which help to stabilize its tertiary structure.



a) Describe the nature of the disulphide bonds that help to stabilize the tertiary structure of a protein such as lipase.

b) Name two other types of bonding that help to stabilize tertiary structure.

Question 67

Region A on the figure (from question 38) is a secondary structure. Describe the nature of region A.

Question 68

Monosaccharides can also be linked together to form long chain molecules called polysaccharides. Give three differences (other than the presence of monosaccharides or amino acids) between a polypeptide and a polysaccharide chain.

Question 69

Tabulate five differences between collagen and hemoglobin.

Question 70

Haemoglobin possesses a quaternary structure. What does this mean?

Question 71

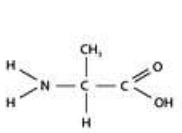
Outline the classification of proteins?

Question 72

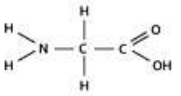
Name the five elements found in haemoglobin.

Question 73

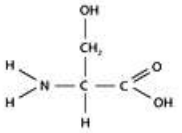
The diagrams below show the structure of three amino acids



alanine



glycine



serine

a) Draw a diagram to show the structure of a tripeptide with the following sequence:alanine – glycine – serine

b) What is the name given to the sequence of amino acids in a protein?

Question 74

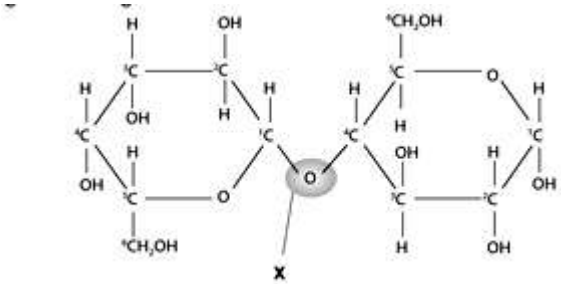
With reference from figure from question 43, what substance, apart from the tripeptide, would be formed when the three amino acids combine?

Question 75

Briefly explain the groups of amino acids?

Question 76

The diagram below shows a disaccharide called lactose. The carbon atoms are numbered. You are not expected to have seen this structure before. Lactose is a reducing sugar found in milk. It is made from a reaction between two monosaccharides: glucose and galactose.



a) Suggest two functions that lactose could have.

b) What is the name given to the reaction referred above those results in the formation of lactose?

Question 77

With reference from figure of question 76,

c) Identify the bond labeled X in the diagram

d) Draw diagrams to show the structures molecules of lactose.

Question 78

With reference from figure of question 76,

a) Using the information in the diagram, is the alpha or beta form of glucose used to make lactose? Explain your answer.

b) Like lactose, sucrose is a disaccharide. If you were given a solution of sucrose and lactose, state briefly how you could distinguish the two.

Question 79

Copy and complete the table below which summarizes some of the functional categories into which proteins can be placed.

Category	**Example**

Structural	
Enzyme	
	Insulin
	Haemoglobin and myoglobin
Defensive	
	Actin and myosin
Storage	

Question 80

State three (3) features that α- helices and beta sheets have in common.

Question 81

The table compares monosaccharides and amino acids. Copy and complete the table by ticking (V) each statement that you think is correct and putting a cross (X) where you think the statement is incorrect.

Statement	**Monosaccharides**	**Amino acids**
Always contain nitrogen		
Many be polymerized into macromolecules		
Insoluble in water		

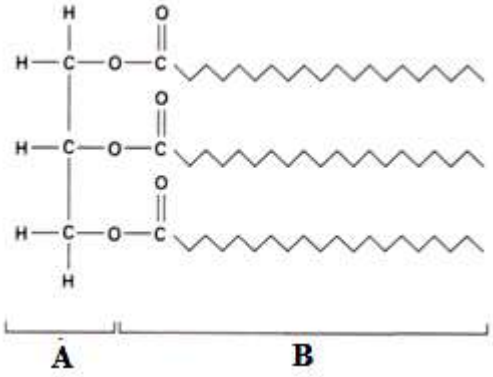
May be linked by glycosidic bonds		
Released by complete hydrolysis of cellulose		
Always contain carbon, hydrogen and oxygen.		

Question 82

Tabulate four differences between cellulose and glycogen.

Question 83

The diagram below shows the structure of a lipid molecule:



a)

i) Name the parts labeled A and B

ii) Name the type of lipid

iii) Name the chemical reaction used to form the bonds between A and B

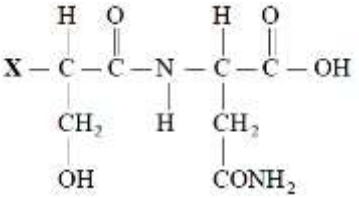
b)

i) State one function of this type of lipid in living organisms

ii) State one feature of the molecules of this type of lipid which makes them suitable for the function you have given.

Question 84

The following diagram shows the molecular structure of a dipeptide which has been formed by joining two amino acids together



i) Give the formula of the chemical group present at position X on this molecule.

ii) The table below shows the chemical structure of the R – group in a number of different amino acids.

Amino acid	**Structure of R – group**
Alanine	CH_3
Asparagine	CH_2CONH_2
Aspartic acid	$CH_2\ COOH$
Glutamine	$(CH_2)_2CONH_2$
Serine	$CH_2\ OH$

Use the information in the table to name two amino acids from which the dipeptide was formed.
First amino acid –
Second amino acid -

Question 85

Starch, cellulose, phospholipids and proteins are all macromolecules.

i) Which of these molecules is

- Not a polymer
- Not found in a chloroplast?

ii) Give one chemical element present in all proteins but not present in starch, cellulose and phospholipids.

Question 86

Define and classify monosaccharides

Question 87

Outline the chief functions of monosaccharides.

Question 88

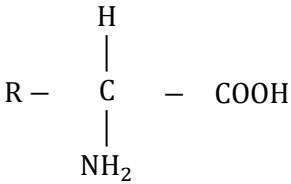
The suitability of cellulose and starch to their respective structural and storage roles is related to their molecular structures. Relate their functions to their molecular structure.

Question 89

Outline four properties of which a typical should have in order for it to function as a biological catalyst.

Question 90

Below is the structure of one important molecule in the body



a)

i) What general type of a molecule is shown is the formula?
ii) What is the simplest form of R?

b) Which part of the structure gives acidic properties, and which part gives basic properties to the molecule?

Question 91

With reference to the structure in question 90,

a) Such molecules show polymerization and are thus very important biologically.

   i) What is meant by polymerization?

   ii) If molecules of this type polymerize, what will be formed?

b) With the aid of a diagram, illustrate the product formed when two of the units shown above are joined.

Question 92

With reference to the structure in question 90,

a) What general type of a biochemical reaction is this?

b) What name is given to the type of bond formed between the two units?

Question 93

Why water is termed as the universal solvent?

Question 94

Discuss the biological significance of the properties of water to living organisms?

Question 95

"Without lipids life could be difficult for the living organisms". Justify this statement

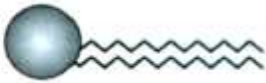
Question 96

How would you expect the saturation levels of membrane phospholipid fatty acids to differ in plants adapted to cold environments and plants adapted to hot environments?

Question 97

How do fats differ from oils?

A



B

Question 98

Identify with labels which one represents a lipid and which a phospholipid?

Question 99

With reference of figure from question 97

a)

i) Which of the two molecules is water-soluble?

ii) Explain your answer to c (i) above.

b) State one function of each molecule.

Question 100

With aid of a diagram, describe the structure of isomers of a glucose molecule

Question 101

What structural features of carbohydrates amount for the fact that a wide variety of polysaccharides exists.

Question 102

Water is important for all living organisms. The functions of water are directly related to its physical properties. What properties of water contribute to each of the following?

a) Transpiration.

b) Thermoregulation in endotherms.

Question 103

What is unique about solid state of water when compared with the solid state of other compounds?

Question 104

Relative to other substances, water tends to resist changes in temperature. Why?

Question 105

Water strides are common insects that can skip across the surface of ponds and streams. This life style is enabled by two properties of water. Name them correctly

Question 106

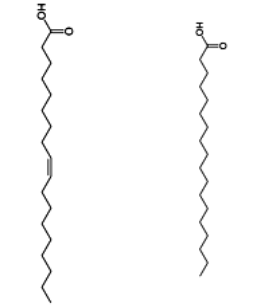
Water is colorless and transparent. What is the collective biological significance of these properties?

Question 107

Name two proteins which are structural molecules and two carbohydrates which are structural molecules

Question 108

Given two fatty acids



oleic acid stearic acid

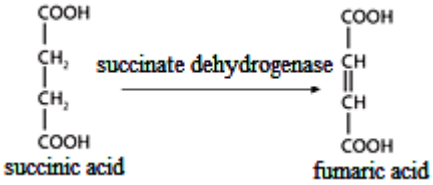
i) Which of the two is unsaturated fatty acid?

ii) Tristearin and triolein are glycerides made up of fatty acids stearic acid and oleic acid respectively. Which one is more likely to be an oil? Give reasons(s)

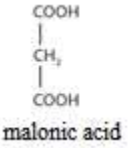
Question 109

The reaction below occurs during aerobic respiration. The reaction is catalysed by the enzyme succinate dehydrogenase.

a) Name the substrate in this reaction



b) The molecule malonic acid, which is shown here, inhibits this reaction. It does not bind permanently to the enzyme. Describe how malonic acid the enzyme succinate dehydrogenase.



Question 110

Heavy metals such as lead and mercury bind permanently to –SH groups of amino acids present in enzymes. These –SH groups could be in the active site or elsewhere in the enzyme.

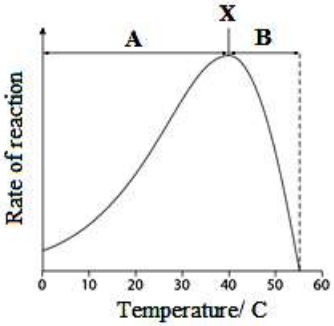
a)

i) Name the amino acid which contain –SH groups.
ii) Explain the function of –SH groups in proteins and why binding of heavy metals to these groups inhibit the activity of an enzyme.

b) What type of inhibition would be caused by the heavy metals?

Question 111

The graph below shows the effect of temperature on the rate of reaction of an enzyme.



a)

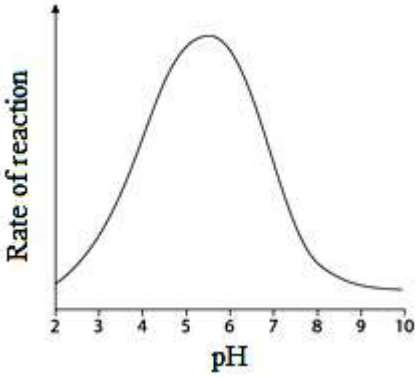
i) What is indicated by X?
ii) What temperature would X be for a mammalian enzyme?

b)

i) Explain what is happening in region A.
ii) Explain what is happening in region B
iii) Enzymes are effective because they lower the activation energy of the reaction they catalyse. Explain what is meant by "activation energy"

Question 112

The graph shows the effect of changes in pH on the activity of the enzyme lysozyme.

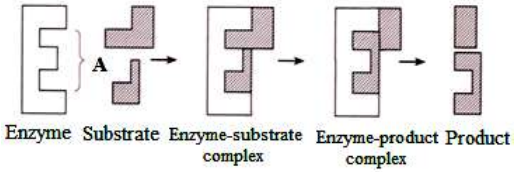


a) Briefly describe the effect of pH on activity of enzymes

b) Explain why pH affects the activity of enzymes

Question 113

The diagrams below illustrate one model of enzyme action



a)

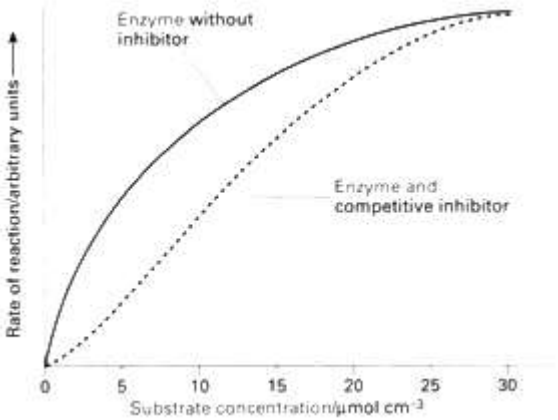
i) Name the part of the enzyme labeled A.

ii) Explain how this model can account for the specificity of enzymes.

b) With reference to this model, explain the effect of a competitive inhibitor on an enzyme catalysed reaction

Question 114

The graph below shows the results of an investigation into the effect of a competitive inhibitor on an enzyme controlled reaction over a range of substrate concentrations.



a) Give one factor which would need to be kept constant in this investigation

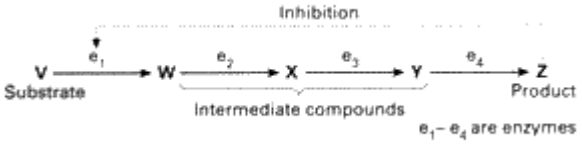
b)

i) Explain the difference in the rates of reaction at the substrate concentration of $10\mu molcm^3$

ii) Explain why the rates of reaction are similar at the substrate concentration of 30 $\mu molcm^3$

Question 115

The diagram represents a metabolic pathway controlled by enzymes



a) Name the type of control mechanism which regulates production of compound Z.

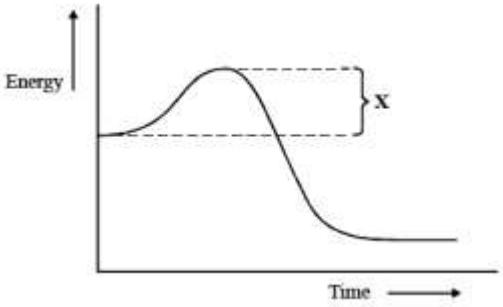
b) Explain precisely how an excess of compound Z will inhibit its further production.

Question 116

When heated, hydrogen peroxide breaks down to water and oxygen

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

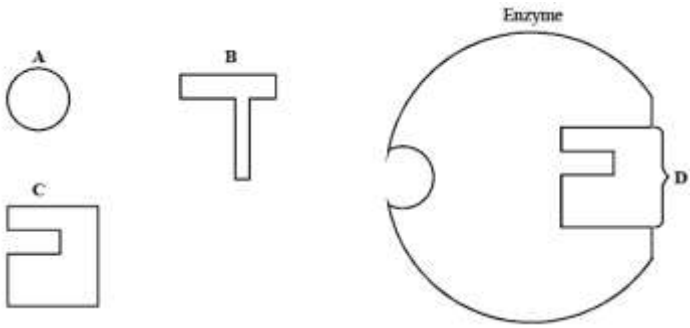
The graph shows the energy changes which take place during this reaction.



What is represented by the part of the curve labeled X?

Question 117

The diagram represents an enzyme and three molecules that could combine with it.



i) Name part of the enzyme labeled D.

ii) Molecules A and B inhibits the enzyme in different ways. Explain how each molecule inhibits the enzyme.

Question 118

Catalase is an enzyme. It catalyses the breakdown of hydrogen peroxide in the reaction:

$$2H_2O_2 \quad \rightarrow \quad 2H_2O + O_2$$

In an investigation, samples of different substances were added to hydrogen peroxide in a series of test tubes. The rate of reaction was measured by recording the rate at which bubbles of oxygen were produced. A scale going from 0 for no bubbles to 5 for the maximum rate of bubbling was used to measure this. The result are shown in the table

Tube	Substance added	Rate at which bubbles of oxygen were produced
A	Piece of liver	4
B	Ground liver and sand	5

C	Sand	0
D	Piece of cooled, boiled liver	0

a) Explain the difference between the rate at which bubbles were produced in:

   i) Tubes A and B

   ii) Tubes A and D

b) Explain the purpose of tube C.

Question 119

Explain why in an enzyme controlled reaction, a point will always be reached when an increase in substrate concentration will not produce a significant change in a reaction rate.

Question 120

Malonate is an inhibitor of the enzyme succinate dehydrogenase. How would you determine whether is a competitive or non – completive inhibitor?

Question 121

Define the following terms:

   i) Activation energy

   ii) Active site

   iii) Apoenzyme

   iv) Coenzyme

Question 122

How do enzymes speed up the rate of reaction?

Question 123

List three structures that are found in both prokaryotic and eukaryotic cells.

Question 124

Name two characteristic features that distinguish prokaryotic cells from eukaryotic cells.

Question 125

Outline the similarities between mitochondria and chloroplasts.

Question 126

What characteristics of a molecule determine whether or not it can cross the membrane?

Question 127

Compare simple diffusion and facilitated diffusion.

Question 128

State one difference between osmosis and diffusion.

Question 129

What is meant by the term mitochondrion?

Question 130

How do phagocytosis and pinocytosis differ?

Question 131

What are the differences between amylose and amylopectin?

Question 132

Why is glucose not very good for storage?

Question 133

Why glycogen is also called "animal starch"?

Question 134

Apart from its compactness, how does the structure of glycogen make it more suitable for its function than starch?

Question 135

Can you tell the differences between $\propto -\text{helix and } \beta$ – strands?

Question 136

Point out four differences between fibrous protein and globular proteins.

Question 137

Briefy explain how the hydrogen bond holds the protein structure.

Question 138

Identifying the type of enzyme that would catalyse the reactions shown below.

i) $\text{ATP} + \text{glucose} \rightarrow \text{ADP} + \text{glucose} - 6 - \text{phosphate}$
ii) $\text{Maltose} + \text{water} \rightarrow \text{glucose} + \text{glucose}$

Question 139

What are factors affecting diffusion according to the Fick's law?

Question 140

Point out three (3) differences between competitive and non – competitive inhibition.

Question 141

What are the functions of the following parts of prokaryotic cell?

i) Ribosomes
ii) Pili and fimbriae
iii) Capsule
iv) Cell wall
v) Plasmids

Question 142

Briefy explain the three (3) functions of lysosomes.

Question 143

Tabulate the differences between peroxisomes and lysosomes.

Question 144

What are the factors affecting the fluidity of the plasma membrane?

Question 145

Define the following terms:

i) Endocytosis
ii) Exocytosis

Question 146

Briefly explain the functions of Proteins in the cell membrane.

Question 147

Define the following terms:

i) Cell specialization
ii) Cell differentiation

Question 148

What are the shortcomings of the fluid mosaic model of membrane structure?

Question 149

Define the following term:

i) Integral proteins
ii) Peripheral proteins

Question 150

What are the influences of cholesterol on the plasma membrane?

Question 151

What is meant by the term Phospholipid bilayer?

Question 152

What are the effects of the presence of cholesterol in the phospholipid bilayer?

Question 153

Define the two basic types of cells.

Question 154

i) What is meant by the term “organelle” of eukaryotic?
ii) List down the organelles of eukaryotic.

Question 155

Define the following classes of Carbohydrates:

i) Monosaccharides
ii) Disaccharides
iii) Polysaccharides

Question 156

Outline physical properties of monosaccharides.

Question 157

What are functions of monosaccharides?

Question 158

What is meant by the following terms?

i) Maltose
ii) Lactose
iii) Sucrose

Question 159

Define the following terms:

i) Starch
ii) Glycogen
iii) Cellulose

Question 160

What are the properties of Polysaccharides?

Question 161

a) What are the components of starch?
b) Briefly explain the two components of starch.

Question 162

Briefly explain why Starch is suitable as a storage material?

Question 163

Outline the Function of polysaccharides

Question 164

Describe the Benedict's test for reducing sugar.

Question 165

Describe the iodine test for carbohydrates.

Question 166

List down the bonds that hold the protein structure.

Question 167

Define the following terms:

i) Simple proteins
ii) Conjugated proteins

Question 168

What is meant by the term “Denaturation” of proteins?

Question 169

What are the Physical and chemical agents that can cause denaturation of proteins?

SOLUTIONS

Question 1

i) It is the control centre of all cell's activities. It is involved in synthesis of ribosomes.
ii) The folded membrane of endoplasmic reticulum provides surface area where chemical reactions can take place**.** Involved in initial processing and transport of proteins.
iii) Digestion of materials that enter the cell by endocytosis**.** Digestion of unwanted or worn out organelles in the cell.
iv) It sorts, modifies and sends proteins to their final destination**.** Formation of lysosome.

Question 2

i) Control the entry and exit of materials in discrete organelles such as mitochondria and chloroplast.
ii) They isolate organelles so that specific metabolic reactions can take place within them.
iii) They provide an internal transport system e.g. endoplasmic reticulum.
iv) They isolate enzymes that might damage the cell e.g. lysosomes.
v) They provide surfaces on which reactions can take place.

Question 3

- The idea of considering chloroplasts and mitochondria asprokaryotic invaders is supported by several similarities that these organelles have with the prokaryotic cells. These similarities includes:
  i) Mitochondria and chloroplasts have 70s ribosomes likeprokaryotes.
  ii)Mitochondria and chloroplasts have a size similar to that of prokaryotes.
  iii) Mitochondria and chloroplasts have their own circular DNA.
- The idea that chloroplasts and mitochondria evolved as prokaryotic invaders of eukaryotic cells also can be supported by the fact that these organelles are surrounded

by two membranes: an inner and outer membrane. The inner membrane is believed to belong to the invading prokaryote and the outer membrane is the remnant of the membrane used by the invaded cell to engulf the prokaryote.

Question 4

Advantages of an organism being multicellular includes;

i) Being multicellular allows organisms to become relatively large in size.

- The size to which a unicellular organism grows is limited by needs for efficient transport of materials and by nucleus which can only exert control over a certain limited volume of cytoplasm. Multicellular organisms, however, are not limited by these factors and can grow to a large size.

ii) Multicellularity allows cells to be specialized to perform specific functions.

- Instead of every cell carrying out all tasks, certain cells become specialized for one function, others for a different function. Specialization greatly increases efficiency with which organisms carry out their functions.

iii) Multicellularity allows organisms to exploit a wide range of environments.

- Multicellular organisms can live in various environmental conditions which single celled organisms cannot survive. For example dry terrestrial habitats.

iv) Being multicellular also gives advantage of having longer life span.

Question 5

i) Ribosomes
ii) Cilia
iii) Flagella
iv) Centrioles
v) Cytoskeleton

Question 6

Lysosomes are sometimes known as suicide bags because when they rupture and release their contents in the cell, they result in self-digestion of the cell.

Question 7

Lysosomes are membrane-bound vesicles that contain hydrolytic enzymes used to digest macromolecules. The digestive enzymesenclosed by lysosomes include nucleases, lipases, proteases etc.

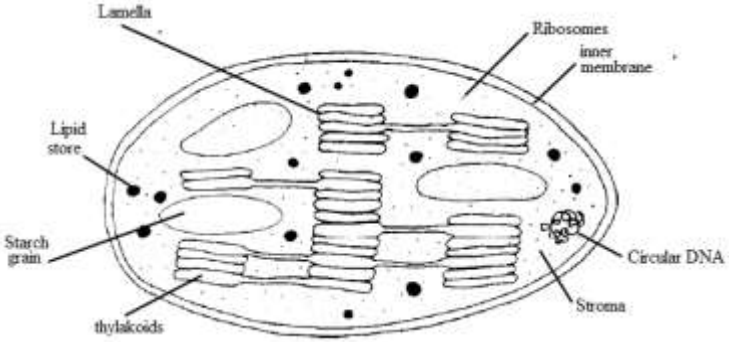
Question 8

The Golgi apparatus acts as cell's post office because just like post office receive, sort, label and make sure the letters get to their appropriate address (destination), the golgi apparatus:

- Receives the proteins from endoplasmic reticulum or elsewhere in the cell.
    - Sorts the proteins and pack them into vesicles
    - Send the vesicles to their final destination. The destination could be another part of the cell or outside the cell.

Question 9

Chloroplast:



Question 10

Membrane bound organelles offer the following advantages to eukaryotic cells:

i) Cells can concentrate and isolate enzymes and reactants in a smaller volume, thereby increasing the rate and efficiency of chemical reactions.

ii) The organelles provide discrete compartments in which specific activities can take place and the resulting subdivision of the cytoplasm allows eukaryotic cells to function efficiently in spite of their large size.

iii) Having a membrane around an organelle allows the rate at which metabolic reactions occur within the organelle to be regulated by the rate at which reactants enter the organelle.

iv) Cells can confine potentially harmful proteins and molecules within their membrane bound organelles, protecting the rest of the cell from their harmful effects.

Question 11

a) A – Ribosomes
B- Vacuole
C – Smooth endoplasmic reticulum

b)

i) Structure X (cell wall) has the following functions;
   - Provides mechanical strength to the cell and plant as whole.
   - Protects the cell from many pathogenic organisms.
   - Some cell walls serve as storage of food reserves
   - Maintenance of cell shape

ii) Structure Y (chloroplast)

- It is the site of photosynthesis

Question 12

Main ideas of the cell theory are;

i) Cells are basic units of structure and function of all living things.
ii) All living organisms are made up of cells.
iii) All cells arise from pre- existing cells.

Question 13

- It is advantageous for a cell to be small because small size of the cell allows for rapid and efficient transport of materials across the cell. This is due to the fact that:

- Small cells have large surface area to volume ratio. The large surface area increases the efficiency of transport of materials across the cell membrane.
- Small size of thecell means distance of transport of material between cells will be short and this improves the efficiency of transport of material between cells.
- Steep concentration gradients for diffusion are easily maintained in cells with small size.

- Also because of small size of the cell, communication from nucleus (control centre of the cell) to other organelles is easy and fast and hence the cell can be well regulated.
- Small size of the cell also makes it much easier for cells to interact with their environment.

Question 14

a) Mitochondria and chloroplasts are organelles of the eukaryotic cells. These organelles have certain features which show that they are semi – independent cells which live within the eukaryotic cell. These features include:

i) They have their own genetic material as they possess a circular DNA.
ii) They have their own 70s ribosomes for protein synthesis.
iii) They can replicate on their own.

Question 15

The chloroplast is adapted to its function in the following ways;

i) Chloroplasts contain both DNA and ribosomes so they can quickly and easily manufacture some of the proteins needed for photosynthesis.
ii) The thylakoid membrane provides a large surface area for photosynthesis reactions to occur.
iii) The stroma fluid contains enzymes needed for various reactions of photosynthesis.
iv) The photosynthetic pigments attached to the granal membranes are arranged in a very precise manner to allow maximum absorption of light for photosynthesis.
v) The granal membranes have enzymes attached to them, which help them to manufacture ATP.
vi) The thylakoid is surrounded by stroma so that the products of the reactions that occur in thylakoid can readily pass into the stroma where further reactions occur.

Question 16

a) Golgi body
b)

Question 17

Mitochondrion	**Golgi apparatus**
It is bound by double membrane	It has a single membrane
It appear as a rod – shaped organ	It is made up of stack of cisternae.
Its inner membrane is highly folded to form structures known as cristae	It's membrane is not folded

a) Eukaryotic cells are cells which have a membrane bound nucleus.
b) Ribosomes

Question 18

The fluid mosaic model of membranes is described as dynamic because according to this model, membrane components are not static and fixed in the membrane but rather they are in a continuous motion and continuously change their positions in the cell membrane.

Question 19

The Davson-Danielle model was different from fluid Mosaic model in the following ways;

Davson-Danielle model	**Fluid mosaic model**

Phospholipid bilayer is sandwiched between two layers of protein.	Phospholipid bilayer forms the fundamental structure of the membrane and proteins are embedded in it.
Suggested that the membrane is a static structure.	Proposed that the membrane is a fluid dynamic structure.
Proteins cover both surfaces of the phospholipid layer.	Some proteins are found on the surface of the phospholipid bilayer (peripheral proteins) and some proteins are embedded deep in it (integral proteins)

Question 20

Lipid bilayer is the structure formed by two layers of phospholipid molecules while double membrane is the structure formed by two membranes and each membrane is made up of a phospholipid bilayer.

Question 21

Non polar tails of a phospholipid are made up of fatty acid chains.

Question 22

i) D – Plasmid
   E – Capsule

ii) **Plasmid**
   Carries additional genes that confer bacteria with special characteristics such as antibiotic resistance.
   Capsule
   Offers additional protection to the bacteria.

Question 23

Question 24

	Prokaryotic cell	**Eukaryotic cell**
Contains ribosomes attached to the endoplasmic reticulum	X	√
Genetic material consist of linear chromosomes	X	√
Diameter of the cell is 1 μm	√	X

a) Lysosomes are membrane – bound organelles that contain hydrolytic enzymes used to digest macromolecules.

b)

i) Autolysis refers to the self-digestion of a cell by enzymes released by lysosomes.

ii) The other functions of lysosomes are;

- Autophagy: digestion of unwanted or worn out organelles in the cell.
- Release of enzymes outside the cell for digestion of materials.
- Digestion of extracellular materials that enter the cell by endocytosis.

Question 25

Name of the organelle	**Description**	**One function**

Golgi apparatus	*Composed of flattened disk like sacs associated with vesicles*	*Formation of lysosomes*
Centrioles	Cylindrical organelles made up of microtubules	Involvedin spindle organization during cell division in animal cells.
Mitochondrion	Rod – shaped structure with a double membrane, the inner one folded to form cristae	*Site of aerobic respiration.*

a)

Question 26

Fatty acids being hydrophobic, they can't interact with water. So they point inward away from aqueous environment. On the other hand, phosphate heads are hydrophilic: thus they point outward interacting with aqueous solution outside and inside the cell.

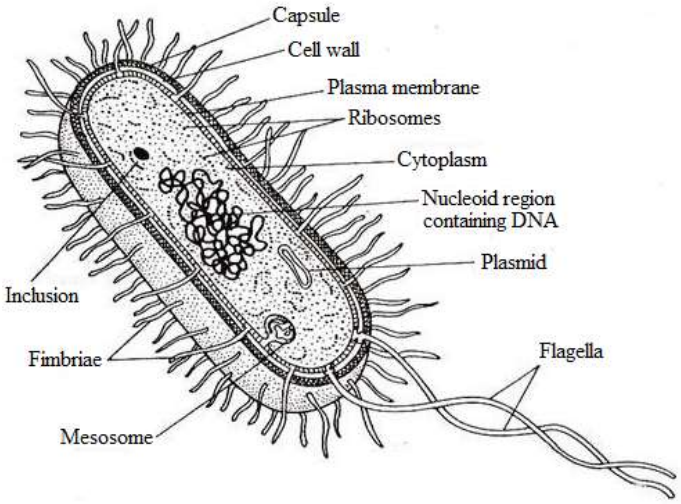
Question 27

a) Unsaturated fatty acids are fatty acids with one or more double bonds**.**

b) Double bonds in unsaturated hydrocarbon chains tend to increase the fluidity of a phospholipid bilayer by making it more difficult to pack the chains together.
Cells of the organisms living at lower temperatures have high proportions of unsaturated fatty acids in their membranes to maintain fluidity of the membrane.

Question 28

The prokaryotic cell



Question 29

Mesosomes:

- Involved in cell wall formation around daughter cell following cell division.
- Assist in separation of DNA molecules after their replication during cell division.

Pilus

- Involved in adherence or attachment of bacteria to surface or other cells.
- F or sex pili facilitate sexual reproduction of bacteria.

Plasmid

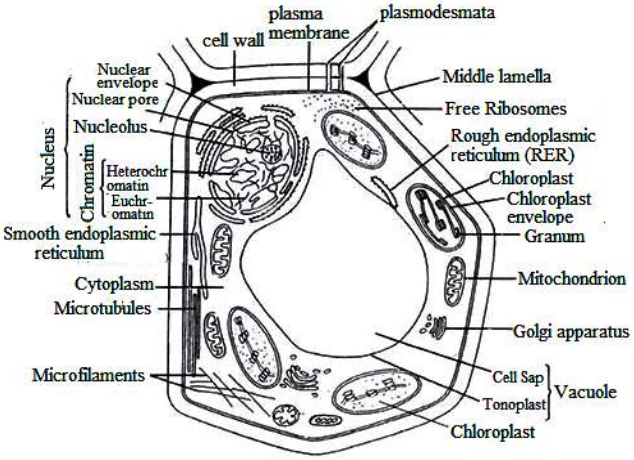
- Carries genes that gives bacteria special characteristics such as antibiotic resistance

Question 30
Prokaryotic cells are cells that lack a true nucleus. This means the DNA in prokaryotic cells is not within a nucleus.
Question 31
Differences between prokaryotic and eukaryotic cells.

Prokaryotic cell	**Eukaryotic cell**
They have no nucleus	They have membrane bound nucleus
Have 70S ribosomes	Have 80S ribosomes
They lack membrane bound organelles	They have membrane bound organelles
They have a naked circular DNA	They have linear DNA associated with histone proteins to form chromosomes
They are relatively small in size with diameter of 0.5 – 10μm	They are relatively large in size with diameter of 10 – 100 μm

Question 32

Typical plant cell:



Question 33

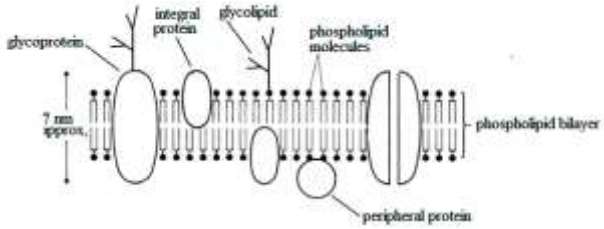
i) **Nucleus** is an organelle of eukaryotic cell which act as a control centre of all activities of the cell while **nucleolus** is a sub organelle located within the nucleus of eukaryotic cell. It appears as a darkly stained structure within the nucleus.

ii) Differences between plant vacuole and animal vacuole

Plant vacuole	**Animal vacuole**
It is relatively large in size	It is relatively small in size
It is a permanent structure of a plant cell	It is usually a temporary structure of an animal cell.
It most cases there is only one vacuole in a plant cell	Animal cells can have one or more vacuoles.

Question 34

A simplified structure of the plasma membrane:



Question 35

Cell Membrane	**Cell wall**
It is present in all cells.	It is only present in plant, bacteria, fungi and algal cells.
It is mainly made up of lipids and proteins.	Its composition vary depending on the cell in which it is found e.g. in plant cell it is made up of cellulose while in fungi cell it is made up of chitin.
It is selectively permeable allowing only certain molecules to pass through.	It is completely permeable to biological molecules.
It is metabolically active and living.	It is metabolically inactive and nonliving.
It is relatively thin and fluid in nature	It is a thick and rigid structure.
It protects the protoplasm and control exchange of materials between the cell and its surrounding environment.	It determines the cell shape and offer protection to the cell.

Question 36

i) Lipid soluble and small in size
ii) Channel proteins

Question 37

Factor	Value of factor
Surface area	High
Difference in concentration	High
Thickness of exchange surface	Low

Question 38

Differences between rough endoplasmic reticulum and smooth endoplasmic reticulum

Rough endoplasmic reticulum	**Smooth endoplasmic reticulum**
It has ribosomes attached on its surface.	It has no ribosomes attached on its surface.
It is mainly involved in initial processing and transport of proteins.	It performs various functions including synthesis of cell membrane components, metabolism of carbohydrate and synthesis of steroid hormones.

Question 39

i) Control of exchange of materials between the cell and external environment.

ii)

- They are involved in break down of fatty acids and amino acids into smaller molecules that can be used for energy production by mitochondria.

- The contain enzyme catalase which breaks down hydrogen peroxide produced in the cell and prevent the harmful effects of hydrogen peroxide in the cell.
- They are also involved in lipid biosynthesis

Question 40

The term facilitated diffusion refers to a process by which a substance diffuses through the membrane with the help of membrane proteins.

Question 41

Question 42

Facilitated diffusion	**Active transport**
Substances move across the membrane down their concentration gradient	Substance move across the membrane against their concentration gradient.
It is a passive process i.e. it does not require energy	It is an energy requiring process

Osmosis is the movement of solvent molecules from a region of their high concentration to a region of their low concentration through a semi – permeable membrane.

Question 43

Process	
The movement of oxygen molecules	D
The movement of carbon dioxide molecules	A

The active uptake of glucose molecules	C

Question 44

This is becauseits fundamental structure (the phospholipid bilayer) is fluid and proteins are embedded and dispersed in it forming a mosaic pattern.

Question 45

i) It's involved in cell – cell recognition.

ii)
- It enhances both the flexibility and mechanical stability of the bilayer.
- It decreases the permeability of lipid bilayer to small polar molecules.
- It helps to maintain the fluidity of the membrane.

iii) Transport materials across the membrane.

iv) Transport materials across the membrane

v) They act as cell identity markers.

Question 46

Membrane proteins are categorized into two:

i) Intrinsic proteins

ii) Extrinsic proteins

Question 47

A – Carries the genetic information for making protein
It also makes ribosomes.

B – Site where protein synthesis occurs

C – Involved in sorting, modifying and packaging of proteins

Question 48

a)
- They act as receptor sites for specific molecules
- Transport of substances across the cell membrane.

b) The hydrophobic areas in the membrane confer the cell membrane with selectivity to types of molecules that move across it. It prevents the polar hydrophilic molecules from

passing while allowing hydrophobic molecules to pass through.

- The hydrophobic areas also stop the loss of water soluble/polar molecules from inside the cell.

Question 49

a)

- Organelle – chloroplast
- Internal structure – thylakoid.

b)

- Organelle – Nucleus
- Internal structure – Nucleolus.

Question 50

a)

Part of membrane	**Letter**
Transmembrane protein	B
Contain only the elements carbon and hydrogen	D

b) The cell membrane is selectively permeable in that some substances can move across the membrane, while others cannot. Lipid soluble molecules or non – charged molecules and small charged molecules easily pass through the membrane.

Question 51

i) Flagella
ii) Ribosomes
iii) Plasmid

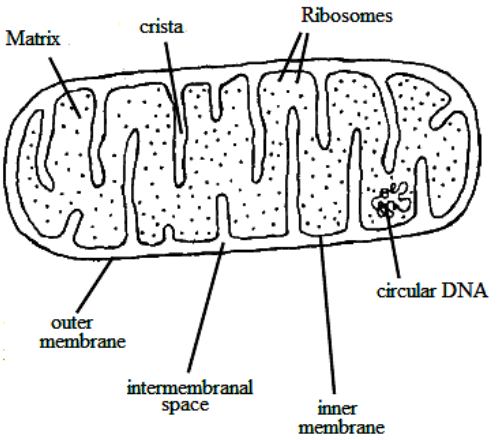
Question 52

i) They both have a naked circular DNA just like the prokaryotes
ii) They both have 70s ribosomes like prokaryotes
iii) They have similar size and shape to the prokaryotes.

iv) Mitochondria and chloroplast just like prokaryotic cells divide by fission.

Question 53

Structure of mitochondrion:



Question 54

Adaptations of the mitochondrion to the functions it performs include:

i) Folding of inner mitochondrial membrane into cristae increases the surface area for reactions occurring on the inner membrane.
ii) It contains both DNA and ribosomes which enable it to easily synthesize some of the proteins it needs.
iii) The matrix contains enzyme for various reactions of respiration.
iv) The outer membrane separates the contents of the mitochondria from the rest of the cell creating a good environment for cell respiration.

Question 55

These organelles are involved in the synthesis of various proteins that are used by the cell as well as those secreted out of the cell.

- Nucleus contains genetic information for synthesis of protein. This information is sent to the ribosomes where it is used to synthesize proteins. The synthesized protein are

passed to the endoplasmic reticulum where they undergo initial processing and modification such as addition of a carbohydrate. From the endoplasmic reticulum, the proteins move in transport vesicles to the Golgi apparatus. The Golgi apparatus sorts the proteins and packs them into vesicles and sends them to their final destination.

Question 56

Two places where cilia are found.

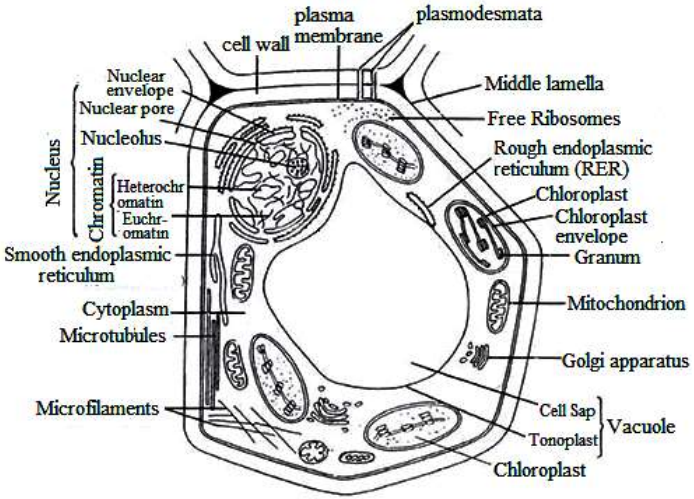
- Fallopian tube – aid movement of ovum from ovary to the uterus
- Lining of the respiratory tract – they sweep mucus and dirt out of the respiratory tract.

Question 57

Bacterial cell is a prokaryotic cell and a frog cell is a eukaryotic cell. So, basically the question asks to differentiate between prokaryotic and eukaryotic cell.

Feature	Bacteria cell	Frog cell
Size of the cell	Relatively small in size, with diameter of 0.5 – 10μm	Relatively large in size with diameter of 10 – 100 μm
Outer boundary material	Surrounded by a cell wall mainly made up of murein	Does not have a cell wall
Organelle for protein synthesis	Ribosomes of 70S type	Ribosomes of 80S type.
Genetic material and its location	• Have a naked circular DNA • The DNA lies free in the cytoplasm in nucleoid region	• Have a linear DNA associated with histone proteins. • DNA is found in a membrane bound nucleus
Organelle for respiration	Respiration takes place on the cell membrane. In other bacteria takes place in mesosomes	Mitochondria
Organelle for transport of lipids and proteins	No special organelle for transport of lipids and proteins	Golgi apparatus

Question 58
A diagram of plant cell:



Question 59
Describe either emulsion test or Sudan III test.

Question 60

		Observation if biological molecules is	
Method	Biological molecule tested for	Present	Absent
Add a few drops of iodine solution	Starch	Solution turns blue-black	Colour of solution remains brown
Add alcohol and shake, pour into water	Lipids	Solutions turns to cloudy white colour	Solution remains clear

Question 61

Biuret test is a chemical test used for detecting presence of proteins. It detects the presence of peptide bonds. The basis of this test is that in presence of peptides, the colour of alkaline solution of copper (II) changes from blue of purple.

The test is performed as follows:

- To a sample of the solution to be tested, add volume of sodium hydroxide solution at room temperature.
- Add a few drops of dilute copper (II) solution and mix gently.
- A purple coloration indicates the presence of peptide bonds and hence protein.

Question 62

i) Protein
ii) Non-reducing sugar

Question 63

a)

i) Amino acids
ii) $\propto -$ helix
iii) Hydrogen bond
iv) The protein become denatured because heating causes increase in molecular vibration which result in disruption of bonds such as hydrogen bonds that holds the protein structure.
v) Secondary structure refers to certain repetitive folded structures that found within most polypeptide chains. These folded structures are of two main types: alpha helix and beta sheet.

b) The $\propto$ helix is formed by hydrogen bonding between amino acids of a single polypeptide segment while β – sheet is formed by hydrogen bonding between amino acids of two or more polypeptide segment.

Question 64

a) Example of fibrous protein – collagen.
   Example of globular protein – haemoglobin

b) Tertiary structure refers to the three dimensional structure that a protein acquires because of interactions between R – groups of amino acids in its polypeptide chain.

Question 65

a) Structure E
b) Structure A
c) Structure B
d) Structure D
e) Structure C
f) Structure A, D and E
g) Structure D

Question 66

Disulphide bond is a bond formed between two cysteine molecules as the result of reaction between the sulphydrlyl groups of the cysteine molecules. The sulphydrlyl groups become oxidized forming a –S-S linkage.

Question 67

- Hydrogen bonding
- Ionic bonds

Question 68

Region A shows a secondary structure of a protein known as α helix. The α helix is formed and held by hydrogen bonding between c = 0 and NH groups of amino acids in a segment of polypeptide chain.

Question 69

Difference between polypeptide and polysaccharide chains.

Polypeptide chain	Polysaccharide chain
Its monomers (amino acids) are linked by peptide bonds	Its monomers (mono saccharides) are linked by glycosidic bonds.
There is no branching in polypeptide chains	The polysaccharide chains can be branched.
Polypeptides dissolve in water forming colloidal suspensions.	Polysaccharides are insoluble in water.

Question 70

Collagen	Hemoglobin
It is a fibrous protein	It is globular protein
It is insoluble in water	It is soluble in water
It functions as a structural protein	It is function as a transport protein
It is a simple protein i.e. it has no prosthetic group	It has heme as the prosthetic group
It is made up of three (3) polypeptide chains	It is made up of four polypeptide chains.

Question 71

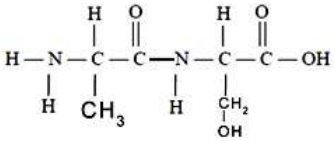
Haemoglobin is made up of more than one polypeptide chain quaternary structure describes the way or manner in which the individual polypeptide chains are arranged and interact to make up haemoglobin.

Question 73

a) Proteins can be classified in three main ways;
   i) Based on their composition
   ii) Based on their structure
   iii) Based on their function

b) Carbon (C), Hydrogen (H), Oxygen (O), Nitrogen (N) and Iron (Fe)

Question 74



Question 75

Primary structure of a protein

Question 76

a) Water (H_2O)

b) The groups of amino acids:

i) Non polar amino acids

These are amino acids which have non polar side chains. Being non-polar, these amino acids are hydrophobic i.e. do not interact with water. An example of a non-polar amino acid is alanine

ii) Polar amino acids

These are amino acids which have polar but uncharged side chains. Because these amino acids are polar, they easily interact with water. Examples of polar amino acids are cysteine and serine.

iii) Acidic amino acids

The acidic amino acids have a carboxyl group (-COOH) in their side chain. In aqueous solution, the carboxyl group loses H^+ and form COO^-. Thus the acidic amino acids are negatively charged.

- There are two acidic amino acids: Aspartic acid and glutamic acid.

iv) Basic amino acids

Basic amino acids bear a positive charge. These amino acids have a nitrogen in their side chain. This nitrogen

combines with a hydrogen ion (H^+) and gives the amino acid a positive charge.

- An example of a basic amino acid is lysine.

Question 77

a)

i) It could be source of energy.

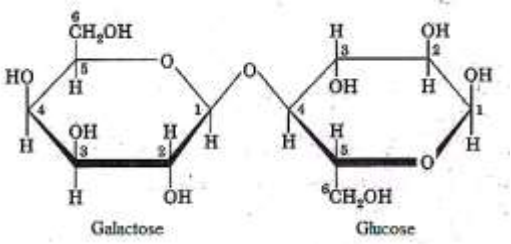
ii) It could be digested to monosaccharides (glucose and galactose) which could then be used as building blocks for larger molecules.

b) Condensation

Question 78

a) Glycosidic bond

b) The structure of lactose:



Question 79

Alpha glucose / ∝ - glucose is used to make lactose.

- The –OH group on carbon atom 1 is below the ring.

Question 80

Carry out Benedict's test on both solutions.

- Lactose would give a brick – red / brown precipitate. (Lactose being a reducing sugar it gives a positive Benedict's test).
- Sucrose would not give any precipitate; the colour of the solutions remains blue. Sucrose being a non – reducing sugar it does not give a positive Benedict's test).

Question 81

Category	Example
Structural	1. Collagen 2. Keratin

Enzyme	Lipase
Hormone	Insulin
Respiratory pigment	Haemoglobin and myoglobin
Defensive	Antibodies
Contractile	Actin
Storage	Ovalbumin

Question 82

i) They are both secondary structures.

ii)They are both held in place by hydrogen bonding.

iii) All the –NH and –C = O groups of peptide bonds are involved in hydrogen bonding.

Question 83

a)

Statement	**Monosaccharides**	**Amino acids**
Always contain nitrogen	**X**	√
May be polymerized into man molecules	√	√
Insoluble in water	**X**	**X**
May be linked by glycosidic bonds	√	**X**
Released by complete hydrolysis of cellulose	√	**X**
Always contain carbon, hydrogen and oxygen	√	√

Difference between cellulose and glycogen.

Cellulose	**Glycogen**
It is a polymer of β glucose.	It is a polymer of α glucose.
It is a structure polysaccharide.	It is a storage polysaccharide

It consists of cross linked chains which run parallel to each other.	Its chains are folded into a compact shape.
Its chains are not branched.	It consists of highly benched chains.

Question 84

i) A– glycerol
B – Fatty acids

ii) Triglyceride

iii) Condensation reaction.

Question 85

i) It provides buoyancy for aquatic animals.

ii) It is less dense than water. Therefore, when it is stored in sufficient amounts in an animal it helps it to float.

Question 86

i) $-NH_2$

ii) First amino acid – serine
Second amino acid – Asparagine

Question 87

i)

- Not a polymer – phospholipids
- Not found in a chloroplast – cellulose.

ii) Nitrogen

Question 88

Monosaccharides can be defined as simple carbohydrates composed of a single sugar unit that cannot be hydrolyzed into simpler sugar.

Monosaccharides are classified according to the number of carbon atoms they contain. This can be simplified in the following table.

Class of Monosaccharide	Number of Carbons
Triose	3
Tetrose	4
Pentose	5
Hexose	6

Question 89

Monosaccharides have several biological functions. The functions of some important monosaccharides includes:

i) Glucose is the major source of energy for most animals.

ii) Glucose is the main form in which carbohydrates are transported in mammals.

iii) Ribose and deoxyribose are used in synthesis of nucleic acids DNA and RNA.

iv) Ribose is used in synthesis of coenzymes such as NAD, FAD and NADP.

v) The synthesis of ATP requires ribose.

Question 90

a) Cellulose consist of straight unbranched chains of glucose molecules that run parallel to each other and are cross linked by hydrogen bonding. The cross – linking bind the chains closely and rigidly together. This gives cellulose high mechanical and tensile strength and makes it suitable for its structural role.

Starches consist of branched chains of glucose which fold into a compact shop. The compact shape makes starch occupy less space in the cell and hence suitable as a storage molecule.

b)

i) It should be a globular protein.

ii) It should be able to bind other molecules i.e. substrate.
iii) It should possess a specific site (an active site) for binding its substrate.
iv) It should maintain its three dimensional shape in the conditions of temperature and pH that exist in the body.

Question 91

a)

i) Amino acid
ii) Hydrogen (H)

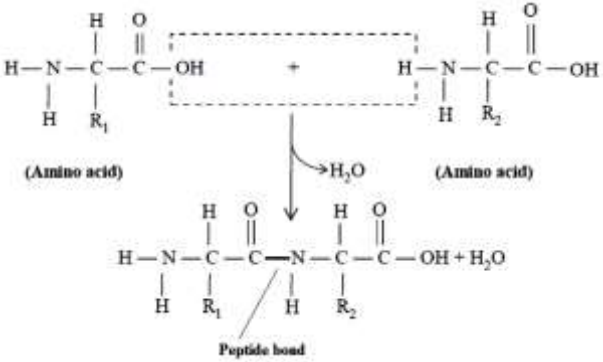
b) – COOH gives it the acidic properties and $-NH_2$ gives it basic properties.

Question 92

a)

i) Polymerization is a process in which two or more small molecules combine to form larger molecules that contain repeating submits.
ii) A polypeptide

b) The formation of a dipeptide:



Question 93
Condensation reaction
Question 94
Peptide bond.
Question 95
Because it dissolves more substances than any other common solvent.

Question 96

The water biological importance of properties of water can be explained as follows.

i) **Water is a universal solvent**
- It allows water to act as the main transport medium.
- All the chemical reactions that takes place in the cell do so in aqueous solution.
- It allows formation of various structures of the cell.

ii) **Water has high latent heat of fusion**
- It makes cells content less likely to freeze.
- It makes aquatic habitat show to freeze in cold weather.

iii) **Water has high surface tension and strong cohesion forces between its molecules.**

- The cohesion forces are important because they assist the movement of water up the xylem allowing columns of water to be formed and drawn up the xylem.
- This is important as it allows some aquatic organisms like pond skaters to land and move on surface of water.

iv) **Water has high heat of vaporization**

- The importance of this is that water produces a cooling action as it evaporates from a surface of an organism. This is because it absorbs large amount of heat as it evaporates.

Ice is less dense than liquid water.

- This is important for aquatic organism living in cold weather because ice forms first on the surface of water and floating ice covers and insulate the liquid water below it.

v) **Water has a high heat capacity.**
- Biochemical processes occur a narrow range of temperature.
- It allows temperature of water bodies to remain constant creating a suitable environment for aquatic organisms.

vi) **Water is difficult to compress**
This makes water an important structural agent. It acts as a skeleton (a hydrostatic skeleton) in organisms like earthworm.

vii) **Water is colorless and transparent to water.**
This allows sunlight to penetrate water bodies enabling aquatic plants to photosynthesize.

Question 97

Lipids have important roles or functions in organisms. For the functions of lipids refer text.

Question 98

Membrane phospholipids fatty acids of plants adapted to cold environment have low level of saturation compared to those of plants adapted to hot environment. Low level of saturated helps the plants in cold environment to maintain the fluidity of their membrane which is in.

Question 99

a)

Fats	**Oils**
Solid at ordinary room temperature	Liquid at ordinary room temperature
Relatively rich in saturated fatty acids	Relatively rich in unsaturated fatty acids
Mainly found in animals	Mainly found in plants

b) A represent a lipid.
B represents a phospholipids

Question 100

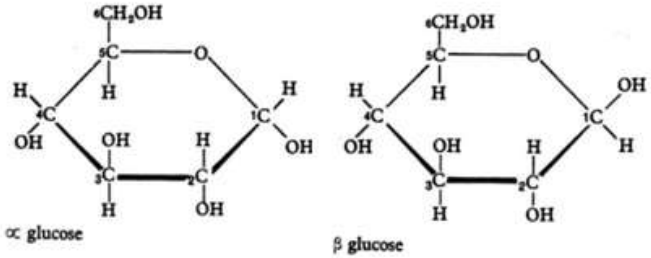
i) Phospholipid
ii) This is because of its phosphate head which is charged and polar and hencehydrophilic.

Question 101

Lipid is an energy store.
Phospholipid is a structural component of the cell membranes.

Question 102

a) Glucose molecules have two isomers: alpha ($\propto$) glucose and beta (β) glucose. The structure of the two isomers differ at the C_1. They differ in the direction that hydrogen (H) and hydroxyl (OH) groups point on carbon atom 1.
   - In $\propto$ glucose, hydrogen point upward and hydroxyl (OH) group point downward while
   - In β – glucose hydroxyl group point upward and hydrogen point downward.



b)

i) Both pentoses and hexose can be used to make polysaccharides.

ii) Monosaccharides can be linked by 1, 4 and 1, 6 linkages. The 1, 6 linkage allows branching to occur.

iii) Both ∝ and β form monosaccharides are used to make polysaccharides and resulting polysaccharides are quiet different. E.g. cellulose is made by β – glucose while starch is made by ∝ - glucose.

iv) The monosaccharides forming the polysaccharides can be either ketoses or aldoses.

Due to these variations, monosaccharides combine and form a wide variety of polysaccharides.

Question 103

High heat of vaporization.

Question 104

High heat of vaporization and high heat capacity.

Question 105

Unlike other substances, solid state of water (ice) has low density compared to its liquid state.

Question 106

This is because it has high heat capacity, meaning a large increase in heat results in a comparatively small size in temperature of water.

Question 107

High surface tension and strong cohesion forces.

Question 108

It allows sunlight to penetrate water bodies enabling aquatic plants to photosynthesize.

Question 109

a) Two structural protein are;
   - Collagen
   - Keratin

   Two structural carbohydrates are
   - Cellulose
   - Chitin

b)
   i) Oleic acid
   ii) Triolein is more likely to be an oil.
      - Unsaturated fatty acids such as oleic acid have lower melting point. So triolein which is made up of unsaturated fatty acid is likely to have low melting point and exist as a liquid at room temperature.

Question 110

a) Succinic acid
b) Malonic acid being structurally similar to succinic acid, it competes with succinic acid for binding to the active site of succinate dehydrogenase. Once the active site is occupied by malonic acid, the succinic acid cannot bind to the enzyme and hence the enzyme action is inhibited.

Question 111

a)
   i) Cysteine
   ii) – SH groups of two cysteine residues in protein can react resulting in formation of a bond known as *disulphide bond***.** The disulphide bond is one of the important bonds that hold the structure of protein.
   - The heavy metals bind permanently to the sulphydrlyl (SH) group and disrupt the disulphide bonds. Disruption of disulphide bonds result in the structure of enzyme being destroyed and hence the enzyme loses its activity.

b) Non – competitive irreversible inhibition.

Question 112

a)

i) Optimum temperature.
ii) The temperature will be in range of $37 - 40℃$

b)

i) In region A, increase in temperature causes increases in kinetic energy of enzyme and substrate. Due to this increase in kinetic energy the chance that substrate and enzyme will collide and react increases. Hence, as seen on the graph, the rate of reaction increases.
ii) As the temperature increase above the optimum temperature, the protein begins to denature. The loss of three dimensional structures of the enzymes causes them to lose their catalytic action. Hence, as seen in the graph, the rate of the reaction decreases.
iii) Activation energy is the minimum amount of energy that the reactants must possess for a reaction to occur. In other words, their reactants must have energy equal to or greater than activation energy for them to react and form products.

Question 113

a) All enzymes have a certain pH at which the maximum rate of their reaction occurs. This is known as optimum pH. Any variation below or above this pH, results in the decrease in the rate of enzyme reaction's re.
b) Changes in pH alter the charged state of acidic and basic amino acids. This result in disruption of ionic bonds which are important in holding the enzyme's structure. Thus changes in pH distort the three dimensional shape of the enzyme. As a result, the enzyme can no longer bind substrate and hence the enzyme's activity is lost.

Question 114

a) Active site.
b) As seen in the diagram, the active site of the enzyme has a specific shape and it binds substrates whose shape is complementary to its shape. Because the active site only binds with substrates of complementary shape, it is very

specific to the substrate it binds and hence to the reaction it catalyses.

c) A competitive inhibitor of an enzyme has a shape similar to the enzyme's substrate and this enables it to bind to the active site of the enzyme. Therefore, the inhibitor competes with the substrate for binding to the active site and once it occupies the active site, the substrate is prevented from binding to the active site.

Question 115

a) Temperature.

b)

i) At substrate concentration of $10\mu molcm^{-3}$, rate of reaction for an enzyme without inhibitor is higher than that of the enzyme with a competitive inhibitor. This is because for the competitively.

ii) At substrate concentration of 30 $\mu molcm^{-3}$, substrate displaces all inhibitor from active sites of the enzymes such that virtually all active sites are occupied by substrates. Therefore the rate of reaction becomes similar to that of an inhibited reaction.

Question 116

End – product inhibition.

Question 117

When compound Z begin to be produced in excess, it act as an allosteric inhibitor of the enzyme e_1. By acting as an allosteric inhibitor, compound Z changes the shape of the enzyme such that substrate V can no longer bind to the active site of the enzyme and the reaction converting substrate V to W cannot occur. This inhibition causes the metabolic pathway to stop and hence further production of compound Z stops as well.

Question 118

a) Activation energy of the reaction.

b)

i) Active site

ii) Molecule A acts as an *allosteric inhibitor*. It binds to the enzyme at the allosteric site and causes the shape

of the enzyme to change. By changing the shape of the enzyme, it affects the ability of the substrate binding to the active site.

- Molecule B acts as a *competitive inhibitor* of the enzyme. Because it has a shape similar to that of substrate, it competes with the substrate for binding to the active site and when it binds the active site, it prevents the substrate from binding.

Question 119

i) Higher rate of reaction is observed in tube B than tube A because grinding increases the surface area of the liver for reaction allowing more hydrogen peroxide to enter the liver and come into contact with catalase.

ii) Boiling of the liver causes its enzymes to be denatured because heating breaks the bonds that hold the three dimensional structure of the enzyme. The disruption of three dimensional structures of enzymes makes them unable to bind the substrate. Hence no substrate enzyme complex will be formed and zero rate of reaction is observed in test tube D.

Question 120

Tube C serve as a control to show that sand did not affect the reaction when it was put in the test tube with ground liver.

Question 121

As the substrate concentration is increased in an enzyme controlled reaction, it reaches a point when all enzymes' active sites become occupied by the substrate. Further increase in substrate concentration above this point will not produce any increase in the rate of the reaction because there is no free enzyme to bind and react with any additional substrate.

Question 122

To a reaction inhibited by malonate, increase the concentration of substrate (substrate of enzyme succinic dehydrogenase) and observe the rate of reaction. If the rate of reaction increases then malonate is a competitive inhibitor but if the rate of the reaction remains unchanged, malonate is a noncompetitive inhibitor.

Question 123

i) Activation energy is the minimum amount of energy that the reactants must possess for a reaction to occur.
ii) Active site is a specific region of an enzyme where a substrate binds and undergoes a chemical reaction.
iii) Apoenzyme – is a protein component of an enzyme that requires the presence of a cofactor to form a functioning enzyme.
iv) Coenzyme is a non –protein organic compound required for the functioning of an enzyme, but it only binds loosely and temporarily to an enzyme.

Question 124

Enzymes speed up the rate of reaction by lowering the activation energy required for a reaction to occur. Lowering the activation energy means reactants will need less energy to react and therefore more reactant molecules would react to form products at any given time.

Question 125

i) Cell membrane
ii) DNA
iii) Ribosomes

Question 126

i)Prokaryotic cells do not have nucleus.

ii) Prokaryotic cells lack membrane bound organelles.

Question 127

Similarities between mitochondria and chloroplasts:

i) Mitochondria and chloroplasts have 70s ribosomes likeprokaryotes.
ii) Mitochondria and chloroplasts have a size similar to that of prokaryotes.
iii) Mitochondria and chloroplasts have their own circular DNA.

Question 128

- The size of the molecule: Small molecules can cross the membrane freely while large ones cannot.
- Whether the molecule is charged or not: Non-charged (non-polar) molecules can freely cross the membranes while the charged (polar) molecules cannot.

Question 129

Simple diffusion is the process by which ions or molecules move from a region of their high concentration to a region of their low concentration.

Facilitated diffusion is a process by which a substance diffuses through the membrane with the help of membrane proteins.

Question 130

Difference between osmosis and diffusion

Diffusion	**Osmosis**
The process by which ions or molecules move from a region of their high concentration to a region of their low concentration.	The movement of solvent molecules from a region of their high concentration to a region of their low concentration through a semi – permeable membrane.

Question 131

Mitochondrion is a double membrane bound organelle found in the cytoplasm of nearly all eukaryotic cells.

Question 132

Phagocytosis	**Pinocytosis**
Is a type of endocytosis in which materials ingested by the cell are in solid form.	Is a type of endocytosis in which materials ingested by the cell are in liquid form.
A sac known as phagocytotic vacuole is formed, which is of relatively large size.	Vesicles of relatively small size are formed.

Question 133

Amylose	**Amylopectin**
It constitutes about 10 – 30% of starch	It constitutes about 70 – 90% of starch
The bonding involved in its formation is 1, 4 glycosidic bonds	The bonding involved in its formation are 1, 4 glycosidic bonds and 1, 6 glycosidic bonds
With iodine it stains blue	With iodine it stains red – violet
It has relative low molecular weight	It has relatively high molecular weight
It consists of unbranched coiled chains of glucose units	It consist of branched chains of glucose units

Question 134

i) It is very reactive.

- Being reactive, glucose might get into reactions where it is not wanted.

ii) It is very soluble in water. Being soluble in water is a problem for two reasons.

- It would dissolve in water and around the plant cell, and might be lost from the cell.
- When dissolved, it would increase the concentration of the solution in the cell. This would cause water to enter the cell by osmosis and would cause damage to the cell.

Question 135

It's because of its similarity to starch in function and structure i.e. they both function as storage molecules and they have similar structure.

Question 136

The general structure of glycogen has many branches (side chains) compared to starch. This structural difference allows more glucose to be released quickly which is important for quick energy release in animals. Starch is good storage, but glycogen is more efficient as energy reserve in animals.

Question 137

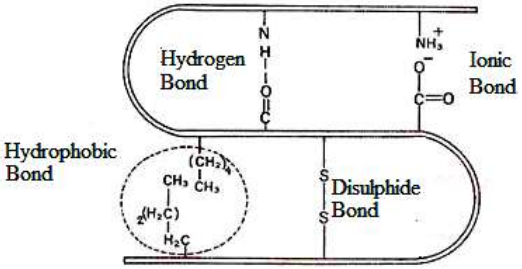
$\propto$ - helix	**β – strands**
They have a coil like structure	They have a flattened sheet like structure
It is formed and held by hydrogen bonds between amino acids of a single polypeptide chain segment	It is formed by hydrogen bonding between amino acids of two or more polypeptide segments.

Question 138

Fibrous proteins	**Globular proteins**
Polypeptide chains form long strands	Polypeptide chains folded into spherical shape
They have a very strong and stable structure	They have a relatively less stable structure
They are insoluble in water	They are soluble in water
They have a structural function	Perform wide variety of functions e.g. acts as enzyme, hormones, transport proteins etc.

Question 139

Hydrogen bonds occur between some hydrogen atoms and some oxygen and nitrogen atoms in the polypeptide chain. The hydrogen atoms have a small positive charge and the oxygen and nitrogen atoms have a small negative charge. The opposite charge attracts to form hydrogen bonds NH_3. Although these bonds are weak, the large number of them maintains the molecules in a three-dimensional shape.



Question 140

i) Transferase

ii) Hydrolase

Question 141

Factors affecting difusion:

i) **Concentration difference / concentration gradient**
When a substance is diffusing between two compartments, the greater the concentration difference between the compartments, the faster the substance will diffuse. For diffusion across the cell membrane, the two compartments are inside and outside of the cell.

ii) **Surface area**
The rate of diffusion is directly proportional to the surface area of a membrane through which diffusion takes place. In other words, the greater the surface area of the membrane, the greater the rate of diffusion. To increase their surface area, cell membranes usually possess structures such as microvilli.

iii) **Diffusion distance**
The rate of diffusion is inversely proportional to the square of diffusion distance. The shorter the distance between compartments across which diffusion occur, the faster the rate of diffusion.

iv) **Size of the molecules/ ions**
The rate of diffusion is inversely related to the size of the diffusing molecules. That is a smaller molecule will diffuse faster than a larger one.

v) **Nature of the diffusing molecule**
Because molecules diffuse through the hydrophobic phospholipid bilayer, the more hydrophobic the molecule is, the faster its diffusion across the membrane.

vi) **Nature of the structure through which diffusion occurs**

Question 142

Competitive inhibition	Non – competitive inhibition
There is a structural similarity between substrate and inhibitor.	No structural similarity between the inhibitor and the substrate.
Inhibitor and substrate compete with each other to bind to the active site of the enzyme.	Inhibitor binds to the enzyme and site other than the active site.
It can be relieved by increasing substrate concentration.	The rate of reaction cannot be increased by increasing substrate concentration.

Question 143

Function of the following parts of prokaryotic cell:

i) **Ribosomes**
Ribosomes are involved in the process of protein synthesis.

ii) **Pili and fimbriae**
- Pili are involved in adherence or attachment of bacteria to surfaces or other cells.
- A special type of pili known as F or sex pili facilitate sexual reproduction of bacteria i.e. facilitate the transfer of genetic materials.

iii) **Capsule**
- Capsule facilitate adherence of bacteria to surfaces and offer additional protection to the bacteria.

iv) **Cell wall**
- The cell wall protects the bacteria cell from mechanical damage and from osmotic rupture/lysis.

v) **Plasmids**

- The plasmids contain genes that are normally non-essential to survival but may confer certain properties like antibiotic resistance.

Question 144

Functions of lysosomes

i) Digestion of extracellular materials that enter the cell by endocytosis.
   - Lysosomes fuse and release their enzymes into vacuole or vesicles containing materials engulfed by the cell by endocytosis. The enzymes then break down the materials into simpler molecules. In turn, the useful products formed are absorbed by the cytoplasm. The undigested materials left behind are expelled from the cell by exocytosis.

ii) Extracellular digestion: Release of enzymes outside the cell for digestion of materials.
   - In certain occasions, lysosomes release their enzymes outside the cell by exocytosis and bring about digestion of materials outside the cell. E.g. during fertilization, the lysosome of sperms known as acrosome release their enzymes that digest the egg membrane and provide a way for entry of sperm nucleus into the egg.

iii) Autolysis
   - Autolysis comes from two words “auto” which means self and “lysis” means splitting, so autolysis refers to self-digestion of a cell by enzymes released by lysosomes. In this process, the lysosomes raptures inside its cell and the released enzymes digest and degrade the cell. For this reason, the lysosomes are also known as suicide bags.

iv) Autophagy
   - Autophagy refers to the process by which unwanted or worn out organelles are engulfed and digested within the lysosomes. In this process, the unwanted organelle to be digested is first enclosed

by a single membrane. The resulting structure then fuses with lysosome and lysosomal enzymes digest the unwanted organelle.

Question 145

Differences between peroxisomes and lysosomes

Lysosomes	Peroxisomes
Lysosomal enzymes are synthesized by ribosomes bound to rough endoplasmic reticulum.	Peroxisomal enzymes are synthesized by free ribosomes in the cytoplasm.
Their enzymes are involved in digestion of macromolecules.	Their enzymes are involved in fatty acid oxidation and detoxification.
Lysosomes bud off from golgi apparatus	Peroxisomes bud off from endoplasmic reticulum.

Question 146

Factors affecting the fluidity of the plasma membrane

i) Amount of unsaturated fatty acids

The unsaturated fatty acids pack/fit loosely in the phospholipid bilayer. This means that the higher the amount of unsaturated fatty acids in the phospholipid bilayer, the more loose the packing of phospholipid molecules in the phospholipid bilayer. Therefore, as the amount of unsaturated fatty acids in the membrane increase, the membrane fluidity increases as well.

ii) Temperature

A rise in temperature increases the random movement of components of the phospholipid bilayer. This increased motion leads to increased membrane fluidity. So membrane fluidity increases as the temperature increases.

iii) Amount of cholesterol present in the membrane

The influence of cholesterol in the membrane fluidity has already been explained.

Question 147

i) Endocytosis is a process in which an extracellular material enters the cell by infolding of the cell membrane to form a vesicle/vacuole.
ii) Exocytosis is process exactly opposite to endocytosis; Endocytosis (endo - inside) transport large molecules into the cell while exocytosis (exo – outside) transport large molecules to the outside of the cell.

Question 148

Functions of proteins in the cell membrane:

i) Transport of substances across the cell membrane.
Certain plasma membrane proteins are involved in the passage of substances through the membrane. Some of these proteins are;
ii) Some proteins play a structural role
They help to stabilize and provide structural support to the plasma membrane.
iii) Some proteins act as enzymes
Certain plasma membrane proteins are enzymatic proteins that catalyze specific metabolic reactions.
iv) Some proteins act as receptors for specific molecules such as hormones
These proteins have a specific binding site where hormones or other chemical molecules can bind and bring about a desired effect to the cell.
v) Proteins are also involved in cell – cell recognition
Some proteins have carbohydrate chains attached to them. These are known as glycoproteins. The carbohydrate chains of glycoproteins like those of glycolipids differ from one cell to another. Thus, they also serve as identity markers of the cells.

Question 149

i) **Cell specialization** refers to the fact that different types of cells have different structures and abilities that enable them to perform their functions.
ii) **Cell differentiation** refers to series of events through which cells become structurally and functionally specialized.

Question 150

This model had some shortcomings:

i) The model suggested that all cell membranes are identical: this was known to be false
ii) This model pictured the cell membrane as a static structure: this was found to be wrong

Question 151

i) **Integral proteins**
Integral proteins are membrane proteins which are firmly embedded in the phospholipid bilayer. Some of the integral proteins protrude from one membrane surface only, while others span the entire membrane from one surface to the other surface such that they protrude on both sides. These integral proteins that span the membrane from one surface to the other are known as **transmembrane proteins**.
ii) **Peripheral proteins**
Unlike integral proteins, peripheral proteins are not embedded in the lipid bilayer. Instead, they are loosely attached to the membrane surface.

Question 152

Cholesterol has the following influences on the plasma membrane:

a) *At high temperatures, cholesterol stabilizes the membrane and makes it less fluid.*
This is because it decreases the movement of the phospholipid fatty acid chains in the phospholipid bilayer.

b) *At low temperatures, cholesterol maintains membrane fluidity and prevent it from freezing.*
    - This is because its presence in the membrane interferes with the close packing of phospholipid fatty acid chains.
    - This is of particular importance to the organisms living at low temperatures since the fluidity of the membrane is important for its functioning.

Question 153

Phospholipid bilayer is a structure that consists of two layers of phospholipid molecules.

Question 154

The presence of cholesterol in the phospholipid bilayer has the following effects:

i) It interferes with close packing of the phospholipid fatty acid chains.
ii) It decreases the mobility/movement of the phospholipid fatty acid chains.

Question 155

Prokaryotic cells are cells that lack a true nucleus. This means the DNA in prokaryotic cells is not within a nucleus.

Eukaryotic cells are cells which have a membrane bound nucleus.

Question 156

i) An organelle is a cell component that performs a specific function in that cell. Organelles present in eukaryotic cells are surrounded by a membrane similar in structure to the plasma membrane.
ii) The organelles of eukaryotic:
    - Nucleus
    - Ribosome
    - Endoplasmic reticulum
    - Golgi apparatus

- Lysosomes
- Peroxisomes

Question 157

i) Monosaccharides are the simplest group of carbohydrates. These simple sugars cannot be hydrolyzed or broken down further to give simpler sugars.
ii) Disaccharides are carbohydrates composed of two (2) monosaccharide units, (di-stands for two). A disaccharide is formed by a condensation reaction between two monosaccharides.
iii) Polysaccharides are polymers made up of many monosaccharide units which are linked by glycosidic bonds. They contain very long chains of hundreds or thousands of monosaccharide units, which may be either in straight or branched chains.

Question 158

Monosaccharides have the following physical properties:

i) They are readily soluble in water.
ii) They are usually colorless.
iii) They are crystalline solids.
iv) Most of them have a sweet taste.
v) They are reducing sugars.

Question 159

The functions of monosaccharides includes:

i) Glucose is the major source of energy for most animals.
ii) Glucose is the main form in which carbohydrates are transported in mammals.
iii) Ribose and deoxyribose are used in synthesis of nucleic acids DNA and RNA.
iv) Ribose is used in synthesis of coenzymes such as NAD, FAD and NADP.
v) The synthesis of ATP requires ribose.

vi) Ribulose forms ribulose biphosphate which acts as CO_2 accepter in photosynthesis.
vii) The pentoses and hexoses are building blocks of disaccharides and polysaccharides.

Question 160

i) **Maltose** is a disaccharide made up of two glucose molecules.
ii) **Lactose** also known as milk sugar is a disaccharide made up of glucose and a galactose. It is found only in milk of mammals, and is the main source of energy for infant mammals.
iii) **Sucrose** also known as table sugar or cane sugar is a disaccharide made up of glucose and a fructose.

Question 161

a)
i) Starch is a polysaccharide formed from condensation of alpha glucose units.
ii) Glycogen is the major form of storage polysaccharide in animals. Like starch, it is the polymer of alpha glucose.
iii) Cellulose is a polysaccharide consisting of long, unbranched chains of beta glucose which are linked by 1, 4 glycosidic bonds.

b) Polysaccharides have the following properties:
i) They are relatively insoluble in water.
ii) They are not sweet.
iii) They are non – reducing sugars.
iv) They cannot be crystallized.

Question 162

The components of starch are:

i) Amylose
ii) Amylopectin

Question 163

- **Amylose**
  Amylose consist of long, unbranched chains of alpha glucose which are linked by 1, 4− glycosidic bonds. The unbranched chains of amylose are coiled up into spiral – like structure. Amylose usually makes up $10 - 30\%$ of starch.
- **Amylopectin**
  In contrast to amylose, amylopectin consists of highly branched chains of glucose units. In amylopectin, alpha glucose units are linked by 1, 4 glycosidic bonds forming linear chains which are branched through formation of 1, 6 glycosidic bonds. 1, 6 glycosidic bond is formed as the result of condensation reaction between hydroxyl group at C_1 of one glucose molecule and hydroxyl group at C_6 of another glucose molecule.

Question 164

Starch is suitable as a storage material for the following reasons:

i) It is generally insoluble in water. So, when it is stored, it does not affect the osmotic balance of the cell i.e. it does not cause water to enter the cell by osmosis.
ii) It is folded into compact shape which makes it occupy less space in the cell.
iii) It can easily be converted back to glucose when needed by the cell.
iv) It is relatively large in size which makes itunable to diffuse through the cell membrane. Hence, it can't be lost from the cell.

Question 165

Polysaccharides have a number of important functions in living organisms. These includes:

i) They are used as storage material. For example: starch in plants and glycogen in animals.

ii) They are used as structural components: chitin and cellulose provide strong support for skeleton of arthropods and green plants respectively.
iii) They are used protective substances: Mucopolysaccharides such as hyaluronic acid form protective coats animal cells.
iv) Polysaccharides are also involved in variety cellular recognition and intercellular communication.

Question 166

Benedict's test is the test used for detectingpresence of reducing sugars. In this test the Benedict's reagent which is a blue colored alkaline solution of copper (II) sulphate is used.

The basis of Benedict's test is that when a reducing sugar is heated with Benedict's reagent, it carry out reduction of copper (II) sulphate to give a precipitate of copper (I) oxide which has a characteristic colour.
The test is carried out as follows:

- To a test tube containing a small volume of a test sample, a small volume of Benedict's reagent is added.
- Shake and heat the solution in a boiling water bath for a few minutes
- Formation of a precipitate with colour of the reaction mixture changing progressively from blue through green, yellow, orange, brown to deep red indicate the presence of reducing sugar.

Question 167

Iodine test is used to indicate the presence of starch in a sample. The basis of this test is that starch changes the colour of iodine solution from brown to blue-black. The test can be carried out as follows:

- To a test tube containing a sample to be tested, few drops of iodine solution are added.
- Colour change from brown to blue-black indicates the presence of starch. If the colour of the solution remains brown, then there is no starch in the sample.

Question 168

a) The bonds that hold the protein structure include:
   i) Ionic bonds
   ii) Hydrophobic interactions
   iii) Disulphide bonds
   iv) Hydrogen bonding

b)
   i) **Simple proteins**
   There are proteins which are made up of amino acids only.

   ii) **Conjugated proteins**
   These are proteins, which in addition to amino acids contain a non-protein component/group. The non-protein component is called a prosthetic group.

Question 169

a) Denaturation is a process in which a protein loses its three dimensional structure.

b) Physical and chemical agents that can cause denaturation include;

- **Temperature rise**
  As the temperature increases, the rate of molecular vibration increases. This increase in vibration of atoms / molecules in protein disrupt weak interactions such as hydrogen bonds and as the result the protein unfold.
- **Organic solvents and detergents**
  These disrupt the structure of proteins by interfering with hydrophobic interactions. Organic solvents and detergents have ability of interacting or bonding with non-polar groups of amino acids. These disrupt the hydrophobic interactions between the amino acids, causing the protein to unfold into extended polypeptide chain.
- **Strong acids and bases**
  Strong acids and bases disrupt the protein's structure by breaking ionic bonds between charged amino acids.
- **Heavy metals**

Heavy metals such as mercury (Hg^{2+}) and lead (Pb^{2+}) disrupt the protein structure by interfering with ionic bonds.

- **Mechanical force**
  When mechanical force is applied to a protein (e.g. by processes such as stirring and grinding), the protein structure become disrupted. The protein structure is disrupted because mechanical force can break weak interactions such as hydrogen bonds.