SEMINAR QUESTIONS DISCUSSED ON 16th/07/2023 AT
MIDLAND HIGH SCHOOL KAWEMPE-KAMPALA
FACILITATED BY
ASSOCIATION OF BIOLOGY EDUCATORS (ABE)

THEME 1: CELL BIOLOGY

Histology
QN: 1.1

(a) Describe the distribution and structure of simple plant tissues in stems.
(b) Explain how the structure of tissues responsible for water transport in plants relates to functions.
(c) Describe, with reference to skeletal connective tissue, the relationship between structure and function.

Cell physiology
QN: 1.2

In an investigation to determine the effect temperature on the membrane fluidity. Observations made are expressed graphically in **Figure 1**. In another investigation, two blood samples, **A** and **B**, were stored at 4 °C for 5 days. Sample **A** was then stored at 37 °C for 24 hours. Glucose was added to sample **B**, which was stored at 37 °C for 24 hours. The potassium ion concentration in the erythrocytes was recorded. The results are

Figure 1

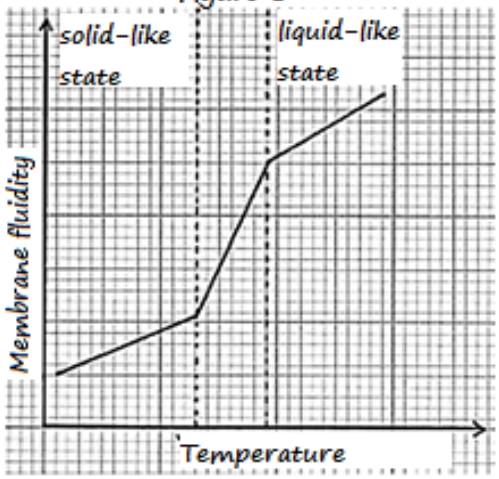
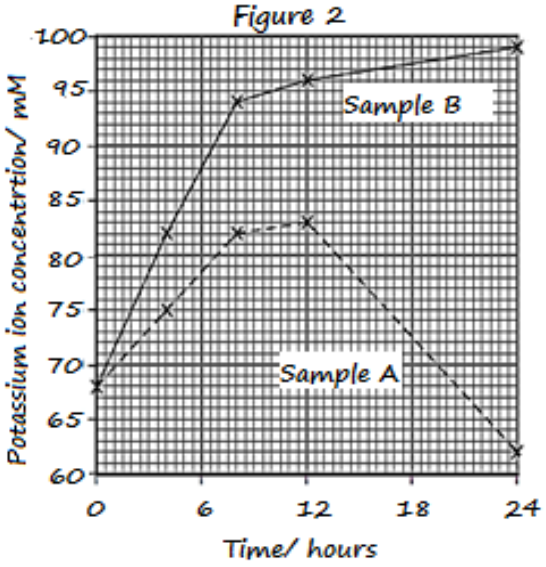


Figure 2



shown graphically in **Figure 2**.

Using Figure 1:

a) Describe the relationship between membrane fluidity and temperature.
b) (i) Explain the effect of temperature on membrane fluidity.
(ii) How does the liquid-like state affect the permeability of the membrane?
c) Account for the changes that would occur when 20% cholesterol is added to the plasma membrane.

Using figure 2:

d) Compare potassium ion concentration in erythrocytes from sample A and B.
e) Account for the differences above in (d).

f) How does the removal of potassium ions from medium surrounding the erythrocytes in sample B affect the osmotic balance?

Chemicals of life

QN: 1.3.1

The table shows figures from metabolism of carbohydrates, lipids and fats. Carefully analyze the data and answer questions that follow.

Food	Metabolic energy produced (kJ per 100g of food)	Metabolic water produced (g per 100g of food)	Oxygen consumed (L per 100g of food)	Carbon dioxide released (L per 100g of food)
Carbohydrates	1,760	56.0	81.0	81.0
Proteins	1720	41.3	94.0	75.0
Lipids	4,000	107.0	196.0	139.0

(a) From the data above, explain the reasons why animals store fats?
(b) Why do lipids need more oxygen on for cellular oxidation than carbohydrates of the same quantity?
(c) Calculate the respiratory quotients of the different energy sources.
(d) With reference to the above calculated respiratory quotient of carbohydrates; how can respiratory quotient be used to determine;
(i) The type of respiration taking place
(ii) A type of substrate being metabolized.
(iii) Whether hibernation is taking place or not.
(e) Explain other reasons why animals store fats?
(f) Account for the role of proteins in living things.

QN: 1.3.2

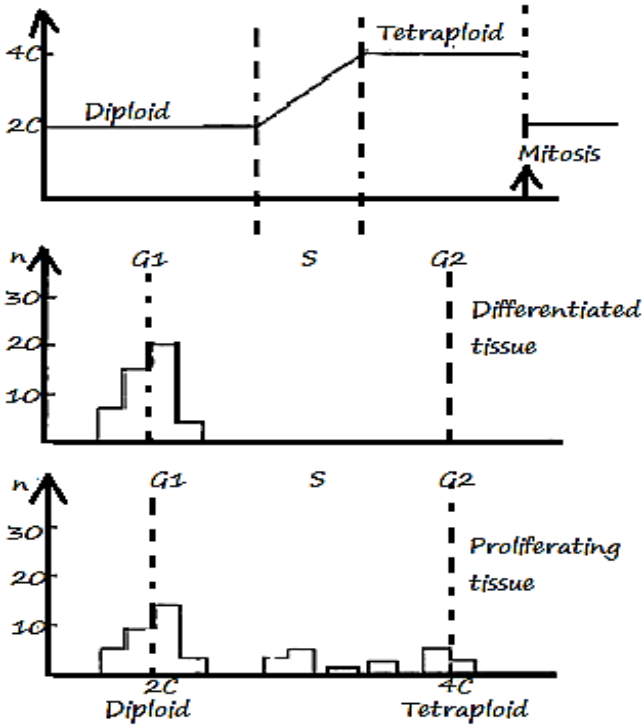
(a) Give an account of the chemical nature and variety of carbohydrates.
(b) Outline the role of carbohydrates in the life of a plant.

Cell division

QN: 1.4.

In the figure below, the **top graph** shows the changes in DNA cycle from interphase to mitosis of a cell in a body tissue. Below the graph are population histograms showing number of nuclei showing DNA content and DNA content of cells (diploid or tetraploid). The **first population histogram** shows number of nuclei showing DNA content and DNA content of cells in the differentiated tissue (non-dividing cells) during the different stages of mitosis. The **second population histogram** shows number of nuclei showing DNA content and DNA content of cells in the proliferating tissue (rapidly dividing cells) during the different stages of mitosis.

(a) From the figure; describe changes in the DNA cycle from interphase to the end of mitosis in;
(i) Differentiated tissue.
(ii) Proliferating tissue.
(b) Account for the above changes in (a)
(i) Differentiated tissue.
(ii) Proliferating tissue.
(c) Compare the DNA content in proliferating and differentiated tissues.
(d) Explain the main events that occur during the
(i) G1 phase.
(ii) S phase.
(iii) G2 phase.
(e) The above phases are necessary prior to mitosis. Explain.
(f) Describe the process by which a polypeptide is formed from DNA.



Cell structure and function
QN: 1.5.1

(a) Describe the structure of plant cell wall
(b) Compare the structures of plant cell wall and plasma membrane
(c) Explain the functioning of Golgi apparatus in animal cells.

QN: 1.5.2

(a) Describe how a whole set of codons required for formation of a polypeptide are assembled from DNA.
(b) How are codons assembled provide a basis for formation of a single polypeptide?

THEME II: ECOLOGY

QN: 2.1

The following data relate to two species of leaf-mining moths. The larvae of one species mine the leaves of birch trees and the larvae of the other species mine the leaves of oak trees. The data were obtained during an investigation of mortality factors affecting the two species of moths.

Stage in life history	Number of individuals surviving to the end of each stage as a percentage of the number entering the stage.	
	Birch leaf miner	Oak leaf minor
Instar 1	92	95
2	95	90
3	82	73

4	5	70
5	45	64
Prepupa	66	71
Pupa	80	64

a) **(i)** If 100 eggs were hatched, calculate the actual number of birch leaf miners which could be expected to survive to the end of the 5th instar stage. Clearly show your method of calculation and correct to the nearest whole number at each stage of your calculation.

(ii) Given that the survival rate of the comparable 5th instar of the oak leaf miner is 28 per cent, comment on the survival rates of the two species.

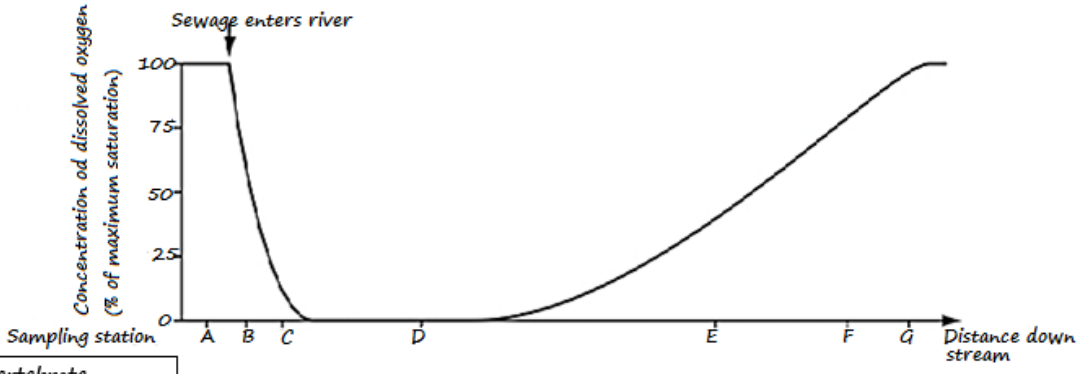
b) State two ways in which the survival pattern to the end of the pupal stage of the oak leaf miner compares with that of the birch leaf miner.

c) Suggest four factors which could limit the population of leaf mining species during their life cycles.

QN: 2.2

The figure below shows the effect of sewage discharge into rivers on the concentration of dissolved oxygen downstream and species of invertebrate animals along seven sampling points along the river.

The table shows the invertebrate animals at seven sampling stations, A to G, along the river.



Invertebrate animals	A	B	C	D	E	F	G
Stonefly nymph	✓						✓
Fresh water shrimp	✓					✓	✓
Caddis fly larva	✓					✓	✓
May fly nymph	✓	✓			✓	✓	✓
Midge larva	✓	✓	✓		✓	✓	✓
Rat tailed maggot		✓	✓	✓			
Water louse	✓	✓			✓	✓	✓
Wandering snail					✓	✓	✓
Tubifex worm	✓	✓	✓	✓	✓	✓	✓

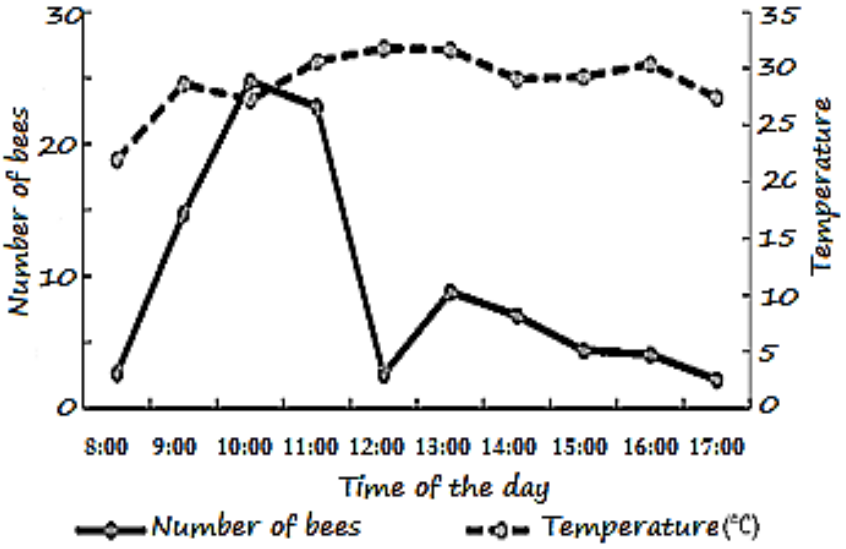
(a) Describe the trends in concentration of dissolved oxygen downstream.

(b) Account for the trends in (a) above.

(c) Describe the pattern of distribution of the invertebrates among the seven sampling stations.
(d) Explain the above pattern.
(e) Draw a table to categorize invertebrate animals in order of decreasing dissolved oxygen according to the **Five-point scale (Biotic index) for water pollution studies using presence and absence of indicator species**.
(f) Sampling station A has a higher biotic index than B. Explain.
(g) Other than non-vertebrate animals, state other two biological indicators of water quality.

QN: 2.3

The figure shows the number of bees that leave the hive to forage in a specific field at different times of the day. The changes in the environmental temperatures was also recorded and the results presented graphically as in the figure below. Study the figure below and answer the questions that follow.



(a) Explain the relationship between times of the day and number of bees visiting the flowers in the field.
(b) How does pollination affect the distribution of organisms in the environment?
(c) The evolution of flowering plants has been closely bound with the evolution of insects. Explain.
(d) Bees and flowering plants show example of coevolution; describe three other forms of coevolution in an ecosystem.

THEME III: MAINTENANCE OF LIFE

<u>Nutrition in green plants</u>

QN: 3.1.1

Two species of **saltbush** (**Atriplex sp.**), one a C3 plant and the other a C4 plant, where placed under the same conditions and their rates of carbon dioxide output or intake, were measured.
The data below shows their rates of net photosynthesis (carbon dioxide uptake in light), respiration (carbon dioxide release in the dark), and photorespiration (increase in photosynthesis in oxygen-free air in the light), at three different temperatures.

a) Represent the above data graphically.

b) Explain what is meant by the term photorespiration?

c) From the graph, compare C3 and C4 plants.

d) Account for the observed differences in the results obtained.

	Carbon dioxide flux ($mgdm^{-3}hr^{-1}$)					
	C3			C4		
	20°C	30°C	40°C	20°C	30°C	40°C
Net photosynthesis	27	29	17	24	31	32
Respiration	2.5	4	8	1.7	3	5.3
Photorespiration	5	11	10	0	0	0

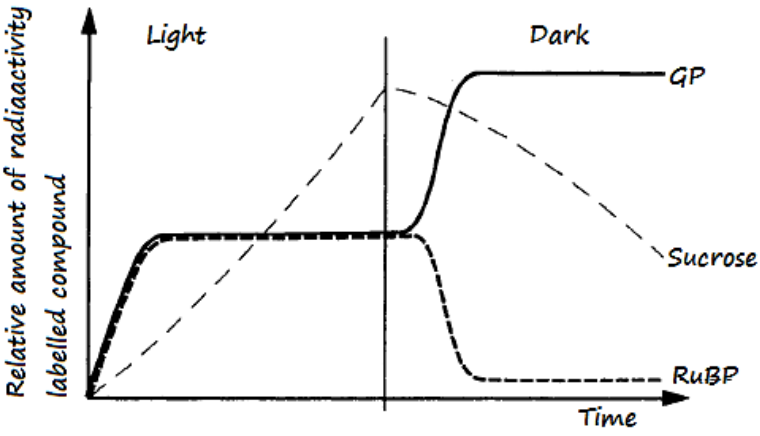
e) Suggest which of two plants is likely to grow faster in tropical climate. Give a reason for your answer.

f) Explain the ecological advantage of the photosynthetic adaptation of the two plant species?

g) Describe the photosynthetic mechanism that occurs in CAM plants.

QN: 3.1.2

Algae were supplied with a radioactive isotope of carbon, ^{14}C, and allowed to photosynthesize. After a period of time, the light was switched off and the algae left in the dark. The graph shows the relative amounts of some radioactive labelled compounds over the period of the experiment.



(a) Explain the changes in relative amounts of each of the radioactive compound shown in figure above after the light was switched off:

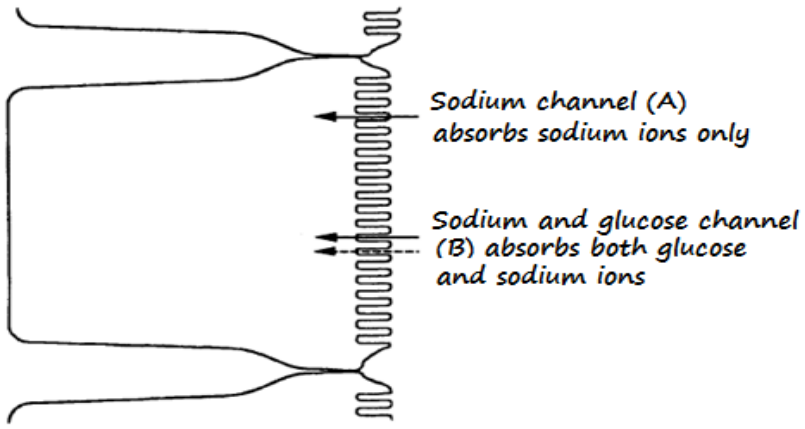
(b) Explain the relationship between GP, RuBP and sucrose before light is switched off.

(c) With evidence from the graph, explain what is meant by a limiting factor.

<u>Nutrition in animals</u>

QN: 3.1.3

The epithelial cells of the intestinal villi absorb sodium ions in two different ways. These are shown in the diagram.



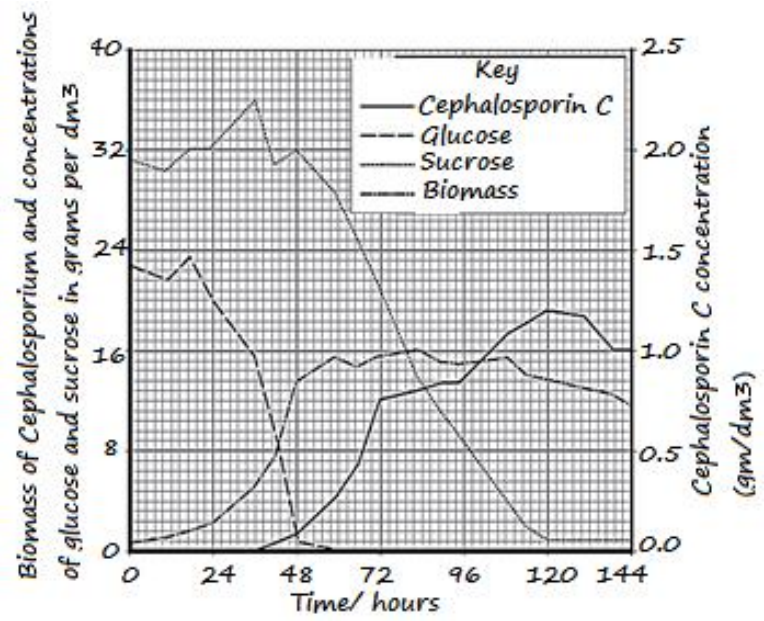
a) Explain how blocking of the sodium channels (A) might lead to diarrhoea.

Standard oral rehydration therapy involves giving the patient a mixture of glucose and salts having approximately the same solute concentration as blood.
Several ways have been investigated of making oral rehydration therapy more effective.
c) Suggest why:
i) adding extra glucose to the mixture would be unwise;
ii) Using a mixture of starch and salts reduces the extent and duration of the diarrhoea even more.
d) With reference to a named carnivorous mammal describe how (i) protein is digested and absorbed into the bloodstream and (ii) the products are assimilated.

Respiration.

QN: 3.2.1

In an investigation to determine the rate of substrate consumption during antibiotic production, a fermenter was used to grow the fungus ***Cephalosporium*** which makes the antibiotic **Cephalosporin C**. The reaction medium contained a mixture of the sugars glucose and sucrose, and other mineral ions. The fermentation chamber was flashed with nitrogen under sterile air. The graph below shows changes in the concentrations of **glucose, sucrose, Cephalosporin C** and the **biomass of *Cephalosporium*** measured in the fermenter over 6 days.



a) Describe the changes in concentrations of glucose and cephalosporin C through the 6-days period.
   i. Glucose concentration.
   ii. Cephalosporin C
b) State and explain the relationship between glucose concentration, the biomass of *Cephalosporium* and the concentration of Cephalosporin C.
c) What evidence is there that *Cephalosporium* is able to use glucose more easily than sucrose?
d) Ethanol is one of the primary metabolites formed in the fermentation chamber.
   i. Sketch a graph showing how concentration of ethanol and biomass of Cephalosporium would vary with time.
   ii. Explain the relationship between ethanol and biomass of Cephalosporin as sketched in (i) above.

e) Explain the following observations. Why

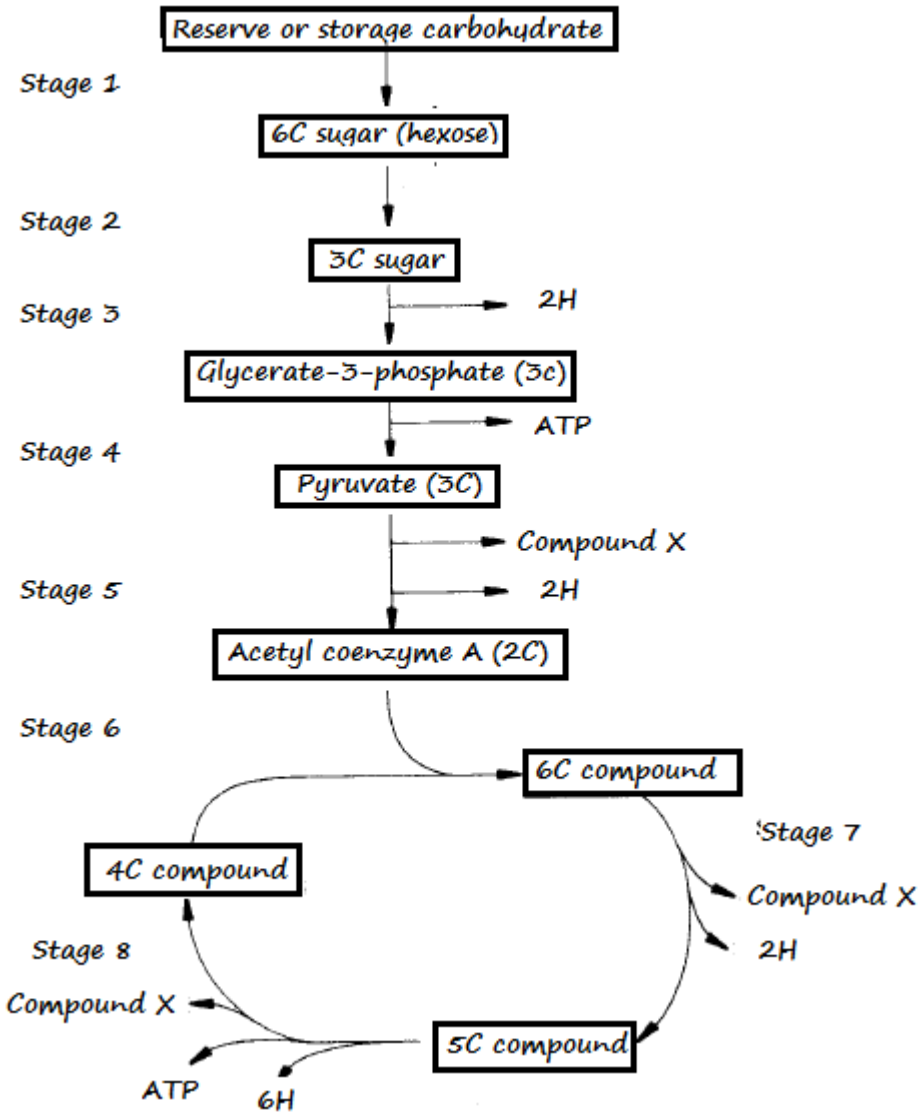
i. Other mineral ions were added to the reaction medium?

ii. Nitrogen was flashed in the reaction vessels?

iii. Sterile air was used to introduce nitrogen?

QN: 3.2.2

The diagram below shows some of the stages in cell respiration.



(a) Describe the fate of hydrogen atoms removed from stages 3, 5, 7 and 8.

(b) Identify compound X, and explain the significance for its removal at stage 5, 7 and 8.

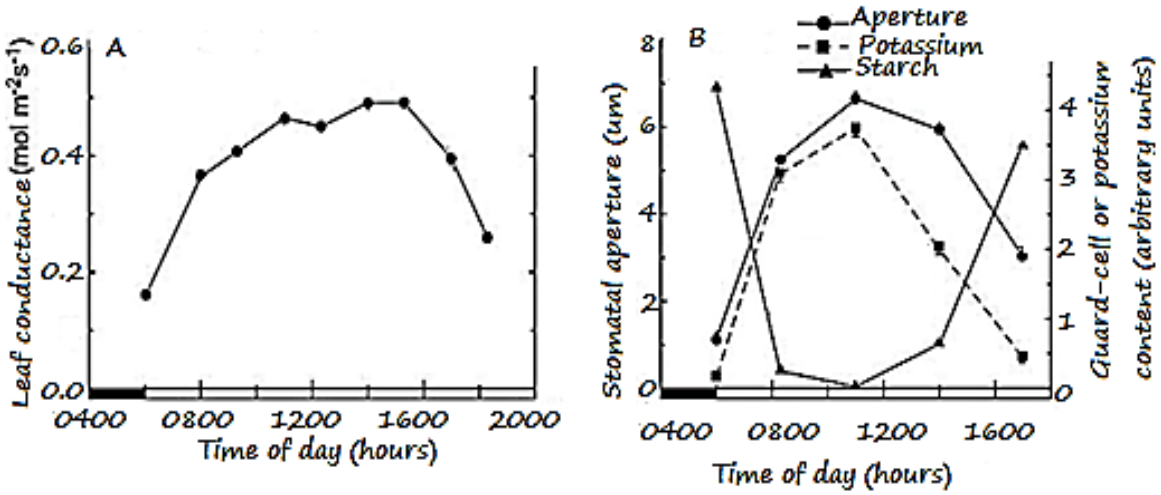
(c) Outline the chemical changes which proteins and fats undergo when they are used as an energy source, indicating where the products of these changes link up with carbohydrate respiration.

<u>Uptake and Transport in plant.</u>

QN: 3.3.1

The basic stomatal physiological parameters were examined and results presented graphically in figure A and B.

Figure A shows the pattern of leaf conductance over the course of the day. Leaf conductance was measured by counting number of open stomata during the investigation. Figure B below shows pattern of stomatal aperture size, potassium ion content in the guard cells, and starch content of a leaf guard cell over the course of the day.



(a) Describe the relationship between patterns of;

- Guard cell starch content and potassium ion content.
- Potassium ion content and leaf conductance.

(b) Explain the effect of time of the day on the stomatal aperture size of the leaf.

(c) Compare the trends in leaf conductance and guard cell starch content over the course of the day.

(d) Account for the differences in (c) above.

(e) What would happen leaf conductance if a respiratory poison was injected into the guard cells? Give a reason (s) for your answer.

QN: 3.3.2

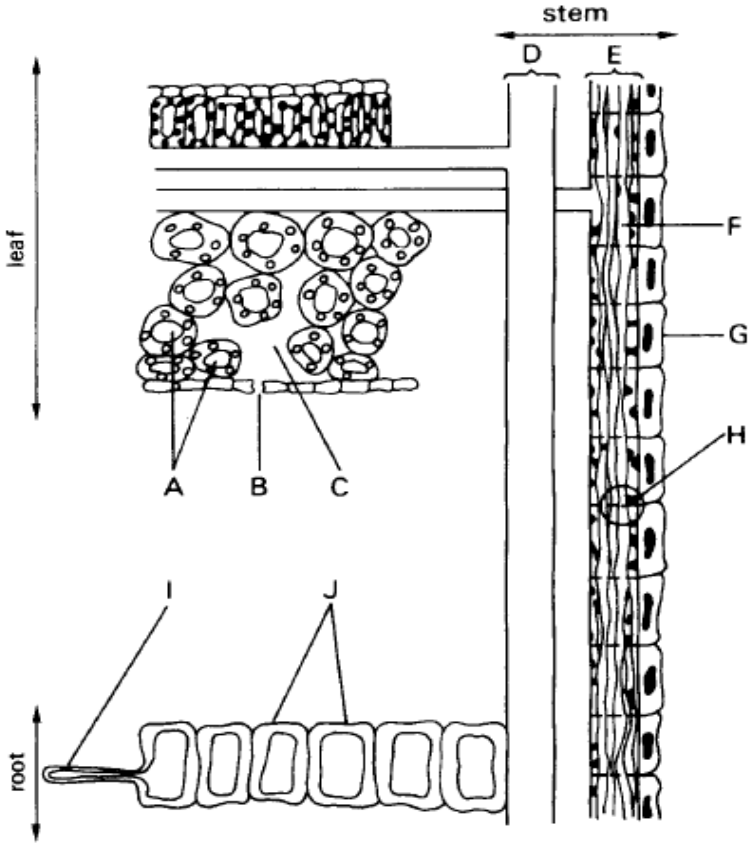
Figure shows a simplified view of the vascular system in the flowering plant.

(a) Identify the structures labelled A to J in Figure.

(b) Describe how raw materials (other than water) enter a flowering plant.

(c) Describe the mechanisms by which water passes through a plant from the soil to the atmosphere, showing how the various cells along its path are adapted for their function.

(d) Describe the way in which pore B opens.



Transport in animals

QN: 3.4.1

The graphs below show pressure changes through the heart. Graph A shows the changes in the blood pressure in **o**ne side of the heart. Graph B shows the changes in blood pressure in the other side of the heart over same time period.

a) Calculate the heart rate in beats per minute. Show your working.

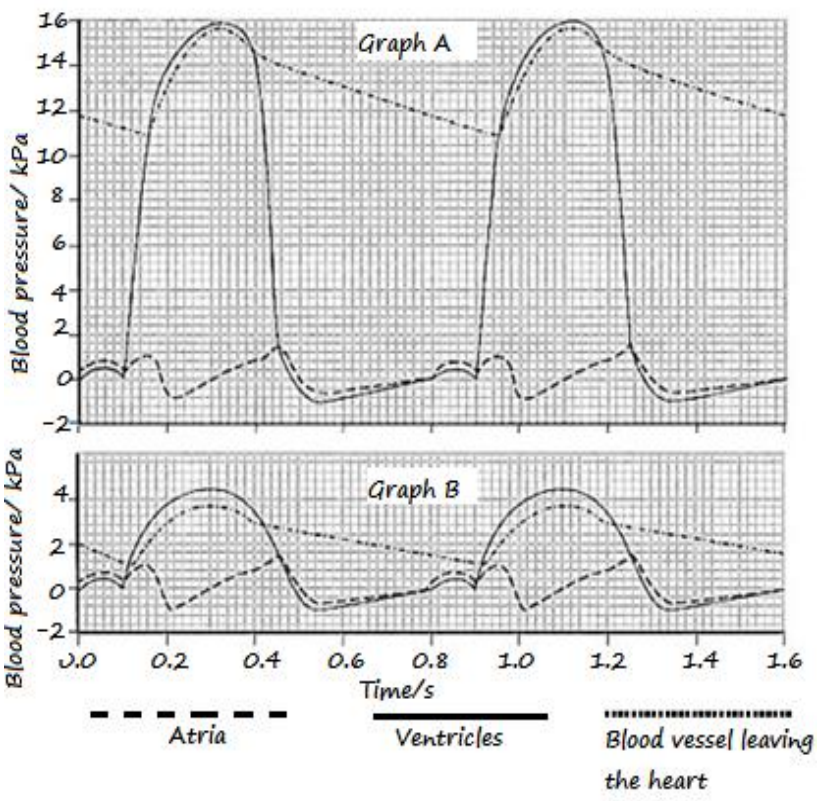
b) Giving reasons from the graphs, which side of the human heart is represented by Graph A and B.

c) Using graph A;

(i)Describe the blood pressure changes between 0.0 and 0.45 seconds,

(ii) Account for the above changes that occur in this part of the cardiac cycle.

d) How different are blood vessels carrying blood away from heart in graph A and graph?

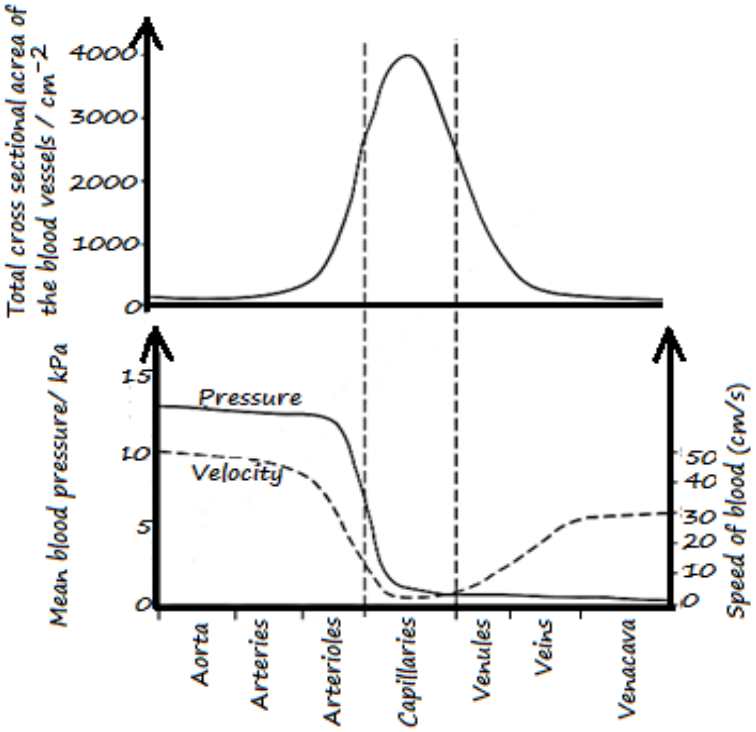


e) Why is the highest pressure reached in the ventricle in graph A is much higher than the pressure reached in the ventricle in graph B.

f) Account for the effect of increased level of carbon dioxide in blood on blood pressure in man

QN: 3.4.2

The figure below shows the total cross sectional area of the blood vessels in the systemic circulation. It also shows the changes that occur in blood pressure and speed (velocity) of blood in the different blood vessels.



(a) Describe how mean blood pressure and speed of blood change with cross-sectional area of blood vessels.

(b) Explain the effect of total cross sectional area on the mean blood pressure and speed of blood in the different blood vessels.

(c) Work out the drop in;

(i) Blood pressure from the start of aorta to the end of capillaries.

(ii) Velocity of blood from the start of the aorta to the middle of capillaries.

(d) Account for

(i) What brings about the drop in the results obtained in (c) (i) above.

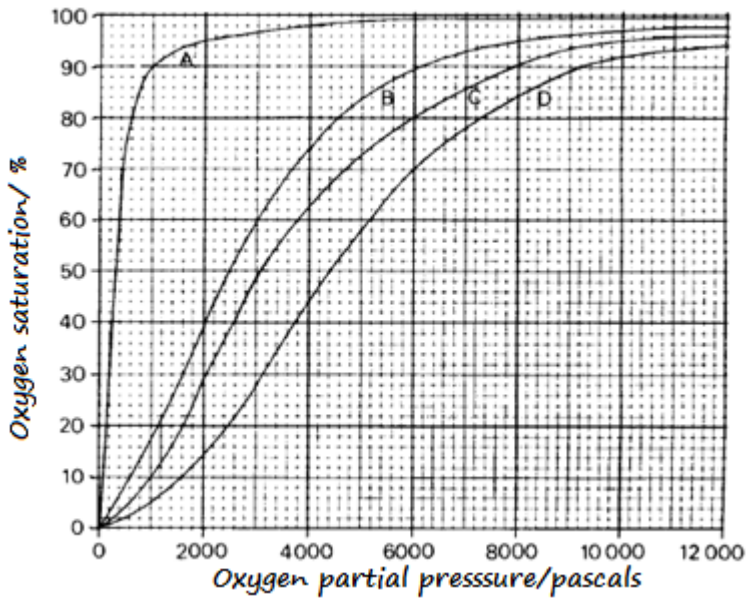
(ii) The significance of the above results in (c) (ii).

(e) Explain the role of the brain in the control and maintenance of blood pressure in mammals.

(f) Of what significance is it to regulate blood pressure?

QN: 3.4.3

The oxygen dissociation curves figure7.12 represent the relationship between the partial pressure of oxygen and the percentage oxygen saturation of two respiratory pigments. Curve A shows the response of myoglobin in muscle and curves B, C and D the response of haemoglobin in the blood at three different partial pressures of carbon dioxide.



KEY

A = myoglobin in muscle

B = haemoglobin at CO_2 partial pressures 2666 Pat (20 mm Hg)

C = haemoglobin at CO_2 partial pressures 5332 Pa (40 mmHg)

D = haemoglobin at CO_2 partial pressures 10 664 Pa (80 mmHg)

A Pascal (Pa) is a unit of pressure. A pressure of100 000 pascals is approximately equal to atmospheric pressure (760 mm Hg).

a) For curve B, explain the effect that increasing partial pressure of oxygen has on the saturation of the respiratory pigment.

b) Over which range of partial pressures of oxygen does the most rapid reaction with haemoglobin occur for (i) curve Band (ii) curve D?

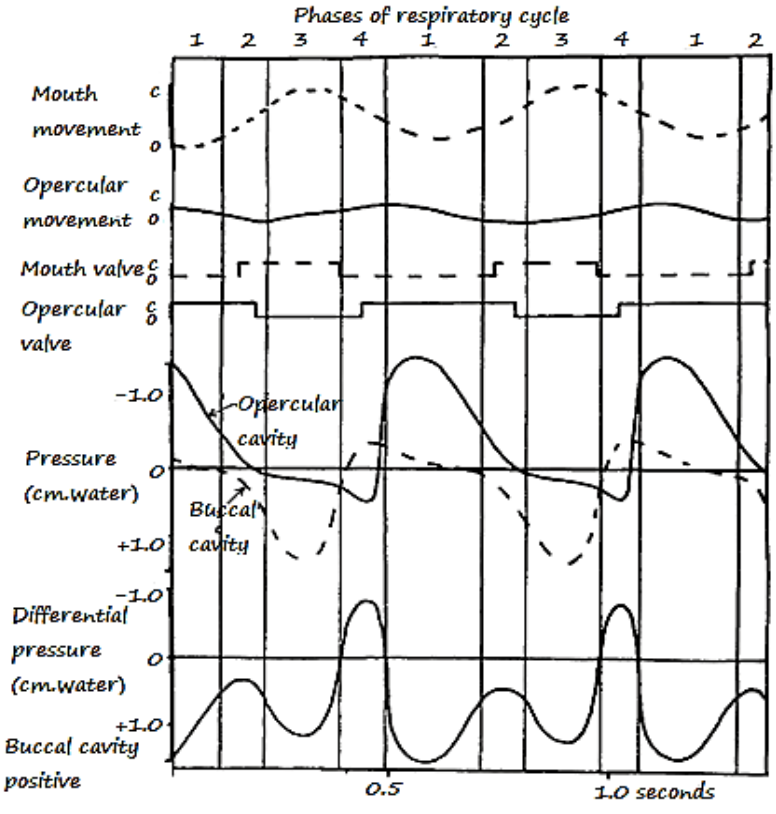
i) curve B

ii) curve D

c) Where in the body of a mammal is the partial pressure of carbon dioxide likely to be high, as in curve D? Explain.
d) If the blood when fully saturated with oxygen is able to carry 100 cm^3 (ml) of oxygen per dm^3 (litre), calculate the volume of oxygen released per dm3 (litre) from the blood when blood that is 90 per cent saturated flows into a tissue where the partial pressure of oxygen is 4000 Pa (30 mmHg) and that of carbon dioxide is 5333 Pa (40 mmHg)
e) Suggest reasons for the differences in curve A and curve D.
f) Curve A is similar to a curve obtained when investigating the oxygen-carrying capacity of the respiratory pigment in an aquatic worm which burrows in mud.
Explain how this curve indicates the worm's adaptation to its environment.

<u>Gaseous exchange</u>
QN: 3.5.1

Figure Shows Movements of the mouth and operculum with associated pressure changes in the buccal and opercular cavities during breathing in a fish species, trout (*Salmo trutta sp.*) (70 gm) at 17° C. Dashed lines relate to the mouth and buccal cavity. The differential pressure between the two cavities is shown below. C and O Indicate 'closed' and 'open' respectively.



(a) Account for the pressure changes in the buccal cavity in the buccal cavity during one complete respiratory cycle.
(b) Compare the pressure changed in the buccal cavity and opercular cavity in one respiratory cycle.
(c) What is the physiological significance of difference between the pressure in the buccal cavity and opercular cavity?
(d) Explain the following observations.
(i) Fish breathes at a higher rate than any other terrestrial animals.
(ii) Fish consumes less oxygen during winters.
(iii) Fish need more oxygen as temperature of water increases.
(iv) Identify phases during which buccal pumping and suction pumping occur
(e) How is the gas exchange system of fish suited for its function?

Defense against diseases

QN: 3.6.1

Figure below shows the changes in B cell clone size at different times of exposure to a similar antigen. Study it carefully and answer questions that follow.

(a) Identify the B cells types at A, B and C.

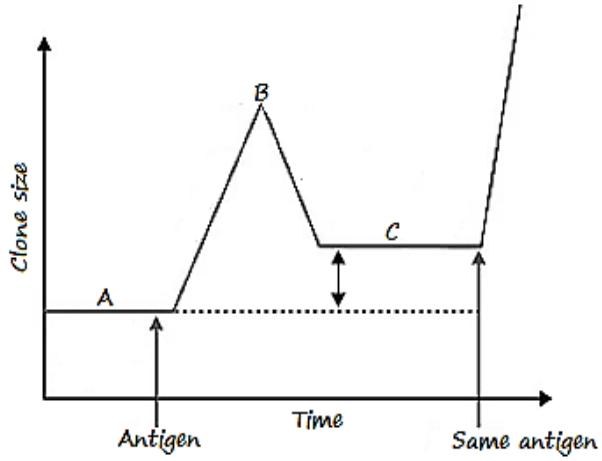
(b) Describe the pattern of B cell clone size with time.

(c) Account for the above changes in the clone size of B cells.

(d) Distinguish the type of response on first from that of second exposure.

(e) Explain the role of T cells in antibody production on antigen exposure.

(f) How do antibodies destroy antigens in the body of living organisms?



Coordination

QN: 3.7.1

The graph shows changes in the concentration of the ciliary muscles as a person watches a humming bird move from one flower to another while feeding on nectar.

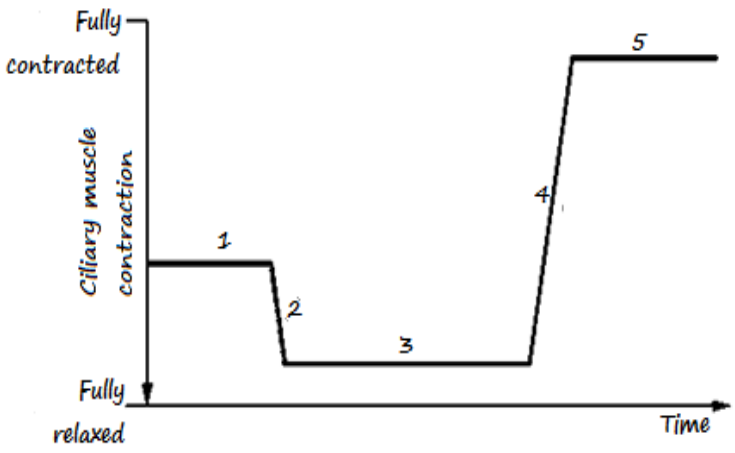
(a) With reasons, in which period of time 1, 2, 3, 4 or 5 was the humming bird

(i) Feeding from a flower very near to the person.

(ii) Flying away from the person.

(iii) Flying towards the person.

(b) Explain the role of nervous system in determining the amount of light entering the eye as the person watches the bird.

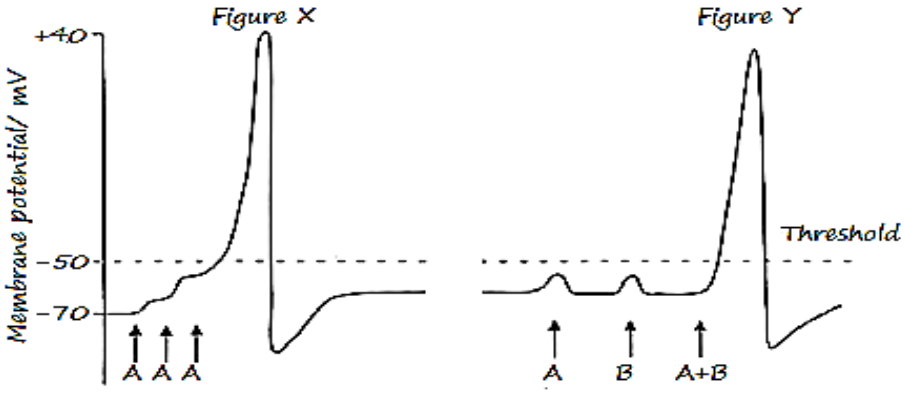


(d) How does the distribution of cones across the retina affect acuity and sensitivity to light by different parts of the retina for the above person?

(e) Describe the mechanism of photo transduction in the appropriate photosensitive cells in the above person.

QN: 3.7.2

The figures X and Y below show changes in the membrane potential of a post synaptic neurone. Figure X shows changes in post synaptic membrane potential when three different stimuli are delivered in a rapid succession via presynaptic neurone A. Figure Y shows changes in post synaptic membrane potential when both presynaptic neurones A and B are stimulated simultaneously. Study them carefully to answer questions that follow.



(a) What feature of synapses is shown in the figures above?

(b) Explain how the action potential is fired in the post synaptic neurone when stimulated at,

(i) Post synaptic neurone A alone with the three rapid and successive stimuli.

(ii) Both post synaptic neurones A and B respectively once with single stimuli each.

(c) Using figure X, describe the role of the observed feature in impulse transmission.

(d) Predict and explain what would happen to membrane potential if intensity of a single stimulus arriving at A is tripled and applied once.

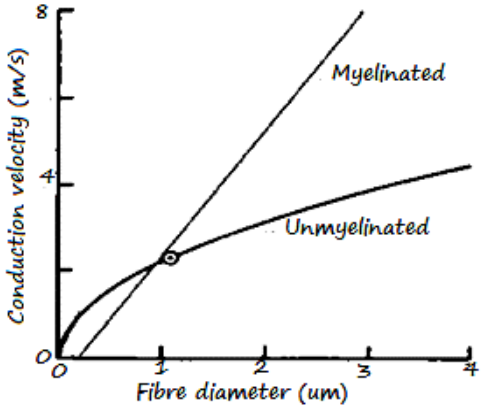
(e) Describe the changes which occur when an impulse arrives at the axon of the presynaptic knob of an excitatory chemical synapse.

(f) Describe the role of nerves in survival of organisms in within their environments.

(g) Describe the effect of the follicle stimulating hormone on its target organ.

QN: 3.7.3

The **graph** shows the variation in conduction velocity of the nerve fibre at varying diameters when the axon is myelinated and unmyelinated. **Table** below shows the ionic concentrations inside and outside of a nerve fibre in the brain.



Ion	Relative permeability	Intracellular concentration (mM)	Extracellular concentration (mM)
Chloride	0.45	13	150
Potassium	1.00	100	5
Sodium	0.04	15	150

(a) Describe the effect of fibre diameter on conduction velocity when;

(i) Unmyelinated.

(ii) Myelinated.

(b) (i) compare the relationship conduction velocity and fibre diameter for the two fibres.

(ii) Account of the above differences.

(c) Using the table, explain how the above state of the nerve fibre is maintained

(d) Account for the changes when a stimulus arrived at the above nerve fibre.

(e) Describe how an action potential is propagated along a myelinated axon.

QN: 3.7.4

In an experiment to determine the effect of auxin treatment on the length of axillary shoot, the following procedures were carried out on five groups of pea seedlings as follows.

A. Apical bud removed.

B. apical bud removed and auxin placed on cut stump.

C. apical bud removed and gibberellin acid placed on cut stump.

D. apical bud removed and cytokinin placed on cut stump.

E. plants left intact.

Days after start of treatment	Mean total axillary shoot lengths per plant (mm)				
	A	B	C	D	E
2	3	3	3	3	3
4	10	4	12	9	3
6	30	4	45	32	3
8	50	5	90	47	3
10	78	6	116	80	3
13	118	30	150	119	3

The table below shows results obtained at different time intervals after treatment.

(a) Represent the above data graphically.

(b) Describe the effect of the treatments on the mean total axillary shoot lengths of each group of pea seedlings.

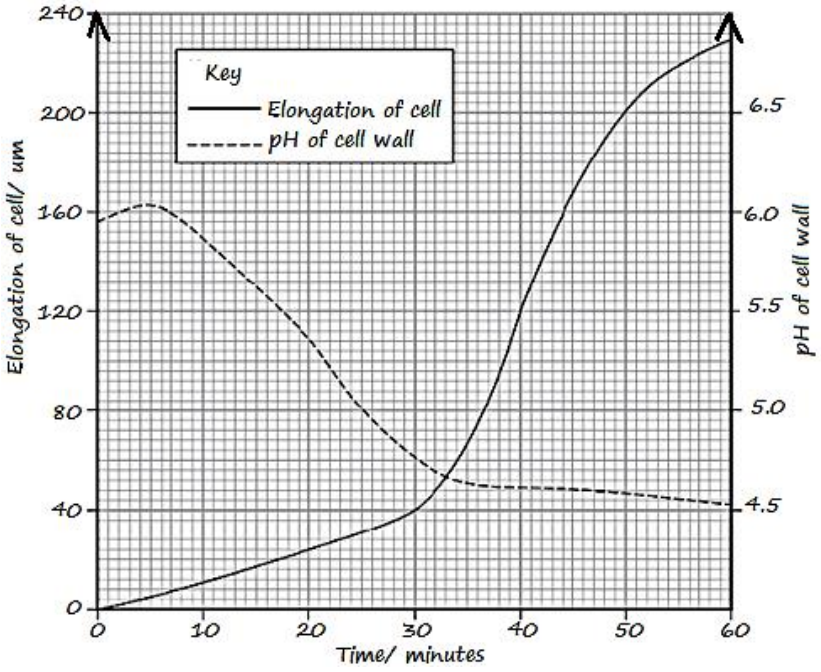
(c) Account of the above effects in (b) above.

(d) Compare the effects of auxins and gibberellins in plant growth and development.

(e) Of what commercial significance are auxins, gibberellic acids and cytokinin?

QN: 3.7.5

The graph below shows the effect of auxin on the pH of the cell wall and cell elongation; when auxin was added to plant cells. The pH of cell wall and cell elongation was measured over a period of 60 minutes as shown below.



(a) Calculate the maximum rate of elongation of the cell.

(b) Describe the effect of auxin on;

(i) pH of cell wall.

(ii) Elongation of cell.

(c) Explain the,

(i) Effect of auxin on pH of cell wall.

(ii) Relationship between pH of cell wall and elongation of the cell.

(d) (i) What is meant by the term apical dominance?

(ii) Describe the role of auxins in apical dominance.

(e) Explain why auxins are used as selective weed killers in cereal crops.

(f) Outline the effects of auxins in plants.

(g) Synthetic growth retardants are used to limit the height of both cereals and ornamental species which are grown for their flowers. Describe two economic advantages of using growth retardants.

HOMEOSTASIS.

Temperature regulation.

QN: 3.8.1

On a hot day, a student has an ice drink. The graphs below I and II show some of the changes to the student's body produced by the iced drink.

Fig I

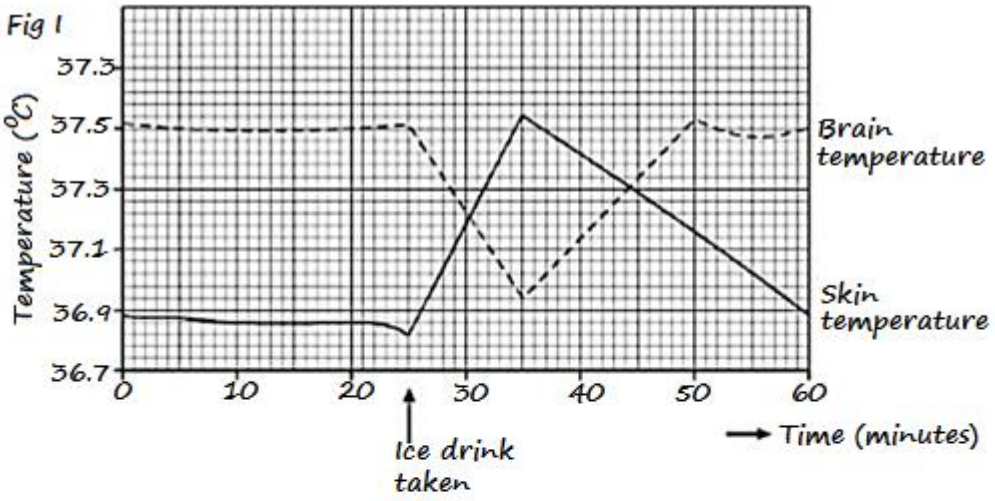
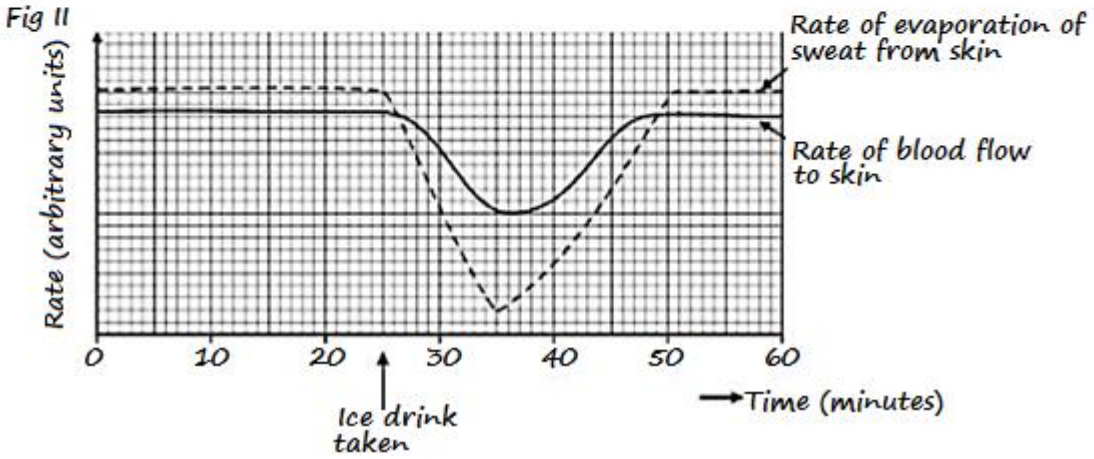


Fig II



(a) Describe the relationship between;

(i) Brain temperature and rate of blood flow to the skin.

(ii) Rate of blood flow to the skin and skin temperature.

(b) Using the two figures above, explain the effects of the ice drink taken as observed.

(c) Relate the structural and physiological adaptations of mammals to hot environments.

QN: 3.8.2

The temperature of Mary's brain and one of her fingers was recorded at six different external temperatures.

Temperature		
External	Brain	Finger
20	36.9	37.0
15	37.0	36.8

10	36.7	36.5
5	36.9	36.2
0	36.8	35.6
-5	37.0	34.3

a) Calculate the maximum temperature range for (i) Mary's brain, and (ii) Mary's finger.
b) Represent the results above on a suitable graph
c) From the plotted graph, explain the relationship between external temperature and;
   i. Mary's finger.
   ii. Mary's brain.
d) Explain how the human body responds to an external temperature of 40°C
e) In the UK, the external temperature can drop below 0°C. Explain how the human body maintains a stable internal temperature when the external temperature is 0°C.

<u>Blood sugar regulation.</u>

QN: 3.8.3

(A). In a medical study, the ADH levels in the blood of eight people were measured.
Four of the people, A, B, C and D, do not have diabetes insipidus.
The other four people, E, F, G and H, have diabetes insipidus.
The results are shown in the table 1.

	ADH level in blood (μg per dm^3)	
People without diabetes insipidus	A	5.2
	B	2.8
	C	4.9
	D	3.5
People with diabetes insipidus	E	0.1
	F	0.2
	G	0.1
	H	0.0

a) Explain the difference in the mean ADH levels in the people without diabetes insipidus and those with diabetes insipidus.
b) Explain the role of ADH regulating the water content of the blood.

(B). Table 2 shows the results of two blood tests carried out on three people to check their blood glucose levels. Person 1 is healthy.

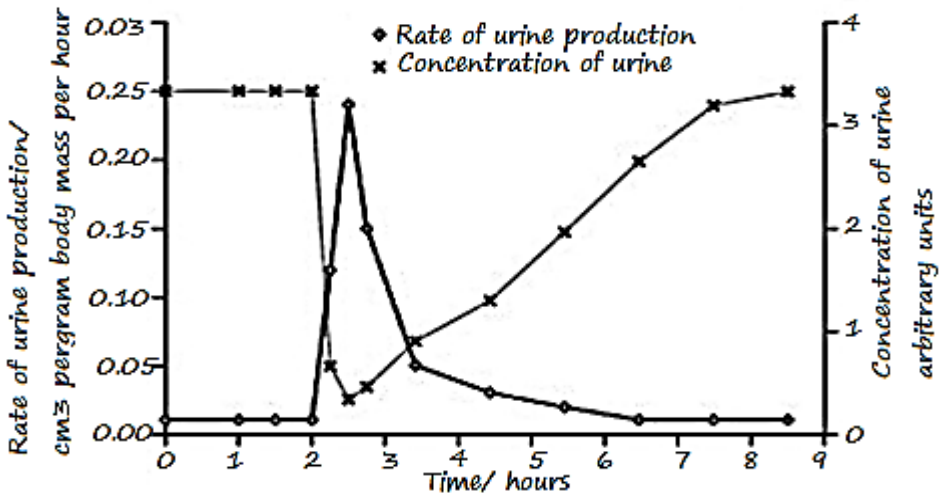
	Blood glucose (mmol/l)	
	After fasting for 12 hours	Two hours after drinking 75g glucose
Person 1	5.4	6.4
Person 2	5.6	9.0
Person 3	7.8	12.1

a) Compare the glucose levels of person 1 and person 2 after fasting for 12 hours.
b) Compare the glucose levels of person 3 with the glucose level of person 1, two hours after drinking 75g glucose. Give an explanation for your answer.
c) Compare diabetes insipidus and diabetes mellitus.

Excretion & osmoregulation

QN: 3.8.4

The common vampire bat, Desmodus rotundus, feeds on blood of sleeping mammals ingesting about 60% of its body mass in blood with each meal. The protein-rich food has the same water potential as the bat's plasma but has a high volume. The stomach of vampire bats concentrate the blood meals very quickly by absorbing water.



The rate of urine production and concentration of urine produced by a captive common vampire bat was determined before and after one blood meal. The bat was provided with a blood meal during the second hour of the investigation. The results are shown in the graph.

(a) Describe the effects of feeding on the rate of production of urine and the concentration of urine.

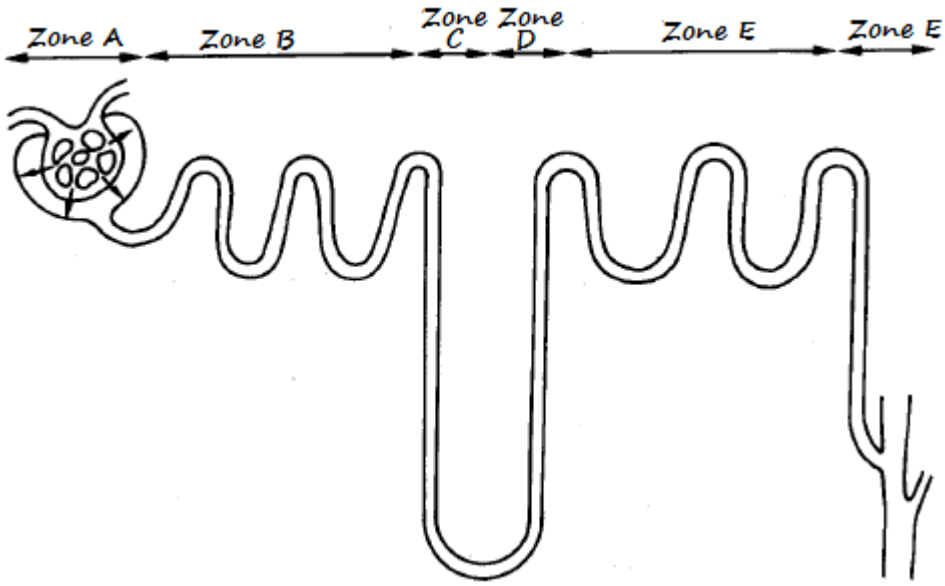
(b) Explain the significance of the above effects in (a) to the bat.

(c) Account for the large quantities of urea excreted by D. rotundus.

(d) Vampire bats are able to produce a much more concentrated urine than that produced by humans. Suggest how they are able to this.

QN: 3.8.5

Figure represents a mammalian kidney nephron.



(a) Briefly describe the major process that takes place in Zone A.
(b) State the approximate percentage proportion of glucose, sodium ions and water which passes out of the tubule through Zone B and the process involved in passing out.
(c) Explain the effect of aldosterone on the tubule lining of Zone D.
(d) Briefly explain the homeostatic mechanism controlling the functioning of parts E and F when the osmotic pressure of the blood rises.
(e) Explain the following;
(i) the blood vessels in the area of the loop of Henle run parallel to each other:
(ii) the blood vessels leading to the glomerulus are wider in diameter than those leaving it;
(iii) There are more microvilli on the cells lining the proximal convoluted tubule (first convoluted tubule) than on those lining the distal convoluted tubule (second convoluted tubule).

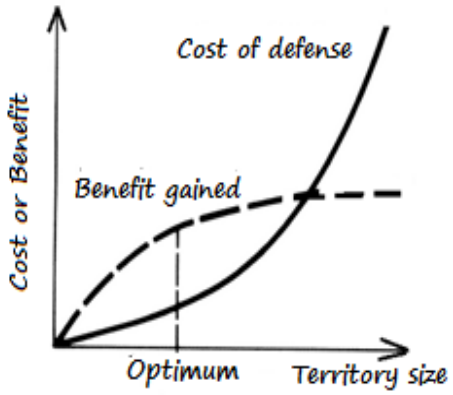
<u>Support, movement & locomotion.</u>
QN: 3.9.1

(a) Compare the skeletal systems of mammals, herbaceous plants and trees to show how,
(i) The organism is supported;
(ii) Growth occurs;
(iii) The types of skeleton are adapted to the way of life of the organism.
(b) Describe the sequence of events involved in the stimulation and contraction of a skeletal muscle fibre. (Start your answer at the point where the impulse reaches the end of the motor fibre.)

<u>Patterns of behaviour</u>
QN: 3.10.1

The graph below shows the effect territory size on both cost of defense and Benefit gained from territoriality of sunbirds.

(a) Describe the changes in cost of defense and benefit gained with territory size.
(b) Account for the above observations.
(c) An exceedingly high cost defense is observed during the breeding period.
Explain.
(d) How do birds defend territories?
(e) State any two ways by which birds may physically mark their territories.



(f) Outline the advantages and disadvantages of territoriality.
(g) Compare conditioning and reasoning.

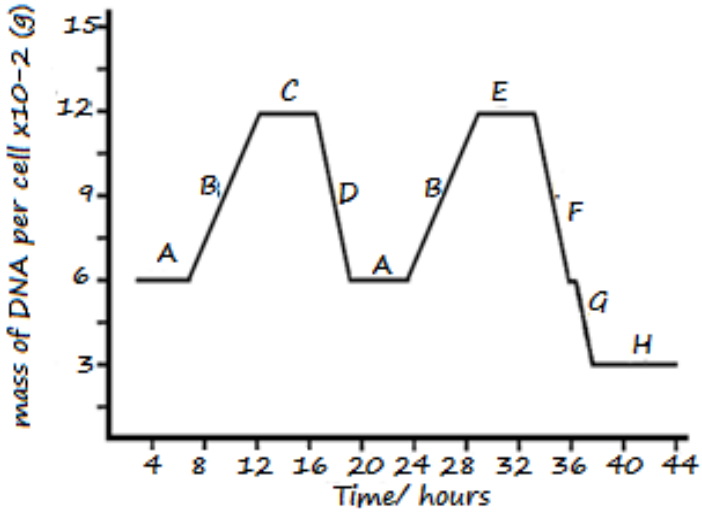
THEME IV: CONTINUITY OF LIFE

Reproduction

QN: 4.1.1

The graph below shows the changes in the intracellular mass of DNA in human testicular cells (in wall of seminiferous tubules) during spermatogenesis.

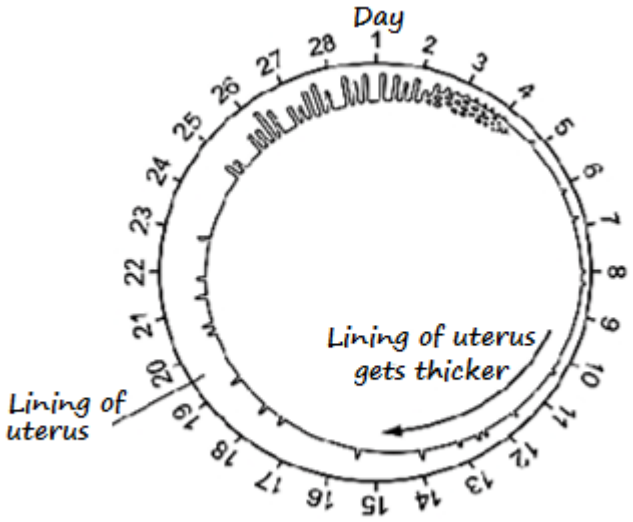
(a) Describe the trend in the mass of DNA per cell with time at the different phases from the graph.
(b) Explain the observed changes in mass of DNA at;
(i) A
(ii) B
(iii) C and E
(iv) D
(v) F
(vi) G



(c) Describe post division events that occurring at H.
(d) Explain how the above process is controlled by the endocrine system.
(e) What are the advantages of asexual reproduction compared with sexual reproduction?

QN: 4.1.2

The diagram shows the changes that occur to the uterus during the menstrual cycle.
(a) Describe the change in the thickness of lining the uterus from day 1 to day 28.



(b) Explain the hormonal interaction that result into the above changes in uterine wall thickness.

(c) Describe the development of the Graafian follicle from the oogonium to ovulation.

QN: 4.1.3

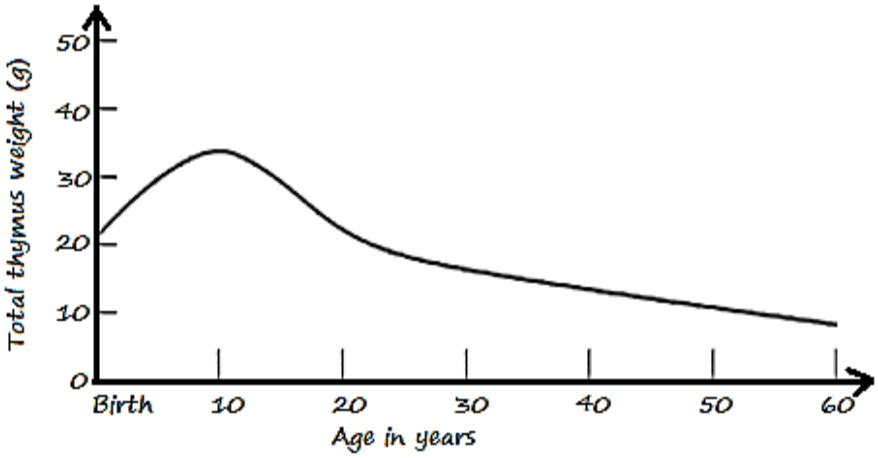
Describe the process of fertilization in an angiosperm from the moment of pollination.

Describe the development of the ovule into the seed in a NAMED angiosperm.

Growth and development

QN: 4.2.1

The graph below shows the changes in the weight of the thymus from birth to 60 years. Study it carefully and answer the question that follow.



(a) Describe the relationship between age and total thymus weight.

(b) Account for the pattern of total thymus weight with age.

(c) Provide an account for the predicted pattern of percentage growth of the reproductive organs.

(d) Explain the effect of;

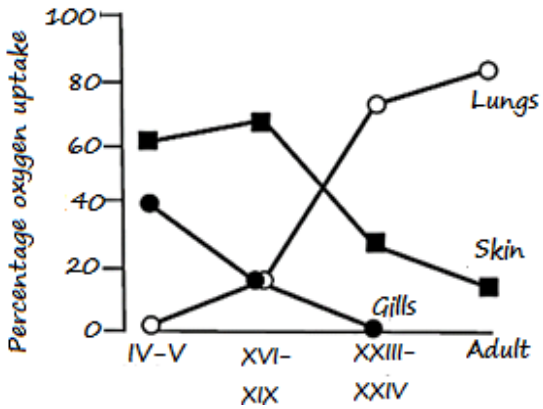
(i) Removing the thymus from a new born baby.

(ii) Removing the thymus from a 60 year old person.

(iii) Grafting a maternal tissue onto a newly born baby whose thymus is removed.

QN: 4.2.2

Figure below shows change in percentage of total oxygen taken up across the skin, gills and lungs during the different stages metamorphosis of a frog at 20°C.



(a) Describe the changes in percentage of total oxygen taken up across the;

i. Gills.
ii. Skin.
iii. Lungs.

(b) Account for the above changes.

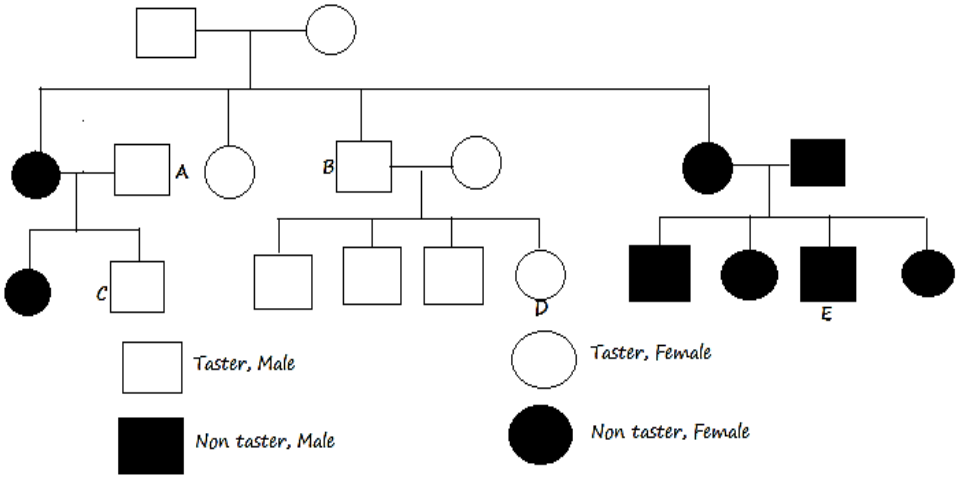
(c) Air breathing occurs between stages V to XXIV metamorphosis, yet air is not utilized in initial growth and development stages. Explain.

(d) At stage IV, gills and skin perform 100% gas exchange. Explain.
(e) Stage XXIII-XXIV is the metamorphic climax. Outline the post metamorphic changes that in a frog during and after this stage.
(f) State the principal role of the skin in gas exchange in the adult frog. Explain.
(g) Briefly describe the major stages of frog metamorphosis.

Inheritance

QN: 4.3.1

In human beings the ability to taste phenylthiourea depends upon the presence of a dominant gene.
(a) Construct genetic diagrams showing;
(i) The genotype of the parental generation and the F1 generation, and the gametes of the cross between a homozygous "taster" and a homozygous "non-taster".
(ii) The genotype and phenotype of the progeny of a cross between tow genotypes of the F1 type in (i) above.
(b) Study the figure below. State, with reasons, the possible genotypes of persons A, D, C, D, and D.



The occurence of phenylthiourea tasters in a family.

(c) In guinea pigs, black coat color is dominant to brown and short hair is dominant to long hair. These characters are not linked. A breeder has only stocks of long-haired brown and short-haired black guinea pigs. Explain clearly how pure breeds of long-haired black guinea pigs can be obtained.
(c) Haemophia is a sex linked disease which impacts the body's ability to form blood clots. The allele which causes haemophilia is carried on the X-chromosome. Explain why a male can only inherit haemophilia from his mother.
(d) Giving an example, explain how a mutation can result into formation of a non-functional protein.

Evolution

QN: 4.4.1

(a) What observations and deductions are derived from Darwin's theory of evolution?
(b) Clearly show how meiosis leads to evolution?

QN: 4.4.2

When a new road system was constructed, it split a population of a rare snail species into three smaller populations, A, B and C. As a result, each of these populations became reproductively isolated. The Hardy-Weinberg was used to calculate the relative allele frequencies, p and q, of a dominant and recessive allele respectively in each population. The table below shows the values of p and q, and the estimated sizes of these three populations.

Snail population	Estimated population size	Immediately after road building		10 years after road building	
		p (frequency of dominant alleles)	q (frequency of recessive alleles)	p (frequency of dominant alleles)	q (frequency of recessive alleles)
A	1000	0.50	0.50	0.52	0.48
B	100	0.49	0.51	0.63	0.37
C	10	0.40	0.60	0.20	0.80

(a) Explain how the above type of isolating mechanism among the three snail populations leads to emergence of new species in a population?

(b) Describe the form of speciation which occurs upon the new road construction.

(c) Determine the changes in number of the heterozygous snails in the three populations. Clearly show your working

(d) (i) The habitat for these populations did not change over the ten years. Explain the term used to describe the **random** changes in allele frequency in a small population.

(ii) Outline the factors which alter the allele frequency in the above populations in (d) (i) above.

(e) Explain which of the snail populations in table above experienced most genetic change.

(f) With relevant examples, describe the post zygotic forms of reproductive isolating mechanisms which may occur in a population of organisms.

THEME V: DISSECTION

Toad

QN: 5.1.

You are provided with a freshly killed specimen labeled W. Study it and answer the questions that follow.

(a) (i) Name the peculiar feature that can aid in the identification of its habitat.

ii) Explain briefly the importance of the features named in a)i) above

b) Give three ways in which the covering of the animal's body is adapted for its survival.

c) Dissect the specimen to display;

i) Blood vessels that drain from structures attached to the lower jaw and the anterior upper trunk.

ii) Blood vessels that carry blood to abdominal secretive and excretory organs and those that drain the left hind limb. Draw and label with the heart in a displaced state.

Rat **QN: 5.2.**	You are provided with a freshly killed specimen labeled R i) With reference to the cover of the body, give the importance of each of the structure to the animal. ii) Examine the feet of the animal, and how are they adapted for its survival in the habitat. b) Dissect the specimen on the tray to expose the superficial structures of the ventral side of the neck, and displace the visible neck structures and their accessory structure anteriorly. Draw and label the musculature of the neck, chest region, and thoracic region. c) Open the abdomen to display vessels that carry blood; to structures responsible for chemical digestion from the heart; and from structures responsible for secretion and excretion on the left back to the heart. Draw and label your dissection excluding the heart.
Cockroach **QN: 5.3.** **QN: 5.3.2**	You are provided with specimen K. Examine it carefully and answer the questions that follow: (a) Place the specimen ventral side uppermost spread out the wing and then examine the anterior wing and posterior wing using a hand lens. (i) Give four structural differences observed between the anterior wing and posterior wing. (ii) Explain one way the structures of the anterior and posterior wing relate to their function. (iii) Cut off the left hind limb and outline the adaptations of the structures anterior to the foot of the hind limb that enables the animal to efficiently locomote. (b) Place the specimen's dorsal side uppermost; open up the abdomen by cutting along the left lateral side. Displace the alimentary canal to the left. Immerse the specimen in the water fully. Draw and label all the buoyant internal structures visible in the specimen. (c) By further dissection, Dissect the specimen by cutting along the right lateral side of the thoracic region to expose only the structures attached to the ventral cuticle. Draw and label the exposed structures with the alimentary canal discarded.