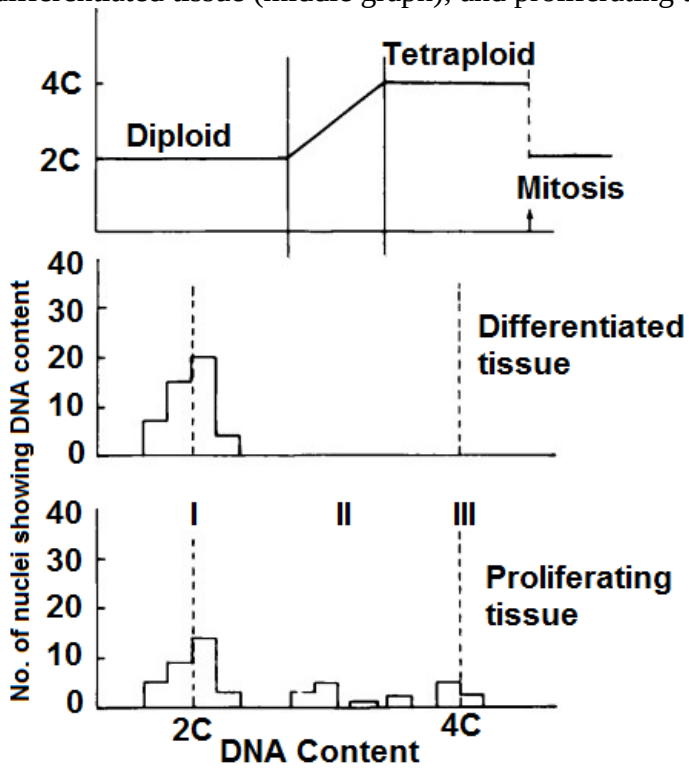
THEME I: CELL BIOLOGY

CELL DIVISION

1.1 The amount of deoxyribonucleic acid (DNA) present in each cell nucleus was measured in a large number of cells taken from two different cultures of human bone marrow, that is, differentiated tissue (non-dividing cell culture) and rapidly dividing cell culture (proliferating tissue). The figure below shows the DNA cycle in a cell from interphase to mitosis (top graph), differentiated tissue (middle graph), and proliferating tissue (bottom graph).

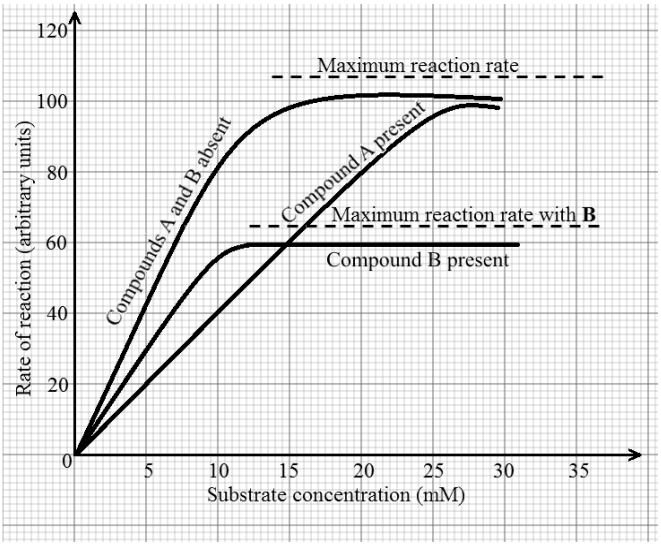


a) From the graph, describe the changes in the DNA cycle up to mitosis. (04 marks)
b) With reference to the graph, explain the changes in the DNA cycle. (07 marks)
c) Compare the content of DNA in proliferating and differentiated tissues. (06 marks)
d) For each phase labelled I, II and III in the proliferating tissue graph,
i) Deduce the phase of the cell cycle the cells could be in. (03 marks)
ii) Explain the main events that occur during the phase. (07 marks)
iii) Suggest the significance of the phase to cell. (03 marks)
e) Summarise the semi-conservative process of DNA replication. (10 marks)

ST JOHN SS, WAKITAKA

ENZYMES

1.2 The figure below shows the results from an experiment in which the effect of different concentrations of substrate on the rate of an enzyme-catalysed reaction was investigated. The experiment was then repeated using the same experimental conditions and substrate concentrations but in the presence of fixed amounts of compounds **A** and **B** (0.2 mM).



(a) Describe the relationship between the rate of reaction and substrate concentration when
(i) compounds **A** and **B** were absent. (*04 marks*)
(ii) compound **A** was present. (*03 marks*)
(iii) compound **B** was present. (*03 marks*)

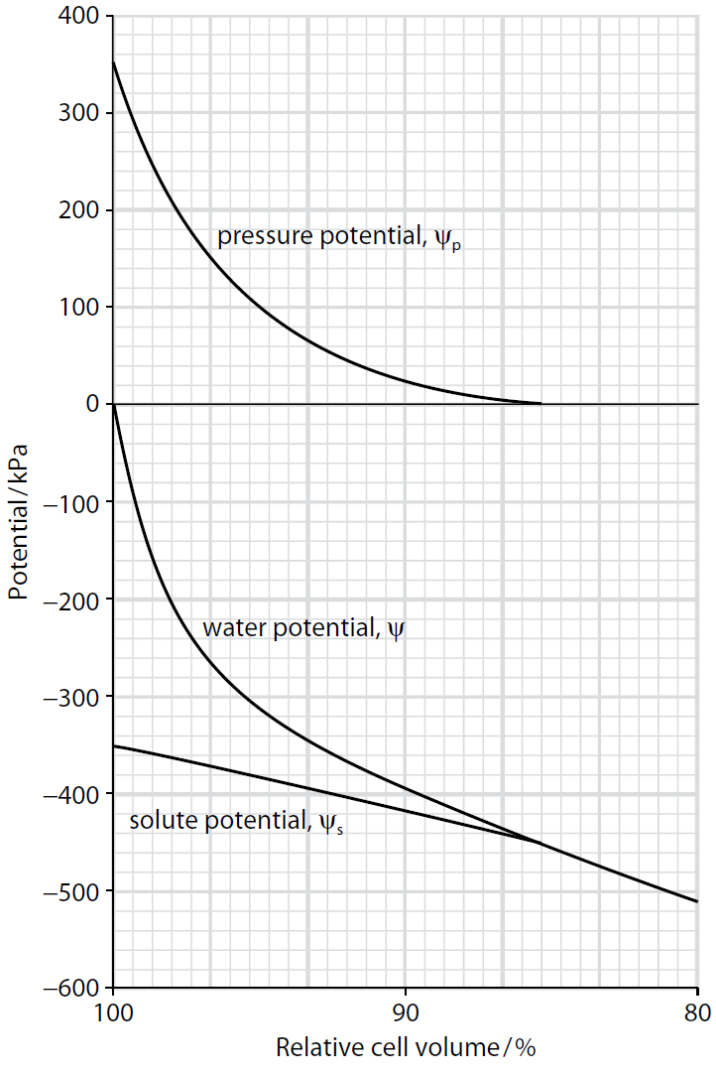
(b) Explain the experimental results in the
(i) absence of compounds **A** and **B**. (*06 marks*)
(ii) presence of compound **A**. (*07 marks*)
(iii) presence of compound **B**. (*07 marks*)

(c) Compare the rate of reaction in the presence of compounds **A** and **B**. (*05 marks*)
(d) What might be the effect of using 0.4 mM of compound **A** in the investigation? (*02 marks*)
(e) Suggest why compounds with similar properties to compounds **A** and **B** are often used to combat bacterial infections in the body. (*03 marks*)

IMPACT HIGH SCHOOL, KITEGA

CELL PHYSIOLOGY

1.3 The figure below shows the changes in water potential (ψ), pressure potential (ψp) and solute potential (ψs) of a plant cell as its volume changes due to water loss or gain. Note that 80% relative cell volume means the cell or protoplast has shrunk to 80% of the volume it was at 100% relative cell volume.

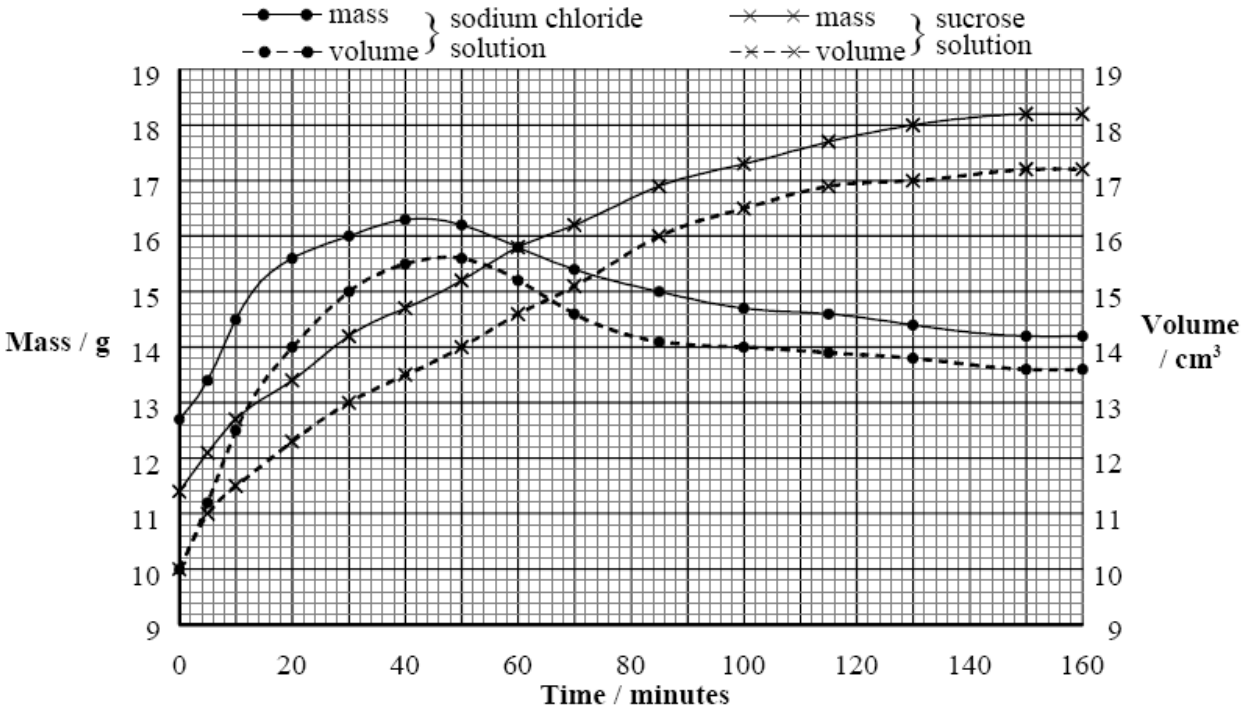


a) Distinguish between **pressure potential, water potential** and **solute potential**. (03 marks)
b) Compare the changes in solute potential and pressure potential as the cell changes volume.
c) Describe the changes in pressure potential, water potential and solute potential.
d) Account for the changes in pressure potential, water potential and solute potential.
e) Discuss the following:
i) The pressure potential curve is not linear.
ii) The equation that links ψp, ψs and ψ.
f) Suggest how the state of the cell could be of advantage and disadvantage to the plant at:
i) 100 % relative cell volume.
ii) 80% relative cell volume.

JINJA PROGRESSIVE SCHOOL

1.4 A physiological process was studied using bags made of an artificial permeable membrane. In an experiment, equal volumes of each of the following solutions were placed into separate bags:
6 mol dm^{-3} sodium chloride. 6 mol dm^{-3} sucrose.

The bags, each of the same size, were placed in distilled water at constant temperature. At regular intervals over a period of 160 minutes, both the volume and mass of each bag was measured. The figure below shows the data collected.



(a) Compare the rates of change in mass and volume for the two bags. (10 marks)
(b) Explain the change in mass and volume for the two bags. (08 marks)
(c) Calculate the rates of increase in mass and in volume for the bag containing sodium chloride solution during the first 30 minutes. (03 marks)
(d) Suggest why for a short time, there is a decrease in mass while the volume is still increasing for the bag containing sodium chloride solution. (04 marks)
In another experiment, vacuolar contractions in *Paramecium caudatum*, a freshwater protist, were observed. A culture of *P. caudatum* was exposed to different concentrations of salt and the numbers of vacuole contractions per minute were counted. The table below shows the data.

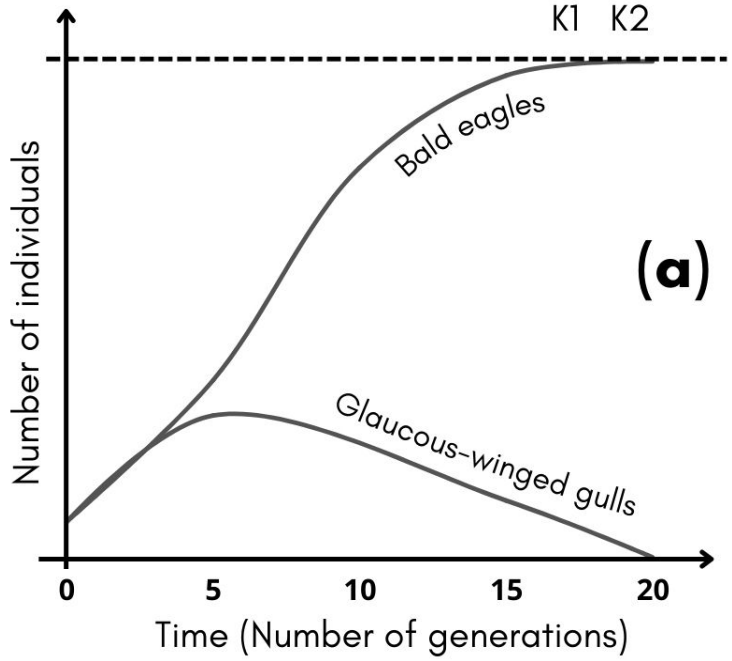
Salt concentration / arbitrary units	Number of contractions per minute
0	10
1	8
2	5
3	1
4	0

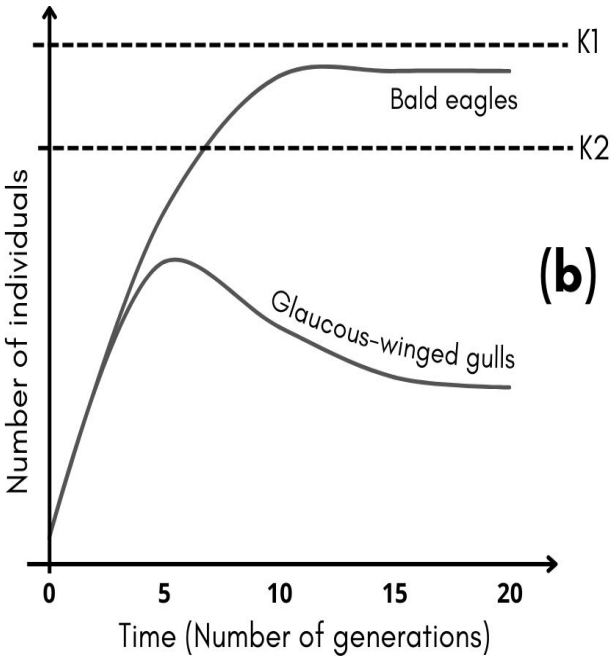
(e) (i) Comment on the vacuole responses shown by the data. (02 marks)
ii) Describe how vacuole contractions in paramecia are brought about. (08 marks)
(f) Suggest and explain what would happen to vacuolar contractions if a respiratory inhibitor was introduced into the environment of *P. caudatum*

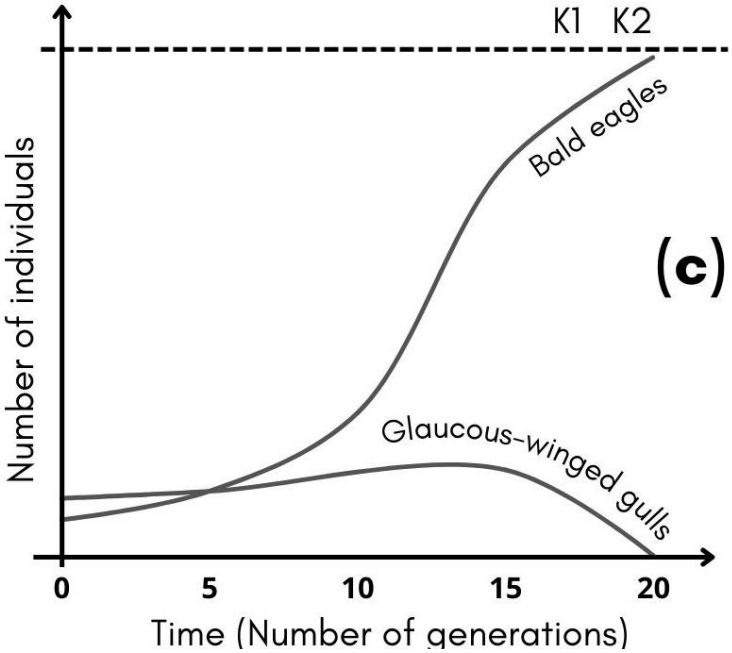
. **LAKE SIDE COLLEGE, MASESE**

THEME II: ECOLOGY

2.1 Figures (a), (b) and (c) below illustrate outcomes of interaction between bald eagles (*Haliaeetus leucocephalus*) and glaucous-winged gulls (*Larus glaucescens*) living on isolated islands in the sea. K1 and K2 represent the carrying capacities of bald eagles and glaucous-winged gulls, respectively.



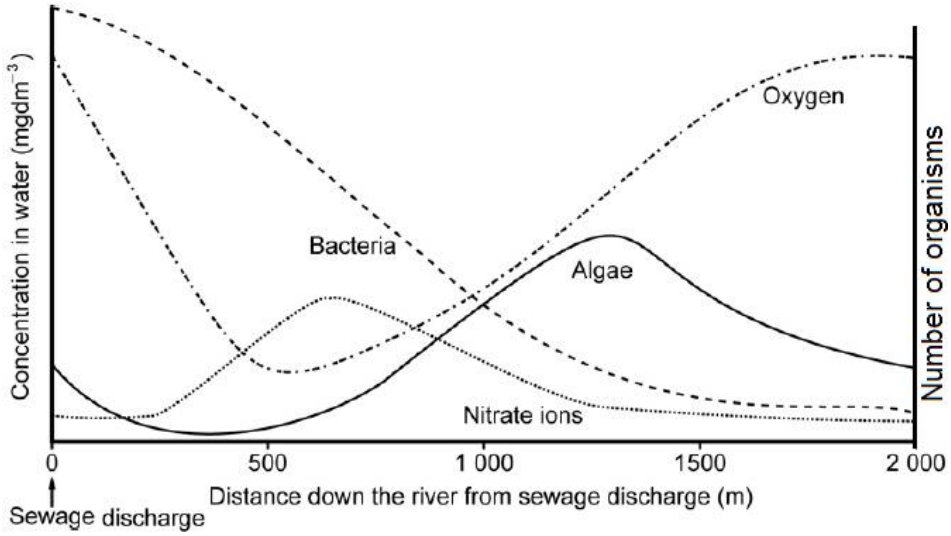




(a) Describe the observed phenomena in:
i) Figure (a)
ii) Figure (b)
iii) Figure (c)
(b) Suggest explanation for the observed effects of bald eagle activity on the dynamics of glaucous-winged gull colony in:
i) Figure (a) (04 marks)
ii) Figure (b)
iii) Figure (c)
(c) With the exception of birds and humans, explain how living organisms affect the distribution and abundancy of other organisms in their natural environment.

DABANI GIRLS, BUSIA

2.2 Ecologists studied the effects of sewage effluent on the levels of oxygen concentration, bacterial population, algal growth and nitrate ion concentration in a fresh water river. The report indicated that dead fish were found in the water at 500 m downstream from the point of sewage discharge. The given graph is plotted based on their findings.



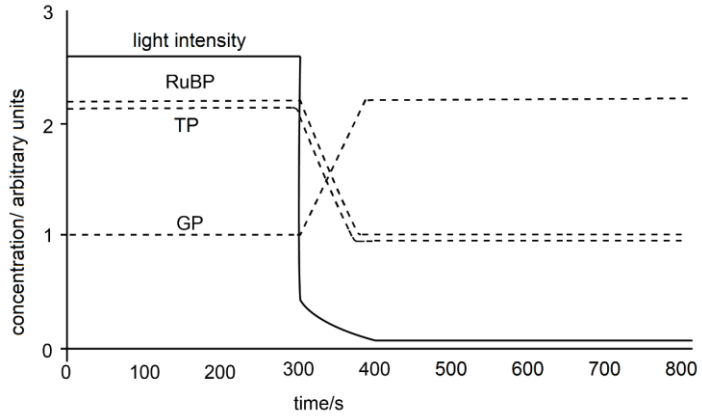
a) Describe the effect of adding sewage into the river on:
i) The number of bacteria.
ii) Oxygen concentration.
iii) Nitrate ion concentration.
b) Explain the effect of adding sewage into the river on:
i) The number of bacteria.
ii) Oxygen concentration.
iii) Nitrate ion concentration.
c) Explain the effect of changes in nitrate ion concentration on algal growth in the river.
d) Account for reports suggesting that dead fish were found in the water at 500 m downstream from the point of sewage discharge.
e) Identify and suggest ways of minimizing the different forms of pollution in rivers.

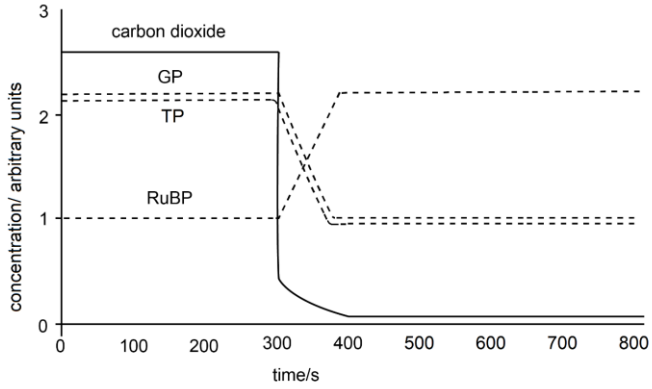
KOLOLO SS

THEME III: MAINTENANCE OF LIFE

NUTRITION IN GREEN PLANTS

3.1 The relative concentrations of three intermediate compounds in the Calvin cycle: glycerate-3-phosphate (GP), triose phosphate (TP) and ribulose bisphosphate (RuBP) were determined. The effects of changes in light intensity and carbon dioxide concentration on the relative concentrations of these compounds were investigated. The results are shown in the graphs below.



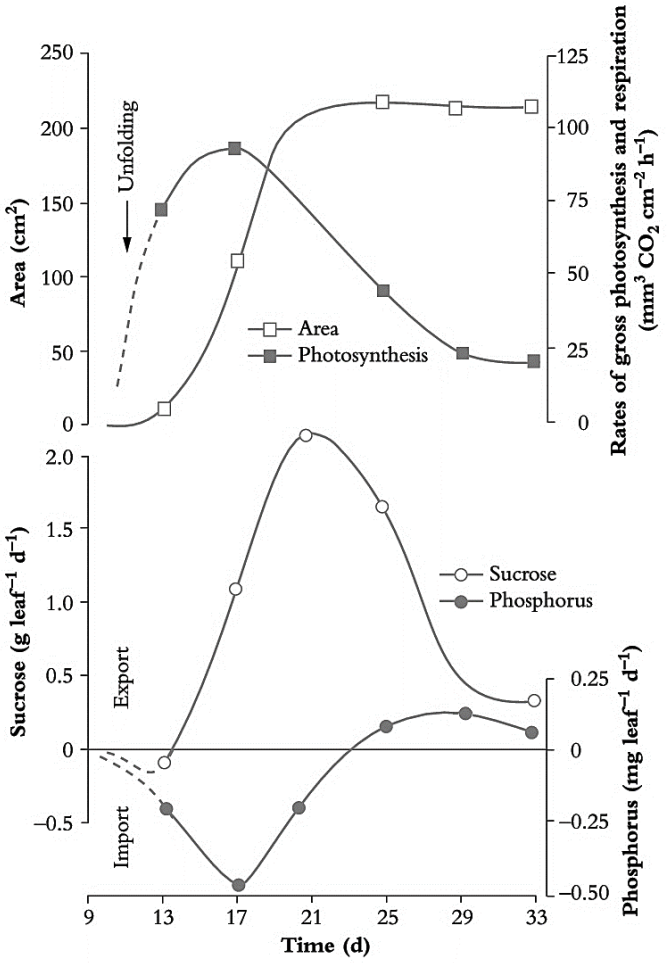


(a) With reference to the graphs, describe the changes in the concentrations of GP, TP and RuBP
i) As the light intensity changes. (06 marks)
ii) As the carbon dioxide concentration changes. (06 marks)
(b) By referring to the figure, explain the trends in the concentrations of GP, TP and RuBP
i) As the light intensity changes. (08 marks)
ii) As the carbon dioxide concentration changes. (08 marks)
(c) Describe events that convert light energy into usable form of energy in plant leaves. (06 marks)
(d) Suggest how leaves of plants in sunny and shady habitats suite sunlight capture. (06 marks)

KAKIRA SS

TRANSPORT IN PLANTS

3.2 The figure below shows time course of sucrose (photoassimilate) and phosphorus net import (-) into and export (+) from a cucumber leaf during its development.



(a) Describe the relationship between
i) Leaf area and photosynthesis. (06 marks)
ii) Photosynthesis and sucrose movement in the leaf. (06 marks)

(b) Compare the movement of sucrose and phosphorus in cucumber leaf. (06 marks)

(c) With reference to the graph, explain the movement of sucrose and phosphorus in cucumber leaf. (06 marks)

(d) Outline the mechanism of exporting sucrose from leaves to plant parts that need it. (06 marks)

HOMELAND COLLEGE . KITEGA

3.3 Figure A shows changes in the relative humidity of the atmosphere during the daylight hours of one day. Figure B shows changes in the tension in the xylem of a tree during the same period.

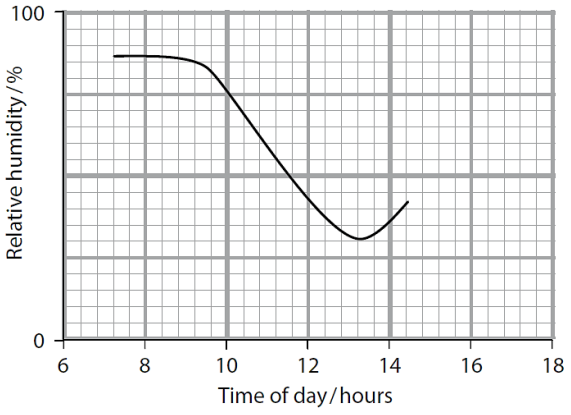


Figure A

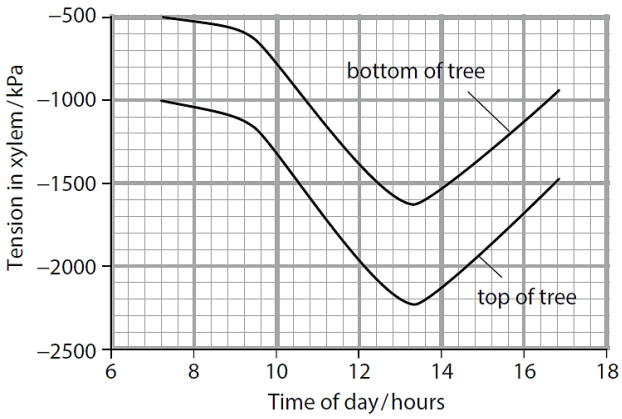


Figure B

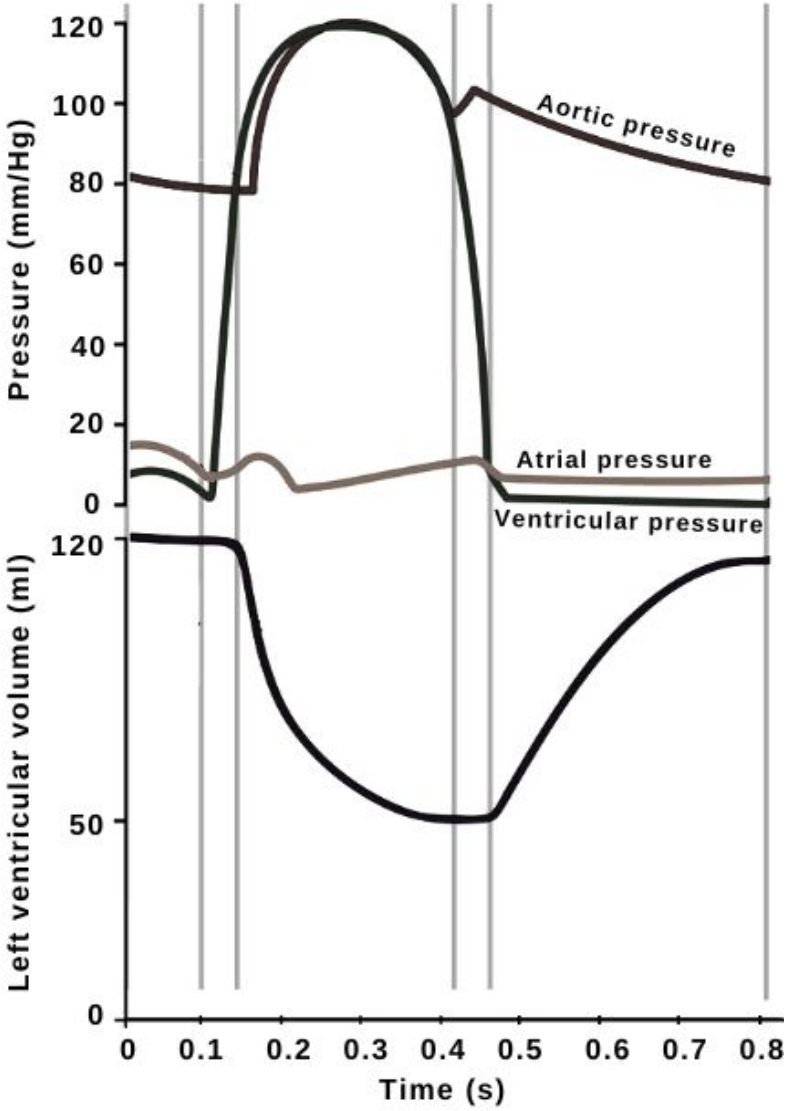
(a) What is the relationship between relative humidity and xylem tension?
(b) Explain the relationship between relative humidity and xylem tension.
(c) Compare xylem tension at the top and the bottom of the tree.

(d) Account for the differences observed in xylem tension between the tree top and bottom.
(e) Describe water movement into and through xylem vessels.
(f) Using techniques that measure small changes in diameter, the lowest daily changes in the diameter of a tree trunk are observed during daylight hours and are greatest at night. Suggest an explanation for these observations.

JINJA COLLGE SCHOOL

TRANSPORT IN ANIMALS

3.4 The graph below shows blood pressure changes in the left side of the heart and in the aorta, during one heartbeat. Study the figure provided to answer questions that follow.



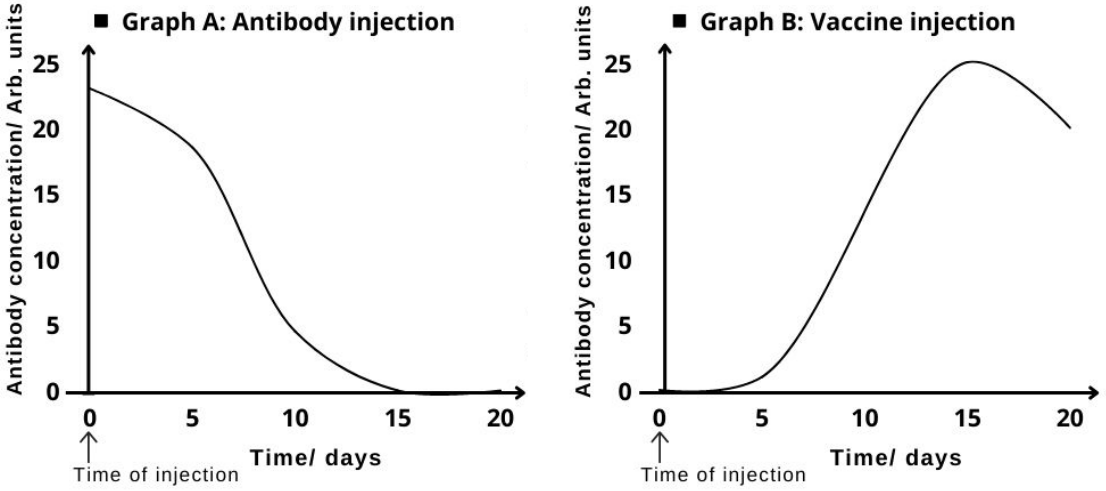
(a) Describe the changes in ventricular volume and pressure throughout the cardiac cycle.
(b) Compare pressure changes in heart chambers during the cardiac cycle. (07 Marks)
(c) Using information in the graph, show time intervals that correspond with atrial and ventricular contractions and relaxations. (03 Marks)
(d) Explain how pressure changes within the heart chambers are initiated and sustained during the cardiac cycle. (15 Marks)
(e) Account for the changes in aortic pressure during the cardiac cycle. (06 Marks)

LUMA EASTERN COLLEGE, BUSIA

DEFENSE AGAINST DISEASE

3.5 People who have not been vaccinated against tetanus may be exposed to the bacteria causing tetanus if they cut their skin. A fresh accident victim was hospitalised and given an injection of anti-tetanus antibodies. Unaware that the accident victim had been injected with anti-tetanus antibodies, another medical team administered the vaccine containing anti-tetanus antigens as a precaution. The graphs below show the concentrations of antibodies present in the plasma after a

first injection of antibodies (graph A) followed by another injection of the vaccine (graph B). The graphs are drawn to the same scale.

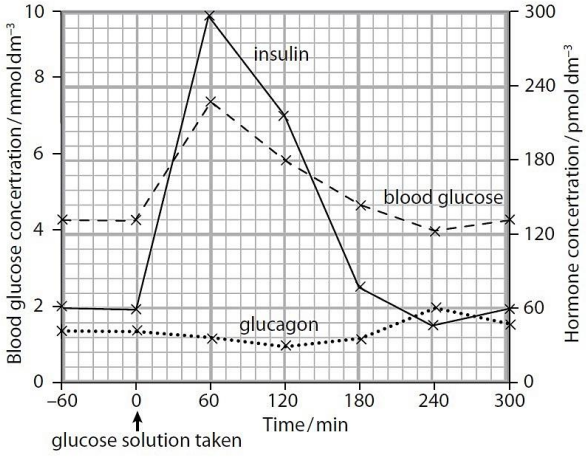


(a) (i) Describe the variation in antibody concentration in graph A and graph B. (05 marks)
(ii) Explain the reasons for the differences in the two responses. (07 marks)
(b) Compare the responses obtained after the first injection of antibodies and another injection of antigens. (06 marks)
(c) By referring to the graphs, suggest
i) Why the double injection of anti-tetanus antibodies and antigens was necessary. (05 marks)
ii) The disadvantage of vaccination being given as two injections rather than one. (02 marks)
iii) Why a booster injection must be given a few months after the first injection. (02 marks)
(d) Outline the production of antibody with regard to vaccinations. (10 marks)
(e) Hospitals in places with venomous snakes keep anti-venom antibodies. Suggest how this anti-venom is produced. (04 marks)

GREEN FIELDS, IGANGA

HOMEOSTASIS

3.6 An investigation was carried out to determine the response of pancreatic cells to an increase in the glucose concentration of the blood. A person who had been told not to eat or drink anything other than water for 12 hours then took a drink of glucose solution. Blood samples were taken from the person at one-hour intervals for five hours, and the concentrations of glucose, insulin and glucagon in the blood were determined. The results are shown in the graph below.



(a) Describe the relationship between the concentrations of glucose and insulin in blood.
(b) Compare the concentrations of insulin and glucagon hormones. (04 Marks)
(c) Explain the changes in the concentrations of glucose and insulin in blood, after taking glucose.
(d) Explain why the person was told not to eat or drink anything other than water for 12 hours before having the glucose drink.

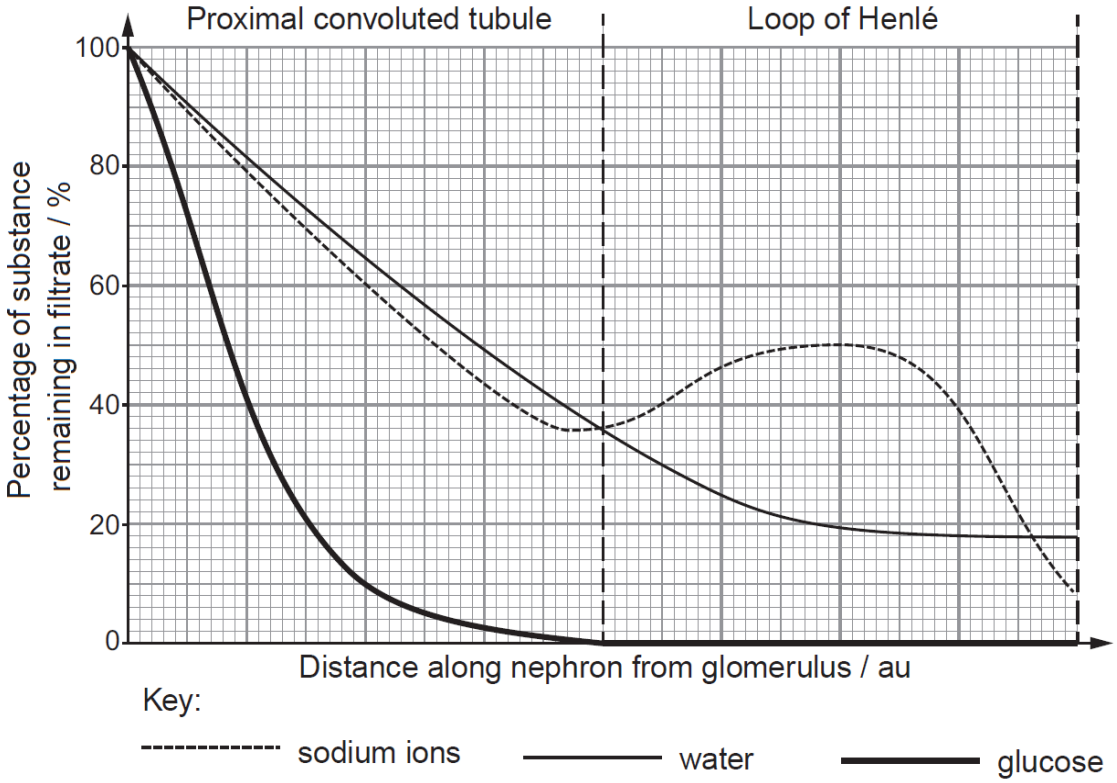
(e) With reference to the figure, describe the following:
i) Response of the pancreatic cells to an increase in the glucose concentration.

ii) The sequence of events that follow the binding of glucagon to its membrane receptor on a liver cell.

(f) Suggest how the results will change if the investigation continued longer than five hours without the person taking any food.

IGANAG HIGH SCHOOL

3.7 The graph below illustrates the changes in the percentage of sodium ions, glucose and water remaining in the filtrate as it passes from the start of the proximal convoluted tubule to the end of the loop of Henlé in the kidney.



(a) Describe the changes in the filtrate as it passes through a nephron from the proximal convoluted tubule to the end of the loop of Henlé. (09 marks)

(b) Use the information from the graph to explain the changes in the filtrate as it passes through a nephron from the proximal convoluted tubule to the end of the loop of Henlé. (12 marks)

(c) Give an account of how renal filtrate is produced to enter the proximal convoluted tubule. (08 marks)

(d) Explain why negative feedback, and not positive feedback, is involved in homeostatic mechanisms. (05 marks)

(e) Describe the suitability of cells in the proximal convoluted tubule and loop of Henlé for their function. (06 marks)

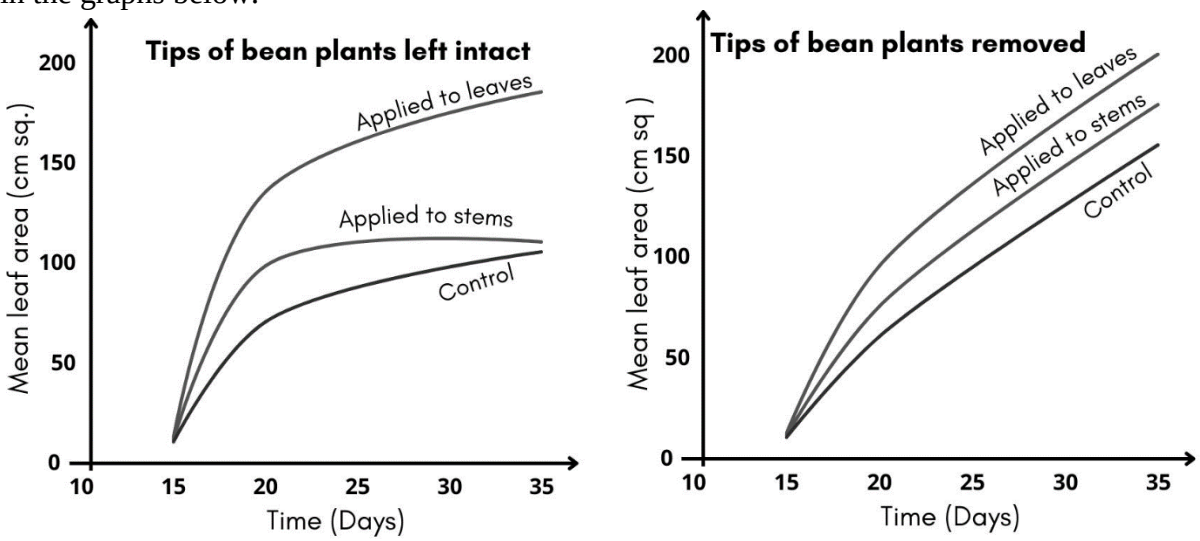
HOLY CROSS LAKE VIEW SS, WANYANGE

COORDINATION

3.8 In an experiment, the same quantity of the hormone gibberellin was applied to either the first leaf or the stem of dwarf bean plants and the leaf area of the plants was then measured over the following three weeks.

The experiment was then repeated under exactly the same conditions except that the tip of each plant was removed at the same time that the gibberellin was added. The control experiment in

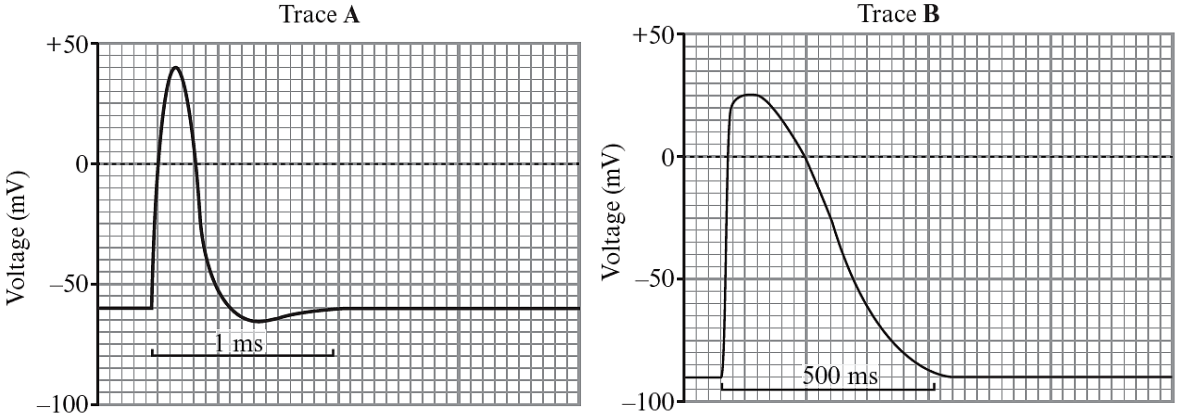
both cases was to use a group of plants to which no gibberellin was added. The results are shown in the graphs below.



(a) Use the information in the figure to compare the effects of
i) Removing and allowing the growing tips on the growth of leaves. (08 marks)
ii) Applying gibberellin to the leaves rather than the stem of intact bean plants. (08 marks)
(b) From your knowledge of plant hormones in general, explain the effects of removing the growing tips on the growth of leaves in the absence of gibberellin. (04 marks)
(c) (i) In what ways did the removal of the growing tips influence leaf size when gibberellin was applied? (05 marks)
ii) Suggest a hypothesis to explain why the removal of the growing tips influences leaf size when gibberellin is applied. (04 marks)
(d) Outline the role of gibberellin in the germination of seeds. (05 marks)
(d) Compare hormonal coordination in plants and animals. (06 marks)

BUSOGA HIGH SCHOOL

3.9 Trace A below is an oscilloscope recording of changes in voltage across the membrane of a myelinated neurone during an action potential. Trace B is another oscilloscope recording, showing changes in voltage across the membrane of a cardiac muscle fibre.



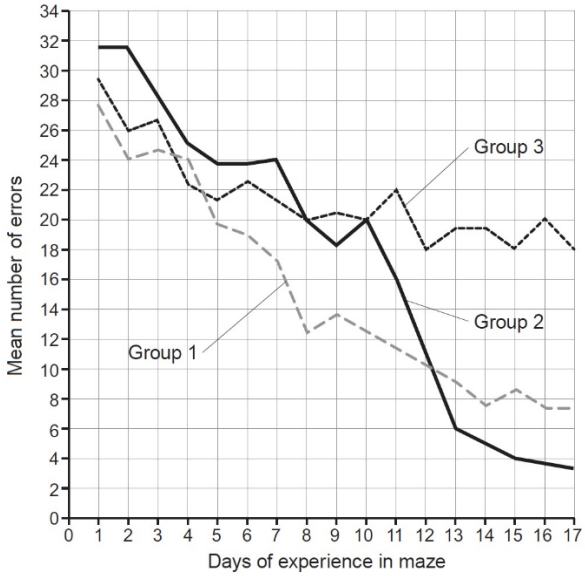
(a) Compare the voltages in Trace A and Trace B.
(b) Explain the voltages in Trace A and Trace B.
(c) Describe how the

i) Resting potential is maintained in the neurone.
ii) Potential across the membrane is reversed when an action potential is produced.
(d) With reference to **only** the
i) Pre-synaptic neurone of a synapse, explain the mechanism by which chemicals that block calcium ion channels work as anaesthetics to reduce pain. (05 marks)
ii) Post-synaptic neurone of a synapse, explain the mechanism by which chemicals that block sodium ion channels work as anaesthetics to reduce pain. (05 marks)
iii) Post-synaptic neurone, explain how curare, a competitive acetylcholine inhibitor causes muscle paralysis. (05 marks)
iv) Cardiac muscles, explain why curare has no effect on muscle contraction. (03 marks)
(e) Explain why
i) Multiple sclerosis condition caused by the immune system destruction of neurone myelin sheaths slows down nerve impulse transmission.
ii) Myelinated axons use less ATP to transmit nerve impulses than non-myelinated axons of the same diameter.

MM COLLEGE , WAIRAKA

PATTERNS OF BEHAVIOUR

3.10 In an investigation on learning in rats, thirty female rats were placed in three groups and the number of errors they made when going through the maze was recorded. One group of rats was rewarded every time they completed the maze while another was never rewarded. The third group of rats was placed in the maze every day and only rewarded from day 10 onwards.



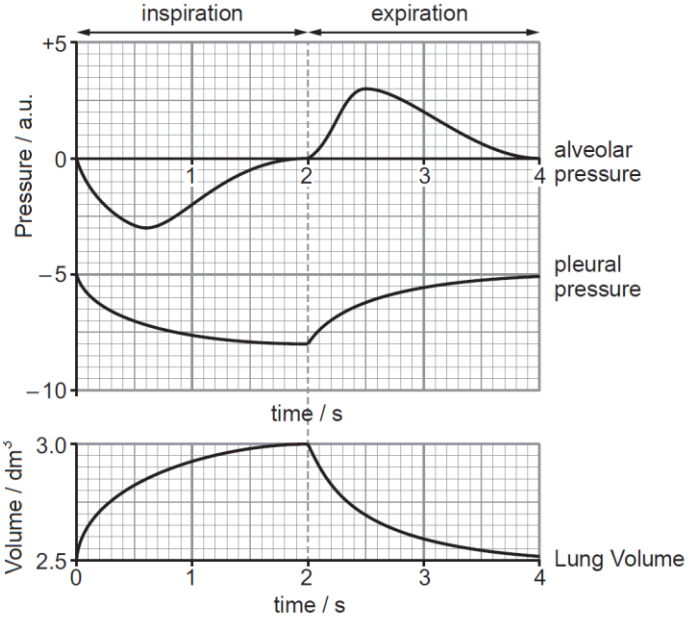
(a) Using the information provided
i) Comment on the error patterns exhibited by each group of rats. (09 marks)
ii) Associate each group of rats with one error pattern, and explain your conclusions. (08 marks)
(b) Workout the percentage change in the number of errors for group 2, between the 10th and 13th days. (03 marks)
(c) Contrast the following phenomena
i) Innate behaviour and learned behaviour. (06 marks)
ii) Learning in rats and learning in humans. (04 marks)
(d) Suggest how the learning shown by error patterns in the graph
i) Benefits rats. (04 marks)
ii) Differs from other forms of associative learning. (06 marks)

IGANGA PARENTS SCHOOL,

ABE-CURATED SEMINAR QUESTIONS; OCTOBER, 1st 2022 AT HOLY CROSS LAKE VIEW SS, WANYANGE

GAS EXCHANGE

3.11 The graph below shows the pressure and volume changes during a single ventilation cycle of a healthy human at rest.



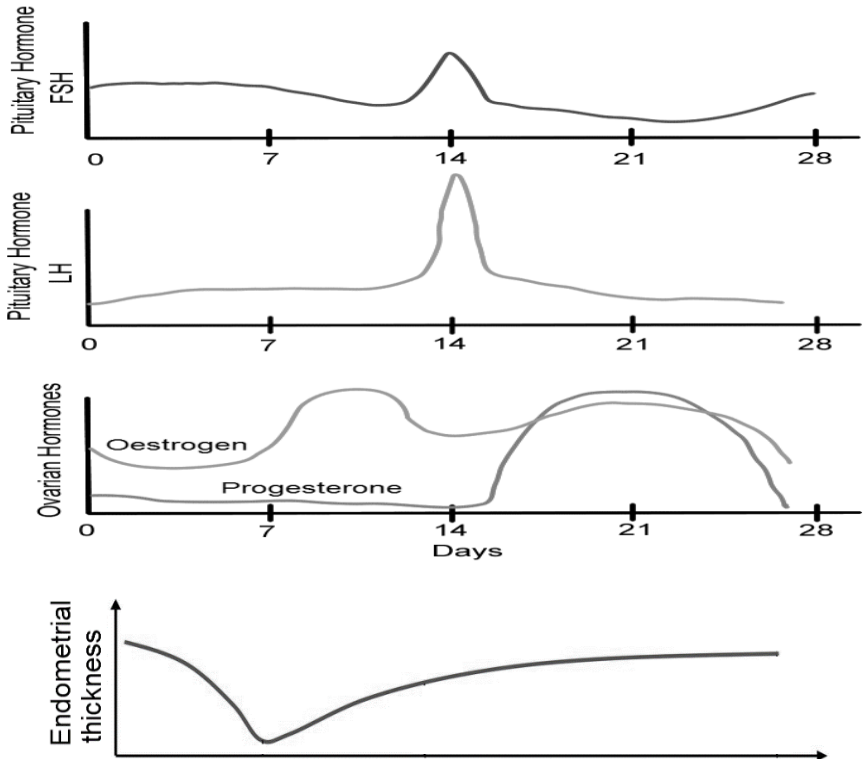
(a) From the graphs, describe the pressure and volume changes shown during
i) Inspiration. (08 marks)
ii) Expiration. (07 marks)
(b) From the graphs, explain the causes of the pressure and volume changes shown during
i) Inspiration.
ii) Expiration.
(c) Suggest the changes that are expected in these curves during strenuous exercise.
(d) Describe how the human respiratory system maintains homeostasis.
(e) Suggest why it is important to control breath

GREAT AUBREY MEMORIAL COLLEGE

THEME IV: CONTINUITY OF LIFE

REPRODUCTION

4.1 The figure below shows hormonal changes across the human menstrual cycle, including circulating concentrations of gonadotropins; luteinizing hormone (LH) and follicle-stimulating hormone (FSH), and ovarian hormones; oestrogen, and progesterone. The corresponding thickness of endometrium is also shown.

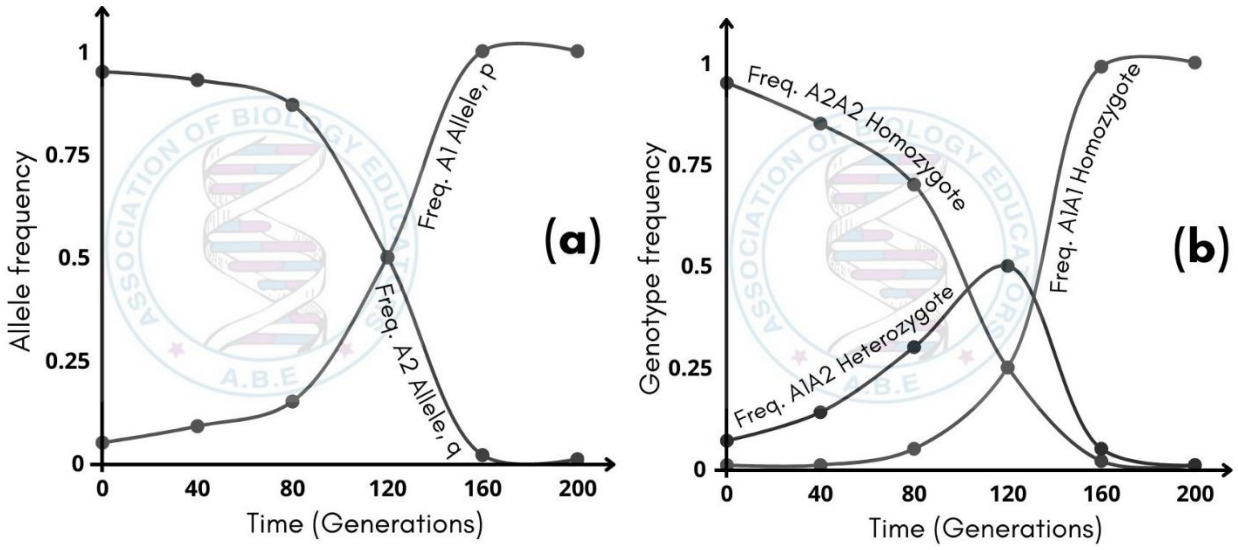


a) Describe the changes in the relative levels of
i) Gonadotropins.
ii) Ovarian hormones.
iii) Endometrium.
b) Compare the relative levels of oestrogen with progesterone across the menstrual cycle.
c) Explain how the following are involved in controlling of the menstrual cycle:
i) Gonadotropins.
ii) Ovarian hormones.
d) Explain how changes in endometrial thickness adapt it for events after fertilisation.

KYABAZINGA COLLEGE,

EVOLUTION

4.2 The figure below shows the allele frequency trajectories for two alleles being studied by population geneticists. This study investigated the Hardy-Weinberg phenomenon in an infinite large population, involving one gene that has only two possible alleles. Graph (a) represents the change in allele frequency of A1 (p) and A2 (q) under selection for A1 as a recessive. Graph (b) represents the change in genotype frequencies, A1A1 (p^2); A1A2 (2pq) and A2A2 (q^2) associated with allele frequency changes.



a) From the figure above, describe:
i) The changes in allele frequency over several generations.
ii) The relationship between allele frequency and genotype frequency over several generations.
b) With reference to the figure above, explain
i) The major factors that affect allele frequency in a population over long periods of time.
ii) Why the frequency of the A2 allele persisted in the population.
c) Explain how frequencies of alleles and genotypes would change in a small population.
d) Suggest why it is important to track allele frequencies in populations over time.
e) Relate changes in the gene frequency to evolution.

BUSOGA COLLGE MWIRI

THEME V: PRACTICALS,

TOAD DISSECTION

5.1 Dissect the specimen to display blood vessels that;
(a) Draining blood from urinary structures.
(b) Supplying blood to structures responsible for absorption of nutrients and secretion.
Draw and label your dissection with the heart in undisplaced state. (24 marks)

5.2 Dissect the specimen to display;
(a) Structures for sensitivity posterior to the kidneys and those in the thoracic region.
(b) Blood vessels that supply structures for excretion, gonads and those draining structures for absorption of food nutrients with the heart pinned anteriorly/ displaced. Draw and label your dissection (27 marks)

5.3 Dissect the specimen to display;

(a) Blood vessels that drain from structures attached on the lower jaw and the anterior upper trunk.

(b) 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 undisplaced state. (28 marks)

PLANT ANATOMY

5.4. Examine specimens **P, Q and R** provided and answer the questions that follow;

(a) (i). Describe the structure of specimens **P and Q**

(ii) How does each specimen benefit from its structural uniqueness as described in a(i) above

b) i) Obtain one of the mature inner most floret of **specimen P** with all intact features, remove the non-essential floral parts and place the remaining parts on a slide. Observe under low power of microscope. Draw and label.

(ii) Repeat the procedure in b (i) above for a mature floret from **specimen R.** Give **one** outstanding difference and two similarities in the structure of the two florets.

(c) Observe the stigma of specimen **P** under low power of the microscope. How is it adapted to perform its functions?

(d) Remove a mature floret from specimens' **Q and R.** Open the florets longitudinally and observe each floret using a hand lens. Describe;

(i) Floret from **Q** using floral diagram.

(ii) The androecium and the corolla of the floret from Specimen **R**

Specimen P *–Dandelion inflorescence*

Specimen Q*-bougainvillea inflorescence*

Specimen R*-lantana camera inflorescence*

5.4 You are provided with specimen **P, Q, R and S** which are plant reproductive organs

(a) Describe the pattern of floret arrangements of specimens **P** and **R**

(b) Using a hand lens, carefully examine one floret of specimen **Q** and specimen **S**.

(i) State observable structural differences between them.

(ii) How are essential reproductive parts in florets of **P adapted** to function?

(c) Obtain one of floret of **R.** remove non-essential structures and the stamens, cut a thin cross section of the ovary of specimen **R.** Observe it under low power of microscope. Draw and label.

(d) Construct a dichotomous key using essential reproductive features of florets for identification **P, Q, R and S.**

*Inflorescence of guinea grass with hanging filaments and seen Stigma-****P***

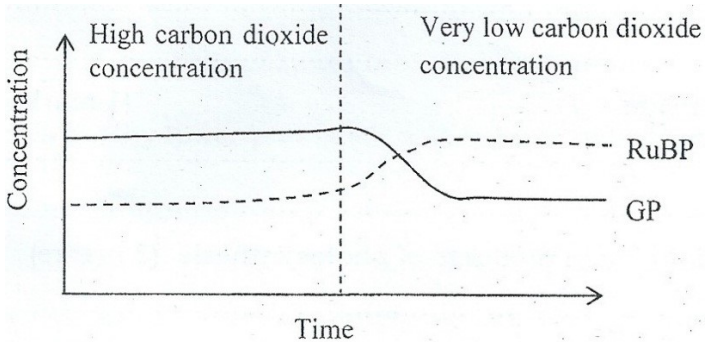
*Fresh bidens pilosa-****Q***

*Banana spathe with at least four Florets-****R***

*Crotalaria Flower-****S***

P530/1 SECTION B TYPE QUESTIONS

1. A Sample of chlorella was allowed to photosynthesize at high and low carbon dioxide levels. The graph below shows the concentrations of Glycerate – 3- phosphate (GP) and Ribulose bisphosphate (RuBP) during the investigation.



(a) (i) Account for the different concentrations of RUBP during the whole course of the investigation (3mks)

(ii) Explain why the level of GP falls when the level of carbon dioxide is reduced (1mk)

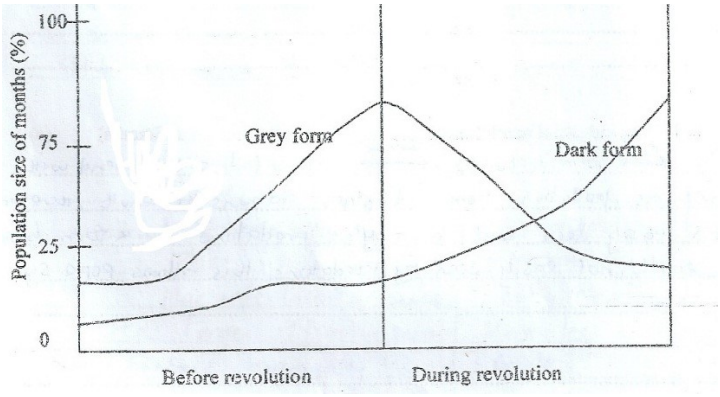
(iii) Give two condition which must be kept constant throughout the investigation. (1mk)

(b) State the role played by the following during the process of photosynthesis

(i) Light (1mk)

(ii) Phospoenopyruvate. (1mk)

2. The figure below shows the variation of number of peppered moths before and during the industrial revolution in UK.



(a) Describe the changes in the population of both peppered of moths.

(i) Before industrial revolution (1½mks)

(ii) During industrial revolution (1½mks)

(b) Account for the changes in the population of the peppered moths

(i) Before industrials revolution (3mks)

(ii) During industrial revolution. (3mks)

(c) What form of natural selection is being represented in the graph in the period of industrial revolution (1mk)

3. (a) Give three main structural differences between Bryophytes and Pteridophytes. (3mks)

(b) Describe how ferns are better adapted to live on land than mosses? (3mks)
(c) Explain why lower plants are restricted to moist habitats? (2mks)
(d) Describe the ecological importance of mosses. (2mks)

4. (a) Distinguish between simple and facilitated diffusion. (2mks)

(b) State any one application of simple diffusion and one application of facilitated diffusion in living systems

(c) With examples, briefly describe the importance of any six modifications that facilitate the movement of materials by diffusion in living organisms (6mks)

5. (a)(i) What is meant by omosregulation? (1mk)
(ii) State the importance of osmoregulation in unicellular organisms. (1mk)
(b) Explain how the following organisms overcome their osmoregulatory problems
(i) Fresh water bony fish (4mks)
(ii) Marine bony fish (4mks)

6. (a) State any three differences between bacteria and protozoa (3mks)
(b) State three importance of bacteria in the natural ecosystem. (3mks)
(c) Describe any three adaptations of bacteria that enable them to survive in various ecosystems (3mks)

7. (a) (i) What is meant by the term internal fertilization? (1mk)
(ii) Describe the evolutionary significance of internal fertilization. (2mks)
(b) (i) State how reproduction by use of gametes may cause variation (3mks)
(ii) State the advantages of reproduction without use of gametes over reproduction Using gamete (4mks)

8. The table below shows the water potential of four cells, A,B,C and D which were placed in separate sucrose solutions having a water potential of -540 Kpa.

Cell	Water potential / Kpa
A	-1700
B	-2000
C	-1500
D	-1200

(a) Giving a reason, suggest which cell would initially absorb water at the fastest rate. (3mks)
(b) Explain why the water potential of each of these cells is a negative value (4mks)
(c) Assuming the pressure potential of cell D is 800Kpa, calculate its solute potential. (3mks)

9. (a) What is meant by **conservation of nature**? (2mks)
(b) Give three advantages of nature conservation to humans (3mks)
(c) State three ecological problems associated with nature conservation. (3mks)
(d) Explain why it is easier to conserve resources in aquatic ecosystems. (2mks)

10. (a) Describe the features of a nucleus which makes it a key organelle for protein synthesis. (2mks)
(b) Explain the role of each of the following in protein synthesis.
(i) Transfer RNA (2mks)
(ii) DNA helicase (2mks)

(c) Give two physiological functions of proteins in cells. (2mks)

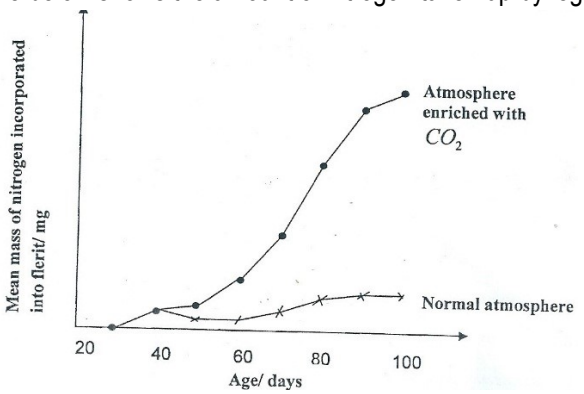
11. (a) Define the following as applied to photosynthesis
(i) Action spectrum

(ii) Absorption spectrum

(b) Using a flow diagram, show the sequence of the electron flow during the cyclic photophosphorylation.

(c) Compare C_3 and C_4 plants.

12. Describe how the structure and function of squamous and columnar epithelial cells are related. (10mks)
13. Explain the following statements;
    (a) Mature erythrocytes are biconcave and lack a nucleus (2mks)
    (b) The immune system of the body responds slowly on the first exposure to an infection but rapidly and efficient to the second exposure to same infection (4mks)
    (c) The oxygen dissociation curve of a lugworm, ***Arenicola*** lies to the left of that of man. (2mks)
    (d) Small mammals have a higher metabolic rate than bigger ones. (2mks)
14. The figure below shows the amount of nitrogen taken up by legumes in two different atmospheres



(a) Compare the uptake of nitrogen by the legumes in two atmospheres. (2mks)
(b) Explain why the uptake of nitrogen by the legumes;
    (i) Is highest in an atmosphere enriched with carbon dioxide (4mks)
    (ii) Cannot be enriched by artificial lighting on a bright day in a normal atmosphere (3mks)

15. (a) Explain the following observations;
    (i) Increase in carbon dioxide levels of blood minimizes heat loss from the body. (4mks)
    (ii) Cutting the nerve supply of carotid and aortic bodies does not interfere with regulation of the ventilation rate. (3mks)

(b) Outline three ways a large surface area to volume ratio has been achieved in organisms for gaseous exchange. (3mks)

16. (a) State three similarities between sexual reproduction in angiosperms and mammals (3mks)
    (b) Give the reproductive adaptations which contribute to the evolutionary success of;
    (i) angiosperms (3mks)
    (ii) mammals (4mks)
17. (a) In bred strains of animals such as mice are usually preferred in experiments such as testing the effect of new drugs.
    (i) What is meant by 'In-bred' strains? (1mk)
    (ii) What advantages do investigators derive from the use of 'In – bred' strains (2mks)

(b) State three consequences of inbreeding in wild life populations. (3mks)

(c) In cattle, colour fur and its distribution are determined by two genes that are not linked. A red and spotted fur cow was mated with a uniform black fur bull. All the F_1 offspring had uniform black fur. The F_1 offspring were crossed. Determine using genetic crosses the phenotypic ratio of the offspring after a test cross. (5mks)

18. How are the properties of the following substances related to their suitability as nitrogenous excretory products in a named vertebrate.

(a) Ammonia (4mks)

(b) Urea. (3mks)

(c) Uric acid. (3mks)

19. (a) Define the term 'counter current flow system' in fishes (1mks)
(b) How does the counter current flow system differ from the counter current multiplier system? (3mks)
(c) Explain the advantage of the counter current flow system over the parallel flow system in fishes.(1mk)
(d) How is the structure of the gill of a bony fish suited to its functions? (5mks)

20. (a) (i) What is photophosphorylation? (1mk)
(ii) Where in the plant cell does cyclic photophosphorylation take place? (1mk)
(b) How does photosynthesis in C_4 plants differ from that of CAM plants and how are they similar? (4mks)
(c) C_4 photosynthesis is considered to have a greater productivity than C_3 photosynthesis. Explain why not all plants have C_4 Metabolism? (2mks)
(d) State two ways in which a palisade mesophyll cell is adapted to carry out photosynthesis. (2mks)

21. (a) Liverworts and mosses have sometimes been described as the amphibians of the plant world. Briefly explain this observation. (3mks)
(b) (i) How are ferns better adapted to life on land that liverworts or mosses? (5mks)
(ii) In what main respects are mosses, liverworts and ferns poorly adapted to life on land? (2mks)

22. (a) Define the following terms. (1mk@)
    (i) Genetic equilibrium
    (ii) Genetic load
    (iii) Genetic death

(b) Give any four factors which can disrupt the genetic equilibrium of a sexually reproducing population of organisms (2mks)

(c) Some people can roll their tongue while others cannot. The allele for tongue rolling is dominant to that of the non – rollers. The percentage of all tongue rollers is 71.2%.

(i) What is the percentage of the non – rollers? (1mk)
(ii) What is the probability of an individual in a population being heterozygous for tongue rolling? Show your working. (3mks)
(iii) Calculate the genotype frequency of heterozygous individuals for tongue rolling. (1mk)

23. (a) With reference to an axon, explain the meaning of the following.
    (i) Absolute refractory period. (1mk)
    (ii) Relative refractory period (1mk)

(b) What is a synapse? (2mks)

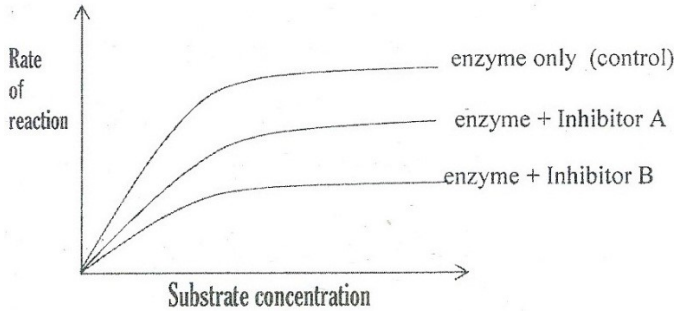
(c) Describe briefly how an impulse is transmitted across a neuron – muscular junction (6mks)

24. (a) Briefly describe the meaning of the following.
    (i) Deme (ii) gene pool (iii) allele frequency (1mk@)

    (b) Briefly explain the Hardy – Weinberg principle. (4mks)

    (c) List the assumptions made in deriving the Hardy – Weinberg equation. (3mks)

25. The figure below shows the effect of increasing the concentration of a substrate on the rate of an enzyme – controlled reaction in the presence of inhibitors A and B, in relation to the control experiment without the inhibitor.



(a) Describe the effect of each inhibitor on the rate of reaction
    (i) Inhibitor A . (2mks)
    (ii) Inhibitor B (2mks)

(b) Explain the difference in the effect of inhibitor A and B on the rate of reaction. (6mks)

26. (a) What do you understand by the terms? (2mks)
    (i) Sex linked genes
    (ii) Sex limited genes

    (b) (i) In Drosophila, the gene for wing length and for eye colour are sex linked. Normal wing and red eye are dominant to miniature wing and white eye. In a cross between a miniature wing, red eyed male and homozygous normal wing white eyed, using genetic crossing, determine the phenotypic ratio of F_2 generation. (4mks)

    (i) Assuming that no crossing took place, determine the phenotypes of F_2 generation (4mks)

27. A study was carried out to determine the dry mass of seeds and seedlings over a period of early germination, and the percentage change in their constituents recorded in the table below.

Constituent	Ugerninated seeds	5 day seedling	10 day seedling
Cellulose	15	15	20
Lipids	33	19	15
Salts	5	5	5
Proteins	24	22	23.5
Starch	0	7	3

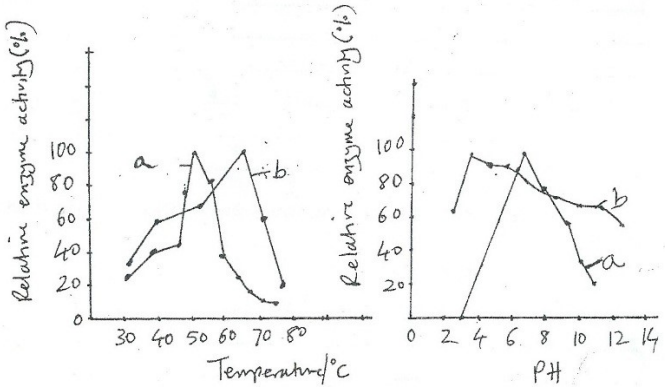
(a) Suggest the possible explanations for the change in percentage of; (2½ mks@)
    (i) Starch (ii) Lipids

(b) Explain the relationship between amount of starch and cellulose in; (2½ mks@)

(i) 5 day seedling
(ii) 10 day old seedlings

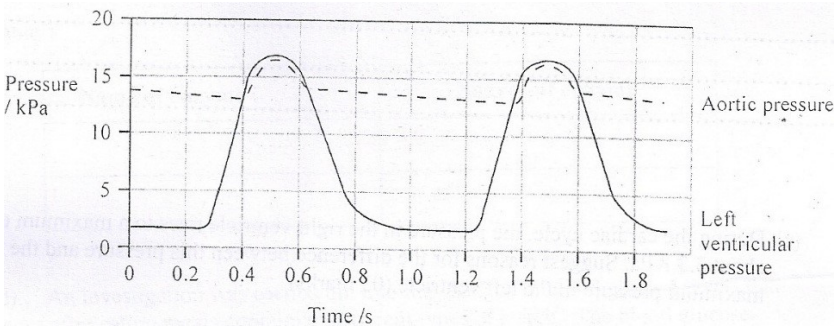
28. (a) Distinguish between the terms **immunity** and **autoimmunity**. (2mks)
(b) Suggest three key roles played by the body immune system (3mks)
(c) State three ways body openings are protected from entry of pathogens. (3mks)
(d) State two human diseases resulting from autoimmune disorders. (2mks)

29. The figure below shows the activity of bacterial enzymes at different pH and temperature.



(a) Which graph represents the bacteria that lives in (1mk)
(i) Cool and neutral conditions
(ii) Hot and acidic conditions.
(b) Compare the changes in enzyme activity with temperature and pH for organisms that live in hot and acidic environment to those that live in cool and neutral environment. (4mks)
(c) With reference to the enzyme structure, explain how the following affect enzyme activity.
(i) pH (ii) Temperature (3mks)
(d) Explain why the same enzyme may be able to work at different optimum pH and temperature conditions in similar organisms living in different environments. (2mks)

30. The figure below shows changes in the blood pressure in the aorta and the left ventricle during two complete cardiac cycles.

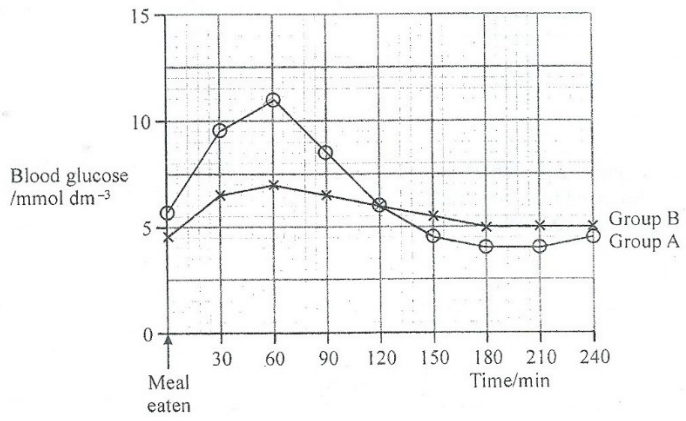


(a) On the graph, draw an arrow to show when the left atrioventricular (mitral) valve closes. (1mk)
(b) Use the information in the graph to calculate the heart rate. Show your working. (2mks)
(c) During the cardiac cycle, the pressure in the ventricle falls to a much lower level than in the aorta. Suggest an explanation for this difference. (3mks)
(d) During the cardiac cycle, the pressure in the right ventricle rises to a maximum of 3.3 Kpa. Suggest reasons for the difference between this pressure and the maximum pressure in the left ventricle.(3mks)

31. Carbohydrates in the human diet are important sources of energy. Much of these are supplied in form of starch present in potatoes, bread and some breakfast cereals is more rapidly digested than the starch found in beans, peas and lentils, pasta and wholegrain cereals. The latter is referred to as 'slow release' starch.

(a) Explain one way in which the structure of starch molecule is related to its function of storage. (2mks)

(b) An investigation was carried out into the changes in blood glucose levels of two groups of volunteers. Group A and Group B, were measured and recorded immediately before eating a meal and then at 30 minutes intervals for 240 minutes afterwards. None of the volunteers had diabetes.
The meal eaten by group A contained cornflakes and white bread toast.
The meal eaten by group B contained pasta and beans.
Suggest one reason why the starch stored in wholegrain cereals and beans may not be digested as readily as the starch in bread and potatoes. (1mk)
The mean blood glucose levels in moldm^{-3}, for each group were calculated and the results are as shown on the graph below. The normal level of glucose in the blood is about 5.0 to 5.5 moldm^{-3}



(i) Compare the changes in the blood glucose levels of group A with those of group B throughout the period of investigation. (3mks)

(ii) Suggest explanations for the differences in blood sugar levels of the two groups. (2mks)

32. Locusts are insects that are capable of flying for relatively long periods of time.
When flying, locusts use carbohydrates and lipids as energy sources.
An experiment was carried out to investigate the changes in the concentration of monosaccharides and lipids in the blood of a locust during flight.
Measurements were made of the concentrations of monosaccharides and lipids at the beginning and at 60 minute intervals during flight.
The results are as shown in the table below.

Time during flight in min	Concentration of monosaccharide in g/mm^{-3}	Concentration of lipids in gmm^{-3}
0	30.0	3.0
60	13.0	10.0
120	12.0	19.0
180	11.5	20.0
240	11.0	20.0
300	11.0	20.0

(a) Compare the changes in the concentration of monosaccharides with the changes in concentration of lipids during the flight. (4mks)

(b) Suggest an explanation for the changes in the concentration of both of these compounds during flight. (4mks)

(c) In this investigation, the mass of stored glycogen in the locust was also measured and was found to decrease by 390g during the flight. Suggest an explanation for this change in mass of glycogen. (2mks)

33. Raw sewage from homes is taken to the sewage works for treatment. The sewage enters large tanks where the solids settle at the bottom. The water is removed and treated. Any ammonia present is oxidized to nitrates. The effluents (untreated) water is released into a local river.

The quality of effluents has to meet certain standards. For example, biochemical oxygen demand must **not** be greater than 20 mg per dm^3 and suspended solids **must not** exceed 30 mg per dm^3. The effluents are tested regularly to ensure that the limits are **not** exceeded.

The table below shows results of an analysis of the effluents from a sewage treatment works over a six – month period.

	March	April	May	June	July	August
Suspended solids/mg dm^{-3}	26	26	33	28	21	12
Biochemical oxygen demand/mg dm^{-3}	15	21	25	32	10	7
Nitrate/mg dm^{-3}	4.7	9.1	17.0	20.0	0.5	14.0

(a) During the six – month's period, the pumping equipment at the sewage works failed and raw sewage entered the river. In which month did the pumping equipment fail? Give a reason for your answer. (1mk)

(b) Effluent may contain suspended solids. Describe the effects that the suspended solids may have on the aquatic plants in the river. (2mks)

(c) Explain why the effluents had a high biochemical oxygen demand (B.O.D) during the months of May and June. (2mks)

(d) Describe two adaptations shown by aquatic invertebrates to a low oxygen environment. (2mks)

(e) Describe the changes that might have taken place in the aquatic community following discharge of raw sewage into the river. (3mks)

34. (a) Name and state the basic elements of the functional units of the following parts of the ear. (2mks)

(i) Semi – circular canals (ii) Cochlea

(b) Explain how the basic elements in a(i) and (ii) allow animals to perceive a stimulus. (3mks)

(c) Explain the following;

(i) Most people feel pain in the ears when they skin dive at a depth 5 meter. (2½mks)

(ii) After spinning around for short time, a person feels dizzy and may seem to be spinning in the opposite direction. (2½mks)

35. (a)Humans possess one of the following blood groups A,B,AB and O. Describe these phenotypes in terms of;

(i) The constituents of the red blood cell membranes (4mks)

(ii) The plasma antibodies.

(iii) Their possible genotypes.

(c) Erminette fowls are characterized by possessing light coloured feathers with occasional black ones, giving them a flecked appearance. A cross between two erminettes produced a total of 48 progeny consisting of 22 erminettes, 14 blacks and 12 white fowls.

(i) Using these results, suggest s genetic basis for the erminette pattern in the fowls. (2mks)

(ii) Construct a genetic diagram of a cross to show how the erminatte pattern is inherited in fowls. (4mks)

36. (a) State two main characteristics of learned behavior. (2mks)

(b) With an example in each case, state what is meant by the following forms of associative learning.

(i) Conditioning (2mks)

(ii) Trial and error learning (2mks)

(c) State the importance of each type of associative learning in b(i) and (ii) above in their natural habitat. (2)

(d) Explain why learned behavior is likely to vary between individuals of the same species. (2mks)

37. (a) What is displacement activity? (2mks)

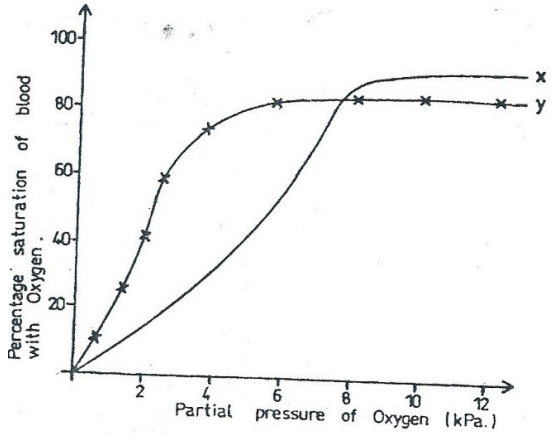
(b) State the ecological importance of each of the following forms of behavior.

(i) Territorial behavior (3mks)

(ii) Courtship behavior (3mks)

(c) Give two ways in which animals avoid predation (2mks)

38. The figure below shows oxygen dissociation curves for haemoglobin of two animals **x** and **y,** living in different habitats.



(a) From the figure, state three differences in the behavior of haemoglobin of the two animals (3mks)

(b) (i) Outline the characteristics of haemoglobin of animal y. (3mks)

(ii) From the characteristics in (b) (i) suggest the nature of the habitat in which y lives. (1mk)

(c) Human haemoglobin has a higher affinity for carbon monoxide than oxygen. What is the effect of this fact? (3mks)

39. (a) Differentiate between respiratory quotient and basal metabolic rate. (BMR) (2mks)

(b) The table below shows the respiratory quotients in germinating seeds under different treatments.

Treatment	RQ
(i) 4hr soaking in water	6.0
(ii) 4hr soaking then exposure to air	1.8
(iii) 4hr soaking and then 24hr exposure to air.	1.0

Explain the different respiratory quotients of the germinating seeds under the different treatments (6mks)

(c) Explain why the MBR varies with the age of the individual (2mks)

40. (a) (i) Describe how the quadrat method can be used to estimate the species population density. (2mks)

(ii) State the advantage and disadvantage of the method. (2mks)

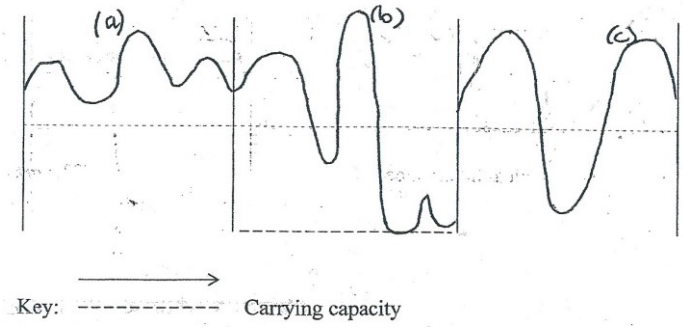
(b) (i) Why is it important to estimate population size? (2mks)

(ii) In estimating the number of fish in a small lake, 625 fish were caught, marked and released. After one week, 920 fish were caught and of these 150 had been marked. What is the estimated size of fish population (2mks)

(iii) In using the method in b (ii) above to estimate the population size of fish, state two assumptions that were made. (2mks)

41. (a) Define the term ***carrying capacity*** (2mks)

The figure below shows three populations growth curve pattern **a, b** and **c** that occur naturally.



(b) Describe and suggest reasons for the observed pattern of each population growth curve.

(i) Pattern **a** (2mks) (ii) pattern **b** (3mks) (iii) pattern **c** (3mks)

42. (a) What is meant by ***apical dominance***? (2mks)

(b) State the causes of each of the following.

(i) Apical dominance (2mks) (ii) Seed dormancy (3mks)

(c) What is the ecological importance of;

(i) Apical dominance (2mks) (ii) Seed dormancy (2mks)

43. (a) What does ***heterozygous advantage*** mean? (2mks)

(b) Using sickle cell anaemia, illustrate how heterozygous advantage occurs. (2mks)

(c) Suggest three ways in which the rate of evolution of a species can increase naturally. (3mks)

(d) (i) In cats, a gene **B** is responsible for black colour as an allele **L** is responsible for yellow colour. These genes show incomplete dominance and hybride **BL** is tortoise shell. The genes are also sex linked.

State the possible gemetes and genotypes in the parents, F_1 and F_2 generations, if a black female is mated with a yellow male. (3mks)

(ii) To what extent are male and female kittens produced by their coat colour? (2mks)

44. (a) What is meant by the term ***extinction*****?** (1mk)

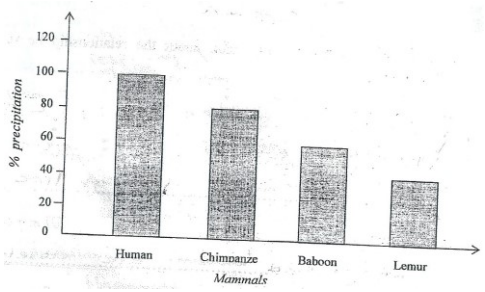
(b) State one natural cause of extinction (1mk)

(c) Mention the ways in which human activity has accelerated the rate of extinction in present times. (3mks)

(d) Suggest three measures that can be put in place to prevent extinction of species. (3mks)

(e) Explain why large predators such as birds of prey are more prone to extinction that herbivores (2mks)

45. (a) The graph below shows precipitation of serum, when human serum is mixed with different serum of different animals and precipitates are compared. Use it to answer the questions below it.



(i) Describe the trend of precipitation from human to lemur. (2mks)

(ii) Explain how precipitation is formed when sensitized rabbit serum is mixed with any mammal's serum (3mks)

(b) Explain the difference in the amount of precipitation formed between chimpanzee and man (2mks)

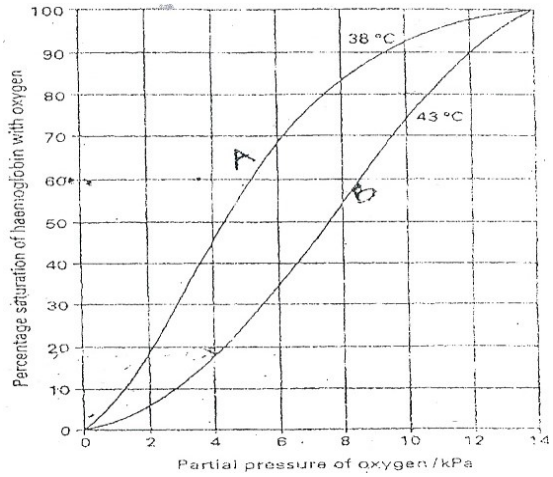
(c) State **one** evolutionary conclusion about the relationship between human being and

(i) Chimpanzee (ii) Lemur (2mks)

46. (a)What is meant by the term;

(i) Stroke volume? (ii) Cardiac output? (iii) Percentage saturation with oxygen? (3mks)

(b) the graph below show the oxygen dissociation curve of haemoglobin from mammals at two different temperatures. (curve A at 38^{o} C and curve B at 43^{o}C) .



(i) In which part of the body of a mammal is temperature likely to be as in curve B. (1mk)

(ii) Suggest a reason for the difference in shape of curve A and B (2mks)

(iii) Blood that is fully (100%) saturated with O_2 carries 105cm^3 of O_2 in 1dm^3 of blood. Calculate the volume of oxygen released from 1dm^3 when blood becomes 90% saturated at a temperature of 38^{o}C reaches a part of the body where the temperature is 43^{o}C and the partial pressure of O_2 is 4Kpa. Show your working.

47. (a) Give the evolutionary advantage of the following types of pollination

(i) Cross pollination (ii) Self pollination (2mks@)

(b) Explain the advantages in flowering plants of

(i) Pollen grains being small (ii) Embryo sac being large (5mks)

(c) Suggest why the chances of survival and development of wind pollen grains are much less than those of spore of a fern plant. (1mk)

48. (a) (i)Define the term ***osmoconformer*** (1mk)

(ii) Explain osmoregulation in fish occupying both marine and fresh water habitats. (5mks)

(c) Give two ecological and physiological advantages of the fish in (a)(ii) above over marine teleost.(4mks)

49. The information below was collected by a Geneticist concerning the number of individuals with their corresponding heights in a given population.

Number of individuals ('0000	1.5	2.2	5.0	9.0	16.0	22.0	14.0	4.0	3.0
Height (cm)	155	160	167	170	173	176	185	191	195

(a) Using the information provided plot a graph of the number of individuals ('000) against their height. (5mks)

(b) From the graph, determine the number of individuals measuring **180.00**cm in height. (1 mk)

(c) (i) Which type of variation is exhibited by the individuals regarding the character in question? (1mk)

(ii) Apart from height, give four other characters that show similar behavior in man (2 mks)

(iii) State four properties of the characters you have mentioned above (2 mks)

(d) Variation can be due to environmental or genetic factors. Describe how both sources can lead to **speciation and evolution**.

(e) How has man made use of his knowledge of variation and evolution to his benefit?

50. Ecologically when a broad spectrum pesticide is used in pest control, pesticide resurgence may arise. The table below shows the changes in number of pests after a period of pesticide application from 1982 up to 1985

Time / Year	Number of pests survived
1982	800
1983	600
1984	500
1985	900

(a) What is meant by **pesticide resurgence**? *(2mks)*

b) Explain the effect of using a broad spectrum pesticide in managing population of pests *(03 mks)*

c) State two ways pesticides can affect organisms in the environment *(2 mks)*

d) Under what circumstance can pest resurgence arise in biological pest control? *(3mks)*

51. a) Outline the three types of stimuli *(1½ mks)*

b) State one example for each of the stimuli given in 51 (a) above *(1½ mks)*

c) Mention any three ways by which learned behavior can be modified *(03 mks)*

d) Outline any two significance of **imprinting** *(01 mk)*

e) What is meant by **pheromones**? *(03 mks)*

REVISION BREAKDOWN I

Enzymes, Histology, Chemicals of life, Cell physiology (Movement in and out of cells), Cell Biology (Cytology, Cell division and Protein synthesis)

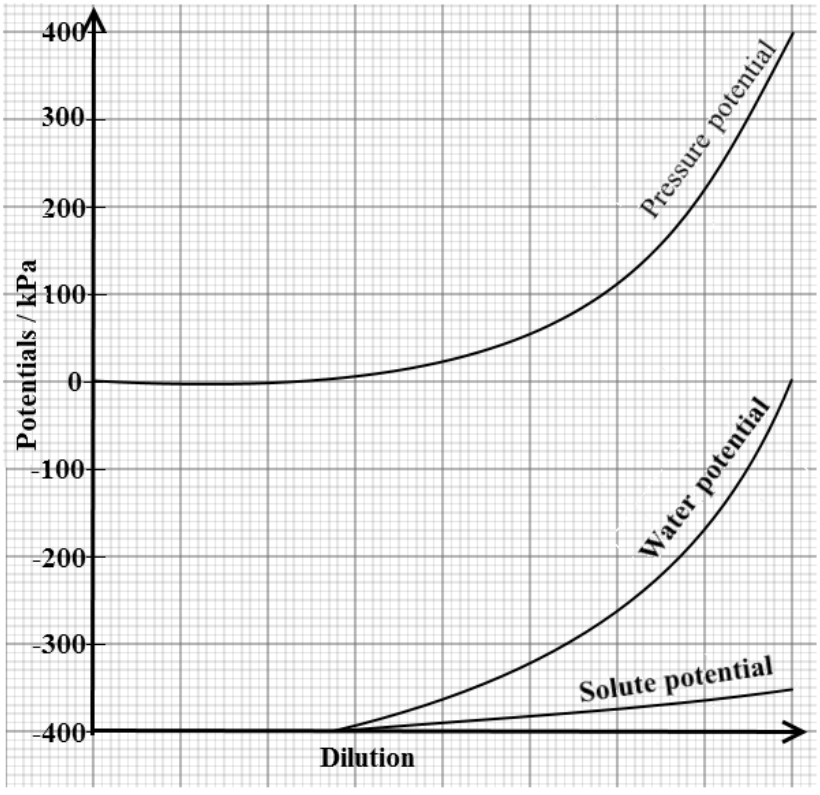
1. (a) How are organelles involved in the production and secretion of enzymes?(*10 marks*)
(b) (i) Describe the structure of an enzyme molecule. (*04 marks*)
(ii) Explain how inhibitors affect the rate of enzyme catalysed reactions.(06 marks)

2. (a) Using illustrations where necessary, describe how the structures of polysaccharides are related to their functions. (*10 marks*)
(b) Explain different ways in which carbohydrates are used in cells. (*10 marks*)

3. (a) Relate structure to function of cell membrane proteins. (*06 marks*)
(b) Describe the role of plasma membrane in movement of substances across cells (*14 marks*)

4. (a) Compare the structure and functioning of arteries and xylem vessels. (*10 marks*)
(b) Explain how features of the sieve tube element enable the phloem to carry out its function. (*04 marks*)
(c) Describe the functions of the different components of human blood. (*06 marks*)

5. The graph in Fig. **1** shows the relationship between water potential, solute potential and pressure potential for a fully plasmolysed plant cell placed in hypotonic solution that is experiencing increasing dilution. Study Fig. **1** and answer the questions that follow.



(a) Compare the effect of dilution on pressure potential and water potential of the cell. (*04 marks*)

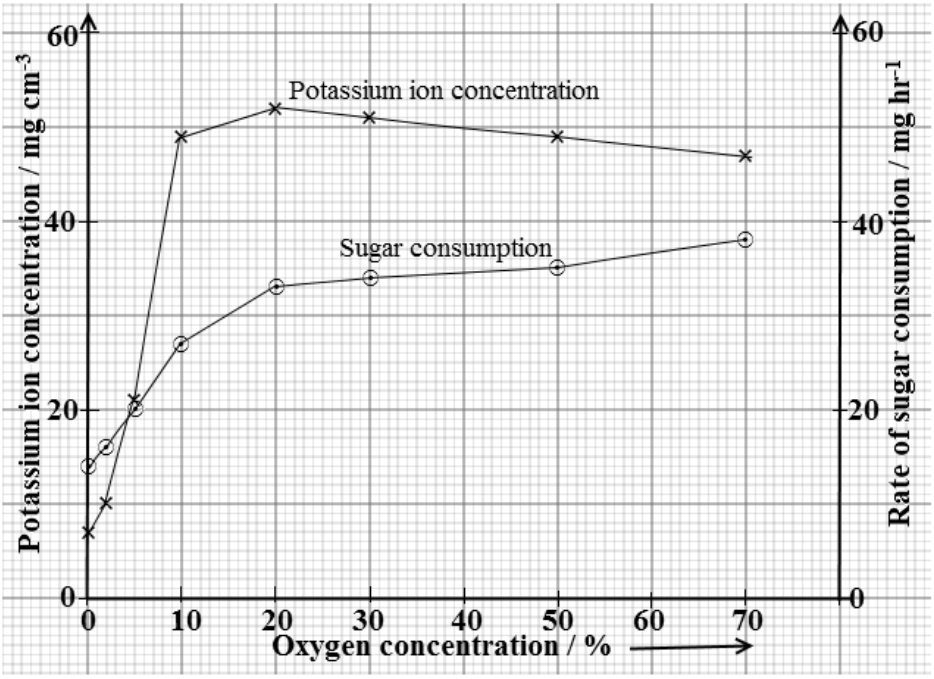
(b) Explain the changes in each of the following as dilution increases:

(i) Pressure potential (*05 marks*)

(ii) Water potential (*05 marks*)

(iii) Solute potential (*05 marks*)

The graph in Fig. **2** shows the concentration of potassium ions and sugar consumption in freshly detached roots at different concentrations of oxygen in the bathing fluid. The detached roots were thoroughly washed in distilled water before the experiment started. Study Fig. **2** and answer the questions that follow.



(c) Describe the relationship between sugar consumption and potassium ion concentration in roots. (*05 marks*)

(d) Explain the effect of oxygen concentration on potassium ion concentration in roots. (*05 marks*)

(e) Suggest why
(i) freshly detached roots were used in the experiment. (*02 marks*)
(ii) roots were first thoroughly washed in distilled water. (*02 marks*)
(iii) ions were present in the roots at 0% oxygen concentration. (*03 marks*)

6. (a) Compare the cellular characteristics of prokaryotes and eukaryotes. (*12 marks*)
(b) Explain why cells in the pancreas have large amounts of rough endoplasmic reticulum and Golgi bodies. (*04 marks*)
(c) Describe how the structure of the nuclear envelope relates to its role in assembly of proteins. (*04 marks*)

7. (a) Describe the structure of transfer ribonucleic acid molecule. (05 marks)
(b) How do the properties of the genetic code guide protein synthesis? (05 marks)
(c) Explain how nitrogen in the urea of cattle in a field of grass can become a component of protein in beef. (10 marks)

REVISION BREAKDOWN II– INTERRELATIONSHIPS

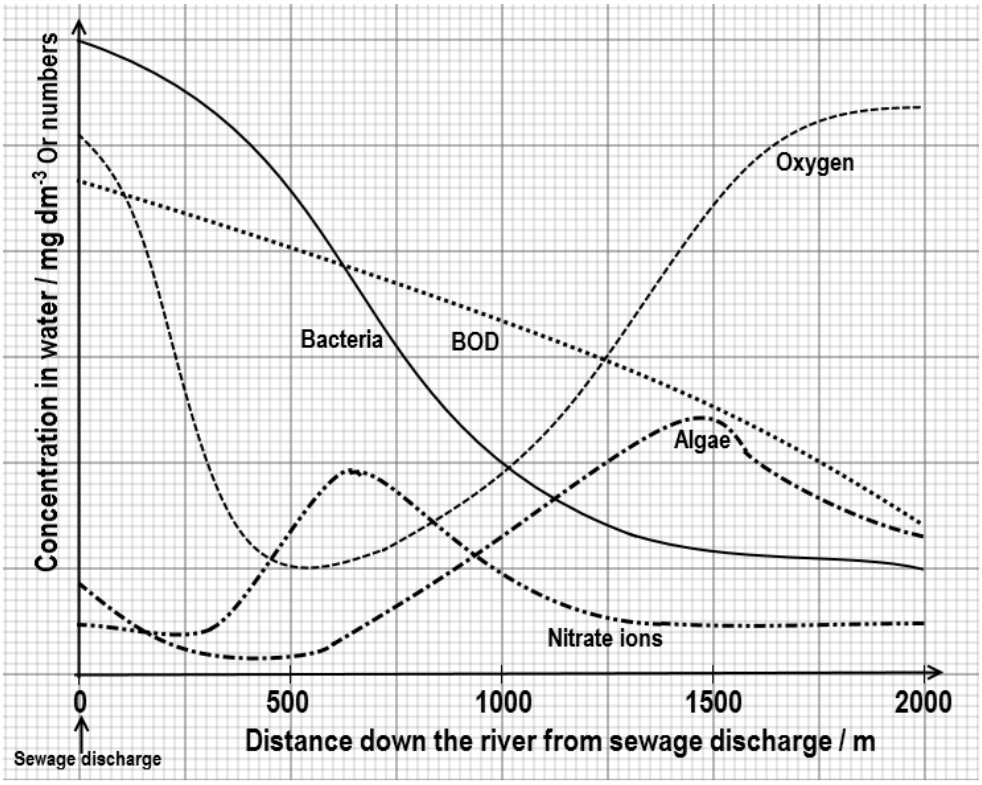
Population and Community ecology, Ecosystems & Human impact on environment

8. (a) Describe the
(i) changes in biodiversity that start on a bare rock. (*06 marks*)
(ii) role of biotic factors in recolonising an abandoned field. (*05 marks*)
(b) Compare events of colonising bare rocks and recolonising abandoned fields. (*09 marks*)

9. With named examples, explain how **two closely related species** can occupy the same habitat seemingly competing for the same kinds of resources. (*20 marks*)

10. (a) Explain why decomposition occurs faster in tropical rain forests than in grasslands. (*07 marks*)
(b) How does increased concentration of atmospheric carbon dioxide and sulphur dioxide affect plant life? (*06 marks*)
(c) Suggest why the proportion of energy passed on to the next trophic level is
(i) greater in invertebrates than in mammals. (*04 marks*)
(ii) greater in mammalian herbivores than in mammalian carnivores. (*03 marks*)

11. The graph in **Figure 1** shows the conditions in a river during the dry season, below a point at which there is a continuous discharge of diluted sewage.
Study Fig. **1** and answer the questions that follow.



(a) Explain the relationship between distance from sewage discharge point and
  (i) oxygen concentration. (*07 marks*)
  (ii) biological oxygen demand (BOD). (*03 marks*)

(b) Explain the effect of discharging diluted sewage into the river on
  (i) nitrate ion concentration. (*09 marks*)
  (ii) population of algae. (*07 marks*)
  (iii) population of bacteria. (*04 marks*)

(c) Suggest and explain
  (i) what would happen to the level of pollution in the river during extreme conditions of dry season. (*06 marks*)
  (ii) how the water quality can be monitored basing on physical conditions. (*04 marks*)

REVISION BREAKDOWN III

Inheritance, Evolution, Reproduction, Growth and Development

12. (a) Explain how events of meiosis cause gametes to vary genetically. (*05 marks*)

(b) In peas, the allele for tallness, **T**, is dominant to the allele for dwarfness. Another dominant allele, **R**, at a locus on another pair of homologous chromosomes controls the production of an enzyme involved in the conversion of sugar to starch, resulting in formation of smooth, round seeds. The mutant allele, **r**, is responsible for wrinkled seeds.
  (i) Using a genetic diagram, show the results from self-fertilisation of heterozygous tall plants with wrinkled seeds. (*09 marks*)
  (ii) Explain why some growers prefer pea varieties that form wrinkled seeds to those of normal seeds. (*03 marks*)

(c) Suggest why a dominant allele for an **unfavourable** condition is likely to disappear from a population more rapidly than a recessive allele for an **unfavourable** condition. (*03 marks*)

13. (a) Describe how gene mutation may affect the phenotype of an organism. (*10 marks*)
(b) Explain why:
  (i) gene mutation by deletion usually causes severe effects than substitution mutation. (*07 marks*)
  (ii) sickle cell allele is at a selective disadvantage in non-malarial regions. (*03 marks*)

14. (a) Describe how environmental factors and hormones interact to control growth and development in insects. (*13 marks*)
(b) Outline the **advantages** and **disadvantages** of exoskeleton to arthropods. (*07 marks*)

15. (a) Discuss how **negative** and **positive** feedback mechanisms regulate the ovarian and menstrual cycles in adult humans. (*16 marks*)
(b) Compare sperm and egg production in humans. (*04 marks*)

TOPIC BREAKDOWN IV

Classification, Nutrition, Transport, Gas Exchange, Respiration, Homeostasis, Coordination, Behaviour, Support and Locomotion

16. (a) What structural features of angiosperms led them to successfully colonize land? (*10 marks*)

(b) (i) Describe the structure of the pollen grain. (*05 marks*)

(ii) Explain how the production of pollen grains has enabled flowering plants to adapt to terrestrial life. (*05 marks*)

17. (a) Explain how the light independent stage of photosynthesis leads to the production of triose phosphate. (07 marks)

(b) Show the origin of the raw materials for the light independent stage of photosynthesis and the possible uses of the triose sugar produced. (*13 marks*)

18. (a) Explain how the of loop of Henle produces an ion gradient across the medulla in mammals. (*08 marks*)

(b) Describe how bony fish overcome the osmoregulatory problems in

(i) fresh water. (*04 marks*)

(ii) marine water. (*04 marks*)

(iii) estuarine water. (*04 marks*)

19. (a) Compare the properties of air and water as respiratory media. (*10 marks*)

(b) Explain why

(i) multicellular organisms evolved special gas exchange surfaces. (*04 marks*)

(ii) carnivores satisfy energy needs **mostly** from respiring organic acids. (*06 marks*)

20. (a) Describe the role of electron transport chain in the synthesis of ATP. (*10 marks*)

(b) (i) How is the synthesis affected by metabolic poisons? (*05 marks*)

(ii) Explain the importance of ATP in living organisms. (*05 marks*)

21. (a) What are the characteristics of a successful closed circulatory system?

(b) How does the circulatory system of mammals meet the varying needs of tissues?

(c) Explain how a single cardiac cycle is controlled in the human heart. (*09 marks*)

22. (a) (i) Describe the pathways of water movement across the root. (*06 marks*)

(ii) How can the movement of organic molecules in plants be monitored?

(b) Explain the role of endodermis in uptake and transport of water in plants. (*08 marks*)

23. (a) Describe, how, starting at the stomach, the structure of the alimentary canal enables it to perform its functions of digestion and absorption. (*10 marks*)

(b) How is digestion controlled in man? (*10 marks*)

24. (a) Describe the sequence of events which result in actin sliding past myosin. (*12 marks*)

(b) (i) Outline four differences between slow twitch and fast twitch muscles. (*04 marks*)

(ii) How is the skeletal muscle structure suited for its functions? (*04 marks*)

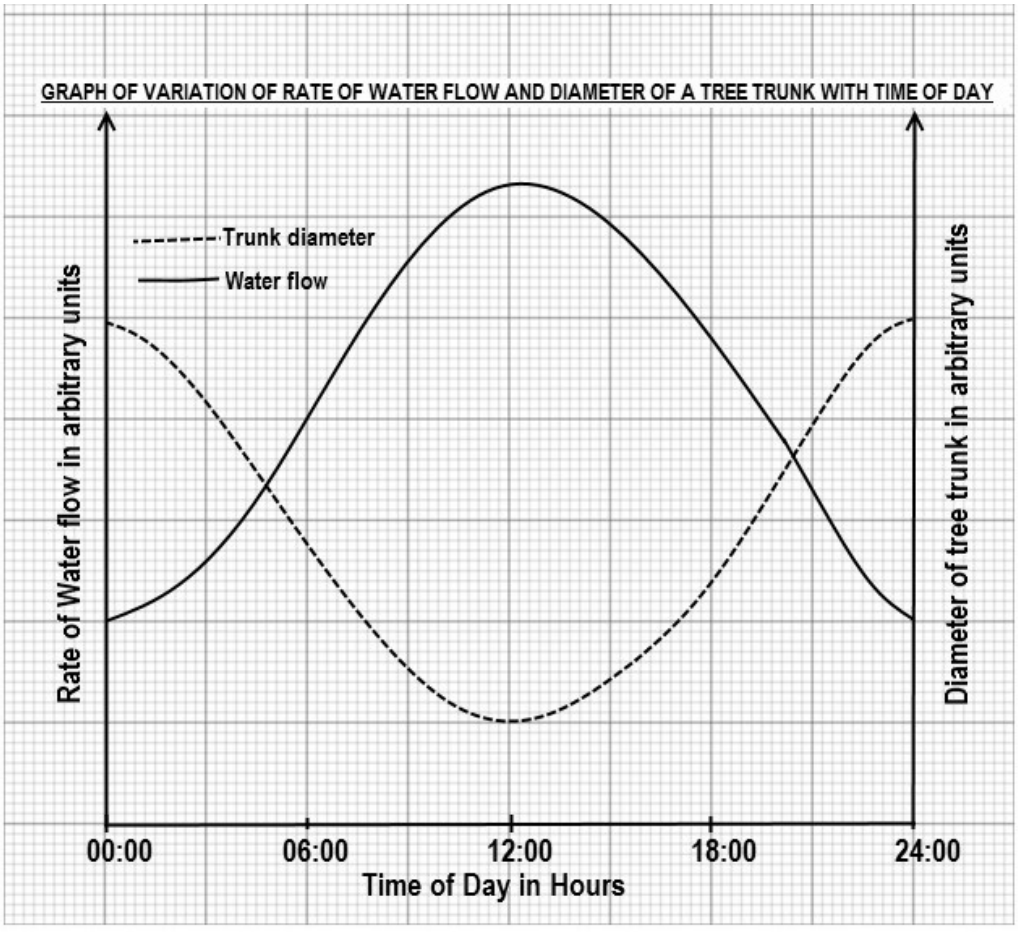
25. (a) Describe the events that take place within a human female from the release of the secondary oocyte to the implantation of the embryo. (*14 marks*)
(b) How is the placenta suited to its roles in humans? (*06 marks*)

26. (a) State the ways by which immunity can be acquired. (*05 marks*)
(b) Describe the structure and function of a human antibody. (*07 marks*)
(c) Explain the importance of the ABO blood group system in blood transfusion.(*08 marks*)

27. Describe each and give the significance of the following animal behaviours.
(a) Territoriality
(b) Imprinting
(c) Fixed action patterns
(d) Honey bee communication

28. Describe the various reactions of plants to light. (*20 marks*)

29. The graph in **Figure 1** shows the rate of water flow up a tree and the diameter of the tree trunk over a 24 hour period. Study the figure and answer the questions that follow.

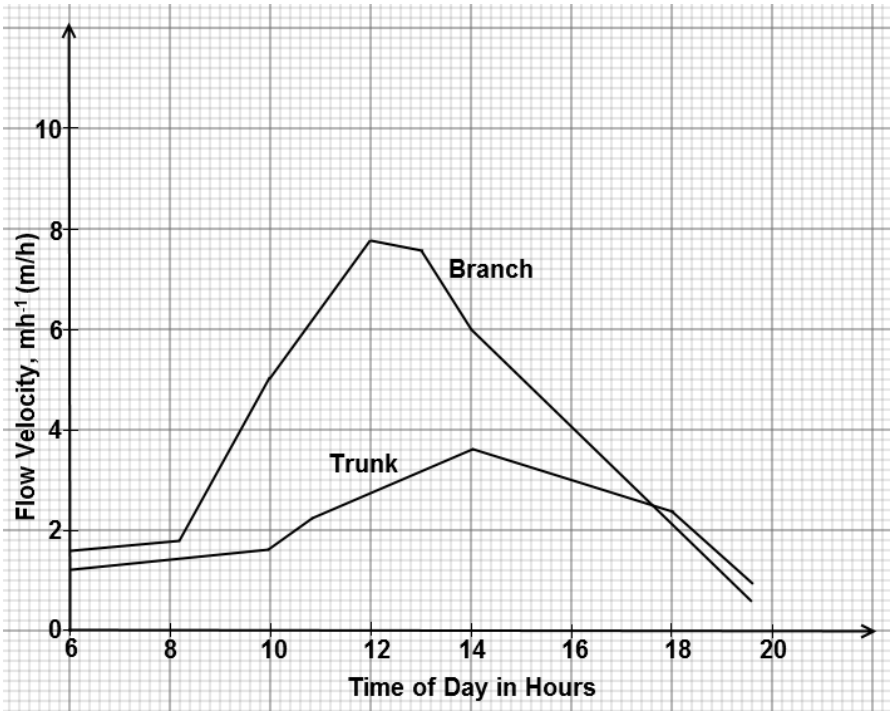


(a) Describe the trend in:
  (i) Rate of flow of water during the 24-hour period. (*04 marks*)
  (ii) Diameter of the tree trunk over the 24-hour period. (*03 marks*)

(b) Explain the changes in the:
  (i) Rate of flow of water during the 24-hour period. (*08 marks*)
  (ii) Diameter of the tree trunk over the 24-hour period. (*06 marks*)

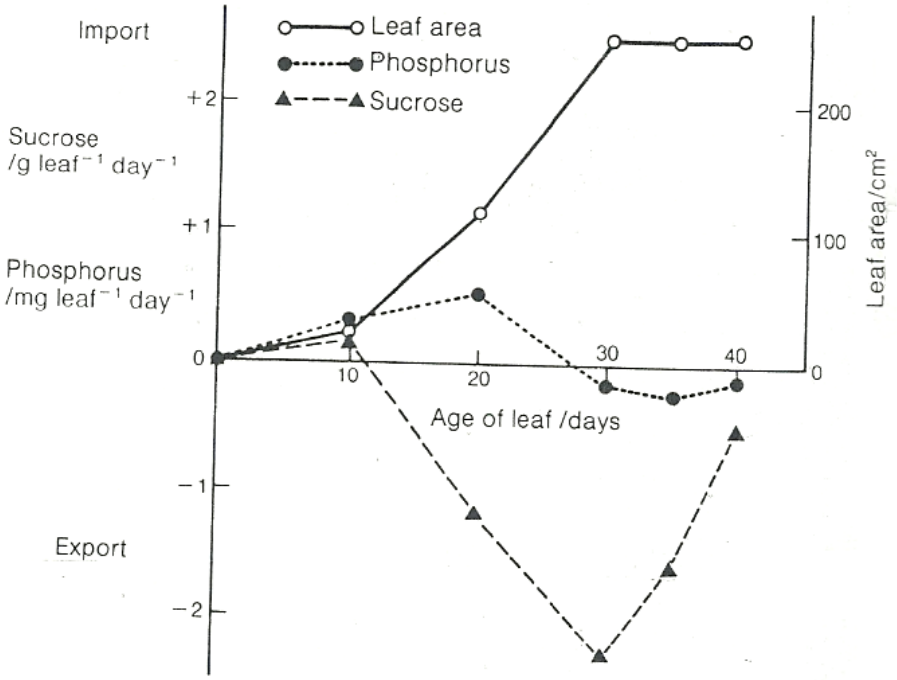
(c) Explain:
  (i) What would happen to the rate of water flow if the tree was sprayed with the herbicide ammonium sulfamate that kills living cells. (*06 marks*)
  (ii) How plant tissues for water transport in the trunk are **adapted** for diurnal changes in diameter? (*04 marks*)

The graph in **Figure 2** shows changes in linear velocity of flow of sap through the xylem of a tree trunk and one of its small branches at the top. Measurements were taken at two-hourly intervals on a hot day. Study the figure and answer the questions that follow.



(d) From **figure 2**, explain the trend of linear flow velocity of sap through the xylem for period shown. (*09 marks*)

30. **Figure 1** shows the growth of a single plant leaf with its **import (+)** and **export (-)** of sucrose and phosphorus during a period of 40 days. Study the figure and answer the questions that follow.



(a) From figure 1 above, explain the relationship between:

(i) Leaf area and movement of sucrose. (*09 marks*)

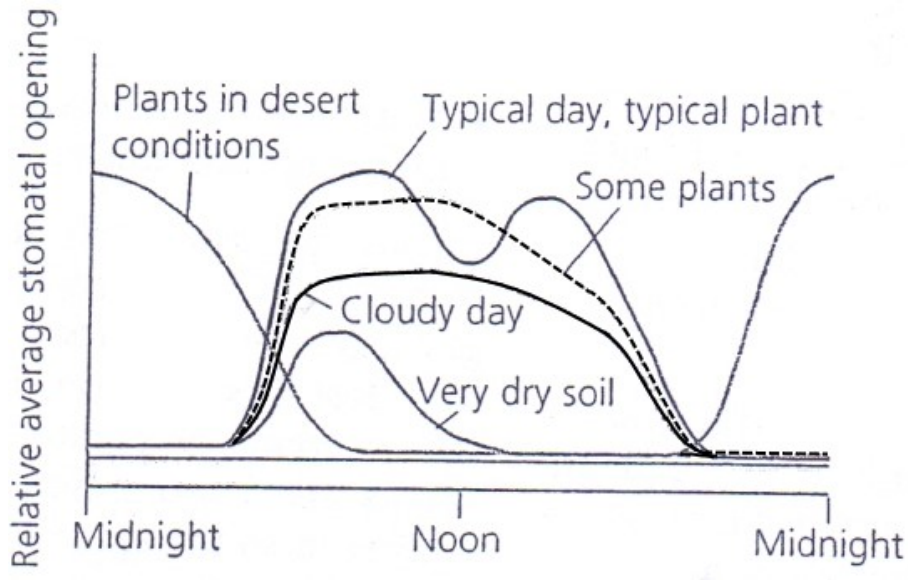
(ii) Age of leaf and movement of phosphorus. (*08 marks*)

(b) Describe how the following are imported and exported through the leaf:

(i) Sucrose. (*03 marks*)

(ii) Phosphorus. (*02 marks*)

Figure 2 shows how external factors affect stomatal opening in various plants. Study the figure and answer the questions that follow.



(c) Compared with a typical plant on a typical day, describe the effect of the following conditions on stomatal movement:

(i) Very dry soil (*05 marks*)

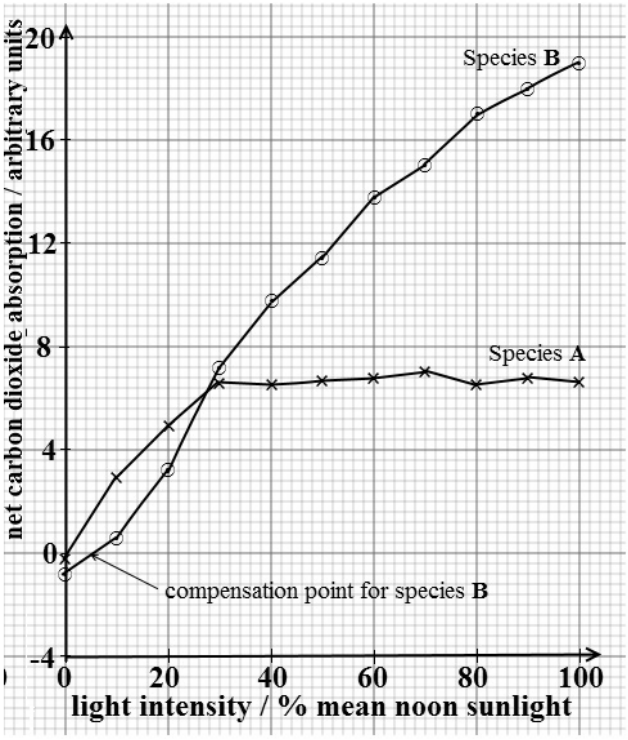
(ii) Cloudy day (*05 marks*)

(d) Considering the plants in desert conditions:

(i) What are the **advantages** and **disadvantages** of the observed stomatal movement? (*05 marks*)

(d) (ii) Explain how structural features are indicative of their habitat. (*03 marks*)

31. **Figure 1** shows the amount of carbon dioxide absorbed in photosynthesis (+) or released in respiration (-) by plant species A and B, growing at relatively constant temperature and varying light intensities from darkness to the equivalent of mean noon sunlight. Study Fig. **1** and answer the questions that follow.

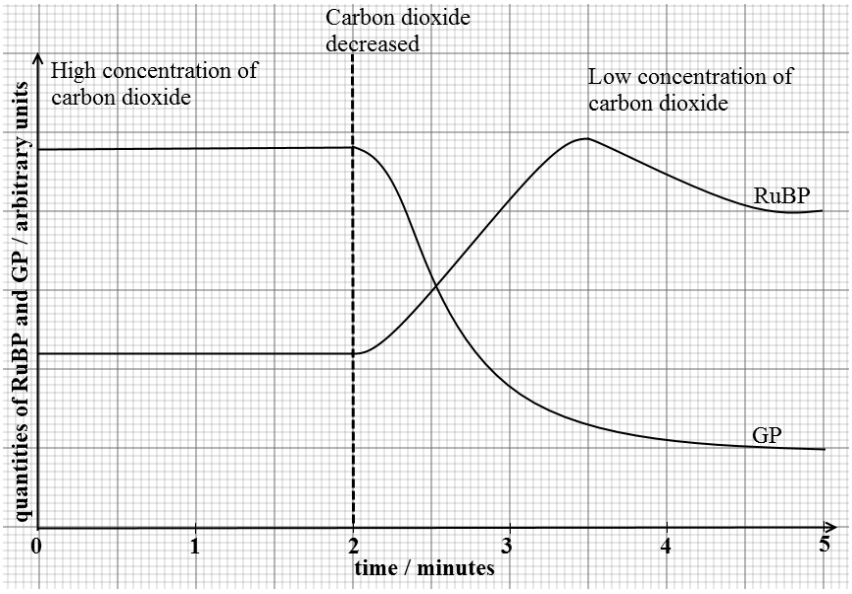


(a) Compare the effect of light intensity on carbon dioxide absorption in species **A** and **B**. (*03 marks*)

(b) How do the data provided for species **A** and **B**
(i) indicate their habitat preferences? (*07 marks*)
(ii) explain their photosynthetic efficiency? (*08 marks*)

(c) (i) Suggest **three** structural differences between the leaves of species **A** and **B** based on their habitat requirements. (*03 marks*)
(ii) Explain what would happen to the rate of photosynthesis in species B at light intensity above 100 % mean noon light (*03 marks*)

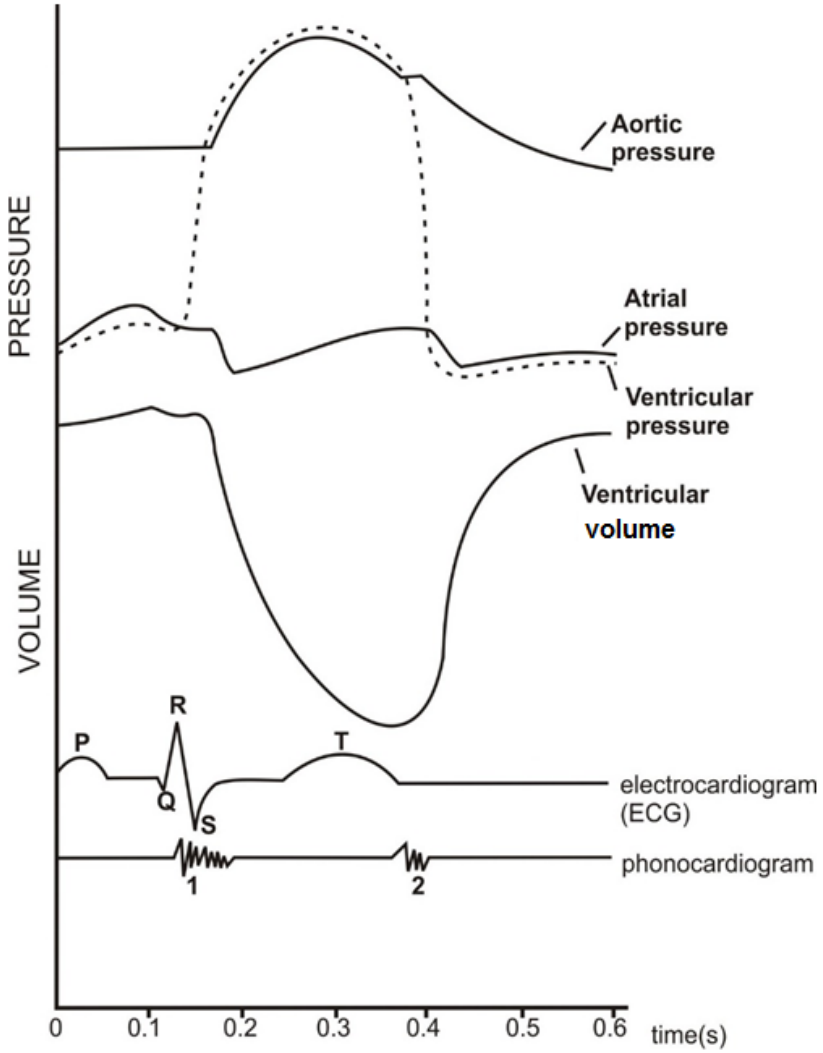
Figure 2 shows the changes in the quantities of glycerate 3-phosphate (GP) and ribulose bisphosphate (RuBP) manufactured by algae at constant temperature and light intensity, and varying concentration of carbon dioxide. Study Fig. **2** and answer the questions that follow.



(d) Describe the effect of the decreased carbon dioxide concentration on the levels of GP and RuBP after 2 minutes.(*07 marks*)

(e) Suggest explanations for the changes to the levels of GP and RuBP after 2 minutes. (*09 marks*)

32. The figure below shows pressure changes that occur in the left atrium, aorta and left ventricle, and an electrocardiogram (ECG) recording of the pattern of electrical activity associated with a heart during one complete beat in humans.



(a) Describe the changes in:
(i) Atrial pressure. (*07 marks*)
(ii) Ventricular pressure. (*07 marks*)

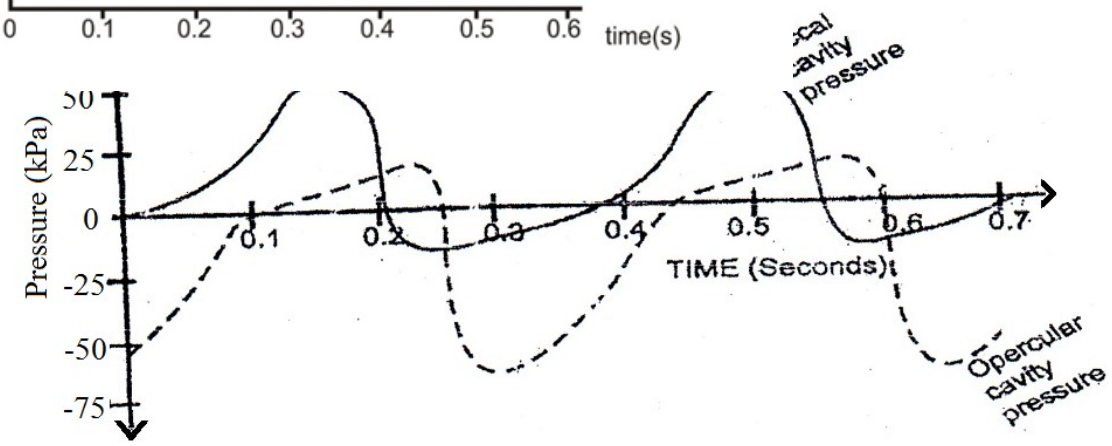
(b) What are the differences in the changes in ventricular pressure and ventricular volume between 0.1 seconds and 0.5 seconds? (*03 marks*)

(c) Explain the effect of the changes in atrial, aortic and ventricular pressures on blood flow during the cardiac cycle. (*15 marks*)

(d) Explain the pattern of:
(i) Electrical activity. (*3 marks*)
(ii) Sounds on the phonocardiogram. (*04 marks*)

(e) Explain how the internal heart structure is related to its functioning. (*03 marks*)

3 …percular cavities of a teleost fish.



(a) Compare pressure changes in buccal cavity and opercular cavity in the first 0.4 seconds. *(08 marks)*

(b) Explain the observed changes in buccal cavity and opercular cavity from 0.2 seconds to 0.6 seconds. *(12 marks)*

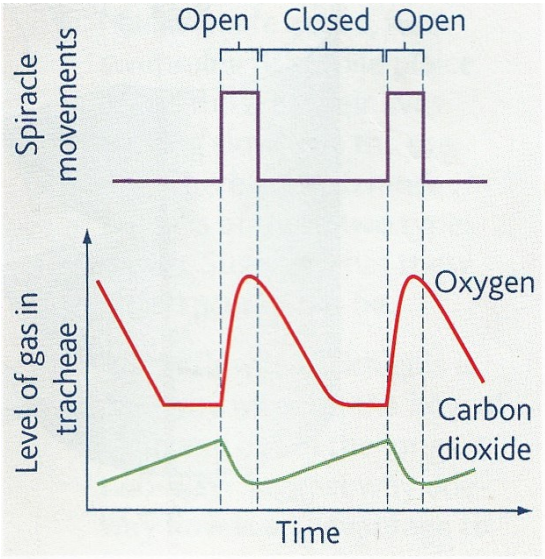
(c) What is the physiological significance of the differences between the pressure in the buccal and opercular cavities? *(03 marks)*

The figure on the right shows results of an experiment which measured the levels of oxygen and carbon dioxide in the tracheal system of an insect over a period of time. During the experiment, the opening and closing of the insect's spiracles was observed and recorded.

(d) Describe the pattern of level of gases in tracheae in relation to spiracle movements. *(04 marks)*

(e) Explain the pattern of level of gases in tracheae in relation to spiracle movements. *(06 marks)*

(f) (i) From the information provided by the graph, suggest the causes of spiracle opening. *(02 marks)*



(ii) What is the advantage of the observed spiracle movements to a terrestrial insect? *(05 marks)*

QUESTIONS ON ANIMAL DISSECTION

Cockroach
Toad / Frog
Rat

1. You are provided with

ATOM SCIENCE CENTRE

NATIONAL ASSOCIATION OF BIOLOGY TEACHERS
Contacts: +256704129440, +256755624442, +256701792750

A - LEVEL BIOLOGY SEMINAR QUESTIONS,SUNDAY 25TH SEPTEMBER 2022

VENUE: Makerere University, CoCIS

1. The graph in the figure 1 below shows the changes in the cardiac output of two mammals **A** and **B**; of different sizes over a 10hour period. The mammals were given a hot drink at 7:00am and1:00pm. Study it carefully and answer questions that follow.

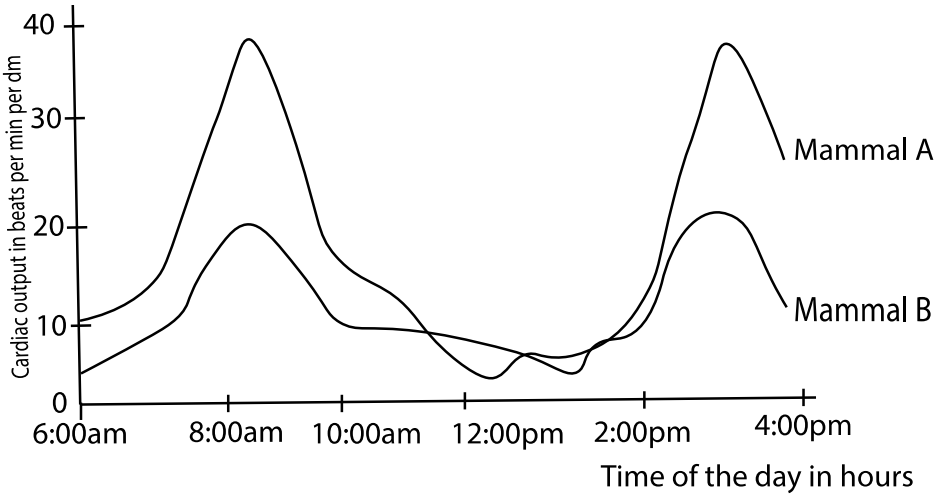


Figure 1 Changes in cardiac output of two mammals with time

a. Compare the cardiac output of both mammals over the 10-hour period.
b. Account for the difference in the cardiac output of the two mammals over the 10- period.
c. Suggest three factors that are likely to affect the cardiac output of a mammal.

RHINES SS NAMUSERA

2. Immunity is a unique characteristic of the animal kingdom.
a. What do you understand by the term **immunity?**
b. Describe **four** characteristics of the adaptive immune system.
c. Describe the role of T cells in the immune response.
d. The graph in the figure below shows the development of an infection with Human Immunodeficiency Virus (HIV) over a period of 10 years and its effect on the number of T4 cells in the body. Study it carefully and answer the questions that follow.

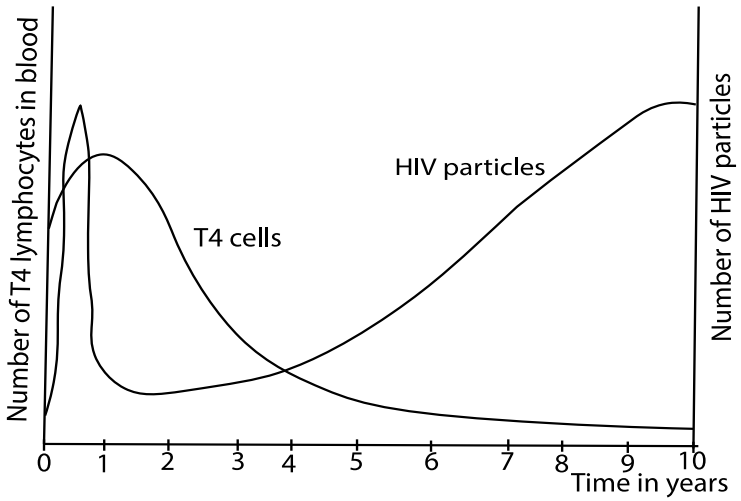


Figure 2 Variation of number of lymphocytes and HIV particles in blood

i. Describe the changes in the number of HIV particles over the 10-year period.
ii. Explain the relationship between the number of t4 cells and the number of HIV particles in the blood over the period of study.
iii. Using the results in the graph above, explain the occurrence of the opportunistic infections in the later years of the infection.
iv. Briefly explain the features of HIV that makes it a successful pathogen.
v. Suggest possible ways of controlling the number of HIV particles.
vi. Why are antibiotics ineffective against viral diseases like AIDS.

MAKERERE COLLEGE SCHOOL

3.

a. What is meant by the following ecological terms?
   i. Indicator species.
   ii. Biotic index
   iii. Endangered species
b. Explain the use of biotic indices in monitoring environmental changes.
c. What are the advantages of in-situ conservation of endangered species?
d. The graph in the figure below shows number of lichen species growing along a 20 km transect from the urban centre.

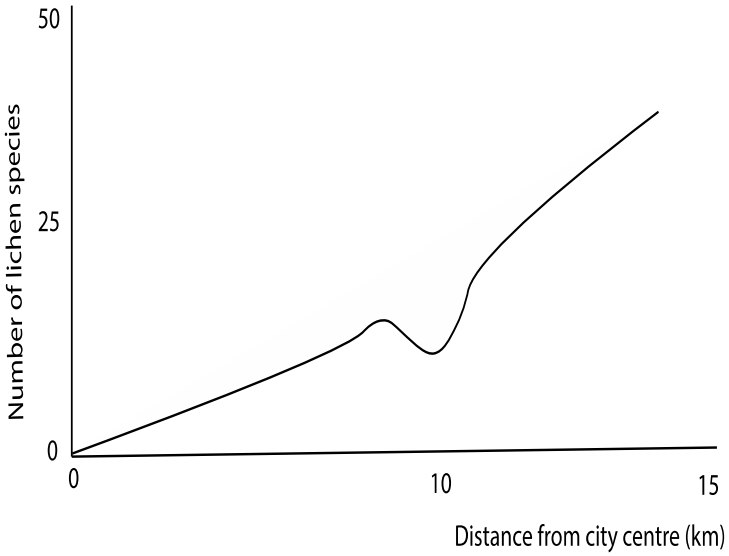


Figure 3 Variation of number of lichen species with distance from city center

i. Explain the relationship between the distance from the city centre and the number of lichen species.
ii. Suggest an explanation for the changes in the lichen species at a distance of 10km from the city centre.

e. Describe the;
(i) Relationship between organisms in the lichen
(ii) Role played by the lichens in the primary succession.

KYADDONDO SS

4. In an investigation to determine the influence of alcohol on the volume of urine produced, two groups A and B each of six healthy males of the same age, height and weight, were given the same food and did the same exercise for 24-hour period before resting. After the 24-hour period, each group was given the following to drink.

Urine was collected from each man every hour.

Assume that the volume of urine collected is equal to the volume of urine produced.

TIME OF COLLECTION	**AVERGAE VOLUME OF URINE COLLECTED**	
	GROUP A	**GROUP B**
After 1 hour	599	643
After 2 hours	413	504
After 3 hours	112	132

a. State the two;
i. Planning steps the investigators had to take before the investigation could start.
ii. Other factors that need to be kept constant.
iii. Steps that the investigators took to ensure reliability of the results.

b. Explain the difference in results obtained in the table above.

c. Why does urine production almost stop after serious bleeding?
d. Why is it important for terrestrial mammals to be able to produce a hypertonic urine?

KAWEMPE MUSLIM SS

5.

a. Explain the following observations.
   i. Dormancy of seeds of some lettuce varieties is broken by light after water uptake.
   ii. Many light- independent seeds are small.
   iii. Lettuce seed do not germinate under canopy grounds.
   iv. Many seeds start to sprout in fleshy ploughed soils.
   v. Trying to germinate seeds in space is difficult.

b. The graph in the figure below shows the effects of chilling on the concentrations of two different hormones in the seeds of sugar maple. Study it carefully and answer the questions that follow.

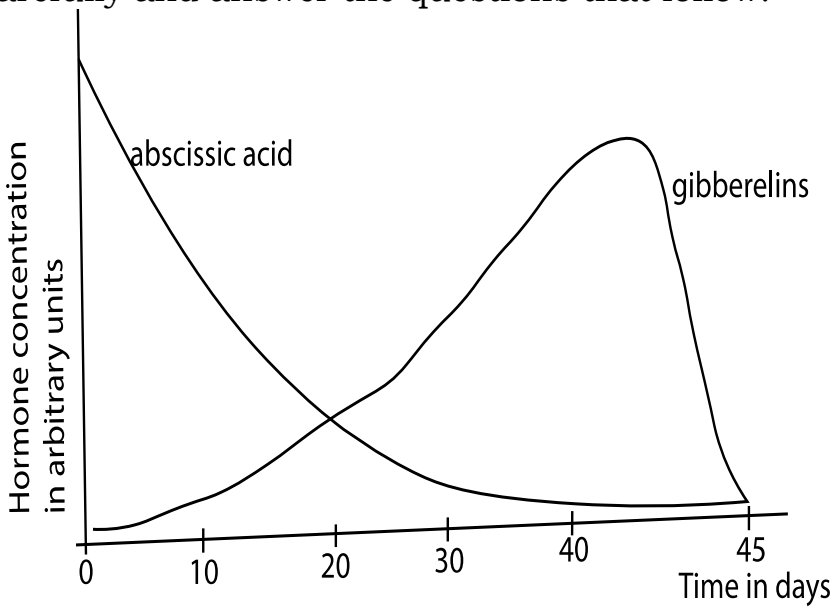


Figure 4: Hormone concentration varying with time

(i) state the differences observed in the concentration of the two hormones in the seeds of sugar maple.
(ii) Explain the variation in the concentrations of gibberellins for the first 40 days.
(iii) Of what advantage is the difference in the concentration of the two hormones in the seeds of sugar maple to a famer in the temperate regions?
(iv) Apart from seed germination, give two other instances where low temperature treatment has been used to initiate development following dormancy.

JINJA COLLEGE

6. In 1882 Engelman placed the green alga *Cladophora* in a suspension of aerobic bacteria. After different parts of the single filament had been exposed to light of different wavelengths, he observed the distribution of the bacteria. His results are represented in the following diagram.

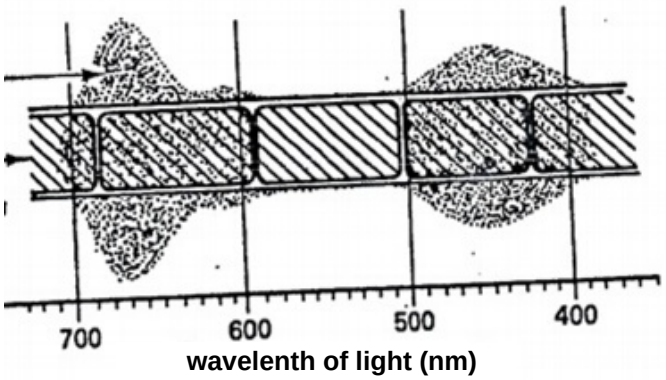


Figure 5 Distribution of bacteria on a filament of Cladophora

a. Name the factor in the bacterial environment that determines their distribution.

b. i)Describe the relationship between wavelength of light and photosynthesis in the alga, as suggested by the distribution of the bacteria.

ii) State the most effective wavelength of light for photosynthesis in the alga. Give a reason for your answer.

c. The cellular components of a cabbage leaf were separated into fractions in ice cold isotonic buffer solution containing dilute methylene blue, divided into equal parts and treated as follows:

		COLOUR OF SOLUTION	
Part		***After 5 minutes***	***After 45 minutes***
1	Darkness at	Blue - green	Blue - green
2	Darkness at 25°C	Blue - green	Blue - green
3	Light at 5°C	Blue - green	Pale - green
4	Light at 25°C	Pale - green	Pale - green

i)Outline a procedure for separating the chloroplasts from other cell organelles.

ii) State why it was necessary to suspend the cells in ice cold buffer solution during the separation.

iii) Explain the purpose of adding methylene blue.

d. Discuss the effects on the activity of the chloroplast suspension in:
   (i) temperature
   (ii) light

e. Suggest two ways in which the design of the investigation could be improved.

f. The graph in figure 6 shows the absorption spectra of chlorophyll a, chlorophyll b and xanthophylls

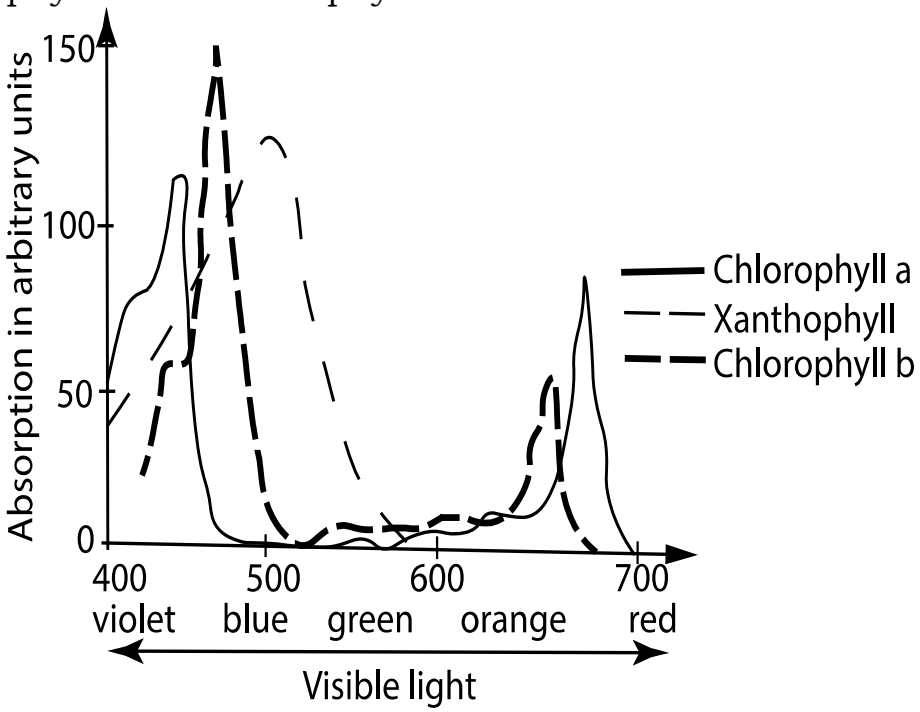


Figure 6 Absorption spectra of leaf chlorophyll pigments

i. Describe the effect of visible light on chlorophyll a?

ii. How do chlorophyll b and xanthophyll contribute to ***photosynthesis***?

g. (i) What is meant by ***photophosphorylation***?
(ii) How does cyclic photophosphorylation differ from non-cyclic photophosphorylation?

SSAKU SS

7. The graph in figure 7 illustrates the relationship between time, temperature and the amount of product formed in an ***enzyme - catalyzed reaction***. In the experiment, the samples were **incubated at different temperatures** for periods of 1, 2 and 5 hours. The quantities of products formed were then determined.

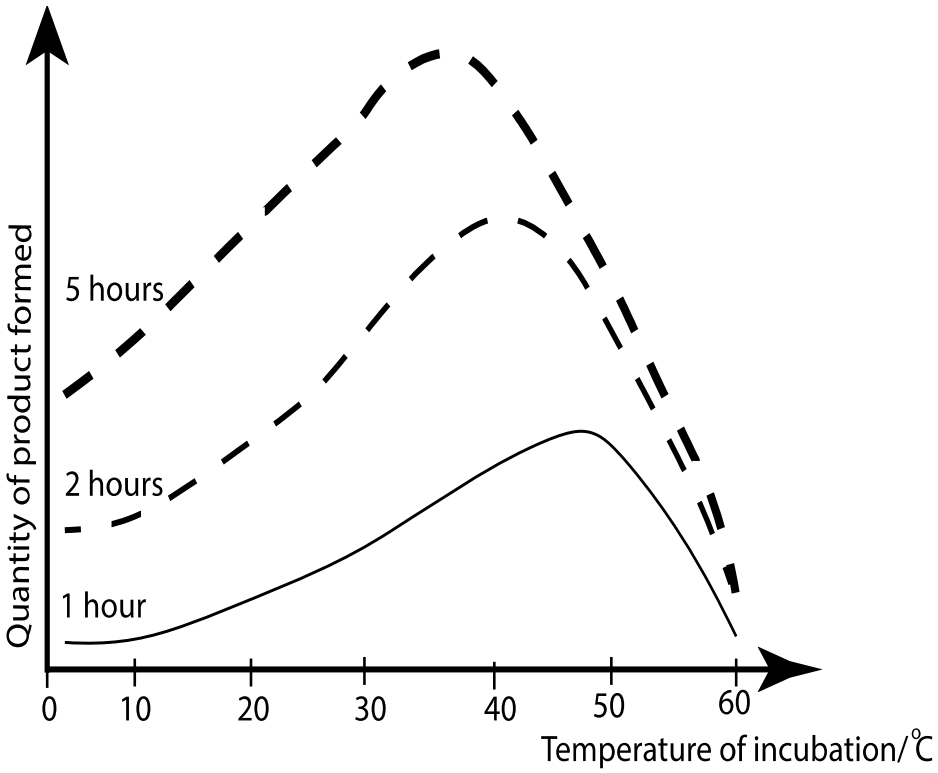


Figure 7: *Variation of quantity of product formed with temperature*

a. Explain the effect of increasing the incubation temperature on the quantity of product formed, as shown by any one of the curves presented in the graph above

b. Explain why the optimum temperature is higher if the quantity of products formed is measured after hour rather than after 5 hours.

ZION SS

8. Figure 8 illustrates the influence of substrate concentration on the rate of an enzyme - catalyzed reaction, the enzyme concentration and the temperature being kept constant.

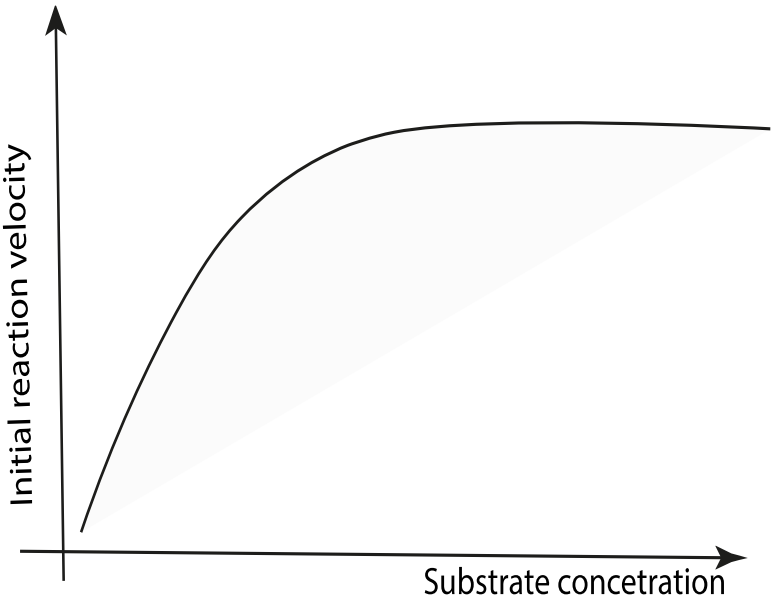


Figure 8

a. Explain why an increase is substrate concentration at low substrate concentrations increases the initial reaction velocity but an increase at high substrate concentrations does not do so?
b. What change in conditions would cause a marked increase in reaction velocity at high substrate concentrations?

(c) Describe the essential features of the immune system in mammals.

(d) Give an account of the ABO blood group system in humans.

(e) Explain why certain ABO group donations cause agglutination in the recipient, while others do not.

(f) Besides blood, other tissues can be transplanted from one mammal to another. Discuss the problems associated with such procedures and the steps taken to minimize transparent failure.

BOMBO SS

9. An experiment was carried out to investigate the effect of an auxin, indole acetic acid (IAA), and gibberellic acid (GA_3) on the elongation of segments of pea stem. A control group of pea segments received no added IAA or GA3; other groups of pea segments were treated with equivalent quantities of IAA only. GA3 only or both IAA and GA_3. The results are shown in the graph in figure 9 below.

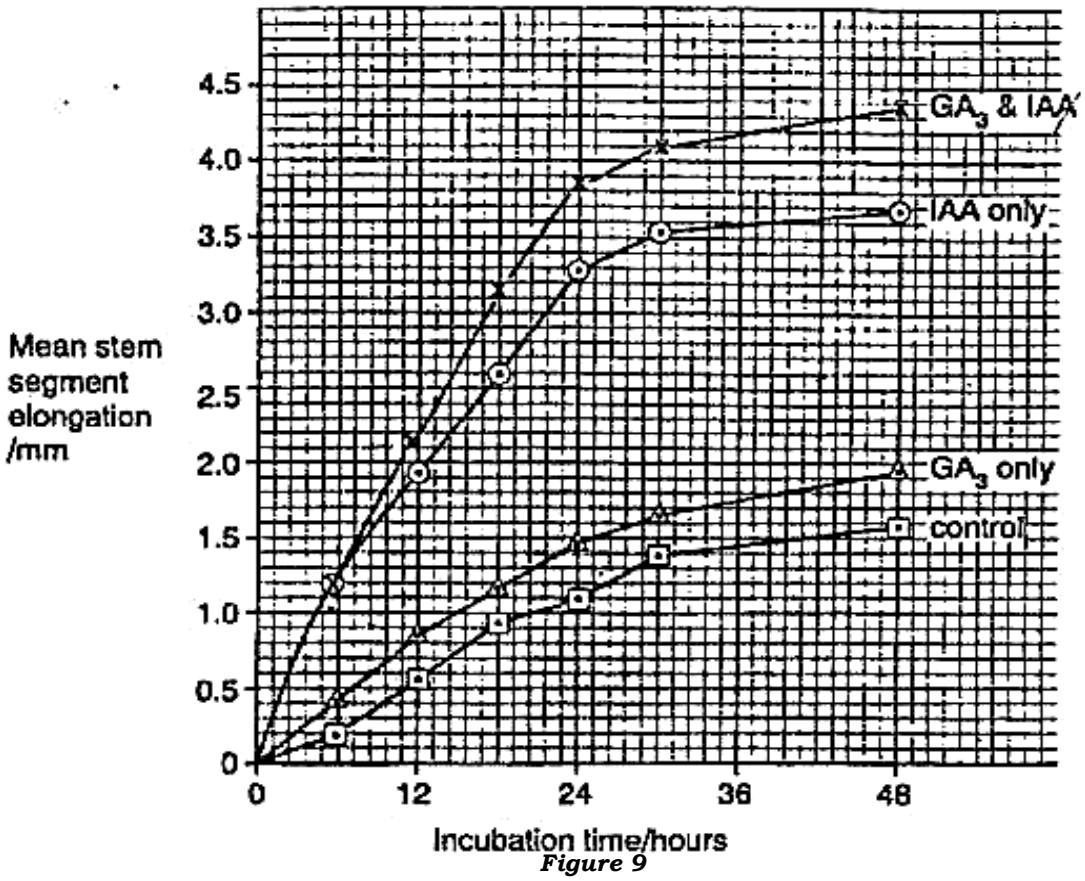


Figure 9

a. Calculate the percentage increase in the mean length of the stem segments between 12 hours and 24 hours in the control. Show your working.

b. Comment on the growth of the stem segments over 48 hours:

(i) when IAA only was added;
(ii) when GA_3 only was added;
(iv) when IAA and GA_3 were added together

c. Explain how IAA causes stem elongation.

d. Explain the part played by GA_3 in seed germination.

e. IAA related substances are often used in gardening. State their use.

MIDLAND SS

10.

a. The table below shows the effect of different types of breathing on ventilation.

Breathing type (all at rest)	**Tidal volume /cm³**	**Respiration rate /breaths min⁻¹**	**Dead space volume/cm³**	**Pulmonary ventilation /cm³ min⁻¹**	**Alveolar ventilation /cm³ min⁻¹**
Quite	**500**	**12**	**150**	**6000**	**4200**
Deep,slow	**1200**	**3**	**150**	**6000**	**5250**
Shallow,	**150**	**40**	**150**	**6000**	**0**

i. What do you understand by; **dead space volume?**
ii. Pulmonary ventilation = Tidal volume x respiratory rate. Using the data above, derive a similar word equation to show how the rate of alveolar ventilation has been calculated.
iii. Explain why alveolar ventilation decreases with shallow rapid breathing.
iv. What will happen to a person who continues to ventilate by shallow, rapid breathing?

b. Three types of cells are found in the alveolus. Type 1 cells are thin and flat. Type 2 cells are secretory and first activated in the foetus, later in pregnancy. Finally, the alveoli also contain some white blood cells called macrophages.

i. Using the information above, explain the roles of the three cell types in the alveolus.
- Type 1 cells
- Type 2 cells
- Macrophages

ii. State the problems associated with diving and how they are overcome by diving mammals such as seals.

iii. Sometimes babies born prematurely display breathing difficulties, a condition known as respiratory distress syndrome (RDS). Without treatment they may become exhausted and die. Suggest the cause of this conditions and explain why they become exhausted.

c. Describe the adjustments of the body before, during and after exercise.

KASAWO ISLAMIC SCHOOL

11.

a. Hormones form part of the coordination system n vertebrates.

i. Outline the properties of hormones.

ii. How do hormones exert their effects at target cells?

b. Three patients A, B and C were starved for 12 hours and then each was given 50g of glucose in 150cm^3 of water. The blood glucose concentration was measured for each patient immediately and then at 30-minute intervals for a period of 2½ hours. The table below summaries the results from three patients.

Time after ingestion of glucose in hours	**Blood glucose concentration in mg per 100cm^3**		
	A	B	**C**
0	90	105	240
½	132	165	275
1	155	240	325
1½	110	145	310
2	95	120	300
2½	90	105	290

c. Using the same axes plot a graph of these results

(i) Explain the results obtained from all three patients one hour after the ingestion of the glucose.

(ii) Give an interpretation of the results for each patient with reasons to support your explanation.

BOMBO ARMY SS

12. The table below shows (in arbitrary units) heat losses (-) and heat gains (+) by a naked man at rest at different environmental temperatures. All other environment conditions are constant.

Heat loss	**(-) and heat gain (+) in arbitrary units**		
Environment temperature (°C)	**Skin surface**		
	By radiation and convection	*By evaporation*	*Body core*
20.0	- 160	- 20.0	- 120
22.5	- 125	- 22.5	- 85
25.0	- 110	- 25.0	- 50
27.5	- 85	-27.5	- 20
30.0	- 55	- 30.0	0
32.0	- 25	- 60.0	+ 5
25.0	+ 5	- 100.0	+ 5
37.5	+ 40	- 140.0	+ 5
40.0	+ 80	- 180.0	0

(a) On the same axes plot graphs of the heat losses and heat gains by radiation and convection at the skin surface, by evaporation at the skin surface and by body core against environmental temperature.

(b) Describe and explain the trends in heat loss and heat gain

by:
(i) radiation and convection at the skin surface,
(ii) evaporation at the skin surface.
(iii) the body core.

(c) Explain the trends in heat loss and gain.
(d) Explain why heat losses at the skin surface do not result in a similar loss of body - core heat.
(e) Explain how the data above support the view that
(f) What are the benefits and the costs of maintaining a constant body temperature in mammals?
(g) Why is prolonged exposure to cold frequently fatal?

KASENGE GREENHILL SS

13. (a) Give an account of the production of gametes by the mammalian ovary.
b) Explain the role of hormones in the sexual cycle of a female mammal.
c) How does the role of the hormones change:
(i) in the early stages of pregnancy,
(ii) in the final stages of pregnancy?

d) The graphs A, B, C and D show the changes in the concentration in the blood of four hormones associated with a menstrual cycle.

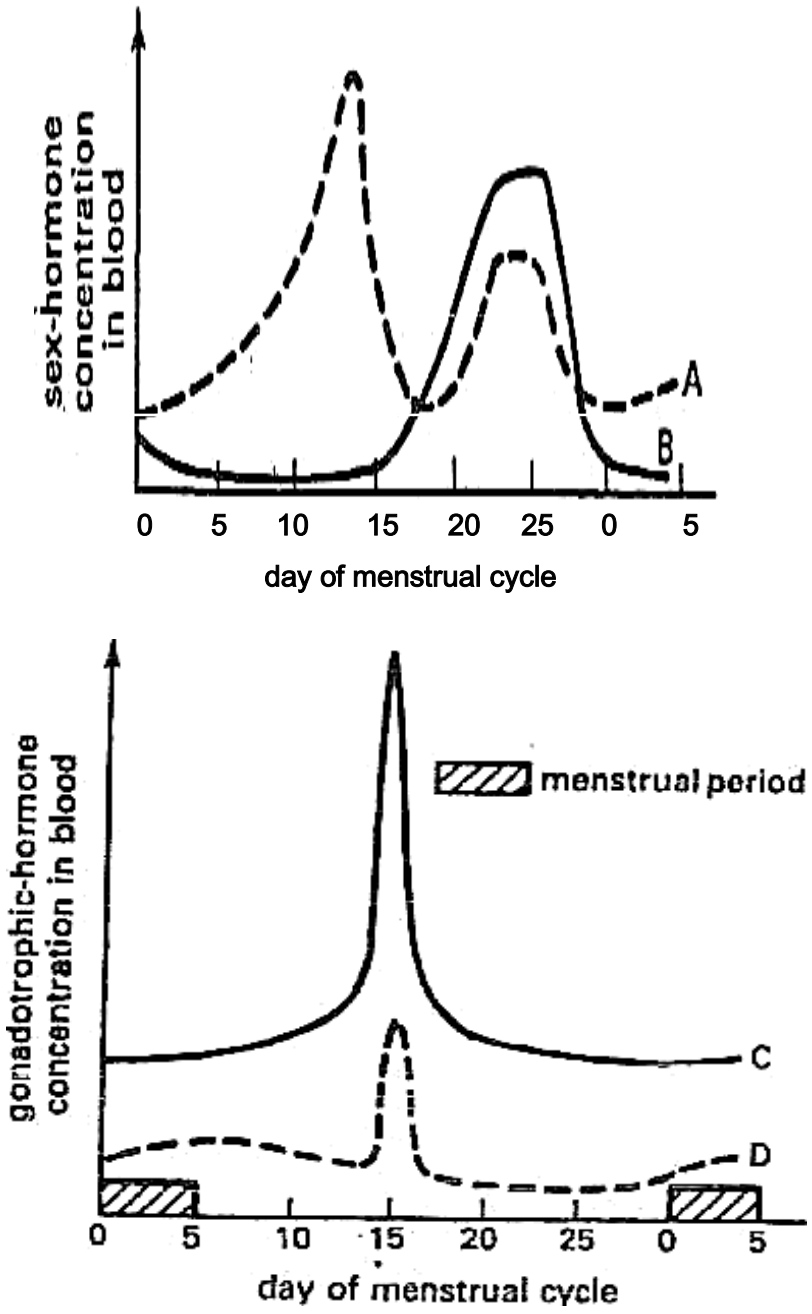


Figure: 10

e. The table shows the four main hormones associated with the menstrual cycle.

Name of hormone	Graph **(A, B, C** or **D)**	Site of production	**Effect**
Follicle-stimulating hormone (FSH)			
Luteinizing hormone (LH)			
Oestrodial (Oestrogen)			
Progesterone			

(i) Copy the table and complete it by giving the graph **(A, B, C,** or **D)** by which each hormone is represented and by giving one site of production and one effect of each hormone in a mature female.

(ii) What changes occur in the levels of oestrogen and progesterone in the maternal blood in the early stages of pregnancy?

f) Explain **negative feedback.** What is its significance in biological systems?

(g) Discuss how the human placenta is adapted to its role in maintaining the developing fetus.

ATLAS HIGH SCHOOL

14. In fish, oxygen is transported in the blood in the form of oxyhaemobin. The table below shows the percentage saturation of blood with oxygen of a teleost (bony) fish after equilibrating with oxygen of different partial pressures. The experiment was carried out at two different partial pressures of carbon dioxide.

Partial pressure of oxygen in Pa*	**Percentage saturation of blood with oxygen**	
	Partial pressure of carbon dioxide at 500 Pa	***Partial pressure of carbon dioxide at 2600 Pa***
500	30	5
1000	70	13
2000	90	24
3000	96	33
4000	98	41
5000	99	48
7000	100	60
9000	100	69
11000	1000	76
13000	100	81

* A Pascal (Pa) is a unit of pressure. A pressure of 100 000 Pascal's is approximately equal to atmospheric pressure (760 mm Hg).

(a) Present the data in a suitable graphical form.
(b) Calculate the difference of percentage saturation of blood with oxygen at the two different partial pressures of carbon dioxide at an oxygen partial pressures of 500 Pa.
(c) With reference to the graph, describe the effects of different partial pressure of carbon dioxide on the percentage saturation of blood with oxygen.

(d) Explain how the properties *of* the haemoglobin molecule are affected by changes in the oxygen and carbon dioxide partial pressures.

(e) Explain how changes in oxygen content of the blood at different partial pressure of carbon dioxide are important in the release of oxygen to the tissues of the fish.

(f) What information do experiments of this type give about the environmental conditions in which fish would maintain a high level of growth as required in commercial fish farming?

(g) What are the short- and long-term effects of the respiratory and circulatory systems of a person moving from low to high altitude?

MAKINDYE SS

15. The table below shows the rates at which carbon dioxide is taken up (+) and released (-) from the stem of an herbaceous plant and from a single leaf of the same species at different light intensities.

Light intensity (arbitrary units)	**Uptake (+) and release – of carbon dioxide (mg 50cm $^{-2}$ h^{1})**	
	Stem	**Leaf**
0.0	- 0.5	- 0.5
1.0	- 0.2	+ 0.6
2.5	+ 0.3	+ 2.8
4.0	+ 0.8	+ 4.6
5.0	+ 1.0	+5.3
7.0	+ 1.6	+ 6.0
11.0	+ 2.5	+6.3

(a) Graph the data on a single set of axes.

(b) (i) Explain the term compensation point

(ii) What is the compensation point of this stem?

(iii) Calculate the rate at which carbon dioxide is used in photosynthesis by 50cm^2 of the leaf at a light intensity of 1 arbitrary unit.

(c) Explain the shape of the graph line for the leaf above a light intensity of 5 arbitrary units.

(d) Explain, in terms of anatomical and physiological factors, why

(i) the leaf takes up carbon dioxide faster than the stem;

(ii) the leaf and the stem release carbon dioxide at the same rate in darkness.

(e) Suggest three practical difficulties you would meet in conducting an experiment to obtain data of the kind given in the table.

NAMILYANGO SS

16. Write account of the following:

(a) the ways in which heritable variation arises;
(b) the ways in which genetic isolation may occur
(c) the theory of Natural selection
(d) How does the behavior of chromosomes during the first meiotic division.
  (i) differ from the behaviour during mitosis.
  (ii) result in genetic variation?
(e) Describe how new species may arise. Illustrate your answer with named examples.
(f) Explain why closely – related species may be unable to interbreed successfully.

KAWEMPE ROYAL COLLEGE

17.

a. Describe the sequence of events that take placewhen a nerve impulse arrives at a synapse

Figure 11 shows the changes in membrane potential in a presynaptic neuron and post synaptic neuron when an impulse passes across a synapse.

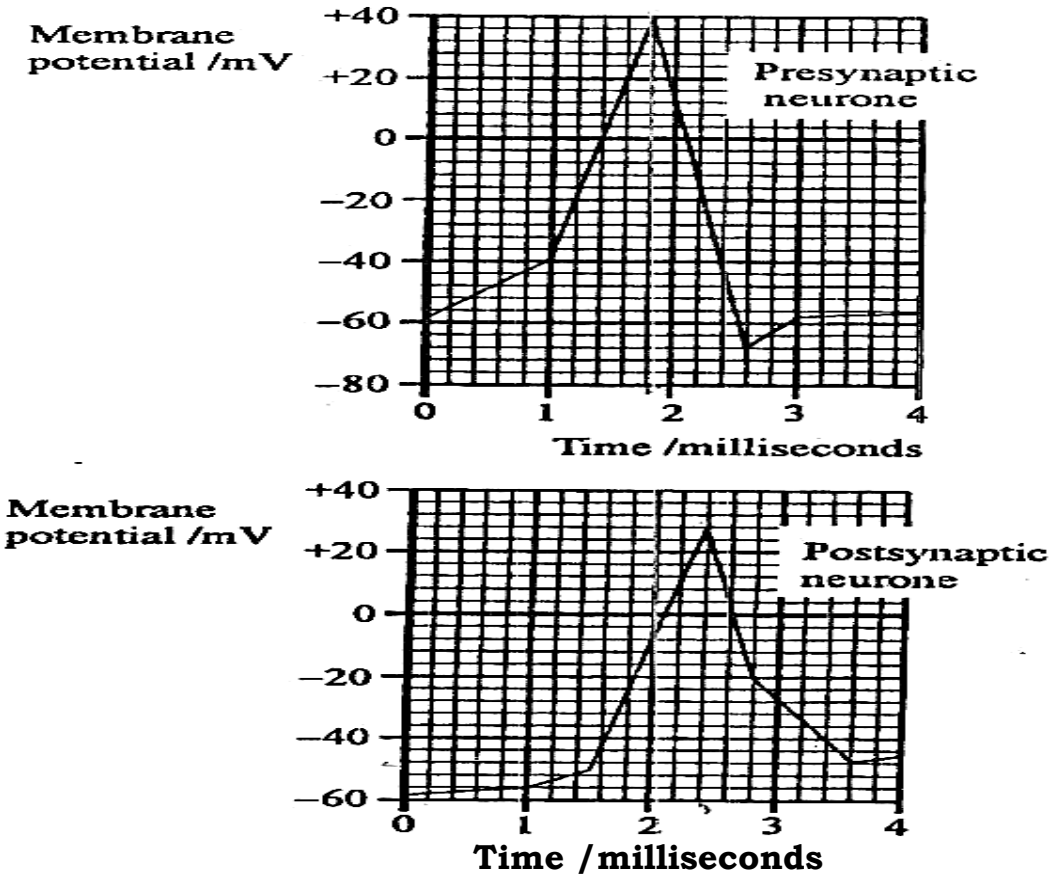


Figure: 11

b. Explain how depolarization occurs in the presynaptic neuron.
   i. The maximum depolarization occurs in the presynaptic neuron is +40mV. What is the; maximum depolarization in the postsynaptic neuron?
   ii. How long is the delay between the maximum depolarization in the presynaptic and postsynaptic neurons?
   iii. What is the cause of the delay?

c. Describe how nicotine affects synaptic transmission.
d. Mammals have myelinated axons whereas invertebrates, such as squids, have non-myelinated axons. Explain the advantage of having myelinated axons.
e. The table below shows the relationship between the axon diameter and speed of conduction in an axon of a squid and that of a cat.

Axon	**Diameter (pm)**	**Conductivity Velocity (ms $^{-1}$)**
Squid	650	24
Cat	4	26

f. Suggest why it is possible for both animals to conduct impulses with similar velocity.

KAWANDA SS

18.

a. Distinguish between transcription and translation.
b. Describe the process of translation in living organisms
c. What is the significance of translation in living organisms?

CORNERSTONE ACADEMY

19.

a. A group of scientists led by Paul Nurse, worked with the fusion yeast; *Schizosaccaromyces pombe.* They identified a gene in the

yeast whose product of translation is a protein kinase. They investigated the activity of the protein kinase in cells of the yeast as the cell cycle progressed. At each concentration of kinase, they determined the percentage of dividing cells. Their results are given in figure 12 below.

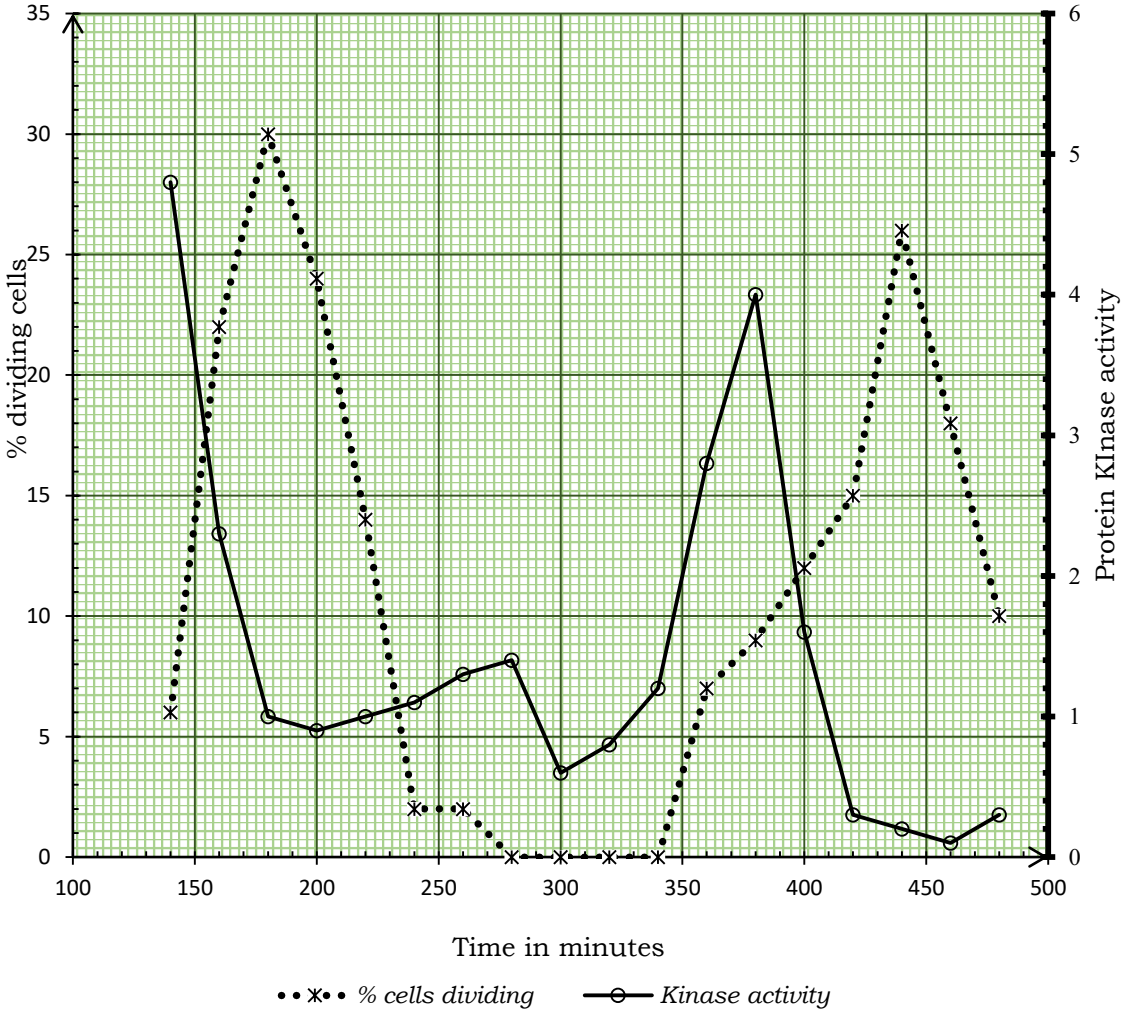


Figure 12

i. Compare the changes in concentration of protein kinase and percentage of dividing cells with time.
ii. What conclusion(s) can you draw from the observed changes in concentration of kinases and percentage of dividing cells.
iii. According to the graph, what is the significance of interphase in regulation of cell cycles?

b. A study was carried out to determine the distance between the centromeres of the chromosomes and poles of the cell; and the distance between centromeres of sister chromatids. The results are shown on the graph in figure 12 below.

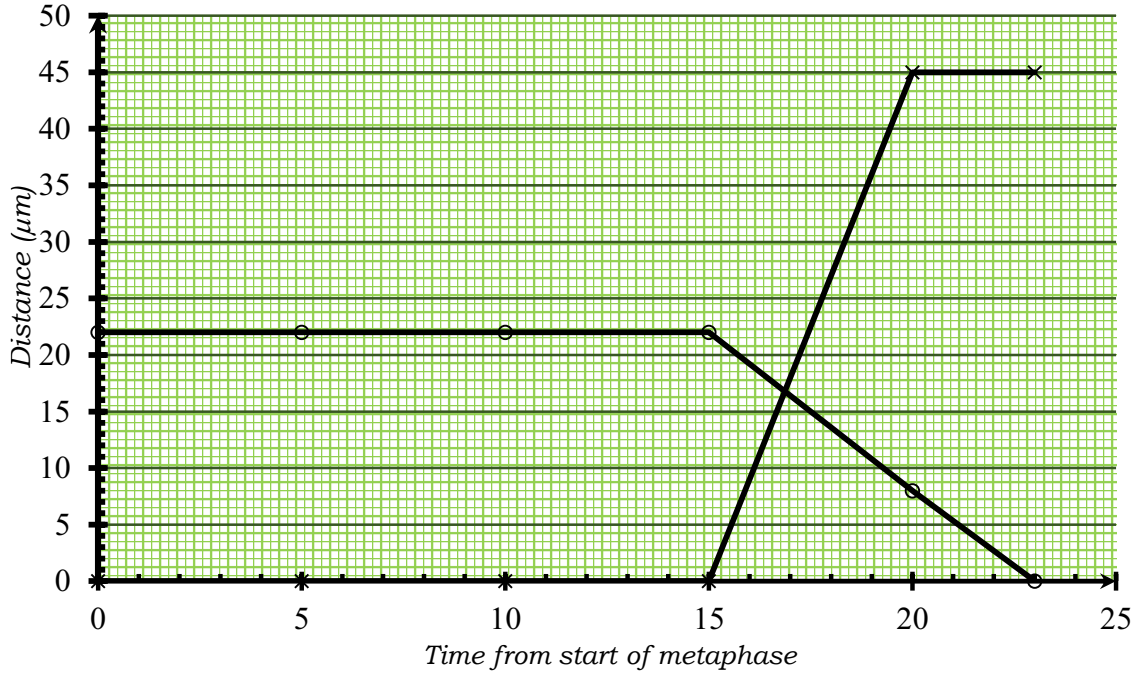


Figure 13

i. Identify each of the curves above.
ii. Give an explanation for each of the graphs you have identified.

c. A homozygous purple flower short stemmed plant was crossed with a homozygous red flowered long-stemmed plant and the F1 phenotypes had purple flowers and short stems. The genes controlling flower color and length of the stem are linked. If two F1 plants were crossed, what would be the F2 generation if;
   i. There was crossing over.
   ii. Crossing over occurred.

IMPACT HIGH SCHOOL LUGAZI

20. In an experiment, a liposome was constructed by combining two lipid layers in an aqueous environment. Two set ups were made; one with 20% and the other with 50% cholesterol. A control experiment was set up by leaving the liposome free without cholesterol. The permeability of the membranes to glycerol *(propan-1, 2, 3-tri-ol*) was determined in each set up over a range of temperatures. The results are given in the graph in figure11 below.

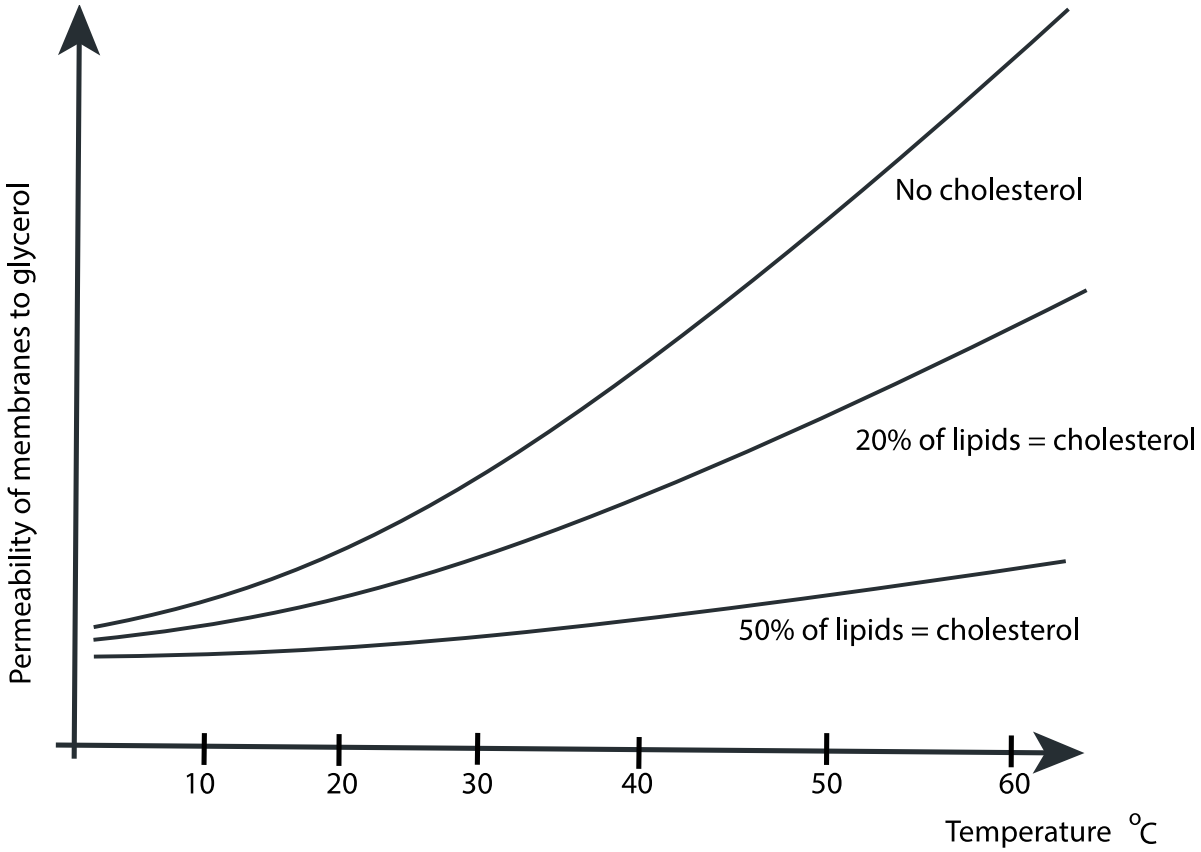


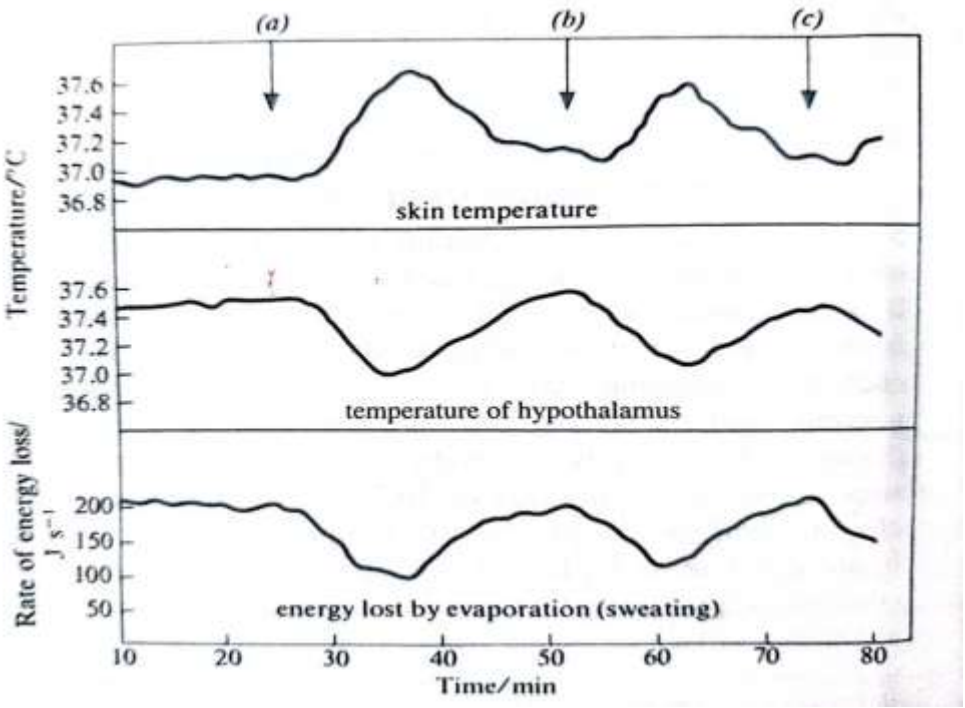
Figure 14 *Changes in permeability of liposomes to glycerol*

a. From figure 11;
   i. Describe the variation of permeability of membranes containing liposomes to glycerol as temperature of the medium changes
   ii. Explain the observable difference between the relative permeability of membranes to glycerol in the presence of 20% and 50% cholesterol.

b. Explain the effect of temperature on the fluidity of membranes.
c. How does the effect of temperature on fluidity affect permeability of membranes to glycerol?
d. Why do proteins remain in the phospholipid bilayers?
e. Describe the role of proteins in the phospholipid layer?

KIBULI S. S. A-LEVEVEL BIOLOGY SEMINAR, 17th SEPTEMBER 2022

1. The graphs below show the relationship between skin temperature, temperature of the hypothalamus and the rate of evaporation for a human in a warm chamber maintained at 45 ^{0}C. Iced water was swallowed at points labelled (a), (b) and (c).



(a) Describe the relationship between the temperature of the hypothalamus and the rate of sweating.

(b) Between the first two intervals iced water intake, explain why there are changes
  (i) in the temperature of the hypothalamus and the skin.
  (ii) rate of energy loss by evaporation.

(c) Why was iced water not given until 20 minutes after the start of the experiment?

(d) The onset of a fever is often accompanied by shivering and a feeling of cold known as chill.
  (i) Explain these symptoms in terms of the mechanism of control of body temperature.
  (ii) What is the significance of this response to the body?

(e) (i) Outline the different ways in which plants avoid excess heat.
  (ii) Explain why plants suffer physiological damage when exposed to high temperature and high humidity.

KIBULI SS

2(a) Compare cell-mediated response and humoral response.

(b) Describe the evidence that show that the thymus gland is important in the development of the immune response.

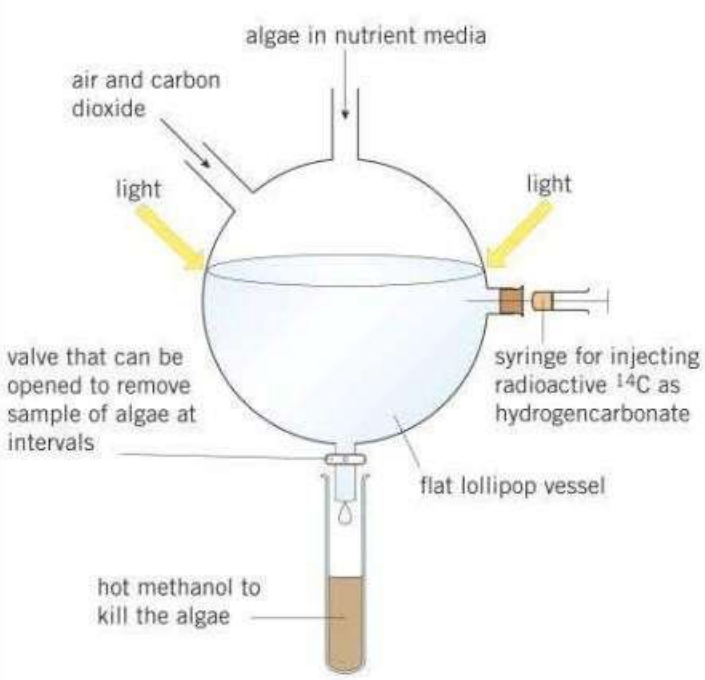
(c) Explain how the immune response is regulated.

(d) Explain the colonial selection theory.

(e) Explain why we do not produce antibodies against the antigens on our own.

ST .HENRYS COLLEGE KITOVU

3. Melvin Calvin and his co-workers using a 'lollipop' experiment investigated the light-independent reaction. In this experiment single-celled algae are grown in the light in a thin-transparent 'lollipop'. Radioactive hydrogen-carbonate is injected into the 'lollipop'. This supplies radioactive carbon dioxide to the algae. At 5 seconds intervals, samples of photosynthesising algae are dropped into hot methanol to stop chemical reactions instantly.
The compounds in the algae are then separated out and those that are radioactive are identified. The 'lollipop' apparatus and a table summarising the results of the experiment are shown below.

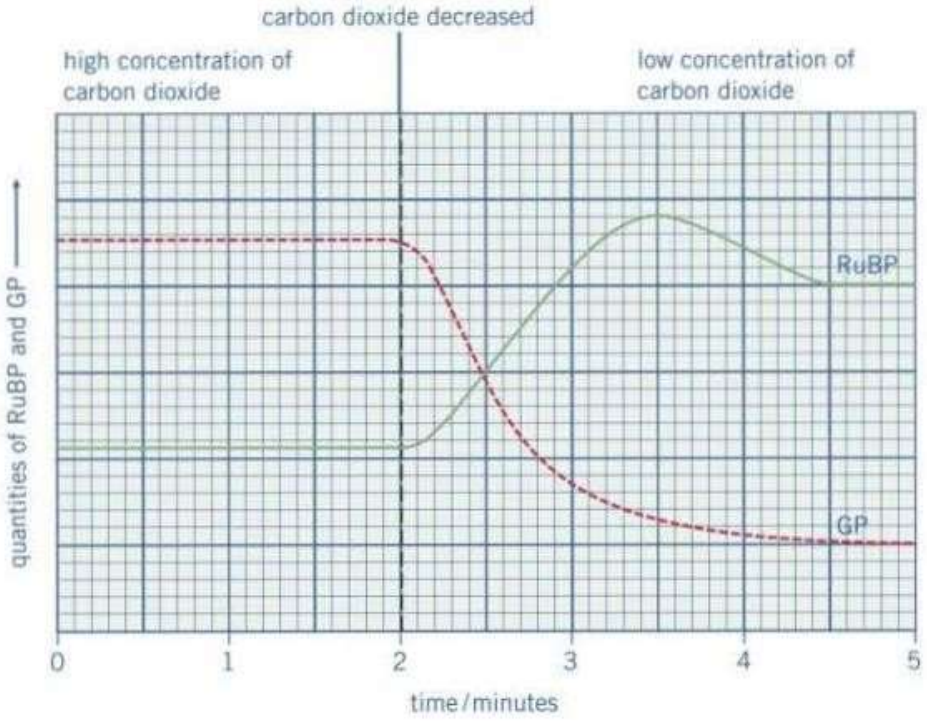


▲ **Figure 7** *The 'lollipop' apparatus used by Melvin Calvin*

Time (seconds)	Substances found to be radioactive
0	carbon dioxide
5	glycerate-3-phosphate
10	glycerate-3-phosphate + triose phosphate
15	glycerate-3-phosphate + triose phosphate + glucose
20	glycerate-3-phosphate + triose phosphate + glucose + ribulose bisphosphate

(a) Explain why the carbon dioxide supplied to the algae was radioactively labelled.
(b) Explain how the information in the table provides evidence that glycerate-3-phosphate is converted into triose phosphate.
(c) Suggest an explanation of how methanol might stop further chemical reactions taking place.
(d) Why was it necessary to conduct the 'lollipop' experiment in sufficient light conditions?

In a further experiment, samples of algae were collected at 1-minute intervals over a period of five minutes. The quantities of glycerate-3-phosphate (GP) and ribulose bisphosphate (RuBP) were measured. At the beginning of the experiment, the concentration of carbon dioxide was reduced. The graph below shows the results of this experiment.



(e) Describe the effects on the quantities of GP and RuBP on the decrease of carbon dioxide after two minutes.

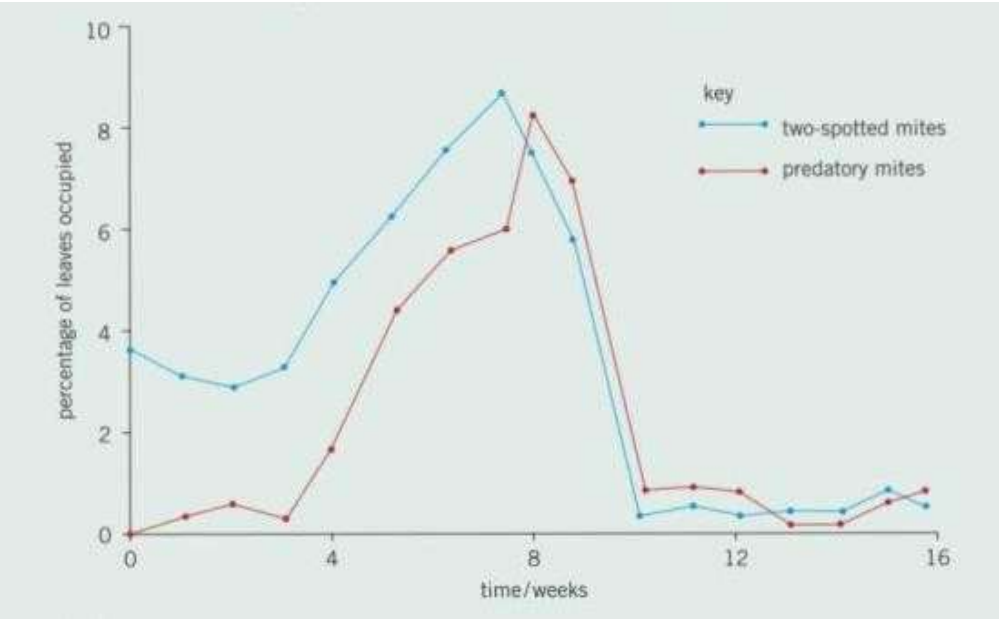
(f) Explain the changes to the levels of GP and RuBP.

(g) Explain why the majority of plants are C_3 plants despite their disadvantage of photorespiration.

KAWEMPE MUSLIM SS

4(a) Insect pests of crop plants can be controlled by chemical pesticides or biological agents. What are the advantages and disadvantages of using biological agents?

Two-spotted mites are pests of strawberry plants. Ecologists investigated the use of predatory mites to control two-spotted mites. They then recorded the percentage of strawberry leaves occupied by two-spotted mites and by predatory mites over a 16-week period. The results are summarised in the figure below.



(b) Explain the relationship between the percentage of leaves occupied by predatory mites and two-spotted mites during the period of this investigation.

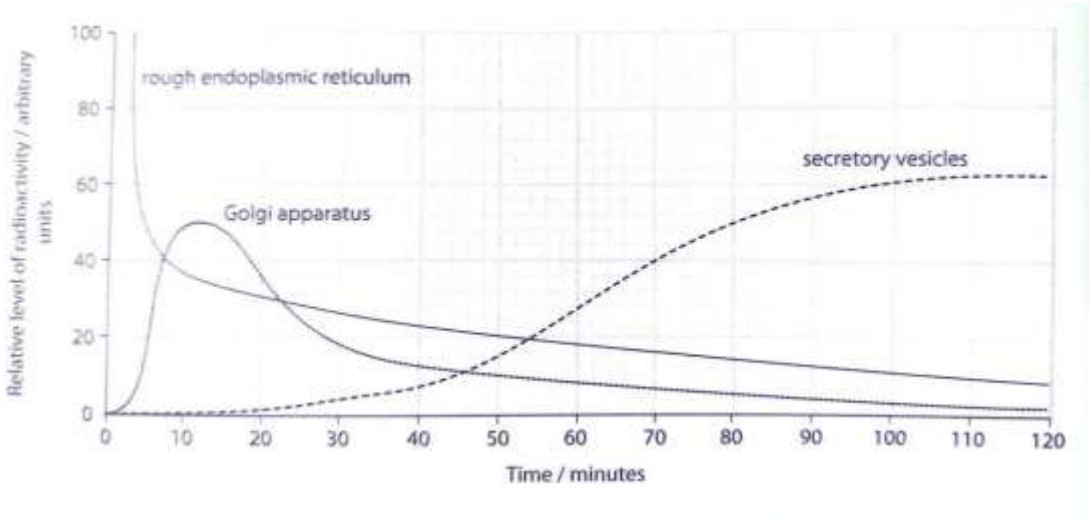
(c) The ecologists concluded that in this investigation the control of by the two-spotted mites by biological agent was effective. Explain how the results support this conclusion.

(d) Farmers who grow strawberry plants and read about this investigation might decide not to use these predatory mites. Suggest reasons for their decision.

(e) The ecologists repeated the investigation but sprayed chemical pesticide on the strawberry plants after 10 weeks. After 16 weeks no predatory mites were found but the population of two-spotted mites had risen significantly. Give an explanation for the rise in the population of two-spotted mites.

MT ST MARY'S NAMAGUNGA

5. An investigation was carried out to track the movement of amino acids through different organelles in a cell. Pancreatic cells were provided with a small quantity of amino acids containing tritium atoms, ^{3}H, instead of normal hydrogen atoms. Tritium is radioactive, and molecules containing it can be detected. They are said to be tritium 'labelled'. After a short-time the pancreatic cells were provided with a large quantity of unlabelled amino acids. Samples of cells were extracted at particular times, and the levels of radioactivity in the rough endoplasmic reticulum, Golgi apparatus and secretory vesicles were determined. The results are summarised in the figure below.



(a) Explain the pattern shown by these results.

(b) Explain why the pancreatic cells were chosen for this experiment.

(c) With evidence from the figure above state the sequence in which labelled amino acids moved through the three organelles.

(d) Insulin does not enter liver cells but brings about its effects with a receptor on the liver cell surface.

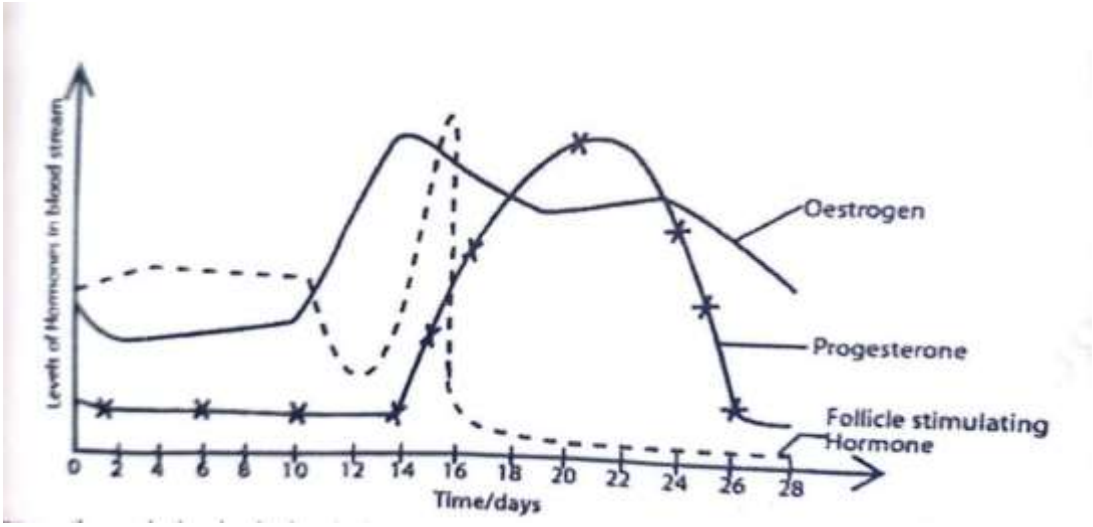
(i) Explain why insulin molecules are not able to enter liver cells.

(ii) What kind of molecules in a cell membrane that could act as a receptor for insulin?

(iii) Explain how the binding of insulin on the surface membrane of liver cells causes a decrease in blood glucose concentration.

NAMILYANGO COLLEGE

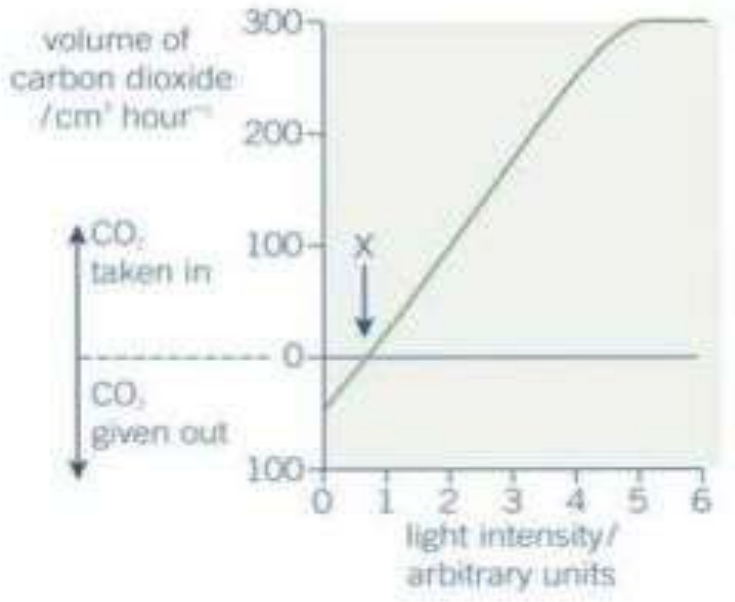
6. A study was conducted on the hormonal changes in the menstrual cycle a fertile female of a reproductive age. Periodical changes in the level of the gonadotrophic hormone, follicle stimulating hormone and two other steroid hormones, oestrogen and progesterone were studied over 28 days of the menstrual cycle. The hormonal changes are shown in the figure below.



(a) Compare the variation in the levels of oestrogen and progesterone.
(b) Explain the
  (i) relationship between follicle stimulating hormone and oestrogen in the 28 days of the menstrual cycle.
  (ii) variations in the level of progesterone throughout the cycle.
(c) (i) Predict the changes in the levels of the three hormones if fertilisation occurs on the 17th day of the cycle.
  (ii) Suggest reasons for your answer in (c)(i) above.
(d) Explain the significance of the three types of hormones in fertility drugs.

NABISUNSA GIRLS

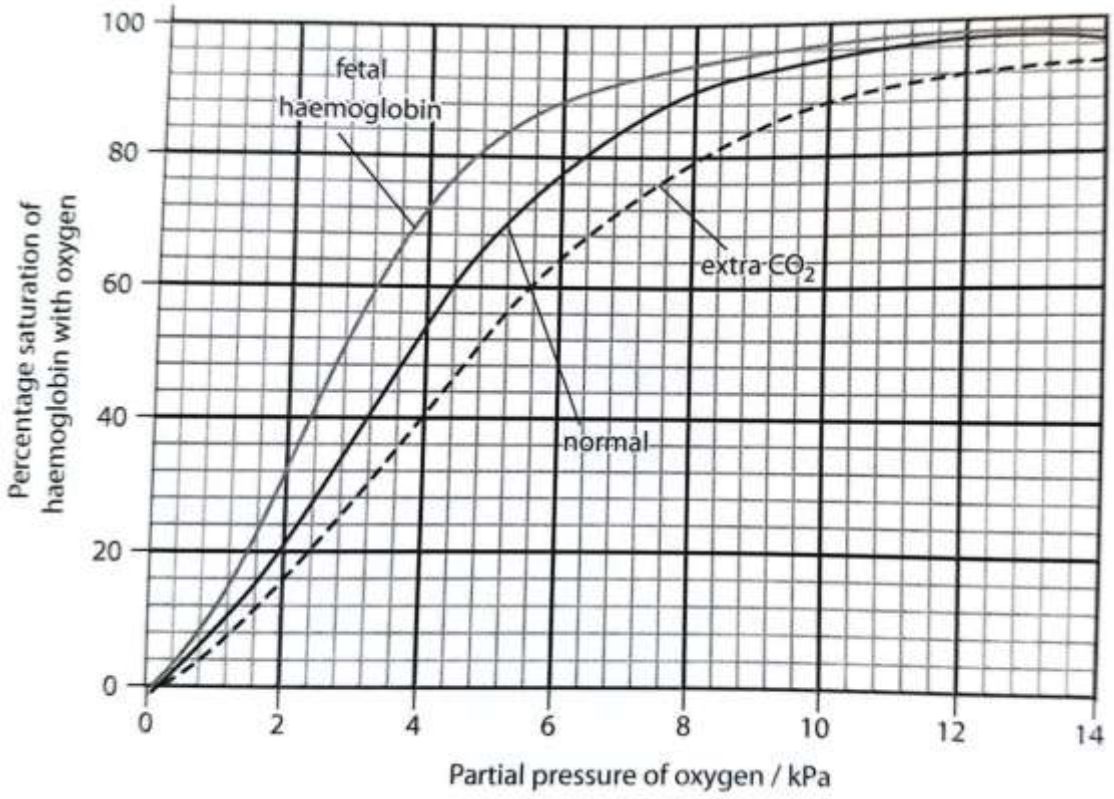
7. The figure below shows the volume of carbon dioxide produced by a sample of tomato plants at different light intensities.



(a) Explain the effect of light intensity on carbon dioxide exchange in the tomato plants.
(b) Explain why at point X neither carbon dioxide is not taken in nor given out.
(c) Some herbicides cause the stomata of plants to close. Explain how these herbicides might lead to the death of plants.
(d) Explain the advantage to a plant being able to control the opening and closing of the stomata.
(e) Water flow over the fish gills is one-way whereas the flow of air in and out of the mammalian lungs is two-way. Explain why the one-way flow of a fish is advantageous over the two-way flow in the mammalian lungs.
(f) Outline the physiological effects in the body of breathing in excess
  (i) carbon dioxide
  (ii) oxygen.

UBUNTU HILL SCHOOL

8. The figure below shows the oxygen dissociation curves of human haemoglobin in the presence of a range of concentrations of carbon dioxide.



(a) Explain how the structure of the haemoglobin molecule generates an oxygen dissociation curve that is sigmoid.

(b) (i) The partial pressure of oxygen in the alveoli 12 kPa. Use the graph to determine the percentage saturation of normal haemoglobin in the alveoli.

(ii) 1 g of fully saturated haemoglobin carries $1.3cm^3$ of oxygen. Calculate the volume of oxygen bound to 1 g of haemoglobin at a partial pressure of 12 kPa.

(iii) Use the graph to determine the volume of oxygen released to rapidly respiring cells.

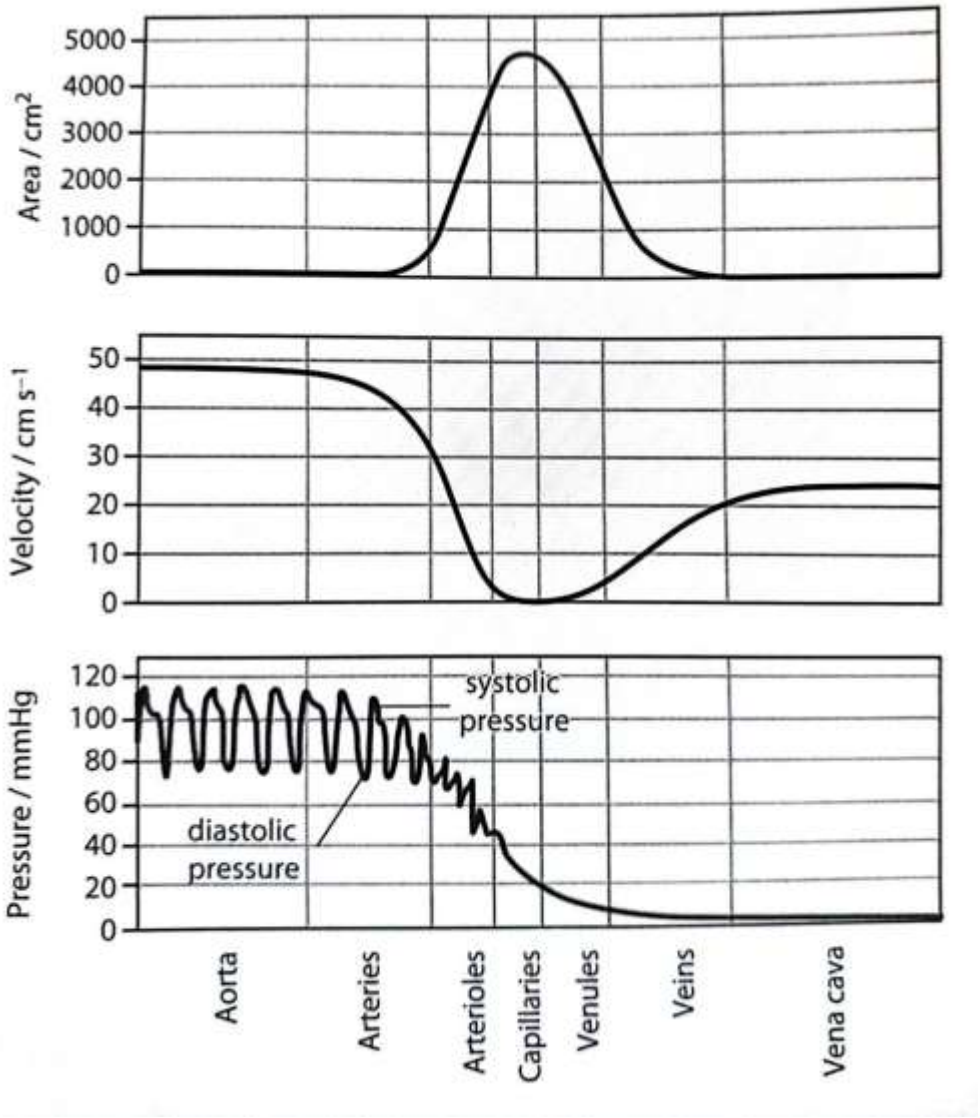
(c) Why is it an advantage to the body for the dissociation curve to take the orientation shown on the graph at a high carbon dioxide concentration?

(d) Explain why the foetal oxygen dissociation curve is different to that of the normal adult haemoglobin.

(e) Explain how the of red blood cells maximises the transport of oxygen to tissues.

GOMBE SS

9. The figures below show how blood pressure, cross-sectional area and blood velocity change in different blood vessels.



(a) (i) Explain how the blood pressures change as blood moves from the aorta to the vena cava.

(ii) Explain how the velocity changes as blood flows from the aorta to the vena cava.

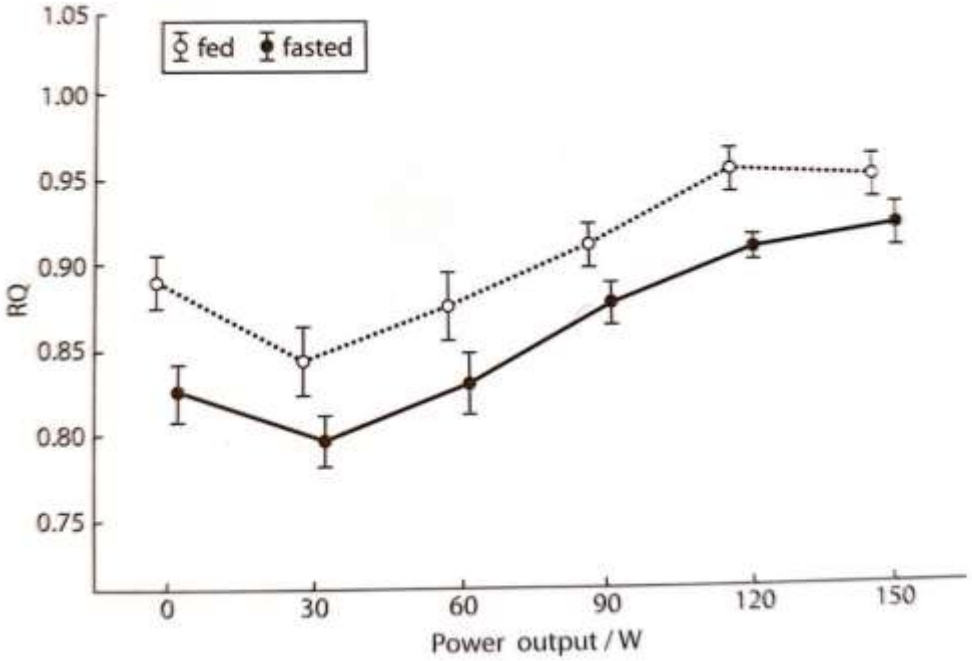
(b) When an animal is wounded, its overall blood pressure rises, but the area in the vicinity of the wound swells as a result of local vasodilation. Suggest what the advantage of these changes might be.

(c) Describe the role of the nervous and hormonal systems in the control of the heart rate.

(d) Outline the adjustments that occur to the heart rate and circulatory system just before, during and after a vigorous exercise.

GAYAZA HIGH SCHOOL

10 An investigation was carried out into the effect of fasting on the RQ of two students. One of the students was given no food (fasting) for 12 hours while the other ate a normal balanced diet. The students were then made to exercise at increasing intensities in rooms set at the same temperature and humidity. The volumes of oxygen used in their bodies and carbon dioxide produced were measured and the RQ calculated for the different exercise intensities. Intensity was measured as power output. The results are shown in the figure below.



(a) (i) The temperature and humidity of the room were kept the same.
Suggest two factors that would need to be controlled.
(ii) Compare the effects of increasing exercise intensity on RQ of the two students.
(iii) Explain the results obtained in the figure above.

(b) Migratory birds like geese have a much higher ratio of saturated fatty acid than non-migratory birds such as ostriches. Explain the reasons for this difference.

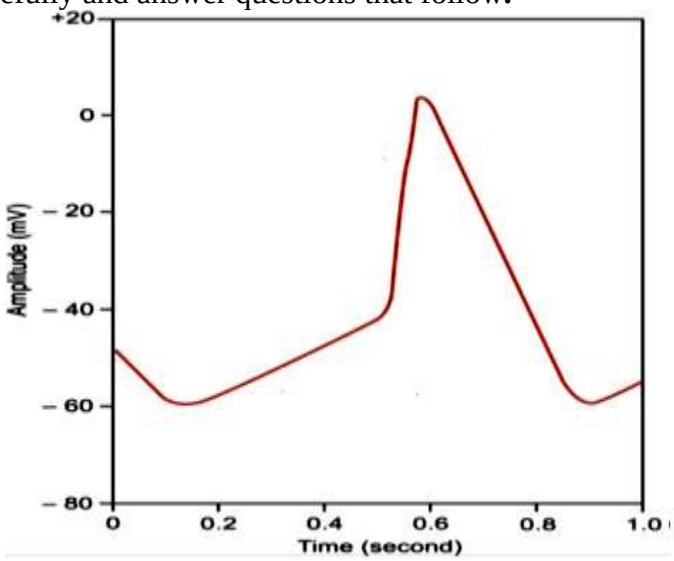
(c) Most hibernating animals have an RQ between 0.8 to 0.9. Give an explanation for this observation.

(d) (i) Describe the process of ATP synthesis in the mitochondrion.
(ii) Outline the ways in which ATP is used by the cells.

(e) Explain why the majority of plants cannot survive in flooded soils but rice can.

ST MARY'S COLLEGE KISUBI

11(a) The figure below shows the variation of the amplitude (potential) of the SAN of human cardiac muscle (pacemaker) with time. The resting potential of the SAN is -55 mV. Study the graph carefully and answer questions that follow**.**



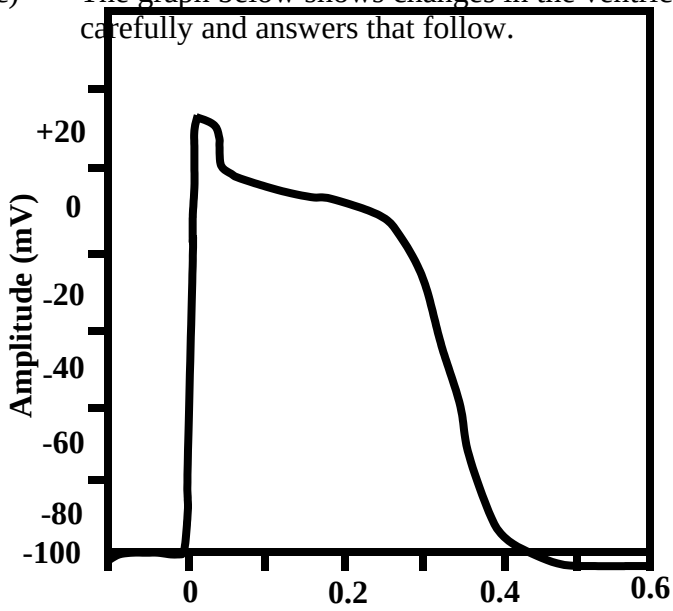
(i) Describe the changes in the potential/amplitude of the SAN with time.

(ii) Account for the above changes in the figure above.

(b) (i) Explain the effects of the different innervations to the SAN.

(ii) Explain the functions of the conducting systems of the heart.

(c) The graph below shows changes in the ventricular action potential. Study the graph carefully and answers that follow.



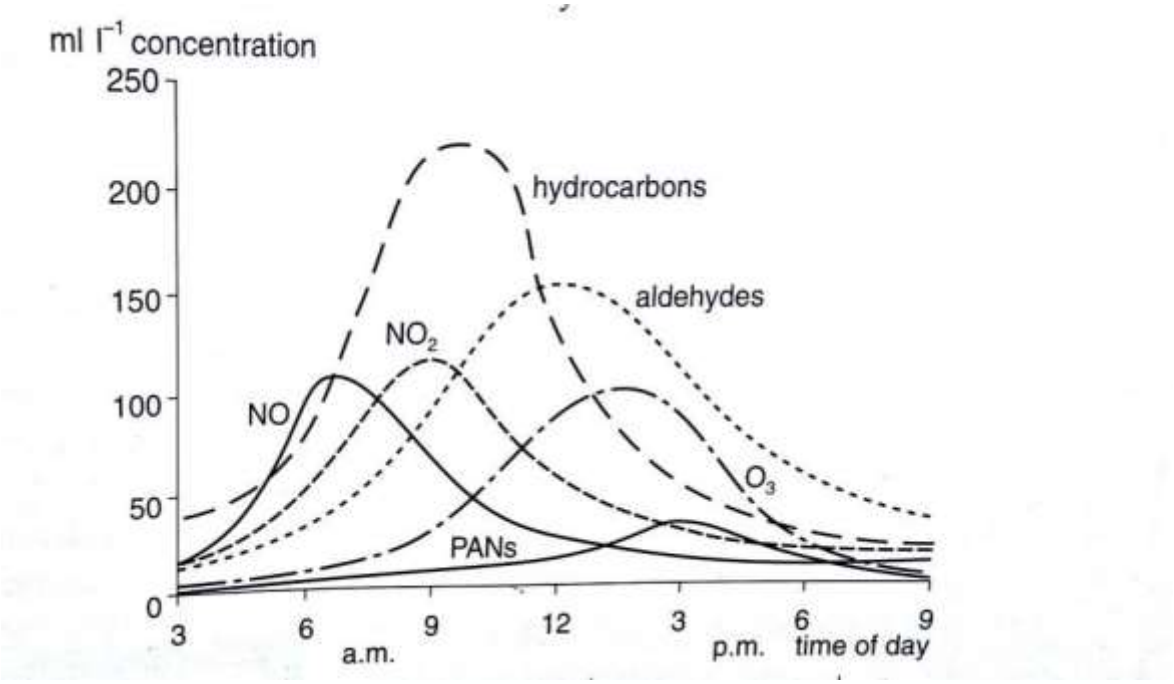
(i) From the graph above describe changes in the ventricular action potential.

(ii) Explain the changes in the ventricular action potential.

(iii) Account for the significance of the changes represented above.

SEETA HIGH SCHOOL

12(a) The graph below shows the composition of the photochemical smog on a sunny day in Kampala city. Study it carefully and answer questions that follow.



(i) Explain why the concentrations of NO, $N0_2$ and Hydrocarbons increase in the morning.

(ii) Suggest an explanation for the timing of the peak concentrations of NO and $N0_2$.

(iii) Explain how hydro-carbons accelerate the formation of Ozone hole.

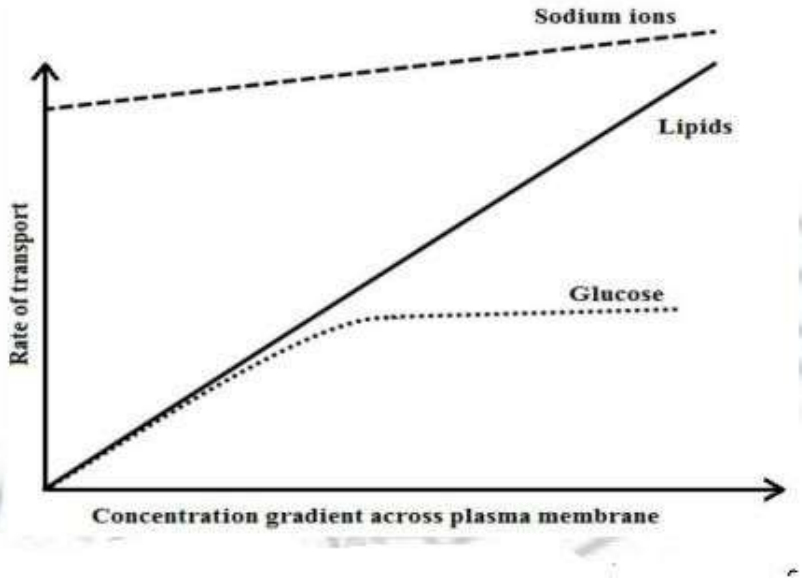
(iv) Explain the increase in the concentration of PANs (peroxyacetyl nitrate) in the mid-morning.

(v) Why might cyclists advised not to leave work early in order to avoid rush-hour traffic.

(vi) Explain why the peak of the Hydrocarbons is higher than any other pollutant.

TRINITY COLLEGE NABBINGO

13, The graph below shows the rates of transporting sodium ions, lipids and glucose across the membrane of living cells.



(a) Describe the rate of transport of each substance across the plasma membrane.

(b) Account for the observed trends in the transport of sodium ions and glucose.

(c) Compare the rate of lipid and glucose transport.

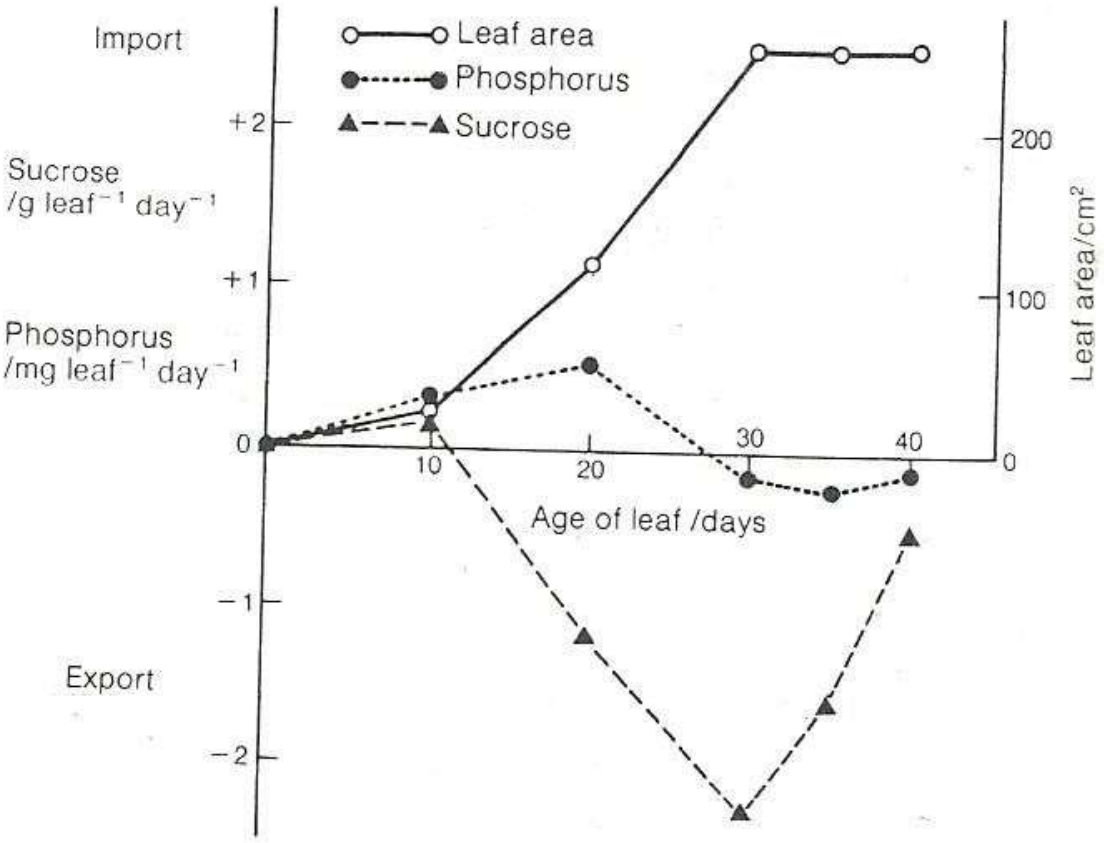
(d) (i) Explain how the mechanisms of transportation of substances in (b) above are beneficial and disadvantageous to cells.

(ii) Outline the adaptations cell membranes for the mechanisms of transport explained in (d) (i) above.

UGANDA MATYRS SS NAMUGONGO

14 Figure 1 below shows the growth of a single plant leaf with its **import (+)** and **export (-)** of sucrose and phosphorus during a period of 40 days. Study the figure and answer the questions that follow.

Figure 1



(a) From figure 1 above, explain the relationship between:

i) Leaf area and movement of sucrose.

ii) Age of leaf and movement of phosphorus.

(b) Describe how the following are imported and exported through the leaf:

iii) Sucrose.

iv) Phosphorus.

Figure 2 shows how external factors affect stomatal opening in various plants. Study the figure and answer the questions that follow.

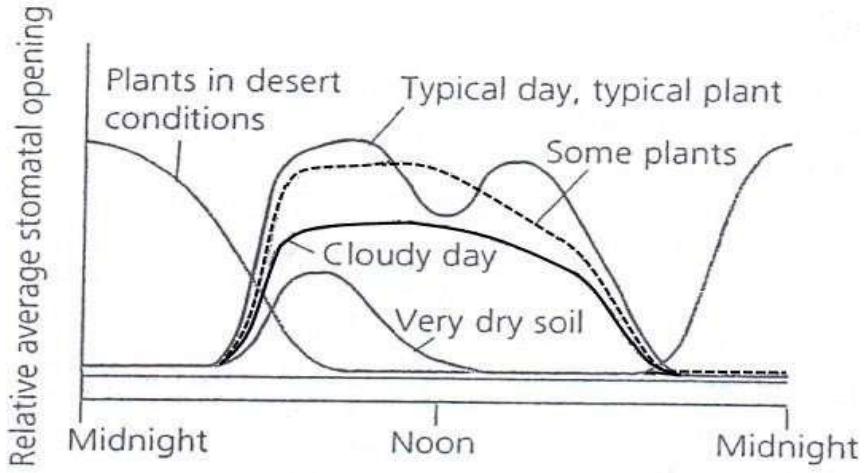


Fig. 2

(c) Compared with a typical plant on a typical day, describe the effect of the following conditions on stomatal movement:

(i) Very dry soil.

(ii) Cloudy day.

(d) Considering the plants in desert conditions:

(i) What are the **advantages** and **disadvantages** of the observed stomatal movement?

(ii) Explain how structural features are indicative of their habitat.

KINGS COLLEGE BUDO

15 (a) Outline the features which are unique to the skeletal muscle.

(b) How is the structure of myosin filament suited to its role in the muscle contraction?

(c) Describe the events which lead to the shortening of the skeletal muscle.

(d) Explain why rigor mortis occurs after death.

ST JULIAN SCHOOLS

16 (a) Explain why nitrogenous waste do not normally occur in plants.

(b) How does the human body deal with excess amino acids.

(c) In the mammalian kidneys the relative length of the loops of Henle shows considerable variation from one species to another. Suggest with reasons type of habitats in which you expect to find species with extremely long and short loops of Henle.

(d) Nitrogenous waste in animals may occur as ammonia, urea or uric acid. The table below shows the percentage of these three compounds in the urine of four different animals.

	Ammonia	**Urea**	**Uric acid**
Fresh water fish	56	6	0
Sea water fish	7	81	0
Lizard	0	0	91
Bird	3	4	72

(i) Explain the difference in the main excretory compound in fresh and sea water fish.

(ii) Both the lizards and birds are terrestrial and egg-laying. How do these characteristics relate to the nature of their main excretory products?

IGANGA SS

17 (a) Explain why it is important to study food webs rather than food chains in an ecosystem.

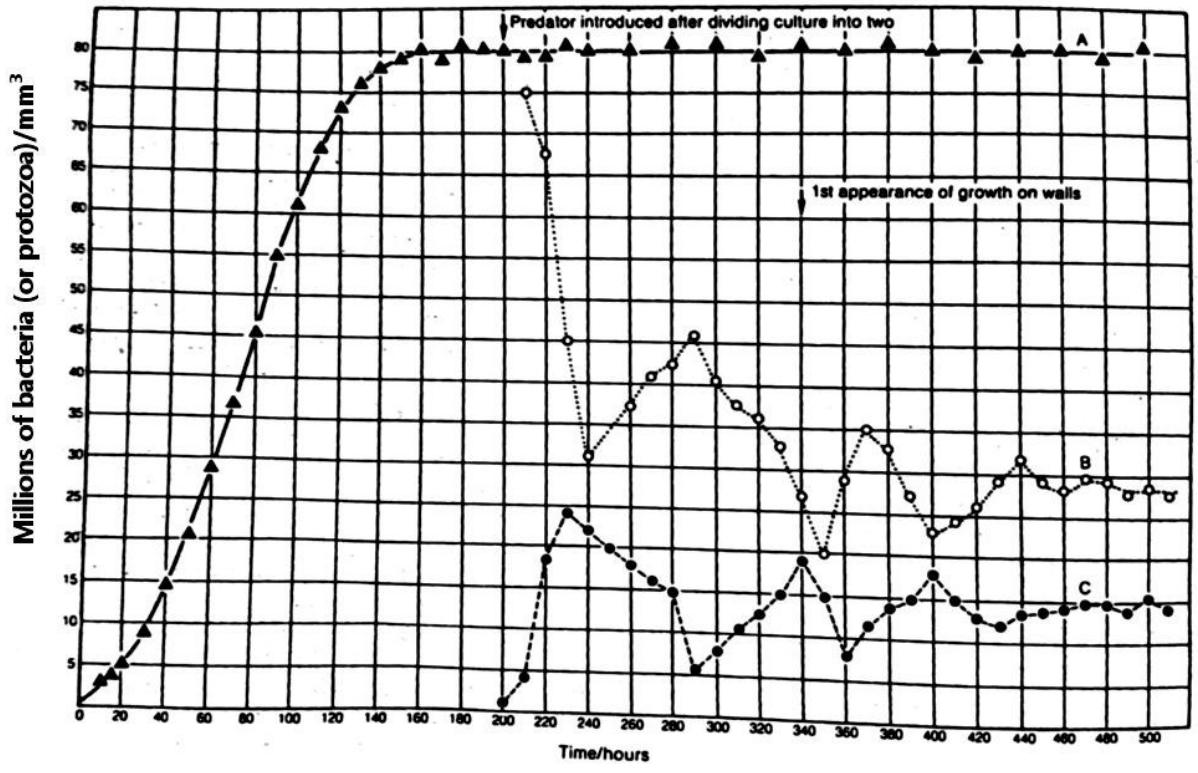
(b) Consider the trophic levels of a pyramid of numbers and illustrate how energy is lost in passing through the levels.

(c) Describe the ways in which nitrogen is incorporated into a food chain.

KAKUNGULU MEMORIAL SCHOOL

UBIOTA BIOLOGY SEMINAR QUESTIONS S6
HELD AT KYAMBOGO 17th JUNE, 2018

1. A bacterial culture was established in liquid medium at an initial concentration of 1 million bacteria per mm^3 of solution. The growth of the culture was monitored by sampling every 10 hours and counting the number of bacteria in the sample. The results are shown graphically below. After 200 hours the culture was split into two equal volumes labelled A and B in the figure. A protozoa was introduced into the culture B and the subsequent changes in the protozoa numbers were plotted in culture C
   Study the information fully and answer the following questions



(a) State the time range during which the bacterial culture is growing at its maximum rate in the absence of the protozoa. **(02 marks)**

(b) (b) State how long it takes the bacteria colony to double its number in the absence of the protozoa

(a) After the colony has been growing for 40 hours **(01 mark)**

(b) When number present is 35 million per mm^3 **(01 mark)**

(c) Explain the difference between your answer to b (i) and (ii) **(02 marks)**

*Prepared by Resourceful Biology Teachers **KIMULI PATRICK (Makerere College)** 0776-284672, 0705-809796*
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***WAMBI JEREMIAH (Mount St. Mary's Namagunga)** 0782-788334*

(d) Explain the change in the bacterial population after 80 hours **(09 marks)**

(e) (i) Describe the relationship between the population of the bacteria in B and the protozoa in C up to 260 hours **(04 marks)**

(ii) Explain the relationship in e(i) above **(08 marks)**

(f) The protozoa stays in the liquid part of the culture medium but the bacteria in B soon were observed to form colonies on the walls of the vessel

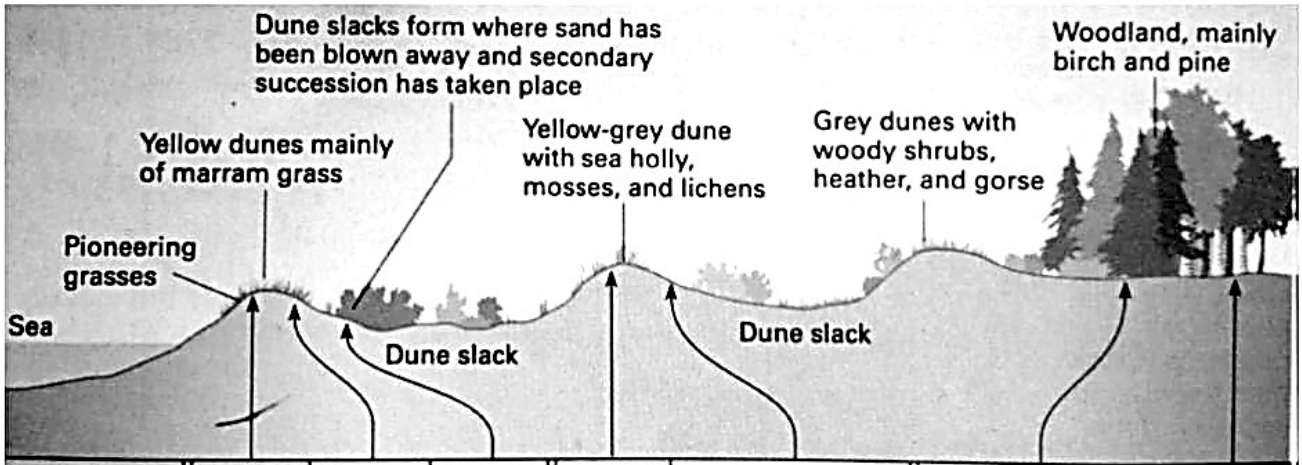
(i) Explain how growth on the walls may be an advantage to the bacteria in this experiment. Use evidence from the graph. **(05 marks)**

(ii) Comment on the possibility of wall growth in A **(03 marks)**

(iii) If no wall growth occurs in B, explain what would happen to the bacteria and protozoa population **(02 marks)**

(g) How do the results of the experiment relate to natural ecosystem? **(02 marks)**

2. The figure below shows the changes in soil properties and plant communities on a land scape and sand dune at stud land bay, dorset over a period of 365 years



Age/years	0–65	65–95	95–125	125–185	185–245	245–365	> 365
Soil pH	6.6–7.0	4.8–5.5	3.9–4.6	3.9–4.5	3.9–4.5	3.6–4.5	~ 4.5
Humus/%	0.2	0.6	2.5	3.2	8.2	13.5	> 40
Colour of soil	Yellow			Yellow-grey		Grey	Brown

(a) (i) With a reason, identify the type of primary succession that took place at stud land bay.

(ii) State two abiotic factors that would prevent the observed changes on the water body from taking place.

(iii) Identify which of the factors changing on the bay are physical and chemical

(b) Explain the observed changes in the soil properties over the 365 years period

(i) Soil pH

(ii) Humus

(iii) Colour of soil

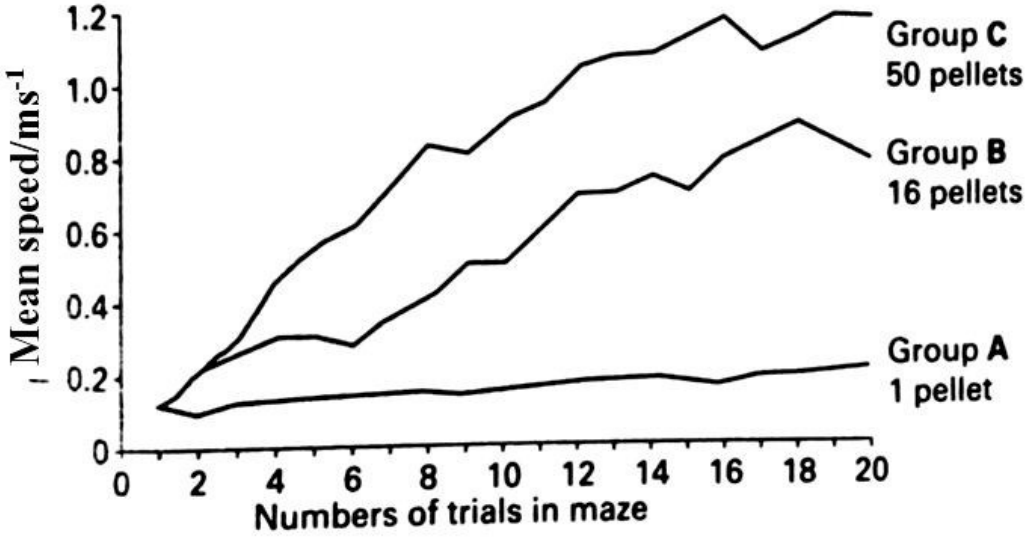
(c) Basing on evidence from the table, state the period of time when primary productivity of the ecosystem is highest

(d) Describe the events that lead to the observed changes in landscape between zero(0) years and 65 years

(e) State the factors that affect the number and diversity of species reaching an area

(f) How does the pioneer community differ from climax community?

3. In an experiment the ability of rats to learn the route out of a maze was investigated. Three groups of rats were used. Each rat in group A was put in the maze and when it found its way out it was given one pellet of food, the time taken for each rat to get through the maze was measured and the mean speed for each group of rats calculated. Each rat in group **A** was put through the maze 20 times. The rats in the other two groups were treated in exactly the same way except that each rat in group **B** was rewarded with 16 pellets of food and each rat in group **C** with 50 pellets



(a) Giving evidences from the graph; state the type of learning behavior shown by the rats in the experiments **(04 marks)**

(b) Explain how each of the following affected the behavior of the rats

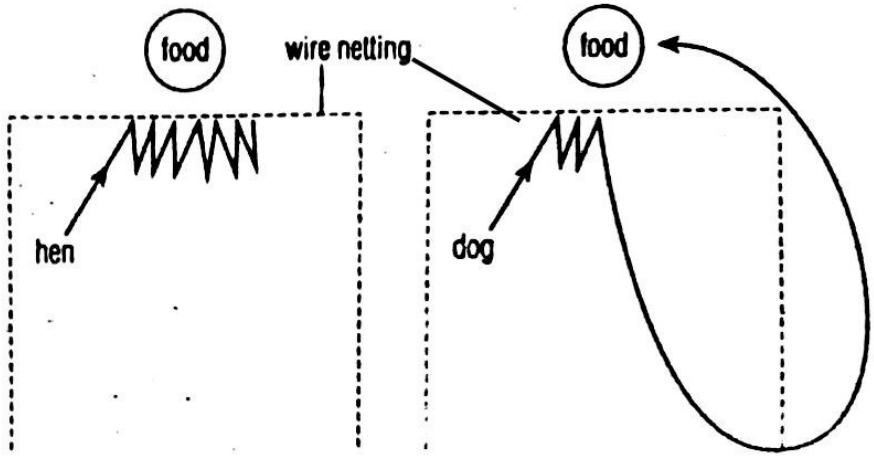
(i) Number of trials made **(06 marks)**

(ii) Quantity of food **(05 marks)**

(c) Apart from the factors investigated, suggest **two (2)** other factors that can increase the ability of the rats to learn by the form of learning under investigation **(02 marks)**

(d) How does the behavior shown by the rats in the experiments differ from instinctive behavior? **(05 marks)**

(e) The figures below show the response shown by a hen and a dog towards a visible food source when each was first starved and then placed separately in transparent wire netting left open at one end with food placed outside the netting on the opposite end which is closed.



(i) State the form of behavior shown by the dog **(01 mark)**

(ii) Mention **three (3)** characteristics of the type of behavior identified in e (i) above **(03 marks)**

(iii) Explain the behavioral response shown by each animal **(14 marks)**

4. The table 1 below shows the rate at which carbon dioxide is taken up (+) and released (-) from stem of herbaceous plant and from a single leaf of the same species at different light intensities.

Light intensity (arbitrary units)	**UPTAKE (+) AND RELEASE (-) OF CARBONDIOXIDE /mg50cm^{-2}h^{-1}**	
	STEM	**LEAF**
0.0	-0.5	-0.5
1.0	-0.2	+0.6
2.5	+0.3	+2.8
4.0	+0.7	+4.6
5.0	+1.0	+5.3
7.0	+1.6	+6.0
11.0	+2.5	+6.3

(a) Present the data provided in the table above in a suitable graph. **(06 marks)**

(b) Calculate the rate at which carbon dioxide is used in photosynthesis by 50cm^2 of the plant organ at light intensity of 3 arbitrary units. **(03 marks)**

(c) Explain,

(i) The rate of uptake and release of carbon dioxide of the leaf of a plant as light intensity increases. **(14 marks)**

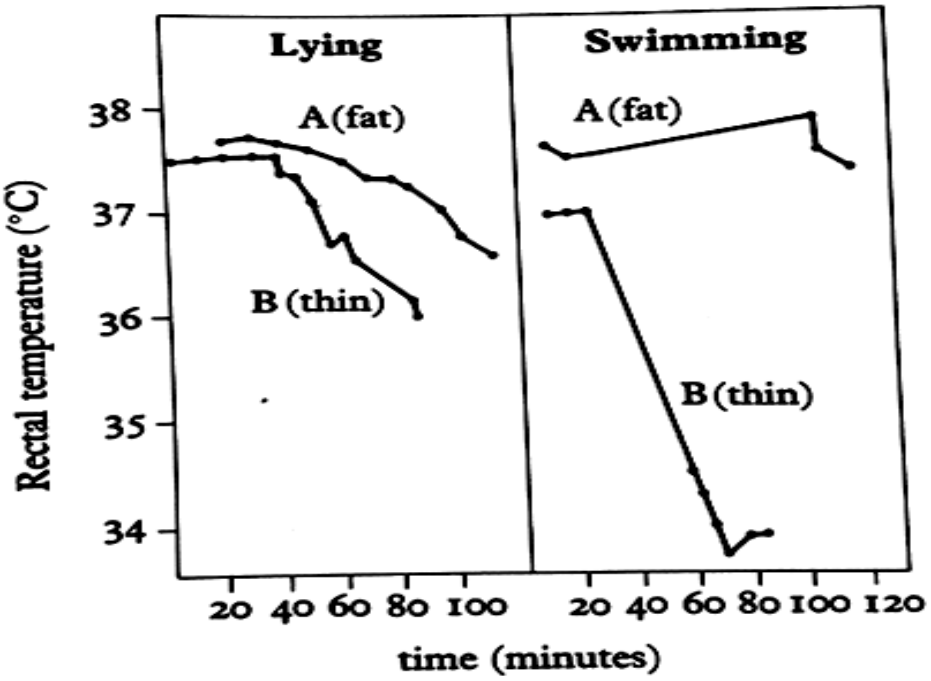
(ii) The difference in the rate of uptake of carbon dioxide of leaf and stem of plants. **(06 marks)**

(iii) From your graph, the difference in the light compensation points of the leaf and stem of plants. **(04 marks)**

(d) Suggest any three practical difficulties you would meet in conducting an experiment to obtain data of the kind given in the table. **(03 marks)**

(e) State physiological problems likely to be faced by a plant beyond light intensity of 3 arbitrary units. **(04 marks)**

5. Figure 1 below shows the results of an experiment on the body temperature of two human subjects, **A** and **B**. **A** is fat whereas **B** is thin, both subjects had their body temperature recorded at intervals while immersed in water at 16^0**C**. Results obtained first with the subjects lying still, and then while the subjects were swimming.



a) (i) From the figure above, state any **two (2)** factors that affect the body's ability to regulate body temperature of an individual. (2 *marks*)

(ii). Describe the effect of change in each of the factors in a (i) above on the rectal temperature. (6 *marks*)

(iii). Give an explanation for the effects described in a (ii) above. (15 *marks*)

b) Explain;

(i) Why rectal temperature and not skin temperature was used in the experiment. (04 *marks*)

(ii) The effect of increasing water temperature to 25^0 C. (03 *marks*)

(iii) Why prolonged exposure to severe cold of the living cell at the tips of the fingers may die? (03 *marks*)

c) State the structural and physiological changes that occurred in the body of the thin human throughout the time of experiment. (04 *marks*)

d) How can thin bodied organisms survive in conditions of low temperature?

6. The blood fluke, *Schistosomamansoni* is an important helminth parasite that resides within the mesenteric veins of its definite host.
   Experiments were carried out and the graph in figures **1, 2** and **3** below show the effect of temperature, light and salinity on the hatching of the eggs of *Schistosomamansoni*.
   At hourly intervals, the number of eggs hatching was determined and expressed as a percentage of total hatch.
   Figure 1 shows the effect of temperature on hatching. After 4 hours of treatment at the temperature shown, the samples were incubated for further two hours at 28°C at constant light and salinity.
   Figure 2 shows the effect of light on hatching. One sample was kept in light for 6 hours while a second was first kept in dark for 3 hours, and then transferred to light for hours at constant temperature and salinity.
   Figure 3 shows the effect of salinity on hatching after treatment for 6 hours at constant temperature and light (percentage of total hatch is expressed as a percentage of number of eggs hatching in 0% saline)

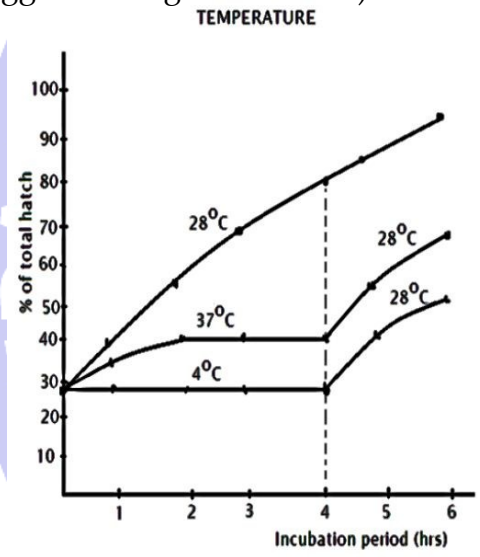


Fig. 1

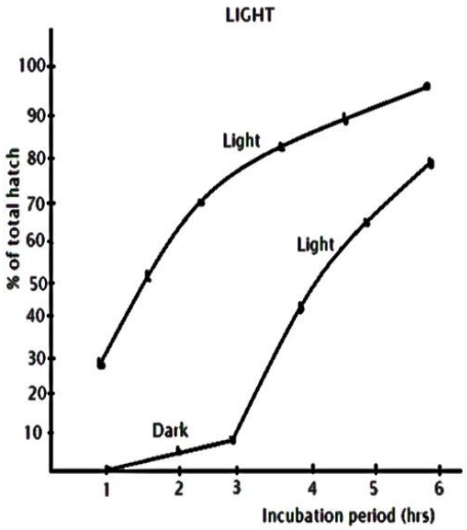


Fig. 2

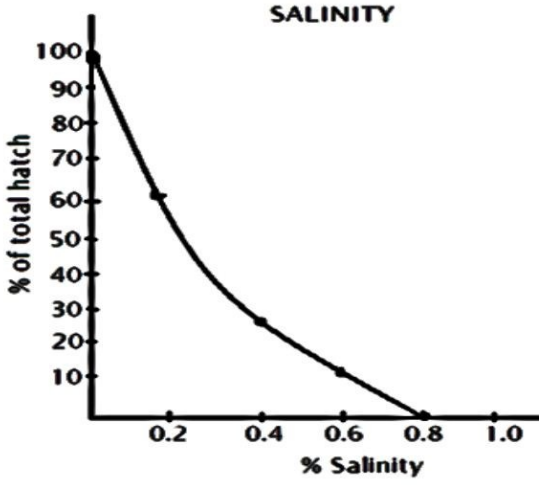


Fig. 3

The eggs kept in 0.8 saline for 6 hours as in **figure 3** above were removed divided equally into four lots and placed in a range of saline solutions for further 6 hours. The results are as shown in **table 1** below.

Table 1

0	Total hatch after 6 hours (%)
0.0	100
0.2	40
0.4	20
0.6	8

Study the graphs and **table 1** and then answer these questions.

(a) Outline the parasitic features of the ***Schistosomamansoni***.

(b) What is the effect of temperature on the hatching of the effects of ***Schistosomamansoni***?

(c) Explain the effect of light on the percentage of the total hatch of the eggs.

(d) What is the effect of salinity on the percentage of the total hatch on the eggs?

(e) (i) From the data presented and restricting yourself to the egg stage only discuss the adaptation of ***Schistosomamansoni*** to its mode of life.

(ii) Give other adaptations of ***Schistosomamansoni*** to its mode of life.

(f) (i) Name the disease caused by the blood fluke to man.

(ii) Explain how the disease is spread and the spread of the disease controlled.

(g) State advantages of the parasitic mode of life.

7. The figures 1 a, b and c show the different factors affecting uptake of mineral ions by valonia a plant growing in water.

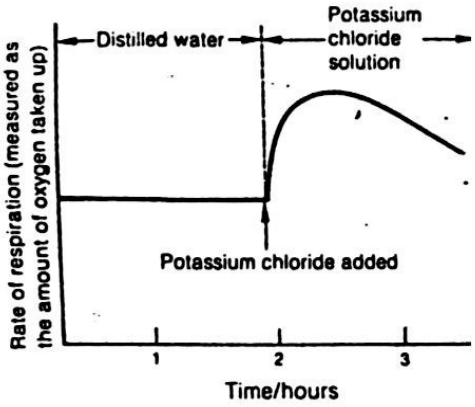


Fig 1 (a)

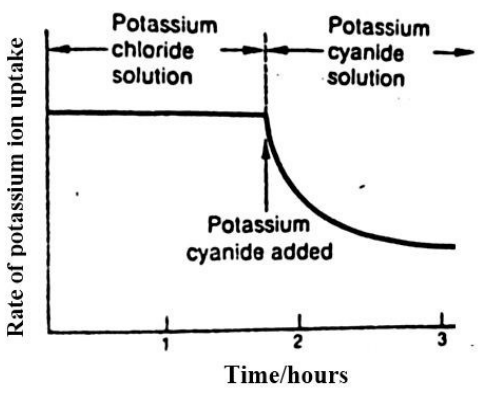


Fig 1 (b)

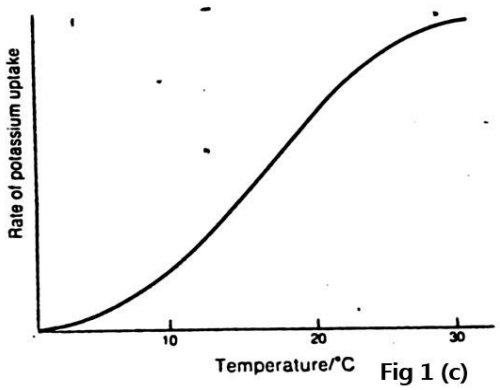


Fig 1 (c)

(a) Describe what each of the figures 1a, b and c represent **(09 marks)**

(b) Explain the shapes of each of the graphs in figures 1 a, b and c **(14 marks)**

(c) Suggest reasons why the rate of respiration in figure 1 (a) is above zero in the first 2 hours of experiment **(02 marks)**

(d) (i) what would happen to the rate of respiration and rate of uptake of potassium ions in figures 1 (a) and (b) respectively if the investigation was allowed to run for more 3 hours **(02 marks)**

(ii) Give reasons for your observations in d (i) above **(04 marks)**

(e) Describe

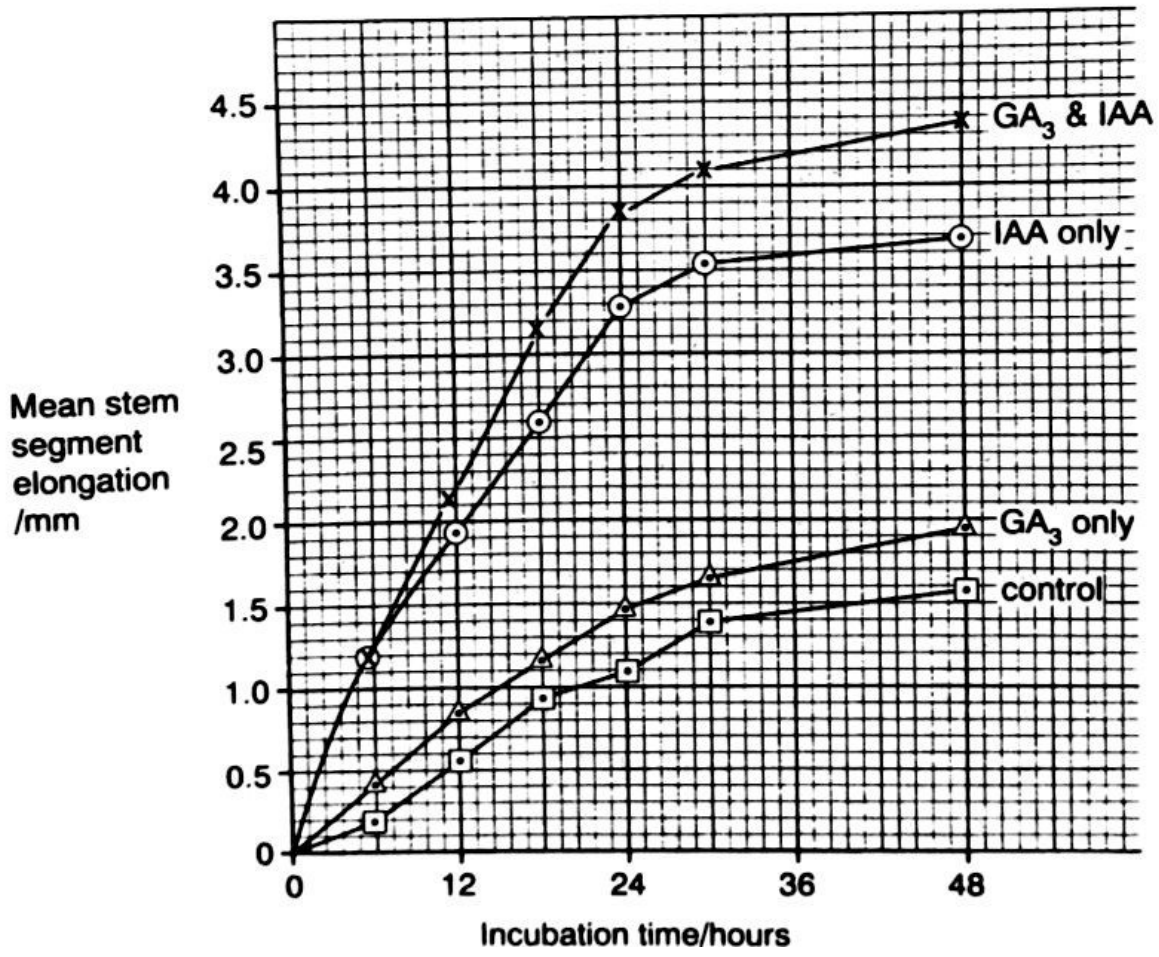
(i) The role of ATP in uptake of potassium ions by a water plant **(03 marks)**

(ii) How potassium ions absorbed may find their way to the xylem of a plant **(03 marks)**

(f) State **three (3)** factors that increase uptake of mineral ions by velonia plant **(03 marks)**

8. An experiment was carried out to investigate the effect of an auxin, Indole Acetic Acid (IAA) and Gibberellic acid (GA_3) on the elongation of segments of pea stem.

A control group of pea segments received on added IAA or GA_3 other groups of pea segments were treated with equivalent quantities of IAA only, GA_3 only or both IAA and GA_3. The results are shown in the graph.



(a) Describe the effect of each of the following plant hormones on the mean stem segment elongation

(i) Gibberellic acid (GA_3) **(03 marks)**

(ii) Indole acetic acid (IAA) **(03 marks)**

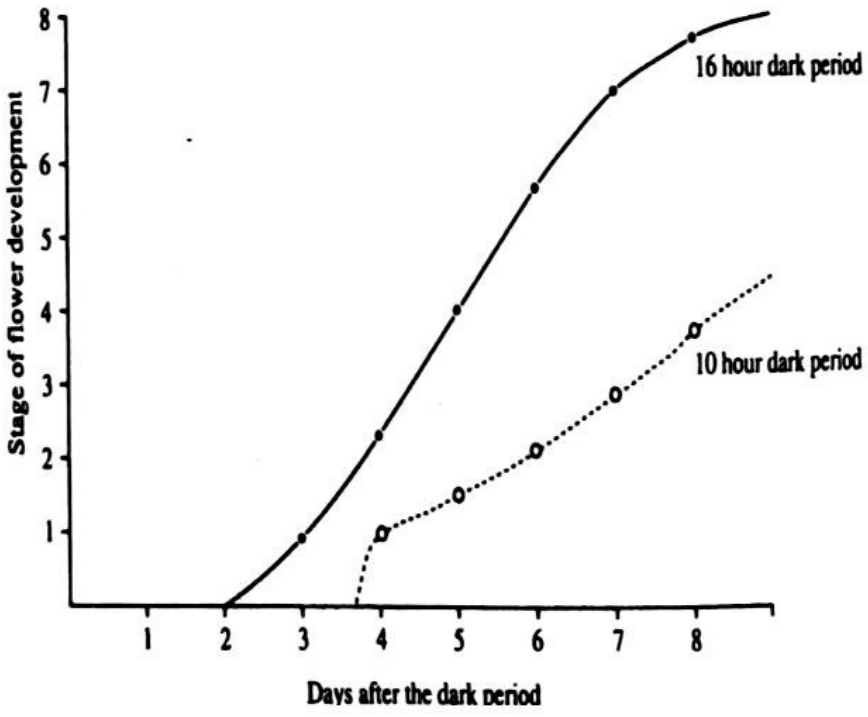
(b) (i) With a reason, state the biological relationship exhibited by gibberellins and IAA **(03 marks)**

(ii) Explain the difference in the effect on the mean stem segment elongation when the pea plants were treated with IAA only and when treated with a mixture of IAA and GA_3. **(03 marks)**

(c) Describe the role of GA3 in seed germination **(08 marks)**

(d) How have farmers used IAA to their benefit? **(04 marks)**

(e) Flowering in the cocklebur plant occurs as a result of exposure to a period of darkness. The development of the flower has been divided into eight stages (0- no flower, up to 8- fully developed flower). The graph shows the average stage of flower development for two batches, each of ten plants, one of which was kept in the dark for 16 hours and the other for 10 hours.



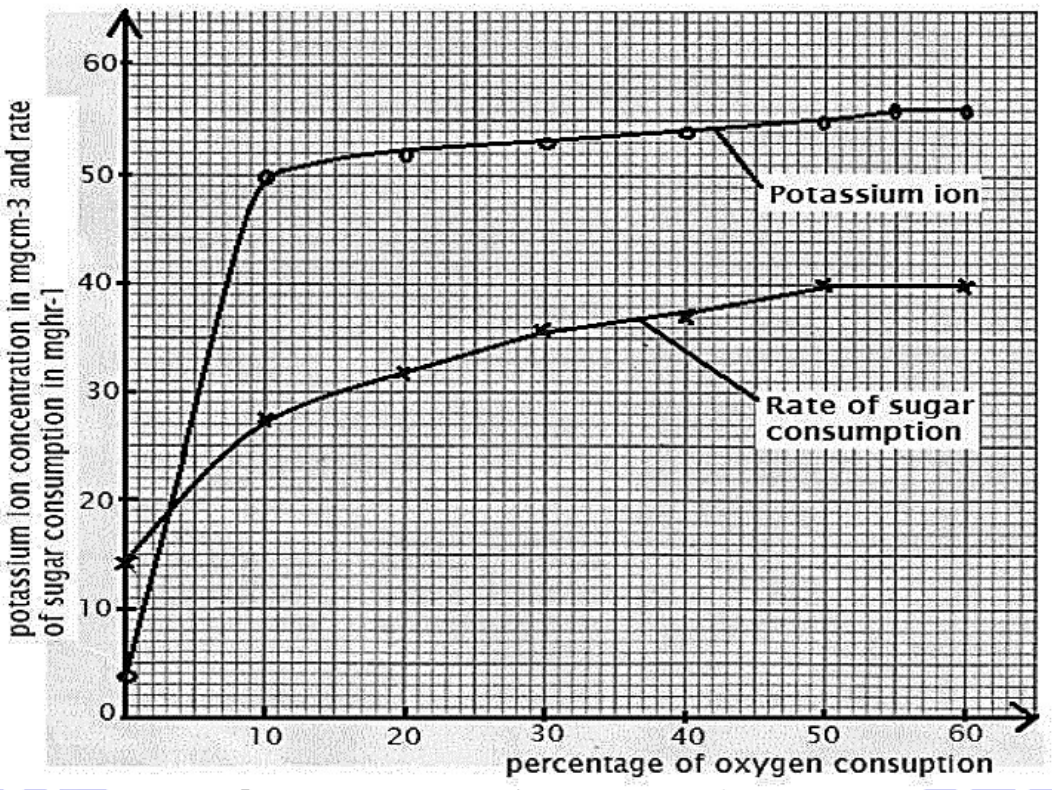
(i) Compare the effect of length of dark period on flowering in the cocklebur plants. **(04 marks)**

(ii) Explain the difference between the two batches of plants after eight days **(02 marks)**

(iii) Suggest reason(s) why there was a delay between the exposure to darkness and start of flower development **(02 marks)**

(iv) State **one** practical applications for this type of research.

9. The relationship between potassium ion concentration in the roots and sugar consumption at different oxygen concentration was investigated. The **figure 1** below shows the concentration of potassium ions ($Mgcm^{-3}$) and the rate of sugar consumption ($Mghr^{-1}$) by roots of freshly uprooted plant when inserted in a bathing fluid at different oxygen concentration.



(a) Compare the effects of oxygen concentration on potassium ion concentration in the roots and rate of sugar consumption. **(07 marks)**

(b) Explain the,

(i) Presence of potassium ion concentration in the roots without oxygen. **(06 marks)**

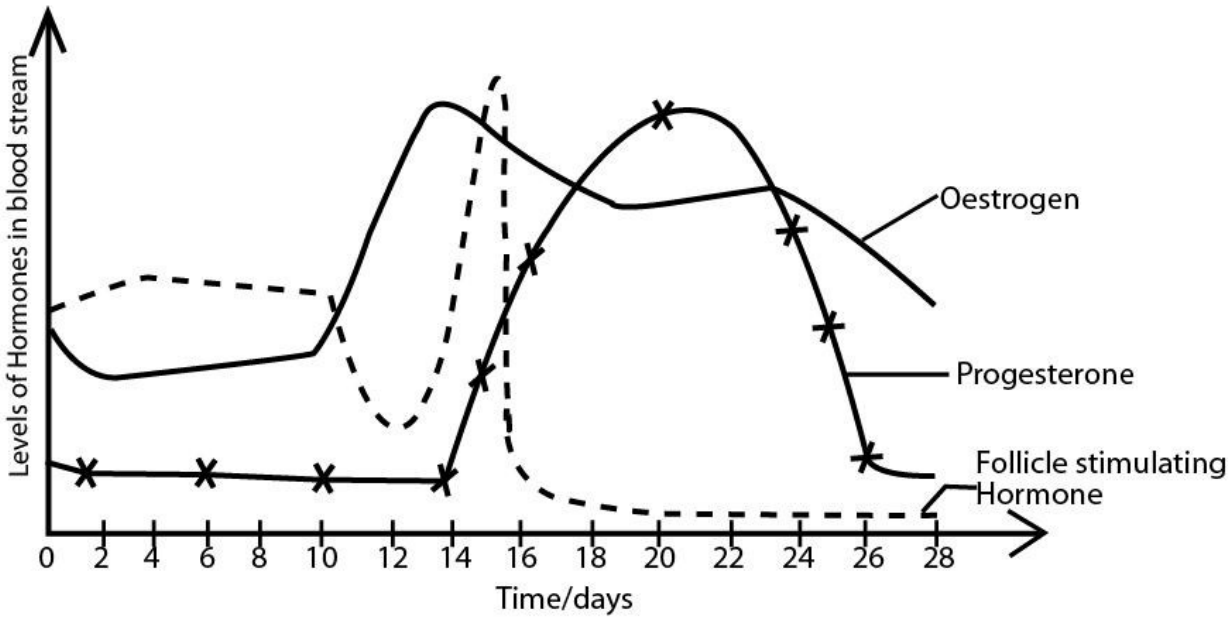
(ii) Relationship between potassium ion concentration and oxygen consumption. **(12 marks)**

(iii) Effect of increasing percentage of oxygen consumed on rate of sugar consumption. **(07 marks)**

(c) Predict change in concentration of potassium ions in the roots and rate sugar consumption if the experiment was to continue for some time up to 90% oxygen consumption. Suggest reasons for your answer. **(05 marks)**

(d) State other three factors other than oxygen concentration that could affect the rate of potassium ion uptake by roots. **(03 marks)**

10. Study was conducted on hormonal changes in a menstrual cycle of a fertile female of reproductive age periodical changes in a level of gonadotropin hormone, follicle stimulating hormone and two other steroid hormone, Oestrogen and progesterone where studied over 28 days of menstrual cycle the hormonal changes are shown in figure below.



(a) Compare the variation in the level of oestrogen and progesterone hormones.
(b) Explain the
(i) Relationship between the follicle stimulating hormone and progesterone hormone.
(ii) Variation in the level of progesterone hormone thought the menstrual cycle.
(c) Predict the changes in the level of three hormones in fertilization that occur on the seventeenth day of the cycle.
(d) Suggest the reasons for your answer in 11.c. above.
(e) Explain the significance of the three types of hormones as fertility drugs.

11. In an investigation, a culture medium containing 1800 yeast cells cm-3 and glucose was setup in a laboratory fermenter and maintained in a constant temperature water bath for a period of 20 hours. The glucose concentration, ethanol concentration and pH were monitored. The number of yeast cells was estimated at intervals during the process. The results obtained are shown in the graph below.
(a) Suggest reasons for the changes in the population density of yeast cells over the 20- hour period
(b) Explain the changes in each of the following during the period of investigation
(i) Glucose concentration

(ii) Ethanol concentration
(iii) pH

(c) State the:
(i) Significance of using microorganisms in industrial processes.
(ii) Precautions taken to ensure that a high yield of uncontaminated products are obtained.

(d) Describe the technique that is most likely to have been used to estimate the population density of yeast cells.

12. In an investigation several potato tissue cylinders of approximately equal size were obtained using a cork borer, the cylinders were divided into two groups A and B. the mass of each of the cylinders was measured and recorded. Each of the cylinders in group A was placed in a sucrose solution of a given concentration. Cylinders from group B were treated similarly except 0.1g of Gibberellic acid was added to each sucrose solution, the setups were left to stand for 4 hours, then after 4 hours each cylinder was removed from its solution, reweighed and the percentage change in mass calculated. The results obtained recorded in the table below.

Sucrose molarity	Percentage change in mass	
	Group A	Group B
	Sucrose solution only	Sucrose solution+ Gibberellic acid
0	+7	+42
0.1	+6	+38
0.2	+5	+36
0.3	+1	+27
0.4	-4	+6
0.5	-8	+3
0.6	-14	-3
0.7	-17	-4
0.8	-16	-7

Gibberellic acid is produced naturally in potato tubers, it stimulates the production of carbohydrase enzyme

(a) What precautions should be taken by the investigator to ensure accurate results are obtained

(b) (i) Plot a graph to show the percentage change in mass of cylinders in groups A and B at different concentration of sucrose

(ii) Using a graph obtained for group A; explain how change in concentration of sucrose affected the mass of cylinders

(ii) Explain the difference in results obtained for groups A and B at different sucrose concentrations

(c) (i) From the graph, state the molarity of sucrose solution which would have the same water potential as the potato cylinders. Give a reason for your answer

(ii) Explain why the water potential of a sucrose solution always has a negative value

(iii) Why it is difficult to make potential that exists in intact plant tissues

(d) State

(a) Two other ways in which similar results can be obtained without measuring masses of cylinders

(ii) Precautions necessary when using each of the methods

13. In an experiment, two healthy human subjects **A** and **B** at rest were made to breathe in and out through a spirometer filled with pure oxygen, in the spirometer of subject A the carbon dioxide absorber was left in place while in that of subject B the carbon dioxide absorber was removed the results were obtained using a recording paper and ventilation rate of the subjects recorded over a period of 7 minutes. The table below shows the data collected

Time in minutes	**Subjects**	0	1.0	2.2	3.0	4.0	5.5	6.0	7.0
Ventilation rate (dm^3 min^{-1})	**A**	19	17	16	22	21	25	23	19
	B	15	16	20	28	40	57	74	-

(a) Represent the data in the table above graphically

(b) What are the effects of composition of on the ventilation rate?

(c) Explain how changes in composition of air results into changes in ventilation rate observed from the graph

(d) Suggest why breathing in excess oxygen by divers at a pressure higher than atmospheric pressure can be fatal

(e) The figure below shows the changes in percentage saturation of haemoglobin with oxygen with oxygen tension at two different carbon dioxide concentration

Taking 5 Kpa carbon dioxide partial pressure as normal partial pressure of carbon dioxide in human

(i) Redraw the graph, to show percentage saturation of haemoglobin with oxygen varies at different oxygen tensions if carbon dioxide concentration is 9Kpa

(ii) Explain the significance of the relative position of curves at 2 Kpa and 8 Kpa carbon dioxide to that of normal carbon dioxide partial pressure to the human

(iii) Why organism like arenicola that live in environments with low oxygen tension don't show Bohr effect?

14. A study was carried out on germinating maize seeds to determine the rate of ethanol production by intact seeds and in seeds whose testa had been removed (non-intact seeds). The results are shown in table 1.

Time /days	Rate of ethanol production in arbitrary units	
	Intact seeds	Non-intact seeds
0	0.00	0.00
2	0.15	0.25
4	0.25	0.40
6	0.35	0.60
8	0.45	0.75
10	0.45	0.75
12	0.45	0.75

In another experiment involving maize seeds, the changes in mass of starch and amylase concentration, as the seeds germinate, at a two day interval was determined. The results are shown on figure 1 below. Use the above information to answer the questions that follow

(a) (i) Represent the results in table 1 in a suitable graphical form. **(07 marks)**

(ii) Compare the trends of ethanol production in a (i) above. **(05 marks)**

(iii) Explain the differences in the rate of ethanol production observed in a (ii) above. **(08 marks)**

(iv) During the first seven days of germination, the respiratory quotient for intact seeds was found to be higher than for non-intact seeds. Suggest an explanation for this difference. (05 marks)

(b) Explain the relationship between the mass of starch and concentration of amylase,

(i) In the first two days. **(03 marks)**

(ii) After day two. **(07 marks)**

(c) From figure 1 and table 1, what conclusion can you draw about the process of germination in maize? **(03 marks)**

(d) State two internal factors that could affect the results of the second experiment.

15. The figure 1 below shows the changes in the membrane potential showing the electrical events associated with the nerve impulse in an axon. While figure 2 shows changes in the permeability of the membrane of axon to sodium and potassium ions during transmission of an impulse which occurs very fast and rapidly.

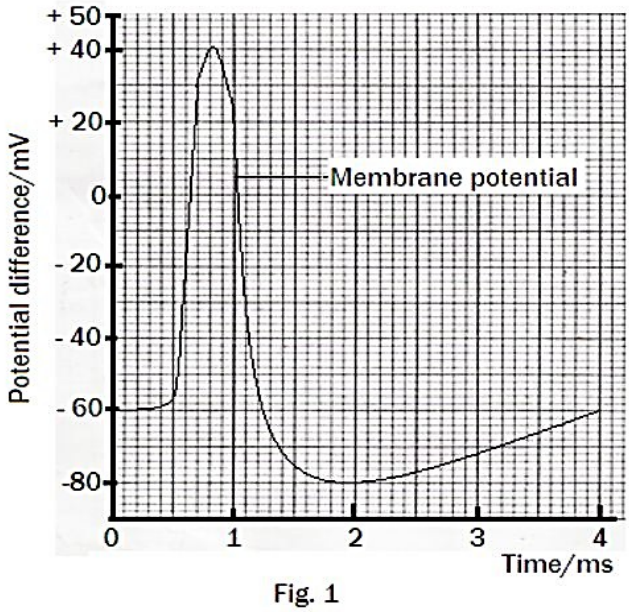


Fig. 1

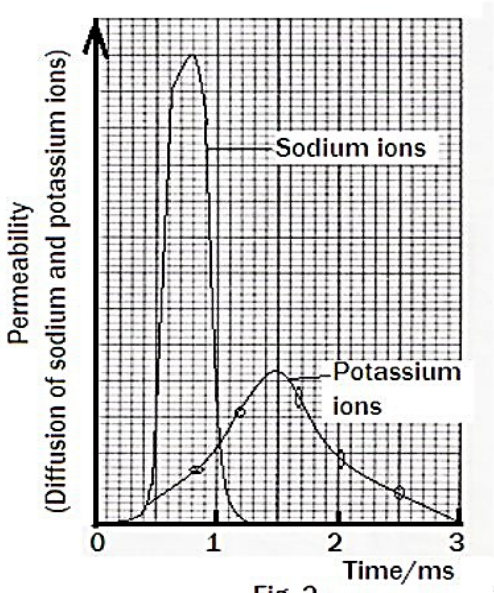


Fig. 2

(a) Compare the trend of diffusion of sodium and potassium ions across the membrane of an axon over the 3 milliseconds (ms) period.

(b) Using both figures 1 and 2, Explain the trend of each of the following during the propagation of the impulse in the axon,

(i) Membrane potential.

(ii) Sodium ions.

(iii) Potassium ions.

(c) In each case, state two factors which can cause rapid and slows propagation of impulses.

(d) Give the significance of fast conduction of impulses to organisms

16. A dromedary is a breed of Arabian camel that in habits dry desert areas, in an investigation on effects of dehydration on the fluid compartments of dromedary and human were compared and the results obtained were as shown in table 1 below.

Organism	**Volume of fluid compartment/%of normal volume**					
	Normal conditions of ample water supply			**Conditions when lack of water causes a loss of 25% total body water**		
	Plasma water	**Other body water**	**Body solids**	**Plasma water**	**Other body water**	**Body solids**
Dromedary	100	100	100	90	70	100
Human	100	100	100	65	75	100

(a) Represent the information in table 1 graphically

(b) Using your graph in (a) above, explain how dehydration affects both dromedary and human

(c) Explain how the physiological adaptations to desert life differs in camels and desert rats

(d) How is a hump of significance to camels

(e) Suggest reasons why

(i) Fat in camel is concentrated mainly in the hump

(ii) Camel has thick fur on its back

SECTION B

CELL BIOLOGY

17. **(a)** Account for the significance of the following theory in the field of cytology

(i) Cell theory **(10 marks)**

(ii) Endosymbiotic theory **(10 marks)**

18. **(a)** Explain how the following process occur in the cell and significance.

(i) Autophagy. **(4 marks)**

(ii) Autolysis. **(4 marks)**

(b) Describe the role of;-

(i) Cell wall **(6 marks)**

(ii) Cell membranes. **(6mrks)**

19. **(a)** Give an account of the fluid mosaic model. **(8 marks)**

(b) How does the model differ from the Davison? **(3 marks)**

(c) State how a bacteria cell

(i) Differ from the Eukaryotic cell **(5 marks)**

(ii) Similar to the Eukaryotic cell **(5 marks)**

MICROSCOPY

20. **(a)** Explain the limitations of;-

(i) Optical microscope **(3 marks)**

(ii) Electron microscope **(3 marks)**

(b) A check cell was mounted on a microscope and its field of view appeared to be 3mm given that the eye piece and objective. Len were X 5 ad x 100 respectively. Calculate the actual size of cell in

(i) Micro **(2 marks)**

(ii) Nanometer **(2 marks)**

(iii) Angstrone **(2 marks)**

(c) An onion bulb was cut longitudinally and scrapped off the tip of the inner most layer, a drop of water was added and covered with a cover ship and then examined under low power, and the number of cell observed were 20. The field of field was measured found to be 2.0mm. Calculate the actual length of one cell in micrometer.

CHEMICALS OF LIFE

21. **(a)** What is meant by the zwitter ion? **(2 marks)**

(b) Describe the biological functions of amino acid. **(5 marks)**.

(c) Account for the structural and physiological role of lipids. **(15 marks)**

(d) How do inhibitors change the rate of enzyme controlled reaction? **(6 marks)**

22. **(a)** Water is most essential chemical of life. Explain in relation to its properties.

(b) Explain the diversity and the function of lipids **(06 marks)**

23. **(a)**The DNA molecule is a single ingredient to reveal the paternity of an individual, discuss.

(b) Describe how a molecule of pepsin can be transcribed and translated from a precursor molecule of DNA.

(c) The diverse function of protein is related to molecule organization, explain.

24. **(a)** Explain why a single base deletion from one deoxyribonucleic acid molecule usually caused greater than the replacement of one base by another different base
(b) Using a named example, describe how a gene may affect a phenotype of organism

HISTOLOGY

25. **(a)** Explain the criteria based on to classify the types of muscles. **(8 marks)**
(b) Give an account for the sliding filament hypothesis **(12 marks)**

26. The Epithelial tissue suits its function because of it structure. Explain. **(20 marks)**

27. Describe how the following tissues are related to their functions;
(i) Parenchyma, (ii) Collenchyma, (iii) Sclerenchyma, (iv) Xylem, (v) Phloem and (vi)Red Blood cells**.**

28. Explain the distribution pattern of mechanical tissue in a stem and root of a dicotyledonous plant. **(8 marks)**

29. **(a)** Describe the structure of vascular system of higher plants. **(7 marks)**
(b) How is the system adapted to its function? **(13 marks)**

ALTERNATION OF GENERATION

30. **(a)** Explain what is meant by alternation of generation.
(b) Compare the life cycle of moss and ferns
(c) Explain the significance of alternation of generation to the life of organisms.

31. A moss alternates between two distinct forms of life cycle as a gametophyte and sporophytes. **(10 marks)**
(b) Describe how;-
(i) Gametophyte form sporophyte. **(4 marks)**
(ii) Sporophyte form a Gametophyte. **(4 marks)**
(c) Explain why the life of a moss is limited in a moist environment. **(02 marks)**

CLASSIFICATION

32. **(a)** Distinguish between:-
(i) Natural and artificial classification. **(2 marks)**
(ii) Coelomates and acoelomates **(2 marks)**
(iii) Apterophyte and pterophyte **(2 marks)**
(iv) Diploblastic and triploblastic **(2 marks)**
(b) Explain the limitations of:
(i) Two kingdom system of classification **(3 marks)**

(ii) Three kingdom system of classification. **(3 marks)**

(c) Fungi were originally classified under the plant kingdom.

(i) Outline the distinct features of Fungi that made it necessary to place in their own Kingdom.

(ii) Explain why their own kingdom wide spread and vast in number. **(4 marks)**

(iii) What is the economic importance of Fungi?

MONERA

33. **(a)** Explain the criteria based on classifying of the bacteria. **(10 marks)**

(b) Using suitable examples, describe the necessity of bacteria to coexist with other organisms.

34. **(a)** What is a virus? (1mrks)

(b) Explain why viruses form border line between living and non-living organism. **(4 marks)**

(c) Explain the criteria on which the virus can be classified. **(4 marks)**

(d) Describe how a T4 lymphocytes is dissolved by a HIV Virus. **(10 marks)**

(e) At what level of organization is a virus? **(1 marks)**

(f) Describe how the T4 lymphocytes is destroyed by HIV Virus.

35. **(a)** Write short notes on the following:-

(i) Bilateral symmetry. **(2 marks)**

(ii) Polymorphism. **(2 marks)**

(iii) Cephalization. **(2 marks)**

(b) Explain the structural features that have enabled bryophytes to adapt to terrestrial life. **(8 marks)**

(c) Describe the structural difference between gymnosperm and angiosperm.

HOMEOSTASIS

36. **(a)** Describe the functioning of the counter current exchange mechanism in terrestrial mammals that permit water conservation.

(b) Explain the physiological mechanism of regulating mammalian core body temperature at a steady state in cold condition. Describe the interaction of various species of organs in an eco-system.

37. **(a)**Describe the process of mechanical osmoregulation in fish water hydrophytes.

(b) Explain the mechanism by which mammals get rid of different nitrogenous wastes out of the bodies.

38. **(a)** Explain the role of ADH hormone to;-

(i) An individual who has drunk a lot of water.

(ii) An individual who has eaten a salty meal.

(b) The proteins are essential structural and biological component in man but required in normal level. Explain how the normal levels are obtained.

(c) Explain the role of aldosterone hormone in regulation the level of sodium ions.

(d) Why is a salt sugar solution administered to an individual suffering from rehydration due to vomiting or diarrhea?

39. **(a)** Describe the process of osmoregulation in Humans. **(09 marks)**

(b) Explain,

(i) Immediate physiological responses by endotherms to extreme cold. **(05 marks)**

(ii) How shunt vessels play role to regulate core body temperatures in a changing environmental temperatures. **(06 marks)**

TRANSPORT

40. **(a)**Explain how mammalian kidney maintains pH of the blood.

(b) Explain how the loop of Henle operates a count current multiplier system.

41. (a) Describe the events of the cardiac cycle. **(12 *marks*)**

(b) Explain how **the heart action** is controlled. **(08 *marks*)**

EVOLUTION AND POPULATION GENETICS

42. **(a)**What is meant by polyploidy?

(b) Discuss the criteria that will lead to the emergence of polyploidy in a population. **(12 marks)**

43. **(a)** What is meant by natural selection?

(b) Describe the role of each of the following in natural selection.

(i) Mutation

(ii) Meiosis

(iii) Fertilization

44. **(a)**Explain the meaning of the following;-

(i) Genetic isolation

(ii) Reproductive isolation

(b) Explain how the gene frequency of population may be altered.

45. **(a)**Describe how Darwin explains evolution of a new species by natural selection. **(10 marks)**

(b) Explain how the following may lead to evolution of a new species.

(i) Selective breeding. **(05 marks)**

(ii) Increased population size. **(05 marks)**

46. **(a)** What is meant by the term gene mutation? **(03 *marks*)**

(b) Describe the **role** of gene mutation in giving rise to sickle cell anemia in individuals.

(9 *marks*)

(c) Explain **the ecological** significance of the existence of sickle cell trait in African population. **(08 *marks*)**

47. **(a)** Explain how each of the following evolution mechanism would lead to speciation

(i) Geographic isolation.

(ii) Polyploidy.

(b) Explain how vestigial organ provide support for organic evolution.

GROWTH

48. **(a)** What is meant by annual rings?

(b) Describe the secondary condition that will lead to the emergence of polyploidy in a population.

(c) Explain the metamorphic change under gone by phyllogens in plants.

49. **(a)** Explain the causes of seed dormancy and how they can be controlled.

(b) Describe the Physiology of seed germination.

GASEOUS EXCHANGE AND RESPIRATION

50. **(a)** Difference between aerobic and anaerobic respiration.

(b) Describe what happen to the end product of glycolysis in absence of oxygen.

(c) Why is it important to produce ATP during cellular respiration?

51. **(a)** Compare the process of gaseous exchange and ventilation in bony fish.

(b) Explain how respiratory compound liquids enter the Krebs cycle in the cell of a living organism

52. **(a)** Describe how the structure of mitochondria are modified to suite their function.

(b) Explain the mechanism that leads to the formation ATP molecules that occur involving inner membrane of mitochondria.

LOCOMOTION AND SUPPORT

53. **(a)** What problem of support and locomotion do terrestrial animal face.

(b) How is support achieved in a woody plant?

54. **(a)**Describe the methods of movement without use of muscles in animals.
(b) Explain the differences in energy expenditure a running animal and an equal size fish specialized for swimming. **(08 marks)**

55. **(a)** Describe the different ways in which continuous exercise promote muscle performance in human
(b) Explain how flight is achieved in insects.

COORDINATION

56. **(a)** Describe **the structure** of mammalian retina. **(10 marks)**
(b) Explain how **fast** speed of impulse transmission is ensured in nerve cells? **(10 marks)**

57. **(a)** Describe structure of neurons in the Central nervous system. **(07 marks)**
(b) Explain processes that lead to transmission and inhibition of nerve impulses along axons of neurons**.** **(13 marks)**

ECOLOGY

58. Explain of each of the following in an eco-system.
(i) Competition.
(ii) Host parasite relations.

59. **(a)** Compare the adaptation of life on land shown by insects and mammals. **(08 marks)**
(b) Describe the adaptation of aquatic organisms for existence in their habitants.

60. **(a)** Explain what is meant by each of the following ecological terms
(i) Natural resources
(ii) Indicator species
(b) Discuss the significance of conservation of natural resources in an ecosystem
(c) Explain how indicator species can be applied to monitor levels of pollution of particular natural resources.

BEHAVIOUR

61. **(a)** Distinguish between;
a. Insight and imprinting
b. Aggression and altruism
(b) Explain the significance of
(i) Territoriality behavior
(ii) Habituation
(c) Explain how a bee can communicate the location of a food source.

NUTRITION

62. **(a)** Explain the significance of **pigments** and **light** in photosynthesis. **(12 marks)**
(b) How does altitude **affect distribution** of C_3 and C_4 plants? **(08 marks)**

PRACTICAL (PAPER III)

63. **(a)** You are provided with specimen **R.** Classify it into the following groups;
(i) Kingdom
(ii) Phylum
(iii) Class
(b) Observe the head of the specimen and state how it is adapted to its habitat.
(c) Dissect **R** to display the main superficial muscles of the left thigh of the specimen. Draw and label the muscles.
(d) Continue to dissect the specimen to display;
(i) The blood vessels that drain blood from the alimentary canal and its associated organs back to the heart, with the alimentary canal displaced to your right and the heart turned upwards and pinned through the ventricle.
(ii) The blood vessels that take blood from the heart to the thoracic region of the animal.
(iii) Draw and label your dissection showing (i) and (ii) on one diagram.

64. You are provided with specimen **K**. Examine it carefully and answer the questions that follow;
(a) Stretch one hind limb of the specimen and examine it using a hand lens.
i. Draw and label the region of the limb anterior to the foot.
ii. Outline the adaptations of the foot that enable the animal to efficiently locomote.
(b) i) Remove and spread one inner wing of specimen. Examine it using a hand lens. Draw but **do not** label.
ii) State two differences in the Venn diagram between the inner wing and the outer wing.
(c)(i) Dissect the specimen by cutting along the lateral side of the specimen to expose only the abdominal structures. Draw and label in undisturbed condition.
(ii) By further dissection, open up the thoracic region by cutting along the right lateral side. Displace the alimentary canal to the left. Immerse the specimen in water fully. Draw and label all the buoyant internal structures visible in the specimen.

PART I: ORGANISATION IN CELLS AND ORGANISMS

STRUCTURE AND FUNCTION OF CELLS

1. (a) Distinguish between **cell organelle** and **cell inclusion** (02 Marks)
(b) Describe the fine structure of the following: (13 Marks)
(i) Golgi complex (ii) Nucleus (iii) Mitochondrion
(c) Relate structure to functioning in each of the structures in (b) above. (05 marks)

2. (a) Describe the structure of plant cell wall (10 Marks)
(b) Compare the structures of plant cell wall and plasma membrane (07 Marks)
(c) Describe how membrane structure is related to traffic of materials across. (12 marks)

3. (a) Describe the functioning of Golgi apparatus in animal cells. (14 marks)
(b) Give an account of roles of lysosomes in animal cells. (06 marks)

4. Give an account of the distribution and functions of the membranes of cells. (20 marks)

CHEMICALS OF LIFE

5. Relate the properties of water to its biological importance. (20 marks)

6. (a) Why are enzymes essential in biotic systems? **(04 marks)**
(b) How is enzyme activity regulated in cells? **(16 marks)**

7. (a) Describe the structure of triglycerides. (**06 marks)**
(b) Account for the functions of lipids in the bodies of organisms. **(14 marks)**

8. (a) Give the differences between fibrous and globular proteins. **(04 marks)**
(b) With examples, explain the factors causing protein denaturation. **(12 marks)**
(c) Give four differences between polysaccharide and polypeptide chains.

9. (a) What is a protein? **(03 marks)**
(b) Discuss with suitable examples the variety of functions of proteins. **(13 marks)**
(c) Explain how their structure permits this wide variety of functions. **(04 marks)**

10. (a) In what ways do lipids differ from carbohydrates? **(04 marks)**
(b) Using examples, account for the functions of lipids in organisms. **(10 marks)**
(c) Why do many organisms store lipids rather than carbohydrates? **(06 marks)**

11. (a) What structural features of carbohydrates account for the wide variety of polysaccharides? **(07 marks)**
(b) Give differences between cellulose and glycogen. **(07 marks)**
(c) Why are lipids more suitable storage compounds in animals than glycogen? **(06 marks)**

CELL PHYSIOLOGY (MOVEMENT IN AND OUT OF CELLS)

12. **Figure 1** shows changes in the different potentials of a fully plasmolysed plant cell placed in a hypotonic solution.
Figure 2 shows the rate of movement of two different substances across a phospholipid membrane; glucose by facilitated diffusion and water by simple diffusion, at varying extracellular concentration.

Figure 1

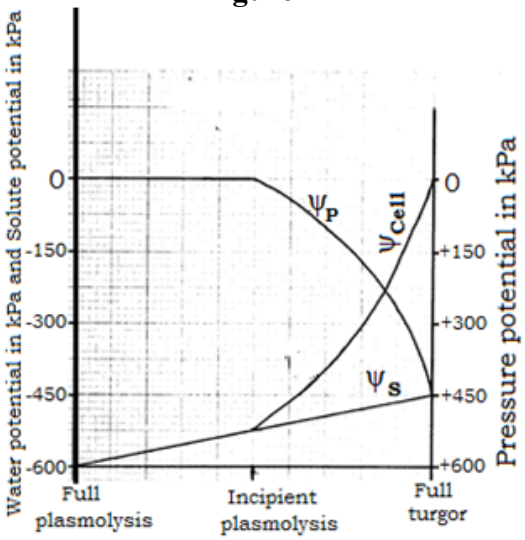
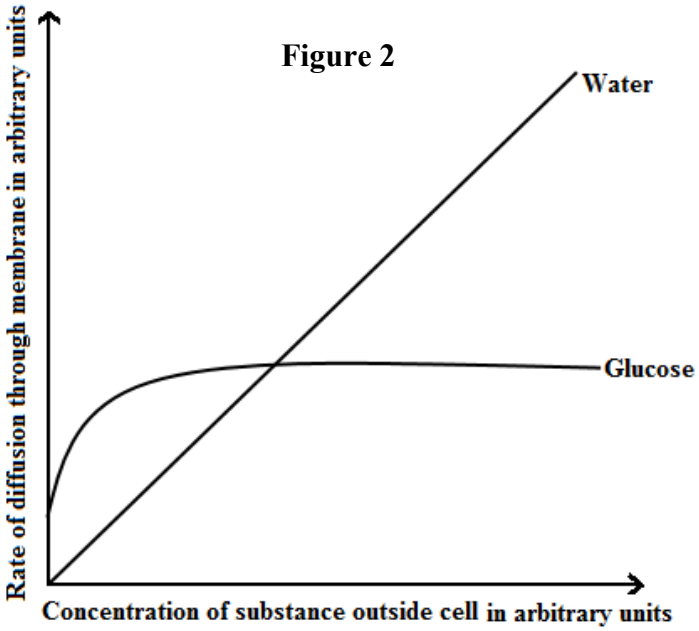


Figure 2



(a) From **figure 1,** compare the changes in pressure potential and water potential from full plasmolysis to full turgor. **(05 marks)**
(b) As indicated in **figure 1**, explain the change in water potential from full plasmolysis to full turgor. **(15 marks)**

From **figure 2:**
(c) Describe the effect of increasing extracellular concentration:
(i) on glucose uptake. **(07 marks)** **(ii)** on water uptake **(05 marks)**
(d) Explain the observed rates of uptake of glucose and water. **(08 marks)**

LEVELS OF ORGANISATION AND DIVERSITY OF LIFE

13. (a) Describe the distribution and structure of simple plant tissues in stems. **(14 marks)**
(b) Explain how the structure of tissues responsible for water transport in plants relates to function.

14. (a) State five similarities between angiosperms and conifers that allow them to be classified together. **(05 marks)**
(b) State five differences between angiosperms and conifers which mean they belong to separate groups. **(05 marks)**
(c) List five features which distinguish dicotyledons from monocotyledons. **(05 marks)**
(d) Briefly explain how angiosperm reproduction is suited for terrestrial conditions. **(05 marks)**

15. (a) Outline the unique features of bacteria. **(07 marks)**
(b) Briefly describe the four nutritional categories of bacteria **(08marks)**
(c) How are bacteria economically important? **(05 marks)**

PART II: THE MAINTENANCE OF LIFE

NUTRITION

16. (a) Describe the basic structure of a chlorophyll molecule (07 Marks)
(a) (b) Describe the physical and chemical mechanisms by which solar energy is converted into the chemical energy of ATP during the light stage of photosynthesis (06 Marks)
(b) (c) Give an account of how atmospheric carbon dioxide gets incorporated into a hexose sugar in the Calvin cycle. (07 Marks)

17. (a) Explain photophosphorylation in terms of chemiosmosis. (10 marks)
(b) Outline the light-independent reactions of photosynthesis. (10 marks)

18. (a) Discuss the feeding mechanisms animals use. (10 marks)
(b) Describe the control of secretion of digestive juices in man. (10 marks)

19. (a) What are the differences between the digestive systems of herbivorous and carnivorous mammals? (08 marks)
(b) Discuss the main advantages of a parasitic mode of life. (05 marks)
(c) Give an account of the major adaptations shown by parasites, using plant and animal examples. (07 marks)

20. The dye reduction technique was used in a controlled experiment conducted to analyze the effects of different conditions on the photosynthetic rate of incubated chloroplast suspensions.
Each chloroplast suspension was mixed with **Dichloro phenol indophenol** (DCPIP), an electron acceptor that changes from blue to colourless when it is reduced. Each sample was placed individually in a spectrophotometer and the percentage transmittance was recorded.
The three samples used were prepared as follows:
• ***Sample 1*** — chloroplast suspension + DCPIP
• ***Sample 2*** — chloroplast suspension surrounded by black foil wrap + DCPIP
• ***Sample 3*** — chloroplast suspension that has been boiled + DCPIP

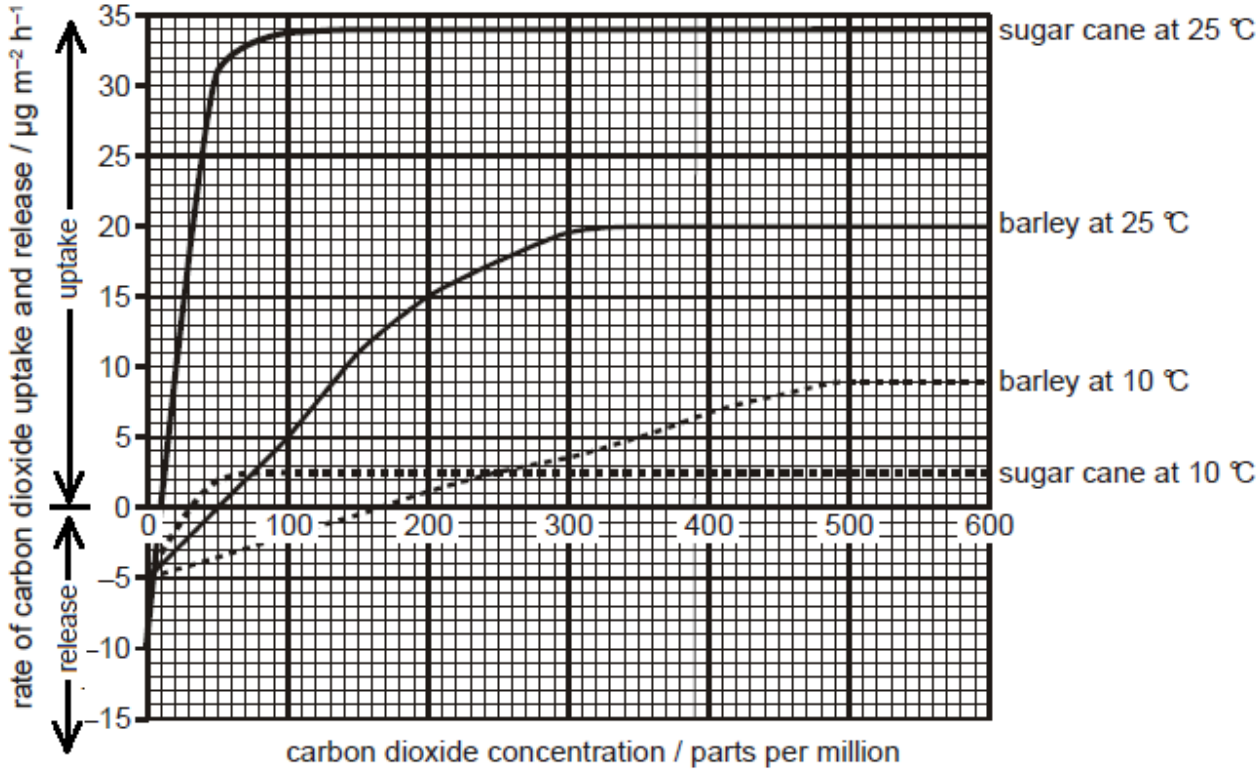
Table 1

Time (Minutes)	Transmittance (%)		
	Sample 1	Sample 2	Sample 3
0	28.8	29.2	28.8
5	48.7	30.1	29.2
10	57.8	31.2	29.4
15	62.5	32.4	28.7
20	66.7	31.8	28.5

(a) On the same axes, present the results in table 1 graphically. ***(07 Marks)***
(b) From your graph, explain the difference in transmittance for the three different samples of results. ***(08 Marks)***

In another investigation on photosynthesis using a carbon dioxide analyser, the rate of carbon dioxide absorption by undetached leaves of two plants, barley and sugar cane, was measured. The leaves enclosed by a carbon dioxide analyser were provided with air, moving at a constant rate. Light intensity was kept constant and high, equivalent to full sunlight.

The results of the investigation



(c) Explain the observed carbon dioxide uptake / release in the two species at the different temperatures. ***(15 marks)***

(c) Explain the necessity of:

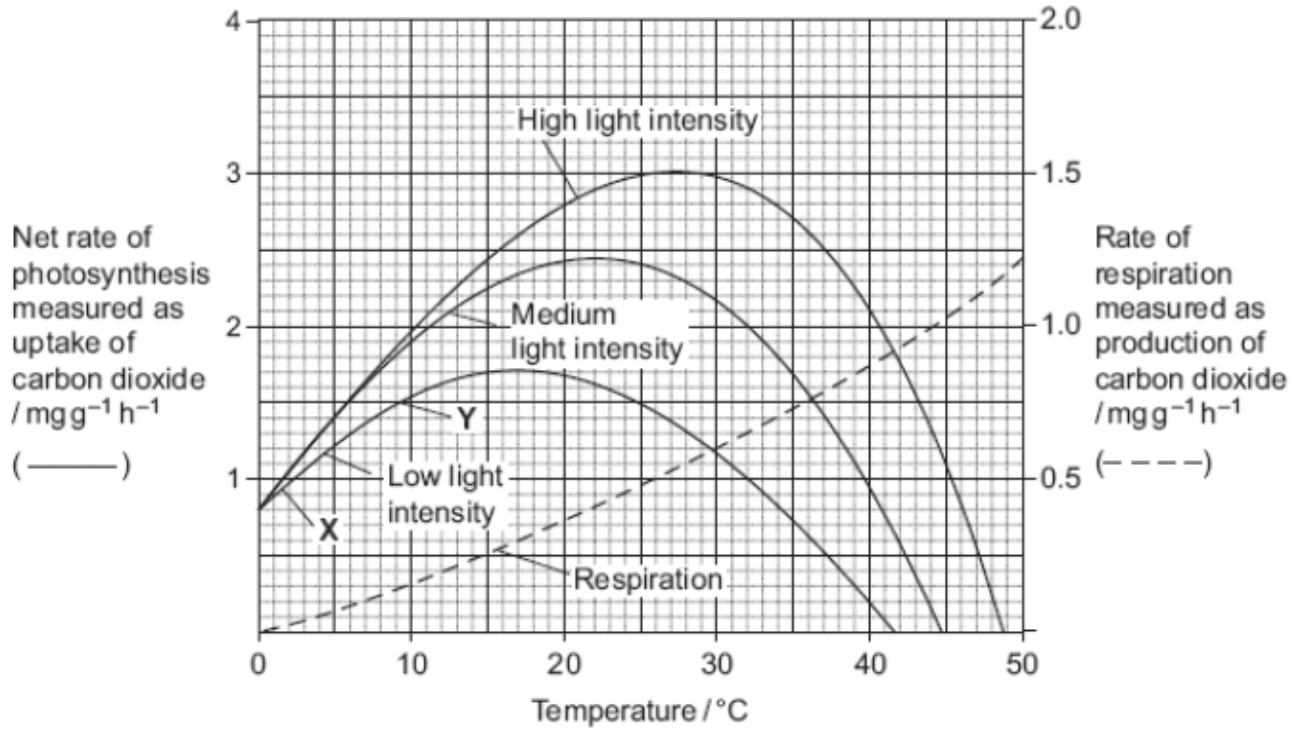
(i) Measurements being made at the same and high light intensity. ***(02 marks)***

(ii) Leaves remaining attached to the plant during the experiment. ***(02 marks)***

(e) Compare the response of the two species, sugar cane and barley, to differences in carbon dioxide concentration and temperature. ***(06 marks)***

21. Scientists investigated the effects of temperature and light intensity on the rate of photosynthesis in creeping azalea plant. They investigated the effect of temperature on the **net rate** of photosynthesis at three different light intensities. They also investigated the effect of temperature on the rate of respiration. Figure 1 shows the results.

Figure 1



(a) What is meant by **net rate** of photosynthesis?

(b) (i) Explain the factors that limited the rate of photosynthesis from point marked X to Y.

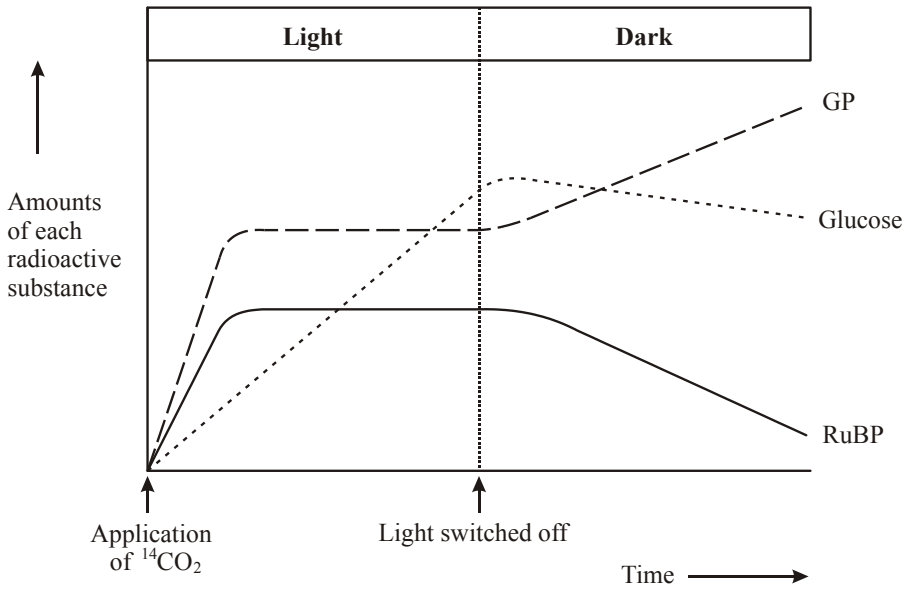
(ii) Comment on the photosynthetic efficiency of azalea plant at different light intensities

(c) Compare respiration and photosynthesis at high light intensity.

(d) Explain the rate of respiration as shown in the graph.

Figure 2 shows the results of an experiment in which photosynthesising cells were kept in the light and then in darkness.

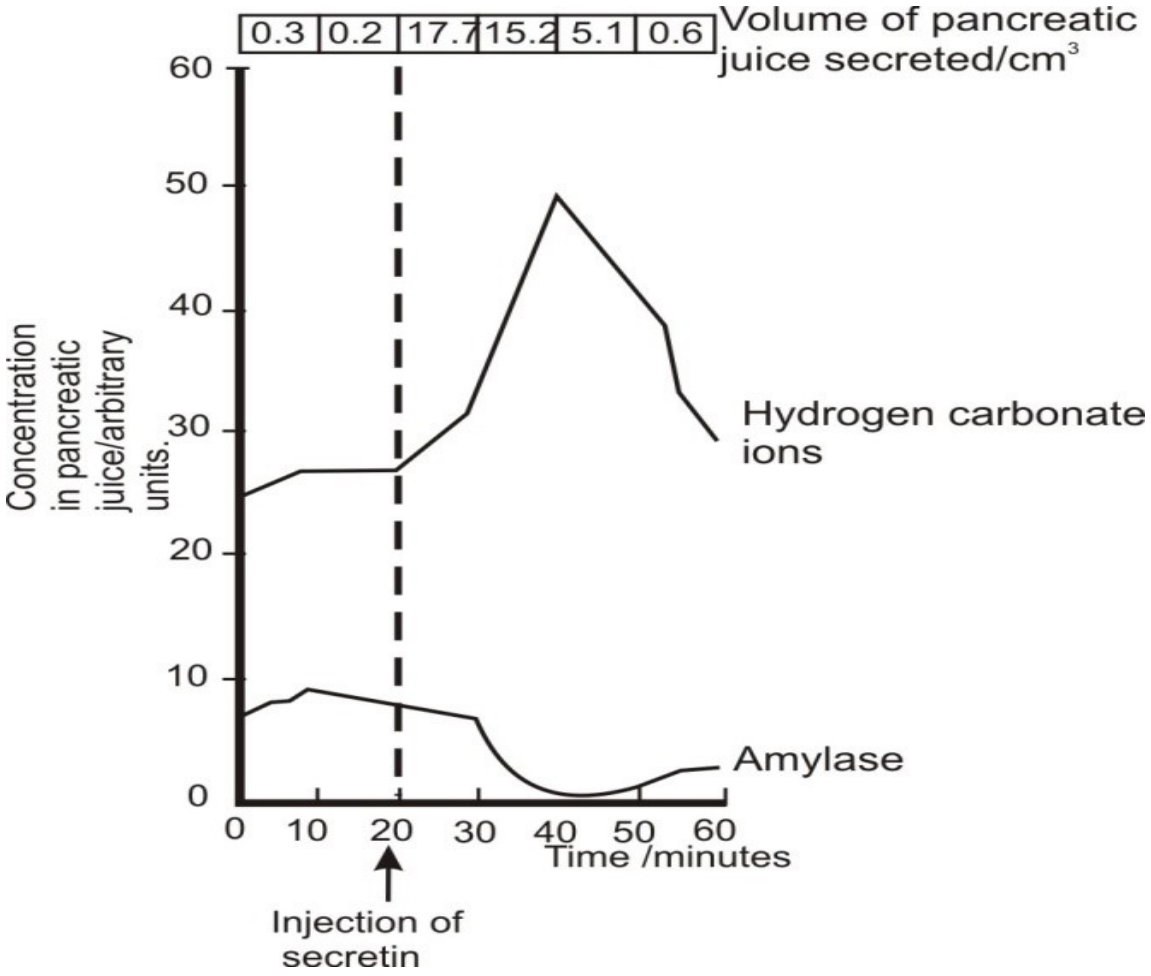
Figure 2



(e) Explain the effect of varying illumination cycles on the amounts of each radioactive substance.

22. Figure I below shows how an injection of secretin affects the secretion of pancreatic juice by the pancreas.

Figure I



From Figure I above:

(i) Use the graph to describe the effect of secretin on the pancreas. **(10 marks)**

(ii) Explain why the concentration of amylase in the pancreatic juice decreased shortly after the injection of secretin. **(06 marks)**

What other digestive secretion is stimulated by secretin. **(02 marks)**

Certain types of ulcer are thought of to be made worse by the production of too much acid from the stomach. Doctors have used a number of different methods to treat these ulcers. Suggest how the following treatments might reduce the amount of acid secreted by the stomach:

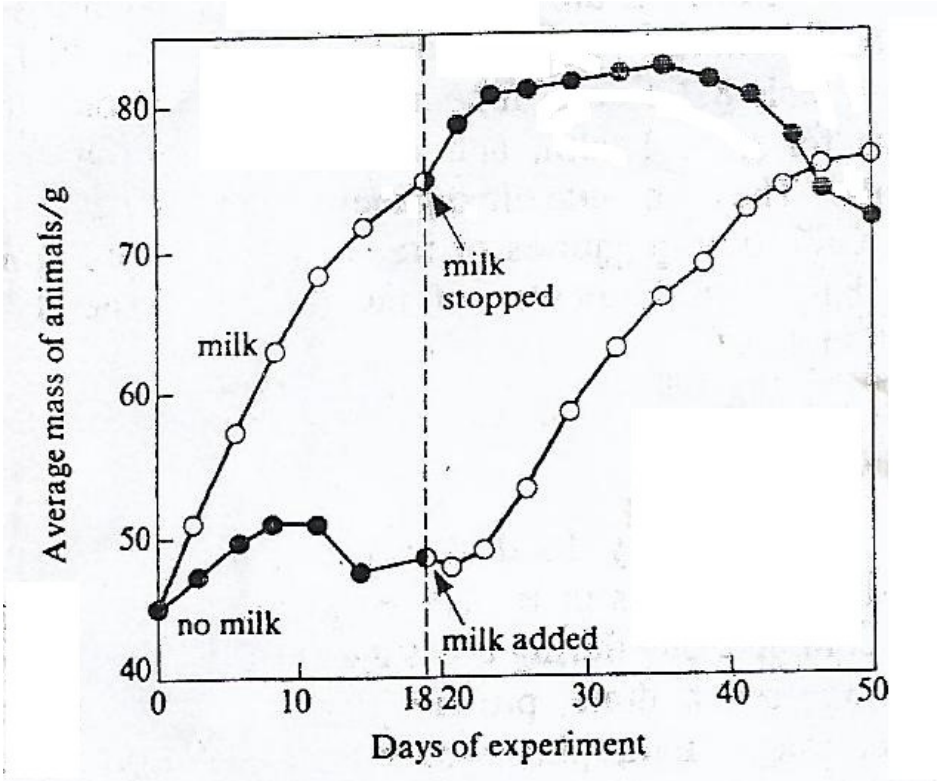
Cutting the vagus nerve to the stomach. **(05 marks)**

(ii) Giving the patient atropine, a drug which blocks the action of acetylcholine. **(05 marks)**

Figure II below shows the results of an experiment in which two sets of eight young rats were fed on a diet of pure casein, starch, sucrose, lard, inorganic salts and water.

The first set received additionally 3 cm^3 of milk per day for the first 18 days.

On day 18, the extra milk was denied the first set, but given to the second set of rats instead.



From Figure II above:

What hypothesis can you deduce from the graph? **(03 marks)**

Give reasons for your answer in (d) above. **(06 marks)**

Why is a diet of milk inadequate for an adult? **(03 marks)**

GAS EXCHANGE

23. **Figure I** below shows the pressure changes in the buccal and opercular cavities of a teleost fish obtained by using hypodermic tubing connected to a pressure recorder. Negative pressure indicates expansion while positive pressures mean contraction of the cavities.

Figure I

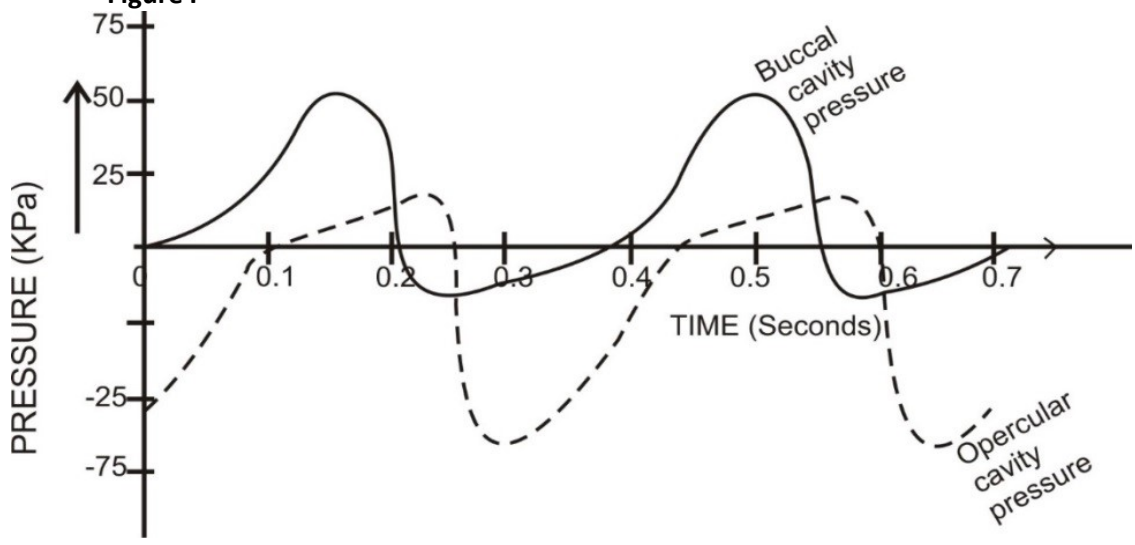
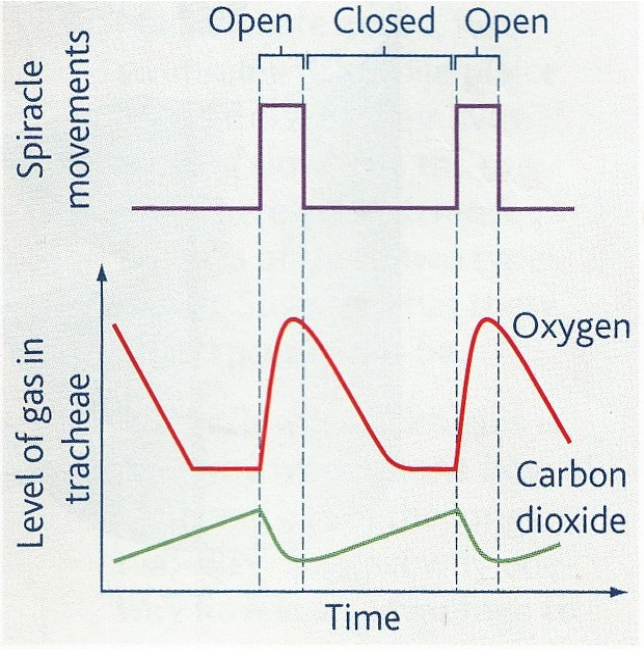


Figure II below shows results of an experiment which measured the levels of oxygen and carbon dioxide in the tracheal system of an insect over a period of time. During the experiment, the opening and closing of the insect's spiracles was observed and recorded.

Figure II



From Figure I:

(a) Compare pressure changes in the buccal cavity and opercular cavity in the first 0.4 seconds. **(08 marks)**

(b) Account for the observed changes in pressure in the buccal and opercular cavities from 0.2 seconds to 0.6 seconds **(12 marks)**

(c) What is the physiological significance of the difference between the pressure in the buccal and opercular cavities? **(03 marks)**

From Figure II:

(d) Describe the pattern of level of gases in tracheae in relation to spiracle movements. **(04 marks)**

(e) Explain the pattern of level of gases in tracheae in relation to spiracle movements. **(06 marks)**

(f) (i) From the information provided by the graph, suggest the causes of spiracle opening. **(02 marks)**

(ii) What is the advantage of the observed spiracle movements to a terrestrial insect? **(05 marks)**

24. (a) Compare the suitability of air and water as gas exchange media. *(12 marks)*
(b) Explain why most plants lack specialized organs for gas exchange *(04 marks)*
(c) Despite the high efficiency of gills as respiratory structures in aquatic environments, terrestrial animals do not use gills for gaseous exchange. Explain. *(04 marks)*

25. (a) Compare the structures and mechanism of gaseous exchange in humans and frogs. *(10 Marks)*
(b) Describe the involuntary control of breathing in humans. *(10 Marks)*

RESPIRATION

26. (a) Explain the reactions that occur in the matrix of the mitochondrion that are part of aerobic respiration. ***(10 marks)***
(b) Outline the role of oxygen in providing cells with energy. ***(05 marks)***
(c) Describe the central role of acetyl CoA in carbohydrate and fat metabolism. ***(05 marks)***

27. ***Figure I*** shows results from the experiment of simultaneous saccharification and fermentation of steam-pretreated sugarcane (*Saccharum officinarum*) bagasse by ***Saccharomyces cerevisiae,*** a strain of yeast. Bagasse, the fibrous residue obtained after extracting juice from sugar cane consists approximately of 50% cellulose, 25% hemicellulose, and 25% lignin.

Figure I

During the experiment, temperature of the medium was maintained at 37^0C, and initial pH adjusted to 6.1. Nitrogen was flushed into the reaction vessels at the beginning of the experiment.

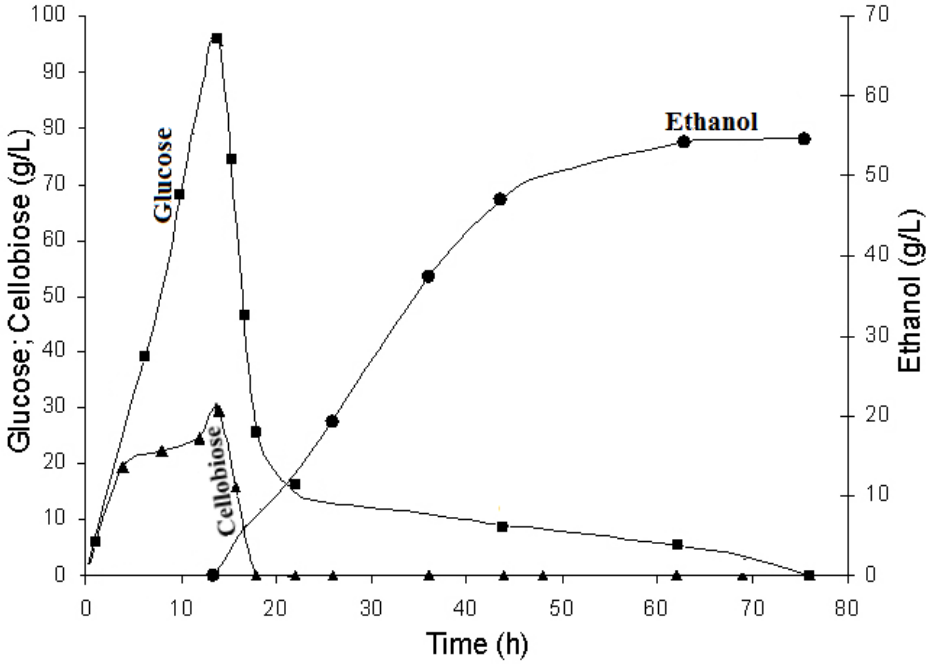
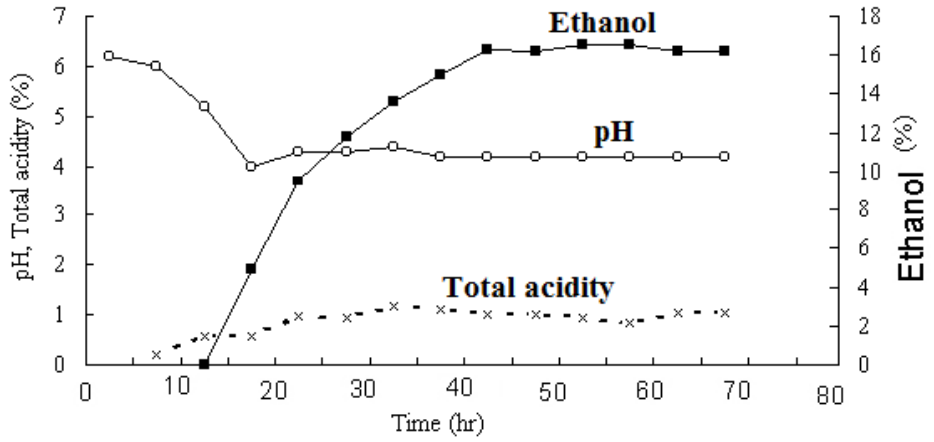


Figure II shows changes in pH and total acidity during the same period of time.

Figure II



(a) From **figure I:**
(i) Describe the changes in the concentration of sugars and ethanol. (10 marks)
(ii) Explain the changes in the concentration of sugars and ethanol. (10 marks)

(b) Explain the necessity of the following in the experiment:
(i) Steam-pretreatment of sugarcane bagasse (05 marks)
(ii) Adjustment of pH to 6.1 (02 marks)
(iii) Flushing nitrogen into the reaction vessel. (02 marks)

From **figure II:**
(c) Explain the observed changes in pH and total acidity of the medium during the experiment. (07 marks)
(d) Suggest one reason for the observed efficiency of the experiment. (04 marks)

28. Five small discs cut from spinach leaves were floated on a small volume of buffered hydrogen carbonate solution in a flask attached to a respirometer. The discs were first exposed to bright light, then to dim light and finally left in the dark. Oxygen release was recorded as positive values and oxygen uptake as negative values.

The results obtained from this experiment are given in table 1.

Table 1

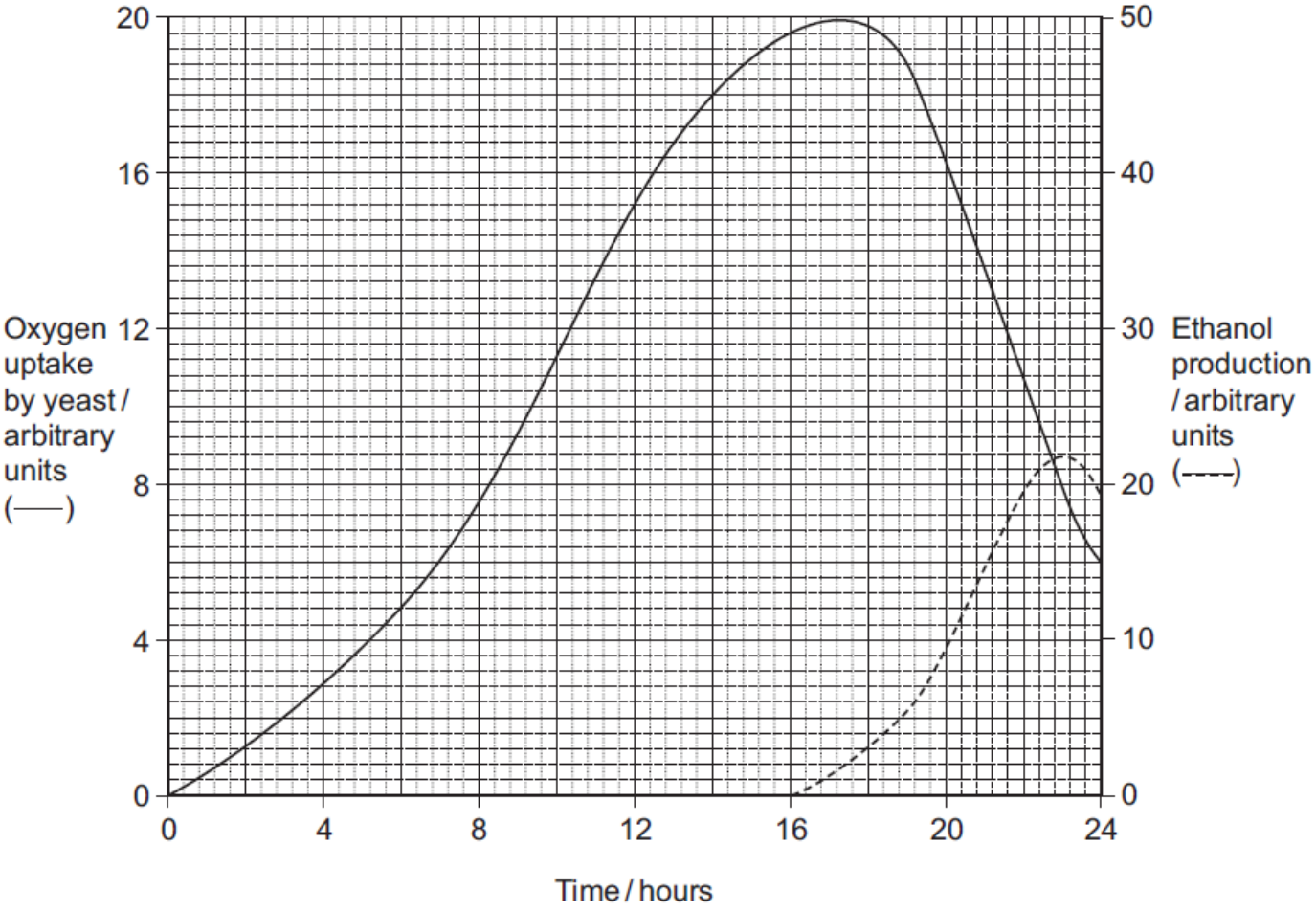
Light intensity	Time interval in minutes	Oxygen uptake or release for each 3 minutes interval in mm^3
Bright light	0 – 3 3 – 6 6 – 9 9 – 12	+57 +64 +58 +60
Dim light	12 – 15 15 – 18	+16 +3
Dark	18 – 21 21 – 24 24 – 27 27 – 30	- 16 - 12 - 15 - 14

(a) Present the data in suitable graphical form (06 Marks)

(b) (i) Calculate the mean rate of oxygen release in bright light (03 Marks)
(ii) Explain the significance of the results obtained from this experiment. (08 Marks)

(c) Explain the use of the following in the experiment above: (03 Marks)
(i) Five small leaf discs, not one.
(ii) HCO_3^{2-} solution
(iii) Buffered solution

In an experiment, a student investigated respiration in a population of yeast growing in a sealed container whose results are shown in the graph below.



(d) Calculate the rate of oxygen uptake between 2 and 4 hours. ***(02 marks)***

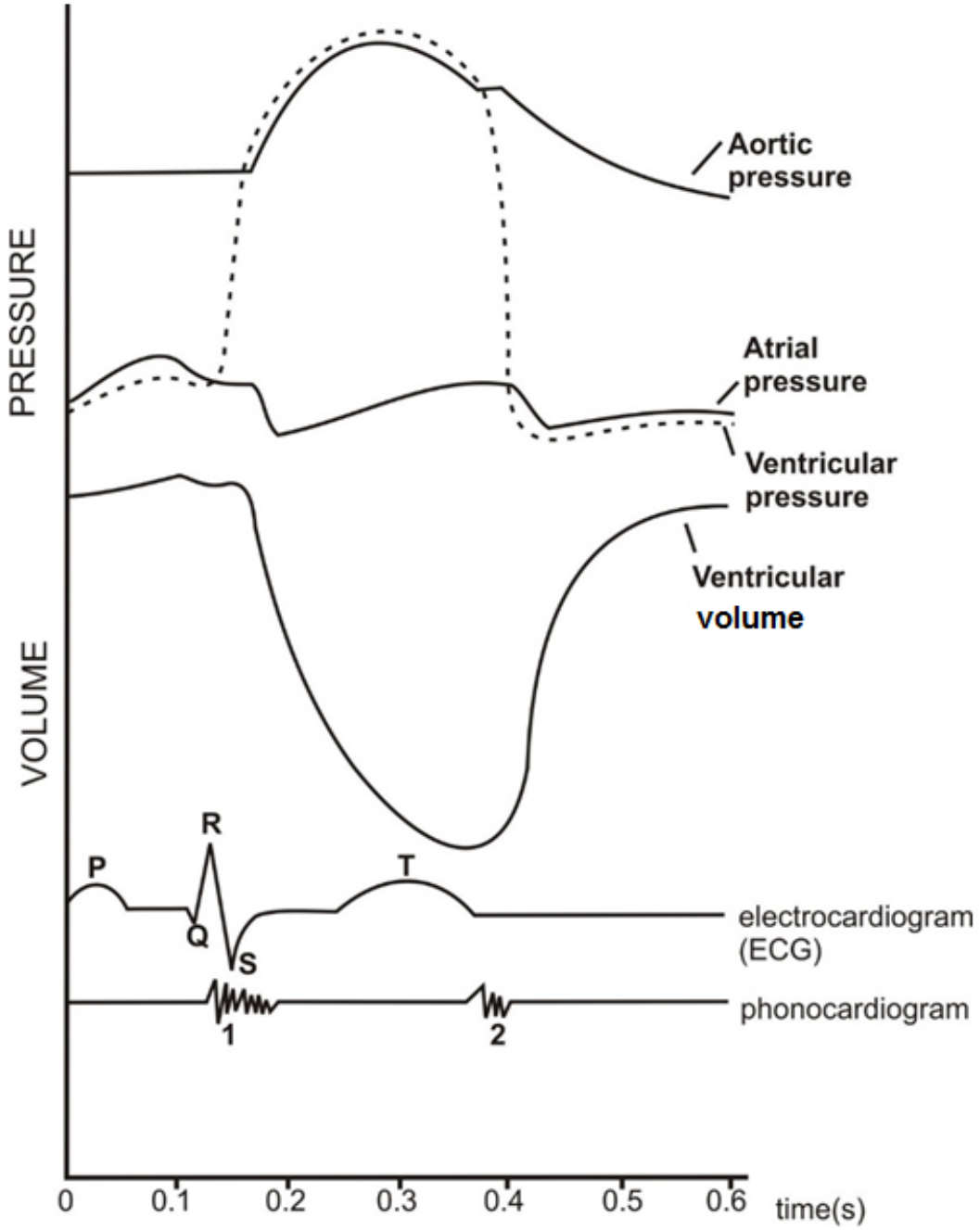
(e) During the period of investigation, account for the changes in:
(i) Oxygen uptake during this investigation. ***(06marks)***
(ii) Ethanol during this investigation. ***(05 marks)***

(f) The student repeated the investigation but added sodium azide after 4 hours. Suggest and explain how the addition of sodium azide would affect oxygen uptake and the production of ethanol. ***(04 marks)***

(g) Give other commercial applications of fermentation. ***(03 marks)***

TRANSPORT

29. The figure below shows the pressure and volume changes that occur during the mammalian cardiac cycle (of a dog). The pressure changes were measured in the left atrium and ventricle, and the aorta. Volume changes were measured for both ventricles.
The electrical activity in the heart wall (electrocardiogram) and heart sounds (phonocardiogram) as recorded in a human subject are also shown.



(a) Describe the changes in:
(i) Atrial pressure. **(07 marks)**
(ii) Ventricular pressure. **(07 marks)**
(b) What are the differences in the changes in ventricular pressure and ventricular volume between 0.1 seconds and 0.5 seconds? **(03 marks)**

(c) Explain the effect of the changes in atrial, aortic and ventricular pressures to blood flow during the cardiac cycle. **(15 marks)**

(d) Explain the pattern of:
(i) Electrical activity **(03 marks)**
(ii) Sounds on the phonocardiogram. **(02 marks)**
(e) Explain how the internal heart structure is related to its functioning. **(03 marks)**

30. The table below shows the percentage saturation of haemoglobin with oxygen at varying partial pressures of oxygen in man. The experiment was carried out at two different partial pressures of carbon dioxide.

Partial pressure of oxygen/kPa	**Percentage saturation of haemoglobin with oxygen**	
	At 3 kPa partial pressure of carbon dioxide	At 6 kPa partial pressure of carbon dioxide
0	0	0
1	10	4
2	38	8
4	90	35
6	96	60
7	100	70
11	100	83
13	100	85

(a) Using the same axes, plot the results in a suitable graphical form. (08 marks)
(b) Account fully for the shape of the curve at 3 kPa partial pressure of carbon dioxide. (16 marks)
(c) Explain the position of the curve at 6 kPa with respect to that at 3 kPa partial pressure of carbon dioxide. (08 marks)
(d) Use the graph to explain why human haemoglobin:
(i) is saturated with oxygen in the lungs. (04 marks)
(ii) releases oxygen when it reaches the tissues. (04 marks)

31. The data below was obtained from experiments using plant materials treated as shown below. **Figure I** shows the uptake of potassium ions in an aerated solution by young cereal roots which had previously been thoroughly washed in pure water. After 90 minutes potassium cyanide was added to the solutions.

Figure I:

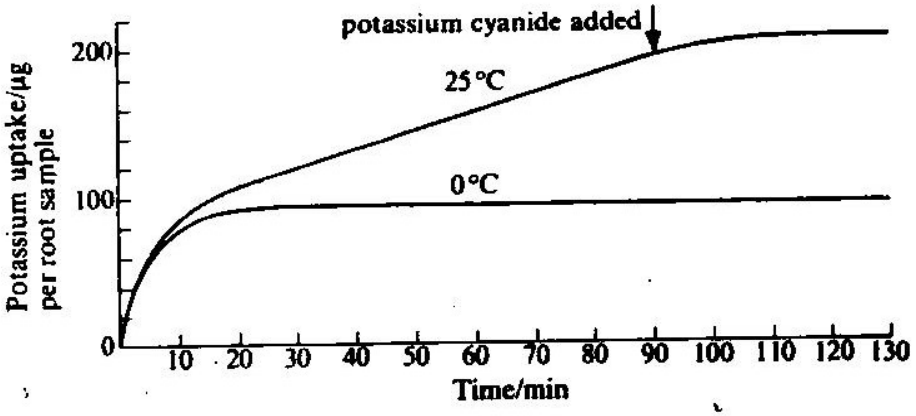
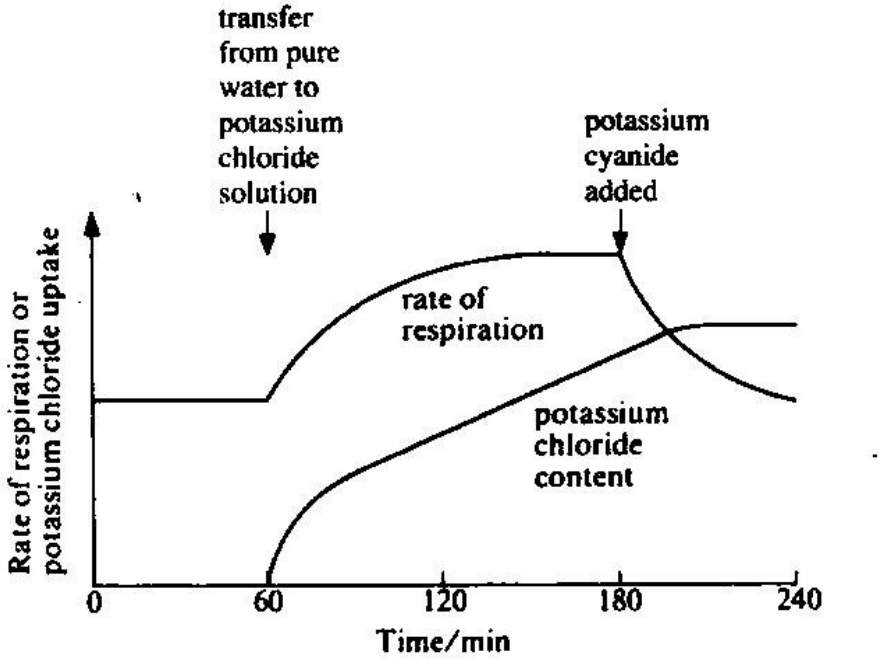


Figure II shows the rate of respiration and uptake of potassium chloride by young carrot discs. The carrot discs had previously been thoroughly washed in pure water and transferred to potassium chloride solution after 60 minutes. Potassium cyanide was added to the solution after 180 minutes.
Figure II:



With reference to figure I:
(a)(i) Compare the change in uptake of potassium ions at 0^0C and 25^0C. (05 marks)
(ii) Explain fully the trend of uptake of potassium ions at 0^0C. (06marks)

(b) Explain why:
(i) The same rapid uptake of potassium ions occurred in the first few minutes of the experiment at both temperatures. (02 marks)
(ii) The uptake of potassium ions at the two temperatures greatly differs for much of the experiment. (06 marks)

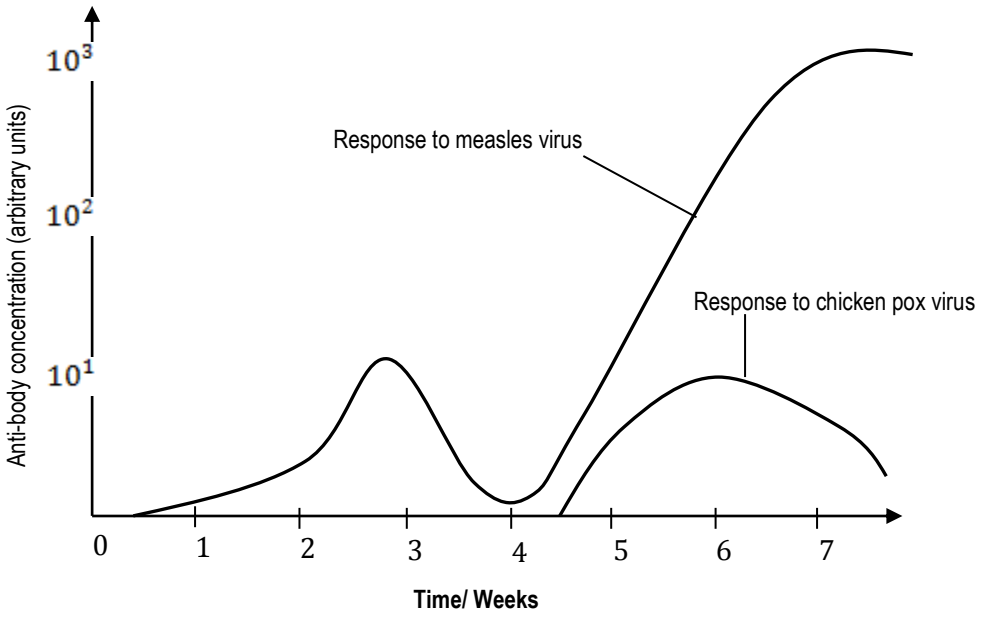
(iii) Potassium cyanide has the effect it does at each temperature. (03 marks)
(iv) The cereal roots were washed before placing them in a solution containing potassium ions. (01 mark)
(v) In a similar experiment, but involving phosphate uptake, 16% of the phosphate taken up by barley roots over a short period could be washed out after transferring to pure water again. (02 marks)
(vi) Ions cannot reach the xylem entirely by means of the apoplast pathway. (03 marks)

With reference to Figure II:
(c) Explain the trend in rate of respiration:
(i) Before addition of potassium cyanide. (09 marks)
(ii) After addition of potassium cyanide. (03 marks)

32. With reference to a mammal, describe the means by which blood circulation is maintained and controlled. (20 marks)

DEFENSE AGAINST DISEASE

33. The concentration of antibodies of a child was measured over a period of eight weeks. The child was exposed to the measles virus at a time 0 weeks when he inhaled droplets from the infected person. At the fourth week, the child was exposed to the measles virus, and at the same time, he was exposed to chicken pox virus. The results are shown in the graph below.



Use the information provided to answer the questions that follow.

a) Compare the variation in concentration of antibodies during the first and the second exposure to the measles virus. **(08 marks)**
b) Account for the differences in (a) above. **(04 marks)**
c) Using the results above, suggest why;
(i) Children who catch measles for the first time suffer symptoms of the disease, but normally recover completely within two to three weeks of being infected. **(05 marks)**
(ii) A person who has had measles normally is immune for life. **(04 marks)**
(iii) A measles patient is mostly infectious about 8-16 days after first infection. **(04 marks)**

d) How do the results above illustrate that the immune response is specific? **(01 mark)**
e) State with reasons the type of immunity illustrated. **(02 marks)**
f) How have the results of this study been applied by humans in the prevention and control of certain human disease? **(02 marks)**

g) Certain plants called Cyanogenic plants use hydrogen cyanide as a defense mechanism against herbivores. The table below shows the average cyanide content of leaves of certain plants of different ages.

Age of leaf (weeks)	Average cyanide content of leaf (mg/100g by weight)
1	9.9
3	4.3
5	2.1
7	1.0
9	0.5
11	0.2
15	0.0

(i) Present the information in the table above graphically. **(04 marks)**
(ii) State the relationship that exists between cyanide concentration and age of the leaf. **(01 mark)**
(iii)In what way could this relationship be of survival value to the plant? **(02 marks)**
(iv)Suggest any other defense mechanisms used by plants. **(03 marks)**

34. (a) Outline the various ways antibodies combat antigens in the human body. (05 marks)
(b) Explain the ways in which the human body gains immunity. (15 marks)

PART III: ADJUSTMENT AND CONTROL

GENERAL PRINCIPLES OF HOMEOSTASIS

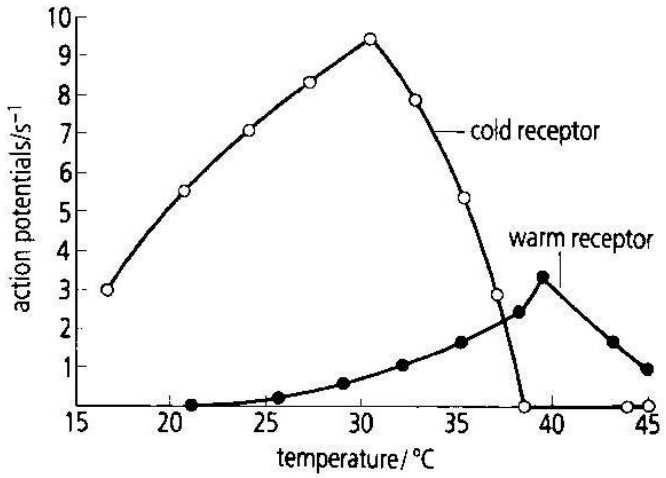
35. Describe how unicellular organisms and cells of multicellular organisms control their internal environment

36. (a) Distinguish between **negative** and **positive** feedback loops. (2 *marks)*
(b) Explain how feedback mechanisms regulate each of the following:
(i) The menstrual cycle in a non-pregnant human female (10 *marks)*
(ii) Blood glucose levels in humans. (08 *marks)*

TEMPERATURE REGULATION

37. **Figure 1** shows the effect of temperature on heat receptors in mammalian skin.

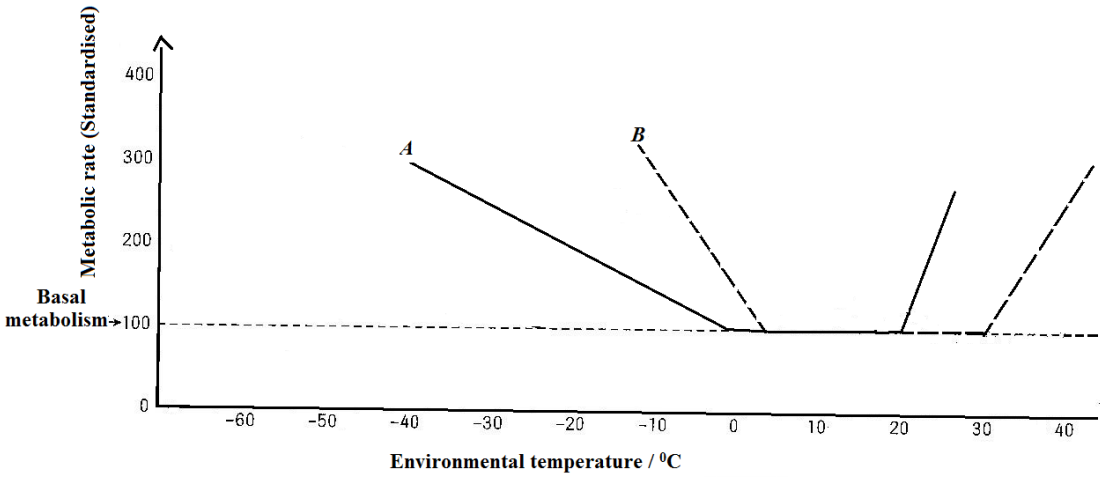
FIGURE 1:



(a) Explain the effect of temperature on the response of:
(i) Cold receptor **(06 marks)**
(ii) Warm receptor **(06 marks)**

Figure 2 shows variation of metabolic rate with environmental temperature in mammals A and B.

FIGURE 2:

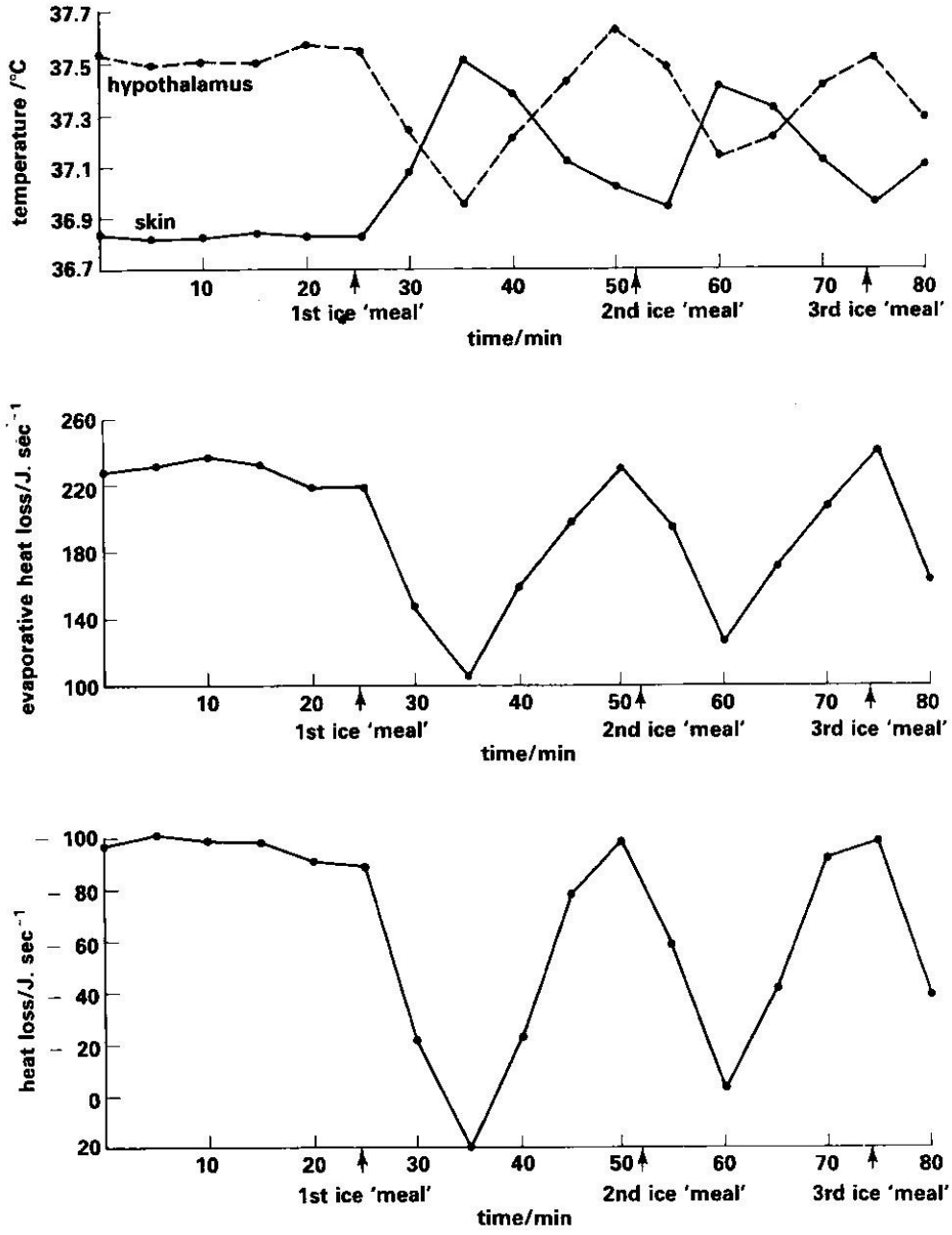


(b) Explain the relationship between metabolic rate and environmental temperature for mammal A. **(12 marks)**

(c) With reasons, suggest the possible habits of mammals A and B. **(04 marks)**

Figure 3 shows the relationship between evaporative heat loss, heat loss, skin and hypothalamus temperatures in humans following experimental ice meals for a human in a warm chamber at 45^0C. Iced water was swallowed at the labelled points.

FIGURE 3:



(d) Account for the relationship between the four variables between the 1st and 2nd ice meals.
(12 marks)

REGULATION OF GLUCOSE

38. In an experiment a person who does not have diabetes ate two slices of white bread. The change in her blood glucose concentration was recorded over the next 120 minutes. The experiment was repeated; first with two slices of brown bread and then with two slices of whole meal bread. Figure 1 shows the results of the three experiments.

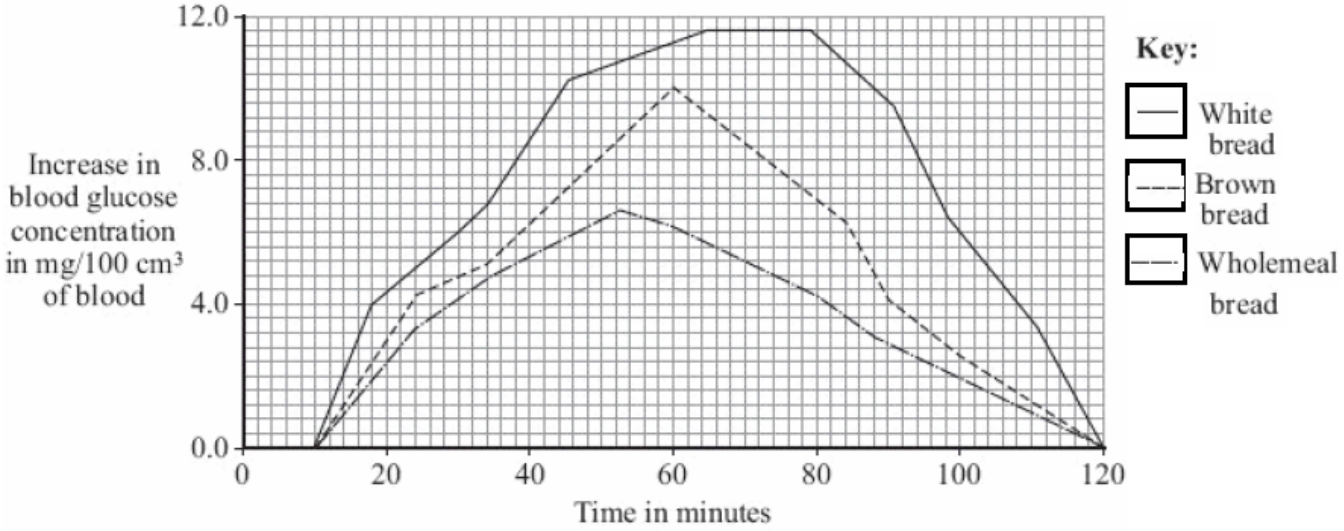
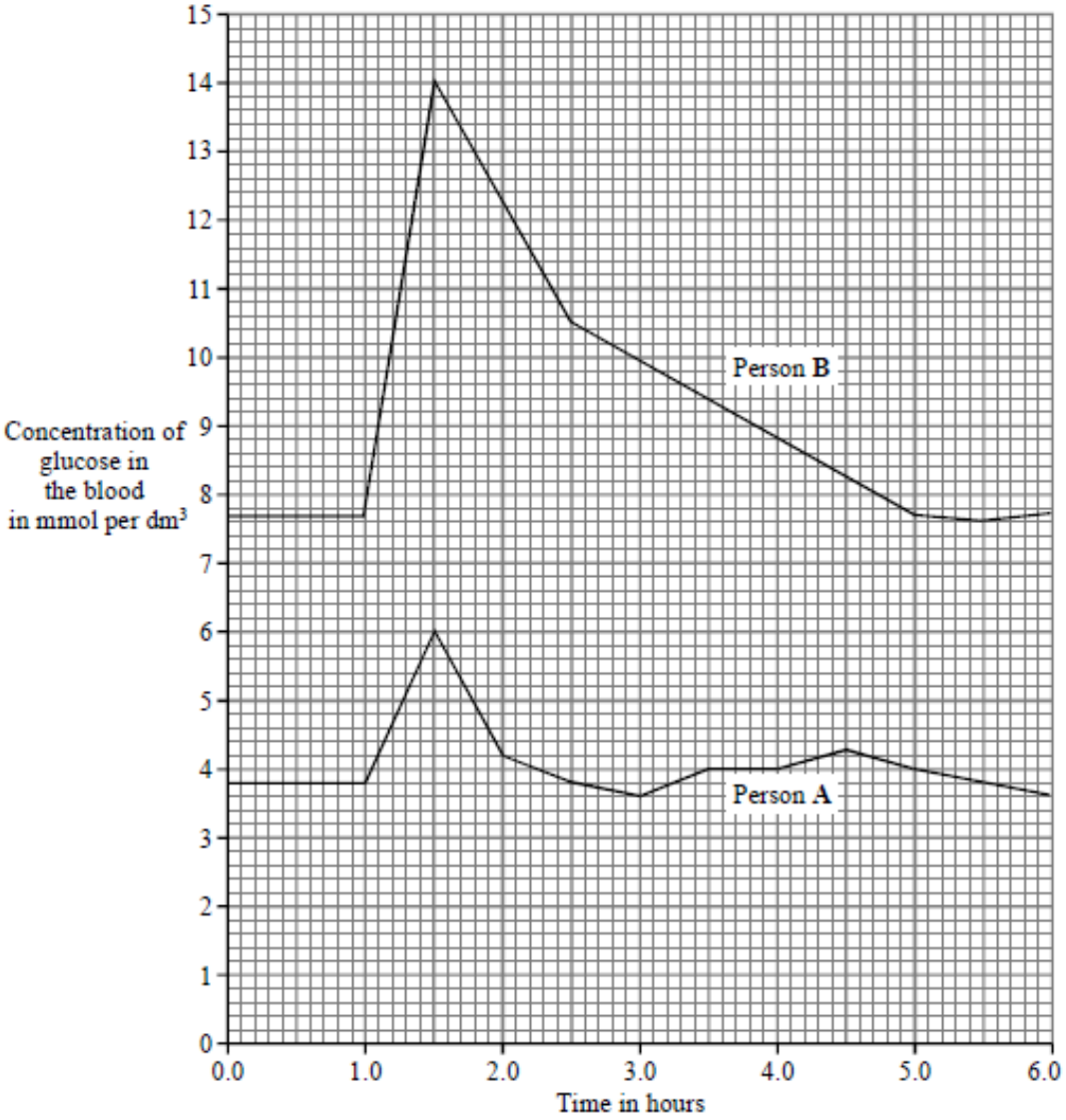


Figure 2 below shows the concentration of glucose in the blood of two people. Person **A** is non-diabetic. Person **B** has diabetes. Each person ate 75 grams of glucose at 1.0 hours.



FROM FIGURE 1:
(a) (i) Which type of bread would be most suitable for a person with diabetes?
(ii) Give two reasons for your answer.

(b) Explain, as fully as you can, the reasons for the changes in blood glucose concentration when the person ate the brown bread.

FROM FIGURE 2:
(c) Explain the observed changes in the glucose concentration in both persons after the meal.

(d) (i) Explain two dangers of having high concentration of glucose in the blood.

Pancreatic-cell transplantation is a new treatment for diabetes. Insulin-making cells are taken from up to three dead donors. The cells are kept alive before being injected into the diabetic in a small operation. The cells soon begin to make insulin. In one recent study 58 % of recipients of pancreatic-cell transplants no longer needed insulin injections.
(ii) Give the advantages and disadvantages of the new treatment for diabetes compared with using insulin injections.

REGULATION OF PH

39. Explain how the following are involved in maintaining pH of body fluids.
(a) Chemical buffer systems **(08 marks)**
(b) Respiratory centre **(07 marks)**
(c) Kidney **(05 marks)**

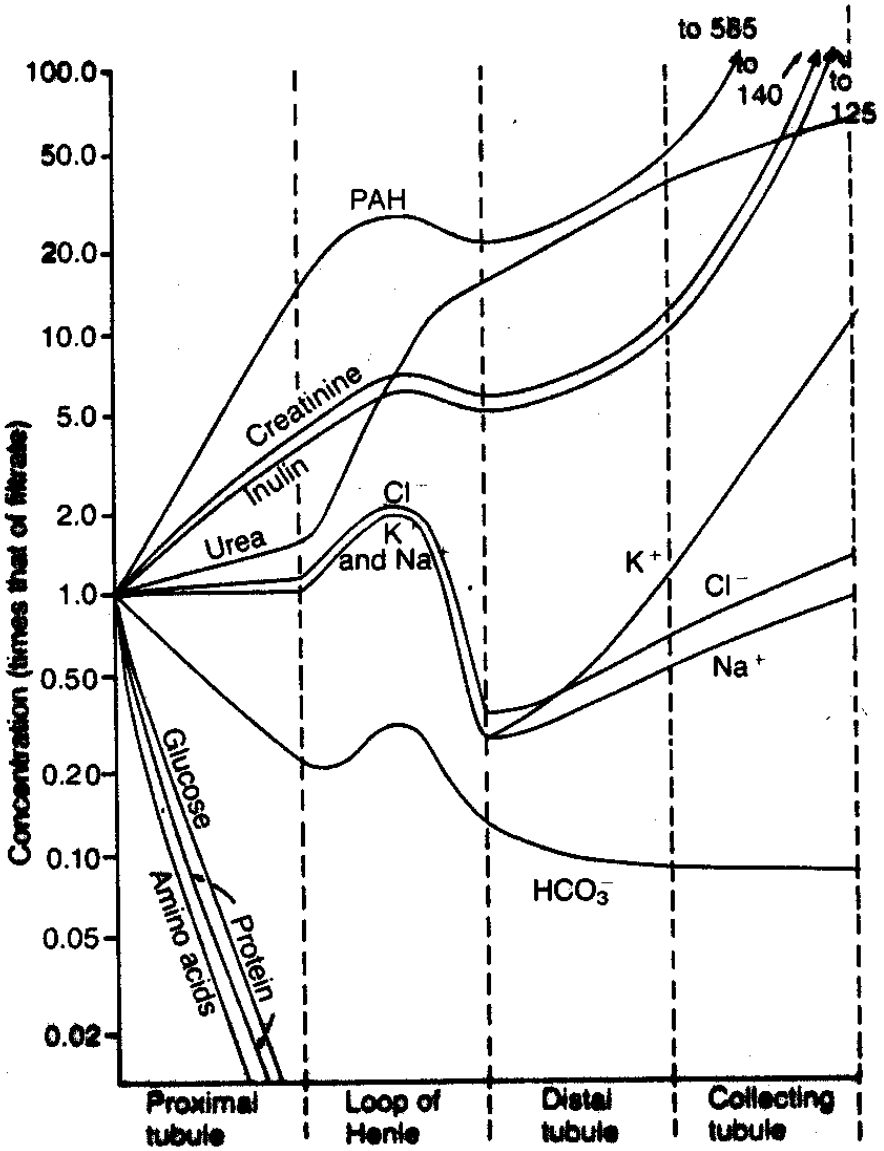
EXCRETION AND OSMOREGULATION

40. Two species of amoeba were transferred from their natural habitats to different dilutions of sea water, and each individual was given time to adjust to its new environment. The table below shows data about the rate of vacuolar contractions with varying solute concentrations.

	Number of vacuolar contractions per hour	
Sea water concentration in % (normal sea water = 100%)	***Species A***	***Species B***
5	82	20
10	74	63
15	65	64
20	58	56
30	34	31
40	14	13
50	0	6
60	0	0

(a) Present the results of the experiment graphically.
(b) Describe the activity of contractile vacuoles with changes in salinity.
(c) Explain by reference to the data, the difference in vacuolar contraction in the two species of Amoeba when placed in the higher concentrations of seawater.
(d) What information may be deduced about the natural habitats of the two species from the rates of vacuolar contractions?

41. The figure below shows variation in concentration of **cations** (K^+, Na^+), **inorganic anions** (HCO_3^-, Cl^-), **organic anion** (*p*-aminohippurate - PAH), **inulin**, (a fructose Polymer), **excretory wastes** (Urea and Creatinine – a product of muscle metabolism derived from creatine phosphate), and **metabolites** (glucose, amino acids and protein of low molecular weight) along the different regions of the nephron. Inulin is not synthesized, destroyed, or stored in the kidneys.



(a) Explain the concentration of the following along the different regions of the nephon:
(i) Ions (ii) Metabolites (iii) Excretory wastes

(b) ***Explain the***:
(i) Absence of cells, immunoglobulins, and large molecular weight proteins in glomerular filtrate.
(ii) Clinical importance of selective filtration of cells, immunoglobulins, and large molecular weight proteins.
(c) ***Explain why the***:
(i) Rate of plasma ultrafiltration in the kidney glomeruli far exceed that in all other capillary beds.
(ii) Proximal tubular fluid is essentially isosmotic to plasma.
(d) What is the significance of producing concentrated urine osmotically to a named land dweller?

42. (a) The **table** below shows changes in percentage of total excretory material of an amphibian with age.

Age of tadpole or frog(days)	Percentage of total excretory material	
	Ammonia	Urea
50	92	8
55	88	12
65	84	16
75	83	17
90	68	32
95	20	80
100	13	87
110	12	88

(i) Represent the tabulated data graphically **(08 marks)**
(ii) Describe the change in the ammonia percentage of total excretory material. **(05 marks)**
(iii) With a reason, identify the period when the animal leaves water. **(02 marks)**
(iv) Explain the need to change the excretory product on transitioning from water to land. **(06 marks)**
(v) State two structural changes that accompany the change in excretory product. **(01 mark)**

43. (a) Describe the source and fate of the major excretory products in living organisms. (13 marks)
(b) Explain how fresh water fishes have been able to overcome their osmoregulatory problems. (07 marks)

44. An investigation was carried out to determine the effect of a strong saline solution on the rate and concentration of urine produced by a dog. The experiment begun with the dog first being allowed to drink water to its full. Then minutes later, it was injected with a strong saline solution through the carotid artery. The dog was then monitored closely and the relevant measurements taken.

The table below shows the results obtained. The rate of urine production was expressed in cm^3 per minute while the corresponding concentration of the urine produced was expressed in arbitrary units. Study the table and the answer the questions that follow:

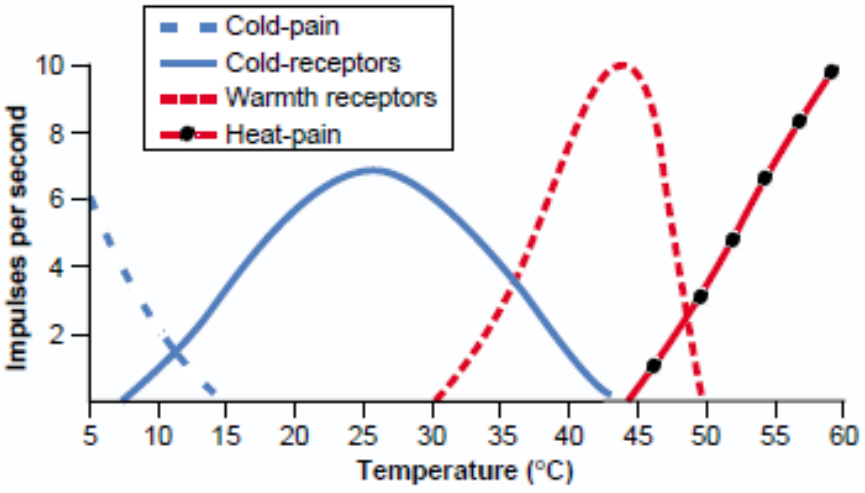
Time (minutes)	0	10	20	30	40	50	60
Rate of urine production (cm^3/min)	6.5	7.3	1.0	2.0	3.3	5.0	6.5
Concentration of urine (arbitrary units)	2.0	2.0	8.0	6.0	3.7	2.0	2.0

(a) Using appropriate scales and the same axes, draw graphs to reflect these results. **(09 marks)**
(b) Explain the inclusion of measurements recorded at time zero (0) in this investigation **(02 marks)**
(c) Comment briefly on the effect of saline solution on:
(i) The rate of urine production
(ii) The concentration of urine produced by the dog during this investigation **(08 marks)**
(d) Account fully for the observed changes in (c) above. **(13 marks)**
(e) Give the main structural and physiological advantages the animals living in arid habitats have for water conservation. **(11 marks)**

PART IV: RESPONSE AND COORDINATION

RECEPTION OF STIMULI

45. Figure **I** below shows the discharge frequencies at different skin temperatures of a pain fiber stimulated by *cold,* a *cold fiber,* a *warmth fiber,* and a *heat-pain fiber.*



(a) From the graph, describe the relationship between temperature and the responses of the four types of nerve fibers. **(15 marks)**

(b) Explain:

(i) Why when the temperature of the skin is actively changing, a person feels much stimulation than when the temperature remains constant. **(05 marks)**

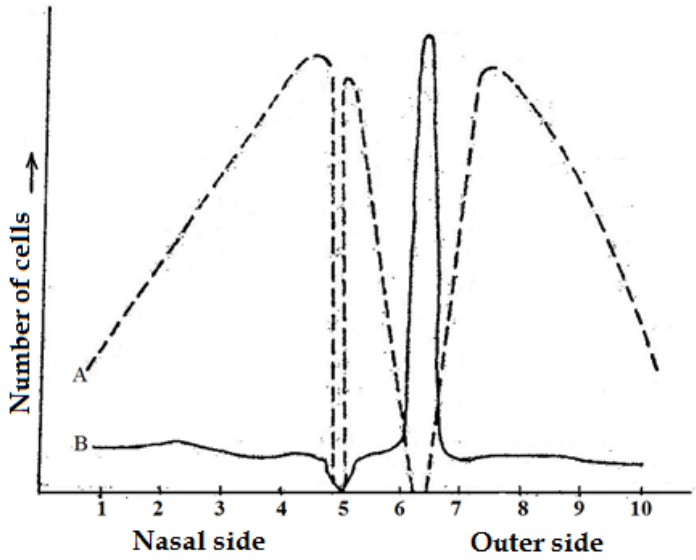
(ii) The significance of the phenomenon in (b) (i) above to an animal. **(02 marks)**

(c) From the graph above, explain:

(i) How a person determines different temperatures of the environment. **(02 marks)**

(ii) Why freezing cold and burning hot sensations can be painful **(01 mark)**

Figure **II** below shows the number of receptor cells **(type A – Rods, Type B - Cones)** in the human retina along a horizontal line from the nasal side of the eye to the outer side. Distances are expressed in arbitrary units.



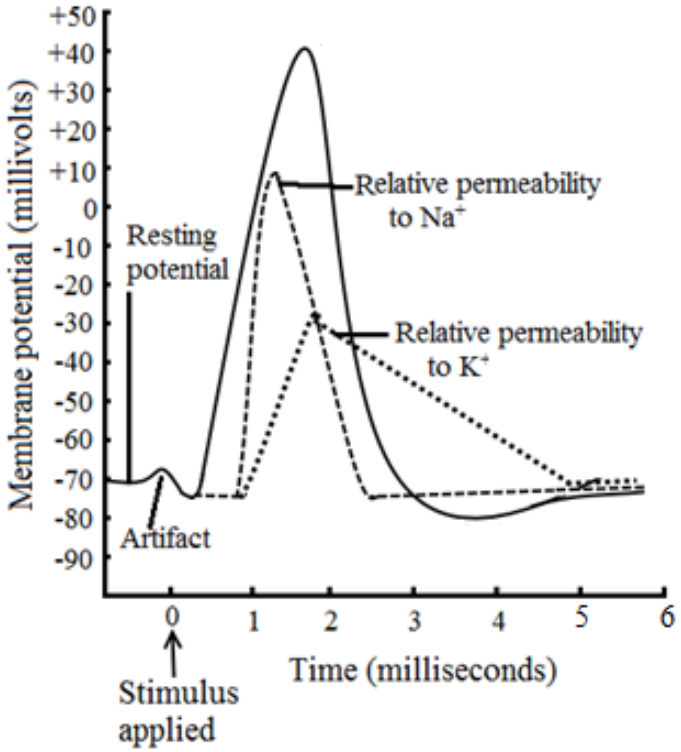
(d) From the graph, describe the distribution of both types of receptor cells in the retina. **(07 marks)**

(e) Explain the significance of the distribution of the two types of receptor cells in the retina as shown in the graph.

(08 marks)

NERVOUS AND HORMONAL COORDINATION

46. The figure below shows changes in potential difference and permeability of the neurone membrane sodium ions and potassium ions during propagation of a nerve impulse in an axon.



(a) How is the potential difference of -70mV maintained across the axon membrane? (04 marks)
(b) Account fully for the changes in potential difference and number of ion channels open from 0 ms to 2 ms. (16 marks)
(c) Explain the mechanism of propagation of the nerve impulse along the length of the axon.
(d) Describe the functional properties of neurones
(e) Explain the role played by synapses in animal responses.

47. (a) What is meant by **neurosecretion**?
(b) Explain the role of the hypothalamus in the regulation of neurosecretions.
(c) Describe the mechanism of steroid hormonal action in a named mammal.

EFFECTORS

48. (a) (i) Distinguish between **synchronous** and **asynchronous** muscles in insects.
(ii) Describe the effect of action of synchronous muscles on insect locomotion.
(b) (i) Describe the sliding filament theory of muscle contraction
(ii) To what extent is the sliding filament theory of muscle contraction supported with evidence?

SUPPORT

49. (a) Describe how support is achieved in terrestrial dicots and aquatic plants. (13 marks)
(b) Comment on the suitability of exoskeleton to provide support and locomotion in arthropods. (07 marks)

PATTERNS OF BEHAVIOUR

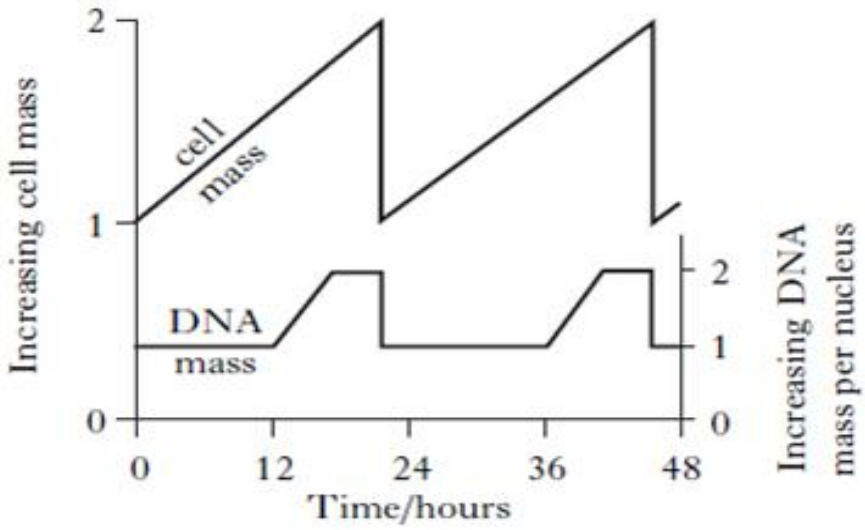
50. (a) Explain the role of each of the following in social behavior:
(i) Territoriality ***(05 marks)***
(ii) Dominance hierarchies ***(03 marks)***
(iii) Courtship behavior ***(03 marks)***
(b) Explain the different forms of honey bee dance communication ***(09 marks)***

PART V: REPRODUCTION, DEVELOPMENT AND HEREDITY

CELL DIVISION

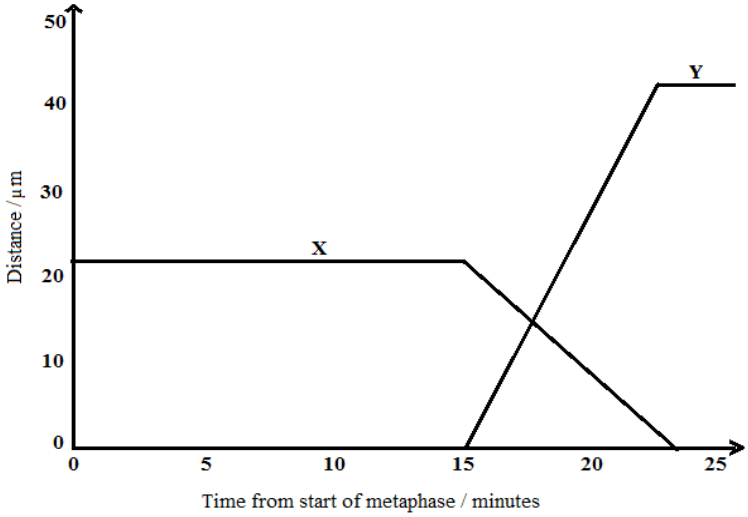
51. Figure 1 below shows changes in the quantities of nuclear DNA and cell mass during repeated cell cycle.

FIGURE 1



The curves in figure 2 below represent changes during mitosis in the distance between:
(i) Centromeres of chromatids and pole of the cell.
(ii) Centromeres of sister chromatids.

FIGURE 2



Using figure 1:
(a) For one cell cycle only, describe the changes in:
(i) Mass of DNA. (2½ marks)
(ii) Cell mass. (1½ marks)

(b) For one cell cycle only, explain the trend in:
(i) Mass of DNA. (08 marks)
(ii) Cell mass. (08 marks)

(c) Explain the significance of the observed changes in mass of DNA from 12 hours to about 23 hours. (01 mark)

Using figure 2:
(d) Identify what curves X and Y represent. (01 mark)
(e) Explain the trend in distance represented by:
(i) Curve X. (08 marks)
(ii) Curve Y. (07 marks)
(f) Explain the variation in the maximum distance achieved in X and Y. (03 marks)

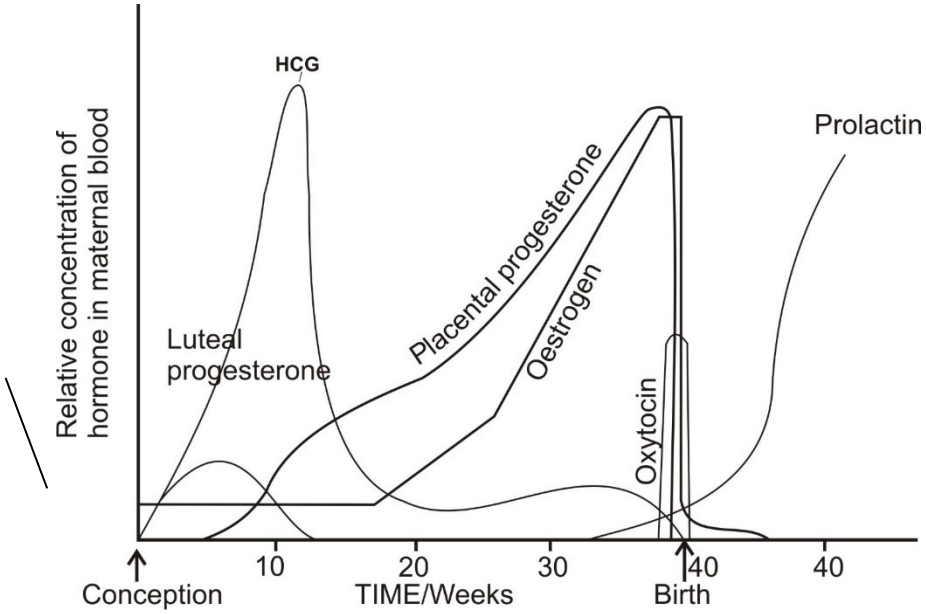
REPRODUCTION

52. (a) The table below shows the difference in percentage saturation of blood with oxygen at varying partial pressure of oxygen between a pregnant woman and that of a fetus developing in her uterus.

Partial pressure of oxygen/mmHg	Percentage saturation of blood with oxygen	
	Mother	Fetus
1.3	8	10
2.7	20	30
3.9	40	60
5.3	65	77
6.6	77	85
8.0	84	90
9.3	90	92
10.6	92	92

(i) Plot the result in a suitable graphical form. **(07 marks)**
(ii) Compare the percentage saturation of blood for the mother and that of the fetus. **(03 marks)**
(iii) Suggest why the two curves plotted in (a) (i) are sigmoid. **(07 marks)**
(iv) Explain the physiological significance of the position of the fetal curve. **(03 marks)**

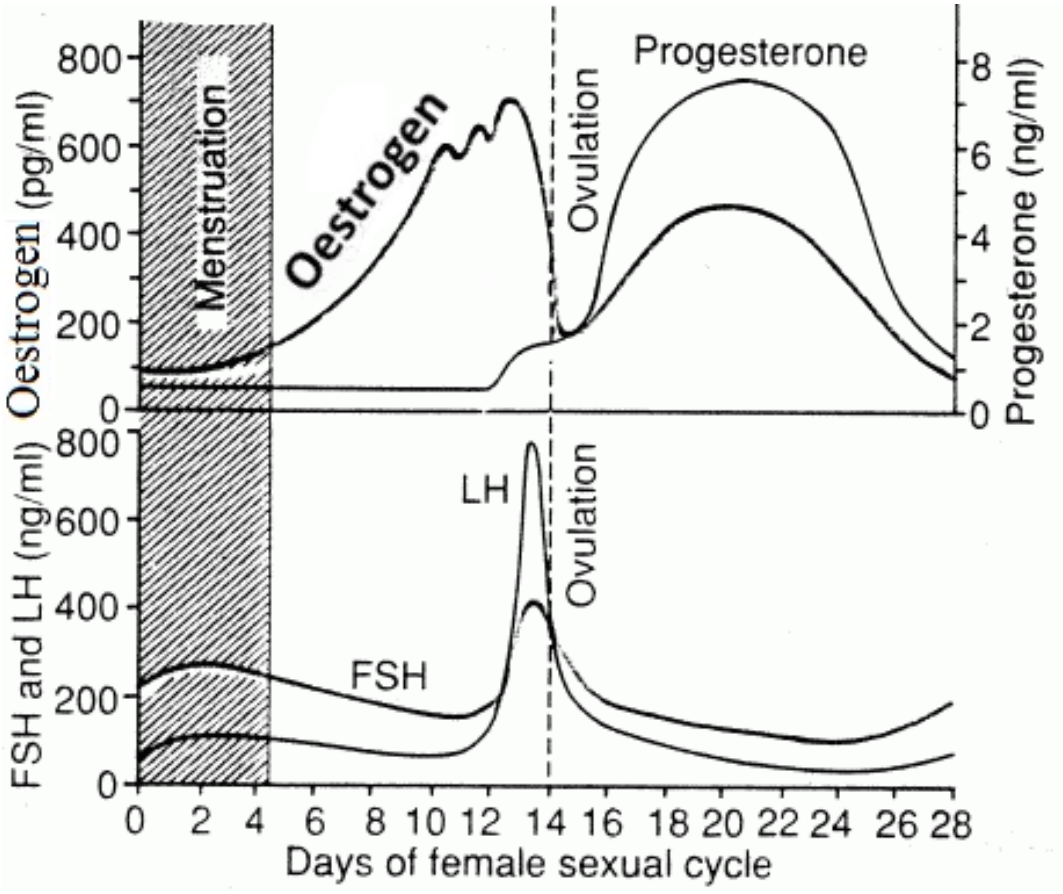
(b) The figure below shows the changes in the level of some reproductive hormones immediately after conception.



(i) Compare the levels of luteal and placental progesterone. **(04 marks)**
(ii) Explain the variation in the level of:
- HCG (Human Chorionic Gonadotrophin) hormone **(06 marks)**
- Oestrogen hormone **(07 marks)**

(iii) What are the effects of the hormones oxytocin and prolactin towards the end of pregnancy? **(03 marks)**

53. The graph below shows the changes in the sex hormones and thickness of the uterine wall obtained by close observations made using blood samples that were withdrawn from an adult human female at regular intervals of days and by scanning the uterus respectively. The investigation was done for over a period of one month (28 days) immediately after the previous menstruation period.



(a) Describe the changes in the concentration of:
(i) Oestrogen hormone. **(05 marks)**
(ii) Progesterone hormone. **(04 marks)**
(b) Explain the different phases of the menstrual cycle **(10 marks)**
(c) Explain the relationship between oestrogen and progesterone concentration. **(10 marks)**
(d) Explain what would happen if fertilization had occurred on the 21st day of the month.

54. (a) Describe the structure and development of an ovule. **(10 marks)**
(b) Explain the contribution of the different types of pollination to evolutionary potential in plants. **(10 marks)**

THE CYCLE OF LIFE

55. (a) With examples, explain fully what is meant by **parthenogenesis**. **(05 marks)**
(b) Compare alternation of generation in named bryophyte and pteridophyte.

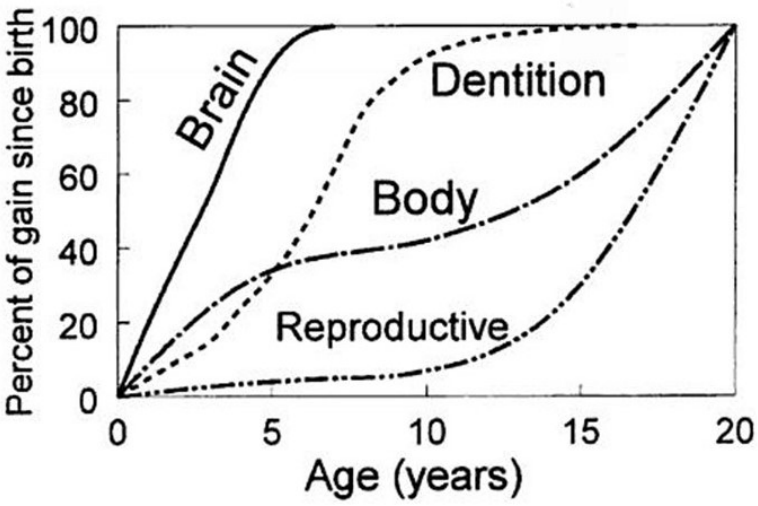
PATTERNS OF GROWTH AND DEVELOPMENT

56. The table below shows the relative changes in dry mass of the endosperm and embryo during germination of maize seeds in a well illuminated environment.

Time after planting (days)	Dry weight of endosperm	Dry weight of embryo (mg)	Total dry weight (mg)
0	43	2	45
2	40	2	42
4	33	7	40
6	20	17	37
8	10	25	35
10	6	33	39

(a) Plot a graph of the data in the date and use it to compare the changes in dry mass of the endosperm and embryo **(02 marks)**
(b) Account for the changes in each of the following during germination of maize:
(i) Dry mass of endosperm **(06 marks)**
(ii) Dry mass embryo **(06 marks)**
(iii) Total dry mass **(06 marks)**

The figure below shows the relative growth rates of the brain, teeth (dentition), whole body and reproductive organs of humans.



(c) Describe the pattern of growth of the reproductive organs. **(03 marks)**

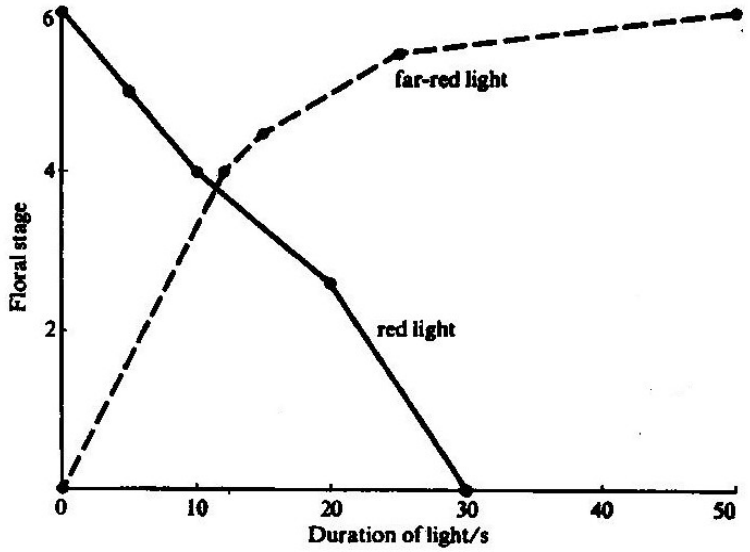
(d) Explain the rate of growth of the:
(i) Teeth. **(06 marks)**
(ii) Brain. **(06 marks)**
(iii) Whole body. **(05 marks)**

(e) Identify and explain the growth pattern exhibited in the figure. **(02 marks)**

CONTROL OF GROWTH

57. (a) What is meant by **photoperiodism**? **(02 marks)**
(b) Explain the effect of photoperiod on:
(i) Plant flowering **(08 marks)**
(ii) Dormancy in plants **(04 marks)**
(iii) Breeding behaviour in animals **(06 marks)**

58. A study was carried out to determine the effect of red and far–red light interruptions of long night on the intensity of flowering of a short-day plant. The figure below shows the results obtained from the study.



In another experiment, three species of the genus of a plant and a hybrid between two of them were tested for their vernalisation requirements.
The sample plants of each strain were subjected to different periods of time at 4^0C before being returned to their original conditions.
The number of days which elapsed between the end of cold treatment and the onset of flowering were recorded. The results obtained are shown in the table below.

Weeks at 4^0C	Number of days between end of cold treatment and the onset of flowering			
	A	B	C	AXB (Hybrid)
0	*	40	25	75
1	160	38	25	65
2	110	36	25	50
4	90	34	25	40
8	35	32	25	32
16	24	28	25	24

KEY: *= did not flower

Use the above information in the table and figure to answer the questions that follow.

(a) Describe the effect of interruption of the night period on the intensity of flowering of each of the following types of light:
(i) Red light **(04 marks)**
(ii) Far-light **(04 marks)**
(b) Give the explanation for the effects described in (a) above. **(10 marks)**
(c) Explain how red and far–red light interruptions would have affected the intensity of flowering if they had used a long day plant **(03 marks)**

(d) (i) What was the effect of subjecting the sample plants of each strain to different periods of time at 4^0C. **(05 marks)**

(ii) Explain the results shown in the table **(08 marks)**

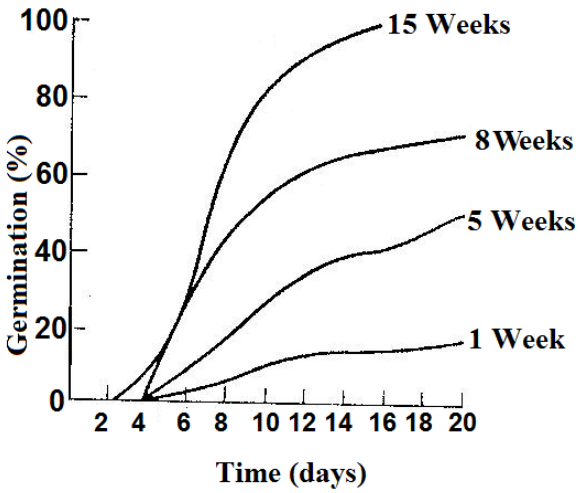
(e) Predict and explain what would happen if the experiment in the table had been carried out at 1^0C. **(03 marks)**

(f) What is the significance of the two experiments to an agriculturalist? **(03 marks)**

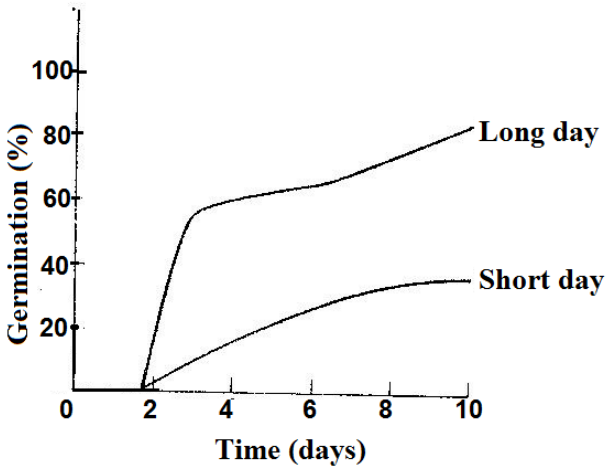
59. Experiments were performed to investigate some of the factors which influence flowering of a short day plant species, and the onset of germination of seeds of the same species.

Experiment I was on the effect of increasing time of dry storage on the germination of the species seeds. All the seeds were kept at 15^0C. Each curve represents a germination test on a seed sample stored for the number of weeks indicated.
Experiment II was on the germination of seeds under long-day illumination cycles (20 hours light: 4 hours dark) and short day cycles (20 hours dark: 4 hours light) separately.

Experiment I



Experiment II



Experiment III was on the germination of seeds during an eight day period. Before starting the investigation, some of the seeds and some of the intact fruits were treated as indicated in the table below:

Treatment	*Percentage germination by day*			
	2	**4**	**6**	**8**
Intact fruits in air	0	6	10	10
Fruits with pericarp cut	0	12	28	38
Naked seeds in air	0	14	30	42
Seeds with testa pricked	14	45	53	53
Seeds in oxygen	40	56	72	78
Pricked seeds in oxygen	25	62	70	84

(a) Compare the percentage germination of the two seed samples in **Experiment II.** **(03 marks)**

(b) Explain the effect of:
(i) Varying illumination cycles on seed germination in **Experiment II.** **(10 marks)**
(ii) Exposed a brief flash of light in the middle of the dark period in **Experiment II** on flowering of the plant. **(04 marks)**

(c) State what would be the effect of illumination on the flowering when the same treatment of the plant in **Experiment II** was subjected to:
(i) A long day plant. **(02 marks)**
(ii) A day neutral plant. **(01 mark)**

(d) Explain the effect of changing the period of day storage in **Experiment I** on seed germination. **(07 marks)**

(e) (i) Describe the effect of different seed treatments on seed germination in **Experiment III.** **(03 marks)**
(ii) Account for the observed influence in **Experiment III**. **(04 marks)**

(d) What are the advantages of spores over seeds in reproduction? **(06 marks)**

INHERITANCE

60. Two phenotypically wild-type ***Drosophila*** (with long wings and red eyes) are crossed, and two mutant phenotypes (curved wings and lozenge eyes) are seen to segregate among the progeny as follows:

Females
600 long-wing, red eyes
200 curved wing, red eyes
Males
300 long wing, red eyes
300 long wing, lozenge eyes
100 curved wing, red eyes
100 curved wing, lozenge eyes

(a) With reasons, state the genetic nature of? **(08 marks)**
(i) The curved wing mutation
(ii) The lozenge eye mutation
(iii) The female parent
(iv) The male parent

(b) Using appropriate symbols and a genetic cross, explain the observed results. **(12 marks)**

61. (a) In cats the allele for short hair is dominant to the allele for long hair; the gene involved is autosomal.
Another gene which is sex-linked produces hair colour; its alleles produce black or white coat colour, and the heterozygote combination produces tortoise-shell colour.
If a long-haired black male is mated with a tortoise-shelled female homozygous for short hair, what kind of offspring will be produced in the F_1? **(08 marks)**

(b) Gene R for red flower colour can only express itself phenotypically in the presence of gene C which complements its action to form colour. When two white-flowered plants with genotypes CCrr and ccRR were crossed, the F_1 generation all had red flowers.
What would be the phenotypic ratio of the F_2 progeny when the F_1 progeny are selfed? (Show your working). **(12 marks)**

62. In the garden pea, ***Pisum sativum***, the dominant alleles of two unlinked genes, **A**/**a** and **B**/**b**, are needed to make the pods tough and inedible. All other genotypes result in soft, edible 'sugar-snap' pea pods.
• Pods with genotypes including the dominant allele **A** have a thin layer of cells lining the pod.
• Pods with genotypes in which the recessive allele **a** is homozygous have no thin lining layer.
• Pods with genotypes including the dominant allele **B** have lignin added to the thin lining layer, when it is present.
• Pods with genotypes in which the recessive allele **b** is homozygous do not have added lignin.
(a) Explain the phenotypes of pea pods with the following genotypes: **(04 marks)**
(i) **AAbb**
(ii) **aaBB**
(b) Two pea plants of genotypes **AAbb** and **aaBB** were interbred to give an **F1** generation, and these in turn were interbred to give an **F2** generation.
Using an appropriate genetic cross, including gametes, show the genotypes and phenotypes of the **F1** and **F2** generations.
Give the ratio of phenotypes expected in the **F2** generation. **(16 marks)**

63. (a) Explain how meiosis can result in an almost infinite genetic variety. *(12 marks)*
(b) Describe sex linkage in humans. *(8 marks)*

GENES AND CHROMOSOMES

64. (a) Explain why a single base deletion from one Deoxyribonucleic molecule usually causes greater effect than the replacement of one base by another different base. **(10 marks)**
(b) Using a named example, describe how a gene mutation may affect a phenotype of an organism. **(10 marks)**

65. (a) What is the significance of the distribution of deoxyribonucleic acid in eukaryotic cells? **(05 marks)**
(b) How does the structure of deoxyribonucleic acid suit it for functioning? **(08 marks)**
(c) Describe the role of Ribonucleic acid in protein synthesis. **(07 marks)**

66. Give an account of the following disorders: *(20 marks)*
(a) Phenylketonuria (PKU)
(b) Down's syndrome
(c) Erythroblastosis foetalis
(d) Blue-baby condition

PART VI: ECOLOGY AND EVOLUTION

ORGANISM AND ITS ENVIRONMENT

67. (a) Describe energy flow through an ecosystem and the relative efficiency with which it occurs. **(10 marks)**
(b) Explain the impact of the following on ecosystems:
(i) Deforestation **(05 marks)**
(ii) Global temperature rise **(05 marks)**

68. Using named examples in each, discuss the following ecological concepts.
(a) Succession **(07 marks)**
(b) Limiting factors **(06 marks)**
(c) Carrying capacity **(07 marks)**

69. (a) Give an account of different types of survivorship curves. **(09 marks)**
(b) Account for the different types of population dispersion. **(11 marks)**

ASSOCIATIONS BETWEEN ORGANISMS

70. A scientist carried out research on two species of flour beetles (***Tribolium***) and clover (***Trifolium***).
In his research he grew the beetles in the same medium and different media under different climatic conditions.
On the other hand he grew the plants together and separately.
The following are his findings:

Table I:

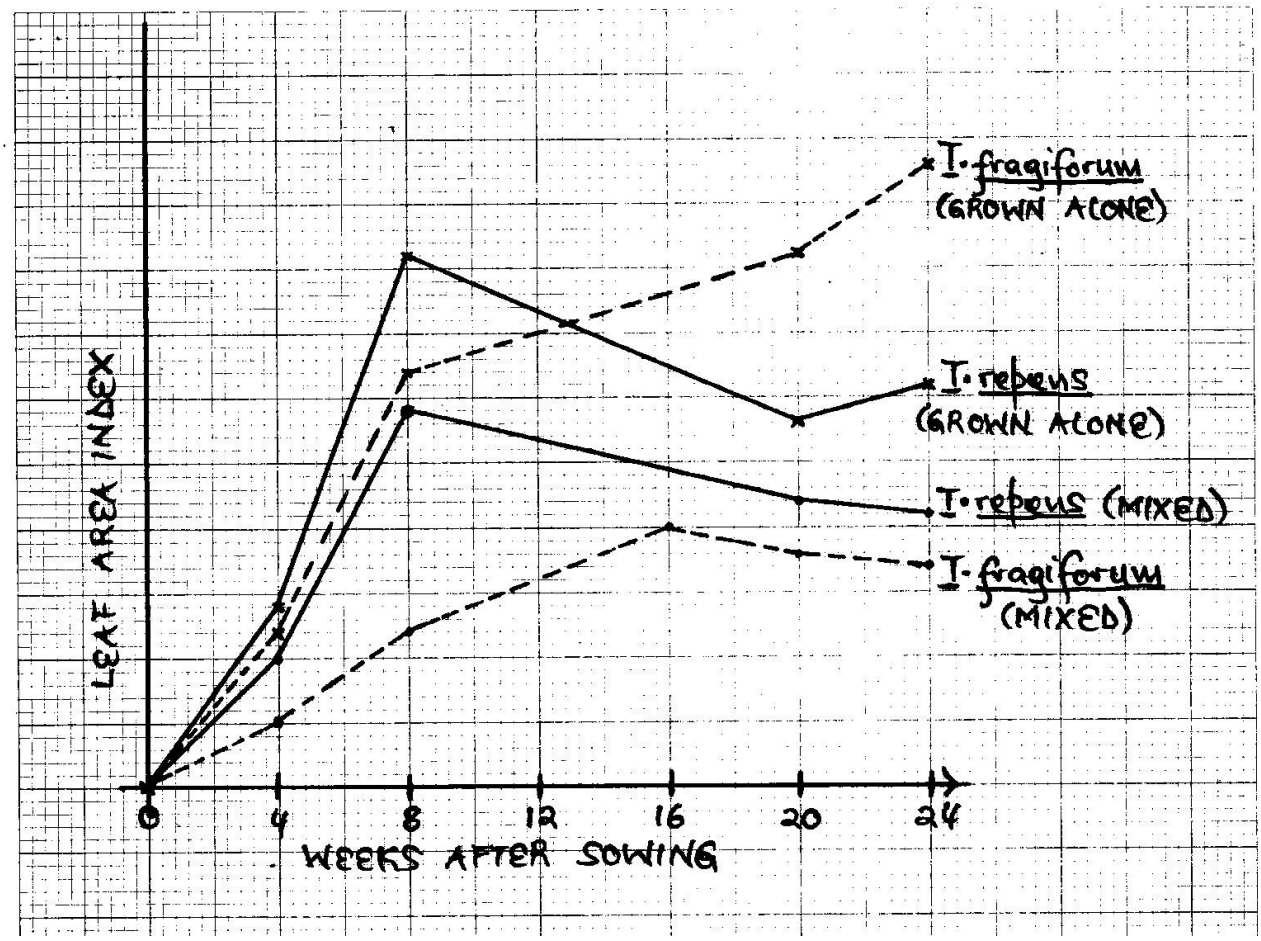
Climate	Temperature/^{o}C	Relative humidity/%	Results of interspecific competition	
			Tribolium castenum	***Tribolium confusum***
Hot-wet	34	70	100	0
Hot-dry	34	30	10	90
Warm-wet	29	70	86	14
Warm-dry	29	30	13	87
Cool-wet	24	70	31	69
Cool-dry	24	30	0	100

(a) Comment on the effect of changing temperature and relative humidity on the population of *Tribolium* species. (05 marks)

(b) Explain the observed behaviour of the *Tribolium* species over time. (10 marks)

(c) What biological principle is illustrated by the result in table I? (03 marks)

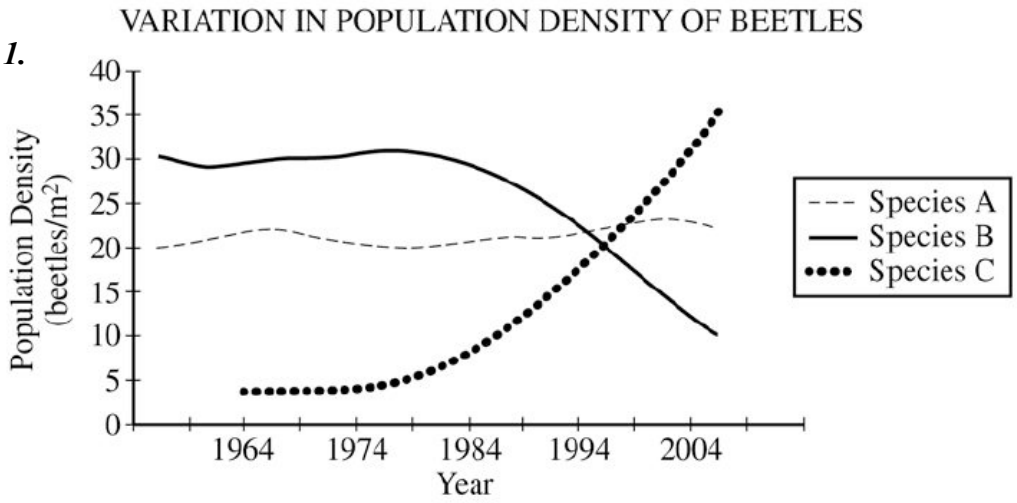
The graph below show the variation of leaf area index for *Trifolium fragiforum* and *Trifolium repens* with time:



(d) Compare the growth of:
(i) ***Trifolium*** species grown separately. **(06 marks)**
(ii) ***Tribolium*** species grown together. **(06 marks)**
(e) Why did the ***Trifolium*** species grown together not behave like the case of the beetles above? Give evidence for your discussion from the graph. **(07 marks)**
(f) State other ecological factors that may affect the population of the beetles and clover in an ecosystem. **(03 marks)**

71. According to fossil records and recent published observations, two species of leaf-eating beetles (species **A** and **B**) have existed on an isolated island in the Pacific Ocean for over 100,000 years. In 1964 a third species of leaf-eating beetle (species **C**) was accidentally introduced on the island. The population size of each species has been regularly monitored as shown in graph **1.**

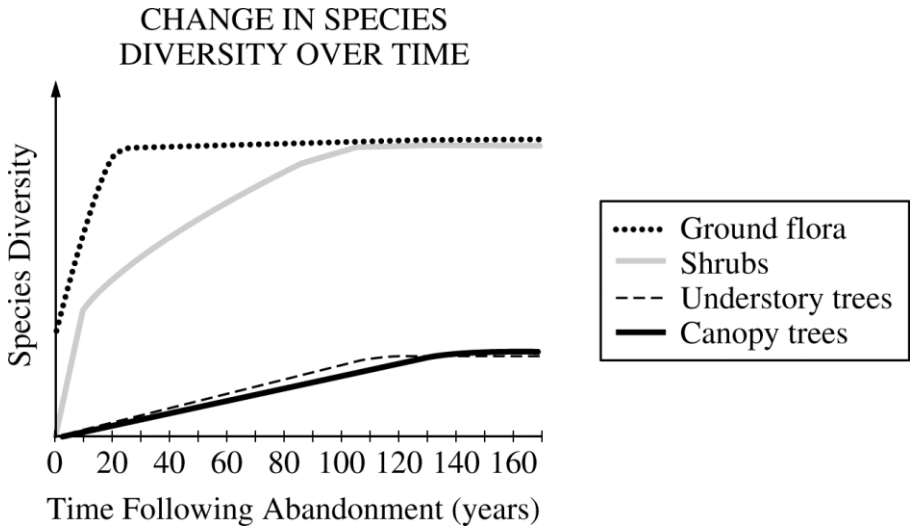
Graph 1.



(a) Explain the pattern of population density observed in species C. **(07 marks)**
(b) Explain the effect that the introduction of beetle species C has had on the population density of species A and species B. **(05 marks)**
(c) Suggest **e**xplanation for the patterns of population density observed in species A and in species B. **(04 marks)**
(d) With a biological explanation, predict the population density of species C in 2014. **(06 marks)**
(e) Explain why invasive species are often successful in colonizing new habitats. **(08 marks)**

Graph **2** shows changes in plant diversity following the abandonment of an agricultural field in a certain biome.

Graph 2.



(f) **Describe** the differences in plant diversity shown in graph **2**. **(06 marks)**
(g) **Explain** how the changes in plant diversity affect the animal species composition between years 0 and 120. **(04 marks)**

ORIGIN OF LIFE AND SPECIATION

72. (a) Explain the theory for the origin of species by **panspermia**. *(06 marks)*
(b) Describe the evidence for evolution provided by the geographical distribution of placental marsupial and monotreme mammals. *(04 marks)*
(c) Explain how isolation can lead to speciation. *(10 marks)*

EVOLUTION IN EVIDENCE

73. (a) Explain the modern theory of evolution by natural selection. ***(08 marks)***
(b) With named examples, discuss how natural selection explains the following phenomena:
(ii) Mimicry ***(05 marks)***
(ii) Convergent evolution ***(03 marks)***
(iii) Parallel evolution ***(04 marks)***

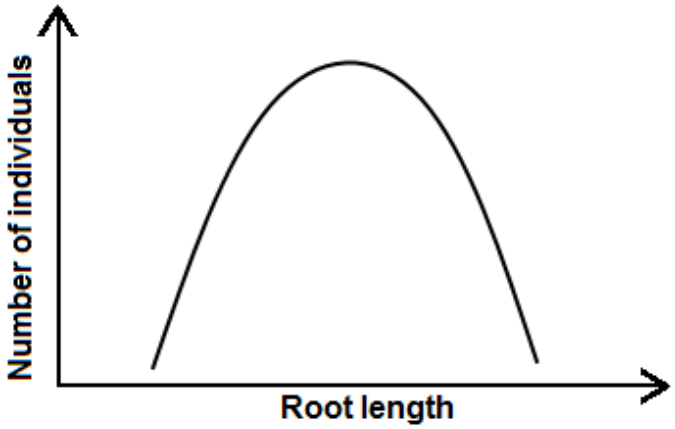
POPULATION GENETICS

74. In a laboratory population of diploid, sexually reproducing organisms a certain trait was studied. This trait is determined by a single autosomal gene and is expressed as two phenotypes. A new population was created by crossing 51 pure breeding (homozygous) dominant individuals with 49 pure breeding (homozygous) recessive individuals. The table below shows the results obtained after four generations.

Generation	NUMBER OF INDIVIDUALS		
	Dominant	Recessive	Total
1	51	49	100
2	280	0	280
3	240	80	320
4	300	100	400
5	360	120	480

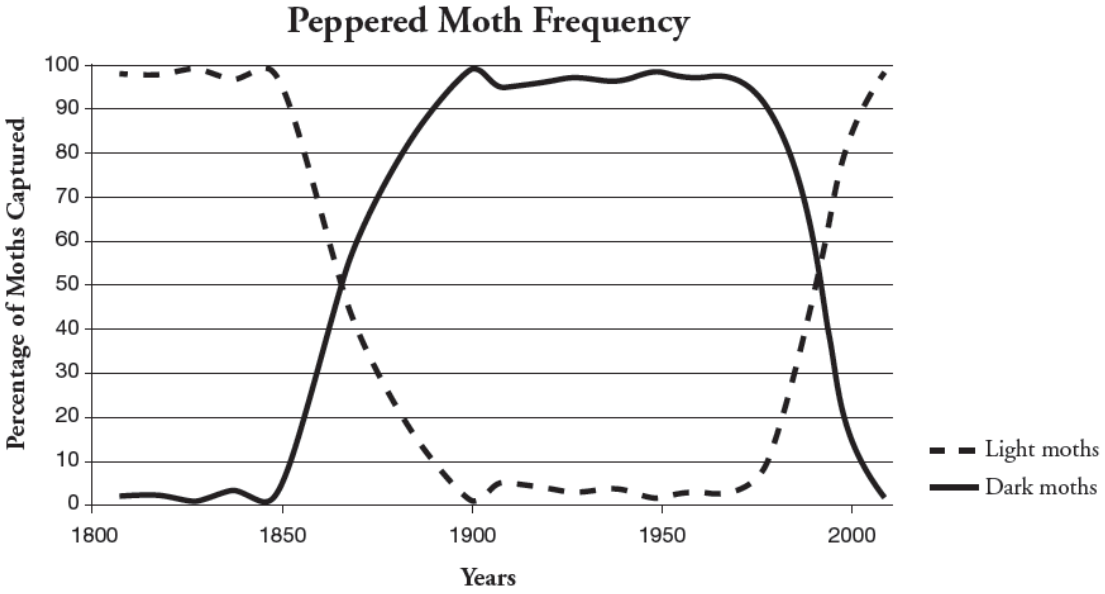
(a) Identify and explain the choice of organism used to perform this experiment. *(03 marks)*
(b) On the basis of the data in the table, suggest explanation for the change in the phenotypic frequency between the first and third generations. *(07 marks)*
(c) Explain whether or not this population is in Hardy-Weinberg equilibrium. *(05 marks)*

The graph below shows the distribution of root length in a population of a species of grass. The population inhabits an area in which the soil water is held mainly below 20 cm.



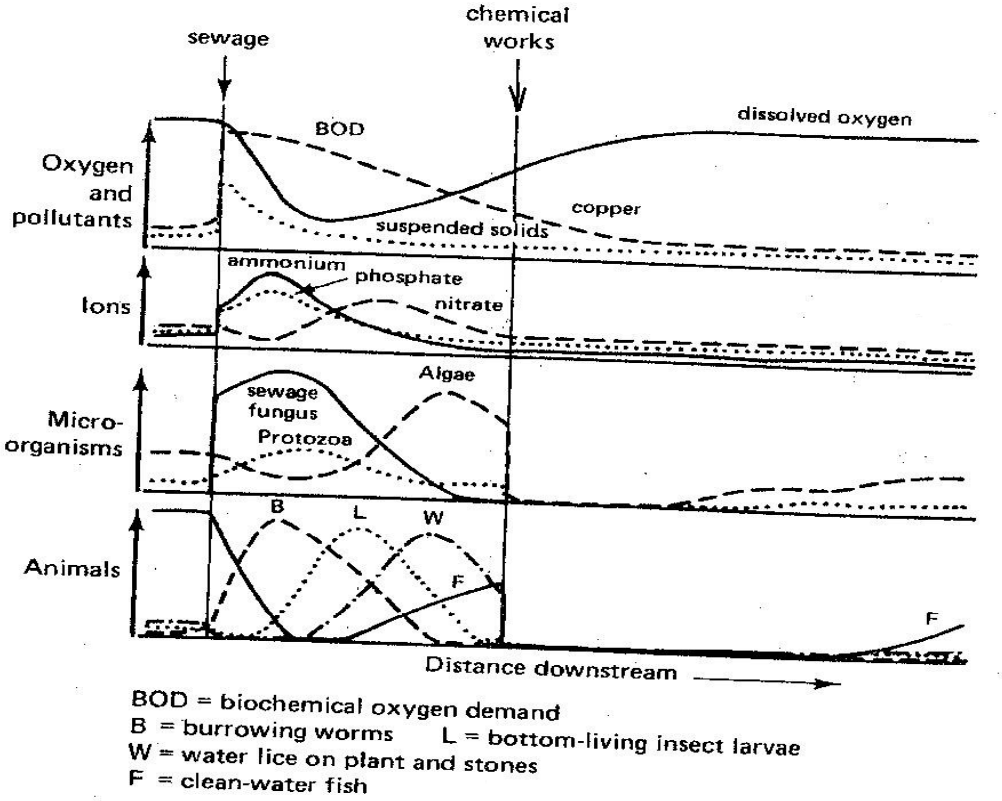
(d) Explain the type of selection in operation from the information given.
(3 marks)
(e) Describe the evolutionary mechanisms that cause a change in the distribution of root lengths.
(4 marks)

The graph below shows the change in frequency of two varieties of peppered moths in an urban centre, from the period of industrial revolution to the 21st century.



(f) Describe the changes in peppered moth frequency for the period shown. *(5 marks)*
(g) Explain the observed changes in peppered moth population for the period given. *(13 marks)*

75. The figure below shows some of the effects of sewage and waste copper discharge into a river.

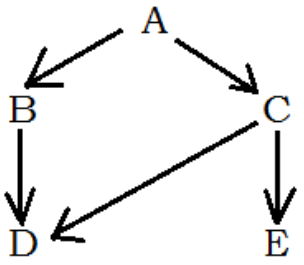


(a) Account for the observed changes in:
(i) Biochemical oxygen demand.
(ii) Concentration of ions.
(iii) Population of micro-organisms
(iv) Population of fresh water vertebrates

(b) With evidence from the figure above, suggest how an organism can be used as a pollution indicator.

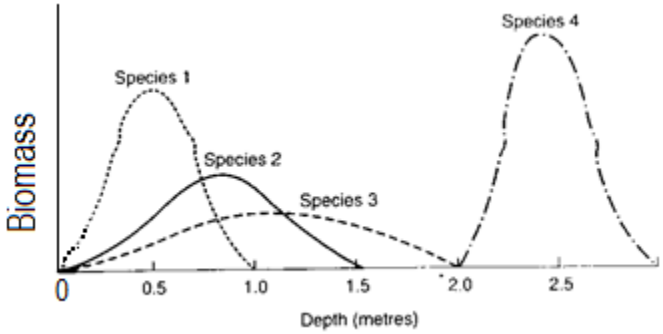
(c) Assuming that chemical works also emit heat, suggest the possible effects on the river's:
(i) Chemical content.
(ii) Composition of organisms.

76. The figure below shows the energy flow in a simple food web of five organisms **A, B, C, D** and **E**.



(a) What is meant by the term **food web**? (3 Marks)
(b) Explain the extent to which the populations of organisms **A, B, D** and **E** might be affected over time if organism **C** were **suddenly removed** from the feeding relationship above. (12 marks)

The distribution of four species of organisms at different depths in a pond was investigated and the data presented graphically as shown below:



(c) Describe the distribution of the four species of organisms in the pond. (10 Marks)
(d) Explain the distribution of the four species of organisms in the pond. (15 Marks)

QUESTIONS ON PRACTICALS

DISSECTION

Rat dissection

Question 1 (40 marks, 60 minutes)

You are provided with a freshly killed specimen labeled R

i) With reference to the cover the body, give the importance of each of the structure to the animal. (03marks)

ii) Examine feet of the animal, how are they adapted for its survival in the habitat (03marks)

b) Dissect the specimen on the tray to expose the superficial structures of the ventral side of the neck, displace the visible neck structures and their accessory structure anteriorly. Draw and label the musculature of the neck, chest region and thoracic region. (12 marks)

c) Open the abdomen to display vessels that carry blood

To structures responsible for chemical digestion from the heart

From structures responsible for secretion and excretion on the left back to the heart.

Draw and label your dissection excluding the heart. (24marks)

Question 2

a)i) Observe the head of specimen M from the dorsal view. Draw and label the visible structures used for sensitivity. (06marks

ii) Dissect the specimen to expose the musculature of the neck, thorax and fore limbs up to the elbows. Draw and label. (10marks)

b) Pin the specimen provided ventral side up and make a median longitudinal cut through the skin and pin back the skin. Carefully open up the thoracic cavity by cutting through the ribs on either side to the neck.

Display the heart and associated blood vessels.

Turn over the heart upside down and pin it to your left hand side.

Display the following:

Blood vessels that carry blood to the left side of the head region, fore limbs and visible structures in the thoracic cage in undisplaced state. Draw and label your dissection to show the parts you have displayed. **(24 marks)**

c) By further dissection, display the route of blood flow from the hind limb, abdominal back muscles, and the kidney on the left. Draw and label (13 marks)

Question 3

You are provided with specimen T which is fleshly killed.

a) Examine the hind limb and state three ways it is adapted for the survival of the specimen in its habitat. (03 marks)

b) Examine the head of the specimen and draw and label the ventral view of the anterior part of the head to show the structures for sensitivity. (05 marks)

c) Dissect the abdominal region of the specimen to expose the blood vessels.

i) Returning blood from the structures for reproduction and secretion.

ii) Supplying the structures for absorption of nutrients and excretory organs.
Draw and label (27 marks)

Question 4

a) Dissect the specimen on the tray to expose the superficial structures of the ventral side of the neck and the internal structures of the thorax in undisturbed condition. Draw and label. (22 marks)
ii) Proceed with your dissection and open up the abdominal cavity. Pull and fix the liver lobes anteriorly, turn the stomach upside and displace it to the right side of the specimen. Draw and label the structures previously underlying the stomach. (11 marks)
b) Dissect the specimen to display vessels that carry blood from structures responsible for digestion and absorption of food in the abdomen. Draw and label the structure displayed.
(17 marks)
c) By further dissection,
Cut and remove the alimentary canal,
Display the blood vessels that drain the left hind limb, kidney and the gonads. Draw and label.
(15marks)

Question 5

(a)You are provided with a freshly killed rat. Examine the animal carefully and describe:
(i) Structure and distribution of fur. (06marks)
(ii) The structural features of the tail.(03marks)
(iii) Outline the significance of your observations in (a) (i) and (ii) to the survival of the animal.
(05marks)
(b) Dissect the abdominal region, and display the internal structures in this part of the body. Deflect liver lobes anteriorly, displace duodenum to the right and the rest of the intestine (ileum) to the left. Re-arrange the structures so that the structures within the mesentery can be seen clearly. Cut and remove stomach and spleen. Draw and label. (20marks)

Cockroach dissection

Question 1

You are provided with specimen K. Examine it carefully and answer the questions that follow:
a) Place the specimen ventral side upper most spread out the wing and then examine the anterior wing and posterior wing using a hand lens.
i) Give four structural differences observed between anterior wing and posterior wing. (04 marks)
ii) Explain one way the structures of the anterior and posterior wing relate to their function.
(04marks)
ii) Cut off the left hind limb and the outline the adaptations of the structures anterior to the foot of the hind limb that enables the animal to efficiently locomote. *(04 marks)*
b) Place the specimen 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 water fully. Draw and label all the buoyant internal structures visible in the specimen. *(15 marks)*

c) By further dissection, Dissect the specimen by cutting along the right lateral side of the thoracic region to expose only the structures attached on the ventral cuticle. Draw and label the exposed structures with the alimentary canal discarded. *(10 marks)*

Question 2

You are provided with specimen Y, which is freshly killed.

(a) Cut off appendages at their proximal ends, remove all the wings including the tegmina. Describe the structure of the animal's body. (10 marks)

(b) Lay the animal dorsal side upper most, cut off the elytra and the wings close to their bases. Lift the 10^{th} abdominal tergum. Draw and label the visible structures on the ventral cuticle when the tergum is displaced. (4 marks)

(c) State the sex of the specimen. Describe the external structures used for determining the sex. (2 marks)

Question 3

(a) You are provided with a freshly killed cockroach, labeled specimen Q. lay the animal ventral side uppermost. Observe the structures posterior to the point of attachment to the cercus.

i) Count and record the number of abdominal segments visible in this region. (01 mark)

ii) Draw and label (04 marks)

(b) Lay the animal dorsal side upper most. Cut through the left lateral side of the abdomen and thorax, leaving the anterior most segment of the animal intact. Lift the dorsal cuticle and displace it to one side of the specimen. Cover the dissection with water and clear away the fat bodies and displace the alimentary canal to the right of the specimen. Draw and label the exposed structures on both cuticles. (18 marks)

Question 4

You are provided with a freshly killed cockroach.

(a) Cut off the antenna from its base:

(i) Measure and record the length of the antenna and the rest of the body (02 marks).

(ii) What is the significance of the ratio in promoting the survival of the animal (02 marks)

(b) Examine the antenna and describe its structural features. (05 marks)

(c) Explain three ways the antenna is suited to its functions. (03 marks)

(d) Identify the sex of the cockroach, and draw and label those external features which you used to determine the sex of the cockroach. (4 marks)

(e) Remove the wings of the specimen. Pin down the specimen with the dorsal side upper most. Lift the free edge of the tergum in the middle of the right lateral side of abdomen. Cut the anterior edge of the terga and remove all the terga except those posterior to the middle of the abdomen. Avoid damaging the organs.

(i) List all the visible organs after removing the terga. (4marks)

(ii) Make a fully labeled drawing of the digestive system. (8 marks)

(f) Cut off the tegmina, posterior wings, antennae and limbs, Place the specimen dorsal side upper most, cut through its right lateral side and dissect to expose the structures with in the abdominal and thoracic regions. Displace the salivary glands to the right of the specimen. Displace the alimentary canal to the left. Remove all unnecessary tissue to display the alimentary canal and the structures on the ventral cuticle. Draw and label structures exposed in your dissection.

(18 marks).

5. (a) Using a hand lens examine the compound eye, fenestra, antennary pit and antenna. Describe their structural features. (06 marks)
(b) Examine the head region, search for the mouth parts, describe their relative positions and associated structural features. (06 marks)
b) Using a low power microscope, examine the ventral view of the pretarsus.
(i) Describe the structure of the pretarsus (3 marks)
(ii) Draw and label (4 marks)
(c) Place the animal ventral side upper most. Draw and label the posterior end of the abdomen together with its associated structures. (3 marks)
(d) Place the specimen dorsal side upper most, cut through the left hand edge of the exoskeleton of the abdomen and dissect to expose the structures with in the abdominal region. Displace the alimentary canal to the left of the animal. Remove the unnecessary tissue display all the parts of the alimentary canal and structures on the dorsal cuticle. Draw and label.
(18 marks)

Toad dissection

Question 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 (01 mark)

ii) Explain briefly the importance of the features named in a)i) above ($02\frac{1}{2}$ marks)

b) Give three ways in which the covering of the animal's body is adapted for its survival. **(03 marks)**

c) Lay the specimen on its back with its hind limbs away from you. Cut through the angles of the jaws to separate.
i) Open the mouth widely. Draw and label the inner side of the lower jaw and floor of the mouth.
ii) Describe an activity which you are going to use to establish how the structures in C(i) above are adapted to their functions and explain briefly your findings.

Description of the activity
Explanation

d) Proceed to pin up the specimen and carry out a normal dissection.
i) Expose the heart turned forward, the routs of the blood vessels and the main tributaries that bring blood from the right side and taking blood away to the left side.
ii) Pull the right lung out and pin
iii) Cut off the lower jaw

iv) Deflect the alimentary canal to your left, lift the left kidney over the right and pin to display blood vessels supplying the digestive system and the kidneys.
v) Cut off and remove the ileum and the rectum.
vi) Cut off and remove other visceral structures posterior to the kidneys and ventral to expose structures attached on the vertebral column. Make one drawing of this dissection and label. (29 marks)

Question 2

You are provided with **specimen K (Toad)** which is freshly killed. (03marks)

a) Observe the fore and hind limbs. State three observable structural differences between them.

b) Put the specimen ventral side uppermost on a dissecting board and pin with limbs fully stretched. Dissect to pull out the skin from the body wall and upper region of limbs.

i) Observe the right hind limb, draw and label the observable thigh muscles together with the remaining part of limb which should not be labeled.

(06marks)

ii) How significant is the structure of the hind to locomotion. (03marks)

iii) How is the skin adapted to gaseous? (02 marks)

c) By further dissection, display the blood vessels draining blood from the thoracic and abdominal cavity organs back to an anteriorly displaced heart. Deflect the alimentary canal to the left of the specimen. Draw and label your dissection.

(26 marks)

Question 3.

You are provided with specimen **K** which is freshly killed.

(a) Examine the dorsal part of the skin and the foot of the hind limbs. How is their structure related to function for the survival of the organism in its habitat?
   (i) Dorsal part of skin (01mark)
   (ii) Foot of hind limbs (02marks)

b i) Dissect the specimen to display blood vessels that
   (i) Drain blood from the head region
   (ii) Supply blood to the lungs

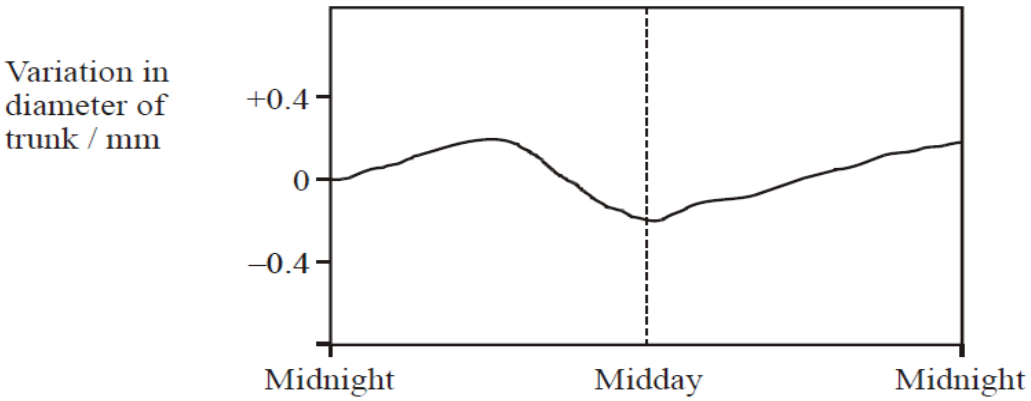
Draw and label the vessels on the left hand side of the specimen including an undisplaced heart.

(13 marks)

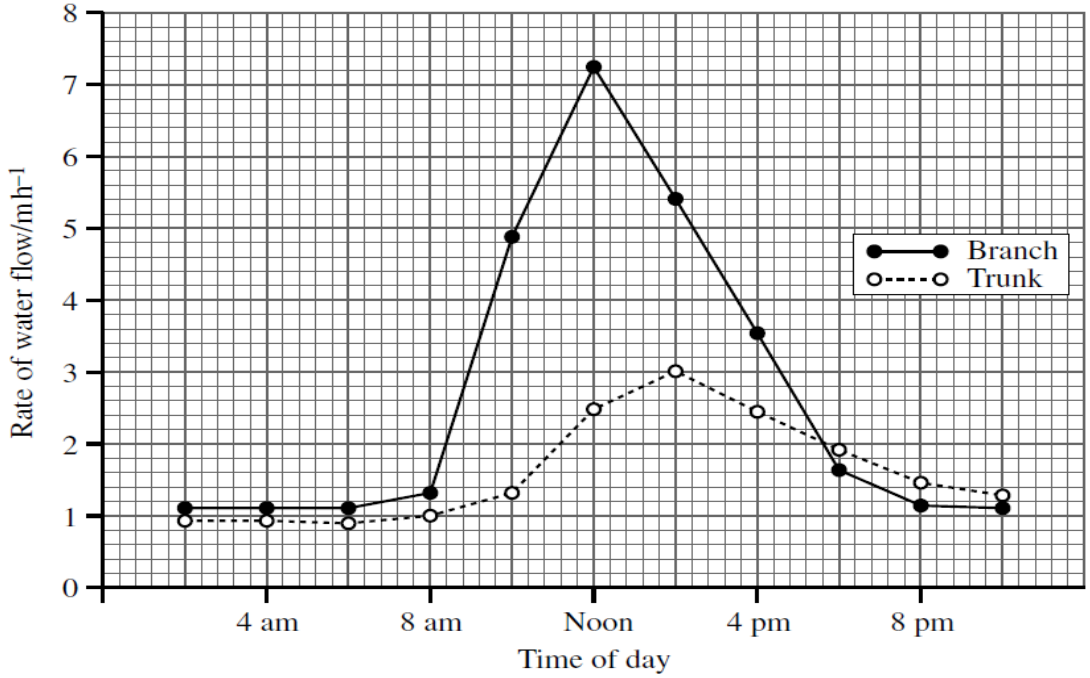
(ii) By carefully loosening the tissue, cut out the rectum and lower part of the ileum without damaging the capillaries around it. Displace the remaining part of alimentary canal to the left of specimen and liver lobes sideways to display blood vessels that drain blood from the abdominal region back to an undisplaced heart. Draw and label the visible structures within the abdominal region. **(23 marks)**

UMSSN A LEVEL INTERACTIVE BIOLOGY SEMINAR 2018
DISCUSSION QUESTIONS

1. The graph shows the daily changes in the diameter of the trunk of a pine tree.



(a) Explain why the diameter of the trunk is smallest at midday.
(b) Describe the adaptations of xylem and phloem to their functions.
(c) Discuss the role of each of the following in plants;
(i) hydathodes (ii) casparian strip
(d) The rate of water flowing through a branch of a tree and the tree trunk was measured over a 24-hour period. The results are shown in the graph below.



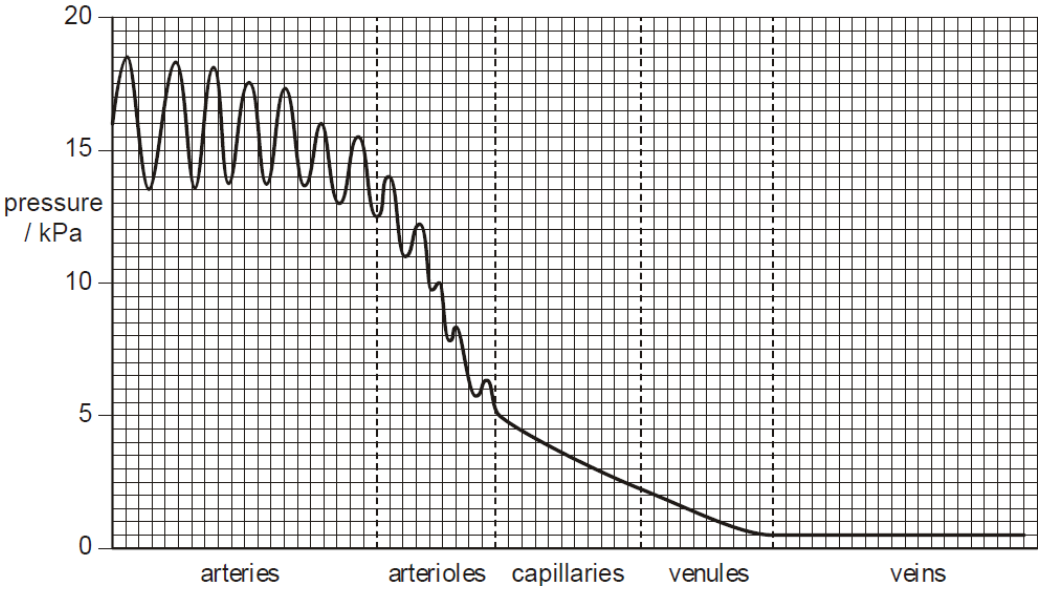
(i) Compare the rate of water flow through the trunk and branch.
(ii) Explain the changes in the rate of water flow in the branch over the 24-hour period.
(iii) Explain the difference in the rate of water flow in the branch and in the tree trunk. **UMSS NAMUGONGO**

2. (a) How does a mutation lead to a non-functional enzyme?
(b) Describe the structure of transfer RNA molecule.
(c) Describe the features of a gene which enable it to code for a particular protein?
(d) Compare DNA replication and DNA transcription.
(e) With reference to the sickle cell allele, explain the term heterozygous advantage. **MT. ST. HENRY'S MUKONO**

3. (a) Distinguish between collagen and cellulose.
(b) How are each of the following biomolecules adapted for their functions;
(i) collagen (ii) cellulose (iii) Glycogen
(b) What is meant by Lactose intolerance?

ST. ELIZABETH NKOOWE

4. The graph shows the pressure of blood as it flows through arteries, capillaries and veins.



(a) Describe the changes in the pressure of the blood as it flows through the vessels.
(b) Explain what causes the rise and fall in pressure across arteries.
(c) What causes the drop in blood pressure as it flows from arteries to veins?
(d) Explain why it is important that the pressure is lower by the time blood reaches the capillaries.?
(e) Venous pressure seems too low. How is blood able to flow along the venous system?
(f) The table below shows the blood flow to various organs while a person is at rest and during strenuous exercise.

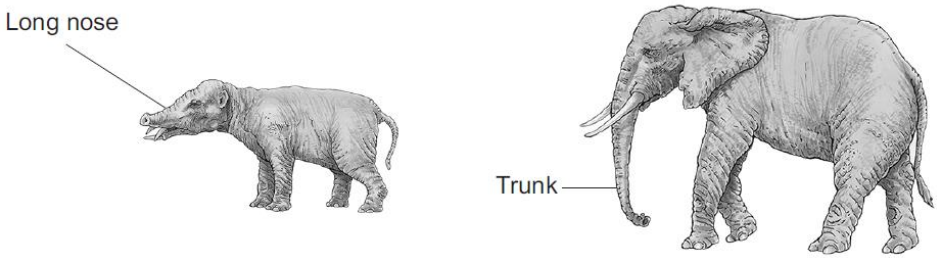
Organ	Blood flow at rest /cm^3 min^{-1}	Blood flow during strenuous exercise /cm^3 min^{-1}
Skeletal muscle	1200	12 500
Skin	500	1900
Kidneys	1100	600
Intestine	1400	600
Other	1600	1900
Total	5800	17 500

(i) With reference to the functioning of arteries, explain how blood flow to organs such as the kidneys is decreased during strenuous exercise.
(ii) Suggest explanations for the pattern of changes in the blood flow to the organs during strenuous exercise.
(iii) The skeletal muscle respires much more rapidly during strenuous exercise. Explain how this results in oxyhaemoglobin unloading more oxygen to the tissue.
(g) What is the significance of red blood cells being impermeable to cations? **NAALYA S.S. BWEYOGERERE**

5. (a) Describe the causes and effects of Coronary Heart Diseases.
(b) Outline the risk factors of Coronary Heart Disease.
(c) (i) How is tissue fluid formed and returned to circulatory system?
(ii) Describe any factors that may cause accumulation of tissue fluid.
(d) (i) Discuss the benefit of fetal haemoglobin having high affinity.
(ii) Why do adults not keep with fetal haemoglobin? **JJINJA PROGRESSIVE S.S.**

6. The figure shows *Phiomia,* an ancestor of elephants *that* lived about 35 million years ago and a modern African elephant.

Phiomia African elephant



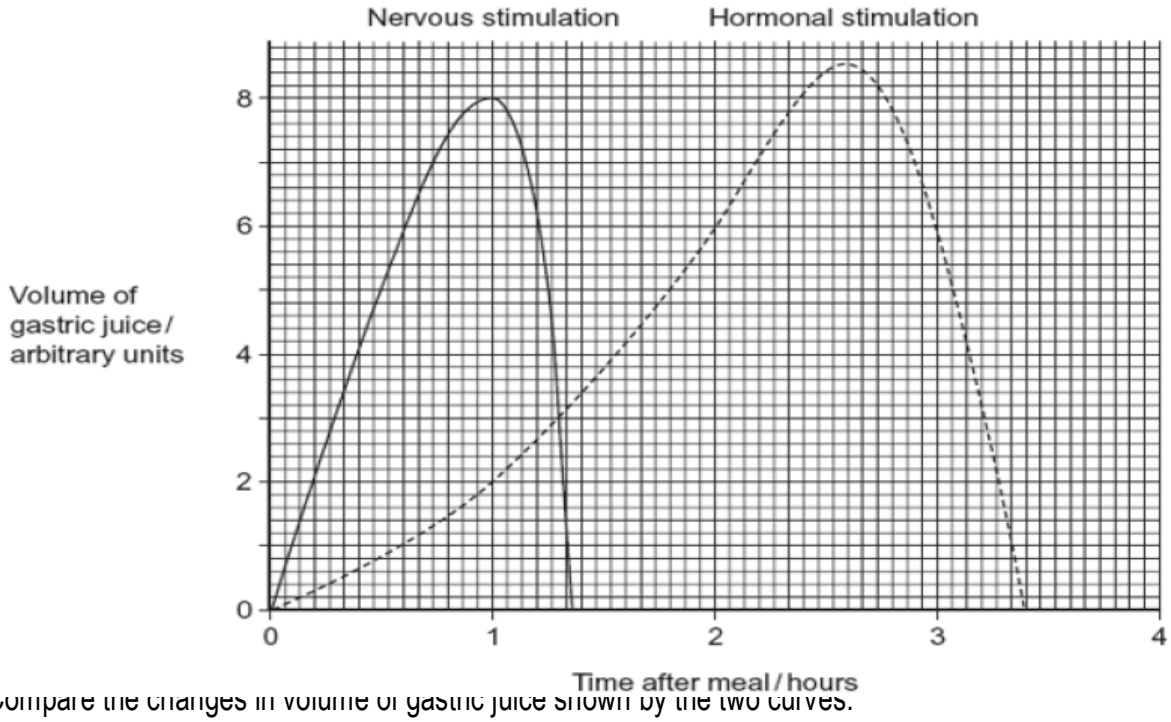
(a) In the 1800s, Charles Darwin and J. B. Lamarck had different theories about how the long nose of *Phiomia* evolved into the trunk of the African elephant. Explain how the elephant's trunk evolved according to:
(i) Lamarck (ii) Darwin
(b) What is Adaptation? (c) Describe the process of Adaptation.
(d) Suggest explanations for the following evolutionary events:
(i) the continual failure to develop a vaccine to give long term protection against malaria plasmodia.
(ii) the incompleteness of the fossil record.
(iii) the high prevalence of sickle cell anaemia in the sub-Saharan Africa.
(iv) the development of industrial melanism in peppered moths (Biston betularia) in Great Britain in the mid 1800s..

ST. JOSEPH'S OF NAZARETH

7. (a) Discuss the functioning of each of the following parts of the kidney nephron;
(i) Bowmans Capsule (ii) Proximal Convoluted Tubule
(iii) Loop of Henle (iv) Collecting Duct
(b) How is the kidney nephron adapted to carry out its functions?
(c) What is meant by countercurrent hairpin multiplier?
(d) Describe the significance of the countercurrent heat exchanger in o6rgans such as long limbs of birds.

NAMILYANGO S.S.

8. (a) Explain why release of digestive secretions in man should be controlled.
(b) Cells in the stomach wall release gastric juice after a meal. The graph shows how the volumes of gastric juice produced by nervous stimulation and by hormonal stimulation change after a meal.



(i) Compare the changes in volume of gastric juice shown by the two curves.

(ii) Describe the evidence from the graph that curve A represents the volume of gastric juice produced by nervous stimulation.
(iii) How are the changes shown by the graph brought about?
(c) The table summarises mechanisms of control of release of digestive secretions along different parts of the gut.

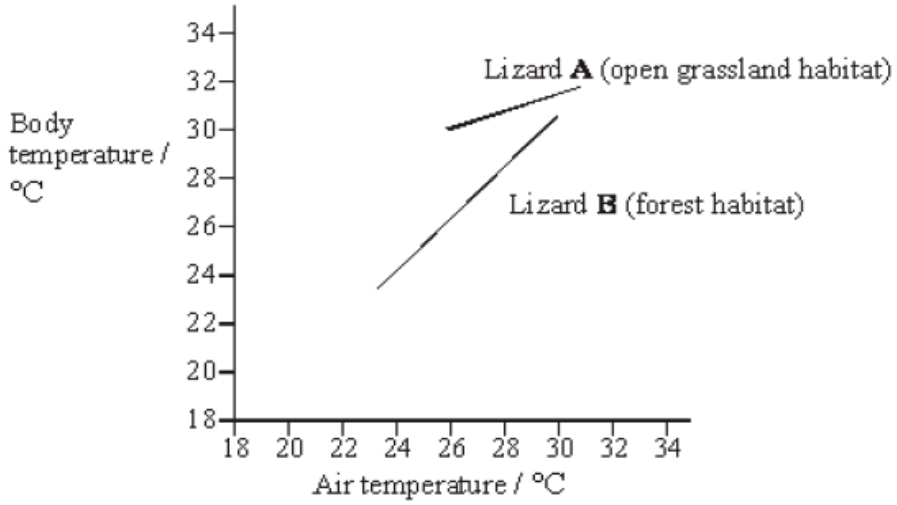
Part of gut	Control mechanism
Mouth	Nervous only
Stomach	Both nervous and hormonal
Ileum	Hormonal control only

Discuss the variation in the trend of control of release of digestive secretions. **ST. JOSEPH'S S.S. NSAMBYA**

9. (a) Discuss the nutritional groups of; (i) Bacteria (ii) fungi
(b) Describe the characteristic features of fungi.
(c) How do fungi differ from plants? **MPOOMA SCHOOLS MUKONO**

10. (a) What happens in a neurone during; (i) a resting Potential? (ii) an Action Potential?
(b) How does an Action Potential move along a Neurone?
(c) How does the Size of Stimuli affect a Nerve Impulse?
(d) Discuss the factors that affect speed of Nerve Impulse. (e) What are the Properties of Synapses?
(f) How does Fast Twitch Muscle Fibres work? (g) How does Slow Twitch Muscle Fibres work?
ST.LAWRENCE S.S. SSONDE

11. The graph shows results of an investigation into the relationship between air temperature and body temperature for two lizards living in different habitats. The investigation took place on a hot sunny day over a period of four hours

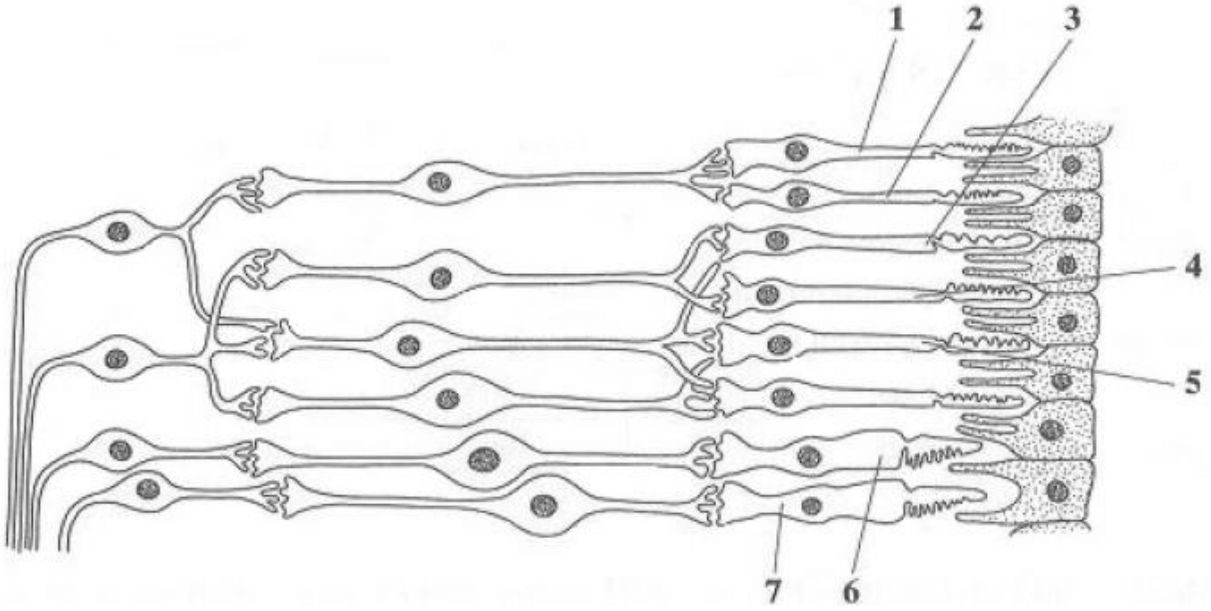


(a) Explain the relationship between the air temperature and the body temperature for lizard B.
(b) Suggest an explanation for the different pattern shown by lizard A.
(c) Lizard B moves more slowly when its body temperature is 24°C than when it is 28°C. Explain what causes the slower movements at the lower temperature.
(d) Discuss the physiological adaptations of a camel to survive in desert environment. **BILAL ISLAMIC S.S.**

12. Buffers are substances that regulate pH by releasing or accepting hydrogen ions (H+). Haemoglobin and amino acids acts as a buffer in the blood.
(a) Describe how haemoglobin and amino acids act to reduce the concentration of hydrogen ions in the blood.
(b) Describe how the kidney tubules act reduce the concentration of hydrogen ions in the blood.
(c) Discuss the causes of Bohr effect. **ROYAL COLLEGE BULOBA**

13. (a) What is meant by positive feedback?
(b) Explain positive feedback mechanism during;
(i) Parturition (ii) Propagation of an action potential alone the nerve cell
(iii) Reduction of blood pressure when a person loses substantial amount of blood
(iv) Activation of pepsinogen (v) Control of body metabolism after the high critical temperature .
KITANTE HILL

14. The diagram shows part of the retina in a human eye.



(a) Explain each of the following observations.

(i) When light falls on cells 1 and 2, only one spot of light is seen. But, when light falls on cells 2 and 3, two spots of light are seen.

(ii) When one unit of light energy falls on cell 3, no light is seen. But, when one unit of light energy falls on cell 3, one unit falls on cell 4 and one unit falls on cell 5, light is seen.

(b) Cells of the same type as cells 6 and 7 are found in large numbers at the fovea. This results in colour vision with high visual acuity. Explain what causes vision using the fovea.

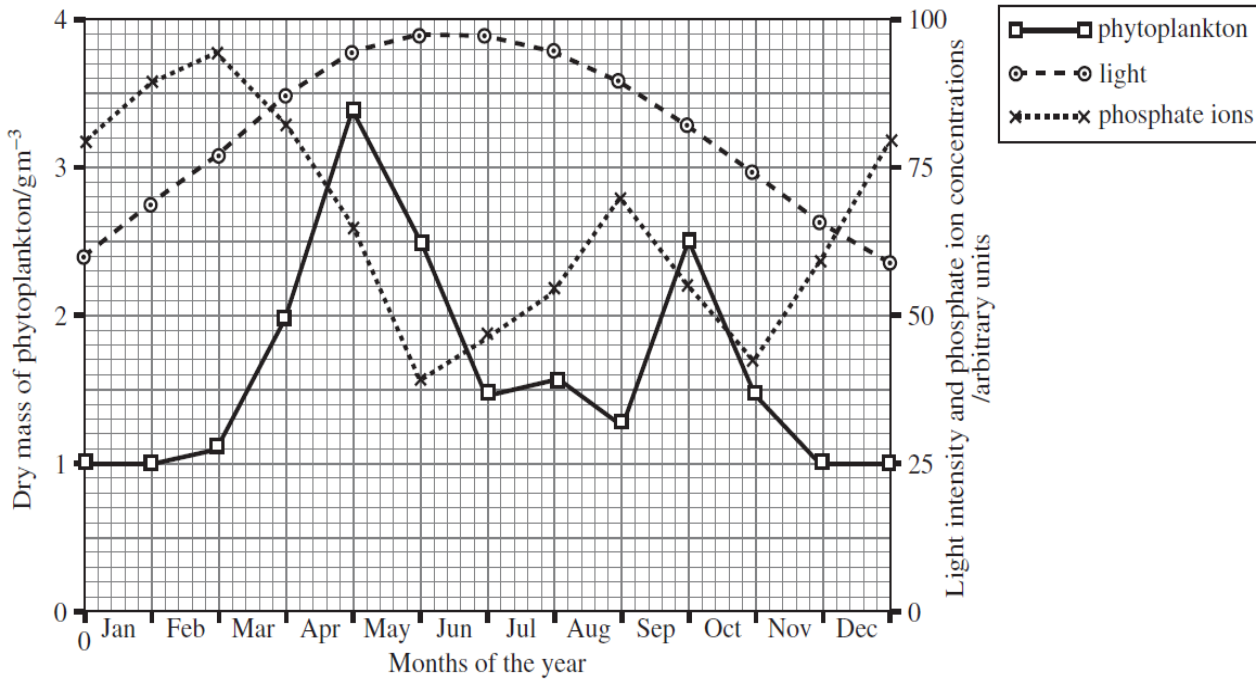
(i) to be in colour; (ii) to have high visual acuity.

(c) Explain the trichromatic theory of colour vision in cone cells.

(d) Explain each of the following as applied to receptor cells;

(i) Flicker fusion (ii) Adaptation **SEROMA CHRISTIAN HIGH SCHOOL**

15. The graph shows the abundance of phytoplankton (microscopic plants) throughout one year in the surface waters of a lake. The changing amounts of light and phosphate ions in the water are also shown in the graph. Phosphate ions are necessary for the growth of the phytoplankton.

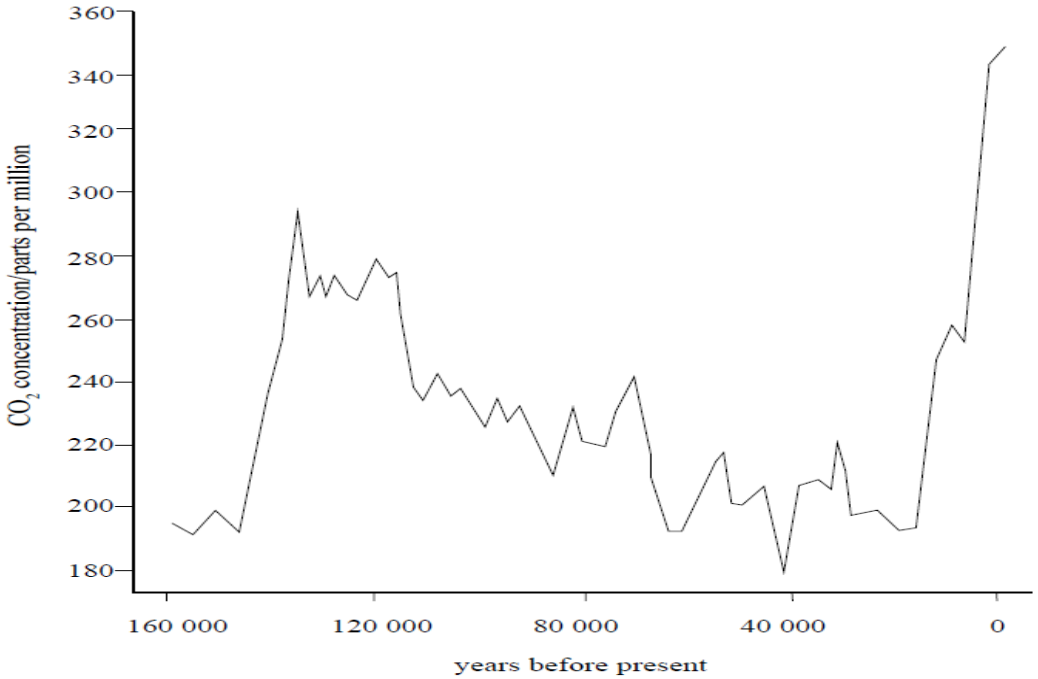


(a) Comment on the relationship between dry mass of phytoplankton with;

(i) light intensity over the year (ii) phosphate ion concentration over the year

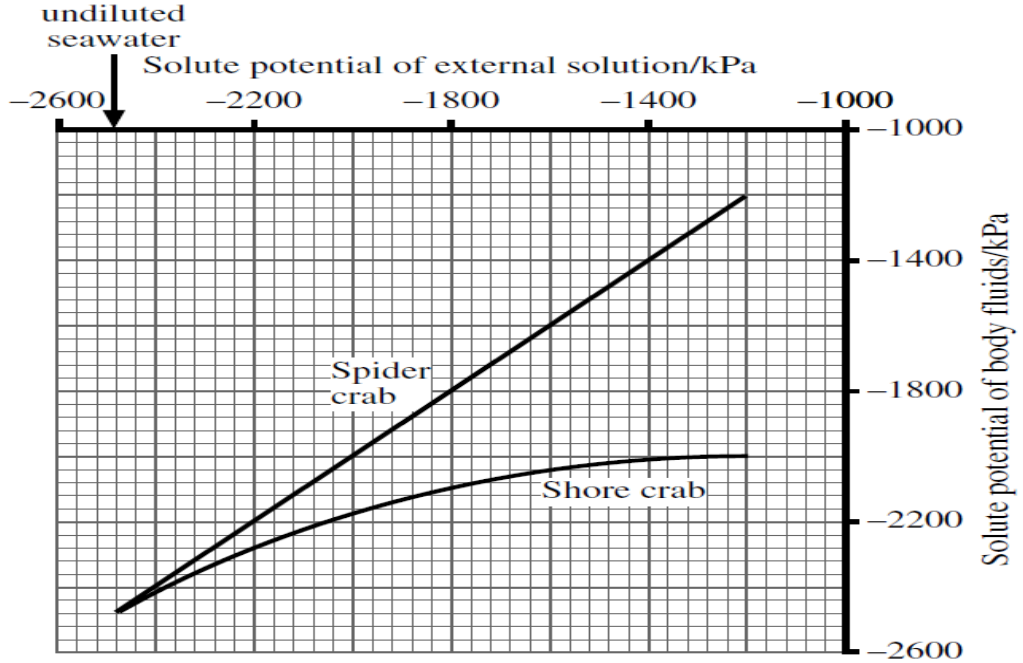
(b) Describe and suggest an explanation for the changes in the phytoplankton population during the months of May and September.
(c) The zooplankton populations peak twice during the year. During which months are these peaks most likely to occur? Explain your choice.
(d) Discuss how different biotic factors affect distribution of organisms in an ecosystem. **KAKIRA S.S.**

16. The graph shows changes in atmospheric carbon dioxide levels over the last 160,000 years.



(a) Describe and explain the causes of increasing atmospheric carbon dioxide concentration.
(b) Outline why global warming may accelerate loss of biodiversity.
(c) Discuss the indicators of global warming in the world today. **LUGAZI HOMESTONE SCHOOL**

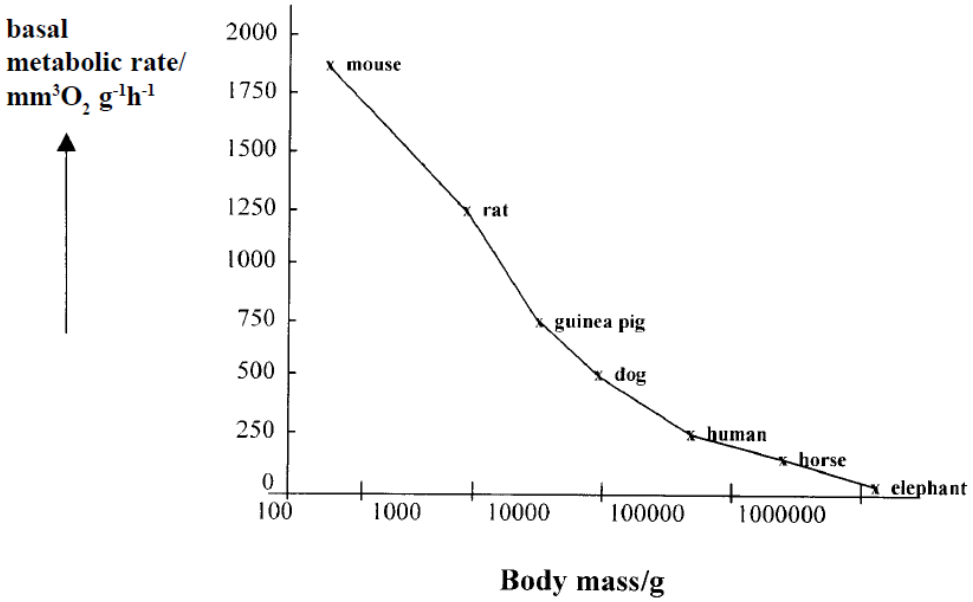
17.(a) Explain what is meant by; (i) osmoconformer? (ii) Osmoregulator?
(b) Describe the role of contractile vacuole in fresh water protists.
(c)The spider crab (*Maia*) lives in the sea at a depth of over 30 metres, while the shore crab (*Carcinus*) lives in estuaries as well as along the shoreline. When the two species of crab are placed in dilute solutions of seawater the solute potential of their body fluids is altered. The results are shown in the graph below.



(i) Explain the effect of diluting seawater on the solute potential of the body fluids of the spider crab.

(ii) When the shore crab is placed in dilute solutions of seawater it absorbs salt through its gills from the surrounding solution. What is the effect of absorbing salt on the solute potential of the body fluids?
(iii) What is the evidence from the graph that the shore crab absorbs salt when placed in dilute solutions of seawater? **LUWEERO S.S**.

18. The graph below shows the basal metabolic rate of various mammals.



(a) What is meant by the term 'basal metabolic rate'?
(b) How is the metabolic rate of different mammals measured?
(c) Explain why smaller mammals have higher metabolic rates than large mammals.
(d) How do small animals get enough oxygen to the tissues to maintain a continuous high rate of metabolism?
(e) Discuss the factors that determine basal metabolic rate in organisms. **ST. CYPRIAN H/S KYABAKADDE**

19. When DDT was first manufactured it was used as a method of controlling housefly populations. The populations of two species of houseflies and the spider were monitored over a period of thirteen months. Shortly after the second month of data collection the DDT was applied and it was not toxic to the spider. The results of the study are recorded are recorded in table 1 overleaf. Study the table carefully and answer the following questions.

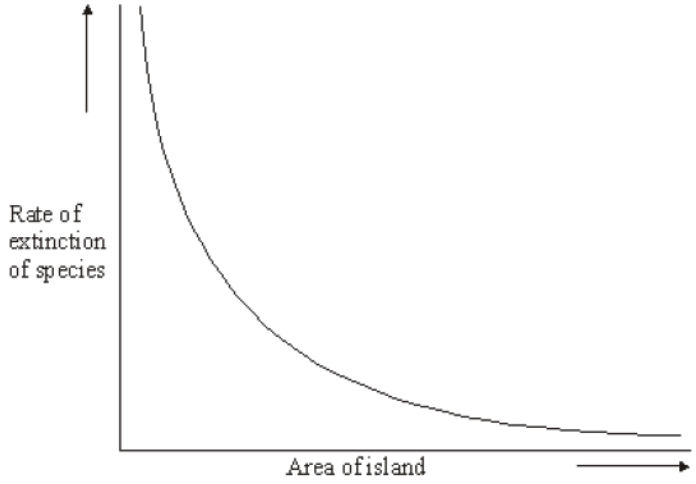
Time (months)	1	2	3	4	5	6	7	8	9	10	1	12	13	14
Housefly W (x1000)	35	35	35	20	2	7	17	32	50	65	79	88	82	81
Housefly Y (x1000)	79	82	79	80	62	40	17	0	-	-	-	-	-	-
Spider R (x1000)	72	76	81	78	66	56	49	46	46	48	55	70	85	86

(a) Plot suitable graphs on the same axes to represent the results in the study.
(b) (i) How does the population of the spider relate with the populations of the houseflies in this investigation?
(ii) Explain the relationship in the populations in (b) (i) above.
(c) (i) How do you explain the effect of the use of DDT on the observed trends of the three populations of the animals? (ii) Basing on the information given, what would happen if DDT was toxic to the spider?
(d) (i) Discuss the properties of DDT as an effective pesticide in controlling population of pests.
(ii) Explain the following: Biomagnification; Bioaccumulation; and Bioremediation.
NAALYA S.S. BWEYOGERERE

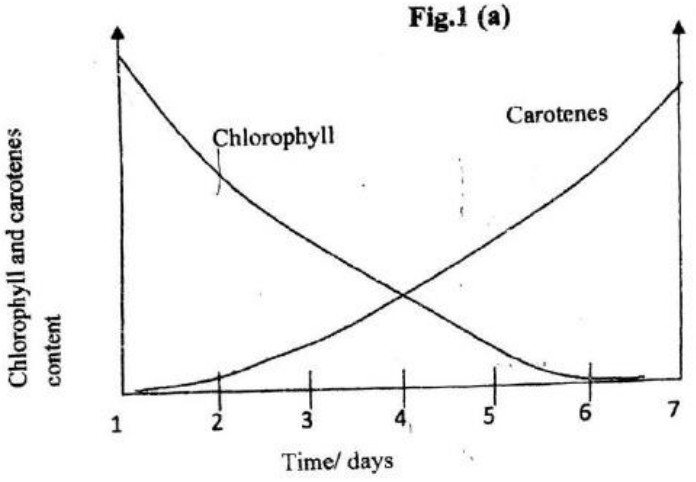
20. (a) Describe mechanisms which promote genetic variability in plants
(b) Discuss the shortcomings of inbreeding in a population. **EASTERN COLLEGE BUSIA**

21.(a) Distinguish between the fluid mosaic and Danielli-Davson models of the plasma membrane.
b) Explain how the;
i) golgi bodies function in cells.
ii) Plasma membrane allows transport of materials across it. **UGANDA MARTYRS KAYUNGA**

22. (a) Define the term; (i) Biodiversity (ii) biological conservation
(b) Give the aims of biological conservation.
(c) The graph shows the rate of extinction of species of birds on islands of different size.



(i) Describe the relationship between the rate of extinction of species and the area of the island.
(ii) Suggest the cause of this relationship.
(d) Describe how other factors may affect the rate of extinction of species on an island. **NSAMBYA S.S.**
23. Figures 1 (a) and 1 (b) show the physiological changes that occur in a fruit as it ripens.



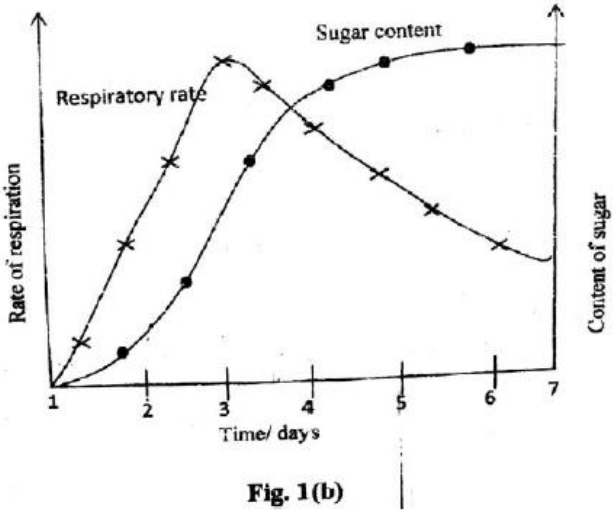


Fig. 1(b)

(a) Describe how each of the following variables change with time:
(i) Respiratory rate (ii) Sugar content
(b) Explain the variation in each of the following; (i) Respiratory rate (ii) Sugar content
(c) Explain the relationship between the content of chlorophyll and carotenes.
(d) What is the ecological significance of each of the changes depicted on the figures?
(e) Outline other changes which occur in a fruit as it ripens. In each case, give the importance of the change.
STANDARD HIGH ZANA

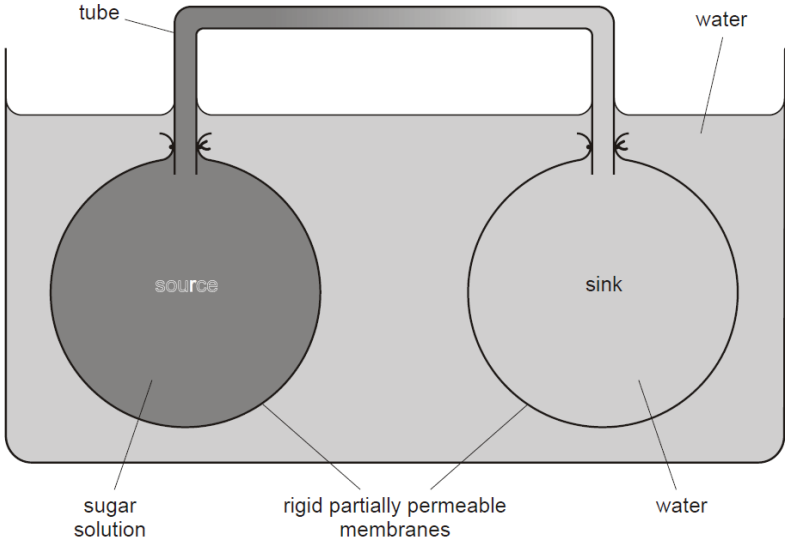
24. (a) Explain the changes which occur to the bitten part of the human body by the wasp.
(b) Describe how the B lymphocyte defend the body against infections.
ST. AUGUSTINE'S COLLEGE WAKISO

25.(a) What is meant by phytochromes?
(b) Describe the control of flowering in tobacco by the phytochromes.
(c) Describe geotropism in plants. **MIDLAND HIGH SCHOOL**

26.a) Compare the structure and functioning of the cardiac and skeletal muscles.

b) Explain how structural features of birds are related to flight. **EAST HIGH NTINDA**

27. The diagram below shows a physical model to illustrate the principle of mass flow in plants.

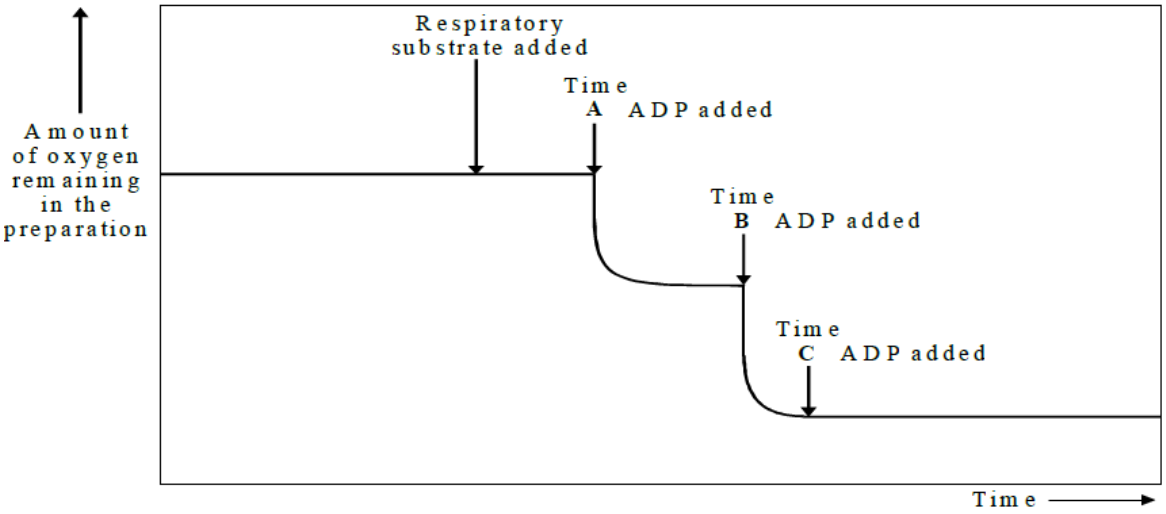


(a) What is meant by mass flow? (b) (i) Give examples in plants of a source and a sink.

(ii) Use the information in the diagram to explain how mass flow of materials between the source and the sink would be brought about.

(c) State two pieces of evidence to show that sugar transport from sources to sinks in plants does not only involve passive movement by mass flow. **MACKAY MEMORIAL**

28. A preparation of mitochondria was made from liver tissue. Substances were added to this preparation and the amount of oxygen in the preparation was monitored over a period of time. The diagram shows the trace obtained and the times when the different substances were added.



(a) Suggest why respiratory substrate added to this preparation was a molecule from Krebs cycle and not glucose.

(b) What additional substance, other than those mentioned on the diagram, would need to be added to this preparation in order to get the results shown?

(c) Explain: (i) why the amount of oxygen fell between lines A and B;

(ii) the shape of the trace after time C. **KIRA COLLEGE BUTIKI**

29. (a) Describe the post-natal circulatory changes in the human newborn baby.

(b) What is the significance of the changes mentioned above?

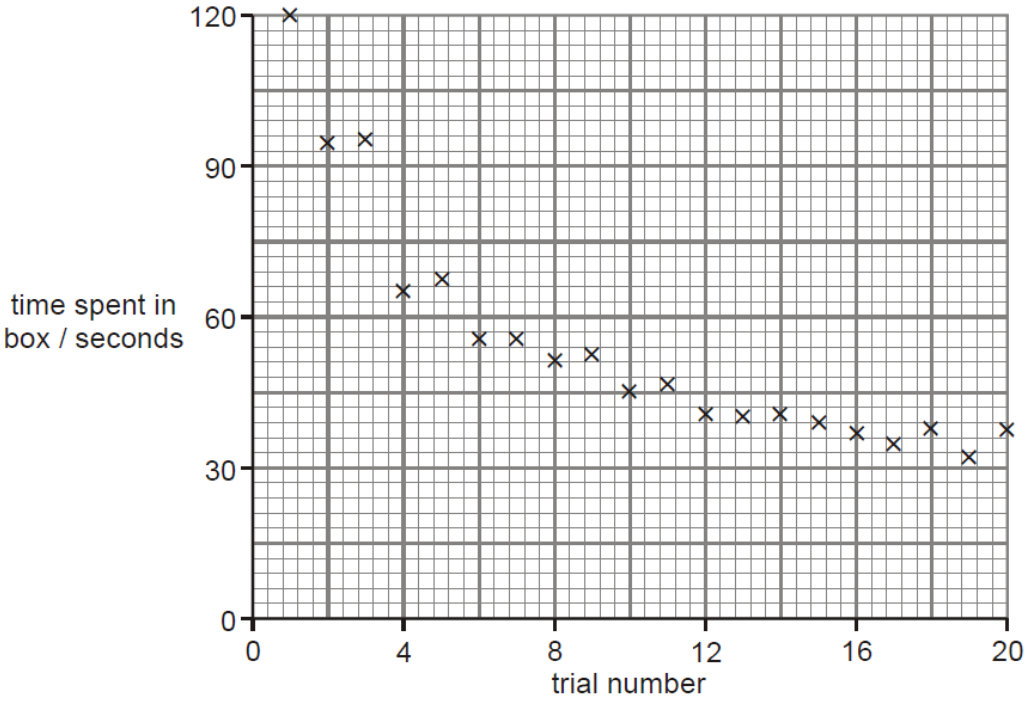
(c) How is the mammalian placenta adapted for the transportation role?

(d) Describe the role of the placenta in maintaining pregnancy. **BUDDO S.S.**

30. (a) Describe how food ingestion stimulates larval development into an adult grasshopper.

b) Explain the significance of giant axon neuro-secretion in man. **ST. THOMAS AQUINAS JINJA KAROLI**

31.(a) Describe the process of secondary growth in a dicotyledonous stem.
(b) What are the functions of the following in a stem? (i) rays (ii) cork **JINJA S.S.**
32. (a) Define operant conditioning.
(b) During an experimental trial, a cat was placed inside the puzzle box. If the cat pulled the loop with its mouth or a paw, the door opened and it could escape. The time taken for the cat to escape was recorded. The experiment was then repeated several times with the same cat. The figure shows a graph of the time taken for the cat to escape from the puzzle box during repeated trials.



(i) Account for the changes in time spent by cat in box at different trial numbers.
(ii) What evidence shown by the figure shows that learning took place?
(iii) State three factors that could affect the learning of a new situation like a puzzle box in animals.
(iv) How could the time needed by the cat to escape out of the puzzle box be reduced?
(c) Discuss the characteristics of reflexes. **TURKISH LIGHT ACADEMY**
33. The figure shows the changes in leaf area index (ratio of leaf surface to soil surface (m^2 cm^{-2}) of two species of clover, *Trifolium repens* and *Triforium fragiferum*, growing in a pure and mixed stand.

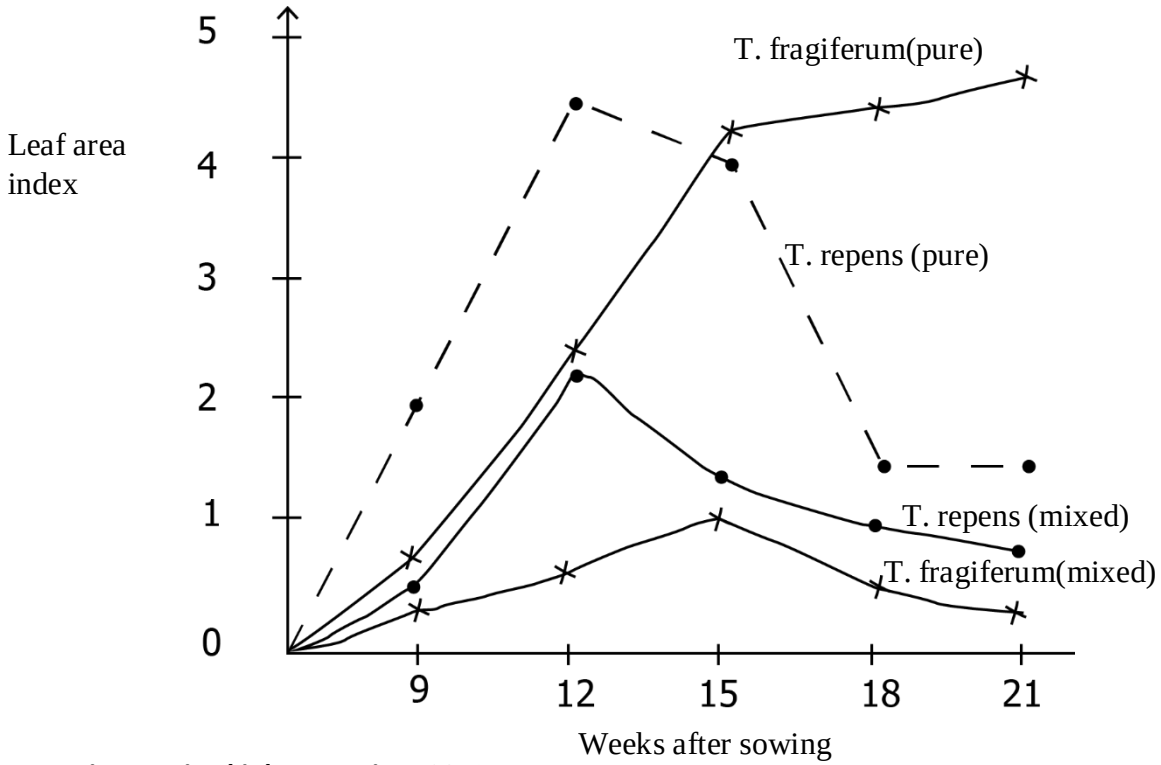


Table 1 shows the characteristics of the petioles and leaf size of the two species of clover.

	Characteristic	
	T.fragiferum	*T.repens*
Petiole length	Long	Short
Leaf size	Large	Small

Use the information in the figure and table to answer the questions that follow.

(a) Compare the leaf area index of *Trifolium repens* and *T.fragiferum* in the;

(i) pure stands (ii) mixed stands

(b) Explain the trend in leaf area index for *Trifolium repens* in pure stands.

(c) Explain the difference in growth rate of the two species in mixed stands.

(d) Explain why *Trifolium fragiferum* continues to grow after the peak of Trifolium repens?

(e) What conclusion can you draw from the results in a mixed stand.

(f) What other factors are likely to have caused the difference in growth rate of the two species in mixed stand?

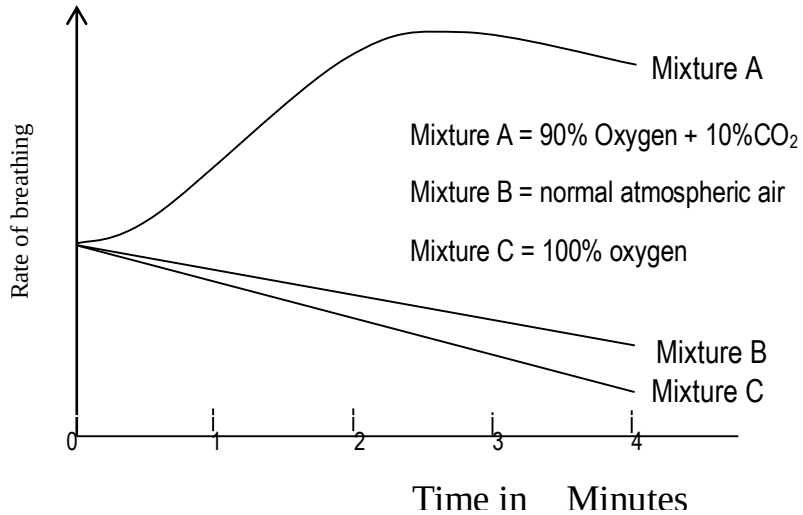
CRESTED S.S. MAKINDYE

34. (a) Describe the structure of a lenticel.

(b) how are the conditions for efficient gaseous exchange fulfilled in terrestrial plants?

(c) explain the absence of transport pigments in plants. **ST. MICHAEL HIGH SCHOOL SSONDE**

35. In an experiment, a subject was given various mixtures to breath and the rate of breathing was measured. The results are shown in graph 1



Five small discs cut from spinach leaves were floated in a small volume of buffered hydrogen carbonate solution in a flask attached to a respirometer. The discs were first exposed to bright light, then to dim light and finally left in the dark. Oxygen release was recorded as positive values and oxygen up take as negative values.

The results obtained from the experiment are given below in table 1.

Light intensity	Time interval in minutes	Oxygen uptake or release for each 3 minutes interval (mm^3)
Bright light	0-3	+57
	3-6	+64
	6-9	+58
	9-12	+60
Dim Light	12-15	+16
	15-18	+3
Dark	18-21	-16
	21-24	-12
	24-27	-15
	27-30	-14

Use the information to answer the questions that follow.

(a)(i)Present the data in table 1 in suitable graphical form

(ii) Calculate the mean rate of oxygen release in bright light

(iii) Explain the significance of the results obtained from this experiment

b) Explain what the data in graph 1 show concerning how the rate of breathing is controlled.

c) In the light of the information provided by graph 1. Show why mouth to mouth resuscitation is a better means of artificial respiration than pressing on the chest wall.
d) Why is it more dangerous to rebreath expired air if it is passed through soda lime?

LOYAL COLLEGE NAMUGONGO

36. (a) Compare carbohydrates and lipids.
(b) Explain why a hibernating animal first converts carbohydrates to lipids before hibernation.
(c) Describe the role played by lipids in life. **ENTEBBE S.S.**

37. (a) Explain the significance of co-existence of plants and animals towards them.
b) How do the terrestrial plants survive their excretory challenges? **LUZIRA S.S.**

38. The graphs below indicate the population growth of two related aquatic microorganisms of species A and B in two sets of culture media. In figure 1 of the first set, both species were cultured in a long and cylindrical vessel while in figure 2 of the second set both species were cultured in a shallow Petri dish.
Study the two graphs and answer the questions that follow.

figure 1

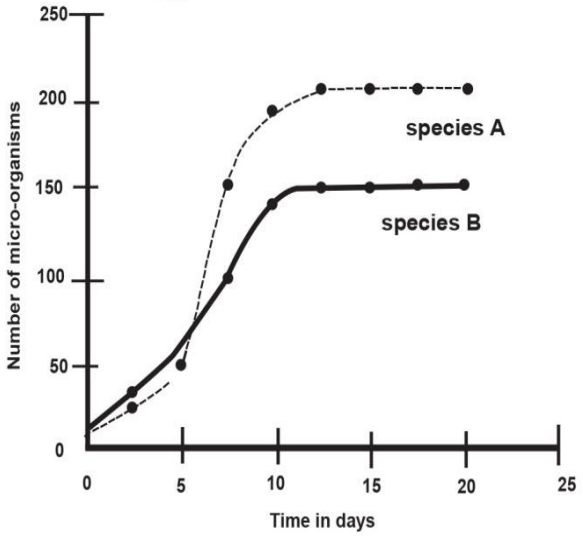
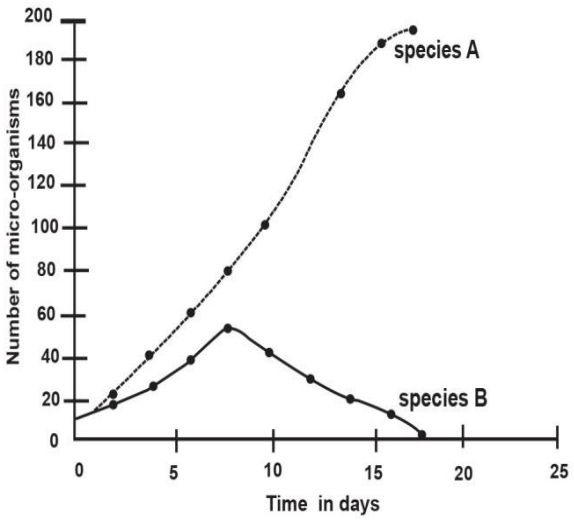


figure 2



(a) Describe the population changes with time of:
(i) A (i) B in long and cylindrical vessels
(b) Compare the population changes of both species in figure 1
(c) State the interaction of the two species in the first set
(d) Explain the interaction stated in (c), above
(e) Explain the population changes of both species up to 7½ days in figure 2
(f) Explain the population changes of both species from 7½ days in figure 2
(g) State and explain the competitive exclusion principle. **JINJA COLLEGE SCHOOL**

39. a) Describe the hormonal control of post – fertilization changes in human female up to breast feeding.
(b) How is the viability of the sperms in humans maintained? **ST. LUCIA NAMAGOMA**

40. (a) Describe the chemiosmotic synthesis of energy within the chloroplasts.
(b) Compare the chemiosmotic synthesis of energy described above with that in mitochondria.

GREENHILL ACADEMY

41. (a) Describe how abnormal haemoglobin arises in a human population.
(b) Explain the effect of the gene for abnormal haemoglobin in humans.
(c) Differentiate between sex-linked and sex limited genes. **BUGEMA ADVENTIST**

42.(a) Account for the advantages of panting to sweating.
(b) Explain why panting can result into the following conditions.
(i) Excessive alkalinity of blood. (ii) Increased heat production.
(c) (i)Describe metabolic ways endothermic animals use in hot conditions to control body temperature.
(ii) Give an account of osmoregulation in estuarine fish. ***NDEJJE S.S.***

43. In an experiment to study the effectiveness of DDT towards the cabbage pest, *Pieris rapae* which feeds on cabbage leaves, two adjacent farm yards where prepared and *Pieris* was introduced in each farm and left for some time. After spraying one farm yard with DDT for three consecutive times, the number of eggs that survived and hatched into larvae at the sprayed and non sprayed farm yards was determined as shown by Graph A .
In another set of experiment, *Pieris rapae* was exposed to birds as its control agents and the changes in the population of both, with time was determined as indicated by Graph B. Study the graphs and answer the questions that follow

TABLE A

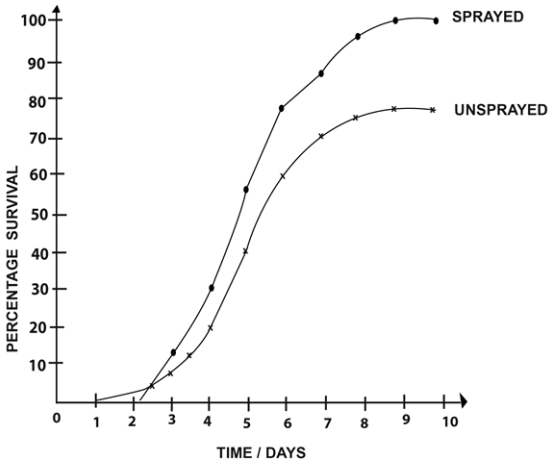
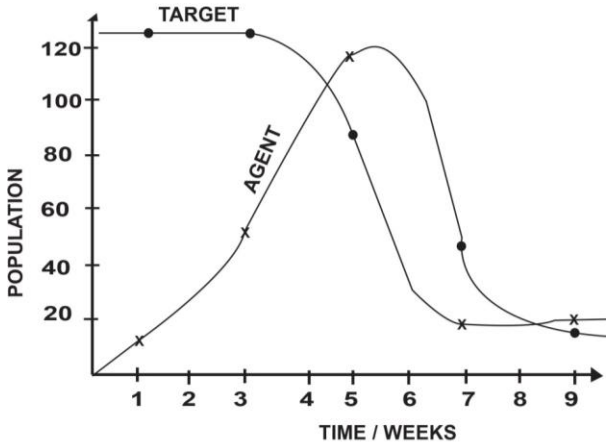


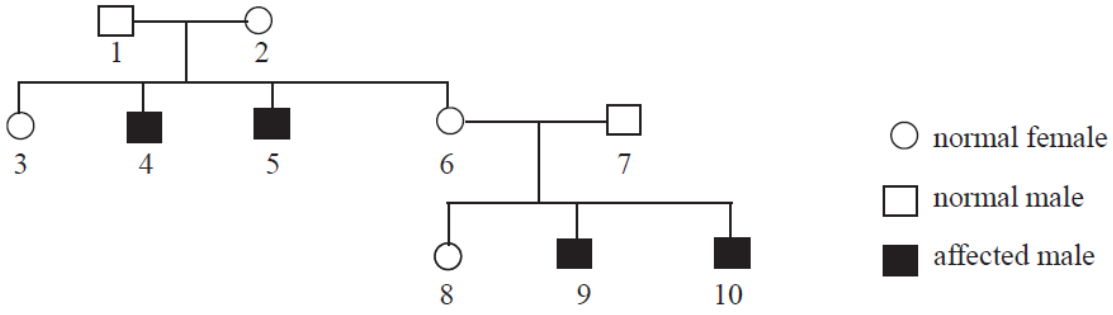
TABLE B



(a) (i) Account for the increase in the population of the control agent.
(b) Explain the decrease in the population of the control agent.
(c) (i) Account for the decrease in the population of *Pieris rapae.*
(ii) Account for the population of *Pieris* and that of the control agent from 8½ to the 9th week.
(d) Compare the number of eggs of *Pieris* between the sprayed and non sprayed farm yards.
(e) Account for the differences in the number of eggs of *Pieris* at the sprayed and non-sprayed farm yards.
(f) Explain one property of DDT other than the one shown above, which render it unsuitable for environmental use.
(g) Outline any three advantages of the method used in Graph B to that used in Graph A.

GOOD SAMARITAN S.S.

44. The family tree below shows the inheritance of Duchenne muscular dystrophy in a family.



(a) What conclusion can you draw about the genetic control of the disease? Give a reason for your answer.
(b) What would a genetic counsellor say to parents 6 and 7 when explaining what the probability would be of their next child suffering from Duchenne muscular dystrophy?
(c) State two other genetic diseases in humans transmitted in the same way.
(d) Outline the importance of pedigree diagrams /family tree in genetics. **KASAWO S.S.**

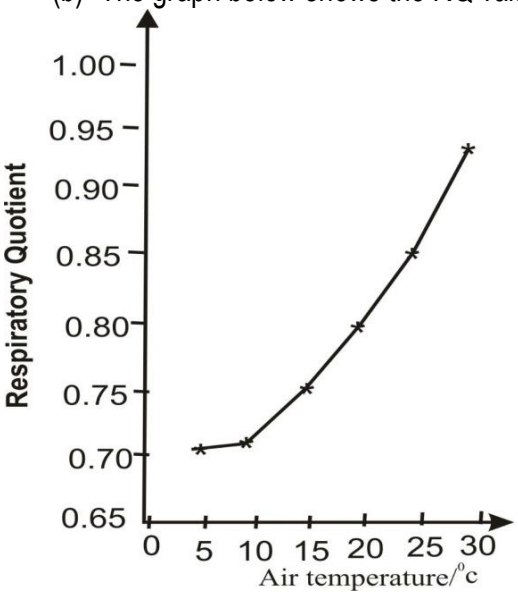
45. (a) Explain the glowing eyes of the cat at night, when shone with light.
(b) Account for the sensitivity of rods towards light.
(c) Describe the physiological behavior of a rod in darkness. **ST.PETER'S S.S. NAALYA**

46. Carbohydrates and lipids are useful energy sources in cells

(a) (i) Explain the difference in the energy values of carbohydrates and lipids as energy sources

(ii) Explain why a hibernating animal first converts carbohydrates to lipids before hibernation

(b) The graph below shows the RQ values of a mouse at different air temperatures



(i) Using the information in the graph, explain the relationship between RQ and air temperature.

(ii) Explain circumstances under which RQ would rise over 1.01.

NAMIREMBE HILLSIDE

47. The table below shows the excretion of urea in the urine of a healthy student on high and low protein diets.

Diet	Protein intake/g per day	Daily output of urea/g
High protein	189	21.4
Low protein	56	8.5

(a) Calculate the percentage difference in the daily output of urea between the two diets in relation to the total daily urea output.

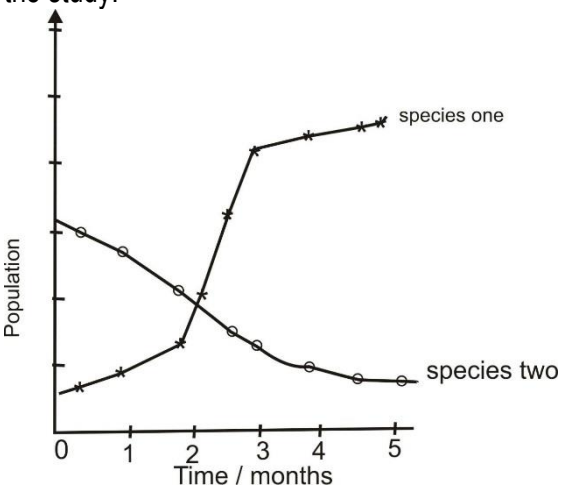
(b) (i) Explain the difference in the output of urea between the two diets.

(ii) What is the significance of: glycogenesis, glycogenolysis and gluconeogenesis.

(c) (i) Suggest reasons why many aquatic organisms excrete ammonia rather than urea as the end product of protein metabolism.

(ii) Sate other ways other than ability to osmoregulate that freshwater animals utilize to prevent over dilution of their tissues. ***GAYAZA HIGH SCHOOL***

48. Parasitic wasps can be used for biological control of white flies. Wasps were released into a glass house at the same time to find out which one was more effective. Graph shows how the population of both species varied during the study.



(a) (i) What is meant by biological pest control?

(ii) Explain the changes in the population size of species one.

(b) (i) Account for the advantages and disadvantages of using biological control rather than pesticides in the control of pests.

(ii) Give an account of the phenomenon of greenhouse effect

KIBULI SEC SCH

49. In cats short hair is dominant over long hair, the gene involved is autosomal. Another gene which is sex linked produces hair color, its alleles produces black or white coat color and the heterozygote combination produces tortoise shell color.

(a) If a long haired black male is mated with a tortoise shelled female homozygous for short hair, what kind of offsprings will be produced in F1?

(b) (i) If the F1 cats are allowed to interbreed freely among themselves, what are the chances of obtaining long haired males.

(ii) Apart from being sex linked what else can you say about the inheritance of the gene for coat color?

(iii) Describe how sex is determined in Drosophila, reptiles and birds. ***KINGS COLLEGE BUDDO***

50. Three different varieties of maize X, Y and Z were grown in three separate habitats with different soil conditions. The characteristic features of the soils in each habitat are summarised below. *Use it to answer the questions that follow.*

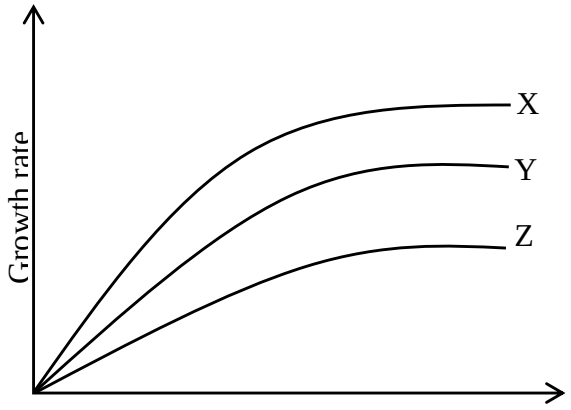
Habitat I: 95% nitrogen, 85% organic matter, more micro-organisms.

Habitat II: 20% nitrogen, 24% organic matter, few micro-organisms.

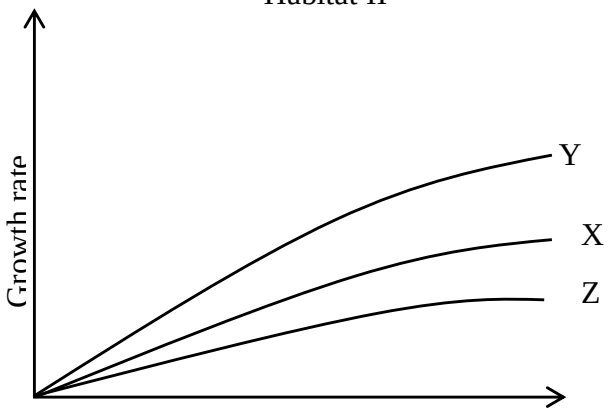
Habitat III: 95% nitrogen, 85% organic matter, more weeds, more micro-organisms.

Results of the study for each habitat are shown in figures below

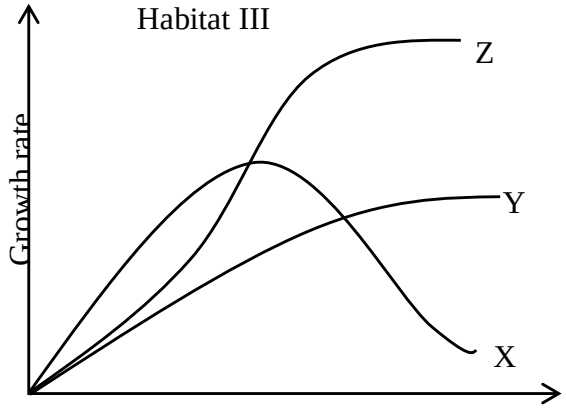
Habitat I



Habitat II



Habitat III



(a) Compare the growth rate for the three varieties in;

(i) Habitat I

(ii) Habitat II

(b) Giving reasons, describe the habitat preferences for each variety of maize.

(c) Explain;

(i) the differences in growth rate of variety X in habitat I and II.

(ii) how the significance of the growth rate of the varieties in habitat III to a farmer?

(d) (i) What are the possible sources of nitrogen to plants.

(ii) Outline the importance of organic matter in the soil. **ST MARY'S COLLEGE KISUBI**

HEARTFELT SUCCESS