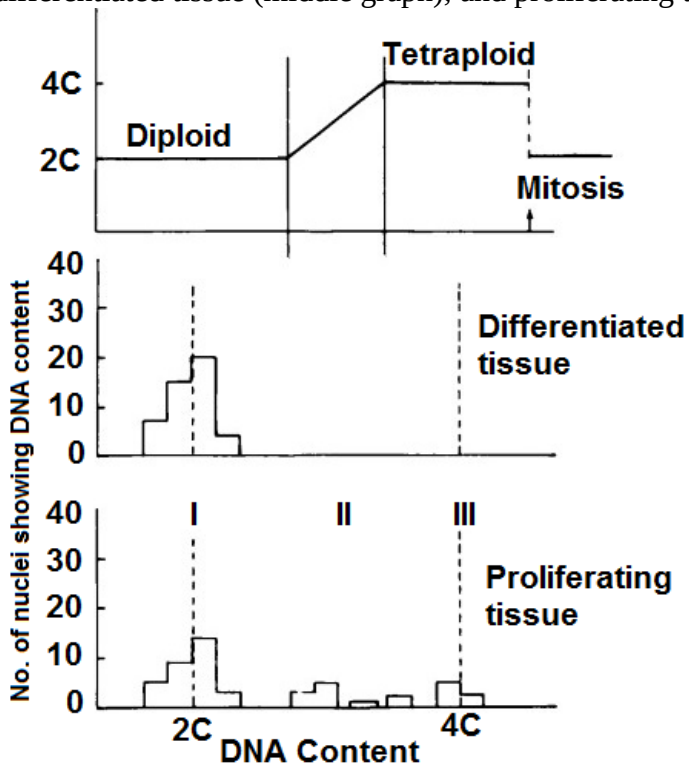
THEME I: CELL BIOLOGY

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).

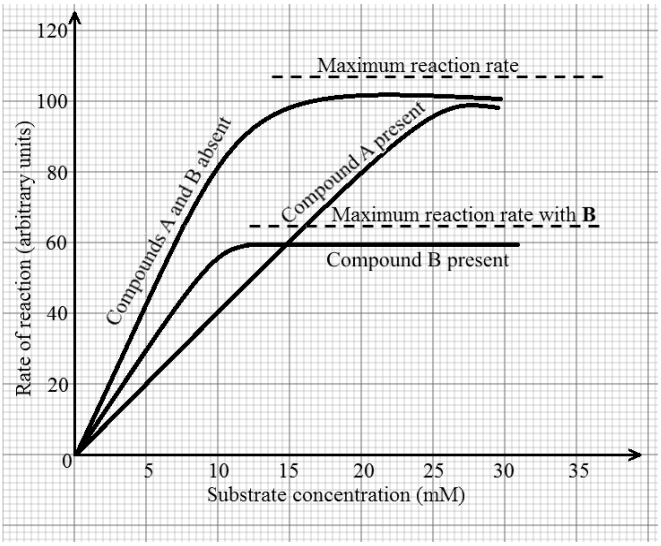


a) From the graph, describe the changes in the DNA cycle up to mitosis. (04 marks)
b) With reference to the graph, explain the changes in the DNA cycle. (07 marks)
c) Compare the content of DNA in proliferating and differentiated tissues. (06 marks)
d) For each phase labelled I, II and III in the proliferating 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*)

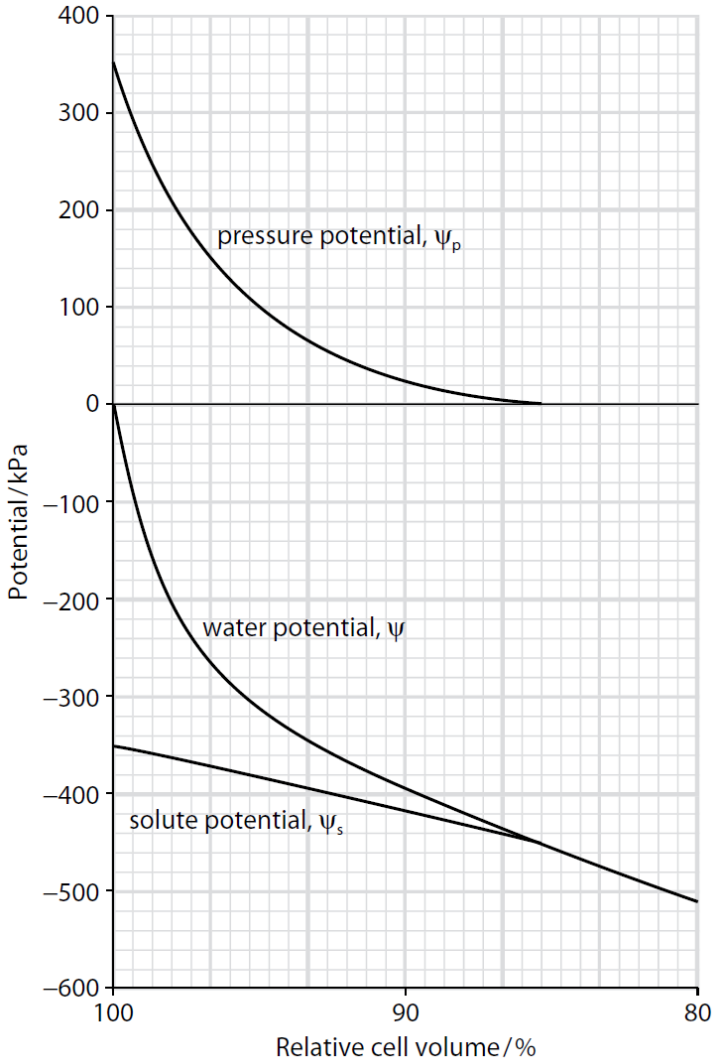
(b) Explain the experimental results in the
(i) absence of compounds **A** and **B**. (*06 marks*)
(ii) presence of compound **A**. (*07 marks*)
(iii) presence of compound **B**. (*07 marks*)

(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.

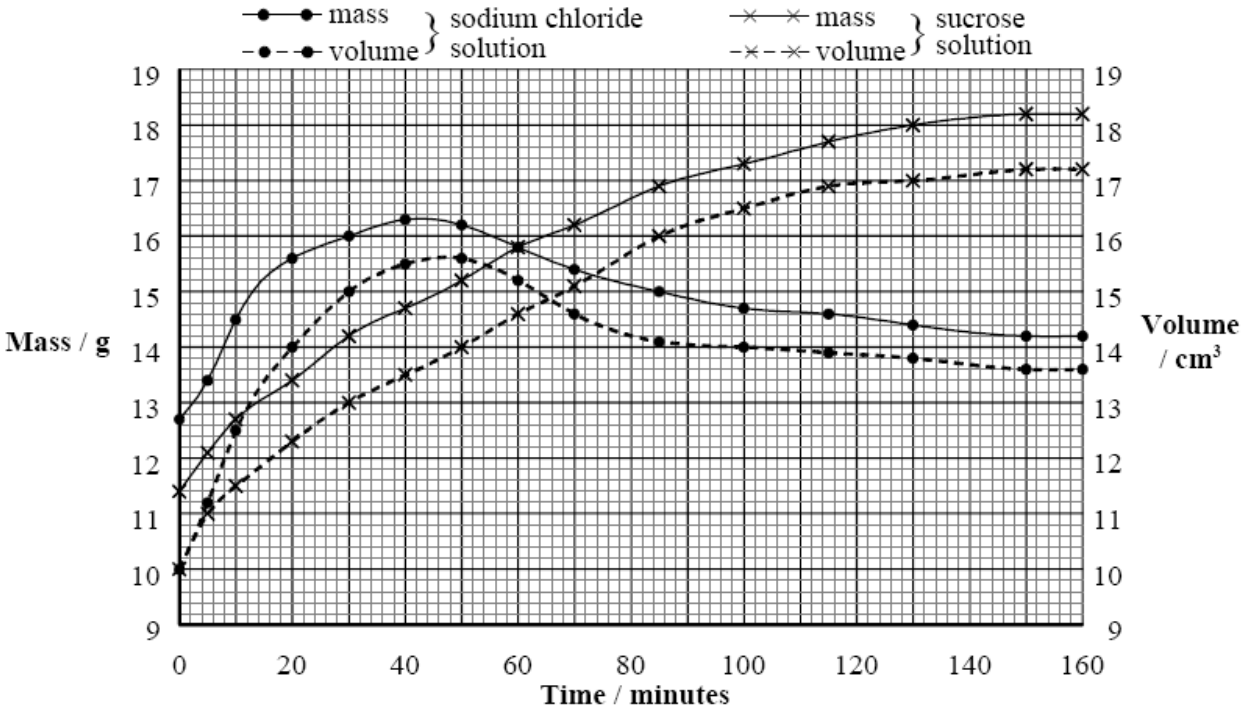


a) Distinguish between **pressure potential, water potential** and **solute potential**. (03 marks)
b) Compare the changes in solute potential and pressure potential as the cell changes volume.
c) Describe the changes in pressure potential, water potential and solute potential.
d) Account for the changes 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.

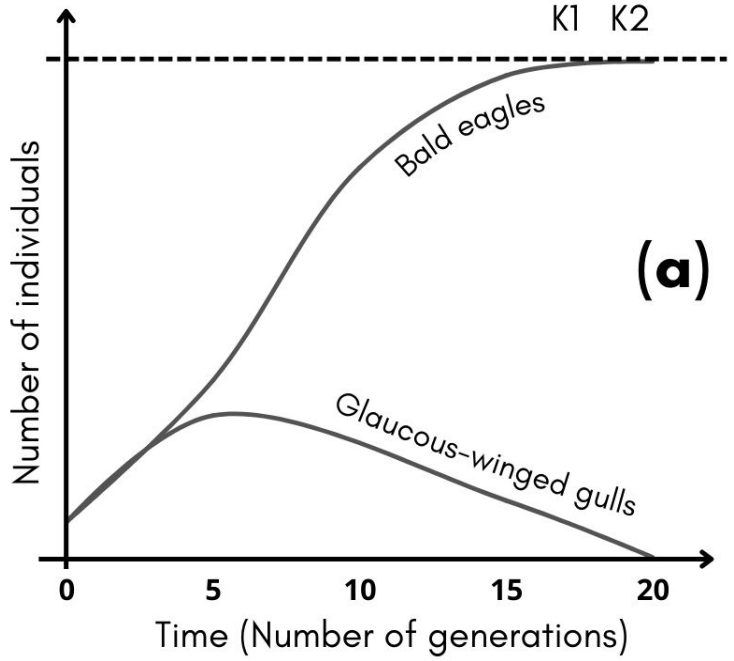
Salt concentration / arbitrary units	Number of contractions per minute
0	10
1	8
2	5
3	1
4	0

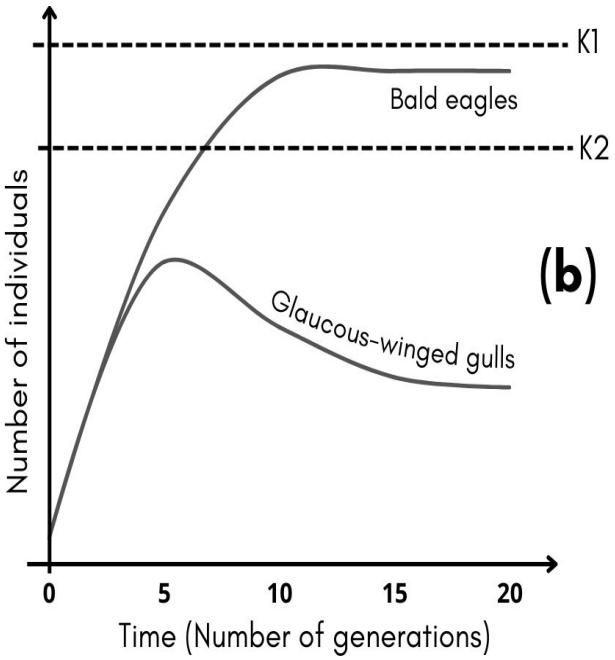
(e) (i) Comment on the vacuole responses shown by the data. (02 marks)
ii) Describe how vacuole contractions in paramecia are brought about. (08 marks)
(f) Suggest and explain what would happen to vacuolar contractions if a respiratory inhibitor was introduced into the environment of *P. caudatum*

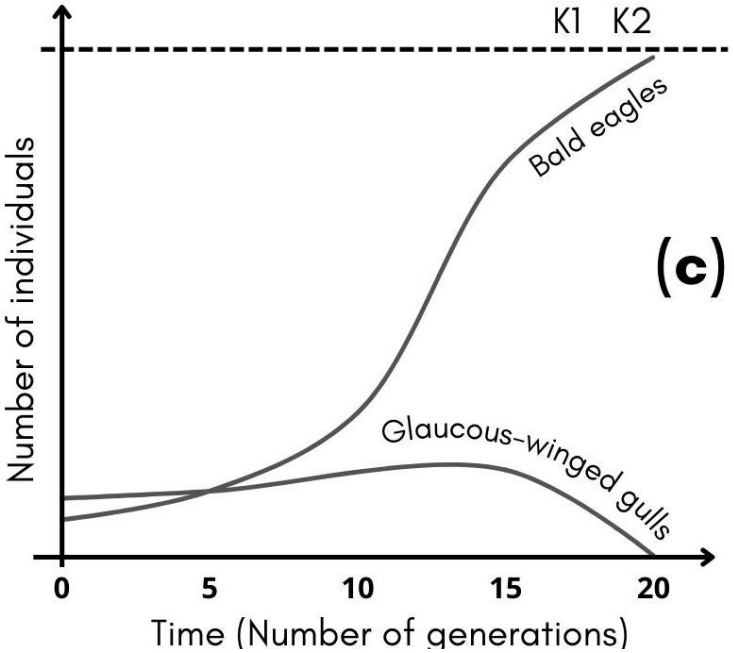
. LAKE SIDE COLLEGE, MASESE

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.



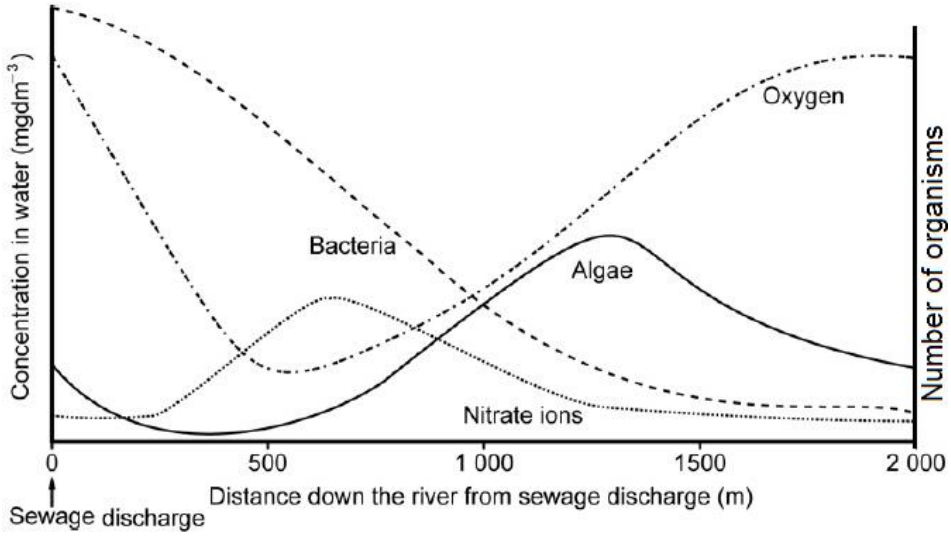




(a) Describe the observed phenomena in:
i) Figure (a)
ii) Figure (b)
iii) Figure (c)
(b) Suggest explanation for the observed effects of bald eagle activity on the dynamics of glaucous-winged gull colony in:
i) Figure (a) (04 marks)
ii) Figure (b)
iii) Figure (c)
(c) With the exception of birds and humans, 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.



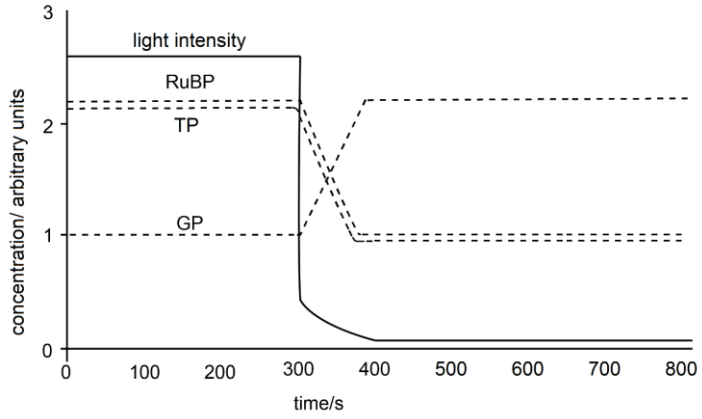
a) Describe the effect of adding sewage into the river on:
i) The number of bacteria.
ii) Oxygen concentration.
iii) Nitrate ion concentration.
b) Explain the effect of adding sewage into the river on:
i) The number of bacteria.
ii) Oxygen concentration.
iii) Nitrate ion concentration.
c) Explain the 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.

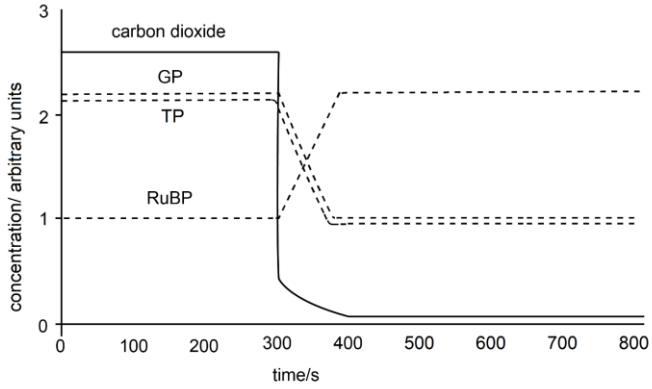
KOLOLO SS

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.



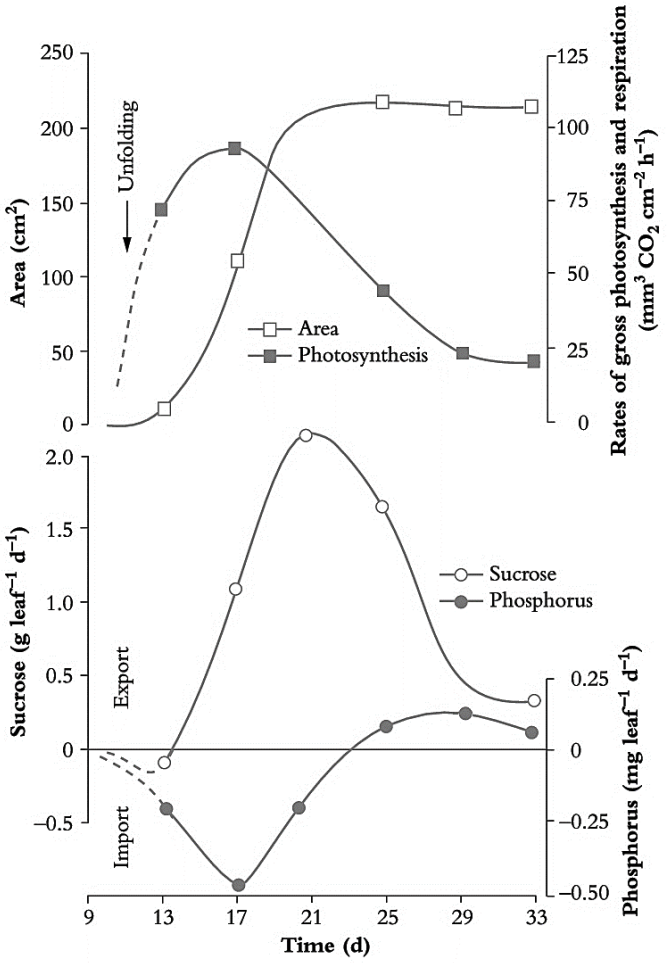


(a) With reference to the graphs, describe the changes in the concentrations of GP, TP and RuBP
i) As the light intensity changes. (06 marks)
ii) As the carbon dioxide concentration changes. (06 marks)
(b) By referring to the figure, explain the trends in the concentrations of GP, TP and RuBP
i) As the 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.

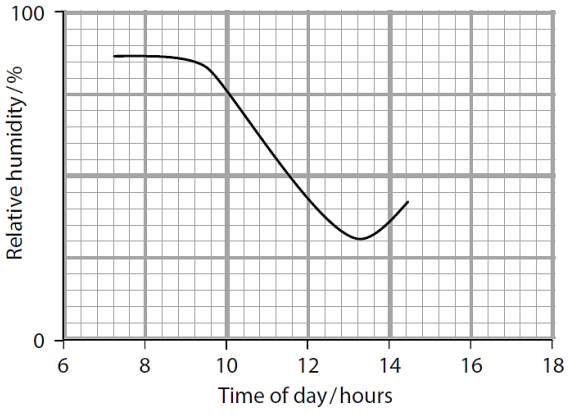


Figure A

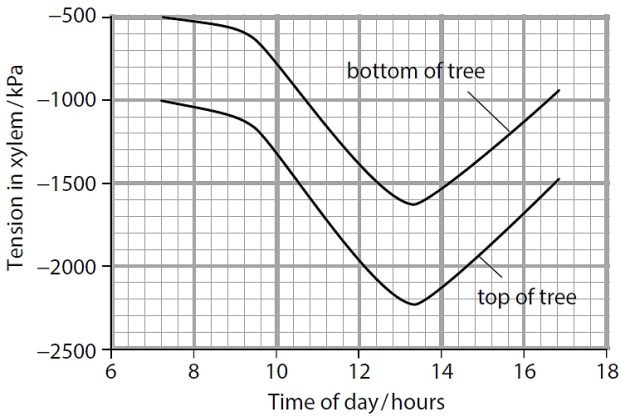


Figure B

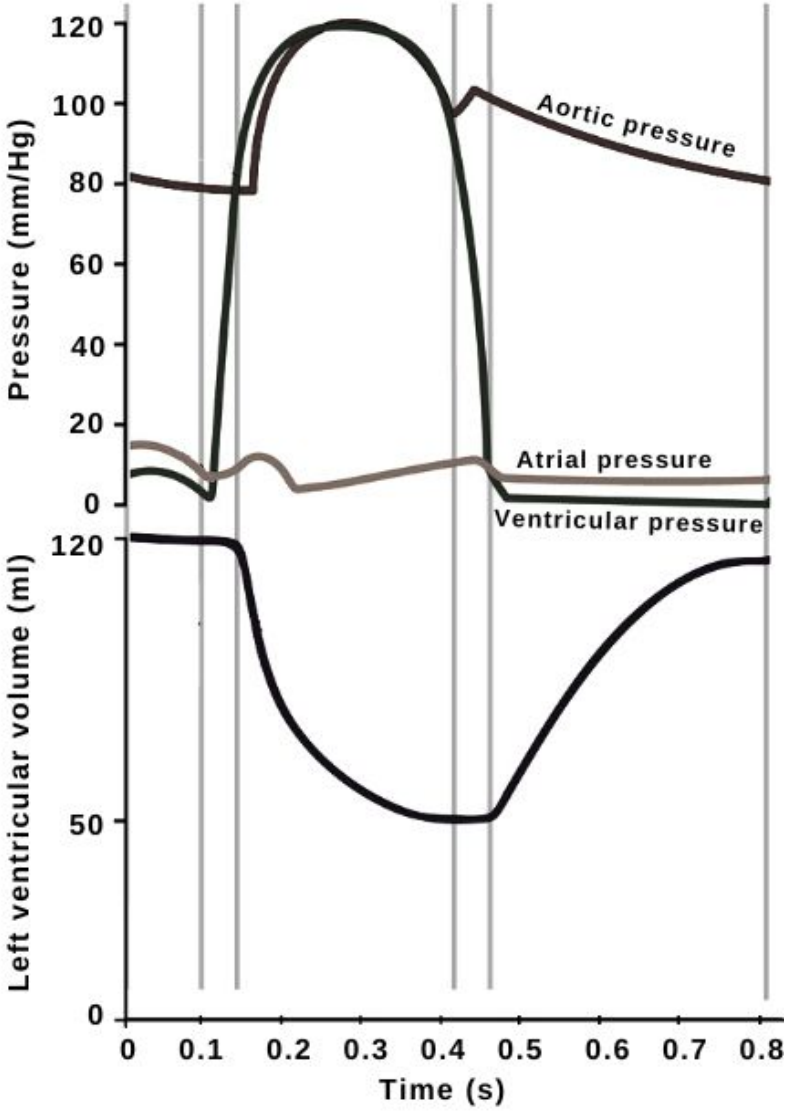
(a) What is the relationship between relative humidity and xylem tension?
(b) Explain the relationship between relative humidity and xylem tension.
(c) Compare xylem tension at the top and the bottom of the tree.

(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.



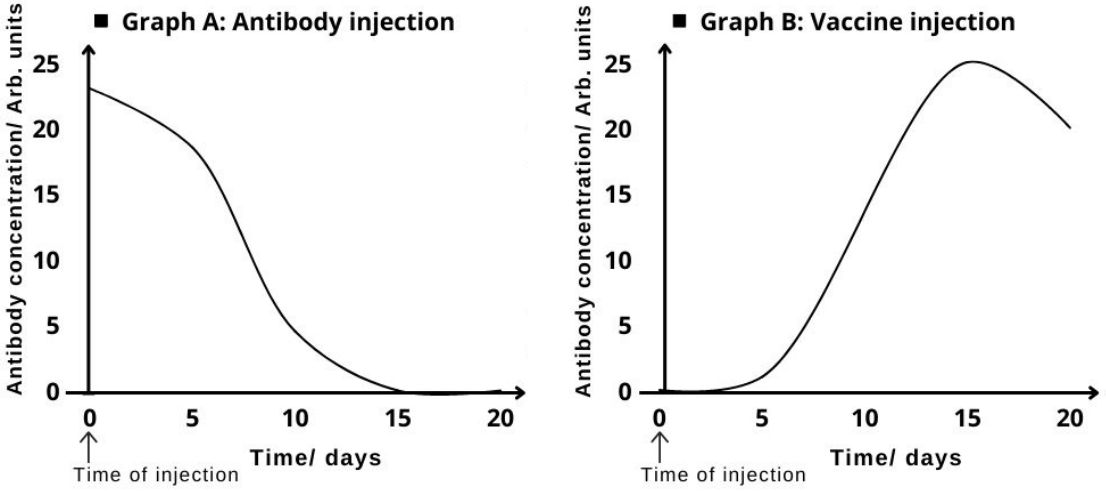
(a) Describe the changes in ventricular volume and pressure throughout the cardiac cycle.
(b) Compare pressure changes in heart chambers during the cardiac cycle. (07 Marks)
(c)Using information in the graph, show time intervals that correspond with atrial and ventricular contractions and relaxations. (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.

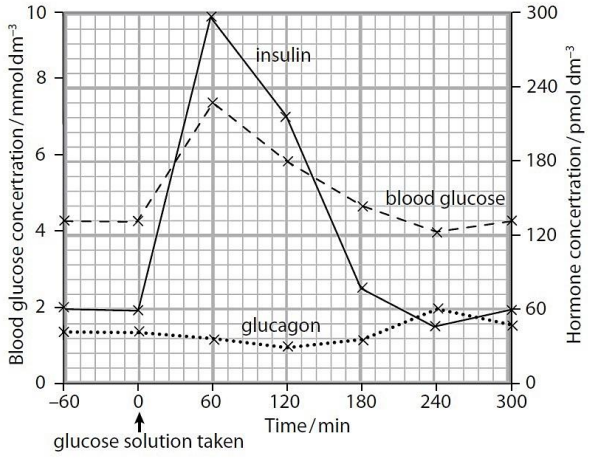


(a) (i) Describe the variation in antibody concentration in graph A and graph B. (05 marks)
(ii) Explain the reasons for the differences in the two responses. (07 marks)
(b) Compare the responses obtained after the first injection of antibodies and another injection of antigens. (06 marks)
(c) By referring 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.

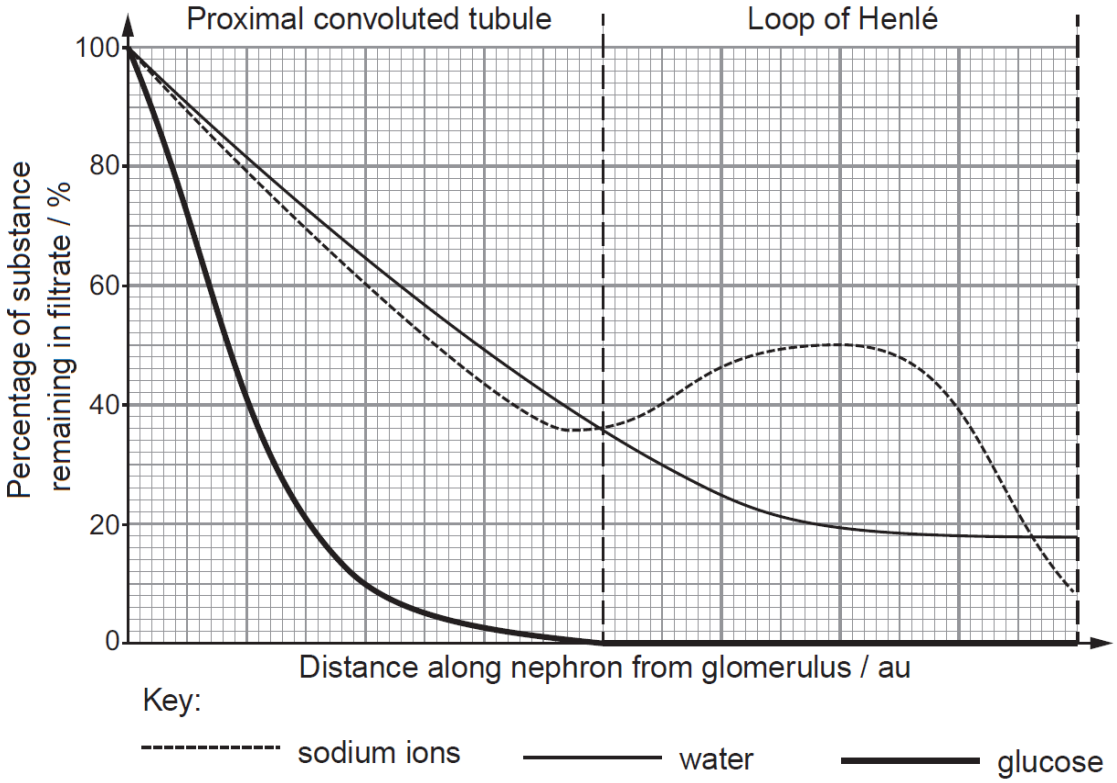
(e) With reference to the figure, describe the following:
i) Response of the pancreatic cells to an increase in the glucose concentration.

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)

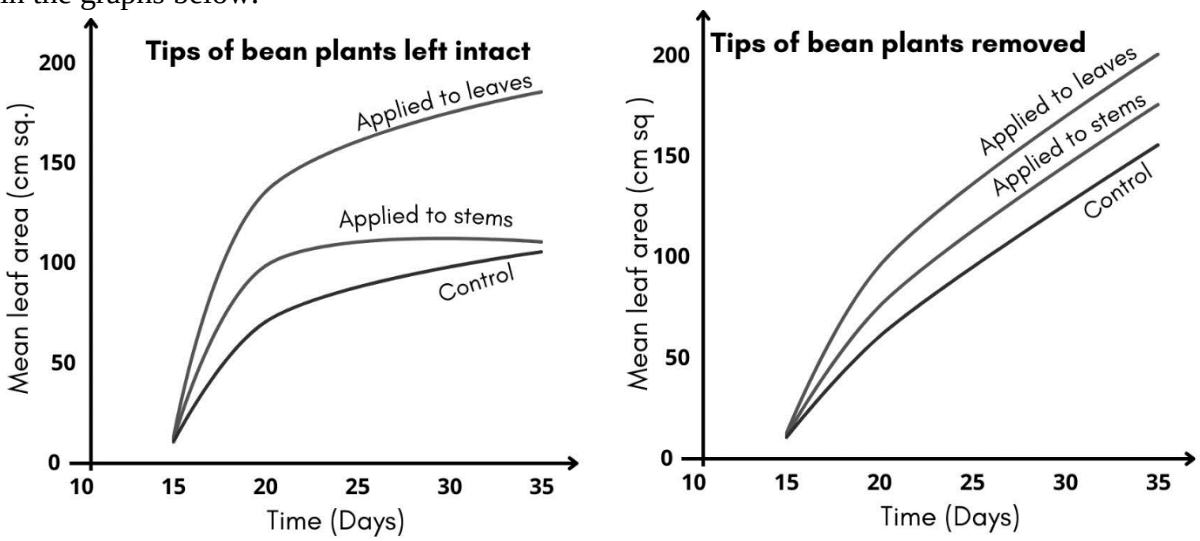
HOLY CROSS LAKE VIEW SS, WANYANGE

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

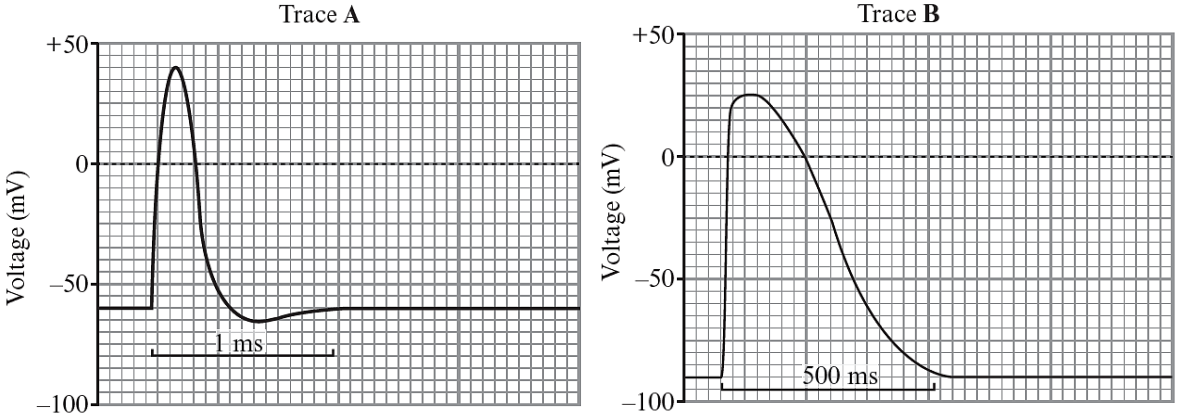
both cases was to use a group of plants to which no gibberellin was added. The results are shown in the graphs below.



(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.



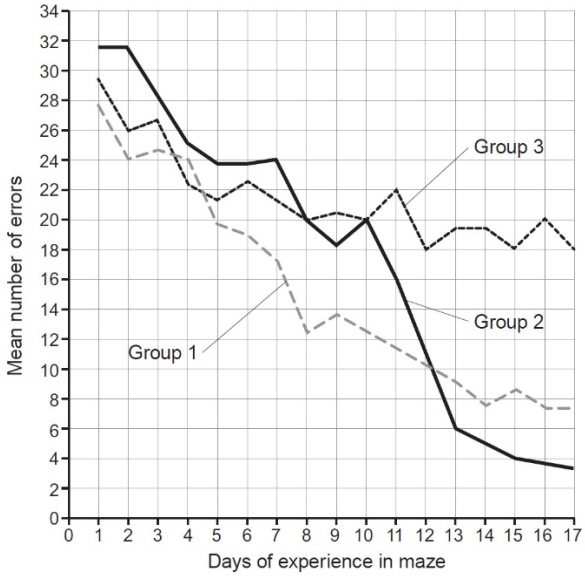
(a) Compare the voltages in Trace A and Trace B.
(b) Explain the voltages in Trace A and Trace B.
(c) Describe how the

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.



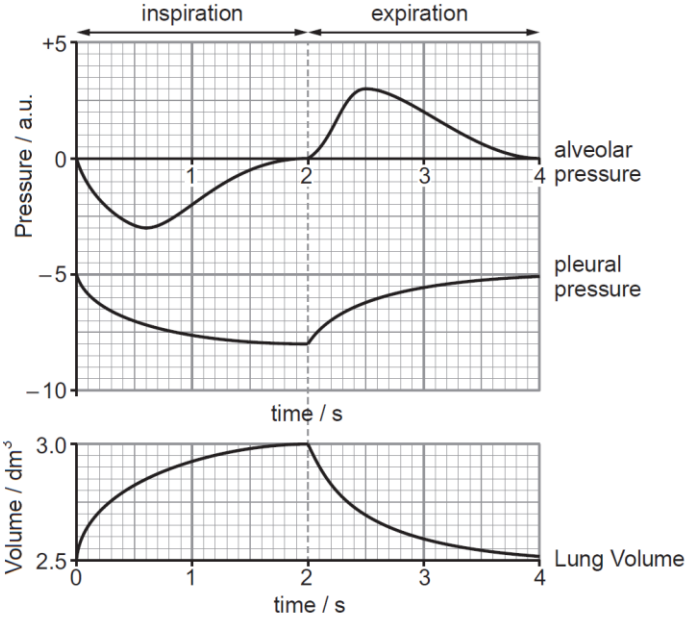
(a) Using the information provided
i) Comment on the error patterns exhibited by each group of rats. (09 marks)
ii) Associate each group of rats with one error pattern, and explain your conclusions. (08 marks)
(b) Workout the percentage change in the number of errors for group 2, between the 10th and 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.



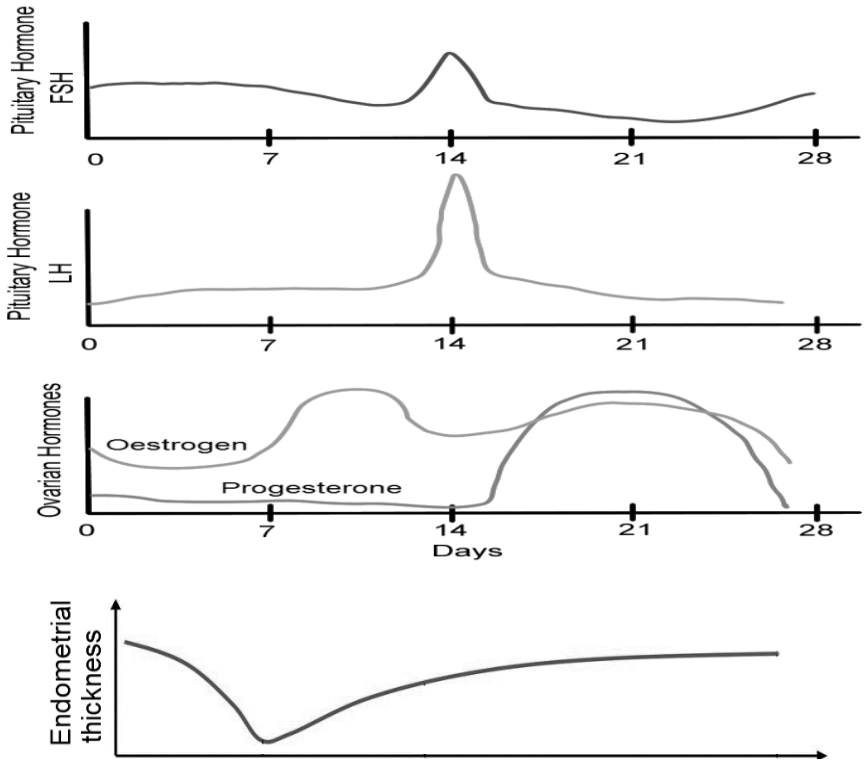
(a) From the graphs, describe the pressure and volume changes shown during
i) Inspiration. (08 marks)
ii) Expiration. (07 marks)
(b) From the graphs, explain the causes of the pressure and volume changes shown during
i) Inspiration.
ii) Expiration.
(c) Suggest the changes that are expected in these curves 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.

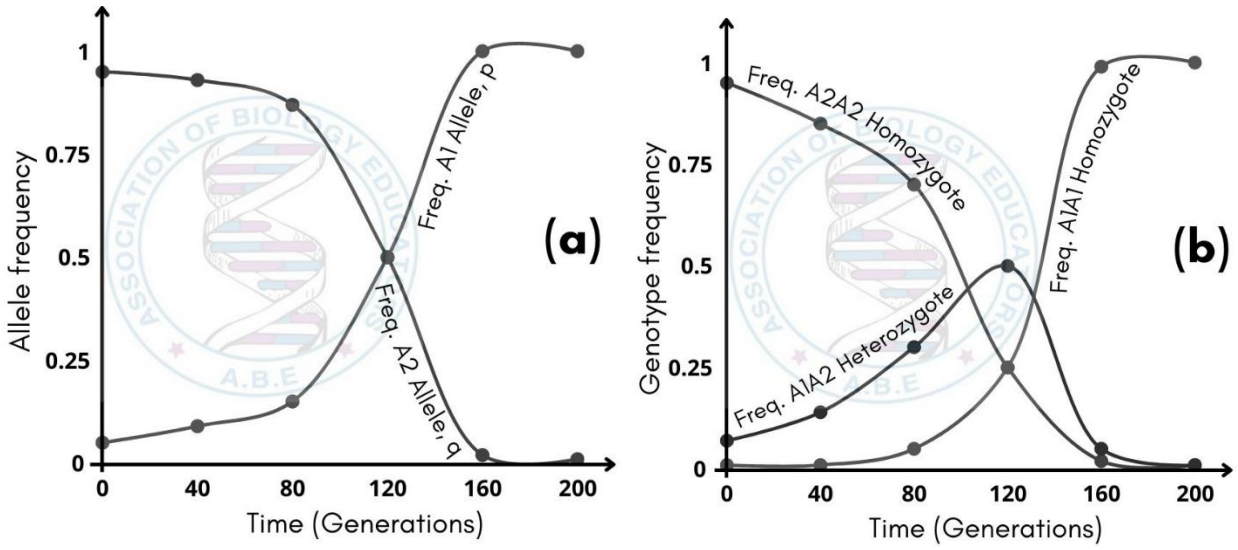


a) Describe the changes in the relative levels of
i) Gonadotropins.
ii) Ovarian hormones.
iii) Endometrium.
b) Compare the relative levels of oestrogen with progesterone across the menstrual cycle.
c) Explain how the following are involved in controlling of the menstrual cycle:
i) Gonadotropins.
ii) 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***