Association of Biology Educators (ABE)

2023 'A' LEVEL NATIONAL SEMINAR-SERIE No:5 HELD AT HOLY CROSS LAKE VIEW S.S WANYANGE, JINJA (U) ON THE SATURDAY 07TH OCTOBER, 2023

This write up is a university link, and has been epically designed as part of ABE National seminar series of the 2023. The Association of Biology Educators (ABE) team has curated sample questions to ease your revision, using expert guidance. i) Senior 5 and 6 topics (according to NCDC syllabus); ii) Plant and Animal biology; iii) 4 themes, i.e., Cell Biology topics, Ecology, Maintenance of life topics & Continuity of life topics.

QUESTION BOOKLET

ABE (U)
2023
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FOREWORD

This write-up is a ***university link***. The **Association of Biology Educators** (ABE) team has curated sample questions to ease your revision, using expert guidance.

A-level Biology Revision Tips

- First, set your Biology goal. What final grade do you aim to score in Biology? Do you know the individual paper scores needed to clinch **A, B, C, D, E, O** *or* **F**?
- Next, create a revision timetable. Revise Biology **daily**, during hours when your brain is fresh.
- Manage your time effectively - Adhere to your Biology reading time table, no matter what!
- Balance your revision as per **3 simple** guidelines:
  i) Senior 5 and 6 topics (according to NCDC syllabus);
  ii) Plant and Animal biology;
  iii) 4 themes, i.e., Cell Biology topics, Ecology, Maintenance of life topics & Continuity of life topics.
- Outside the exam season, actively participate in as many discussions as possible with classmates.
- During revision, practice drawing using well-sharpened pencil as though you are in the exam.

How to use this write-up

You can read this work from cover to cover, or you can dip in and out of the different topics as needed.

As a student, first read your notes to understand the key concepts. Once you have understood the basics in a given topic, start answering questions. In this work, questions are arranged in a sequence following the Uganda Biology syllabus. Therefore, you can quickly locate the topics where you need to focus your revision.

Note that whereas this work covers all the key concepts and principles, it does not exhaust all the possible questions in each topic. Accordingly, use it alongside your notes, textbooks and any other materials recommended by your teachers.

I hope that you find this work helpful. Good luck with your exams!

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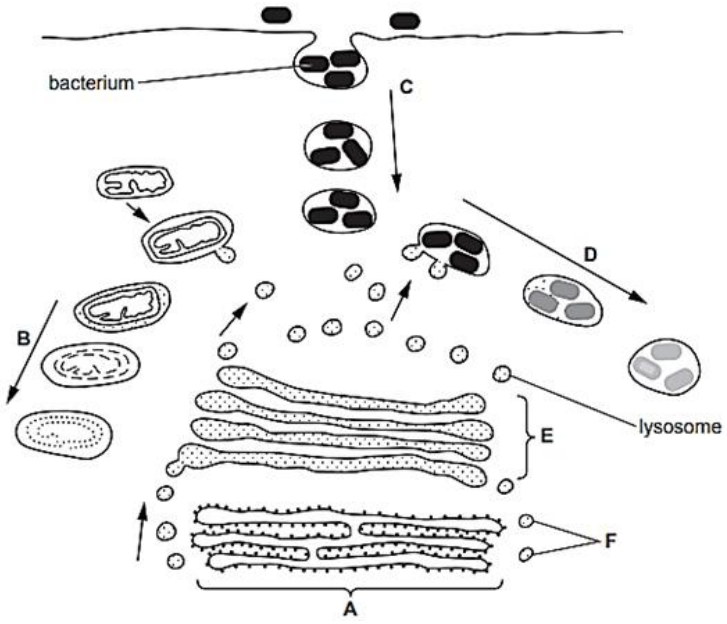
THEME 1: CELL BIOLOGY

1.1 CELL STRUCTURE FUNCTION.

1.1.1 Figure below shows events that occur during synthesis of intracellular enzymes in a macrophage.



(a) Name the
(i) Organelles **A, E** and **F.**
(ii) Process at **C** and **D**
(b) With reference to the process occurring at **B** and **D**, outline the role of lysosomes.
(c) Explain the functional relationship between structure **A**, **E** and **F.**
(d) Explain the role of membrane proteins in maintaining lower pH within lysosomes.
(e) Briefly describe the functioning of lysosomes during process **B**.

1.1.2 (a) Describe the role of lipids in maintaining fluid property of cell membranes.
(b) What are the functions of cytoplasmic microtubules in eukaryotic cells?

1.2 CELL DIVISION

1.2.1 (a) Describe the;
(i) Structure of a DNA molecule.
(ii) Main steps in DNA replication in a cell.
(b) Explain how the structural properties of DNA allow for replication.
(c) Diagram **A** below shows the different phases during the cell cycle of a eukaryotic cell. Diagram **B** shows the amount of DNA present during the different phases. Study the diagrams and answer the questions that follow.

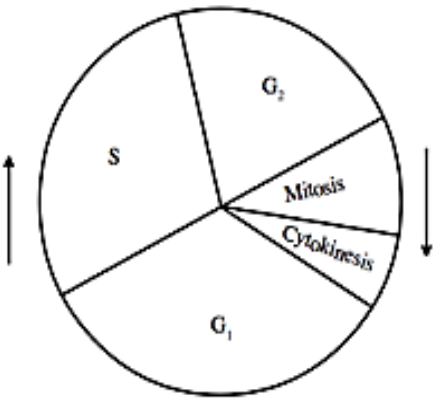


DIAGRAM A

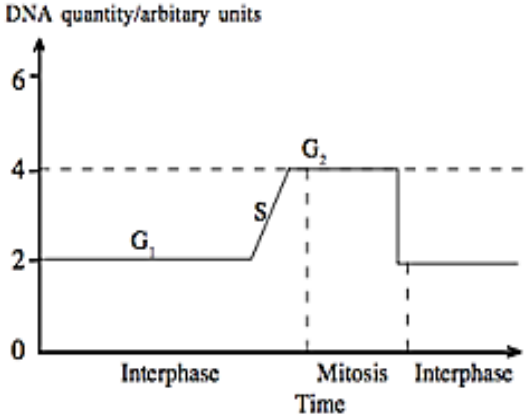


DIAGRAM B

(i) Explain the change in the quantity of DNA in a cell during phase **S**.
(ii) What will be the quantity of DNA in arbitrary units at the end of the mitotic cell division?
(iii) How is the quantity of DNA returned to this level?

(iv) What would be the quantity of DNA in arbitrary units at the end of a meiotic division? Give a reason for your answer.

1.2.2 (a) (i) Describe the role performed by centrioles during cell division

(ii) Errors during meiosis result in aneuploidy, Discuss the potential causes of trisomy during meiosis and the consequences of such errors on the offspring.

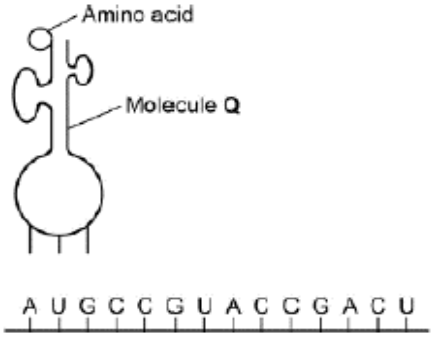
(b) How does genetic recombination during meiosis contribute to genetic diversity within a population?

1.3 CHEMICALS OF LIFE

1.3.1 (a) Describe the chemical properties of proteins.

(b) Explain the biological significance of proteins in the human body.

1.3.2 The diagram below represents one process that occurs during protein synthesis.



(a) Name the process shown.

(b) Identify the molecule labelled **Q**.

(c) In the diagram above, the first codon is AUG. Give the base sequence of:

(i) The complementary DNA base sequence

(ii) The missing anticodon.

The table below shows the base triplets that code for two amino acids.

Amino acid	Encoding base triplet
Aspartic acid	GAC, GAU
Proline	CCA, CCG, CCC, CCU

(d) Aspartic acid and Proline are both amino acids. Describe how two amino acids differ from one another. You may use a diagram to help your description.

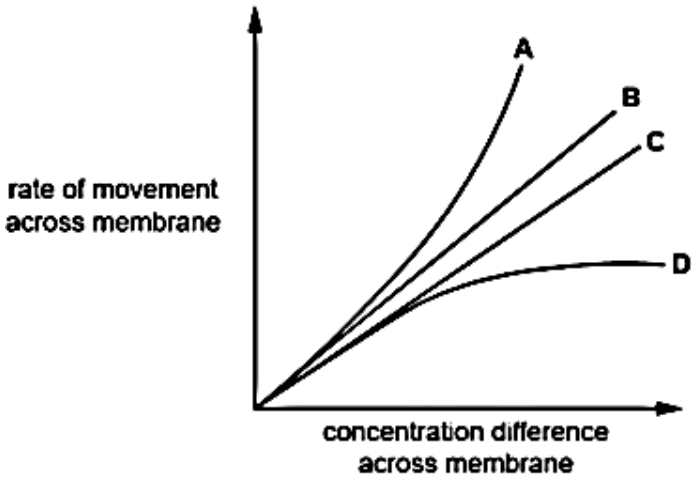
(e) Deletion of the sixth base (G) in the sequence shown in the diagram above would change the nature of the protein produced but substitution of the same base would not. Use the information in the table and your own knowledge to explain why.

1.3.3 The graph shows the rate of movement of four different substances across a membrane

(a) Give an example of substance B and D and explain how it can move across the membrane.

(b) Compare the movements of substances B and D across the Plasma membrane.

(c) Explain how the presence of a competitive inhibitor would alter the rate of movement of substance D.



1.3.4 (a) Explain how pH affects enzyme-controlled reactions

(b) How does the spatial arrangement of enzyme proteins in membranes help regulate enzyme activity?

1.4 CELL PHYSIOLOGY

1.4.1 (a) (i) State the process by which water leaves a cell.

(ii) Describe the routes that water molecules take through the cell surface membrane.

A student carried out an investigation to determine the effects of different sucrose concentrations on cells from pieces of onion epidermis. The results are shown in the Table.

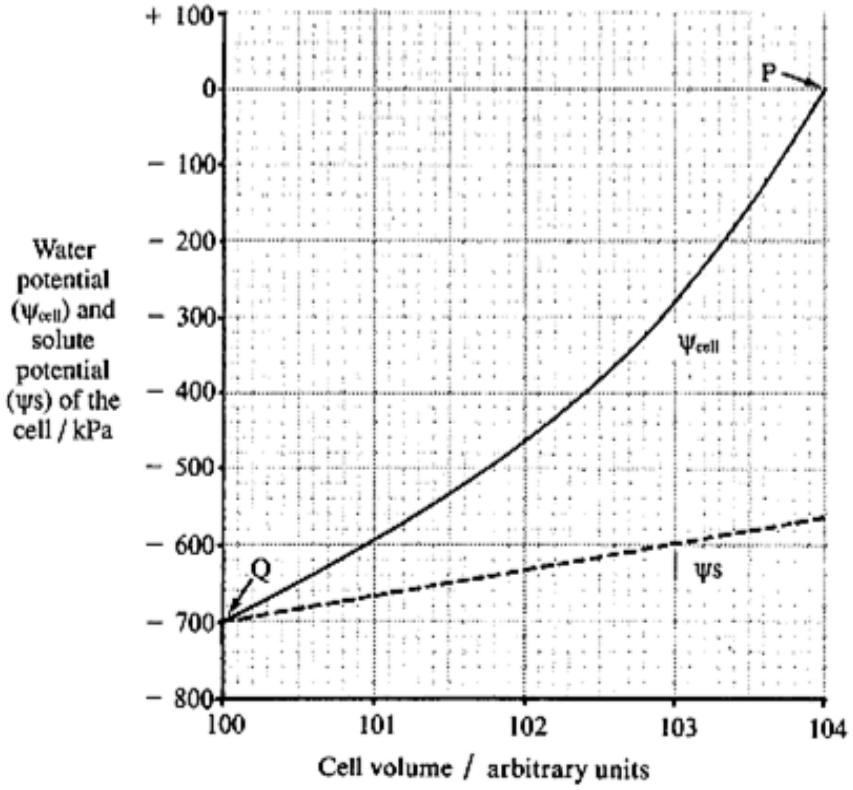
Conc. of sucrose solution (mol dm^{-3})	0.0	0.1	0.3	0.4	0.5	0.6	0.7	0.8	1.0
Water potential of sucrose solution (kPa)	0	–260	–860	–1120	–1450	–1800	–2180	–2580	–3500
Percentage of cells plasmolysed (%)	0	0	3	7	39	57	83	94	100

(b) Plot a graph to represent the results in the table.

(c) Explain the results from this investigation.

(d) The water potential of the onion epidermis cells can be assumed to be the same as the water potential of a solution that causes 50% plasmolysis. Use your graph to estimate the water potential inside these onion epidermis cells.

1.4.2 The graph below shows the relationship between the volume, water potential ψ cell and solute potential (ψs') of a cell immersed in a series of sucrose solutions of increasing concentration. In each solution the cell was allowed to reach equilibrium with the bathing solution, so that water was being neither lost nor gained, before the measurements were made.



(a) Explain what is meant by the following terms.

(i) Solute potential (ψs)

(ii) Pressure potential ψp)

(b) What terms are used to describe the condition of the cell at P and at Q? Suggest reason in each case.

(c) Calculate the pressure potential (ψp) of the cell when its volume is 103 units. Show your working.

(d) Explain two ways in which reversible changes in cell volume may be important in Flowering plants.

1.5 HISTOLOGY

1.5.1 Figures 1 and 2 are simple plant tissues.

Figure 1

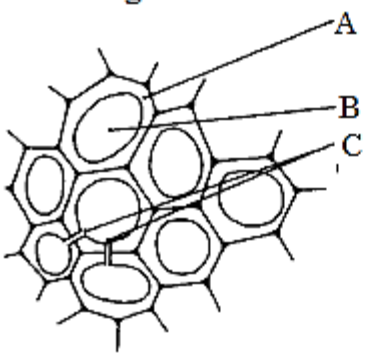
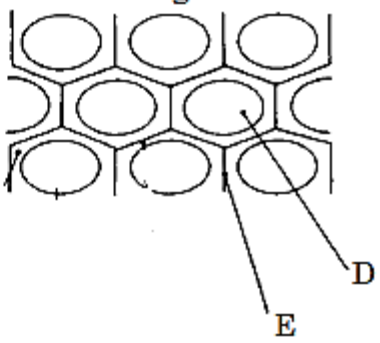


Figure 2



(a) (i) Identify plant tissue 1 and 2.

(ii) Name parts labelled A, B, C, D and E.

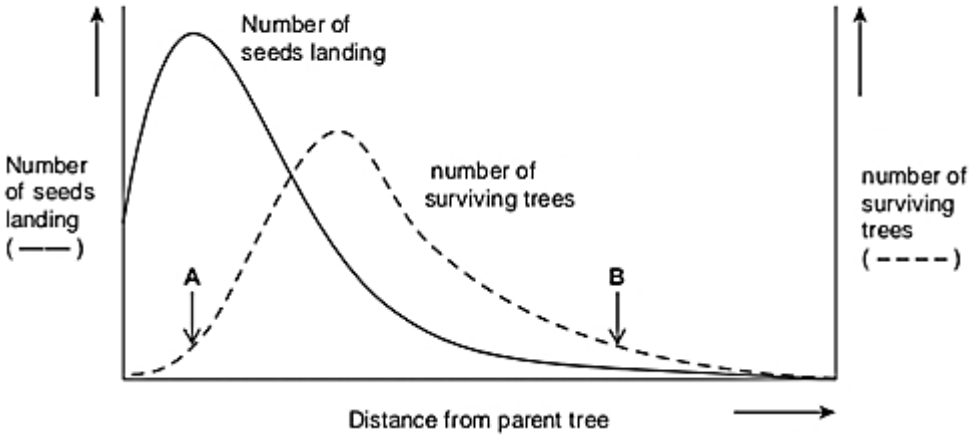
(b) Explain how the above plant tissues are suited to performing their function.

(c) For a named complex plant tissue, explain how it is adapted to performing its function.

(d) Describe, with reference to skeletal connective tissue, the relationship between structure and function.

THEME 2: ECOLOGY

2.1 An ecologist measured the number of seeds landing at different distances from a parent tree. He then produced then determined how the number of new trees that grew from the seeds and survived varied with distance from the parent plant. The results of the investigation are summarized in the graph below.



(a) Compare the variation in number of seedlings landing and number of surviving trees with distance from the parent plant.

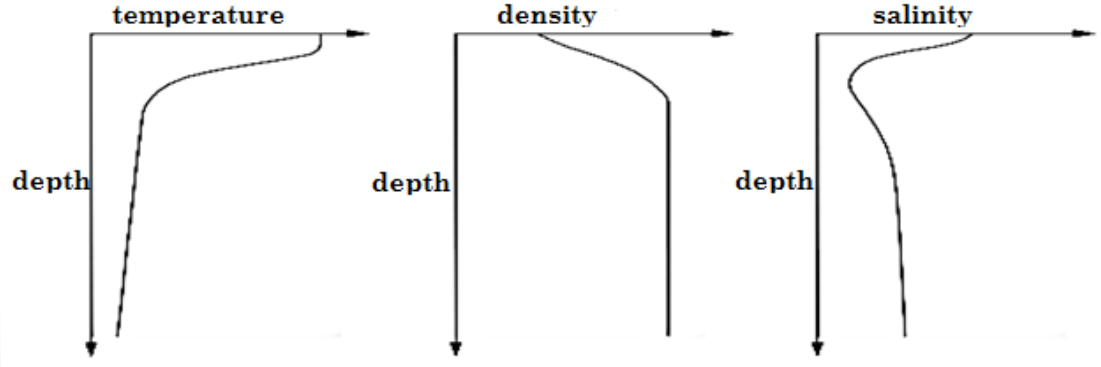
(b) Suggest reasons for the number of surviving trees at points

(i) A

(ii) B

(iii) Between A and B

2.2 The figure below shows the changes in temperature, density and salinity of water with increasing depth of the ocean.



(a) Describe effect of depth on the temperature and density of the water.

(b) Explain the relationships between temperature, density and salinity in the ocean.
(c) Predict with reasons, how the concentration of dissolved oxygen would vary with depth.
(d) Describe other parameters that can be used to assess the water quality of any water body.

2.3 The graph I below shows how the net primary productivity of the marine alga ***Hormosira banksia*** varies with depth and sea temperature. Graph II shows the effect of algal blooms on the productivity of the marine alga ***Hormosira banksia***.

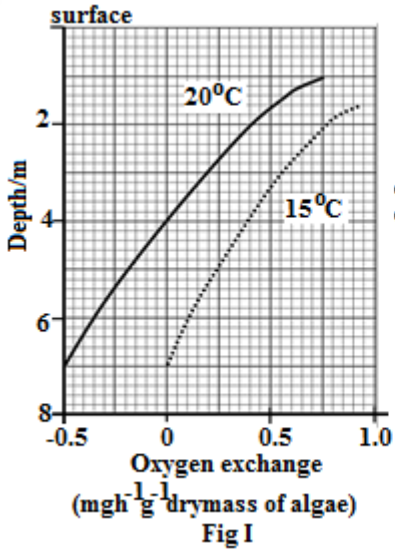


Fig I

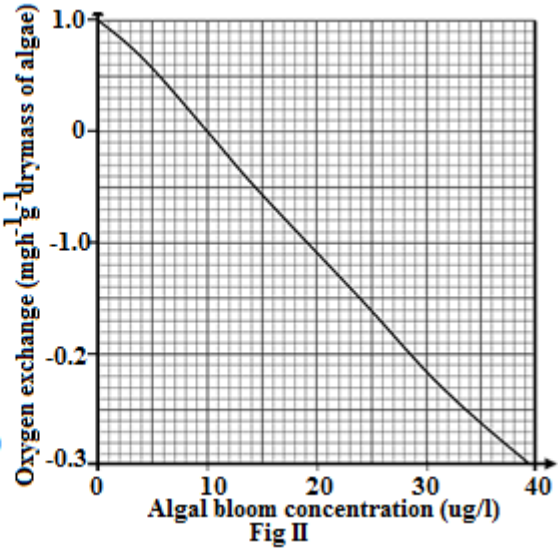


Fig II

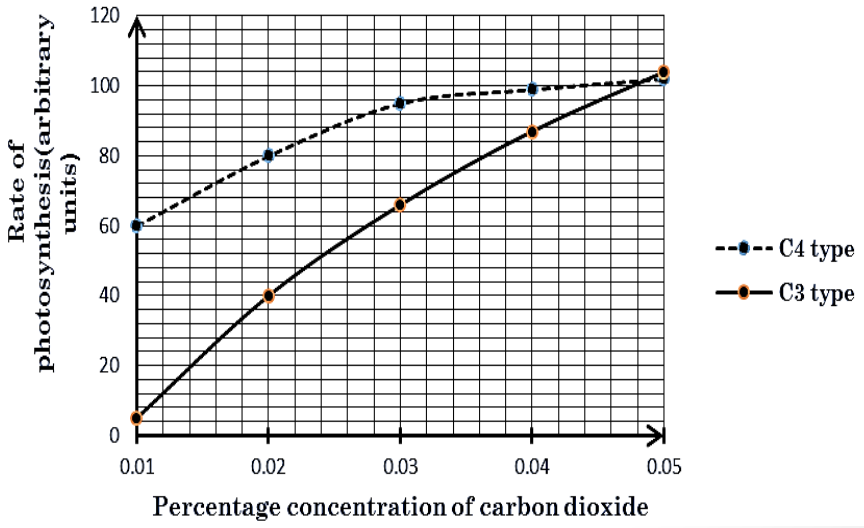
(a) (i) Using the graph, explain the relationship between net primary productivity and depth.
(ii) Explain the effect of algal bloom concentration on the oxygen exchange for the marine alga *Hormosira banksia.*
(b) What is meant by the term net primary productivity?

(c) (i) Explain why oxygen exchange can be taken as an indicator of net primary productivity.
(ii) What concentration of algal is considered dangerous to aquatic life?
(d) (i) Show clearly on each curve the position of the compensation point. Give the reason for your answer.
(ii) Account for the difference in the positions of the compensation points at each temperature.
(iii) Would H. Banksii be able to survive at greater depths in warmer or colder seas? Explain.
(e) State any other four ecological effects of algal blooms.

THEME 3: MAINTAINANCE OF LIFE

3.1 NUTRITION.

3.1.1 An experiment was carried out in which a group of two distinct types of grass species, *Alloteropsis semialata* with different photosynthetic pathways was exposed to high intensity artificial sun light and a temperature of 30℃, at different carbon dioxide concentrations. All other factors are kept constant. The rate of photosynthesis (per unit area of leaf) was



measured over 30-minute period. Results are shown on the graph in the figure below.

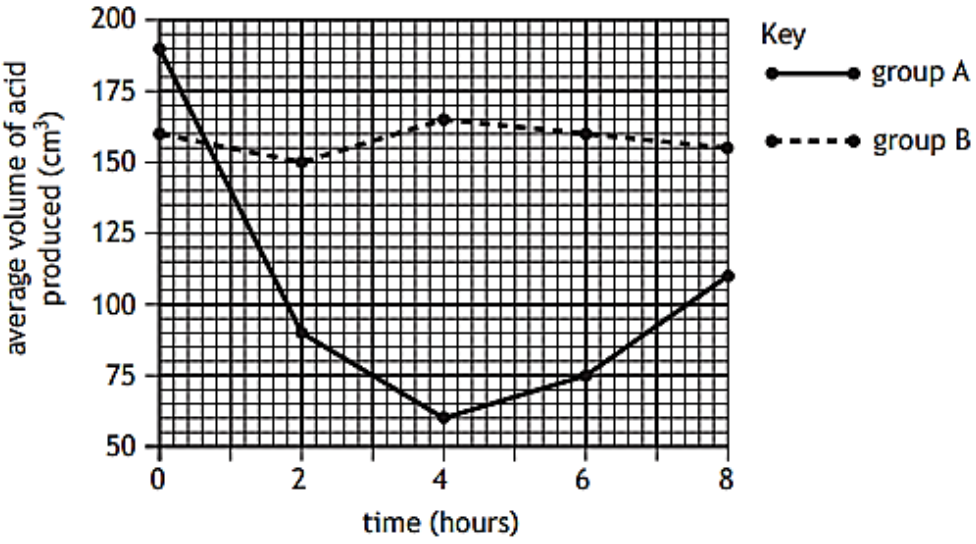
(a) Describe the variation in the rate of photosynthesis of C4 type with carbon dioxide concentration.

(b) Compare the variation in rate of photosynthesis for the C3 and C4 types of *A. semialata* species.

(c) Explain the differences between the rates of photosynthesis for the C3 and C4 types of *A. semialata*.

(d) Describe how carbon dioxide is fixed in C4 type of *A. semialata* species.

3.1.2 In an investigation of the effect of a proton inhibitor drug on the quantity of acid secreted by oxyntic cells of the stomach, two groups of people, **A** and **B** that produced too much acid in their stomach were used. People in group **A** were given the drug as a tablet at the start of the investigation while group **B** was the control group. The average acid production of each group was measured every 2hours over an eight-hour period. The results are shown on the graph in the figure below.



(a) Describe the effect of taking the drug on acid production of group **A** during the investigation.

(b) Account for the difference in the amount of acid secreted by the two experimental groups.

(c) (i) Explain why the control group was used in this trial.

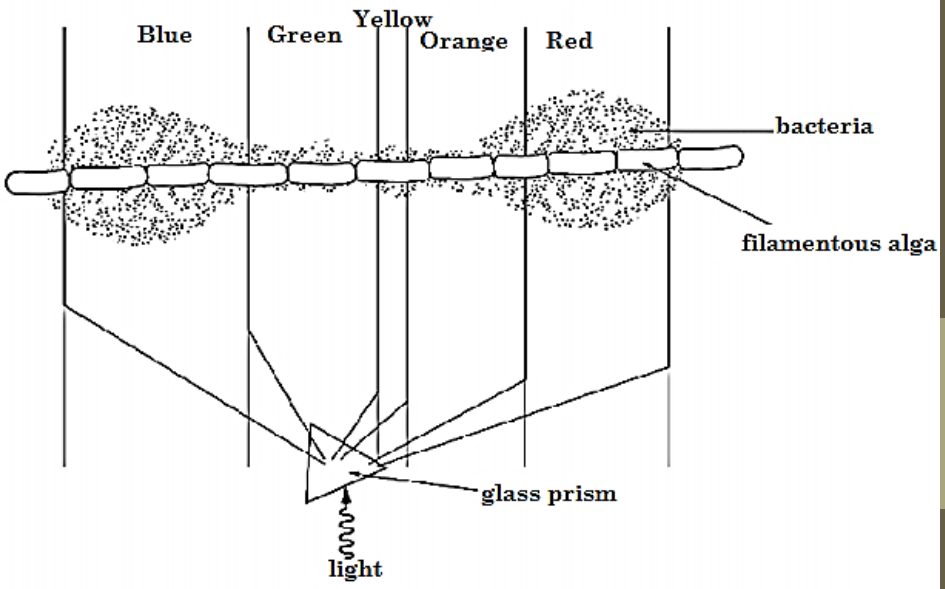
(ii) Suggest how the control group would have been treated.

(iii) Suggest how the individuals would be assigned to each group in order to reduce bias.

(d) Outline the roles of hydrochloric acid in digestion.

3.1.3 A scientist, Engelmann set up an experiment to investigate the effect off wavelength of light on the production of oxygen during photosynthesis. He set up an experiment using a filamentous alga (a single strand of photosynthetic cells joined end to end) which was exposed to light that has been passed through a prism which split the light into different wavelengths.

Motile bacteria were introduced into the experimental set up and their distribution along the alga is shown in the diagram below.



(a) Explain the role of water in photosynthesis.
(b) Describe the distribution of bacteria along the filamentous alga.
(c) Suggest reasons for the observed distribution of the bacteria in (b) above.
(d) Use the figure above, sketch a graph for the effectiveness of the different wavelengths to the distribution of the motile bacteria along the alga.

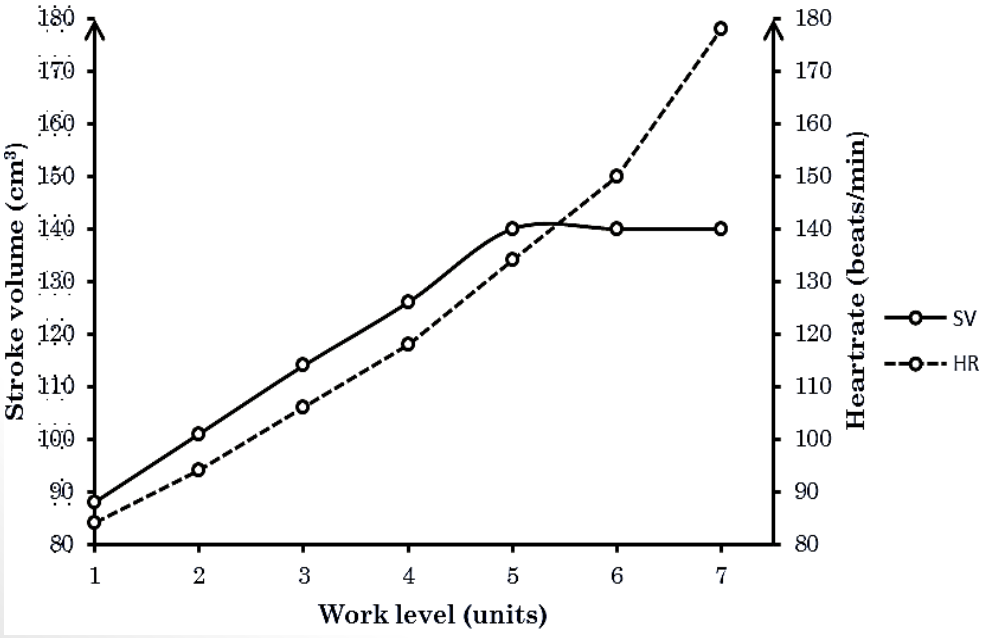
3.1.4 Plant species A and B grow naturally in different habitats. In an experiment the exchange of carbon dioxide between the atmosphere and species A and B was determined over a range of light intensities from darkness to the equivalent of mean noon sunlight. A constant temperature was maintained throughout the experiment. The amount of carbon dioxide absorbed or released was determined by measuring the carbon dioxide concentration in a stream of air before and after it had passed over the plants. The data obtained are given below.

Light intensity as a percentage of mean noon sunlight	Net carbon dioxide absorption in arbitrary units.	
	Species A	Species B
0	-0.1	-0.8
10	+3.0	+0.5
20	+5.3	+3.5
30	+6.5	+7.0
40	+6.5	+9.3
50	+6.7	+11.5
60	+6.8	+13.2
70	+7.0	+15.0
80	+6.5	+17.0
90	+6.8	+18.0
100	+6.7	+19.0

(a) Plot the above data in suitable graphical form.
(b) Compare the effect of light intensity on net carbon dioxide absorption of both species.
(c) Explain the extent to which species A and species B might be able to grow in the same habitat.
(d) (i) What is meant by the term compensation point?, Clearly indicate on your graph the compensation points for species B.
(ii) What is meant by the term limiting factor?, and from the knowledge of photosynthetic pathways, explain precisely how three named factors can be limiting in photosynthesis.
(e) Identify plant species A and plant species B.

3.2 TRANSPORT.

3.2.1 The heart rate and stroke volume of a 40 year old cyclist were monitored as he used an exercise bike. The cyclist was told to pedal at a constant rate as his work level was gradually raised by increasing the resistance to pedaling. The graph in the figure below shows the changes that occurred in the cyclist's heart rate (HR) and stroke volume (SV) at seven different work levels.



(a) Compare the changes that occurred in the cyclist's stroke volume and heart rate when the work level increased.
(b) Account for the changes that occurred in the cyclist's stroke volume when the work level increased.
(c) Of what significance is the difference between

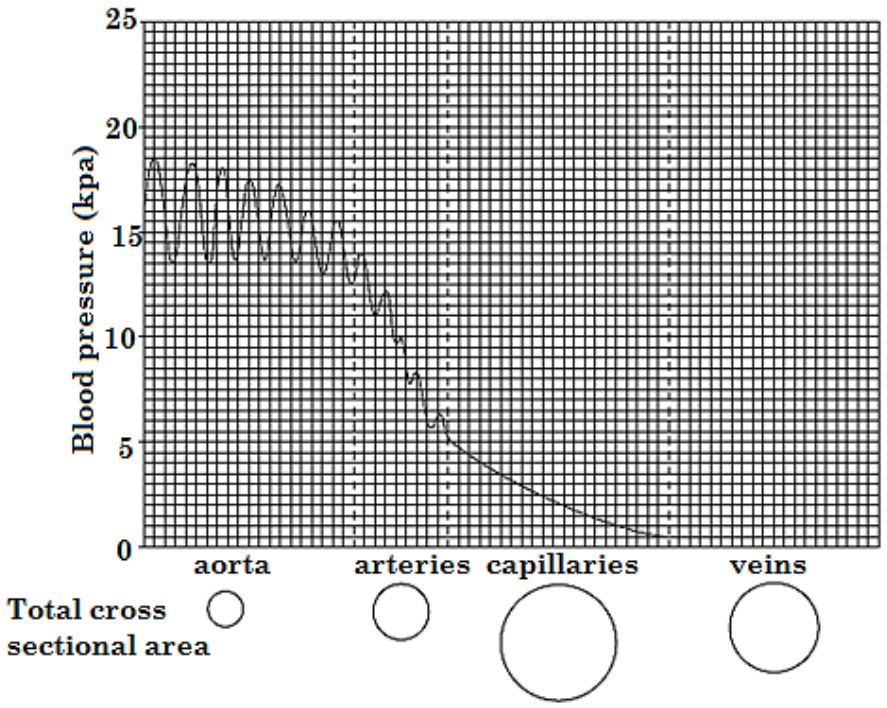
stroke volume and heart rate at work level (1unit to 5.5units) to this cyclist?

(d) Calculate the cyclist's cardiac output when his work level was 6units.

(e) Describe how increased work level of the cyclist resulted into an increase in the heart rate.

(f) Apart from the factor depicted on the graph, explain other factors that affect the rate of heart beat in mammals.

3.2.2 The figure below provides information about the blood pressure in the different parts of the mammalian blood circulatory system. The figure also shows the total cross-sectional area of the vessels, relative to one another, in parts of the blood circulatory system.



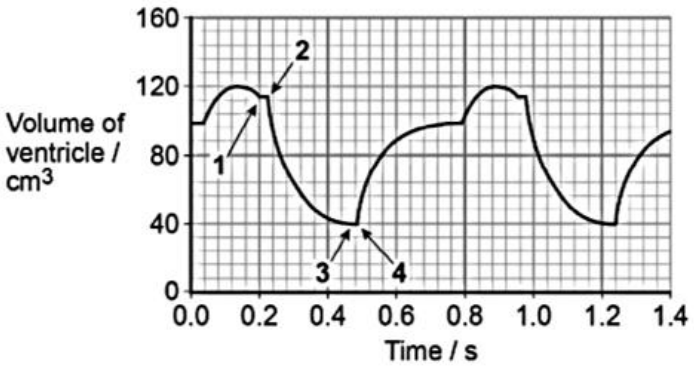
(a) The pressure fluctuates as blood flows along the aorta, as shown in Figure. Explain what causes this fluctuation.

(b) Using the figure, describe the pressure changes in the blood as it flows through the circulatory system from the aorta to the veins.

(c) Explain what causes the overall change in pressure as blood flows from the aorta to the arteries and from the arteries to capillaries?

(d) Explain why it is important that the pressure changes as blood flows from aorta to the capillaries.

3.2.3 The figure below shows the volume changes in the left ventricle of a human heart during two cardiac cycles. The numbers 1, 2, 3 and 4 represent times when the heart valves open or close.



(a) Fill in the table below using appropriate numbers to show when the ventricular and semilunar valves close and open.

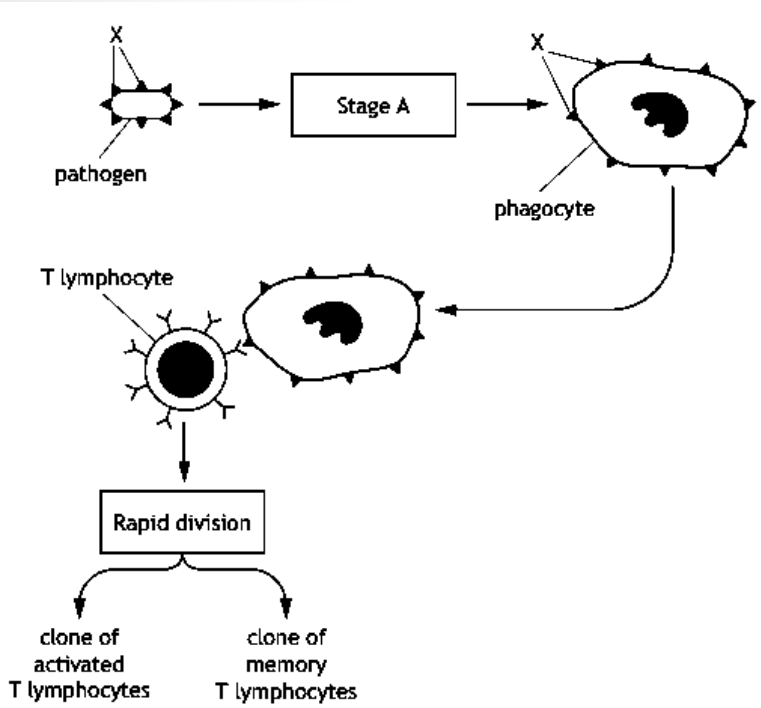
	Valves open	Valves close
Semilunar valves		
Atrioventricular valves		

(b) Calculate the heart beat rate from the figure above.

(c) Describe and explain the changes in the ventricular volume over a period of one cycle.

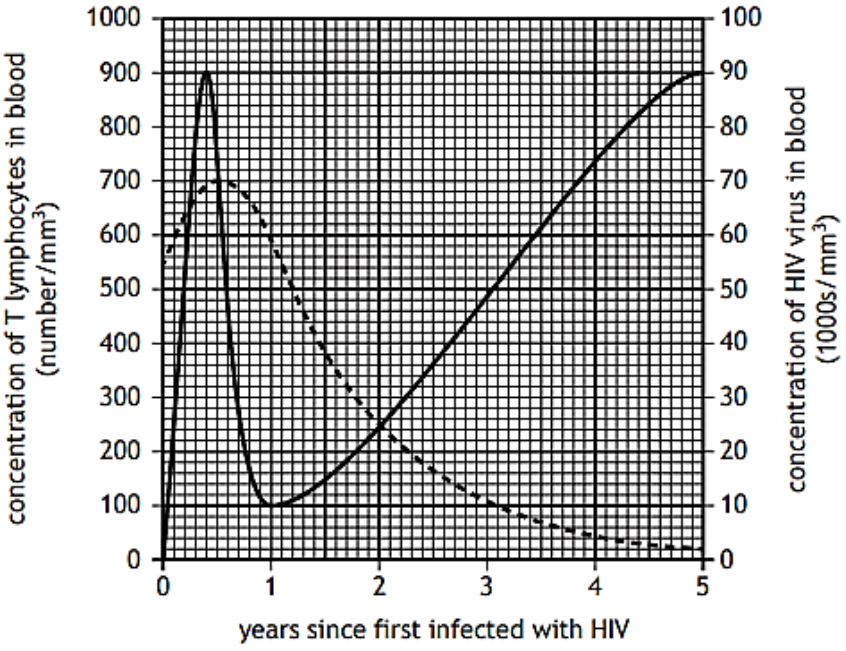
3.3 DEFENCE AGAINST DISEASES

3.3.1 Diagram below shows some of the stages leading to the production of a clone of T lymphocytes by the immune system in response to infection by a pathogen.



(a) Name the;
(i) structures labeled **X**
(ii) cell labeled **Y**
(b) Briefly describe what happens during stage **A**.
(i) Describe the role of T lymphocyte in the immune response.
(ii) How different is the role of T lymphocyte from B lymphocyte in the immune response.
(c) The T-cell secretes chemicals called cytokines. Describe the effects of cytokines.
(d) (i) State how a Tuberculosis pathogen avoids the immune system.
(ii) Suggest **three** reasons why it has proved difficult to control tuberculosis by vaccination.

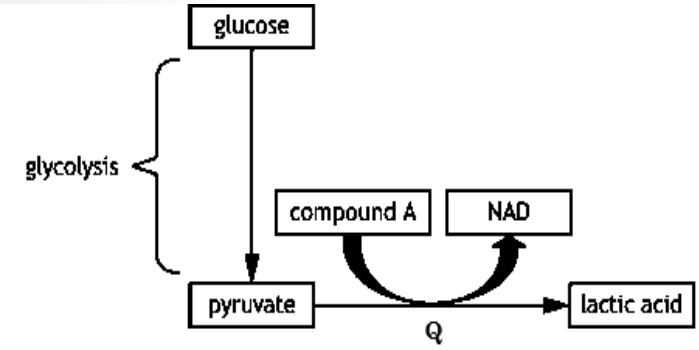
3.3.2 The graph in the figure below shows the concentration of the HIV virus and T lymphocytes in the blood of an individual in the years following HIV infection.



(a) Describe the changes in the concentration of HIV virus in blood over the 5-year period.
(b) Compare the changes in the concentration of T lymphocytes and HIV virus in blood over the 5-year period.
(c) Explain the differences between the concentration of T lymphocytes and HIV virus in blood over the period of study.
(d) Using the results in the graph above, explain the occurrence of the opportunistic infections in the later years of the infection
(e) (i) Briefly explain the features of HIV that makes it a successful pathogen
(ii) Why are antibiotics ineffective against viral diseases like AIDS?

3.4 RESPIRATION

3.4.1 The diagram represents glycolysis and the metabolic pathway which synthesizes lactic acid in the mammalian cell.



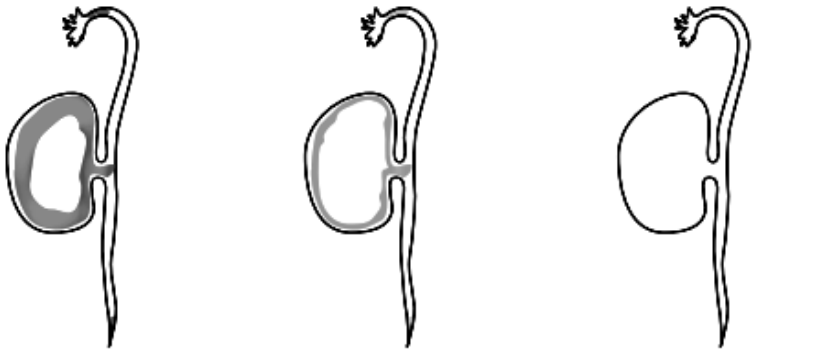
(a) Name;
(i) compound **A**
(ii) enzyme **Q**
(b) State the part of cell where glucose is converted to pyruvate.
(c) Describe what happens during the energy investment phase of glycolysis.
(d) (i) Under what conditions is pyruvate converted to lactic acid.
(ii) Explain the importance of converting pyruvate to lactic acid.
(e) What is the fate of lactic acid produced?
(f) How different is the process that leads to production of lactic acid in mammalian cells from that in higher plants?

3.4.2 (a) Explain the following phenomena related to the formation of ATP during the process of chemiosmosis:
(i) In isolated mitochondria that have had their outer membranes removed, electron transfer takes place but the mitochondria are unable to produce ATP.
(ii) The pH of the inter-membrane space is lower than the pH inside the rest of the mitochondrion.
(iii) If isolated mitochondria are supplied with ADP and inorganic phosphate and placed in a solution of pH 8, no ATP is produced, yet if these mitochondria are placed in an acidic solution, ATP is produced.
(b) In the space below, show how a molecule of Adenosine tri-phosphate (ATP) is formed from its five molecular sub-units.

3.4.2 In an investigation of respiratory activity of plant tissues, three groups of germinating broad bean seeds and an electron acceptor solution (2,3,5-triphenyl-tetrazolium chloride - TTC) were used. When TTC diffuses into actively respiring cells, it accepts electrons from the electron transport chain and changes from colourless to pink. The seeds were first treated as shown in the table.

Seed	**Treatment**
Group **A**	Kept at 22 °C for 24 hours before the investigation
Group **B**	Kept at 6 °C for 24 hours before the investigation
Group **C**	Kept at 22 °C for 24 hours and then placed in water at 90 °C for 5 minut the investigation

The groups of seeds were then sliced longitudinally and TTC placed on the cut surface for 10 minutes. The cut surfaces of the seeds in each group were then observed for the pink colour. In the figure below, the shaded regions represent the tissues that stained a pink colour.



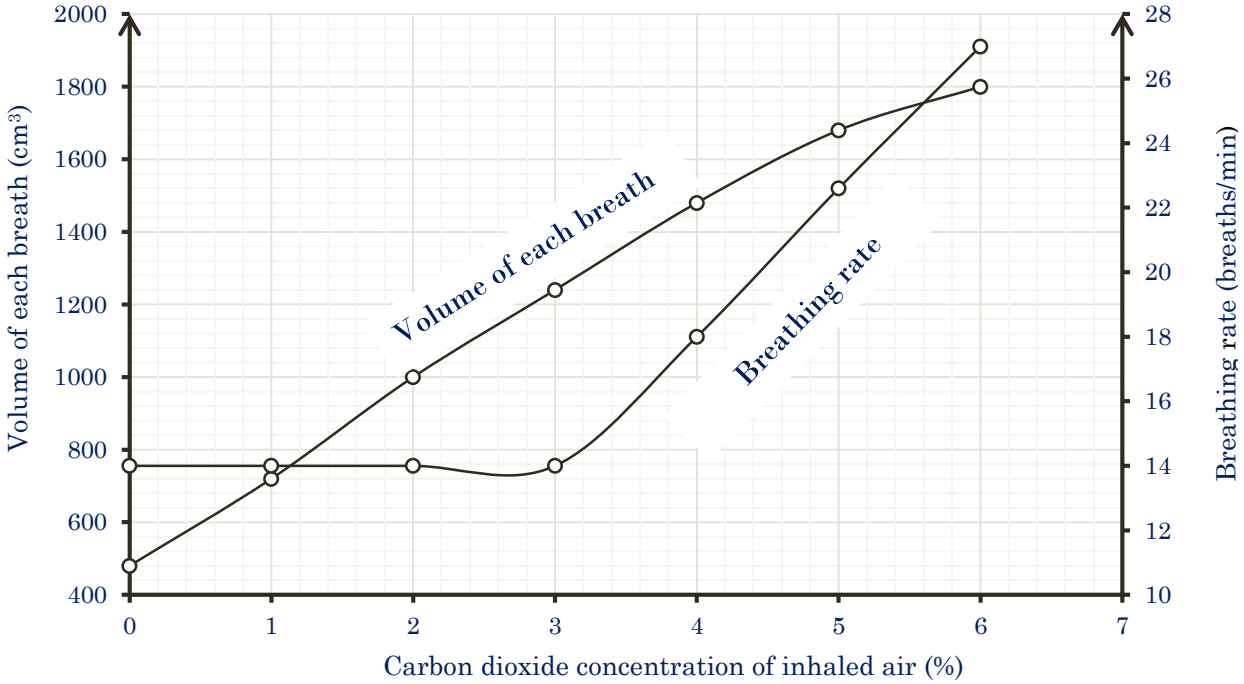
seeds in group A seeds in group B seeds in group C

(a) Describe the differences observed in the seeds in groups A, B and C.
(b) Suggest reasons for the following:

(i) Results observed in the seeds in group A.
(ii) Difference in the amount of staining observed in the seeds in groups B and C when compared to those in group A.
(c) Even in the absence or short supply of oxygen, respiration can take following the anaerobic pathway after glycolysis. In plant cells, this pathway is the same as the one used in yeast cells.
State the
(i) Hydrogen acceptor in this pathway.
(ii) Intermediate compound in this pathway.
(iii) Products of this pathway.
(d) Explain why this pathway is important for the plant cell.

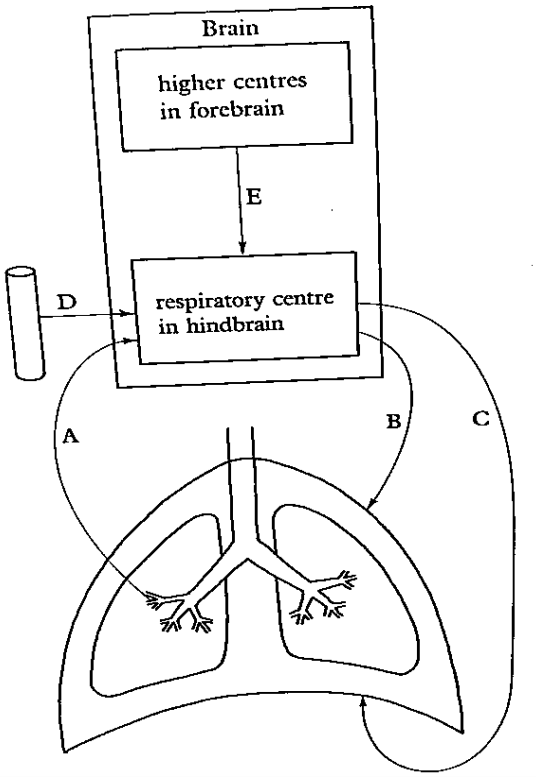
3.5 GASEOUS EXCHANGE

3.5.1 The graph in the figure below shows changes that occurred in a man's breathing rate when he inhaled air containing different concentrations of carbon dioxide.



(a) Describe the effect of the increase in carbon dioxide concentration of inhaled air on the;
(i) Volume of each breath
(ii) Breathing rate
(b) Explain the effect of the increase in carbon dioxide concentration of inhaled air on the;
(i) Volume of each breath
(ii) Breathing rate
(c) Calculate the volume of air inhaled in one minute when the carbon dioxide concentration was 2%.
(d) (i) Predict what the volume of each breath would have been if a carbon dioxide concentration of 7% had been used.
(ii) Suggest why the increase in the volume of each breath becomes less at carbon dioxide above 4%.
(e) Apart from carbon dioxide concentration, explain other factors that affect the breathing rate.
3.5.2 The figure below shows the neuro-connections between the respiratory apparatus of a mammal and the respiratory centre in the hind brain involved in the control of breathing.
A. Represents the vagus nerve which transmit impulses from walls of the bronchial tubes in the lungs to the medulla.

B. Represents the intercoatal nerves which transmit impulses from the respiratory centre to the intercostal muscles.
C. Represents the phrenic nerve which transmits impulses from the respiratory centre to the diaphragm.
D. Represents nerves which transmit impulses from walls of a certain blood vessel to the respiratory centre.
E. Represents nerve which tracts within brain which connect the higher centres (cerebral cortex) with the respiratory centres.



- State what is observed is observed when the following experiments are carried out. Give a reason(s) for your answer.

1. A, B and C are cut.
2. A, D, and E cut, but B and C left intact.
3. B, C, D and E are cut. The lungs are inflated by means of a pump and impulses recorded from A with an oscilloscope.
4. A and E are cut. The concentration of carbon dioxide in inspired air is increased to three per cent.
5. Experiment 4 is repeated. But with D cut.
6. A and E are cut. The concentration of carbon dioxide increased to five per cent.
7. Experiment 6 is repeated. But with D cut.

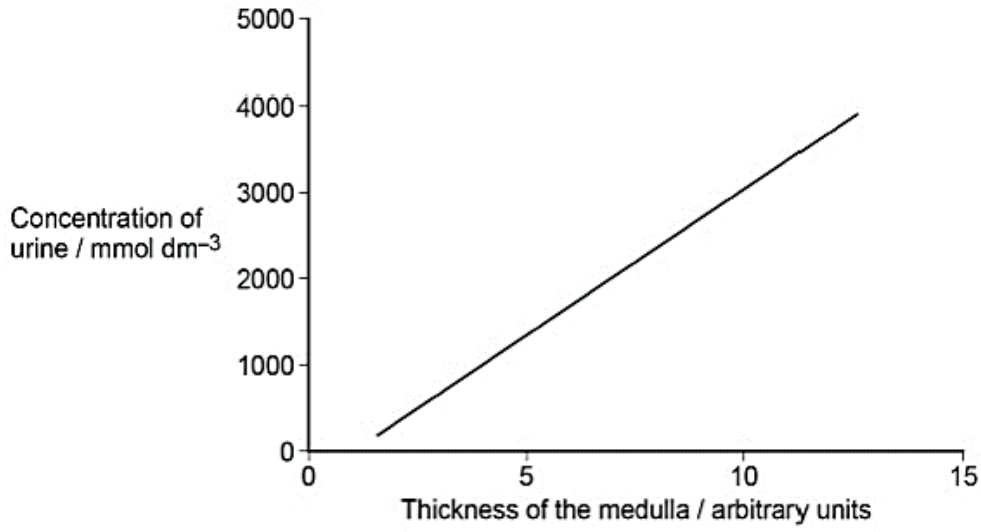
- Predict the effect of

i. Cutting E but leaving all other nerves intact.
ii. Cutting A and D but leaving B, C and E intact.

- If your predictions turned out to be correct, what conclusions would you draw concerning the role of higher centres in the control of breathing?

3.6 HOMEOSTASIS

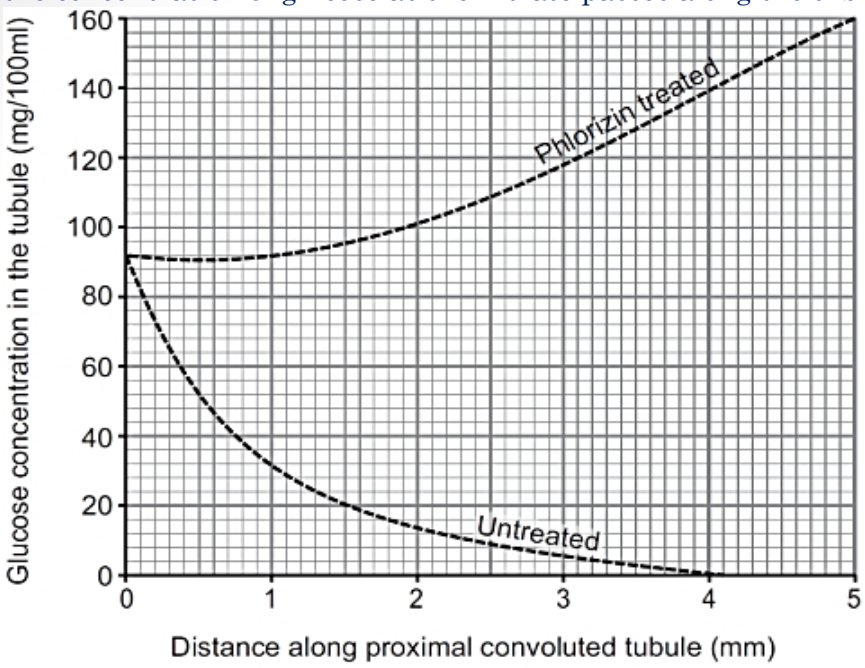
3.6.1 The graph below shows the relationship between the thickness of the kidney medulla of different species of mammals and the concentration of their urine.



(a) Explain the pattern shown by the results in the graph.
(b) Explain why some mammals such as the bats produce highly concentrated urine than others such as human.
(c) Describe and explain the effect of eating protein rich foods to the composition of urine.

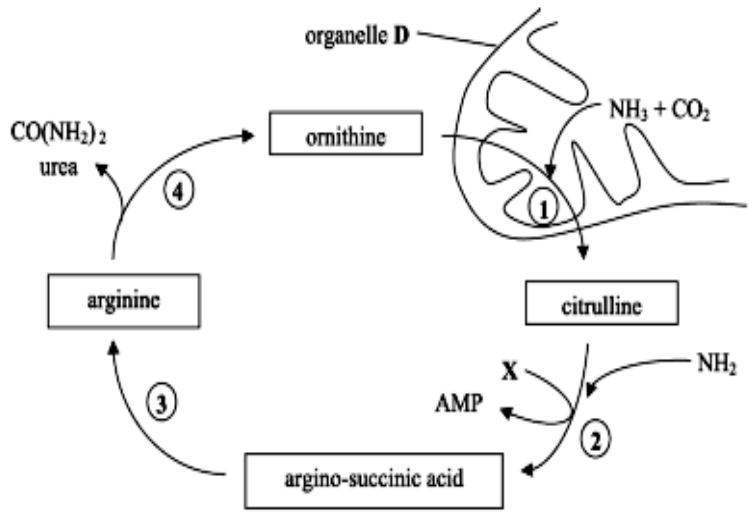
3.6.2 The proximal convoluted tubule of the kidney nephron selectively reabsorbs glucose and sodium ions into the surrounding blood capillaries. The uptake of glucose from the lumen of the

tubules can be prevented completely by introducing a chemical phlorizin. The graph below shows the concentration of glucose as the filtrate passes along the tubule.



(a) Calculate the percentage change of glucose in the tubule from 0 to 4mm in the nephron treated with phlorizin.
(b) Compare the levels of glucose in treated and untreated nephron.
(c) Explain the effect of phlorizin on glucose reabsorption from the filtrate.
(d) How is the proximal convoluted tubule adapted to performing its function?

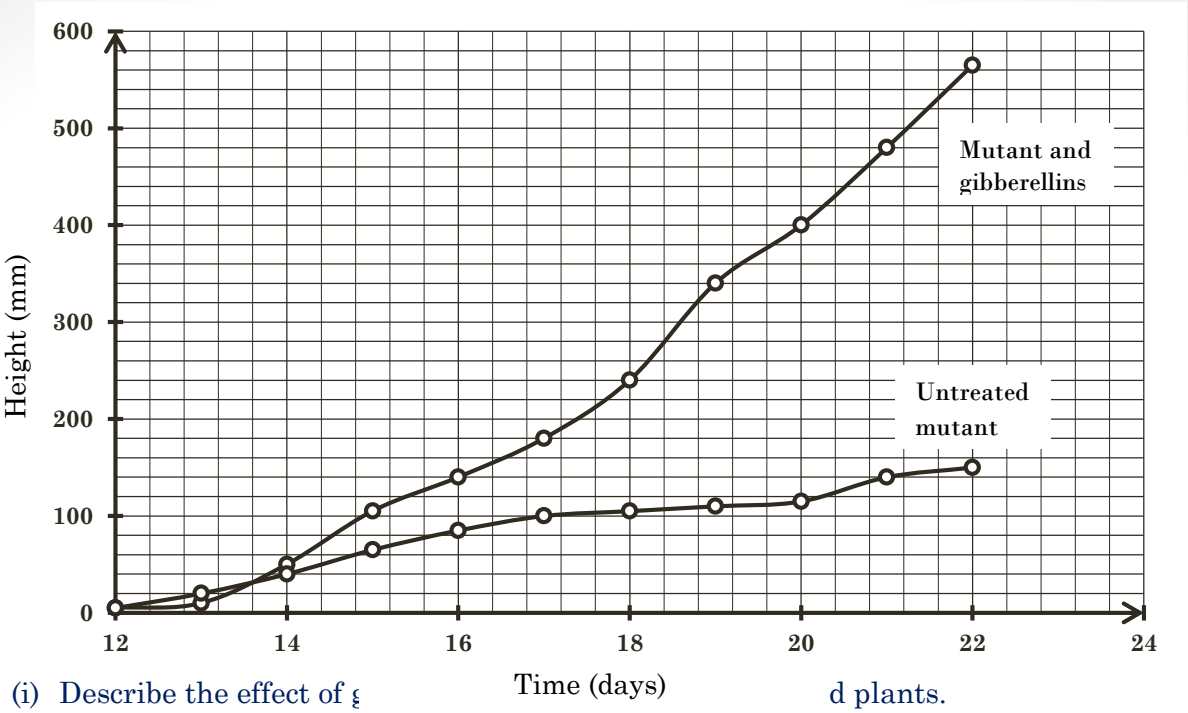
3.6.3 One of the main functions of the liver cells is the formation of urea by the ornithine cycle, an outline of which is shown in the figure below



a) Identify organelle D, where step 1 of the cycle takes place.
b) Explain how ornithine and citrulline move into and out of the organelle D respectively, during the cycle.
c) How has the ammonia that is used in step 1 been formed?
d) Identify the compound labelled X in the figure.
e) Describe how the mitochondrial membrane structure is related to the function of a mitochondrion.

3.7 COORDINATION

3.7.1 (a) Outline **two** similarities and **two** differences between plant growth substances and mammalian hormones.
(b) In an investigation to determine the effect of gibberellins on growth and development of rapid-cycling brassicas plants, two groups of mutant forms were treated separately as follows.
Leaves of one batch were applied gibberellins 12 days after planting.
Leaves of the batch received no gibberellin 12 days after planting.
Leaves of mutant plants are clustered together at similar height close to the ground due to failure of internode gaps between leaves to expand.
The heights of plants in each of the two groups were measured at regular time intervals. The results are shown in figure below.



(i) Describe the effect of ɡ d plants.

(ii) Compare the variation in the height of untreated plants and plants treated with gibberellins.

(iii) Explain the difference in the height of the two groups of plants over the experimental period.

(iv) Other than the effect of gibberellin demonstrated in the experiment, outline other effects of gibberellin in plant growth and development.

(v) Suggest three reasons for the choice of rapid-cycling brassicas plants in this investigation.

3.7.2 (a) Explain how hormones alter a plant's growth in response to

(i) Overcrowding by other plants.

(ii) The top plant shoot being eaten by an animal.

(b) Outline the organization and roles of the autonomic nervous system in mammals.

3.8 BEHAVIOR

3.3.1 (a) Describe what is meant by:

(i) Innate behaviour

(ii) Learned behaviour.

(b) Describe the advantages to animals of innate and learned behaviour, with reference to specific examples of each type of behaviour.

3.9 SUPPORT AND LOCOMOTION

3.9.1 In an experiment to investigate muscle contraction,

- Six thin strips of fresh skeletal muscle tissue were cut to similar lengths, and each strip was placed on a white tile together with some buffer solution.
- The initial length of each strip was measured using a ruler.
- A small volume of a test solution was added to each strip of muscle and after five minutes, the final length of each strip was measured.

The results are shown in the Table below.

	Test solution added		
	Unboiled ATP ($mgdm^{-3}$)	**Boiled ATP ($mgdm^{-3}$)**	**Glucose(gdm^{-3})**

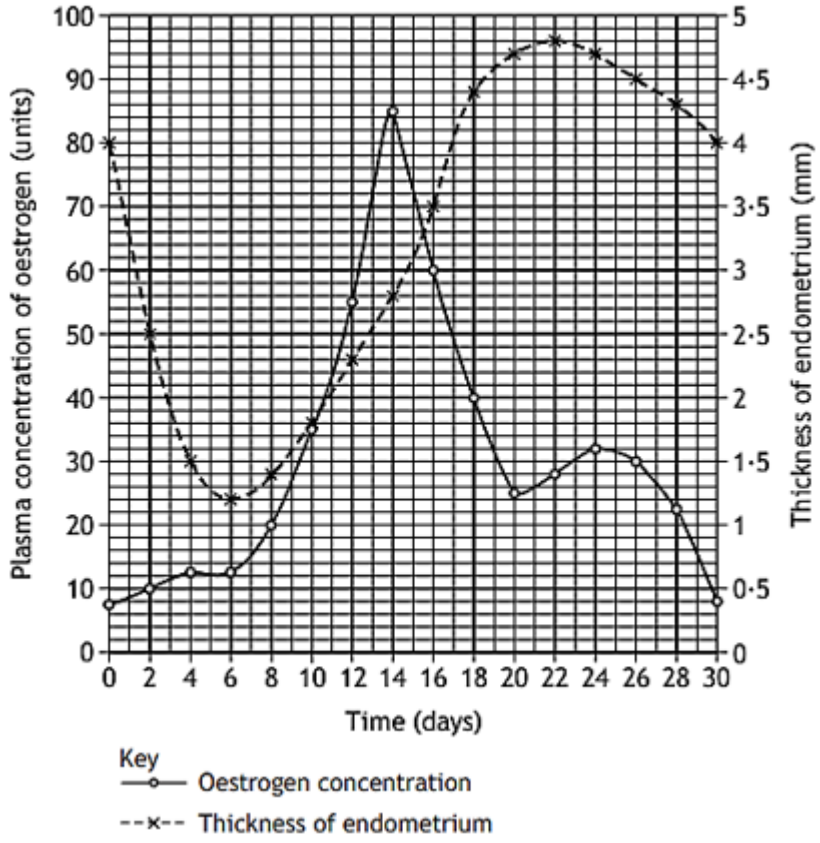
	1.0	0.50	0.25	0.10	1.0	0.10
Initial length(mm)	40	39	39	40	39	41
Final length (mm)	28	29	32	36	28	41

(a) Work out the percentage change in length of each strip and fill your results in the Table.
(b) On a suitable graph, represent the percentage change in length results for the six test solutions.
(c) Explain the effect of adding the following test solutions on the percentage change in length of the strips.
(i) Different concentrations of unboiled ATP.
(ii) Glucose solution
(d) Suggest an explanation for the difference in results when boiled ATP solution was added to a muscle strip and when unboiled ATP was added to a muscle strip.
(e) Describe how the structure of the skeletal muscle relates to its function.

THEME 4: CONTINUITY OF LIFE

4.1 REPRODUCTION

4.1.1 The graph in the figure below shows how the plasma concentration of oestrogen and thickness of the endometrium vary during a woman's menstrual cycle.



(a) Describe the changes in the plasma concentration of oestrogen hormone.
(b) Account for the changes in the thickness of endometrium over the 30-days period.
(c) Explain
(i) What would happen if fertilization had occurred on the 22nd day of the month?
(ii) How the relationship between oestrogen and luteinizing hormone is an example of positive feedback.
(d) Describe how oestrogen may act as a contraceptive.

4.1.2 (a) Describe the process that occurs during the production of a pollen grain in the anther of a flowering plant until the mature grain is exposed to a visiting pollinator.
(b) By what means may pollen grains be prevented from reaching the receptive stigma of the same flower?

4.2 GROWTH AND DEVELOPMENT

4.2.1 The graph in the figure I, shows changes in the respiratory quotient of pea during germination. The graph in figure II, shows the rate of intake of oxygen by dormant and non-dormant seeds.

Figure I

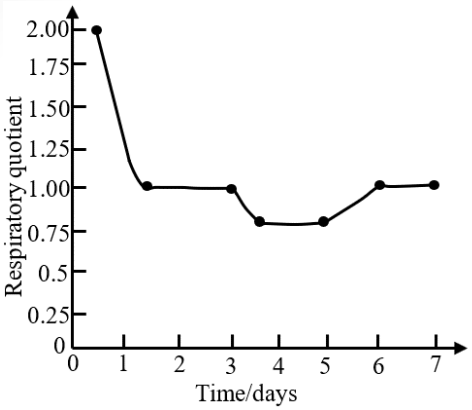
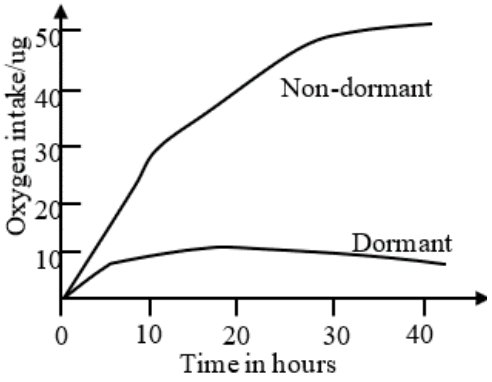


Figure II



(a) (i) Explain the changes in the respiratory quotient of pea during germination.

(ii)Why is monitoring the RQ important in the study of seed germination?

(iii) What factors can influence the RQ in germinating pea seeds?

(iv)How might a high RQ value in germinating pea seeds impact their overall growth and energy utilization?

(b) (i) Compare the rate of oxygen intake in both type of seeds.

(ii) Explain the difference in the oxygen intake in both types of seeds.

(iii) Describe what can be done to a dormant seed to make it germinate.

4.2.2 (a) What is the role of the apical meristem in root growth?

(b) (i) Describe the role played by the cork cambium in the formation of a lenticel.

(ii) Describe the functions of lenticels on the stem.

4.3 GENETICS AND VARIATION

4.3.1 (a) Plants can produce offspring (new plants) by sexual reproduction. Give the main points about offspring produced by sexual reproduction.

(b) New plants can be made from a parent plant by using tissue culture. Why new plants are produced using tissue culture?

4.3.2 (a) Meiosis results in genetic variation in the gametes which leads to variation in the offspring formed by sexual reproduction. Describe how meiosis causes this variation and explain the advantage of variation to species.

(b) An old form of wheat, emmer wheat (Triticum turgidum), has diploid chromosome number of 28 (2n=28). A wild wheat, eikom wheat (Triticum tauschii), has diploid chromosome number of 14 (2n=14). These two species occasionally crossed and produced sterile hybrid plants. Due to error in cell division, one of these hybrid plants formed male and female gametes with 21 chromosomes. Fusion of these gametes resulted in viable offspring. These plants were a new species, Triticum aestivum (2n=42), the modern bread wheat. Explain why Triticum aestivum is fertile while the majority of hybrid plants were not.

(c) Explain how major evolutionary forces lead to formation of new species?

4.3.3 (a) In cats the allele for short hair is dominant to the allele for long hair; the gene involved is autosomal. Another gene that 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 F_1?

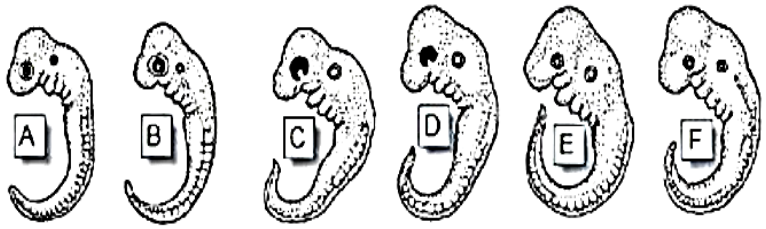
(b) Gene R for red flower colour can only express itself phenotypically in the presence of gene C which complements its action to form colour. When two white-flowered plants with genotypes CCrr and ccRR were crossed, the F_1 generation all had red flowers.

What would be the phenotypic ratio of the F_2 progeny when the F_1 progeny are selfed? (Show your working).

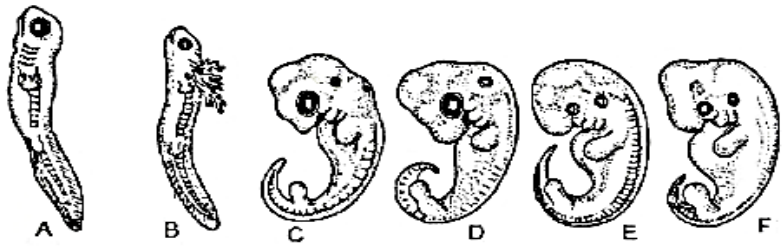
(c) What is the role of mutation in evolution?

4.4 EVOLUTION AND POPULATION GENETICS

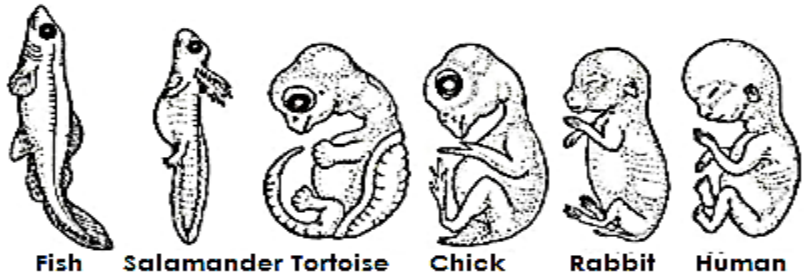
4.4.1 The figures 9.1 A to D below show six different embryos of six organism.



Figures 9.2 below show older, more developed embryos from the same organisms



Figures 9.3 below show the same embryos at their most advanced stage, shortly before birth.

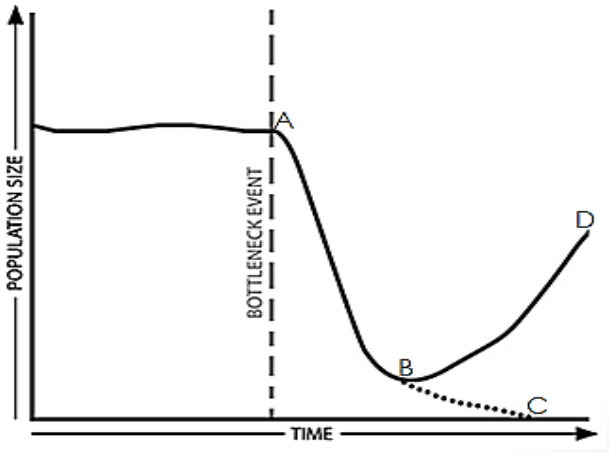


(a) Describe how the embryos changed for each of these organisms from their earliest to the latest stages.

(b) Observe clearly the six embryos in their earliest stages. Describe physical similarities that exist among the six embryos.

(c) Explain how these embryos can be used as evidence of evolution from a common ancestor for the six organism.

4.4.2 The figure below shows the changes that occur to a population of individuals before and after a bottle neck event.



a) What does region BC and BD represent?

b) Suggest explanations to possible effects of the bottleneck event to the population in regions,

i. AB

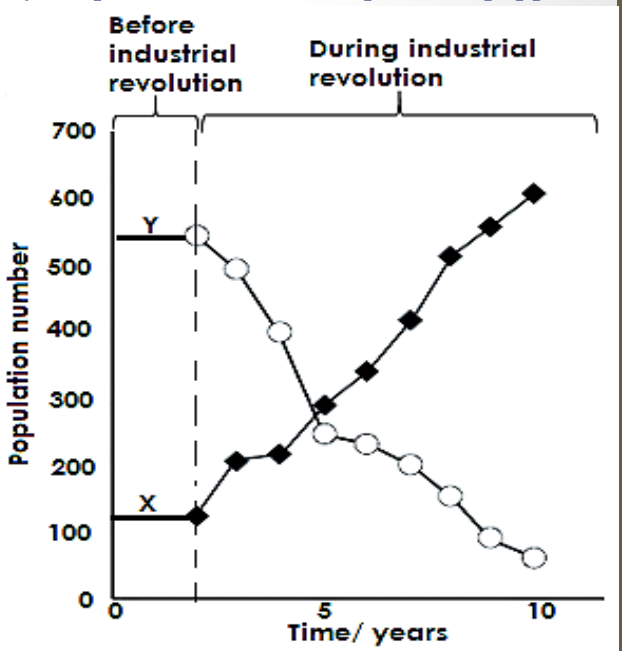
ii. BC

c) Describe three examples of bottleneck effect that may naturally occur.

d) Population before bottleneck is less susceptible to changes in allele frequency by genetic drift unlike population at B.

e) Compare bottle neck effect and founder effect.

4.4.3 The graph below shows the population size of polymorphic forms of same species of peppered moth (Biston betularia) before and during the industrial revolution as studied by Benard Kettlewell (1953). The data was obtained by setting traps to capture moths for 10 consecutive years. Traps were located in same area each year.



a) Identify the morphic forms of Biston Betularia represent by letter X and Y.

b) Calculate the percentage change in population of the two morphic forms the 10 years period.

c) Account for the population size of two morphic forms in (a) above;

i. Before industrial revolution

ii. During the industrial revolution

d) Describe how the type of selection and the responsible selection pressure operate to distribute the morphic forms of the peppered moth.

e) How does distribution of morphic forms after industrial revolution provide evidence for evolution?

THEME 5: PRACTICALS

Toad dissection

You are provided with specimen K which freshly killed animal.

Dissect the specimen to expose the heart and display

i) Blood vessels draining right fore limb and head region

ii) Blood vessels supplying organs for digestion and left hind limb with the heart placed dorsally.

Draw and label your dissection

Cockroach dissection

a) You are provided with **specimen Y.** Examine it carefully and answer the questions that follow. Display the animal on the dissecting board with the dorsal side upper most. Cut along one lateral line of the specimen, except its three anterior most segments and displace the dorsal terga to the left and alimentary canal to the right. Draw and label the structures exposed on the ventral and dorsal tergum that are used for removal of insoluble nitrogenous waste, reproduction, sensitivity, breakdown and absorption and transport of the digested nutrients and oxygen. (22 marks)

Rat dissection

You are provided with a freshly killed specimen labeled R

i) With reference to the cover of the body, give the importance of each of the structure to the animal.

ii) Examine the feet of the animal, and how are they adapted for its survival in the habitat.

b) Dissect the specimen on the tray to expose the superficial structures of the ventral side of the neck, and displace the visible neck structures and their accessory structure anteriorly. Draw and label the musculature of the neck, chest region, and thoracic region.

c) Open the abdomen to display vessels that carry blood; to structures responsible for chemical digestion from the heart; and from structures responsible for secretion and excretion on the left back to the heart. Draw and label your dissection excluding the heart.