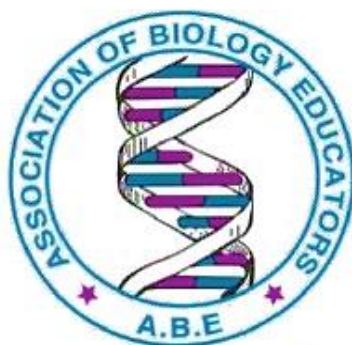


Association of Biology Educators (ABE)



2023 'A' LEVEL NATIONAL SEMINAR-SERIE No: 7 HELD AT SACRED HEART SECONDARY SCHOOL, GULU (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.

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SATURDAY 07TH OCTOBER, 2023

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!

Frederick Dongo-Shema
President, ABE.

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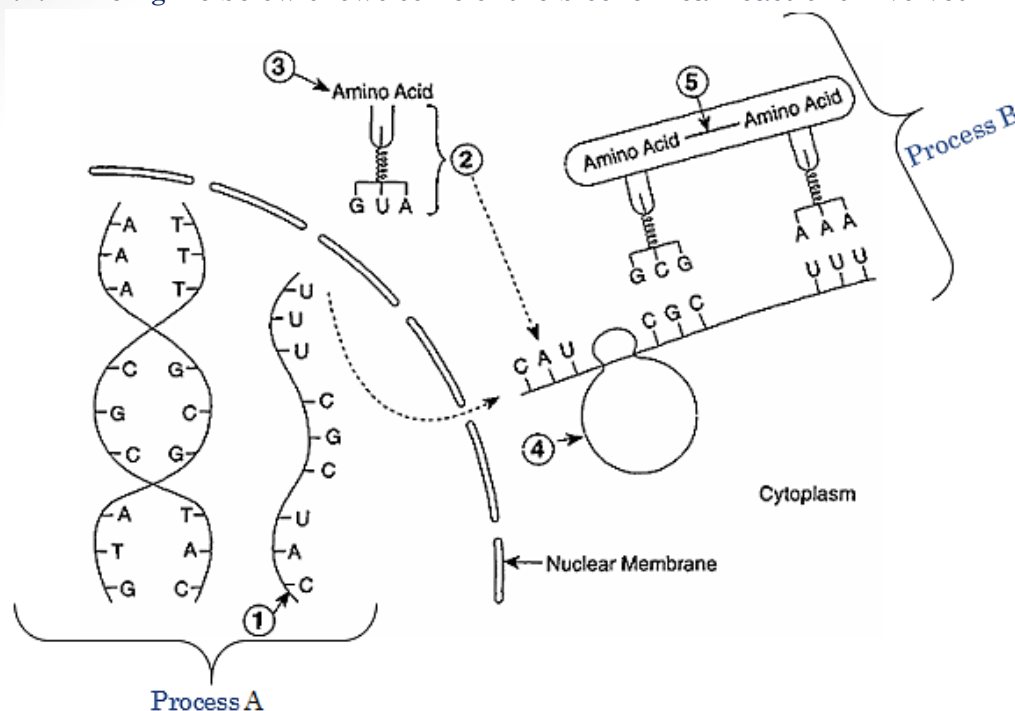
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THEME 1: CELL BIOLOGY

1.1 CELL STRUCTURE AND FUNCTION

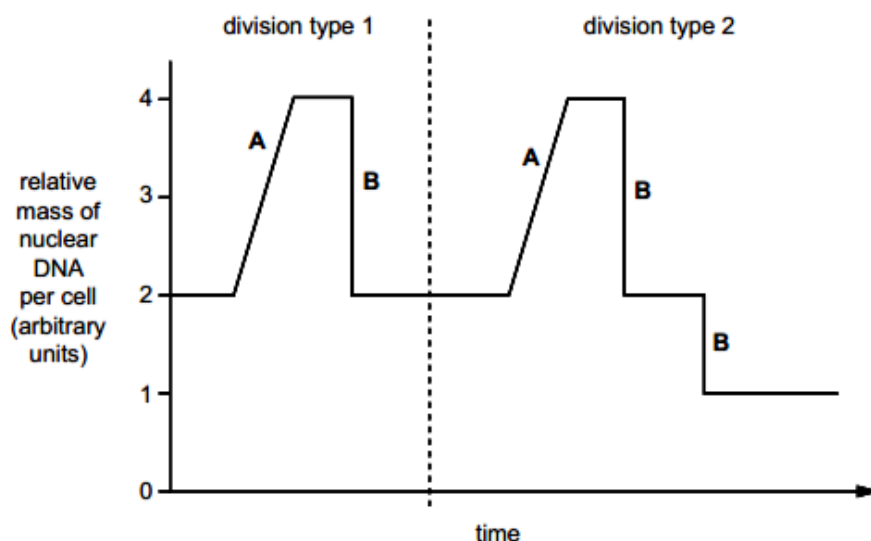
1.1.1 The figure below shows some of the biochemical reactions involved in a cellular process.



- Identify processes A and B, and structures represented by numbers 1, 4 and 5.
- What is the fate of product of processes A?
- Outline the events occurring in processes B
- Compare process A and B.
- Explain why DNA in the nucleus is not used directly in processes B.

1.2 CELL DIVISION

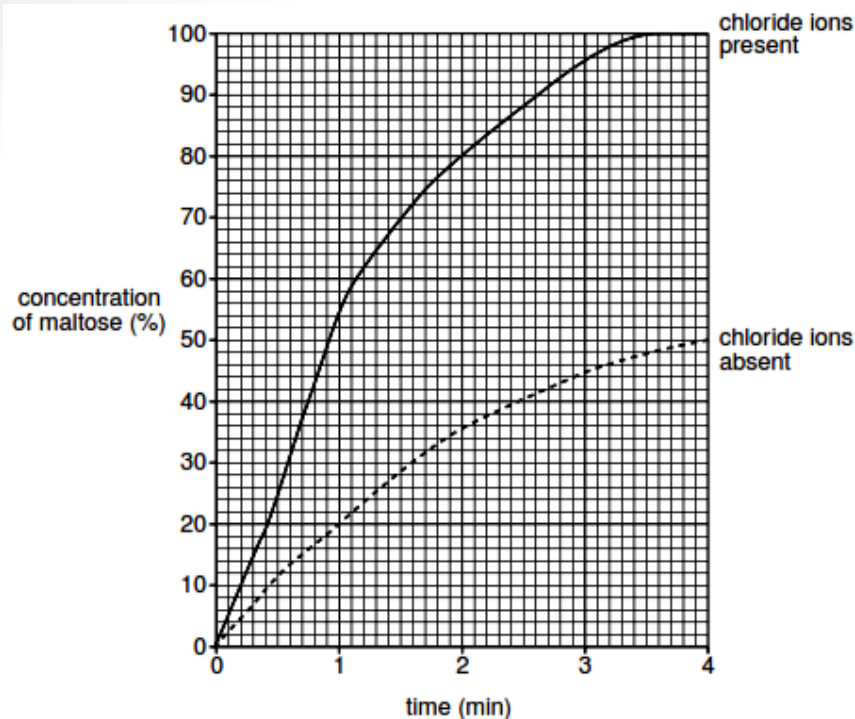
1.2.1 The figure shows changes over time in the mass of nuclear DNA in some of the cells of the testes of a diploid organism. During this time period, two different types of nuclear division occurred.



- Identify the two types of division represented in Fig. 1.1. Name the processes that are occurring at the points labelled A and B, which cause the change in the mass of DNA per cell.
 - Discuss the ways in which genetic variation is produced, including the role of nuclear division.

1.3 CHEMICALS OF LIFE

- Compare saturated and unsaturated fatty acids. (10 Marks)
 - Explain the functions of neutral fats in animals. (10 Marks)
- The figure shows the results that the student obtained from a practical procedure in which the rate of formation of maltose was measured in the presence and absence of chloride ions.

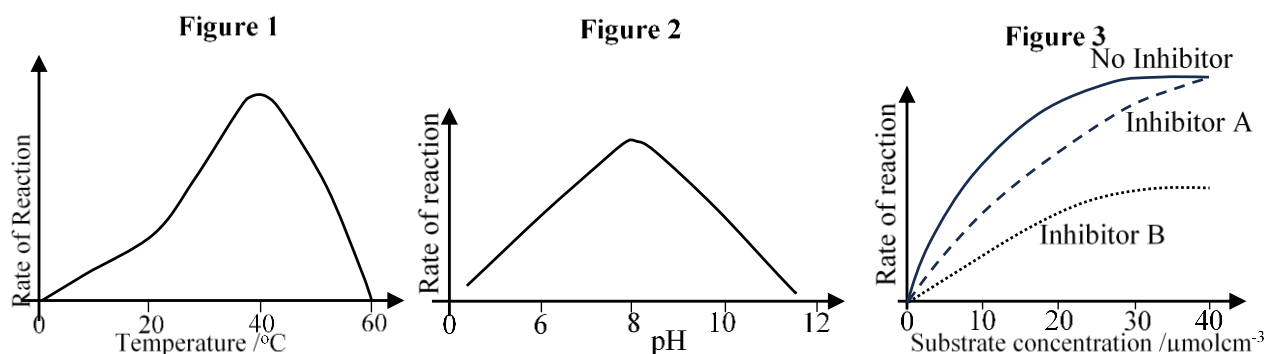


- Describe the effect of chloride ions on the rate of reaction.
- Explain the effect of chloride ions on the rate of reaction.
- Explain why different enzymes are involved in each stage of digesting carbohydrates from polysaccharide into monosaccharides.
- State three variables that need to be controlled in this practical procedure in order to produce valid results.

1.3.3 (a) Describe the structure of a haemoglobin molecule.

(b) Compare the structures of haemoglobin and collagen.

1.3.4 The figure below shows the effects of different factors on the rate of an enzyme-catalyzed reaction:



- Explain the effect of
 - Temperature in the rate of reaction
 - pH on the rate of reaction
- Figure 3 shows the effects of increasing substrate concentration in the presence of inhibitors A and B, in relation to the control experiment with no inhibitor.
 - Describe the effect of each inhibitor on the rate of reaction.
 - Fully account for the differences in the effect of the inhibitors A and B on the rate of reaction.

1.4 CELL PHYSIOLOGY

1.4.1 (a) What are the characteristic features of a cell membrane?

(b) Describe mechanisms of transporting small molecules through the cell membrane.

1.4.2 (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.

1.5 HISTOLOGY

1.5.1 (a) Describe how cells are organized into tissues, using xylem and phloem as examples.

(b) What adaptations of xylem and phloem enable them to carry out their functions?

THEME 2: ECOLOGY

2.1 (a) Describe a suitable method of measuring the distribution and abundance of plants over a short distance.

(b) Describe the types of ecological interaction that can occur between different species in a habitat.

2.2 The table below shows the net primary production by plants in four different ecosystems.

Ecosystem	Net primary production (kJ m ⁻² year ⁻¹)
Temperate grassland	9 240
Temperate woodland	11 340
Tropical grassland	13 440
Tropical rainforest	36 160

(a) Explain the differences in net primary production in these ecosystems.

(b) The table below compares the energy egested, absorbed and respired in four types of animal.

animal	percentage of energy consumed that is:			
	egested	absorbed	respired	converted to biomass
grasshopper, a herbivorous insect	63	37	24	
perch, a carnivorous fish	17	83	61	
cow, a herbivorous mammal	60	40	39	
bobcat, a carnivorous mammal	17	83	77	

(i) Complete the table to show the percentage of energy consumed that is converted into biomass.

(ii) Using the data from the table, explain how the trophic level of a mammal affects the percentage of its food energy that it is able to convert to biomass.

(iii) Suggest which of these four animals could be farmed to provide the maximum amount of food energy in kJ m⁻² year⁻¹ for humans. Explain the reasons for your choice.

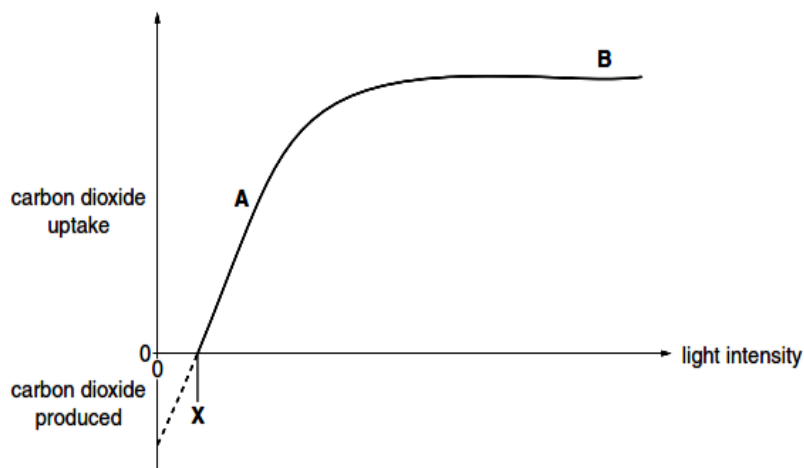
2.3 (a) How are bacteria adapted for the diversified mode of life?

(b) Describe the role of bacteria during the evolutionary success of man.

THEME 3: MAINTENANCE OF LIFE

3.1 NUTRITION

3.1.2 The figure below shows the relationship between light intensity and the relative carbon dioxide uptake and production in a plant.



- As light intensity increases from 0 (zero) to X.
- at light intensity X.
- at light intensities greater than X.

(i) State the factor that is limiting the rate of photosynthesis at A on the graph.

(ii) Suggest one factor that may limit the rate of photosynthesis at B.

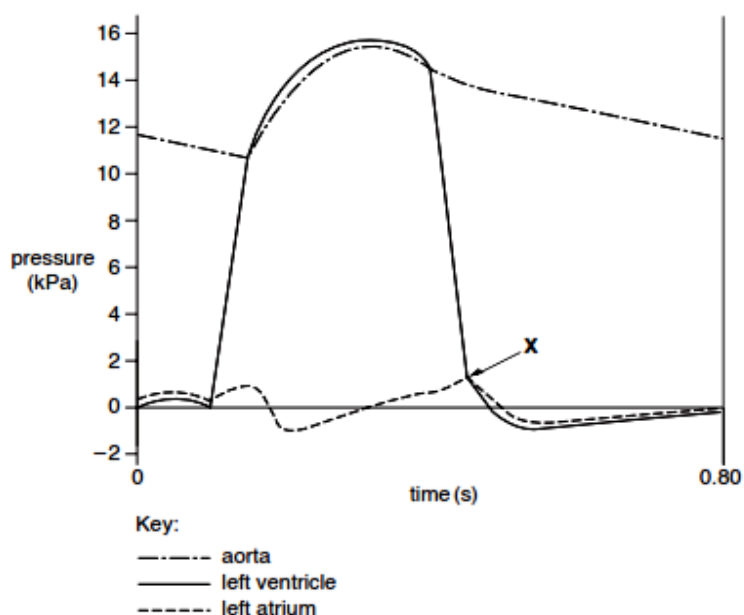
(iii) Carbon dioxide is given off by the plant when the light intensity is lower than X.

Name the process that produces carbon dioxide in the plant.

(iv) With reference to the figure, explain the biochemical processes that are occurring in the plant:

3.2 TRANSPORT

3.2.1 The figure below shows the changes in pressure inside the heart chambers during one heartbeat.



(i) Calculate the heart rate from the information in the figure.

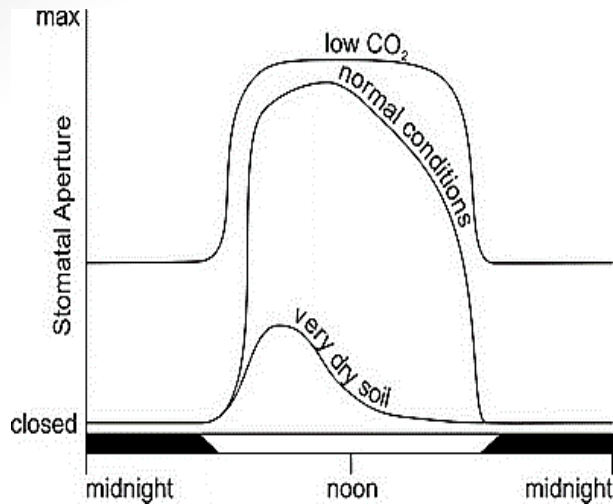
Show your working and give your answer to the nearest whole number.

(ii) Describe and explain what happens immediately after X on Fig.

3.2.2 (a) Describe the hormonal and nervous mechanisms involved in the control of heart rate.

(b) Explain how the activation of the 'fight or flight' response affects voluntary, involuntary and cardiac muscle.

3.2.3 The graph below plots the variation of size of stomatal aperture with time of the day for a typical plant under various environmental conditions. Three environments are investigated: normal conditions, very dry soil, and an experimentally induced low carbon dioxide environment.



a) Describe the **effect** of the following environmental conditions on stomatal aperture during the 24-hour period.

- Normal conditions.
- Very dry soils.
- Low carbon dioxide environment.

b) Explain the observed results in stomatal aperture under the different environmental conditions during the 24-hour period.

c) Contrast the stomatal aperture during day and during night at all the environmental conditions. Explain your answer using the potassium ion-hydrogen ion pump theory.

d) Some plants produce abscissic acid. Explain how abscissic acid affects stomatal aperture.

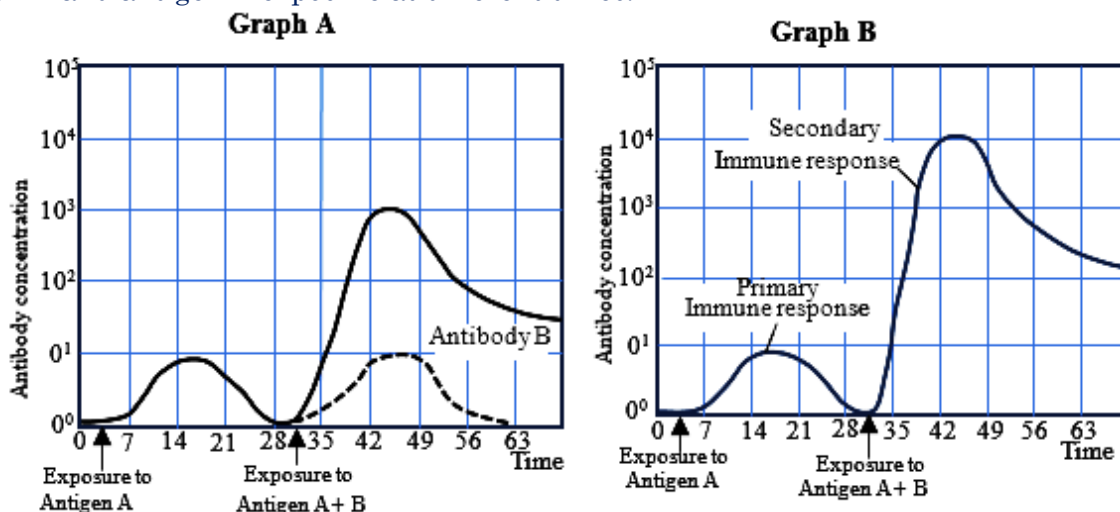
3.3 DEFENCE AGAINST DISEASES

3.3.1 (a) Describe the actions of the B lymphocytes in the immune response. (10 marks)

(b) What biological reasons make it difficult to produce an effective vaccine for malaria? (07 marks)

(c) Suggest why adults who have survived malaria may lose their immunity when they leave a malarial area. (03 marks)

3.3.2 The graphs below show effect of antigen exposure on the response of the immune system. Graph A and B show changes in antibody concentrations produced by the immune system on antigen A and antigen B exposure at different times.



a) Using graph A and B, Determine the maximum concentration of antibody B produced by the immune system.

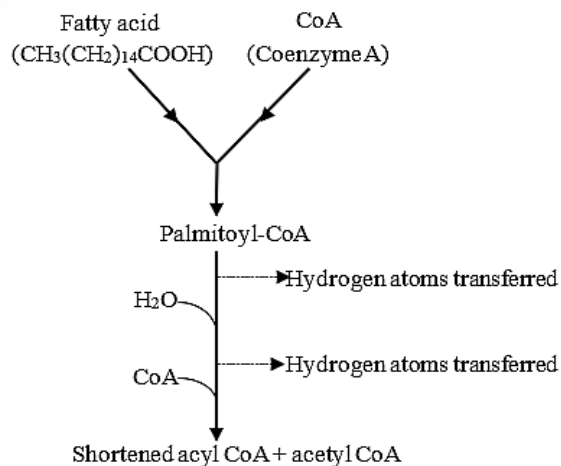
b) (i) Compare the effect of same antigen exposure on antibody concentration as indicated in graphs A and B.

(ii) Explain the differences in the responses in (b) (i) above.

c) Explain the difference in strength of antigen A and antigen B using the graphs above.

3.4 RESPIRATION

3.4.1 The figure below shows a simplified example of beta oxidation, the process used to break down fatty acids to acetyl CoA for use in respiration.



(a) (i) Using the information in the figure, calculate the percentage of carbon atoms in the fatty acid that are able to enter the Krebs cycle.

(ii) Calculate the efficiency of the link reaction. Using your answer to part (i), state whether the link reaction is more, less or equally efficient when compared to the reactions described in Fig. 2. Show your working.

(iii) Suggest a role for coenzymes other than coenzyme A in beta oxidation.

3.4.2 (a) Why does aerobic respiration yield fewer molecules of ATP than the theoretical maximum?

(b) Explain why the incomplete breakdown of glucose in anaerobic respiration produces less ATP than aerobic respiration.

3.4.2 The table below contains data that show the respiration rate of a selection of fruits and vegetables stored at different temperatures after harvesting. The respiration rate is measured by the rate of carbon dioxide produced.

Fruits and vegetables	Respiratory rate ($\text{mg CO}_2\text{kg}^{-1}\text{ h}^{-1}$)				
	at 0°C	at 5°C	at 10°C	at 15°C	at 20°C
Apple	3	4	9	15	20
Asparagus	60	105	215	235	270
Blackberry	19	36	62	75	115
Cauliflower	17	21	34	44	69
Onion	3	5	7	7	8
Orange	4	6	8	18	28
Parsnip	12	13	22	37	n/a*
Potato	n/a*	12	16	17	22
Turnip	8	10	16	23	25

(a) (i) Describe the pattern of respiration shown by cauliflower at increasing storage temperatures of 0°C to 20°C .

(ii) Discuss what the data in the table indicate about the best conditions for storage of fruits and vegetables.

(iii) Identify, with reasons, which fruit or vegetable listed in the table is least likely to spoil during storage.

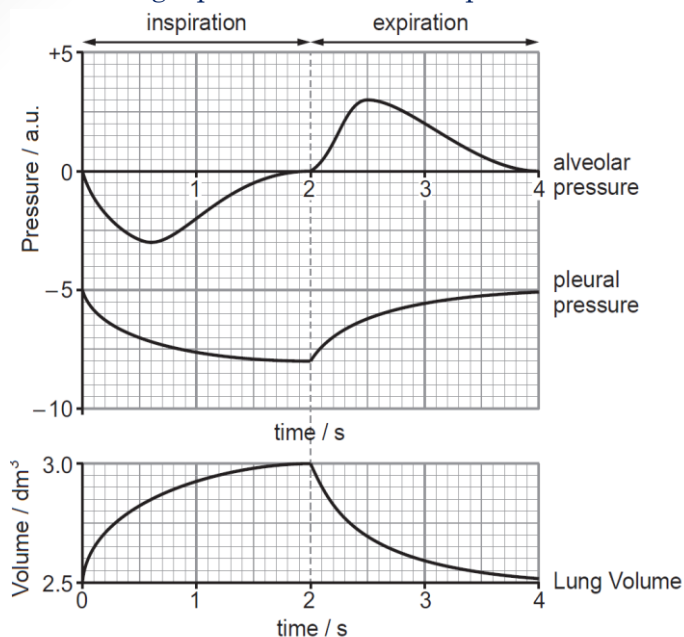
(iv) Which fruit or vegetable listed in the table is likely to be the most difficult to keep fresh during storage? Give a reason for your answer.

(b) Suggest why, even though blood carries oxygen, certain parasites live in the blood of mammals are adapted to respire anaerobically.

(c) Explain why, anaerobic respiration pathway in animal cells can be reversed, yet this is not possible in yeast cells.

3.5 GASEOUS EXCHANGE

3.5.1 The graph below shows the pressure and volume changes during a single ventilation cycle of a healthy human at rest. The pressure is given in arbitrary units and the volume is measured in cubic decimetre (dm^3).



of a healthy human at rest. The pressure is given in arbitrary units and the volume is measured in cubic decimetre (dm^3).

(a) From the graphs, describe the pressure and volume changes shown during

(i) Inspiration.

(ii) Expiration.

(b) Explain the changes in the pressure and volume shown during

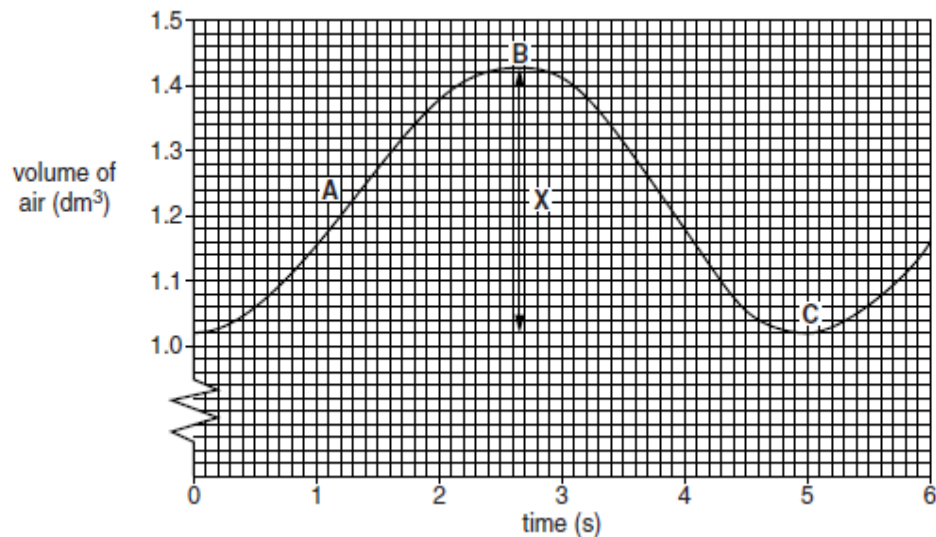
(i) Inspiration.

(ii) Expiration.

(c) Suggest the changes that are expected in these curves during strenuous exercise.

(d) What is the role of the human respiratory system in maintaining homeostasis?

3.5.2 The figure below shows changes in volume of air in the lungs of a student at rest during one breath.



(a) Name the measurement represented by line X, and give its meaning.

(b) Explain what causes the change in the volume of air between points B and C

(c) About 1dm^3 of air cannot be expelled from the lungs. What name is given to this volume, and suggest why it is not possible to expel all air from the lungs.

(d) How is the alveoli adapted for gaseous exchange in man?

3.6 HOMEOSTASIS

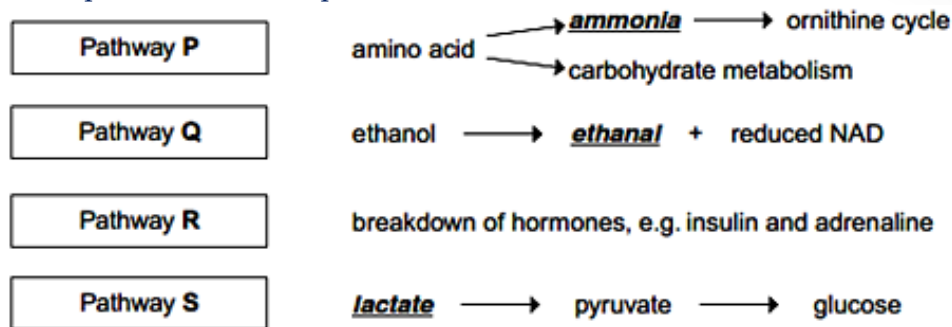
3.6.1 (a) Explain how the glomerulus is able to perform its function.

(b) Describe the features of the glomerulus and Bowman's capsule that allow them to perform their function effectively.

3.6.2 (a) Describe how negative feedback is used to control blood glucose concentration.

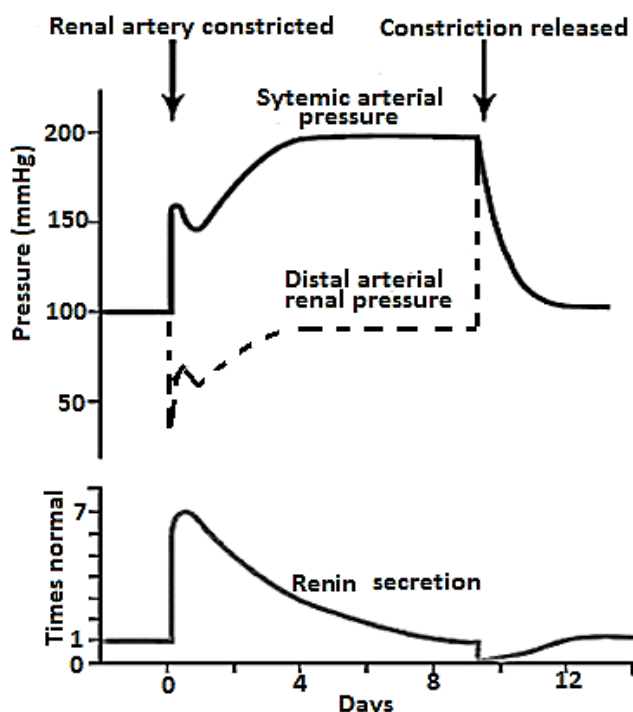
(b) Explain the effect of high protein intake in the diet on concentration of urea in urine.

3.6.3 The figure below outlines some of the reaction pathways that take place in the liver cells. The underlined words represent toxic compounds.



- (a) (i) State the product of the ornithine cycle in Pathway P and the organ to which this product is transported for removal from the body.
- (ii) The lactate that enters pathway S is produced by cells, such as muscle cells, undergoing anaerobic respiration.
- (iii) Suggest why lactate that enters pathway S is converted into pyruvate by the hepatocytes (liver cells) rather than by muscle cells in which it is produced.
- (b) Explain what might happen to a person if the liver did not break down insulin as shown in pathway R.
- (c) (i) Using information from Pathway Q, suggest the consequences for liver metabolism if a person has a regular high alcohol intake.
- (ii) State precisely where in the liver cell the excess reduced NAD can be re-oxidised.

3.6.4 Figure below shows effect of placing a *constricting clamp* on the renal artery of one kidney after the other kidney has been removed. Changes in systemic arterial blood pressure, renal artery distal to the clamp and rate of renin secretion are shown.



- (a) Describe the effect of renal artery constriction on,
 - i. Sytemic arterial pressure.
 - ii. Distal arterial renal pressure.
 - iii. Renin secretion.
- (b) Explain the observed changes in systemic arterial pressure, distal arterial renal pressure and renin secretion during renal artery constriction.
- (c) Explain the relationship between sytemic arterial pressure and distal arterial renal pressure when constriction is released.

3.7 COORDINATION

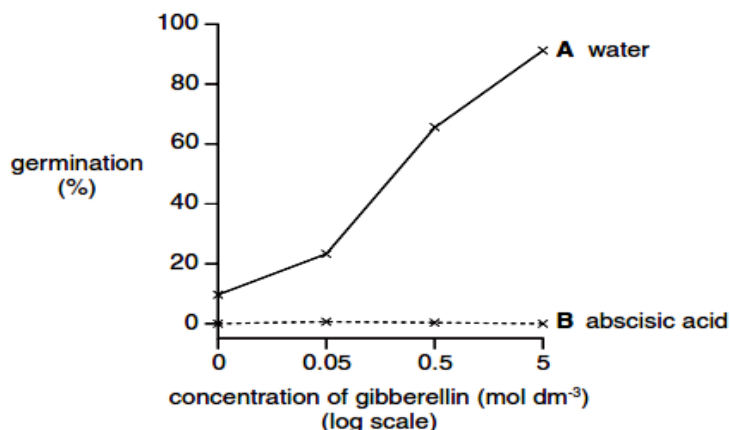
- 3.7.1** (a) Explain how hormones alter a plant's growth in response to
(i) Overcrowding by other plants. (ii) The top plant shoot being eaten by an animal.
(b) Outline the organization and roles of the autonomic nervous system in mammals.
- 3.7.2** (a) Describe how a neurone receives communication from the adjacent neurone.

(b) What is the importance of the junctions between neurones in the functioning of the nervous system?

3.7.3 (a) Explain why plants need to be able to respond to their environment.

(b) The figure shows the results of an investigation into the effects of plant growth substances on germination.

- A large number of lettuce seeds was divided into eight equal batches.
- Each batch of seeds was placed on moist filter paper in a Petri dish and given a different treatment.
- The batches of seeds were left to germinate at 25 °C in identical conditions and the percentage germination was calculated.



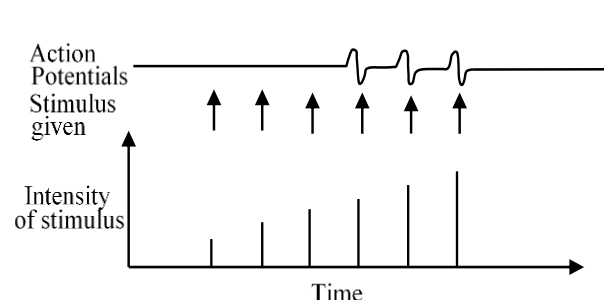
(i) With reference to the figure, describe the effects of the plant growth substances on the germination of lettuce seeds.

(ii) Explain why all the lettuce seeds were kept at 25 °C.

(iii) State three variables, other than temperature, that needed to be controlled in the investigation.

(c) State two commercial uses of plant growth substances.

3.7.4 A neurone was suspended in a suitable solution and connected both to an electrical stimulator and an oscilloscope. The intensity of the stimulus could be varied. The oscilloscope produced a visual record of the action potentials in the neurone. The diagrams show the apparatus and a summary of the results of the experiment.



apparatus and a summary of the results of the experiment.

(a) (i) What sort of solution would be suitable to use in this experiment?

(ii) Explain why this solution is used.

(b) Explain why the first three stimuli do not produce action potentials.

(c)(i) Give two similarities between the action potentials and graded potentials.

(ii) Sense organs receive stimuli at different intensities. Explain how the neurons transmit this information.

(d) Explain what happens at a point on a neurone when an action potential is generated and a resting potential is re-established.

3.8 BEHAVIOR

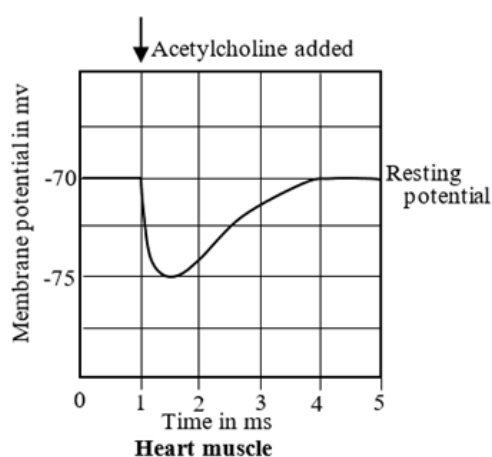
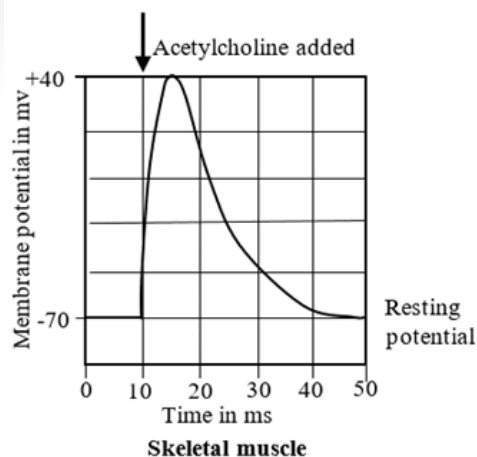
3.8.1 (a) Describe what is meant by:

- Innate behaviour
- 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 (a) The graphs below show the effect of **acetylcholine** on the stimulation of skeletal and heart muscle.



(i) Compare the effects of **acetylcholine** on skeletal muscle and heart muscle.

(ii) Explain the effect of acetylcholine on the membrane potential of the skeletal muscle.

(b) (i) Use information in the

graph to explain why, at the start of an action potential, the potential difference across the membrane rapidly changes from negative to positive.

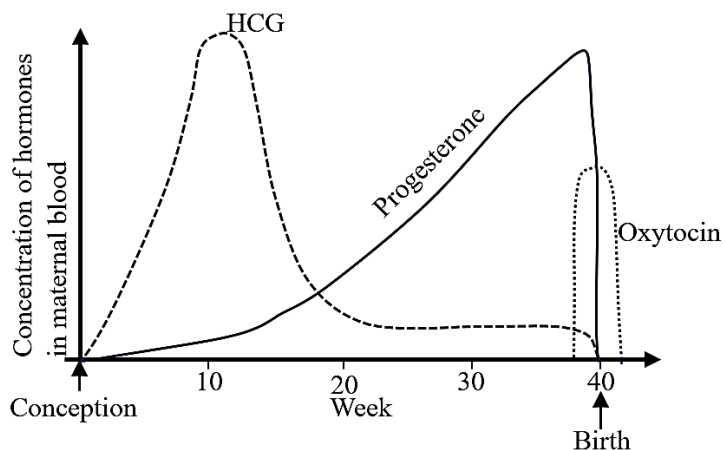
(ii) Suggest why, during a period of intense nervous activity, the metabolic rate of a nerve cell increases.

(iii) Predict the effect on an action potential of lowering the external concentration of sodium ions. Explain your answer.

THEME 4: CONTINUITY OF LIFE

4.1 REPRODUCTION.

4.1.2 The level of hormones in the lady was monitored over the whole period of gestation to birth. The graph below shows the changes in the concentration of hormones in blood.



(a) Describe the changes in the concentration of the following hormones

(i) HCG

(ii) Progesterone

(b) Explain the variation of the following hormones in the blood

(i) Oxytocin

(ii) Progesterone

(c) Oestrogen, relaxin and human placental lactogen are some of the other hormones in blood during the gestation period. State the functions of hormones.

(d) State any five physiological changes that occur to the female body during the gestation period.

4.1.2 (a) Discuss the effectiveness of various birth control methods used by females

(b) State the factors that are responsible for the infertility in the male population.

4.1.3 (a) (i) Describe the structure of the placenta.

(ii) What adaptations make the placenta successful in maintaining the developing fetus till birth?

(b) Describe the events that lead to implantation.

4.2 GROWTH AND DEVELOPMENT.

4.2.1 The table below shows the actual number of cells at every hour interval during the growth of yeast cells

Hours	No of cells	Increase in cells hourly intervals
0	10	0
5	30	20
10	70	40
15	90	20
20	100	10
25	100	0

- Distinguish between actual growth and rate of growth.
- Using the table above, plot a graph showing the actual growth and rate of growth.
- With examples explain allometric and isometric growth.
- Describe the events that lead to the formation of secondary tissues in woody plants.
- How is secondary growth different from primary growth?

- 4.2.2** (a) (i) Distinguish between primary and secondary meristems
(ii) State the functions of ray initials in the plant.
(b) Describe the events that lead to secondary growth in woody plants.

4.3 GENETICS AND VARIATION

4.3.1 (a) Suggest how the ability to use echolocation may have evolved from an ancestor that did not have that ability.

(b) Using a suitable example, describe the key features of genetic or environmental variation.

4.3.2 (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).

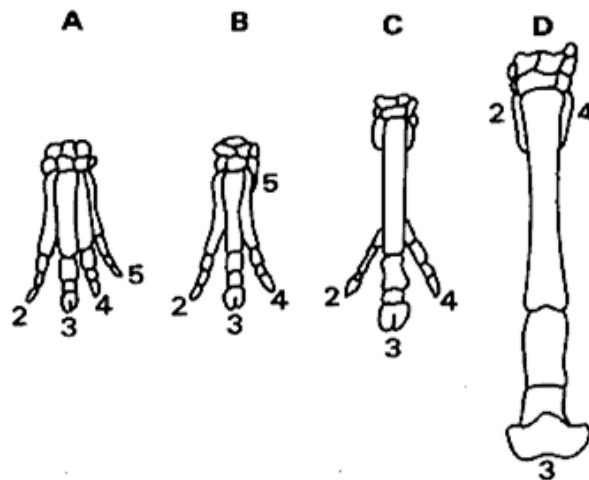
(c) What is the role of mutation in evolution?

4.4 EVOLUTION AND POPULATION GENETICS.

4.4.1 Figure below shows, in chronological sequence from A to D, fossils of the forelimb skeletons of four related mammals.

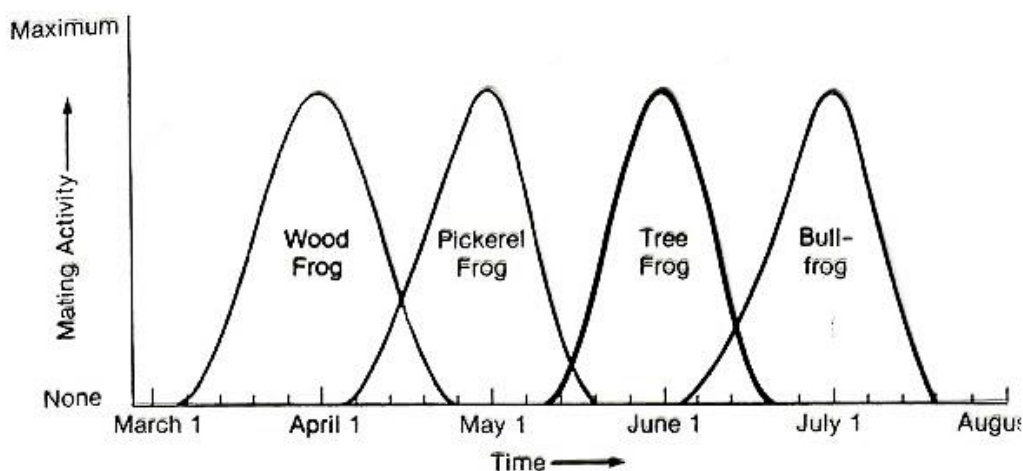
- Describe briefly the structural changes seen in the fossil sequence.
- What were the possible adaptive advantages of these structural changes?
- Explain how the chronological sequences of the fossils in the figure above provide evidence for evolution.
- How might each of the following be used as support for the theory of evolution?

i. Human beings possess an appendix which seems to have no function.



- ii. Marine sharks retain urea in their blood, thus maintaining their osmotic pressure close to that of the surrounding sea water. Fresh-water sharks show the same phenomenon.
- iii. Viral DNA has the same basic structure as human DNA.

4.4.2 The figure below shows the times when four different frog species carry out their mating activity.



- Identify the type of isolating mechanism in the figure above.
- What is the significance of the trends observed in the breeding times of the four frogs?
- Explain how the difference in the breeding times results into formation of new species.
- Which type of speciation occurs among the above frog population?
- Describe the possible barriers that may occur to hybrids when Wood frog and Pickerel frog successfully breed.

4.4.3 The table below shows changes in frequency of allele A for two populations of Darwin's finches on the Galapagos Islands over 10 generations after the effect of two different evolutionary mechanisms on the two populations.

In **Population 1**, after a storm passed through the Galapagos, a few finches ended up on an island where no finches were found before, mated and established a new population on that island.

In **Population 2** of Darwin's finches on an Island in the Galapagos, severe drought favoured one phenotype over the other in a population of birds that had both thin and thick size beaks.

Generations		1	2	3	4	5	6	7	8	9	10
Frequency of allele	Population 1	0.65	0.55	0.45	0.40	0.35	0.30	0.20	0.10	0.00	0.00
	Population 2	0.50	0.30	0.70	0.20	0.40	0.80	0.30	0.70	1.00	1.00

- Present the data above on suitable graphical form.
- Describe the pattern in frequency of allele A over the 10 generations in,
 - Population 1.
 - Population 2.
- With reference to results, explain the evolutionary mechanism that caused changes in allele frequency observed in the two populations upto the 9th generation.
- Suggest reasons for the observed results in the allele frequency from the 9th to the 10th generation for the two populations.
- Briefly describe other two evolutionary mechanisms that may lead to change in allele frequency in a small population.

THEME 5: PRACTICAL

Toad dissection

You are provided with specimen T which is freshly killed animal.

Place specimen T on a dissecting tray while facing away from you and dissect it carefully to displace the stomach and duodenum to your right hand side and turn the liver lobes anteriorly. Cut the mesentery that holds ileum leaving that of the rectum intact. Displace the ileum to the left of the specimen. Draw and label all internal structures seen in your dissection within the abdominal region. (28marks)

Cockroach dissection

You are provided with a freshly killed cockroach, labeled **specimen Q**.

- a) Suggest the habitat of the specimen with reasons basing on the head. (05marks)
- b) 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)
- c) 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 to display structures for food storage and digestion.

Draw and label the exposed structures on both cuticles anterior to the sixth abdominal segment. (18 marks)

Rat dissection

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
 - i) To structures responsible for chemical digestion from the heart
 - ii) From structures responsible for secretion and excretion on the left back to the heart.
- Draw and label your dissection excluding the heart. (24marks)

DISCLAIMER.

These questions are built in a similar style to that presented within the previous exam board's sample assessment materials. There can be no guarantee of the extent to which these questions will reflect the actual examination questions students will sit. We hope that schools and students find these questions useful in the exam preparations for this year. However, we take no responsibility for the relevance of this document to actual examinations sat.

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