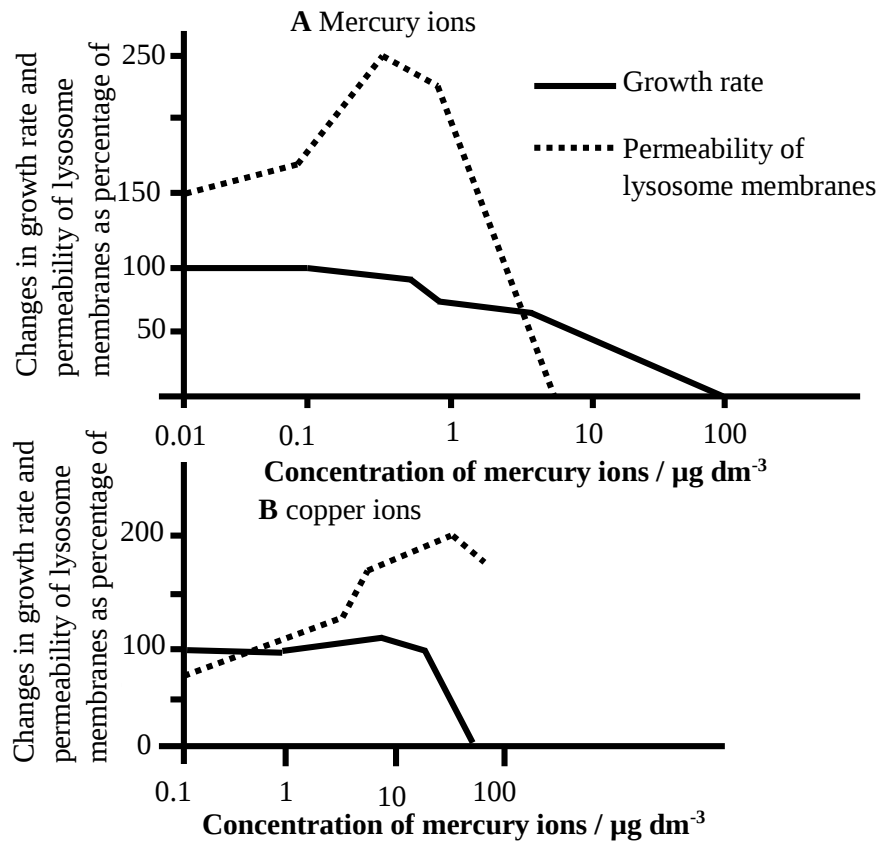
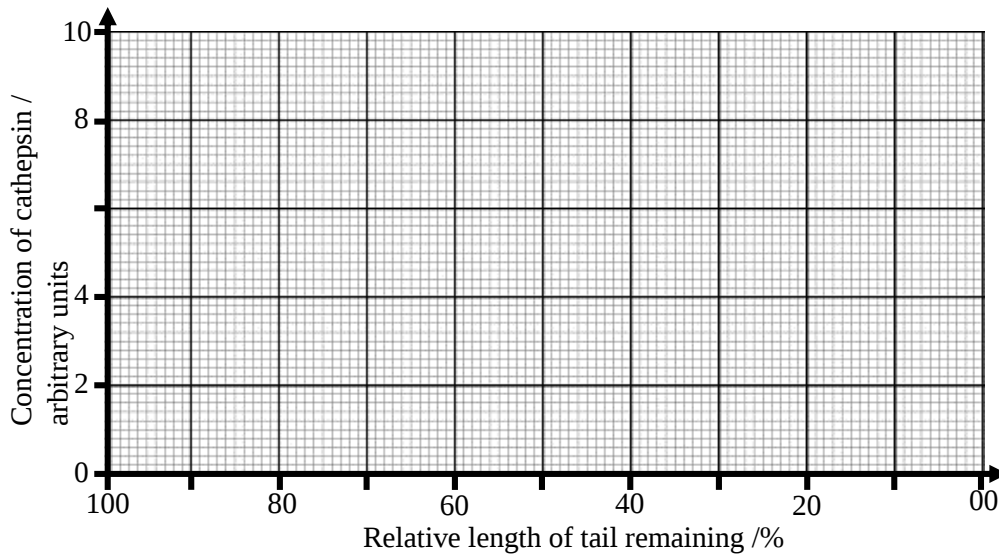


A LEVEL QUESTIONS

1. (a) Explain the effect of increasing temperature on the chemical compositions of the plasma membrane. (08 marks)
(b) (i) Explain the significance of Compartmentation in living cells. (12 marks)
(ii) Explain how evolution is seen at cellular level. (12 marks)
(c) (i) Explain how the differences in the percentage composition of the chemical components of the cell membrane relate to the function and location of the cells. (08 marks)
(ii) Describe how amphipathic lipids form Lipid bilayer and Micelle. (08 marks)
2. (a) Describe the changes to homologous pair of chromosomes during meiosis. (12 marks)
(b) Explain the role of the different components of chromosomes. (08 marks)
3. (a) Describe the structure of phospholipids and explain how it relates to its function. (08 marks)
(b) Describe how haemoglobin shows allostery. (08 marks)
(c) Explain the advantages of metabolic pathways in cells. (12 marks)
4. (a) Differentiate between the following
(i) Haemoglobin and collagen. (05 marks)
(ii) Alpha helical and beta pleated structure. (05 marks)
(iii) Allosteric and non-allosteric enzymes. (06 marks)
(iv) Lock and key hypothesis with induced fit. (06 marks)
5. (a) Describe how the structure of enzymes relates to its function. (08 marks)
(b) Illustrate the concept of allosteric modulation in enzyme activity. (06 marks)
6. (a). Describe features of carrier mediated transport across the plasma membrane. (08 marks)
(b) Describe the mechanism of phagocytosis in a neutrophil. (06 marks)
(c) Compare facilitated diffusion with active transport. (08 marks)
(d) Explain the sequence of events that occur when a plant cell is placed in
(i) Weak solution
(ii) Strong solution (10 marks)
(e) Describe the adaptations of the transport proteins that make up the cell membrane to their role. (08 marks)
7. The graph below shows changes in the growth rate of *C. Hexvosa* and in the permeability of its lysosomal membrane following an increase in concentration of copper and mercury ions. The figures are expressed as percentages of those in the controls.

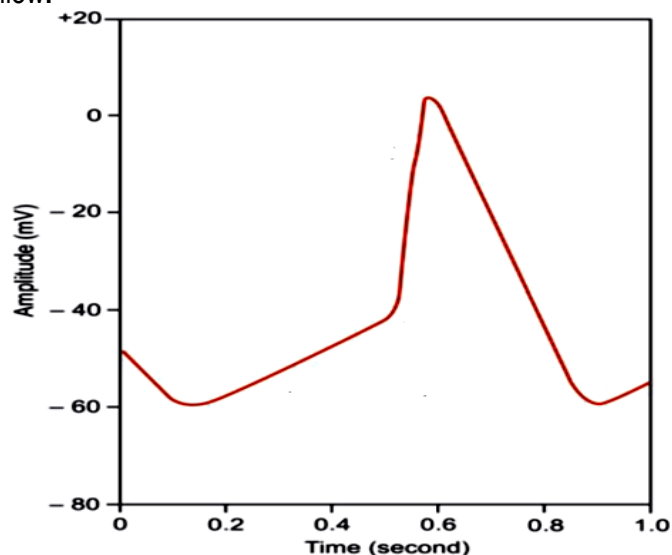


- Compare the effect of the concentration of copper ions and mercury ions on the rate
 - Growth rate
 - Permeability. (04 marks)
- Explain the relationship between the concentration of copper ions and the permeability of the lysosomal membrane. (03 marks)
- Suggest how the controls in the investigation should have been treated. (02marks)
- It has been suggested that the measuring of the permeability of lysosome membranes may be useful than measuring growth rate when monitoring copper pollution. describe the evidence from graph b which supports the suggestion. (03 marks)
- The graph below shows changes in concentration of Cathepsins with decreasing tail length in developing frogs.



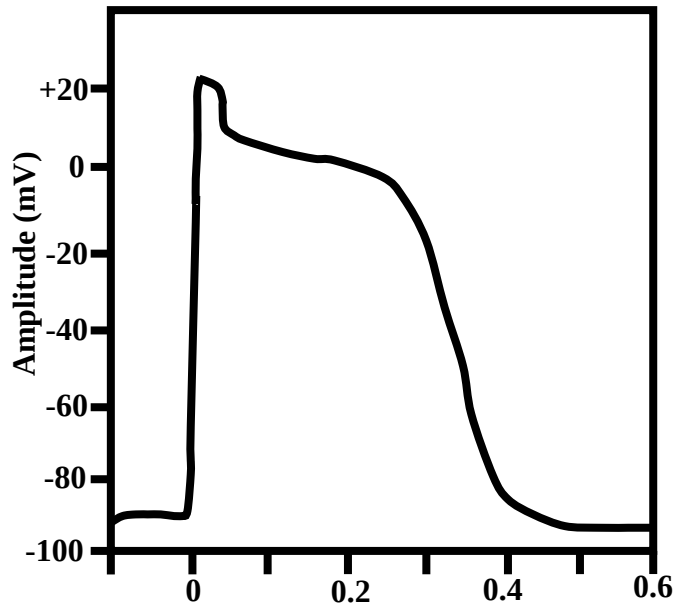
- (i) Describe the relationship between relative length of tail remaining with concentration of Cathepsins. (03 marks)
- (ii) Account for the above changes in the relative length of tail. (05 marks)
- (iii) Explain the advantages to the developing frog from the breakdown of the tail. (02 marks)
- (iv) Apart from protein digesting enzyme, suggest one other type of digestive enzyme that you would expect to show a similar change in concentration as the tadpoles' tail is shortened. Give reason for your answer. (02 marks)

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

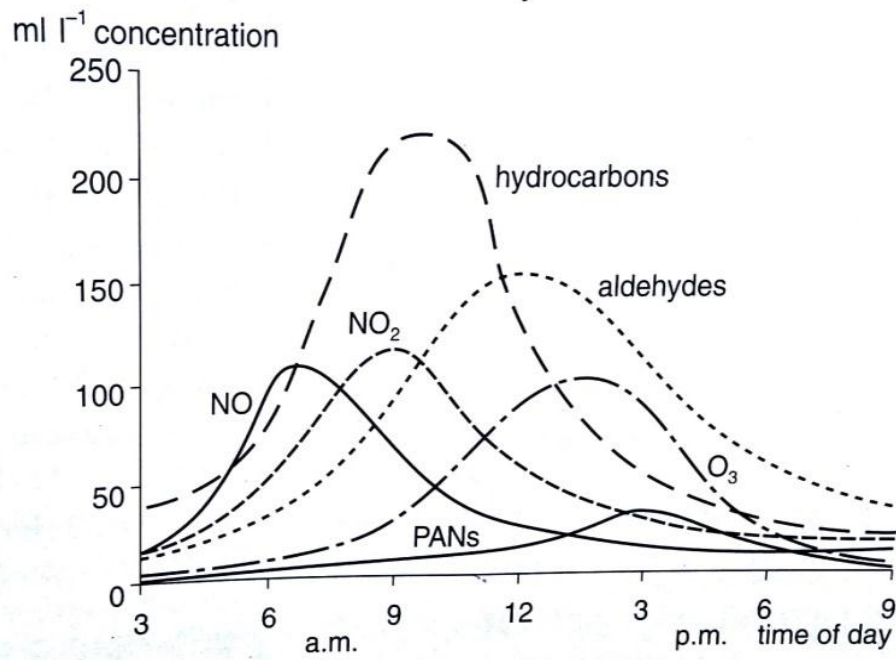


- (i) Describe the changes in the potential/amplitude of the SAN with time. (08 marks)
- (ii) Account for the above changes in the figure above. (12 mark)
- (i) Explain the effects of the different innervations to the SAN. (08 marks)
- (ii) Explain the functions of the conducting systems of the heart. (08 marks)

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

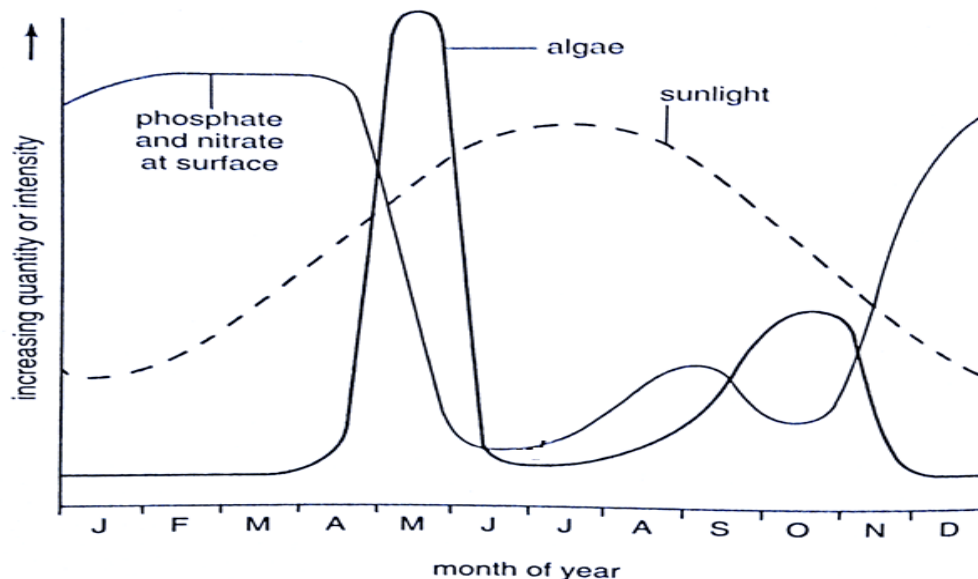


- (i) From the graph above describe changes in the ventricular action potential. (06 marks)
 - (ii) Explain the changes in the ventricular action potential. (06 marks)
 - (iii) Account for the significance of the changes represented above. (06 marks)
9. a) The graph below shows the composition of the photochemical smog on a sunny day in Kampala city. Study it carefully and answer questions that follow.



- (i) Explain why the concentrations of NO, NO₂ and Hydrocarbons increase in the morning. (06 marks)
- (ii) Suggest an explanation for the timing of the peak concentrations of NO and NO₂. (06 marks)
- (iii) Explain how hydro-carbons accelerate the formation of Ozone hole. (05 marks)
- (iv) Explain the increase in the concentration of PANs in the mid- morning. (06 marks)
- (v) Why might cyclists advised not to leave work early in order to avoid rush-hour traffic. (03 marks)
- (vi) Explain why the peak of the Hydrocarbons is higher than any other pollutant. (05 marks)

10. The graph shows the abundance of algae throughout one year in the surface waters of a lake. Changing amounts of light and phosphate and nitrate ions in the water are shown in the graph.



- (a) Comment on the relationship between increasing quantity of algae with
 - (i) Light intensity over the year. (05 marks)
 - (ii) Phosphate and nitrate ions concentration over the year. (06 marks)
- (b) Describe and suggest an explanation for the changes in the phytoplankton population during the months of May and September. (08 marks)
- (c) Describe the different biotic factors affect the distribution of organisms in the ecosystem. (10 marks)

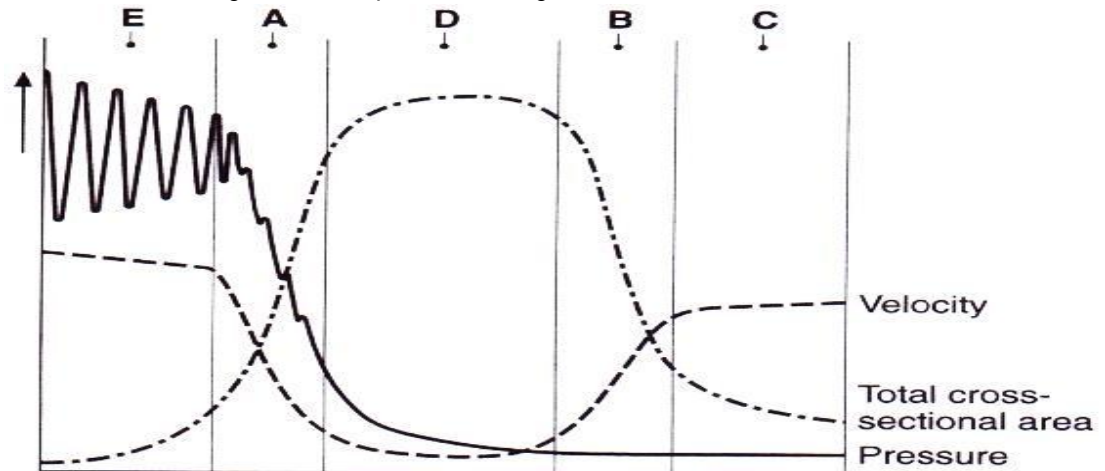
11. In the normal ECG. The paper on which the ECG was recorded was running at a speed of 25mm s⁻¹

- (a) Calculate the heart rate in beats per minute. (Consider 1 beat = 20mm on the grid)
- (b) An adult male recorded his ECG at different heart rates during an exercise. The contraction time and filling time were calculated from ECGs. The results are shown in the table below

Heart rate (beats per minute)	Contraction time (s)	Filling time (s)
39.5	0.37	1.14
48.4	0.39	0.82
56.6	0.39	0.66
58.0	0.38	0.60
60.0	0.38	0.57
63.8	0.40	0.54
68.2	0.42	0.45

69.8	0.38	0.46
73.2	0.38	0.44
75.0	0.38	0.39
78.9	0.38	0.36
81.1	0.39	0.33
85.7	0.37	.032
88.2	0.39	0.30

- (i) Present the above result on a suitable graph. (06 marks)
- (ii) Describe the relationship between the heart rate and the following
 ➤ Contraction time
 ➤ Filling time. (04 marks)
- (iii) Account for the relationships portrayed above. (08 marks)
- (iv) Suggest how a could have increased his heart rate for purposes of the experiment. (02 marks)
- (c) The graph below shows changes in blood pressure along the different blood vessels.



- (i) Identify blood vessels A, B, C, D and E. (04 marks)
- (ii) Describe the changes in blood pressure of each of the identified regions. (08 marks)
- (iii) Account for the changes in the blood pressure above. (08 marks)
- (iv) Explain the changes in blood velocity along the major blood vessels above. (12 marks)
- (v) Explain the significance of blood in capillaries having a very low pressure. (03 marks)
- (vi) Describe factors that ensure venous return. (12 marks)

12. a) The following table that shows the flow rate and concentration of certain substances taken at region A, B, C and D of the nephron in the human kidney.

Part of the nephron	Rate of flow Cm ³ /min	Solute concentration (g/cm ³)				
		Protein	glucose	Sodium ions	Ammonium ions	Urea
A	4	0	0	0.6	0.04	1.80
B	200	0	0.10	0.72	0	0.05
C	40	0	0	0.3	0	0.15

D	2000	7	0.10	0.72	0	0.05
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- Basing on your knowledge of kidney nephron, suggest with credible reasons which parts/regions are represented by A, B, C and D. (12 marks)
- Explain the difference between the rate of flow between B and D. (06 marks)
- Describe the mechanism of selective reabsorption of nutrients. (08 marks)
- Describe the role of phosphate-buffer system in maintenance body fluid P^H . (08 marks)

b) The following table shows the relative concentration of urine in different mammals relative to the concentration in man (the value for man is taken as an arbitrary unit of 1.00). The corresponding thickness of the medulla of the kidney is given for each mammal. The thickness is measured relative to the size of the remainder of the rest of the kidney

Mammal	Urine concentration (relative to man)	Thickness of medulla (relative to the remainder of the kidney)
Man	1.00	3.0
Otter	0.35	1.1
Sheep	0.70	2.2
Rat	1.92	5.4
Gerbil	4.15	9.1
Organism X	3.73	8.9

- Present these results as a suitable line graph. (04 marks)
- Describe the relationship between the relative medulla thickness and urine concentration. (04 marks)
- Explain the relationship above. (06 marks)
- Suggest with reasons the possible habitat of organism X. (04 marks)

13. (a) The seed capsules of shepherd's purse (capsella) occur in two different shapes. i.e. triangular and top shaped. Two independently segregating dominant genes (**A** and **B**) influence the capsule, individuals carrying allele **A** will have triangular shape even though in presence of **B**. All genotypes with dominant alleles of both of these genes **A** and **B** would produce plants with triangular shaped capsule. Only those with double recessive of **a** or **b** would produce with top shaped capsule.

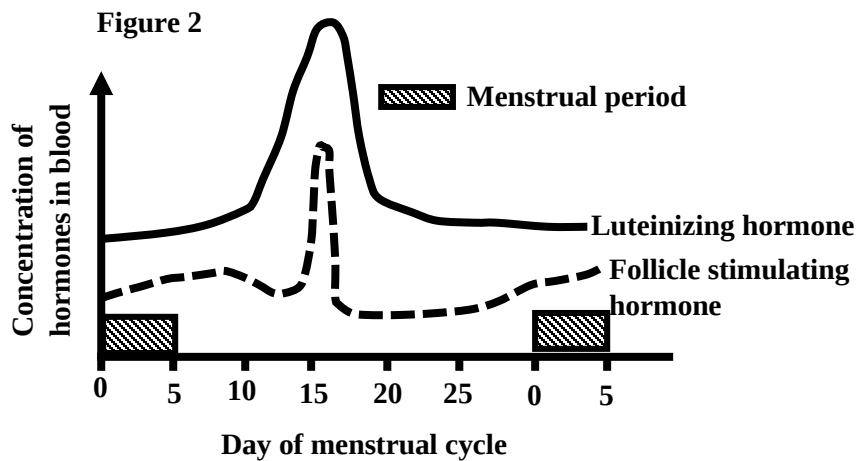
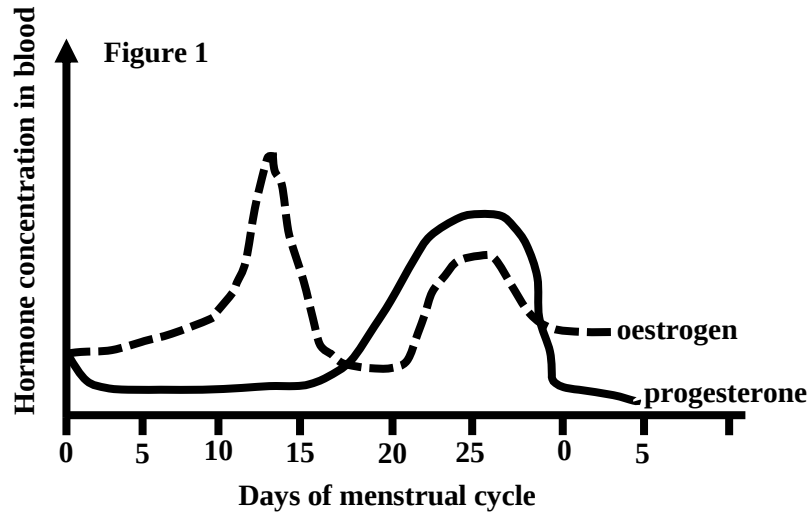
- List the genotypes that will result in top shaped and triangular shaped seed capsules. (04 marks)
- Genotype **AABB** results into triangular shape seed capsule and genotype **aabb** results into top shaped seed capsule. Plant with top shaped seed capsule is crossed with triangular seed capsule. Work out the expected genotypes and phenotypes and their ratios in the F₁ and F₂ generations. (10 marks)
- With reasons name the type of interaction. (06 marks)

- Explain why ATP is a more efficient source of energy than glucose. (06 marks)
 - Compare photophosphorylation and oxidative phosphorylation. (08 marks)

(c) Explain the different changes that occur during respiration.

(10 marks)

15. Figure 1 and 2 below show the changes in the concentrations in the blood of four hormones associated with a menstrual cycle.



(a) From figure 1;

(i) Compare the concentration of hormones in blood.

(08 marks)

(ii) Explain the variations of the progesterone during the menstrual cycle.

(06 marks)

(b) From figure 2, explain the changes in the concentration of luteinizing hormone.

(06 marks)

(c) Using the information obtained from figure 1 and 2, explain how negative feedback operates in the control of the hormones of the menstrual cycle.

(08 marks)

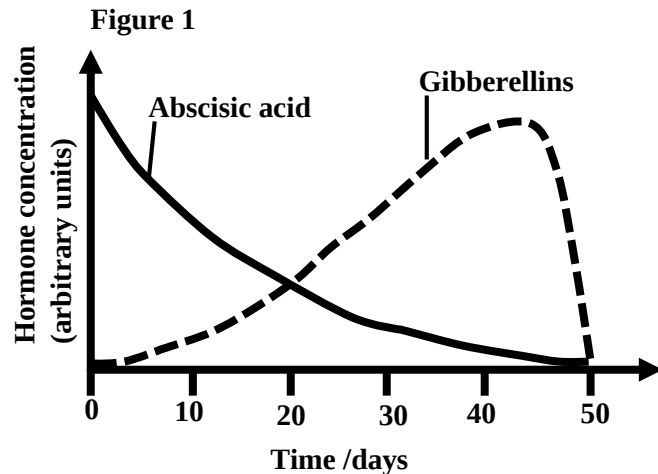
(d) Explain the effect of the following on menstrual cycle.

(i) Oestrogen pills

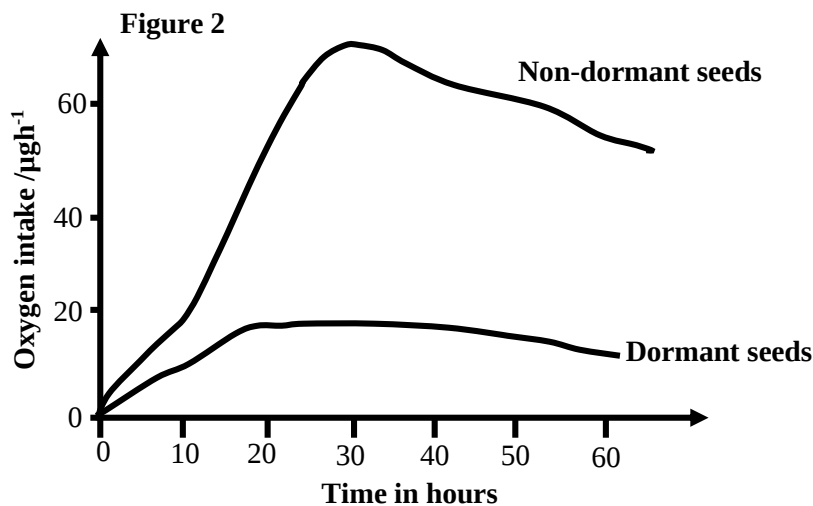
(ii) Progesterone pill.

(10 marks)

16. Figure 1 shows the effect of chilling on hormone concentrations in the seed of sugar maple. Figure 2 shows the rate of oxygen intake in dormant and non-dormant seeds during an experiment on germination. Both sets of seeds were first soaked in water and the rate of oxygen uptake was measured for every 10 minutes during the experiment.



- (a) (i) Compare the concentrations of the two hormones in the seeds of sugar maple. (06 marks)
 (ii) Explain the relationship between time of chilling and abscissic acid during the experiment. (08 marks)



- (b) Explain the pattern of oxygen intake for non-dormant set of seeds. (08 marks)
 (c) Explain the differences in the intake of oxygen between the non-dormant set of seeds and the dormant set of seeds. (04 marks)
 (d) Explain the expected causes of seed dormancy in figure 1. (08marks)
 (e) State the commercial uses of abscissic acid and gibberellins. (06 marks)

17. Figure 1 and figure 2 below show the effect of **acetylcholine** on the stimulation of skeletal and heart muscle.

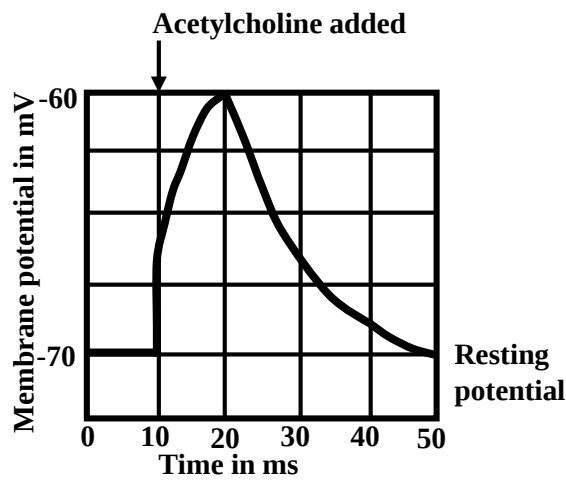


Figure 1. Skeletal muscle

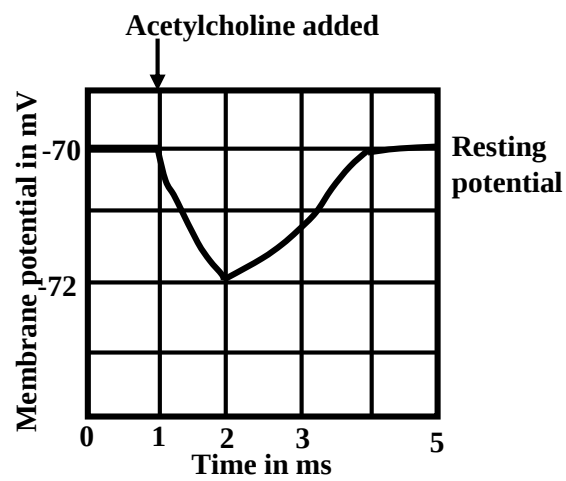
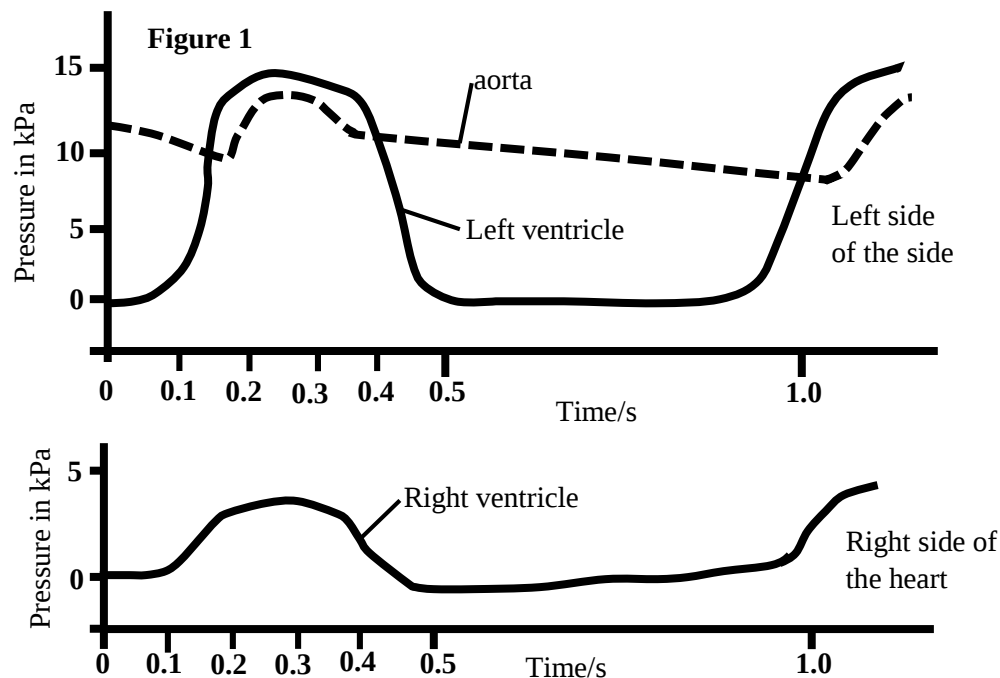


Figure 2. Heart muscle

- (a) (i) Describe the effect of **acetylcholine** on skeletal muscle. (04 marks)
(ii) Compare membrane potential in the skeletal and heart muscle on application of acetylcholine. (04 marks)
(iii) Explain how the effects of **acetylcholine** on heart muscle differ from its effects on skeletal muscle. (12 marks)
- (b) (i) Suggest why, during a period of intense nervous activity, the metabolic rate of a nerve cell increases. (04 marks)
(iii) Predict and explain, the effect on an action potential of lowering the external concentration of sodium ions. Explain your answer. (10 marks)
(iii) State any two importance of synapse in the body. (02 marks)

18. The graphs in figure 1 below show the changes in pressure in the aorta and in the left and right ventricles of the heart, during the cardiac cycle. Time 0 indicates the start of atrial contraction.

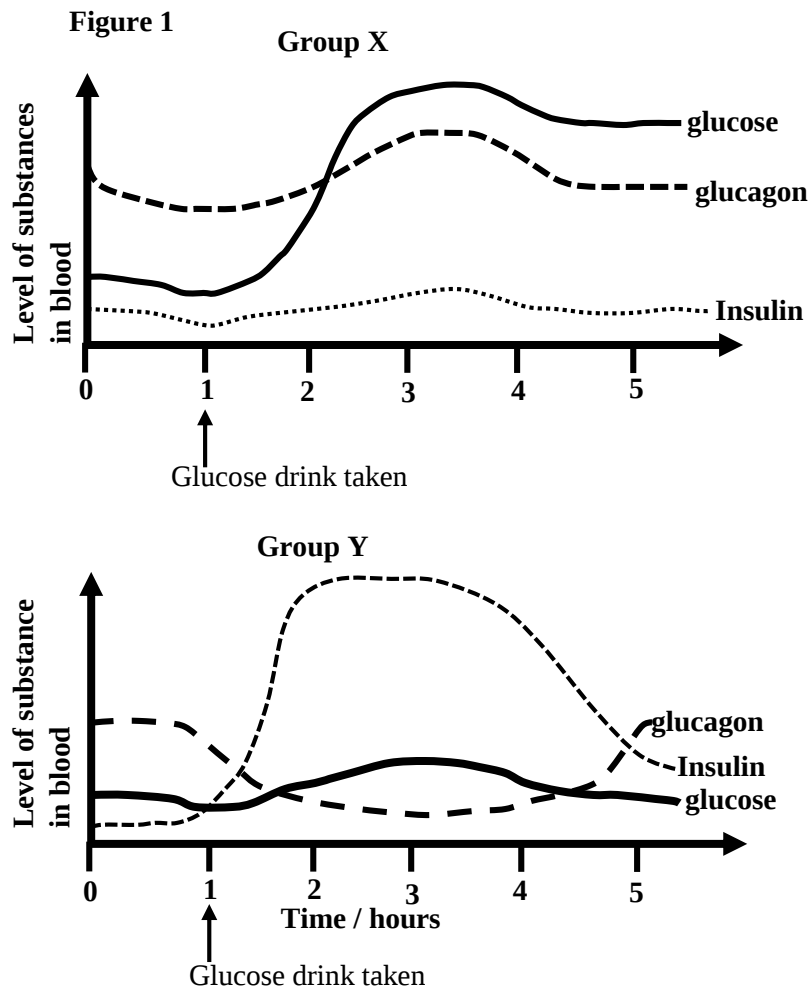


The table 1 below gives the rate of blood flow to different parts of the body at rest and during strenuous exercise.

Part of the body	Rate of blood flow/ $\text{cm}^3\text{min}^{-1}$	
	At rest	During exercise
Liver and intestines	2500	90
Body muscle	1000	16000
Kidneys	1000	300
Brain	750	750
Skin	500	1000
Heart muscle	250	1200

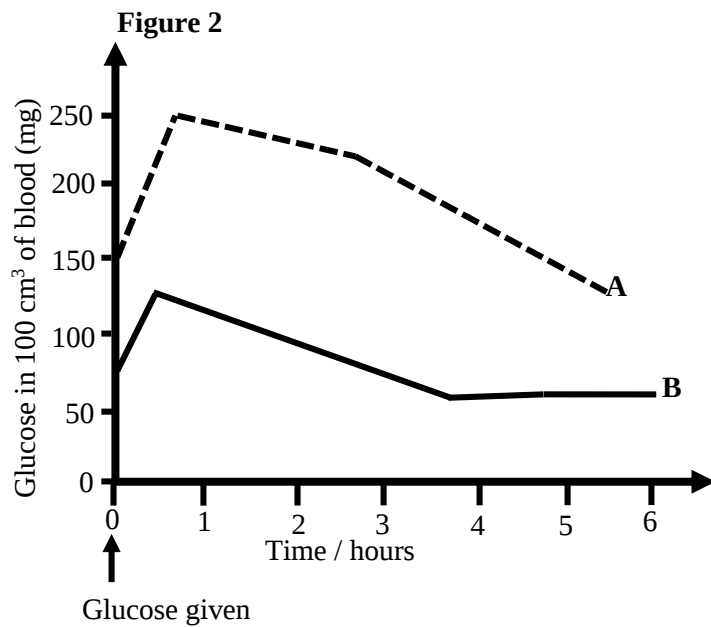
- (a) (i) Compare the changes in pressure in the left ventricle with those in the right ventricle. (04 marks)
(ii) Explain the difference in the pressure in the left ventricle with those in the right ventricle. (06 marks)
- (b) Explain the differences in changes in the pressure in the aorta and left ventricle. (06 marks)
- (c) Cardiac muscle is described as myogenic. Explain how the cardiac cycle is coordinated within the heart. (08 marks)
- (d) Explain the changes in the rate of blood flow at rest and during exercise in the following
- Liver and intestines
 - Skin
 - Heart
- (e) (i) Why does the rate of blood flow to the brain remain the same. (02 marks)
(ii) State any four long term effects of exercise to the body. (04 marks)

19. An experiment was carried out with two groups of people, group X and group Y. Every 15 minutes blood samples were taken from all members of both groups and the mean levels of insulin, glucagon and glucose were calculated. After an hour, every person was given a glucose drink. The results are shown in the figure below.



- (a) With reference from graphs in figure 1.
- Compare the changes in the insulin levels between the two groups from the point when glucose is taken. (06 marks)
 - Explain why the glucose levels falls in both groups during the first hour. (02 marks)
 - Using information from the graphs, explain the changes in the blood glucose level in group Y after the glucose is drunk. (08 marks)
 - Explain the difference in blood glucose level in group X compared to group Y. (04 marks)
 - Suggest what might happen to the blood glucose level of group X if they had no food intake over the next 24 hours. (02 marks)

- (b) Two human subjects of similar build, A and B, were each given 60g of glucose by mouth after 8-hour overnight fast. Their blood glucose was then monitored at intervals and the results are shown in the graphs.



- (i) Compare the levels of glucose in blood of the two individuals **A** and **B**. (06 marks)
 - (ii) Explain the differences in the levels of blood in individuals **A** and **B**. (06 marks)
 - (iii) State significance of maintaining constant glucose levels. (04 marks)
20. Figure 1 below shows the variation in the rate of transpiration for two different plant species, Species A living in a relatively wet environment and species B living in a dry environment.

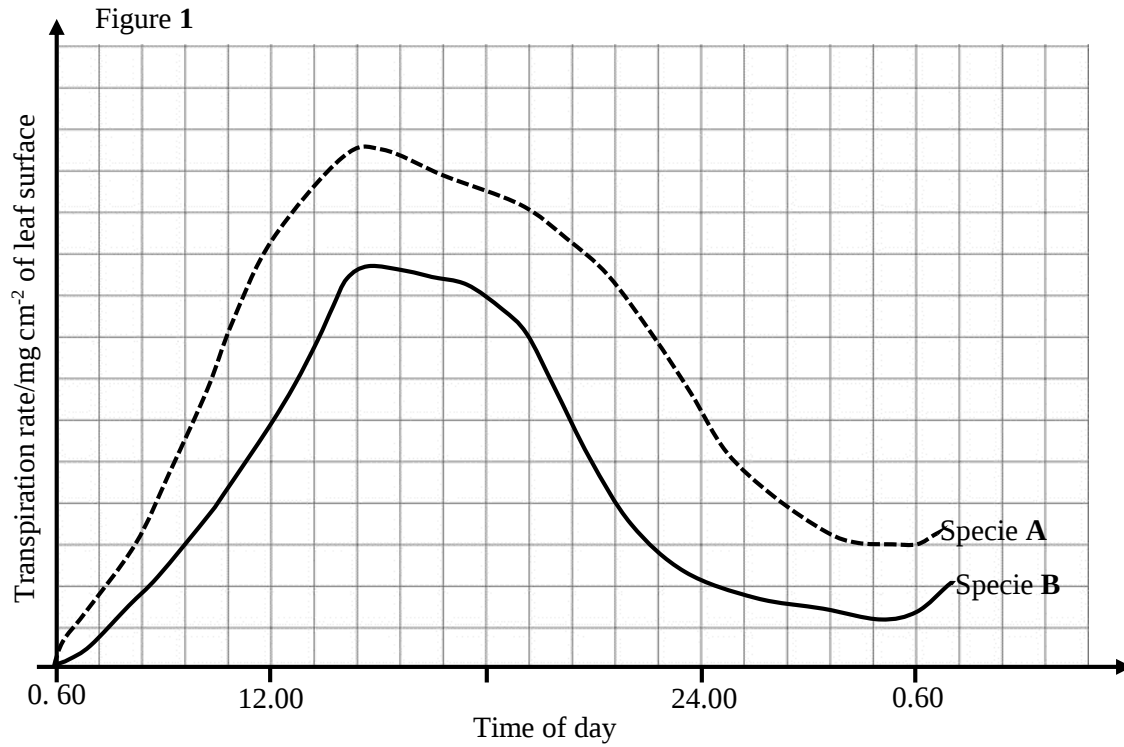
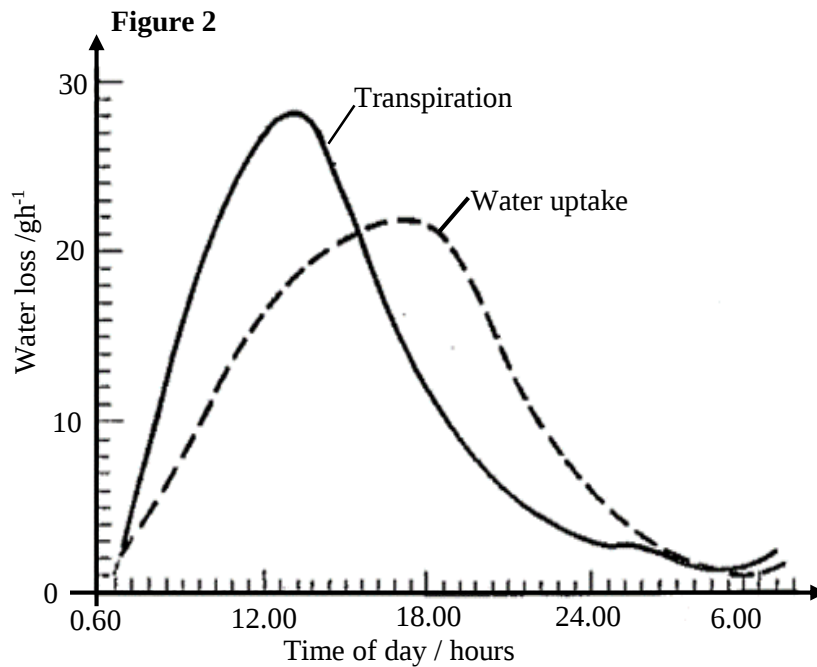


Figure 2 shows the rate of transpiration and rate of water uptake of a sunflower plant at different times of the day.



(a) With reference to graph 1

(i) Describe the effect of increase in the time of day on the rate of water absorption.

(04 marks)

(ii) Compare the rate of transpiration in both species of plants.

(02 marks)

(iii) Suggest the structural features of the two plants responsible for the differences in the rate of transpiration. (06 marks)

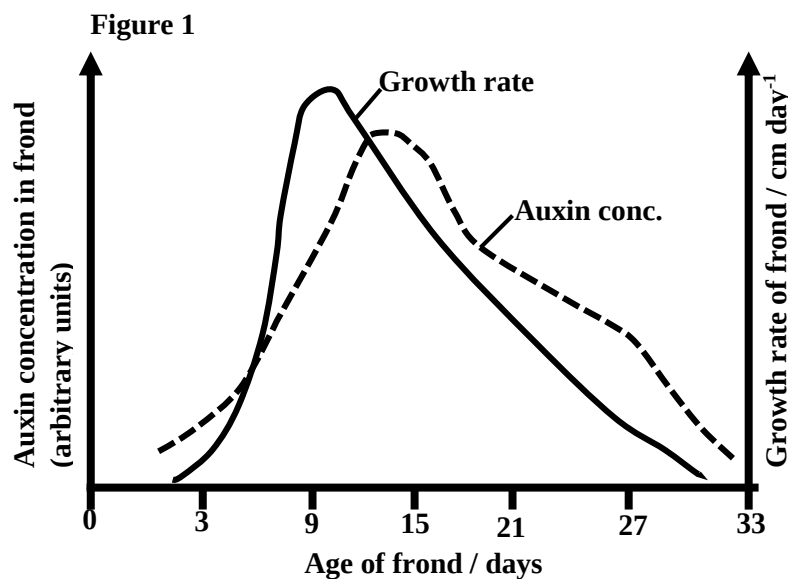
(b) With reference to figure 2:

(i) Compare the rate of water uptake and transpiration. (06 marks)

(ii) Explain the relationship between the water uptake and transpiration. (06 marks)

(iii) State and explain any other two environment factors that may cause changes in the rate of transpiration. (04 marks)

21. Growth rate of ferns was measured using the leaves, the concentration of auxins was also monitored for a period of 33 days. The 20 fronds were measured for every 3 days and the average increase in size was recorded. The results are represented in Figure 1 below.



(a) (i) Explain the relationship between auxin concentration and growth rate of fronds. (08 marks)

(i) Explain why average of 20 fronds was taken during the investigation of growth rate. (04 marks)

(b) The table below shows the effect of keeping 10mm long segments of oat radicles and coleoptile in a culture solution containing IAA (an auxin) in the dark for 24 hours.

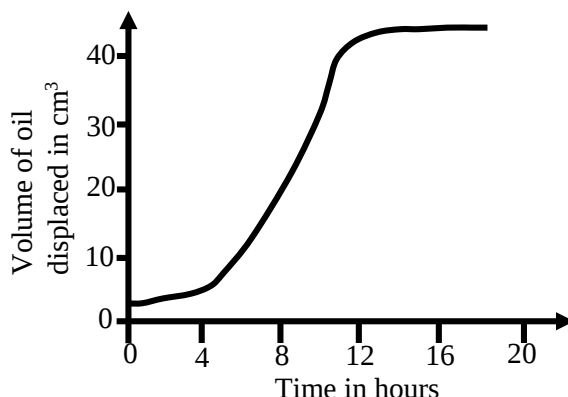
Culture solution (IAA in parts per million)	Mean segment length after 24 hours (mm)	
	Radicle	coleoptile
2% sucrose only	11.5	12.0
2% sucrose + 0.0001 ppm IAA	14.3	12.5
2% sucrose + 0.01 ppm IAA	12.2	15.8
2% sucrose + 1.0 ppm IAA	11.0	16.7
2% sucrose + 100.0 ppm IAA	11.0	16.8

(i) Why were the radicle and coleoptile segments kept in the dark throughout the experiment? (02 marks)

(ii) Compare the effect of IAA concentration on the mean length of radicle and coleoptile. (08 marks)

(iii) State any three differences between plant growth regulators and animal hormones. (05 marks)

22. In an experiment, the respiratory metabolism of yeast was investigated by measuring the volume of oil displaced by the carbon dioxide produced from the breakdown of glucose as a substrate as shown below.



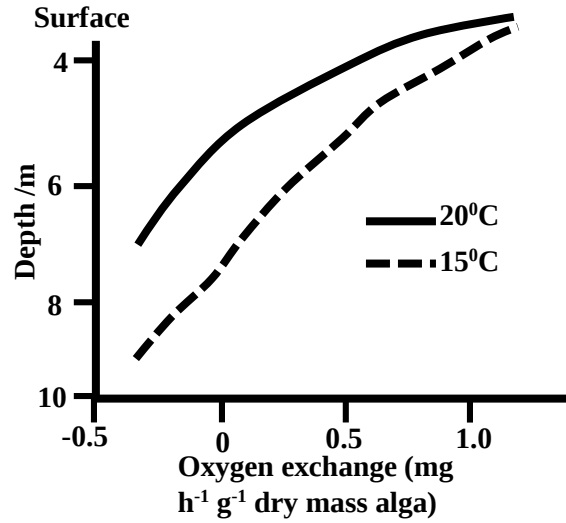
In another but related experiment, the ability of the yeast to metabolise a range of different carbohydrates was investigated. The volume of oil displaced in 20 minutes was noted for each type of substrate. The conditions were kept the same throughout. The results are shown below.

Carbohydrate	Volume of oil displaced / cm ³
glucose	8.7
Sucrose	5.9
Lactose	0.9
maltose	6.1
Starch	0.8
Fructose	8.9
none	0.9

- (a) From the graph account for the relationship between the volume of oil displaced and time in the course of the experiment. (12 marks)
- (b) Represent the results in table above on a graph. (08 marks)
- (c) (i) What is the purpose of the experiment without the carbohydrate. (01 mark)
- (ii) suggest the factors that were kept constant during the investigation. (03 marks)
- (d) State and explain the observe volume of oil displaced by the following carbohydrates
- (i) Glucose and fructose. (04 marks)
- (ii) Sucrose and maltose (04 marks)
- (iii) Starch and lactose (04 marks)

23. The graph below shiws how net primary productivity of the marine alga *Hormosira banksii* varies with depth and sea temperature.

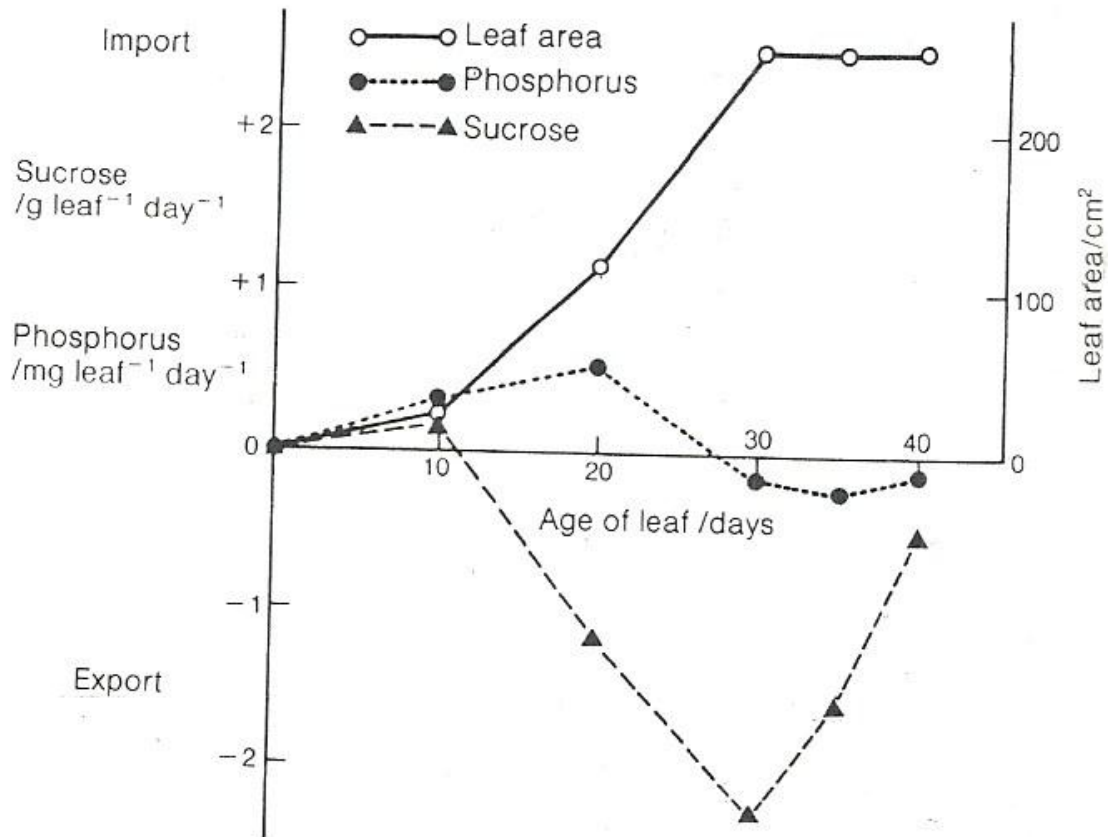
- (a) What is meant by the term net primary productivity? (03 marks)
- (b) Explain why oxygen exchange can be taken as an indicator of net primary productivity. (02 marks)



- (c) (i) using the graph, state and explain the relationship between net primary productivity and depth. (04 marks)
- (ii) Explain the effect of temperature on the productive as shown in the graph. (04 marks)

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

Fig. 1



- a) From figure 1 above, explain the relationship between:
- i) Leaf area and movement of sucrose. (09 marks)
 - ii) Age of leaf and movement of phosphorus. (08 marks)
- b) Describe how the following are imported and exported through the leaf:
- i) Sucrose. (03 marks)
 - ii) Phosphorus. (02 marks)

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

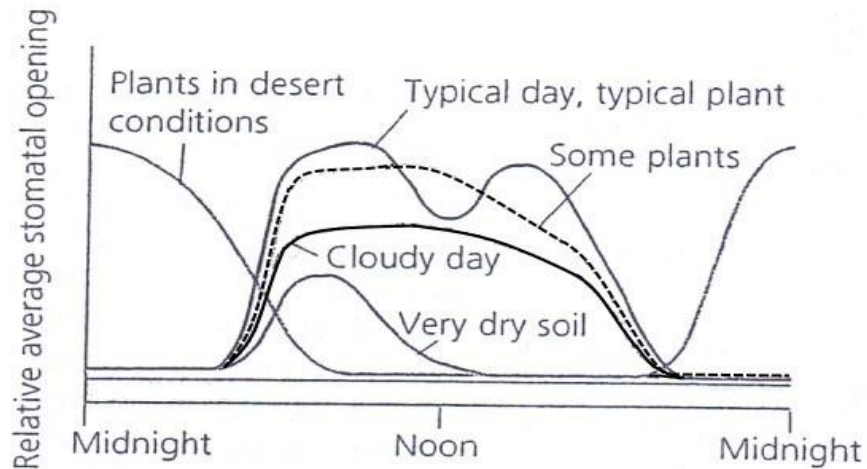


Fig. 2

- c) Compared with a typical plant on a typical day, describe the effect of the following conditions on stomatal movement:
- (i) Very dry soil. (05 marks)
 - (ii) Cloudy day. (05 marks)
- d) Considering the plants in desert conditions:
- (i) What are the **advantages** and **disadvantages** of the observed stomatal movement? (05 marks)
 - (ii) Explain how structural features are indicative of their habitat. (03 marks)

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

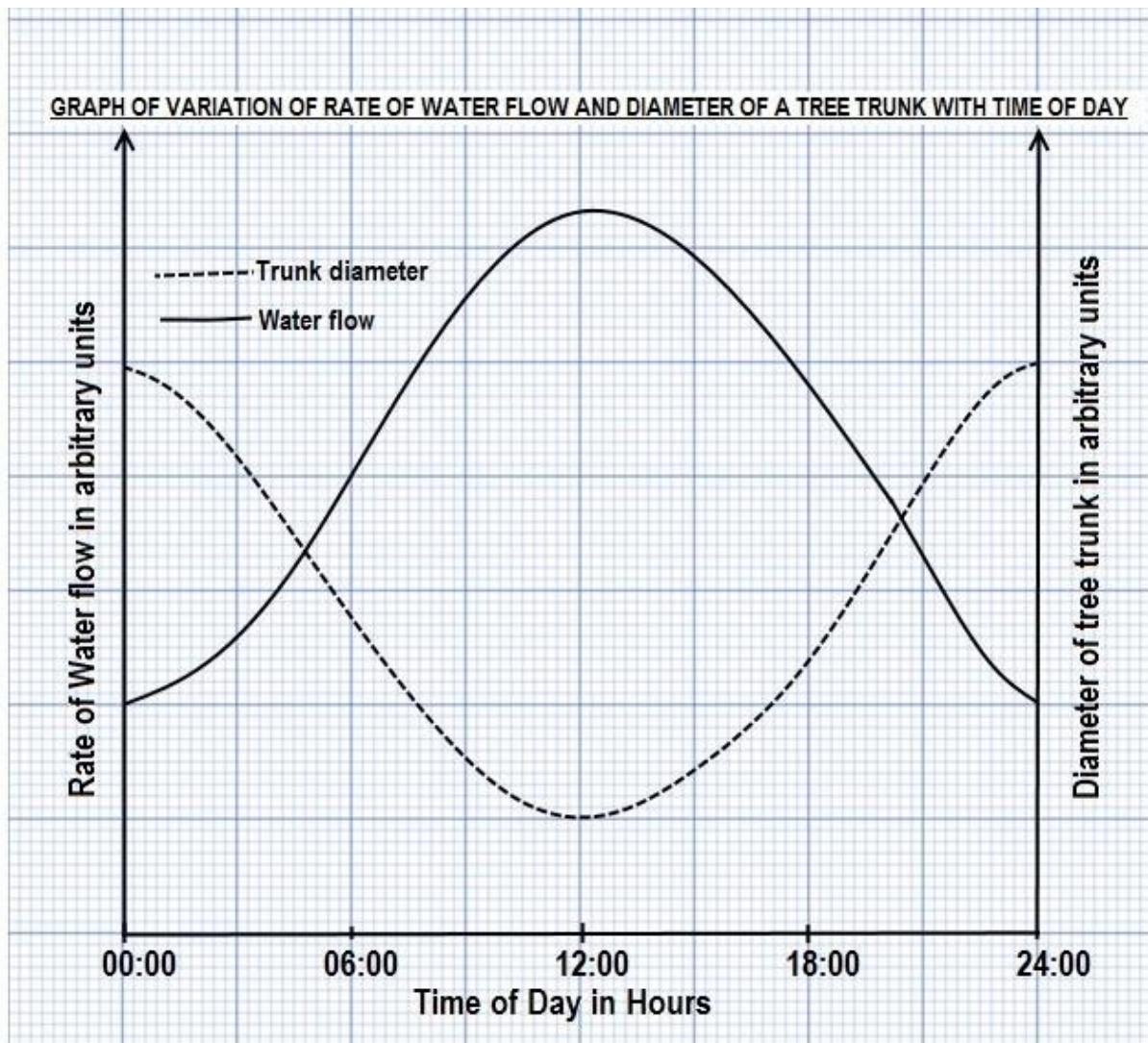


Fig. 1

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

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

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

that follow.

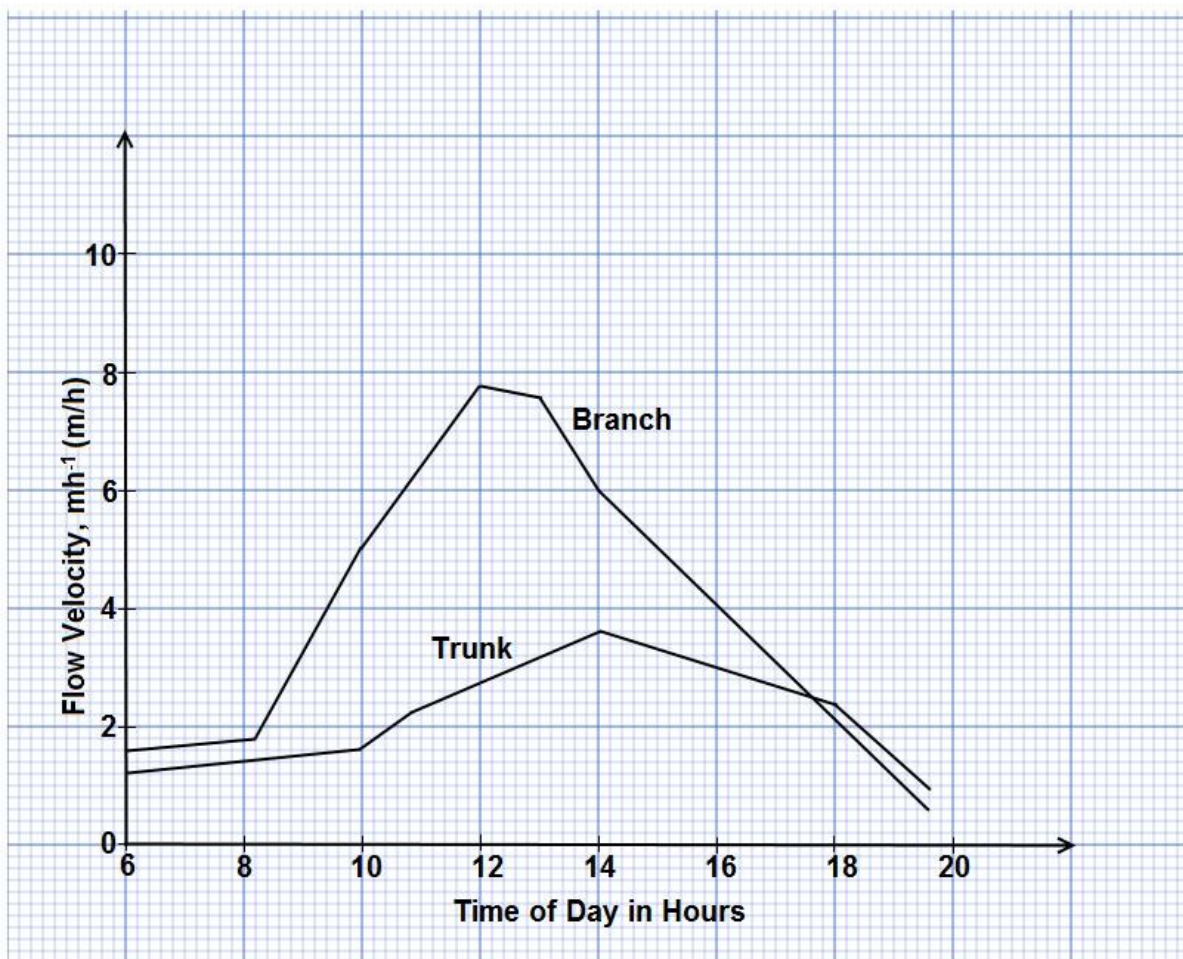


Fig. 2

- (d) From **figure 2**, explain the relationship between the size of plant parts and linear flow velocity of sap through the xylem during daylight hours. (08 marks)

26. Fig. 1 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).

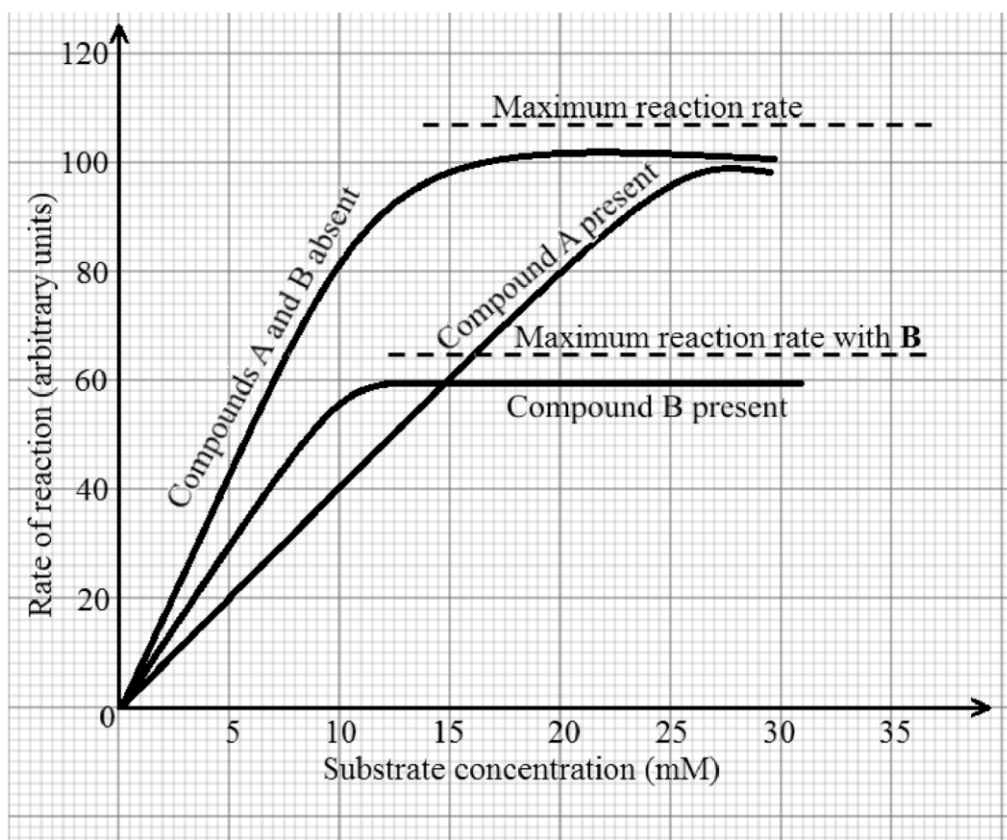


Fig. 1

- 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)