ATOM SCIENCE CENTRE

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

VENUE: Makerere University, CoCIS

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

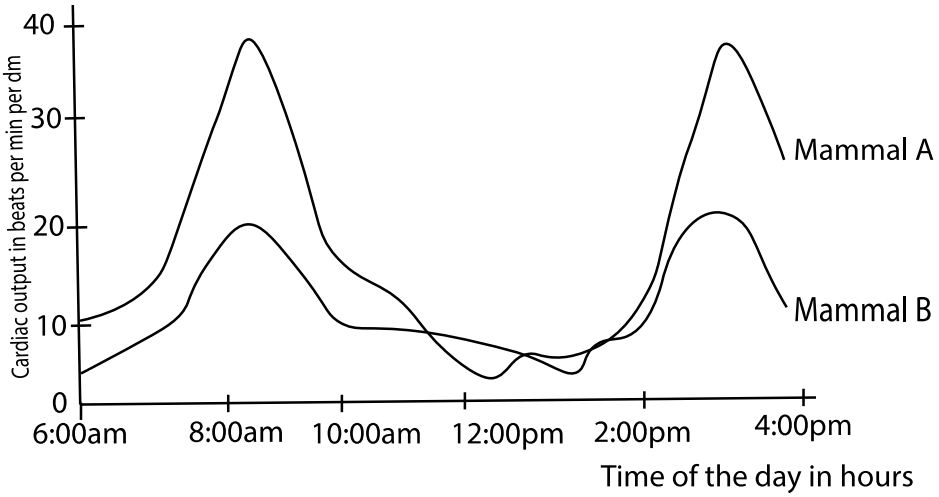

Figure 1 Changes in cardiac output of two mammals with time

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

RHINES SS NAMUSERA

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

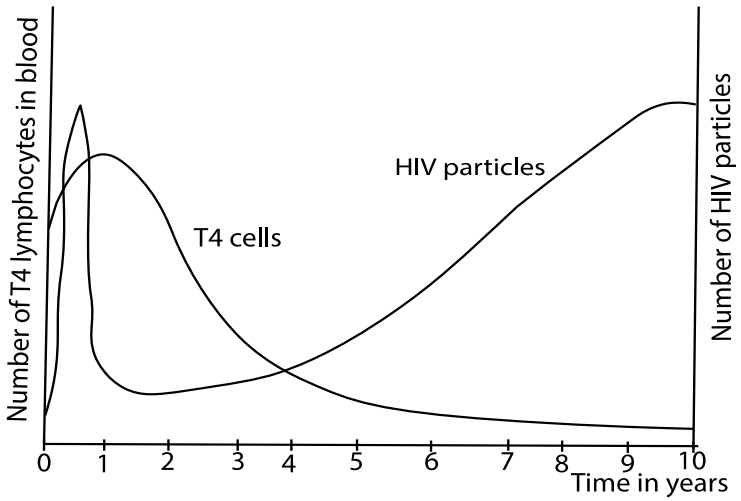

Figure 2 Variation of number of lymphocytes and HIV particles in blood

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

MAKERERE COLLEGE SCHOOL

3.

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

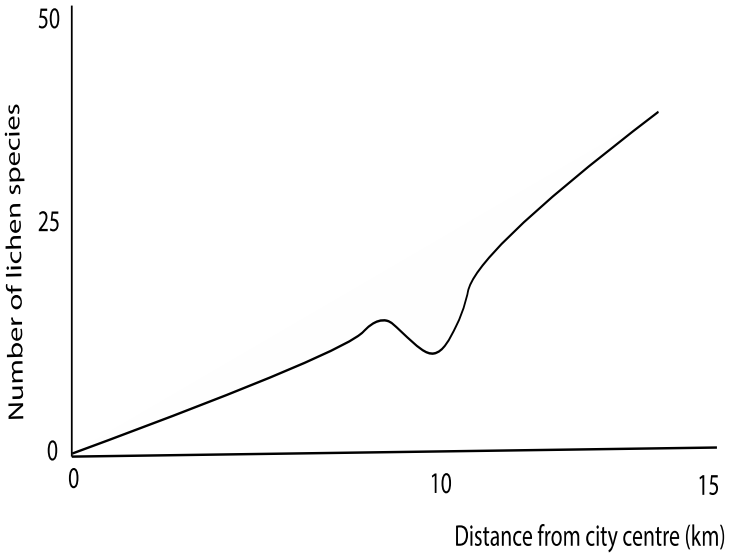

Figure 3 Variation of number of lichen species with distance from city center

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

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

KYADDONDO SS

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

Urine was collected from each man every hour.

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

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

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

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

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

KAWEMPE MUSLIM SS

5.

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

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

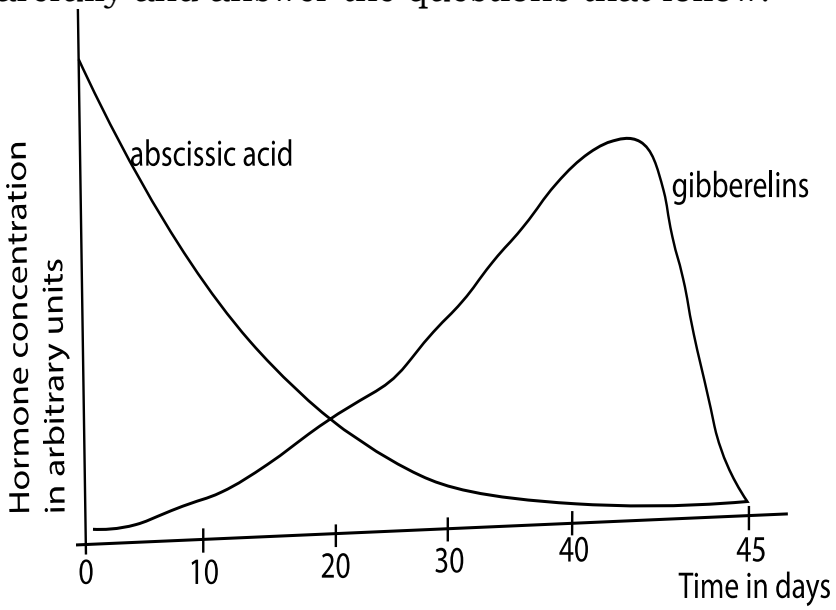

Figure 4: Hormone concentration varying with time

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

JINJA COLLEGE

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

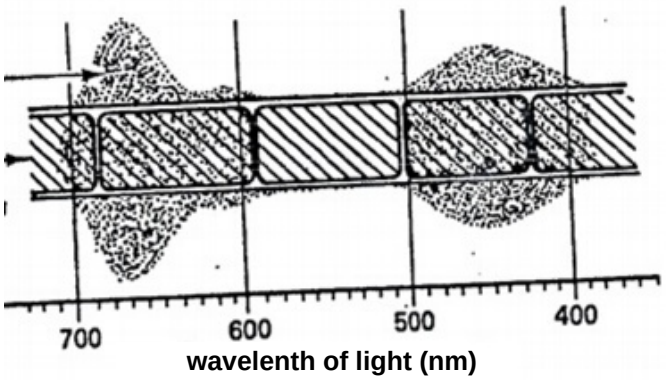

Figure 5 Distribution of bacteria on a filament of Cladophora

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

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

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

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

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

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

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

iii) Explain the purpose of adding methylene blue.

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

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

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

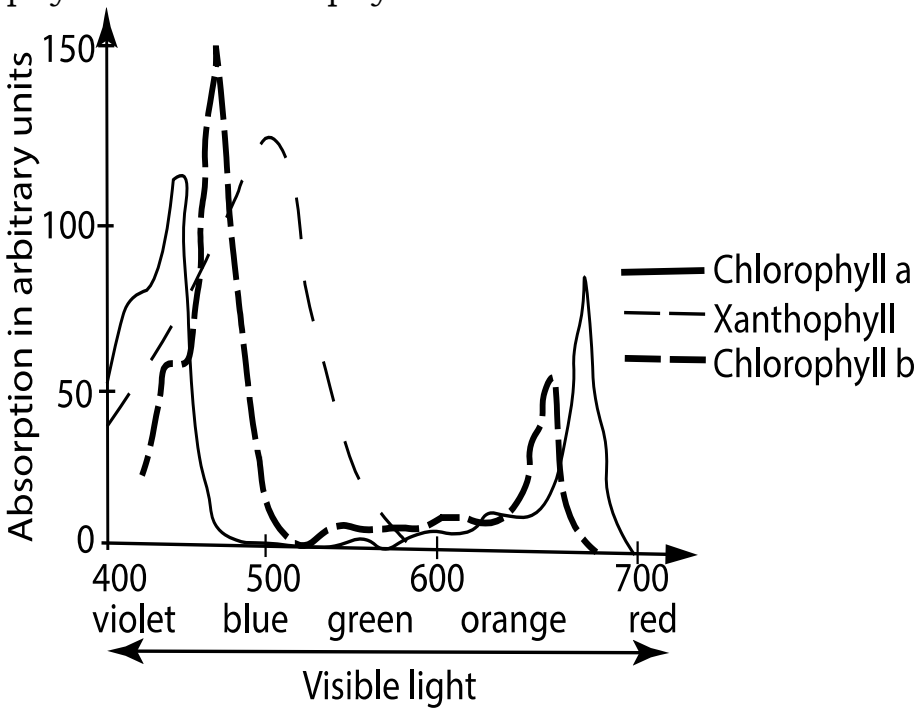

Figure 6 Absorption spectra of leaf chlorophyll pigments

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

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

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

SSAKU SS

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

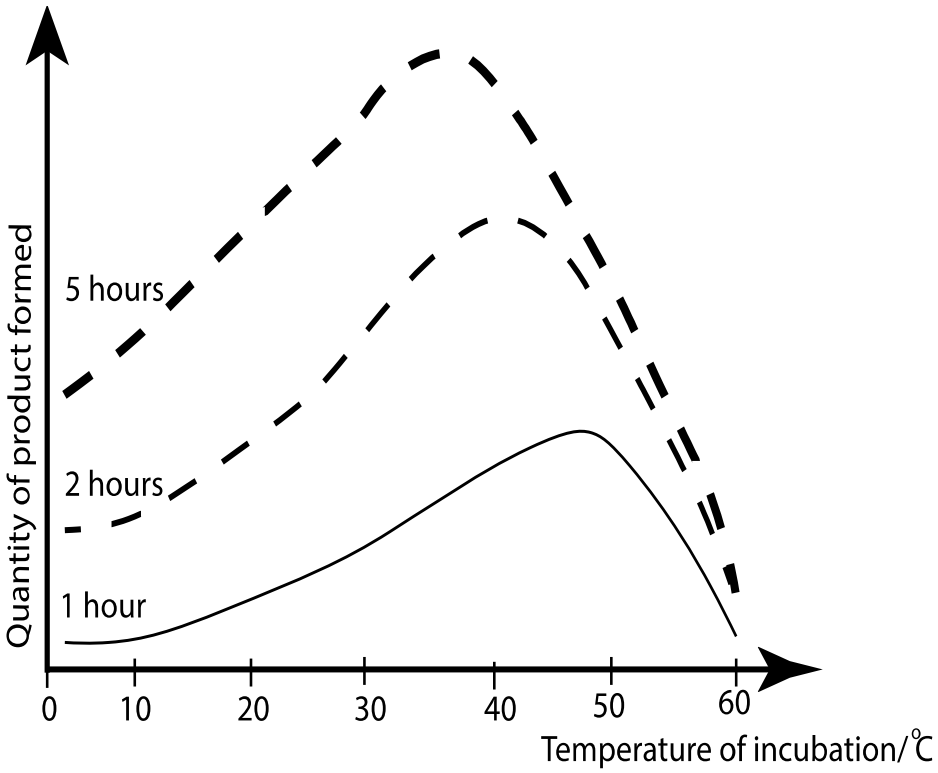

Figure 7: *Variation of quantity of product formed with temperature*

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

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

ZION SS

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

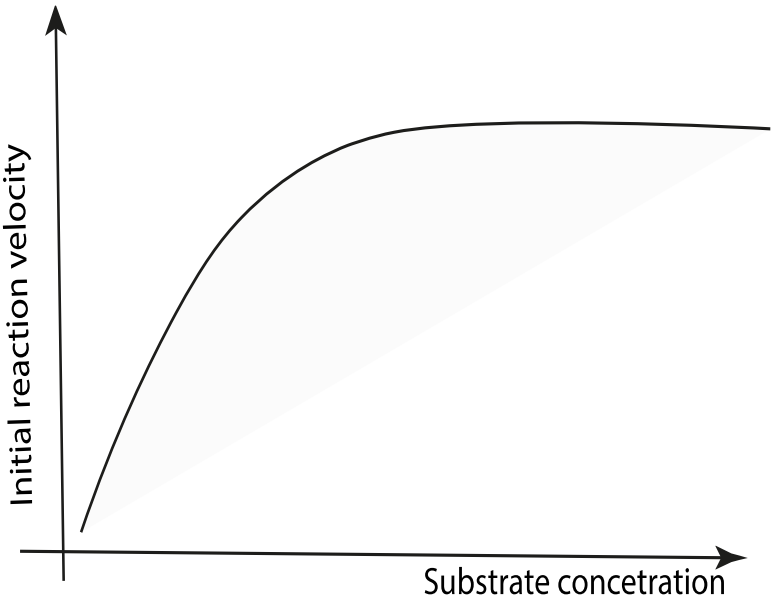

Figure 8

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

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

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

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

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

BOMBO SS

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

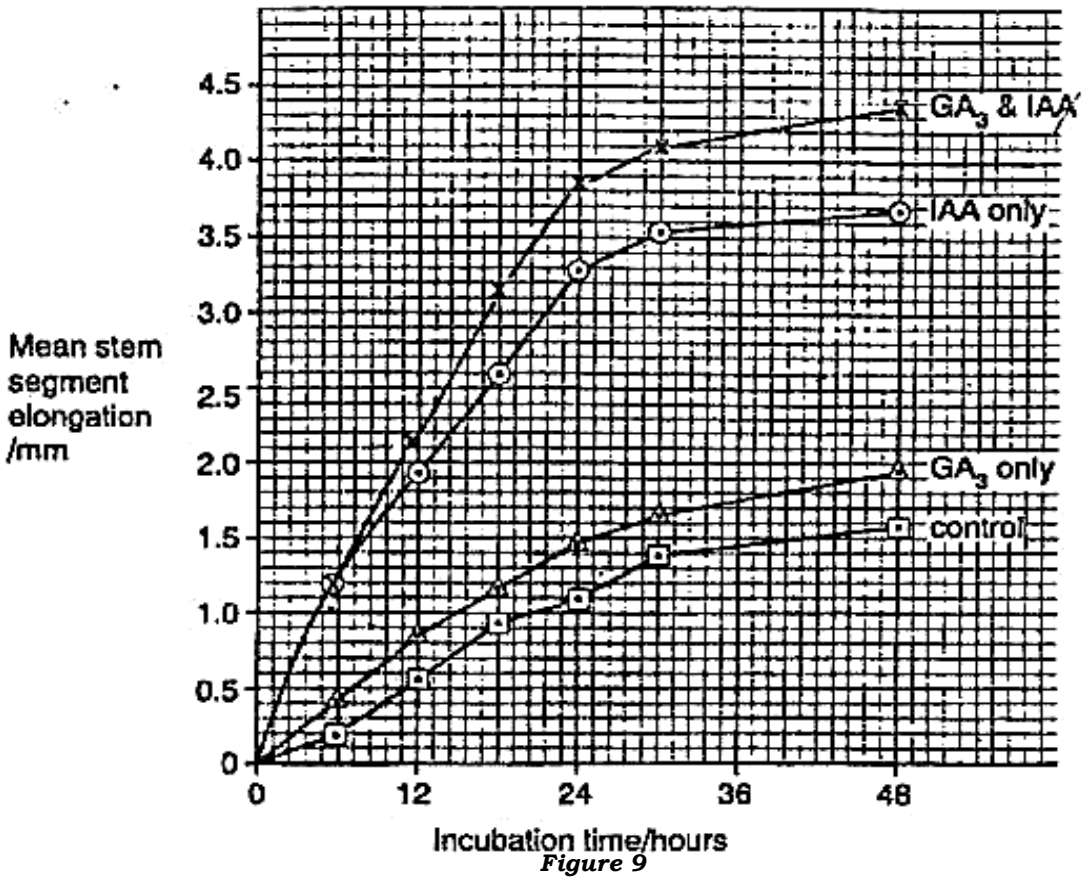

Figure 9

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

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

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

c. Explain how IAA causes stem elongation.

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

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

MIDLAND SS

10.

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

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

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

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

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

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

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

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

KASAWO ISLAMIC SCHOOL

11.

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

i. Outline the properties of hormones.

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

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

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

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

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

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

BOMBO ARMY SS

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

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

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

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

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

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

KASENGE GREENHILL SS

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

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

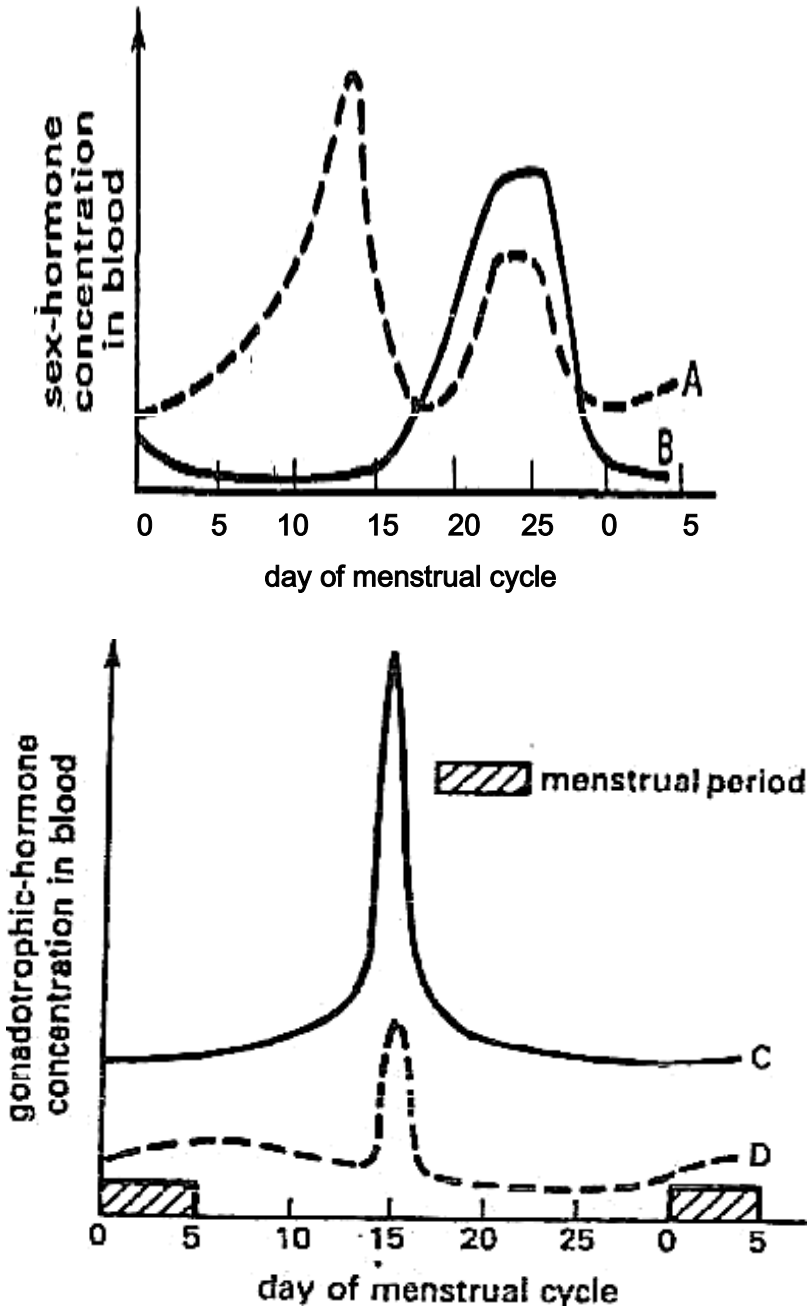

Figure: 10

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

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

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

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

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

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

ATLAS HIGH SCHOOL

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

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

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

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

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

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

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

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

MAKINDYE SS

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

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

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

(b) (i) Explain the term compensation point

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

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

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

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

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

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

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

NAMILYANGO SS

16. Write account of the following:

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

KAWEMPE ROYAL COLLEGE

17.

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

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

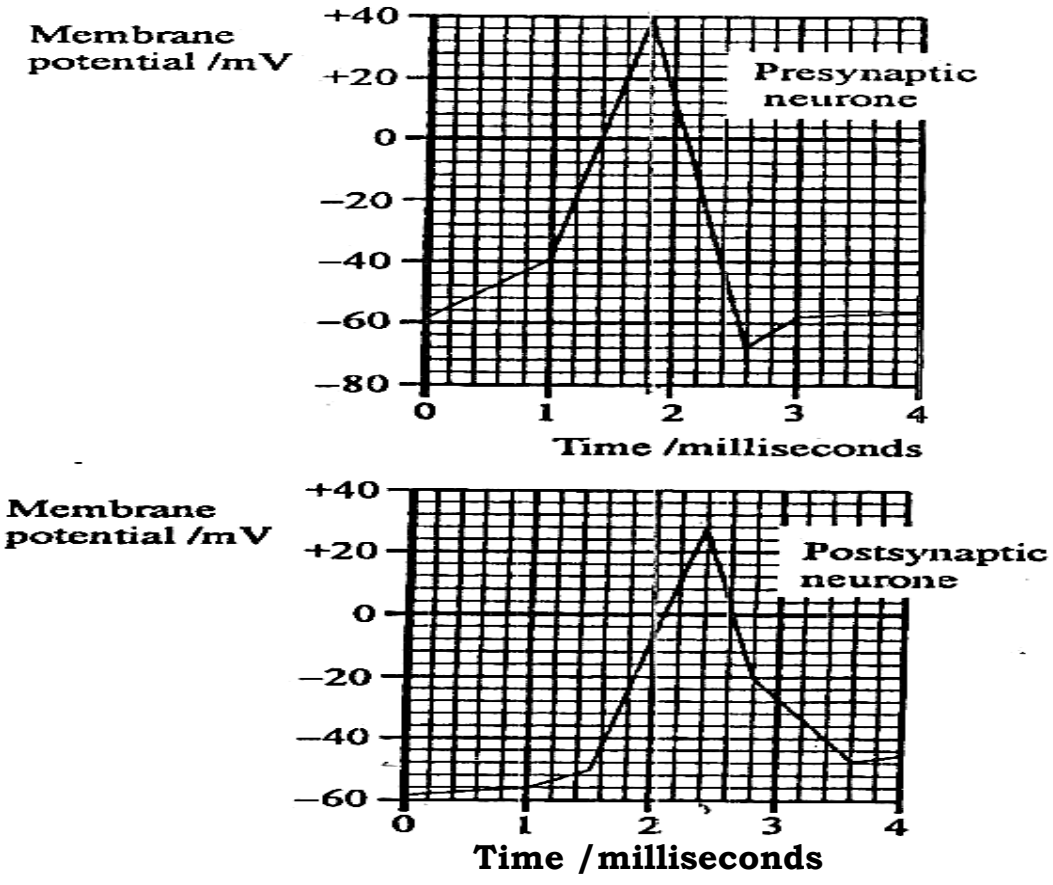

Figure: 11

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

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

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

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

KAWANDA SS

18.

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

CORNERSTONE ACADEMY

19.

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

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

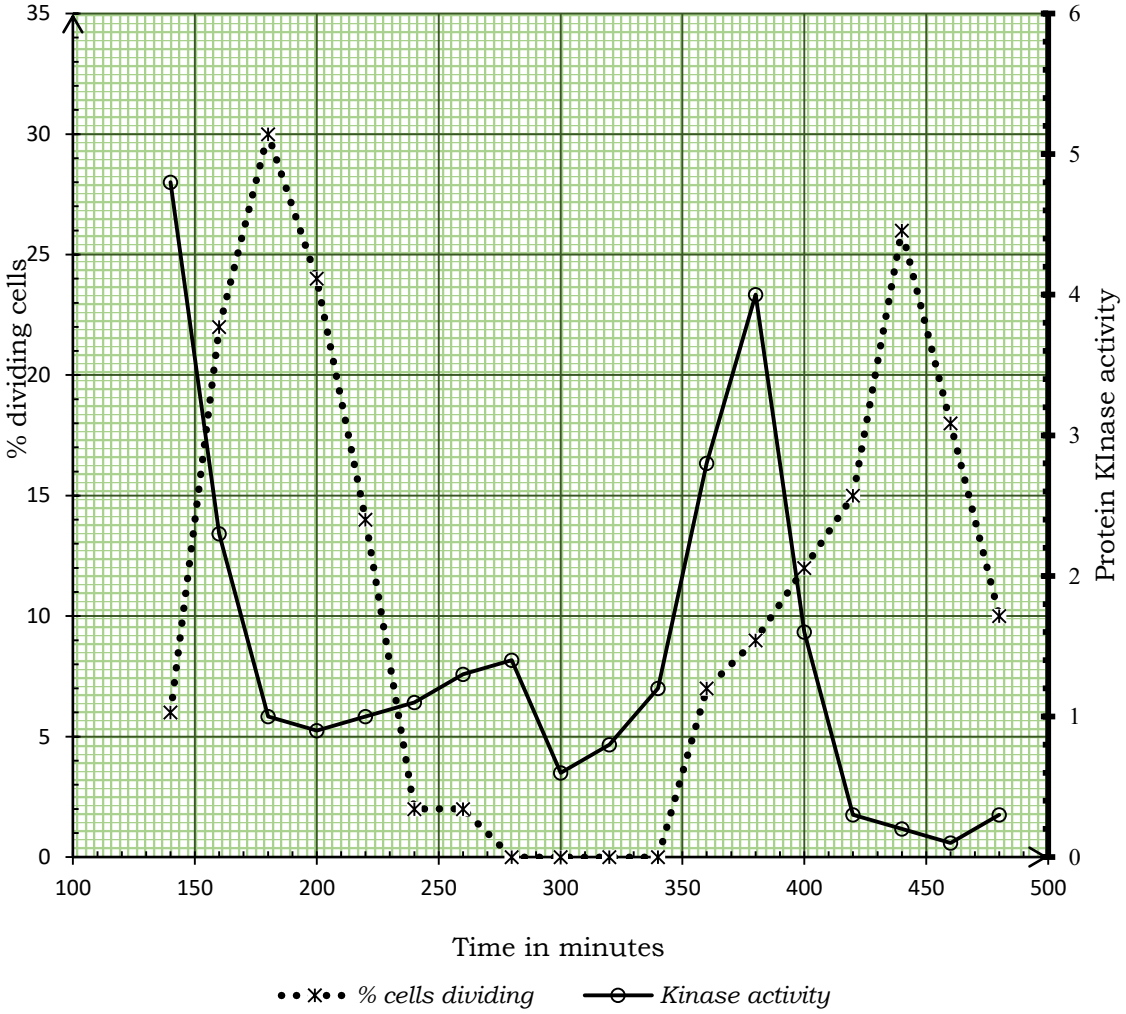

Figure 12

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

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

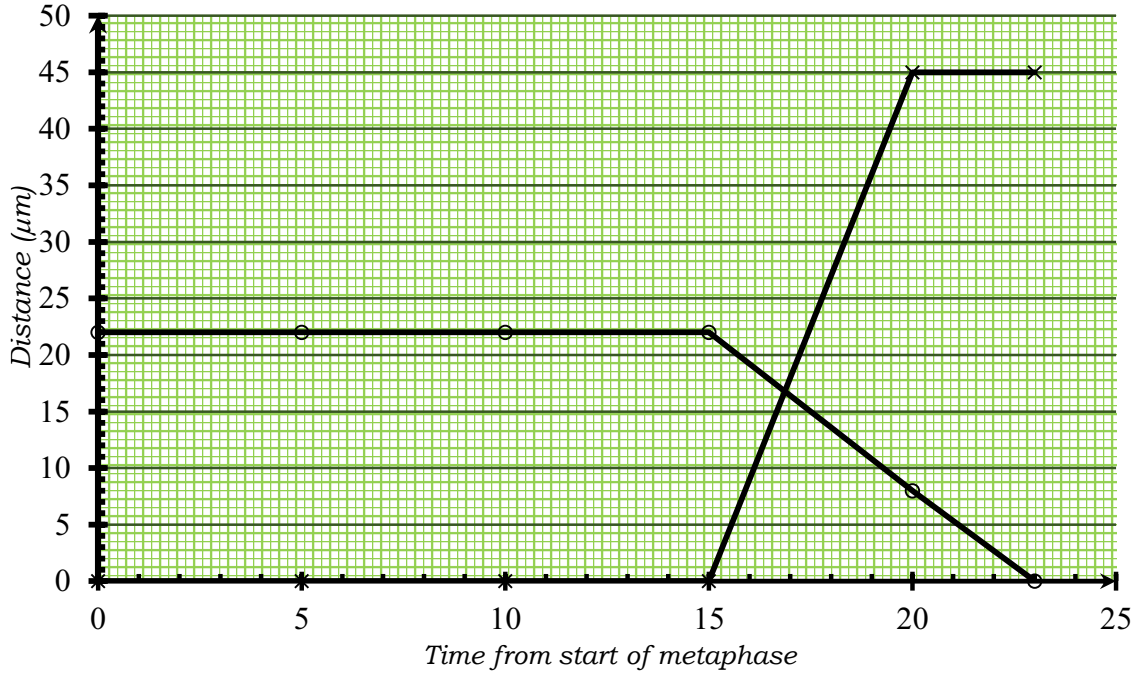

Figure 13

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

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

IMPACT HIGH SCHOOL LUGAZI

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

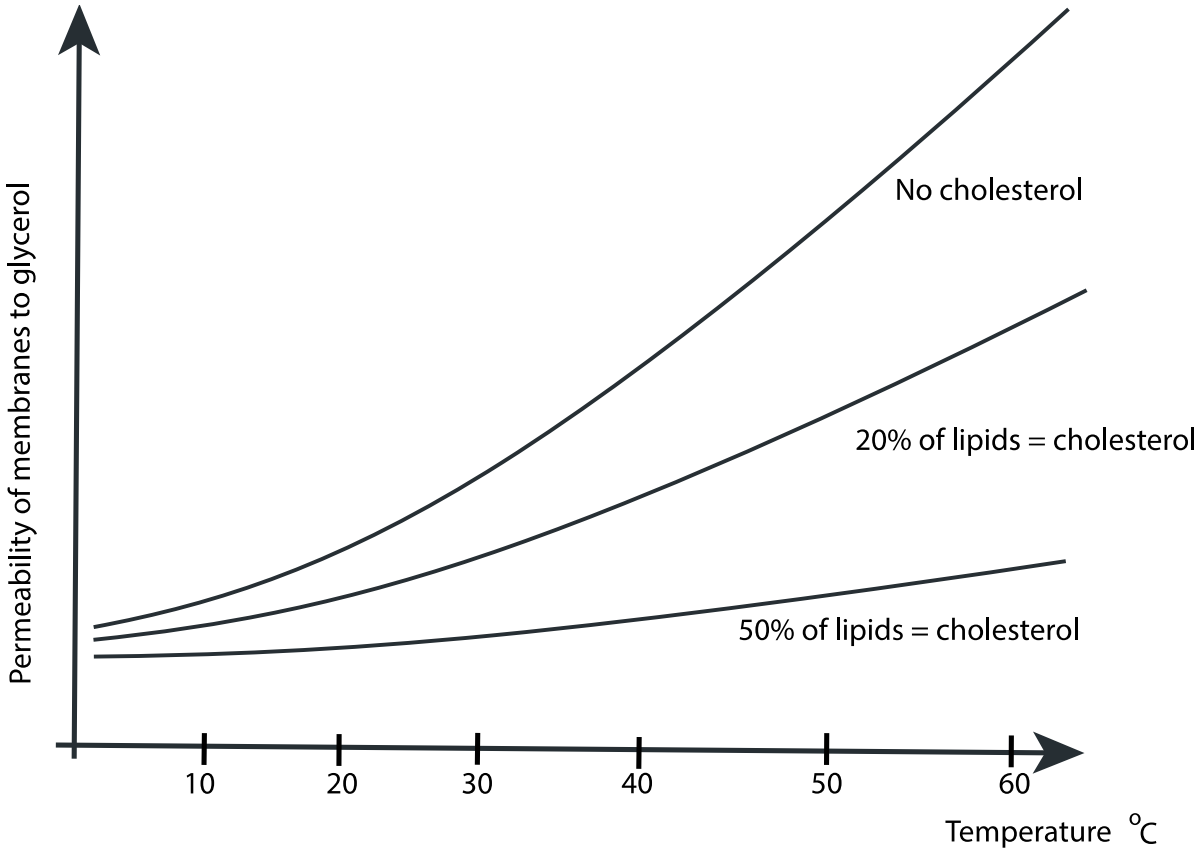

Figure 14 *Changes in permeability of liposomes to glycerol*

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

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