1. a) What is meant by the term allele frequency? (02 marks)
b) List three forces which may alter the allele frequency in a small   population.   c) The algebraic expression of the Hardy – Weinberg principle is $p^2 + 2pq + q^2$
    Where p and q are the frequencies of two alleles.
i) State, in words, the Hardy – Weinberg principle. (01 mark)

ii) The allele for woolly hair (**H**) is dominant over that for normal hair (**h**). The alleles for **H** and **h** have the frequencies p and q respectively. In a certain population of 1200 people, 1092 individuals have woolly hair. Assuming the Hardy -Weinberg principle applied, calculate the frequency of occurrence of each of the genotypes **HH, Hh and hh.** (04 marks)

2. (a). State four differences between primary and secondary succession. (4mks)

   b). State three effects of living organisms on the abiotic environment during primary succession. (3mks)

   c). Explain the competitive exclusion principle. (3mks)

3. (a). Describe the trend of succession in a terrestrial ecosystem. (10mks)

b). Explain the human activities that interfere with nutrient recycling and energy flow in a terrestrial ecosystem. (10mks)

4. a) What is meant by alternation of generations in plant life cycles?
                                                                         (02 marks
   b) Describe the essential features of the life cycle of the fern, *Dryopteris filixmas.*
                                                                         (10 marks)

   c) Explain the evolutionary advancements ferns show over bryophytes.   (08 marks)

5. Tongue rolling in a human population is caused by a dominant allele. If in a population 84%of the people are tongue rollers, using Hardy-Weinberg formula determine.
   a) Frequency of the allele for non-tongue rolling and tongue rolling.
   b) The percentage of the population who are;
        i)   Heterozygous for the tongue rolling
        ii)   Homozygous dominant for tongue rolling
        iii) Non-tongue rollers.

6. Cystic fibrosis occurs in the population with a frequency of 1 in 1000.calculate
   i)   The frequency of allele frequency in the population
   ii)   The frequency of the carrier genotype.

7. A particular species of insects may occur in either light or dark form. The dark fruit is dominant. In a contain population of 5000 such insects, there are 950, which are dark using the hard Weinberg's equation, calculate and show your working.

i)   The frequency of light allele
ii)   The frequency of the dark allele
iii)   The number in the population which are heterozygotes.

8. **(a)**What is meant by polyploidy?

(b) Discuss the criteria that will lead to the emergence of polyploidy in a population.   **(12 marks)**

9.
   a) What is meant by natural selection?

   (b) Describe the role of each of the following in natural selection.

   (i) Mutation

   (ii) Meiosis

   (iii) Fertilization

10. In the inheritance of feather colour in chickens, there is an interaction between two autosomal gene loci, I/i and C/c. Individuals carrying the dominant allele, I, have white plumage even if they also carry the dominant allele, C, for coloured plumage.

11.   (a) (i) State the term that is applied to this type of interaction.   (01 mark)
         (ii) List the genotypes that will result in coloured plumage.   (01 mark

          (a) Explain the meaning of the following;-

          (i) Genetic isolation

          (ii) Reproductive isolation

          (b) Explain how the gene frequency of population may be altered.

      12.
a) Define the term **natural selection**.   (2 marks)
b) Distinguish between **natural** and **artificial** selection.   (3 marks)
c) Using the knowledge of the peppered moth, explain how changes in intensity of the selection pressure can lead to speciation.
      (9 marks)
d) Explain the post zygotic isolating mechanisms that act on populations to cause speciation.
      (6 marks)
      13.
a) Why was **Gregor Mendel** very successful in his experiments on the garden pea *Psium sativum*?   (5 marks)
b) Explain the **principle of segregation** using your knowledge of meiosis.   (6 marks)

c) Chicken with shortened wings and legs are creepers. When creepers are mated with normal chicken, they produce creepers and normal birds with equal frequency. When creepers are mated with creepers, they produce two creepers and one normal chicken. Crosses between normal birds produce only normal birds.

   i. Explain the results using your knowledge of genetics. (3 marks)

  ii. Show by means of a crossing experiment, how the 2:1 ratio of progeny can be obtained. (6 marks)

14.

a)

  iii. What is meant by comparative serology? (2 marks)

  iv. Outline the procedure of comparative serology as used in evolutionary biochemistry (5 marks)

  v. How can comparative serology provide evidence for descent by modification? (3 marks)

b) Explain the use of homologous and analogous structures in explaining evolution by natural selection. (6 marks)

c) What are the main weaknesses of Lamarck in his theory of use and disuse of parts? (4 marks)

15. The figure below shows, in chronological sequence from A to D, fossils of the forelimb skeletons of four related mammals.
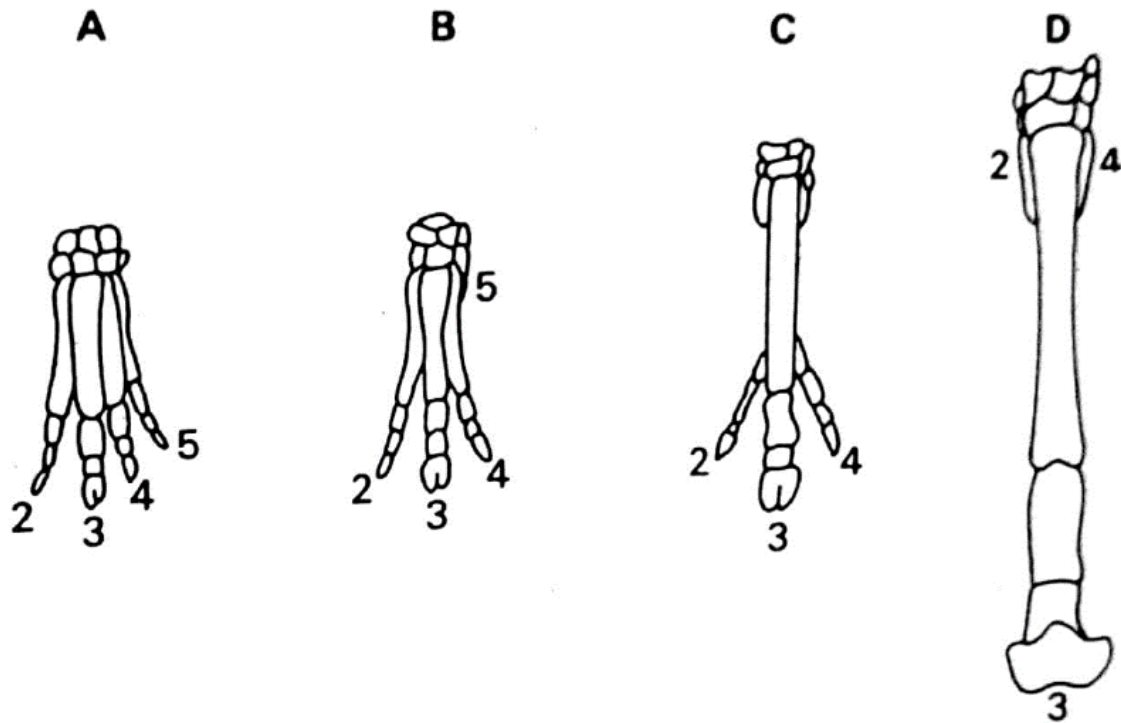

a) To which modern mammal are these most closely related? (01 mark)

b) Describe briefly the structural changes seen in the fossil sequence.   (03 marks)
c) What were the possible adaptive advantages of these structural changes?   (03 marks)

d) Briefly describe how dating of fossils from sedimentary rocks can be used as an evidence of evolution and state its reliability. (03 marks)

TRANSPORT QUESTIONS

1. The oxygen dissociation curves for aquatic animals are usually to the left of those of terrestrial ones because
   A. There is less oxygen in water
   B. Air is less dense than water
   C. Aquatic animals are less active
   D. Aquatic animals use less oxygen

2. Which one of the following is the correct order of events in the heart after the contraction of the atria?
   A. Atrio – ventricular valves open, ventricle contract, semi lunar valves close
   B. Ventricles contract, atrio – ventricular valves close, semi lunar valves open
   C. Ventricles contract, atrio – ventricular valves open, semi lunar valves open
   D. Atrio – ventricular valves open, semi lunar valves open, ventricles contract

3. High concentration of carbon dioxide in the tissues leads to
   A. Increase in the affinity for oxygen by haemoglobin
   B. Increase in the loading tension of haemoglobin
   C. Shifting of the dissociation curve to the left
   D. Lowering of the affinity for oxygen by haemoglobin

4. Which of the following animal groups have body segments and closed circulatory system?
   A. Crustacea
   B. Platyhelminthes
   C. Annelida
   D. Insect

5. Which of the following ions move from the plasma into the red blood cells to maintain electro-neutrality during the uptake of carbon dioxide by the blood in the tissues?
   A. Cl^-
   B. CO_3^{2-}
   C. K^+
   D. HCO_3^-

6. An organism living in an oxygen deficient environment has
   A. Haemoglobin that easily picks up oxygen
   B. Its oxygen dissociation curve to the right
   C. Haemoglobin that readily releases its oxygen
   D. Haemoglobin that less readily picks up oxygen

7. High carbondioxide concentration in respiring tissues is important because it causes
   A. Local vasodilation, allowing more blood into the tissues
   B. Low pH in the tissues leading to unloading of oxygen

C. Local vasoconstriction creating high blood pressure
D. Increase heart beat
8. Mixing of oxygenated and deoxygenated blood in amphibians is minimized by
   A. Rapid contraction of the ventricle
   B. Spongy nature of heart muscles
   C. Spiral valve in the trancus arteriosus
   D. Columnae carnae in the ventricular walls

9. Which one of the following pairs of events occur together to increase the oxygen concentration in the alveoli of the lungs?
   A. Contraction of diaphragm muscles and internal intercostal muscles
   B. Relaxation of diaphragm muscles and internal intercostal muscles
   C. Contraction of diaphragm muscles and external muscles intercostal muscles
   D. Relaxation of the diaphragm muscles and external intercostal muscles

10. In higher plants, the problem of obtaining oxygen for respiration is solved by leaves possessing
   A. Large intercellular spaces
   B. Compact palisade layer
   C. Thin lower epidermis
   D. Numerous stomata on lower epidermis
11. Figure 2 shows oxygen dissociation curves for Haemoglobin of two animals x and y, living in different habitats.
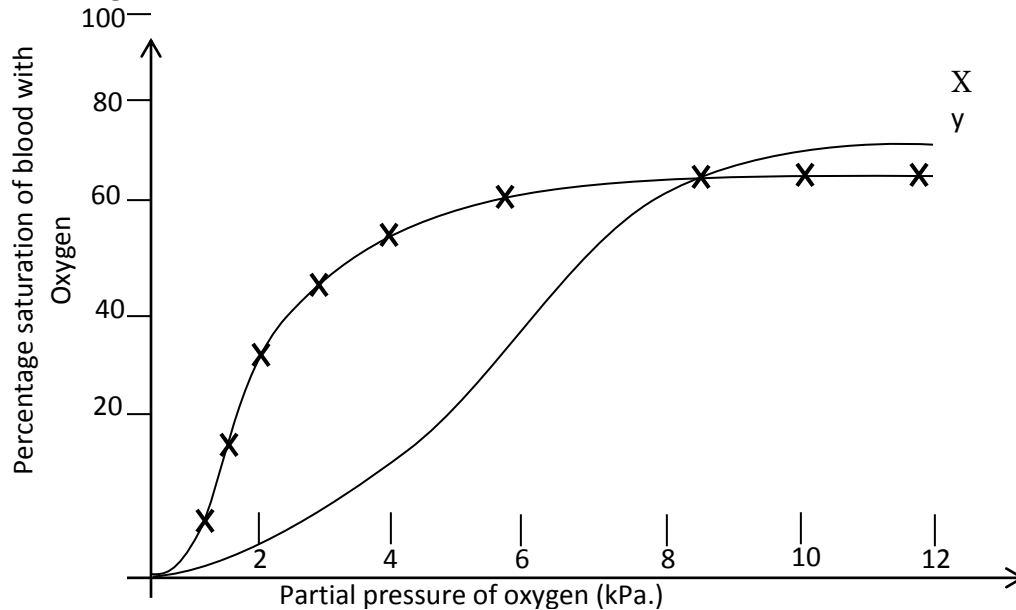
(a) From the figure, state three differences in the behavior of haemoglobin of the two animals. (03 marks)

(b) (i) Outline the characteristics of the haemoglobin of animal y. (03 marks)

(ii) From the characteristics in (b) (i) suggest the nature of the habitat in which animal y lives.
(01 mark)

(c) Human haemoglobin has a higher affinity for carbon monoxide than oxygen. What is the effect of this fact?

PAPER TWO QUESTIONS

1. (a) How does each of the following explain the movement of water and mineral salts up the xylem?

(i)	Cohesion and tension theory.	(06 marks)
(ii)	Root pressure	(05 marks)

(b) Describe the characteristics of the open and closed circulatory systems.
(09 marks)

1. Describe the structure of the haemoglobin molecule.
(*04 marks*)

(ii) Explain why the affinity of haemoglobin for oxygen increases when it already possesses oxygen. (*03 marks*)

3. (b) Describe how the pH of blood and tissue fluid in mammals is maintained. a) Describe the adaptations of blood in terrestrial animals living in the following environmental conditions.

|		
(i)	Extreme oxygen tensions	(*08 marks*)
(ii)	High altitudes	(*04 marks*)

(b) Explain how each of the following affects the dissociation of haemoglobin in the mammalian blood, suggesting in each case, the physiological advantage of the effect.

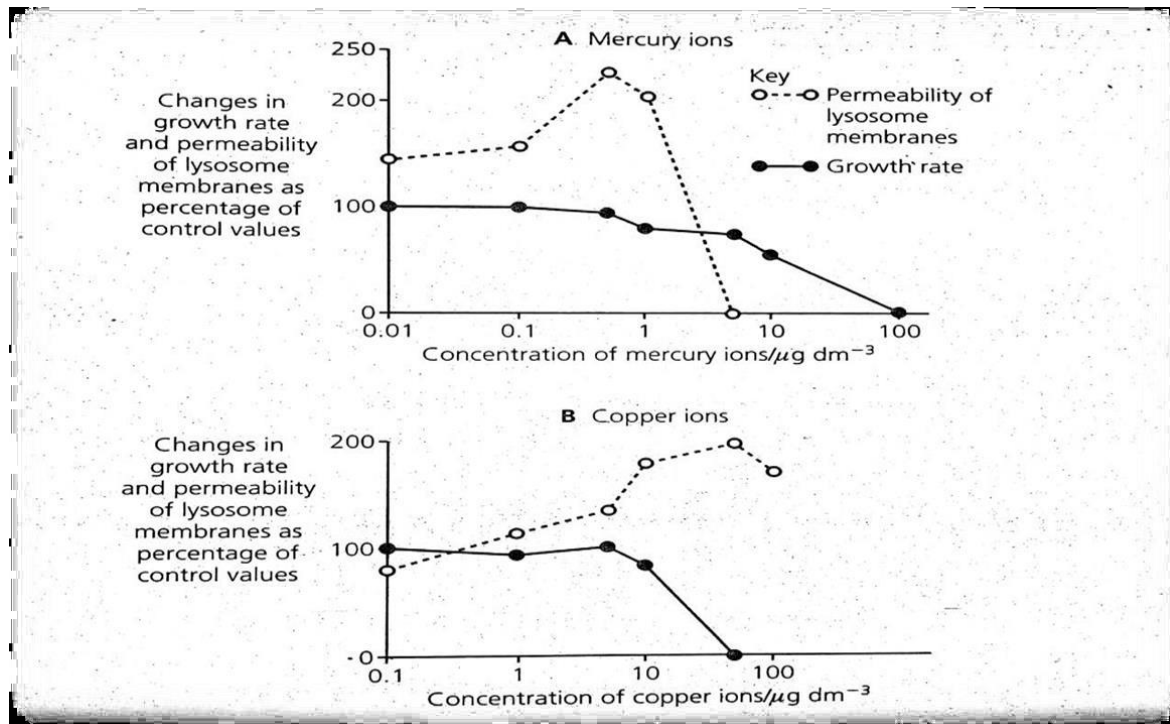|		
(i)	Increased body temperature	(*04 marks*)
(ii)	Small body size	(*13 marks*)

2. When phospholipid bilayers are heated, the tail become more mobile at critical transition temperature, they absorb a great deal of heat and become so mobile that they behave like a liquid. The graph below shows the effect of temperature on the heat absorption of a pure phospholipid bilayer and one to which 20% cholesterol has been added.

Rate of heat
absorption

Pure phospholipid

Phospholipid +
20% cholesterol

| | | | | | | |
| 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 |

Temperature/°C
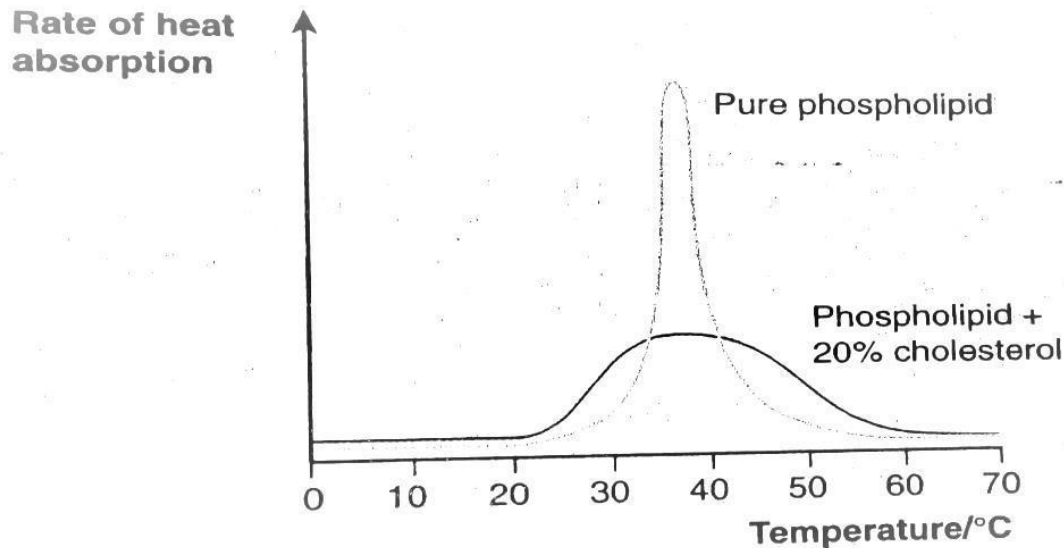
a) (i) Compare the two graphs one with phospholipid and the other lacking

b (i) how does the phospholipid tail behaving like a liquid affect the permeability of the plasma membrane?   (3 marks)

(ii) How is this different for the bilayer with 20% cholesterol added?   (2 marks)

(iv) Suggest function for cholesterol molecules in plasma membranes. Explain your answer.

(v) Importance of fluidity of plasma membrane.

3. 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

Changes in growth rate and permeability of lysosome membranes as percentage of control values

A. Mercury ions

Key
o---o Permeability of lysosome membranes
●——● Growth rate

Concentration of mercury ions/μg dm^{-3}

B Copper ions

Concentration of copper ions/μg dm^{-3}

a) Compare the effect of the concentration of copper ions and mercury ions on the rate
(i) growth rate
(ii) Permeability

b) Explain the relationship between the concentration of copper ions and the permeability of the lysosomal membrane

c) Suggest how the controls in the investigation should have been treated

d) 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

e) From the graph give one disadvantage of using membrane permeability to monitor copper pollution