

3.3 BIOLOGY (231)

This was the seventh time the revised KCSE Biology syllabus was tested.



3.3.1 CANDIDATES' GENERAL PERFORMANCE

The performance of the candidates in the three Biology papers is given in the table below. The performance of the candidates in the years 2008, 2009, 2010 and 2011 is also given for comparison.

Table 10: Candidates' Overall Performance in Biology In the years 2008, 2009, 2010, 2011 and 2012

Year	Paper	Candidature	Maximum score	Mean score	Standard Deviation
2008	1	274,215	80	22.24	14.42
	2		80	21.09	11.55
	3		40	17.30	6.76
	Overall		200	60.64	29.12
2009	1	299,302	80	20.14	12.31
	2		80	18.41	10.30
	3		40	15.86	8.43
	Overall		200	54.29	28.80
2010	1	317,135	80	21.39	13.76
	2		80	18.67	10.82
	3		40	18.42	8.31
	Overall		200	58.39	30.44
2011	1	363,817	80	22.74	12.41
	2		80	23.31	13.04
	3		40	18.84	8.10
	Overall		200	64.87	31.05
2012	1	389,523	80	19.77	12.84
	2		80	20.70	12.09
	3		40	11.97	6.59
	Overall		200	52.41	29.43

From the table it can be observed that:

- There has been an increase in candidature for the past four years.
- There was a drop in performance in the year 2012 compared to 2011 as indicated by the mean scores of the papers.
- The standard deviation values indicate that the papers adequately discriminated learners of different abilities.

ANALYSIS OF POORLY PERFORMED QUESTIONS

The questions that were performed poorly by the candidates are discussed below.

3.3.2 Biology Paper 1 (231/1)

Question 15

What name is given to a group of hormones that controls the development of secondary sexual characteristics?

Weaknesses

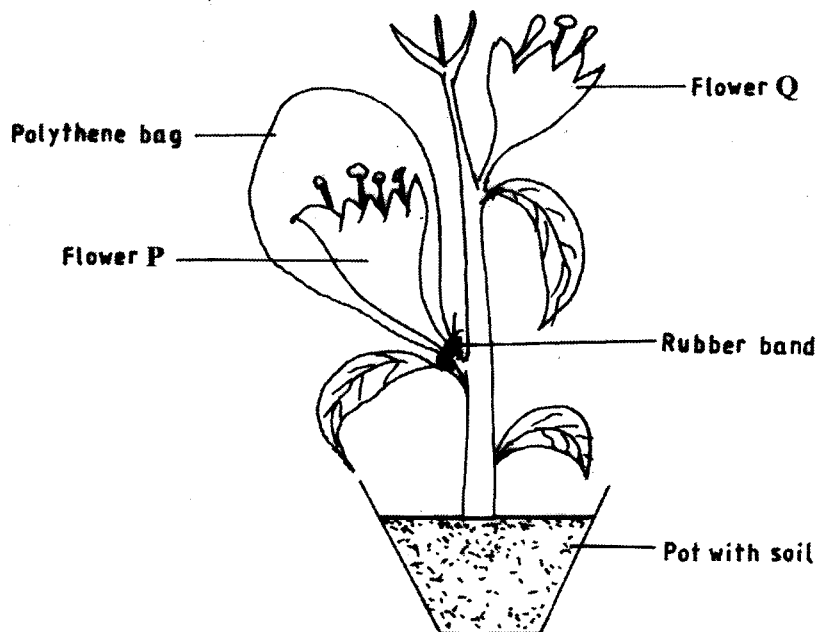
Most candidates were not able to give the correct response. They gave a variety of specific hormones in both sexes.

Expected response

Androgens;

Question 16

- 16 The diagram below represents an experimental set-up used by students to investigate a certain process.



Flower Q produced seeds while P did not. Account for the results.

(3 marks)

Weaknesses

Some candidates failed to link the inability to produce seeds with pollination and as a result they lost the marks for the entire question. Others were unable to synthesize that the plant is self sterile hence cross pollinated.

Expected response

The plant is self sterile hence cross pollinated; polythene bag prevented cross pollination; flower Q received pollen from other plants.

Question 18

Why are plants able to accumulate most of their waste products for long?

Weaknesses

Most candidates gave recycling/re-use as a response; an indication that they may have interpreted the question incorrectly.

Expected response

Most of the waste products are harmless/non-toxic to the plant/
The wastes are converted into harmless products;

Question 19

List four symptoms of diabetes mellitus.

Weaknesses

Most candidates were unable to give the correct symptoms of diabetes mellitus. The candidates may not have understood the meaning of diabetes mellitus or the topic is not exhaustively covered during instruction.

Expected responses

Frequent urination/*polyuria*
Excessive thirst/*polydipsia*
Increased appetite/*polyphagia*
Weight loss
Excess glucose in blood
Poor resistance to diseases
Fatigue
Blurred vision
Glucose in urine

Question 22

State the importance of divergent evolution to organisms.

Weaknesses

Most candidates went back to the meaning of divergent evolution in their response. The question required candidates to give the importance of divergent evolution to organisms. This could be an indication that instruction does not adequately emphasize application of this concept in life.

Expected response

Results in adaptations to exploit different ecological niches; leads to formation of new species;

Question 26

26 (a) state the theories of evolution proposed by the following scientists:

Charles Darwin;

Jean-Baptiste de Larmack.

26 (b) state the evidence of evolution based on

(i) cell organelles;

(ii) fossils.

Weaknesses

Most candidates were unable to answer the question correctly. This observation is consistent with that on question 22 on the same topic. This could be an indication that the topic is not adequately covered during instruction. Evolution is one of the last topics in this course. The performance on this topic may imply that it is covered in a hurry to complete the syllabus. The abstract nature of the content in this topic calls for more creativity and improvisation during instruction for the learners to sufficiently grasp and apply the concepts of evolution.

Expected responses

26 (a) Charles Darwin:

Theory of natural selection;

Jean-Baptiste de Larmack:

Theory of inheritance of acquired characteristics;

26 (b)

(i) Similar organelles perform similar functions in different organisms suggesting that they originate from a common ancestry;

(ii) Fossils of different ages show common phylogenic relationships meaning that the evolved from a common ancestry;

3.3.3 Biology Paper 2 (231/2)

Question 1(a)

1 In a certain plant species which is normally green, a recessive gene for colour (n) causes the plants to be white in colour. Such plants die at an early age. In the heterozygous state, the plants are pale green in colour but grow to maturity.

(a) Give a reason for the early death of the plants with the homozygous recessive gene.

(2 marks)

Weaknesses

Most candidates were unable to associate the white colour with lack of chlorophyll. They narrowed themselves to the genetics and could not think about the implication of the white colour. Candidates should pay attention to the details in the question.

Expected response

The plants lack chlorophyll/do not photosynthesize; they die as soon as the food reserves are depleted;

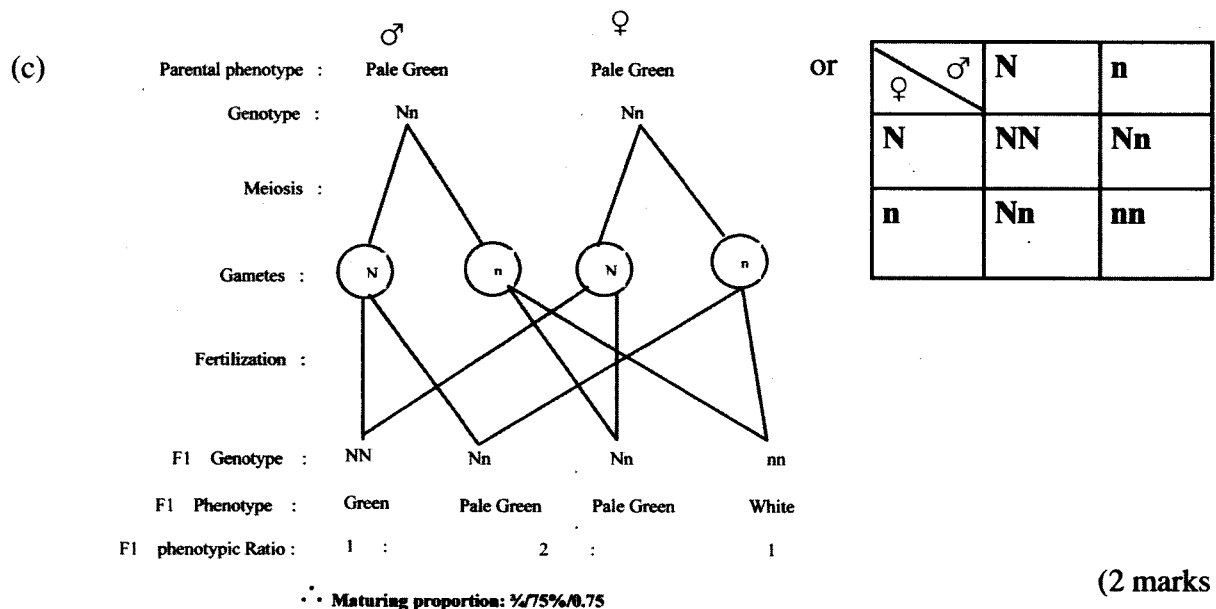
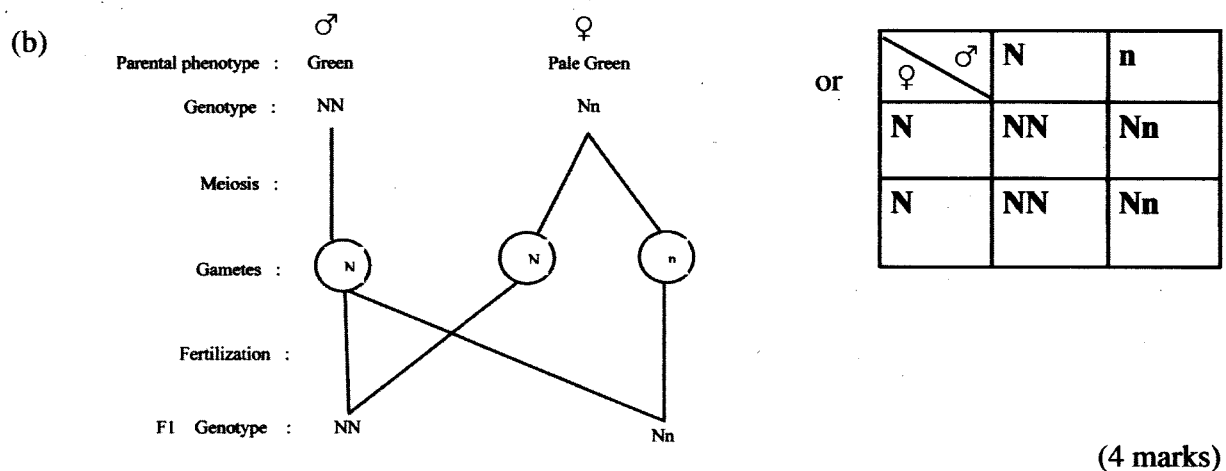
Question 1 (c)

If heterozygous plants were self-pollinated and the resulting seeds planted, work out the proportion of their offspring that would grow to maturity.

Weaknesses

Most candidates did not know how to express the resulting cross as a phenotypic ratio.

Expected response



Question 2 (c)

State three physiological mechanisms of controlling the human body temperature during a cold day.

Weaknesses

Some candidates did not know the difference between physical, behavioural and physiological mechanisms. Other candidates only gave the structures involved.

Expected response

Vasoconstriction;
Hair rises;
Increase in metabolic rates;
Shivering;

Question 4 (b)

State three ways in which support is brought about in a leaf.

Weaknesses

Most candidates were not able to link the support in the leaf with the general support in plants.

Expected response

The rigid mid rib holds the leaf from the stem;
Profuse network venation keeps the leaf spread out;
Turgidity in the spongy mesophyll keeps the leaf open;

Question 5

- (a) Describe the process of inhalation.
- (b) Explain the mechanism of stomatal opening.

Weaknesses

Most of the candidates were not able to give a correct account of each of the two processes.

Expected response

- (a) The external intercostal muscles contract while internal intercostal muscles relax; the rib cage is pulled upwards and outwards; the diaphragm muscles contract and the diaphragm flattens; the volume of the thoracic cavity increases/the pressure in the thoracic cavity decreases; air rushes into the lungs; from the atmosphere through the nose
(4 marks)
- (b) The osmotic pressure of guard cells increase when sugar is manufactured during photosynthesis/starch is converted to sugar in low acidity/potassium moves into guard cells during the day; water enters guard cells from the surrounding cells by osmosis; because the guard cells are bean shaped with thin outer walls and thick inner walls, the thin outer walls expand faster as the cell becomes turgid; thus the thick inner wall curves; causing the stomatal aperture to open.
(4 marks)

Question 8 (a)

Using a relevant example, describe how an allergic reaction occurs in a human being.

Weaknesses

Most candidates knew the manifestation of allergies in humans but could not give the biological concept behind them.

Expected response

- (a) An allergic reaction is a hypersensitive response; to an antigen by the body immune system; The body immune system responds by overproducing antibodies; against harmless antigens; The antigen-antibody reaction occurs on the surface of body cells, which burst open; and release histamines; Histamines cause inflammation/itching/swelling/pain, etc; which damage the body; Allergic people are hypersensitive to materials like dust/pollen grains/some foods/some drugs/some pollutants, etc;

3.3.4 Biology Paper 3 (231/3)

QUESTION 1 (c)



- (c) Account for the change in shape the seedling will undergo to straighten. (6 marks)

Weaknesses

Most candidates were unable to link the straightening of the seedling with the effect of auxins. Those who were able to associate it with auxins were unable to correctly explain how they bring about the straightening.

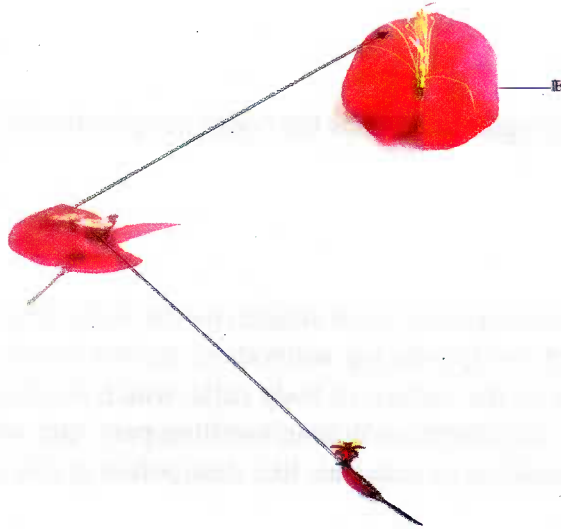
Expected response

- (c) Emergence of the hypocotyle exposes it to light;
Light stimulates migration of auxins to the lower side of the hypocotyle;
High concentration of auxins; on the lower side;
Stimulates faster rate of growth than on the upper side;
Faster elongation of the lower side straightens the seedlings;

(6 marks)

Question 2 (b) (ii)

(b) The photograph below shows different parts of a flower.



- (i) Name the class of the plant from which the photograph was taken. (1 mark)
- (ii) Using observable features on the photograph, give **three** reasons for your answer in (b) (i) above. (3 marks)

Weaknesses

Most candidates gave the correct class of the plant. However most of them could not give the correct reasons based on the photograph. This could be an indication of inability to apply knowledge and pay attention to details. The reasons are clearly observable from the photograph: broad bract/lamina; network venation; 5 sepals/petals;

Expected response

Broad bract/lamina;
Network venation;
5 sepals/petals;

QUESTION 2 (b) (v)

- (v) Name the part labelled **E** on the photograph. (1 mark)

Weaknesses

Most candidates were unable to identify the bracts. Candidates were expected to analyse the floral parts in order to arrive at a correct response.

Expected response

- (v) Bract; (1 mark)

QUESTION 3 (b) (ii)

You are provided with a potato, a 10 ml measuring cylinder, dilute hydrogen peroxide solution and substances **F** (pH 4), **G** (pH 7) and **H** (pH 9). Cut the potato and remove a piece measuring 1 cm³ from it.

Cut the 1 cm³ piece into tiny pieces and crush (macerate) them on a clean white tile using a glass rod.

Divide the macerated potato into **three** equal portions for use in the procedure that follows:

- I. Put 2 cm³ of substance **F** (pH 4) into the 10 ml measuring cylinder.
Add **one** portion of the macerated potato into the measuring cylinder.
Read and record the volume of the mixture in the table provided below.
Add one drop of washing-up solution.
Add 1 cm³ of dilute hydrogen peroxide solution to the mixture and immediately start a stop clock or watch. At the end of **two minutes**, read the mark to which the foam rises.
Record the reading in the table provided.
Clean and rinse the measuring cylinder with distilled water.
- II. Put 2 cm³ of substance **G** (pH 7) into the measuring cylinder.
Add the **second** portion of the macerated potato.
Read and record the volume of the mixture in the table.
Add one drop of washing-up solution.
Add 1 cm³ of dilute hydrogen peroxide solution to the mixture and immediately start a stop clock or watch. At the end of **two minutes**, read the mark to which the foam rises.
Record the reading in the table.
Clean and rinse the measuring cylinder with distilled water.
- III. Put 2 cm³ of substance **H** (pH 9) into the measuring cylinder.
Add the **third** portion of the macerated potato.
Read and record the volume of the mixture in the table.
Add one drop of washing-up solution.
Add 1 cm³ of dilute hydrogen peroxide solution to the mixture and immediately start a stop clock or watch. At the end of **two minutes**, read the mark to which the foam rises.
Record the reading in the table.

	F (pH 4)	G (pH 7)	H (pH 9)
Volume of solution + portion of potato			
Volume of solution + portion of potato + foam			
Volume of foam			

(9 marks)

- (a) Using the data obtained in the table, calculate the volume of the foam produced in each of the pH 4, pH 7, and pH 9 substances. Record the volumes in the table.
- (b) Account for
- (i) the observation made when hydrogen peroxide was added to the potato mixture (3 marks)
 - (ii) the difference in the volume of foam produced in pH 4 and pH 9 substances. (2 marks)

Weaknesses

Most candidates were unable to associate the difference in the volume of foam produced at pH 4 and pH 9 with the effect of pH on enzyme activity.

Expected response

More foam is produced at pH 9; which is optimum for catalase enzyme activity;

GENERAL ADVICE TO TEACHERS

Questions involving application of knowledge were poorly performed by candidates compared to those that required factual knowledge. This could be a likely indication that the instruction should go beyond mere transfer of factual information.

Questions involving biological processes were equally performed poorly. Some candidates had the points to build up the processes but could not put them down coherently. The points were not flowing as per the requirements of the biological procedure in question. This could be an indication that these candidates had simply memorized the points and therefore could not use them to build the biological process in the task.

Topics with abstract content such as evolution should be approached creatively to ensure that learners are active participants in the teaching learning process. Teachers should ensure that the learners understand and are able to apply the knowledge behind the biological concepts in such topics.

The syllabus should be covered adequately to enable students to have a clear grasp of the content. All the suggested activities should be covered practically for the candidates to internalize the scientific concepts behind them.

The technical words used in biology should be fully embraced and candidates adequately exposed to their use in their scientific communication. Use of correct biological terms with correct spelling should be emphasized during teaching.

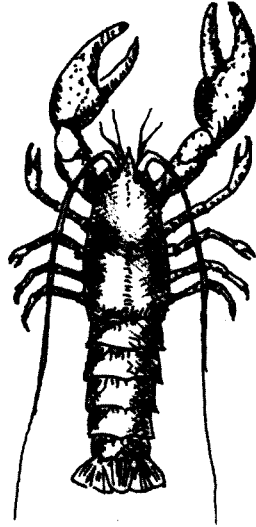
The correct way of drawing and labeling of diagrams should be given emphasis during teaching-learning process. Biology cannot be taught without using diagrams. Techniques of answering questions on adaptations should be taught. Candidates should clearly relate the structure to the function in order to score.

Finally, all the biology topics in the syllabus are tested by the three papers. Teachers should therefore ensure that all the topics are adequately covered during teaching. All content areas should be equally emphasized during instruction. There should be no discrimination on the basis of past biology examination papers. The content area you think is never tested could be in the next test paper. Let us prepare our candidates adequately.

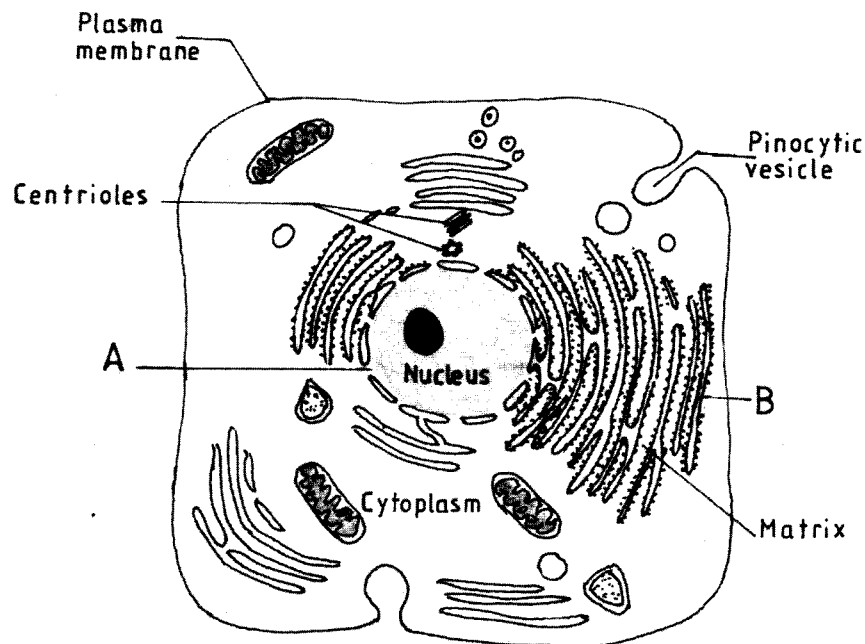
4.2 BIOLOGY (231)

4.2.1 Biology Paper 1 (231/1)

- 1 How does nutrition as a characteristic of living organisms differ in plants and animals? (2 marks)
- 2 The diagram below represents a certain organism collected by a student at the sea shore.



- (a) Name the class to which the organism belongs. (1 mark)
 - (b) Give **three** reasons for your answer in (a) above. (3 marks)
- 3 The figure below is a fine structure of a generalised animal cell as seen under an electron microscope.



- (a) Name the parts labelled **A** and **B**. (2 marks)
- A**
- B**

- (b) How is the structure labelled **B** adapted to its function? (2 marks)

- 4 In an investigation, a student extracted three pieces of paw paw cylinders using a cork borer. The cylinders were cut back to 50 mm length and placed in a beaker containing a solution.

The results after 40 minutes were as shown in the table below.

Feature	Result
Average length of cylinders (mm)	56 mm
Stiffness of cylinders	stiff

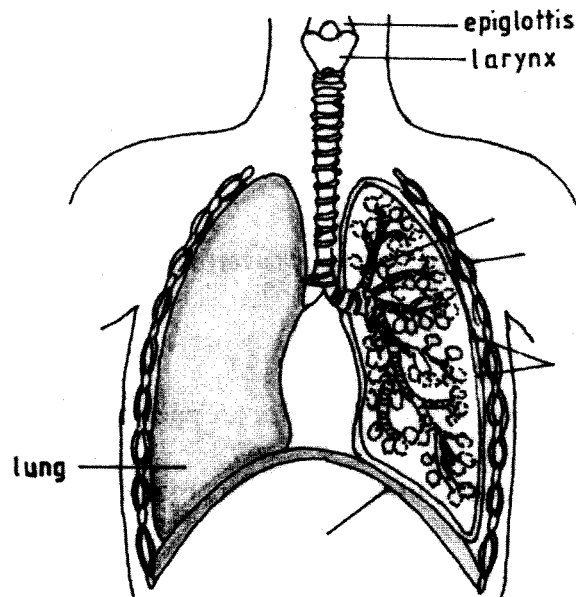
- (a) Account for the results in the table above. (3 marks)
- (b) What would be a suitable control set-up for the investigation? (2 marks)

- 5 The table below shows results of a study of three plants **C**, **D** and **E** growing in different habitats.

Feature	Plant C	Plant D	Plant E
Number of stomata on upper surface of leaf per square area	4	20	6
Number of stomata on lower surface of leaf per square area	6	0	8
Thickness of leaf cuticle (mm)	0.4	0.1	0.2
Surface area of roots (cm ²)	2000	1000	1200

- (a) Which one of the plants **C**, **D** and **E** grows in an area of relatively low water availability? (1 mark)
- (b) Explain your answer in (i) above. (3 marks)

- 6 The diagram below represents part of the gaseous exchange system in human.



- (a) Name the parts labelled F and G. (2 marks)

F

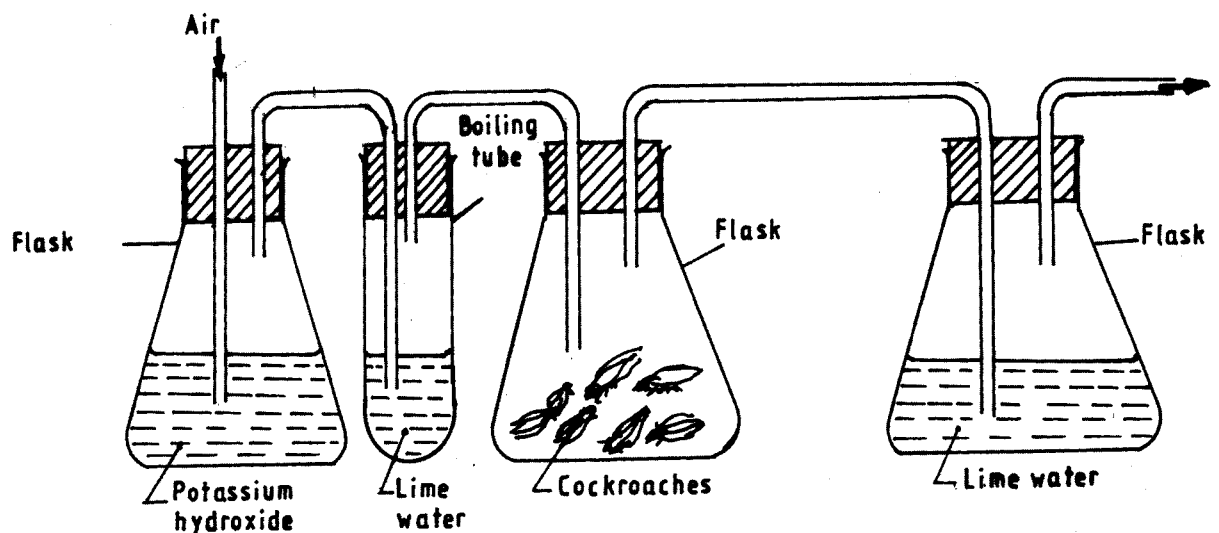
G

- (b) State **one** function of each of the parts labelled H and J. (2 marks)

H

J

- 7 The diagram below represents a set-up that students used in an investigation.



- (a) Name the physiological process that was being investigated. (1 mark)
- (b) State the role of potassium hydroxide in flask K. (1 mark)

(c) Account for the observation in boiling tube L and flask N. (2 marks)

L
N

8 What is the probability of a couple with blood group AB getting a child with blood group AB?
Show your working. (4 marks)

9 State the importance of negative phototaxis to termites. (1 mark)

10 What is meant by the term irritability? (1 mark)

11 (a) State **two** ways in which heart muscles are special. (2 marks)

(b) Name the muscles found in the following organs: (2 marks)

stomach;
bone.

12 (a) Name the part of a light microscope used to bring an image of a specimen into sharp focus. (1 mark)

(b) Why is it recommended to keep the stage of the microscope dry? (1 mark)

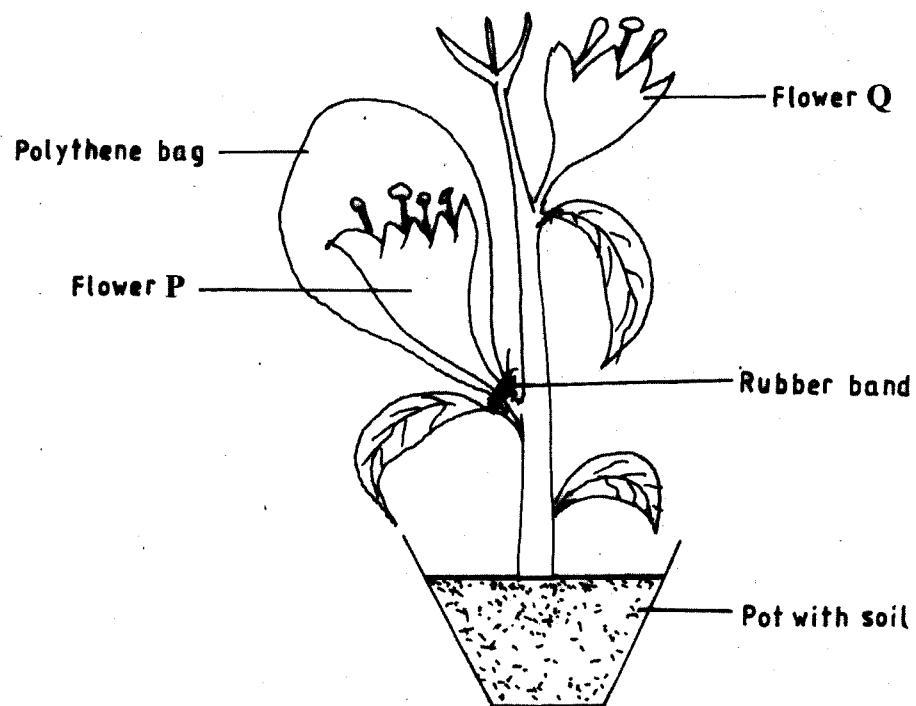
13 State **three** factors that affect the rate of diffusion. (3 marks)

14 (a) Name the type of respiration that is most efficient. (1 mark)

(b) Give a reason for your answer in (a) above (1 mark)

15 What name is given to a group of hormones that controls the development of secondary sexual characteristics in a human male? (1 mark)

- 16 The diagram below represents an experimental set-up used by students to investigate a certain process.



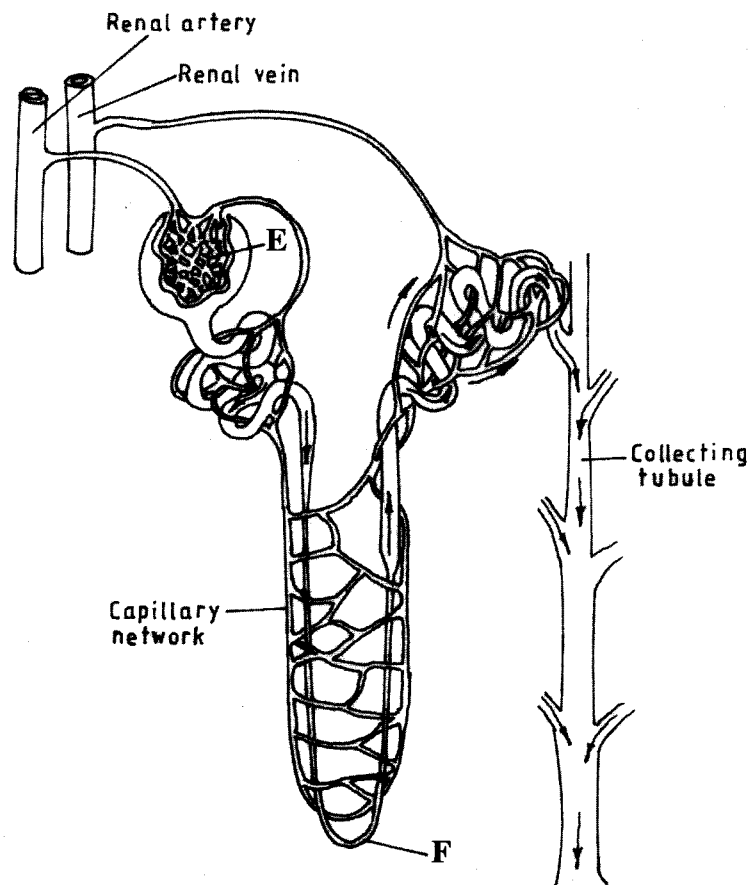
- Flower Q produced seeds while P did not. Account for the results. (3 marks)
- 17 Name **two** substances that leave the foetal blood through the placenta. (2 marks)
- 18 Why are plants able to accumulate most of their waste products for long? (1 mark)
- 19 List **four** symptoms of diabetes mellitus. (4 marks)
- 20 State **three** aspects that can be used to estimate growth in seedlings (3 marks)
- 21 Name the process through which free atmospheric nitrogen is converted into nitrates. (1 mark)
- 22 State the importance of divergent evolution to organisms. (2 marks)
- 23 Name the strengthening materials found in the following support tissues: (2 marks)
- (a) collenchyma;
- (b) xylem.
- 24 State **four** characteristics of apical meristem cells. (4 marks)

- 25 State the role of the following hormones in the life cycle of insects: (2 marks)
- ecdysone hormone;
- juvenile hormone.
- 26 (a) State the theories of evolution proposed by the following scientists. (2 marks)
- Charles Darwin
- Jean-Baptiste de Lamarck
- (b) State the evidence of evolution based on (2 marks)
- (i) cell organelles
- (ii) fossils.
- 27 What is the function of contractile vacuoles in amoeba? (1 mark)
- 28 State **two** differences between open and closed circulatory systems. (2 marks)
- 29 Name **two** nutrients that are absorbed without being digested by enzymes in humans. (2 marks)
- 30 Name the organelle that is involved in each of the following: (2 marks)
- (a) manufacture of lipids
- (b) formation of lysosomes.....

SECTION A (40 marks)

Answer **ALL** the questions in this section in the spaces provided.

- 1 In a certain plant species which is normally green, a recessive gene for colour (n) causes the plants to be white in colour. Such plants die at an early age. In the heterozygous state, the plants are pale green in colour but grow to maturity.
- (a) Give a reason for the early death of the plants with the homozygous recessive gene. (2 marks)
- (b) If a normal green plant was crossed with the pale green plant, what would be the genotype of the first filial generation (F_1 generation)? Show your working. (4 marks)
- (c) If heterozygous plants were self-pollinated and the resulting seeds planted, work out the proportion of their offspring that would grow to maturity. (2 marks)
- 2 The diagram below illustrates the structure of the kidney nephron.



- (a) Name the part labelled E. (1 mark)
- (b) How is the part labelled F adapted to its function? (4 marks)

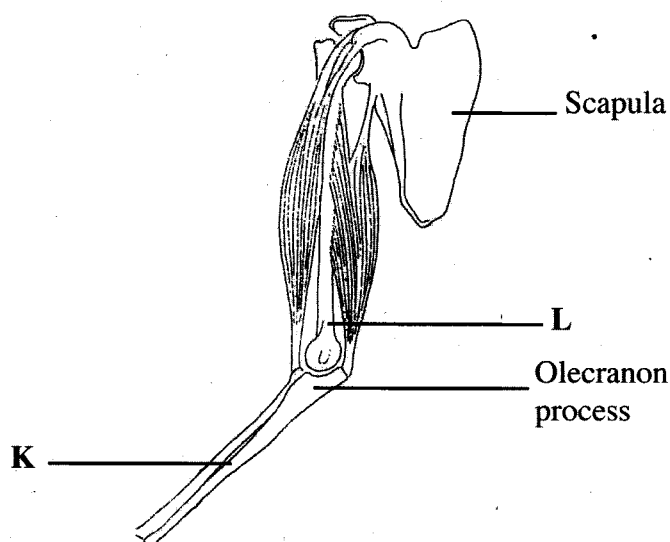
- (c) State **three** physiological mechanisms of controlling the human body temperature during a cold day. (3 marks)

- 3 (a) In an investigation, equal amounts of water was placed in three test-tubes labelled **G**, **H** and **J**. Pondweeds of equal length were dropped in each test tube. The test-tubes were then placed in identical conditions of light and carbon (IV) oxide at different temperatures for five minutes. After the five minutes, the bubbles produced in each test-tube were counted for one minute. The results were as shown in the table below.

Test tube	Temperature (°C)	Number of bubbles
G	20	28
H	35	42
J	55	10

- (i) Name **one** requirement for this process that is not mentioned in the investigation. (1 mark)
- (ii) Name the gas produced in this investigation. (1 mark)
- (iii) Account for the results in test-tubes **H** and **J**. (2 marks)
- (b) State **two** ways in which the human intestinal villus is adapted to its function. (4 marks)

- 4 (a) The diagram below illustrates arrangement of bones and muscles of the human arm.



- (i) Name the bones labelled **K** and **L**. (2 marks)
- K**
- L**

- (ii) Explain how the upward movement of the lower arm is brought about by the bones and muscles shown in the diagram above. (3 marks)
- (b) State **three** ways in which support is brought about in a leaf. (3 marks)
- 5 (a) Describe the process of inhalation. (4 marks)
- (b) Explain the mechanism of stomatal opening. (4 marks)

SECTION B (40 marks)

Answer question 6 (**compulsory**) and either question 7 or 8 in the spaces provided after question 8.

- 6 The data provided below represent populations of a predator and its prey over a fifty years' period.

TIME IN YEARS	POPULATION IN RELATIVE NUMBERS	
	POPULATION OF P	POPULATION OF Q
5	24500	17000
10	30000	20500
15	33500	26000
20	33500	30000
25	31000	33000
30	27000	32000
35	25000	30000
40	29000	27500
45	32500	28000
50	34000	28500

- (a) (i) Using the same axes, draw graphs of the relative populations of **P** and **Q** against time. (7 marks)
- (ii) With a reason, identify the curve that represents the prey. (2 marks)
- (iii) Account for the two populations between 25 and 32 years. (2 marks)
- (iv) Which years were the two populations equal? (2 marks)

- (v) A part from predation, state **three** biotic factors that may have led to the decline of the prey population. (3 marks)
- (b) Describe the hazards of air pollution by Sulphur (IV) Oxide. (4 marks)
- 7 Using a relevant example in each case, describe simple and conditional reflex actions. (20 marks)
- 8 (a) Using a relevant example, describe how an allergic reaction occurs in a human being. (10 marks)
- (b) Describe how environmental factors increase the rate of transpiration in terrestrial plants. (10 marks)

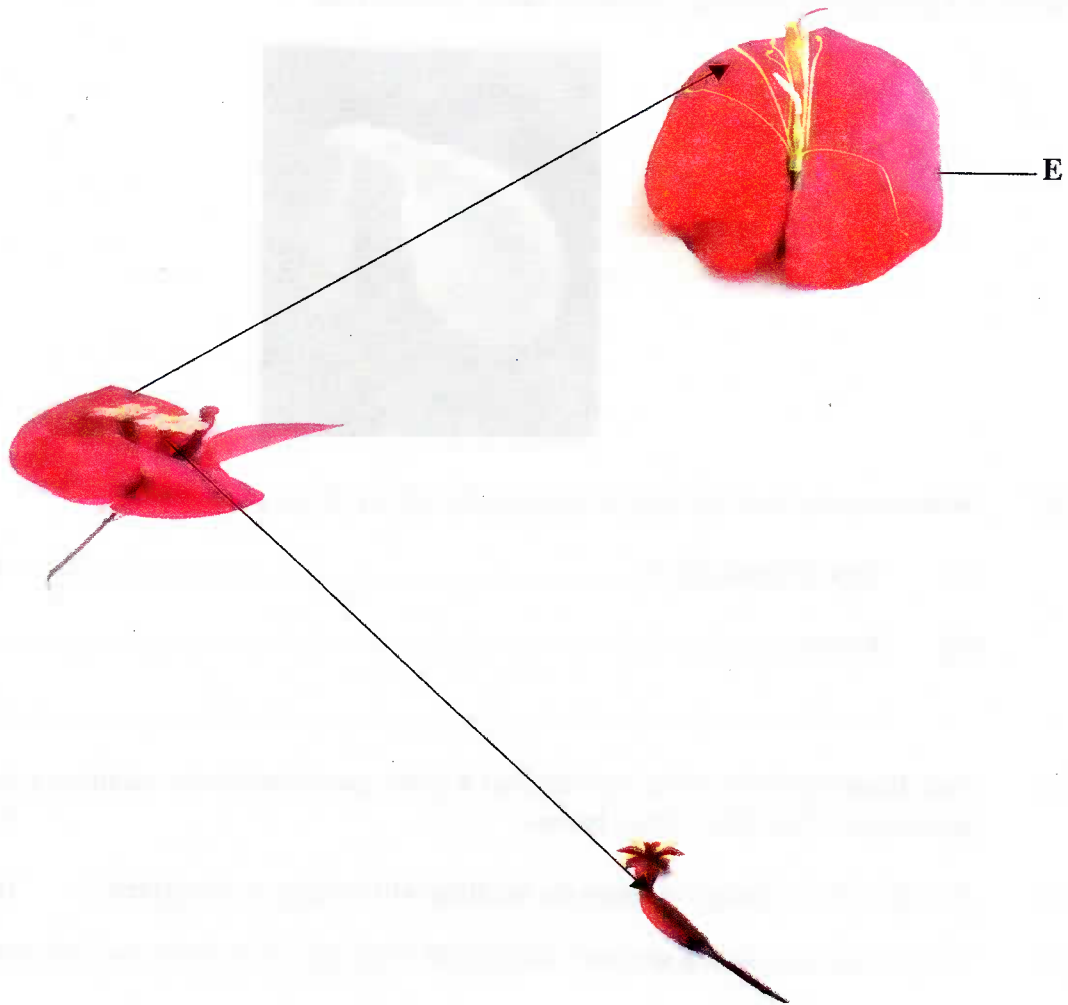
4.2.3 Biology Paper 3 (231/3)

- 1 Below is a photograph showing a seedling during germination.



- (a) With a reason, name the type of germination shown in the photograph.
- (i) Type of germination (1 mark)
- (ii) Reason
..... (2 marks)
- (b) State **three** functions of the part labelled **A** in the germination of a seedling up to the appearance of the first foliage leaves. (3 marks)
- (c) Account for the change in shape the seedling will undergo to straighten. (6 marks)
- 2 (a) You are provided with a specimen labelled **D** which has been grown on a substrate.
- (i) Name the specimen (1 mark)
- (ii) What type of asexual reproduction occurs in the specimen? (1 mark)
- (iii) Using a mounting pin, pick a few strands of specimen **D** and place them on the white tile. Using a hand lens, observe the strands and make a labelled drawing. (3 marks)

- (b) The photograph below shows different parts of a flower.



- (i) Name the class of the plant from which the photograph was taken. (1 mark)
- (ii) Using observable features on the photograph, give **three** reasons for your answer in (b) (i) above. (3 marks)
- (iii) Name the agent of pollination for the flower in the photograph. (1 mark)
- (iv) State **three** observations on the photograph that support the answer in (b) (iii) above. (3 marks)
- (v) Name the part labelled **E** on the photograph. (1 mark)

- 3 You are provided with a potato, a 10 ml measuring cylinder, dilute hydrogen peroxide solution and substances F (pH 4), G (pH 7) and H (pH 9). Cut the potato and remove a piece measuring 1 cm³ from it.

Cut the 1 cm³ piece into tiny pieces and crush (macerate) them on a clean white tile using a glass rod.

Divide the macerated potato into **three** equal portions for use in the procedure that follows:

- I. Put 2 cm³ of substance F (pH 4) into the 10 ml measuring cylinder.
Add **one** portion of the macerated potato into the measuring cylinder.
Read and record the volume of the mixture in the table provided below.
Add one drop of washing-up solution.
Add 1 cm³ of dilute hydrogen peroxide solution to the mixture and immediately start a stop clock or watch. At the end of **two minutes**, read the mark to which the foam rises.
Record the reading in the table provided.
Clean and rinse the measuring cylinder with distilled water.
- II. Put 2 cm³ of substance G (pH 7) into the measuring cylinder.
Add the **second** portion of the macerated potato.
Read and record the volume of the mixture in the table.
Add one drop of washing-up solution.
Add 1 cm³ of dilute hydrogen peroxide solution to the mixture and immediately start a stop clock or watch. At the end of **two minutes**, read the mark to which the foam rises.
Record the reading in the table.
Clean and rinse the measuring cylinder with distilled water.
- III. Put 2 cm³ of substance H (pH 9) into the measuring cylinder.
Add the **third** portion of the macerated potato.
Read and record the volume of the mixture in the table.
Add one drop of washing-up solution.
Add 1 cm³ of dilute hydrogen peroxide solution to the mixture and immediately start a stop clock or watch. At the end of **two minutes**, read the mark to which the foam rises.
Record the reading in the table.

	F (pH 4)	G (pH 7)	H (pH 9)
Volume of solution + portion of potato			
Volume of solution + portion of potato + foam			
Volume of foam			

(9 marks)

- (a) Using the data obtained in the table, calculate the volume of the foam produced in each of the pH 4, pH 7, and pH 9 substances. Record the volumes in the table.

(b) Account for

- (i) the observation made when hydrogen peroxide was added to the potato mixture (3 marks)
- (ii) the difference in the volume of foam produced in pH 4 and pH 9 substances. (2 marks)

5.2 BIOLOGY (231)

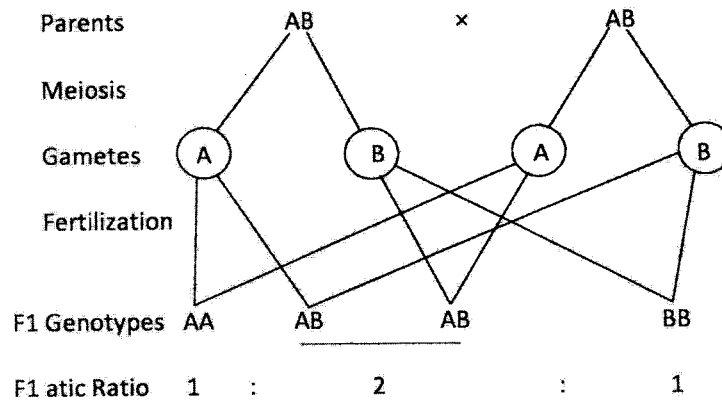
5.2.1 Biology Paper 1 (231/1)



1. Plants make their own food from Carbon (IV) Oxide and water in the presence of light autotrophic/ photosynthesis; while animals eat ready made food from plants or animals/heterotrophic nutrition;
(2 marks)
2. (a) Crustaceae/crustacea; (1 mark)
(b) Head fused with thorax/has a cephalothorax;
Have two pairs of antennae;
Have compound eyes/a pair of compound eyes;
Have several pairs of limbs/five to twenty pairs of limbs;
Exoskeleton is hard;
Have external gills;
Four pairs of mouth parts consisting of maxilla, mandibles, labium and labrum.
(max 3 marks)
3. (a) (i) A - nucleopore; B - Rough Endoplasmic Reticulum; (2 marks)
(b) Surface covered with ribosomes; for protein synthesis;
Has interconnected channels: for transportation of proteins; (2 marks)
4. (a) The solution was hypotonic/less concentrated compared to the cell sap of pawpaw cylinder cells;
The tissue/cells gained water by osmosis; becoming turgid/longer/stiff; (3 marks)
(b) Pawpaw cylinders of the same size/length; placed in an isotonic solution;
Boiled potato cylinders of the same size; placed in a similar solution; (2 marks)
5. (a) Plant C; (1 mark)
(b) Thick cuticle reduces water loss;
Low number of stomata reduces water loss;
Large root-surface area enhances water absorption; (3 marks)
6. (a) F - Bronchiole;
G - Intercostal muscles/external intercostal muscles; (2 marks)
(b) H - (Pleural membranes) secrete and enclose pleural fluid to lubricate lungs/protect lungs; (1 mark)
J - (Diaphragm) separates chest cavity from abdominal cavity/works to effect volume and pressure changes in chest cavity necessary for inhalation and exhalation/ventilation/breathing; (1 mark)

7. (a) Respiration/aerobic respiration; (1 mark)
- (b) Flask K Potassium hydroxide removes Carbon IV Oxide from atmospheric air; (1 mark)
- (c) L - Lime water remains clear because Carbon (IV) Oxide has been removed;
Flask N lime water forms a white precipitate because the respiring cockroaches produce Carbon (IV) Oxide; (2 marks)

8. Parental genotype is AB



or

♀ \ ♂	A	B
A	AA	AB
B	AB	BB

Probability is $\frac{1}{2}$ or 0.5/50%;

(4 marks)

9. Reduces dehydration; Avoid predators; (max) (1 mark)
10. Ability of an organism to detect, interpret and respond to changes in the environment/stimulus; (1 mark)
11. (a) Can contract continuously without fatigue;
Their contraction is started by the muscles themselves/myogenic; (2 marks)
- (b) stomach: smooth;
bone: skeletal; (2 marks)
12. (a) Fine adjustment knob; (1 mark)
- (b) Avoid refraction of light;
Prevent wetting of the slide; (1 mark)
(max)

13. Temperature; surface area; distance that particles have to travel; diffusion/concentration gradient; size/density of particles; surface area to volume ratio; thickness of membrane; medium of diffusion (3 marks)
14. (a) Aerobic respiration; (1 mark)
(b) It releases more energy per unit mass; (1 mark)
15. (a) Androgens; (1 mark)
16. The plant/flower is self sterile/not successfully self pollinated; covering prevents pollination; in flower P. Flower Q received pollen from other plants/cross pollination; (3 marks)
17. Carbon IV Oxide; Nitrogenous waste/urea; (2 marks)
18. Most of the waste products are harmless;
Converted into harmless products; (1 mark)
19. Passing urine frequently/polyuria; glucose/excess glucose in blood/hyperglycaemia; constant feeling of thirst/dehydration; loss of weight; excessive eating/increased appetite/polyphagia/hyperphagia; poor resistance to diseases; (4 marks)
20. height/length; weight/mass; surface area; (3 marks)
21. Nitrogen fixation; (1 mark)
22. Results in adaptations that enable organisms to exploit different ecological niches; leads to the formation of new species; (2 marks)
23. (a) Cellulose;
(b) Lignin; (2 marks)
24. Small/round; central nucleus/prominent nucleus; dense cytoplasm/protoplasm; no vacuoles; continuously dividing; thin cell walls (4 marks)
25. Ecdysone causes metamorphosis; towards adult stage
Juvenile hormone maintains larval characteristics; (2 marks)
26. (a) Theory of natural selection; (1 mark)
Theory of environmental influence on inherited characteristics; (1 mark)
(b) (i) Similar organelles performing similar functions in different organisms suggest a common ancestry/cell biology; (1 mark)
(ii) Fossil records/palaeontology/by comparing fossils to show phylogenetic relationship between organisms/common ancestry; (1 mark)

27. Removes excess water/waste products/Homeostasis; (1 mark)

28.

Open	Closed
<ul style="list-style-type: none">Blood flows in haemocoel/ sinuses/body cavity directly in contact with cellsBlood flows at low pressureBlood lack pigments	<ul style="list-style-type: none">Blood confined in vessels;Blood flows at high pressure;Blood has pigments for oxygen and Carbon (IV) Oxide transportation

(2 marks)

29. Water; mineral ions; vitamins

First two

2 marks

30. (i) Smooth endoplasmic reticulum;

(1 mark)

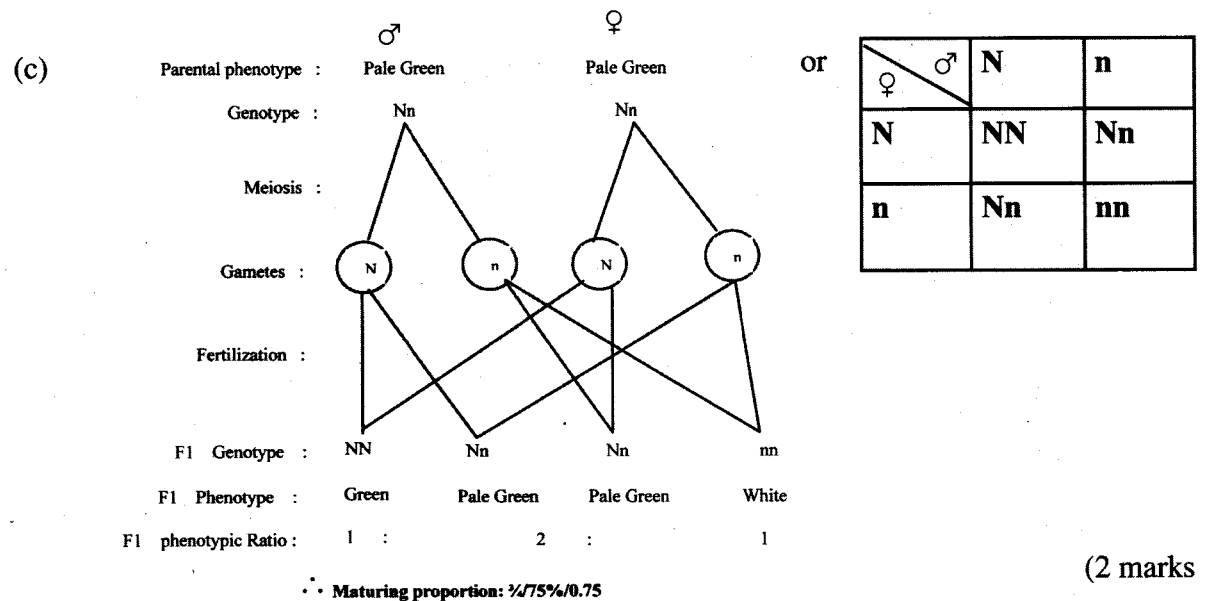
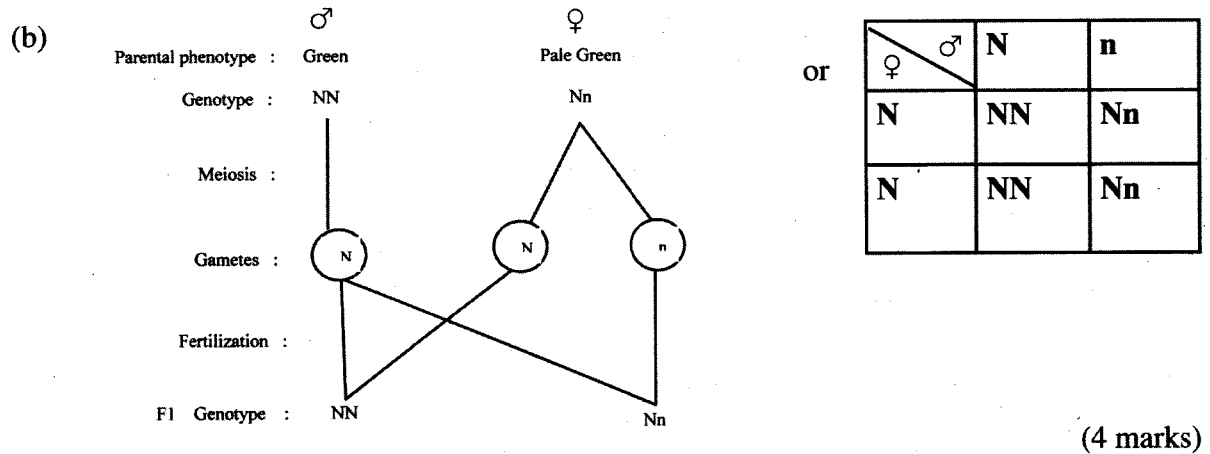
(ii) Golgi bodies/golgi apparatus.

(1 mark)

5.2.2 Biology Paper 2 (231/2)

1. (a) Lack of chlorophyll, the plants do not manufacture food photosynthesize; plants die as soon as the stored food reserves get depleted; (2 marks)

(b) Parental phenotype: Normal x pale green



2. (a) E - glomerulus; (1 mark)
F - loop of henle; (1 mark)
- (b) It is long; to increase the surface area for re-absorption of water;
It is U - shaped; to bring about counter - current flow/multiplier effect to enhance, water absorption.
It is lined with a network of blood capillaries; to enhance re-absorption of water; (4 marks)
- (c) vasoconstriction; hair rises; metabolic rate increases; shivering (3 marks)
First correct 3

3. (a) (i) chlorophyll; (1 mark)
(ii) oxygen; (1 mark)
(iii) Test tube **H** is at optimum temperature for enzyme activity; hence high rate of photosynthesis/more bubbles. In test tube **J** most enzymes have been denatured by the high temperature; hence low rate of photosynthesis/fewer bubbles. (2 marks)
- (b) – The villus epithelium is thin; for faster diffusion of dissolved food substances;
– The epithelium has goblet cells; which produce mucus to lubricate food passage;
– They have microvilli; which further increase their surface area for absorption;
– Have lacteal; for absorption of fatty acid & glycerol/transportation of lipids;
– Highly vascularised; for absorption of digested food. (4 marks)
First correct 2
4. (a) (i) **K** - ulna; (1 mark)
L - humerus; (1 mark)
- (ii) movement of the lower arm upwards takes place at the elbow/olecranon process which is between the ulna and the humerus; biceps/flexor muscles contract; while the triceps/extensor muscles relax; bringing about the movement of the lower arm upwards. (3 marks)
- (b) – The rigid midrib holds leaf out away from the stem;
– Profuse network of veins have lignified cells which support leaf to stay spread out;
– Turgidity in spongy mesophyll and palisade cells support the leaf to remain open; (3 marks)
5. (a) The external intercostal muscles contract while internal intercostal muscles relax; the rib cage is pulled upwards and outwards; the diaphragm muscles contract and the diaphragm flattens; the volume of the thoracic cavity increases/the pressure in the thoracic cavity decreases; air rushes into the lungs; from the atmosphere through the nose (4 marks)
- (b) The osmotic pressure of guard cells increase when sugar is manufactured during photosynthesis/starch is converted to sugar in low acidity/potassium moves into guard cells during the day; water enters guard cells from the surrounding cells by osmosis; because the guard cells are bean shaped with thin outer walls and thick inner walls, the thin outer walls expand faster as the cell becomes turgid; thus the thick inner wall curves; causing the stomatal aperture to open. (4 marks)

6. (a) (i) title - Graph of Prey-predator relationship; (OWTE)

Scales X axis; Graph should cover more than half of the grid provided.
Y axis; Graph should cover more than half of the grid provided.

correct plotting P; Q;
smooth curves P; Q;

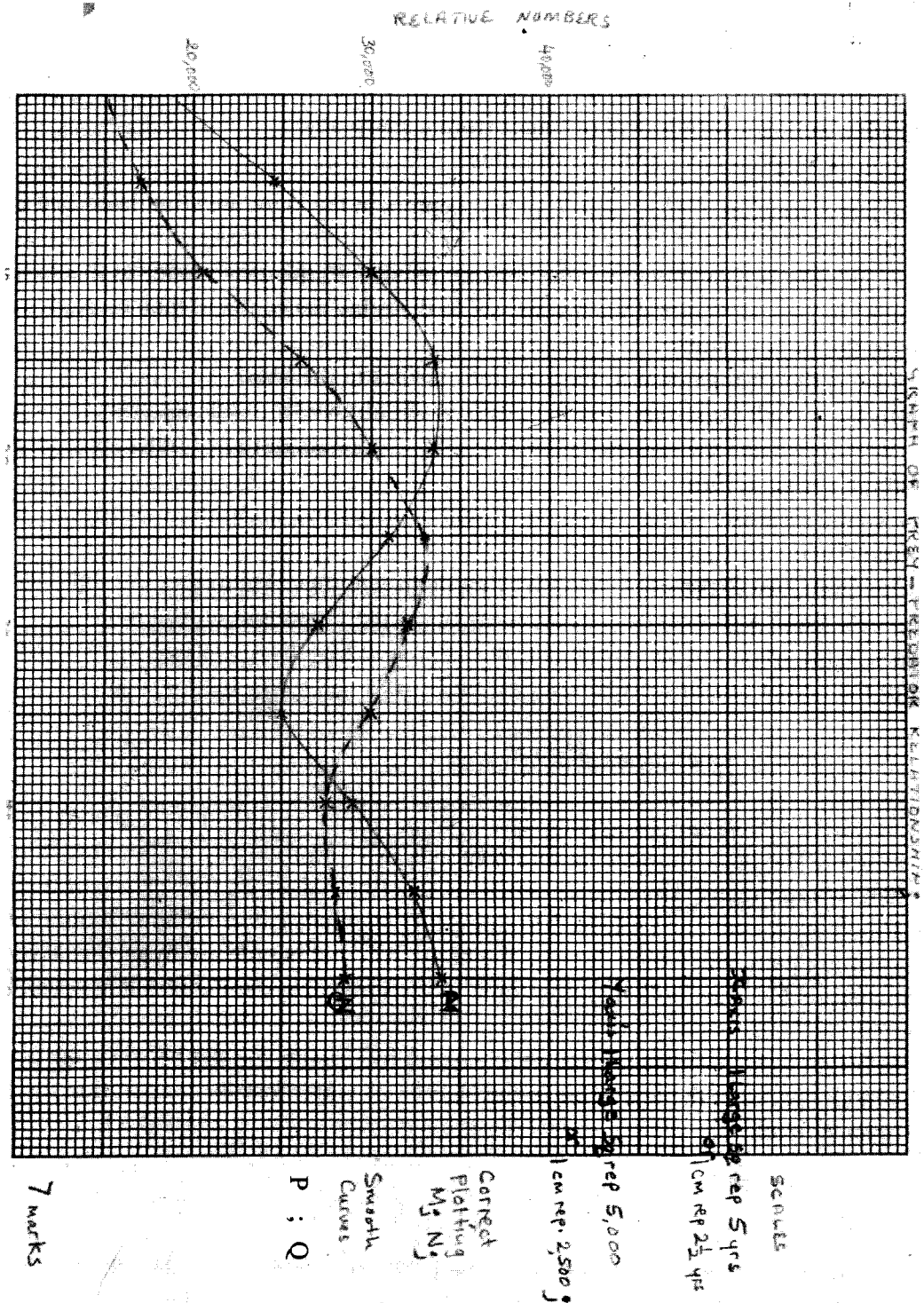
labelling axes;

(7 marks)

(ii) P represents the prey;
- Prey population is initially higher/
prey population usually starts falling earlier;

(1 mark)

(iii) Both populations decrease; (1 mark)
because prey is not enough to sustain predator/population environmental stress limit
population of prey; (1 mark)



- (iv) at 23 ± 0.5 years; and at 39 ± 0.5 ;

(2 marks)

- (v) less food for the prey/intra specific competition;
emigration of the prey;
diseases causing death of the prey;
parasitism;
human activities

(3 marks)

- (b) sulphur dioxide in the air - causes respiratory diseases; poisons plants; forms acid rain which increase soil pH; corrodes metals in buildings; (4 marks)
Total (20)

7. **Simple reflex action** - withdrawal of finger from a sharp object.

Is an automatic response to a specific stimulus;

When the finger touches a sharp object, pain receptors in the skin; are stimulated and trigger off a nerve impulse;

The nerve impulse is transmitted via the sensory neuron; to the grey matter of the spinal cord;

The impulse is then transmitted via a synapse; to the relay neuron; and then through another synapse; to the motor neuron;

The impulse is then transmitted to the effector muscles in the hand;

These effector muscles contract; and the finger is withdrawn from the hot object;

(Accept use of other relevant examples)

Conditioned reflex action

Is an automatic response evoked from an animal by unrelated stimulus; substituted for the one which normally elicits the response;

It develops from past experience; and involves modification of behaviour through learning; It weakens with time; and must be reinforced by repeating the unrelated stimulus;

Students salivate when the bell for lunch rings; because they have learned to associate the ringing of the bell at lunchtime with food; from experience; every time it rings, they are offered food;

(Accept use of other relevant examples)

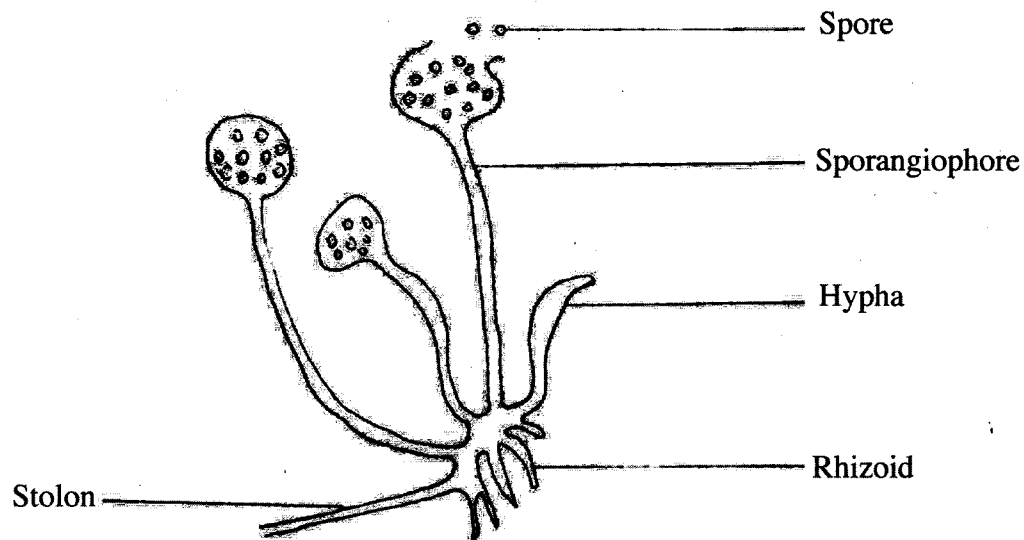
Maximum 20 marks

8. (a) An allergic reaction is a hypersensitive response; to an antigen by the body immune system; The body immune system responds by overproducing antibodies; against harmless antigens; The antigen-antibody reaction occurs on the surface of body cells; which burst open; and release histamines; Histamines cause inflammation/itching/swelling/pain, etc; which damage the body; Allergic people are hypersensitive to materials like dust/pollen grains/some foods/some drugs/some pollutants, etc; (10 marks)
- (b) In bright light; stomata are fully/wide open; increasing contact between the atmosphere and air spaces in the leaf; This in turn increases water loss by evaporation through the open stomata
- High environmental temperatures; increase the rate of evaporation from the leaf surface thus more water leaves cells due to the increased diffusion gradient;
- In a windy day; air around the leaf is carried away reducing water vapour around the leaf; more water moves into the atmosphere from the leaf air spaces;
- In low humidity/when the atmosphere is less saturated with water vapour; more water will move from leaf air spaces into the atmosphere; leading to increased rate of transpiration;
- Low atmosphere pressure; increases diffusion gradient between atmospheric and leaf increased rate of evaporation;
- Availability of water; causes turgidity of guard cells hence stomata open; increasing rate of transpiration.

(10 marks)

5.2.3 Biology Paper 3 (231/3)

1. (a) (i) Epigeal germination; (1 mark)
 (ii) Hypocotyle grows faster; raising the cotyledons above the ground level; (2 marks)
- (b) Protection of the embryo/plumule/plumule and radicle;
 Food storage;
 Photosynthesis; (3 marks)
- (c) Emergence of the hypocotyle exposes it to light;
 Light stimulates migration of auxins to the lower side of the hypocotyle;
 High concentration of auxins; on the lower side;
 Stimulates faster rate of growth than on the upper side;
 Faster elongation of the lower side straightens the seedlings; (6 marks)
2. (a) (i) Rhizopus/Bread mould/cassava mould/ugali mould/mould/mucor; (1 mark)
Rhizopus spp;
- (ii) By spores/sporulation/sporulation; (1 mark)
- (iii)



Mg x5 - x 25

Drawing (D)

1. Continuous outline
2. Use of double lines
3. Stolon/Rhizoid not a must

L = 5 max 2 marks

D = 1

mg = 1

Max = 3 marks

- (b) (i) Dicotyledonae; (1 mark)
- (ii) Net/Reticulate venation/network venation;
Floral parts in 5s/fours/five sepals/five petals;
Broad leaf lamina/bract;
Presence of leaf paticle; (3 marks)
- (iii) Insects; (1 mark)
- (iv) Conspicuous bracts/ petals/ sepals/brightly coloured petals/bracts;;
Tabular corolla;
Landing stage/corolla stage/platform; First correct three (3 marks)
- (v) Bract; (1 mark)

3. (a)

	F (pH 5)	G (pH 7)	H (pH 9)
Volume of solution + portion of potato	2.2 ± 0.2 ;		
Volume of solution + portion of potato + foam	4.2 ± 0.5 ;		
Volume of foam	2.0 ± 0.5 ;		

- Award accuracy for volume of solution + portion of potato $3 \times 1 = 3$ marks
 - Values should be $F < G < H$ and solution + potato + foam is $>$ solution + potato; 3 marks
 - Award correct subtraction for volume of foam $3 \times 1 = 3$ marks
- (b) The enzyme catalase; in the potato tissue breaks down hydrogen peroxide to water; and oxygen; (3 marks)
- (c) More foam is produced at pH 9; which is optimum for catalase activity; (2 marks)