

6.0 BIOLOGY (231)

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

6.1 CANDIDATES' GENERAL PERFORMANCE

The performance of the candidates in the three Biology papers is given in the table below. The performance of candidates in the years 2006 and 2007 is also give for comparison.

Table 11: Candidates' Overall Performance in Biology in the years 2006, 2007 and 2008

Year	Paper	Candidature	Maximum Score	Mean Score	Standard Deviation
2006	1		80	19.83	13.35
	2		80	23.2	13.06
	3		40	11.63	7.00
	Overall	217,675	200	54.89	31.00
2007	1		80	27.10	13.68
	2		80	35.01	14.63
	3		40	21.81	8.73
	Overall	248,519	200	83.90	33.00
2008	1		80	22.24	13.42
	2		80	21.09	11.55
	3		40	17.30	6.76
	Overall	274,215	200	60.64	29.12

From the table above, it can be observed that:

- 6.1.1 The candidature has been increasing over the years.
- 6.1.2 There was a drop in performance in the year 2008 when compared to 2007, with lower mean scores and standard deviations in all the three papers.

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

6.2 PAPER 1 (231/1)

Question 2

State the importance of the following processes that take place in the nephron of a human kidney:

- (a) ultrafiltration;
- (b) selective reabsorption.

The candidates were required to know the importance of ultrafiltration and re-absorption.

Weaknesses

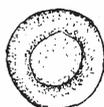
The candidates gave the meaning of the ultrafiltration and re-absorption instead of their importance. They did not mention direction of movement of substances. Majority were not able to name the materials ultra filtrated or reabsorbed. Some did not know the difference between re-absorption and absorption.

Expected Responses

- (a) **Ultra filtration:** To remove toxic/ harmful substances/urea/nitrogenous waste from the blood stream.
- (b) **Selective re-absorption:** To return useful substances/glucose and amino acids back into the blood stream.

Question 4

The diagrams below show a red blood cell that was subjected to a certain treatment.



At start



At the end of experiment

- (a) Account for shape of the cell at the end of the experiment.
- (b) Draw a diagram to illustrate how a plant cell would appear if subjected to the same treatment.

The candidates were required to know what treatment would cause a red blood cell to crenate and draw a diagram to represent a plasmolysed cell.

Weaknesses

The candidates confused the terms “*turgid*”, “*flaccid*” and “*crenation*”. The term “*treatment*” was interpreted by some to mean “*medicine*”. The diagrams were poorly drawn and although labelling was not required they were wrongly labelled. Some candidates shaded or dotted the diagrams.

Expected Responses

- (a) The red blood cell was placed in a hypertonic solution. It lost water by osmosis and became crenated.

Question 5

- (a) State **two** factors that affect enzymatic activities.
- (b) Explain how **one** of the factors stated in (a) above affects enzymatic activities.

Candidate were required to recall any of the factors that affect enzymatic activities:- temperature, pH, substrate concentration, co-factors and inhibitors.

Weaknesses

Candidates wrote “*pH*” as “*ph*” and “*PH*”. Some confused enzyme with substrate concentration. Majority of candidates only recalled temperature and pH. Others confused properties with factors affecting enzymatic activities.

Expected Reponses

- (a) Temperature; pH; co-factors; co-enzyme; substrate concentration; cell wall inhibitors; enzyme concentration; product concentration.

Question 7

- (a) What is a fossil?
- (b) How does convergent evolution occur?

Candidates were required to define the term fossil and describe how convergent evolution occurs.

Weaknesses

In defining fossil, the word '*preserved*' was missing making the definition incomplete or wrong. There was confusion between "*homologous*" and "*analogous*" structures and also between "*divergent*" and "*convergent*" evolution.

Expected Responses

- (a) Preserved remains of dead organisms that lived in ancient times.
- (b) Convergent evolution occurs when two dissimilar species/structures/organisms of different embryonic origin in response to similar environmental conditions develop similar characteristics/modified to perform similar functions.

Question 9

Give **three** factors that determine the amount of energy a human being requires in a day.

Candidates were required to mention three factors that determine the amount of energy a human being requires in a day.

Weaknesses

Most candidates gave health as a factor and confused "*gender*" with "*sex*". They gave factors affecting rate of respiration. "*Metabolic rate*" was confused with "*B.M.R*" and majority explained instead of stating.

Expected Responses

- Sex.
- Basal metabolic rate (B.M.R).
- Occupation/activity.
- Age.
- Body size.

Question 10

- (a) Name the antigens that determine human blood groups.
- (b) State the adaptation that enables the red blood cells to move in blood capillaries.

Candidates were to name the antigens that determine blood groups.

Weaknesses

Many candidates named blood groups and many did not know the difference between "*antigens*" and "*antibodies*".

Expected Responses

- (a) Antigens A; and B/ rhesus factors/rhesus antigens/antigen D.
- (b) Pliable/flexible/able to change its shape.

Question 14

Describe the **three** characteristics of a population.

The candidates were required to state characteristics of a population and explain each one of them.

Weaknesses

Most candidates were not able to state correct characteristics. Some gave general definitions of populations. Others simply stated but did not explain.

Expected Responses

- **Growth:** increase in numbers/decrease in numbers/change in numbers/growth rate.
- **Dispersion:** spread or distribution of organisms in a habitat.
- **Density:** the number of individuals per unit area.

Question 15

Explain what happens when there is oxygen debt in human muscles.

Candidates were required to have the knowledge of anaerobic respiration, oxygen debt and its effects on the tissues.

Weaknesses

Most candidates scored on either the second or last marking point and missed the first mark of muscles being subjected to respire anaerobically. Others confused "***lactic acid***" with "***pyloric acid***".

Expected Responses

Muscles are subjected to respire anaerobically resulting in accumulation of lactic acid in the tissue causing fatigue/muscle cramps.

Question 17

Account for the following phases of a sigmoid curve of growth of an organism:

- (a) lag phase;
- (b) plateau phase.

Candidates were required to account for some phases of a sigmoid curve of growth of an organism.

Weaknesses

The candidates did not realize that they were describing growth in one organism. There was confusion of number of

cells increasing with number of organisms increasing.

Expected Responses

- (a) **Lag phase:** The number of cells dividing are few/the cells have not yet adjusted to the surrounding environmental factors.
- (b) **Plateau phase:** Most cells fully differentiated/few cells are still dividing. Rate of cells dividing is equal to rate of cells dying.

Question 20

- (a) What is single circulatory system?
- (b) Name an organism which has single circulatory system.
- (c) Name the opening to the chamber of the heart of an insect.

Candidates were required to have the knowledge of circulatory systems and blood flows in the systems.

Weaknesses

Some candidates gave incomplete answers. Many replaced the heart with the body. Majority were not able to distinguish between “closed”, “open single” and “double circulatory” systems.

Expected Responses

- (a) Circulatory system in which blood passes through two capillary systems before flowing back to the heart/blood passes only once through the heart to complete the circuit.
- (b) Earthworm/Leech/Ragworm/fish.
- (c) Ostium.

Question 22

State **two** characteristics of aerenchyma tissue.

Candidates were required to state two characteristics of aerenchyma tissue.

Weaknesses

Majority of the candidates did not qualify their answers. The word ‘**large**’ was not mentioned, while others gave many air spaces as a response. The nature of the cell walls was missing in most of candidates answers.

Expected Responses

- Large air spaces.
- Thin cell walls.

Question 27

Explain how anaerobic respiration is applied in sewage treatment.

The application of anaerobic respiration in sewage treatment was required.

Weaknesses

90% of the candidates did not get marks in this question. Majority of the candidates were unable to relate bacteria to sewage treatment/breakdown. Most of them thought micro organisms were to suffocate first and get destroyed during the treatment.

Expected Responses

(Anaerobic) micro organism/break down harmful substances in sewage.

Question 29

State a function of amniotic fluid.

Candidates were to state the function of amniotic fluid.

Weaknesses

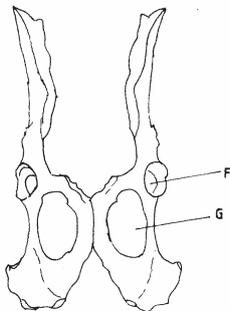
Some candidates confused “*baby*” with “*foetus*” and “*child*”. Some of the candidates could not associate amniotic fluid with the foetus in the uterus.

Expected Responses

Cushions foetus against shock/provides a suitable medium for embryo to grow.

Question 30

The diagram below shows two fused bones of a mammal.



- (a) Identify the fused bones.
- (b) Name the
 - (i) bone that articulates at the point labelled **F**
 - (ii) the hole labelled **G**.

Candidates were required to identify bones that fuse to make up the pelvic girdle.

Weaknesses

Many candidates left this question unanswered while others gave incorrect responses.

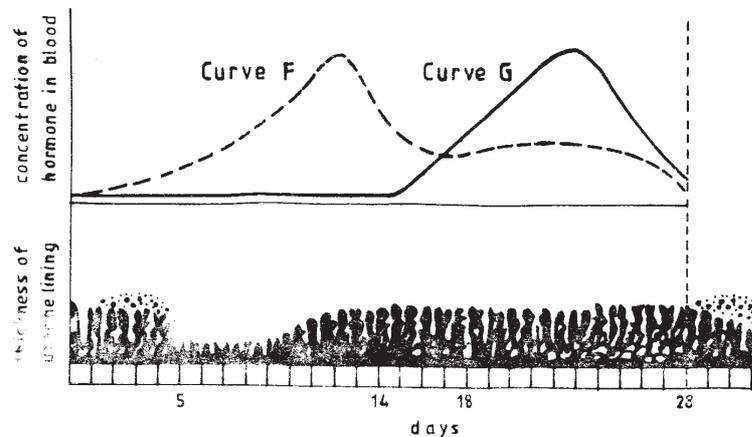
Expected Responses

- (a) Pelvic girdle.
- (i) Femur.
(ii) Obturator foramen.

6.3 PAPER 2 (231/2)

Question 1

The figure below shows changes that take place during menstrual cycle in human.



- (a) Name the hormones whose concentrations are represented by curves F and G.
- (b) State the effects of the hormones named in (a) above on the lining of the uterus.
- (c) (i) Name the hormone which is released by the pituitary gland in high concentration on the 14th day of the menstrual cycle.
(ii) State **two** functions of the hormone named in (c)(i) above.
- (d) State the fertile period during the menstrual cycle.

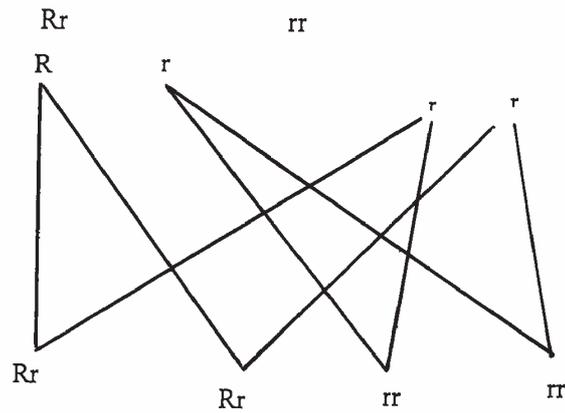
Candidates were required to know the role of hormones in the menstrual cycle and fertility period.

Weaknesses

The candidates showed lack of mastery of the roles of specific hormones and also could not determine the fertile period.

Expected Responses

- (a)
- F: Oestrogen.
 - G: Progesterone.
- (b)
- F: Promotes healing and repair of the uterus.
 - G: Causes thickening of the uterine lining.



Genotype	Rr	rr
Phenotype	Round seeds	Wrinkled seeds

(d) Test cross whether an individual showing a character for a dominant gene is homozygous or heterozygous.

Question 5

A freshly obtained dandelion stem measuring 5cm long was split lengthwise to obtain two similar pieces.

The pieces were placed in solutions of different concentrations in petri dishes for 20 minutes.

The appearance after 20 minutes is as shown.



- Account for the appearance of the pieces in solutions L_1 and L_2 .
- State the significance of the biological process involved in the experiment.

Candidates were required to have the knowledge of plant cell physiology.

Weaknesses

Candidates could not distinguish between “*hypotonic*”, “*hypertonic*” and “*isotonic*”. Other candidates were not clear as to the difference between “*epidermis*”, “*cortex*”, “*bulging*” and “*curving*”.

Expected Responses

- L_1 : Inner cells gained water by osmosis. Increased in length hence becoming turgid, leading to curvature. The epidermal cells did not gain water because they are covered by a waterproof cuticle.

L₂: Inner cells lost water (by osmosis) leading to flaccidity hence the curvature. The epidermal cells did not gain water due to waterproof cuticle.

- (b)
- Support in herbaceous plant.
 - Absorption of water.

Question 6

An experiment was carried out to investigate transpiration and absorption of water in sunflower plants in their natural environment with adequate supply of water. The amount of water was determined in two hour intervals. The results are shown in the table below.

Time of day	Amounts of water in grammes	
	Transpiration	Absorption
11 00 – 13 00	33	20
13 00 – 15 00	45	30
15 00 – 17 00	52	42
17 00 – 19 00	46	46
19 00 – 21 00	25	32
21 00 – 23 00	16	20
23 00 – 01 00	08	15
01 00 – 03 00	04	11

- (a) Using the same axes, plot graphs to show transpiration and absorption of water in grammes against time of the day.
- (b) At what time of the day was the amount of water the same for transpiration and absorption?
- (c) Account for the shape of the graphs of:
- (i) transpiration;
 - (ii) absorption.
- (d) What would happen to transpiration and absorption of water if the experiment was continued till 05 00 hours?
- (e) Name **two** factors that may affect transpiration and absorption at any given time.
- (f) Explain how the factors you named in (e) above affect transpiration.

Candidates were required to have knowledge about:

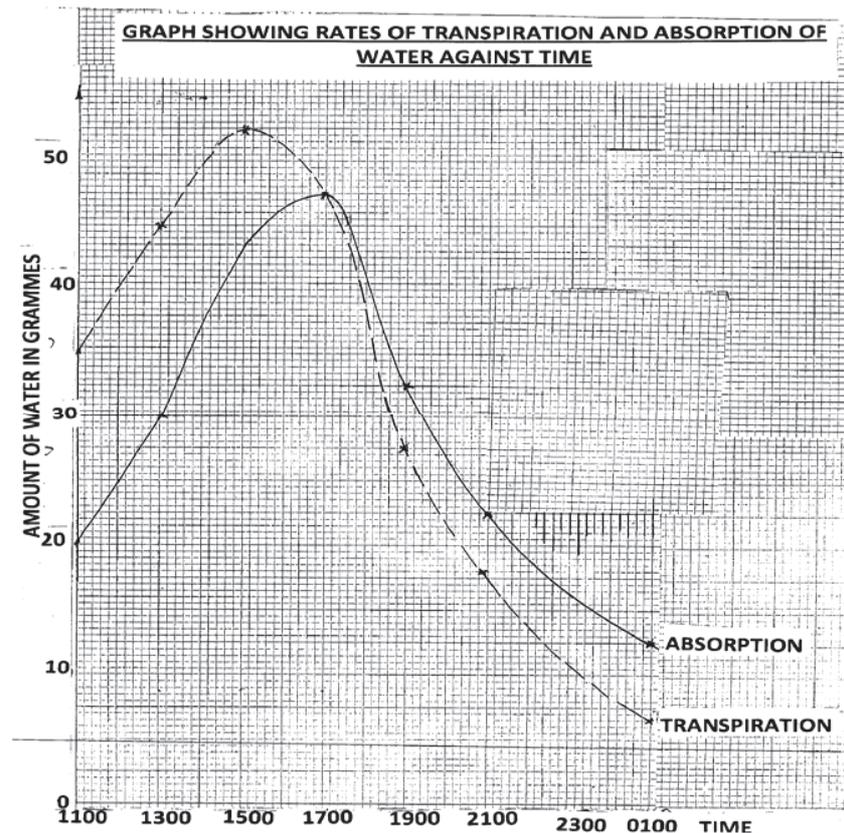
- i) a 24 hour day;
- ii) plotting of graphs;
- iii) interpretation of the graph with respect to time of the day;
- iv) factors that affect transpiration and absorption;
- v) relationship between transpiration and absorption.

Weaknesses

Candidates could not relate the two processes to time of day. Plotting the graph and the curve was difficult to most of them and many were not able to explain how atmospheric pressure and humidity affect the rate of transpiration and absorption of water.

Expected Responses

(a)



(b) 17.00 – 19.00 hrs;

(c) (i) *Transpiration*

- **11.00 – 19.00 hrs:** (Rapid) Increase in the rate of transpiration due to high light intensity/high temperature.
- **10.00 – 03.00 hrs:** Decrease in the rate of transpiration due to low light intensity (or absence of light)/low temperature.

(ii) *Absorption*

- **11.00 – 19.00 hrs:** Increase in the rate of absorption of water to replace water lost through transpiration.
- **19.00 – 03.00 hrs:** Decrease in rate of absorption of water due to the fact that the rate of transpiration has declined.

(d) Both transpiration and absorption decrease.

- (e) Wind, humidity, atmospheric pressure.
- (f)
- **Wind:** the rate of transpiration is faster when it is windy than when the air is still.
 - **Humidity:** when humidity is low, the rate of transpiration is faster due to a steep diffusion gradient than when it is high.
 - **Atmospheric pressure:** the rate of transpiration is high at low atmospheric pressure due to a high diffusion gradient between inter cellular spaces and the atmosphere than at high atmospheric pressure.

Question 7

Describe the nitrogen cycle.

Candidates were required to have knowledge of the nitrogen cycle.

Weaknesses

Candidates' responses indicated confusion on the role of different types of bacteria, fungi, algae and lightning. The chemistry behind formation of nitrates was not known. Knowledge on purification to form ammonia was lacking.

Expected Responses

During thunderstorms, nitrogen gas combines with oxygen to form nitrogen oxides. Nitrogen oxides dissolve in water to form nitric acid. Acid is deposited in the soil by rain, nitric acid combines with chemical substance to form nitrates, which are absorbed by plants.

In the soil, symbiotic bacteria such as Rhizobium which are found in root nodules of leguminous plants fix free nitrogen to nitrates, free living bacteria such as clostridium and Azotobacter fix nitrogen to nitrates. Nostoc algae and Anabaena fix nitrogen to nitrates. Plants use nitrates to form plant proteins from nitrates. Animals feed on plants and convert plant proteins into animal proteins. Plants and animals die and are decomposed by bacteria and fungi. Decomposing plants and animals release ammonia which is converted to nitrites by nitrosomonas bacteria. Nitrites are converted to nitrates by nitrobacter bacteria. Nitrates in the soil can be converted to free nitrogen denitrification by some fungi/pseudomonas/thiobacillus bacteria.

Question 8

- (a) State **four** characteristics of gaseous exchange surfaces.
- (b) Describe the mechanism of gaseous exchange in a mammal.

Candidates were required to have knowledge on characteristics of gaseous surfaces and mechanism of gaseous exchange in a mammal.

Weaknesses

Candidates gave characteristics of specific surfaces instead of characteristics that are general and common to all surfaces. They did not qualify the blood capillaries or even thinness of the walls. There was confusion of roles played by the parts involved in inhalation and exhalation.

Expected Responses

- (a)
- Highly vascularized/network of blood capillaries.

- Large surface area for gaseous exchange.
- Thin membrane.
- Moist lining.

(b) ***Breathing in:*** External intercostal muscles contract, internal intercostal muscles relax, lifting the ribcage upwards and outwards. Muscles of the diaphragm contract, hence, it flattens. The volume of the thoracic cavity increases, while the pressure decreases. Higher air pressure in the atmosphere forces air into lungs through nose.

Breathing out: External intercostal muscles relax, while internal intercostal muscles contract, moving the ribcage downwards and inwards. The muscles of the diaphragm relax, hence, the diaphragm assumes dome shape. The volume of thoracic cavity decreases, while pressure increases, forcing air out of the lungs through the nose.

6.4 PAPER 3 (231/3)

Question 1

Below is a photograph of a dissected mammal. Examine the photograph.



- (a) Name the parts labelled A, B, C, D and G.
- (b) State the function of the structures labelled E and F.
- (c) In the photograph label the structure where vitamin K is produced.
- (d)
 - (i) Name the sex of the mammal in the photograph.
 - (ii) Give a reason for your answer in (d) (i) above.
- (e)
 - (i) The actual length of the dissecting scissors in the photograph is 15 cm. Calculate the magnification of the photograph.
 - (ii) Calculate the actual length of the mammal from the tip of the nose to point X on the tail.

Candidates were required to observe a photograph of a dissected mammal, identify some parts, stating functions, carry out some measurements and calculate magnification.

Weaknesses

Majority of the candidates had wrong spellings and most were unable to relate organ to function. Poor identification of digestive system organs in a mammal was evident in candidates' responses and many candidates were unable to measure and calculate magnification. There was confusion of technical terms, for example "*egestion*", "*excretion*" etc.

Expected Responses

- (a) **A:** Liver;
B: Stomach;
C: Spleen;
D: Small intestines;
G: Duodenum;
- (b) **E:** Store faeces/undigested food/indigestible food materials.
F: It contains/stores/harbours bacteria; which produce cellulose /enzymes to breakdown/ digest cellulose/digestion of cellulose
- (c) Colon/large intestines.
- (d) (i) Male
(ii) Presence of the prostate gland/testis/seminal vesicles.
- (e) (i) $\frac{9}{15} = X0.6 / \frac{3}{5}$
(ii) $\frac{14.6cm}{0.6} = 24.3cm$

Question 2

You are provided with substances labelled **S, T, U, X** and **Y**. **S, T** and **U** are food substances, while **X** is 10% sodium hydroxide solution and **Y** is 1% copper sulphate solution. Carry out tests to determine the food substance(s) in **S, T** and **U**.

Substance	Food substance being tested for	Procedure	Observations	Conclusion
S				
T				
U				

Candidates had to use reagents provided to carry out food tests, record correct procedure, name the food to be tested, make observations and conclusions.

Weaknesses

Most candidates had incorrect procedures, wrong colour observations, wrong spellings and confused the foods to be

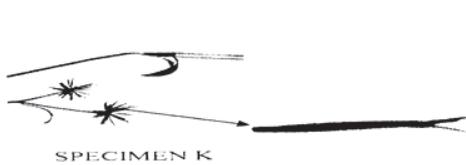
tested. Poor recording of procedures, observations and conclusions was also evident in candidates responses.

Expected Responses

Substance	Food substance being tested	Procedure	Observation	Conclusion
S	Protein	To 1 ml of food substance add equal amount of sodium hydroxide, add a few drops of copper sulphate solution dropwise, shaking after each drop.	Purple, violet colour	Protein present
T	"	"	No colour change/ blue colour	Protein absent;
U	"	"	Light pale purple colour	Trace protein present

Question 3

Below are photographs of specimens obtained from plants. Examine the photographs.



- (a) In the table below name the mode of dispersal and the features that adapt the specimen(s) to that mode of dispersal.

Specimen	Mode of dispersal	Adaptive features
K		
L		
M		
N		
P		
Q		

- (b) (i) Label any **two** parts on specimen **L**.
- (ii) State the type of placentation in specimen **L**.
- (c) Name the structure labelled **W** on specimen **P**.

Candidates had to identify various kinds of fruits and relate adaptive features to mode of dispersal and name some parts of fruits.

Weaknesses

Candidates confused “*pollination*” and “*dispersal*”, “*seed*” and “*fruit*”, “*mode of dispersal*” and “*agent of dispersal*”. Parts of fruits were wrongly spelt.

Expected Responses

(a)

Specimen	Mode of dispersal	Feature that adapts the specimen to mode of dispersal
K	Animal(s)	Hooks
L	Animal(s)	Fleshy/succulent/juicy
M	Wind	Parachute hairs/pappus
N	Wind	Winged/pericarp
P	Animal(s)	Fleshy/succulent
Q	Self mechanism/explosive	Lines of dehiscence/weakness/sutures

- (b) (i) Specimen L
- Epicarp
 - Mesocarp.
 - Endocarp.
 - Seed.

(ii) Axile/central.

(c) Seed/endocarp.

6.5 ADVICE TO TEACHERS

- 6.5.1 Questions testing experimental design were performed poorly by candidates. Teachers should carry out experiments on physiological process, for example: osmosis.
- 6.5.2 The correct way of drawing and labelling of diagrams and drawings should be practiced and emphasized during the teaching – learning process.
- 6.5.3 Despite having a question on genetics every year the performance in this area is still poor and requires more emphasis during teaching.
- 6.5.4 Evolution is still not understood well by candidates and every year questions testing evolution are performed poorly.
- 6.5.5 Stages of “*mitosis*” and “*meiosis*” are not clearly understood by candidates. Use of slides may help in this area.
- 6.5.6 Questions that test adaptation are performed poorly because candidates do not relate structure to function.
- 6.5.7 Use of correct terms when teaching Biology will promote correct use by candidates.
- 6.5.8 The results of practical papers indicate that practicals are not taught well.