

6.0 BIOLOGY (231)

This is the fourth time the revised KCSE Biology syllabus was tested.

6.1 CANDIDATES' GENERAL PERFORMANCE



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The performance of the candidates in the three Biology papers is given in the table below. The performance of candidates during the last three years is also given for comparison.

Table 11: Candidates' Overall Performance in Biology during the years 2006, 2007, 2008 and 2009

Year	Paper	Candidature	Maximum Score	Mean Score	Standard Deviation
2006	1		80	19.83	13.35
	2		80	23.02	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	8.72
	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
2009	1		80	20.14	12.31
	2		80	18.41	10.30
	3		40	15.86	8.43
	Overall	299,302	200	54.29	28.80

From the table it can be observed that:

- 6.1.1 The candidature has been increasing over the years.
- 6.1.2 The performance in 2009 is comparable to that of 2006 where the mean score and standard deviation are comparable.
- 6.1.3 The performance in 2007 was the best but dropped the following year, 2008.

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

6.2 PAPER 1 (231/1)

Question 3

State the functions of the following parts of a light microscope:

- (a) Objective lens
- (b) Diaphragm

Candidates were required to state functions of some parts of a light microscope.

Weaknesses

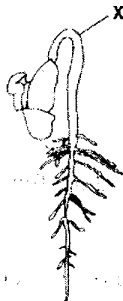
Candidates confused the objective lens with the adjustment knobs and functions of diaphragm mistaken for those of the mirror and condenser.

Expected Responses

- (a) Magnification of the object/image; Acc. Magnification alone
- (b) Regulate amount of light (falling on the object on microscope).

Question 4

- (a) The state during which a seed cannot germinate even when conditions for germination are suitable is called
- (b) The diagram below represents a stage during germination of a seed.



- (i) Name the type of germination illustrated in the diagram.
- (ii) State the role of the part labeled X during germination of a seed

Candidates were required to know germination of seeds; types of germination, the role of epicotyl and seed dormancy.

Weaknesses

Candidates confused dormancy with dominance and confused ground, surface and in soil for above the ground. Other labeled X instead of stating the function showing lack of understanding the question.

Expected Responses

- (a) (seed) dormancy;
- (b) (i) Epigeal;
- (ii) Protection of the (delicate) plumule; pulls the cotyledons above the ground;

Question 5

- (a) What is meant by the following terms:
 - (i) hybrid vigour;
 - (ii) polyploidy?
- (b) State **two** causes of chromosomal mutations.

Candidates were required to define hybrid vigour, polyploidy and causes of chromosomal mutations.

Weaknesses

Candidates did not bring out the comparison of offspring with the parents. They said polyploidy is having an extra chromosome. They also confused causes of gene and chromosomal mutations.

Expected Responses

- (a) (i) Production of plants and animals that have greater productivity/have beneficial characteristics than either of their parents.
- (ii) Condition in which an individual has more than two sets of chromosomes;

- (b)
- Radiation such as alpha, gamma, beta and UV light, X-rays;
 - Increase in temperature;
 - Chemicals such as colchicines/ phenols/ pesticides;
 - Heavy metals such as lead/ mercury;
 - Viruses such as papilloma;
 - Mustard gas for gene mutation;

Question 7

State the functions of the following cell organelles:

- (a) Ribosomes
 (b) Lysosomes

Knowledge of structure of the cell and its cell organelles and the functions of the cell organelles was required.

Weaknesses

Candidates interchanged functions of lysosome with those of ribosomes. For lysosome they confused the word destroy with repair.

Expected Responses

- (a) (Site) protein synthesis;
 (b) Break down worn out cells/organelles/food materials;

Question 9

- (a) Name the causative agents of the following diseases in humans:
 (i) typhoid;
 (ii) amoebic dysentery
 (b) Name the disease in humans caused by *plasmodium falciparum*.

Candidates were required to name some diseases in humans and their causative agents.

Weaknesses

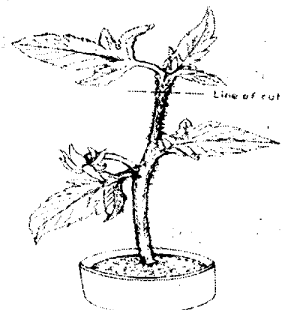
Poor spelling as well as not following rules of writing scientific names taught in Binomial nomenclature e.g. underlining separately and use of capital and small letters were common.

Expected Weaknesses

- (a) (i) *Salmonella typhi*;
 (ii) *Entamoeba histolytica*;
 (b) Malaria;

Question 11

In an experiment the shoot tip of a young tomato plant was decapitated as shown in the diagram below.



- (a) State the expected results after 2 weeks.

- (b) Give reasons for your answer in (a) above.

Candidates were tested on apical dominance.

Weaknesses

Candidates used words grouping, forming, sprouting and developing interchangeably. Period of two weeks not well understood and they showed lack of knowledge of biological terms e.g. decapitation.

Expected Responses

- (a) The auxillary buds will sprout/lateral buds will sprout/lateral branches will be formed;
- (b) Decapitation removes the hormone auxins/IAA which is produced in terminal bud/the stem tip; absence/removal of the hormone promotes branching/development of auxillary/lateral buds;

Question 13

- (a) Distinguish between diffusion and active transport.
- (b) State **one** role that is played by osmosis in:
- (i) plants;
- (ii) animals.

Candidates were to distinguish between diffusion and active transport.

Weaknesses

Candidates confused the two physiological processes with osmosis. Students only defined without bringing out differences and assuming osmosis is for all molecules instead of water only.

Expected Responses

- (a) In diffusion molecules move from a highly concentrated region to a lowly concentrated region while in active transport molecules move from a lowly concentrated region to a highly concentrated region; No energy is required in diffusion while energy is required in active transport; No carrier molecules are required in diffusion while carrier molecules are required in active transport;
- (b) (i) Plants — absorption of water from the soil by root hairs/ movement of water between plant cells/opening and closing of stomata/support due to turgidity/feeding in insectivorous plants;
- (ii) Animals — reabsorption of water by blood capillaries from renal tubules/absorption of water in the alimentary canal/colon/gut/large intestines; Movement of water from cell to cell/in and out of cells;

Question 17

Explain why plants do not require specialized excretory organs.

Candidates had to know the excretory organs of plants and those of animals and excretory products in order to explain why plants do not require specialized excretory organs.

Weaknesses

General answers were given as if only one method was for all wastes e.g. removal by diffusion which is only for gases but not others like papain etc. They were not also able to identify areas where wastes are deposited in plants.

Expected Responses

Waste products are mainly made from carbohydrates and hence not as harmful as proteinaceous materials; waste products are formed slowly; Non-toxic forms/waste products accumulate slowly/plants are less active

Some waste products (such as oxygen or carbon IV oxide) are re-usable/re-cycled:

Some waste products such (as resins and gums) are stored in insoluble form in (dead) tissues; or in living tissues as fruits, leaves and bark);

Some of the waste like some gases are removed by simple diffusion;

Question 18

Explain how the following factors affect the rate of photosynthesis:

- (a) concentration of carbon (iv) oxide
- (b) light intensity.

Candidates were required to state the effect of carbon (iv) oxide concentration and light intensity change to rate of photosynthesis. The candidates gave importance of factors instead. They were not aware that the two factors do not increase the rate indefinitely but only to optimum level.

Expected Responses

- (a) Rate of photosynthesis increased as the Carbon (iv) Oxide concentration increases up to optimum level (and vice versa); until it stops.
- (b) Rate of photosynthesis increases as the light intensity increases up to optimum level (and vice versa); decreases until it stops

Question 19

- (a) State **three** effects of dumping untreated sewage into a river.
- (b) Name **one** process that is responsible for loss of energy from one trophic level to the next

Candidates were required to know the effects of water pollution by untreated sewage and energy transfer from one level to another.

Weaknesses

Candidates gave general effects of pollution without limiting themselves to pollution by sewage. They did not seem to understand eutrophication.

Expected Responses

- (a) Kill organisms in water; reduce amount of oxygen in the water; reduce the quality of water for (human) consumption/change water P^H; interferes with the food chain/trophic levels; leads to eutrophication/ algal bloom; causes water borne diseases/cholera/typhoid/amoebic dysentery;
- (b) Respiration/defecation/excretion;

Question 20

Other than using the quadrat, give **two** methods of estimating population of grass.

Candidates were required to know methods of estimating population of grass.

Weaknesses

They portrayed lack of knowledge by giving many different wrong terms e.g. Beltline, transect line, square, capture recapture, percentage cover, photography, rope and tally method.

Expected Response

Belt transect;

Line transect;

Question 21

Explain what happens in humans when the concentration of glucose in the blood decreases below the normal level.

Knowledge of homeostasis was tested.

Weaknesses

Candidates do not understand the general principles of homeostasis. They were not able to differentiate the terms glucagon, insulin and antidiuretic hormone.

Expected Responses

Pancreas releases glucagon; hence glycogen is converted to glucose;

Fat is converted to glucose; reduced rate of respiration;

Question 24

Explain how the following factors determine the daily energy requirement in humans:

- (a) Age
- (b) Occupation
- (c) Sex

Understanding energy requirements in human beings.

Weaknesses

Candidates knew the factors that affect daily energy requirements but could not explain how. For age majority of candidates wrote on body size, surface area to volume ratio, activity, and occupation was confused with activity or where people stay. Sex was confused to mean sexual intercourse while others thought it was about gender.

Expected Responses

- (a) Age-young people are actively growing hence require more energy than older people;
- (b) Occupation – manual workers require more energy than sedentary workers;
- (c) Sex – males are more muscular hence require more energy than females;

Question 25

State two ways in which aerenchyma tissue in aquatic plants are adapted to their functions:

This question tested adaptation of aquatic plants.

Weaknesses

Candidates do not write full answers. They simply wrote thin walls or large air space without adding functions.

Expected Responses

Thin walled for easy diffusion of gases;

Have large airspaces/store a lot of air which makes the plant buoyant/
for gaseous exchange;

Question 26

How are the mitochondria adapted to their functions?

The question tested adaptations of mitochondria.

Weaknesses

Candidates confused folded and coiled. They did not understand that cristae are the inner membranes that are folded but they wrote cristae is folded. They thought that matrix is an adaptation.

Expected Responses

Inner membrane is highly folded/have cristae to provide a large surface area;
for attachment of enzymes;

Question 27

State **two** ways in which anaerobic respiration is applied in industries.

Candidates were required to know anaerobic respiration, organisms involved and application in industries.

Weaknesses

Candidates were not able to distinguish between baking, brewing etc. Some wrote brewing bread, fermentation of alcohol and making breweries.

Expected Responses

Baking; brewing; processing of dairy products; e.g Cheese, yoghurt, sour milk,
production of organic acid; e.g oxalic, citric, vinegar, butyric acid;

6.3 PAPER 2 (231/2)

Question 1

When the offsprings of purple and white flowered pea plants were crossed, they produced purple and white flowered plants in the ratio of 3:1

Using letter H to represent the gene for purple colour.

- (a) State the genotype of:
 - (i) parents
 - (ii) F₁ generation
- (b) Work out the cross between plants in the F₁ generation
- (c) Account for the colour of the flowers in plants of the F₁ generation

Candidates were tested on genetics and required to differentiate between genotypes and phenotypes.

Weaknesses

Candidates did not use the letter symbols given. They were not able to differentiate between genotype and phenotype and could not distinguish between complete and incomplete **dominance**.

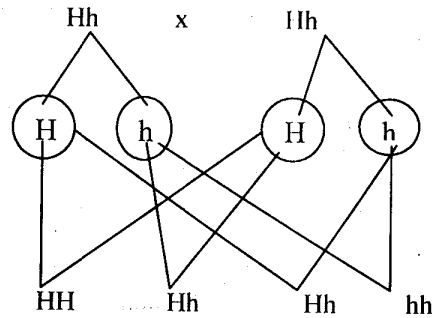
Expected Responses

- (a) (i) Parents genotype HH; hh;
- (ii) Hh;

- (b) F_1 selfed
(Parental genotypes)

(Gametes)

(Fertilization)



- (c) The gene for purple colour is **dominant** while the gene for white colour is recessive;

Question 3

- (a) (i) What is meant by the term biological control?
(ii) Give an example of biological control.
- (b) (i) What is eutrophication?
(ii) What are the effects of eutrophication?
- (c) Name a substance that is responsible for acid rain.

Candidates were required to have the knowledge of pollutants, causes, effects and control.

Weaknesses

Candidates did not know about eutrophication, their answers lacked details and specific examples.

Expected Responses

- (a) (i) Using a living organism to regulate/control/reduce/check the population of another organism;
(ii) Beetles introduced to feed on water hyacinth;
Fish introduced to feed on mosquito larvae;
- (b) (i) Enrichment of water bodies with nitrates/phosphates due to discharge of sewage/run off water containing fertilizers; leading to rapid growth of surface plants/aquatic plants/phytoplanktons;
(ii) (Proliferation of plants) block light from reaching plants underneath; Which will not photosynthesise; The plants die and decompose leading to depletion of oxygen; (as a result) animals also die/suffocate; (3 marks)
- (c) Nitrogen dioxide/sulphur dioxide;
Acc. Nitrogen (IV) oxide & sulphur (IV) oxide

Question 4

- (a) (i) Explain the changes that take place in the pupil and iris of a human eye when a person moves from a dark room to a room with bright light.
(ii) What is the significance of the changes explained in (a)(i) above?
- (b) How does the human eye obtain nutrients?
- (c) Explain why images that form on the blindspot are not perceived.

Knowledge of the eye in terms of structure and functions was required

Weaknesses

Candidates did not know the difference between muscles of iris and the ciliary. They lacked knowledge of how the eye obtains its nutrients and distribution to various parts of the eye.

Expected Responses

- (a) (i) Circular muscles of the iris contract while radial muscle relax; reducing the size of the pupil; hence, less light enters the eye;
- (a) (ii) The retina is protected from damage;
- (b) Choroid; has a dense network of blood capillaries; from which nutrients diffuse out to supply the eye;
- (c) The blind spot has no photoreceptors; hence no impulses are generated to be transmitted to the brain; (for interpretation)

Question 5

- (a) Explain what happens when a wilting young plant is well watered.
- (b) Name a support tissue in plants thickened with
 - (i) cellulose;
 - (ii) lignin.
- (c) Give three functions of pectoral and pelvic fins in a fish.

Candidates were required to know the effect of watering a wilting plant, support tissues in a plant and functions of various fins in a fish.

Weaknesses

Most candidates did not seem to know that roots absorb water. Some talked of plant becoming turgid instead of cells. Functions of pectoral and pelvic fins were separated by some candidates thus an indication that they do not know that they have the same functions.

Expected Responses

- (a) Root hairs/roots absorb water by osmosis; cells of the plant become turgid; leaves become firm and spread out/plants become firm/upright;
- (b) (i) Collenchyma;
- (b) (ii) Xylem/Tracheids/vessels/sclerenchyma;
- (c) Steering; Balancing; Braking; changing direction;
Prevent fish from pitching;

Question 6

An experiment was carried out to investigate the effect of temperature on the rate of a reaction catalysed by an enzyme. The results are shown in the table below.

Temperature (°C)	Rate of reaction in mg of products per unit time.
5	0.2
10	0.5
15	0.8
20	1.1
25	1.5
30	2.1
35	3.0
40	3.7
45	3.4
50	2.8
55	2.1
60	1.1

- (a) On the grid provided draw a graph of rate of reaction against temperature.
- (b) When was the rate of reaction 2.6 mg of the product per unit time?
- (c) Account for the shape of the graph between:
 - (i) 5°C and 40°C;
 - (ii) 45°C and 60°C.
- (d) Other than temperature name two ways in which the rate of reaction between 5°C and 40°C could be increased.
- (e)
 - (i) Name one digestive enzyme in the human body which works best in acidic conditions
 - (ii) How is the acidic condition for the enzyme named in (e)(i) above attained?
- (f) The acidic condition in (e)(i) above is later neutralized.
 - (i) Where does the neutralization take place?
 - (ii) Name the substance responsible for neutralization.

Skills of drawing graph and interpretation and the factors affecting enzyme action were tested.

Weaknesses

Many misspelt rennin and there was lack of knowledge in reading from graph. Most reversed the axis and the origin of the graph was omitted by many.

Expected Responses

- (a) Graph: Scale; Axes; plotting points; curve;
- (b) 33°C; and 52°C; (\pm 0.5°C)
- (c)
 - (i) As temperature increases rate of reaction increases/more products are formed (per unit time); because enzymes become more active;
 - (ii) As temperature increases rate of reaction decreases/less products are formed (per unit time); because enzymes become denatured; by high temperature;
- (d) Increase in enzyme concentration; increase in substrate concentration;
- (e)
 - (i) Pepsin; Rennin /chymosin;
 - (ii) Wall of stomach/gastric glands; produce Hydrochloric acid;
- (f)
 - (i) Duodenum;
 - (ii) Bile juice/salts;

Question 7

How are flowers adapted to wind and insect pollination?

Adaptation of different structures of a flower to pollination was tested.

Weaknesses

Candidates confused dispersal with pollination, seeds with pollen grains, fertilization with pollination, brightly coloured with attractive, nectar guides with honey guides etc.

Expected Responses

Insect pollinated flowers

(Entomophilous)

Are scented to attract insects; Have sticky stigma for pollen grains to stick on; Are brightly coloured to attract insects; Presence of nectar to attract insects; Have nectar guides to guide the insect to the nectaries; Stigma/anthers located inside the flower tubular/funnel shaped corola to increase chances of contact by insects; sticky/spiny/spiky pollen grains which stick on the body of insect; and on stigma; large/conspicuous flowers easily seen by insects/ attract insects; Anthers firmly attached to filament for insects to brush against them; landing platform to ensure contact with anther and stigma; Mimicry to attract (male) insects;

Wind pollinated flowers (Anemophilous)

Anthers/stigma hang outside the flowers to increase chances of pollination; the style/filament is long to expose stigma/anthers; stigma is hairy/feathery/branched to increase surface area over which pollen grains land/trap pollen grains; pollen grains are smooth/dry/light/small to be easily carried by wind; large amount of pollen grains to increase chances of pollination; Anthers loosely attached to filaments to enable them sway to release pollen; Pollen grains may have structures which contain air to increase buoyancy; Flowers have long stalks holding them out in the wind;

Question 8

Describe the role of the liver in homeostasis in the human body.

Candidates were required to know the homeostatic function of the liver.

Weaknesses

Candidates gave general functions of the liver and not homeostatic functions. Factors of hormones were not clearly given. Insulin does not convert, it stimulates conversion.

Expected Responses

Regulation of blood glucose;

The (normal) amount of glucose in the blood is about 90 mg/100 cm³; increase in blood sugar level is detected by cells of the pancreas; which secrete insulin; insulin stimulates the liver; to convert excess glucose to glycogen; further excess glucose is converted to fats (until the normal blood sugar level is attained); Excess glucose is oxidized to (Carbon dioxide, water and energy)/excess glucose used in respiration;

Decrease in blood sugar level below the normal level is detected by the pancreas; which secrete glucagon; which stimulates the liver; to convert glycogen to glucose (until the normal sugar level is attained); Fats/amino acids are converted to glucose, Reduced oxidation of glucose ;

Deamination

Excess amino acids are deaminated/removal of the amino group; the amino group is converted into ammonia. Ammonia combines with carbon (IV) oxide to form urea; urea is excreted in urine through the kidney;

Detoxification

Poisonous substances are converted to less harmful compounds;

Maintenance of body temperature/Thermoregulation;

Heat is generated (in the liver) by chemical activities; The heat is distributed;