

### 3.3 BIOLOGY (231)

This was the eighth 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 2009, 2010, 2011, 2012 and 2013 is also given for comparison.

**Table 11: Candidates' Overall Performance in the years 2009, 2010, 2011, 2012, 2013 and 2014**

Year	Paper	Candidature	Maximum score	Mean score	Standard Deviation
2009	1		80	20.14	12.31
	2		80	18.41	10.30
	3		40	15.86	8.43
	<b>Overall</b>	<b>299,302</b>	<b>200</b>	<b>54.29</b>	<b>28.80</b>
2010	1		80	20.14	13.76
	2		80	18.41	10.82
	3		40	15.86	8.31
	<b>Overall</b>	<b>317,135</b>	<b>200</b>	<b>58.39</b>	<b>30.44</b>
2011	1		80	22.74	12.41
	2		80	23.31	13.04
	3		40	18.84	8.10
	<b>Overall</b>	<b>363,817</b>	<b>200</b>	<b>64.87</b>	<b>31.05</b>
2012	1		80	19.77	12.84
	2		80	20.70	12.09
	3		40	11.97	6.59
	<b>Overall</b>	<b>389,523</b>	<b>200</b>	<b>52.41</b>	<b>29.43</b>
2013	1		80	28.03	14.49
	2		80	22.36	12.70
	3		40	12.88	7.64
	<b>Overall</b>	<b>397,319</b>	<b>200</b>	<b>63.26</b>	<b>32.06</b>
2014	1		80	23.91	14.49
	2		80	18.92	11.83
	3		40	20.82	8.39
	<b>Overall</b>	<b>432,977</b>	<b>200</b>	<b>63.65</b>	<b>32.57</b>

From the table it can be observed that:

- (i) There has been an increase in candidature for the past five years.
- (ii) There was a slight improvement in performance in the year 2014 compared to 2013 as indicated by the mean scores of the papers.
- (iii) 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.

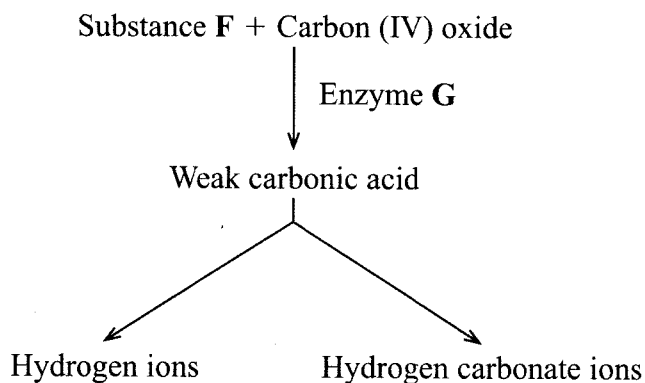
### 3.3.2 Biology Paper 1 (231/1)

No difficult questions were reported in this paper.

### 3.3.3 Biology Paper 2 (231/2)

#### Question 2

The diagram below illustrates the role played by red blood cells in the transportation of carbon (IV) oxide.



- (a) Other than the carbon (IV) oxide transportation in the red blood cells, name the other form of carbon (IV) oxide transportation in humans. (1 mark)
- (b) (i) Name substance F ..... (1 mark)
- (ii) Name the enzyme marked G and state its role in the reaction. (2 marks)
- Enzyme .....
- Role.....
- (c) Explain why transportation of carbon (IV) oxide in red blood cells is advantageous. (2 marks)
- (d) Explain the role of calcium ions in blood clotting. (2 marks)

#### Weaknesses

Most candidates were not able to correctly interpret the diagram. This could be associated with inadequate instruction on carbon (IV) oxide transportation. Some candidates confused carbon (IV) oxide transportation with carbon (II) oxide poisoning.

### Expected responses

- (a) Carbonic acid/carbaminohaemoglobin/hydrogen carbonate;
- (b) (i) Water;  
(ii) Carbonic acid;  
  
Role: catalyses reaction between carbon IV oxide and water to form (weak) carbonic acid;
- (c) Prevents accumulation of acidity/maintains pH of blood since hydrogen ions combine with haemoglobin to form haemoglobinic acids  
Faster; due to the catalytic effect of carbonic anhydrase;
- (d) Activates thromboplastin; thrombokinase to neutralize heparin/convert prothrombin to thrombin;

### Question 4 (b)

- (b) (i) Differentiate between sickle cell anaemia and sickle cell trait. (2 marks)
- (ii) Explain why people with sickle cell trait have an adaptive survival advantage over normal individuals in malaria endemic regions. (2 marks)

### Weaknesses

Most of the candidates were unable to distinguish between sickle cell anaemia and sickle cell trait. Neither could they explain the survival advantage sickle trait has over normal individuals in malaria endemic regions. Genetics is covered in form four and in a rush to clear the syllabus; the area may not have been addressed adequately during instruction.

### Expected response

- (i) Sickle-cell trait is heterozygous while sickle cell anaemia is a homozygous condition;
- (ii) People with sickle cell trait are resistant to malaria; because the plasmodium cannot survive in sickle shaped red blood cells.

## Question 6

An experiment was done to determine the uptake of nitrogen from the soil by broad bean seedlings. The experiment was done with one set of seedlings **M** grown in the atmosphere enriched with carbon (IV) oxide and another set up of seedlings **N** grown in the normal atmosphere.

The amount of nitrogen in each seedling was measured in milligrams at intervals of ten days. The table below shows the results obtained.

	Amount of Nitrogen in Milligrams									
SET M	0	25	70	125	160	395	635	860	895	915
SET N	0	15	35	50	65	105	120	125	135	140
TIME (DAYS)	15	25	35	45	55	65	75	85	95	105

- (a) Using the same axis draw line graphs of nitrogen uptake by the two (**M** and **N**) sets of broad bean seedlings against time. (8 marks)
- (b) Determine the rate of uptake of nitrogen in Set **M** between 65 and 85 days. (2 marks)
- (c) (i) What is the relationship between carbon (IV) oxide concentration in the air and nitrogen uptake? (1 mark)
- (ii) Account for the relationship in (c)(i) above. (3 marks)

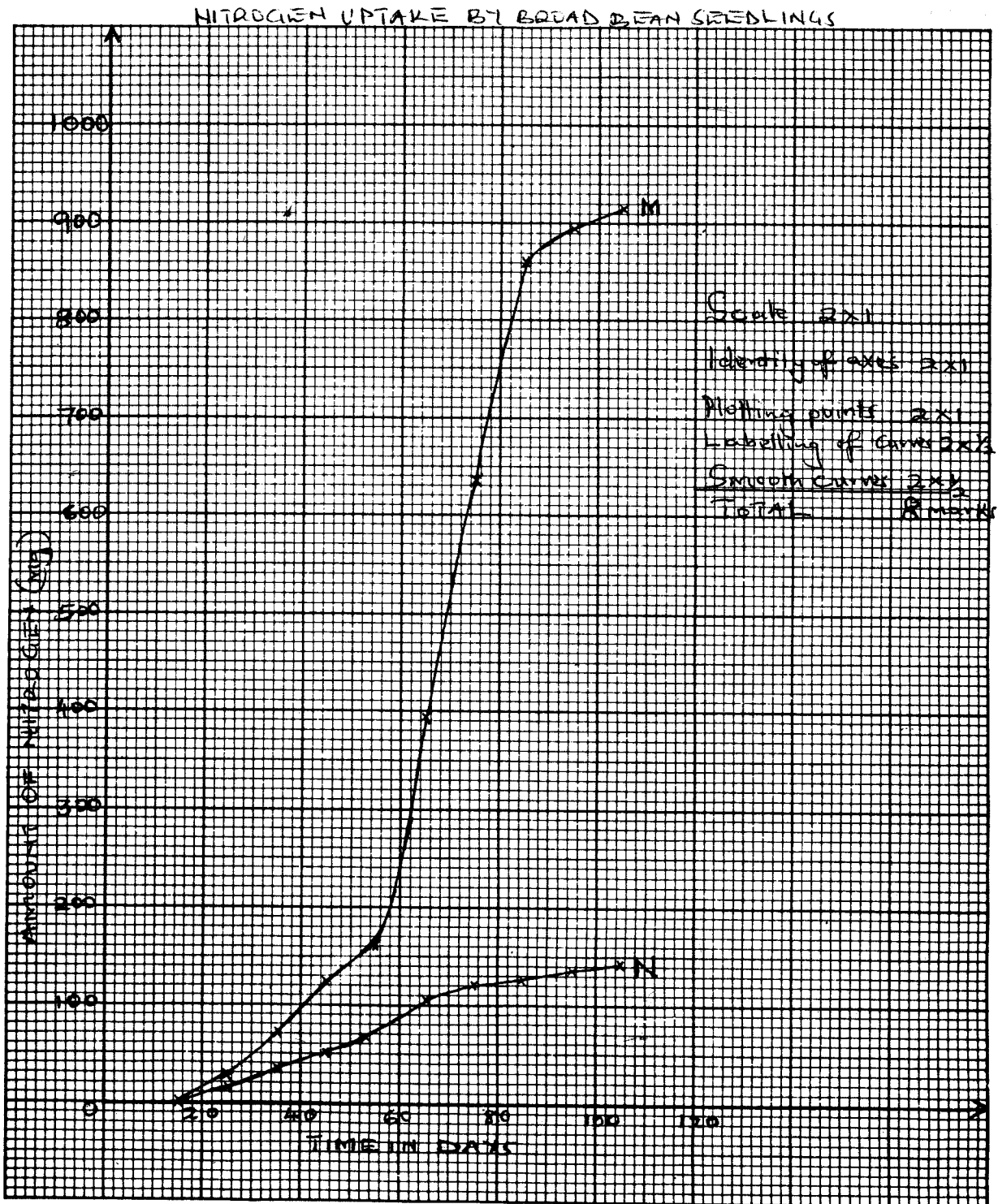
### Weaknesses

Some candidates were not able to draw the correct graph. This could be attributed to the weakness in obtaining the correct scales for the two axes given the diversity of the figures provided in the table. Most of the candidates did not understand the fact that in addition to glucose synthesis, amino acids are also formed in the process of photosynthesis.

### Expected response

- (a) Scale 2x1 mark
- Identity of axes 2x1 mark
- Plotting of points 2x1 mark
- Labelling of curves 1 mark ( $\frac{1}{2} \times 2$ )
- Smooth curves 1 mark ( $\frac{1}{2} \times 2$ )

(b) At 65 = 395;  $\frac{860 - 395}{20} \cdot \frac{465}{20}$ ; = 23.25  $\pm$  1 mg/day  
 At 85 = 860



- (c) (i) The higher the carbon (IV) oxide content in air, the higher the nitrogen uptake and vice versa;
- (ii) More Carbon (IV) oxide in the air makes the seedlings to photosynthesize more; hence more amino acids/protein; are formed in the dark stage; formation of amino acids/protein requires nitrogen;
- (d) (i) The concentration of nitrogen would remain constant;
- (ii) Despite decline in CO<sub>2</sub>; the nitrogen already absorbed/taken up by the plant will still remain;
- (iii) Lightning;  
By free-living bacteria/micro organisms;  
By Rhizobium (in root nodules of legumes);

### 3.3.4 Biology Paper 3 (231/3)

No difficult questions were reported in this paper

### 3.3.5 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 in schools does not adequately address the development of critical thinking skills.

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.

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.

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.