

# **RESUME OF THE CHIEF EXAMINERS' REPORTS FOR THE SCIENCE SUBJECTS**

## **1. STANDARDS OF THE PAPERS**

All the Chief Examiners for the Science Subjects unanimously reported that the standard of the papers compared favourably with those of previous years.

## **2. PERFORMANCE OF CANDIDATES**

The Chief Examiners gave varying reports on the standard of performance of candidates. Some of them, including those for Animal Husbandry 1, Animal Husbandry 2, Biology 1, Biology 2, Crop Husbandry & Horticulture 1, Crop Husbandry & Horticulture 2 and Physics 1 and Physics 2 reported that there was an improvement in the performance of candidates as compared to previous years. On the contrary, those for Chemistry 1 and Integrated Science 2 reported that the candidates' performance was poorer than that of previous year. Again, other Chief Examiners including those for Chemistry 2, Fisheries 1, Fisheries 2, Forestry 1, Forestry 2, General Agriculture 1, General Agriculture 2 and Integrated Science 1 reported that the candidates' performance was average.

## **3. A SUMMARY OF CANDIDATES' STRENGTHS**

- (1) **Legible Handwriting:** Candidates in some papers were commended by the Chief Examiners for writing legibly which made marking easier. These papers included Animal Husbandry 1, Animal Husbandry 2, Crop Husbandry & Horticulture 1, Crop Husbandry & Horticulture 2, Forestry 1, Forestry 2, Fisheries 2, General Agriculture 2 and Integrated Science 1.
- (2) **Provision of Precise Answers:** Some of the Chief Examiners commended candidates for providing precise answers. They included the Chief Examiners for Animal Husbandry 1, Animal Husbandry 2, Biology 2, Chemistry 2, Crop Husbandry & Horticulture 1, Forestry 1, General Agriculture 1 and Integrated Science 1 and Physics 1.
- (3) **Adherence to the Rubrics of the Paper:** The subjects for which the Chief Examiners commended candidates for obeying the rubrics included Animal Husbandry 1, Animal Husbandry 2, Biology 2, Chemistry 1, Chemistry 2, Crop Husbandry & Horticulture 2, Forestry 1, Forestry 2, Fisheries 2, General Agriculture 1, General Agriculture 2, Integrated Science 1, Integrated Science 2, Physics 1 and Physics 2.

#### 4. A SUMMARY OF CANDIDATES WEAKNESSES

- (1) Lack of In-depth Knowledge of the Subject Matter: It was indicated in the reports of majority of the Chief Examiners that the responses of many candidates lacked of in-depth knowledge of the subject matter. The Chief Examiners included those for Biology 1, Chemistry 1, Chemistry 2, Crop Husbandry and Horticulture 2, Fisheries 2, General Agriculture 1, General Agriculture 2, Integrated Science 2 and Physics 2.
- (2) Misunderstanding of the Questions: The Chief Examiners for Animal Husbandry 2, Biology 2, Chemistry 1, Crop Husbandry and Horticulture 1, Crop Husbandry and Horticulture 2, Fisheries 2, General Agriculture 1, General Agriculture 2 and Integrated Science 1 reported that the responses of many candidates portrayed they did not understand the questions that were set.
- (3) Wrong Spelling of Scientific Terms: It was also reported by majority of the Chief Examiners that scientific terms were wrongly spelt by many candidates. The papers for which this report was made included Animal Husbandry 1, Animal Husbandry 2, Biology 1, Biology 2, Chemistry 1, Chemistry 2, Crop Husbandry & Horticulture 1, Forestry 1, Forestry 2, Fisheries 2 and General Agriculture 2.
- (4) Poor Expression in English Language: The Chief Examiners for Biology 1, Chemistry 2, Crop Husbandry & Horticulture 2, Fisheries 2 and Physics 2 expressed concern over poor construction of sentences by many candidates. As a result the examiners found it difficult to understand what the candidates wanted to put across.
- (5) Poor Plotting of Graphs: The Chief Examiner for Physics 1 and Integrated Science 2 lamented that graphs were poorly plotted by many candidates.
- (6) Failure to Adhere to the Convention of Writing Scientific Names: It was noted by the Chief Examiners for Biology 1 and Integrated Science 1 that some of the candidates did not adhere to the convention of writing scientific names.
- (7) Poor skills in Data Computerization: The Chief Examiners for Integrated Science 2 and Physics 1 lamented majority of the candidates lacked skills in data computerization.
- (8) Poor Drawing of Maps: The Chief Examiner for Forestry 2 reported that maps were poorly drawn by majority of the candidates.

## 5. **SUGGESTED REMEDIES**

The following suggestions were made by the Chief Examiners to curtail the weaknesses of the candidates:

- (1) Teachers should make the necessary efforts to cover all topics in the syllabus.
- (2) Students are advised to read through examination questions carefully and understand them before they attempt to answer them.
- (3) Teachers should take their students through spelling drills of scientific terms regularly.
- (4) Students should read story books and take lessons in English Language more seriously.
- (5) Students should be introduced to the plotting of points on graphs regularly. This will improve their graphical presentation of information.
- (6) Teachers should make efforts to teach their candidates the convention of writing scientific names.
- (7) Teachers should ensure that their students take lessons in Mathematics seriously to acquire the necessary skills in computerization.
- (8) Teachers should assist their students also advised to practice the drawing of maps during their lessons.

# **ANIMAL HUSBANDRY 1**

## **1. GENERAL COMMENTS**

The standard of the paper has been consistent with previous year's paper on Animal Husbandry. Candidates' performance had improved.

## **2. A SUMMARY OF CANDIDATES' STRENGTHS**

Commendable features observed in the scripts of candidates include the following:

- (1) Answers were straight to the point.
- (2) Improvement in the usage of the English Language.
- (3) Improved practical skills.
- (4) Legible handwriting.

## **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

The following weaknesses were identified:

- (1) Wrong spelling of scientific terms;
- (2) Non-adherence to the rubrics of the paper.

## **4. SUGGESTED REMEDIES**

The following remedies were suggested.

- (1) Candidates should read the question meticulously and have a full grasp of what is required.
- (2) Candidates should improve upon their spelling of scientific terms.

## **5. DETAILED COMMENTS**

### **Question 1**

- (a) **Identify each of specimens A, B and C.**
- (b) **Name two forms in which each of specimens A and B could be used as feed ingredients in animal production.**
- (c) **Name two forms in which specimen C is used to feed livestock.**
- (d) **State four problems associated with the use of specimen A as feed ingredient for farm animals.**
- (e) **Give two reasons why it is not advisable to use the unprocessed form of specimen B to feed farm animals.**

In part (a) candidates lost marks when the identification was generalised. For example, candidates wrote cassava instead of “a piece of cassava”.

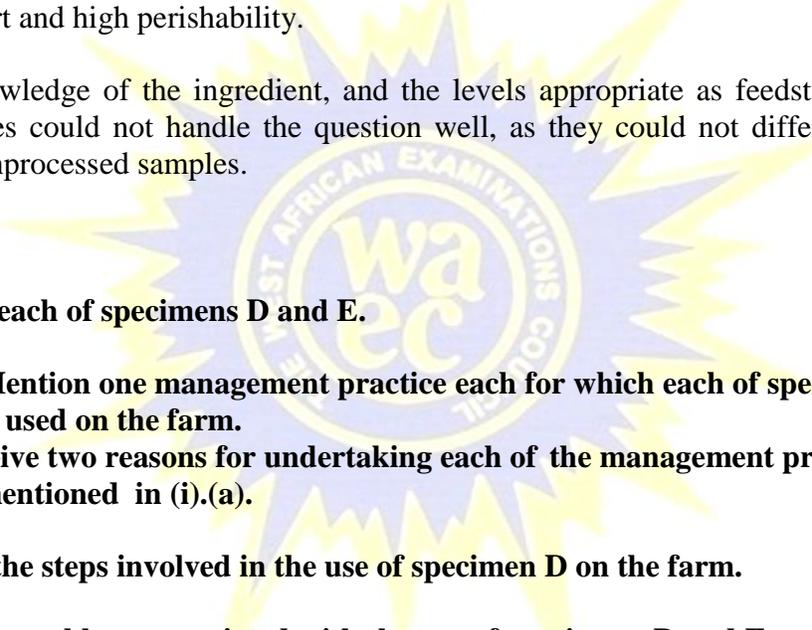
Candidates did not understand part (b), and focused on uses of the samples. Cassava is used in the form of raw cassava, cassava peel and dried cassava. Groundnut is used in the form of whole groundnut, cake and oil.

For part (c) answers provided were commendable since most of the candidates were able to state ‘hay’ and “silage” as forms of the specimen.

In part (d), excessive use of the cassava and the health problems due to the ingredients in the sample are expected to feature in the answers. Most candidates fared poorly here, as it appeared, they were not well-informed about the subject, under consideration. Attention was however given to accessibility of the sample; i.e. its availability. Expected problems included low protein level, bulky to transport and high perishability.

For part (e) knowledge of the ingredient, and the levels appropriate as feedstuff is important. Again, candidates could not handle the question well, as they could not differentiate between processed and unprocessed samples.

## **Question 2**

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- (a) Identify each of specimens D and E.**
  - (b) (i) Mention one management practice each for which each of specimens D and E is used on the farm.**  
**(ii) Give two reasons for undertaking each of the management practice you have mentioned in (i).(a).**
  - (c) Outline the steps involved in the use of specimen D on the farm.**
  - (d) State two problems associated with the use of specimens D and E would be required in their production.**

In part (a) candidates did well in identifying specimen D (Burdizzo). Quite a number of them spelt it rightly. Identifying “Hacksaw with blade”. was a challenge as candidates only wrote “Hacksaw” and lost marks.

In part (b) candidates were required to mention castration - as the management practice, for which Burdizzo is needed. Almost all candidates got it right.

Specimen E was an equipment for de-horning, however few candidates noted that it could be used for “cutting metals and plastic tubes”. With regards to reasons for “Castration”, almost all candidates had correct answers.

In part (c) candidates were required to follow the process involved in castration step-by-step. Many candidates mixed up the steps. Restraining the animal was very important before any other step would be regarded as valid.

For part (d) expected answers included, may cause injury to animal, and the blade may break. Most candidates were able to identify the farm animals, although few were not smart enough to know the “cows” are female cattle and so cannot be castrated with Burdizzo.

### **Question 3**

- (a) (i) **Name four parts of specimen F.**  
(ii) **Name the management practice that had been carried out on the mouth part of specimen F.**  
(iii) **Five three reasons for carrying out the management practice you have named in (ii).**  
(iv) **State two precautions that should be taken when carrying out the management practice you have named in (ii).**
- (b) (i) **Identify specimen G.**  
(ii) **State two types of harm caused by specimen G to farm animals.**  
(iii) **Mention two methods of controlling specimen G in animal production.**

Question 3 was well responded to; with candidates scoring very high marks.

In part (a), candidates could identify the sample, with few candidates losing marks for wrong spelling. They were able to determine practice. i.e. Debeaking, however few candidates misunderstood what was meant by “management practice”. Precautions to be taken when debeaking was adequately answered by candidates.

Part (b) was answered satisfactorily.

### **Question 4**

**The table below shows records of the production of day-old chicks on two farms A and B. Study the table carefully and answer the questions that follow.**

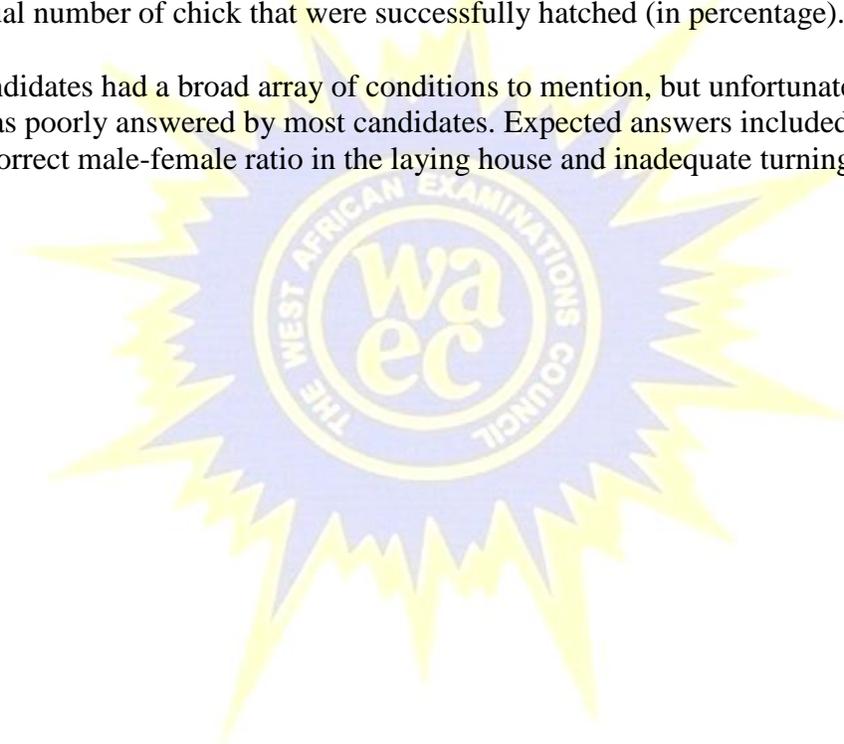
<b>Parameter</b>	<b>Farm A</b>	<b>Farm B</b>
<b>Number of eggs set</b>	<b>500</b>	<b>500</b>
<b>Number of eggs removed</b>	<b>40</b>	<b>100</b>
<b>Number of day old chicks produced</b>	<b>400</b>	<b>300</b>

- (a) Mention three activities that are carried out from the time of setting the eggs till the day-old chicks are produced.**
- (b) Determine the percentage fertility of the eggs set on each farm.**
- (c) Determine the percentage hatchability of eggs set on each farm.**
- (d) State four factors that could account for the results obtained on farm B.**

Candidates' responses were generally good for part (a).  
Generally, most candidates answered part (b) well.

In part (c), candidates appear not to understand 'hatchability'; and this showed in their responses/calculations. Candidates were expected to state the number of eggs in the hatchery as against the actual number of chick that were successfully hatched (in percentage).

For part (d) candidates had a broad array of conditions to mention, but unfortunately, this part of the question was poorly answered by most candidates. Expected answers included poor quality of eggs set, incorrect male-female ratio in the laying house and inadequate turning of eggs.



## **ANIMAL HUSBANDRY 2**

### **1. GENERAL COMMENTS**

The standard of the paper and candidates' performance were similar to those of previous years.

### **2. A SUMMARY OF CANDIDATES' STRENGTHS**

The following commendable features were observed in the scripts of candidates:

- (1) Candidates who understood the questions provided answers that were straight forward and to the point;
- (2) Adherence to the rubrics of the paper;
- (3) Legible handwriting by candidates.

### **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

Identified weaknesses included the following:

- (1) Poor expressions/poor language;
- (2) Spelling mistakes were common in the scripts of candidates;
- (3) Some candidates; answers showed lack of understanding of the questions.

### **4. SUGGESTED REMEDIES**

Remedies suggested to overcome weaknesses included the following.

- (1) Candidates should be encouraged to read well-written books and speak good English.

### **Question 2**

- (a) **Mention six factors that affect milk yield in cattle.**
- (b) **Give two examples of each of the following groups of farm animals:**
  - (i) **non-traditional animals;**
  - (ii) **monogastrics.**
- (c) **Discuss five management practices that should be carried out to ensure successful grasscutter production.**

This question was also popular with the candidates. The general performance was fairly good.

In part (a) Some of the answers given showed that either candidates were not taught or did not understand the question. Some of the correct answers are age, diseases, breed of animal, ambient temperature, upper size, availability of feed and water, milking technique etc.

Candidates answered this part (b) satisfactorily

For part (c) many candidates stated the management practices and discussed them. Some only defined the practices.

### **Question 3**

- (a) Explain four disadvantages of branding cattle.**
- (b) Discuss goat production in West Africa under the following headings:**
  - (i) housing;**
  - (ii) feeding;**
  - (iii) diseases and pests;**
  - (iv) marketing.**

This question was unpopular with candidates and the general performance was sub-standard.

For part (a) some of the candidates mentioned damage of the skin, secondary infection, pain to the animal. In some cases, the point mentioned were not fully explained. Other correct answers are death through profuse bleeding and infection, injury to handlers, healing of the skin leading to difficulty in reading the marks and keeping records.

Sub-question (b) was poorly answered. It is expected that answers would be tailored to goat production in West Africa and not the modern production systems found in foreign countries and sometimes in large scale commercial farms.

Candidates missed this important point and therefore performed badly. For instance, under housing, goats in West Africa are not housed, at best they are provided with a simple pen built from local/poor quality materials. In terms of feeding, the feed is usually not balanced; the goats browse on plants, feed for themselves and could be fed on forage, kitchen waste, crop residues.

Many feed for themselves and therefore it is not usual to find feeding troughs etc. in their pens. Diseases are generally not controlled. Diseased animals are usually killed/sold. Animals are often sold live and the price is not regulated. They are marketed when there is a pressing need.

#### **Question 4**

- (a) State four effects characteristics of dairy cattle.**
- (b) (i) List four characteristics of a good pasture grass.**  
**(ii) Outline three activities that should be carried out for the efficient management of pasture.**
- (c) Describe five signs of ill-health in farm animals.**

This question was popular with candidates. The performance was fairly good. Candidates demonstrated their knowledge of all the sub-questions.

The question (a) on the characteristics of a dairy cattle was well tackled. Many candidates provided correct answers. E.g. well-shaped body (not triangular shape), large udder, docility, high milk yield etc.

In part (b) candidates were also able to list the characteristics of a good pasture grass. E.g. easy to establish, palatable, drought tolerance, high biomass, fast growth, ability to withstand competition and trampling etc.

Part (c) was an easy sub-question as indicated by the correct answer provided for efficient management of pasture. E.g. fertilizer application, liming, weed control, irrigation, reseeded/oversowing etc.

describing the methods. Some candidates erroneously mentioned footbath, disinfection, dipping in disinfectant, vaccinate with disinfectant, drenching with disinfectant etc.

Candidates were expected to describe methods such as rotational grazing, quarantine, proper sanitation, dipping, drenching, pour on etc.

# **BIOLOGY 1**

## **1. GENERAL COMMENTS**

The 2012 WASSCE Practical Biology Examination paper compares favourably with the previous years. However, the performance of the candidates was above average.

## **2. A SUMMARY OF CANDIDATES' STRENGTHS**

- (1) Candidates were able to relate the structural features of specimens to their function
- (2) Candidates were also able to describe the test for starch in a sequential order as demanded.
- (3) Improvement in the labelling of biological drawings by using ruled guidelines and horizontal labelling.

## **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

- (1) Poor grammatical expression.
- (2) Wrong spelling of technical terms still continue to be a major challenge to candidates.
- (3) Failure to use observable features of the specimens to bring out the differences.
- (4) Lack of understanding of biological conventions.

## **4. SUGGESTED REMEDIES**

- (i) Biology teachers should also make sure that their students take their English lessons seriously.
- (ii) To overcome the spelling mistakes, biology teachers should conduct spelling exercises on biological terms periodically.
- (iii) There should be practical classes for students throughout the duration of the course.
- (iv) Teachers should emphasize biological conventions to their students during lessons.

## **5. DETAILED COMMENTS**

### **Question 1**

**Specimen A<sub>1</sub> is an organism growing on bread.**

**Specimen A<sub>2</sub> of specimen A<sub>1</sub> mounted under low power microscope.**

***Study specimens A<sub>1</sub>, A<sub>2</sub> and B carefully and use them to answer Questions 1 (a) to 1 (c).***

- (a)
  - (i) **Classify specimens A and B into their phyla/divisions and classes.**
  - (ii) **State the association which exists between specimen A<sub>1</sub> and the bread.**
  - (iii) **State three factors that promote the association in (ii).**
- (b) **State three observable features of specimen A<sub>2</sub> and how each of these features makes the organism successful in its mode of life.**
- (c)
  - (i) **State five differences between specimens A<sub>2</sub> and B.**
  - (ii) **State the trophic levels of specimens A<sub>2</sub> and B giving reasons.**
  - (iii) **State two ways by which specimen A<sub>1</sub> is of economic importance.**

- (a) Candidates found the classification very difficult and were therefore not able to classify the Specimen A into its phyla and classes. The association between specimen A and B was well known by most of the candidates and therefore scored full marks. Candidates who lost this mark was due to spelling mistake as most of the candidates spelt “saprophytism” as “saprophitism”. The factors that promote the association was also well answered by many candidates.
- (b) This sub-question was well answered by most candidates as they stated correctly the observable features and related them to their functions.
- (c) Majority of the candidates lost marks because they used negative comparisons instead. For example, instead of comparing the rhizoids of the Rhizopus to the root of Tridax, candidates were giving answers as Rhizopus has rhizoids while Tridax has no rhizoids. Also, most candidates use their theoretical knowledge instead of the features on the specimens. The trophic level as well as the economic importance of specimen A was well stated.

## **Question 2**

**Study specimens C, D and E carefully and use them to answer Questions 2 (a) to 2 (d).**

- (a) **Name the class to which each of specimens C, D and E belongs.**
- (b)
  - (ii) **State the feeding habits of each of specimens C, D and E.**
  - (ii) **State two features each of specimens C and E which adapt the specimens to their feeding habits.**
- (c)
  - (i) **State two ways by which specimen D is of economic importance.**
  - (ii) **Outline two measures each by which the populations of specimens C and D can be controlled.**
- (d)
  - (i) **State the habitat of specimen C.**
  - (ii) **State two observable features of specimen C which adapt the specimen to its habitat.**

- (a) Stating the classes of specimens C,D and E was well answered by most candidates although a few candidates did not score any marks due to spelling mistakes.
- (b) Majority of the candidates could not name the feeding habits of specimens C, D, and E. They rather described the type of food the specimens fed on. Expected answers were filter feeding, saprophytic and filter feeding, saprophytic and filter feeding for specimens C, D and E respectively. Also, the features that adapt the specimens to their feeding habit was also poorly answered as most candidates gave answers for specimen C are mouth

brushes for sweeping food into the mouth and presence of horny jaws for chewing food/plankton but the candidates were writing presence of siphons or spiracles for gaseous exchange. This answer was an adaptation of specimen C to aquatic life. For specimen E, the tadpole, mouth for creating water flow into the tadpole, presence of gill rakers to sieving or straining food and long coiled intestines for digestion of water weeds/grass.

- (c) The economic importance of specimen D/larva of housefly is a posed a challenge to most candidates. They lost marks because candidates were stating the economic importance of the housefly and not the larva as demanded by the question. The following answers were expected from the candidates.

- Spoils/contaminates food
- Speeds up decay
- Helps to recycle nutrients in nature
- Serves as food for fish.

Majority of the candidates were to able state measures aimed at the controlling the population mosquito larvae. Some candidates lost marks because they stated that draining of rivers as the control measures because the larvae of mosquito is not found in rivers.

- (d) Most candidates were able to state adaptive features of housefly and larvae of mosquito.

### **Question 3**

**Study specimens F, G, H, J and K carefully and use them to answer Question 3(a) to 3(d).**

- (a) (i) **State the method of reproduction in specimen G and J.**  
(ii) **State two reasons for the answer in (i) above.**  
(iii) **How does the propagation of specimen F differ from that of specimen H ?**  
(iv) **What type of food substance is stored in specimen G?**  
(v) **Describe a food test that can be used to confirm the food substance in specimen G.**
- (b) (i) **Name the fruit type of specimen H.**  
(ii) **Give one reason for your answer in (i) above.**
- (c) (i) **State two differences and three similarities between specimens G**

**and J.**

- (ii) **State one way by which specimen J is of economic importance.**
- (d) (i) **Make a drawing, 8 - 10 cm long, of the longitudinal section of specimen K and label it fully.**
- (ii) **Name two classes of food that is likely to be stored in specimen K.**
- (a) It appears that the candidates did not understand question as they wrote separate answers for specimens G and J when the question demanded actually demanded one answer.

The candidates failed to notice that it was the presence of buds which sprouts and presence of stored food that is why specimen G and J are vegetatively propagated. Most candidates were able to outline the procedure for the test for starch. However, some candidates described the test of starch in leaves while a few others described the test for proteins in the Irish potato.

- (b) The mentioning of the fruit types was well answered by most candidates. However, most candidates could not give correct reasons for the fruit type. Candidates must note that a fruit is considered as a false fruit when it is formed from one ovary and a compound fruit when is formed from an inflorescence
- (c) Most candidates could state the differences and similarities between Irish potato and ginger because of the negative comparisons they used. The expected responses are indicated below:

Specimen G/Irish potato tuber	Specimen J/ Ginger rhizome
- Nodes and internodes not distinct	- Nodes and internodes not distinct
- Axillary bud distinct	- Axillary bud covered with scale leaves
- Lenticles present	- Lenticels absent
- Has no roots	- Roots present
- It is a stem tuber	- It is a rhizome

## **BIOLOGY 2**

### **1. GENERAL COMMENTS**

The standard of the paper compared favourably with those of previous years. There was an improvement in performance of the candidates.

### **2. SUMMARY OF CANDIDATES' STRENGTHS**

- (1) Few candidates displayed some improvement in expressing themselves well in English Language.
- (2) Candidates provided answers of each question on fresh page.
- (3) Candidates showed mastery of matching corresponding points in a tabular form.

### **3. SUMMARY OF CANDIDATES' WEAKNESSES**

- (1) Most candidates failed to go by rubrics with respect to biological drawings.
- (2) Scientific terms were wrongly spelt by many candidates.
- (3) Candidates showed lack of knowledge with regards to questions bothering on description and explanation.

### **4. SUGGESTED REMEDIES FOR THE WEAKNESSES**

- (1) Students should read all instructions to the paper and follow them to the letter.
- (2) Tutors should take their students through spelling drills with respect to technical terms.
- (3) Tutors should encourage their students to work sufficient tutorials and assignments on how to provide concise and accurate answers.

### **5. DETAILED COMMENTS**

#### **Question 1**

- (a) Generally many candidates attempted the question and they all scored very low marks.  
They could not describe epigeal germination by coming out with the systematic presentation of the stages involved in the germination process. It must be noted that seed imbibed water and swelled; testa ruptured/split; the hypocotyls of the germinating seed elongated; pushing the seed out of the soil; the cotyledon(s) become exposed to sunlight; and turned green to photosynthesize; the plumule developed into a green shoot; the radical developed into a root/taproot; and the cotyledon(s)/ endosperm dried off / fell off.

Majority of the candidates failed to state the differences between epigeal

germination and hypogeal germination. Expected responses indicated below:

### DIFFERENCES

Epigeal germination	Hypogeal germination
<ul style="list-style-type: none"><li>- Hypocotyl elongates</li><li>- Cotyledons emerge out of the soil</li><li>- Plumule does not emerge simultaneously with radical</li><li>- Cotyledon turn green</li><li>- Energy is derived mainly from cotyledons</li></ul>	<ul style="list-style-type: none"><li>- Epicotyl elongates</li><li>- Cotyledon remains in the soil</li><li>- Plumule and radical emerge Simultaneously</li><li>- Cotyledon does not photosynthesize</li><li>- Energy is derived mainly from endosperm</li></ul>

- (b) Many candidates could not produce the required diagram of a germinating seed. Also they could not go by the rubrics with respect to biological drawings. Surprising, only a few candidates could state the functions of the labelled parts of the germinating seed.

### Question 2

- (a) Most candidates were able to name the dental disease and stated the causes of dental diseases.
- (b) Candidates were able to describe the digestion of a meal of meat and yam as it passes through the alimentary canal of humans. However, few candidates could not state the digested products, that is, amino acid and glucose respectively of the meal even though most of them could state the uses of the digested products.
- (c) Many candidates could state the function of each of the elements in plant nutrition except molybdenum for nitrogen fixation by nitrogen-fixing bacteria; activates the enzyme that reduces nitrates to nitrites/ammonia. Also, copper is component of respirator enzymes/enzymes present in the material which acts as electron carrier for chlorophyll.

### **Question 3**

- (a) Majority of the candidates were able to state the methods of determining food chains in a community, but they failed to describe the methods that they stated. For instance, the direct observation method involved the observing the organisms feed on different organisms using the naked eyes/binoculars/cameras. The examination of the gut/stomach contents method also involved the dissection of organisms and the contents of their gut examined to identify food ingested.
- (b) The few candidates that attempted this question showed complete lack of knowledge on the life cycle of a tapeworm, hence performed very poorly. Expected responses included:
- Tapeworm has flat, long, tape-like/ ribbon-like body
  - It is a hermaphrodite/ bears male and female organs
  - Adult tapeworms live in the intestinal tract of adult vertebrate;
  - The head is attached to the intestine with suckers and hooks
  - Mature proglottides contain ripe fertilized eggs;
  - Which break off and are passed out with faeces of the primary host;
  - Pig/cow is the secondary host which feeds on the faeces.
  - The eggs hatched into hexacanth embryo with six hooks
  - The eggs are protected by onchosphere;
  - The hexacanth embryo bores through the alimentary canal and moves into the blood stream where it moves into the muscle of the cow/pig
  - to develop into bladder worm which is dormant;
  - If the infected pork/ beef is eaten by human;
  - The head is pushed out of the bladder; hooks itself to the intestinal wall of human; where it grows into an adult.

### **Question 4**

- (a) Many of the candidates could not define the terms co-dominance, sex-linked characters, and genetic engineering. It must be noted that co-dominance is defined as a condition in which the traits of both alleles in a heterozygous organism are fully expressed in the phenotype. Examples included human blood group AB and Roan cattle. Sex-linked characters are inherited traits which occur in a particular sex far more than the other as a result of the gene responsible for the trait being borne on the X- chromosome. Here, examples include colour blindness, haemophilia, baldness, hair on ear lobe/ hypertrichosis. Genetic Engineering is a genetical technology whereby gene(s) for a specific trait/character is/ are transferred from one organism to another; this manipulation/ alteration gives the receiving organism the desired character. Examples are human gene introduced into bacteria for the production of insulin/thyroxin and production of organs for human organ transplant.
- (b) This was a genetic question requiring candidates to use a genetic diagram to determine the probability of the offspring having haemophilia disease was well answered by most candidates.

### **Question 5**

- (a) Majority of the candidates found it difficult to state the structural differences between prokaryotic cells and eukaryotic cells. Expected responses included:

<b>Prokaryotic cells</b>	<b>Eukaryotic cells</b>
- Lack nucleus/ non-nucleated/ Absence of the nuclear membrane.	-Have nucleus/ nucleated/ presence of nuclear membrane.
- Genetic material/ DNA is present In cytoplasm	-Genetic material/ DNA is found in the nucleus.
- Lack membrane-bound organelles.	- Have membrane-bound organelles.
- Simpler and smaller	- Complex and larger.
- Few organelles	- Many organelles.
- DNA not present	- DNA is associated with RNA/ protein
- Circular DNA is present	-Linear DNA is present.

- (b) This sub-question was well answered by the candidates as they correctly mentioned structures in plants and animals cells.
- (c) Candidates who attempted these questions did well except that they failed to describe the demonstration of plasmolysis using *Spirogyra* filament in an experimental situation . It is important for candidates to note that the filament of *Spirogyra* in pond water was placed on a glass slide; it was observed under low power of the microscope; the cells were found to be turgid; the pond water was absorbed using filter paper; a drop of strong salt solution was added; and was left for a few minutes; it was observed that the protoplasm/ cytoplasm shrank; and pulled away from the cell wall; leaving a gap between the cell wall and the plasma membrane.

### **Question 6**

- (a) Majority of the candidates found it difficult to define oral contraceptives. These contraceptives contain female hormones/ oestrogen/progesterone which are taken orally daily to prevent ovulation/production of ovum/egg thereby preventing conception/ pregnancy/fertilization. However, many candidates stated correctly the advantages of contraceptives.

- (b) Majority of the candidates correctly named the common symptoms of STDs and stated the preventive measures of STDs.
- (c) Many candidates failed to state the similarities and differences between sexual reproduction in mammals and sexual reproduction in flowering plants which should have been presented as below:

Similarities between sexual reproduction in mammals and flowering plants:

- Both involve fusion of male and female gametes;
- Hormones/ chemicals are involved;
- Offspring and hybrids;
- Both involve the process of meiosis;
- Two parents are involved.

**DIFFERENCES**

Mammals	Flowering plants
- Two parents are involved	May involve one or more plants;
- Copulation involved	Pollination involved;
- Fewer offspring produced	More offspring produced;
- Male and female organs borne on separate individuals.	Male and female organs may be borne on same individual;
- Male gametes motile	Male gametes non-motile;
- Single fertilization exhibited	Double fertilization exhibited.

# **CHEMISTRY 1**

## **PRACTICAL**

### **1. GENERAL COMMENTS**

The three alternative papers (A, B and C) were of comparable standard. Taking them together, they compared favourably with those of previous years.

Generally, the performance of this year's candidates appeared to be significantly better than that of the previous year.

### **2. A SUMMARY OF CANDIDATES' STRENGTHS**

- (i) Most candidates recorded burette readings to the two decimal places as required and the calculated values were also left in the appropriate significant figures.
- (ii) There was a remarkable improvement in candidates' titration skills. Many candidates obtained the maximum points.
- (iii) Calculations were done in correct steps.
- (vi) Almost all candidates tabulated their titre values in pencil.
- (vii) The observations and inferences were quite acceptable.

### **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

- (1) As usual, several candidates had difficulties in handling question 2 in all the three alternative papers. ie. they exhibited inappropriate qualitative analysis techniques.
- (2) Tests were wrongly recorded by many of the candidates. In the test column, a few of the candidates only named the reagents without recording the tests performed. Other difficulties were:
  - (i) Drawing conclusions from irrelevant and inappropriate tests.
  - (ii) Not showing clearly whether filtrate or residue was being used.
  - (iii) A few candidates performed and recorded tests which were not demanded by the question.
- (3) Wrong spellings were encountered.

#### 4. SUGGESTED REMEDIES

- (i) Students should be made to do a lot of practical exercises.
- (ii) Tutors should endeavour to go through the exercises, drawing students attention to essential points.
- (iii) Candidates must ensure that, they go over their work to correct mistakes like arithmetical error, wrong spelling etc.

#### 5. DETAILED COMMENTS

### ALTERNATIVE A

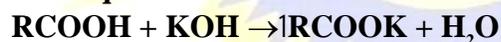
#### Question 1

A is a solution of a weak acid, RCOOH.

B is 0.050 mol dm<sup>-3</sup> KOH.

- (a) Put A into the burette and titrate it against 20 cm<sup>3</sup> or 25 cm<sup>3</sup> portions of B using phenolphthalein as indicator.  
Repeat the titration to obtain consistent titre values.  
Tabulate your results and calculate the average titre.
- (b) From your results and the information given, calculate the
  - (i) concentration of A in mol dm<sup>-3</sup>;
  - (ii) pH of the acid RCOOH given that its dissociation constant K<sub>a</sub> at the temperature of the titration is 1.7378 x 10<sup>-3</sup>.

The equation for the reaction is



$$\text{pH} = \frac{1}{2}\text{pK}_a - \frac{1}{2}\log [\text{C}]$$

- (c) Why was phenolphthalein used as the indicator.
  - (a) As already mentioned, titres were quite good and most candidates scored the maximum mark.
  - (b)
    - (i) This appeared straight forward and was handled well by most candidates.
    - (ii) Even though the equation  $\text{pH} = \frac{1}{2}\text{pK}_a - \frac{1}{2}\log [\text{C}]$  was given to them, the calculation was difficult for quite a number of candidates. Teachers must take note and ensure that students know how to use the calculators. However, the handling of the calculation of the pK<sub>a</sub> was quite good.

## Question 2

**C is a mixture of two salts. Carry out the following exercises on C. Record your observations and identify any gas (es) evolved. State the conclusion drawn from the result of each test.**

- (a) **Put all of C into a boiling tube. Add about 10 cm<sup>3</sup> of distilled water and stir.**
- (b) (i) **To about 2cm<sup>3</sup> portion of the solution, add NaOH<sub>(aq)</sub> in drops and in excess then heat.**
- (ii) **To another portion of the solution, add BaCl<sub>2(aq)</sub> solution followed by excess HCl<sub>(aq)</sub>.**
- (iii) **To the third portion of the solution, add dilute HNO<sub>3</sub> followed by AgNO<sub>3</sub> solution and then excess NH<sub>3(aq)</sub>.**

- (a) In general, a number of candidates wrote tests incorrectly. After dissolution of the mixture, several candidates were still adding the reagents to C instead of 'portion of solution C+ reagent'. Many of the candidates failed to report on the addition of distilled water to the mixture.
- (b) (i) After the addition of NaOH<sub>(aq)</sub> in drops and in excess, a few of the candidates omitted the warming or heating. Hence marks were lost even though the observation and inference were correct. That is, they managed to generate enough gas to perform both litmus and the HCl vapour test.
- (ii) Many described the odour of ammonia gas as urine-like instead of pungent/choking/irritating.

## Question 3

- (a) **Explain briefly each of the following observations:**
- (i) **a precipitate of calcium hydroxide is insoluble in excess sodium hydroxide whereas that of lead (II) hydroxide is soluble;**
- (ii) **When carbon (IV) oxide is bubbled through lime water, it turns milky, but the milky disappears when the gas is bubbled for a long time.**
- (b) (i) **State the indicator used in titrations involving iodine solution.**
- (ii) **How is the indicator used to obtain accurate result in the titration?**
- (iii) **What is the colour of the indicator at the end point?**
- (c) **Name two gases usually collected by**
- (i) **upward displacement of air;**
- (ii) **downward displacement of air.**
- Give a reason for your answer in (i).**

- (a) (i) Performance here was appreciably good. They knew that lead (II) hydroxide is amphoteric and reacts with excess  $\text{NaOH}_{(aq)}$ .
- (ii) Many of the candidates wrote  $\text{Ca}(\text{HCO}_3)$  instead of  $\text{Ca}(\text{HOCO}_3)_2$ . There were several other cases where candidates could not write formulae of compounds correctly.
- (b) It was evident from the responses that some of the candidates have not carried out titrations involving iodine solution.

They were unable to mention the indicator used let alone explain how it is used to obtain accurate result. Teachers must work hard to complete the syllabus.

- (c) Some candidates interchanged the answers for (i) and (ii). Again instead of naming the gases, many of them gave the formula and lost the marks.

## **ALTERNATIVE B**

### **Question 1**

**J is  $0.050 \text{ mol dm}^{-3} \text{ HNO}_3$ . K is a solution containing 20 g of a mixture of  $\text{NaNO}_3$  and  $\text{Na}_2\text{CO}_3$  per  $\text{dm}^{-3}$ .**

- (a) **Put J into the burette and titrate it against  $20.0 \text{ cm}^3$  or  $25.0 \text{ cm}^3$  portions of K using methyl orange as indicator. Repeat the titration to obtain consistent titre values.**

**Tabulate your results and calculate the average volume of J used.**

**The equation for the reaction is  $2\text{HNO}_{3(aq)} + \text{Na}_2\text{CO}_{(aq)} \rightarrow 2\text{NaNO}_{3(aq)} + \text{CO}_{2(g)} + \text{H}_2\text{O}_{(l)}$**

- (b) **From your result and the information given, calculate the**
- (i) **concentration of  $\text{Na}_2\text{CO}_3$  in K in  $\text{mol dm}^{-3}$ ;**
  - (ii) **concentration of  $\text{Na}_2\text{CO}_3$  in K in  $\text{g dm}^{-3}$ ;**
  - (iii) **percentage by mass of  $\text{NaNO}_3$  in the mixture used to prepare solution K.**

**[H= 1.0; C = 12.0; O = 16; Na = 23.0]**

In general candidates seemed comfortable with question 1 and some scored maximum marks.

Most candidates were able to calculate the mass concentration of  $\text{Na}_2\text{CO}_3$  in the mixture.

They were also able to deduce the mass of  $\text{NaNO}_3$ , hence its percentage by mass in the mixture.

## Question 2

**Q is a mixture of two salts. Carry out the following exercises on Q. Record your observations and identify any gas(es) evolved. State the conclusion drawn from the result of each test.**

- (a) Put all of Q into a test tube, add about 5 cm<sup>3</sup> of distilled water. Shake the mixture for about a minute. Filter the mixture, and keep both the residue and the filtrate.**
- (b) To about 1 cm<sup>3</sup> portion of the filtrate, add dilute HCl followed by BaCl<sub>2(aq)</sub>.**
- (c) (i) Put the residue into a test tube. Add dilute NH<sub>3</sub> in drops till all of it dissolves.**  
**(ii) To a portion of the resulting solution from (i), add dilute NaOH in drops and in excess.**  
**(iii) To another portion of the resulting solution from (i) add dilute NH<sub>3</sub> in drops and then in excess.**

Many candidates did not give indication of having added distilled water. After filtration, some candidates were still referring to the sample as Q.

They failed to show whether they were using the filtrate, residue or resulting solution. Teachers must endeavour to address this problem, common with many students.

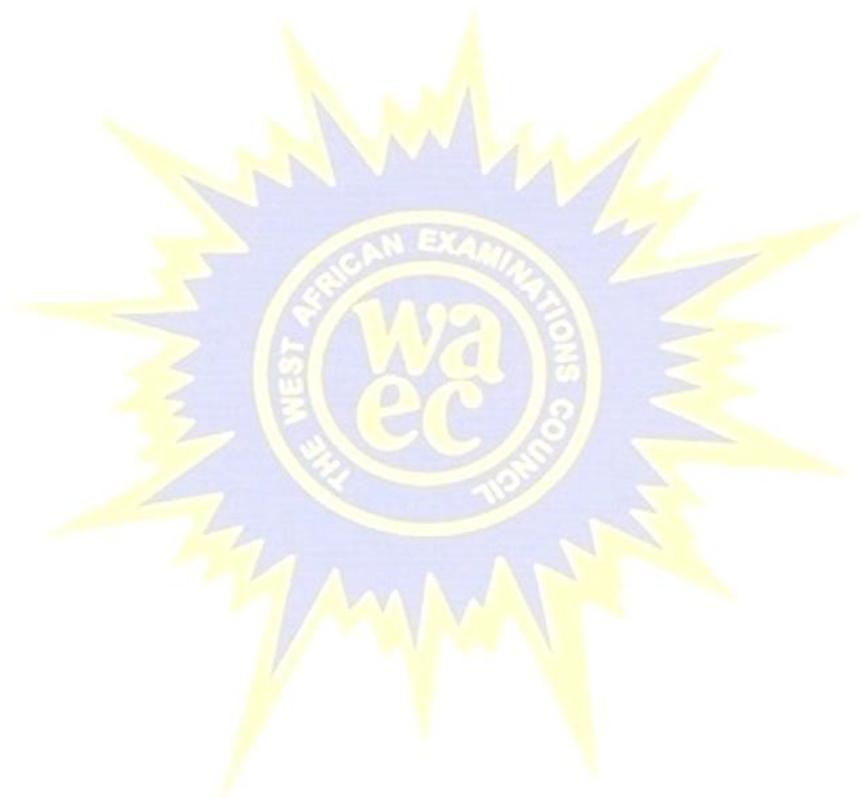
## Question 3

- (a) Explain briefly each of the following laboratory practices:**
  - (i) if sodium hydroxide solution is put into the burette during titration, the burette has to be washed immediately after the exercise;**
  - (ii) the funnel is always removed from the burette before titration starts;**
  - (iii) hydrogen chloride gas is not collected over water.**
- (b) If 15 cm<sup>3</sup> of 0.20 mol dm<sup>-3</sup> potassium hydroxide is diluted to 40 cm<sup>3</sup>, calculate the concentration of the resultant solution.**
- (c) Describe briefly one chemical test that could be used to distinguish between zinc chloride and aluminium chloride.**
- (d) List four pieces of apparatus that are normally used in determining the solubility of a given salt.**

Candidates scored high marks and it was clear they were comfortable with the question. They demonstrated an appreciable understanding of the dilution formula.

However, in the sub-question (d) many listed several pieces of apparatus not used in determining the solubility of a given salt.

Regrettably, in some of the cases where correct pieces of apparatus were listed, they were wrongly spelt.



# ALTERNATIVE C

## 1. GENERAL COMMENTS

The standard of the paper compared favourably with that of previous years. The performance of candidates was generally very poor.

## 2. A SUMMARY OF CANDIDATES' STRENGTHS

- (1) Candidates provided solution of each question on fresh page.
- (2) Candidates showed much improvement in expressing themselves well in English.

## 3. A SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Spelling mistakes of technical terms were many in the answers of candidates.
- (2) Most candidates showed lack of knowledge with regards to questions demanding descriptive approach.
- (3) Few candidates failed to read all instructions to the paper thereby giving irrelevant answers.

## 5. DETAILED COMMENTS

### Question 1

X is a solution of HCL

Y is a solution containing 5.3 g of Na<sub>2</sub>CO<sub>3</sub> per dm<sup>3</sup>.

- (a) Put X into the burette and titrate it against 20.0 cm<sup>3</sup> or 25.0 cm<sup>3</sup> portions of Y, using methyl orange as indicator.

Repeat the titration to obtain consistent titre values.

Tabulate your readings and calculate the average volume of acid used.

The equation for the reaction is



- (b) From your results and the information given, calculate the

- (i) concentration of X in mol dm<sup>-3</sup>;
  - (ii) mass of Cl in 1 dm<sup>3</sup> of solution X;
  - (iii) mass of NaCl that would be produced if 1 dm<sup>3</sup> of Y was neutralized completely.
- [H = 1.0; C = 12.0; O = 16.0; Na = 23.0; Cl = 35.5]

Unlike alternative A and B candidates performance was not satisfactory. As usual the titres were quite good. Most candidates were able to calculate the concentration of X in mol dm<sup>-3</sup>. But many of them were not able to recognise that this was the same as moles of the Cl<sup>-</sup> ie.

Moles of Cl<sup>-</sup> = Conc. of x in mol dm<sup>-3</sup> in 1 dm<sup>3</sup> of X.

Similarly many were not able to relate moles of Na<sub>2</sub>CO<sub>3</sub> to moles of NaCl.

### **Question 2**

**Z is a mixture of two salts.**

**Carry out the following exercises on Z and record your observations.**

**State the conclusion drawn from the result of each test.**

- (a) Put all of Z into a boiling tube. Add about 10 cm<sup>3</sup> of distilled water and stir.**
- (b) Divide the solution from (a) into four portions.**
  - (i) To the first portion, add dilute NaOH in drops and then in excess.**
  - (ii) To the second portion, add NH<sub>3(aq)</sub> in drops and then in excess.**
  - (iii) To the third portion, add BaCl<sub>(aq)</sub> followed by excess dilute HCl.**
  - (iv) To the fourth portion, add freshly prepared FeSO<sub>4(aq)</sub> followed by concentrated H<sub>2</sub>SO<sub>4</sub> down the side of the test tube.**

A significant number of the candidates kept referring to the dissolved sample as Z instead of 'portion of solution Z'.

Many also confused 'white gel ppt' for Al<sup>3+</sup>, Zn<sup>2+</sup> with 'white ppt' for SO<sub>4</sub><sup>2-</sup>. The concept of gelatinous ppt appear to worry many students. Teachers must endeavour to carefully show the difference during practical lessons i.e. (the nature of ppt).

### **Question 3**

- (a) For each of the following gases state the method of collection:**
  - (i) methane;**
  - (ii) hydrogen chloride;**
  - (iii) ammonia.**
- (b) Describe briefly one chemical test that could be used to distinguish between sodium chloride and sodium tetraoxosulphate (VI) solutions.**
- (c) State why**
  - (i) anhydrous cobalt (II) chloride is used to test for presence of water.**
  - (ii) the lid of a desiccator is smeared with petroleum jelly.**

- (d) (i) **Mention three precautions that must be taken during the preparation of a standard solution from the concentrated stock acid.**
- (ii) **Calculate the: concentration of stock hydrochloric acid in mol dm<sup>-3</sup> from the following data:**  
**density = 1.18 g cm<sup>-3</sup>;**  
**% purity = 32%;**  
**molar mass = 36.5 g mol<sup>-1</sup>.**

This question was satisfactorily answered except for the sub-questions A and D.

- (a) Responses of candidates showed clearly that they were familiar with preparation of gases.

However quite a number of them got mixed up with the terms used. The following must be explained during teaching

- (i) 'upward delivery' is the same as 'downward displacement of air'  
(ii) 'downward delivery' is the same as 'upward displacement of air'
- (d) Calculation of concentration of stock acid  
Responses from candidates showed that they lacked knowledge of preparation of chemicals in laboratory. A few however handled it well by using various steps instead of the formula in the marking scheme.

Preparation of solutions is a regular activity of science teachers. It should therefore not be difficult to get students to appreciate skills and techniques involved in this exercise. Sample questions could be discussed and solved in the class.

## **CHEMISTRY 2**

### **1. GENERAL COMMENTS**

The standard of the paper was the same as compared to the previous year. The questions covered a wide range of topics in the syllabus.

The general performance of the candidates was nothing different from that of the previous year.

### **2. A SUMMARY OF CANDIDATES' STRENGTHS**

Some of the commendable features that were identified in candidates scripts are

- (1) orderly presentation of material;
- (2) better understanding of scientific concepts;
- (3) ability to handle questions in physical chemistry;
- (4) ability to follow instructions.

### **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

Some of the weaknesses which made candidates lose marks include the following.

- (1) Inability to use English language to present ideas lucidly
- (2) Inability to draw structure of organic compounds.
- (3) Inability to deduce number of electrons present in ions.
- (4) Weakness in solving problems in organic chemistry.
- (5) Inability to indicate direction when explaining trends in periodic properties of elements and boiling points of compounds.
- (6) Presentation of irrelevant materials.
- (7) Inability to bring out key components of definitions.

### **4. SUGGESTED REMEDIES**

- (1) Organic chemistry should be taught alongside physical and inorganic chemistry. Students should be encouraged to do more exercises in organic chemistry especially drawing of structures.
- (2) Insistence on the use of correct English Language in all subjects must be intensified.
- (3) Students must be taught to provide concise answers to questions.
- (4) Key components in definitions must be stressed.
- (5) Attractive forces responsible for trends in melting and boiling points of compounds must be emphasized.
- (6) Encourage students to indicate direction when explaining trends in periodic properties of elements.

## 5. DETAILED COMMENTS

### Question 1

- (a) (i) Define electronegativity.  
(ii) State the trend of electronegativity on the periodic table.
- (b) (i) Copy and complete the following table.

Particle	Mass Number	Number of protons	Number of electrons	Number of neutrons
Na			11	12
Al	27		13	
O <sup>2-</sup>	16	8		
Mg <sup>2+</sup>	24			12

- (ii) Explain briefly why  
(r:1<sub>BB</sub>—a<sup>+</sup> ions are diamagnetic but <sub>27</sub>Co<sup>2+</sup> ions are paramagnetic;  
(S:1—a<sup>+</sup>, Mg<sup>2+</sup> and Al<sup>3+</sup> ions are isoelectronic species.
- (c) (i) Define isotopes.  
(ii) Name two elements that exhibit isotopy.
- (d) (i) Write and balance each of the following nuclear equations:  
(α)  ${}^{14}_6\text{C} \rightarrow \text{A} + {}^{14}_7\text{N}$ ;  
(β)  ${}^{14}_7\text{N} + \text{B} \rightarrow {}^1_1\text{H} + {}^{17}_8\text{O}$
- (ii) Identify A and B in (i)
- (e) Arrange the following orbitals in order of increasing energy:  
3d, 4s, 2s, 3p, 2p.

Almost all candidates attempted this question and most of them scored very high marks.

- (a) Candidates could define electronegativity but some of them could not state the trend across the period and down the group.
- (b) (i) Candidates determined the missing numbers of the particles in the table except for number of electrons for O<sup>2-</sup> and Mg<sup>2+</sup>.  
(ii) Most candidates could explain diamagnetism and paramagnetism in relation to

paired and unpaired d-orbital electrons respectively. However, some candidates used fully-filled and partially-filled for paired and unpaired orbitals.

- (c) Candidates gave correct definition for isotopes and examples though a few of them used symbols instead of names as examples.
- (d) Nuclear equations were well balanced and A and B well identified. But a few candidates replaced A and B with beta and alpha particles in the equations.
- (e) Most of them arranged the orbitals in the correct order of increasing energy.

### **Question 2**

- (a)
  - (i) **Define the term solubility.**
  - (ii) **If 25 cm<sup>3</sup> of a saturated solution of Ca(OH)<sub>2</sub> was neutralized by 15 cm<sup>3</sup> of 0.10 mol dm<sup>-3</sup> HCl,**
    - (α) **write a balanced equation for the reaction;**
    - (β) **calculate the mass of Ca(OH)<sub>2</sub> in 25 cm<sup>3</sup> of the saturated solution;**
    - (γ) **determine the solubility of Ca(OH)<sub>2</sub>**  
**[H = 1.00; O = 16.0; Ca = 40.0]**
- (b)
  - (i) **What is an acid-base indicator?**
  - (ii) **Give two examples of an acid-base indicator.**
  - (iii) **State which indicator(s) you would use to determine the end-point of the following titrations:**
    - (α) **dilute hydrochloric acid against sodium hydroxide solution;**
    - (β) **dilute hydrochloric acid against ammonium hydroxide solution;**
    - (γ) **ethanoic acid against sodium hydroxide solution.**
- (c) **Classify**  
**NH<sub>4</sub><sup>+</sup>, HCO<sub>3</sub><sup>-</sup>, Cu<sup>2+</sup> and OH<sup>-</sup> as Bronsted-Lowry acid, Bronsted-Lowry base or Lewis acid.**
- (d) **Describe briefly how the pH of a solution could be determined in the laboratory.**

Majority of the candidates attempted this question and performance was quite good.

- (a)
  - (i) Most candidates could define “solubility”. Only a few of them could not score for either refusing to indicate that the solution should be saturated or the dissolution should take place at a given temperature.
  - (ii) Most could write out the balanced equation and proceeded to calculate mass solubility of Ca(OH)<sub>2</sub>.

- (b) Most candidates failed to imply that indicators are weak acids and bases. Those who did also proceeded to show that they ionize only slightly instead of saying that they give different colours in acid/base media. Candidates could give examples of indicators and the types required for various reactions were well indicated.
- (c) The classification of  $\text{NH}_4^+$ ,  $\text{HCO}_3^-$ ,  $\text{Cu}^{2+}$  and  $\text{OH}^-$  as Bronsted-Lowry acid/base or Lewis acid was well done. In some few cases candidates placed one species under more than one class.
- (d) Most candidates described the determination of pH of a solution by using litmus paper instead of pH paper/meter or universal indicator. Those few who could specify the use of pH paper/meter or universal indicator described the determination very well.

### **Question 3**

- (a) **Explain briefly each of the following terms giving appropriate examples in each case:**
- general formula;**
  - homolytic fission.**
- (b) (i) **Define hybridization.**
- (ii) **With the aid of an appropriate diagram, indicate how the C = C double bond in an alkene is formed.**
- (c) **An organic compound G with molecular mass 74 contains 49.2 % of carbon, 42.2 % of oxygen and the rest being hydrogen.**
- Determine the**
    - empirical formula of G;**
    - molecular formula of G.**
  - If G reacts with ethanol in the presence of concentrated  $\text{H}_2\text{SO}_4$  to form a sweet liquid H, deduce the structures of G and H.**  
[ H = 1.00; O = 16.0; C = 12.0]
- (d) **Explain briefly why the boiling point of  $\text{C}_2\text{H}_5\text{OH}$  is  $78^\circ\text{C}$  while that of its isomer  $\text{CH}_3-\text{O}-\text{CH}_3$  is  $-24.4^\circ\text{C}$ .**
- (e) **Write the structure of amino acid,  $\text{CH}_3\text{CH}(\text{NH}_2)\text{COOH}$**
- in alkaline medium;**
  - at isoelectric point.**

- (a) (i) Most of the candidates who attempted this question could not tell what General Formula is and those who could give examples failed to indicate the homologous series to which the formula belonged.
- (ii) Most of them took homolytic fission to be nuclear fission and defined it as such. They could also not give examples.
- (b) Correct definition of hybridization was given but in (ii) candidates could not draw the appropriate diagram to explain how the C = C double bond in alkene is formed.
- (c) Candidates could determine the empirical and molecular formula of G perfectly well but could not draw the structure of G and then that of H after G had reacted with conc  $\text{H}_2\text{SO}_4$ .
- (d) Candidates could not use the forces holding the molecules of  $\text{C}_2\text{H}_5\text{OH}$  (hydrogen bond) and  $\text{CH}_3-\text{O}-\text{CH}_3$  (van der Waals forces) to explain why the differences in boiling points of the two isomers.
- (e) Most candidates could not draw the structures of  $\text{CH}_3\text{CH}(\text{NH}_2)\text{COOH}$  in alkaline medium and at isoelectric point.

#### Question 4

- (a) (i) **Describe briefly how each of the following bond types are formed;**  
 (α) **dative bond;**  
 (β) **metallic bond.**  
 (ii) **State the type of bond in each of the following substances:**  
 (r:  $\text{Y}_c(\text{g});1$   
 1  $9\text{S};1$   $\text{a}(\text{s});1$   
 1  $9\text{X};1$   $\text{aY}(\text{s});1$   
 1
- (b) (i) **Give two characteristic features of boiling.**  
 (ii) **What will be the effect of reduction of atmospheric pressure on the boiling point of water?**  
 (iii) **State two difference between boiling and evaporation.**  
 (iv) (α) **Arrange the following compounds in order of decreasing boiling point.**  
 $\text{NaH}_{(\text{s})}$ ,  $\text{CS}_{2(\text{l})}$ ,  $\text{CO}_{2(\text{g})}$ .  
 (β) **Explain briefly your answer in (α) above.**

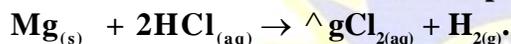
(c) The table below shows the physical properties of substances Q, R and S.

Substance Melting point/°C Boiling point/°C Solubility in water at 25 °C

Q	30	117	insoluble
R	31	160	insoluble
S	861	1200	soluble

### Question 5

(a) Consider the redox reaction represented by the following equation:



(i) State the change in oxidation number of

(α) magnesium;

(β) hydrogen.

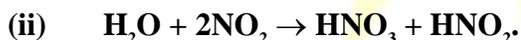
(ii) Which species is being

(α) oxidized?

(β) reduced?

(iii) Identify the oxidizing agent.

(b) State the property exhibited by nitrogen (IV) oxide in each of the following equations:



(c) (i) State Faradays law of electrolysis.

(ii) Explain briefly how electrolysis affects the pH of electrolytes using each of the following substances as electrodes:

(α) carbon;

(β) copper.

(iii) State two applications of electrolysis.

(d) A current of 1.26 A is passed through an electrolytic cell containing a dilute tetraoxosulphate (VI) acid solution for 7.44 hours.

(i) Write the

- (r:1 half-cell reaction equations;
- (s:1 overall reaction equations.

**(ii) Calculate the volume of the gas liberated at the**

- (α) anode;
  - (β) cathode at s.t.p.
- [ I F = 96500; Molar volume of gas = 22.4 dm<sup>3</sup> ]

The general performance in this question was not encouraging.

- (a) Only a few candidates could state the change in oxidation number of Mg and hydrogen and were able to identify the species being oxidised and the species is reduced in (ii) and the oxidising agent in (iii).
- (b) Very few candidates could state the property exhibited by nitrogen (iv) oxide in the two reactions.
- (c) In Faraday's first law most candidate used quantity of current and quantity of charge instead of quantity of electricity.  
In (iii) candidates, were good in specifying the applications of electrolysis.
- (d) The candidates could not write the half-cell and the overall reaction equations and only a few managed to calculate the volume of gas liberated at the anode and cathode a stp.

### Question 6

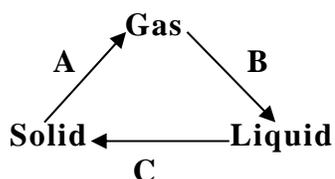
- (a) Consider the equilibrium reaction represented by the following equation:
- $$\text{Ca}^{2+}_{(aq)} + 2\text{HCO}_3^{-}_{(aq)} \rightleftharpoons \text{CaCO}_{3(s)} + \text{CO}_{2(aq)} + \text{H}_2\text{O}_{(l)}$$

**Predict the effect of each of the following changes on the equilibrium composition.**

- (i) concentration of Ca<sup>2+</sup> is increased;
  - (ii) amount of CaCO<sub>3</sub> is increased;
  - (iii) amount of H<sub>2</sub>O is increased;
  - (iv) concentration of HCO<sub>3</sub><sup>-</sup> is decreased.
  - (v) catalyst is added.
- (b)
- (i) Describe briefly how pure crystals of zinc tetraoxosulphate (VI) can be prepared in the laboratory from zinc granules and dilute tetraoxosulphate (VI) acid.
  - (ii) Write a balanced equation for the reaction in (i) above.
  - (iii) Write equations to show sulphur (IV) oxide is converted to tetraoxosulphate (IV) acid in the Contact process.

(c) Explain briefly why an aqueous solution of ammonium chloride has a pH less than 7.

(d) Consider the following figure:



State the processes represented by A, B and C, respectively.

(e) Arrange the three states of matter in order of decreasing kinetic energy; forces of cohesion.

- Performance in this question was average.
- (a) Candidates confused equilibrium composition with equilibrium position. Answers given related to equilibrium position rather than equilibrium composition.
- (b) Majority of the candidates could not go beyond the addition of dilute  $\text{H}_2\text{SO}_4$  to zinc granules in a beaker in the preparation of zinc tetraoxosulphate (VI) in the lab. Only a few could write the equation involved. Again, they could not show how sulphur (IV) oxide is converted to tetraoxosulphate (VI) acid in the Contact Process.
- (c) Candidates could just not explain why aq.  $\text{NH}_4\text{Cl}$  has a pH less than 7.
- (d & e) Most candidates could identify the phase changes represented by A, B, C and could also arrange the 3 states in decreasing order of kinetic energy and forces of cohesion.

# **CROP HUSBANDRY AND HORTICULTURE 1**

## **1. GENERAL COMMENTS**

The standard of the paper was comparable with those of previous years and the performance of candidates was better.

## **2. A SUMMARY OF CANDIDATES' STRENGTHS**

Commendable features in the scripts of candidates are summarized as follows:

- (1) Candidates exhibited good answering skills;
- (2) Improvement in the usage of the English Language;

The handwritings of candidates were legible.

## **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

The following weaknesses were observed in the scripts of candidates:

- (1) Wrong spelling of scientific terms;
- (2) Lack of answering skills.

## **4. SUGGESTED REMEDIES**

It was suggested that:

- (1) Teachers should teach candidates how to answer questions.
- (2) Candidates should endeavour to spell scientific terms correctly.

## **5. DETAILED COMMENTS**

### **Question 1**

- (a)
  - (i) **State two signs of maturity of specimen A.**
  - (ii) **Mention three problems associated with delayed harvesting of specimen A.**
  - (iii) **State three advantages of including specimen A in crop rotation system.**
- (b)
  - (i) **Identify specimen B by its scientific name.**
  - (ii) **Name two planting materials that could be used in the propagation of specimen B.**
  - (iii) **Outline the steps involved in the processing of specimen B into white sugar.**

This is one area where many candidates did very good work. The signs of maturity of specimen A (cowpea) was well answered. Again, the advantages of including specimen A in Crop Rotation Systems was also beautifully answered.

However, the steps involved in processing specimen B (sugarcane) into white sugar were mixed up by few candidates. Some candidates stated “stem cutting” as planting materials for sugarcane instead of short setts, long setts or soldier setts. Many candidates wrote scientific names in brackets when candidates were expected to “underline” them.

### **Question 2**

- (a) Identify each of the disease conditions on specimens C and D.**
- (b) Name the causal organism of each of the diseases you have identified in (a).**
- (c) State two symptoms of the disease you have identified on specimen C.**
- (d) Enumerate three methods of controlling the disease you have identified on specimen C.**
- (e) State one mode of transmission of the disease you have identified on specimen D.**
- (f) State two symptoms of the disease you have identified on specimen D.**
- (g) Mention two methods of controlling the disease you have identified on specimen D**

This question was fairly well answered. The specimens were fairly well identified as (black pod disease) and (cassava leaf mosaic/mosaic) and are caused by fungus and virus respectively.

Symptoms of black pod disease are that the entire pod in black, black/brown spots appear on pod and whitish material appear on pod and the disease could be controlled by removing or destroying infected pods, regular weeding and planting at recommended distance.

Cassava mosaic which is transmitted by piercing and sucking insects and infected plant cutting could be identified by mottling of leaves, leaf distortion and mosaic pattern on leaves. The disease could be controlled by uprooting and burning infected plants and practicing good farm sanitation.

### **Question 3**

- (a) Identify each of specimens E and F.**
- (b) Mention one feature of specimen E that helps in its dispersal.**
- (c) Name one agent of dispersal of specimen F. Give one reason of your answer.**
- (d) Give three reasons why both specimens E and F are of economic importance to the farmer.**
- (e) Enumerate three methods of controlling specimen E on the farm.**

Candidates answered part (a),(b), and (c) satisfactorily.

Many candidates did not answer part (d) satisfactorily.

The phrase economic importance was misunderstood to mean economic benefit and not something adverse in crop farming.

Some candidates failed to use the word recommended as a good way of prescribing agro-chemicals.

Methods of controlling specimen E was well handled by the candidates.

#### **Question 4**

- (a) (i) **Identify the crop from which specimen G was obtained by its common name and scientific name.**
- (ii) **Mention two methods of planting the crop from which specimen G was obtained.**
- (iii) **Name two pests of specimen G.**
- (iv) **Outline the steps that a peasant farmer could use to obtain the grains from specimen G.**
- (b) (i) **Identify the crop from which specimen H was obtained by its scientific name.**
- (ii) **Name two fungal diseases and two pests which affect the production of specimen H.**
- (iii) **Mention the main vitamin that is found in specimen H.**

Candidates performed averagely. The identification and method of planting rice were well answered.

Pests of rice include monkey, rice bugs, birds and rodents.

The steps involved in obtaining the grains posed a challenge as most candidates could not give a step by step account.

Candidates gave the scientific name of tomato correctly, and were able to give some of the pests and diseases of tomato as well as the main vitamin obtained from the vegetable.

## **CROP HUSBANDRY AND HORTICULTURE 2**

### **1. GENERAL COMMENTS**

The standard of the paper is the same as that of the previous years' papers. However, the candidates' performance was better than that of the previous years.

### **2. A SUMMARY OF CANDIDATES' STRENGTH.**

The following commendable features were noticed in the scripts of candidates.

- (1) Most of the candidates followed the rubrics of the paper.
- (2) Candidates exhibited good answering skills.
- (3) Candidates wrote legibly which made marking easier.

### **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

The following weaknesses were observed in the scripts of candidates.

- (1) There was generally, poor articulation of facts and knowledge by a lot of candidates;
- (2) Quite a number of candidates exhibited poor understanding of basic concepts in Crop Husbandry and Horticulture;
- (3) Poor English grammar and expression is still the problem, as well as spelling mistakes of common English words and scientific terms.

### **4. SUGGESTED REMEDIES**

The following suggestions were made to remedy weaknesses of candidates.

- (1) Teachers advised to teach the basic concepts or principles in Agriculture;
- (2) Teachers conduct practical work and discuss the learning outcome with the students;
- (3) Students should be encouraged to read story books and text books to enhance their vocabulary.

### **5. DETAILED COMMENTS**

#### **Question 1**

- (a) **State three objectives of each of the following cultural practices in crop production:**
  - (i) **topping;**
  - (ii) **staking.**

- (b) **Give four reasons for the extensive cultivation of sorghum in the savanna zone of West Africa.**
- (c) **Describe three types of beds that could be used in vegetable production.**

Most candidates did not attempt this question. Unfortunately, however, it was very poorly answered by those candidates who attempted and answered it. The objectives of (i) topping was the one most poorly answered. Correct answers could be as following:

- Checks plants from growing tall to avoid lodging;
- Helps plants to develop thick stems to support fruits;
- Aids crops to develop more leaves. e.g. tobacco;
- Makes harvesting of fruits and leaves easier;
- Enhances/increases fruiting of crop/increase fruiting etc.;
- Enhances bigger fruit formation.

Objectives of staking include facilitates harvesting of fruits, prevents fruits from rolling, makes farm operations easier and gives support during period of strong wind.

Candidates did not understand part (b) and so could not answer it well. Correct answers include the following:

- The crop has small leaf area which results in less loss of moisture/water.
- It has efficient well-branched root system to absorb moisture.
- The above ground part grows slowly until the root system becomes well established.
- Leaves have waxy coat and roll in time of water stress/drought tolerant.
- Silica cells present in the endodermis strengthen the stem thus preventing collapse during drought stress.
- Sorghum plant prefers warm growing conditions/high temperature, low temperature, low humidity etc.
- Some sorghum varieties tolerate acidic soils e.g. savanna zones.
- It is widely utilized by the people in the area.

In part (c) most candidates were able to mention the types of beds but failed to describe them.

## **Question 2**

- (a) **Mention three types of planting materials used for the propagation of yam.**
- (b) **Give two examples of each of the following types of crops:**
- (i) **fibre crops;**
  - (ii) **medicinal crops;**
  - (iii) **tree crops;**
  - (iv) **grain legumes.**
- (c) **Discuss three problems associated with cassava utilization in West Africa.**

In part (a) candidates could not mention the correct planting materials used for the propagation of yam and wrote names of other planting material. Correct answers included:- yam seeds, bulbils, vine/stem cutting, tissue culture, plantlets, micro-setts/yam setts, minisetts, seed yam.

Part (b) the question was well answered and candidates could score more marks.

In part (c) problems associated with cassava utilization were fairly well stated by candidates.

### **Question 3**

- (a) State three measures that a farmer should adopt to derive maximum benefit from improved varieties of crop.**
- (b) Explain each of the following crop improvement methods:**
  - (i) introduction;**
  - (ii) selection.**
- (c) Describe five methods of breaking seed dormancy.**

Apart from sub-question (b) which candidates could not answer well. The rest of the question was answered satisfactorily. Candidates found it difficult to distinguish between introduction and selection. Introduction is the importation of economic crops from one place to another where it never existed whilst selection is the process of choosing crops with desirable characteristics from a large pool of different individuals for continuous propagation.

### **Question 4**

- (a) State four advantages of intercropping in crop production.**
- (b) (i) Outline the life cycle of maize stem borer.**  
**(ii) State two ways of controlling maize stem borer on the farm.**
- (c) Discuss two ways in which value chains are important in the production and marketing of cereals.**

Only few candidates attempted sub-question (a) and they lost a lot of marks because their responses were poor.

Expected answers included: good use is made of land, one crop can benefit from the other, cover provided by the crops protects the soil from erosion and harvesting of different crops at different times ensure continuous supply of food over a longer period.

In part (b) candidates found it difficult to outline the life cycle of main stem borer as well as ways of controlling them. Some of the ways of controlling maize stem borer include the use of appropriate insecticide, uprooting and burning of maize stalks and practicing crop rotation.

Candidates could not answer sub- question satisfactorily.

Correct answer included:

- Products from value chain approach are higher in quality and safety.
- Consumers' needs and specifications are satisfied.
- Value is added at every step of the chain to offer better products for the consumer.
- Ensure higher revenue for the farmer.
- Products have competitive market advantage.
- Post harvest losses are advantage.

### **Question 5**

- (a) (i) **What is landscaping as used in ornamental horticulture.**  
(i) **State four ways in which landscaping is important to a community.**
- (b) **Mention six principles of landscape design.**
- (c) **Describe four management practices that are carried out on house plants.**

Quite a number of candidates answered this question and their performance was good. However, many of them could not give the correct definition of landscaping. Landscaping is defined as the art of creating and preserving beauty in the surrounding of human habitation by employing plants as one of the major materials.

### **Question 6**

- (a) **Give two reasons for fermenting cocoa beans.**
- (b) **Give one reason each for the need to consider the following factors when establishing enterprises in horticulture:**
- (i) **knowledge in horticulture;**
  - (ii) **labour;**
  - (iii) **business registration.**
- (c) **Explain two ways in which each of the following factors affect crop production:**
- (i) **solar radiation;**
  - (ii) **rainfall;**
  - (iii) **soil.**

Almost all candidates answered question 6. Performance was satisfactory although candidates encountered some difficulty in stating ways which solar radiation affects crop production.

# **FORESTRY 1**

## **1. GENERAL COMMENTS**

The standard of the paper was comparable to that of the previous year. Candidates' performance was average.

## **2. A SUMMARY OF CANDIDATES' STRENGTHS**

Candidates' major strengths were that:

- (1) Majority of the candidates were able to identify the specimens correctly.
- (2) They adhered to the rubrics of the paper.
- (3) Many candidates had legible handwriting.

## **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

The main weakness of candidates was the wrong spelling of scientific terms and names.

## **4. SUGGESTED REMEDIES**

Candidates should note and spell scientific terms and names correctly.

## **5. DETAILED COMMENTS**

### **Question 1**

- (a) Identify each the specimens A and B.**
- (b) Name the habitat of each of specimens A and B.**
- (c) Draw and label specimen A.**
- (d) Indicate the trophic level in the food chain to which specimen A belongs.**
- (e) State two ways in which specimen A is important in forestry.**
- (f) State the main function of specimen B in the forest ecosystem.**
- (g) Name two types of specimen B that are edible.**

Majority of candidates were able to answer part (a) and (b) satisfactorily. For part (c), candidates were able to indicate the trophic level in the food chain to which specimen A belongs.

Part (d) was also answered satisfactorily. Part (e) was a bit difficult to some few candidates. The expected answer is as food to mankind and feed to some animals.

Lastly, candidates' performance in part (f) was not satisfactory. Correct answers should be as follows:

- Wood-ear mushroom (*Auricularia, spp.*)
- Oyster mushroom
- Abalone mushroom (*Pleurotus cysticliosis*)
- Monkey seat mushroom (*Ganoderma spp.*), etc.

### **Question 2**

- (a) Identify specimen C by its common name and scientific name.**
- (b) Draw and label specimen C.**
- (c) State one function each of two of the parts of specimen C that you have labelled in (b).**
- (d) Name two vegetation zones in Ghana where specimen C could be found.**
- (e) Give three uses of a mature plant of specimen C.**

Majority of candidates answered part (a) satisfactorily.

For part (b), horrible drawings were presented so candidates obtained low marks. Candidates should learn how to draw good diagrams. Performance in part (c) was unsatisfactory. The correct answers should be

- Prop root: anchorage/support
- Leaf : for photosynthesis; for transpiration; for gaseous exchange
- Node: for strength/provide strength
- Bud: develops into new shoots

Parts (d) and (e) were answered satisfactorily by many candidates.

### **Question 3**

- (a) Identify each of specimens D and E.**
- (b) State four observable differences between specimens D and E.**
- (c) Mention three uses of a mature plant of specimen D.**
- (d) Name the habitat of specimen E.**
- (e) Mention the kingdom to which specimen E belongs.**
- (f) State two ways in which specimen E is of economic importance.**

Part (a) was answered satisfactorily by candidates. In part (b), the sub-question was not easy for many candidates. The correct answers should be as follows in a tabulated form:

<b>Teak seedling (naked) - D</b>	<b>Fern Plant - E</b>
- Broad leaves	- Narrow and small leaves
- Tap roots	- False roots
- Prominent stem	- Absence of true stem
- Absence of spots on the leaves	- Presence of dark spots on the leaves
- Smooth leaf margin	- Serrated leaf margin

Parts (c), (d), (e) and (f) were answered satisfactorily by majority of candidates.

#### **Question 4**

- (a) Identify each of specimens F and G.**
- (b) Outline the steps involved in the production of specimen F from a log.**
- (c) Mention four uses of specimen F.**
- (d) Name the habitat of specimen G.**
- (e) State three ways in which specimen G is of economic importance.**

Part (a) was answered satisfactorily. Part (b) was poorly answered by majority of the candidates.

The processes involved in sequential order are as follows:

- Peeling/Slicing of log
- Drying of sheets/sliced material
- Glueing of veneer sheets
- Pressing of glued sheets
- Edging of plywood

Sub-questions (c), (d) and (e) were excellently answered by majority of candidates.

## **FORESTRY 2**

### **1. GENERAL COMMENTS**

The standard of the paper was similar to that of the previous years. Candidates' performance was similar to that of the previous year.

### **2. A SUMMARY OF CANDIDATES' STRENGTH**

Candidates' strength could be summarised as factors:

- (1) Adherence to rubrics
- (2) Legible handwriting

### **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

The main weaknesses of candidates were:

- (1) Poor drawing of map.
- (2) Wrong spelling of scientific terms.

### **4. SUGGESTED REMEDIES**

Suggested remedies for weaknesses are:

- (1) Candidates should learn how to draw diagrams/map well.
- (2) Candidates should endeavour to spell scientific terms correctly

### **5. DETAILED COMMENTS**

#### **Question 1**

- (a) **Mention four causes of bushfires.**
- (b) **Outline four measures that could be adopted to minimize the incidence of bushfires.**
- (c) **Explain four ways in which insects could be beneficial to the forester.**

This question was attempted by many of the candidates and performance was satisfactory.

## **Question 2**

- (a) Mention five ways in which record keeping is important in forestry.**
- (b) State five differences between forest trees and savanna trees.**
- (c) Draw the map of Ghana showing the locations of the various vegetation types.**

Sub-questions (a) and (b) were answered satisfactorily by candidates. In part (c), most of the candidates found it difficult to draw the map of Ghana showing the location of the various vegetation types.

## **Question 3**

- (a) List five characteristics of trees suitable for agroforestry practices.**
- (b) Define each of the following terms as used in forestry:**
  - (i) afforestation;**
  - (ii) reforestation;**
  - (iii) reforestation.**
- (c) Discuss three functions of the Wildlife Division of the Forestry Commission of Ghana.**

It was easy for many candidates to list five characteristics of trees suitable for agroforestry practices under sub-question (a). The terms

- (i) afforestation
- (ii) reforestation and
- (iii) reforestation were correctly defined in sub-question (b).

The function of the Wildlife Division of the Forestry Commission of Ghana were difficult to the majority of candidates in sub-question (c).

The expected answers include:

- Regulation of the utilization of wildlife resources.
- Promote public awareness of wildlife management.
- Development of animal breeding facilities to complement natural wildlife.
- Promotion of ecotourism
- Regulation of the internal pet trade.

## **Question 4**

- (a) Give four reasons for carrying out forest mensuration.**
- (b) Draw the map of Ghana and indicate the locations of the following national parks:**
  - (i) Bui national park;**

- (ii) Kakum national park;**
- (iii) Mole national park.**

**(c) Explain three ways in which forest policy is important to a country.**

Performance of the candidates in part (a) was unsatisfactory. The expected answers are as follows:

- For comparison of current future state of forest
- For quality determination
- For trade purposes or selection
- Costing and pricing of forest products
- Effective management of forest estates

Performance in part (b) were also unsatisfactory. Candidates could not answer part (c) satisfactorily. Expected answers are as follows:

- Better management of forest resources
- Better control and utilization of forest land and resources
- Address social needs of rural communities
- Conform to international conventions and standards of forest management
- Development of natural estates
- Development of timber industry
- Eco-development of revenue
- Environmental conservation
- Research purposes

### **Question 5**

- (a) State five ways of controlling weeds in the early stages of plantation establishment.**
- (b) Give five reasons for conserving the forest.**
- (c) Distinguish between predators and endangered species as used in forestry.**
- (d) Outline the procedure for harvesting timber.**

Candidates were able to give satisfactory answers for part (a). These include regular weeding, mulching, close planting, application of appropriate weedicide, canopy formation.

Many candidates answered part (b) satisfactorily.

For part (c), some of the candidates could not distinguish clearly between predators and endangered species as used in forestry.

Predator refers to animal that catches and feeds on other animals whilst endangered species refer to the species whose population or habitat have become relevant in size and may get extinct if not given adequate protection.

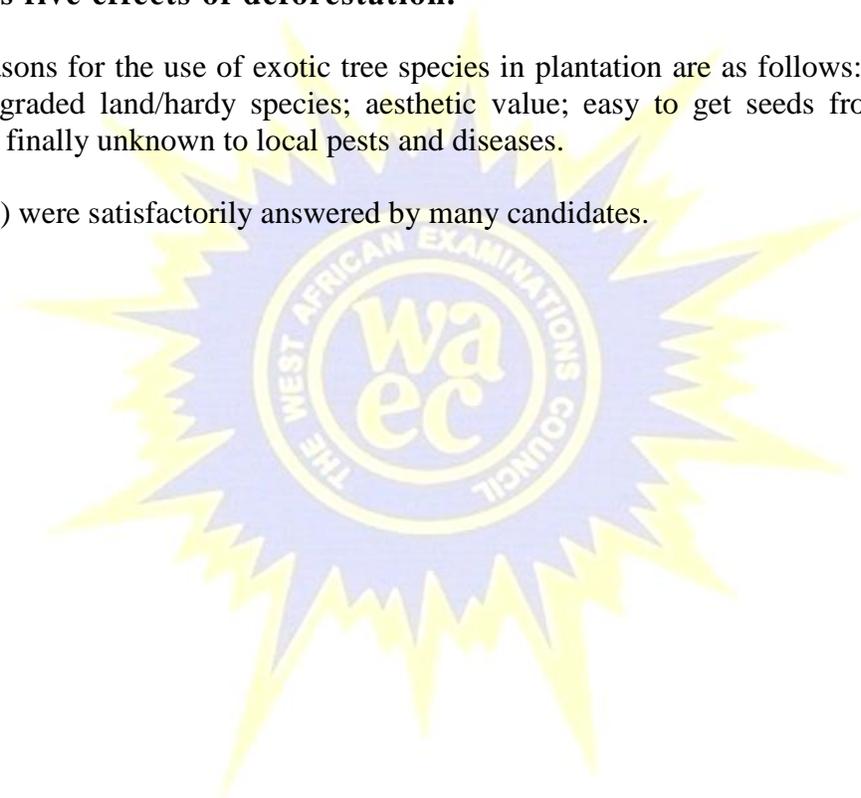
The procedure for harvesting timber required in part (d) should be outlined as follows; permit acquisition, yield approval, extraction of logs and finally loading.

**Question 6**

- (a) **Give four reasons for the use of exotic tree species in plantations.**
- (b) **Define each of the following ecological terms:**
  - (i) **altitude;**
  - (ii) **humidity;**
  - (iii) **turbidity.**
- (c) **Discuss five effects of deforestation.**

The correct reasons for the use of exotic tree species in plantation are as follows: rapid growth; suitable for degraded land/hardy species; aesthetic value; easy to get seeds from established plantations and finally unknown to local pests and diseases.

Parts (b) and (c) were satisfactorily answered by many candidates.



# **FISHERIES 1**

## **1. GENERAL COMMENTS**

The standard of the paper is at par with previous ones.

The performance of candidates shows a slight improvement of over that of previous years.

## **2. A SUMMARY OF CANDIDATES' STRENGTHS**

Notable strengths included the following.

- (1) Improvement in the usage of the English Language.
- (2) Adherence to rubrics by candidates.

## **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

Weaknesses identified in the scripts of candidates were:

- (1) Most candidates exhibited bad handwriting;
- (2) Wrong spelling of scientific terms.

## **4. SUGGESTED REMEDIES**

The following remedies were suggested:

- (1) The teaching and learning processes should be improved by the schools.
- (2) Teachers should conduct spelling exercises on scientific terms periodically.

## **5. DETAILED COMMENTS**

### **Question 1**

The lengths (in centimetres) of a batch of tilapia caught in a sample net from a fish pond are presented below. The tilapia were offsprings of the same parent and were spawned at the same time.

9	13	10	15	12	11	13	14	10	16
9	14	12	15	11	14	12	13	16	11
13	12	15	8	14	11	13	10	15	11
14	9	11	12	11	13	12	14	13	10
14	11	12	12	10	12	10	13	11	12

- (a) Draw a frequency distribution table of the lengths provided.

- (b) Present the data you have obtained in (a) in a suitable graphical form.**
- (c) Describe the graph you have drawn.**
- (d) Explain three factors which could be responsible for the differences in the lengths of the fish.**
- (e) Name three fishing gears which could be used to sample the fish.**

Most candidates were able to draw the frequency distributor table. A few missed out one length, ending up with 49 lengths instead of 50.

Most candidates correctly drew a line graph using the figures produced in the table. Some candidates produced bar charts.

Many confused the function of protection for defence, and rather named pincers for protection instead of exoskeleton or carapace. The part of the question about paired fins was well answered. The drawing of the dissected fish was very poorly done. Organs were drawn without any relation to other organs.

Most candidates could not describe the shape of the graph they had drawn. For factors responsible for differences in lengths, most candidates were able to only name the factors, but were unable to explain the factors.

For fishing gears which could be used to sample the fish many ignored the information in the question which indicated that the fish were removed from a fish pond and indicated that a trawl could be used to sample them.

## **Question 2**

- (a) Identify specimens A and B.**
- (b) (i) Draw and label the external features of specimen A.**
  - (ii) Which of the external features of specimen A that you have labelled in (i) is used for protection?**
- (c) (i) Name the paired fins on specimen B.**
  - (ii) State two functions of the paired fins of specimen B that you have named in (i).**
- (d) Dissect the stomach of specimen B.**
  - (i) Draw and label the internal organs of the stomach of specimen B.**
  - (ii) State one function each of four of the internal organs of specimen B that you have labelled in (i)**

The drawing of shrimp A was generally poor. Some of the drawings did not show any resemblance to the specimen at all. The appendages were poorly indicated, the two parts of cephalothorax and abdomen were early shown.

Many confused the function of protection for defence, and rather named pincers for protection instead of exoskeleton or carapace. The part of the question about paired fins was well answered. The drawing of the dissected fish was very poorly done. Organs were drawn without any relation to other organs.

### **Question 3**

- (a) Identify specimens C, D, E and F.**
- (b) State one use of each of specimens C, D, E and F in the construction of fishing gear.**
- (c) Name one other material which could be used as a substitute for each of specimens C, D, E and F in the construction of fishing gear.**
- (d) What would be the nature of each of specimens C, D, E and F if used in water for six months.**
- (e) State two measures which could be adopted to ensure the extended use of specimens C and E.**

Identifications in part (a) were generally correctly done. The uses of the identified specimens were also quite well done. However, for specimen F (nylon rope) most candidates could not be specific to state the use of the rope, such as a line for a hook or float line or lead line, but they stated that they are used “to construct fishing net”.

Answers to part (c) about substitutes for specimens C, D, E and F were quite satisfactory. However, some candidates offered “empty gallon” as substitute for a cork used as a float. An empty gallon not closed will be filled with water and cannot be used as a float on a gill net.

In part (d) very poor answers were given for the state of the specimens used in water for six months. Many candidates stated that the cork, the stone and the cane will turn “black” instead of “algae will grow on it”.

Many candidates could not offer measures to extend the use of specimens. A few stated that they should be dried in the sun, rather than in the shade.

## **FISHERIES 2**

### **1. GENERAL COMMENTS**

The standard of the paper is at par with previous ones.

The performance of candidates generally appears to be an improvement over that of previous years.

### **2. A SUMMARY OF CANDIDATES' STRENGTHS**

The following strengths were identified:

- (1) Generally, candidates answered new questions on new pages in the answer booklet.
- (2) Candidates writing was generally every legible.
- (3) Sub-question were well numbered.

### **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

The major weaknesses noticed were:

- (1) Many candidates did not understand the requirements of the questions asked. When required to discuss, or explain, they only mentioned the issues;
- (2) Poor usage of English Language;
- (3) Inadequate preparation of candidates;
- (4) Wrong spelling of scientific terms

### **4. SUGGESTED REMEDIES**

It was suggested that:

- (1) Teachers should take time to coach students or the requirements of questions in the context in which they are asked.
- (2) Candidates should improve upon their usage of the English Language.
- (3) Spelling exercises should be conducted by teachers on scientific terms.

### **5. DETAILED COMMENTS**

#### **Question 1**

- (a) **List five facilities which would be required at fish landing site.**
- (b) **Name four methods of fish preservation.**

- (c) Outline the process of external fertilization in fishes**
- (d) Describe four negative effects of aquaculture activities on the environment.**

This was a popular question. Part (a) and (b) were very well answered. Part (c) was also well answered.

Answers to part (d) were limited to pollution, destruction of vegetation and pond breeding mosquitoes.

However, many candidates did not recognize the conditions under which ponds could breed mosquitoes. Many made a blanket statement that “ponds breed mosquitoes”.

### **Question 2**

- (a) Mention five characteristics of tilapia which make them suitable for culture.**
- (b) List five industries related to the fisheries sector in Ghana.**
- (c) With the aid of a suitable diagram, describe an earthen fish pond.**

This was a popular question. Part (a) was generally well answered. However, the point concerning the tolerance of tilapia of temperature changes was wrongly stated by many candidates.

Part (b) was misrepresented by many candidates to mean employment avenues in the fisheries sector. Some mentioned fisheries research, fisheries commission etc. Candidates were expected to name industries such as net-making, boat building, etc.

Part (c) was very poorly answered. Most of the attempted the question were not able to produce a suitable drawing of a fish pond. Pond walls were vertical, showing no sloping or width. Pond inlets and outlets, even though shown were mostly not in the right places. The drawings did not show any proportion between the length/width and the height.

Furthermore, most candidates did not provide any description in words, apart from the drawing.

### **Question 3**

- (a) (i) Name three types of aquatic habitats of fish**  
**(ii) State three characteristics of each of the three aquatic habitats you have named in (i).**
- (b) Explain four measures which could be adopted to promote fish marketing in Ghana.**

Part (a)(i) was quite well answered, except that some candidates stated “blackish” instead of “brackish” water and “salt water” for marine water. Part (a)(ii) and (a)(iii) were poorly answered. The characteristics were poorly stated. Most dwelt on the salt content, but stated “no salt” for fresh water, “moderate salt” for brackish water and “high salt” or “salty” for sea water.

Part (b) was poorly answered. Candidates only mentioned the measures to be adopted to promote fish marketing, but failed to explain those measures, as the question demanded.

### **Question 4**

- (a) Distinguish between the terms fishery and fisheries.**
- (b) Give four examples each of fishery and fisheries.**
- (c) Discuss four ways in which the Economic Exclusive Zone is beneficial to your country.**

Very few candidates attempted this question, which was very poorly answered. Almost all candidates were unable to provide a distinction between “Fishery” and “Fisheries” demanded by part (a). There was a mix-up of examples for “Fishery” and “Fisheries” in part (b). Fisheries refers to all fishing activities on a water body whilst fishery refers to a unit of the term fisheries.

For part (c), no correct benefits of EEZ was stated. Very few candidates indicated that countries make “profits” from the EEZ. Some benefits include access control, non-dumping rights and fisheries rights.

### **Question 5**

- (a) Explain the following fishery regulatory methods:**
  - (i) closures;**
  - (ii) catch limits;**
  - (iii) gear restrictions;**
  - (iv) regulations on fishing effort.**
- (b) Discuss four problems facing artisanal fishermen in Ghana.**

Part (a) was not well answered, but candidate were only able to make one point about the issues. For (i) closures most candidates who attempted the question only stated that it was a “stoppage” of fishing in “an area”. They could not add other issues such as “over a period” or “the rationale”. Similarly, for catch limits, gear restrictions and regulation of fishing effort, most candidates were not able to offer explanations, but only stated the definitions.

Part (b) of the questions was fairly answered. Most candidates only mentioned some of the issues without any attempt at discussion. Some of the problems are limited credit, dwindling fish stock and expensive fishing inputs.

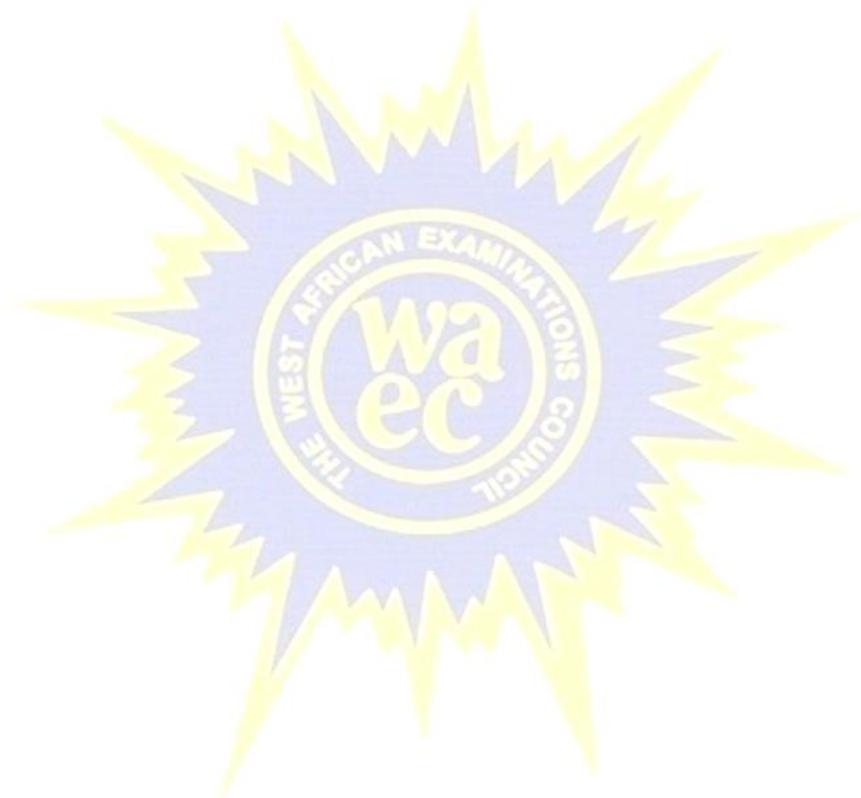
### **Question 6**

- (a) Define the term aquaculture.**
- (b) Explain four objectives of fish processing.**
- (c) Discuss five factors that affect the growth of fish in ponds.**

This was a popular question. In part (a), most candidates defined aquaculture as the “growing of aquatic organism”. Some added “in water”. The issues of “controlled growing” and “suitable structures” were not mentioned.

In both parts (b) and (c), candidates only mentioned the issues but did not explain the objectives of fish processing as required in part (b), nor did they discuss the factors that affect the growth of fish in ponds as required in part (c).

Fish processing aims at preventing spoilage, increasing shelf life and adding value etc. Factors affecting growth of fishing include temperature, dissolved oxygen, salinity and pH.



# **GENERAL AGRICULTURE 1**

## **1. GENERAL COMMENTS**

It was generally a good paper comparable with that of previous years.

Candidates' performance this year was average.

## **2. A SUMMARY OF CANDIDATES' STRENGTHS.**

The Chief Examiner commended candidates for the following features noticed in their scripts:

- (1) Most candidates were able to give precise answers.
- (2) Some showed detailed knowledge of the subject matter.
- (3) Most candidates obeyed the rubrics of the paper which included answering one question only on a page.

## **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

The following weaknesses were observed in the scripts of candidates:

- (1) Candidates work gave an indication that some of them did not perform the practical activities in the examination room but rather answer questions on what they have read in textbooks.
- (2) A good number of candidates who performed the experiment to determine the texture of soils using the wet manual feel method could not outline the procedure used in a sequential manner.

The question was generally well answered by many candidates. Specimen A was correctly identified as sickle and its uses were satisfactorily given. The maintenance of Specimen A was well answered, however, answers such as 'store in cool dry place' and 'use the specimen for its intended purpose' were incorrect. Specimen B and C were correctly identified by most candidates as cotton stainer/*Dysdercus sp.* and weevil/*Sitophilus sp.* However, a few candidates had the spellings wrong and therefore lost the marks. The types of damage caused by Specimens B and C were answered well. The answers of some candidates were devoid of facts on the control of specimens B and C. Candidates could have considered the following for cotton stainer:

- use of appropriate insecticide;
- crop rotation;
- handpicking of insect/egg mass;
- early planting and early harvesting;
- regular weed control;
- planting of resistant/tolerant varieties.

For weevil, the following answers could have been considered:

- use of appropriate insecticide;
  - crop rotation;
  - use of healthy/clean planting material;
  - proper drying of seeds before storage;
  - cleaning of storage bins/equipment/sanitation;
  - early harvesting.
- (3) It was clear from the work of most candidates that they did not understand the concepts in the Agricultural Economics section of the General Agriculture syllabus.

#### **4. SUGGESTED REMEDIES**

In order to overcome the weaknesses observed the following remedies were suggested.

- (1) During practical lessons, teachers should ensure that candidates report their results based on what they observe and measure. Practice and drills should be enforced during practical lessons.
- (2) The Ghana Education Service/Schools should organise workshops on the concepts of Agricultural Economics for Agricultural Science teachers.

#### **5. DETAILED COMMENTS**

##### **Question 1**

- (a)
  - (i) **Identify specimen A.**
  - (ii) **State two uses of specimen A on the farm.**
  - (iii) **State two ways of maintaining specimen A.**
- (b)
  - (i) **Identify each of specimens B and C.**
  - (ii) **State two types of damage caused by each of specimens B and C to crops.**
  - (iii) **Mention two way of controlling each of specimens B and C.**

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- crop rotation;
- use of healthy/clean planting material;
- proper drying of seeds before storage;
- cleaning of storage bins/equipment/sanitation;
- early harvesting.

### **Question 2**

- Name each of the parts of specimen D labelled I, II, III and IV.**
- State three functions of each of the parts of specimen D labelled I and III.**
- State one function of each of the parts of specimen D labelled II and IV.**
- Mention three farm animals from which specimen D could be obtained.**

Since labelling of the parts of specimen D (complex stomach of a ruminant) was considered as identifying the parts, correct spelling was required for full marks. Most of the candidates correctly labelled the parts except for 'reticulum' which some candidates misspelt as 'recticulum'.

The functions of rumen, omasum and Abomasum were very well answered by many candidates but that of reticulum was poorly answered. Candidates could have considered the following functions for reticulum:

- removes foreign materials in the food;
- forces up partially digested food into the mouth for proper chewing/rumination/regurgitation.

The farm animals from which Specimen D could be obtained was correctly answered by most candidates as seep, goat and cattle.

### **Question 3**

**Specimen E and F are two different types of soils.**

- Perform an experiment to determine the texture of each of specimens E and F using the wet manual feel method. Outline the procedure you used.**
- State your observations from the experiment you have performed in (a).**
- Identify each of the soil types E and F based on your observations.**

- (d) **Mention two practices that a farmer could adopt to improve the texture of specimen E for vegetable production. Give reasons for your answer.**
- (e) **List three problems that a farmer could encounter if the farmland contains a high amount of specimen F.**

Some candidates who performed the experiment correctly could not outline the procedure used in a sequential manner and therefore lost marks. A good number of candidates did not perform the experiment but rather depended on their knowledge of experiments in textbooks to describe the experimental procedure and therefore got it wrong.

Candidates who performed the experiment during the examination stated their observations from the experiment correctly while some of the candidates who relied on textbook knowledge wrongly stated the observations for the experiment as determination of water-holding capacity of soils. Most candidates who performed the experiment correctly were able to identify specimens E and F as sandy soil and clayey soil respectively.

Most candidates correctly stated the practices that a farmer could adopt to improve the texture of specimen E (sandy soil) for vegetable production but could not give the reasons for undertaking the practices and therefore lost marks. Some of the reasons that could have been given included:

- bind soil particles together to improve soil structure;
- mulching of soil to control erosion/bind soil particles;
- cover cropping for roots of cover crops to bind soil particles and leaf fall to add organic matter to soil;
- add organic matter/manure, compost to bind soil particles.

The problem to encounter if farm land contains high amount of specimen F (Clayey soil) was well answered by most candidates.

**Question 4**

**An incomplete production function table of cowpea on a five hectare farm is presented below.**

*Study the table carefully and use it to answer the questions that follow.*

<b>Variable Factor (workers)</b>	<b>Total Product (bags)</b>	<b>Marginal Product (bags)</b>	<b>Average Product (bags)</b>
<b>1</b>	<b>4</b>	<b>4</b>	<b>I</b>
<b>2</b>	<b>10</b>	<b>II</b>	<b>5.4</b>
<b>3</b>	<b>III</b>	<b>7</b>	<b>5.7</b>
<b>4</b>	<b>23</b>	<b>6</b>	<b>5.8</b>
<b>45</b>	<b>28</b>	<b>5</b>	<b>IV</b>

<b>56</b>	<b>31</b>	<b>V</b>	<b>5.2</b>
<b>7</b>	<b>VI</b>	<b>1</b>	<b>4.6</b>
<b>8</b>	<b>32</b>	<b>0</b>	<b>VIII</b>
<b>9</b>	<b>30</b>	<b>VIII</b>	<b>3.3</b>
<b>10</b>	<b>IX</b>	<b>-4</b>	<b>2.6</b>

- (a) Copy and complete the table by filling in each of the spaces labelled I, II, III, IV, V, VI, VII, VIII and IX.
- (b) How many workers should be used on the farm achieve maximum production. Give one reason for your answer.
- (c) Describe each of the three stages of production.

The section (a) of this question was very well answered by many candidates. The formulas used to calculate for I, II, III... IX were as follows:

Total product = total output produced at a given level of input.

Average product =  $\frac{\text{Total product}}{\text{Total Input}}$

Marginal product =  $\frac{\text{change in total product}}{\text{change in input level}}$

Sections (b) and (c) were poorly done by most of the candidates. A good number of candidates did not even attempt the sections. The answers that could have been provided are as follows: the number of workers to be employed to achieve maximum production is eight and the reason is that, at this stage total product is 32 (maximum) and marginal product is zero (0).

At stage one of production, both total product and average product are rising. At stage two, there is decreasing average and marginal returns. Stage three is the stage of negative marginal product or absolute decreasing total product.

## **GENERAL AGRICULTURE 2**

### **1. GENERAL COMMENTS**

The standard of the paper was the same as those of previous years and the performance of candidates was average.

### **2. A SUMMARY OF CANDIDATES' STRENGTHS**

Candidates exhibited the following strengths:

- (1) Most of the candidates adhered to the rubrics of the paper.
- (2) The quality of handwriting of candidates was commendable.

### **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

The following weaknesses were noticed in the scripts of candidates:

- (1) Wrong spelling of scientific terms.
- (2) Inadequate preparation.

### **4. SUGGESTED REMEDIES**

In order to overcome the weaknesses identified, it is recommended that:

- (1) The teaching and learning processes should be improved in schools.
- (2) Teachers should conduct spelling exercises on scientific terms periodically.

### **5. DETAILED COMMENTS**

#### **Question 1**

- (a) **Mention four factors that influence sustainable agricultural production?**
- (b) **Outline three routine maintenance practices that are carried out on a tractor.**
- (c) **Explain three factors that could accelerate agricultural development in Ghana.**

Most of the candidates answered this question but their performance was average. Some candidates confused sub-questions (a) and (c). Question (a) was not well answered. Expected answers included: social factors, technological factors, economic factors and biotic factors

The word routine was not properly understood and therefore periodic maintenance practices such as changing of oil, plugs and types were wrongly given as answers.

Some factors that accelerate agricultural development are access to capital, land tenure system and availability of labour.

### **Question 2**

- (a) Outline four factors to consider, when planning a farmstead.**
- (b) Discuss four problems associated with communal land ownership in Ghana.**

This question was also popular with the candidates but a few of them performed poorly on sub-question (a). Most of such candidates correctly listed the factors but they could not outline them well. The factors include nature type of soil; topography and water supply. Required answers for sub-question (b) included fragmentation of land, litigation, land may be underdeveloped and culture and tradition of the community.

### **Question 3**

- (a) Distinguish between each of the following terms as used in agriculture:**
  - (i) micronutrients and macronutrients;**
  - (i) straight fertilizer and compound fertilizer**
- (b) Discuss five ways in which organic matter helps in the maintenance of soil productivity.**

This was perhaps the most popular question as candidates correctly distinguished between micronutrients and macronutrients; and between straight fertilizer and compound fertilizer. Candidates' discussions of ways in which organic matter helps to maintain soil productivity were satisfactory. Such ways included: improving soil fertility, increasing water holding capacity and increased aeration.

### **Question 4**

- (a) Describe each of the following methods of land preparation in agriculture:**
  - (i) slashing;**
  - (ii) stumping;**
  - (iii) mounding;**
  - (iv) ridging.**
- (b) Discuss four ways in which soil loses its fertility.**

Candidates description of the listed land preparation activities such as slashing, mounding and stumping were good. Their description of ridging was particularly poor. They did not however, find the discussion of ways in which soils lose their fertility difficult. Ways mentioned included: burning, leaching and erosion.

### **Question 5**

- (a) State four agronomic factors that cause the death of transplanted seedlings.**
- (b) Outline the steps involved in calibrating knapsack sprayer.**
- (c) Explain three ways in which mulching improves crop yield.**

Only few candidates attempted this question. Performance was not satisfactory. Ways in which mulching improves crop yield was well answered. Stating the agronomic factors that cause the death of transplanted seedlings was another uphill task for them. A few of them correctly stated such factors as improper watering, wrong timing of transplanting and root damage. Factors such as pest, diseases, age of seedlings and poor firming of transplanted seedlings were rarely stated.

Most candidates could not correctly outline the steps involved in the calibration of a knapsack sprayer.

### **Question 6**

- (a) Mention two causes of non-pathogenic diseases of crops.**
- (b) State four objectives of tillage.**
- (c) Discuss five problems affecting rice production in West Africa.**

Most candidates knew of only nutrient deficiency and high/ low temperature as causes of non-pathogenic diseases of crops. Only a few of them knew of other causes as drought, excess moisture, physical, injury, toxins/poisons and genetic disorders. However, candidates' performance on sub-questions b and c were generally satisfactory. Some objectives of tillage are to produce soil of suitable tilth, check soil moisture loss and plough fertilizer into the soil.

Most candidates provided correct responses to sub-question (c) such as land tenure, limited sources of funding, high cost of irrigation and pests and diseases.

### **Question 7**

- (a) (i) Define the term cross-breeding as used in animal improvement.**  
**(ii) State four advantages of cross-breeding in animal production.**
- (b) Discuss five ways in which fish farming is important to the economy of your country.**

Sub-question (a) was poorly answered by most candidates who attempted this question as they neither correctly define cross-breeding in animal production nor state the advantages of this method of animal improvement.

The importance of fish farming to the national economy were, however, fairly well discussed by the candidates. These included provision of income and employment and as source of food.

### **Question 8**

- (a) **Give two advantages of each of the following animal husbandry practices:**  
(i) **creep feeding;**  
(ii) **debeaking.**
- (b) **Mention two bacterial diseases of farm animals.**
- (c) **Describe five symptoms of ill-health in farm animals.**

This was another popular question and performance on it was above average.

The advantages of creep feeding and of debeaking were correctly given by most of the candidates. But the use of the words “prevents” for “checks” and “lack” for “inadequate” in their answers caused them some marks. Eg. Debeaking prevents cannibalism instead of debeaking checks or controls cannibalism. Candidates appeared to have a fairly good knowledge of bacterial diseases. A few of them, however, wrongly mentioned coccidiosis, trypanosomiasis, rinderpest and foot and mouth diseases as bacterial diseases.

Candidates descriptions of symptoms of ill health in farm animals were generally good. These symptoms included diarrhea, lack of appetite and decreased productivity.

### **Question 9**

- (a) **List four records that are kept on a farm.**
- (b) (i) **Define the term value chain as used in agriculture.**  
(ii) **State two benefits of value chain development in agricultural production.**
- (c) **Discuss three factors to be considered in the establishment of an agribusiness.**

Most of the candidates who attempted this question correctly listed records kept on farms. In a few cases, candidates listed component records of classified records. Eg. Birth record, health records, weaning record and mortality record which are all components of production record.

Expected records included the following:

- Production record
- Labour record
- Financial record
- Inventory record

Regrettably, candidates in general had little or no knowledge of the value chain concept and therefore could hardly answer sub-question (b).

Value chain is a business-oriented model of how agricultural enterprises receive raw materials, add value to these materials through production and support processes.

Benefits of value chain include the fact that it enables entrepreneurs to determine which type of competitive advantage to pursue, products are higher in quality/safety and consumer's needs and specifications are met. Most of them, however, correctly, discussed the factors to be considered in establishing an agricultural business.

### **Question 10**

- (a) State two advantages and two disadvantages of the individual extension teaching method.**
- (b) Give two reasons for carrying out each of the following marketing functions:**
  - (i) grading;**
  - (ii) advertising;**
  - (iii) packaging.**
- (c) Explain three factors that determine the supply of land for agricultural production.**

Candidates' knowledge about the advantages and disadvantages of the individual extension teaching methods was average. Similarly, candidates' performance on the listed marketing functions were fairly good.

However, candidates' explanations of the factors that determine the supply of land for agricultural production were good enough. These explanations dwelt mainly on population, soil type and land tenure system. Other factors such as climate, topography and religion and culture were hardly explained.

# **INTEGRATED SCIENCE 1**

## **1. GENERAL COMMENTS**

The standard of the paper compared favourably with those of previous years. The performance of candidates was average.

## **2. A SUMMARY OF CANDIDATES' STRENGTHS**

- (1) Improvement in the spelling of scientific terminologies
- (2) Handwriting of most candidates very legible.
- (3) Orderly presentation of answers
- (4) Adherence to the rubrics of the paper
- (5) Good expression in the English Language

## **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

- (1) Failure to understand the demands of the questions
- (2) Inability to show steps in computation.

## **4. SUGGESTED REMEDIES**

- (i) Students should be advised to read through examination questions carefully and understand the demands of the questions before answering them.
- (ii) Teachers should advise their students that marks are awarded to the various steps of the solution to mathematical computation and that the final answer attracts a small fraction of the total marks allocated to the question.

## **5. DETAILED COMMENTS**

### **Question 1**

- (a)
  - (i) What are plastics ?
  - (ii) State three uses of plastic materials
- (b) With the aid of a diagram, describe how a piece of nail can be magnetized using a piece of bar magnet.
- (c)
  - (i) Explain the term de-horning as used in animal production.
  - (ii) State three ways in which the nitrogen cycle is important to living organisms.

- (d) (i) **Name two organisms involved in the nitrogen cycle.**  
(ii) **State three ways in which the nitrogen cycle is important to living organisms.**
- (a) Majority of the candidates could not define term plastics because they related plastics to rubber. It is important for candidates to note that plastics are polymers of hydrocarbons which can be moulded into shapes. However, many candidates were able to state the uses of plastic materials.
- (b) This sub-questions was not well answered by most candidates because they were unable to make an illustrative diagram showing how a piece of nail is magnetized using a bar magnet. Description of how a piece of nail is magnetized was difficult for most candidates. The expected answer are indicated below:
- The bar magnet is stroked continuously
  - in the same direction indicated,
  - it must be repeated for about six times
  - each time moving the magnet along the nail
  - far away in the direction.
- (c) Majority of the candidates could explain the term de-horning as well as stated the ways in which de-horning is important in animal production. Some the correct responses provided by candidates included preventing animals from hurting themselves, giving the animal mores space to move about and making the handling of farm animals easier.
- (d) This sub-question was poorly handled by most candidates. The candidates demonstrated lack of the knowledge of the nitrogen cycle. However few candidates who were able to name the organisms involved in the cycle failed to underline the words.

Candidates must know scientific name of an organism ought to be underlined separately, that is, both the generic name and the species name. On the ways in which the nitrogen cycle I important to living organisms, the expected responses included supply of nutrients, release of locked up nitrogen in living organisms and improvement of nutrient balance.

## **Question 2**

- (a) **State**
- (i) **two differences between boiling and evaporation,**
  - (ii) **two factors that affect the rate of evaporation**
- (b) **State one reason each for carrying out each of the following management practices in a brooder house:**
- (i) **ensuring good ventilation;**
  - (ii) **control of human traffic to the brooder house;**
  - (iii) **visit brooding chicks first before older birds;**
  - (iv) **debeaking two to three-week old chicks;**

- (v) **strictly following the recommended medication and vaccination schedules.**
- (c) **Explain the role of each of the following organisms in a food chain:**
- (i) **green plants;**
  - (ii) **herbivores;**
  - (iii) **carnivores.**
- (d) (i) **List two types of dissolved substances that may be present in water.**  
(ii) **Describe briefly an experiment to investigate the presence of dissolved substances in water.**
- (a) Majority of the candidates were not able to bring out the differences between boiling and evaporation. The expected responses are indicated in the table below:

<b>BOILING</b>	<b>EVAPORATION</b>
- Occurs throughout the liquid	- Occurs only at surfaces of the liquid
- Occurs at definite temperatures	- Occurs at any temperature
- Bubbles can be observed throughout the liquid	- Bubbles not observed
- Boiling does not result in cooling/heat is gained	- Evaporation results in heat is loss.
- A decrease in pressure lowers the boiling temperature	- A decrease in pressure increases the rate of evaporation

However, most candidates were able to state the factors that affect the rate of evaporation.

- (b) Many candidates were able to give correct reasons for taking some management practices in the brooder house. However, few candidates wrote “to prevent eating of eggs” as the reason for debeaking two to three-week old chicks was inappropriate.

- (c) This sub-question was well answered by most candidates as they demonstrated their knowledge of the food chain stating correctly the roles each of green plants, herbivores, and carnivores play in the food chain..
- (d) Listing the types dissolved substances present in water was difficult for most candidates. They thought the question was about substances that can dissolve in water hence incorrect responses such as water and salt were given. The expected responses included acids/alkali, dissolved salts and gases. Also the description of the experiment to investigate the presence of dissolved substances were poorly handled by most candidates.

The expected responses are indicated below:

- Clean an evaporating dish
- and pour some water into it.
- Heat the water gently until all of evaporates
- concentric rings of solid remain in the dish
- indicating the presence of dissolved substances in water.

### **Question 3**

- (a) (i) **List two examples of worms that infest farm animals.**  
(ii) **State two precautions that could be taken to reduce worm infestation in farm animals.**
- (b) (i) **Describe how the end-products of digestion of fats and oils is absorbed in humans.**  
(ii) **State two ways in which fats and oils are important to the human body.**
- (c) (i) **What is a functional group?**  
(ii) **Draw the structure of each of the following functional groups:**  
( $\alpha$ ): **alkynes;**  
( $\beta$ ): **alkanols;**  
( $\gamma$ ) **organic acids.**
- (d) (i) **What is relative density?**  
(ii) **The density of a piece of stone is  $2500 \text{ kg m}^{-3}$ .**

**Determine its relative density.**

***[Density of water is  $1000 \text{ kg m}^{-3}$ ]***

- (a) This sub-question was well answered by most candidates as they named the worms that infest farms animals. Some of the responses of the candidates included tapeworm, roundworm, and hookworms. However, the mention of earthworm by few candidates was not correct. Many candidates were able to state the precautions needed to be taken to reduce worm infestations in farm animals.

#### **Question 4**

- (a) **Describe briefly how the skin of a mammal carries out each of the following functions**
- (i) **excretion;**
  - (ii) **protection.**
- (b) **Outline the steps leading to the electrolytic extraction of aluminium from its ore.**
- (c) (i) **What is a transformer?**  
(iii) **Draw and label a step-up transformer.**
- (d) **State two deficiency symptoms of each of the following plant nutrients:**
- (i) **nitrogen;**
  - (ii) **phosphorus**

(a) Many candidates were able to describe how the skin of a mammal carries out the functions of excretion and protection.

(b) This sub-question was poorly answered by majority of the candidates. They were unable to present the steps leading to the electrolytic extraction of aluminium from its ore in sequential manner. The steps involved in the extraction of aluminum from its ore included:

- Heating/roasting of bauxite/ore
- to convert iron (II) oxide to iron (III) oxide.
- Crush/grind roasted bauxite into powder
- Dissolution of powdered bauxite in hot concentrated sodium hydroxide solution
- Iron (III) oxide/impurities remove by filtration
- Addition of freshly prepared  $\text{Al}(\text{OH})_3$
- Filter
- Wash
- Dry
- Heat  $\text{Al}(\text{OH})_3$  to get pure alumina

(c) Many of the candidates demonstrated lack of knowledge in transformers because they could not explain the term transformer as expected. It is important for candidates to know that a transformer is an electrical device that is used to either step-up or step-down an alternating current. Drawing of the step-up transformer was difficult for most candidates. They could not come out with a clear distinction between the secondary coils and primary coils.

- (d) Majority of the candidates demonstrated their lack of knowledge of the plant nutrients because they were unable to mention the deficiency symptoms for nitrogen and phosphorus. The deficiency symptoms of nitrogen included chlorosis and stunted growth of plants. For phosphorus, they included stunting of green plants, older leaves having purple colour, slender stems in grass plants and roots and bark development.

### **Question 5**

- (a) (i) **What is meant by molar mass?**  
(ii) **An aqueous solution of sodium hydroxide contained in a bottle is labelled 0.20 M. Determine the mass of sodium hydroxide used in preparing the solution.**  
**[Na = 23, O = 16, H = 1]**
- (b) **An electrical appliance rated 240 V, 1500 W is connected to an a.c. mains and used for 2 hours. Calculate the**  
(i) **resistance of the appliance,**  
(ii) **cost of running the appliance.**
- (c) **State five qualities of fertile soil.**
- (d) (i) **List the two types of cell division that occur in eukaryotes.**  
(ii) **State three differences between the two types of cell division you have listed in (i).**

- (a) This sub-question was fairly answered by most candidates. They explained the term molar mass as being the mass of one mole of a substance. However, the concept of the mole being equal to  $6.02 \times 10^{23}$  particles/Avogadro number of particles was not mentioned at all. Determination of the mass of one mole of a substance was correctly calculated by most candidates.
- (b) This sub-question was poorly answered by most candidates. They could not calculate the resistance of the appliance. The method of calculating the resistance is as follows:

$$\begin{aligned}\text{Resistance} &= \frac{\text{Voltage}}{\text{Power}} \\ &= \frac{240^2}{1500} \\ &= 38.4\Omega\end{aligned}$$

- (c) Majority of the candidates correctly stated the qualities of a fertile soil. Some of the correct responses provided by the candidates included supply of air, good soil texture, favourable soil pH, and rich in organic matter.
- (d) Many candidates demonstrated their lack of knowledge in cell division. They were unable to mention the types of cell division. The expected answers included mitotic cell division (mitosis) and meiotic cell division (meiosis).

Also, they could not state the differences between mitosis and meiosis. The expected answers are indicated below:

<b>Mitosis</b>	<b>Meiosis</b>
Takes place in the somatic/body cell	- Takes place in germ cells/sex cell
- Produces two daughter cells	- Produces four daughter cells
- Occurs in one phase only	- Occurs in two phases
- No pairing up of chromosomes	- Pairing up of homologous chromosomes
- No exchange of genes	- Exchange of genes
- Chromosome number is halved	- Chromosomes number is maintained
- No crossing over	- Crossing over occurs
- Daughter cells are identical to the parents	- Daughter cells not identical to parents

### **Question 6**

- (a) (i) **What is a thermostat?**  
 (ii) **List three electrical appliances that make use of thermostats in their operation.**
- (b) **Explain each of the following terms as used in crop production:**  
 (i) **pricking out;**  
 (ii) **staking;**  
 (iii) **filling-in.**

- (c) (i) **Explain the term phenotype as used in genetics.**  
(ii) **The offsprings resulting from the cross between a red-flowered plant and a white-flowered plant were all found to be red. With the aid of appropriate crosses, illustrate the observation.**
- (d) (i) **What is a neutralization reaction?**  
(ii) **With the aid of litmus papers, demonstrate that all the reactants in a neutralization reaction have been used up.**

- (a) The sub-question was well answered by most candidates. They were able to explain the term thermostat as an electrical device which regulates temperature. They were also able to list electrical appliances that make use of thermostat. However, the names of some of the appliances were wrongly spelt by some candidates resulting in the loss of marks.
- (b) Most candidates were able to explain the importance of staking and filling-in in crop production.
- (c) Majority of the candidates were able to explain the phenotype as the physical appearance of an organism. However, most candidates could not properly illustrate the crossing between a red flower and a white flower.

The convention that a capital letter and a small letter represented a dominant character and a small letter respectively was not adhered to. Therefore,  $RR$  and  $rr$  represent dominant red and recessive white respectively.

Using a different letter to represents a white character was not appropriate.

- (d) The term neutralization was well explained by most candidates. However, they could not demonstrate that all reactants in a neutralization reaction have been used up. They could not comprehend that they needed to use both blue and red litmus papers together to test the reactants in a neutralization reaction. Both the red and blue litmus papers must be dipped into the final solution, if the litmus papers do not change colour, then all the reactants have been used up.

## INTEGRATED SCIENCE 2

### 1. GENERAL COMMENTS

The standard of the paper was comparable to those of the same as previous year. However, performance of candidates was below average.

### 2. A SUMMARY OF CANDIDATES' STRENGTHS

- (1) Orderly presentation of their work;
- (2) Provision of concise answers;
- (3) Demonstrated skill in data computerization;
- (4) Improvement in the spelling of scientific words.

### 3. A SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Inability to state the uses of simple laboratory apparatus.
- (2) Inability to plot graphs.

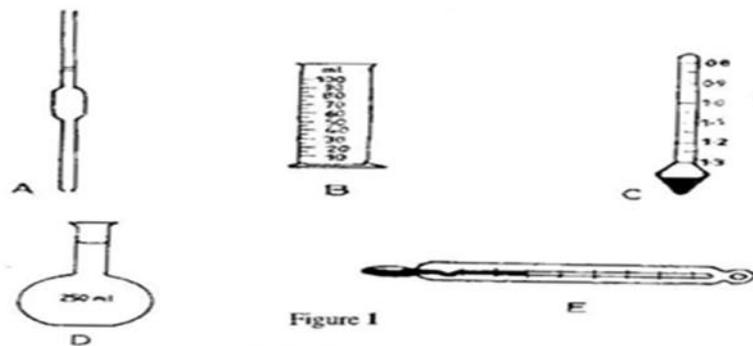
### 4. SUGGESTED REMEDIES

- (1) Efforts must be made to equip school laboratories with simple apparatus.
- (2) Science teachers must supplement drawing of graphs by giving students more graphs to plot.

### 5. DETAILED COMMENTS

#### Question 1

Figure 1 is an illustration of instruments used in a school laboratory.  
*Study the carefully and use it to answer the questions that follow.*



- (a) Identify the instruments labelled A, B, C, D and E.**
- (b) State one use of each of the instruments B, C, D and E.**
- (c) Describe how instrument A is used.**

- (a) Majority of the candidates were able to identify the instrument A, B, and E as pipette, measuring/graduated cylinder respectively. However, many candidates wrongly identified instruments C and D as hygrometer and flat bottomed flask. Candidates must note that instrument C and D were hydrometer and volumetric flask respectively.
- (b) Many candidates stated the correct use of instrument A. However, stating the correct uses of instruments B,C,D and E was difficult for most candidates. It is important for candidates to note the following with respect to the correct uses of the instruments:

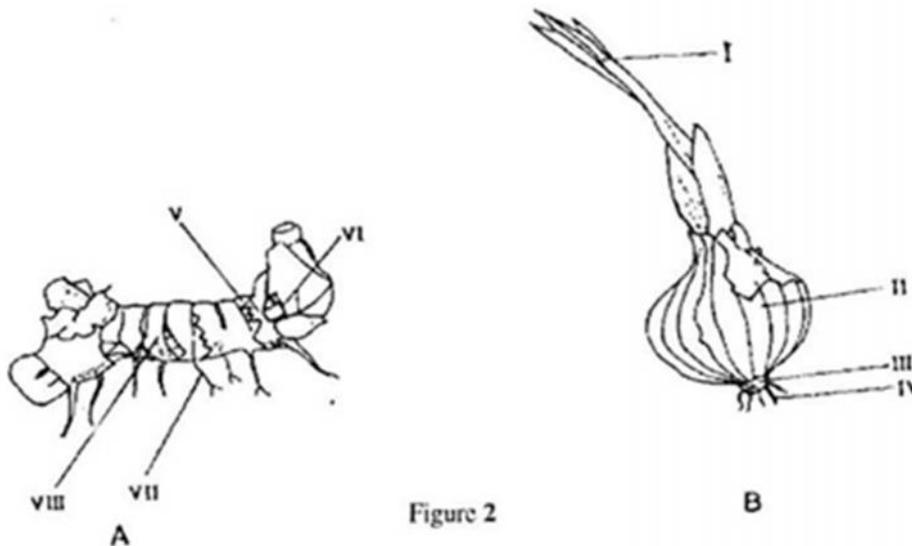
- B - Is used in measuring volumes of liquid/water.  
It was wrong to state that it is measure liquids. This could mean the measuring of temperature, density, mass of pH of liquid.
- C - Is used for measuring the relative density of liquids.
- D - Is used to prepare standard/known volume of solution. Omission of the under listed words rendered the answer wrong.
- E - Is used to measure temperature.

- (c) Description of how pipette is used posed a challenge to many candidates. Candidates were expected to give sequential description as indicated below:
  - The pointed end/ top of A is immersed in the solution.
  - The mouth is put at the blunt/opposite and air sucked from it
  - The liquid level is made to rise above the mark.
  - A thumb is used to seal/block the end of where the month is put.
  - The thumb is partially removed to drain the solution/liquid to the mark.
  - The thumb is completely removed to allow solution/liquid to drain into a given container.

## Question 2

Figure 2 is an illustration of plant organs used in vegetative propagation.

Study the figure carefully and answered the questions that follow.



- (a) (i) Identify organs A and B.
- (b) (i) Name the parts labelled I, II, III, V, VI, VII and VIII.  
(ii) State one function of each of the parts labelled I, IV, and VIII.
- (c) State two observable similarities and two observable differences between organs A and B.
- (d) List two observable features of organ A which make it suitable for vegetative propagation.
- (e) State three reasons why the organ A is regarded as a shoot.
- (a) Majority of the candidates were able to identify organs A and B as rhizome and bulb respectively.
- (b) This sub-question was not well answered by many candidates. They were expected to give specific adjectives to qualify the names of some labelled parts to strike out the differences.

The expected responses are indicated below:

- I - Foliage leaf
- II - Scale/ scaly leaf
- III - Swollen Stem
- VI - Adventitious root
- VI - Axillary bud

Stating the functions of the labelled parts I, II, and III was difficult for many candidates. The correct functions of the labelled parts were:

- I - For photosynthesis/Transfer of prepared food to other parts of the plant/ stores food.
- II - Takes nutrients/water from the soil/Support the bulb
- III - Stores food/Transfers water/ prepared food from leaf to the roots/for vegetative propagation.

- (c) This sub-question was poorly handled by majority of the candidates. They were expected to state the observable differences between characteristics of organs A and B. They must note that the characteristics must correspond to score. The expected answer were indicated below:

<b>ORGAN A</b>	<b>ORGAN B</b>
- Swollen stem	- Reduced stem
- Scale leaves in concentric rings	- Scale leaves not in concentric rings
- Internodes have wider spacing	- Internodes have smaller spacing

On the similarities between organs A and B, candidates must note that the features used must be observable. Therefore, it was wrong for candidates to state both organs could be used for vegetative propagation. The expected answers included both organs have

- nodes/internodes
- scale/scaly leaves
- stems
- buds
- adventitious root

- (d) This sub-question was well answered most candidates as they mentioned correctly the presence of buds and swollen stem as the observable features of organ A used for vegetative propagation.

- (e) It was surprising that most candidates could not state the reason why organ A is regarded as a shoot. Candidates must note that the presence of structures such as stem, leaves, internodes/nodes, buds and adventitious roots qualifies the organ to be regarded as a shoot.

### Question 3

In an experiment to investigate a scientific principle, a load  $M_0$  was suspended at distance  $d$  on the other side of the fulcrum,  $F$ , for the system to balance horizontally as illustrated in Figure 3a.

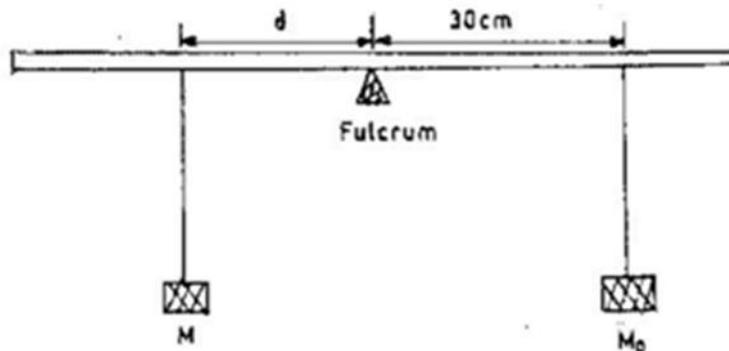


Figure 3a

The mass  $M$  and the corresponding distance,  $d$ , were recorded. The experiment was repeated for masses,  $M = M_1, M_2, M_3, M_4$  and  $M_5$  and the corresponding distances,  $d = d_1, d_2, d_3, d_4$  and  $d_5$  measured and recorded.

Figure 3b below represents the masses,  $M = M_1, M_2, M_3, M_4$  and  $M_5$  while Figure 3c represents the corresponding distances  $d = d_1, d_2, d_3, d_4$ , and  $d_5$ .

*Study the figures carefully and answer the questions that follow.*

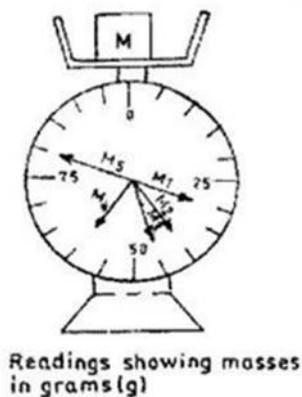


Figure 3b

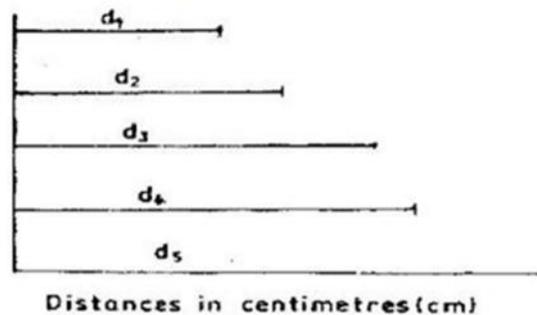


Figure 3c

- (a) (i) **Read and record the masses,  $M = M_1, M_2, M_3, M_4,$  and  $M_5$ .**  
(ii) **Measure and record the raw distances,  $d = d_1, d_2, d_3, d_4,$  and  $d_5$ .**  
(iii) **Convert the raw values of distances recorded in (ii) to actual distances  $D = D_1, D_2, D_3, D_4,$  and  $D_5$  using the scale,  $1 \text{ cm} = 5 \text{ cm}$ .**  
(iv) **Determine the value for each of the distances obtained in (iii).**  
(v) **Tabulate the result obtained in (i), (ii), (iii) and (iv) as shown below.**

<b>M/g</b>					
<b>Raw distance d/cm</b>					
<b>Actual distance D/cm</b>					
$\frac{1}{D}$					

- (b) **Plot a graph with M on the vertical axis and on the horizontal axis.**  
(c) **Determine the slope of the graph.**

- (a) This sub-question tested candidate's ability to read scales and measure lengths using the ruler. It is important for candidates to note the following details:
- (i) Before reading from a scale the intervals between must be checked for ample between 25 and 50 resulting in each small interval of 5 units.
- (ii) Measuring distances in cm must be rounded up to one decimal point, for examples 3.1 and 4.0.
- (iii) In writing the correct unit the original unit must be taken through the same operation as for the parameter.  
For example, D is measured in cm so when the reciprocal of D is found as  $1/D$  then cm also become  $1/\text{cm}$  or  $\text{cm}^{-1}$ .
- (iv) In any table values of an inverse must be in decimals not fractions.
- (b) Plotting of the graph was difficult for most candidates. It is important for candidates to adhere to the following details when plotting graph:

- (i) Instead of rounding off the values obtained, the powers of 10 could have been used. For example,  $1/D = 0.062 \rightarrow 6.2 \times 10^{-2}$
  - (ii) The axes must be labelled correctly. For example, m/g, 1/D cm. The symbol of the parameter and its corresponding unit must appear to score.
  - (iii) The scale must be in the range of the values determined and must have regular intervals. Avoid intervals of odd numbers. Direct matching of points is unacceptable.
  - (iv) Plotting of points must link corresponding points on both the x and y axes.
  - (v) Acceptable best line is the one that passes through any three correct corresponding points. Inversion of axes could lead to the loss of marks.
- (c) Determination the slope of the graph was not well answered by many candidates. Candidates must note that calculation of slope first requires a triangle shown and labelled ABC on the graph. Calculation of the slope must reflect figures captured by the triangle ABC.

#### **Question 4**

The table below shows the arrangement of four crops cultivated in a farming system adopted by a school over a four year period.

*Study the table carefully and answer the questions that follow.*

<b>Year</b> <b>Plot</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>
Plot 1	Maize	Cassava	Groundnut	Cabbage
Plot 2	I	Groundnut	Cabbage	II
Plot 3	III	Cabbage	IV	Cassava
Plot 4	Cabbage	Maize	V	Groundnut

- (a) **What type of farming system is illustrated in the table?**
- (b) **Name each of the crops labelled I, II, III, IV, and V.**
- (c) **List two diseases that attack the crop labelled II.**

**(d) State two reasons for including groundnut in the farming system illustrated.**

**(e) Mention three advantages of using such a farming system.**

(a) This sub-question was well answered by most candidates. However, few candidates who did not take note of the fact different crops were cultivated in each year indicated wrongly that the type of farming system was mixed farming. The correct answer was crop rotation.

(b) This sub-question was fairly well answered by most candidates as they named correctly named the labelled crops.

(c) This sub-question was also well answered by majority of the candidates as they correctly mentioned diseases that attack crop labelled II (maize). Some of the correct responses included rust, leaf blight, smut, downy mildew, streak, stunt and brown spot.

(d) This sub-question was fairly answered by most candidates. Candidates must note that the following pairs are the same so they cannot be stated to score separately:

- Fixes atmospheric nitrogen in soil/fertilizers the soil
- Decrease soil pH/increase plants soil microbe
- Acts as cover crop/reduces erosion
- Improves soil structure/ glues soil particles together
- Reduces evaporation/keeps soil water

(e) The candidates demonstrated their knowledge of the advantages of using crop rotation. Some of the correct responses provided by the candidates included:

- Wide varieties of crops obtained;
- Helps in controlling weed growth;
- Control pests;
- Control diseases;
- Maintains fertility of the soil;
- Helps to save on nitrogen fertilizers;
- Efficient utilization of nutrients by the crops;
- There is reduction in labour use due to the absence of frequent clearing;
- Crop production is on piece of land for a long time;
- There is risk of total crop failure.

# **PHYSICS 1**

## **1. GENERAL COMMENTS**

The standard of the paper was the same as those of previous years. The performance of candidates, generally, was good and comparable to that of the previous years.

## **2. A SUMMARY OF CANDIDATES' STRENGTHS**

Some commendable features observed in candidates' answers included the following:

- (1) Most candidates were able to collect and record (data) from the experiment.
- (2) Most candidates were able to summarize data, collected, processed and presented in a composite table.
- (3) Most candidates were able to state correctly the appropriate scale for the x-axis and y-axis of graphs drawn.
- (4) Candidates used large right-angled triangle in computing slopes of graphs.

## **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

Some weaknesses noticed in candidates' answers provided included:

- (1) Some candidates did not record values to the correct precision of measuring instrument used.
- (2) Some of the data collected by some candidates did not have units.
- (3) Some traces of ray diagrams did not have arrows on the light rays.
- (4) Some candidates did not know how to read and record intercept values.

## **4. SUGGESTED REMEDIES**

- (1) Students should be introduced to practical work early enough to enable them get exposure to practical work before they take the examination.
- (2) Candidates should learn to record data to the accuracy of the instrument/ equipment used.
- (3) Students should be introduced to the plotting of points on graphs regularly. This will improve their graphical presentation of information and interpretation of the information presented.
- (4) Candidates should spend time to study the subject physics, particularly the theory to facilitate the understanding of the practical aspect of the subject.

5. DETAILED COMMENTS

ALTERNATIVE A

Question 1

(a)



You are provided with a uniform metre rule of mass  $M$  indicated on its reverse side, a knife edge, a graduated measuring cylinder of known mass,  $m_1$  marked on it and other necessary apparatus.

- (i) Read and record the values of  $M$  and  $m_1$ .
- (ii) Balance the metre rule horizontally on the knife edge. Read and record the balance point as  $G$ .
- (iii) Tie a loop of thread round the neck of the measuring cylinder.
- (iv) Fill the cylinder with the sand provided to the  $2\text{cm}^3$  mark. Record the volume,  $V$ , of the sand.
- (v) Hang the cylinder at the  $2\text{ cm}$  mark of the metre rule and adjust the position of the knife edge until the rule balances horizontally.
- (vi) Read and record the new balance position  $K$ .
- (vii) Determine the values of  $e$  and  $f$ .
- (viii) Determine the mass  $m_2$  of the sand in the measuring cylinder.

$$\text{Hint: } m_2 = \frac{Mxf}{e} - m_1$$

- (ix) Repeat the procedure by filling the measuring cylinder to the mark  $V = 4, 6, 8$  and  $10\text{ cm}^3$ . In each case, ensure that the measuring cylinder is kept constant at the  $2\text{ cm}$  mark on the metre rule.
  - (x) Tabulate your readings.
  - (xi) Plot a graph with  $m_2$  on the vertical axis  $V$  on the horizontal axis.
  - (xii) Determine the slope,  $s$ , of the graph
  - (xiii) State two precautions taken to ensure accurate results.
- (b)
- (i) Determine the mass  $7.5\text{ cm}^3$  of the sand using your graph.
  - (ii) A gold coin of mass  $102.0\text{g}$  has uniform cross-sectional area of  $10.0\text{ cm}^2$ .

Calculate its thickness.

[Density of gold =  $19.3\text{ g cm}^{-3}$ .]

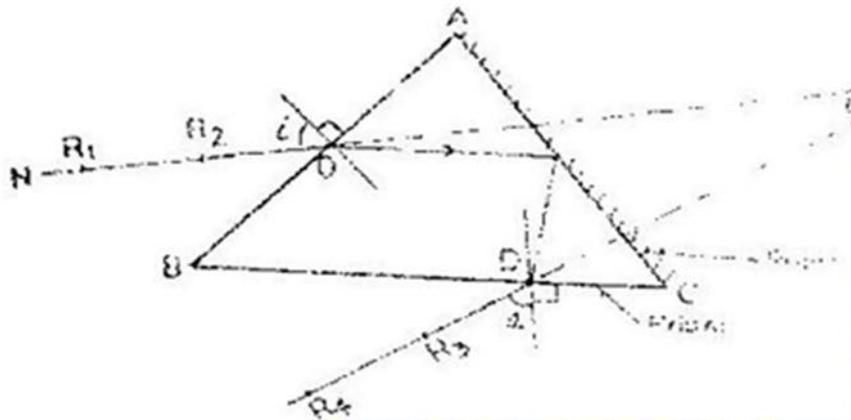
Candidates computed correctly the mass of sand for different volumes of sand in the cylinder and completed a composite table summarizing the data collected.

Candidates were able to draw a graph showing correct labels and scales for the axes. The slope of the graph was also computed using a large right-angled triangle.

Many candidates however recorded the centre of gravity  $G$  and volume of sand in the cylinder without units or without any decimal place.

## Question 2

(a)



Using the above diagram as a guide, carry out the following experiment:

- (i) Place the equilateral triangular glass prism on the drawing paper. Trace the outline  $ABC$  of the prism;
- (ii) Remove the prism. Draw a line  $NO$  such that it makes an angle  $i = 25^\circ$  with the normal at point  $O$  on side  $AB$ ;
- (iii) Fix two pins  $R_1$  and  $R_2$  vertically on line  $NO$ .

Replace the prism on its outline;

- (iv) Place the reflecting surface of the plane mirror in contact with face  $AC$  of the prism;
- (v) Looking through face  $BC$  of the prism, fix two other pins at  $R_3$  and  $R_4$  such that the pins appear to be in a straight line with the images of the pins at  $R_1$  and  $R_2$ ;
- (vi) Remove the prism, the mirror and the pins.

Draw a line to join points  $R_4$  and  $R_3$ ;

- (vii) Produce line  $R_4 R_3$  to meet line  $NO$  produced at  $T$ ;
- (viii) Measure and record the angles  $\theta$  at  $T$  and  $e$  at  $D$ ;
- (ix) Repeat the procedure for four other values of  $i = 30^\circ, 35^\circ, 40^\circ$  and  $45^\circ$ . In each case, measure and record the corresponding values of  $\theta$  and  $e$ .
- (x) Tabulate your readings;

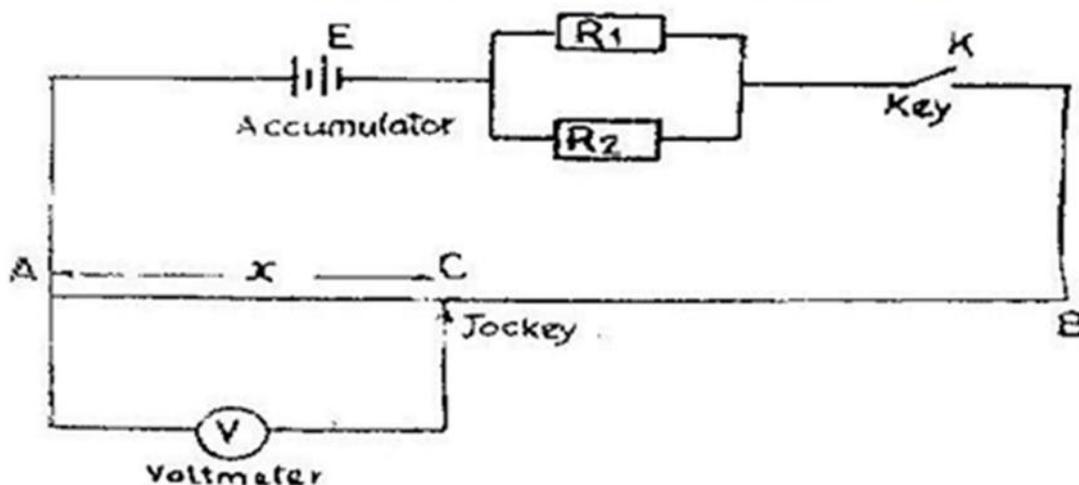
- (xi) Plot a graph with  $e$  on the vertical axis and  $\theta$  on the horizontal axis, starting both axes from the origin (0,0);
  - (xii) Determine the slope,  $s$ , of the graph and the intercept,  $c$ , on the horizontal axis;
  - (xiii) Evaluate  $k = s-1$ ;
  - (xiv) State two precautions taken to ensure accurate results.  
[Attach your traces to your answer booklet.]
- (b)
- (i) State four characteristics of the image of an object formed by a plane mirror.
  - (ii) State two conditions necessary for total internal reflection to occur in a medium.

Many candidates were able to follow the procedure correctly and obtained the desired results. The results were correctly tabulated and the required graph plotted. However, some candidates drew ray diagrams without arrows on the rays. Some did not also indicate the intercept on the horizontal axis.

Conditions for total internal reflection to occur were poorly and wrongly stated.

### Question 3

(a)

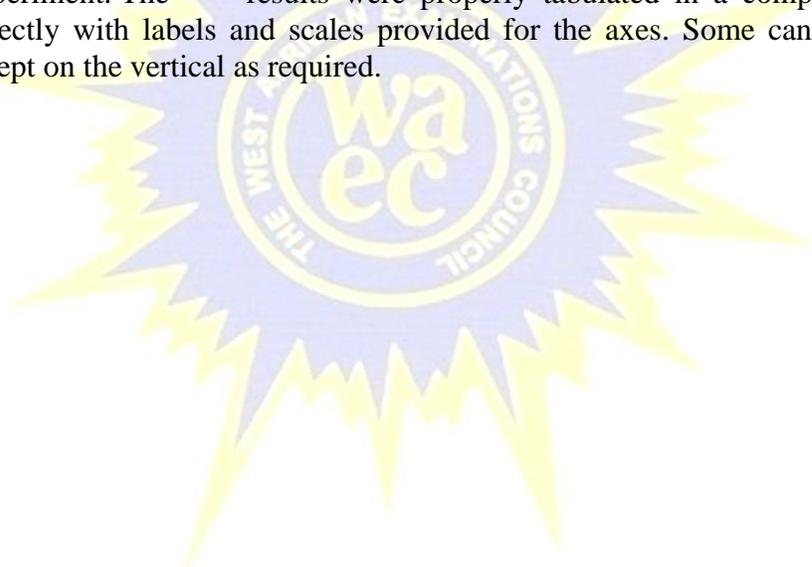


You are provided with a voltmeter,  $V$ , a cell/Battery  $E$ , standard resistors  $R_1$  and  $R_2$ , a potentiometer  $AB$ , a key  $K$ , a jockey and other necessary materials.

- (i) Set up a circuit as shown in the diagram above.
- (ii) Close the key  $K$ .
- (iii) Use the jockey to make contact with the potentiometer wire  $AB$  at a point  $C$  such that  $AC = x = 20$  cm.
- (iv) Read and record the voltmeter reading,  $V$ .
- (v) Evaluate  $x^{-1}$  and  $V^{-1}$ .
- (vi) Repeat the procedure for other values of  $x = 30, 40, 50, 60$  and  $80$  cm.

- (vii) **Tabulate your readings.**
  - (viii) **Plot a graph with  $V^{-1}$  on the vertical axis and  $x^{-1}$  on the horizontal axis, starting both axes from the origin (0,0).**
  - (ix) **Determine the**
    - ( $\alpha$ ): **slope, s, of the graph,**
    - ( $\beta$ ) **intercept, c, on the vertical axis.**
  - (x) **State two precautions taken to ensure accurate results.**
- (b) (i) **State two devices in which Ohm's law does not apply.**
- (ii) **A current of 1 A is supplied to two resistors of resistances 2  $\Omega$  and 3  $\Omega$  connected in parallel. Calculate the current in each resistor.**

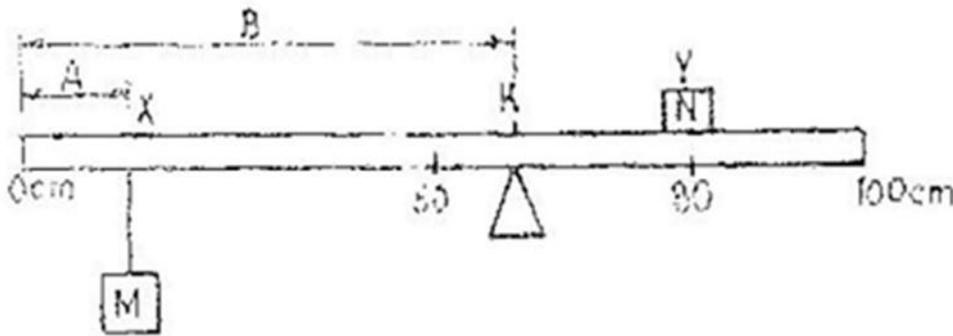
In this question, candidates were to set up a circuit having a voltmeter, cell/battery, two standard resistors a potentiometer, key and jockey. They were to use the jockey to make contact at the point C such that  $AC = X = 20\text{cm}$ , read and record the voltmeter reading  $V$  and calculate  $X^{-1}$  and  $V^{-1}$ . The process is repeated for five other values of  $X$  and the corresponding  $X^{-1}$  and  $V^{-1}$  are determined. Many candidates who attempted this question followed the procedure and successfully carried out the experiment. The results were properly tabulated in a composite table and graph drawn correctly with labels and scales provided for the axes. Some candidates did not indicate the intercept on the vertical as required.



## ALTERNATIVE B

### Question 1

(a)



You are provided with a uniform metre rule, a knife edge, some masses and other necessary apparatus

- (i) Determine and record the centre of gravity of the metre rule.
- (ii) Fix the 100 g mass marked N at a point Y, the 80 cm mark, of the rule using an adhesive.
- (iii) Suspend another 100 g mass marked M at X, a distance  $A = 10$  cm from 0 cm mark of the rule.
- (iv) Balance the arrangement horizontally on the knife edge as shown in the diagram above.
- (v) Measure and record the distance B of the knife edge from the 0 cm mark of the rule.
- (v) Repeat the procedure for four other values of  $A = 15, 20, 25$  and  $30$  cm.
- (vii) Measure and record the corresponding values of B in each case.
- (viii) Tabulate your readings.
- (ix) Plot a graph with B on the vertical axis and A on the horizontal axis.
- (x) Determine the
  - (r: slope, s, of the graph.
  - (s:1 intercept, c, on the vertical axis.
- (ix) Evaluate

$$(r:1 \quad |_{B1N1} \left( \frac{1-2s}{3} \right) 100$$

1

$$(s:1 \quad |_{c1N1} \left( \frac{2c}{s} \right) 160 ?$$

1

1

1

State two precautions taken to ensure accurate results.

- (b) (i) Define *moment of a force about a point*.  
(ii) State two conditions under which a rigid body at rest remains in equilibrium when acted upon by three non-parallel coplanar forces.¶

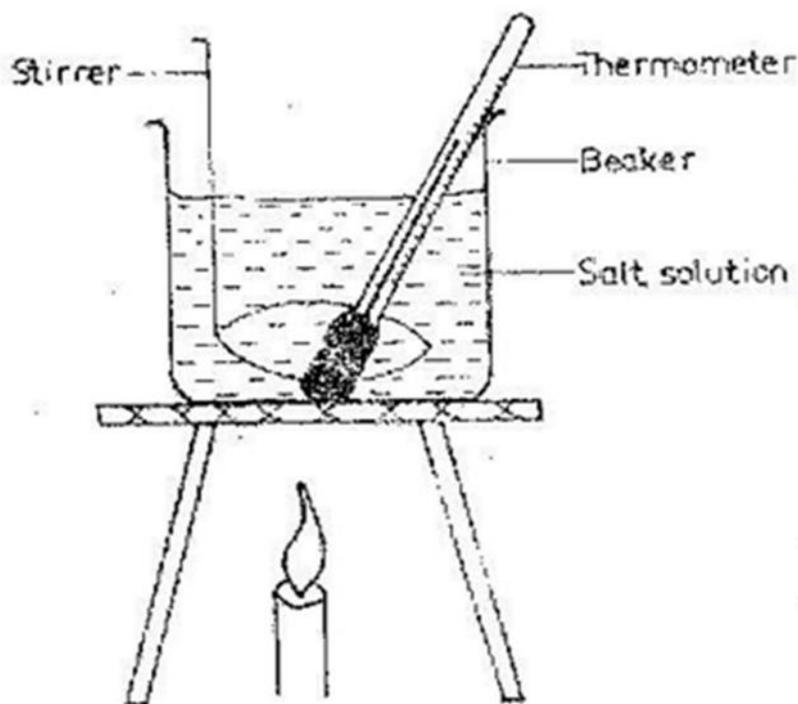
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Many candidates were able to perform the experiment and summarized their results in a composite table. The graph was correctly drawn with labels and scales provided for the axis. The slope was correctly determined using a large right angled triangle.

Some candidates did not determine the centre of gravity of the metre rule and those who did some, recorded it without any decimal place and others recorded without unit.

### Question 2

(a)



You are provided with a beaker, a thermometer, a stirrer stop watch/clock, measuring cylinder, table salt, water and other necessary materials.

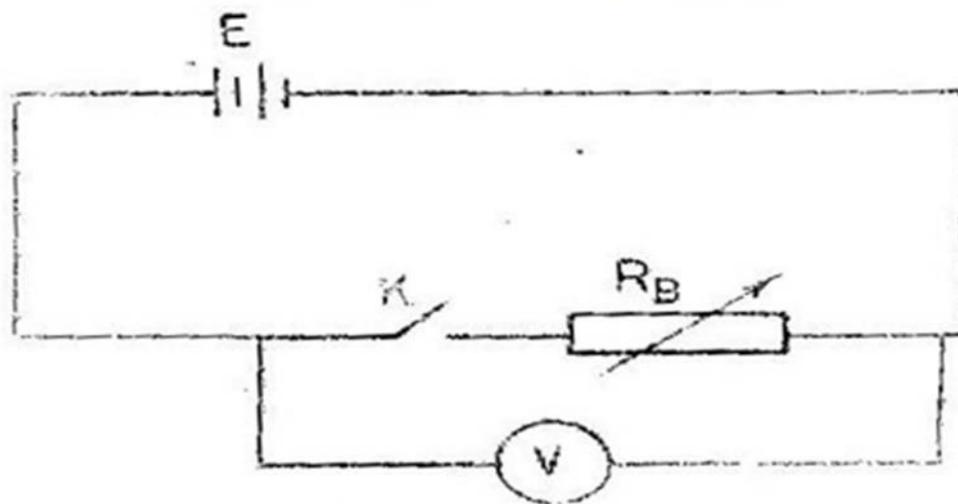
- (i) Measure  $200 \text{ cm}^3$  of water into the beaker.
- (ii) Heat the water until it boils steadily for about 2 minutes.
- (iii) Read and record the boiling point  $b_0$ .
- (iv) Add table salt of mass  $m = 10 \text{ g}$  to the boiling water and stir continuously until another boiling point  $b_i$  is attained.
- (v) Read and record  $b_i$ .

- (vi) Evaluate  $\theta_i = (b_i - b_0)$ .
  - (vii) Using the same mixture, repeat the procedure four more times by adding 10.0 g of salt each time to give the cumulative mass  $m_i$  of salt as 20, 30, 40 and 50 g.
  - (viii) In each case allow the mixture to boil steadily for at least 2 minutes then read and record the boiling point  $b_i$ .
  - (ix) Tabulate your readings.
  - (x) Plot a graph with  $m_i$  on the vertical axis and  $\theta_i$  on the horizontal axis.
  - (xi) Determine the slope,  $s$ , of the graph.
  - (xii) State two precautions taken to ensure accurate results.
- (b) (i) Define the boiling point of a liquid.  
 (i) What is the effect of impurities on the boiling point of a liquid?

Candidates who attempted the question were able to perform the experiment and tabulate their results in composite table. The graph was correctly drawn and the slope calculated over a large right angled triangle. This question was however not popular with candidates, but the few who attempted it did it well.

**Question 3**

(a)

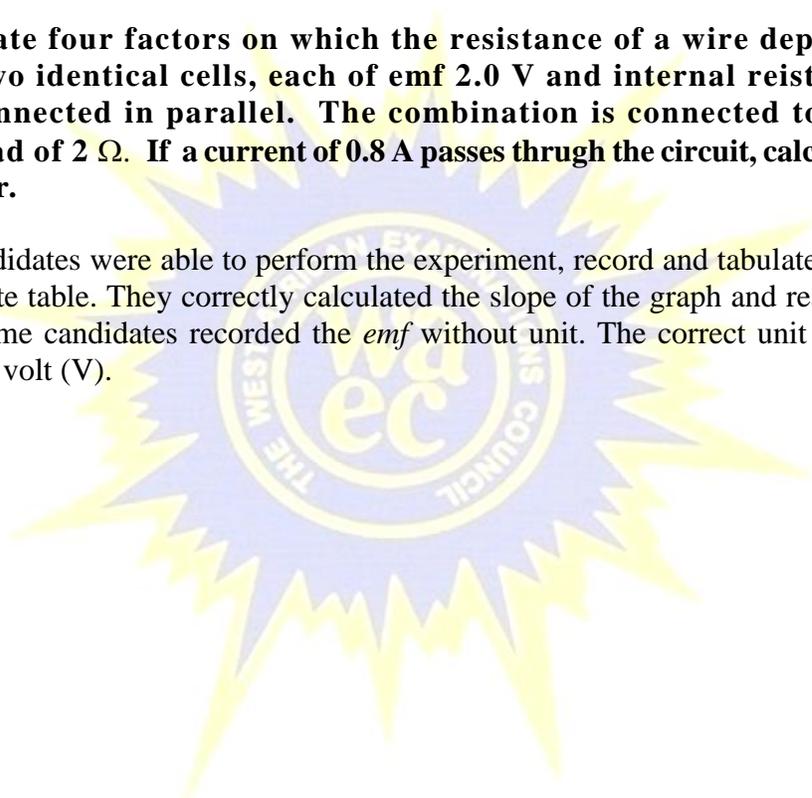


You are provided with an accumulator  $E$ , a resistance box  $R_B$ , a key  $K$  and other necessary materials.

- (i) Measure and record the emf of the accumulator.
- (ii) Connect a circuit as shown in the diagram above.
- (iii) With the key open, read and record the voltmeter reading  $V_0$ .
- (iv) Set the value of the resistance in the resistance box at  $R = 2 \Omega$ .

- (v) Close the key. Read and record the voltmeter reading  $V$ .
  - (vi) Evaluate  $R^{-1}$  and  $V^{-1}$ .
  - (vii) Repeat the procedure for four other values of  $R = 4, 6, 8$  and  $10 \Omega$ . In each case, evaluate the corresponding values of  $R^{-1}$  and  $V^{-1}$ .
  - (viii) Plot a graph with  $V^{-1}$  on the vertical axis and  $R^{-1}$  on the horizontal axis, starting both axes from the origin  $(0,0)$ .
  - (ix) Determine the
    - ( $\alpha$ ) slope,  $s$ , of the graph,
    - ( $\beta$ ) intercept,  $c$ , on the vertical axis.
  - (x) Evaluate  $k = \frac{s}{c}$ .
  - (xi) State two precautions taken to ensure accurate results.
- (b)
- (i) State four factors on which the resistance of a wire depends.
  - (ii) Two identical cells, each of emf  $2.0 \text{ V}$  and internal resistance  $r$  are connected in parallel. The combination is connected to an external load of  $2 \Omega$ . If a current of  $0.8 \text{ A}$  passes through the circuit, calculate the value of  $r$ .

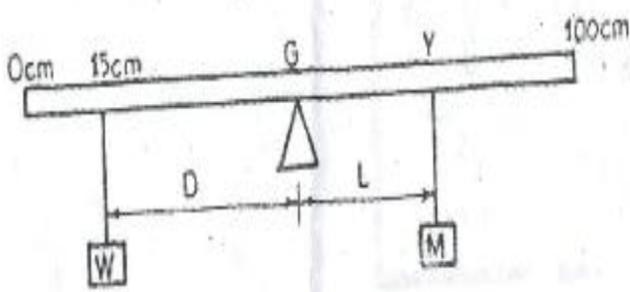
Many candidates were able to perform the experiment, record and tabulate their results in a composite table. They correctly calculated the slope of the graph and read the intercept well. Some candidates recorded the *emf* without unit. The correct unit for the voltage read is the volt (V).



## ALTERNATIVE C

### Question 1

(a)



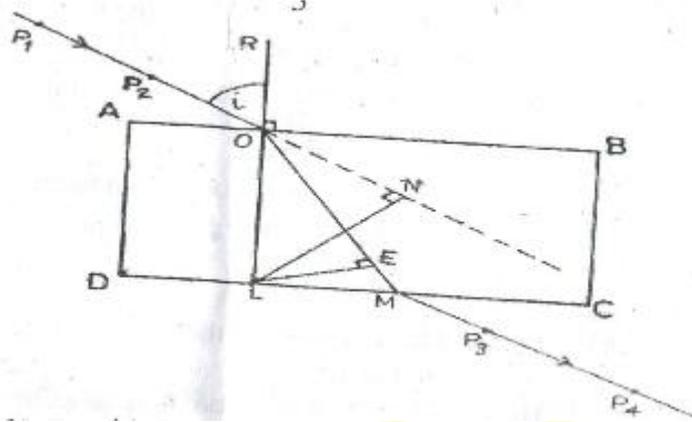
You are provided with a uniform metre rule, a knife edge, masses and other necessary apparatus.

- (i) Suspend the metre rule horizontally on the knife edge. Read and record the point of balance G of the metre rule. Keep the knife edge at this point throughout the experiment.
  - (ii) Using the thread provided, suspend the object labelled W at the 15 cm mark of the metre rule.
  - (iii) Suspend a mass  $M = 30$  g on the other side of G. Adjust the position of the mass until the metre rule balances horizontally again.
  - (iv) Read and record the position Y of the mass M on the metre rule.
  - (v) Determine and record the distance L between the mass M and G. Also, determine and record the distance D between W and G.
  - (vi) Repeat the procedure for four other values of  $M = 40, 50, 60,$  and  $70$  g. In each case; ensure that W is kept constant at the 15 cm mark and the knife edge at G.
  - (vii) Evaluate  $L^{-1}$  in each case.
  - (viii) Tabulate your readings.
  - (ix) Plot a graph with M on the vertical axis and  $L^{-1}$  on the horizontal axis.
  - (x) Determine the slope, s, of the graph.
  - (xi) Evaluate  $\frac{s}{D}$ .
  - (xii) State two precautions taken to ensure accurate results.
- (b)
- (i) State the principle of moments.
  - (ii) Define centre of gravity.

Many candidates were able to perform the experiment and tabulated their results in a composite table. Graphs were well plotted, and slope correctly calculated. Many students could however could not define centre of gravity.

## Question 2

(a)



You are provided with a rectangular glass prism, cellotex board, drawing papers, four optical pins and other necessary apparatus.

Using the diagram above as a guide, carry out the following instructions:

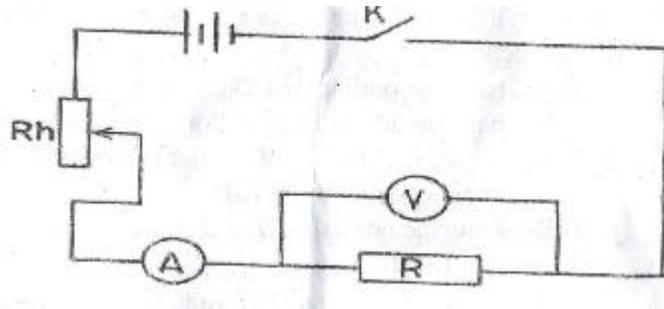
- (i) trace the outline  $ABCD$  of the glass block on a sheet of paper attached to the cellotex board;
- (ii) remove the block and mark a position  $O$  such that  $AO$  is about one quarter of  $AB$ ;
- (iii) draw the normal  $ROL$  and the incident ray such that  $i = 20^\circ$ ;
- (iv) fix two pins at points  $P_1$  and  $P_2$  on the incident ray;
- (v) replace the block and fix two other pins at point  $P_3$  and  $P_4$  such that the pins appear to be in a straight line with the images of the pins at  $P_1$  and  $P_2$  when viewed through the block from the side  $DC$  of the block;
- (vi) remove the block and join the points  $P_4$  and  $P_3$  producing the line to meet  $DC$  at  $M$ ;
- (vii) draw a line to join point  $O$  and  $M$ ;
- (viii) draw the normal  $LE$  and  $LN$  to the refracted ray and the extended incident ray, respectively;
- (ix) measure and record the lengths  $LE$  and  $LN$ ;
- (x) repeat the procedure for other values of  $i = 30^\circ, 40^\circ, 50^\circ$  and  $60^\circ$ ;
- (xi) Tabulate your readings;

Candidates who answered this question were able to produce neat traces. The perpendiculars  $LE$  and  $LN$  were properly constructed. For varying angles of incidence  $i$  the corresponding  $LE$  and  $LN$  were properly constructed and measured. A graph of  $LE$  on vertical axis against  $LN$  on the horizontal axis was correctly plotted and the slope determined.

Few candidates however did not have arrows on their traced light rays.

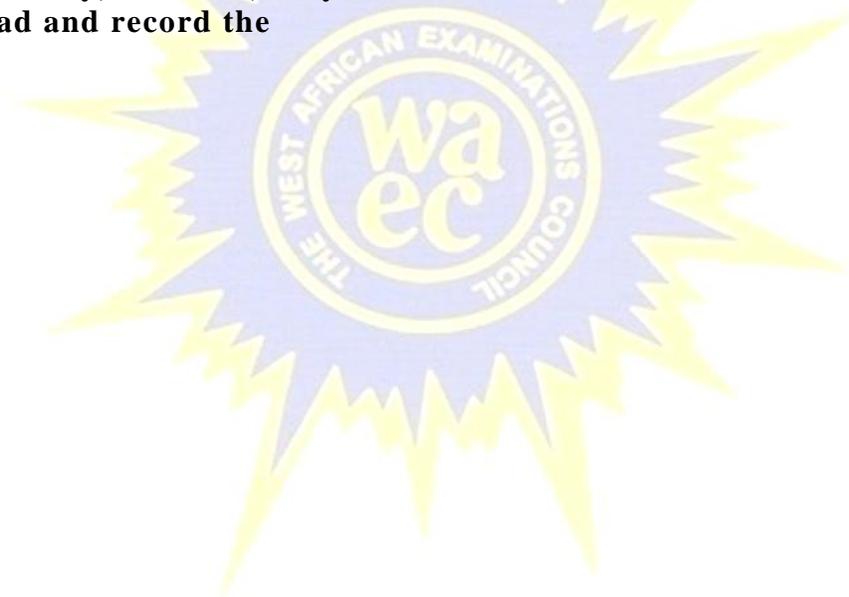
**Question 3**

(a)



You are provided with a rheostat, an ammeter, a voltmeter, a standard resistor, a cell, a key and other necessary

- (i) Measure and record the emf,  $V_0$  of the cell provided.
- (ii) Connect a circuit as shown in the diagram above.
- (iii) With the key,  $K$  closed, vary the rheostat  $R_h$  to obtain a current  $I = 0.20$  A. Read and record the



## **PHYSICS 2**

### **1. GENERAL COMMENTS**

The standard of the paper compares favourably with those of previous years. The performance of candidates was satisfactory.

### **2. A SUMMARY OF CANDIDATES' STRENGTHS**

- (1) The candidates correctly labelled the axis of graphs drawn.
- (2) Diagrams were appropriately drawn and labelled.
- (3) Candidates were able to use calculators to evaluate what appears to involve complex decimal values and square roots.

### **3. A SUMMARY OF CANDIDATES' WEAKNESSES**

The following weaknesses of candidates were identified:

- (1) Many candidates could not convert from  $\text{cm}^2$  to  $\text{m}^2$ .
- (2) Some candidates mixed up S. I units with C.g.s units and yet had their final answers in S. I units.
- (3) Candidates had problems with their grammatical constructions which negated some of the answers they intended to provide.
- (4) Candidates showed a general weakness in understanding topics in electrostatics, nuclear physics and wave theory.
- (5) Candidates could not apply Kirchoff's laws appropriately to solve the simple question they were given.

### **4. SUGGESTED REMEDIES**

- (i) School authorities should ensure that students offering Physics are taught by experts in the subject.
- (ii) Teachers of the subject must research to make themselves abreast with topics in electrostatics, nuclear physics, wave theory and electricity. These topics should be taught early enough to enable students revise them adequately before they take the examination.
- (iii) Teachers should pay attention to the conversion from c.g.s to S.I units and vice versa.
- (iv) Physics Teachers must themselves pay close attention to the use of correct English Language and ensure that their students write their answers in Good English.

## 5. DETAILED COMMENTS

### Question 1

**A metallic bar 50 cm long has a uniform cross-sectional area of 40 cm<sup>2</sup>. If a tensile force of 35 kN produces an extension of 0.25 mm, calculate the value of Young's modulus.**

Young's Modulus equation was very well known and correctly quoted, majority of the students could not convert 40 cm<sup>2</sup> into m<sup>2</sup>. Instead of 40 x 10<sup>-4</sup> m<sup>2</sup> or 4.0 x 10<sup>-3</sup> m<sup>2</sup>, many simply made it 4.0 x 10<sup>-1</sup> m<sup>2</sup>, and hence arrived at the wrong answer.

### Question 2

**(a) What are beats?**

**(b) Differentiate between noise and music.**

(a) Many candidates correctly defined beats.

(b) Many candidates could not differentiate between noise and music. Noise is unwanted sound of irregular frequency whereas Music is sound of regular frequency (pleasant to the ear)

### Question 3

**(a) What is a black body?**

**(b) Sketch a graph of intensity against wavelength for two different temperatures T<sub>1</sub> and T<sub>2</sub> for a black body where T<sub>1</sub> > T<sub>2</sub>.**

(a) Many candidates had a good idea of what a black body is. However, the graphical representation relating intensity to wavelength for two temperatures T<sub>1</sub> and T<sub>2</sub> with T<sub>1</sub> > T<sub>2</sub> was not appropriately illustrated. For two temperature T<sub>1</sub> and T<sub>2</sub> with T<sub>1</sub> > T<sub>2</sub>, the peak for the higher temperature must shift towards the lower wavelength.

### Question 4

**Explain why the intensity of sound diminishes with respect to distance from a source.**

Many candidates could not explain the diminishing of sound as the source of sound moves away. Intensity decreases as a source of sound moves away because intensity varies inversely as the square of distance from the source. Hence as distance increases, intensity decreases.

### **Question 5**

**Distinguish between active satellite and passive satellite.**

Many candidates attempted this question, but scored poor marks for the answers provided. Many confused an active satellite with a geostationary satellite. An active satellite is a satellite which reflects signals from one part of the globe to another and also amplifies such signals.

A passive satellite only reflects signals from one part of the globe to another.

### **Question 6**

**List three uses of rockets.**

In this question many candidates assumed the uses of satellites as those for rockets. Rockets are employed;

- to display fireworks as part of entertainments
- for space exploration
- to launch war missiles
- to launch satellites into space.

### **Question 7**

**A network was illustrated and candidates were to calculate the currents  $I_1$  and  $I_2$**

From Kirchoff's laws;

$$2 = 4I_1, \therefore I_1 = \frac{2}{4} = 0.5A.$$

$$0 = 2I_2 - 4I_1 \therefore 2I_2 = 4I_1$$

$$I_2 = \frac{4}{2} I_1 = \frac{4}{2} \times \frac{1}{2} = 1A$$

### **Question 8**

**State one similarity and two differences between a semiconductor diode and a transistor.**

This was a popular question attempted by many candidates, but was poorly answered. The similarities between the two devices are.

- Both can be used as switches
- Both have p-n junctions
- Both can be used as a rectifier.

Differences between semiconductor diode and transistor are tabulated below.

Diode	Transistor
- consists of a single p-n junction	- consists of more than one p-n junction
- cannot be used for amplification	- used for amplification
- is a two terminal device	- is a three terminal device

### **Question 9**

**An illustration of an inverting amplifier with an input voltage of 2 V, was given and candidates were to calculate for the amplifier:**

- (a) **voltage gain;**  
 (b) **output voltage.**

Many candidates did not attempt this question. The few who did, provided very poor answers.

The expected answers were:

$$(a) \quad \text{Gain} = \frac{V_{\text{out}}}{V_{\text{in}}} = \frac{-R_f}{R} = \frac{-100}{10} = -10$$

$$(b) \quad V_{\text{out}} = \text{gain} \times V_{\text{in}} = -10 \times 2 = -20 \text{ V.}$$

### **Question 10**

- (a) **Show, using diagrams, how a p-n junction diode is forward biased,**  
 (b) **reverse biased.**

Many candidates provided the required diagrams, but wrote lengthy paragraphs of explanation which were not required.

### **Question 11**

- (a) (i) **Define**  
 (r) **elastic;**  
 (s) **tensile stress;**  
 (t) **tensile strain.**
- (b) **A spiral spring extends by 6 cm when a load of mass 200 g is hung on it. The mass is set into small vertical oscillations.**

Assuming that Hooke's law is obeyed, calculate the

- (i) force constant of the spring,
  - (ii) work done in extending the spring by 6 cm,
  - (iii) period of oscillation of the mass,
  - (iv) frequency of oscillation of mass.
- [ $g = 10 \text{ ms}^{-2}$ ]

Many candidates could not define the terms given. Many could also not state the law that relates strain to stress.

The following answers were require

- (β) Tensile stress is the ratio of tensional/compressive force to the cross-sectional area of a material.
- (φ) Tensile strain is the ratio of the extension to the original length of the material.
- (ii) Stress is proportional to strain provided elastic limit is not exceeded.  
The calculations that were required by this part of the question were properly done, except that few students could not convert from c.g.s to S. I units.

### Question 12

- (a)
  - (i) Explain thermal convection.
  - (ii) List three systems apart from land and sea breezes in which convection takes place.
- (b) State
  - (i) the thermometric property of mercury;
  - (ii) two advantages of platinum resistance thermometer over mercury-in-glass thermometer.
- (c) Mercury at a temperature of  $20 \text{ }^\circ\text{C}$  has a density of  $13.6 \times 10^3 \text{ kg m}^{-3}$ . Determine the new density of mercury if it is heated to  $80 \text{ }^\circ\text{C}$ . [Cubic expansivity of mercury is  $1.82 \times 10^{-4} \text{ K}^{-1}$ .]
- (d) A rectangular block of wood floats with two-thirds of its volume immersed in water. When placed in another liquid, it floats with half of its volume immersed. Calculate the relative density of the liquid.

- (a)
  - (i) A lot of candidates did not explain thermal convection, they merely defined it.
  - (ii) Apart from the stated processes, convection also takes place in
    - heating of rooms in cold countries
    - car radiators
    - domestic water heater
    - ventilation of homes/offices

- (b) (i) Many candidates, instead of stating the thermometric property of mercury as being proportional change in length or volume of mercury, they stated the general properties of mercury as a thermometric liquid.
- (i) The advantages of platinum resistance thermometer over Mercury -in glass thermometer were correctly provided by many candidates.
- (c) The new density  $d_2$  in respect of the original density  $d_1$  are related by

$$d_1 = d_2 (1 + \delta \Delta \varnothing)$$

$$\therefore d_2 = \frac{d_1}{1 + \delta \Delta \varnothing} = \frac{13.6 \times 10^3}{1 + 82 \times 10^{-4} \times (80 - 20)} = \frac{13.6 \times 10^3}{1.01092}$$

$$d_2 = 13.45 \times 10^3 \text{ kgm}^3.$$

- (d) This question was poorly executed. The expected solution is given below.

$$\text{R. D} = \frac{\text{volume of water displaced}}{\text{volume of liquid displaced}} = \frac{\frac{2}{3}v}{\frac{1}{2}v} = 1.33$$

### **Question 13**

- (a) (i) **What is diffraction?**  
 (ii) **State two practical applications of diffraction.**
- (b) **An object is placed 12 cm from a convex mirror of focal length 15 cm. Calculate the image distance from the mirror.**
- (c) **A ray of light is incident on one surface of a rectangular glass prism at a glancing angle of  $60^\circ$ . If the frequency of the light in air is  $5.0 \times 10^{14}$  Hz, determine the**  
 (i) **frequency of the light in the prism,**  
 (ii) **wavelength of the light in air,**  
 (iii) **wavelength of the light in the prism,**  
 (iv) **angle of refraction,**  
 (v) **speed of the light in the block.**

**[Speed of light in air =  $3.0 \times 10^8 \text{ ms}^{-1}$ ; refractive index of the glass = 1.6.]**

- (a) This question was popular with students. Many candidates who attempted the definition of diffraction got it correct. They were also able to state two practical applications of diffraction.

- (b) Many candidates who attempted this question were able to state the lens formula correctly. However, most of them failed to identify the focal length of a convex mirror as negative.

The required solution is given below:  $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$  where  $f = -15$ ,  $u = 12$

Hence  $\frac{1}{-15} = \frac{1}{12} + \frac{1}{v}$  resulting in  $v = -6.67$  cm.

- (c) Many of the candidates who attempted it, did it fairly well.

### **Question 14**

- (a) **Distinguish between a positively charged object and a negatively charged object.**

- (b) **With the aid of diagrams, explain how two identical metallic spheres M and N may be charged to carry positive charges of equal magnitude.**

- (c) (i)



The diagram above illustrates three point charges  $Q_1$ ,  $Q_2$  and  $Q_3$  situated at A, B and C respectively on a straight line in a vacuum such that  $AB = 10$  cm and  $BC = 30$  cm.

Given that  $Q_1 = +50$  uC,  $Q_2 = -5$  uC and

$Q_3 = +20$  uC, calculate the resultant

- (a) electric field intensity at B,  
 (b) force at B.

$[k = (4\pi\epsilon_0)^{-1} = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}]$

- (ii) **Draw the lines of force due to this system of charges.**

- (a) A sizeable number of candidates attempted this question, but it was poorly answered. A positively charged object is one that is deficient in electrons while a negatively charged object is one that has excess electrons.

- (b) Most candidates who attempted this question performed poorly. Most candidates could not provide the correct diagrams. It appears electrostatics was not properly treated in schools.

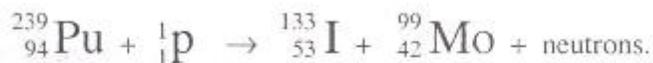
- (c) Only few candidates could quote the formula

$$E = \frac{Kq}{r^2} = \frac{q}{4\pi \epsilon r^2}$$

and then apply it to calculate the magnitude of electric field at a point due to a charge at another point. Many candidates could also not draw the lines of force due to the system of charges given.

### Question 15

- (a) Define half-life.
- (b) The decay constant for a certain element is  $1.6 \times 10^{-17} \text{ s}^{-1}$ . Calculate the half-life of the element in years.
- (c) (i) Give two reasons why it is important to dispose of radioactive waste safely.
- (ii) Plutonium undergoes nuclear fission as shown in the equation below.



Calculate the number of neutrons produced by this reaction.

- (d)

_____	-0.9 eV
_____	-1.5 eV
_____	-3.4 eV
_____	-13.6 eV

The diagram above indicates the energy levels in a certain atom.

- (i) Copy the diagram.
- (ii) Indicate on your diagram with an arrow the energy level involved when a photon of energy 2.5 eV is emitted by the atom.
- (iii) If the atom receives 12.1 eV while in the ground state, indicate with an arrow the energy level to which the electron would jump.

Candidates provided the right answers for the (a) and (b) parts of this question. Half life was properly defined and the calculations involved were properly done. A few candidates could however not convert from years to seconds.  
1 year = 365 days x 24 hrs x 60 mins x 60s.

- (c) This question was generally well answered by candidates.  
The correct equation is  ${}_{94}^{239}\text{P} + {}_1^1\text{P} \rightarrow {}_{53}^{133}\text{I} + {}_{42}^{99}\text{Mo} + \text{neutrons} + y({}_0^1\text{n})$ .  
from which  $y + 99 + 133 = 239 + 1$ ,  $y = 8$ .  
Instead of  $y$  ( $\text{n}$ ) some candidates wrote  $n$  and ended up with  $n$  as if the atomic mass of a neutron is 8.
- (d) The diagram was not well copied in terms of spacing between the energy levels. Many candidates copied the diagram giving equal spacing instead of showing the differences in energy levels with increasing spacing as provided by the question.

