

SCIENCE SUBJECTS

RÉSUMÉ OF SCIENCE SUBJECTS

1. PERFORMANCE OF CANDIDATES

The Chief Examiners expressed varied views on the performance of candidates for the science subjects.

Whereas performance in Fisheries, Biology and Animal Husbandry saw an improvement. There was a slight decline in the performance for General Agriculture, Physics, Chemistry, Integrated Science, Forestry and Crop Husbandry and Horticulture.

2. SUMMARY OF CANDIDATES' STRENGTHS

The Chief Examiners noted that candidates performed well in the following topics of their respective subjects.

(2) BIOLOGY

- (a) Candidates exhibited good knowledge in performance of food test
- (b) Candidates gave precise economic importance of cockroach and moss plant
- (c) They showed clear understanding of deficiency disease and nutrient deficiency diseases in humans

(3) GENERAL AGRICULTURE

- (a) Methods of fish preservation
- (b) Establishment of lawns
- (c) Candidates exhibited adequate knowledge in irrigation.
- (d) Candidates stated correctly the method of applying inorganic fertilizers as well as their advantages
- (e) They stated the functions of the gizzard correctly as well as nutrients obtained from milk from a lamb

(4) CROP HUSBANDRY AND HORTICULTURE

- (a) A good number of candidates exhibited adequate knowledge of the characteristic features of a fertile soil, importance of rainfall to the growth and yield of crops and effects of pests in crop production.
- (b) Some candidates satisfactorily discussed cultural methods of controlling pests in crop production.

(5) CHEMISTRY

The Chief Examiner reported that:

- (a) Candidates showed good understanding of concordance in their choice of titre values for averaging;
- (b) Candidates exhibited a good understanding of the mole concept;
- (c) Candidates had a fair knowledge and understanding of IUPAC nomenclature; Resonance and the periodic chemistry.

(6) PHYSICS

Candidates handled questions in the following areas quite well:

- (a) Methods of demagnetizing a magnet;
- (b) Use of the band theory to explain reduction in resistance of a semiconductor;
- (c) Definition of atomic number;
- (d) Presentation of data in a composite table;
- (e) The use of correct units for both measurable and deduced quantities.

(7) INTEGRATED SCIENCE

Most candidates performed well in the following areas:

- (a) Management practices in maize cultivation;
- (b) Meaning of insanitary condition;
- (c) They were able to identify and name correctly parts of farm animals and laboratory instruments;
- (d) They were able to balance correctly chemical equations for the reaction involved in the preparation of hydrogen gas;
- (e) They were able to state correctly management practices of named animals.

(8) ANIMAL HUSBANDRY

Most candidates performed well in the following areas:

- (a) Ways in which diseases are of economic importance in livestock production;
- (b) Materials used in milking cows;
- (c) Aims of animal improvement programs;
- (d) Importance of bone, milk and feathers to farm animals.

(9) FORESTRY

- (a) Steps involved in raising potted seedlings for out planting.
- (b) Forest industries in Ghana.
- (c) Factors to be considered when selecting a site for nursery.
- (d) Forestry related careers in Ghana.

(10) **FISHERIES**

- (a) Most candidates could identify and name correctly the illustrations in the practical paper.
- (b) Candidates could differentiate between processing and preservation as used in the fishing industry.

Candidates for Biology, Chemistry, Physics, Animal Husbandry and Forestry were commended by the respective Chief Examiners for the orderly presentation of their responses.

Improvement in the spelling and usage of scientific terms was a noted feature in the responses of candidates for Integrated Science, General Agriculture and Fisheries.

3. **SUMMARY OF CANDIDATES' WEAKNESSES**

The Chief Examiners noted that candidates did not perform too well in the following topics of their respective subjects:

(1) **BIOLOGY**

- (a) Technical terms and scientific words were wrongly spelt.
- (b) Many candidates failed to adhere to the guidelines regarding biological drawings.
- (c) Candidates could not adequately explain food preservation facilities such as silos and refrigerators.

(2) **GENERAL AGRICULTURE**

Most candidates had challenges in the following areas:

- (a) Spelling technical terms and scientific names;
- (b) Varieties and family name of egg plant;
- (c) Naming pest and disease that affect egg plants;
- (d) Characteristics of the gizzard;
- (e) Possible causes of acidity.

(3) **CROP HUSBANDRY AND HORTICULTURE**

- (a) Several candidates could not spell technical terms and scientific words correctly.
- (b) Candidates could not adequately explain the following terms: hybridization, relay cropping, succession cropping and organic farming.

(4) **CHEMISTRY**

Most candidates were unable to:

- (a) define atomic radius.
- (b) identify specific tests for various organic compounds.
- (c) differentiate between ions and atoms.

(5) **PHYSICS**

Most candidates

- (a) had difficulty solving problems on mechanics, sound and heat.
- (b) could not give the reason for using steel as a compass needle and iron as a core of electromagnets.
- (c) failed to record length measured with the metre rule to 1 decimal place in centimetres.
- (d) were unable to make simple deductions from the graphs.
- (e) were unable to plot points correctly to the accuracy of chosen scales.

(6) **INTEGRATED SCIENCE**

Most candidates shown weakness in the following areas:

- (a) spelling common words correctly;
- (b) basic electronics, writing of chemical formulae of compounds and Rhesus factor;
- (c) plotting graphs with correct values;
- (d) poor description of the process that goes on in the stomach of humans.

(7) **ANIMAL HUSBANDRY**

Majority of the candidates were unable to:

- (a) spell essential key words;
- (b) state steps involved in the preparation of bone meal;
- (c) indicate ways of restraining farm animals;
- (d) state effects of temperature on some parameters in livestock production;
- (e) explain differences between hand mating, pen mating and pasture mating.

(8) **FORESTRY**

Commonly identified difficulties included:

- (a) Wrong spelling of technical words;
- (b) Poor drawing skills;
- (c) inability to state why black poly bags are used for nursing seedlings.

(9) FISHERIES

Candidates expressed difficulties in:

- (a) the spelling of technical terms;
- (b) the explanation of how salting, drying and freezing preserves fish;
- (c) stating reasons for seasonal variations in fish catch;
- (d) stating the effect of fish spoilage on clients.

4. SUGGESTED REMEDIES

The Chief Examiners for the Science subjects generally recommended that candidates should be taken through many practical lessons to improve their performance. Moreover, candidates should be adequately prepared for the examination and given the needed help to improve upon the usage of the English Language.

The Chief Examiners also made the following suggestions:

- (1) candidates should read questions carefully and adhere to instructions;
- (2) candidates should be helped to identify and understand the scientific principles underlying everyday occurrence;
- (3) teachers should allot more time for practical lessons;
- (4) teachers should demonstrate the procedure used in practical activities;
- (5) teachers should give more exercises in organic chemistry especially drawing of structures.
- (6) teachers should help students to master biological drawings.
- (7) teachers should do their best to explain the theories and principles in Physics and their applications to students.

ANIMAL HUSBANDRY 2

1. GENERAL COMMENTS

The standard of this paper was good for the level of candidates involved and are comparable with previous years' papers. However, the performance of most of the candidates was not encouraging, as quite a number of them performed below average.

2. SUMMARY OF CANDIDATES' STRENGTHS

- (1) Majority of the candidates answered the questions in an orderly manner. This is commendable because it made marking of scripts easier than it would have been if they had done otherwise. A good number of candidates answered different questions on different pages, as instructed on the answer booklets. This is commendable, and candidates are encouraged to keep it up.
- (2) Candidates were quite impressive this year, as majority of them wrote the question numbers behind the answer booklets in the order in which they answered them.
- (3) All the candidates attempted to answer at least, some of the questions, even though some of them had little or no idea on the requirements of some questions.
- (4) Candidates had very little difficulties answering the following questions:
 - (a) ways in which diseases are of economic importance in livestock production;
 - (b) ways in which fencing is important in livestock farm;
 - (c) materials used in milking cows;
 - (d) animals that are fed on pellets and mash diets;
 - (e) aims of animal improvement programmes.

3. SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Some of the candidates had difficulty in understanding some questions, thus, such questions were either left unanswered, or answers provided in some cases had no linkage with the questions involved.
- (2) ***Wrong spelling of essential key words*** was a major problem encountered in this paper. This caused some candidates to lose points unnecessarily; a situation which could have been avoided. In addition, it appeared some ***candidates did not devote enough time to read over their answers to questions***, to enable them rectify issues with omissions and correct wrongly spelt words. Though it is possible the candidates did not know the correct spellings of such words, it is believed that reading over the answers could have drawn their attention to words that were ***mistakenly spelt wrongly***.
- (3) It was a common observation that some candidates provided more answers to some of the questions, than were expected. This has been a general practice for some time now. In addition, others answered either **five** or **all the six** questions for this paper, instead of answering **only four** as indicated in the instructions. Though the current decision is that examiners should mark all and select the best four answers out of the

total number of questions answered, candidates who do that in future might be penalized. The challenge here is that, instead of the candidates focusing and spending adequate time on only four questions, they end up answering parts of each of the six questions because of inadequate time. Remember the time allocated is just enough to answer four questions, but not six. In addition, the candidates would have limited time left to read over answers they had provided for possible correction of errors. Candidates might perform better, if they spent time focusing on four main questions they could answer best, rather than attempting all questions partially.

- (4) Some of the candidates also spent so much time to answer questions, and later cancelled them out, probably because they later realized those questions were not the easiest. This is time wasting, and it could be avoided if they devote the first 5 minutes of the time allowed, to read all the questions at the start of the paper, and decision taken on which ones to attempt or otherwise, before they start work.
- (5) A good number of candidates were unable to form correctly, simple sentences to make meaning to readers. Consequently, they end up bringing out expressions with different meanings from what they possibly intended to write.
- (6) Though this year's questions did not involve writing of scientific names, candidates who attempted to write the scientific names of some plant species, did so without adhering to the rules of presenting scientific names, hence in most cases they were marked down.
- (7) Areas that posed much problems to the candidates include:
 - (a) effects of low temperature on some parameters in livestock production;
 - (b) differences between hand mating, pen mating and pasture mating;
 - (c) explanation of the term "dystocia";
 - (d) disadvantages of deep litter system in poultry production;
 - (e) explanation of the term cross breeding;
 - (f) differences between hand mating, pen mating and pasture mating

4. SUGGESTED REMEDIES

- (1) Candidates need to improve their reading skills, to enable them to build more vocabularies for use under examination conditions.
- (2) At the start of a paper, candidates should be encouraged to *spend about five minutes of their time* to read and understand all the questions and decide on questions to attempt before they start work.
- (3) Teachers need to emphasize the need for candidates to obey instructions during examinations. This will help them to spend good time to answer the right number of questions, rather than *wasting time to provide additional answers* to some questions, which would eventually not add additional scores to their work.
- (4) Decision must be taken to penalize candidates who answer more questions than is expected. This would possibly serve as deterrent to such practices in future.

- (5) Candidates should be advised to convince themselves on which questions they wish to answer, before tackling them. This will help minimize the excessive cancellation of answers to a whole question, after wasting time to write all those answers.

5. **DETAILED COMMENTS**

QUESTION 1

- (a) **State four changes that take place after the chopped forage has been compressed and covered in silage preparation.**
- (b) **Give two reasons for carrying out each of the following practices in pasture management:**
- (i) **weeding;**
 - (ii) **controlled burning;**
 - (iii) **irrigation;**
 - (iv) **fertilizer application.**
- (c) **State three functions of phosphorus in animal nutrition.**
- (d) **Copy and complete the table below by ticking (✓) the appropriate column to indicate the effect of low temperature on farm animals under the following parameters.**

<i>Parameter</i>	<i>Effect</i>		
	<i>Increase</i>	<i>Decrease</i>	<i>Normal</i>
(i) Pulse rate			
(ii) Water intake			
(iii) Grazing time			
(iv) Milk yield			
(v) Feed intake			

- (a) This question did not pose much problems to most of the candidates.

Some of the candidates, however, indicated that the compressed forage would be flattened. It is common knowledge that any compressed material would be flattened, but it should be noted that it is not a change which occurs in the ensiled material.

Others indicated that the colour of the forage changes from green to brown. This is incorrect because though the colour of the forage changes, it does not change to brown, but rather to olive green. It is rather hay, that changes colour from green to brown upon drying.

The expected answers on changes that occur to forage during silage preparation include:

- (i) oxygen is used up, and carbon dioxide content increases;

- (ii) the temperature of the ensiled mass increases;
- (iii) bacteria ferments carbohydrate to produce lactic acid, which causes pH of the medium to reduce (acidity increases);
- (iv) digestibility of Nutrient Detergent Fibre (NDF) increases.

(b)

Weeding – some of the candidates who attempted this question defined weeding. However, that was not the focus of the question. Major challenges encountered here were candidates' inability to express themselves well, causing a significant change in the intended meaning of some statements. Expected answers include – to reduce competition with crops over space, air, water and nutrients. Weed control also helps minimize pest and disease spread, eases harvesting of forage, removes poisonous weeds and improves the aesthetic value of the pasture.

Controlled burning – this question posed some challenges to some candidates because it was misunderstood. Lots of the candidates were rather giving reasons for *controlling bush burning*, instead of reasons for practicing controlled burning. Consequently, they were marked down. The expected answers, however, include – to kill some parasites and their eggs, destroy old herbage, promote new growth of forage, to add potassium to the soil, controls weeds/unwanted plants, etc.

Irrigation – Some candidates said irrigation supplies water to the soil. This is more or less a definition of the term, but not a reason for carrying it out. Expected reasons for irrigating crops include – to improve nutrient uptake from the soil, to rehydrate plants, improve plant growth especially during the dry season, improve yield of herbage, etc.

Fertilizer application – most of the candidates had no challenge at all with this question. They were on point, giving reasons such as for increased nutrient content of the soil/pasture, to regulate soil pH, etc.

(c)

This question did not pose much challenge to the candidates. Those who really knew the roles of phosphorus in the body of animals, gave precise answers. Some of the expected functions of phosphorus include – for bone and teeth formation, for egg shell formation, for acid-base balance in the body, for protein synthesis and for transport of fatty acids.

(d)

This was one of the simplest questions in this paper, but only a few of the candidates had perfect scores. Candidates who got it wrong either did not know the answers to that question, or they did not understand the question. When temperature reduces, the pulse rate

of the animal increases to improve blood flow to ensure constant body temperature. Water intake of the animals, however, decreases as perspiration reduces drastically. Grazing time increases, feed intake and milk yield also increase under reduced temperature conditions. Some of the candidates *ticked all the columns in the table*, causing them to score zero for this question.

QUESTION 2

(a) Explain each of the following mating methods in farm animals:

- (i) hand mating;**
- (ii) pen mating;**
- (iii) pasture mating.**

(b)

- (i) Mention two advantages of each of the mating methods explained in (a).**
- (ii) Mention two disadvantages of each of the mating methods explained in (a).**

(c) Name two methods of collecting semen from a bull.

(a)

(i) Hand mating – Most of the candidates had partial explanation for this term. Hand mating is a method of mating livestock whereby a female animal on heat is taken to a male animal for mating, after which the female animal is returned to its cage/area of confinement. Most of the candidates *did not indicate that the female animal is returned after mating*, hence partial marks were awarded to their explanations.

(ii) Pen mating – is a method of mating where male and female animals in an appropriate mating ratio are enclosed in a pen for purposes of mating. The challenges encountered by the candidates include their failure to indicate that the *animals are in each mating ratio*, and that any of the *males in the pen could mate any of the females* there made them score partial marks.

(iii) Pasture mating – In this section, the candidates did not have much challenge with this question. Whereas pasture mating involves free mating taking place among male and female animals during grazing, some of the candidates did not explain that any male animal has equal chances of mating any female animal they come across, hence results in indiscriminate mating. That is a key feature of this method of mating, but was not captured by the candidates, making their explanations for the term like pen mating.

(b)

(i) Over here, some candidates mentioned some advantages, but these were not unique to the system they were referring to. For instance, indicating that pen mating is not expensive, without comparing it to the pasture mating method makes that answer incorrect.

This is because pen mating could be more expensive than the pasture mating method, but not more than the hand mating method. Consequently, such candidates were either marked down, or scored partial marks in some cases.

(ii) The challenges here were like those in (2bi). The candidates were not comparing the disadvantages with other appropriate mating methods. For instance, a candidate saying pen mating is expensive may not be correct, because hand mating is more expensive, so they were expected to compare the high cost of pen mating with pasture mating for full score.

(c) Here, candidates who knew the answers had no challenges at all. Some candidates wrote “natural methods” and “artificial methods” as answers to this question. These were incorrect, because all the semen collection methods are artificial, and they were expected to indicate means of achieving that. Expected answers include use of dummy or teaser bull, use of artificial vagina, use of electro-ejaculator or the use of hand massage.

QUESTION 3

(a) State four ways in which diseases are of economic importance in animal production.

(b) Give three examples of each of the following types of parasites of farm animals:

(i) ectoparasites;

(ii) endoparasites.

(c) State five causes of low production of ruminants in West Africa.

(d)

(i) Explain the term fodder crop.

(ii) Give three examples of fodder crops.

(a)

In this question, candidates were expected to state some of the ways in which diseases of livestock affect the farmer and the economy in general. Though candidates did not face much challenges with this question, some of them were stating symptoms of diseases. Such candidates were marked down, because they were expected to rather provide responses such as reduced productivity, reduced income due to procurement of medication for treatment, reduced patronage of products due to fear of the diseases, enable discovery of new vaccines/medications, high mortality of animals resulting in total losses etc.

(b)

(i) Ecto-parasites – This question was expecting candidates to list some parasites which live on the body of livestock. It seemed some of them got confused as to which organisms were ecto parasites, and which ones were endo parasites, so they interchanged

them. In addition, some of them could not differentiate pests from parasites, so were listing pests such as tsetseflies, instead of ecto-parasites such as fleas, lice, ticks, mites, leeches, blow fly larvae, etc.

(ii) Endo-parasites – Candidates were expected to list parasites which live inside the body of the host animal. Those who really knew what was expected of them were on point. Answers expected from the candidates include tape worm, liver fluke, round worm, plasmodium, hook worm, pin worm and trypanosome.

(c) In this question, candidates were expected to indicate some of the obstacles hindering smooth production of livestock in West Africa. They had minimal challenges with this question as most of them scored full points. Some of the expected challenges were unfavourable climatic conditions such as inadequate rainfall, low technical know-how of farmers, poor livestock breeds, poor production systems, high incidence of pests and diseases, inadequate supply of high-quality feed, poor marketing systems, high rate of inbreeding, high cost of feed, among others.

(d)

(i) This question was quite challenging to most of the candidates. A lot of them were explaining the term fodder, rather than fodder crop, hence a lot of them scored partial marks for this question. Whereas *fodder* is a harvested crop which is either preserved or served to livestock in the fresh state, *fodder crop* on the other hand is an arable crop which is cultivated purposely for feeding livestock. The difference should be noted.

(ii) This did not pose much challenge to the candidates as they were right on point. The only problem was with candidates who wrote scientific names of the fodder crops but failed to abide by the rules governing writing of scientific names (not underlined, and not ensuring that the genus name starts with upper case while the species name starts with lower case alphabet. Examples of fodder crops include maize, millet, sorghum, *Panicum maximum*, wheat, cowpea, cassava, etc.

QUESTION 4

- (a) (i) **Explain the term monogastric.**
- (a) (ii) **Give two examples of monogastrics.**
- (b) **Explain each of the following terms as used in animal nutrition:**
 - (i) **concentrate;**
 - (ii) **additive.**
- (c) **State four ways in which roughages are important in the diet of farm animals.**
- (d) **List four materials which could be used in milking cows.**
- (e) **Mention two animals that could be fed on each of the following forms of prepared feed:**
 - (i) **pellets;**
 - (ii) **mash.**

(a)

(i) This question did not pose much challenge to those who knew it. Others rather explained ruminant livestock in place of monogastric. This was a common observation from school to school. Monogastric is a livestock with simple stomach/ single stomach or simple digestive system.

(ii) This was not a challenge to candidates who knew what monogastric animals are. Expected answers include all the poultry species (chicken, guinea fowl, turkey, ducks, quail etc), pigs, dogs, rabbits, grasscutters, etc

(b)

(i) Concentrate – this question was not answered properly by some of the candidates. It should be remembered that concentrates are animal feed which are *high in digestible nutrients* but are *low in fibre*. The two key points need to be present in the definition to make the explanation complete. Candidates who stated only one of the key points were awarded partial scores.

(ii) Additives – This also posed some challenges to the candidates. It should be borne in mind that additives are substances which are *added in small quantities* to livestock feed to provide nutrient or non-nutrient benefits to the livestock. The candidate needs to indicate that they are added in smaller quantities to differentiate them from other feed ingredients.

(c) This question wanted candidates to state some of the roles of roughages in the diets of livestock. Some of them said it improves digestibility of the feed. This is incorrect because feed with higher levels of roughage has lower digestibility, even though it improves the rate of feed movement in the GIT of the animals. It should be remembered

that faster movement of feed in the GIT does not imply higher digestibility. Expected answers include provision of bulk in animal feed, enhanced bowel movement, reduction of constipation, as a source of energy etc.

(d) This question did not pose much problems to the candidates. A lot of them gave very laudable responses to this question. Some of the expected answers include cheese cloth for filtering the milk, hand gloves, stool, restraining rope, protective clothing, milking machine, etc

(e)

(i) Pellets – There was no challenge with this question, because all livestock species can be fed with pelleted feed.

(ii) Mash – Similarly, there was no problem with this question. All livestock species except fish can be fed with mash diets.

QUESTION 5

(a) (i) **Explain each of the following terms as used in animal production:**

(i) **flushing;**

(ii) **dystocia;**

(iii) **parturition.**

(b) **State four ways in which fencing is important in livestock farm.**

(c) **Mention five ways in which rearing of rabbit is important.**

(d) **State five disadvantages of deep litter system in poultry production.**

(a)

(i) Flushing – This question posed some challenges to candidates because expected key points in the explanation were missing. Flushing is the act of giving *extra nutritious feed to female animals over a period of 2-3 weeks* before and after mating to enhance multiple ovulation and implantation of the embryo. Most of the candidates explained the term without including the time interval/duration for the activity. That is very important to differentiate it from steaming up and creep feeding.

(ii) Dystocia – This is an abnormal birth or difficulty to give birth in farm animals. A lot of the candidates did not seem to have ever heard of the terminology, as they either left it unanswered, or the answer they provided had different meaning all together.

(iii) Parturition – This was one of the most answered questions. It was possibly the friendliest, as most of the answers were on point in their explanations. Parturition is the act of giving birth in livestock.

(b) Most of the candidates knew the answers to this question, but the way the answers were presented made them unacceptable. Candidates should bear in mind that fencing *does not stop nor prevent* theft and predators on the farm, but it *rather helps minimize* these. Remember fencing cannot stop/prevent some predators like hawk from the farm, nor prevent theft by workers on the farm. For answers to questions like these, the words “stop”, and “prevent” should be avoided as much as possible.

(c) This was a good question for most students as they were on point with their responses. Rabbits are reared for income, meat, pelt, it's easier to start as less capital is required.

(d) This question appeared controversial to the candidates as a lot of them were comparing their answers against the extensive system of livestock rearing. That is inappropriate because the deep litter system is a type of intensive system, and therefore when one is considering its disadvantages, it ought to be compared with other intensive systems of production such as battery cages, *but not* with the extensive system of production.

QUESTION 6

(a) **State four aims of animal improvement programs.**

(b) **Mention four hormones involved in reproduction in farm animals.**

(c) (i) **Explain the term cross breeding.**

(ii) **State two disadvantages of inbreeding.**

(d) (i) **Explain the term natural pasture.**

(ii) **State six problems that are associated with range lands in West Africa.**

(a) This was a simple straight forward question demanding reasons behind animal improvement programmes. Candidates who knew what it was, were on point. Improvement programmes are aimed at enhancing feed conversion efficiency, obtaining disease tolerant breeds, to improve growth rates, increase litter size, reduce maturity period, reduce aggression, etc.

(b) This question demanded some hormones which play roles in reproduction in farm animals. Though candidates knew the names of some hormones, some of those listed do not play roles related to reproduction. The hormones which are involved in reproduction include Prolactin, Oestrogen, Oxytocin, Progesterone, Testosterone, Relaxin, etc. Some of those who stated the correct hormones unfortunately spelt them wrongly. These are one-word answers, and they must be spelt correctly to score.

(c)

(i) Most of the candidates knew what cross breeding was but were unable to explain it clearly. It should be noted that cross breeding involves mating of animals which belong to *different breeds* but of the *same species*. *Crossbreeding is not possible if the animals are not of the same species*, and therefore candidates were expected to indicate so.

(ii) In this question, candidates were expected to state some of the challenges associated with inbreeding. Candidates did not have much challenges with these. Some of the expected answers include transmission of chronic diseases to future generations, reduced livestock vigour, may lead to inbreeding depression, leads to decline in fertility, etc

(d)

(i) Some of the candidates explained it simply as *pastures which are natural*. This explanation is inappropriate because it repeats the key words in the question, and therefore such answers are not acceptable. Natural pastures are grazing lands which were not cultivated nor are managed with human efforts. They are natural because there is no human intervention in its management. Candidates were expected to explain the terms natural, and pastures in different words from those in the questions, to score full marks.

(ii) Similar to other questions, this one did not pose much challenges to the candidates. They were mostly on point with answers to this question. Some of the expected answers include urbanization leading to inadequate land size, wildfires destroy the forage, presence of toxic plants which cause poisoning, high incidence of diseases and pests, poor and unreliable yield of pastures, etc.

ANIMAL HUSBANDRY 3

1. GENERAL COMMENTS

The standard of the paper was comparable to that of previous years. The general performance was average. The questions set spread across the entire syllabus.

2. SUMMARY OF CANDIDATES' STRENGTHS

- (1) There was systematic and logical presentation of answers by candidates.
- (2) Generally, candidates did not copy the questions before answering them.
- (3) Most exhibited legible handwritings.
- (4) Some candidates demonstrated that they were well taught by providing innovative answers through application of knowledge.
- (5) The areas that were well answered are:
 - (a) farm animals that possess feathers;
 - (b) importance of bone, milk and feathers to farm animals;
 - (c) major feed nutrients found in cassava;
 - (d) feed stuff that contains carbohydrate;
 - (e) processing of feed stuff and reasons for boiling cassava tuber before feeding it to farm animals;
 - (f) farm animals that could be fed with specimen G (boiled cassava);
 - (g) farm animals that could be infested with specimen H (Tsetsefly) and how it can be controlled.

3. SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Sentences and expressions made by some candidates' lack of understanding and got their answers wrong;
- (2) Spelling mistakes were common in some candidates work, especially the technical words e.g., carbohydrate instead of carbohydrate, protain instead of protein.
- (3) Some candidates provided more than one answer and this made them score nothing in the responses they provided. e.g., what is the major nutrient in cassava? Some wrote carbohydrate, protien, vitamins
- (4) Some were also wasting the answer sheets by cancelling their work on every page.
- (5) Areas that were poorly answered are:
 - (a) preparation of bone meal;
 - (b) ways of restraining farm animals and the activities that could be carried out when using rope to restrain farm animals;
 - (c) sources of water and its use on the poultry farm.

4. SUGGESTED REMEDIES

- (1) Teachers should recommend the appropriate text books to students.
- (2) Candidates should familiarize themselves with technical terms.
- (3) Candidates should adhere strictly to the rubrics.
- (4) Candidates should be taken through past WASSCE questions to become familiar with what they should expect.

5. DETAILED COMMENTS

QUESTION 1

- (a) **Give three ways in which each of specimens A, B and C are important to farm animals.**
- (b) **Describe how specimen A could be processed into bone meal.**
- (c) **Name three farm animals on which specimen C could be found.**

- (i) Bone meal: - Most candidates were able to write that it supplies calcium and phosphorus to the animal when added to their feed.
- Aids in the production of red blood cells in the marrow.
 - Serves as a frame work.

Only a few candidates could not answer this part well, they mentioned it provides calcium without any linkage to when fed with it. Others mentioned it produces cells without reference to the name of that particular cell.

- (ii) Most of the candidate were able to mention that milk is a source of protein for growth and development and to repair worn out tissues as well as fostering orphaned young animals.

- (iii) Feathers: - this part was also well answered as candidates came out with answers such as
- For brooding
 - For incubating
 - For keeping their body warm etc.

- (b) Processing bone into bone meal: - This part was poorly answered even though most of them started well but ended up saying that the bone is burnt and crushed. When the bone is burnt then it ought to be used for liming.

Candidates were expected to say that by the

Dry Method.

- Bone is washed or cleaned after the excesses meat adhering onto the bone is removed
- Dry
- Crush or grind
- Bag and store or

Wet Method

- Boil the bone
- Remove adhering excess meat
- Dry
- Crush/Grind
- Bag and store

(c) Candidates had a field day here as almost all of them were able to mention animals that posses Specimen C (feather) those who could not was as a result of wrong spelling e.g., duck was written as dark, guinea fowl as guinii fowl etc.

QUESTION 2

- (a) (i) **Mention four sources of specimen D in animal production.**
(ii) **State four ways in which specimen D could be used in poultry production.**
- (b) **State four ways in which farm animals could be restrained using specimen E.**
- (c) **Mention three activities which could be carried out using specimen E.**

(a)
(i) This part was surprisingly poorly answered by most of the candidates. They were rather mentioning, feed stuffs, water troughs etc instead of sea, lakes, rivers, rainfall, lagoons and dams.

(ii) This item was well answered by most of the candidates. They were able to mention

- used to mix drugs
- used to clean the brooder house
- ducks use it in thermoregulation
- cleaning equipments
- source of drinking water to quench thirst

(b) This part was poorly answered even though most candidates mentioned that it could be tied to the head, leg, snout, they failed to add that one end should be tied to a stationary body to restrain its movement. Candidates were expected to say:

- (i) Tying the rope around the neck of the animal to a stake
 - (ii) Tying the rope around the horns of the animal to a stake
 - (iii) Tying the rope around the legs
 - (iv) Tying the snout and the hind legs to a stake in terms of pig etc.
- (c) This part was well answered by almost all the candidates. They mentioned:
- (i) during castration;
 - (ii) medication;
 - (iii) dehorning;
 - (iv) slaughtering;
 - (v) transportation;
 - (vi) animal shows among others.

QUESTION 3

- (a)
 - (i) **Name the major feed nutrients supplied by specimen F to farm animals.**
 - (ii) **List five other feed stuff which could also provide the major feed nutrient named in (a)(i).**
- (b) **Mention four ways in which specimen F could be processed for feeding farm animals.**
- (c) **Give two reasons why specimen G may be preferred to specimen F in feeding farm animals.**
- (d) **Name three farm animals which could be fed with specimen G.**

(a)

(i) This item was well answered by most of the candidates. They were able to mention carbohydrate except a few who could not spell carbohydrate correctly and others who mentioned all the feed nutrient

E.g., Carbohydrate, protein, vitamins, minerals hence attracting zero.

(ii) Most candidates were able to mention plantain, banana, cocoyam, potato etc except a few who repeated the cassava and others who mentioned feed stuffs in the legume family E.g., beans

- (b) This part was also well answered by candidates. They came out with expected answers such as:
- Boiling;
 - Roasting;
 - Flaking;
 - Drying;
 - Chopping;
 - Fermentation.

But once again some had the spelling wrong.

- (c) About half of the candidates were able to explain that when specimen G is boiled, the hydrogen cyanide content which is toxic to the animal is reduced to a large extent and it is highly palatable and digestible when boiled. However, others were not able to mention the name of the toxic material in specimen F whilst others spelt cyanide as cynide
- (d) This was a windfall for almost all the candidates. They were able to mention cattle, sheep, goat, grasscutter etc

QUESTION 4

- (a) (i) **Name three farm animals which could be infested with specimen H.**
- (ii) **Mention two parts of the body of the host where specimen H is commonly found.**
- (iii) **Mention four ways of controlling specimen H on a farm.**
- (b) (i) **Name two farm animals which could be attacked by specimen J.**
- (ii) **State four effects of specimen J on its host.**

- (i) This item was well answered by the candidates. Answers provided include cattle, sheep, goat etc.
- (ii) This part was poorly answered by most of the candidates. Most kept mentioning the skin, fur. They are expected to mention a part of the body.
- E.g.
- tail
 - udder
 - around the genitalia
 - ears
 - hooves etc

- (iii) This part was also well answered by the candidates. They mentioned
- quarantine new stocks
 - clean environment
 - dipping with acaricides
 - spraying with acaricides etc

Some candidates mentioned spraying, dusting, dipping with a killing agent e.g. acaricide or appropriate chemical

- (b) (i) This part was well answered as candidates mentioned the farm animals that could be attacked by Specimen J (Tsetsefly).
- e.g., cattle
 - goat
 - sheep
 - etc

- (ii) Effects of specimen J on farm animals.
- This item was well answered by most of the candidates. Some answers include:
- anaemia
 - reduction in production;
 - reduction in reproduction;
 - trypanosomiasis

However, some candidates could not spell trypanosomiasis correctly.

BIOLOGY 2

1. GENERAL COMMENTS

The standard of the paper compared favourably with that of previous years. The general performance of candidates was slightly better than last year.

2. SUMMARY OF CANDIDATES' STRENGTHS

- (1) Most candidates displayed some improvement in expressing themselves well in the English Language.
- (2) Candidates exhibited satisfactory knowledge in the following topics:
 - (a) animal nutrition in regarding deficiency diseases, their remedies and food tests as in questions 2(a & b); preservation and storage of foods and examples of food types that can be preserved in silos and refrigerators as in question 3 (b);
 - (b) ecology of population especially factors that affect population size as in question 3 (c); classification of vertebrates in their evolutionary trend with examples as in question 4 (b);
 - (c) transport in plants/guttation and biological principles underlying guttation as in question 5(a);
 - (d) organelles involved in protein synthesis and source of amino acids used in synthesizing proteins in cells as in question 5(c);
 - (e) life processes performed by living organisms as in question 5 (e) and
 - (f) Biology as a source of life as in question 5 (f).
- (3) Candidates complied with the Paper instructions which required that they should answer two questions only from Section A and all the questions in Section B.

3. SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Candidates could not list supporting tissues in plants and state the characteristic feature each that adapts each of the supporting tissues listed as in question 1 (a).
- (2) Candidates failed to go by the rubrics regarding biological drawings as in question 1(b) with respect to making diagram of the transverse section of monocotyledonous stem. For example:
 - (a) clarity of lines which involves lines of drawing should not be woolly or broken at some points;
 - (b) neatness of labels e.g., guidelines must be ruled using ruler, labels must be written horizontally, guidelines must not cross each other etc. shading of drawings must be avoided etc. all were not complied with.
- (3) Technical terms were wrongly spelt as such as names of supporting tissues as in question 1(a),
 - (a) spelling of labels of diagram of transverse section of monocotyledonous stem as in (b), names of nutrient deficiency diseases as in 2 (b) (ii),
 - (b) examples of food types that can be preserved in the storage facilities as in 3(b),

- (c) factors that affect population size of living organisms as in 3 (c),
- (d) classes of vertebrates in their evolutionary trends and example of each class of vertebrates as in 4 (b),
- (e) list of organelles involved in protein synthesis as in 5 (b) (i) and naming the branch of Biology concerned with the study of tissues,
- (f) plants, DNA and the environment as in 5 (f).

4. SUGGESTED REMEDIES

- (1) Candidates 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.
- (4) Tutors should ensure that candidates know and understand the rubrics of the subject.

5. DETAILED COMMENTS

QUESTION 1

- (a) (i) **List four supporting tissues in plants.**
- (ii) **State one characteristic feature each that adapts each of the supporting tissues listed in 1(a)(i) to its function.**
- (b) **Make a diagram, 6 cm to 8 cm long of the transverse section of the stem of a monocotyledonous plant and label fully.**

Few candidates attempted this question. However, their performance was fairly satisfactory.

- (a) (i) Candidates should note that the four supporting tissues in plants are:
 - Parenchyma;
 - Collenchyma;
 - Sclerenchyma;
 - Xylem.
- (ii) Characteristic feature that adapts each of the supporting tissues to its function are:
 - Parenchyma cells become turgid; they give strength/support to herbaceous plants;
 - The walls of collenchyma cells are thickened at the corners; hence the plants have some degree of flexibility/ this enables the plants to withstand strains / bend but recover;

- In sclerenchyma the cells are dead/thickened/elongated/lignified/ pericycle and other hard parts of the plants; this gives the plant parts mechanical support
- Walls of xylem tissues are thickened/lignified; thereby providing mechanical strength.

(b) Most of the candidates failed to go by the rubrics regarding biological drawings. Candidates should therefore take note of the following guidelines regarding biological drawings:

Title (TL) *Diagram of transverse section of monocotyledonous stem*

Quality (Q)

Clarity of Lines (CL)

Size (Sz) (6cm to 8cm)

Neatness of Labels (NL)

Details (D)

Scattered vascular bundles shown (SV)

Prominent ground tissues shown

Closed vascular bundles shown/ no cambium (CV)

Labels (L)

Epidermis, ground tissue/parenchyma, vascular bundle/xylem, phloem, sclerenchyma

QUESTION 2

- (a) (i) **What is deficiency disease?**
 (ii) **Name five nutrient deficiency diseases in humans.**
 (iii) **State one remedy each for the diseases named in 2(a)(ii).**
- (b) **Outline a chemical test for:**
 (i) **glucose in orange fruit;**
 (iii) **starch in a tuber of yam.**

Most candidates answered this question satisfactorily. Candidates must note the following responses to the questions as presented below:

(a) (i) Candidates were expected to define Deficiency disease as a disease caused by lack of/ insufficient/inadequate supply of nutrients/ food substances.

(ii) Names of nutrient deficiency diseases and their remedies are outlined below:

Name of Nutrient deficiency disease	(iii) Remedy for disease named
Goitre/Goiter	Consumption of iodized salt/seafood
Rickets	Consumption of a diet rich in calcium/phosphorus/vitamin D
Anaemia/Anemia	Eating a diet rich in iron
Kwashiorkor	Diet of infants should contain protein
Scurvy	Consumption of foods/fruits rich in vitamin C
Pellagra	Addition of Niacin/vitamin K to diet
Night blindness	Consumption of foods rich in vitamin A
Beriberi	Consumption of foods rich in vitamin B
Stunted growth	Consumption of foods rich in iodine
Marasmus	Consumption of protein and carbohydrate

However, most of the candidates lost valuable marks due to wrong spellings of names of diseases.

(b) Most of the candidates exhibited good knowledge in performance of food test.

The expected chemical tests were outlined below:

(i) Glucose in orange fruit

- Orange fruit is cut, and its juice is extracted into a beaker/test tube;
- Few drops of Benedict's solution/ Fehling's solutions A and B / 1 and 2;
- Is added to equal volume of orange juice;
- And heated gently;
- A red/orange/brick-red precipitate;
- Shows presence of glucose;
- For Benedict's solution when heated;
- Shows red/yellow precipitate;
- Confirming presence of glucose.

Note: Fehling's solution A = Copper sulphate in water

Fehling's solution B = Sodium hydroxide in water

Benedict's solution = Copper sulphate, sodium citrate/ sodium carbonate

(ii) Starch in a tuber of yam

- The tuber of yam is peeled;
- Sliced/ground;
- A few drops of iodine solution;
- Is added to the yam;

- Blue-black color formed;
- Indicates presence of starch.

QUESTION 3

- (a) **Explain briefly food preservation in the following facilities:**
- (i) **silo;**
 - (ii) **refrigerator.**
- (b) **List four examples each of food types that can be preserved in the facilities in 3(a)(i) and 3(a)(ii).**
- (c) **List six factors that affect population size of living organisms.**

Candidates provided satisfactory answers to this question. It is worth noting that

- (a) Candidates were expected to explain briefly the preservation of food in the following facilities as follows:

- (i) Silo
 - Is used to store properly dried loose grains;
 - It is made of aluminium/steel/ other suitable materials;
 - To protect grains against storage pests/ weevils/ rodents/ birds;
 - Both grains and silos are fumigated;
 - To kill/prevent the growth of microorganisms/weevils/egg/larva of insects/pests;
 - Silo is air- tight to prevent growth of microorganisms/pests/for suitable storage conditions such as temperature, relative humidity etc.
 - Silo can store large quantities of grain for many years.
 - (ii) Refrigerator
 - Involves storing food under very low temperature;
 - And removes heat from food substances;
 - To slow down activities of enzymes;
 - That cause spoilage;
 - Reduce the growth rate of microbes;
 - (Perishable) Food is kept fresh for a long period of time.
- (b) Examples of food type that can be preserved in (i) the Silo facility include:
- Wheat;
 - Rice;
 - Maize;
 - Grains;
 - Millet;
 - Sorghum.

Examples of food type that can be preserved in (ii) the Refrigerator facility include:

- (Leafy) vegetables;
- Eggs;
- Tomatoes;
- Fruits;
- Bread;
- (dry) fish/ meat.

Some candidates lost marks due to wrong spellings of type of foods preserved.

(c) Factors that affect population size of living organisms include the following:

- Mortality/death rate;
- Natality/birth rate;
- Immigration;
- Emigration;
- Natural disaster;
- Availability of food;
- Famine;
- Man-made disasters/war;
- Space/spacing;
- Predation.

Few candidates lost marks due to wrong spellings of technical words.

QUESTION 4

- (a) **Explain briefly the reason why blood groups A and B in humans can exist both in the heterozygous and homozygous forms while blood group O can only exist in homozygous form.**
- (b) (i) **Name the Classes of vertebrates in order of their evolutionary trend.**
(ii) **Give one example each of the Classes of vertebrates named in 4(b)(i).**
- (c) **Explain briefly independent assortment of genes.**

Generally, performance in this question by candidates who attempted it was only average.

- (a) Candidates were required to explain the reason why blood groups A and B in humans can exist both in the heterozygous and homozygous forms while blood group O can only exist in homozygous form.

The expected responses to this question is presented as follows:

- Blood grouping in humans is determined by three alternative genes or alleles: - A, B and O;
- A person can only possess two alleles of the genes on a pair of homologous chromosomes;

- Gene O is recessive to both genes A and B; which are dominant or co-dominant or possess antigens A and B in the red blood cells;
- Hence, it is possible to have blood group A as AA (homozygous) or AO (heterozygous);
- And blood group B as BB or BO;
- Blood group O can only exist genotypically as OO or does not possess antigen A or B in the red blood cells;
- In the homozygous recessive state.

(b) Most of the candidates correctly listed classes of vertebrates and their corresponding examples.

Name of Classes of vertebrates in their evolutionary trend with examples are given below:

<i>(i) Class of vertebrates</i>	<i>(ii) One example</i>
Pisces/ Osteichthyces/ Chondrichthyces	Tilapia; Tuna; Salmon; Herring; Perch/Catfish; Shark; Dogfish; Skate; Ray
Amphibia	Frog; Toad; Salamander; Newt
Reptilia	Snake; crocodile; tortoise; turtle; lizard; wall gecko
Aves	Dove; pigeon; parrot; weaver bird; hawk; eagle; domestic fowl; vulture; ostrich; guinea fowl
Mammalia	Human; monkey; rat; rabbit; guinea pig; whale; dog; goat; bat

(c) Candidates were expected to explain briefly independent assortment of genes as presented below:

- It is the random selection of genes;
- During meiosis;
- To produce gametes;
- Where the genes are separate or segregate;
- So that only one pair is found in any one gamete;
- In the dihybrid inheritance in heterozygote;
- The pairs of alleles are found on different pairs of chromosomes;
- Only four types of gametes are produced in approximately equal numbers.

OR

- In dihybrid inheritance;
- The pairs of alleles or genes are found on different pairs of chromosomes;
- These alleles or genes segregate or separate from one another;
- And combine/recombine randomly;
- During meiosis;
- So that only one of the pair of genes is found in any one gamete.

QUESTION 5

- (a) (i) **What is guttation?**
(ii) **Explain briefly the biological principles underlying the process of guttation.**
- (b) (i) **List three organelles in the cell that are involved in protein synthesis.**
(ii) **Name one source of amino acids used in protein synthesis in cells.**
- (c) **Outline the steps taken to change from viewing an object placed under a low power magnification to a high-power magnification when using an optical microscope.**
- (d) **Describe briefly the process of dissecting a rabbit to expose its alimentary canal.**
- (e) **Name six life processes which living organisms are capable of performing.**
- (f) **Name the branch of Biology which is concerned with the study of:**
(i) **tissues;**
(ii) **plants;**
(iii) **DNA;**
(iv) **the environment.**

The performance of candidates on this question was quite good.

- (a) (i) Candidates were required to define Guttation as follows:
- It is the release or secretion of water as droplets;
- Through special structures/hydathodes;
- At the tips/margins of leaves at high humid conditions.
- (ii) The biological principle underlying guttation is as follows:
- Guttation occurs in a plant growing in a warm/moist soil with humid atmosphere;
- It is a phenomenon which is caused by root pressure at the early hours of the morning/night;
- When there is low rate/no transpiration;
- The high root pressure favours the absorption of water;
- The rate of water absorption soon exceeds the rate of transpiration;
- And the excess water must be removed;
- As liquid droplets through the hydathodes.
- (b) (i) The organelles in the cells that are involved in protein synthesis are
- Rough endoplasmic reticulum;
- Ribosomes;
- Golgi apparatus;
- Nucleus.

- (ii) The sources of amino acids used in synthesizing protein in cells are; digested proteinous foods such as meat, fish, beans, eggs, milk which are ingested and digested into amino acids or free amino acids in the cytoplasm of cells such as valine, alanine, glutamine, leucine, serine, methionine, phenylalanine, isoleucine, arginine, lysine, cysteine, proline, serine, etc.
- (c) Performance of candidates on this sub-question was generally poor. Candidates are to note steps taken to change from viewing an object placed under a low power magnification to a higher magnification when using an optical microscope. The steps are as follows:
- The revolving nose piece is turned;
 - And this moves the low power objective piece away from the center of the stage;
 - And brings the high-power objective piece to the center of the stage;
 - Then the fine adjustment knob is turned slowly while looking into the eye piece;
 - To obtain sharp image;
 - Till the detail of the specimen is focused/ seen on the slide;
 - Coarse focusing knob should not be used.
- (d) Candidates were expected to describe briefly the process of dissecting a rabbit to expose its alimentary canal. The correct process is outlined below:
- The freshly killed/ chloroformed rabbit is laid on its back;
 - The limbs are stretched out and pinned on the dissecting board;
 - The skin is pinched over the abdomen with forceps and lifted up away from the body wall;
 - A small incision is made on the skin;
 - The cut is extended longitudinally upward to the ribcage and downward to the anal opening;
 - The skin is pulled apart with the forceps;
 - The skin is gently separated from the body wall and pinned to the dissecting board;
 - The abdominal wall is lifted with the forceps;
 - The cut is continued up to the neck;
 - Pulling the abdominal wall away from the gut with the aid of the forceps;
 - The alimentary canal is spread out gently the liver is pushed upwards, the stomach to the right, the duodenum downwards and ileum to the left;
 - The various organs can now be studied.
- (e) Candidates exhibited adequate knowledge of life processes performed by living organisms.
- Life processes which living organisms are capable of performing are
- Nutrition feeding;

- Reproduction;
 - Respiration;
 - Movement/locomotion;
 - Irritability/ sensitivity;
 - Growth;
 - Excretion.
- (f) Most of the candidates were able to state correctly branch of Biology which is concerned with the study involved in as indicated below:
- (i) Tissues is Histology
 - (ii) Plants is Botany
 - (iii) DNA is Genetics/ Molecular Biology
 - (iv) The environment is Ecology



BIOLOGY 3

1. GENERAL COMMENTS

The standard of the paper was appropriate and compared favourably with that of previous years.

Candidates' performance was generally satisfactorily and better than last year.

2. SUMMARY OF CANDIDATES' STRENGTHS

- (1) Candidates showed marked improvement in relating structural features of organisms to their functions as well as to their habitats.
- (2) Candidates presented differences between organisms in the tabular format as required.
- (3) Candidates gave precise economic importance of cockroach and moss plant.

3. SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Technical terms and scientific words were wrongly spelt.
- (2) Many candidates failed to adhere to the guidelines regarding biological drawings.
- (3) Candidates exhibited little knowledge in tools used for collecting specimens.

4. SUGGESTED REMEDIES

- (1) Teachers should take their students through drills and assignments with respect to technical terms and their descriptions.
- (2) Students should master the art of relating observed features of organisms to their functions.
- (3) Teachers should draw the attention of students to the importance of observing the rules of binomial nomenclature.
- (4) Teachers should organize regular practical lesson to assist students to develop keen observation skills and be guided to adhere to the guidelines of biological drawing.

5. DETAILED COMMENTS

QUESTION 1

- (a)
 - (i) **Name the class to which specimen B belongs.**
 - (ii) **State two reasons for the answer in 1(a)(i).**
- (b)
 - (i) **Name the habitat of specimen A.**
 - (ii) **State one structural feature that adapts specimen A to its habitat.**
- (c)
 - (i) **In a tabular form, state two observable structural differences between specimens A and B.**
 - (ii) **State two observable structural similarities between specimens A and B.**

- (d) (i) **What is the symmetry of specimen B?**
(ii) **Name one tool each which could be used to collect samples of specimens A and B for scientific studies.**
(iii) **Name two structures in specimen B that could be affected by oil spillage in its habitat.**
- (e) **Make a drawing, 6 cm to 8 cm long of the ventral view of specimen A and label fully.**

Performance of candidates on this question was generally good.

- (a) (i) Majority of the candidates answered this sub-question very well.

However, a few candidates wrongly spelt the class Osteichthyes.

- (ii) Most of the candidates gave correct reasons to support the class given in a(i) their correct answers included:

- fins strengthened by bony rays;
- overlapping, backwardly pointing scales;
- presence of bony skeleton.

- (b) (i) This sub-question requested for the habitat of tadpole. Many candidates correctly stated the pond or stream as the habitat. However, some candidates lost marks for stating aquatic habitat which is rather a type of habitat.

- (ii) This question asked for one structural feature of tadpole that adapts tadpole to its habitat. A good number of candidates correctly identified the tail for swimming or gills for exchange of gases or streamlined body for smooth swimming.

- (c) (i) Majority of the candidates did not have much difficulty in tabulating observable structural differences between Tilapia and tadpole as indicated below:

Specimen A / Tadpole	Specimen B / Tilapia
- Fins absent	- Fins presence
- Tail fin without bony rays	- Tail fin with bony rays
- Scales absent	- Scales present

- (ii) Candidates correctly identified the two observable structural similarities between

Tilapia and tadpole. Their correct answers include the following:

- operculum;
 - streamlined bodies;
 - bilaterally symmetrical;
 - eyes;
 - tail.
- (d) (i) This question, tasked candidates to state the symmetry of Tilapia. Majority of the candidates correctly stated bilateral symmetry as the answer. However, few candidates lost marks for wrong spelling of bilateral.
- (ii) This question was poorly answered by majority of candidates. Majority of them could not state correctly tools used for collecting organism from their habitats.

The expected answers include:

Dip net, scoop net, long handled net used for collecting tadpole, tow net, drag net, wicker, fish strap, cast net, fishing net, dip net basket used for collecting Tilapia.

- (iii) Candidates were required to name two structures of Tilapia that could be affected by oil spillage in its habitat. Majority of the candidates correctly identified gills, fins, mouth, eyes, nostrils.
- (e) This sub-question tasked candidates to draw the ventral view of tadpole. Many of the candidates failed to adhere to the guidelines regarding biological drawings. Performance was consequently poor. Candidates should therefore take note of the guidelines for biological drawings as indicated below.

Title: Diagram / drawing of ventral view of specimen A / tadpole.

- Quality of drawing which include clarity of lines, size (6 cm to 8 cm), neatness of labels, magnification;
- details of drawing which include showing of the following features; operculum, muscular tail and coiled intestine;
- labels such as head, eye, mouth, operculum, tail fin, coiled intestine / alimentary canal should be indicated.

QUESTION 2

Study specimens D, G and H and answer questions 2(a) to 2(e).

- (a) (i) Place two drops of specimen D on a white tile and add two drops of iodine solution.

Copy and complete the table below, stating the test, observation and inference.

<i>Test</i>	<i>Observation</i>	<i>Inference</i>

- (ii) Put 5 ml of specimen D into a test tube and add 2 ml of sodium hydroxide solution followed by three drops of copper (II) tetraoxosulphate (VI) and shake.

Copy and complete the table below, stating the test, observation and inference.

<i>Test</i>	<i>Observation</i>	<i>Inference</i>

- (iii) Give the name of each of the tests in 2(a)(i) and 2(a)(ii).
- (b) State two ways by which specimen G is of economic importance.
- (c) (i) Name the kingdom to which specimen G belongs.
(ii) State two reasons for the answer in 2(c)(i).
(iii) Name four other organisms that belong to the same kingdom as specimen G.
- (d) (i) Name the Phylum to which specimen H belongs.
(ii) State three reasons for the answer in 2(d)(i).
- (e) (i) Explain briefly the role of specimen G in nutrient recycling.
(ii) What is the mode of nutrition of specimen G?

Majority of the candidates exhibited a fairly good familiarity and ideas about the performance of food test.

- (a) (i) This question, asked candidates to use iodine solution to perform a test on sample D and record observation and inference.

Majority of candidates correctly recorded the test observation and appropriate inference

- (ii) Candidates were given sodium hydroxide solution and copper (II) tetraoxosulphate (VI) solution to perform food test on the sample. Majority of the candidates correctly recorded the test observation and inference.

- (iii) This question asked candidates to give the name of each of the test in (a)(i) and (ii). Most of the candidates correctly named iodine test or Test for starch and Biuret test or

Test for protein respectively for a(i) and a(ii). However, a few candidates lost marks due to wrong spelling of Biuret.

- (b) Candidates were asked to state ways by which mushroom is of economic importance. Most of the candidates were able to identify mushroom as a source of food, source of income or employment, for medicinal purposes and as an agent of decay of organic matter.
- (c) (i) Generally, candidates did not find much difficulties in stating the kingdom of mushrooms as Fungi. However, a few candidates lost marks because they did not write the technical term of the Kingdom Fungi properly by starting with a capital 'F'.
- (ii) Candidates readily stated the characteristics of Kingdom Fungi. Their correct responses include: presence of mycelium / hypha; cell wall made of chitin; lack of chlorophyll.
- (iii) Again, candidates were able to give the names of other organisms which belong to the same kingdom as mushroom. Their correct answers include Yeast, Rhizopus, Mucor, Aspergillus, Toadstool, Puff Ball, Rust, Smut, Bracket Fungus and Penicillium. However, some candidates lost marks due to wrong spelling of examples of organisms under Kingdom Fungi.
- (d) (i) This question, asked candidates to name the phylum of giant snail. Candidates correctly provided Mollusca as the answer. Again, some candidates wrongly used small letter to begin the name.
- (ii) Majority of the candidates correctly provided reasons to support their answer to 2d(i) /Mollusca.

Most of the expected answers include:

- has shell;
- has tentacles;
- body divided into head, viscera hump and muscular foot;
- has muscular foot;
- has mantle.

- (e) (i) This sub-question tasked candidates to explain the role of mushroom in nutrient recycling. Only a few candidates answered the question satisfactorily.

Candidates should therefore note that, mushroom is a decomposer. It decays dead organic matter to return gaseous products to the atmosphere, mineral elements to the soil and humus

to the soil. Plants subsequently absorb the nutrients from the soil to manufacture organic matter. Herbivores feed on plants and some organic matter is transferred to animals. Plants and animals die to leave dead bodies in the soil.

- (ii) Most of the candidates correctly stated the mode of nutrition of mushroom as saprophytic nutrition. However, a few candidates could not distinguish the correct answer from saprophytism which is a type of a biological association.

QUESTION 3

Study specimens J, K, L and M and answer questions 3(a) to 3(g).

- (a) **Classify specimen J into its:**
- (i) **Phylum;**
 - (ii) **Class.**
- (b) **State two reasons each of the answers in 3(a) (i) and (ii).**
- (c) **Use arrows to indicate the relationship among specimens J, K and L in a cycle.**
- (d) (i) **State two observable characteristic features that adapt specimen L to its habitat.**
- (ii) **State two observable structures that adapt specimen M to its habitat.**
- (e) **In a tabular form, state two observable structural differences between specimens J and M.**
- (f) (i) **Name one habitat each of specimen J and M.**
- (ii) **State three ways each by which specimens J and M are of economic importance.**
- (g) **Classify specimen M into:**
- (i) **Division;**
 - (ii) **Class.**

- (a) This question tasked candidates to classify adult cockroach into its phylum and class.

Majority of the candidates were able to correctly identify the phylum as Arthropoda and class as Insecta. A few candidates lost marks due to wrong spelling of the taxa.

- (b) This question requested candidates to provide reasons for the classification in (a). A great number of candidates gave the correct reasons which they related to their respective taxa. However, a few candidates wrongly included reasons meant for Arthropoda only for class Insecta. This mix-up is an indication of clear appreciation of different characteristics for different taxa.

The expected correct answers include:

Phylum: Arthropoda

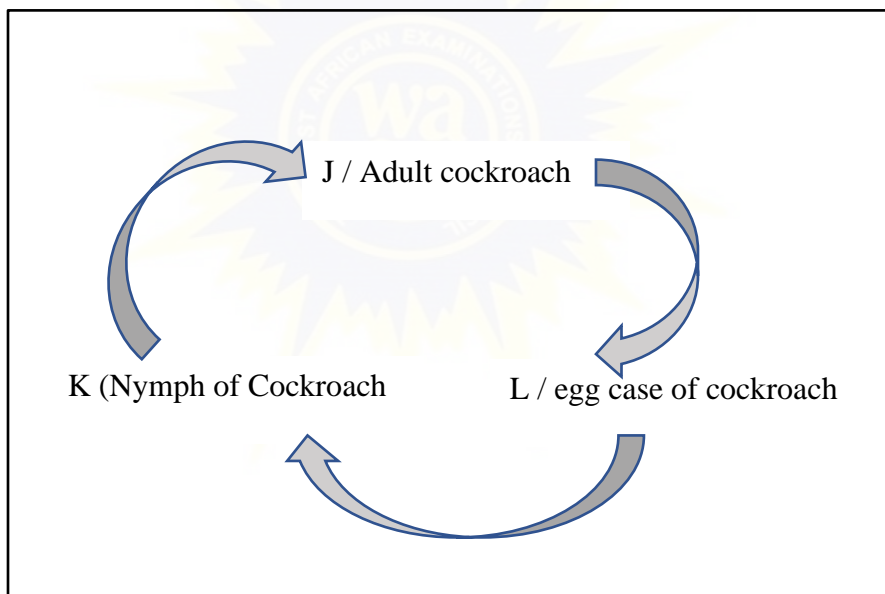
- exoskeleton made of chitin;
- jointed appendages;
- metameric body segmentation;
- bilateral symmetry.

Class: Insecta

- three pairs of legs;
- a pair of antennae;
- a pair of compound eyes;
- three body divisions / head, thorax and abdomen;
- a pair of wings.

(c) Candidates were asked to use arrows to show the relationship among adult cockroach, nymph of cockroach and egg case of cockroach.

Majority of the candidates answered it well as illustrated below:



However, some candidates either omitted arrows or drew it in the wrong direction, therefore, lost marks.

(d) (i) Candidates were asked to state observable characteristic features that adapt the egg case to its habitat.

A good number of candidates correctly identified the brown colour for escaping predation by eggs, chitinous covering for prevention of dehydration.

- (ii) This sub-question asked candidates to state observable structures that adapt a moss plant to its habitat correctly. A good number of candidates correctly identified the following features:
- green leaves for photosynthesis;
 - rhizoids for anchorage;
 - capsule on long stalk for dispersal of spores.
- (e) Candidates were asked to state observable structural differences between adult cockroach and moss plants in a tabular form. This question appears to be the most popular with majority of the candidate scoring full marks.
- (f) (i) Candidates were required to state the habitat of each of cockroach and moss plant. Most of the candidates readily gave the correct habitats for the cockroach as septic tank, toilets, cupboard, cabinets, wooden boxes crevices. However, for a moss plant, only a few candidates correctly identified moist surfaces, moist walls, trunk of trees and forest floors as habitats.
- (iii) Candidates were tasked to provide ways by which cockroach and moss plant are of economic importance. Again, candidates did not have much difficulties in stating economic importance of cockroaches such as destruction of clothes / paper / food / valuable materials; transmission of diseases / leprosy / dysentery, source of food.

With respect to moss plants, only a few candidates noted that they are pioneer colonizers of new habitats, producer in the ecosystem, releases oxygen into the atmosphere, stains walls and absorption of carbon dioxide to reduce global warming.

- (g) Candidates were asked to classify the moss plant into Division and class.

Majority of the candidates, correctly classified moss plant into Division and Class as Bryophyta and Musci respectively. However, some candidates lost marks due to wrong spelling of Bryophyta and Musci.

CHEMISTRY 2

1. GENERAL COMMENTS

The standard of the paper compares favourably with those of the previous years. On the whole, questions were concise and well-structured covering almost the entire syllabus of the subject.

Demands of the individual questions were well articulated and easy to comprehend by the candidates.

The standard should therefore be maintained to enable candidates study all the aspects of the general syllabus and avoid the unnecessary specialization in certain topics of their choice.

2. SUMMARY OF CANDIDATES' STRENGTHS

The major strengths of the candidates identified as far as this paper was concerned include:

- (1) periodic chemistry including chemical bonding and naming of complex ions;
- (2) oxidation/reduction reactions, calculation of e.m.f. of cells from given half equations and the knowledge of the Faraday's Laws;
- (3) Stoichiometry and its application in determining percentage yield;
- (4) calculations on solubility of salts and isotopic mass from the knowledge of relative atomic mass and percentage abundance;
- (5) knowledge of radioactivity and its uses;
- (6) dissociation of weak acids and bases in aqueous solution and the corresponding K_a and K_b expressions. Calculation of hydroxonium ion concentration;
- (7) organic chemistry, isomerism, functional group identification and resonance in benzene.

3. SUMMARY OF WEAKNESSES

Despite the strengths mentioned and observed in several cases, some candidates were unable to present their answers in a systematic way. In such cases, the candidates were unable to score maximum marks. The major weaknesses identified in the candidates' responses to the tasks involved in the questions include:

- (1) the physical property that would enhance the separation of a mixture of water and palm-oil;
- (2) comparison of the rates of forward and backward reactions for a reversible reaction at time zero;
- (3) organic functional group identified with ammonical $\text{AgNO}_{3(\text{aq})}$;
- (4) how molecules assume their shapes and dipole moments in molecules;
- (5) why the $\text{C}=\text{C}$ bond energy is larger but not twice as that of $\text{C}-\text{C}$ and why the bond energy of Cl_2 is not the same as its bond dissociation energy.

4. SUGGESTED REMEDIES

- (1) Early completion of the syllabus.
- (2) Candidates should have a thorough grasp of the principles behind the answers they provide.
- (3) Routine administration of exercises on the various topics treated.
- (4) Encouragement of extra learning with self examination.

5. DETAILED COMMENTS

QUESTION 1

- (a) State Faraday's second law of electrolysis.
- (b) Separate the following redox reaction into balanced half equations:
$$\text{Cu} + \text{NO}_3^- \rightarrow \text{Cu}^{2+} + \text{NO} + \text{H}_2\text{O}.$$
- (c) Calculate the e.m.f. of the cell formed by combining the following half-equations:
$$\text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^- \rightarrow \text{SO}_2 + 2\text{H}_2\text{O} \quad E^\circ = +0.17 \text{ V}$$
$$\text{Br}_{2(\text{g})} + 2\text{e}^- \rightarrow 2\text{Br}^- \quad E^\circ = +1.07 \text{ V}$$
- (d) Explain briefly why sugar does not conduct electricity.
- (e) State one use of each of the following processes in the chemistry industry:
 - (i) cracking;
 - (ii) hydrogenation of vegetable oil.
- (f) State one:
 - (i) physical property that would enhance the separation of a mixture of palm-oil and water;
 - (ii) neutral oxide that is a colourless liquid at room temperature.
- (g) In a reversible reaction, state how the rate of the forward reaction compares to that of the backward reaction.
 - (i) at time zero;
 - (ii) before equilibrium;
 - (iii) at equilibrium.
- (h) Write a reaction equation to show the effect of heat on the following compound: $\text{Pb}(\text{NO}_3)_{2(\text{s})}$.
 - (i) Draw the structural formulae of two isomers of $\text{C}_3\text{H}_7\text{OH}$.
 - (j) Consider the following carbon compounds: ethanol, ethane, butane
 - (i) Arrange them in increasing order of their boiling point.
 - (ii) Explain briefly your answer in j(i).
- (a) The requirement of the question was recall of the Faraday's second Law of electrolysis.

Majority of the candidates were able to state the law. However, some few candidates used “mass of the substance” in place of “amount of substance”.

- (b) Almost all the candidates were able to separate the given redox reaction into balanced half equations.
- (c) Calculation of the e.m.f. of a cell from given half equations can be done in two ways:
 - (i) $E_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}}$ method
 - (ii) Identifying the oxidation and redox half equations from the E° values given and summing them-up. About 40% of the candidates failed to add the positive sign to the calculated e.m.f. as +0.90 V
- (d) Most of the candidates were able to say that the absence of ions in sugar is responsible for its inability to conduct electricity. However, they failed to add that it is a covalent compound / contain molecule.
- (e) Almost all the candidates were able to give the use of cracking and hydrogenation of vegetable oil in the chemical industry.

But some candidates were confused with fractional distillation of crude oil to obtain its fractions and the breaking down of the large fractions / hydrocarbons by the process of cracking.

- (f)
 - (i) Just a few candidates were able to state the physical property that enhances the separation of a mixture of water and palm oil – Immiscibility
 - (ii) Majority of the candidates were able to state that “water” is the neutral oxide that is a colourless liquid at room temperature.
- (g) Almost all the candidates were able to state how the rate of the forward reaction compares to that of the backward reaction (i) before equilibrium and (ii) at equilibrium for a reversible reaction.
- (h) Most of the candidates were able to write the reaction equation to show the effect of heat on $\text{Pb}(\text{NO}_3)_{2(s)}$ as: $2\text{Pb}(\text{NO}_3)_2 \rightarrow 2\text{PbO} + 4\text{NO}_2 + \text{O}_2$
- (i) Almost all the candidates were able to draw the structural formulae of the two isomers of $\text{C}_3\text{H}_7\text{OH}$. Some few could not as they saw the compound as not an alkanol.
- (j) Majority of the candidates were able to arrange ethanol, ethane and butane in the correct order of increasing of their boiling points but could not explain or give the reasons for the answer.

The reason is that, ethane and butane belong to the same homologous series / are alkanes, but butane is heavier / contains stronger van der Waals forces. And that ethanol contains hydrogen bonds therefore has the highest boiling point.

QUESTION 2

- (a) (i) Define *atomic radius*.
(ii) Explain briefly why the ratio of ionic radii $\frac{\text{Na}^+}{\text{Mg}^{2+}}$ is greater than 1.

- (b) Consider the following equation:



If 30.0 g of propan-1-ol produces 16.8 g of propene, calculate the percentage yield of propene.

$$[\text{H} = 1.0; \text{C} = 12.0; \text{O} = 16.0]$$

- (c) What would be the final volume of a fixed mass of a gas if its initial pressure is halved and the absolute temperature doubled.
- (d) (i) Identify the class of organic compound that could be detected using each of the following reagents:
(α) Biuret reagent;
(β) Ammoniacal silver trioxonitrate (v) solution;
(γ) Bromine in tetrachloromethane.
(ii) State what is observed in each of the cases stated in (d)(i).
- (e) (i) Under what condition does water react with sodium?
(ii) Name the products formed when water reacts with sodium.

- (a) (i) Majority of the candidates were able to define atomic radius. Some candidates defined it in terms of two atoms in a covalent bond rather than identical/same atoms in the covalent bond.
(ii) Candidates were able to explain why the ratio of ionic radii $\text{Na}^+/\text{Mg}^{2+} > 1$
- (b) Vast majority of the candidates were able to do this single application on stoichiometry.
- (c) Again, majority of the candidates were able to use the general gas equation to deduce the final volume of a gas whose initial pressure was halved, and its absolute temperature doubled.
- (d) Majority of the candidates were able to identify the class of organic compounds that could be detected using
1. Biuret reagent
 2. Bromine in tetrachloromethane; and what would be observed.

3. However, they could not do same for ammoniacal silver trioxonitrate (V) solution.

The response should have been “Terminal alkyne” and the observation, “white precipitate”.

- (e) Most of the candidates were able to state the condition under which water reacts with sodium and named the products formed.

QUESTION 3

- (a) Consider the following table and use it to answer the questions that follow.

Elements	Atomic number	Mass number
A	10	20
B	12	24
C	17	35
D	20	40
E	25	50

- (i) Which of the elements:
- (α) is an alkaline earth metal;
 - (β) belongs to group VII;
 - (γ) belongs to the d-block of the periodic table;
 - (δ) would readily form an ion with a double positive charge?
- (ii) How many electrons are there in D?
- (iii) What type of bond would exist between D and C when they combine?
- (iv) Write the formula of the compound formed when B combines with C.
- (v) State the element which is inert.
- (vi) Select the element which has a catalytic property.
- (b) Consider the following reaction equation:
- $$\text{CaCO}_{3(s)} \rightarrow \text{CaO}_{(s)} + \text{CO}_{2(g)} \text{ heat}$$
- (i) What type of reaction does the equation illustrate?
- (ii) Give a reason for the answer stated in (b)(i).
- (iii) What would be observed if
- (α) water is sprinkled on CaO?
 - (β) excess water is added to CaO?
- (iv) Write a balanced chemical equation for the reaction in (b)(iii)(β).
- (c) (i) The heat of solution for NH_4Cl is $+15.1 \text{ kJ mol}^{-1}$. State with reason the effect of increase in temperature on the solubility of NH_4Cl .
- (ii) If a salt of mass 5.10 g dissolves in distilled water of volume 7.70 cm^3 at 50°C , determine the solubility of the salt in mol dm^{-3} at the stated temperature.

[Mr of salt = 165.5]

(a) This question was answered by all the candidates and they performed very well. This suggests that the candidates are well vested in periodic chemistry.

(b) Almost all the candidates were able to state the type of reaction illustrated by the equation:



Decomposition:

But they could not give a reason for the answer as well as state what would be observed if

1. water is sprinkled on CaO;
2. excess water is added to CaO.

In the first case, the CaO cracks with hissing sound and breaks up into powder.

In the second case, the CaO dissolves / forms a milky suspension and the container becomes warm.

The candidates were able to write balanced equation for the reaction of CaO with water.

(c) The majority of the candidates were able to state the effect of increase in temperature on the solubility of NH_4Cl whose heat of solution was given as $+15.1\text{kJ mol}^{-1}$.

Candidates were able to determine the solubility of salt from information on its mass, molar mass and volume.

QUESTION 4

(a) **Explain briefly how molecules assume their shapes.**

(b) (i) **State the difference between polar covalent bond and coordinate covalent bond.**

(ii) **Illustrate dipole moment in each of the following molecules:**

(α) **NF_3 ;**

(β) **CO_2 ;**

(γ) **H_2O .**

(c) (i) **Define each of the following terms:**

(α) **natural radioactivity;**

(β) **nuclear fusion;**

(ii) **State one difference between natural radioactivity and artificial radioactivity.**

(iii) **Give two uses of nuclear fusion.**

(d) **The equilibrium constant for the reaction $\text{H}_{2(g)} + \text{I}_{2(g)} \rightleftharpoons 2\text{HI}_{(g)}$ at a certain temperature is 6.0. Calculate the equilibrium concentration of HI at that**

temperature when the equilibrium concentration of H_2 and I_2 are 0.2 mol dm^{-3} and 0.3 mol dm^{-3} respectively.

- (e) (i) Explain briefly why the $\text{C}=\text{C}$ bond energy is larger but not twice as large as the $\text{C}-\text{C}$ bond energy.
- (ii) Give the IUPAC name of each of the following complex ions:
- (α) $[\text{Cu}(\text{NH}_3)_4]^{2+}$;
- (β) $[\text{Fe}(\text{CN})_6]^{4-}$.

- (a) Only a few of the candidates were able to explain how molecules assume their shapes. The requirement was that "Pairs of electrons around a central atom repel each other thereby arranging themselves as far apart as possible to minimize any repulsion.
- (b) (i) Majority of the candidates were able to state the difference between polar covalent bond and coordinate covalent bond.
- (ii) Just a handful of the candidates were able to illustrate dipole moment in NF_3 , CO_2 and H_2O . This could be due to the fact that they don't know what dipole moment is.

This is separation of partial charges in covalent compounds with the more electronegative atom attaining the partial negative charge.

- (c) This question on nuclear chemistry was well answered by the candidates. They were able to define natural radioactivity, nuclear fusion and stated the difference between natural radioactivity and artificial radioactivity. They were also able to give the uses of nuclear fusion.
- (d) From the data on the equilibrium reaction:
- $$\text{H}_{2(\text{g})} + \text{I}_{2(\text{g})} \rightleftharpoons 2\text{HI}_{(\text{g})}$$
- the candidates were able to determine the equilibrium concentration of HI.
- (e) A few of the candidates were able to answer this question correctly.
- (i) They could not explain why the $\text{C}=\text{C}$ bond energy is larger but not as twice as large as the $\text{C}-\text{C}$ bond energy.

They failed to recognize that one of the bonds in $\text{C}=\text{C}$ is pi and the other sigma and that the sigma bond is stronger than the pi-bond.

- (ii) Most of the candidates could not name the following complex ions:
- $[\text{Cu}(\text{NH}_3)_4]^{2+}$ - tetra ammine copper (II) ion
- $[\text{Fe}(\text{CN})_6]^{4-}$ - hexacyano ferrate (II) ion

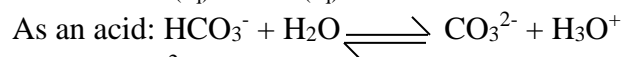
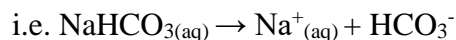
QUESTION 5

- (a) NaHCO_3 acts both as a weak acid and a weak base in aqueous solution.
- Write the:
 - K_a expression for $\text{NaHCO}_3(\text{aq})$;
 - K_b expression for $\text{NaHCO}_3(\text{aq})$.
 - Calculate the $[\text{H}_3\text{O}^+]$ for $0.100 \text{ mol dm}^{-3}$ aqueous solution of NaHCO_3 at 25°C .
[K_a at $25^\circ\text{C} = 4.7 \times 10^{-11}$]
- (b) Chlorine has two isotopes. The isotopic mass and percentage abundance of the heavier isotope are 36.98 and 24.95% respectively.
- Calculate the isotopic mass of the lighter isotope.
 - Sketch the mass spectrum of chlorine.
- (c) (i) The standard enthalpy of combustion of ethanol is $-1368 \text{ kJ mol}^{-1}$. Explain briefly this statement.
- (ii) Explain briefly why the bond energy of chlorine is not the same as its bond dissociation energy.
- (iii) List two factors that favour ionic bond formation.
- (d) Benzene contains six carbon atoms and six hydrogen atoms:
- Draw two stable structures of benzene to show how these atoms are arranged.
 - State the concept behind these structures;
 - State one industrial source of benzene;
 - State one use of benzene.

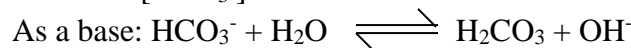
Most candidates avoided this question.

- (a) Majority of the candidates who attempted this question could not answer it well.
- (i) The demand of the question was the expressions for the K_a and K_b for NaHCO_3 in aqueous solution.

The candidates were expected to write the dissociation equations for NaHCO_3 as a weak acid and as a weak base before coming up with the K_a and K_b expressions.



$$\therefore K_a = \frac{[\text{CO}_3^{2-}][\text{H}_3\text{O}^+]}{[\text{HCO}_3^-]}$$



$$K_b = \frac{[\text{H}_2\text{CO}_3][\text{OH}^-]}{[\text{HCO}_3^-]}$$

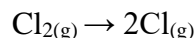
- (ii) Most candidates were able to calculate the $[H_3O^+]$ from information on K_a and concentration of $NaHCO_3$.
- (b) All the candidates were able to calculate the isotopic mass of the lighter isotope but could not sketch the spectrum of chlorine.
- (c) (i)&(ii) Majority of the candidates could not answer these questions. This could be due to the fact that they do not understand the knowledge of Energy and energy changes.
- (iii) Factors that favour ionic bond formation was expected to be easy, but candidates could not list them.

The expected answers are:

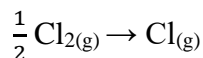
- (i) it means that when 1 mole of ethanol in its normal physical state at 298 K and 1 atm pressure is completely burnt in air/oxygen, 1368 kJ of heat is given out.
- (ii) bond energy is the energy needed to break one mole of Cl – Cl bond to form 2 moles of gaseous chlorine atoms while dissociation energy is the energy needed to break Cl – Cl bonds to form 1 mole of gaseous chlorine atoms.

OR

bond energy is the ΔH for the reaction



While dissociation is the ΔH for the reaction



- (iii) - low ionization energy of the metal atom
- high electron affinity of the non-metal atom
- low polarizing power of the cation
- low polarizability of the anion

- (d) Vast majority of the candidates were able to answer this question. The only problem was the industrial source of benzene which they could not state as “Coaltar”.

CHEMISTRY 3

1. GENERAL COMMENTS

The standard of the paper was comparable to the previous year.

The performance of the candidates however, was lower than that of the previous year.

2. SUMMARY OF CANDIDATES' STRENGTHS

- (1) Candidates could draw table of burette readings to 2 decimal places as required.
- (2) Candidates understood the concept of mole ratio.
- (3) Cations and anions were identified correctly by most of the candidates.
- (4) Improvement in the use of concordant titres for averaging.

3. SUMMARY OF WEAKNESSES

- (1) Significant figures still pose a challenge. Most of the candidates could not leave their answers to the right significant figures.
- (2) Some candidates could not attach the correct units to the values calculated.
- (3) Organic Qualitative Analysis question (Alt. A Question 2) was not well understood.
- (4) Candidates could not attach correct states to the species in equations.
- (5) Most candidates could not answer the question 3 in all the three alternatives.
- (6) Difficulty in identification of colours of precipitates, residues and solution.

4. SUGGESTED REMEDIES

- (1) Teachers should find time to take the students through practical exercises and usual laboratory activities.
- (2) Students should be encouraged to practice more questions on practical work.
- (3) Students should be taken through the key points in:
 - preparation of table of titre values;
 - writing of test, observation and inference for qualitative analysis.

5. DETAILED COMMENTS

ALTERNATIVE A

QUESTION 1

A is a solution containing 5.00 g of HNO₃ in 500 cm³ of solution.

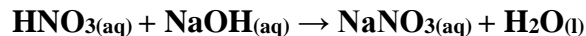
B is a solution of NaOH of unknown concentration.

- (a) **Put A into the burette and titrate it with 20.0 cm³ or 25.0 cm³ portions of B using methyl orange as indicator.**

Repeat the titration to obtain concordant titre values.

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

Equation of the reaction is:



- (b) From your results and the information provided, calculate the:
- concentration of A in mol dm^{-3} ;
 - concentration of B in mol dm^{-3} ;
 - concentration of B in g dm^{-3} .
 - Mass of NaNO_3 formed, if 250 cm^3 of NaOH were neutralized.
[Molar mass of: $\text{NaOH} = 40 \text{ g mol}^{-1}$; $\text{NaNO}_3 = 85 \text{ g mol}^{-1}$]

QUESTION 2

C is an organic compound. Carry out the following exercises on C.

Record your observations and identify any gas(es) evolved.

State the conclusions you draw from the results of each test.

- Put about 10 drops of C on a watch glass and ignite it using a burning splint.
- Put about 1 cm^3 of C in a test tube and add about 1 cm^3 of distilled water. Shake the test tube.
 - Put about 1 cm^3 of C in a test tube and add about 2 cm^3 of acidified $\text{K}_2\text{Cr}_2\text{O}_7$ solution. Warm the mixture gently and leave to stand for 5 minutes.
- Put few crystals of specimen D in a test tube and add about 2 cm^3 of C followed by about 2 cm^3 of 10% $\text{NaOH}_{(\text{aq})}$. Shake the test tube vigorously.
- State the class of compounds to which C belongs.

QUESTION 3

- A zinc salt, E, when heated strongly, produced a brown gas with pungent smell, a colourless gas which rekindled a glowing splint and a residue which was allowed to cool.
 - Identify the salt E;
 - Write an equation for the decomposition of E;
 - State what would be observed when the residue was allowed to cool.
- Describe how 250 cm^3 of $0.2 \text{ mol dm}^{-3} \text{ H}_2\text{SO}_4$ could be prepared from 150 cm^3 of a 1.0 mol dm^{-3} stock of the acid.
- State the effect of aqueous solution of $\text{Al}_2(\text{SO}_4)_3$ on litmus paper.

QUESTION 1

- Conc. of A in mol dm^{-3}

Many of the candidates were able to calculate the mass concentration of the acid (HNO_3) before dividing by the molar mass.

(ii) Conc. of B in mol dm⁻³

Performance was good except that almost all the candidates missed the mark for correct evaluation to 3 significant figures.

(iii) Conc. of B in gdm⁻³

This was quite well handled.

(iv) Mass of NaNO₃ formed

Performance here was average. Many of the candidates were able to find moles of NaOH in 250 cm³ of solution then proceeded to use the equation:

i.e. 1 mole of NaOH \equiv 1 mole of NaNO₃.

Candidates were expected to convert molar concentration to amount of substance in 250 cm³. Most of them could not do this.

QUESTION 2

The concept of oxidizing and reducing agents was not well understood. The iodoform test was not properly done.

The following observations were, however, made.

(c)

Test	Observation	Inference
D(s) + C + NaOH _(aq) + shaking vigorously	Yellow precipitate forms with antiseptic smell	Iodoform produced

- Some candidates stated yellow solution instead of yellow ppt.
- Many also did not get the antiseptic smell.
- Almost all the candidates who made correct observation gave the inference as ethanol / secondary alkanol instead of Iodoform produced.

The expected solution is:

	TEST	OBSERVATION	INFERENCE
(a)	C on a watch Glass + burning splint	Burns with a non- smoky flame	Saturated hydrocarbon may be present
(b)(i)	C + distilled water + shaking	One-layer forms / C dissolves	C is soluble
(ii)	C + acidified $K_2Cr_2O_{7(aq)}$ + Warm and leave to stand for 5 minutes	Orange solution turns green	Primary or Secondary alcohol present
(c)	$D_{(s)} + C$ + $NaOH_{(aq)}$ + shaking vigorously	Yellow precipitate forms with antiseptic smell	Iodoform produced

QUESTION 3

Candidates handled parts (a) and (c) quite well.

Description of dilution of solutions was not well understood.

- (b) Many candidates knew they must use the dilution law but messed up with the simple calculation. In the procedure, some also missed the marks for not using pipette / burette and for not stating volume of the volumetric flask.

The expected answer is:

- (b) Using the law of dilution

$$\begin{aligned}
 C_1V_1 &= C_2V_2 \\
 \therefore V_1 &= \frac{C_2V_2}{C_1} \\
 &= \frac{0.2 \times 250}{1.0} \\
 &= 50 \text{ cm}^3
 \end{aligned}$$

Procedure: 50 cm³ of the stock solution is pipetted into a 250 cm³ volumetric flask. The flask is topped up to the mark with distilled water. Flask is stoppered and shaken to obtain a uniform solution.

ALTERNATIVE B

QUESTION 1

E is a solution containing 5.99 g of HNO_3 per dm^3 .

F is a solution containing 13.0 g of $\text{Na}_2\text{CO}_3 \cdot y\text{H}_2\text{O}$ per dm^3 .

- (a) Put E into the burette and titrate it against 20.0 cm^3 or 25.0 cm^3 portions of F using methyl orange as indicator.

Repeat the titration to obtain concordant titre values.

Tabulate your results and calculate the average volume of E used.

The equation for the reaction is:



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

- concentration of E in mol dm^{-3} ;
- concentration of F in mol dm^{-3} ;
- concentration of F in g dm^{-3} .
- percentage of water of crystallization in $\text{Na}_2\text{CO}_3 \cdot y\text{H}_2\text{O}$.

[H = 1.0; C = 12.0; O = 16.0; Na = 23.0]

QUESTION 2

G is a mixture of two salts, one of which is a sodium salt. Carry out the following exercises on G.

Record your observations and identify any gas(es) evolved.

State the conclusions you draw from the results of each test.

- (a) Put G into a beaker and add about 10 cm^3 of distilled water. Stir the mixture and filter. Keep both the filtrate and residue. Test the filtrate with litmus paper.
- (b) To about 2 cm^3 of the filtrate add dilute HCl followed by few drops of $\text{BaCl}_{(\text{aq})}$.
- (c)
 - Place about half of the residue from (a) in a boiling tube and add about 10 cm^3 of dilute HNO_3 .
 - To about 2 cm^3 portions of the clear solution from (c)(i), add dilute NaOH in drops and then in excess.
 - To another 2 cm^3 portions of the solution, add dilute HCl.

QUESTION 3

- (a)
 - Describe briefly how copper (II) tetraoxosulphate (VI) solution could be converted to zinc tetraoxosulphate (VI) solution in the laboratory.
 - Write a chemical equation for the reaction in (i).
- (b) State what would be observed when hydrogen gas is passed over heated copper (II) oxide.

QUESTION 1

Candidates were expected to work out for the value of y in $\text{Na}_2\text{CO}_3 \cdot y\text{H}_2\text{O}$. Calculating the value of y was not properly done.

The expected response is:

(b) (i) Conc. of E in mol dm⁻³

$$\text{Molar mass of HNO}_3 = 1 + 14 + 48$$

$$= 63 \text{ g mol}^{-1}$$

$$\text{Conc. of E} = \frac{5.99}{63}$$

$$63$$

$$= 0.0951 \text{ mol dm}^{-3}$$

(ii) Conc. of F in mol dm⁻³

$$C_E V_E = 2$$

$$C_F V_F = 1$$

$$C_F = \frac{C_E V_E}{2 V_F}$$

$$2 V_F$$

$$= 0.0951 \times V_E$$

$$2 \times 20/25$$

$$= \text{Say } a \text{ mol dm}^{-3}$$

(iii) Conc. of F in gdm⁻³

$$\text{Molar mass of Na}_2\text{CO}_3 = (2 \times 23) + 12 + (16 \times 3)$$

$$= 106 \text{ g mol}^{-1}$$

$$\text{Conc. of F in g dm}^{-3}$$

$$= a \times 106$$

$$= \text{Say } b \text{ g mol}^{-1}$$

(iv) % of water of crystallization

$$\text{Mass of water} = (13.0 - b)$$

$$= \text{Say } C \text{ (g)}$$

$$\text{Percentage of water in Na}_2\text{CO}_3 \cdot y\text{H}_2\text{O}$$

$$= \frac{C}{13.0} \times 100$$

$$13.0$$

$$= \text{Say } X \%$$

QUESTION 2

Performance was average. The major issue was the incorrect way of using tests performed. Most of the candidates kept on adding, not stating whether they were adding to filtrate or residue (though correct observations were made).

Confirmatory test for Pb^{2+} using dil HCl could not be done.

QUESTION 3

(i) Candidates were to describe how to replace Cu in CuSO_4 using Zn. Most of the candidates answered the question without stating the appropriate laboratory instrument to use.

They failed to state the condition under which the reaction will be quickened and what would happen to the CuSO_4 .

(ii) Majority of the candidates stated that hydrogen gas will be evolved instead of stating the colour change from black to brown.

ALTERNATIVE C

QUESTION 1

G is $0.045 \text{ mol dm}^{-3} \text{ H}_2\text{SO}_4$

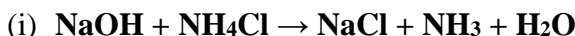
H was prepared by dissolving a sample of NH_4Cl in excess of $0.092 \text{ mol dm}^{-3} \text{ NaOH}$ solution.

(a) Put G into the burette and titrate it against 20.0 cm^3 or 25.0 cm^3 portions of H using methyl orange as indicator.

Repeat the titration to obtain concordant titre values.

Tabulate your results and calculate the average volume of G used.

The equations for the reactions are:



(b) From your results and the information provided, calculate the:

(i) concentration of NaOH in H in mol dm^{-3} ;

(ii) amount of NaOH that reacted with NH_4Cl ;

(iii) amount of NH_4Cl added;

(iv) mass of NH_4Cl added;

(v) volume of NH_3 evolved.

[H = 1.0; N = 14.0; O = 16.0; Na = 23.0; Cl = 35.5; $V_m = 22.4 \text{ dm}^3$]

QUESTION 2

J is a mixture of two salts. Carry out the following exercises on J.

Record your observations and identify any gas(es) evolved.

State the conclusions you draw from the result of each test.

- (a) Put all of J into a boiling tube and add about 10 cm³ of distilled water. Stir the mixture thoroughly and filter. Keep both the filtrate and the residue.
- (b)
 - (i) To about 2 cm³ portion of the filtrate, add NH_{3(aq)} in drops and then in excess.
 - (ii) To another 2 cm³ portion of the filtrate, add BaCl_{2(aq)} and then add dilute HCl.
- (c) Divide the residue into two portions.
 - (i) Heat the first portion strongly in a boiling tube.
 - (ii) Add dilute HCl to the second portion in a test tube.

QUESTION 3

- (a) Give one example of each of the following substances:
 - (i) a gas that turns damp red litmus paper blue;
 - (ii) a compound of calcium used to neutralize soil acidity.
 - (iii) a gas other than oxygen that can relight a glowing plant.
- (b) State what would be observed, when;
 - (i) sodium hydroxide pellets are exposed to the atmosphere for some time;
 - (ii) ethene is passed through bromine water.
- (c) Explain briefly why when carbon (IV) oxide is bubbled through lime water, it turns milky, but the milkiness disappears when the gas is bubbled for a long time.

QUESTION 1

(b)(ii) Candidates were to find the amount of alkali consumed in a back-titration exercise.

Most of them used mol dm⁻³ instead of mol.

Amount of NaOH used by NH₄Cl

It appeared many of the candidates were not conversant with the back-titration concept. They missed the mark. As a result, it affected performance for b(iii), b(iv) and b(v). Teachers must endeavour to take students through all the relevant practical topics.

QUESTION 2

White gelatinous precipitate and white chalky, precipitate were not understood by the candidates. Some of them did not know the difference.

Again, Effervescence was missing in most of their answers hence those candidates lost the mark allocated to the observation.

- In the Test column, many of the candidates did not indicate whether they were adding reagents to filtrate or residue.
- In b(i) many stated 'white ppt' as the observation instead of 'white gelatinous ppt'.
- In b(ii) many gave the inference CO_2 from CO_3^{2-} without evidence of having performed the chemical test i.e. colour gas turns limewater milky

QUESTION 3

Test for CO_2 using limited lime water and bubbling in excess could not be explained.

The expected response is:

- (a)
 - (i) NH_3
 - (ii) CaO / $\text{Ca}(\text{OH})_2$ / CaCO_3
 - (iii) N_2O
- (b)
 - (i) the pellets dissolves to form a solution
 - (ii) Bromine water changes from brown to colourless
- (c) The lime water turns milky because of the formation of insoluble CaCO_3 and the milkiness disappears due to the formation of soluble $\text{Ca}(\text{HCO}_3)_2$

CROP HUSBANDRY AND HORTICULTURE 2

1. GENERAL COMMENTS

The standard of the paper in terms of both level of difficulty and syllabus coverage compares favourably with those of previous years. However, candidates' performance was generally lower than last year.

2. SUMMARY OF CANDIDATES' STRENGTHS

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

- (1) Most candidates obeyed the rubrics of the paper including answering one question only on a page
- (2) Good number of candidates exhibited adequate knowledge of the characteristic features of a fertile soil, importance of rainfall to the growth and yield of crops and effects of pests in crop production
- (3) Some candidates satisfactorily discussed cultural methods of controlling pests in crop production

3. SUMMARY OF CANDIDATES' WEAKNESSES

The Chief Examiner noticed the following weaknesses in the scripts of candidates:

- (1) Several candidates could not spell technical terms and scientific words correctly
- (2) Most of the candidates could not adequately explain the following horticultural terms; hybridization, relay cropping, succession cropping and organic farming
- (3) Candidates' knowledge of Quality and Safety Standards in food industry is poor

4. SUGGESTED REMEDIES

The Chief Examiner made the following suggestions meant to remedy the weaknesses of candidates:

- (1) Teachers should periodically use question and answer to drill students on scientific words and technical terms
- (2) Concerted efforts should be made by students to cover the entire syllabus especially in the area of Horticultural terms and Quality and Safety Standards in food industry
- (3) Candidates should cultivate the habit of articulating their views correctly and concisely using good language

5. DETAILED COMMENTS

QUESTION 1

- (a) **State four characteristics of a fertile soil used in crop production.**
- (b) **Explain three ways in which soil organic matter is important in crop production.**
- (c) **Discuss five ways in which rainfall influences the growth and yield of crops.**

A great majority of the candidates attempted this question and exhibited fairly good familiarity and ideas about characteristics of a fertile soil and importance of soil organic matter in crop production.

- (a) Generally, candidates did not find much difficulties in stating characteristics of a fertile soil in crop production. Their correct answers included adequate nutrients, good soil structure and good texture
- (b) Majority of candidates enumerated correct importance of soil organic matter in crop production but most of them could not explain its effects on the soil

It is, therefore, useful for the candidates to note that presence of organic matter adds nutrients to the soil; increases the number and activities of soil micro and macro-organisms; leading to decomposition and recycling of nutrients thereby increasing soil fertility.

- (c) Even though most of the candidates listed ways in which rainfall influences the growth and yield of crops, they could not discuss the listed points satisfactorily.

The correct ways in which rainfall influence the growth and yield of crops include the following:

- provides water for good plant growth and development;
- provides needed water to dissolve plant nutrients in the soil;
- provides needed water to facilitate nutrients uptake and transportation;
- provides water which is necessary for photosynthesis;
- heavy rainfall may cause soil erosion and low crop yield;

QUESTION 2

- (a) **Explain the term hybridization as used in crop production.**
- (b) **Give two advantages of hybridization in crop production.**
- (c) **Discuss three advantages of vegetative propagation.**
- (d) **Give two precautions to be taken when performing each of the following activities in vegetable production.**
 - (i) **transplanting;**
 - (ii) **staking.**

Many candidates attempted this question, but general performance was poor because they could not explain the stated term and precautionary measures in carrying out some cultural methods.

- (a) Candidates generally failed to explain the term hybridization. It should be noted that, it is the process of crop improvement where two separate individuals of desirable characteristics are crossed to produce progenies that combine the characteristics of both parents.
- (b) Most of the candidates could not, satisfactorily, outline the advantages of hybridization in crop production.

The correct advantages include:

- creates genetic variations;
 - results in hybrid vigour;
 - results in yield improvement in crops.
- (c) This sub-question was fairly well answered. Their correct advantages of vegetative propagation include:
- produces genetically true-to-type plants;
 - it does not require pollination agent;
 - productions of crops are relatively fast;
 - enables seedless plants to be propagated.
- (d) This sub-question was generally badly answered as candidates failed, in most cases, to give precautions to be taken in performing transplanting and staking activities in vegetable production.

Expected answers include the following:

Transplanting:

- seedlings should be watered copiously at least an hour before they are removed to reduce root damage;
- seedlings should be uprooted carefully with ball of soil to avoid root damage;
- always transplant young and healthy seedlings to ensure survival;
- transplanting should be done in the evening or early in the morning;
- water copiously immediately after transplanting.

Staking:

- stakes should be strong enough to provide the needed support for the plant to be staked;
- train plants or seedlings gently onto the stake
- stake at the appropriate state of growth.

QUESTION 3

- (a) **Explain each of the following terms as used in crop production:**
- (i) **relay cropping;**
 - (ii) **phased planting;**
 - (iii) **succession cropping.**
- (b) **Give six ways in which weeds are of importance to a vegetable farmer.**
- (c) **Discuss two ways by which spear grass could be controlled in a yam farm.**
- (d) **Mention four examples of hedging plants.**

This was another popular question and candidates' performance in it was only average.

- (a) Most of the candidates could not explain the stated farming systems.

An explanation of the terms are as follows:

- (i) Relay cropping

It is the growing of two or more crops on the same plot of land such that part of their life cycle occur simultaneously or overlaps.

- (ii) Phased planting

It refers to the growing of two or more crops on the same farm or field by arranging planting dates systematically to ensure continuous sequence of growth and harvesting.

- (iii) Succession cropping

It is a system of multiple cropping where two or more crops are grown on the same farm or field within a year with one crop planted after the harvest of a preceding one.

- (b) This sub-question was well answered by candidates who correctly gave ways in which weeds are of importance to a vegetable farmer.

However, ways such as the following were rarely given:

- weeds increase cost of production of crops;
- weeds cause a decline in crop yield by competing with crops for water, nutrients, sunlight and space;
- weeds act as alternative host to pests and diseases of crops;
- some weeds are medicinal.

- (c) This sub-question on ways in which spear grass could be controlled in a yam farm was badly answered.

Candidates should note that spear grass could be controlled by:

- ploughing and harrowing during dry season;
- use of systemic herbicides;
- embarking on good crop rotation.

(d) Most of the candidates gave correct examples of hedging plants.

Their correct answers include:

- Blue duranta
- Ice plant
- Hibiscus
- Croton
- pride of Barbados
- Lantana
- Blue plumbago
- Thumbegia
- Milkbush
- Bougainvillea

Candidates' difficulty in giving examples of hedging plants was wrong spellings of names which caused them valuable marks.

QUESTION 4

- (a) (i) **What is organic farming?**
(ii) **Mention five benefits of consuming food produced through organic farming.**
- (b) **Discuss four effects of poor-quality vegetables on the health of consumers.**
- (c) **Mention five ways for ensuring quality and safety standards in the pineapple industry.**

This question was attempted by only a few candidates and general performance was poor. Perhaps the topics "Organic farming, Quality and Safety Standard in food industry" are not properly taught in schools.

(a) (i) A lot of candidates could not clearly explain the term "Organic farming". It is, therefore, useful for candidates to note that organic farming is a practice of farming that avoids the use of agro-chemicals but encourage the use of botanicals or manure from living organisms or use of biological control.

(ii) Again, only a few candidates were able to mention the benefits of food produced from organic farming.

Their correct responses include:

- food tastes better;
- quality of fruits and vegetables produced are nutritionally superior to those grown conventionally;
- food produced organically have longer shelf life;

- food generally do not pose health problems.

(b) This sub-question was fairly well answered by few of the candidates who correctly stated the effects of poor-quality vegetables on health of consumers.

Most of them, however, could not adequately explain the stated effects.

Obvious effects such as the following were, however, hardly stated.

- cancer of lungs and throats as a result of chemical contamination of vegetables;
- chemicals contamination of vegetables may lead to hormonal imbalance causing infertility.

(c) Majority of the candidates were not able to mention and discuss ways of ensuring quality and safety standards in pineapple industry satisfactorily.

Expected answers include the following:

- strict adherence to time lapse between application of chemicals, harvest and use of the crop;
- ensure cleanliness in packaging, handling and transportation;
- apply correct dosage of chemicals;
- practice organic farming;
- clean harvested produce before packaging and storage;
- harvest produce at the appropriate stage of ripening.

QUESTION 5

(a) **Explain six effects of pests in crop production.**

(b) **Discuss three cultural methods of controlling pests in crop production.**

(c) **Mention two ways in which soil living organisms is important in vegetable farming.**

The performance of candidates on this question was generally good.

(a) Candidates were generally able to explain the effects of pests in crop production well and scored full marks in most cases.

However, few of the effects which were hardly mentioned include:

- defoliation of leaves of crop plants;
- injection of toxins into fruits leading to secondary infection;
- attack young shoots and leaves making them susceptible to fungal attack.

- (b) Most of the candidates correctly enumerated cultural methods of controlling pests in crop production.

Their correct answers include:

- to practice crop rotation;
- ploughing and harrowing to overturn the soil to expose pathogens in the soil
- timing of planting to avoid pests and pathogens.

- (c) Candidates' performance on this sub-question was only fair as most of them were able to mention the importance of soil living organisms in vegetable farming.

Their correct importance include:

- decomposed organic matter and mix them with soil leading to increase soil fertility;
- convert atmospheric nitrogen unto nitrogenous compound in the soil to be used by plants.

QUESTION 6

- (a) **Discuss the production of tomato under the following headings:**

- (i) **soil requirement;**
- (ii) **land preparation;**
- (iii) **varieties;**
- (iv) **transplanting;**
- (v) **uses.**

- (b) **List four actors involved in the tomato enterprise in West Africa.**

Many candidates attempted this question and performed fairly well on it.

- (a) Generally, candidates did not find much difficulties in discussing the production of tomato under the following headings: soil requirement, land preparation, varieties, transplanting and uses.

Their correct responses include the following:

Soil requirement

Fertile soil i.e., well aerated, deep, well drained and loamy soils, neutral pH and rich in minerals soil.

Land preparation

Slash with cutlass, fell trees, remove stumps and burn, plough and harrow field, prepare ridges to allow for good growth, dig planting holes of planting distance of 60 cm x 60 cm.

Varieties

Roma V.F, Laurano, Raki, Rasta, Ronita Owusu Bio

Transplanting

- seedlings are transplanted when they are about 3 to 4 weeks old;
- transplanted at a spacing of 60 cm within rows and 60 cm to 75 cm between rows
- transplanting is done early in the morning or late in the afternoon
- water seedlings before and after transplanting

Uses

- food in the form of paste or tomato puree,
- food in the form of stew;
- food in the form of soup.

(b) Candidates appeared to have a fairly good knowledge of actors involved in the tomato enterprise in West Africa.

The actors involved include:

- tractor operators;
- farmers;
- country buyers;
- processors
- wholesalers;
- middle men / women;
- retailers;
- market queens.

CROP HUSBANDRY AND HORTICULTURE 3

1. GENERAL COMMENTS

The standard of the paper in terms of both level of difficulty and syllabus coverage compares favourably with those of previous years.

However, candidates' performance is generally lower than last year.

2. SUMMARY OF CANDIDATES' STRENGTHS

The Chief Examiner observed the following as some of the strengths of candidates:

- (1) Most of the candidates worked according to the rubrics of the paper.
- (2) A good number of candidates exhibited fairly good knowledge about the operation carried out on budded citrus seedling and reasons for carrying out budding.
- (3) Majority of the candidates were able to correctly identify a pair of secateurs and garden line.

3. SUMMARY OF CANDIDATES' WEAKNESSES

The Chief Examiner identified the following as weaknesses exhibited by candidates:

- (1) Several candidates lacked understanding and correct uses of horticultural terminologies
- (2) Majority of the candidates could not state factors affecting success of budding of citrus seedlings
- (3) Some candidates could not state satisfactorily disadvantages of using clay pot for propagating ornamental plants

4. SUGGESTED REMEDIES

The Chief Examiner recommended the following remedies:

- (1) Scientific words and horticultural terminologies should be carefully taught
- (2) Concerted efforts should be made by students to cover the entire syllabus especially in the area of budding and grafting
- (3) Practical lessons should be organized more frequently, supervised and discussed

5. DETAILED COMMENTS

QUESTION 1

- (a) **Outline the steps involved in preparing specimen A for planting.**
- (b) **Name four varieties of the crop from which specimen A was obtained.**
- (c) **Mention three factors which could promote the disease condition of specimen B.**
- (d) **Name four planting materials used for propagating specimen B.**

Many candidates attempted this question but failed to answer it satisfactorily.

- (a) Most of the candidates answered this sub-question well but their responses did not follow the sequential order.

The correct steps involved in preparing pineapple sucker for planting involved:

- trim the dead vegetative materials;
- treat in appropriate chemicals;
- sun dry for about seven days;
- leave in upright position for about 18 – 24 hours before planting.

- (b) Candidates readily provided varieties of pineapple (Specimen A). Their correct responses include:

- Sugar leaf;
- Red Spanish;
- Abakka;
- Queen;
- MD Two;
- Cayenne.

However, some candidates lost marks due to wrong spellings of varieties of pineapple.

- (c) Candidates' performance in this question was generally below average.

Candidates should note that the factors which promote the disease condition of specimen B (a tuber of yam with rot) include the following:

- poor harvesting or injury during harvesting;
- bruises during packaging or storage;
- poor handling during transportation;
- when planted in soils infested by nematodes;
- when exposed to humid conditions;
- when stored in closed environment or in poor ventilated environment.

- (d) Most candidates correctly stated the planting materials of Specimen B (tuber of yam with rot).

Expected planting materials include:

- yam seed;
- pieces of vine;
- true setts or setts;
- mini setts or microsetts;
- tissue culture.

QUESTION 2

- (a) (i) **Name the operation that was carried out on specimen C.**
(ii) **Give three reasons for carrying-out the operation on specimen C.**
(iii) **State three factors which could affect the success of the operation carried out on specimen C.**
- (b) **State four horticultural uses of specimen D.**
- (c) **Mention four methods of using specimen E to establish a lawn.**

Performance of candidates on this question was poor. This raises the issue of whether grafting and budding are being properly taught in schools.

- (a) (i) The operation carried out on specimen C (a budded citrus seedling) was correctly named by some candidates as budding or grafting.
(ii) A lot of candidates could not adequately state the reasons for carrying out budding.

Reasons that most of them did not state include the following:

- to prevent diseases or control soil borne diseases;
- early maturity of fruits / precocity;
- two varieties of fruits on one plant;
- to control height;
- to produce fruits that are true-to-type.

- (iii) Most of the candidates were not able to state correctly factors affecting success of budding or grafting operation.

Candidates should however, note that factors affecting success of budding or grafting operation include the following:

- joint must be protected from drying;
- scion and stock should be about the same size in diameter;
- using budding tape to wrap the union firmly;
- avoid wetting cut surfaces;
- cambium matching the cambium of the stock;
- water or irrigate regularly.

(b) Candidates had some knowledge of the horticultural uses of specimen D (Rose plant). However, most of them could not give the required number of uses.

Other horticultural uses include:

- as specimen plant;
- as cut flower;
- as a hedging plant;
- means of showing affection / love;
- beautify the environment.

- (c) This sub-question was well answered by most of the candidates. The expected methods of establishing specimen E (Love/Tafo grass) include:
- sprigging;
 - sodding;
 - plugging;
 - seeding.

QUESTION 3

- (a) (i) **Mention two uses of specimen F.**
(ii) **State three ways of maintaining specimen F.**
- (b) **State three uses of specimen G.**
- (c) (i) **Give three disadvantages of using specimen H as pot for propagating ornamental plants.**
(ii) **Mention two management practices that should be carried out on specimen H before using it for propagation of ornamental plants.**

This question was well answered by most candidates.

- (a) (i) Most of the candidates correctly stated the uses of Specimen F (a pair of secateurs) as indicated below:
- for trimming leaves, roots, flowers etc
 - for cutting budwood;
 - for preparing leaf cutting;
 - for preparing stem cuttings.
- (ii) Candidates appeared to lack adequate knowledge of how to maintain a pair of secateurs.

Maintenance practices hardly mentioned include:

- replace spring when weak or loose;
 - tighten bolt and nut when necessary;
 - sharpen metal parts or blades.
- (b) Majority of candidates gave correct uses of specimen G (Garden line). Their correct responses include the following:
- for making straight lines;
 - for lining up beds;
 - for measuring plots;
 - for pegging plots.

- (c) (i) Candidates appeared to lack adequate knowledge of the disadvantages of using clay pot (Specimen H) for propagating ornamental plants.

The expected disadvantages include:

- pots breaks when roots of plants expand or when pot falls down
 - heavy to handle or difficult to transport
 - toxic salts tend to build up when used for a long period
 - encourages growth of algae.
- (ii) Most of the candidates correctly stated management practices carried out on clay pot (Specimen H) before it could be used for propagating ornamental plants.

The correct management practices are:

- wash well before use;
- soak in water overnight before use;
- crocking the pot before filling with soil.

- (iii) Candidates correctly provided examples of containers which could be used in place of clay pot in propagation of ornamental plants.

Examples given are outlined below:

- plastic pots
- fibre grass pots
- metal pots
- bamboo
- calabash
- seed tray
- polythene bags
- concrete pot

QUESTION 4

- (a) (i) **Mention two fungal diseases of crop from which specimen J was obtained.**
- (ii) **State four uses of the crop from which specimen J was obtained.**
- (iii) **Mention three varieties of crop from which specimen J was obtained.**
- (b) (i) **Give the soil and rainfall requirements of crop from which specimen K was obtained.**
- (ii) **Name two products that could be obtained from processing specimen K.**

- (a) Majority of the candidates performed well in this sub-question as they correctly provided the fungal diseases, uses and varieties of specimen J (oil palm fruits).

- (i) Fungal diseases of specimen J (oil palm fruits)
 - Anthracnose
 - Cercospora
 - Fusarium wilt
 - *Phytophthora palmivora*

- (ii) Uses of crop from which oil palm fruit was obtained
 - cosmetics
 - kernel oil for cooking
 - palm oil for polish, lubricant, margarine
 - leaves for making brooms and roofing materials
 - palm fronds for making baskets
 - oil for making soap

- (iii) Varieties of crop from which oil palm was obtained
 - Microcarya
 - Dura
 - Tenera
 - Pisifera

Some candidates, however, lost marks either due to wrong spellings of technical words or did not follow the basic rules for writing scientific names

- (b) Although these sub-questions were fairly well answered, a few could not identify specimen K as cocoa pod, therefore had their responses wrong.

Their correct responses are given below:

- (i) Rainfall and soil requirements for cultivation of specimen K (cocoa pod).

Rainfall and soil requirements for the crop from which specimen K (cocoa pod) was obtained were outlined below:

Rainfall is between 1,000 – 3,000 mm per annum averaging 1,500 mm annually, fairly distributed throughout.

Soil should be deep, well drained, clay loam, rich in mineral nutrients and slightly acidic to slightly alkaline.

- (ii) Products derived from processing specimen K (Cocoa pod) are listed below
 - chocolate
 - cocoa butter
 - alcoholic beverages
 - cosmetic

FISHERIES 2

1. GENERAL COMMENTS

The standard of the paper compared favourably with that of previous years with respect to content syllabus coverage and level of difficulty.

The performance of candidates was better than last year.

2. SUMMARY OF CANDIDATES' STRENGTHS

- (1) Majority of candidates showed scholarship in having read or undergone good tuition in the course work.
- (2) There was ample display of familiarity with the topics and the course work.
- (3) Candidates were familiar with topics such as 'what to consider when selecting fish species for stocking' and 'the role of extension services in the development of the fishing industry.'

3. SUMMARY OF CANDIDATES' WEAKNESSES

- (1) A few questions were not numbered. This wasted valuable time of examiner in sorting out the question numbers.
- (2) Whether questions are numbered or not, it is helpful to introduce the answer in a very short sentence, not more than a sentence. It assists the examiner in recognizing the question being answered quickly.
- (3) Some candidates failed to read the questions well. Thus, some gave more points than required. This is a waste of time for both candidates and examiners.
- (4) Some answers could not be recognized quickly because of poor English expressions. This is not an English paper, but marks can only be awarded when the point is made right

4. SUGGESTED REMEDIES

Candidates must simply take a few minutes to read the questions and the instructions very well and carry out these instructions

5. DETAILED COMMENTS

QUESTION 1

- (a) **Explain five factors to be considered in selecting fish species to stock a pond.**
- (b) **Name five fisheries research and training institutions in Ghana.**
- (c) **List five daily activities related to fishing in freshwater communities in Ghana.**

- (a) The candidates were able to list the factors to consider when selecting fish species to stock a pond, however, the explanation was not well given.

Expected Response

Factors to consider when selecting fish species to stock a pond

- Adaptability to the environment/hardiness
- Prolificacy
- Marketing opportunities
- Acceptability
- Disease resistance
- Fast growth
- Ability to accept artificial feed
- Resistance for parasites

- (b) The candidates could mention 'universities' but not the specific university. They could not mention any other training institution and hence those who attempted this sub question scored low marks.

Expected Response

Fisheries Research and training institutions in Ghana

- University of Development Studies
- Department of Fisheries, University of Cape Coast
- Faculty of Renewable Natural Resources, KNUST
- Water Research Institute
- Marine Fisheries Research Division of Fisheries Commission
- Department of Oceanography, University of Ghana, Legon

- (c) This question was answered by most candidates. However, candidates could only mention “fish marketing” and “net mending”.

Expected Responses

Daily activities related to fishing in fresh water fishing communities in Ghana

- Net mending / Gear repairs
- Boat mending
- Going fishing
- Fish processing
- Fish preservation
- Fish marketing
- Fueling outboard motors
- Fishing craft construction

QUESTION 2

- (a) **Discuss five roles played by Extension Services in the development of fishing industry in Ghana.**
- (b) **Discuss three effects of fish spoilage on the client of the fisheries business.**
- (c) **Name four fishing crafts.**

(a) All the candidates who attempted this question answered it well. The common answers they provided included 'Linking fishers to research' and 'Education of fisher folks' on fishery regulations'

Expected Responses

Role played by Extension services in the Development of the fisheries industry

- Linking fishers to research / extension workers
 - Linking fishers to marketing opportunities
 - Education of fisher folks on fishery regulations
 - Training / Fishers adopt improved fishing techniques and innovations
 - Dissemination of information / enable fishers to be aware of support services available to them
 - Job creation
- (b) The candidates who attempted this question had challenges with understanding the sub question. Some understood it as causes of spoilage.

Expected Responses

Effect of fish spoilage on the clients of fish business

- Reduction in revenue
 - Loss of customers
 - Increase in operational cost
 - Health hazards
 - Loss of taste of the fish
- (c) Candidates who answered this question produced good responses. The common ones mentioned by candidates included “dugout canoe”, “planked canoe” and trawler.

Expected Responses

Examples of fishing crafts

- purse seiner
- long liner
- pole and line vessel
- trawler
- rafts
- dugout canoes
- outrigger canoes
- planked canoes
- inshore vessels

QUESTION 3

- (a) (i) **State five effects of aquatic alien plant species on fishery habitat.**
(ii) **Give the common and scientific names of three aquatic alien plant species.**
- (b) (i) **Describe three ways of improving the quality of water in a fish pond.**
(ii) **Name three fishing gear.**

(a) (i) This sub question was not well answered. Candidates could only have mentioned 'Spreads to cover water surfaces' and 'Decreases light penetration'

Expected Responses

Effects of Aquatic alien plant species on fishery habitat

- Spreads to cover water surfaces
- Decreases light penetration
- Reduces dissolved oxygen (DO) content
- Increases acidity of pond water
- Sedimentation through decay
- Rapid water loss through transpiration

(ii) In answering this sub question, the candidates who attempted it could only mention the common names but had challenges with the correct spelling of the scientific names.

Expected Responses

Common and scientific names of aquatic alien plant species

<u>Common Name</u>	<u>Scientific Name</u>
1. Water hyacinth	<i>Eichornia crassipes</i>
2. Water Lettuce	<i>Pistia stratiotes</i>
3. Water ferns	<i>Azolla filiculoides</i>
4. Filamentous Algae	<i>Enteromorpha flexura</i>
5. Hornwort	<i>Ceratophyllum sp.</i>
6. Kariba weed	<i>Salvinia molesta</i>

- (b) Candidates had challenges understanding this sub question. However, a few of them could mention 'stirring the water' and 'adding more water'

Expected Responses

(i) Ways of improving water quality in a fish pond

- Stirring water to increase dissolved oxygen (D.O.) content
- Application of lime to correct pond water pH
- Application of lime to destroy pathogens
- Application of manure to increase phytoplankton population
- Reduce turbidity / add water

- (ii) All the candidates who attempted this sub question did not have any challenge in answering it.

Expected Responses

Examples of fishing gear

- Hook and line
- Cast net
- Seine net
- Traps
- Gill net
- Purse seine
- Trawl
- Spear
- Harpoon

QUESTION 4

- (a) **State five daily management practices carried out in a fish pond.**
- (b) **Explain how each of the following processes preserve fish:**
- (i) **salting;**
 - (ii) **drying;**
 - (iii) **freezing.**
- (c) (i) **State three characteristics of artisanal fisheries.**
- (ii) **State three objectives of fisheries management.**

Most of the candidates did not answer this question. Those who did attempted only part (a). Candidates were familiar with the methods of fish preservation but not how the method preserves the fish.

(a) Expected Responses

Daily management practices carried out in a fish pond

- checking for leakage / monitoring water level
- cleaning filters / surrounding of pond
- observing fish behaviour
- feeding of fish
- watching out for predators
- monitoring water quality parameters
- manuring
- harvesting

(b) Expected Responses

(i) How drying preserves fish

- create unfavourable conditions for microbes
- microbes cannot grow
- drying kill microbe
- enzymes become inactive when dry
- decrease water content

(ii) How Freezing preserves fish

- microbes rendered inactive
- flesh of fish hardens to lowering ease of microbes' invasion
- enzyme activities is reduced

(iii) How Salting preserves fish

- dries up fish flesh / extracts moisture from the fish flesh
- salt kills microbes
- salt prevent entry of microbes

(c) (i) **Expected Responses**

Characteristics of Artisanal fishery

- gear used are simple / hand operated
- crafts used are simple and traditional
- labour intensive
- very low capital investment
- poorly developed infrastructure
- difficulty in accessing credit
- marketing and distribution of products is difficult

(ii) **Expected Responses**

Objectives of fishery management

- maximization of fish production / yield
- maintenance of stock levels
- conservation of fishery resources
- conservation of fishery environment
- maintenance of spawning stocks

QUESTION 5

- (a) **State five items of expenditure for culture fisheries.**
- (b) **Draw and label the external features of a bony fish.**
- (c) (i) **Name two diseases of fish.**
- (ii) **State three fisheries policies in Ghana.**

Question 5 was answered well by the candidates who attempted it. However, some had challenges with 5 C (i), fishery policy in Ghana.

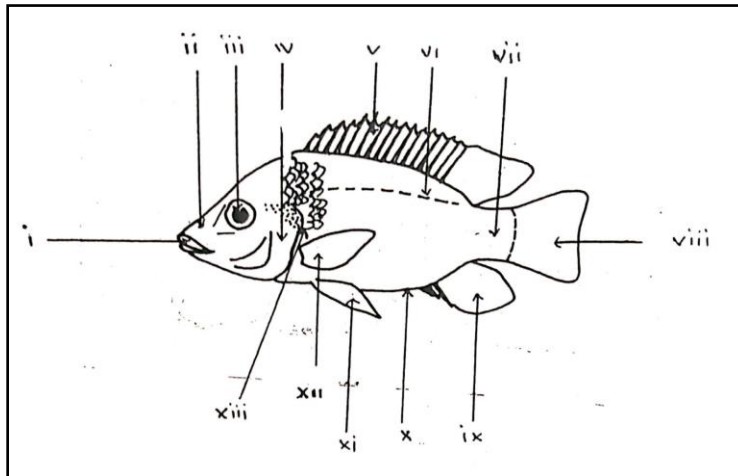
(a) **Expected Responses**

Items of expenditure for culture fisheries

- land
- pond construction
- fingerlings / fish seed
- medication
- labour costs / salaries and allowances
- maintenance of facilities

- tax
- fish feed
- harvesting tools

(b) Diagram of a bony fish



Expected labeling

- | | | | |
|------|-----------------|-------|---------------------|
| i. | mouth | viii. | tail fin/caudal fin |
| ii. | nostril | ix. | anal fin |
| iii | eye | x. | anus |
| iv | operculum | xi. | pectoral fin |
| v. | dorsal fin | xii. | pelvic fin |
| vi. | lateral line | xiii. | scale |
| vii. | caudal peduncle | - | |

(c) (i) Expected Responses

Diseases of fish

- gill rot
- furunculosis
- ich

(ii) Expected Responses

Fisheries Policies in Ghana

- subsidy on fuel
- no import duty on gear
- zonation of areas for aquaculture
- limiting number of fishing units
- fishing closures
- catch quotas
- licensing of fishing vessels

QUESTION 6

- (a) Name three fish species which live in each of the following habitats:**
- (i) marine;**
- (ii) freshwater.**
- (b) (i) List three ways of controlling the population of tilapia in a pond.**
- (ii) Mention three facilities necessary for the smooth functioning of a modern fish landing site.**
- (c) List four fish products.**
- (d) State two reasons for seasonal variation in fish catch.**

(a) Candidates had challenges differentiating fish species based on their habitats.

(i) Expected Responses

Marine Fish species

- Cassava fish
- Anchovies
- Chub mackerel
- Sardines
- Red snappers
- Skip jack tuna
- Yellow fin tuna
- Grey mullet

(ii) Fresh water Fish species

- Tilapia
- African catfish
- Mud fish
- Tiger fish
- Butter fish
- African carp
- Electric catfish

- (b) (i) Candidates could only mention harvesting as the only means of controlling the population of tilapia in a pond.

Expected Responses

Control of Tilapia population in a fish pond

- continuous harvesting
 - fry harvesting
 - use of predator e.g. catfish
 - stocking unisex (monosex population)
- (ii) Candidates were only familiar with fuel pump and source of water as the facilities needed for proper functioning of a modern landing site.

Expected Responses

Facilities necessary for the smooth functioning of a modern landing site

- source of water
 - cold storage
 - slip way
 - breakwater
 - dry dock
 - jetty
 - fuel pump
- (c) Candidates were familiar with the traditional fish products like smoked fish, dry fish and salted fish.

Expected Responses

Fish products

- Fish fillets
 - Fish chunks
 - Fish flakes
 - Canned fish
 - Smoked fish
 - Dried fish
 - Salted fish
 - Pickled fish
 - Marinated fish
 - Fried fish
- (d) This question was not attempted by most candidates

Expected Responses

Reasons for seasonal variation in fish catch

- Variation in spawning of fishes
- Seasonal upwelling
- Differences in climatic factors
- Differences in the breeding cycle of fish



FISHERIES 3

1. GENERAL COMMENTS

The standard of the paper compared favourably with that of previous years.

The performance of candidates was slightly higher than the previous years.

2. SUMMARY OF CANDIDATES' STRENGTHS

- (1) Candidates were able to identify specimens properly.
- (2) Candidates used the appropriate terms in the subject.
- (3) They were precise and straight to the point.

3. SUMMARY OF WEAKNESSES

- (1) Candidates understood the demand of the question 1(b) to mean the methods by which the fish was obtained from water. Some indicated cast net, trawl etc.
- (2) Scientific names and some fisheries terminologies were wrongly spelt and used respectively.
- (3) Candidates were unable to apply their knowledge in theory to the practical work.

4. SUGGESTED REMEDIES

- (1) Teachers must endeavour to expose the candidates to indepth theoretical knowledge to enable them apply it to the practical work.
- (2) Candidates should make conscious effort to learn and use terminologies appropriately.

5. DETAILED COMMENTS

QUESTION 1

- (a) **Identify each of the specimens labelled A, B, C and D.**
- (b) **State the method of producing each of the specimens labelled A and C.**
- (c) **Describe the processes through which specimens C and D were obtained.**
- (d) **Name two equipment that could be used to obtain specimen C.**

- (a) Generally, this sub question was well answered except Specimen D which was identified by most candidates as frozen fish.

Expected Responses

Identification

Specimen A	=	Gutted fish
Specimen B	=	Scaled tilapia fish
Specimen C	=	Sun dried tilapia fish
Specimen D	=	Chilled tilapia fish

- (b) This sub question was not answered well. Candidates understood the demand of the question to mean the methods by which the fish was obtained from water. Some indicated cast net, trawl etc.

Expected Responses

Method of production

(i) Specimen A (Gutted fish)

- Gutting / Fishing processing

(ii) Specimen C (Sun dried fish)

- Sun drying / Preservation

- (c) This question was well answered, however, there were a few challenges. For instance, candidates mentioned the use of brine instead of dry salt for specimen C and in the case of specimen D, candidates indicated the use of deep freezer instead of the use of ice to chill the fish.

Expected Responses

(i) Description of process of achieving Specimen C (Sun dried fish)

- scale the fish / Fish not scaled
- gut the fish
- wash fish to remove blood
- rub with salt / not salted
- place on mat in the sun or solar chamber
- turn regularly until very dry
- collect and pack

(ii) Description of process of achieving Specimen D (Chilled tilapia fish)

- scale fish
- gut fish
- wash fish
- place fish in a suitable insulated container or ice chest
- place ice in between the layers of fish
- cover / close the container

- (d) This sub question was well answered

Expected Response

Equipment to produce Specimen C (Sun dried fish)

- solar drier
- drying platform / mat

QUESTION 2

- Identify each of the specimens labelled E, F, G and H.**
- State four functions of specimen F.**
- State two products that could be obtained from each of specimens E, F, G and H.**
- Mention four other by-products of fish.**

- (a) Many of the candidates were able to answer this sub question well. They had no problem identifying the specimens.

Expected Response

Identification

Specimen E	=	Entrails
Specimen F	=	fish fins
Specimen G	=	fish liver
Specimen H	=	fish skin

- (b) Many of the candidates were able to answer this sub question well. They were able to mention functions such as steering and defense.

Expected Responses

Functions of Specimen F (Fish fins)

- For Steering
- Balancing
- Swimming
- Defense
- Propulsion

- (c) Candidates were able to mention at least one use of each specimen.

Expected Responses

Products obtained from specimens

- Specimen E (Entrails) – fertilizer, fish meal
- Specimen F (fish fins) – fish fin soup, fertilizer
- Specimen G (fish liver) – oil, fish meal
- Specimen H (fish skin) – leather, fish meal

- (d) Instead of candidates mentioning by products other than the ones mentioned, they repeated the ones mentioned already. This means that they did not pay attention to the requirement of the question.

Expected Responses

Other fish by-products

- fish bones
- gills
- fish scales
- opercula

QUESTION 3

- (a) **Identify each of the specimens labelled J, K and L.**
- (b) (i) **State one use each of specimens J, K and L.**
(ii) **State two methods of applying specimen J.**
- (c) **Mention two materials that could be used in place of each of the specimens J, K and L in fish culture.**
- (d) (i) **State four advantages of using specimen J.**
(ii) **State two ways in which specimen L is important.**

- (a) Many of the candidates were able to answer this question well.

Expected Response

Identification

- Specimen J = Poultry droppings
Specimen K = N.P.K fertilizer
Specimen L = Lime

- (b) (i) Many of the candidates did not have difficulty in answering this sub question.

Expected Responses

Uses of Specimen J (Poultry droppings)

- for manuring fish pond
- to feed fish

Uses of Specimen K (N.P.K.)

- fertilize fish pond
- fertilize grass on pond walls

Uses of Specimen L (Lime)

- correct pond water pH
- kill micro organism / sterilize pond
- clears humic strains of vegetation origin

(ii) A few candidates wrongly mentioned methods like foliar application which is specific to crop plants.

Expected Responses

Methods of applying Specimen J (Poultry droppings)

- Broadcasting method
- Sack method

(c) Candidates were required to mention substitutes for specimens J, K and L. The candidates could mention only substitute for specimen J and not substitute for specimens K and L.

Expected Responses

(i) Materials that could be used in place of Specimen J (poultry dropping)

- farmyard manure
- compost
- pig droppings

(ii) Materials that could be used in place of Specimen K (N.P.K.)

- Urea
- Phosphate fertilizer

(iii) Materials that could be used in place of Specimen L (Lime)

- Ash
- Ca(OH)_2
- Calcium oxide (CaO)
- Calcium carbonate (CaCO_3)

(d) (i) Candidates were able to mention only two disadvantages of specimen J;” it is cheaper and readily available”.

Expected Responses

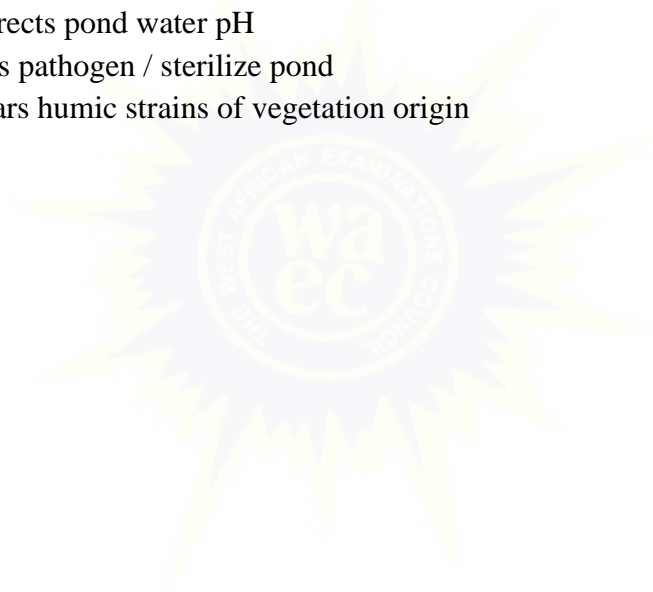
Advantages of Specimen J (Poultry droppings) in fish culture

- slow release of mineral salt
 - environmentally friendly
 - cheaper
 - readily available
 - poultry droppings could be consumed by fish as feed
- (i) Candidates were required to state the role played by specimen L (Lime) in a fish pond. In other words, how is lime important in a fish pond. This was well answered by the candidates who attempted it.

Expected Responses

Importance of Specimen L (Lime)

- corrects pond water pH
- kills pathogen / sterilize pond
- clears humic strains of vegetation origin



FORESTRY 2

1. GENERAL COMMENTS

The standard of the paper was similar to previous years. The performance of candidates was average. However, a few candidates performed creditably to suggest that the trends could change for the better, when teachers of forestry and candidates put in more effort at effective teaching and learning respectively.

2. SUMMARY OF CANDIDATES' STRENGTHS

The following observations were made which could be considered as candidates' strength:

- (1) Orderly presentation of answers by candidates
- (2) Candidates did not copy questions before answering
- (3) Most candidates had legible handwriting
- (4) The segments of the paper that were answered properly are:
 - (a) forest industries in Ghana
 - (b) ways in which forest industries contribute to national economy
 - (c) forestry related careers in Ghana
 - (d) ways in which illegal activities in the forest are detrimental to sustainable forest development
 - (e) explanation of the term nursery
 - (f) factors to be considered when selecting a site for nursery and
 - (g) ways in which nursery is important in forestry.

3. SUMMARY OF CANDIDATES' WEAKNESSES

The weaknesses include:

- (1) Poor English language expressions
- (2) Very long explanations that needed to be concise
- (3) spelling errors such as 'Ancroachment' instead of 'encroachment', seeding instead of 'seedling' 'deplition' instead of 'depletion', 'drinage' instead of 'drainage', 'rais instead of raised, 'degraching instead of degradation among others and
- (4) The areas that were poorly answered include:
 - some definitions of technical forestry terms;
 - the listing of sawn boards which are commonly found on the Ghanaian market
 - star rating classifications and the reasons for carrying out nursery practices.

4. SUGGESTED REMEDIES

The following remedies are considered necessary to stimulate progress in candidates' performance:

- (1) Candidates must do more reading of good English story books to sharpen their English language.
- (2) Candidates should seriously learn the definitions of the terminologies in forestry

- (3) Candidates need to study past questions and the expected responses as well as
- (4) Carefully read questions and understand them before making efforts to handle them.
- (5) Due to lack of adequate number of text books on forestry, it would be good if candidates' brows more from the internet.

5. DETAILED COMMENTS

QUESTION 1

- (a) (i) **Mention four rights governing the use of forest resource in Ghana.**
- (ii) **State two ways in which timber felling rights promote sustainable development of the forest.**
- (b) **Explain four ways in which illegal activities in the forest are detrimental to sustainable forest development.**
- (c) **Explain each of the following terms as used in forestry:**
 - (i) **poaching;**
 - (ii) **encroaching.**

Question 1 was one of the most popular with candidates, but the general performance was erratic.

- (a) Most candidates were unable to figure out the rights governing the use of forest resources in Ghana.

They include:

- Timber Utilization contract
- Timber Utilization Permit
- Salvage Permit
- Admitted right / communal right
- Permit to harvest NTFPs
- alienation right
- hunting permit for some species of animals in and around forest

However, the (a) (ii) on ways in which timber felling rights promote sustainable development of the forest; was handled quiet well by most candidates who attempted that part of Question 1

- (b) Quite a good number of candidates were able to handle this part of the question well. This brought to the fore some level of awareness on the part of candidates about the illegal manipulations of the forest and how unsustainable that could be.

Ways in which illegal activities in the forest are detrimental to sustainable forest development include:

- Illegal felling of trees will lead to destruction of seed trees
 - Illegal farming will destroy wildings and most seeds
 - Illegal mining will destroy most trees
 - Illegal mining will destroy the land
 - Indiscriminate use of fire could destroy a whole forest
 - Illegal felling of trees could lead to over exploitation of resources
 - Illegal hunting using fire or chemical
- (c) Due to difficulty of expression and lack of adequate knowledge on the Poaching and Encroachment, candidates mostly flopped in handling this part of question 1.

The following explanations were required

Poaching - Harvesting of wildlife resources in a protected area without permit

Encroachment – Illegal / Unauthorized / entry into a forest/wildlife reserve / protected area and carry out any activity

QUESTION 2

- (a) (i) **Explain the term invasive plant.**
- (ii) **Give two examples each of invasive plants which are:**
- (α) **hydrophytes;**
- (β) **mesophytes.**
- (b) **State two differences between *evergreen forests* and *savanna* under each of the following characteristics:**
- (i) **rainfall;**
- (ii) **tree height;**
- (iii) **tree form;**
- (iv) **tree bark;**
- (v) **vegetation floor.**
- (c) **State four recreational values of the forest.**

- (a) The question attracted many candidates after which they found out that the (a)(ii) part was quite difficult because it was not clear the crop of plant species that could be described as mesophytes especially. The following answers were expected:

An invasive plant is a plant which has been introduced or is not native to an area and has grown out of control and taken the place of native plant or endemic plant species.

Examples of invasive plants

Hydrophytes

- *Eichornia crissipes* (water hyacinth)
- *Salvinia molesta* (kariba weed)

- *Pistia stratiotes* (water lettuce)
- lemna
- *Nymphaea* spp. (aquatic fern)

Mesophytes

- *Chromolaena odorata* (siam weed / Acheampong)
- *Azadirachta indica* (neem)
- Pulp mulberry
- *Leucaena leucocephala*

(b) The drawing of differences between evergreen forests and savanna under rainfall, tree height, tree form, tree bark and vegetation floor was hectic to a number of candidates. This resulted in very poor handling and therefore poor performance at the question.

Some of the differences include:

Rainfall

- Annual rainfall is high in evergreen forest whilst it is low in savanna
- Rainfall is distributed almost throughout the year in evergreen forest whilst it is restricted to just a few months in savanna.

Tree height

- Trees are tall in evergreen forest whilst trees are short in savanna
- Trees branch at high levels in evergreen forest whilst trees branch at lower levels in savanna

Tree form

- Trees have straight boles in evergreen forest whilst trees have twisted boles in savanna
- Trees are mostly supported with buttresses in evergreen forest, whilst trees usually lack buttresses in savanna

Tree bark

- In the evergreen forests, trees have thin barks, whilst trees in savanna have thick barks / corky barks
- Tree barks are rough/fissured and corky in savanna, whilst tree barks are smooth in evergreen forests

Vegetation floor

- Evergreen forests floors have thick litter covering and humus whilst savanna floor have thin litter covering

- Amount of fauna on the evergreen forest floor is high and low on savanna floors
 - Presence of a lot of seeds on evergreen forest floor but less amount of seeds on savanna floors
 - A lot of weeds on savanna floors whilst evergreen forest floor has low amount of weeds
- (c) Again, candidates could not manage to bring out the recreational values such as; wildlife attracts tourists/ wildlife promotes tourism, keeping of wildlife as pets, trees providing shade for tourists, visitation of national parks as well as ecotourism generating jobs and income.

QUESTION 3

- (a) Explain the term nursery as used in forestry.**
- (b) State five factors to be considered when selecting a site for nursery.**
- (c) State four ways in which nursery is important in forestry.**
- (d) Give three reasons for carrying out each of the following nursery practices:**
 - (i) pest control;**
 - (ii) pricking out;**
 - (iii) watering.**

- (a) Although Question 3 was inviting to a good number of candidates, only a few candidates were able to define or explain the term nursery as a place where young seedlings are raised before they are out planted on to the field.
- (b) Additionally, candidates struggled to bring out the factors to consider when selecting a site for a nursery.

Some of the factors to consider are:

- Nursery must be located close to the planting site
 - Nursery soil should be well drained
 - Nursery should be located near a dependable inexpensive source of water
 - Nursery land should be levelled or gently sloping
 - Nursery should be accessible for ease of transport
 - Nursery should not be located at a crowded / congested place
 - Nursery should not be located in a waterway or the flood plain of a river
- (c) This part of the question was tackled by most candidates with measured difficulty. Few candidates could not give responses to this part at all.

Most candidates gave answers like:

- Nurseries give the opportunity for seed protection and development into seedlings

- Ensures that diseases and pests are easily controlled at the early stage of development
 - Seedlings are protected against the sun and heavy rains
 - Enough care is given to the seedlings
 - Seedlings can have uniform growth
 - Excess seedlings could be kept in the nursery for another planting season
- (d) A good number of candidates had a handle on this part of the question to demonstrate their sound tutorials on nursery practices.

QUESTION 4

- (a) **Explain each of the following terms as used in forestry:**
- (i) **wolf trees;**
 - (ii) **whip trees;**
 - (iii) **crown thinning.**
- (b) (i) **Mention two techniques which could be used in carrying out canopy opening in forest stands.**
- (ii) **Describe each of the techniques mentioned in (b) (i).**
- (c) **Give one reason for carrying out each of the following activities in forestry:**
- (i) **low thinning;**
 - (ii) **selective thinning;**
 - (iii) **pollarding.**

This question was least popular and therefore very few candidates attempted it. The prohibitive nature of the question to candidates suggested that the tutorials they had on forestry terminologies did not span wolf trees, whip trees, crown thinning, low thinning, selective thinning and perhaps pollarding explained as follows:

Wolf trees

These are very large trees with broad crown / long branches and a short main stem.

Whip trees

These are tall trees with slender, unbranched stems

Crown thinning

Selective removal of stems and branches to increase light penetration and air movement throughout the canopy of a stand

The techniques employed in canopy opening was also not familiar with candidates which them stimulated avoidance of the entire question.

The following responses were expected:

Ring barking: - Involves removing of a strip of bark from around the complete circumference of a bole

Girdling: - It involves cutting into the wood in a continuous circle round the bole

Poisoning: - The application of poisonous chemicals to the wood after removing the bark

Hormones: - Application of a plant hormone to the wood after removing the bark

Reasons for carrying out the following forestry activities are

Low thinning

- Removing dead, dying and weak trees from a stand to increase light penetration and allow space for growth.

Selective thinning

- Removing of trees of a particular species, size/diameter or height to allow growth space and improve light penetration

Pollarding

- to promote branching / lateral growth of the trees

In view of these circumstances, candidates must be encouraged to explore additional forestry terminologies and techniques from the very few text books and also from the internet.

QUESTION 5

- Mention five forest industries in Ghana.**
- Explain four ways in which forest industries contribute to the national economy.**
- List four forestry related careers in Ghana.**
- List three sawn boards which are commonly found in the Ghanaian market.**

This was the most popular question attempted by candidates. Most candidates who attempted did very well.

It is important to note that candidates were more innovative with sub-question (c) and this expanded the marking scheme to include researchers, teachers, chainsaw operators, mushroom producers, bee keepers, snail framers, herbalists and pharmacists.

QUESTION 6

- (a) **Explain the term annual allowable cut as used in forestry.**
- (b) **Explain each of the following star rating classifications as used in forestry:**
 - (i) **Scarlet star;**
 - (ii) **Red star;**
 - (iii) **Pink star.**
- (c) **Give one example each of tree species found in each of the star rating classifications explained in (b).**
- (d) **Explain each of the following terms:**
 - (i) **felling cycle;**
 - (ii) **property mark.**
- (e) **State the recommended felling cycle in Ghana.**

This was one of the unpopular questions attempted by candidates. The general performance on this question was poor.

- (a) Candidates had it tough explaining the term annual allowable cut as used in forestry. However, a few candidates demonstrated they had good knowledge of what the terminology meant by paraphrasing.

Annual Allowance cut is that part of the yield or increment on the trees that may be removed without jeopardizing the growing stock on future yield of the forest.

- (b) The few candidates who attempted handling this sub-question performed poorly due to inadequate knowledge on the star rating classifications.

Explanation of star rating classifications

- (i) Scarlet star

These are the most popular trees in the timber trade and therefore tend to be over exploited. These trees are harvested at rates of two times or more, than the sustainable level.

- (ii) Red star

These are tree species that have high demand on the market. They are harvested at more than 50% and less than twice the sustainable rate

- (iii) Pink star

These are species not so well known and are often not popular on the timber market and not liked by timber merchants. They are only harvested at less than 50% their sustainable level.

(c) Candidates again, performed poorly in this sub-question due to very limited insight on the level of usage of the tree species.

Examples of tree species found in each of the star rating classification include:

(i) Scarlet star

- Odum
- Mahogany
- Sapele
- Wawa
- Denya

(ii) Red star

- Kyenken
- Onyina / ceiba
- Hyedua
- Emire
- Dahoma

(iii) Pink star

- Otie
- Esa
- Danta
- Afena
- Ofram

(d) The explanation of the terms ‘felling cycle’ and ‘property mark’ were poorly handled by candidates.

The expected explanations are:

Felling cycle

The time taken to work over the whole area of a forest reserve. It may be short such as 10 years or 20 years or may be as long as 40 years or 50 years depending on the objectives of management and the length of time it takes the tree species to grow from one girth class to another.

Property mark

It is the mark / code of the timber contractor or concessionaire that enhances identification and ownership of timber logs.

(e) Very limited number of candidates were able to give correct answer to this sub-

FORESTRY 3

1. GENERAL COMMENTS

The standard of the paper was comparable to the previous years. There was a little improvement in this year's performance over that of last year.

2. SUMMARY OF CANDIDATES' STRENGTHS

The Chief examiner observed the following strengths:

- (1) Candidate's handwriting was legible
- (2) Almost every candidate answered all the four questions required
- (3) The areas that candidates performed well include:
 - (a) uses of each of specimens B and C; (Axe and Shovel)
 - (b) ways of maintaining specimen C;
 - (c) uses of each of specimens D and E; (Oil palm fruit and sawdust)
 - (d) drawing and labeling of specimen F; (Mushroom)
 - (e) steps involved in raising specimen H (seedling in black polybag) for outplanting.

3. SUMMARY OF CANDIDATES' WEAKNESSES

The candidates exhibited the following weaknesses:

- (1) Poor command of the English Language;
- (2) Spelling mistakes of technical terms, common among them were: stipe, stalk, pileus, mycelium and gills which are the parts of mushroom, were wrongly spelt as stype, stock pileuse, pyleus, mycerium and grills respectively;
- (3) Students of a particular school answered questions on a flat file which is used to keep tetterers and other papers instead of the metallic file used to sharpen forestry tools. This is specimen A in question 1(a) and 1(b). This serious mistake would have been made by the master who collected the specimens for their candidates. This is because the performance of those candidates in the other questions were quite encouraging;
- (4) Some candidates also mixed-up question numbers and solutions. For example, answers which were supposed to be for question 2(a) were given to question 2(d).
- (5) Areas which were poorly answered include:
 - (a) Main uses of specimen A (Flat file) to the forestry;
 - (b) Precautions that should be taken when using specimen B (Axe);
 - (c) By-products obtained from the processing of timber;
 - (d) Ways in which specimen G (Snail) is of economic importance;
 - (e) Reasons why black polybags are used for nursing seedlings.

4. SUGGESTED REMEDIES

- (1) Candidates must answer past questions to get acquainted with the nature of questioning.
- (2) The candidates must read many story books to improve upon their usage of the English language
- (3) Candidates should be given more exercises in their various schools

5. DETAILED COMMENTS

QUESTION 1

- (a) **Draw and label specimen A.**
- (b) **State the main use of specimen A to the forester.**
- (c) **Give three uses of each of specimens B and C.**
- (d) **State three precautions that should be taken when using specimen B.**
- (e) **State two ways of maintaining specimen C.**

This question was very popular with the candidates and the general performance was not bad.

- (a) Some candidates drew the flat file used for keeping documents in offices instead of the tool.

All the labeling should be in horizontal direction. The arrows could however go in any direction. The arrows should be simple (--) and not the spear type (→).

- (b) The main use of specimen A (Flat file) is for sharpening cutting tools)
- (c) Uses of specimen B (Axe) include: for felling trees for cross cutting, for pruning, for splitting or for dividing wood.

Uses of specimen C (Shovel) are: for planting, weeding, loading for construction of beds, digging and for creating trenches.

- (d) **Precautions taken when using B.**
 - Ensure that there are no obstacles around
 - Should be held firmly
 - Ensure the wooden handle is strong
 - The operator should be fit / should not be drunk

(e) **Maintenance of specimen C (Shovel)**

Clean and dry after use. Grease blade when not in use. Store in termite free area when handle is made of wood. Store in dry place.

QUESTION 2

(a) **Mention the group of forest products in which each of specimens D and E could be placed.**

(b) **Give four uses of each of specimens D and E.**

(c) **Name five other by-products obtained from processing of timber.**

This question did not pose much problems to candidates and hence they obtained good marks. The answers they provided include:

(a) Oil palm fruit (specimen D) – Non-Timber Forest Product
Sawdust (specimen E) – Timber forest product

(b) Uses of palm fruit

- It is used for producing palm oil
- palm kernel used as fuel
- oil palm as food for humans
- palm fruit as feed for animals

Uses of sawdust

- used as fuel
- used to claim water logged land
- used as cushion in sporting activities
- used in moulding porous block
- used for growing mushroom
- used in poultry farming
- used for mulching

(c) Other by-products from processing timber

- wood shavings
- bark of logs
- plywood edges
- round core
- wood offcuts
- wood slabs

QUESTION 3

- (a) Draw and label specimen F.**
- (b) Outline the steps involved in producing specimen F by the compost method.**
- (c) State four ways in which specimen G is of economic importance.**

This question was popular among candidates and the performance was average.

(a) The drawing of the gill of the specimen was poorly answered by most of the candidates.

(b) Steps involved in the production of specimen F (mushroom) by compost bag method. The steps are:

- composting of substrate
- bagging the substrate
- sterilizing the bagged substrate
- inoculation
- cropping / harvesting

(c) Ways in which specimen G (Snail) is of economic importance. This question was surprisingly answered poorly by most of the candidates. The answers should be

- it serves as food
- shell as animal feed
- as a source of income
- shell for making terrazzo
- it destroys nursery seedlings

QUESTION 4

- (a) Outline the steps involved in raising specimen H for outplanting.**
- (b) Give three reasons for raising seedlings as in specimen H.**
- (c) Give two reasons why black poly bags are used for raising seedlings.**

(a) Only few candidates were able to answer this question well. However, it was not totally poor.

The steps involved are:

- obtain black polybags/polypots
- fill with forest soil to the brim
- firm the soil
- water the potted soil
- transplant seedlings or sow seeds in pots
- water again

- carry out regular cultural practices
- harden seedlings when ready for outplanting

(b) Most candidates gave wrong answers to this question. It was one of the poorly answered questions.

The answers should be:

- difficulty of tiny seeds to germinate on the field
- ensure survival of the seedling
- ease of controlling diseases and pests
- difficulty of monitoring young seedlings on the field/carry out nursery practices on the field

(c) This question was the overall poorest answered question.

The answers to the questions are:

- black material / pot block the entry of light which might promote the growth of algae and fungi
- roots grow or develop best in dark environment
- termites may not find it easy attacking roots of some seedlings in black poly bags

GENERAL AGRICULTURE 2

1. GENERAL COMMENTS

The standard of the paper compared favourably with that of previous years with respect to content, syllabus coverage and level of difficulty.

The performance of candidates was generally better than the previous year.

2. SUMMARY OF CANDIDATES' STRENGTHS

- (1) Candidates have adequate knowledge on the advantages for using inorganic fertilizers in crop production.
- (2) They have good knowledge on soil water conservation.
- (3) Candidates also had good knowledge of the contribution of cover crops to soil and water conservation.
- (4) They have very good knowledge of marketing functions of agribusiness.
- (5) candidates also showed good knowledge of animal husbandry practices such as dehorning and culling.

3. SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Candidates still could not spell correctly technical words, scientific terms and names of crops.
- (2) Majority of the candidates could not explain the chemical weathering process of hydrolysis, oxidation and solution hence could not explain how water causes weathering in rocks.
- (3) They could not give reasons why farm holdings are generally small in West Africa.
- (4) Candidates could not come out with disadvantages of farm mechanization.
- (5) They had little information about the aims of animal improvement in West Africa.
- (6) Some candidates failed to read the questions well. Thus, some gave more points than was required. This was a waste of time for both candidates and examiners.
- (7) Some answers could not be recognized quickly because of poor English expressions. This is not an English paper, but marks can only be awarded when the point is made right.

4. SUGGESTED REMEDIES

- (1) Tutors should teach the scientific terms and names properly.
- (2) There should also be proper teaching of the chemical processes of weathering.
- (3) Tutors should highlight topics identified as candidates' weaknesses.

5. DETAILED COMMENTS

QUESTION 1

- (a) (i) Give three reasons why disc ploughs are frequently used on soils in West Africa.
- (ii) State four effects of the frequent use of the disc plough on soils.
- (b) (i) Explain the term irrigation.
- (ii) State four disadvantages of overhead irrigation.

(a) (i) Generally, only a few candidates attempted this sub question and they scored low marks.

Majority of the candidates could not give reasons why disc ploughs are frequently used in tropical soils, an indication that the candidates did not know the robust nature of the disc plough.

Expected Response

Reasons why disc ploughs are frequently used on soils in West Africa

- its rolling action permits work on lands with stones
- allows work on soils with stumps
- permits work on lands with slippery/clayey/heavy soils
- it partially turns over soil slices, so grass turfs left help to minimize soil erosion
- tropical soils are usually shallow and therefore it helps to improve soil depth for crop root penetration

(ii) Most of the candidates answered this sub question quiet well. They were able to state the effect of frequent use of the disc plough on soils as demanded by the sub question.

Expected Response

Effects of frequent use of disc plough on soils

- soil pulverization / destruction of soil structure
- soil compaction / formation of hard pan
- poor drainage / poor water percolation
- high water loss from soil surface/evaporation
- causes soil erosion

(b) Majority of the candidates did not find it difficult in explaining the terms irrigation' and stating the disadvantages of overhead irrigation.

Expected Response

(i) Explanation of the term Irrigation

It is the process of artificially applying water to the soil for crop use.

(ii) Disadvantages of overhead irrigation

- expensive in terms of equipment
- heavy droplets damage delicate growing crop
- may damage soil structure
- not efficient in windy areas
- requires high amount of power
- needs a stable water supply for most economical use of equipment
- water must be clean, free of sand and debris
- large amount of water dissolve salts
- leads to spread of diseases
- requires technical know-how/skill to operate

QUESTION 2

(a) **State:**

(i) **two advantages;**

(ii) **four disadvantages;**

of the communal land tenure system.

(b) **Give three reasons why farm holdings are generally small in West Africa.**

(c) **State four disadvantages of farm mechanization.**

Majority of the candidates attempted this question. In part (a), most of the candidates were able to state the advantages and disadvantages of the communal land tenure system.

In part (b), candidates performed poorly generally in giving reasons why farm holdings are small in West Africa. Candidates were baffled by the word 'holdings' as used in the question. In part (c), most candidates lost marks because they were not able to state the advantages of farm mechanization correctly. They limited their answers to only the effect on the soil.

(a) **Expected Response**

(i) Advantages of communal land tenure system

- every member of the community has a right to the land
- government can acquire land easily for public use
- cooperative farming is possible
- land acquisition is sometimes at no cost to community members

(ii) Disadvantages of communal land tenure system

- land cannot be used as collateral for loans
- non-community members do not easily have access to land
- each member is only allocated a small piece of land
- litigation on land / problem with sharing of land
- excessive land segmentation leads to uneconomic use of land
- land fragmentation prevents mechanization
- difficulty in cultivating permanent tree crops
- individuals cannot sell land
- large plots of land may be left undeveloped.

(b) Reasons why farm holdings are generally small in West Africa

- unfavourable land tenure systems
- inadequate capital
- inadequate use of farm machinery and implement
- inadequate processing facilities
- poor rural infrastructure
- poor marketing system
- prevalence of pests
- inadequate storage facilities
- fear of failure due to high risk
- prevalence of diseases

(c) Disadvantages of farm mechanization

- creates unemployment /displaces human labour
- may destroy soil structure
- fumes from machinery pollutes the environment
- expensive to practice
- requires skilled labour to operate and maintain/unavailability of technological know-how

QUESTION 3

(a) What is inorganic fertilizer?

(b) Give four advantages for using organic fertilizers in crop production.

(c) State two ways in which cover crops contribute to soil and water conservation.

(d) Describe four methods of applying inorganic fertilizers in crop production.

Majority of the candidates attempted this question and generally performed well especially in sub question (a), (b) and (c). A few of the candidates had challenges in answering sub question (d) i. e. method of applying inorganic fertilizer and the spelling of technical terms.

Candidate should be made aware that 'Top dressing' is not a method of applying fertilizer. It is a way of applying fertilizer in two dosages and can be practiced using any of the methods of application.

Expected Responses

(a) Explanation of inorganic fertilizer

Any synthetic/manufactured chemical substance which releases nutrients for plant use.

(b) Advantages for using organic fertilizers in crop production

- releases nutrients gradually/add nutrients to soil
- contains both macronutrients and micronutrients
- stabilizes soil pH through its buffering effect
- regulates soil temperature
- provides feed for soil microbes
- reduces leaching of soil nutrients
- improves soil structure/binds soil particles
- improves water-holding capacity of soil
- checks soil erosion
- cost is relatively low

(c) Contribution of cover crops to soil and water conservation

- produce litter which decay to improve soil structure\bind soil particles
- decayed litter adds nutrients to soil
- reduce impact of rain drops on soil
- reduce the rate of evaporation of water from the soil/improve water-retention in soil
- reduce the speed of run-off water hence check erosion
- minimize the effect of wind on soil surface
- create suitable soil micro climate for soil organisms

(d) Methods of applying inorganic fertilizers

- broadcasting
- band / side placement / row placement/side dressing
- ring application
- foliar application / spraying
- fertigation
- drilling method

QUESTION 4

- (a) Enumerate four farming practices which could lead to soil and water loss.**
- (b) State three ways in which water causes weathering of rocks in West Africa.**
- (c) Discuss three factors that influence soil erosion.**

Only a few candidates attempted this question and had low marks. In (a), candidates were expected to enumerate farming practices that could lead to soil and water loss but some candidates rather mentioned drainage, rainfall and wind which are not farming practices. The expected responses are as follows:

- (a) Farming practices that could lead to soil and water loss
 - improper tillage practices eg ploughing along the slope
 - continuous cropping
 - overgrazing
 - continuous use of farm machinery e.g. ploughing
 - clean clearing of farm lands
 - bush burning

- (b) This part was also poorly answered by candidates. Knowledge on hydration, hydrolysis and solution could have helped the candidates score higher marks.

Expected Response

Ways in which water causes weathering of rocks

- force of rain droplets
 - glacier/moving water e.g., rivers
 - freezing of water in rock crevices
 - hydration- rigid attachment of water to rock minerals resulting in chemical alteration of mineral and separating from others.
 - solution – water dissolves soluble minerals and carries them off.
 - hydrolysis – reaction of water with rock mineral to form a new compound results in disintegration.
- (c) The few candidates that answered this sub question were able to state the factors that influence soil erosion but could not properly discuss the factors. Candidates were to mention both the positive and negative effects of the factors.

Expected Response

Factors influencing soil erosion

- Vegetation cover of the area
- Topography /slope of land
- Structure of the soil
- Amount/ intensity of rainfall/water
- Speed of wind/wind
- Human activities
- Organic matter content of soil
- Texture of soil

QUESTION 5

- (a) Describe five cultural methods of controlling crop pest.**
- (b) List four grasses that are used for lawn establishment in West Africa.**
- (c) Give one example of insect pests with the following mouth parts:**
 - (i) boring;**
 - (ii) piercing and sucking.**

(a) Most of the candidates answered this sub question. A few of them answered it satisfactorily by describing the cultural methods of controlling crop pest while majority of them were describing general methods like chemical control and biological control.

Expected Response

Cultural methods of controlling crop pest

- Crop rotation
- Time of planting
- Time of harvesting
- Burning
- Good farm sanitation
- Flooding
- Tillage operations
- Use of pest-resistant varieties
- Weed control

(b) A greater percentage of the candidates who answered this sub question were able to mention the appropriate grasses used for preparing lawns.

Expected Response

Examples of Grasses for lawn establishment

- Carpet grass / savanna grass
- love grass / Tafo grass/Tuttiri
- Japanese turf grass /Japanese cushion grass
- St. Augustine grass
- Bermuda grass / Bahama grass / Doob grass / Devil grass
- Paspalum
- Buffalo grass

(c) Candidates could mention insects with boring mouth parts and those with piercing and sucking mouth parts, but some candidates mention any pest they could remember.

Expected Response

(i) Examples of Boring insects

- Leaf miner
- American bollworm
- Weevil
- Mediterranean fruitfly
- Mango fruitfly
- Budworm
- Thrips
- Beetles
- Stem borer/fruit borer/pod borer

(ii) Examples of Piercing and sucking insects

- Aphids
- Cotton stainers
- Leaf hoppers
- Mealy bugs
- Plant bugs
- Scale insects
- White flies
- Capsids/Mirids
- Fruit moths
- Cotton bollworms

QUESTION 6

- (a) (i) **What is grafting as used in crop propagation?**
(ii) **Explain four factors that influences graft success.**
- (b) **State six measures that could be used to control insect-pests of stored grains.**

(a) Most of the candidates who attempted this question performed poorly. In an attempt to explain grafting, candidates had challenges with the correct spelling of the terms 'stock' and 'scion'. Most of the candidates also failed to state that the stock and the scion should come from the same species.

It is also important to mention that the parts to be joined should be two stems and not any other plant parts such as bud. This will differentiate grafting from budding.

Candidates were able to mention the factors that influence graft success but were not in a position to explain the factors and this contributed to the low marks for this question.

Expected response

- (i) Explanation of grafting as used in crop propagation

It is the union / joining of the cambium layers of two plant stems of the same species to grow as one plant

- (ii) Factors that influence graft success

- compatibility of scion and stock – same species
- skills and knowledge of the operator
- environmental factors eg temperature, humidity
- alignment of stock and scion
- disease infection
- diameter of stock and scion
- physiological stage/age of stock and scion

(b) Most of the candidates stated a few of the measures that is used to control insect pests of stored grains. Other candidates did not take note of the word 'insect' and gave answers for controlling other pest such as rodents and birds.

Expected Response

Measures to Control insect pest of stored grains

- use of concrete floors and rooms
- timely harvesting
- removal of infested grains before storage
- proper drying of grains before storage

- fumigation / cleaning of storage area before storage
- treat grains with appropriate insecticide before storage
- hermetic storage could be done/use of airtight bags
- stores should be well ventilated but water proof
- store should be inspected regularly to detect and control pest
- use of smoke in a local setting

QUESTION 7

(a) Explain each of the following terms as used in animal production:

- (i) flushing;**
- (ii) tethering;**
- (iii) weaning.**

(b) Give two reasons why maintenance ration is important in animal production.

(c) State three benefits of each of the following animal husbandry practices:

- (i) culling;**
- (ii) dehorning.**

(d) Mention two major sources of minerals in animal nutrition.

(a) This sub question was answered by most candidates and they scored almost all the marks. However, in the explanation of flushing, the emphasis on 'female animal' and 'before servicing' did not come out clearly.

Explanation of terms

(i) Flushing

It is the giving of female animals highly nutritious diet just before servicing to increase the level of fertility and chances of multiple births.

(ii) Tethering

Tying of animals by their neck / legs to stumps / trees / rocks with rope to restrict their movement.

(iii) Weaning

It is the process of separating young animals from their mothers and introducing them to solid feed.

(b) Most of the candidates who attempted this question could not give reasons why maintenance ration is important. The responses were on importance of farm animals, an indication that the candidates did not get the requirement of the question,

Expected Response

Importance of maintenance ration in animal production

- sustains basic physiological activities/meet basic nutritional requirements
- prevents malnutrition / ensures that animals develop properly
- maintain body weight of animal

(c) This part was well answered by the candidates who attempted it. Candidates were able to give the benefits of culling and dehorning as animal husbandry practices. This is an indication that the candidates had adequate knowledge in animal husbandry management practices.

Expected Response

(i) Benefits of culling in animal husbandry

- reduces the spread of diseases among animal
- reduces overcrowding
- helps get rid of unproductive/ sick animals
- reduces cost of feeding
- isolate for treatment

(ii) Benefits of dehorning in animal husbandry

- animals are less dangerous to handle
- reduces injury caused by the animal to other animals/minimizes fighting
- transporting animal is easier
- makes more space available in kraal / pen
- animals are not entangled when feeding on natural pasture
- reduces damage to hide of animals
- reduces injury caused by animal to farmer

(d) Candidates could not come out with sources of minerals in animal nutrition. They could only mention bone meals as the source of mineral in animal nutrition.

Expected Response

Major sources of mineral in animal nutrition

- blood meal
- bone meal
- calcium phosphate
- granulated oyster shell / egg shell
- salt lick
- common salt

QUESTION 8

- (a) **State three aims of animal improvement programmes in West Africa.**
- (b) **State four characteristics of the deep litter system of poultry keeping.**
- (c) (i) **What is fish farming?**
 - (ii) **List three structures that are used for growing fish in West Africa.**
 - (iii) **List four methods of preserving fish in West Africa.**

- (a) Animal improvement is aimed at altering the traits of the farm animal to alter its economic importance.

Candidates were rather mentioning the importance of animal production.

Expected Response

Aims of animal improvement in West Africa

- increase quantity of animal product e.g. meat, milk, egg
- increase quality of animal product eg. carcass, meat
- enhance growth rate of animals
- increase resistance to diseases
- increase resistance to pests
- promote adaptability to local environment
- produce animals with high feed conversion efficiency

- (b) In this part, candidates were to state the characteristics of the deep litter system of poultry keeping but candidates rather stated the advantages of that system, an indication that the question was not well understood.

Expected Response

Characteristics of the deep litter system of poultry keeping

- birds are confined in well ventilated house
- house has concrete floor
- floor is covered with litter
- provision of foot bath at the point of entry
- long wall of building facing east-west direction
- provision of feeding and watering troughs

- (c) Candidates did not have difficulty in answering the question. They could define fish farming, mention structures for growing fish and stated some methods of fish preservation.

Expected Response

(i) Meaning of fish farming

The controlled rearing of fish in water.

OR

The practice of rearing fish in a confined water body

(ii) Structures used for growing fish

- earthen ponds
- cages
- concrete tanks/tanks
- raceways
- fish pens
- aquarium

(iii) Methods of preserving fish

- smoking
- drying
- canning
- salting/brining
- freezing
- cooking/boiling/steaming/grilling
- pickling/use of chemicals
- frying
- irradiation

QUESTION 9

(a) (i) What is agribusiness?

(ii) Outline the steps involved in setting up an agribusiness.

(b) Enumerate four marketing functions in agribusiness.

(c) Outline two roles of universities in agricultural extension

- (a) Candidates could define agribusiness but the aspect of 'profit making' did not come out clearly. Candidates did not understand the demand of (a) ii. They rather mention factors to consider when setting up a business such as Land and Capital instead of the steps in setting up an agribusiness.

Expected Response

(i) Meaning of Agribusiness

It is a profit-making enterprise that trades in agricultural products or services.

(ii) Steps involved in setting up an Agribusiness

- Market survey
- Choice of agribusiness type/decision-making
- Selection of business location
- Sourcing for initial investment capital
- Registration of Business
- Opening of Bank accounts
- Acquiring the needed resources
- Commencing the business

(b) Candidates had adequate knowledge in the marketing function in agribusiness and they score high marks in this part.

Expected Response

Marketing functions of Agribusiness

- Assembling
- Sorting
- Grading
- Processing
- Storage
- Transportation
- Financing
- Distribution
- Packaging
- Advertising

(c) Some candidates could only state the general roles played by universities such as research.

Expected Response

Role of Universities in Agricultural extension

- train Extension Agents
- make available research findings to Extension Agents
- develop and introduce better agricultural practices
- design and develop farm tools and implement
- organize training / workshops for farmers
- design and develop innovative ways of teaching farmers

QUESTION 10

- (a) **Distinguish between short term credit and long-term credit in agricultural financing.**
- (b) **State two demerits of each of the following sources of agricultural credits.**
- (i) **individuals;**
 - (ii) **cooperatives;**
 - (iii) **government;**
 - (iv) **money lenders.**
- (c) **State four characteristics of an effective extension system.**

(a) Generally, all the candidates who attempted this sub question performed below expectation. Those who attempted this question could not differentiate between 'long term credit' and 'short term credit'

Expected Response

Difference between *short term credits* and *long-term credits*

Short term credits have repayable periods usually less than 2 years while long term credits are repayable usually within 6 – 35 years.

(b) This question was not well understood by candidates. Candidates were to state the challenges one is likely to face when acquiring credit from such sources to fund his agricultural projects.

Expected Response

- (i) Demerits of Individuals sources of credit
- not always available
 - not very reliable / amount needed may not be granted
 - untimely demand for repayment
 - high interest rate
- (ii) Demerits of Cooperatives sources of credit
- loans not given on time
 - do not always have money for members
 - poor credit management
 - too much bureaucracy
- (iii) Demerits of Government sources of credit
- high level of bureaucracy
 - collateral may be needed depending on the amount

- loan not given on time
- too rigid and does not take the requirement of the individual into consideration
- often governed by political consideration rather than economic considerations

(iv) Demerits of Money lenders sources of credit

- high interest rates
- not always reliable
- untimely demand for repayment
- not always available

(c) Candidates who attempted this sub question confused the characteristics of an effective extension system with the characteristic of agricultural education such as 'learners are usually adult'. Candidates did not understand the requirement of this sub question.

Expected Response

Characteristics of an effective Extension System

- adequate financial support
- effective training of personnel
- effective linkages with researchers and farmers
- farmers involved in all phases of Extension programmes
- good salary and incentives for personnel
- good transportation system
- strong administrative support
- monitoring and evaluation
- good communication among stakeholders

GENERAL AGRICULTURE 3

1. GENERAL COMMENTS

The standard of the paper compared favourably with that of previous years with respect to content, syllabus coverage and level of difficulty.

The performance of candidates was better this year than the previous year.

2. SUMMARY OF CANDIDATES' STRENGTHS

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

- (1) Knowledge of maintenance of knapsack sprayer as a simple farm tool.
- (2) Names of farm animals from which gizzard could be found.
- (3) Correct identification of garden eggs, gizzard pepper etc.
- (4) Candidates could mention pests and diseases of garden eggs.
- (5) Knowledge of cause of soil acidity.
- (6) Knowledge of local methods of preserving pepper such as curing and drying.

3. SUMMARY OF CANDIDATES' WEAKNESSES

The following weaknesses were noticed in the scripts of candidates:

- (1) Poor construction of sentences that made it extremely difficult for examiners to comprehend.
- (2) Inability to mention the effect of soil acidity on crop production.
- (3) Inability to outline steps involved in carrying out experiment to determine soil acidity.
- (4) Wrong spellings of technical terms and scientific names.
- (5) Could not prepare the profit and loss account very well.

4. SUGGESTED REMEDIES

The Chief Examiner made the following suggestions meant to remedy the weaknesses of candidates:

- (1) Teachers should periodically use question and answer to drill students on scientific words and technical terms
- (2) Teachers should give exercises involving preparation of profit and loss account
- (3) Teachers should organize more practical lessons involving identification of specimens

5. DETAILED COMMENTS

QUESTION 1

- (a) (i) **Give the family name of specimen A.**
(ii) **Name three varieties of the crop from which specimen A was obtained.**
- (b) **Name three pests and two diseases that attack the crop from which specimen A was obtained.**
- (c) **Mention three uses of preserving specimen B.**
- (d) **State three ways of preserving specimen B.**

- (a) (i) The candidates could mention the family name, however, a few of them had problems with the correct spelling.

Expected Response

Family name of Specimen A (Garden egg)

- Solanaceae

- (ii) Few candidates were only familiar with Antropo, Obolo black beauty and Aubergine

Expected Response

Varieties of Specimen A (Garden egg)

- Turkey berry
- Thai egg plant
- Aubergine
- White / White beauty / Long white / Round white egg plant
- Casper egg plant
- Fairytail egg plant
- Indian egg plant
- Black beauty egg plant
- Diamond egg plant
- Japanese egg plant
- Purple / Long purple egg plant
- Antropo
- Obolo

- (b) (i) The common pest that candidates were familiar with were grasshoppers, whiteflies and nematodes.

Expected Response

Pest of Specimen A (Garden eggs)

- Bollworm / *Heliothis* spp.
- Grasshopper / *Zonocerus* spp.
- Epilachna beetle / *Epilachna* spp.
- Cutworm / *Spodoptera* spp.
- whiteflies
- aphids
- leafhoppers
- crickets
- plant / leaf bugs
- nematodes
- moths / caterpillar
- Red spider mite / mites
- *Urentius* spp.
- *Selepa docilis*
- Rodents

(b) (ii) The common examples of diseases of garden eggs cited by candidates included mosaic, fruit rot and leaf curl.

Expected Response

Diseases of Specimen A (Garden egg)

- | | |
|-----------------|-------------------|
| - Fruit rot | - Anthracnose |
| - root rot | - Bacteria canker |
| - Fusarium wilt | - Bacteria wilt |
| - Leaf curl | - Damping off |
| - root knot | - Collar rot |
| - Early blight | - Millet rust |
| - Mosaic | - Powdery mildew |
| - Rust | |

Sub questions 1 (c) and (d) were answered very well by the candidates who attempted them.

(c) **Expected Response**

Uses of Specimen B (Hot pepper fruit)

- preparing drinks
- preparing food / garnishing
- flavouring / seasoning of food/spice

- medicine / medicinal purpose

(d) **Expected Response**

Preservation of Specimen B (Pepper)

- curing
- drying
- refrigeration / freezing
- canning
- pickling

QUESTION 2

- (a) **Mention two nutrients that a lamb obtains from drinking specimen C.**
- (b) **Name three animals from which specimen C could be obtained.**
- (c) **List three products that could be obtained from the processing of specimen C.**
- (d) (i) **Mention the function of specimen D in farm animals.**
- (ii) **State three characteristic features of specimen D that enable it to perform efficiently the function mentioned in (d)(i).**
- (iii) **Name three farm animals from which specimen D could be obtained.**

- (a) Candidates could mention the nutrients obtained from fresh milk in general, however, they could not mention the specific vitamins such as vitamin D, B2. and B12

Expected Response

Nutrients in Specimen C (Fresh milk)

- fat
- protein
- water
- calcium
- potassium
- vitamin D
- vitamin B2 / Riboflavin
- vitamin B12
- carbohydrate / lactose

Sub questions (b), (c) and (d) were answered well by all the candidates who attempted it. In (c), the candidates were able to mention only cheese, and ice cream and not the others. A few candidates also had challenges with (d) ii, the characteristics of the gizzard.

(b) **Expected Response**

Animals from which specimen C (milk) could be obtained

- | | |
|-------------------|-----------------|
| - Ewe/sheep | - camel |
| - Cow/cattle | - donkey |
| - Nanny goat/goat | - horse |
| - Sow/pig | - water buffalo |
| - Reindeer | - Yak |

(c) **Expected Response**

Products that could be obtained from processing Specimen C (milk)

- casein
- Butter
- Ice cream / cream
- Cheese
- Confectioneries
- Yoghurt
- Whey
- Body cream
- Skim / skimmed milk
- Powdered milk

(d) (i) **Expected Response**

Function of Specimen D (Gizzard)

- grinding of feed
- churning of feed

(ii) **Expected Response**

Characteristics of Specimen D (Gizzard)

- Thick muscular wall
- Contain small stones / pebbles/ grits
- Rough inner surface / Tough corrugated membrane

(iii) **Expected Response**

Farm animals from which specimen D (Gizzard) could be obtained

- Domestic fowl/ chicken
- Turkey
- Guinea fowl
- Quail
- Duck
- Ostrich
- Goose
- Dove

QUESTION 3

- (a) Outline the steps involved in using specimen E in the control of pest on the farm.**
- (b) State five precautions that should be taken when using specimen E to control pest on the farm.**
- (c) Mention five farm maintenance practices that could be carried out on specimen E.**

(a) Candidates could mention the steps involved in the use of knapsack sprayer but a few of them missed the sequence.

Expected Response

Steps when using Specimen E (Manual Knapsack sprayer)

- fill knapsack sprayer with spray liquid
- tighten the lid
- put knapsack sprayer on your back / mount sprayer
- build pressure in tank by lifting pump lever up and down
- direct nozzle to the crop to be sprayed
- open valve to control amount of chemical to be dispensed at a time
- if pressure is lost, build it up by lifting pump lever up and down

(b) Candidates only focused on the protective items like goggles, boots, gloves. The other precautionary measures such as do not eat or drink when spraying, were not mentioned.

Expected Response

Precautions when using specimen E (Knapsack sprayer)

- wear rubber gloves
- wear protective dresses e.g. long sleeves, long trousers
- wear goggles
- wear rubber boots
- do not spray when it's about to rain
- ensure lid is well tightened / tank is well covered
- spray when it is not windy early morning or late evening
- spray along the direction of the wind
- do not eat when using Specimen E
- do not drink when using Specimen E

(c) Candidates are familiar with maintenance of most farm tools and equipment, and they applied the principle in this sub-question.

Expected Response

Maintenance of Specimen E (Knapsack sprayer)

- depressurize when not in use
- lubricate moving metal parts
- wash tank immediately after use
- replace defective parts e.g. nozzles cracked hose
- tighten loose parts
- store in cool dry place

QUESTION 4

- (a) **Using the water, test tube and the litmus papers provided, determine whether specimen F is acidic or basic.**
- (b) **Outline the steps involved in performing the experiment in (a).**
- (c) **State four possible causes of the result obtained in (a).**
- (d) **Mention three effects of the result of the experiment on specimen F in (a) on crop production.**
- (e) **Name one crop that is likely to grow well on specimen F.**

(a) **Expected Response**

Soil Reaction of Specimen F (Soil sample)

- Specimen F is acidic
- (b) Candidates had difficulty in outlining the steps involved in the experiment to determine soil acidity. The challenge was with the sequence in the steps.

Expected Response

Steps in determining whether soil is acidic or basic

- fill the test tube with some of the soil sample
 - add enough water to the soil sample in the test tube
 - shake / stir the content of the test tube thoroughly
 - allow content to settle
 - dip a blue / red litmus paper into the content of the test tube
 - observe the colour change if any
 - interpret the colour change to determine if soil is acidic or basic
- (c) In this sub question, candidates could only mention leaching and addition of nitrogen fertilizers as the only causes of soil acidity

Expected Response

Causes of soil acidity

- leaching of bases
- addition of nitrogen fertilizers
- acid rain
- nutrients up take / cation absorption
- water logging
- presence of sulphur / oxidation of sulphur in the soil
- respiration of soil organisms / accumulation of CO₂ in soil

(d) The candidates who attempted the question on the effect of soil acidity on crop production had challenges getting the correct answers.

Expected Response

Effect of soil acidity on crop production

- affect the activities of bacteria that release nitrogen from organic matter
- faster leaching of plant nutrients
- Al, Fe, Zn, Mn toxicity
- deficiency / unavailability of P, Mo, Ca, Mg, K, N to crop
- deformation of crop roots
- affect the structure of soil especially clayey soil

(e) Candidates could only mention crops like maize, tomatoes and beans as those that grow well on acidic soils.

Expected Response

Examples of Crops that grow well on acidic soils

- bean e.g. cowpea, soya bean
- carrot
- cucumber
- maize
- garlic
- pepper
- radish
- tomato
- pumpkin

INTEGRATED SCIENCE 2

1. GENERAL COMMENTS

The standard of the paper was the same as those of the previous years. The performance of the candidates was slightly lower as compared to that of last year.

2. SUMMARY OF CANDIDATES' STRENGTHS

- (1) Candidates adhered to the rubrics of the paper.
- (2) The candidates generally presented their responses in legible handwriting.
- (3) Some specific areas candidates demonstrated commendable skills include:
 - (a) management practices in maize cultivation;
 - (b) reason why aluminium does not corrode;
 - (c) meaning of insanitary condition;
 - (d) ways of preventing fire outbreak from electrical sources.

3. SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Candidates had difficulty in spelling common words correctly.
- (2) Some candidates presented their answers in both ink and pencil.
- (3) Candidates were highly challenged in Basic Electronics, writing of chemical formula of compounds and Rhesus factor.
- (4) Candidates could not state ways of conserving water in the home.
- (5) Candidates could not effectively handle the question on the effect of air masses on the environment.

4. SUGGESTED REMEDIES

- (1) Vocabulary drill for candidates on scientific words which are often wrongly spelt should be practiced.
- (2) Candidates should be educated on the importance of the use of ink in writing their answers for which reason, they must desist from presenting their answers in pencil.
- (3) More attention should be given to topics that pose constant difficulty to candidates.

5. DETAILED COMMENTS

QUESTION 1

- (a)
 - (i) **List three major types of weathering.**
 - (ii) **Explain the role of temperature in weathering of rocks.**
- (b) **A 100 W heater is connected to a 240 V mains supply. Calculate the:**
 - (i) **current drawn;**
 - (ii) **resistance of the heater.**
- (c)
 - (i) **List three compounds which have electrovalent bond.**
 - (ii) **Give two characteristics of electrovalent compounds.**

- (d) (i) **What is rhesus factor;**
(ii) **Explain briefly how the rhesus factor in humans could result in miscarriage.**
- (a) (i) This was a recall item and so it was well answered by majority of the candidates.
However, few candidates had problem with the spelling of biological, physical and chemical.
- (ii) Performance on this question was quite poor as candidates failed to recognize that increase in temperature and decrease in temperature make rocks to expand and contract respectively. The continuous expansion and contraction is what brings about the breakdown of rocks to smaller pieces.
- (b) The candidates generally performed satisfactorily on this sub-question. A few of the candidates messed up on changing the subject of the formula $I = P/V$ from $P = IV$, $R = P/I^2$ from $P = I^2R$.
- (c) (i) The chemical formulae for the ionic compounds, that is, $MgCl_2$, KOH was a great challenge to candidates; where the names were written in words, spelling of magnesium and potassium chloride were wrongly done.
- (ii) Majority of the candidates were only familiar with high melting and boiling points of electrovalent compounds. Some of the candidates, who correctly stated that the compounds conduct electricity failed to add that they do so only in aqueous solution or in the molten state. Also, some of the candidates mistook the properties of electrovalent compounds for that of metals.
- (d) The candidates demonstrated poor knowledge of the rhesus factor. They were unable to explain how the factor could result in miscarriage.

The man must be RH^+ and the wife RH^- to make the foetus RH^+ . This will cause agglutination in case there is a leakage of maternal blood into the foetal blood. This explanation eluded the candidates. The sub-question (ii) was completely avoided by the candidates.

QUESTION 2

- (a) (i) **Explain briefly how solar energy is used to generate electricity.**
(ii) **State two other uses of solar energy.**
- (b) (i) **State five ways of conserving water in the home.**
- (c) (i) **State three management practices to ensure high yield in maize production.**
(ii) **Explain how two of the management practices stated in (i) help in ensuring high yield of maize.**
- (d) **State:**
 - (i) **two effects of air masses on the environment;**
 - (ii) **three ways by which global warming can be reduced.**

- (a) (i) This sub-question was poorly responded to by the candidates. They had no idea of solar panels having voltaic cells, from which the light energy removes electrons and the movement of these electrons constitute electric current.
(ii) The candidates performed poorly on this sub-question as well. Most of the candidates could not think of other uses solar energy. Other uses of solar energy include: stimulating the skin to synthesize vitamin D, driving the water cycle.
- (b) The performance of the candidates was unsatisfactory. Candidates rather stated methods of purifying water in the home. The ways to conserve water include: turning off taps when not in use, fixing leakages, flushing toilet only when necessary, re-use of waste water for flushing toilet.
- (c) The performance of candidates on this sub-question could best be described as mixed. They were able to state management practices that ensure high yield but could not explain how these practices help in ensuring high yield such as, controlling weeds minimizes competition; harvesting at right time prevents invasion of pests, application of lime gives required pH.
- (d) (i) Candidates' responses to this sub-question indicated that they had limited knowledge of the subject matter. Effects of air masses include: destruction of biodiversity, destruction of ozone layer, changing the weather, causing acid rain.
(ii) Candidates were comfortable with this sub-question. They limited themselves to correct responses such as afforestation and reducing bush burning. Other expected responses are: use of HFCs instead of CFCs, use of LPG, use of energy efficient appliances.

QUESTION 3

- (a) (i) **Explain why aluminium resists corrosion but iron does not.**
(ii) **State two methods of preventing iron from rusting.**
- (b) (i) **Explain the term *culling* as used in livestock management.**
(ii) **State three benefits of practicing culling.**
- (c) (i) **Distinguish between *grafting* and *budding*.**
(ii) **Give three reasons for grafting and budding.**
- (d) (i) **State the principle of conservation of energy.**
(ii) **State the energy transformation that occur in each of the following devices:**
 - (α) **a moving motorcycle;**
 - (β) **a television set in operation.**

(a) (i) Quite a number of candidates were able to state that aluminium oxide forms a layer that protects it from further oxidation or corrosion but failed to state that iron does not form such a layer and that the oxide formed by iron flakes off. This exposes the iron to further corrosion or oxidation.

(ii) This sub-question was correctly answered by most of the candidates.

(b) The candidates demonstrated a limited knowledge on the subject matter pertaining to this sub-question. The benefit of practicing culling is to improve the growth rate.

(c) Performance of candidates in this sub-question was abysmal. Candidates could not differentiate between grafting and budding and correct reasons for this practice was given only by a few of the candidates.

(d) (i) This sub-question was correctly answered by a majority of the candidates. A few of them sadly wrote about a transfer of energy from one form to another instead of transformation or change of energy from one form to another.

(ii) This sub-question posed a great challenge to many of the candidates. They were expected to state that, chemical energy \blacktriangleright kinetic energy/sound energy/heat energy and electrical energy light \blacktriangleright energy/sound energy/heat energy.

QUESTION 4

- (a) (i) What are *secondary colours* of light?
(ii) Name the colours that results from the combination of each of the following pairs of colours of light:
(α) red and green;
(β) blue and green;
(γ) red and blue.
- (b) (i) Define the *mole of a substance*.
(ii) Calculate the number of atoms in 18 g of magnesium metal.
[Mg = 24, Avogadro number = 6.023×10^{23}]
- (c) (i) Differentiate between *bone* and *cartilage*.
(ii) Name three parts of the human body where cartilages are found.
- (d) (i) Explain the term *deep litter system* as used in poultry.
(ii) Give three advantages of the deep litter system.

(a) (i) Quite a number of the candidates missed the mark of correctness by saying it is the 'combining' instead of 'mixing' and in other cases, they used the phrase 'two or more primary colours' instead of just 'two primary colours'.

(ii) Some candidates got the spelling of the correct answers wrong. Those were cyan and magenta.

(b) Standard definition of a mole of a substance eluded quite a number of the candidates. Questions on mole concept regularly appear and it was expected that candidates would adequately prepare for it but it was not to be.

(c) (i) The candidates failed to appreciate that the question involves both structure and function of bone and cartilage. They correctly stated that bone is hard, and cartilage is soft but failed to state that the bone forms part of the skeletal system while cartilage protects the bones from rubbing against each other.

(ii) The performance of the candidates in this sub-question was very good.

(d) Performance of the candidates in this sub-question was satisfactory but a few of the candidates had difficulty in explaining in clear terms the concept of culling.

QUESTION 5

- (a) Explain how each of the following actions causes loss of soil nutrients:
- crop removal;
 - continuous cropping;
 - drainage.
- (b) (i) Give the reason for using each of the following devices in household wiring:
- earthing;
 - stabilizer;
 - fuse.
- (ii) Explain the behavior of a *p-n* junction diode when it is forward biased.
- (c) State in which way each of the following factors is important in the germination of seeds:
- water;
 - oxygen;
 - warmth;
 - sunlight.
- (d) The table below shows a list of some chemical substances and the sources from which they are obtained but not correctly matched. In a tabular form, match each chemical substance with its correct source.

Substance	Source
(i) Ammonia	Lime water
(ii) Potassium hydroxide	Sour palm wine
(iii) Calcium oxide	Green vegetables
(iv) Ethanoic acid	Ashes of plants
(v) Ascorbic acid	Decomposed organic matter

- (a) This was the most poorly answered sub-question. The candidates attempted defining crop removal, continuous cropping and drainage instead of explaining how these actions cause loss of soil nutrients. The crop removal leaves the ground bare, leading to loss of nutrients through erosion; continuous cropping leads to removal of nutrients by plants with the land not being allowed to regain fertility; drainage involves washing away of dissolved nutrients by water which deprives the soil of its nutrients.
- (b) The candidates showed complete lack of knowledge of the subject matter on this sub-question.

- (i) Earthing is used to conduct excess charges on an appliance safely to earth or to prevent the user of the appliance from getting electric shock when from charges on the casing of the appliance.

Stabilizer is used to keep the voltage through an appliance constant.

Fuse is used to cut power supply to an appliance/circuit when the current goes beyond acceptable level / to protect an appliance from being damaged by excessive current

- (ii) Candidates are to note that when a P-N junction diode is forward-biased, the junction narrows, holes move across the junction to the N-type material and electrons move in the opposite direction into the P-type material. As a result, much more current flows in the circuit

(c) Candidates failed woefully to state the specific roles water, oxygen, warmth and sunlight play in germination of seeds. The candidates are to note the following roles: Water – activates enzymes, oxygen – oxidizes food, warmth – provides suitable temperature for enzymes and sunlight stimulates phytochrome or pigments in the seed to promote germination.

(d) Performance of candidates in this sub-question was commendable. Only a few candidates missed the matching points.

QUESTION 6

- (a) (i) **What is meant by *insanitary condition*?**
(ii) **State three ways by which fire from electrical causes could be prevented.**
- (b) (i) **Give three effects of ecto-parasites on cattle.**
(ii) **List four methods of controlling ecto-parasites of livestock.**
- (c) **Describe briefly how a standard solution of sodium hydroxide is prepared in the laboratory.**
- (d) (i) **Define displacement.**
(ii) **A bird flies with a constant velocity of 100 m s^{-1} for 10 minutes. Calculate the magnitude of its displacement.**

(a) This sub-question was correctly answered by most of the candidates. Some of the ways to prevent fire outbreak from electrical sources mentioned by candidates include: ensuring that all electrical components are kept dry, avoiding overloading sockets, keeping flammable materials away from electrical sources.

- (b) This sub-question was correctly answered by a good number of the candidates. The methods of controlling ectoparasites such as dipping, dusting, observing farm hygiene were correctly stated.
- (c) The candidates demonstrated that they are familiar with the preparation of standard solutions. Some of them, however, failed to state that the beaker containing the NaOH needs to be rinsed several times and the content added to the solution in the volumetric flask, which must be corked and shaken.
- (d) The candidates' performance in this sub-question was very commendable. They were able to define displacement and calculated the displacement by substituting correctly the velocity and time provided.



INTEGRATED SCIENCE 3

1. GENERAL COMMENTS

The standard of the paper compared favourably with that of the previous year.

The performance of the candidates this year was below that of last year.

2. SUMMARY OF CANDIDATES' STRENGTHS

- (1) Most of the candidates were able to identify and name correctly parts of farm animals and laboratory instruments.
- (2) The candidates were able to balance correctly chemical equation for the reaction involved in the preparation of hydrogen gas.
- (3) The candidates were able to state correctly management practices of named animals.

3. SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Poor spelling of scientific words.
- (2) Poor command of the English language.
- (3) Inability to plot graphs with correct values.
- (4) Poor description of the process that goes on in the stomach of humans.

4. SUGGESTED REMEDIES

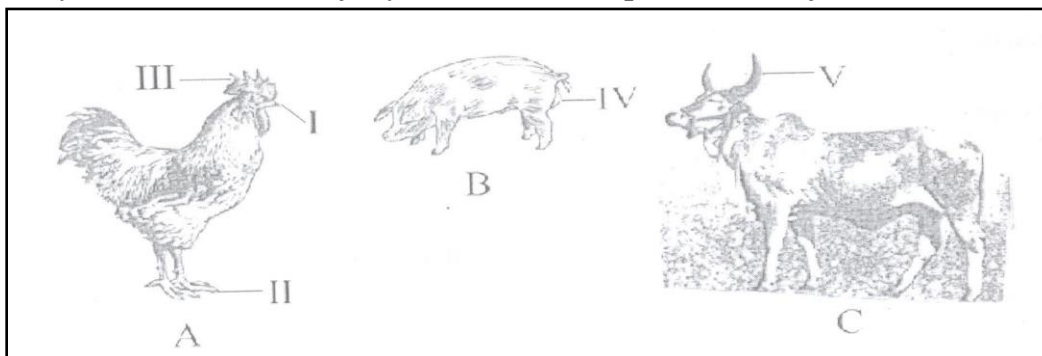
- (1) Students should be encouraged to read story books frequently.
- (2) Students are to note that wrong spelling of one-word answers do not score points.
- (3) Teachers should guide candidates to draw graphs with correct values.

5. DETAILED COMMENTS

QUESTION 1

Fig. 1 is an illustration of three farm animals labelled A, B and C.

Study the illustration carefully and answer the questions that follow.



- (a) Identify each of the animals labelled A, B and C.

- (b) Name each of the parts labelled I, II, III, IV and V.**
- (c) State one function of each of the parts labelled I, II and V.**
- (d) State one management practice that can be performed on each of the parts labelled III, IV and V.**
- (e) Give one reason for undertaking the management practice stated in (d) on each of the parts labelled III, IV and V.**

Most candidates answered this question correctly.

- (a) Most candidates identified the labelled parts correctly. They identified the labelled animals as A – fowl/cock/ rooster; B – Pig/ hog/ swine/ boar; C - Cow/ Bull/ Bullock. However, some candidates had difficulty differentiating between cock and hen, cattle and cow.
- (b) Majority of the candidates named correctly the labelled parts as I – Beak, II – Toe/ claw/ toe nail/ digit, III – Comb/blade/point, IV – Scrotum/ Testes/ Testicles/ Scrotal Sac, V – Horn.
- (c) Majority of the candidates stated correctly the functions of the labelled parts as, I – for pecking (cannibalism)/ feeding/ picking food/ fighting/ defence/ scratching the body/ grooming its feathers. For the part labelled II, a few of the candidates wrote “for digging” instead of for searching for food in the soil. Other correct responses include: help animal to stand firm/ roost on branches/ scratch the body/ for fighting/ to hold the hen firm during mating. V – for fighting/ defence/ protects the head of the animal/ aid digestion/ regulates body temperature/ aids social hierarchy (ranking, breed)/ swimming.
- (d) Most candidates answered this sub-question correctly by stating the following management practices on the labelled parts I – decombing/dubbing, IV – castration and V – dehorning.
- (e) The following were some of the correct reasons given for undertaking management practices in the labelled parts:
 - III - to prevent disturbance from flies, to prevent restlessness, to prevent loss of weight, for easy identification, to unblock beak when feeding, to take load off the head of fowl/make fowl carry light head at natural level;
 - IV – to make animal sterile/ prevent unwanted reproduction, reduce aggressive and mounting behaviour/ reduce injuries due to aggressive mounting/ makes it easier to care for it, produce high quality end product/ prevent tainted/smelly pork, improve health care, to make the animal fat and grow faster;
 - V – to make animal docile/easy to handle/ control/ transport, to prevent it from injuring farmer/ herd mates, to create space for feeding/increase stock density, to

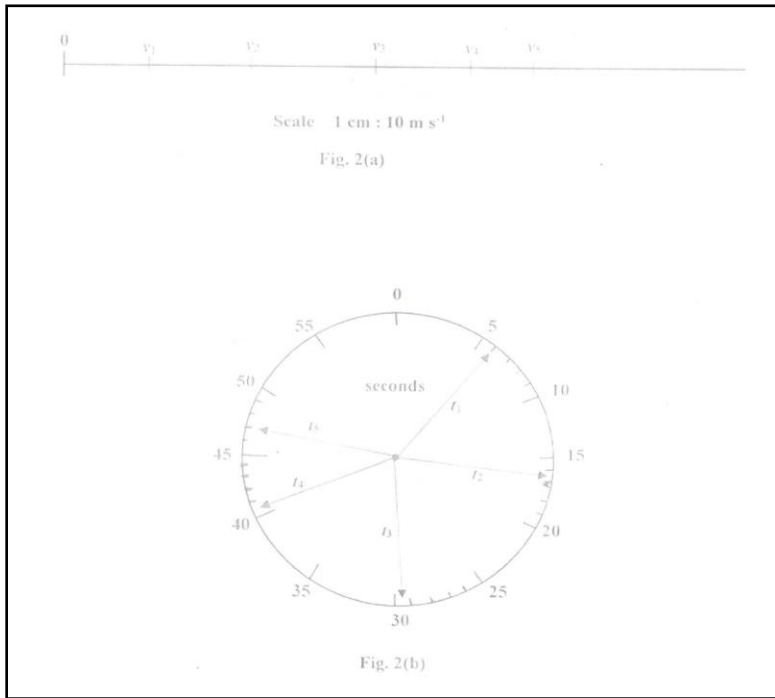
prevent animal from being entangled by bush, to prevent/reduce fighting, to meet breed specification/ for identification.

QUESTION 2

In an experiment to determine a physical quantity of a moving body, the velocity, V , of the body in linear motion was determined at different times t .

Fig. 2(a) and Fig. 2(b) illustrate the velocity $v = v_1, v_2, v_3, v_4,$ and v_5 and the corresponding time interval $t = t_1, t_2, t_3, t_4$ and t_5 respectively.

Study the illustration carefully and answer the questions that follow.



- (a) Read and record the raw velocity $v = v_1, v_2, v_3, v_4,$ and v_5 in Table 1.
- (b) Convert the raw velocity to actual velocity $V = V_1, V_2, V_3, V_4,$ and V_5 using the scale provided. Record the results in Table 1.
- (c) Read and record the time interval $t = t_1, t_2, t_3, t_4$ and t_5 in Table 1.

Table 1

v/cm	V/m s ⁻¹	t/s
v ₁ =	V ₁ =	t ₁ =
v ₂ =	V ₂ =	t ₂ =
v ₃ =	V ₃ =	t ₃ =
v ₄ =	V ₄ =	t ₄ =
v ₅ =	V ₅ =	t ₅ =

- (d) Plot a graph with V on the vertical axis and t on the horizontal axis. [A graph sheet is provided on page 8]

- (e) **Determine the slope, s of the graph.**
- (f) **Determine the intercept, c , on the vertical axis.**

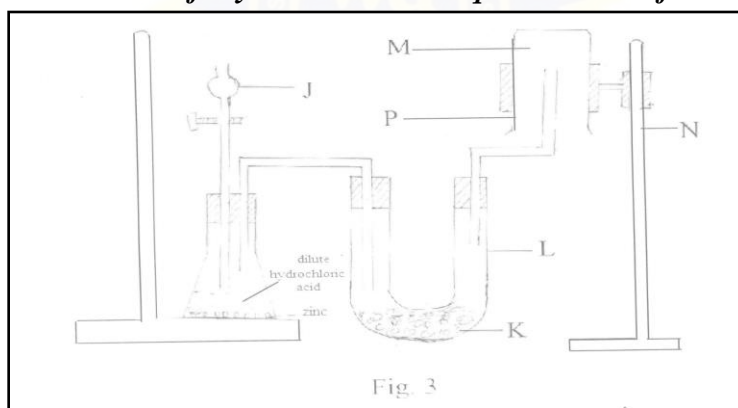
Most candidates were able to read, record and plot the graph correctly. Most of the candidates displayed their multiplication skill by multiplying correctly to obtain the actual velocity.

- (d) Most of the candidates plotted the graph on the correct axis with the correct labelling of axes. Candidates also chose the right and reasonable scale for plotting the graph.
- (e) Some candidates attempted to determine the slope without drawing the triangle to identify the right values on the graph to calculate the slope. However, a few were able to calculate the slope correctly.
- (f) Majority of the candidates drew the straight line to intercept the vertical axis at $(6.5 - 7.5) \text{ ms}^{-1}$.

QUESTION 3

Fig. 3 is an illustration of a set-up used to prepare a gas in the laboratory.

Study the illustration carefully and answer the questions that follow:



- (a) **Name each of the parts labelled J, K, L, M, N and P.**
- (b) **State the function of each of the parts labelled L and P.**
- (c) **State the method of collection of the gas produced.**
- (d) **Describe how the gas produced could be tested for.**
- (e) **Write a balanced chemical equation for the reaction for the preparation of the gas.**

Most of the candidates attempted question three. Some candidates had difficulty stating the correct drying agent. Some candidates failed to add anhydrous to the calcium chloride to complete the correct answer which is anhydrous calcium chloride.

A great number of the candidates stated only splint to be responsible for causing the pop sound when it was introduced to the gas produced, instead of writing that glowing /lighted splint was responsible.

Quite a number of the candidates were able to give the correct name of the labelled parts as follows:

J – thistle funnel/Dropping funnel,

K – anhydrous calcium chloride/ copper (II) tetraoxosulphate (VI), calcium oxide, L – U-tube,

M – Hydrogen,

N – retort stand/clamp stand, P – gas jar/beaker.

Only a few candidates were able to state correctly the function of the labelled parts as L – to direct the gas into P/gas jar/beaker, serves as drying site for the gas; P – to collect gas produced.

Most of the candidates stated correctly the method of collection of gas produced as upward delivery/ downward displacement of air.

In part (d) candidates described the test for the gas produced as introduce glowing/ lighted splint into the gas produced, ‘pop’ sound is heard, indication of presence of hydrogen gas.

Some candidates wrote the chemical equation in part (e) as $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$

QUESTION 4

(a) The table below illustrates tests carried out on glucose and a suspension of a substance X. The substance X was confirmed.

Complete the table and answer the questions that follow.

Test	Observation	Inference
(i) 2 cm ³ of glucose solution in test tube +2 cm ³ of Benedict’s solution
(ii) Mixture in (i) heated
(iii) 2 cm ³ of suspension of X in test tube 1 cm ³ of dil. NaOH+1% solution of CuSO ₄

(b) State two precautions to be taken in carrying out test (a) (iii).

(c) Name any other reagent that could have been used in test (a)(i) to obtain the same result.

- (d) Describe briefly the process that X goes through in the stomach of humans.
 (e) Name one disease caused by the deficiency of X.

Most candidates had difficulties in answering question four. Most candidates could not answer part (a)

Test	Observation	Inference
(i) 2 cm ³ of glucose solution in test tube +2 cm ³ of Benedict's solution	Blue Colour	
ii. Mixture in (i) heated	Brick red/ red/ reddish brown/ brown	Glucose/ reducing sugar present
iii. 2 cm ³ of suspension of X in test tube +1 cm ³ of dil. NaOH +1 % solution of CuSO ₄	Purple/ violet/ mauve colour	X contains protein

Some candidates wrote the precautions to be taken in carrying out test (a)(iii) in part (b) as add the CuSO₄ drop by drop, shake the test tube after each drop/ continually, wear gloves/boots/coat.

Most candidates failed to write the correct response for part (c), candidates were expected to write Fehling's solution A and B/ 1 and 2 for another reagent that could be used in test (a)(i) to obtain the same result.

Some candidates were able to describe the process that X goes through in the stomach of humans in question (4)(d) as; it was digested by pepsin/rennin into peptones/ peptides/ poly peptides / amino acid.

Most candidates were able to name a disease caused by the deficiency of X as kwashiorkor, marasmus, oedema except that a few had difficulty in spelling kwashiorkor.

PHYSICS 2

1. GENERAL COMMENTS

The questions set were within the scope of the syllabus. The standard of the questions did not vary from those of previous years.

The performance of candidates declined slightly from that of last year.

2. A SUMMARY OF CANDIDATES' STRENGTHS

The candidates exhibited commendable skills in the following areas:

- (1) Question numbers were written on top of each page;
- (2) sub-questions were clearly identified.
- (3) Regarding knowledge of the subject matter, candidates demonstrated tremendous skills in the following areas:
 - (a) they stated the quantities that can be deduced from a graph of F against e within the elastic limit;
 - (b) candidates stated correctly the dangers associated with improper use of laser and the safe way of using laser.
 - (c) many of the candidates were able to use the band theory to explain the reduction of electrical resistance of a semiconductor with increase in temperature.
 - (d) the candidates defined correctly atomic number and mass number.

3. A SUMMARY OF CANDIDATES' WEAKNESSES

A Summary of Candidates' Weaknesses:

- (1) Some candidates did not comprehend some of the theories in Physics.
- (2) Units were mixed up and some calculations were not carried out in SI unit by some candidates.
- (3) Most candidates had difficulty in solving problems set on mechanics, sound, heat and electricity.
- (4) Many candidates were not able to give the reason for using steel as a compass needle and soft iron as a core of electromagnets.
- (5) Candidates could not sketch the graphs of intensity against wavelength for a black body radiation at the given temperatures.

4. SUGGESTED REMEDIES

- (1) Teachers should explain Physics theories and principles well for students to understand; and also apply them.
- (2) Students should prepare adequately before attempting the Physics examination.
- (3) Candidates should solve past Physics examination questions.
- (4) Chief examiner's report on Physics should be read by candidates.

- (5) Candidates should improve on their standard in English language to enable them to understand the questions adequately.
- (6) Candidates should give concise answers to questions.

5. DETAILED COMMENTS

QUESTION 1

A varying force F applied to a spring produces corresponding extension e , in the spring.

- (a) State two quantities that can be deduced from a graph of F against e within the elastic limit of the spring.
- (b) Show how any of the quantities stated in (a) could be obtained from the graph.

Many candidates attempted this question but few of them gave correct responses. The expected answers are:

- (a)
- spring constant/force constant.
 - energy stored in the spring/work done in stretching the spring.
 - maximum load the spring can endure (elastic limit).
- (b)
- spring constant is given by the slope of graph.
 - energy stored in the spring is given by the area under the graph.
 - maximum load is obtained from the elastic limit.

QUESTION 2

- (a) State two dangers associated with improper use of lasers.
- (b) State one safe way of using lasers.

This question was popular and was answered correctly by many candidates.

- (a) Some of the dangers associated with lasers are:
- skin burns/rashes/itching;
 - cancer;
 - eye damage;
 - accelerated ageing.
- (b) Safe ways of using laser include:
- use of protective wear;
 - use of regulatory warning labels;
 - minimize/reduce exposure rate;
 - only professionals/trained personnel should handle lasers.

QUESTION 3

Give the reason for using

- (a) steel as a compass needle.**
- (b) soft iron as a core of electromagnets.**

Sub-question (a) was incorrectly answered by most candidates, but a few candidates answered section (b) correctly. The expected responses are:

- (a) Steel is a permanent magnet and does not lose its magnetism easily.
- (b) Soft iron is easily magnetized and demagnetized

QUESTION 4

The electrical resistance of a semiconductor decreases with increase in temperature. Use the band theory to explain this observation.

This question was correctly answered by few candidates. The expected answer is: - The increase in temperature causes the electrons in the valence band of the semiconductor to acquire enough energy to enable them to move across the narrow-forbidden band into the conducting band, thereby lowering the resistance and increasing conductivity.

QUESTION 5

A bullet is fired from a gun at 30° to the horizontal. The bullet remains in flight for 25 s before touching the ground. Calculate the velocity of projection. [g = 10m s⁻²]

Many candidates solved this problem correctly:

$$\begin{aligned}\text{Time of flight } T &= \frac{2u\sin\theta}{g} \\ 25 &= \frac{2u\sin 30}{10} \\ u &= \underline{250 \text{ m s}^{-1}}\end{aligned}$$

QUESTION 6

A satellite launched with velocity V_E just escapes the earth's gravitational attraction. Given that the radius of the earth is R, show that $V_E = \sqrt{20R}$

Few candidates solved this problem correctly.

Most of them did not realize that at the point of escape, KE= Gravitational Potential OR KE = PE.

$$\begin{aligned}\text{Thus: } \quad \frac{1}{2}mv^2 &= mgR \\ V &= \sqrt{2gR}\end{aligned}$$

$$= \sqrt{20R}$$

QUESTION 7

- (a) What is a *black body*?
- (b) Sketch the graphs of intensity against wavelength for a black body radiation at temperatures 1000 K and 2000 K on the same axes.

Most candidates stated correctly what a black body is; but they could not sketch correctly the graph requested.

QUESTION 8

- (a) (i) Define *friction*.
- (ii) State two situations each for which friction is considered to be:
- (α) desirable;
- (β) undesirable.
- (b) (i) State the two conditions fulfilled by a body undergoing simple harmonic motion.
- (ii) A pendulum of length 130.0 cm has a period of oscillation, T_1 . The bob is pulled and released to move in a horizontal circle of radius 50.0 cm. If the period of rotation is T_2 , calculate the ratio $T_1 : T_2$.
- [$g = 10 \text{ m s}^{-2}$, = 3.142]
- (c) A lorry and a car with the same kinetic energy are brought to rest by application of equal retarding forces. Explain why the two vehicles will cover the same distance before coming to rest.

- (a) This question was correctly answered by many candidates.
- (b) A few candidates stated the conditions fulfilled by a body undergoing simple harmonic motion. Those candidates could however not solve the problem that followed.

The expected answers are:

- (i) Its acceleration is directly proportional to its displacement from a fixed point.
- (ii) The acceleration is always directed towards the fixed point.
- (iii) Restoring force must always be present.

Calculation of ratio $T_1:T_2$

$$\begin{aligned}T_1 &= 2\pi \sqrt{\frac{l}{g}} \\&= 2\pi \sqrt{\frac{1.30}{10}} \\&= 2.26 \text{ s} \\ \sin \theta &= \frac{r}{l} = \frac{50}{130} \\&= 22.6 \\ \tan \theta &= \frac{v^2}{rg} \\ \tan 22.6 &= \frac{v^2}{0.5 \times 10} \\ v &= 1.443 \text{ m s}^{-1} \\ T_2 &= \frac{2\pi r}{v} \\&= \frac{2\pi \times 0.5}{1.443} \\&= 2.177 \\ T_1:T_2 &= 1.04:1.00\end{aligned}$$

- (c) This question was not correctly answered by candidates. The expected response is: This is because $K \cdot E = \text{Retarding force} \times \text{distance}$. Since the retarding force is the same for both vehicles, distance moved by both vehicles must be the same.

QUESTION 9

- (a) (i) Explain *magnetic saturation*.
(ii) State two methods of demagnetizing a magnet.
- (b) (i) Define *electrical power*.
(ii) An electric heating coil of resistance R is immersed in 1 kg of water at 20°C . The coil is connected in series with a resistor Y across a 240 V mains supply. The temperature of the water rises to the boiling point in 10 minutes. When Y is disconnected, the time taken for the 1 kg of water at the same temperature to boil is reduced to 6 minutes. Neglecting all heat losses, calculate the resistance R_Y of Y .
[Specific heat capacity of water = $4200 \text{ J kg}^{-1} \text{ K}^{-1}$]
- (c) (i) State and explain the effect of doubling the number of turns of the coil without changing the frequency of rotation on the output voltage of an a.c. generator.
(ii) Illustrate the effect in (i) on a graph of e.m.f. against time for one complete rotation.

Most of the candidates did not attempt this sub-question. Those who attempted it performed poorly.

(a) (i) The expected explanation is, when a magnetic material is being magnetized, its magnetic strength increases gradually to a point where the external field no longer has any effect on the strength of the magnet. The material is then said to reach its magnetic saturation.

(ii) Methods of demagnetizing a magnet.

- Strong heating
- Hammering / rough handling
- Placing it in a solenoid connected to an ac supply.

(b) (i) Electric power is the time rate at which electrical energy is expended.

(ii) Calculation of R_Y

$$\text{When Y is connected, } I = \frac{240}{R + R_Y}$$

$$\text{Heat} = I^2 R t = mc \Delta \theta$$

$$\left(\frac{240}{R + R_Y}\right)^2 (R + R_Y) \times 600 = 1 \times 4200 \times (100 - 20)$$

$$\frac{240^2}{R + R_Y} \times 600 = 4200 \times 80$$

$$R + R_Y = \frac{240^2 \times 6}{42 \times 80} = 102.86$$

$$\text{When Y is disconnected, } I = \frac{240}{R}$$

$$\left(\frac{240}{R}\right) \left(\frac{240}{R}\right) \times R \times 360 = 1 \times 4200 \times (100 - 20)$$

$$R = 61.7$$

$$R_Y = 102.85 - R = 102.86 - 61.7$$

$$= \underline{\underline{41.2 \Omega}}$$

(c) When the number of turns is doubled at a constant frequency of rotation, From $E \propto N$

$$N_2 = 2N_1$$

$$\frac{E_1}{E_2} = \frac{N_1}{2N_1}$$

$$E_2 = 2E_1$$

Therefore, when N is doubled, the output voltage is also doubled.

QUESTION 10

- (a) (i) Define a *wave*.
(ii) Differentiate between *transverse waves* and *longitudinal waves*.
- (b) A source of sound of frequency 550 Hz emits waves of wavelength 600 mm in air at 20°C. Calculate the:
- (i) speed of sound at this temperature;
(ii) wavelength of the sound at 0°C.
- (c) State:
- (i) three defects of the eye;
(ii) the type of lens used to correct each of the defects stated in (i).
- (d) State one:
- (i) advantage of using a convex mirror as a driving mirror;
(ii) disadvantage of using a convex mirror as a driving mirror.

(a) Most candidates were able to define a wave but only few could differentiate between transverse waves and longitudinal waves. The expected responses are:

- (i) A wave is a disturbance that transfers energy/momentum from one point to another without the transfer of matter.
- (ii) For Longitudinal waves the direction of propagation of waves is the same as the direction of vibration/motion of particles of the medium while for transverse waves, the direction of wave propagation is perpendicular to the direction of vibration/motion of particles of the medium.

(b) Most candidates were able to calculate the speed of sound but could not calculate the wavelength at 0 °C. The expected solutions are:

(i) Speed of sound at 20, $v = f\lambda$
 $= 550 \times 0.6$
 $= \underline{330 \text{ m s}^{-1}}$

(ii) The wavelength of sound at 0 °C is obtained from

$$V \propto \sqrt{T}$$
$$\frac{v}{330} = \sqrt{\frac{273}{293}}$$
$$V = 318.5$$
$$318.5 = 550 \times \lambda$$
$$\lambda = \underline{579 \text{ mm}}$$

- (c) Most of the candidates were able to answer this question correctly. The defects and their corrections are:

<u>DEFECT</u>	<u>CORRECTION</u>
- Shortsightedness/myopia	- concave/diverging lens
- Longsightedness /hypermetropia /hyperopia	- convex/converging lens
- Presbyopia	- bifocal lens
- Astigmatism	- cylindrical lens / toric lens

- (d) **ADVANTAGE:**

- Provides wide range/field of view.
- Produces erect image

- DISADVANTAGE:**

- Image is smaller than the object.
- Images are closer than they appear

QUESTION 11

- (a) **In an experiment to measure the specific latent heat of vaporisation of water, a student places a heater in a beaker containing water. The beaker stands on an electronic balance so that the mass of the beaker and water could be measured. The heater is switched on and the reading taken every 100 s when the water starts boiling. The table below shows the readings.**

Time/s	0	100	200	300	400
Reading on balance/g	203.22	201.62	199.79	198.26	196.50
Mass of water evaporated/g	0				

- (i) **Copy and complete the table.**
 - (ii) **Given that the heater supplies energy at the rate of 38 J s^{-1} , add to your table, values of the energy supplied by the heater in 100 s, 200 s, 300 s and 400 s.**
 - (iii) **Plot a graph of energy supplied on the vertical axis and mass of water evaporated on the horizontal axis, starting both axes from the origin (0, 0).**
 - (iv) **Determine the slope of the graph.**
 - (v) **What does the value of the slope mean?**
- (b)
 - (i) **Explain what is meant by *saturated vapour pressure*.**
 - (ii) **State the factor that affects saturated vapour pressure.**

- (a) This question was not popular. Only a few candidates attempted the question. Those who attempted it did not do well.

The candidates could not complete the table. They could neither plot the graph nor determine the slope. They could also not state what the value of the slope represented.

The slope represented the heat energy in joule needed to evaporate 1 g of water at constant temperature.

- (b) During evaporation, the stage at which the molecules of the vapour leave the liquid equals the rate at which molecules in the vapour returns into the liquid. The pressure exerted is then said to be saturated vapour pressure.
Saturated vapour pressure is affected by temperature.

QUESTION 12

- (a) (i) Explain the statement *light is quantized*.
(ii) Define work *function*.
(iii) When light of frequency 5.4×10^{14} Hz is incident on a metal surface, the maximum energy of the emitted electrons is 1.2×10^{-19} J. Calculate the minimum frequency of radiation for which electrons can be emitted.
[$h = 6.6 \times 10^{-34}$ J s]
- (b) Define each of the following terms:
(i) Atomic number;
(ii) Mass number.
- (c) Radon has mass number 222 and atomic number 86. Radon decays by emitting two beta particles to form radium -222.
Write:
(i) the symbol for radon nuclide;
(iii) an equation to represent the decay process.
- (d) State three properties of *x-rays*.
- (a) This question was very popular. Most of the candidates gave correct responses.
(i) Light is quantized means light consists of discrete packets of energy called photons.
(ii) Work function is the minimum amount of energy needed to just liberate an electron from the surface of a metal.
(iii) $hf = hf_0 + K. E_{\max}$
 $hf_0 = hf - K. E_{\max}$

$$f_0 = \frac{6.6 \times 10^{-34} \times 5.4 \times 10^{14}}{6.6 \times 10^{-34}} - \frac{1.2 \times 10^{-19}}{6.6 \times 10^{-34}}$$

$$= \underline{3.6 \times 10^{14} \text{ Hz}}$$

- (b) (i) Atomic number is the number of protons in the nucleus of an atom.
(ii) Mass number is the sum of the number of protons and neutrons in the nucleus of an atom
- (c) Most candidates were not able to write the symbol for radon and the equation of the decay process
Symbol for Radon nuclide: $\frac{222}{86}\text{Rn}$
- (d) Properties of X-rays
- Travel in straight line
 - Penetrate matter
 - Are not deflected by electric/magnetic field
 - Ionize gas
 - Cause certain substance to fluoresce
 - Travel with the speed of light

PHYSICS 3

1. GENERAL COMMENTS

The standard of the paper has not varied from that of the previous years. The performance of candidates saw a dip as compared to that of last year.

2. SUMMARY OF CANDIDATES' STRENGTHS

Some commendable features noted in candidates' answers were:

- (1) Presentation of data in a composite table;
- (2) use of correct units for both measurable and deduced quantities;
- (3) correct distinction of axes;
- (4) computation of slope of graphs using large right-angled triangle;
- (5) evaluation of given expressions using correct substitutions;

3. SUMMARY OF CANDIDATES' WEAKNESSES

Below are some weaknesses noted in candidates' answers:

- (1) Failure to record length measured with the metre rule to 1 decimal place in centimeters;
- (2) inability to make simple deductions from graphs;
- (3) inability to plot points correctly to the accuracy of chosen scales;
- (4) failure to record $\log T$ to at least 3 significant figures.

4. SUGGESTED REMEDIES

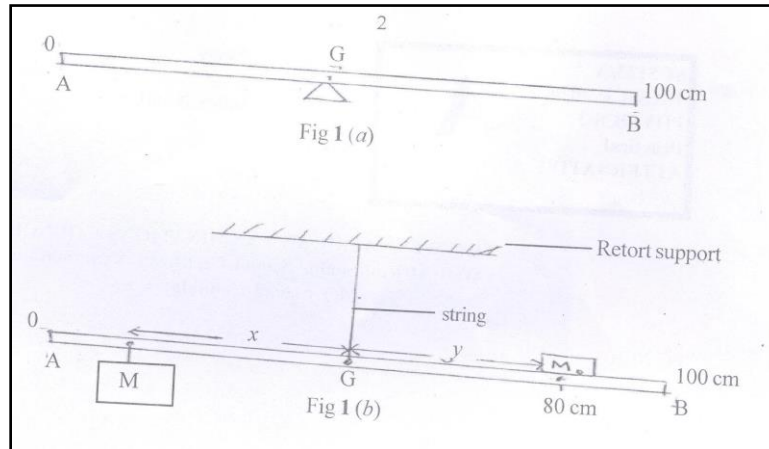
- (1) Students should be exposed to and made to use laboratory equipment early enough;
- (2) Students should be taught the acceptable number of decimal places for the instruments in the laboratory;
- (3) The theory underlying the practical questions should be explained to candidates.

5. DETAILED COMMENTS

ALTERNATIVE A

QUESTION 1

(a)



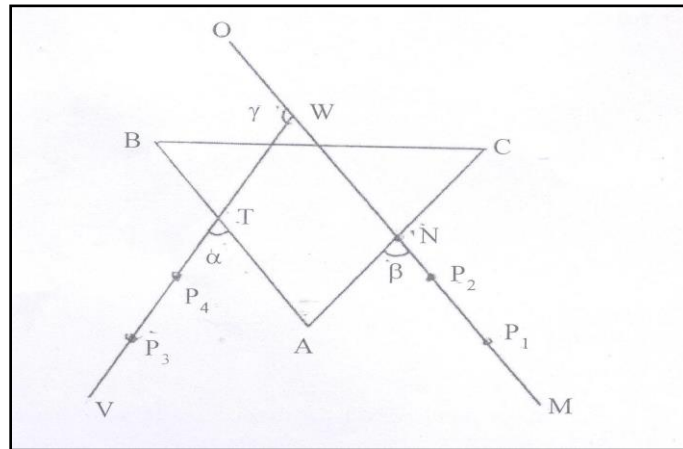
You are provided with a metre rule, knife edge, set of masses, inextensible string, retort support and other necessary apparatus.

- (i) Place the metre rule on the knife edge. Read and record the point G, where the metre rule balances horizontally as shown in Fig 1 (a).
 - (ii) Suspend the metre rule at G with the aid of the string provided and attach the string to the retort support as shown in Fig 1 (b). Keep the string attached to this point throughout the experiment.
 - (iii) Attach the mass M_0 at the 80 cm mark of the metre rule. Determine the distance y of M_0 from G. Keep M_0 at this position throughout the experiment.
 - (iv) Suspend a mass $m = 40$ g on the side AG and adjust its position until the metre rule balances horizontally.
 - (v) Measure and record the distance x of M from G. Evaluate x^{-1} .
 - (vi) Repeat the procedure for four other values of $m = 60$ g, 80 g, 100 g and 120 g. Measure and record x and evaluate x^{-1} in each case.
 - (vii) Tabulate the readings.
 - (viii) Plot a graph of m on the vertical axis and x^{-1} on the horizontal axis, starting both axes from the origin (0, 0).
 - (ix) Determine the slope, s , of the graph.
 - (x) Given that $s = yM_0$, determine M_0 .
 - (xi) State two precautions taken to ensure accurate results.
- (b) (i) Define *the moment of a force about a point*.

- (ii) A uniform metre rule is suspended by an inextensible string at its centre of gravity. If a mass of 60 g is placed at the 25 cm mark, what mass should be placed at 80 cm mark of the metre rule to balance it horizontally.

QUESTION 2

(a)



You are provided with a drawing board, drawing sheets, four optical pins, a triangular glass prism and other necessary materials.

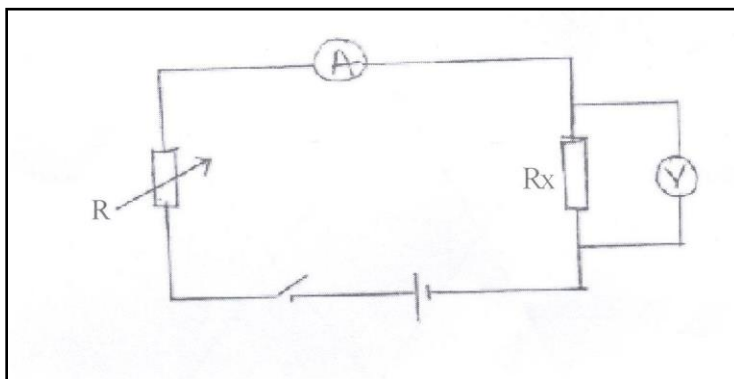
Use the diagram above as a guide to perform the experiment.

- (i) Pin the drawing paper onto the drawing board.
- (ii) Trace the outline ABC of the triangular prism on the drawing paper.
- (iii) Remove the prism from its trace. Measure and record the refracting angle A.
- (iv) Select a point N on the side AC of the outline. Draw a straight-line MO through N and making a glancing angle $\beta = 60^\circ$ with the side AC.
- (v) Fix two pins at P_1 and P_2 on the line MN. Replace the prism on its outline.
- (vi) Look through the side AB of the prism and fix two other pins at P_3 and P_4 such that they appear to be straight line with the images of the pins at P_1 and P_2 .
- (vii) Remove the prism and the pins. Join P_3 and P_4 with a straight-line VT and extend to meet MO at W.
- (viii) Measure and record angles α and γ .
- (ix) Evaluate $\phi = (90 - \beta)$, $\theta = (90 - \alpha)$ and $U = (\theta - \phi)$
- (x) Repeat the procedure for four other values of $\beta = 65^\circ, 70^\circ, 75^\circ$ and 80° . In each case, measure α , γ and evaluate θ , ϕ and U .
- (xi) Tabulate the results.
- (xii) Plot a graph with γ on the vertical axis and U on the horizontal axis, starting both axes from the origin (0, 0).
- (xiii) Determine the slope, s , of the graph.
- (xiv) Determine the intercept, c , on the vertical axis.

- (xv) State two precautions taken to ensure accurate results.
[Attach your traces to the answer booklet]
- (b) (i) Draw a ray diagram to show how a prism is used to invert a beam of light.
- (ii) A ray of light travelling from glass to air is refracted along the surface of the glass. Calculate the critical angle of the glass.
[Refractive index of glass = 1.5]

QUESTION 3

(a)



You are provided with a resistance box R , voltmeter, key, cell of e.m.f. E , standard resistor, R_x , an ammeter and other necessary apparatus.

- (i) Measure and record the e.m.f. E of the cell provided.
 - (ii) Set up a circuit as shown in the diagram above.
 - (iii) Set R to $1\ \Omega$. Close the key, read and record the current I and the corresponding voltage V .
 - (iv) Repeat the procedure for four other values of $R = 2\ \Omega, 4\ \Omega, 6\ \Omega$ and $8\ \Omega$.
 - (v) In each case, read and record I and V .
 - (vi) Tabulate the results.
 - (vii) Plot a graph with V on the vertical axis and I on the horizontal axis.
 - (viii) Determine the slope, s , of the graph.
 - (ix) State two precautions taken to ensure accurate results.
- (b) (i) State two advantages of connecting identical cells in parallel.
- (ii) State two factors to consider in choosing the material for the design of a resistor.

QUESTION 1

- (a) The candidates demonstrated commendable skills in the following areas:
- Data was summarized in a composite table.
 - Graph was drawn with correct labels and scales for the axes.
 - Slope of the graph was computed accurately using large right-angled triangle
 - Evaluation was correctly done.
 - At least one precaution for ensuring accurate results correctly stated in acceptable language.

Weakness of the Candidates

- Most of the candidates did not record G and y at all. Some candidates recorded them to no decimal place.
- (b) Most of the candidates could not give the correct definition of the moment of a force about a point. The value of the unknown mass was correctly determined by most of the candidates.

QUESTION 2

- (a) Most of the candidates answered the question satisfactorily. Traces presented by most of the candidates revealed that they did not perform the experiment but rather used formulae to produce their table of values. Very few of the candidates presented actual traces of the prism.

A few of the candidates drew curves while others just plotted the points without drawing a line through them.

Majority of the candidates also failed to record the refracting angle, A .

- (b) This sub-question was answered satisfactorily by most of the candidates. However, some candidates could not draw the expected ray diagram.

QUESTION 3

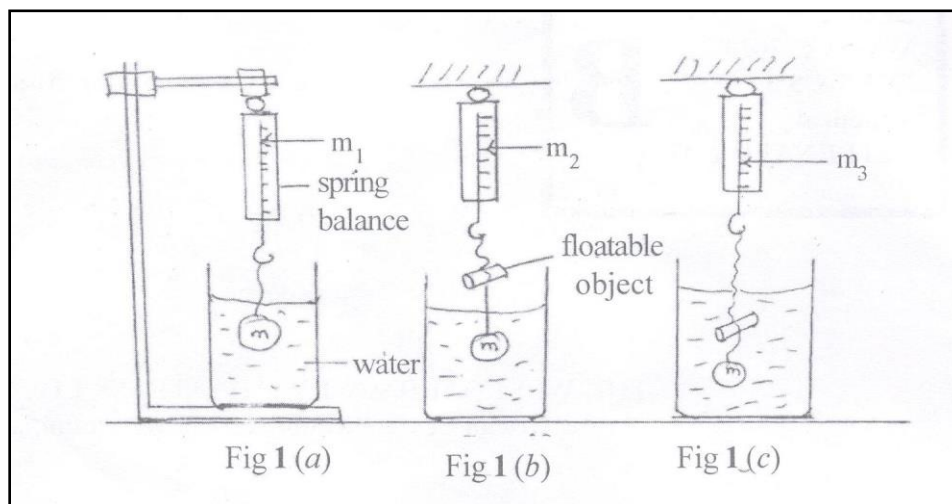
- (a) Candidates who attempted this question presented reasonable values for voltage and current in a composite table. A few of the candidates over-approximated their values when plotting the graph. The value of E , in most cases, was either not recorded or recorded as a whole number.
- (b) (i) Most of the candidates failed to give correct advantages of connecting cells in parallel in a circuit. Some of the correct advantages are: produce larger amount of current; supply steady current for a long period; efficiency is high.

- (i) Most of the candidates stated factors that affect resistance of a resistor instead of factors required in the choice of a material suitable for the design of a resistor.

The expected factors include: the length of the material, the cross-sectional area of the material and the type of material.

ALTERNATIVE B

QUESTION 1



You are provided with a retort stand, spring balance, thread, set of masses, beaker, water, floatable object and other necessary apparatus.

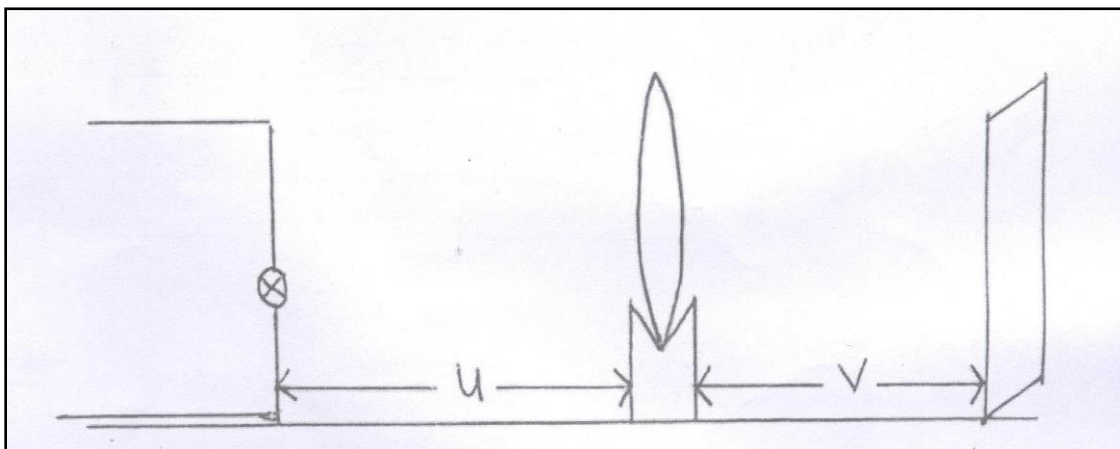
Carry out the following instructions using the diagram above as a guide.

- (i) Fill the beaker with water to about two thirds its volume.
- (ii) Attach the mass $m = 50$ g to the spring balance and immerse it in the water as shown in Fig. 1(a).
- (iii) Read and record m_1 , the reading on the spring balance.
- (iv) Tie m to the floatable object, hang the bodies on the suspended spring balance such that m is completely immersed in the water as shown in Fig. 1(b).
- (v) Read and record m_2 , the reading on the spring balance.
- (vi) Evaluate $(m_2 - m_1)$.
- (vii) Immerse both m and the floating object in the water as shown in Fig. 1(c).
- (viii) Read and record m_3 , the reading on the spring balance.
- (ix) Evaluate $(m_2 - m_3)$;
- (x) Repeat the procedure for $m = 70$ g, 90 g, 110 g and 130 g. In each case, determine m_1 , m_2 and m_3 and also evaluate $(m_2 - m_1)$ and $(m_2 - m_3)$.
- (xi) Tabulate the results.

- (xii) Plot a graph with $m_2 - m_1$ on the vertical axis and $(m_2 - m_3)$ on the horizontal axis.
- (xiii) Determine the slope, s , of the graph.
- (xiv) State two precautions taken to obtain accurate results.
 - (b) (i) State *Archimedes' principle*.
- (ii) A body has a mass 60 g when immersed in water, 61 g when immersed in water with a floatable object attached to it. If the total mass of the floatable object and the body when both of them are immersed in water is 59 g, determine the relative density of the floatable object.

QUESTION 2

(a)



You are provided with a ray box, metre rule, converging lens, screen and other necessary apparatus.

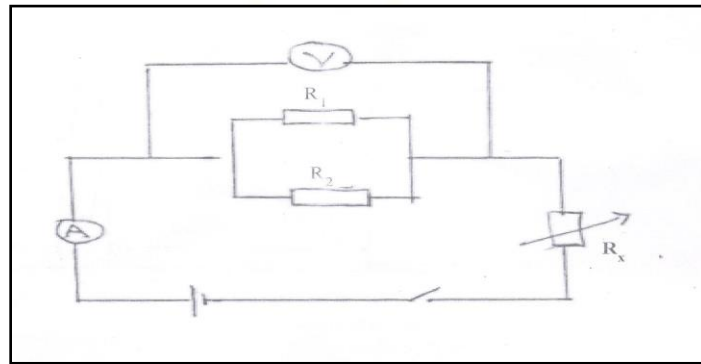
Using the diagram above as a guide, carry out the following instructions.

- (i) Determine and record the focal length f_o of the lens.
- (ii) Set the distance between the illuminated ray box and the lens at $u = 25.0$ cm.
- (iii) Adjust the position of the screen until a sharp image of the cross wire is formed on it.
- (iv) Measure and record the distance v between the screen and the lens.
- (v) Evaluate the magnification, m , of the image on the screen.
- (vi) Evaluate m^{-1} .
- (vii) Repeat the procedure for four other values of $u = 30.0$ cm, 35.0 cm, 40.0 cm and 45.0 cm and determine v , m and m^{-1} in each case.
- (viii) Tabulate the results.

- (ix) Plot a graph with m^{-1} on the vertical axis and u on the horizontal axis, starting both axes from the origin (0, 0)
 - (x) Determine the slope, s , of the graph.
 - (xi) Determine the intercept, c , on the vertical axis.
 - (xii) State two precautions taken to ensure accurate results.
- (b)
- (i) In a projection lantern, at what distance from the lens should the slide be placed to obtain an erect, large image on the screen?
 - (ii) An object has its erect image formed 30 cm from a converging lens. If the focal length of the lens is 15 cm, how many times is the image bigger than the object?

QUESTION 3

(a)



You are provided with an ammeter, a voltmeter, two standard resistors

$R_1 = 2 \Omega$ and $R_2 = 2 \Omega$, key, a battery of e.m.f E , a resistance box R_x and other necessary materials.

- (i) Measure and record the e.m.f. E , of the battery.
 - (ii) Close the key, read and record the current, I on the ammeter and its corresponding voltage, V on the voltmeter.
 - (iii) Close the key, read and record the current, I , on the ammeter and its corresponding voltage, V , on the voltmeter.
 - (iv) Repeat the procedure for four other values of $R = 2 \Omega, 3 \Omega, 4 \Omega$ and 5Ω .
In each case, read and record the corresponding I and V .
 - (v) Tabulate the results.
 - (vi) Plot a graph with V on the vertical axis and I on the horizontal axis.
 - (vii) Determine the slope, s , of the graph.
 - (viii) State two precautions taken to ensure accurate results.
- (b)
- (i) State the four factors that affect the resistance of a wire.

(ii) A $2\ \Omega$ resistor is connected in parallel with a resistor of a resistance R . If the p.d. across R is $1.2\ \text{V}$ and the same amount of current of $0.6\ \text{A}$ flows through R and the $2\ \Omega$ resistor, determine the value of R .

QUESTION 1

- (a) Most of the candidates presented composite tables but had challenges with the accuracy of the values obtained. Aggregably, the challenge could be due to the weight of the floatable object used.
- m_2 was expected to be greater than m_1 and m_3 . Most of the candidates could not get the trend correct.
 - A good number of candidates could also not compute $(m_2 - m_1)$ and $(m_2 - m_3)$ correctly.
 - Some candidates could not get the line of best fit.

Almost all the candidates could not give precautions for this experiment.

- (b) The candidates could not distinguish between principle of floatation and Archimedes principle.

QUESTION 2

- (a) Strength of the Candidates
- Data collected summarized in a composite table.
 - Axes correctly distinguished.
 - Slope of the graph correctly determined using a large triangle.
 - At least one correct precaution provided in acceptable language.

Weakness of the Candidates

- Value of f_0 either not recorded at all or recorded without a decimal place or recorded without a unit.
 - Intercept on the vertical axis was either not shown or not recorded at all
- (b) (i) Most of the candidates failed to provide satisfactory answer to this sub question. They saw the projection lantern as a single convex lens arrangement.
- (ii) Candidates could not solve the problem because they failed to get the correct picture of the ray diagram. A diagram is often required to help in answering the question.

QUESTION 3

- (a) Strength of the Candidates
- Composite table provided to summarise data collected.
 - Slope correctly computed using a large right-angled triangle.

At least one precaution for ensuring accurate results stated.

Weakness of the Candidates

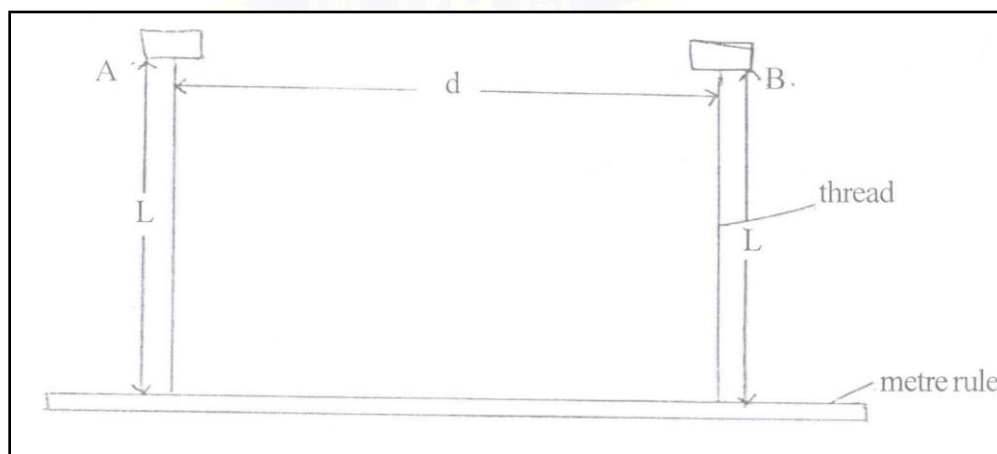
Value of E not recorded at all or not recorded with a decimal place or recorded without a unit

- (b) (i) This question was satisfactorily answered by most of the candidates.
(ii) Most of the candidates who drew a circuit diagram had an easy way to solve the problem.

ALTERNATIVE C

QUESTION 1

(a)



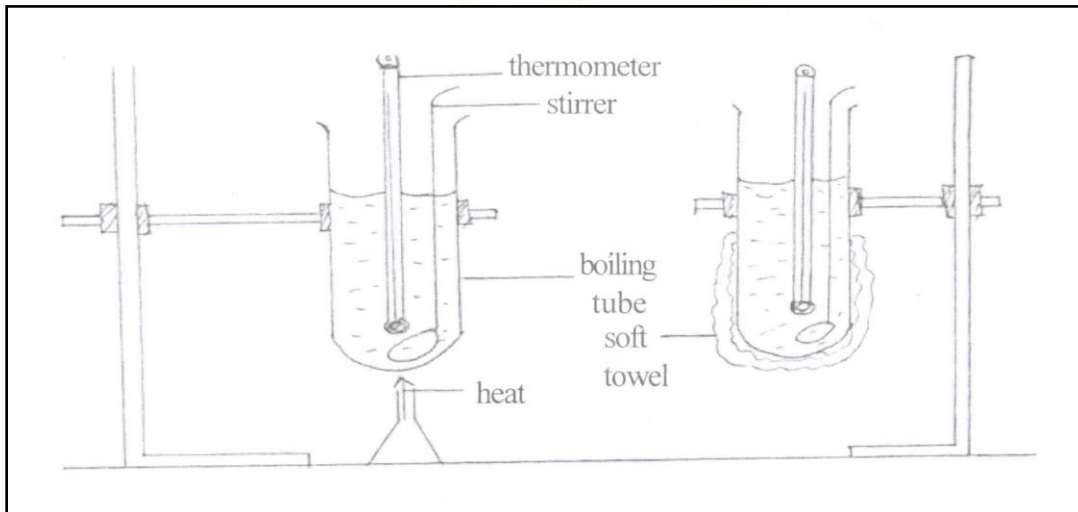
You are provided with two retort stands and clamps, two split corks, 2 pieces of thread, a stop watch, two metre rules and other necessary materials.

- Tie a loop of thread round the metre rule on the 5 cm mark and another on the 95 cm mark.
- Suspend the metre rule horizontally from two rigid supports, A and B.
- Adjust the lengths of the suspending threads such that $L = 100$ cm, ensuring that both are vertical and parallel.
- Displace the ends of the rule slightly in opposite directions and release it so that it oscillates in a horizontal plane about a vertical axis through its centre.
- Determine the time t for 20 oscillations.

- (vi) Evaluate the period T , $\log T$ and $\log L$.
- (vii) Repeat the procedure for four other values of $L = 90$ cm, 80 cm, 60 cm and 50 cm.
In each case, evaluate the period T , $\log T$ and $\log L$.
- (viii) Tabulate the results.
- (ix) Plot a graph with $\log T$ on the vertical axis and $\log L$ on the horizontal axis.
- (x) Determine the slope, s , of the graph.
- (xi) Given that $T = AL^n$, where A and n are constants, determine A .
- (xii) State two precautions taken to ensure accurate results.
- (b) (i) Define the term couple as applied to oscillatory systems.
(ii) Give two practical applications of a couple.

QUESTION 2

(a)



You are provided with a retort stand and clamp, stop watch, boiling tube, measuring cylinder, stirrer, thermometer, face towel or handkerchief, string, source of heat and other necessary apparatus.

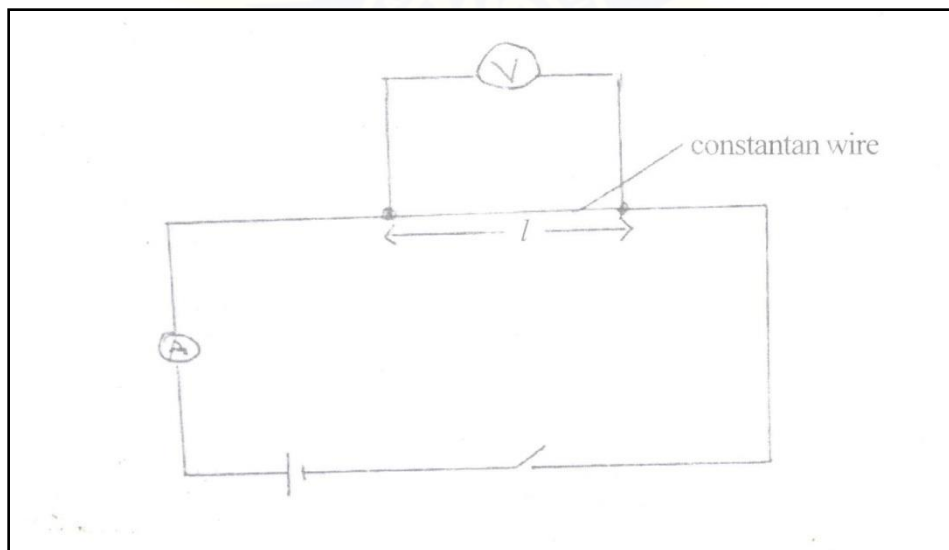
Use the diagram above as a guide to perform the experiment.

- (i) Measure 80 cm^3 of water and pour it into the boiling tube.
- (ii) Insert a stirrer and thermometer into the boiling tube.
- (iii) Suspend the boiling tube by the means of a retort stand and clamp as shown in the diagram above.
- (iv) Heat the water in the boiling tube. Stir at short intervals until the thermometer reads about 85°C .
- (v) Remove the source of heat and allow the temperature to drop to 70°C .

- (vi) Read and record the temperature θ every 1 minute for 5 minutes.
 - (vii) Heat the boiling tube again until the thermometer reads about 85°C .
 - (viii) Wrap the towel around the boiling tube using the string and allow the temperature to drop to 70°C .
 - (ix) Read and record the temperature θ' every 1 minute for 5 minutes.
 - (x) Evaluate $Q = (\theta' - \theta)$ in each case.
 - (xi) Tabulate the readings.
 - (xii) Plot a graph with Q on the vertical axis and time t on the horizontal axis.
 - (xiii) Determine the slope, s , of the graph.
 - (xiv) State two precautions taken to ensure accurate results.
- (b) (i) State two modes of heat loss by the boiling tube in the experiment above.
- (ii) Why is it necessary to stir the water while heat is being supplied to the boiling tube.

QUESTION 3

(a)



You are provided with an ammeter, a voltmeter, a key, a battery, crocodile clips, constantan wire and other necessary materials.

- (i) Set up the circuit as shown in the diagram above.
- (ii) Measure the length $l = 10$ cm of the constantan wire and close the key.
- (iii) Read and record the current I and voltage V .
- (iv) Evaluate $P = \frac{V}{I}$.
- (v) Repeat the procedure for four other values of $l = 20$ cm, 30 cm, 40 cm and 50 cm.

- (vi) Read and record the current I and voltage V and evaluate $P = \frac{V}{I}$ in each case.
- (vii) Tabulate the results.
- (viii) Plot a graph with P on the vertical axis and I on the horizontal axis.
- (ix) Determine the slope, s , of the graph.
- (x) Evaluate X , given that $s = \frac{X}{A}$, where A is the cross-sectional area of the constantan wire of value $1.0 \times 10^{-7} \text{ cm}^2$.
- (xi) State two precautions taken to ensure accurate results.

(b) (i) (α) Express the resistivity of a material in terms of the conductivity σ of the material.

(β) State the SI unit of σ .

(ii) A 10 cm length of a wire of cross-sectional area $1.0 \times 10^{-7} \text{ cm}^2$ has a resistance 6Ω . Calculate the resistivity of the wire.

(a) Strength of the Candidates

- Data presented in a composite table.
- Graph drawn correctly with axes well labelled.
- Slope of the graph correctly computed using large right-angled triangle.
- At least one precaution necessary for ensuring accurate results correctly stated.

Weakness of the Candidates

- The constant A in the expression $T = AL^n$ was not correctly determined.

Candidates usually have challenges in answering practical question that involve multiple calculations in the table of values. A few students who converted the time to period, recorded $\log T$ values to decimal places less than what is required.

(b) Most of the candidates failed to give appropriate definition to the term couple. They failed also to give correct practical applications of a couple.

QUESTION 2

(a) This question was avoided by the candidates. This could be because heat questions generally are time consuming.

QUESTION 3

(a) Generally, simple electrical circuit experiments are appealing to candidates. This year is no exception. Candidates presented composite tables, used simple suitable scales and also stated correct precautions.

(b) Most of the candidates solved this sub-question correctly.