

RESUME FOR THE SCIENCE SUBJECTS

1. STANDARD OF THE PAPERS

All the Chief Examiners reported that the standard of the papers of the various science subjects was appropriate and comparable to that of previous years.

2. CANDIDATES' PERFORMANCE

The Chief Examiners expressed varied views on the performance of candidates for the various science subjects. Performance in Animal Husbandry and Forestry was good. Candidates for Fisheries, Crop Husbandry and Horticulture, Physics and Chemistry were reported to have performed averagely. In Integrated Science and General Agriculture candidates performed poorly.

3. CANDIDATES' STRENGTHS

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

Physics

Projectile motion
Gravitation
Gas laws applications
Nuclear Physics

Biology

Classification of living things
Digestion in mammals

General Agriculture

Animal Improvement
Poultry production
Soil fertility

Chemistry

Physical Chemistry
Inorganic Chemistry
Quantitative analysis (Titration)

Integrated Science

Electricity
Poultry production
Seed dispersal
Ecology
Reproduction in humans

Animal Husbandry

Animal nutrition

Poultry production
Livestock production

Crop Husbandry and Horticulture

Vegetables and their uses
Propagation of crops

In addition, the Chief Examiners for Integrated Science, Physics, Biology, General Agriculture, Crop Husbandry and Horticulture, Fisheries and Forestry reported that candidates adhered to the rubrics of the papers in addition to exhibiting legible handwritings.

Candidates for Integrated Science, Biology, General Agriculture, Animal Husbandry, Crop Husbandry and Horticulture 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, Chemistry and Animal Husbandry. Candidates for Integrated Science and Chemistry were singled out by the Chief Examiners for exhibiting improved computational skills.

Other strengths noted by the Chief Examiners include:

- (1) Provision of concise answers
- (2) Proper understanding of questions

4. CANDIDATES' WEAKNESSES

Candidates were reported to have performed woefully in the following topics of the respective subjects.

Physics

Temperature calculations
Optics
Current electricity
Motion in inclined plane

Biology

Biological relationships
Features and characteristics of micro-organisms
Genetic diagram construction

General Agriculture

Agribusiness
Land surveying
Establishment of beds and borders

Chemistry

Organic chemistry
Qualitative analysis
Electronic configuration

Integrated Science

Magnetism

Reproduction in flowering plants

Circulatory system in humans

Animal nutrition

Crop Husbandry and Horticulture

Cropping systems

Crop improvement

Furthermore, the Chief Examiners lamented that the responses of candidates for some of the subjects showed that they were not adequately prepared for the examination. This feature was reported for Integrated Science, Chemistry, Biology, General Agriculture, Animal Husbandry, Crop Husbandry and Horticulture and Fisheries.

Improper usage of the English language negatively affected the performance of candidates for Integrated Science, Animal Husbandry, Fisheries and Forestry. They were consequently unable to express themselves properly in their responses.

Candidates for Physics, General Agriculture, Animal Husbandry and Crop Husbandry and Horticulture seem not to have understood the demands of the questions and therefore provided shallow answers. This negative feature was compounded by the inability of candidates to spell and use scientific terms properly.

The Chief Examiners were disappointed with the poor drawing skills of candidates. Candidates could not draw proper outlines, draw to scale nor label diagrams properly. In addition improper interpretation of graphs and data was exhibited by candidates for most of the practical papers.

Other notable weaknesses reported in the sciences include:

- (1) Inability to carry out simple calculations
- (2) Inability to explain simple scientific occurrences
- (3) Use of abbreviations in presenting answers
- (4) Inability to assign proper units to figures

5. SUGGESTED REMEDIES

The Chief Examiners for the science subjects generally recommended that candidates should be taken through enough practical lessons to improve their performance.

Candidates should also be adequately prepared for the examination and also given the needed help to improve upon the usage of the English Language.

The Chief Examiners also made the following suggestions:

Candidates should:

- (1) be taken through calculation drills to improve upon their speed and accuracy.
- (2) learn the conventions of writing scientific terms
- (3) identify and understand the scientific principles underlying everyday occurrences
- (4) thoroughly read and understand questions before attempting them

ANIMAL HUSBANDRY 2

1. GENERAL COMMENTS

The standard of the paper was comparable to that of previous years. The questions were simple and straight forward with no ambiguities. The general performance of the candidates was the same.

2. SUMMARY OF CANDIDATES' STRENGTHS

The following strengths were observed by the Chief examiner

- (1) Legible handwriting
- (2) Orderly presentation of answers
- (3) Provision of clear and straight forward answers

3. SUMMARY OF CANDIDATES' WEAKNESSES

The Chief Examiner noted the following weaknesses:

- (1) Poor spellings skills e.g. stomach, for stomach, oesophagus for oesophagus, vitermines for vitamin
- (2) Poor definitions. Candidates had difficulty defining certain terms e.g. inbreeding, crossbreeding
- (3) Failure to cover the syllabus or to undertake thorough studies
- (4) Answering more than one question on a page
- (5) Failure to answer the number of questions specified in the rubrics. Candidates sometimes answer all the questions instead of 4 questions
- (6) Failure to write index number on the answer booklet

4. SUGGESTED REMEDIES

The Chief Examiner made the following suggestions:

- (1) Candidates should be given exercises that will help them overcome spelling mistakes and master definitions of technical terms
- (2) Candidates should plan their studies in such a way that they would be able to cover the syllabus. Group studies is recommended
- (3) Candidates who failed to 'comply' with the rubrics should be penalized

5. DETAILED COMMENTS

Question 1

- (a) **State five problems of livestock production in West Africa.**
- (b) **State six causes of low egg production in layers.**
- (c) **Name three parts of the digestive system of pigs.**

- (d) **State two functions of each of the following hormones in animal production:**
 - (i) **testosterone;**

- (ii) oestrogen;
- (iii) oxytocin.

This question appears to be the most popular question. The general performance was good.

- (a) Candidates had little difficulty answering this sub-question. The problems of livestock production were clearly stated. Some of the candidates, however, discussed the problem and this was not required. Instead of stating the problems, some candidates provided solutions e.g. pest and disease control, provision of water to the animals etc and these were wrong. Scarcity of feed and water, poor breeds, inadequate storage facilities/capital/extension personnel, theft of animals, prevalence of pests and diseases are among the correct answers expected.
- (b) This sub-question was well attempted by candidates. Many of them were able to state the causes of low egg production e.g. high ambient temperature, pest/parasite infestation, incidence of diseases, poor breeds, old age of birds, inadequate feed and water, poor quality feed, irregular feeding etc. statements like weather condition, poor sanitation, inadequate feeding trough, type of feed, health of layer, clean eggs, oval eggs do not answer the question and so did not attract marks.
- (c) This sub-question was a simple one but some candidates confused the digestive system to pigs with that of ruminants. Generally, it appears candidates did not know where the digestive system begins and where it ends. Digestion begins in the mouth and ends in the intestines. It is important for teachers to emphasize the liver, pancreas and gall bladder as important parts of the digestive system of pigs.
- (d) (i-iii) This was the most important part of Question 1. The types of answers given suggest that candidates were ill-prepared for the question; some of them mistook the functions of one hormone for the others. Some candidates were careless in stating the answers e.g. “promotes spermatozoa” instead of “promotes spermatogenesis”. “the development of male characteristics” instead of “male secondary sexual characteristics”, “release of female semen” when females never produce semen”.

Question 2

- (a) **State four functions of protein in farm animals.**
- (b) **Give two advantages and two disadvantages of the deep litter system of keeping poultry.**
- (c) **State five factors that affect milk yield in dairy cattle.**
- (d) **List five benefits of rearing pigs.**
- (e) **Mention two methods of mating in sheep.**

It was one of the most popular questions. General performance was very good.

- (a) A simple question that required candidates to state the functions of protein. Though simple, candidates gave unacceptable answers like: it gives energy, secretes enzymes, provides worn-out tissues; for egg shell formation; makes animals free from pests and diseases etc.

Correct answers included:- formation of sex cell

(gametes)/hormones/antibodies/digestive enzymes/hair/nails/animal products such as meat, milk and eggs; for growth; for repair of worn-out tissues.

- (b) The advantages and disadvantages of the deep litter system of keeping poultry did not pose much problem to candidates. It is, however, wrong for candidates to make direct comparisons in answering the questions. For instance, a candidate who states the advantages as “record keeping is easier” and goes on to give the disadvantage as “record keeping is difficult” cannot score for both.

The common answers provided by candidates to score were:

Advantages: Record keeping is enhanced. It does not require a large plot of land. Easy to carry out management practices. It reduces loss of eggs.

Disadvantages: Easy spread of diseases. It is capital intensive. Difficult to monitor performance of individual bird. Egg eating could occur

- (c) This sub-question required candidates to state five factors that affect milk yield in dairy cattle. Some candidates demonstrated poor understanding of the question, probably because of the use of the term “factor”. The variety of wrong answers provided also shows that candidates were generally ignorant of how to answer such questions. In a question like this, there is no need to qualify the factors in the answers provided, since the question did not ask for factors that could “increase or decrease” milk yield in dairy cattle.

Answers should be correctly stated as:

- temperature (and not high temperature or low temperature)
- diseases
- age of the cow
- plane of nutrition
- breed of animal
- efficiency of milking
- size of udder etc

- (d) Candidates did not have difficulty listing the benefits of pig rearing e.g. large litter size, ability to consume a wide variety of feed, efficient utilization of feed, high dressing percentage, source of income, meat etc.

- (e) Many candidates were able to mention the two methods of mating in sheep i.e. hand mating and pen mating. Candidates should note that tupping and servicing are simply acts of mating, and not methods of mating.

Question 3

- (a) (i) **What is a zoonotic disease?**
- (a) (ii) **Give two examples of zoonotic diseases.**
- (b) **List seven signs of ill-health in farm animals.**
- (c) **State three symptoms of each of the following diseases:**
 - (i) **redwater fever in sheep;**
 - (ii) **rinderpest in cattle;**
 - (iii) **coccidiosis in fowls.**

It was quite popular with candidates but the general performance was very, very poor.

- (a) (i) Most candidates gave wrong definition of zoonotic disease. A disease that affects both man and farm animals. It should be noted that a disease can affect both man and animals but may not be a zoonotic disease. E.g. mastitis. The correct definition is “a disease that can be transferred from humans to animals and from animals to humans”. Note the two-way transfer. The disease should be transferrable both ways before it can be termed a zoonotic disease.
- (a) (ii) Anthrax and rabies were the common examples of zoonotic diseases given. Other correct answers are brucellosis, tuberculosis, bird flu, mad cow disease and tetanus.
- (b) A simple question but not well tackled. Some candidate listed signs of good health instead of signs of ill-health. Others also gave answers like faeces, urine, behavior, movement, appearance of the animal which are not correct. Since both sick and healthy animals produce faeces, urine and move etc. but hard, watery or blood-stained faeces is a sign of ill-health. Similarly, blood in the urine, or foul odour of urine and slow movement / difficulty in movement indicate ill-health.
- (c) A poorly answered sub-question. Candidates were not able to give the symptoms of (i) red water fever disease (ii) rinderpest in cattle (iii) coccidiosis in fowls. Some candidates mistook the symptoms of one disease for another; others did guesswork. Teachers and students must pay attention to diseases because of their importance in any animal production enterprise.

Question 4

- (a) **Define each of the following terms as used in animal production:**
 - (i) **inbreeding;**
 - (ii) **cross breeding.**
- (b) **State four disadvantages of selection in animal production.**
- (c) (i) **Mention six effects of high ambient temperature on layers.**
- (c) (ii) **State three ways of preventing high ambient temperature in a poultry house.**

It was an unpopular question and the performance was generally poor.

- (a) Many candidates could not define inbreeding and crossbreeding and therefore lost precious marks. It is important for teachers to emphasize the definition of terminologies.
- (b) Candidates also had difficulty answering this sub-question. It appears they did not understand the question. Instead of stating the disadvantages of selection in animal production, some candidates gave characteristics of animals to select; others described the different types of selection. Expected answers are: it is time-consuming (not time wasting); costly; tedious; requires expertise; requires accurate and up-to-date records; and also that it may result in the elimination of some desirable traits of parent stock.
- (c)
 - (i) A poorly answered question. Candidates failed to state the specific effects of high ambient temperature on layers. Consequently an answer like “it affects hatchability” is incorrect but “it reduces hatchability of eggs” is correct. Other correct answers included: reduced egg production, reduced egg size/feed intake; increased water intake; increased panting; weight loss; cannibalism.
 - (ii) Candidates were required to state ways of preventing high ambient temperature in a poultry house. It was a difficult question for candidates. Answers showed they were ill-prepared for this question. The solution to the high ambient temperature include proper orientation of the poultry house; adopting of recommended spacing of birds; provision of adequate ventilation; use of construction materials that will not increase the heat load; use of heat extracting fans.

Question 5

- (a) Mention five uses of forage crops.**
- (b) State five characteristics of a good species.**
- (c) List five factors that affect the productivity of pastures in West Africa.**
- (d) State five signs of oestrus in a sow.**

This question was quite popular with candidates. Their performance was above average.

- (a) Candidates had difficulty stating the uses of forage crops. Candidates could easily give answers relating to feeding of livestock with fresh herbage, hay and silage. Other correct uses of forage crops which were not very popular with candidates included: used as bedding material; for roofing of farmsteads; for green manuring; for cover cropping; for fencing; for the control of soil erosion.
- (b) Performance in this question was not as encouraging as expected. Candidates gave a variety of answers which were wrong e.g.
 - resistance to weather condition
 - they have high fibre content
 - they should be green
 - should contain nutrients

Some characteristics of a good pasture species are:

- ability to grow fast
- ability to produce large quantities of seeds
- ability to survive during drought

- ability to withstand frequent cutting/grazing/trampling
 - high nutritive value
 - high digestibility
 - high leaf to stem ratio
- (c) This sub-question was poorly answered. Here again, the word “factor” in the question. “Factors that affect the productivity of pasture in West Africa” posed a problem to candidates. Instead of stating the factors, candidates stated activities that should be undertaken. E.g.
- application of fertilizer
 - planting of leguminous crops
 - practising of rotational grazing etc
- Some candidate deviated by giving reasons for low productivity
The factors that affect productivity of pastures in West Africa include:
- soil fertility
 - climatic conditions of the area
 - type of plant species
 - topography
 - grazing pattern
 - incidence of pests
 - incidence of diseases
 - weed infestation
- (d) This question did not pose a problem to candidates. Some candidates were careless in stating their answers. For instance:
- animal becomes restlessness instead of animal becomes restless
 - mucous discharge from the vagina instead of vulva
 - reddened vulva or swollen vulva instead of reddened and swollen vulva
 - high temperature or abnormal temperature instead of high body temperature

Question 6

- (a) (i) **Stat five characteristics of rabbit that makes it suitable for commercial production.**
- (ii) **Name six breeds of rabbits that are commonly used in commercial production in West Africa.**
- (iii) **List four diseases that affect rabbits.**
- (b) **State five ways in which poultry production is important.**

This is perhaps the most unpopular question. The general performance, however was fair.

- (a) (i) Candidates were asked to state the characteristics of rabbits that make it suitable for commercial production. Performance was above average. Candidates who stated physical features (e.g. long tails/ears) and importance of rearing rabbits (e.g. faeces for manure, source of income) got it wrong.

Rabbits are suitable for commercial production because they

- are prolific
- grow fast
- have short gestation period
- produces good quality meat which is highly marketable
- can efficiently convert a wide range of feed material into meat

- (ii) Candidates were able to mention Flemish giant, California white, New Zealand White, New Zealand red, Chincilla as correct breeds of rabbit but the spellings were poor. Local breed is not acceptable. Other correct breeds are Angora, Lop and Dutch.
- (iii) It is quite obvious that some of the disease of rabbits listed e.g. T.B, Anthrax were guesswork and are incorrect. The correct answers are ear canker (and not ear cancer), coccidiosis, pneumonia, enteritis.
- (b) Candidates were able to tackle this question very well. Poultry production is important not because the birds are prolific but because they are a source of meat, eggs, income, employment, manure etc.

ANIMAL HUSBANDRY 3

1. GENERAL COMMENTS

The standard of the paper for this year was comparable to that of previous years. The questions were clear and unambiguous. The performance of the candidates improved slightly.

2. SUMMARY OF CANDIDATES' STRENGTHS

The Chief Examiner observed the following strengths:

- (1) good presentation of answers
- (2) good identification skills
- (3) clear and straight forward answers
- (4) answering of new question on fresh page

3. SUMMARY OF CANDIDATES' WEAKNESSES

The following weaknesses were observed:

- (1) provision of more answers than required
- (2) wrong spelling of terms
- (3) poor mastery of the subject and hence provision of incomplete answers

4. SUGGESTED REMEDIES

The Chief Examiner suggested the following remedies

- (1) Candidates must read questions well and understand its requirements before tackling them
- (2) Candidates must read text books and continuously practice the spelling of terms in the subjects
- (3) Teachers should guide students to complete the syllabus and prepare enough for the examination.

5. DETAILED COMMENTS

Question 1

- (a) Identify specimen A.**
- (b) Describe how specimen A is used on an animal farm.**
- (c) State four ways in which the management practice carried out using specimen A is important.**
- (d) Mention three equipment that could be used in place of specimen A to perform the same management practice.**

Expected solution:

- (a) Identification
Specimen A - Burdizzo
- (b) Description of use of specimen A (Burdizzo) is used
- restrain animal
 - locate the spermatic cord
 - open the Burdizzo
 - place the scrotum in between the pliers
 - close the Burdizzo tightly to crush the spermatic cord
- (c) Importance of castration
- makes animal docile / easy to handle
 - controls indiscriminate mating
 - makes meat tender / improve meat quality
 - removes characteristic male odour in goats
 - animals grow fat
- (d) Farm animals that could be castrated using Burdizzo
- sheep
 - goat
 - cattle
- (e) Other equipment used for castration
- elastrator / rubber ring
 - sharp knife / blade
 - emasculator

Comments

- (a) There was no problem with the identification of the specimen
- (b) A lot of the candidates were able to describe the process in the use of the specimen. However, it would have been good for the candidates to give the processes in a sequential manner. Some candidates also included practices used in carrying out the open castration.
- (c) Most candidates provided the needed answer since this specimen is often used
- (d) Some candidates mentioned that castration is carried out on cattle, dog, cats, grasscutters and rabbits.
- (e) Similarly they were able to mention other equipment used in carrying out the process.

Question 2

- (a) **Identify each of specimens B, C and D.**
- (b) **Mention the major nutrient provided by each of specimens B, C and D in animal diet.**
- (c) (i) **Which of the specimens B, C and D forms the highest percentage in poultry diet?**
- (ii) **Give one reason for your answer in (c)(i).**

- (d) **Mention two ingredients that could be used to replace each of specimens C and D in animal diet.**
- (e) **State three deficiency symptoms of the nutrient supplied by specimen D in farm animals.**

Expected solution:

(a) Identification

- Specimen B - maize (crushed)
Specimen C - fish (crushed) / fish meal
Specimen D - Oyster shell / shellgrits

(b) Major nutrients supplied by specimens

- Specimen B (Maize) - Carbohydrate
Specimen C (Fish) - Protein
Specimen D (Oyster shell) - Mineral / calcium

(c) Highest percentage in diet

- (i) Specimen B (Maize)
(ii) Maize (Specimen B) forms the highest percentage because it provides energy which is required by the animal for its everyday activity.

(d) Replacement for specimen C and D in animal diet

Specimen C (fish meal)

- blood meal
- meat meal
- feather meal
- soya bean cake / meal
- groundnut cake
- copra cake
- maggot
- cotton seed cake
- cashew nut

Specimen D (oyster shell)

- bone meal
- snail shell meal
- egg shell meal
- dicalcium phosphate
- gypsum salt
- rock phosphate

Deficiency symptoms of mineral / calcium

- poor egg shell formation
- poor teeth formation

- poor blood clotting
- poor nerve functioning
- rickets / weak bones / osteoporosis
- osteomalacia
- paralysis

Comments:

- (a) The specimens were properly identified.
- (b) Almost all of them were able to identify the major nutrients provided. However, some of them mixed up the nutrients with the specimens.
- (c) Most candidates were unable to give the reason for choosing maize
- (d) Some candidates mentioned only one replacement per specimen C which made them to lose marks.
- (e) Deficiency symptoms of calcium were adequately given by most of the candidates.

Question 3

- (a) Identify each of specimens E, F and G.**
- (b) Give two uses of each of specimens E, F and G.**
- (c) State three ways of maintaining specimen G.**
- (d) State three precautionary measures to be taken when using specimen E.**

Expected solution:

- (a) Identification
 - Specimen E - feeding trough
 - Specimen F - wood shavings
 - Specimen G - (Top loading) weighing scale
- (b) Uses
 - Specimen E (Feeding trough)
 - for feeding poultry
 - to administer drugs through feed
 - Specimen F (Wood shaving)
 - As litter material / bedding material
 - packaging material e.g. for egg
 - cushion material in nests
 - as fuel
 - Specimen G (Weighing scale)
 - weighing meat
 - weighing feed and feed ingredients
 - weighing live birds and eggs
- (c) Maintenance of specimen G (Weighing scale)

- clean the scale / wash the pan
 - oil / greese movable parts regularly
 - tighten loose screws
 - do not overload when using
- (d) Precautionary measures when using specimen E (Feeding trough)
- do not fill to the brim to avoid spillage of feed
 - adjust the height (from ground) to a convenient level for the birds to make feeding easy
 - provide rotating bar to prevent birds from soiling the feed
 - keep clean to prevent contamination and disease transfer from mouldy feed
 - mend any damaged part

Comments:

- (a) Most of the candidates were able to identify the specimens correctly. However, specimen G was identified by a number of candidates as “top loading *balance* instead of *scale*”.
- (b) Similarly, used of the specimens were given sufficiently by the candidates.
- (c) Candidates must be further educated to know the difference between maintenance of equipment and precautionary measures taken when using the equipment.
- Generally, answers provided were satisfactory in many cases.

Question 4

- (a) (i) **State two harmful effects of each of specimens H, J and K in livestock production.**
- (ii) **State two ways of controlling each of specimens H, J and K on livestock farms.**
- (b) **Mention three other storage pests of farm animals.**

Expected solution:

- (a) (i) Harmful effects of specimen H, J and K in livestock production

Specimen H (Soldier ant)

- consumption of feed
- cause injuries / predispose animals to diseases
- reduce quality of stored feed
- contaminate water and feed
- disturb farm work

Specimen J (weaver bird)

- consumption of feed / feedstuffs
- contaminate feed with feaces / droppings
- contaminate / pollute water with droppings
- vectors / carriers of diseases / pathogens

- farm animals are disturbed by their presence

Specimen K (Weevil)

- consumes feed / feedstuff
- reduce quality of feed
- contaminate feed

(ii) Methods of controlling Specimen H, J and K

Specimen H (soldier ant)

- use of fire / smoke
- application of common salt
- use of hot water
- application of insecticides / fumigation
- use of spent engine oil
- destruction of abode

Specimen J (weaver bird)

- use of avicide / poison
- use of scare crows
- use of traps
- hunting / shooting

Specimen K (Weevil)

- use of insecticide
- handpicking
- application of heat / roasting
- boiling of feeds / feedstuffs
- drying of feeds / feedstuffs
- fumigation of stored feedstuff

Other storage pests

- cockroaches
- termites
- Rodents (rats, mice etc)
- beetle

Comments:

- (a) (i) A large majority of the candidates provided the right answers.
(ii) The question was adequately answered by the candidates
- (b) Most candidates provided the right answers. However, some of them mentioned mites, grasscutters and a few other organism as storage pests which is incurrent.

BIOLOGY 2

1. GENERAL COMMENTS

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

2. SUMMARY OF CANDIDATES' STRENGTHS

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

3. SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Technical terms were wrongly spelt by many candidates. Technical name of species of organism started with small letter.
- (2) Few candidates showed lack of knowledge with regards to questions bothering on description.
- (3) Few candidates failed to comply with the Paper instructions. Some answered more than two questions from Section A. Also, candidates answered Question 5 in Section B in addition to Question 6 which was meant for candidates in Nigeria, The Gambia and Liberia.

4. SUGGESTED REMEDIES

- (1) Candidates should read all instructions to the paper and follow them to the letter.
- (2) Teachers should take their students through spelling drills with respect to technical terms and names.
- (3) Teachers should encourage their students to work sufficient tutorials and assignments on how to provide concise and accurate answers.
- (4) Teachers should ensure that candidates know and understand the rubrics of the paper.

5. DETAILED COMMENTS

Question 1

- (a)
 - (i) **What is classification of living things?**
 - (ii) **Name the scientist that developed the Binomial System of Classification.**
 - (iii) **State three reasons why it is necessary to classify living things.**
 - (iv) **List seven major groups into which Taxonomists classify living things in order of hierarchy.**
- (b) **State two features each which viruses have in common with:**
 - (i) **living things;**
 - (ii) **non-living things.**

(c) Name two viral diseases each of:

- (i) plants;
- (ii) humans.

Candidates attempted the question and performance was quite satisfactorily.

- (a)
- (i) However, candidates must note that the classification of living things in the sorting/grouping/arranging of living things (in groups); according to their common/similar characteristics/features/shared qualities.
 - (ii) The name of the scientist who developed the Binomial system of classification is Carolus Linnaeus/Carl von Linné
 - (iii) Candidates were able to state the reasons for classification of living things which include the following:
 - to put everything organism into a systematic order/specific group/systematic naming of living things
 - for easy identification of similar living things
 - to indicate the relationship between different categories of living organisms
 - to show evolutionary trends in different groups of living organisms
 - to trace geographical distribution of living organisms
 - for easy reference
 - for easy research/study
 - (iv) Most candidates could list the major groups into which Taxonomists classify living things in order of hierarchy as Kingdom; Phylum/Division; Class; Order; Family; Genus. It must be noted that, listing of groups must be spelt correctly and in right sequence/order to score.
- (b) Candidates rather stated the characteristics of both living things and non-living things and not the features of viruses as presented below:
- (i) Living things
 - Some have protoplasm/ protein coat/ membrane
 - Contain DNA/RNA nucleic acid
 - (ii) Non-living things
 - Appear as crystals
 - Lack organelles
- (c) Candidates could name the viral diseases of the following organisms correctly as presented below:
- (i) Plants
Cassava mosaic disease, bean mosaic disease; (cacao) swollen shoot disease; groundnut rosette; maize streak, cucumber mosaic etc.
 - (ii) Humans
Poliomyelitis/polio; chicken pox; mumps; measles; influenza/flu; AIDS; Ebola disease; (infective) hepatitis; Lassa fever; Avian influenza (Bird flu); Swine flu; bovine flu; Rabies; Zika etc.

Question 2

- (a) **State four characteristics of enzymes.**
- (b) (i) **List two digestive enzymes produced in the duodenum of humans.**
(ii) **Name the substrate that each enzyme listed in (b)(i) acts on.**
(iii) **State the products of each enzyme activity in (b)(i) above.**
- (c) (i) **State one way in which chlorophyll is important in plants.**
(ii) **Name two macro elements that are required for the formation of chlorophyll in plants.**
(iii) **State one deficiency symptom of each macro element named in (c)(ii).**
- (d) **Outline the procedure used for testing for starch in a leaf.**

Generally, candidates answered this question satisfactorily.

- (a) Candidates stated the characteristics of enzymes satisfactorily. Some of which are listed below:
- they are biological catalysts; they alter the rate of biological reactions
 - they remain chemically unchanged at the end of the reaction
 - their actions are reversible
 - they are specific in action as well as specific on substrates
 - they are required in small amounts
 - they are protein in nature
 - they act best at optimum temperatures; high temperature denatures them while low temperature inactivates them
 - they are specific/ sensitive to optimum pH
 - their actions are retarded by poisons/ inhibitors
 - some require co-enzymes to function
- (b) (i) The name of digestive enzymes produced in the duodenum of humans are
- Amylase;
 - Trypsin
 - Chymotrypsin
 - Lipase
- (ii) The name of substrates for each enzyme is
- Amylase - Starch
Trypsin/Chymotrypsin – protein
Lipase – fats and oils/ lipids
- (c) (i) The importance of chlorophyll in plants is that it absorbs sunlight for photosynthesis
- (ii) The macro-elements required for the formation of chlorophyll are Nitrogen, Magnesium and Iron.
- (iii) Candidates could state the deficiency symptoms of each macro-element as follows:
- Nitrogen

- Chlorosis/yellowing of leaves
- Stunted/ poor growth
- poor flower / fruit development

Magnesium

- Chlorosis/yellowing of leaves
- Stunted/poor growth

(d) Few candidates had difficulty in outlining the procedure used for testing starch. The following steps must be stated in outlining the procedure:

- detach leaf to be tested from plant after 4 to 6 hours of exposure to sun to enable it form starch
- put leaf in boiling water for about 30 seconds to kill the cells
- put boiled leaf in a test tube containing 70% warm alcohol/ethylated spirit/ethanol in water bath to decolorise the leaf
- rinse decolorised/brittle leaf in running cold water to soften the leaf tissues or to remove alcohol
- spread out the leaf on white tiles or watch glass and add few drops of iodine solution
- allow to stand for a few minutes
- it turns blue-black indicating presence of starch.

It is worth noting that reasons must be stated for most of the actions taken.

Question 3

- (a) **Name one instrument used for collecting:**
- (i) **soil organisms from a soil sample;**
 - (ii) **tiny insects from a leaf or a stem.**
- (b) **Make a diagram 6 cm – 8 cm long of the instrument named in (a)(ii) above and label fully.**
- (c) **Explain briefly the relationship between three examples of symbiotic organisms.**

Few candidates who attempted this question performed poorly. In addition to this, the question was an unpopular one.

- (a) Candidates could not name the instrument used for collecting:
- (i) Soil organisms from a soil sample as the Sieve and Tullgren funnel
 - (ii) Tiny insects from a leaf or stem as the Pooter.
- (b) Most candidates could not present good diagram of the Pooter. Most of them had problems with the spelling of the names of the structures.

Candidates must note that a good Biological diagram is evaluated based on the following parameters as presented below:

Title: Diagram of a Pooter

Quality:

Size: 6 cm to 8 cm long

Clarity of lines: Lines not broken, lines not wooly;

Neatness of labels: ruled guidelines with no arrow heads, no crossed guidelines, horizontal labels.

Details

Stopper/rubber bung with two openings
Two delivery tubes, inlet tube longer than outlet tube
Inner end of shorter delivery tube with mesh/gauze

Labels

Shorter delivery/suction tube; longer delivery/collection
Tube/mesh/gauze/netting; cotton wool; specimen
Tube/container; vessel rubber
Stopper/bung/cork.

- (c) Candidates had difficulty in explaining the relationship between named examples of symbiotic organisms as presented below:
trichonympha/flagellate, a protozoa living in the gut of termite; helps that termite to digest its cellulose; while the Trichonympha enjoys protection and food in return from the termite.
Sea anemone attaching itself to the shell of hermit crab; thereby enjoying pieces of leftover food therein; the hermit crab in turn enjoys protection against predators or the sea anemone's stings prevent the predators from harming the hermit crab.

Algae and fungi in a lichen; lichen is made up of a fungus and unicellular alga living together; the green alga produces food/ photosynthesis for the association; the fungus protects the alga/absorbs water from the surrounding for the use of the alga.

Rhizobium sp a nitrogen – fixing bacteria living in the root nodules of leguminous plants; fixes atmospheric nitrogen into nitrates for use by the leguminous plant while the Rhizobium sp. enjoys shelter/food/nutrients from the leguminous plant.

It must be noted that any correctly named example of symbiotic relationships or organisms shall be accepted.

Question 4

- (a) **A child belongs to blood group O and the mother belongs to group B. With the aid of genetic cross, state the possible blood groups of the father.**
(b) (i) **Name two forms of adaptive communication in animals.**
(ii) **State two reasons why organisms communicate with one another.**
(a) Most candidates attempted this question satisfactorily.
Candidates were expected to construct three (3) genetic crosses using each of the father's possible blood groups A, B or O to cross with the mother's blood group B.

In conclusion, the father should either be blood group A, B or O.

It must be noted that if each of the genetic crossing is constructed and the crossing sign “X” is missing at the Parental genotype level, the candidates forfeits the score for the genetic diagram.

- (b) Candidates were able to answer the questions satisfactorily.
 - (i) Forms of adaptive communication; candidates were expected to mention the following: sound/auditory/acoustic; visual/vision; smell/chemical/ pheromones; tactile; electrical signal; display of colours/ dancing.
 - (ii) Reasons why organisms communicate included: for food, for mating/ reproduction, for territorial defense, danger/threats/predator presence/offense/attack for tracking routes etc.

Question 5

- (a) **State five important parameters to consider in a biological drawing.**
- (b) **Describe briefly the external features of a fern.**
- (c) **List five digestive organs of a rat that will be visible when the rat is cut open ventrally.**
- (d) **Describe briefly how skeletal muscles bring about movement of the limb of a mammal.**
- (e)
 - (i) **What is antenatal care?**
 - (ii) **List three benefits derived from antenatal visits.**
- (f)
 - (i) **Explain briefly the term Recombinant DNA Technology.**
 - (ii) **State four applications of Recombinant DNA Technology.**

- (a) Candidates stated the parameters to consider in a biological drawing as follows: Title; Quality; Size; Magnification; Clarity of lines/lines not woolly & lines not broken; neatness of labels/rules guidelines; lines not crossed; lines not having arrow heads/horizontal labels; Details of drawing; Label/lines must touch the parts & labels correctly spelt; avoid shading of drawing; draw with a pencil.
- (b) Candidates could not describe briefly the external features of a fern satisfactorily. It is worth noting that ferns are described as having an underground stem called rhizome with thin branched adventitious roots arising from the stem; leaves or fronds develop from buds on the rhizome. Each frond is made up of several pinnules/leaflets/curled leaves and at the base of the curled leaves are the older ones which have been reduced to brown scales. Sporangia or sori develop on the under surface of the mature leaflets and indusium or protective layer covers each sorus.
- (c) Digestive organs or structures to be seen when a rat is cut ventrally are oesophagus/gullet; stomach; duodenum; pancreas; liver; gall bladder; ileum/small intestine; colon/large intestine; caecum; rectum.

- (d) Candidates who answered this question could fairly describe how skeletal muscles bring about the movement of the limb of a mammal. However, reference was made to the upper arm of the fore limb. It must be noted that muscles always work in pairs; these are the biceps/flexor and extensor/triceps; when one set of the muscle contracts the other set relaxes; it moves the bone in one direction; and when the other set contracts the other relaxes; it moves the bone in opposite direction; these two sets of muscles work in opposition to each other/antagonistic in function; movement of these muscles is coordinated by the Central Nervous System/brain.
- (e) (i) It must be noted that antenatal care is the special/total/overall/holistic attention given to a pregnant woman during the period of pregnancy/gestation to ensure safe delivery and healthy baby/babies.
- (ii) Benefits derived from antenatal visits include:
- Personal hygiene/promotes good health of woman/foetus
 - proper nutrition/diet
 - regular intake of prescribed medication/ drugs
 - vaccination/immunization
 - regular exercise
 - counseling
 - monitoring growth/stages/development of foetus/to ensure resolution of pregnancy related complications; leading to safe delivery
 - avoid the use of natural/herbal products and unprescribed drugs
- (f) Candidates had difficulty in providing satisfactory answers to the question.
- (i) Recombinant DNA technology could briefly be explained as the artificial combination of pieces of fragments of DNA into a host DNA by means of a carrier system; the foreign DNA becomes a permanent part of the host; it is replicated and passed on to daughter cells; the donated DNA may be from another organism or artificially synthesized.
- (ii) The application of recombinant DNA Technology include the following:
- production of human insulin
 - production of human growth hormone/any correct named growth hormone/soma tropic hormone
 - production of genetically modified microorganisms/correctly named examples
 - genetically modified crops/foods/grains/fruits/vegetables/animals
 - production of clones
 - production of stem cells in animals
 - repair of damaged tissues/organs
 - production of disease/drought-resistant varieties etc.

BIOLOGY 3

1. GENERAL COMMENTS

The paper maintained the standard of questions set in previous years. Candidates performed better.

2. SUMMARY OF CANDIDATES' STRENGTHS

- (1) A number of candidates made the effort to make good quality drawings of the relevant specimens.
- (2) There was a fair attempt to relate structural features of organisms to their functions
- (3) More candidates are spelling the technical term correctly.

3. SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Once again, many candidates failed to calculate and disclose magnification to the drawing requested for in Question 1(e).
- (2) Standard of spelling of both technical and common words, continues to be poor.
- (3) Candidates did not observed the rule requiring names of taxa to be written with the first letter in capital letter.
- (4) Candidates readily wrote the plural forms of label to drawing whereas the guidelines point to a single structure.
- (5) Many candidates lost marks because of lack of appreciation for the meaning of feature of biological importance mentioned in question 2(a).

4. SUGGESTED REMEDIES

- (1) Instructions should draw students attention to the unwritten requirement for disclosing magnification in the correct format to their drawings.
- (2) Instructions should insist on the proper capital letter for the first letter of the name of a taxon.
- (3) For differences between organisms, instructions should impress on students to consider analogous features of the organisms. Features that are unique to one organism can also be considered.
- (4) Instructors should discuss the meaning of the following expression with students and illustrate them with several examples across the syllabus. Field trips, features of biological importance, adaptations of organisms to their habitats

5. DETAILED COMMENTS

Question 1

- (a) *Study specimens C, D and E carefully and answer questions 1(a) to (e).*
 - (i) **Name the phylum to which specimens C and E belong.**
 - (ii) **State two reasons for the answer in (a) (i).**
- (b) **In a tabular form, state three observable structural differences between specimens**
 - (i) **C and D.**

- (ii) **C and E.**
- (c) **What is the relationship between specimens C and D?**
- (d) (i) **Name the habitat of specimen D.**
(ii) **State two ways in which specimen D is adapted to its habitat.**
- (e) **Make a drawing, 8 cm – 10 cm long of the dorsal view of specimen C and label fully.**

- (a) (i) Phylum of both Butterfly and Grasshopper

This part of the question required candidates to mention the phylum of both butterfly and grasshopper. Many candidates readily stated correctly Arthropoda in response.

A number of candidates spelt the name of the taxon using a small letter ‘a’ and therefore lost credit. Others gave different phyla for the organisms, showing lack of coverage of taxonomy.

- (ii) Reasons for the answer in 1 (a)(i)

A number of candidates gave the required supporting reasons with correct spelling:

- presence of chitinous skeleton
- metameric segmentation
- jointed appendages

Majority of candidates however, had not studied this area of the syllabus and therefore lost marks.

- (b) (i) Differences between Butterfly and Caterpillar

This part of the question required the candidates to state in a tabular form three observable structural differences between butterfly and caterpillar. A number of candidates stated the differences in the required format. But few considered the analogous features to strike the differences. On the basis of the analogous features, the expected answer should be:

Butterfly	Caterpillar
Presence of proboscis	presence of Mandibles
Compound eyes	Simple eyes
Legs are long	Legs are short

On the basis of unique features, the expected answers include:

Butterfly	Caterpillar
Prolong absent	prolong present

Claspers absent	claspers present
Antennae present	antennae absent
Wings present	wings absent

- (b) (i) Differences between Butterfly and Grasshopper

	Butterfly	Grasshopper
Basic of	Clubbed antenna	Tapering antenna
Analogous	Proboscis	Mandibles
Features	Wings multi coloured	Wings uniform colour
	Hind leg short	Hind leg long
Based on	Scales on wings	Scales absent on wings
Unique	Eye spot on wing	Eye spot absent on wings
Features	Hair on abdomen	Hair absent on abdomen

- (c) Relationship between specimens Butterfly and Caterpillar

In a previous examination, candidates failed to response correctly to a similar question. The Chief examiner's report drew schools attention to the weakness but it appears a remedy has not been found. Candidates wrongly stated that caterpillar grows into butterfly for their answer. Others stated wrongly that the caterpillar is part of the life-cycle of butterfly.

The expected answer is caterpillar is the larval stage of butterfly or butterfly is the adult of caterpillar.

- (d) (i) Habitat of caterpillar

This part of the question was correctly answered by majority of the candidates. Leaves of citrus plants or vegetable crops were correctly mentioned as the habitat of caterpillar.

- (ii) Ways in which caterpillar is adapted to its habitat

Candidates were required to identify observable features that enhance successful living in the habitat. A number of candidates identified the features for movements. They mentioned prolegs for firm gripping of leaves and stem during climbing; claspers for attachment to leaves surface for stability.

Other features include spiracles for exchange of gases. Some wrongly mentioned osmeterium which emits foul smell to discourage predators mandible for biting and chewing leaves and colour pattern for camouflage against predators.

(e) Drawing of the dorsal view of Butterfly

The drawing was assessed on four areas:

Heading: Drawing of the dorsal view of specimen C

Quality: This covers clarity of lines, size of drawing within specification, ruled guidelines, neat labels and magnification

Details observed covers

- clubbed shape antennae
- three body division shown
- forewings broader than hindwings

Label: Correct naming of structures or the drawing

More candidates are making effort to improve on the quality of drawing. A fair number of candidates gave the correct heading. Many labeled the parts correctly. However, the shape of the antennae was not well drawn. Some used a single line instead of double lines to represent the antennae. A common error was the omission of disclosure of magnification of the drawing. Some candidates apparently had no previous practice in biological drawing.

Question 2

Study specimens F, G, H and J carefully and answer questions 2(a) to (e).

- (a) **State three observable features of biological importance in:**
- (i) **specimen F;**
 - (ii) **specimen G.**
- (b) (i) **Classify specimens F and G as either stem tuber or root tuber.**
(ii) **Give two reasons each for the answers in b(i).**
- (c) **Classify specimens H and J into the class to which both belong.**
- (d) (i) **In a tabular form, state four observable differences between specimens H and J.**
(ii) **State four observable similarities between specimens H and J.**
- (e) (i) **State the feeding habits of each of specimens H and J.**
(ii) **Name two observable features used for feeding in specimen J.**

(a) Observable features biological importance

This part of the question was poorly answered because the expression: “features of biological importance” was not appreciated by most candidates. This question required candidates to note unique features of carrot plant and stem tuber of Irish potato.

Candidates were expected to observe the following features on:

- (i) Carrot plant:
 - tap root swollen
 - lateral roots
 - reduced / short stem
 - green leaves
 - tapering tap root
- (ii) Irish potato:
 - swollen stem tuber
 - presence of buds
 - presence of scale
 - presence of lenticel

Few candidates were able to respond correctly.

(c) Class of mosquito and cockroach

Majority of candidates recognized the class to be Insecta. Some candidates did not write the name of the taxon correctly.

- (d) (i) Observable differences between mosquito and cockroach. A few candidates failed to present their answers in the tabular format suggested in the question. Good candidates presented their answers as required. The following are suggested answers.

Mosquito	Cockroach
- Smaller in size	Larger in size
- A pair of wings	Two pairs of wings
- Short antennae	Long antennae
- Proboscis	Mandible
- Cylindrical body shape	Dorso – ventrally flattened body
- Absence of spines on legs	Spines on legs

(e) (i) Feeding habit of mosquito and cockroach

Answers of majority of candidates clearly showed that they did not appreciate the requirement of the question. The question asked candidates to describe the way the insects get their food daily.

Expected answers are:

For mosquito - piercing and sucking

For cockroach - biting and chewing

- (e) (ii) Observable features used for feeding by cockroach

A handful of candidates stated the expected answers. Features for biting and chewing of cockroach are mandible, maxillae, labium and labrum.

Question 3

Study specimens K, L, M and N answer questions 3(a) to (f).

- (a) Name the habitats of each of specimens K, L, M and N.**
- (b) State the phylum and class to which specimen M belongs.**
- (c) State three observable features which adapt each of specimens K and M to their habitats.**
- (d) (i) State one respiratory structure possessed by each of specimens L and M.**
(ii) Explain briefly how specimen M is adapted for swift movement in its habitat.
- (e) Stat two ways by which the shell of specimen N is of importance to it.**
- (f) State five observable structural differences between specimens L and M.**

- (a) Habitats of Euphorbia, Crab, Catfish, Periwinkle

This part of the question was based on specific habitats listed in the syllabus. Candidates revealed their inability to distinguish between type of habitat and specific habitat. A large number of candidates stated the type of habitat which is either aquatic habitat or terrestrial habitat as their answer. The expected answers are as follows:

For Euphorbia	-	desert
Crab	-	Mangrove / Marsh land / in holes at river banks / intertidal area
Catfish	-	pond / rivers and lake
Periwinkle	-	Intertidal area / rocky shore and sea

- (b) Phylum and class of catfish

Many candidates correctly identified chordate for the phylum and osteichthyes for the class. wrong spelling cost many candidates marks. Clearly classification needs special attention in schools.

- (c) Observable features that adapt Euphorbia and catfish to their habitat

The evidence from many scripts was that very little time and effort had been given to serious study of adaptations to habitats. Field trips by students to ponds, savanna, forest and sea shore will provide opportunity for student to appreciate the concept of adaptation to habitats.

Candidates were expected to state:

Euphorbia:

- succulent stem; for water storage
- leaves are modified into spine; to cut down excessive water loss
- green stem; for carrying out photosynthesis
- presence of spine; for protection against predators
- thick waxy cuticle; to reduce excessive water loss

Catfish:

- streamlined body; reduce resistance when swimming/movement in water
- possession of pair of fins; to facilitate swimming
- presence of operculum; for protection of gills
- lateral line; for detecting vibration
- presence of dark dorsal region and light central surface; for camouflage to escape predation

(d) (i) Respiratory structure possessed by Crab and Catfish

A straight forward question to state the respiratory structure of Crab and Catfish

For Crab - Gill

Catfish - Gill

(ii) Adaptation of Catfish to swift movement

This part of the question yet again was hinged on the concept of adaptation to habitat. Candidates were asked to explain how catfish is able to swim swiftly in water. Majority of the candidates did not answer the question satisfactorily.

Expected answers include:

- possession of streamlined body; to reduce friction
- possession of unpaired fins; for thrust and steering
- possession of paired fins; for balancing

(e) Importance of the shell to Periwinkle

Majority of candidates wrote answers that earned them credit. The expected include:

- protection from drying out / desiccation
- protection from predation / injury
- colour of the shell provides camouflage to escape predators

CHEMISTRY 2

1. GENERAL COMMENTS

In general, the standard of the paper was the same and candidates performed very well compared to the previous year.

There were questions on knowledge/recalls, comprehensions, applications of concepts and some analysis which is very commendable. The questions were well structured and it afforded the candidates the opportunity to express themselves as far as the language of the subject is concerned. No candidate had the option to specialize in certain sections of the syllabus and get away with, especially the mandatory section A.

It is recommended that this way of setting, the paper should be encouraged in the future examinations.

2. SUMMARY OF CANDIDATES' STRENGTHS

Commendable features identified that should be encouraged include:

- (1) Definition of terms such as enthalpy of combustion, mole, relative atomic mass, hybridization and relevant explanations of concepts;
- (2) stating of basic laws in chemistry such as periodic law, Faraday's law;
- (3) Calculations involving amount of substance, mass of substances from given stoichiometry, relative atomic mass, enthalpy change for reactions using standard enthalpy of formations, order of reactions and rate constants;
- (4) Nuclear chemistry, equilibrium reactions and factors affecting K_c , application of electrolysis, comparison of enthalpies of neutralization involving strong and weak acids, oxidizing and reducing properties of elements from given reaction equations, products of incomplete combustion of hydrocarbons and acid base indicators.

3. SUMMARY OF WEAKNESSES

Weaknesses identified in the answers of the candidates include:

- (1) Identification of the intermolecular forces of attraction between covalent molecules;
- (2) Statement of the periodic law and the meaning of periodic properties of elements;
- (3) What is meant by catalytic cracking and drawing of structures of the isomers of butane;
- (4) Physical properties of compounds such as $\text{Cu}_{(s)}$, $\text{BeCl}_{2(s)}$, $\text{NaH}_{(l)}$ and $\text{CCl}_{4(l)}$;
- (5) Drawing of diagrams to include how $\text{C}=\text{C}$ double bond in alkene is formed
- (6) Stating the similarities between nuclear reactions and chemical reactions

4. SUGGESTED REMEDIES

Early completion of the syllabus and continuous assessment of candidates through quizzes and exercises on the relevant topics be treated. Where appropriate, demonstrations and practicals should be a routine exercise.

5. DETAILED COMMENTS

Question 1

- (a) (i) What is an acid-base indicator?
(ii) Give one example of an acid-base indicator.
- (b) State the property exhibited by nitrogen (IV) oxide in each of the following equations:
(i) $4\text{Cu} + 2\text{NO}_2 \rightarrow 4\text{CuO} + \text{N}_2$;
(ii) $\text{H}_2\text{O} + 2\text{NO}_2 \rightarrow \text{HNO}_3 + \text{HNO}_2$
- (c) (i) Define enthalpy of combustion.
(ii) State why the enthalpy of combustion is always negative.
- (d) (i) Distinguish between a primary cell and a secondary cell.
(ii) Give an example of each of the cells stated in (d)(i).
- (e) Define the term mole.
- (f) Calculate the amount of hydrochloric acid in 40.0 cm^3 of 0.40 mol dm^{-3} dilute HCl.
- (g) Name two substances which can be used as electrodes during the electrolysis of acidified water.
- (h) List two forces of attraction that can exist between covalent molecules.
- (i) Name the products formed when butane undergoes incomplete combustion.
- (j) Write the electron configuration of ${}_{26}\text{Fe}^{3+}$

- (a, b) Majority of the candidates were able to answer this question very well with the exception of stating the properties exhibited by nitrogen (IV) oxide in the equations:
 $4\text{Cu} + 2\text{NO}_2 \rightarrow 4\text{CuO} + \text{N}_2$;
 $\text{H}_2\text{O} + 2\text{NO}_2 \rightarrow \text{HNO}_3 + \text{HNO}_2$.
- (c,d) This section was very well answered by almost all the candidates
- (e) Some candidates could not define the term mole. They referred to it as if it was relative atomic mass.
The mole is the amount of substance that contain as many elementary particles/units/entities as there are carbon atoms in 12g of carbon – 12.
- (f,g) Were answered well by majority of the candidates.
- (h) Few candidates could not list the forces that can exist between covalent molecules. The response expected were, van der Waals forces, induced dipole – induced dipole interaction, dipole dipole interaction, dipolar forces and hydrogen bonds.
- (i) Most candidates could not give the name of the products formed when butane undergoes incomplete combustion. The response expected was; water, carbon (II) oxide and soot.
Most candidates were able to write the electron configuration of ${}_{26}\text{Fe}^{3+}$.

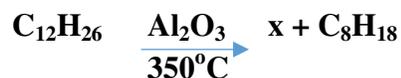
Question 2

- (a) (i) (α) State the periodic law.
(β) What is meant by the term periodic property of elements.
(ii) List three properties of an element which show periodicity.

- (iii) Explain briefly how each of the properties listed in (a)(ii) varies across the period.
- (b) Define relative atomic mass.
- (c) (i) What phenomenon is exhibited by an element Z which exist as ${}^{35}_{17}\text{Z}$ and ${}^{37}_{17}\text{Z}$.
 (ii) What accounts for the difference in the mass number of the element Z.
 (iii) Calculate the relative atomic mass of Z if the percentage abundance of ${}^{35}_{17}\text{Z}$ is 75%
- (d) (i) State the method used for collecting each of the following gases:
 (α) CO_2 ;
 (β) HCl ;
 (γ) H_2 ;
 (ii) Give a reason for your answer stated in (d)(i) (α) and (β).
- (a) Candidates misconstrued periodic law as periodic property of elements. The expected statement of the law was “The properties of elements are the periodic function of their atomic numbers. However, most of the candidates rather gave the explanation of the law. Candidates were able to list some of the periodic properties but could not explain how they vary across the period.
 (b,c,d) Sections of this question was very well answered by the candidates. But few of them used isotopes instead of isotopy as the phenomenon exhibited by Z in ${}^{35}_{17}\text{Z}$ and ${}^{37}_{17}\text{Z}$.

Question 3

- (a) Consider the following reaction equation:



- (i) What type of reaction is represented by the equation?
 (ii) Write the molecular formula of X.
 (iii) Draw the structure of two isomers of X.
 (iv) Name the isomers drawn in (a)(iii).
 (v) Write a balanced equation for the reaction between X and hydrogen.
- (b) Describe one test for fats.
- (c) Sulphur (IV) oxide, is converted to tetraoxosulphate (VI) acid according to the following equation:
 $2\text{SO}_{2(\text{g})} + \text{O}_{2(\text{g})} + 2\text{H}_2\text{O}_{(\text{l})} \rightarrow 2\text{H}_2\text{SO}_{4(\text{aq})}$.

If 1.5 moles of oxygen reacts with Sulphur (IV) oxide, calculate the mass of tetraoxosulphate (VI) acid produced.

[H = 1.0; O = 16.0; S = 32.0]

- (d) Consider the following neutralization reaction:
 $\text{CH}_3\text{COOH} + \text{NaOH} \rightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O}; \Delta H_1$
 $\text{CH}_3\text{COOH} + \text{NH}_4\text{OH} \rightarrow \text{CH}_3\text{COONH}_4 + \text{H}_2\text{O}; \Delta H_2$
 $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}; \Delta H_3.$
- (i) Arrange the enthalpy changes for the reactions in order of increasing magnitude.
- (ii) Explain briefly your order in (d)(i).

- (e) Consider the following substances:
 $\text{Cu}_{(s)}, \text{BeCl}_{2(s)}, \text{NaH}_{(s)}, \text{HF}_{(l)}, \text{CCl}_{4(l)}$

State the substance(s) which

- (i) can conduct electricity;
- (ii) is/are soluble in water.
- (a) Almost all the candidates who attempted this question were able to give the correct and appropriate answers except that they could not draw and name the isomers of C_4H_8 which was represented by X.
- (b) Most of the candidates could describe the test for fat using the translucent test and the Sudan (III) test.
 However, some used the Osmic acid test which was not familiar as far as their practicals was concerned
- (c) This section was application of stoichiometry to calculate the mass of H_2SO_4 produced from a given amount of O_2 . The equation was
 $2\text{SO}_2 + \text{O}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SO}_4$
 The candidates did well in answering this question.

Question 4

- (a) (i) Define hybridization.
- (b) (ii) With the aid of an appropriate diagram, indicate how the C = C double bond in an alkene is formed.
- (c) (i) Calculate the enthalpy change (ΔH) at 25°C for the reaction:
 $\text{C}_2\text{H}_{4(g)} + 3\text{O}_{2(g)} \rightarrow 2\text{CO}_{2(g)} + 2\text{H}_2\text{O}_{(l)}$

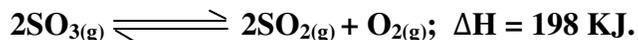
Using the information provided in the table below:

Compound	$\text{C}_2\text{H}_{4(g)}$	$\text{CO}_{2(g)}$	$\text{H}_2\text{O}_{(l)}$
$\Delta H^{\circ}_f / \text{kJmol}^{-1}$	+52.3	-393.5	-286.0

- (ii) State whether the reaction is endothermic or exothermic.

(iii) Give a reason for your answer in (c)(ii).

(d) Given the equilibrium system at 25°C.



(i) Write the equilibrium constant, K_c expression.

(ii) State the effect on K_c at the instant when concentration of SO_3 is increased.

(iii) What would be the effect on the concentration of SO_2 after equilibrium is re-established at 25°C when:

(α) temperature is increased;

(β) pressure is increased.

(iv) Explain your answer in (d)(iii)(α) and (β)

(e) Explain briefly the term homolytic fission and give an example.

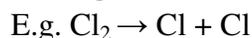
(a) Most of the candidates who attempted this question were able to define hybridization, but some few failed to say that it is the mixing of atomic orbitals.

Few of the candidates could not draw the appropriate diagram to indicate how the C=C double bond in alkene is formed.

(b,c,d) Sections of this question was well answered by the candidates. The only problem was the effect of increase in concentration of the K_c which they all said it has no effect since only temperature affects it.

(e) Most of the candidates saw homolytic fission as the fission reaction in nuclear chemistry and therefore could not give the correct response.

i.e. Process in which a bond is broken and the electrons between the atoms shared equally by the two fragments.



Question 5

(a) What is the nature of each of the following radiations?

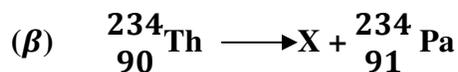
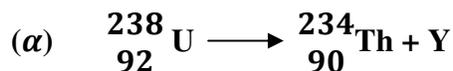
(i) Alpha;

(ii) Beta;

(iii) Gamma.

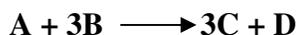
(v) State two factors that determines the stability of a nuclide.

(b) (i) Balance the following nuclear reactions:



- (c) (i) Give two similarities between nuclear reactions and chemical reactions.
(ii) State two uses of radioactive nuclides.

(d) Consider the reaction represented by the following equation:



The initial rate of the reaction was measured using different concentrations of A and B. the results are shown in the table below:

EXP	[A] mold m ⁻³	[B] mol sm ⁻³	Rate (mold m ⁻³ S ⁻¹)
I	0.100	0.100	5.40 x 10 ⁻⁴
II	0.200	0.100	4.32 x 10 ⁻³
III	0.200	0.200	4.32 x 10 ⁻³

- (i) Determine the order of the reaction with respect to each of the reactants;
(ii) What is the overall order of the reaction?;
(iii) Write the rate law expression for the reaction;
(iv) Calculate the rate constant. Give its units.

Question 5 was answered by almost all of the candidates and they performed very well.

The problem faced here are notable:

- the identity of Alpha, Beta and Gamma rays
- using half life as a factor which affects stability of nuclides
- similarities between nuclear and chemical reactions

Aside these, the question is one of the questions which was very well answered by the vast majority of the candidates

CHEMISTRY 3

1. GENERAL COMMENTS

The standard of this year's paper was comparable to that of the previous years in keeping with the high standard of performance of WAEC over the years. In Chemistry 3, the standard of the paper keeps teachers and candidates on their toes to search their books and run to and from the laboratories in order to meet the demands of the paper.

The marking scheme for chemistry 3 has also been maintained in terms of its quality and has been a great assistance to teachers and students. Candidates however performed poorly.

2. SUMMARY OF CANDIDATES' STRENGTHS

Some of the candidates showed strength in the following areas:

- (1) In question 1 for example, recording the volume of solution delivered from the burette (titre values) to two decimal places was done very well by some candidates.
- (2) The averaging of two consistent titres which differ by not more than 0.20 cm^3 was done very well by many candidates.
- (3) The unit of titre values in cm^3 was well done by many candidates
- (4) Writing down the mole ratio from the equations provided was correctly done by many candidates.
- (5) Some candidates were able to use the mole ratio in the calculations very well. In question 2, some of the candidates were able to filter their solutions given and some candidates knew the meaning of filtrate and residue. Some candidates were able to know the use of reagents such as dil HCl or dil HNO_3 , dil NaOH or dil NH_3 aq.
In question 3, a few candidates were able to use some laboratory chemicals and equipment.

3. SUMMARY OF WEAKNESSES

- (1) Some candidates could not use the mole ratio in their calculations. This must be known by all the teachers currently teaching in the various schools.
- (2) Some candidates did not abide by the instructions given. For example some candidates did not follow the order such as question a(i), (ii), 1b(i), b(ii). Some candidates attempted to write down the answers to question b(ii) under question a(ii).
- (3) Some of the candidates could not use the formula calculating the concentration of reactants correctly e.g. $C_1V_1 = C_2V_2$. The substitution of figures into this formula was poorly done.
- (4) Some candidates performed and recorded tests that were not demanded. In some cases, the tests had no bearing on the questions.
- (5) Many candidates lost relevant marks for not leaving their answers in the appropriate significant figures.
- (6) A few candidates also lost marks for using wrong units

- (7) Some candidates also did not score where they used trivial/old instead of IUPAC names
- (8) Many candidates did not care about the state/nature of the sample i.e. whether reagents were being added to filtrate or residue.

4. SUGGESTED REMEDIES

- (1) The solution to the poor standard of students is simply for the teachers and students to work hard in the classrooms and laboratories.
- (2) Teachers have to use their school laboratories very well.
- (3) Teachers must endeavour to expose candidates to a lot of practical exercises.
- (4) They must make time to mark the exercises while drawing their attention to essential points in recording tests, observation and inferences made.
- (5) It must be pointed out to them that the examiner is not in the laboratory as the exercises are being carried out. Hence results well recorded are equally important as exercises/activities performed.

5. DETAILED COMMENTS

ALTERNATIVE A

Question 1

All your burette readings (initial and final) as well as the size of your pipette must be recorded but no account of experimental procedure is required. All calculations must be done in your answer booklet.

A is $0.200 \text{ mol dm}^{-3}$ of HCl.

C is a solution containing 14.3 g of $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$ in 500 cm^3 of solution.

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

Repeat the titration to obtain consistent titre values.

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

The equation for the reaction is:



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

- (i) concentration of C in mol dm^{-3} ;**
- (ii) concentration of C in g dm^{-3} ;**
- (iii) molar mass of $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$;**
- (iv) the value of x in $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$.**

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

Credit will be given for strict adherence to the instructions, observations precisely recorded and accurate inferences. All tests, observations and inferences must be clearly entered in your answer booklet, in ink at the time they are made.

Question 2

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

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

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

- (a) Put all of F in a beaker and add about 10cm^3 of distilled water. Stir well and filter. Keep the filtrate and the residue.
- (b)
 - (i) To about 2cm^3 of the filtrate, add $\text{NaOH}_{(\text{aq})}$ in drops and then in excess.
 - (ii) To about 2cm^3 of the filtrate, add $\text{NH}_3_{(\text{aq})}$ in drops and then in excess.
- (c) To another 2cm^3 portion of the filtrate, add a few drops of $\text{HNO}_3_{(\text{aq})}$ followed by few drops of $\text{AgNO}_3_{(\text{aq})}$.
- (d)
 - (i) Put all the residue into a clean test-tube and add $\text{HNO}_3_{(\text{aq})}$.
 - (ii) To a portion of the solution from (d)(i) add $\text{NaOH}_{(\text{aq})}$ in drops and then in excess.

Question 3

State what would be observed, if the following reactions are carried out in the laboratory:

- (a) methyl orange is dropped into a solution of lime juice.
- (b) hydrogen sulphide gas is bubbled through Iron (III) chloride solution.
- (c) Sulphur (IV) oxide gas is bubbled into acidified solution of KMnO_4 .
- (d) ethanoic acid is added to a solution of K_2CO_3 .

Question 1

The titration dealt with analysis to determine the value of X in $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$. Most of the candidates had titre values which were consistent with the supervisor's titre. Performance was very good.

An appreciable number of the candidates were able to use the mole ratio, the various mathematical steps to calculate the required concentrations. They were also able to calculate the molar mass of $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$ and hence the value of X. A few of them lost the 1 mark for evaluation for not correcting to the nearest whole number.

NB: A few candidates wrote the mole ratio as

$$\frac{\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}}{\text{HCl}} = \frac{1}{2} \text{ instead of}$$

$$\frac{n(\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O})}{n(\text{HCl})} = \frac{1}{2}$$

Question 2

Some candidates did not report on the activity even though they proceeded to work on the filtrate and residue.

A few also described the filtrate as ‘white filtrate’ instead of ‘colourless filtrate’.

(b) (i) Performance by candidates was quite good.

(ii)	<u>Test</u>	<u>Observation</u>
	Filtrate + $\text{NH}_3(\text{aq})$ in drops then in excess -	pale blue gelatinous ppt

Many candidates wrote “precipitate dissolves” instead of “precipitate dissolves to form a deep blue solution”.

(c) Filtrate + $\text{HNO}_3(\text{aq})$ - no visible reaction
+ $\text{AgNO}_3(\text{aq})$ - white ppt

Many candidates did not know that this is enough evidence to establish presence of Cl^- ions. Hence they deduced the presence of Cl^- based on solubility of the AgCl ppt formed on adding excess $\text{NH}_3(\text{aq})$ – (Not required in the question).

d(i) Residue + $\text{HNO}_3(\text{aq})$: Observations made were incomplete in some cases. Many of them did not perform the limewater test before drawing the inference CO_2 from CO_3^{2-} . In few cases, candidates added $\text{HCl}(\text{aq})$ instead of $\text{HNO}_3(\text{aq})$.

Question 3

This question was satisfactorily answered by most of the candidates. The following points must however be noted.

- (b) Many candidates wrote ‘ FeCl_3 solution changes colour to green’ instead of ‘changes colour from ‘brown to green’.
- (d) Some candidates wrote ‘ CO_2 will be observed’ instead of ‘colourless, odourless gas evolved’.

ALTERNATIVE B

Question 1

All your burette readings (initial and final) as well as the size of your pipette must be recorded but no account of experimental procedure is required. All calculations must be done in your answer booklet.

B is a solution of hydrochloric acid

D is a solution containing 2.45 g of anhydrous sodium trioxocarbonate (IV) in 250 cm³ of solution.

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

Repeat the titration to obtain consistent titre values.

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

The equation for the reaction is:



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

- (i) concentration of D in mold m⁻³;
- (ii) concentration of B in mold m⁻³;
- (iii) concentration of B in gdm⁻³;
- (iv) volume of the gas evolved in the reaction at s.t.p.

[H = 1.0; C = 12.0; Na = 23.0, Cl = 35.5; Molar volume = 22.4 dm³ mol⁻¹]

Credit will be given for strict adherence to the instructions, observations precisely recorded and accurate inferences. All tests, observations and inferences must be clearly entered in your answer booklet, in ink at the time they are made.

Question 2

E is a mixture of an organic compound and an inorganic salt. Carry out the following exercises on E.

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

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

- (a) Put all of E in a boiling tube or beaker and add about 10 cm³ of distilled water. Stir the mixture and filter.
Keep both the filtrate and the residue.
- (b) To about 5 cm³ of the filtrate add about 2 cm³ of Fehling's solution and warm.
- (c) (i) To the residue gently add about 5 cm³ dilute HCl. Divide the solution into two portions.
(ii) To the first portion, add NaOH_(aq) in drops and then in excess;
(iii) To the second portion of the solution, add NH_{3(aq)} in drops and then in excess.

Question 3

- (a) Describe briefly one chemical test that could be used to differentiate between
- (i) ethanol and propan-1-ol;
 - (ii) ethene and ethyne.
- (b) Give a reason for each of the following laboratory practices:
- (i) KMnO₄ solution is not acidified with HNO₃ before titration;
 - (ii) FeSO₄ solution is usually prepared fresh when needed;
 - (iii) Sodium metal is usually stored in liquid paraffin;
 - (iv) Alkalis are not stored in glass stoppered reagent bottles.

Question 1

- (a) Observations made for the table of results and calculation of average titre, same as in Alt B.
- (b) The problem was with b(iv) where candidates were expected to calculate the volume of the gas evolved in the reaction at s.t.p.

A sizeable number of the candidates calculated volume of CO₂ from 250 cm³ instead of from 25 cm³ / 20 cm³ of solution. A few also found the volume of CO₂ evolved from 1000 cm³ of solution i.e.

$V(\text{CO}_2)$ from 25 cm³ / 20 cm³ = 0.0925 x 22.4 instead of

$V(\text{CO}_2) = \frac{0.0925 \times 22.4 \times 25}{20}$

$$= \frac{0.0925 \times 22.4 \times 25}{1000}$$

= say y dm³

Question 2

- (a) As observed in Alt A, some candidates did not report on the activity performed i.e. addition of distilled water to the sample E, stirred and filtered. Some who reported also described the filtrate as 'clear filtrate' instead of colourless filtrate. Others also used terms wrongly. E.g. precipitate instead of residue.
- (b) Many of the candidates seem to be comfortable with this question.
- (c) (i) Residue + dil HCl: Some candidates did not report on the chemical test i.e. 'Gas turned limewater milky'. But gave the correct inference which did not score any marks.
(ii) & (iii) Candidates performed creditably well.

Question 3

Majority of the candidates performed quite well on this question. A few however were unable to spell the reagents correctly.

ALTERNATIVE C

Question 1

All your burette readings (initial and final) as well as the size of your pipette must be recorded but no account of experimental procedure is required. All calculations must be done in your answer booklet.

The trioxocarbonate (IV) content of a sample may be determined by dissolving it in an acid and determining the excess acid by titration.

J is a solution obtained by reacting 8.00 g of impure trioxocarbonate (IV), MCO₃ with 1.00 dm⁻³ of 0.200mol dm⁻³ HCl solution.

K is 0.113 mol dm⁻³ NaOH solution.

- (a) **Put J into the burette and titrate it against 20.0 cm³ or 25.0 cm³ portion of K using methyl orange as indicator.**

Repeat the titration to obtain consistent titres values.

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

The equations for the reactions are:

- (i) $\text{MCO}_{3(\text{aq})} + \text{HCl}_{(\text{aq})} \rightarrow \text{MCl}_{2(\text{aq})} + \text{CO}_{2(\text{g})} + \text{H}_2\text{O}_{(\text{l})}$
- (ii) $\text{NaOH}_{(\text{aq})} + \text{HCl}_{(\text{aq})} \rightarrow \text{NaCl}_{(\text{aq})} + \text{H}_2\text{O}_{(\text{l})}$
- (b) From your results and the information provided calculate the:
- (i) concentration of HCl in J in mol dm^{-3} ;
- (ii) amount (in moles) of HCl used up when MCO_3 was added to 1 dm^{-3} of $0.200 \text{ mol dm}^{-3}$ HCl;
- (iii) percentage impurity in MCO_3 .
[$\text{MCO}_3 = 100$]

Credit will be given for strict adherence to the instructions, observations precisely recorded and accurate inferences. All tests, observations and inferences must be clearly entered in your answer booklet, in ink at the time they are made.

Question 2

L is an organic compound belonging to one or more of the following classes of compounds:

- Alkanoic acid;
 - Amide;
 - Alkanol;
 - Reducing sugar.
- (a) Dissolve all of L in about 10 cm^3 of distilled water.
- (b) Perform one characteristic test for each class and determine the class to which L belongs.

Question 3

- (a) A light green powder P is insoluble in water. On heating, a small portion of P decomposes to give a black residue Q.
- Another small portion of P reacts with dilute trioxonitrate (V) acid to give a bluish-green solution, S and a colourless odourless gas R. R turns lime water milky.
- (i) Identify P, Q R and S;
- (ii) Write relevant equations for each of the reactions.
- (b) (i) Give two examples of substances that sublime.
- (ii) Name one solid that can be used as desiccant.
- (iii) A liquid is suspected to be either pure water or an aqueous solution of sodium chloride. Describe one chemical test to identify the liquid.

Question 1

The analysis was about determination of percentage impurity of a substance using the back titration method. Performance by candidates was quite good except for b(iii) where they were to determine the percentage impurity.

Unfortunately, many of the candidates used.

$\frac{\text{Moles of MCO}_3}{\text{Moles of HCl}} = \frac{1}{1}$ as the mole ratio instead of

$$\frac{\text{Moles of } \text{MCO}_3}{\text{Moles of HCl}} = \frac{1}{2}$$

Those who used the 1:1 ratio got the mass of pure MCO_3 to be greater than that of the impure MCO_3 . Such candidates got confused as noticed in the scripts.

Question 2

Many candidates did not give the state of the reagents. Some also kept using L instead of $\text{L}_{(\text{aq})}$ after dissolving all of L in distilled water. Others also omitted conditions like heating where this was necessary.

Question 3

Except for b(iii) this question was also satisfactorily answered by most of the candidates. b(iii) instead of $\text{AgNO}_{3(\text{aq})}$, almost all the candidates used anhydrous CuSO_4 . But this will not be suitable because an aqueous solution of sodium is involved.

CROP HUSBANDRY AND HORTICULTURE 2

1. GENERAL COMMENTS

The standard of the paper compared favorably with that of the previous years. Generally, candidates performed credibly well.

2. SUMMARY OF CANDIDATES' STRENGTHS

The following strengths were observed by the Chief Examiner:

- (1) Generally, candidates adhered to the demands rubrics of the paper.
- (2) Most of the candidates provided answers to questions that demand short answers, this enable them to attempt the required number of questions
- (3) Candidates made good use of the answer booklet

3. SUMMARY OF CANDIDATES' WEAKNESSES

A summary of candidates weaknesses as observed by the Chief Examiner include:-

- (1) Candidates found it difficult to answer questions that demand explanation as found in questions: 1a, 2a, 3b and 6c.
- (2) Poor performance in some cases could not bring out the correct answers required and hence candidates lost marks
- (3) Still there were a few candidates whose handwriting was very difficult to read and this affected them.
- (4) Some candidates may start answering a question on page 2 and then continue on page 6 and jump to page 8 to end it. This is not the best practice.
- (5) Very few candidates did not adhere to the instructions of the paper.

4. SUGGESTED REMEDIES

- (1) Prospective candidates should be guided on how to answer questions that demand explanation.
- (2) Prospective candidates should also be encouraged to improve on their expression of the English language
- (3) They should also make a conscious effort to improve on their handwriting
- (4) Among others, prospective candidates should be briefed or reminded of the need to start each question on a new page

5. DETAILED COMMENTS

Question 1

- (a) **Explain five objectives of crop improvement.**
- (b) **Describe each of the following methods used in crop improvement:**
 - (i) **selection;**
 - (ii) **introduction.**
- (c) **Give four examples of exotic crops in West Africa.**

- (a) This question asked candidates to explain five objectives of crop improvement. A lot of candidates attempted this question. Most were able to state the objectives of crop improvement. The explanations were however poorly done.
- (b) Majority of the candidates could not describe the two terms as used in crop improvement. It is worth noting that selection is the creating of varieties with the best combination of desirable characteristics from population of crops. And introduction is obtaining crop varieties with desirable characteristics and making it available for cultivation in new environment.
- (c) Most candidates were able to provide examples of exotic crops in West Africa. This earned them four good marks.

Question 2

- (a) **Explain two ways in which each of the following factors influence vegetable growth:**
 - (i) **soil temperature;**
 - (ii) **soil structure;**
 - (iii) **soil water.**
- (b)
 - (i) **What is a growth medium**
 - (ii) **Give four characteristics of a good growth medium**
 - (iii) **Give two examples of growth media.**

- (a) This part of the question was poorly answered. For (i) and (iii), candidates wrote on the general factors that influence vegetable growth.
- (b)
 - (i) Many candidates who attempted this question were able to define a growth medium as any substance/mixture of substances in which plant roots can develop and grow.
 - (ii) Most of them were able to give characteristics of a good growth medium.
 - (iii) Here, soil and sawdust were the most examples provided by candidates. Other correct answers include; water, perlite, peat, shredded soaked paper, vermiculite, moss.

Question 3

- (a)
 - (i) **List four methods of planting lawn grasses.**
 - (ii) **Name four grasses suitable for lawn establishment.**
- (b) **Explain five principles of landscape designing.**
- (c) **State two main functions of ornamental plants.**

- (a)
 - (i) Majority of candidates were able to list the methods of planting lawn grasses.
 - (ii) Majority gave the names of grasses suitable for lawn establishment. The wrong answers given however, include: Guinea grass, Elephant grass, green grass among others.

- (b) Once again this question was poorly answered. Most candidates were able to state the principle but the explanation were not adequate. Most explanation were centered on lawn establishment instead of the general landscape. Over the years, this question has been poorly answered.
- (c) This question was satisfactorily answered by majority of the candidates.

Question 4

- (a) Differentiate between monoculture and monocropping.**
- (b) State three advantages of monoculture**
- (c) Explain four principles of crop rotation**
- (d) (i) Mention three tools that are used for laying-out a vegetable garden.**
(ii) State one use of each of the tools mentioned in d(i).

- (a) Majority of candidates could not differentiate between monoculture and monocropping. It should be noted that monoculture is a system of farming which involves growing of the same crop on the same piece of land year after year while monocropping is the system of practice of planting one type of crop at a time on a plot and harvesting it before another crop is planted on the same field.
- (b) Candidates could not provide the specific advantages of monoculture satisfactorily. The expected advantages include:
 - allows for specialization and in organization of resources for producing a particular crop
 - more attention given to the production of the crop
 - makes crop management easy
- (c) Majority of the candidates satisfactorily were able to explain principles of crop rotation.
- (d) This sub-question was poorly answered by candidates. It seems candidates did not understand the term “lay-out of a garden”. Hence, provided names of simple garden tools such as cutlass, hoe, rake for their answers. The expected tools used for farm/field lay-out include; ranging pole, measuring tape, peg, garden line.

Question 5

- (a) Discuss the production of banana under the following headings:**
 - (i) two varieties;**
 - (ii) climatic and soil requirements;**
 - (iii) planting materials;**
 - (iv) two diseases and their control;**
 - (v) three uses.**
- (b) Name two pests and two diseases of pawpaw.**

- (a) This question was generally poorly answered.

- (i) Only a few candidates were able to mention the varieties of banana which include Gros Michel, Robusta, Giant Cavendish, dwarf Cavendish.
- (ii) This part was poorly answered. The rainfall and temperature requirements were poorly answered. Only a few candidates mentioned loamy soil and the accurate pH ranges.
- (iii) Only a few candidates could give the correct planting material for banana which include; maiden suckers, sword suckers, peepers, bull heads, setts, mini setts.
- (iv) Quite a number of the candidates mentioned Panama disease and sigatoka disease but could not provide the corresponding control measures.
- (b) Most candidates could not provide correct answers to the question especially, that on the diseases of pawpaw. Diseases of pawpaw include; Anthracnose, dieback, mosaic, root rot, damping off, leaf spot powdery mildew.

Question 6

- (a) List five examples of micro nutrients required by plants.**
 - (b) (i) List three major nutrients required by vegetables**
 - (ii) State one symptom of each of the nutrient listed in b(i).**
 - (c) Explain three factors that determine the nutrient requirement of maize.**
 - (d) List three ways in which nutrients are lost from the soil.**
- (a) Majority of candidates' responses were quite satisfactory as most of them listed Manganese, Zinc, Cobalt, Copper, Iron, Molybdenum.
 - (b) (i) This sub-question was well answered by most candidates. The expected major nutrients required by vegetables include; Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sulphur, Carbon, etc.
 - (ii) Candidates also gave the correct corresponding deficiency symptoms of the stated nutrients.
 - (c) Most of the candidates could not state correctly the factors that determine the nutrients requirements of maize plant. The expected factors include; type of soil, previous use of land, fertility status of the soil, variety of maize.
 - (d) Most candidates correctly stated the ways nutrients are lost in the soil. Their answers includes; erosion, crop removal, leaching and burning.

CROP HUSBANDRY AND HORTICULTURE 3

1. GENERAL COMMENTS

There is nothing substantial between this year's and previous year's standard. The standard of the paper remains the same. Meanwhile, this year's performance was better than the previous years.

2. SUMMARY OF CANDIDATES' STRENGTHS

Candidates answers were orderly presented:

- (1) numbering of answers were nicely arranged.
- (2) about 80% of this year's candidates avoided lengthy answers. They were precise to the point
- (3) candidates' tabulation on "Observable differences" was nicely presented

3. SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Few candidates produced very poor handwriting
- (2) Some candidates did not understand the term "Observable differences" hence had the answers wrong.
- (3) Some candidates also produced very bad spelling: E.g. phosphorus, potassium and magnesium were spelt wrongly.

4. SUGGESTED REMEDIES

- (1) Candidates need to read the question very well before attempting those questions.
- (2) With reference to the spelling, candidates / students should note that technical words and terms must be correctly spelt to score full marks.
- (3) Instructors/teachers should be encouraged to take students through practical and theory aspect of the syllabus side by side.

5. DETAILED COMMENTS

Question 1

- (a)
 - (i) **State three observable features of specimen A that make it tolerant to drought.**
 - (ii) **Mention two crops that could be intercropped with specimens A.**
 - (iii) **Name two varieties of specimen A that is cultivated in West Africa.**
- (b)
 - (i) **Give the family name of the crop from which specimen B was obtained.**
 - (ii) **Mention two other crops which belong to the same family as the crop from which specimen B was obtained.**
 - (iii) **Outline the steps involved in preparing a piece of land for the nursing of seeds contained in specimen B.**

(iv) State two ways of storing specimen B.

- (a) (i) Candidates could not describe or state the observable features of specimen A that make it tolerant to drought. They rather described or talked about conditions necessary for growth. They were expected to state the features which make the specimen withstand drought conditions e.g. long narrow leaves / fibrous roots system.
- (ii) Quite a number of candidates were able to state / mention the crops which could be intercropped with specimen A.
- (iii) Poorly attempted question. About 95% of the candidates failed to answer the question correctly. They failed to state varieties of millet in West Africa. Expected varieties include: Nyanza, Mangarana.
- (b) (i) Well answered question. Almost all candidates were able to state Malvaceae as the Family name of the crop from which specimen B was obtained.
- (ii) Candidates were able to mention or answer this question very well. E.g. cotton and kenaf were stated correctly by quite a number of the candidates.
- (iii) Poorly answered question. Steps in planting specimen B were completely messed up. The correct steps include: clearing the land, lining and pegging the land, burn debris and sowing of seeds at skate.
- (iv) Almost 50% of the candidates answered this question correctly. However, the remaining candidates gave wrong answers, which made them lost the marks.

Question 2

- (a) **Identify each of specimens C and D.**
- (b) **State three observable differences between specimens C and D.**
- (c) **Give four reasons why it is advisable to use specimen D instead of specimen C in crop production.**
- (d) **Name three major nutrients that could be provided by specimen D.**
- (e) **State three methods of applying specimen C on the farm.**
- (a) Almost all candidates were able to identify each of specimens C and D. e.g. NPK fertilizer / inorganic fertilizer, poultry manure or organic manure. However, few candidates identified poultry manure as poultry dropping.
- (b) This question was poorly answered by almost all the candidates. Candidates did not understand the term “Observable differences” between C and D specimens. Instead of stating colour differences, the shape and the phase of the specimens, candidates were stating wrongly their chemical compositions.
- (c) This question was poorly answered. Expected reasons include: organic manure improves soil structure, enhances soil microbial activities, releases nutrients slowly over a period of time does not pollute the environment.

- (d) Well answered by quite a number of the candidates. The only problem faced by candidates was the spelling of certain nutrients like phosphorus, potassium or magnesium.
- (e) Candidates provided good answers for this question. The only problem faced by candidates was “Ring method” instead of Ring method.

Question 3

- (a) Identify each of specimens E and F.**
- (b) Mention two methods of propagating each of specimens E and F.**
- (c) State two horizontal uses of specimen E.**
- (d) State two cultural practices that could be carried out during the cultivation of specimen F.**
- (e) State three uses of specimen G on the farm.**
- (f) Mention two ways of maintaining specimen G.**

- (a) Candidates were able to identify specimens C and D correctly, but few of the candidates had problems with the spelling of the specimens.
- (b) Methods of propagation of specimen E and F were nicely stated for the maximum marks.
- (c) Horticultural uses of specimen E such as for hedging, wreath making were well stated by many of the candidates.
- (d) Candidates correctly stated the cultural practices on Bougainvillea. E.g. training, watering, weed control as well as fertilizer application.
- (e) Well answered question by the candidates. They gave precise uses of specimen G (Headpan) such as carrying seedlings, carrying fertilizer/manure, carrying soil.
- (f) About 95% of the candidates stated the correct way of maintaining specimen G.

Question 4

- (a) Identify each of specimen H, J and K.**
- (b) State two observable differences between specimens H and J.**
- (c) Mention three uses of each of specimens J and K.**
- (d) Name two planting materials that could be used in propagating specimen K.**
- (e) Give the main reason for setting fire to specimen K on the field just before harvesting.**

- (a) Candidates were able to identify specimen H, J and K correctly as lime, Lemon and sugar cane respectively.
- (b) Candidates presented a nice tabulation but the description of the observable differences between the two specimens H and J were poorly done.

Specimen H (Lime)	Specimen J (Lemon)
--------------------------	---------------------------

Size: small in size	Big in size
Surface: has smooth skin	Has rough skin
Shape: round in shape	No definite shape

- (c) Uses of J and K were done correctly by majority of the candidates.
- (d) About 90% of the candidates stated the right planting materials of specimen K – sugarcane, e.g. short setts, longsetts and soldier setts. However, only few of the candidates had their answers wrong. Some mentioned stem cutting and others stated seeds and leaves, instead of short setts and long setts.
- (e) Almost all the candidates wrote the correct reasons for setting fire to specimen K on the field just before harvesting.

FISHERIES 2

1. GENERAL COMMENTS

The standard of the paper was at par with that of previous years.
The performance of candidates was highly than those of previous years.

2. SUMMARY OF CANDIDATES' STRENGTHS

The Chief Examiner noted the following strengths:

- (1) Legible handwriting.
- (2) Orderly presentation of answers

3. SUMMARY OF CANDIDATES' WEAKNESSES

The following weaknesses were noted:

- (1) Definitions of key terms were poor
- (2) Explanation of terms were also poor
- (3) Inadequate preparation

4. SUGGESTED REMEDIES

The Chief Examiner suggested the following remedies to overcome weaknesses of candidates:

- (1) Students should pay attention to definitions of terms
- (2) Teachers should teach the correct definitions of the fisheries terms
- (3) Students should prepare adequately

5. DETAILED COMMENTS

Question 1

(a) Define each of the following terms as used in fisheries:

- (i) Exclusive Economic Zone;**
- (ii) Maximum Sustainable Yield;**
- (iii) Overfishing;**
- (iv) Spawning stock;**
- (v) Fisheries institutions.**

(b) Explain five ways in which fisheries contribute to national development.

Generally, candidates performed well.

- (a) While most candidates provided correct definitions of the terms, some wrongly indicated that they were processes. Exclusive Economic Zone is the area of sea and its bed within 200 nautical miles from the country's shoreline where the country has exclusive rights. Maximum Sustainable Yield is the greatest harvest from a fish pond. Over fishing is

removing fish from a pond beyond what is allowed. It happens when farmers harvest all the fish including juveniles from ponds and water bodies.

Spawning stock was defined by some candidates as the “population of eggs and sperms that are released to be fertilized at a particular time. Candidates should note that spawning stock is the total weight of fish in a stock that are old enough to spawn.

Fisheries Institutions are institutions established to control all activities in the fisheries industry.

- (b) Most candidates were only able to name the contribution of fisheries to national development, but did not offer any explanation as required.

Question 2

(a) State four regulatory methods used for fisheries conservation in Ghana.

(b) State three traditional methods of fish preservation.

(c) Describe two modern methods of fish preservation.

(d) (i) What is a fish landing site?

(ii) Name six facilities which are necessary for the smooth functioning of a modern fish landing site.

- (a) Candidates confused ‘conservation’ with ‘preservation’ and stated fish preservation method instead. Expected answers were establishment of mesh size limits, catch quotas, close seasons, close areas etc.
- (b) The traditional methods of fish preservation were correctly stated by most candidates.
- (c) The description of modern methods of fish preservation was poorly done. Most candidates just mentioned the methods without describing them.
- (d)(i) The definition of fish landing site was poorly done. Some said it is a place where fish is processed, or marketed. Fish landing site is a place along shores of water body where fish is landed.
- (ii) The sub-question on facilities at fish landing sites was very well answered. Almost all facilities were listed.

Question 3

(a) List five signs of spoilage of fish.

(b) Describe each of the following life processes in fish;

(i) feeding;

(ii) respiration;

(iii) reproduction.

- (a) Signs of fish spoilage were fairly well provided.
- (b)(i) Where candidates were required to describe feeding as a life process, most candidates described how feed is applied to a fish pond. Candidates should note that during feeding water with food particles enter the mouth of fish; mouth closes; water flows over gills,

gill rakers trap food particles and allow water to pass out through the operculum and trapped food is swallowed.

- (ii) Some candidates described circulation in fishes. Also some indicated that oxygen is absorbed by lungs of fishes. During respiration, oxygen from water in the mouth diffuses into the blood stream and diffuses carbon dioxide out.
- (iii) Reproduction in fishes was not properly described by some candidates. Reproduction includes courtship, nest making, egg laying and shading of milt, fertilization and incubation of eggs and subsequent development.

Question 4

- (a) List four main causes of fish spoilage**
- (b) State six factors which affect the growth of fish in a pond.**
- (c) Give three examples of fin fishes.**
- (d) Describe how each of the following items could be applied to fish ponds:**
 - (i) inorganic fertilizer;**
 - (ii) organic fertilizer;**
 - (iii) fish feed.**

- (a) Causes of fish spoilage was generally well answered.
- (b) Factors which affect growth of fish in a pond we correctly listed
- (c) Most candidates gave correct examples of fin-fishes. But some wrongly listed types of fins in fishes
- (d) Most candidates could not differentiate between inorganic fertilizer and organic fertilizer, therefore could not adequately describe their application to fish ponds. Some described the use of organic fertilizer in vegetable gardens. Candidates should note that inorganic fertilizers are broadcasted on pond bottom, over water surface or dissolved in little water and poured into pond. Organic fertilizers are either broadcasted on pond bottom or put in cribs or sack and placed in pond water.

Question 5

- (a) (i) State six problems encountered in fish marketing in Ghana.**
- (ii) Give one solution to each of the problems stated in (a)(i).**
- (b) List four differences between cartilaginous fishes and bony fishes.**
- (c) Give four reasons why fish stock management is important.**

- (a)(i) Problems encountered in fish marketing were satisfactorily stated.
- (ii) Routine solutions were given for each problem: “Government should provide good roads”, etc. some listed problems facing fish farming. Expected answers included: export, provision of cold stores and provision of adequate packaging materials.
- (b) Differences between cartilaginous fishes and bony fishes were satisfactorily listed.

- (c) This was very poorly answered, or not attempted at all by most candidates. Many students linked the question to stocking density in fish ponds. Expected answers included: ensures maximum sustainable catches, gives economic yield, maintains maximum stock size and maintains spawning stock.

Question 6

- (a) **Name four fishery resources protected by international law.**
- (b) **List four jobs opportunities available in the fishery industry.**
- (c) **Explain how each of the following features help fish to adapt to life in water:**
- (i) **swim bladder;**
 - (ii) **scales;**
 - (iii) **lateral line;**
 - (iv) **mouth.**
- (a) This questions was attempted by very few candidates. Some wrongly produced a list of fisheries regulations, (like mesh sizes regulators, fishing methods) and International Organizations like International Marine Organization, Green Peace, International Labour Organization. Expected answers included turtles, whales, sharks, dolphins and tuna.
- (b) Job opportunities were abundantly listed.
- (c)(i) Some candidates indicated that swim bladder enables fishes to swim. Many others correctly gave the required answers.
- (ii) Only a few candidates correctly stated how scales help fish to adapt to life in water. Even then they only mentioned the protective function of scales. It should be noted that scales also overlap backwards and do not impede smooth movement of fish.
- (iii) The function of the lateral line was correctly stated by most candidates.
- (iv) The use of the mouth was limited to its role in feeding. Most candidates ignored its function in gaseous exchange.

FISHERIES 3

1. GENERAL COMMENTS

The standard of the paper was at par with that of previous years'. The performance of candidates was also at par with that of previous years.

2. SUMMARY OF CANDIDATES' STRENGTHS

The Chief Examiner noted the following strengths:

- (1) Legible handwriting
- (2) Orderly presentation of answers

3. SUMMARY OF CANDIDATES' WEAKNESSES

The following weaknesses were noted:

- (1) Candidates showed a lack of understanding of the questions asked
- (2) Improper usage of the English Language
- (3) Inadequate preparation

4. SUGGESTED REMEDIES

The following remedies were suggested by the Chief Examiner

- (1) Candidates should prepare well for examinations
- (2) Candidates should read and understand questions before attempting them
- (3) Candidates should read good English books to improve upon their use of the English language

5. DETAILED COMMENTS

Question 1

The table below represents the average monthly fish landings from the sea, rivers and fish ponds in the country. *Study the table carefully and answer the questions that follow.*

	Jan	March	May	July	Sept	Nov
Sea (mt)	110	120	150	180	170	130
Rivers (mt)	30	40	50	55	60	55
Fish ponds (mt)	25	20	10	5	5	10

- (a) Calculate the total fish landings for each of the following water bodies:

- (i) sea;
 - (ii) rivers;
 - (iii) fish ponds.
- (b) Using the same axes, plot a graph with average monthly fish landings from the sea, rivers and fish ponds on the vertical axis and months on the horizontal axis.
 - (c) Describe the nature of graph drawn.
 - (d) Give three possible reasons for the changes in the fish landings from the sea, rivers and fish ponds.
- (a) Most candidates correctly added up the fish landings from the sea, rivers and ponds. However, most of them did not indicate that the quantities were in metric tons. Moreover, some added the quantities of landings from the sea, rivers and ponds together and struck the average by dividing their answers by 3, to obtain the average for each month.
 - (b) Graph: The graphs were generally poorly drawn. Mostly the points of the graphs were drawn by free hand, instead of being joined by ruled lines. Additionally, the point of the graph for January was joined to point O, which is the origin or point of intersection of the x-axis and the y-axis, even when no value had been provided in the data. The graphs had no headings, axes were not labelled, no scales were provided.
 - (c) The graph description was poorly done. The graph of sea landings should be described as “rising sharply” and “declining sharply”. Some candidates indicated that the graph “rises and falls” the graph for river landings rises sharply and drops gently whilst that for pond drops gently and rises gently.
 - (d) Was quite well answered.

Question 2

- (a) Mention the method used in preserving each of specimens A and B.
 - (b) Describe the method used in preserving specimen A.
 - (c) Name three fish by-products that could be obtained during the production of specimen B.
 - (d) Give three reasons why fish is preserved in the form of specimen A.
 - (e) Name two materials that could be used to package each of specimens A and B.
 - (f) Name three other methods of preserving fish.
- (a) The methods used to preserve specimens A and B were mostly correctly stated as smoking and sun drying.
 - (b) The description of the drying process was satisfactorily, except that some candidates indicated that the fish was put on fire instead of placed on mats/rocks/concrete surface under the sun and turned intermittently.
 - (c) In listing by-products of fish smoking, some candidates listed the fish bones, giving the impression that the fish was filetted. Expected answers were fish entrails/gut, fish skin, gill and fats and oils.

- (d) This sub-question was well answered. Answers included:
 - to improve taste
 - to increase shelf life
 - to add value
 - to minimize spoilage
- (e) Most candidates named correct packaging materials.
- (f) In naming other methods of preserving fish most candidates wrongly repeated the methods already mentioned (smoking and drying). Expected answers were frying, steaming, salting, freezing and marinating.

Question 3

- (a) Name five fish feed ingredients that are required in preparing specimen C.**
- (b) Give two advantages of using specimen C to feed fish.**
- (c) State three advantages and three disadvantages of using specimen D in transporting fish.**
- (d) Name two other items that could be used in transporting fish.**
- (e) (i) Identify specimen E.**
- (ii) Name the water quality parameter measured by specimen E in fish ponds.**
- (iii) Describe how specimen E is used to take measurements in fish ponds.**

- (a) The ingredients were correctly listed.
- (b) Most candidates missed out the key points of the advantage of using pelletized feed, that is to minimize wastage; to reduce pollution of the water; to produce complete feed. Most candidates just said it enables fish to grow.
- (c) Most students misunderstood the question. They wrongly assumed the basket was to be used to transport live fish. Some indicated that the basket allowed air to enter for respiration. Candidates were expected to state that free flow of air minimizes spoilage; it is cheap, it is readily available locally and is light in weight.
- (d) Some assumed that live fish is to be transported and provided wrong responses. Expected answers were nylon, plastic, fish boxes, cardboard and sack.
- (e)(i) Thermometer was correctly identified.
- (ii) Description of use of thermometer was poor in some cases. Some stated that water from the pond is fetched in a container and then the thermometer is placed in the water. Candidates should note that the thermometer is held by the tip and the end dipped into the pond water. It is kept in the water for some time, withdrawn and the reading taken immediately. The process is repeated at several points in the pond, and the average determined.

FORESTRY 2

1. GENERAL COMMENTS

The standard of this year's paper is comparable to that of the previous years. The performance of candidates improved slightly over last year.

2. SUMMARY OF CANDIDATES' STRENGTHS

The chief examiner observed the following strengths:

- (1) clear and straight forward answers
- (2) legible handwriting
- (3) beginning of fresh answers on fresh page
- (4) good command of the English language

3. SUMMARY OF CANDIDATES' WEAKNESSES

The following weaknesses were observed:

- (1) wrong spelling of terms
- (2) poor understanding of terms
- (3) rovision of incomplete answers
- (4) lack of hands-on knowledge of subject matter

4. SUGGESTED REMEDIES

- (1) Students should read text books on the subject and make a conscious effort to understand the terms and learn how to spell them
- (2) Teachers should guide the students to understand the technical terms
- (3) Students should be taken to the field to have practical knowledge of the subject

5. DETAILED COMMENTS

Question 1

- (a) **Define the term agroforestry?**
- (b) **Explain each of the following terms as used in forestry:**
 - (i) **agrosilviculture;**
 - (ii) **agrosilvopastoral;**
 - (iii) **silvopastoral.**
- (c) **State four effects of soil erosion on the forest ecosystem.**
- (d) **Explain four measures that could be used to conserve wildlife.**

Expected solution:

- (a) Agroforestry

Agroforestry is an integrated land use management system where trees or shrubs are cultivated on the same piece of land as crops or livestock or both.

(b) Explanation of terms

- i. Agrosilviculture - this is the growing of crops and woody perennials on the same piece of land
- ii. Agrosilvopastoral - this system comprises of crops, pasture animals and woody perennials on the same piece of land
- iii. Silvopastoral - this system consists of pasture animals and woody perennials on the same piece of land.

(c) Effects of soil erosion

- loss of soil fertility
- leads to exposure of roots of plants
- leads to siltation of water bodies caused by run-off
- leads to physical destruction of land
- leads to landslide

(d) Measures used to conserve wildlife

- the laws that help to conserve wildlife should be enforced, more security men like game guards or game scouts should be employed to help in the law enforcement and offenders should be punished.
- poaching should be prevented, people who go into the restricted area to hunt without permit should be arrested and prosecuted.
- national parks should be provided with water and all the facilities need for the survival of the animals, all structures that would make life comfortable for the animals in the park should be provided, example pond of water, should be created for certain animals like warthog or duck which normally wallow
- the public should be educated on the importance of wildlife through television, radios and vans, the people should be informed about the numerous benefits derived from wildlife.
- encroachment of areas designated for wildlife should be prevented, people who enter areas meant for game and wildlife without permit should be arrested and prosecuted
- offenders of laws should be prosecuted and fined or imprisoned
offenders of wildlife laws should be arrested and punished to serve as warning to others
- games guards should be well equipped

Comments:

This question was tackled by a great percentage of the candidates and most of them had high marks.

- (a) Most candidates defined the terms correctly
- (b) This question was poorly answered. Candidates were confusing the terms, the correct definitions are given above.
- (c) This question was satisfactorily answered by most candidates
- (d) Candidates obtained average marks for this question. Some candidates stated the measures instead of explaining them and as such had half the total marks. Refer to the answers provided.

Question 2

- (a) **Explain each of the following terms as used in forestry:**
 - (i) **skidding;**
 - (ii) **delimiting;**
 - (iii) **compartment.**
- (b) **Explain four ways in which trees are important to animals.**
- (c) **State three reasons why the Forestry Commission is important.**

Expected solution:

- (a) Explanation of terms

- (i) Skidding - The movement of a log with the help of a rope attached to a piece of equipment/ machinery from the felling site of the log to landing.
- (ii) Delimiting - The removal of branches from a timber or felled trees to leave a clean bole for lumbering.
- (iii) Compartment - It is a unit of management area of a forest reserve

- (b) Ways in which trees are important to animals

- Trees could serve as habitat/ home of animals such as reptiles, birds, mammals, insects
Some animals live inside the wood of trees, others live on the tree while others live in buttress of trees. These areas serve as their main living places.
- Fruits borne by a good number of trees could be food for animals.
Animals directly or indirectly feed on plant parts including the fruit, example squirrels and fruit bats live on fruits
- Trees could serve as breeding sites/ grounds for animals

- It is in these trees that the young of animals are borne and nurtured
- Trees could be the source of medicine for some animals
- Some animals take certain parts of plants to treat certain illness or diseases.
- trees could provide hide-outs for animals trying to elude detection of predators
- With the leaves and branches of trees some animals are able to hide themselves from their enemies
- provides shades for animals during sunny or hot days
- the numerous leaves on trees shield animals from the scorching sun

(c) Importance of the Forestry Commission

- promotes sustainable development and protection of the forest resource
- promotes the timber trade
- co-ordinates policies related to forestry
- advice government on forest resource
- collect and disburse revenue to resource owners
- enforce forestry laws

Comments:

This was another popular question, candidates who attempted this question performed satisfactorily.

- (a) Candidates had difficulty explaining the listed terms and hence obtained low marks for this sub-question. Refer to the answers provided.
- (b) Most candidates obtained good marks for this question
- (c) This question was also well answered by almost all the candidates who attempted it.

Question 3

- (a) **Distinguish between the following terms:**
 - (i) **pollarding and pruning;**
 - (ii) **rare species and endangered species.**
- (b) **Explain four ways in which trees are important to animals.**
- (c) **State three reasons why the beekeeping is important.**

Expected solution:

(a) Distinguish between terms

- (i) Pollarding is the cutting of a shoot just above the lower branch to promote lateral growth while pruning on the other hand is the removal of dead / diseased / unwanted branches to promote desired growth of the tree.

- (ii) Rare species are species which are very difficult to come by/ hardly seen/ very scarce while endangered species are species whose population or habitat has become so small that it may be lost forever if adequate protection is not given to it.

(b) Reasons for creating gaps in forests

- for sunlight to reach forest floor for regeneration / germination of seed in seed bank. Could be possible when there is warmth
- to allow sapplings to grow to maturity. The sapplings access to light prevents etiolation and with sunlight, chlorophyll will be formed for photosynthesis to take place
- to allow for natural succession to take place for permanent or climax to be reached, there must be sunlight for photosynthesis and growth.

(c) Importance of beekeeping

- honey obtained from beekeeping serves as food – Honey is used as substitute for sugar. It is also taken directly with flour meals.
- medicine – Honey is used in many medicines. E.g. it is used in making cough mixture.
- propolis obtained from bees serves as immune booster – This means that it helps our bodies to stand against germs.
- wax is industrial raw material – Wax is used in making many things including shoe polish, pomade and crayon.
- source of employment - Many people have gone into honey production as their main business
- income / revenue
- bees are pollinators – Bees are pollinators with their hairy bodies. They are able to transfer pollen grains from the anther to the stigma to effect pollination

Comments:

Candidates who attempted this performed well.

- (a) Most of the candidates answered this question satisfactorily and obtained very high marks
- (b) This sub-question was poorly answered by most of the candidates. Most of them did not understand the term gaps and therefore could not give reasons why they are created. Refer to the answers provided.
- (c) This sub-question was satisfactory answered by most of the candidates who attempted it

Question 4

- (a) **State four differences between natural forests and plantations.**
- (b) **Name five migratory birds that could be found in Ghana.**
- (c) **Mention four factors that could lead to the termination of Timber Utilization Contact.**
- (d) **State three disadvantages of skidding.**

Expected solution:

- (a) Differences between natural forests and plantations

Natural forests	Plantations
- Wide variety of species	- Normally monoculture of few tree species
- Presence of more NTFPs	- Absence or insignificant amount of NTFPS
- Tree species exhibit prominent buttresses	- Little or no buttresses
- Multi layered canopy	- Single-layered canopy
- More resistant / resilient to disease and pest attacks	- Less resistant / resilient to disease and pest attacks
- Soil fertility is high	- Soil fertility is low
- Uneven ages of trees / plant	- Even aged trees / plants

- (b) Migratory birds found in Ghana

- Egret
- Avocet
- whimbrel
- Wood whoopoe
- Reef heron
- Black winged stilt

- (c) Factors which could lead to termination of TUC in Ghana

- using expired permit document
- going beyond the date stipulated on the permit
- harvesting in excess / more than permitted

- failure to mark stumps
- felling undersized trees

(d) Disadvantages of skidding

- disturbance of forest floor
- destruction of seedlings, saplings, seeds etc
- laborious activity
- could kill forest animal like snails, tortoise etc which cannot escape
- could cause erosion in the forest

Comments:

Generally, most of the candidates who attempted this question performed below average.

- (a) Candidates who attempted this sub-question answered it satisfactorily.
- (b) It appears that candidates who attempted this sub-question do not understand the term migratory. Birds like parrots and owls which are not migratory birds were given. Refer to the answer provided for a list of migratory birds.
- (c) This is another poorly answered sub-question.
- (d) Candidates performed unsatisfactorily in answering this sub-question. Again, understanding the term skidding was the problem.

Question 5

- (a) **Discuss four ways in which wildlife is important.**
- (b) **Give four examples of forest based industries in Ghana.**
- (c) **Give the full meaning of each of the following acronyms:**
 - (i) **FORIG;**
 - (ii) **TIDD;**
 - (iii) **WD;**
 - (iv) **FSD.**

Expected solution:

(a) Importance of wildlife

- Tourism / Ecotourism

Wild animals live in specific ecological areas and therefore people travel from place to place to view them. Tourist may visit zoos, nature reserves, sanctuaries etc. This creates jobs/ income and a source of foreign exchange and revenue.

- Sociocultural - Chiefs in the North sit on animal skin as a sign of

supremacy

- festivals in which wildlife is involved, like the Aboakyir festival
- Food - Meat is obtained from the animals
- Education - for people to know the importance of wildlife
- Medicinal - bones of lions are used for strength, droppings of elephant use to cure diseases of children
- Research
- Industrial raw material - animals use in industry and wildlife parts like elephant tusk are used for making buttons
- Economics - some people hunt for wildlife for money

(b) Examples of forest based industries

- saw mill
- plywood mill
- chip board mill
- furniture industries
- civil works
- charcoal industry
- canning and sculpture
- boat / canoe building

(c) Meaning of Acronyms

- i. FORIG - Forest Research Institute of Ghana
- ii. TIDD - Timber Industry Development Division
- iii. WD - Wildlife Division
- iv. FSD - Forest Services Division

Comments:

Performance of candidates who attempted this was average.

- (a) This sub-question was well answered and candidates obtained satisfactory marks.
- (b) Candidates simply did not know what forest based industries are and hence were giving wrong answers like Cocoa Marketing Board, Benso Oil Palm plantain etc. refer to the answers provided.
- (c) Candidates performed excellently with this sub-question.

Question 6

- (a) **Give one reason why each of the following tending operations is important in forestry:**
 - (i) **thinning;**

- (ii) **pruning;**
- (iii) **beating up;**
- (iv) **stumping.**
- (b) **Describe four effects of deforestation on the environment.**
- (c) **Mention two diseases that attack tree seedlings at the nursery.**
- (d) **State two advantages of using exotic tree species in plantation establishment.**

Expected solution:

(a) Importance of tending operations

- i. Thinning - promotes fast growth of plants
 - for free movement on the plantation
 - reduces competition to prevent stunted growth
- ii. Pruning - reduces knot / prevent lateral development of plant / removes diseased branches/to obtain straight boles
- iii. Beating-up - to make optimum use of land/to reduce gaps/to reduce weed growth
- iv. Stumping - to reduce desiccation of seedlings
To make transportation easier

(b) Effects of deforestation on the environment

- loss of habitats of various organisms
Because of the removal of the vegetation, animals and plants that live on trees and those living inside trees buttresses lose their living places.
Example, some plants like ferns. Some animals live in burrow just under trees in order to have low temperatures. As soon as the tree or the plant is removed the habitats are destroyed.
- loss of water sheds
All the plants protecting rivers which are grown at the banks are destroyed. this causes drying up of the rivers through evaporation
- erosion, siltation / accretion
because of the removal of vegetation, rains get into direct contact with the soil causing erosion. The eroded material are sent unto water banks
- loss of biodiversity of some species / extinction
because the vegetation cover is removed, some plants and animals are very difficult to come by because their living places are destroyed,
- flooding
because there are no vegetation, most of the rain water could not be absorbed into the soil but are ran or directed into rivers thereby causing flooding
- climatic variability / change

The presence of trees and other vegetation give a constant humid environment. Once the vegetation is removed the place experiences changes in temperature as well as alternating sunny and cloudy weather

- loss of soil fertility

In the absence of the vegetation cover, soil nutrients are washed from the soil by erosion.

(c) Diseases which attack seedling at nursery

- dumping off
- root knot
- rust

(d) Advantages of using exotic tree species

- They grow fast
- They are resistant to diseases
- Raw materials for industry e.g. rubber, timber and transmission poles
- High coppicing ability e.g. cassia spp, Teak

Comments:

Generally, candidates who attempted this question performed creditably.

- (a) This sub-question was answered correctly by most of the candidates
- (b) Candidates answered this sub-question correctly and hence obtained good marks
- (c) This sub-question was poorly answered. Candidates were giving answers like bacteria, fungi, nematodes which are not diseases.
- (d) Most of the candidates answered this sub-question correctly.

FORESTRY 3

1. GENERAL COMMENTS

The standard of the questions of this year's paper compared favorably with those of the previous years.

The performance of candidates was a little above average.

2. SUMMARY OF CANDIDATES' STRENGTHS

The Chief examiner observed the following strengths

- (1) Almost all the candidates attempted all the questions as required
- (2) Candidates provided straight forward answers with good handwriting
- (3) Most of the candidates understood the questions and provided good answers

3. SUMMARY OF CANDIDATES' WEAKNESSES

The main weakness of most of the candidates was spelling mistakes. Also about 20% of the candidates could not express themselves properly or as expected of them.

4. SUGGESTED REMEDIES

The following remedies are suggested:

- (1) Candidates should read a lot of story books and newspapers.
- (2) Teachers should introduce candidates to the technical terms and guide them to practice their usage and spelling

5. DETAILED COMMENTS

Question 1

- (a) **Mention the main uses of each of specimens A, B and C.**
- (b) **State three precautionary measures that should be taken when using specimen A.**
- (c)
 - (i) **Give one reason why metallic objects should not be kept around when using specimen B.**
 - (ii) **State two ways of maintaining specimen B.**
- (d) **Explain why specimen C is painted in different colours.**
- (e)
 - (i) **Mention the minimum number of specimen C that could be used for a successful operation.**
 - (ii) **Give one reason for your answer in (e) (i).**

This question was answered nicely by most of the candidates except e(i) where a number of the candidates provided 2 or 4 as the answer instead of 3. The question was about the minimum number of ranging poles that could be used at a time. The answer should be 3 so that a straight line could be obtained.

Question 2

- (a) Give three reasons why specimen D is used in alley-cropping.**
- (b) State four nursery practices that could be carried out on specimen D before it is outplanted in the field.**
- (c) Mention four factors that could cause poor establishment of specimen D in the field.**
- (d) Name the type of leaf borne by specimen D.**

- (a) Many candidates failed to answer as expected. The question was to provide reasons for using specimen D (*cassia* sp.) in alley cropping. The answers were:
 - they are easily established
 - they have high coppicing ability
 - they are resistance to fire
 - they have another use as fuel
 - their ability to fix atmosphere nitrogen into the soil
 - production of more litter that decompose to provide more nutrient to the soil
 - possession of deep rooting system to resist being uprooted by wind and the fact that it is easy to eradicate when the need arises
- (b) This was poorly answered. The question was on the nursery practices on the seedlings of *cassia siamea*. Most candidates mentioned pruning, thinning out as well as out planting. It must be noted that the above practices are not done at the nursery. They are done on the field. The nursery practices include watering, shading, fencing, disease and pest control, pricking out and hardening off.
- (c) This was answered nicely by almost all the candidates.
- (d) The type of leaves borne by *cassia* sp. is pinnate compound leaf or simply compound leaf.

Question 3

- (a) Mention four uses of specimen E.**
- (b) Give three characteristics features of specimen E that promote its use.**
- (c) State six problems associated with the harvesting of specimen E from the forest.**
- (d) Name two vegetation types where specimen E could be found.**

- (a) This was on the uses of specimen E (cane), most of the candidates answered it correctly.
- (b) This question asked about the characteristic features of specimen E (cane), most of the candidates wrote about its ability to prevent erosion and its action as wind break. They answered the question as if considering the very specimen (stick or stem) before them. The answers should have been its flexibility, its durability, its beauty and its tensile strength.
- (c) This question asked about the problems associated with the harvesting of specimen E, a lot of candidates talked about the environmental problems like deforestation, erosion that

could be caused by the removal of the plant and the destruction of habitats. the problems like being bitten by snake, being attacked by wild animal or falling into deep pit, getting lost in the forest and stings from bees and wasps, were expected.

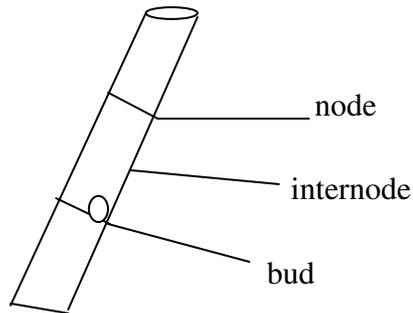
Question 4

- (a) **State three ways in which specimen F is of importance to the forester.**
- (b) **Name three predators of specimen F.**
- (c) **Mention the role of specimen F in the food chain.**
- (d) (i) **Give the family name of specimen G.**
(ii) **Draw and label specimen G.**
- (e) **State four uses of specimen G.**

(a)&(b) These were satisfactorily answered.

(c) The role of earthworm in the food chain is a decomposer and not a consumer.

(d)(ii) This required the diagram of bamboo, stem, arrows like → are not used in labeling. It should be simple straight line touching that part of the diagram being labeled.



Bamboo

Bamboo belongs to the family Coruminaceae

GENERAL AGRICULTURE 2

1. GENERAL COMMENTS

The standard of the paper compared favourably to that of the previous years. Candidates performance was however below average.

2. SUMMARY OF CANDIDATES' STRENGTHS

The Chief Examiner noted the following strengths:

- (1) Effective use of time as majority of candidates were able to finish answering the five questions within the allotted time.
- (2) Questions were answered from each of the five sections as required
- (3) Almost all candidates provided their details on the first page of the answer booklet
- (4) Answers to questions and sub-questions were properly numbered

3. SUMMARY OF CANDIDATES' WEAKNESSES

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

- (1) Inability to express themselves correctly using the English language
- (2) Poor spellings especially of terminologies of agriculture
- (3) Inability to describe agricultural / scientific processes logically
- (4) Poor handwriting in a few cases

4. SUGGESTED REMEDIES

The following recommendations were offered

- (1) Effective teaching of the English language
- (2) Proper teaching of agricultural terminologies should be encouraged
- (3) Students should also be encouraged to use the terms in their writings

5. DETAILED COMMENTS

Question 1

- (a) (i) **What is *farm land survey*?**
- (a) (ii) **Outline the steps involved in conducting a farm land survey.**
- (b) (i) **State five safety measures that should be taken when using machinery on the farm.**
- (b) (ii) **Mention four disadvantages of using manual power on the farm.**

Majority of candidates who attempted this question performed poorly.

- (a) (i) Candidates generally failed to explain what "Farm Land Survey" is. It should be noted that it is the measuring and mapping out of the position, size and boundaries of an area of farm land.

- (ii) Most candidates could not, satisfactorily, outline the steps involved in conducting farm land survey.

The correct steps are

- Reconnaissance survey
 - Preliminary survey
 - Planning the survey
 - Mapping and/or location survey
 - Drawing a map of the farm land
- (b) (i) This question was only fairly well answered. Safety measures including the following were hardly stated
- Never start a farm machine without knowledge of how to operate it
 - Do not use machine when drunk
 - Never top-up fuel level when machine is still running
 - Check and maintain correct tyre pressure

Question 2

- (a) **Explain four problems of farm mechanization in West Africa.**
- (b) **State four roles played by governments in West Africa in the development of agriculture.**
- (c) **Distinguish between farm machinery and farm implement.**

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

- (a) Most of the candidates, at best, were only able to state the problems of farm mechanization in West Africa. Only a few of them could explain the stated problems.
- (b) A fairly good number of them were however, able to state roles played by governments in Agricultural Development in West Africa.
- (c) A fairly good number of the candidates failed to distinguish between farm machinery and farm implement.

It is, therefore, useful to note the distinction as follows: Farm machinery are mechanical devices with moving parts and capable of generating power to accomplish tasks but implements are tools which require external source of power to perform tasks.

Question 3

- (a) **Discuss four ways in which knowledge of soil profile is important to a farmer.**
- (b) **State four ways of improving soil fertility.**
- (c) **List four agricultural liming materials.**

A great majority of the candidates attempted this question and exhibited a fairly good familiarity and ideas about a soil profile.

- (a) Even though most correctly stated the importance of the knowledge of soil profile to farmers, they could not discuss the stated points satisfactorily.

- (b) Generally, candidates did not find much difficulties in stating ways of improving soil fertility. Their answers included mulching which should have been stated as organic mulching since not all types of mulching materials decompose to improve soil fertility as organic mulches do.
- (c) Majority of candidates gave correct examples of liming materials but lost marks in cases where the names of the materials were wrongly spelt.

Liming materials rarely listed by the candidates include the following:

- Bone meal
- Basic slag
- Grpsum
- Biochar
- Magnesium hydroxide

Question 4

- (a) **State five adverse effects of soil erosion on agriculture.**
- (b) **List five ways of conserving water in the soil.**
- (c) **Explain three roles of organic matter in soil productivity.**

The performance of candidates on this question was generally good.

- (a) They stated the adverse effects of soil erosion on agriculture fairly satisfactorily. Most of them did not however explain the adverse effects such as the following
- Eroded materials may silt dams and reservoirs
 - Destruction of farm structure
 - Erosion reduces the area of cultivable lands
- (b) Candidates' performance on this sub-question was only fair as most of them could not state many ways of conserving water in the soil. Ways such as the following were rarely stated:
- Use of soil conditioners
 - Use of wind breaks
 - Zero tillage
 - Minimum tillage
 - Organic manuring
- (c) Most of the candidates, correctly, mentioned the roles of organic matter in soil productivity. The fact that organic matter improves soil texture, as mentioned by some candidates is wrong. It rather improves soil structure. However, many candidates could not explain the correct roles satisfactorily.

Question 5

- (a) **Give two examples of food crops belonging to each of the following groupings:**
- (i) **legumes;**
- (ii) **stem tubers.**
- (b) (i) **Differentiate between beds and borders as used in landscaping.**

- (ii) **State three principles that should be observed when planting in borders.**
- (c) **State two harmful effects of weeds on cultivated crops.**

The performance of candidates on this question was generally poor. Perhaps the topic “Bed and Borders” is not properly taught in schools.

- (a) Candidates were generally able to give examples of crops that are legumes and those that are stem tubers. They, however, found it difficult giving yam as stem tuber and cassava as root tuber and not vice versa. Similarly, they wrongly gave sweet potatoes as stem tuber instead of Irish potato.
- (b) A lot of candidates could not clearly distinguish between Beds and Borders in land scaping. For such candidates, their best answer was the fact that beds can be viewed from all sides/angles and borders can be viewed from two or three sides. Only a few of them knew also that in beds the tallest plants are in the centre/middle tallest plants in borders are at the back/obstacle. Performance in planting / establishing beds and borders in terms of height, colour, form and merging of plants was poor in most cases.
- (c) Candidates were generally familiar with this sub-question. They therefore answered it well scoring the full marks of two (2) in most cases.

Question 6

- (a) **Define the term crop improvement.**
- (b) **Describe each of the following methods of crop improvement:**
 - (i) **introduction;**
 - (ii) **selection.**
- (c) **Define the term a crop pest.**
- (d) **List eight physical barriers that could be used in controlling crop pests.**

Many candidates attempted this question but general performance was poor because they could not explain the stated terms well.

- (a) Crop Improvement
Deals with the development of crop varieties which have desirable characteristics better than existing varieties.
- (b) (i) Introduction
It involves obtaining crop varieties with desirable or superior or characteristics and making it available for wide cultivation in new environments.
- (ii) Selection
Choosing plant / crop varieties with the best combination of desirable characteristics from a population of crops with a variety of genetic constitution.
- (c) Most candidates correctly defined the term “Crop Pest” and scored the two marks allocated to it.
- (d) Except in a few cases, candidates wrongly stated physical methods instead of physical barriers used for controlling pests.

The expected barriers include fencing, waxing of crops, use of nets to cover crops.

Question 7

- (a) **List four effects of malnutrition in animal production.**
- (b) **Give four reasons why artificial insemination is not widely practiced in West Africa.**
- (c) **State four factors that should be considered in selecting a site for fish pond construction.**

This question was also popularly among candidates but performance can only be described as fair.

- (a) Majority of the candidates could state the effects of malnutrition but the following effects were rarely stated:
 - Draught animals become less strong to work
 - Poor quality animal product/poor market value
 - Delayed sexual maturity
- (b) Candidates' knowledge of Artificial Insemination is poor. They could not, therefore, give convincing reasons why artificial insemination is not widely practiced in West African countries.

The correct reasons include the following:

 - The practice is expensive
 - Inadequate in detecting heat
 - Difficulty in detecting heat
 - Short duration of heat
- (c) Candidates exhibited adequate knowledge of construction of fish pond by stating correctly, factors to consider in sitting a fish pond.

Question 8

- (a) **Mention two examples each of the following groups of animal diseases:**
 - (i) **viral disease;**
 - (ii) **bacterial disease;**
 - (iii) **fungal disease;**
 - (iv) **protozoan disease.**
- (b) **State four advantages of silage over hay as feed for ruminants**
- (c) **List four parts of the digestive tract of poultry.**

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

- (a) They could give correct examples of viral, bacterial, fungal and protozoan diseases in farm animals easily. Some examples given are as outlined below:

Viral Diseases

- Foot and mouth Disease
- Bird flu

Bacterial Diseases

- Tuberculosis
- Anthrax

- | | |
|-----------------------|---------------|
| - Rinderpest | - Mastitis |
| - Fowlpox | - Brucellosis |
| - Gumboro Disease | - Pullorum |
| - African Swine Fever | - Blackleg |
| - Newcastle Disease | - Footrot |

Fungal Diseases

- Aspergillosis
- Ringworm
- Candidosis
- Scabies

Protozoan Diseases

- Fowl fever
- Red Water Disease
- Coccidiosis
- Trypanosomiasis

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

- (b) Candidates had some knowledge of silage and hay but they could not give the required number of the advantages of silage over hay as feed stuff. Most of them, however, did not score full marks on the question.
- (c) This sub-question was well-answered. But wrong spellings of the names of parts of the alimentary canal of the poultry bird caused them marks.

Question 9

- (a) Explain four factors that determine the efficiency of labour.**
- (b) Mention four functions of a farm manager.**
- (c) State four factors that influence the supply of agricultural produce.**

- (a) This was another question attempted by many candidates who correctly stated most of the factors that determine the efficiency of labour. Most of them, however, could not adequately explain the stated factors.
- (b) This sub-question was well answered by the generality of the candidates and scored full marks in most cases.
- (c) Candidates were not able to state the factors that influence the supply of agricultural produce. In most cases, they got the price of the produce since they influence both the supply and demand of agricultural produce.

Other factors that influence supply include:

- Number of producers
- Price of related produce
- Technology
- Natural hazards
- Price of factors of production

Question 10

- (a) Mention three roles of research institutions in agricultural extension.**
- (b) Mention five objectives of agricultural extension.**
- (c) (i) Define the term credit as used in agribusiness.**
(ii) Give three reasons why credit is important in agricultural production.
(iii) Mention three formal sources of farm credit.

- (a) Majority of candidates who attempted this question miserably failed to mention the roles of research institutions in agricultural extension. These roles include the following:
 - Identification of major agricultural problems and finding solutions to them for agricultural production through extension agents.
 - Making appropriate recommendations to government on agricultural policies
 - Developing agricultural innovations and new farming technologies to be adopted by farmers through extension education.
- (b) In this question, most candidates confused the objectives of agricultural extension with the roles of Research Institutions. The objectives include the following:
 - To get farmers in the right frame of mind to adopt farming innovations
 - To help farmers to gain managerial skills needed for commercial farming
 - To help improve the general quality of farmers and rural dwellers
- (c) (i) Most candidates lost the marks for the sub-question either by simply saying that credit is money granted farmers or buying goods in the shop and paying for them later. It is suspected that giving the term as “credit” rather than “Agricultural credit” could be the cause of the confusion for candidates.
It should be noted that Agricultural credit/ credit or loan is money service or other forms of capital granted farmers on trust or the provision of collateral to be repaid at an agreed future date normally with interest.
- (ii) Candidate had fairly good ideas about the reason for obtaining agricultural credit. They therefore, in most cases, gave the three reasons for the full three marks.
- (iii) Candidates appeared to have knowledge of the general sources which they readily stated forgetting the word/adjective “formal” describing the sources. As a result most did not score full marks.

The expected formal sources include:

- Banks
- Government Agencies
- Non-governmental organization/NGO
- Co-operative societies
- Marketing Board
- Micro-finance organizations

GENERAL AGRICULTURE 3

1. GENERAL COMMENTS

The standard of the paper generally compared favourably with that of previous years with respect to contents, syllabus coverage and level of difficulty. The performance of candidates was good as compared to the previous years.

2. SUMMARY OF CANDIDATES' STRENGTHS

- (1) Most candidates showed improvements in spelling of scientific names and Agricultural terminologies
- (2) Most candidates were able to start each question on fresh paper
- (3) Most candidates adhered to the rubrics of the paper
- (4) Most candidates were able to identify the specimens provided by their common and scientific names
- (5) Most candidates were able to describe the soil sedimentation experiment correctly

3. SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Candidates could not calculate the number of specimen in an area of a pond
- (2) Few candidates failed woefully in providing scientific names for the specimens provided
- (3) Candidates exhibited poor construction of sentences that made it difficult for examiners to comprehend what they were trying to state.

4. SUGGESTED REMEDIES

The Chief Examiner made the following suggestions meant to remedy the weaknesses of candidates. Teachers/instructors should

- (1) give exercise involving calculation and identification of specimens to their students
- (2) periodically use question and answer to drill students on scientific terms
- (3) be encouraged to learn theory and practical aspects of the syllabus side by side
- (4) be encouraged to read good story books to enrich their vocabulary

5. DETAILED COMMENTS

Question 1

Specimen A shows a technique used in crop production.

Study the specimen carefully and answer questions that follow:

- (a)
 - (i) **Name the crop production technique that has been demonstrated in specimen A.**
 - (ii) **State three conditions necessary for the success of the technique.**
 - (iii) **State two advantages of using the technique in crop production.**
- (b)
 - (i) **Identify specimen B by its scientific name.**

- (ii) State three characteristics of specimen B that makes it a good animal feed.
- (c) (i) Identify specimen C by its common name.
- (ii) Determine the number of specimen C that could be found in a pond of length 4,000 cm and width 1,000 cm if the number of specimen C per square metre is 2.
- (a) (i) Most of the candidates correctly identified the crop techniques demonstrated as grafting
- (ii) Majority of the candidates failed to present the conditions necessary for the success of the crop techniques demonstrated satisfactorily.
The expected responses include:
- plants must be compatible or closely related
 - scion part of the graft should be the same
 - diameter of the cut plants should be the same
 - ensure scion and stock are well aligned
 - conditions around joints parts should be moist
- (iii) The advantages of using the technique were fairly stated by majority of the candidates as follow:
- to grow plants whose cutting are difficult to root
 - to repair damage plant parts
 - early maturity
 - to produce desirable traits in plants / true to type
- (b) (i) Most candidates identified the specimen B as Panicum maximum correctly. However, few candidates failed to present the scientific name correctly.
- (ii) Most of the candidates failed to state the characteristics of specimen B that makes it good animal feed. The expected characteristics include:
- high proportion of leaf
 - is palatable
 - high nutrition value
 - survive drought / resistant to drought
 - survive under continuous grazing
- (c) (i) Almost all the candidates identified the specimen correctly as Tilapia.
- (ii) Determination of the number of specimen/Tilapia found in an area of the pond was poorly done by most of the candidates. The expected calculation is as follow:
- Area of pond = 4,000 cm x 1,000 cm
 = 40 m x 10 m
 = 400 m²
- If number of specimen for 1m² = 2
 Then, number of specimen for 400 m²
 = $\frac{400 \times 2}{1}$
 = 800 specimens/tilapia

Question 2

- (a) (i) **Identify each of specimens D and E.**
(ii) **Give two features of specimen D that enables it perform its functions effectively.**
- (b) (i) **Identify each of specimens F, G and H by their scientific names.**
(ii) **Classify each of specimens F, G and H based on their feeding habits.**
(iii) **State two types of damage caused by specimen H to crops.**
(iv) **State two ways of controlling specimen H.**

(a) (i) Majority of the candidates were able to identify correctly specimens D and E as Gizzard and Crop respectively. However, few candidates wrongly stated “gizzard plus crop” or just digestive system.

(ii) Only a few candidates correctly stated the feature of specimen D that enable it to perform effectively as

- thick wall
- inner lining is rough
- it is muscular

Most candidates failed to state the function of specimen F (crop). The expected responses include:

- reservoir for food
- secretes enzymes
- secretes mucus which moistens and soften food
- passes food onto proventriculus
- serve as hunger sensation

(b) (i) This sub-question was poorly answered by many candidates. Identification of specimen by their scientific names include:

Specimen F - *Zonocerus veriegatus* / *Zonocenus* sp

Specimen G - *Dystercus supersticiosus* / *Dysdercus* sp

Specimen H - *Sitophilus zea* / *Sitophilus* sp

(ii) Most of the candidates did quite well by classifying the specimens based on their feeding habits as follow:

- Specimen F - biting and chewing
- Specimen G - piercing and sucking
- Specimen H - boring

(iii) This sub-question was well answered as most of the candidates provided the type of damage caused to crops by specimen H as follow:

- bore holes in seed
- destroy seed embryo thereby reducing viability
- reduce maize to powder
- create wounds for disease infections

However, few candidates wrongly stated damage caused to plants by pests such as “bore holes into plants” instead of “bore holes in the seeds”.

- (iv) Majority of the candidates provided correctly ways of controlling specimen H as follows:
- thorough cleaning of store room before restocking with grains
 - proper drying of maize / grains before storing
 - early harvesting of maize
 - fumigation of storage facilities
 - etc

Question 3

Study carefully the experimental set-up labelled J.

Use the set-up to answer the questions that follow:

- (a) State the aim of the experiment.**
- (b) Outline the steps involved in setting up the experiment.**
- (c) Besides the floating materials on the surface of the water, state two other observations that could be made from the experimental set-up.**
- (d) Mention four ways in which the floating materials on the surface of the water is of importance in crop production.**
- (e) State two precautions that should be taken when setting up the experiment.**

- (a) Majority of the candidates were able to state the aim of the experiment as “To demonstrate that soil is made up of particles of different sizes”.
- (b) Majority of the candidates could not outline the steps involved in setting up the experiment.

The expected steps involves:

- take a glass jar / measuring cylinder
 - collect soil, dry it and grind it
 - weigh about 100 g of the soil into the glass jar / measuring cylinder
 - pour adequate water (about four times the volume of soil) into the jar
 - add calgon / a dispersing agent / sodium carbonate to aid dispersion of soil particles
 - cover mouth of jar and shake vigorously / stir to aid dispersion
 - place the jar on a table / bench and allow the mixture to stand for at least 24 hours / over night
- (c) The observation in the set up was wrongly stated by majority of the candidates. Expected observations include:
- different layers of soil particles observed
 - coloured water / cleared water / suspended clay particles was observed
- (d) Majority of the candidates provided the correct responses for the importance of the floating organic matter for crop production
- (e) Only few candidates stated correct precautions for the setting up the experiment. Expected responses include:

- volume of water should be large compared to the soil
- soil sample should be dried
- soil sample should be ground
- shake vigorously to disperse the soil
- allow set up to stand overnight / 24 hours

Question 4

- (a) Identify each of specimen K, L and M.**
- (b) State two uses each of specimens K, L and M.**
- (c) Name three tools that should be used before using specimen L in seed bed preparation.**
- (d) State three ways of maintaining specimen M.**

- (a) Majority of the candidates were able to identify specimen K, L and M as Hoe, Rake and a pair of secateurs.

However, few candidates had the spelling of specimens wrong. For example “rake” was wrongly spelt as “rak” and “a pair of secateurs” as just “secateurs” without adding “a pair”.

- (b) Almost all candidates provided the correct uses of the tools provided except that of “a pair of secateurs”.

Uses of specimen M (a pair of secateurs) include:

- for cutting / pruning woody shrubs
- for cutting bud wood / scion
- for making wood cuttings

- (c) This sub-question was fairly answered correctly by majority of the candidates.

Tools used before specimen L (rake) in seed bed preparation include: cutlass, pickaxe, hoe, mattock, spade, shovel.

- (d) Majority of the candidates state the correct ways of maintaining each of the specimen M as follow:

- sharpen cutting edge
- tighten screw
- replace spring when weak
- wash / clean after use
- oil / grease metal part

INTEGRATED SCIENCE 2

(1) GENERAL COMMENTS

The questions cover a wide range of topics and the standard of the paper compares favourably with those of previous years. Candidates' performance, however, was below average as compared with the performance of candidates in the recent past.

(2) SUMMARY OF CANDIDATES' STRENGTHS

- (1) The presentation of responses were orderly and appropriately numbered.
- (2) Handwriting of most students was legible.
- (3) Most candidates attempted the required number of questions.
- (4) Candidates started new questions on fresh pages.

3. SUMMARY OF CANDIDATES' WEAKNESSES

The following were weaknesses of candidates reported by the Chief Examiner:

- (1) Poor understanding of scientific principles;
- (2) Some candidates wasted time answering more than four questions;
- (3) Candidates were not well prepared for the examination. This led to candidates reproducing the questions before answering.
- (5) Poor spelling especially of scientific terms was common as well as the use of wrong terminologies.
- (6) Poor expressions in English language was evident in a number of scripts.

4. SUGGESTED REMEDIES

The Chief Examiner suggested the following remedies to the candidates' weaknesses.

- (1) Vocabulary drill on scientific terms should be encouraged in schools. Special attention should be given to terms which appear to have similar meanings.
- (2) Special lessons should be held on fundamental unit, derived units and SI units.
- (3) Teachers are encouraged to take students through the types of questions often asked and assist students through exercises to be familiar with the requirements of these types of questions

5. DETAILED COMMENTS

Question 1

- (a) (i) **What is meant by the term seed dispersal?**
- (ii) **State three ways in which seed dispersal is important.**
- (b) (i) **Define potential energy?**

- (ii) A 400 g orange on a tree is 120 cm above the ground. Calculate the potential energy of the orange. [$g = 10 \text{ ms}^{-2}$]
- (c) Give two examples each of the following types of fertilizer:
- (i) inorganic fertilizers;
- (ii) organic fertilizers.
- (d) Three liquids, dilute acid solution, alkaline solution and distilled water, were kept in unlabelled identical reagent bottles. Describe briefly a test that could be performed to identify each of the liquids.
- (a) Majority of the candidates could explain seed dispersal and the importance of seed dispersal.
- (b) Many candidates stated the formula as Potential Energy = mgh but defined the g as gravity instead of acceleration due to gravity. They lost marks because they failed to convert the 400 g to 0.4 kg and 120 cm to 1.2 m and got the substitution wrong.
- (c) Some candidates confused 'inorganic' with 'organic', a few however named the common inorganic fertilizers – NPK, urea, ammonium nitrate, muriate of potash etc and organic fertilizers as manure and faeces/sewage.
- (d) Majority of the candidates could identify the three solutions using red and blue litmus paper; a few however failed to indicate that the two litmus papers must be placed separately in each liquid. Some failed to differentiate between the red and the blue litmus, papers and so lost marks.

Question 2

- (a) (i) Explain the term ration as used in animal production.
- (ii) Give three reasons for feeding animals with a balanced diet.
- (b) (i) State three processes involved in purifying water to be supplied to a community?
- (ii) What is the function of liquid ammonia in refrigerators?
- (c) (i) What does the expression *plastics are insulators* mean?
- (ii) A simple electrical circuit has a supply delivering 1.5 V. If the current in the circuit is 0.5 A, calculate the resistance.
- (d) Explain each of the following ecological terms:
- (i) community;
- (ii) population;
- (iii) ecosphere.
- (a) The definition of the term ration, amount of total feed provided to an animal during a 24 hour period, was a challenge to many candidates but they were able to state the reasons for feeding animals with balance diet, e.g., preventing deficiency diseases.
- (b) (i) Candidates were able to name the common processes i.e. filtration, sedimentation, chlorination, but in most cases they got the spellings wrong. Other less common

answers expected include aeration, taste and colour control and corrosion or scale control.

- (ii) $\text{NH}_{3(l)}$ in refrigerator does not regulate heat as stated by some candidates. It takes away heat or it brings about cooling or freezing.
- (c) This sub-section was well answered by most candidates as they demonstrated their knowledge of Ohm's law, but a few, even though, wrote the correct formula, could not manipulate the formula properly.
- (d) The explanation of 'ecosphere' was a challenge to most of them i.e. the part of the universe or earth or atmosphere, that supports life. A few also limited community and population to people and so lost marks.

Question 3

- (a)
 - (i) Give three reasons why water is not a good thermometric liquid.
 - (ii) Give the reason why water is a good cooling agent in machines.
- (b)
 - (i) What is an enzyme?
 - (ii) State three factors that affect the action of enzymes.
- (c) List three characteristics each of the following breeds of farm animals:
 - (i) layers;
 - (ii) dairy cattle.
- (d)
 - (i) Define the term hydrocarbon?
 - (ii) Draw the structural formula of:
 - (α) ethane;
 - (β) ethane.

This question was attempted by many candidates but they performed poorly.

- (a)
 - (i) The narrow range between freezing ($0\text{ }^{\circ}\text{C}$) and boiling ($100\text{ }^{\circ}\text{C}$), anomalous expansion of water and transparency of water which makes it difficult to read its level through glass were hardly mentioned by candidates but were the expected answers.
 - (ii) Most candidates failed to state the correct properties of water responsible for its suitability as a cooling agent. The expected responses were: it is neutral, it has low viscosity which makes it flow easily and also it has a high specific heat capacity which makes it capable of absorbing a lot of heat.
- (b) A fair knowledge of enzymes (biological catalyst) was exhibited, but candidates failed to mention concentration of substrate/enzyme/product as additional factors that affect the action of enzymes. Many candidates failed to appreciate that enzymes are produced by living organisms where they speed up reactions and not only digestion.

- (c) Candidates concentrated rather on the behavior of layers and dairy cattle instead of characteristics, viz ragged/dirty feathers, bright plumage etc (for layers) and large body capacity etc (for dairy cattle).
- (d) Most of the candidates provided correct answer to this sub-question.

Question 4

- (a) (i) **What is meant by the pole of a magnet?**
(ii) **Draw the magnetic lines of force around a bar magnet.**
 - (b) (i) **Distinguish between voluntary action and involuntary action.**
List four post harvest activities required in the preservation of maize.
 - (c) **Describe the processes that take place between pollination and seed formation in flowering plants.**
 - (d) **Distinguish between:**
 - (i) **an atom and an ion;**
 - (ii) **neutralization and esterification.**
- (a) (i) The meaning of ‘the pole of a magnet’ did not come out clearly in the candidates responses even though they know of North and South poles. It’s part of a magnet where the magnetic force is strongest.
- (ii) Most candidates were able to draw the magnetic lines of force. Some poorly, a few however failed to indicate the N/S poles. Others also lost marks because they wrongly indicated direction of arrows from South to North.
- (c) This sub-question was very poorly answered. Many candidates wrote differences between pollination and seed formation which was not the demand of the question. Some wasted time describing self/cross pollination when they should have presented the sequel event from where the pollen grain absorbs water / germinates, developing a pollen tube carrying two nuclei/tube nucleus and generative nucleus the latter dividing to form two male gametes inside the pollen tube which travels through the style into embryo sac of the ovule where the fertilization takes place.
- (d) (i) This was fairly well answered.
- (ii) Neutralization was correctly explained but esterification which involves alkanol and alkanolic acid, was said to involve organic acid instead.

Question 5

- (a) **Define each of the following terms as associated with reproduction in humans:**
 - (i) **copulation;**
 - (ii) **ejaculation;**
 - (iii) **ovulation;**

- (iv) **menstruation.**
- (b) **Name the type of oxide formed when each of the following elements reacts with oxygen:**
- (i) **sulphur;**
(ii) **sodium;**
(iii) **zinc.**
- (c) (i) **What is short-sightedness?**
(ii) **Describe briefly how short-sightedness could be corrected?**
- (d) **Give four reasons why it is important to keep records during crop production.**
- (a) Some candidates confused copulation with ejaculation. The former is the insertion of the penis into the vagina and the latter is the discharge of semen into the vagina during mating.
- (b) About 99% of candidates misread the question and stated the products of the reactions instead of the types as demanded by the question viz. (i) acidic oxide (ii) basic oxide and (iii) amphoteric oxide
- (c) (i) This error that when one is short-sighted, he/she sees only objects closed by and does not see distant objects at all was stated by most candidates. Shortsighted people can see distant objects but not clearly.
(ii) Candidates stated the use of diverging lens but failed to describe how the defect could be corrected i.e. it focuses rays from long distant objects, on the retina for them to be seen clearly.
- (d) Some candidates gave reasons for keeping records in respect of animals when the question demanded answer for crop production. Answers expected included (i) to enable payment of tax (ii) facilitate access to loan (iii) estimate amount of yield expected and even to win awards etc.

Question 6

- (a) **Calculate the mass of quicklime produced when 10 g of limestone is heated.**
[Ca = 40; C = 12; O = 16]

The equation for the reaction is: $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$

- (b) (i) **List three emissions of radioactivity.**
(ii) **State the charge of each of the emissions listed in (i).**
- (c) (i) **List three sources of organic matter in the soil.**
(ii) **State two advantages of tilling as a method of land preparation in crop production.**
- (d) **Name four blood vessels associated with the human heart.**

- (a) Many candidates were able to calculate the molar masses of CaCO_3 (100g/mol) and CaO 56 g/mol but failed to realize that from the equation $100\text{g CaCO}_3 \equiv 56\text{ CaO}$
- $$\therefore 10\text{ g} = \frac{56 \times 10}{100} = 5.6\text{ g of CaO.}$$
- (b) Candidates lost marks when they referred to the particles (in case of alpha and beta) and ray (in case of gamma) as emissions, since it was part of the question. Many stated the correct charge though (+2, -1 and neutral respectively).
- (c) (i) This sub-question posed a big challenge to a number of candidates who gave answers other than dead/decaying plants and animals; tissues of soil organisms; substances synthesized by soil organisms and animal droppings/manure.
- (ii) Well answered by many candidates
- (d) Very poorly answered by many candidates; a few who were close to the answer had spelling challenges of aorta, pulmonary artery, pulmonary vein, vena cava. The question demanded names of blood vessels and not parts of the human heart, which some candidates listed.

INTEGRATED SCIENCE 3

1. GENERAL COMMENTS

The standard of the paper compares favourably with those of the previous years. The performance of candidates showed slight improvement over those of the recent past.

2. SUMMARY OF CANDIDATES' STRENGTHS

Some features noted in candidates' answers include:

- (1) Giving more precise answers by strict observation of given illustrations or diagrams.
- (2) Candidates clearly expressed themselves.
- (3) Use of particular scientific words were employed to drive home answers to questions.
- (4) Reading and recording data has seen more improvement with precision and accuracy.
- (5) Legible handwriting was exhibited.

3. SUMMARY OF CANDIDATES' WEAKNESSES

Candidates exhibited weaknesses in the following

- (1) Plotting of graph
 - Poor labelling of axes
 - Poor choice of scale
 - Poor plotting of points
 - No drawing of sizeable triangles
 - Poor substitution of corresponding values for slope calculation
- (2) Incorrect spelling of scientific terms.

4. SUGGESTED REMEDIES

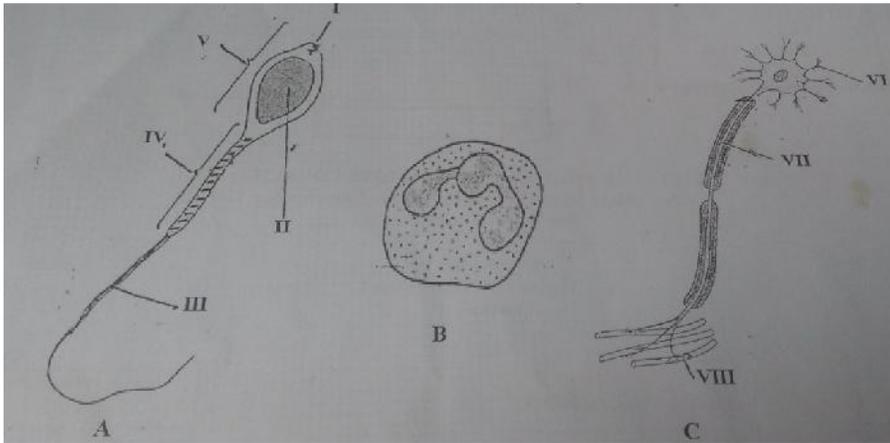
- (1) Teachers must practice plotting of graph with candidates and emphasize on paper representation of axes, scale, points plotting, drawing lines that best fit the points and how to calculate slopes.
- (2) Special attention should be given to the spelling of scientific words.
- (3) Comprehensive teaching learning and effective approach to examination writing must be executed by teachers to give candidates confidence to perform through self effort with integrity.

5. **DETAILED COMMENTS**

Question 1

The diagrams below illustrate three different types of specialized cells, labelled A, B and C, found in humans.

Study the illustrations carefully and answer the questions that follow.



- (a) (i) **Identify each of the cells labelled A, B and C.**
(ii) **Name each of the parts labelled I, II, III, IV, V, VI, VII and VIII.**
(iii) **State one function of each of the parts labelled I, III, VI and VII.**
- (b) (i) **State the location of each of the cells labelled A, B and C in the human body.**
(ii) **State the importance of each of the cells labelled A, B and C.**
- (a) (i) A, B and C were well identified except a few candidates who stated that B was red blood cell instead of white blood cells.
(ii) Many of the candidates knew the names of the labelled parts of the cells in A, B and C. The correct spellings were as follows:
I - acrosome and not accrone;
VI - dendrite and not deadrite;
VII - muscle/effector not synapse.
(iii) I - Candidates to note that acrosome secretes enzyme which dissolves the membrane of the ovum (not the ovary for the head to penetrate.)
III - well answered
IV - receives (not transmit) impulse
VII - transmits (not receives) impulse
- (b) (i) Well answered except in C where a lot of candidates wrongly stated nerves and nervous system. Any other part of the body was correct.
(ii) A number of candidates could not correctly answer this question
A - helps with fertilization not reasoning
B - helps with body's defence system not transport oxygen to the heart
C - relays messages from the brain not to determine stimulus

Question 2

The diagrams below illustrate an electrical circuit used to investigate a scientific law. The rheostat is adjusted to vary the current and voltage in the circuit

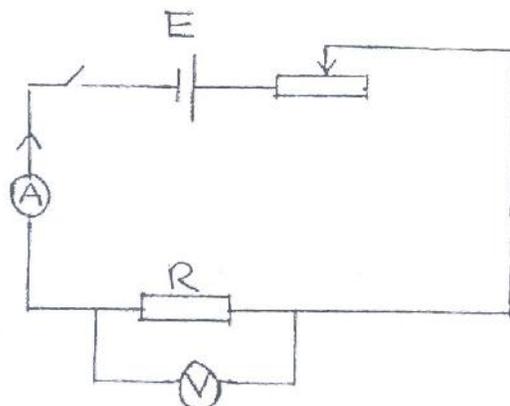
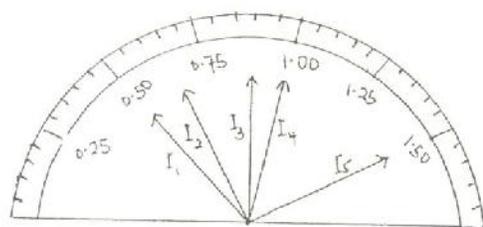
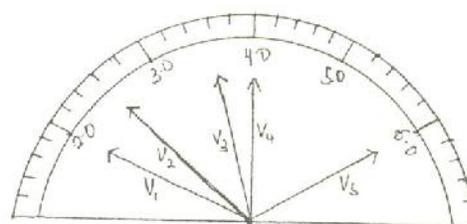


Fig 2(a) and Fig 2(b) below illustrate ammeter readings $I = I_1, I_2, I_3, I_4$ and I_5 and the corresponding voltmeter readings $V = V_1, V_2, V_3, V_4$ and V_5 , respectively when the key is closed.



Ammeter reading in amperes
Fig. 2 (a)



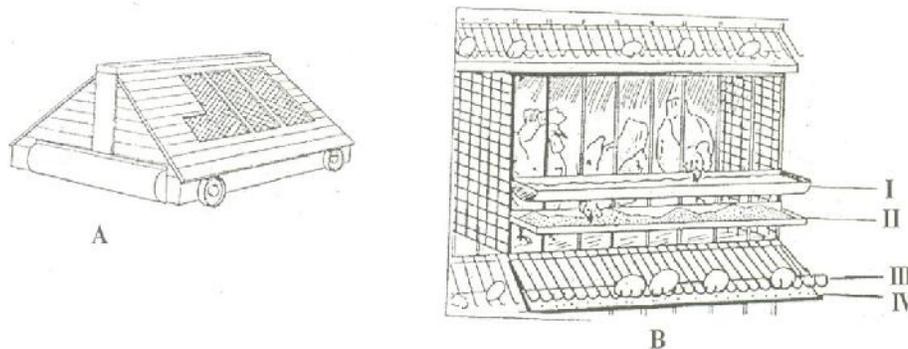
Voltmeter reading in volts
Fig. 2 (b)

- Read and record the ammeter readings $I = I_1, I_2, I_3, I_4$ and I_5 in Table 1 below.
 - Read and record the voltmeter readings $V = V_1, V_2, V_3, V_4$ and V_5 in Table 1 below.
 - Plot a graph with V on the vertical axis and I on the horizontal axis.
 - Describe the slope of the graph.
 - State the significance of the slope.
 - Using the graph, determine the voltage in the circuit when the current $I = 0.82$ A.
 - Using the graph, determine the current in the circuit when the voltage $V = 5$ V.
 - Name the scientific law investigated.
- (b) Readings of electrical meters well read.

- (c) The features of a graph were not tackled well by quite a number of candidates.
- Axes - not well labelled. y-axis had to be V/V not V ; x-axis be I/A not I .
 - Scale - a good scale must have regular intervals of 2, 5 and 10. Intervals are very wrong if they are odd numbers or matching points are used directly on any of the axes.
 - Plotting of points – At least three points must simultaneously represent x and y coordinates to give the line that best fits, out of which a good slope can be deduced or calculated using $\frac{\Delta y}{\Delta x}$
 - Calculation of slope must have a corresponding unit.
- (d) Some candidates had the formula $\frac{\Delta y}{\Delta x}$ but could not substitute correct values from the graph they plotted.
- (e) Candidates should have known that from the graph, the ratio of V/I gives resistance which was the significance of the graph/slope.
- (f)-(g) Well answered by majority of candidates

Question 3

The diagram below illustrates two management systems, labelled A and B, practised in chicken production. Study the diagram carefully and answer the questions that follow.



- (a) Identify the management system being practiced in each of A and B.
- (b) Name the type of housing used in each of the systems labelled A and B.
- (c) Name each of the parts labeled I, II, III and IV.
- (d) Name the type of chicken being kept in the system labelled B.
- (e) State three advantages that the system labelled A has over the system labelled B.
- (f) Give two reasons for recommending the system labelled B to a commercial poultry farmer.

(a) & (b) Few candidates answered the types of management systems correctly.

Correct answers were as follows:

- (a) A - semi intensive system
B - intensive system

(b) A - fold unit / moveable fold unit

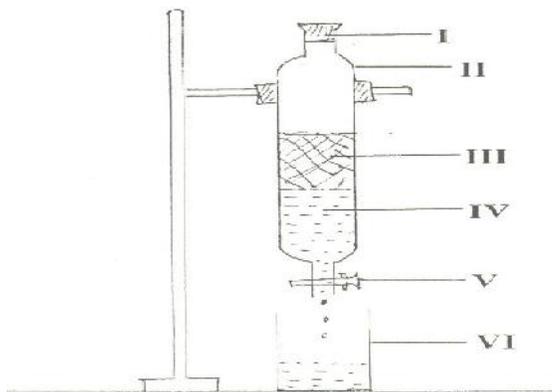
B - battery stage

- (c) Quite a number of candidates could not state the parts of the housing used. Correct technical terms were:
- I - water trough/drinking trough/waterer
 - II - feed (not food) tray / feeder / feeding tray / rack
 - III - egg collection tray / rack
 - IV - faeces / dropping collection tray / rack
- (d) Types of chicken reared in B:
Quite a number of candidates wrote “broiler” instead of layer
- (e) Candidates’ answers to advantages of system A over B were not clear in many cases. Expected answers were as follows:
- birds can exercise
 - less spending on feed
 - effective dropping disposal
 - exposed to sunlight
 - exposed to greens
 - etc
- (f) None of the answers in (e) befits answers for B. Candidates were expected to write the following for B.
- easy to keep records
 - feeding is easy
 - no pecking
 - best for egg production
 - no contaminated food

Question 4

The diagram below is an illustration of a set up used to separate a mixture of kerosene and water.

Study the diagram carefully and answer the questions that follow.



- (a) Name the method used in separating the mixture.
- (b) Identify each of the parts labelled I, II, III, IV, V and VI.
- (c) State the function of each of the parts labelled I and V.
- (d) State one physical property of the liquids that would enable the separation to occur.
- (e) Name the components of two other liquid-liquid mixtures that could be separated using this method.

- (a) A lot of candidates were confused with the method involved
- it was not fractional distillation because heating and boiling points were not involved here
 - it was not distillation because heating was not involved
 - it was not decantation because there was no clear layer of liquid and a precipitate
- The correct answer was separation funnel method
- (b) Correctly answered by most candidates.
- (c) The correct use of the cork was to prevent evaporation or spilling of liquids. Preventing air from entering funnel was not the issue.
- (d) Most candidates correctly stated immiscibility as the physical property involved in the experiment.
- (e) Correctly answered except a few who still cited kerosene and water as an example when the question said state other mixtures (liquid-liquid)

PHYSICS 2

1. GENERAL COMMENTS

The questions set were within the scope of the syllabus. The standard of the questions compared favourably with the previous years'.

The performance of candidates was of average. Some candidates produced fairly good responses to questions but the general performance was average compared to the previous years'.

2. A SUMMARY OF CANDIDATES' STRENGTHS

Candidates demonstrated considerable strength in the following areas:

Correct formulae were quoted and correct substitutions were made;

The phenomena that can be explained by the molecular theory of matter were correctly listed.

Factors that affect the maximum height attained by a bullet fired from a gun were correctly stated.

Stable equilibrium as applied to a rigid body was well defined.

Candidates correctly stated a dielectric is an insulator.

Candidates knew a voltmeter has a higher resistance than an ammeter.

Candidates could distinguish between resistors in parallel and resistors in series; and solved problems on them accordingly.

Few candidates gave concise and coherent responses.

3. A SUMMARY OF CANDIDATES' WEAKNESSES

The following weaknesses of candidates were noted by the Chief Examiner from the responses:

Candidates could not explain how h varies with t^2 .

Most candidates were not able to apply Hooke's law to solve a problem.

Many candidates could not state the advantages of p-n junction diode over diode valve

Candidates had difficulty in stating practical examples of mechanical resonance.

The energy level diagram for the atom was not correctly drawn by most candidates.

Candidates could not draw and label a diagram of astronomical telescope in normal adjustment.

Many candidates had difficulty in solving problems on resistance and gas thermometers, calculation of wavelength of a wave that undergoes transition and the determination of the age of the ancient bone.

4. SUGGESTED REMEDIES

1. Students must prepare adequately or must be prepared before attempting the Physics examination.
2. Candidates must solve past Physics examination questions.
3. Chief examiners report on Physics must be read by candidates.

4. Candidates must improve on their standard in English language to enable them understand the questions better and also give concise responses.

5. DETAILED COMMENTS

Question 1

A particle is dropped from a vertical height h and falls freely for a time t . With the aid of a sketch, explain how h varies with t^2 .

Many candidates were not able to explain the variation of h with t^2 . Some stated that h varies with t^2 , without the correct sketch.

The expected response is, h decreases linearly with t^2 .

Question 2

A particle is projected horizontally at 15 ms^{-1} from a height of 20 m. Calculate the horizontal distance covered by the particle just before hitting the ground. [$g = 10 \text{ ms}^{-2}$]

This question was popular and many candidates calculated the horizontal distance covered correctly.

Question 3

List three phenomena which can be explained by the molecular theory of matter.

This question was misunderstood by some candidates and most of them stated the molecular theory of matter instead of phenomena which can be explained by the theory. Some of the phenomena expected are, Brownian motion, diffusion, surface tension, capillarity, osmosis, viscosity, evaporation etc.

Question 4

A spiral spring has a length of 14 cm when a force of 4 N is hung on it. A force of 6 N extends the spring by 4 cm. Calculate the unstretched length of the spring.

Many candidates were not able to apply Hooke's law correctly in solving this problem. The expected solution is: By Hooke's law $F = ke$

Therefore,

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

Or

$$\frac{F_1}{l_1 - l_0} = \frac{F_2}{A_2}$$
$$\frac{4}{14 - l_0} = \frac{6}{4}$$
$$l_0 = 11.3 \text{ cm}$$

Question 5

- (a) State two factors on which surface tension depends.**
- (b) How can mosquito larvae be made to sink in stagnant water?**

- (a) This question was popular, however most candidates could not state the factors on which surface tension depends.

The expected answers were: Surface tension depends on purity of liquid, temperature of liquid, nature/type of liquid, or viscosity/density of liquid.

- (b) Candidates answered this question correctly by stating that pouring oil/detergent/soap on the water will make mosquito larvae sink.

Question 6

List three advantages of fluorescent tubes over filament bulbs.

Many candidates were able to list the advantages of fluorescent tubes over filament bulbs. They are: brighter, produce less heat, last longer, consume less energy, etc.

Question 7

List three advantages of p-n junction diode over diode valve.

Candidates could not list the advantages of p-n junction diode over diode valves. It appeared semiconductors were not treated by most candidates. The expected responses were: p-n junction diode needs low voltage to operate, does not need time to warm up, is not bulky, is cheaper to manufacture in large quantities, more durable.

Question 8

- (a) State two deductions that can be made from a displacement-time graph**
- (b) If the distance between two equal masses is doubled and their individual masses are also doubled, what would happen to the force between them? Support your answer quantitatively.**
- (c) State two factors that affect the maximum height attained by a bullet fired from a gun.**
- (d) State two practical examples of mechanical resonance.**
- (e) A body is released from rest at the top of a plane inclined at 30° to the horizontal and 4.0 m high. If the coefficient of friction between the body and the plane is 0.3, calculate the time the body takes to reach the bottom of the plane.**

- (a) Most candidates stated velocity, but they could not state initial displacement as one of the deductions that can be made from a displacement time graph.

- (b) This question was popular and most candidates stated that the force will remain the same if the distance between the two equal masses are doubled and their individual masses are also doubled. However, many could not support their answers quantitatively. The expected solution is:

$$\mathbf{F}_1 = \frac{Gmm}{r^2} \qquad \mathbf{F}_2 = \frac{G(2m)x(2m)}{(2r)^2} = \frac{Gmm}{r^2}$$

Therefore $\mathbf{F}_1 = \mathbf{F}_2$

- (c) Candidates stated correctly factors that affect the maximum height attained by a bullet fired from a gun. These factors were: initial velocity, angle of projection, acceleration due to gravity and air resistance.
- (d) Candidates were not able to state examples of mechanical resonance. Most of them stated examples from sound instead.

Expected examples of Mechanical Resonance are:

- collapse of a bridge (by marching soldiers)
- car bodies rattle at (very high speed)
- shattering of glass (due to high pitch notes)
- throwing off a paper rider (from a vibrating stretch string)

- (e) Few candidates attempted to calculate the time the body takes to reach the bottom of the plane, but most of them could not.

The expected solution was:

Let a = the acceleration with which the body moves down the inclined plane.

Net force on the body = ma = mgsinθ - Fμ

OR

$$a = g\sin\theta - \mu g\cos\theta$$

$$a = 10 \times \sin 30 - 0.3 \times 10 \times \cos 30$$

$$= 2.4\text{ms}^{-2}$$

Distance covered, $s = \frac{4}{\sin 30} = \frac{4}{0.5} = 8 \text{ m}$

$$s = ut + \frac{1}{2}at^2$$

$$8 = 0 \times t + \frac{1}{2} \times 2.4 \times t^2$$

$$t = \underline{\underline{2.58 \text{ s}}}$$

Question 9

- (a) Define stable equilibrium as applied to a rigid body.
- (b) Sketch a block and tackle system of pulleys with a velocity ratio 3.
- (c) At the beginning of a race, a tyre of volume $8.0 \times 10^{-4} \text{ m}^3$ at 20°C has a gas pressure of $4.5 \times 10^5 \text{ Pa}$. Calculate the temperature of the gas in the tyre at the end of the race if the pressure has risen to $4.6 \times 10^5 \text{ Pa}$.
- (d) (i)

	<i>Ice point</i>	<i>Steam point</i>
	273 K	375 K
<i>Resistance/Ω</i>	5.67	7.75
<i>Pressure/Pa</i>	7.13×10^4	9.74×10^4

The table above shows readings of the resistance and pressure of a platinum resistance thermometer and a constant volume gas thermometer respectively, when immersed in the same liquid bath. Use the data to determine the temperature of the bath on the:

- (α) resistance thermometer;
- (β) gas thermometer;
- when the resistance and pressure are 7.43Ω and $9.33 \times 10^4 \text{ Pa}$, respectively.
- (ii) By what percentage is the temperature measured on the platinum resistance thermometer in error.

- (a) Candidates were able to define satisfactorily stable equilibrium of a rigid body.
- (b) Few candidates were able sketch a block and tackle system of pulleys with a velocity ratio 3. This diagram should have one pulley at the bottom block and two pulleys at the top block.
- (c) Some candidates calculated correctly the temperature of the gas in the tyre. The expected solution was:

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$
$$\frac{4.5 \times 10^5}{293} = \frac{4.6 \times 10^5}{T_2}$$
$$T_2 = 299.5 \text{ K OR } 26.5^\circ \text{C}$$

- (a) (i) Candidates had difficulty in determining the temperature of the liquid in the bath on the resistance thermometer and the gas thermometer.
- (ii) The candidates could also not determine what percentage the temperature measured on the platinum resistance thermometer is in error. The expected solutions to problems was:

Resistance thermometer:

$$\frac{a}{b} = \frac{c}{d}$$

$$\frac{7.43-5.67}{7.75-5.67} = \frac{R-273}{375-273}$$

$$R = 359.3\text{K}$$

(ii) Error = 359.3-359

$$= 0.3$$

$$\text{Percentage error} = \frac{0.3}{359.0} \times 100\%$$

$$= \underline{0.084\%}$$

Gas thermometer:

$$\frac{(9.33-7.13) \times 10^4}{(9.74-7.13) \times 10^4} = \frac{G-273}{375-273}$$

$$G = 359.0\text{K}$$

Question 10

- (a) What is a *wavefront*?
- (b) (i) State two practical uses of glass prisms.
(ii) List two factors that determine the deviation of a ray of light travelling from air into a triangular glass prism.
(iii) Sketch a graph to illustrate the variation of the angle of deviation, d , with that of incidence, i , for a ray of light travelling from air into a triangular glass prism. Indicate on the graph at which point the angle of incidence, i , equal to the angle of emergence, e .
- (c) (i) Draw and label a diagram of an astronomical telescope in normal adjustment.
(ii) The angular magnification of an astronomical telescope in normal adjustment is 5. If the focal length of the objective is 100 cm, calculate the:
(α) focal length of the eyepiece;
(β) length of the telescope.
- (a) Most candidates could not state what wavefront is: -Wavefront is a surface over/on which particles vibrate in (the same) phase.
- (b) (i) The practical uses of prism were satisfactorily stated by most candidates.
(ii) Most candidates were not able to list the factors that determine the deviation of light ray travelling from air into a triangular glass prism. The expected answers were:
- angle of incidence
- (refracting) angle of the prism
- refractive index of the prism
- (iii) The sketch of graph to illustrate the variation of the angle of deviation, d , with that of incidence, i , for a ray of light travelling from air into a triangular prism

was wrongly done by most candidates. As a consequence, the point at which the angle of incidence, i , equals the angle of emergence, e , could not be determined.

- (c) (i) Candidates were not able to draw a labelled diagram of an astronomical telescope in normal adjustment. Candidates appeared to have no knowledge of this instrument. The expected diagram was



- (ii) Few candidates quoted the correct formula and calculated correctly the focal length of the eyepiece and the length of the telescope.

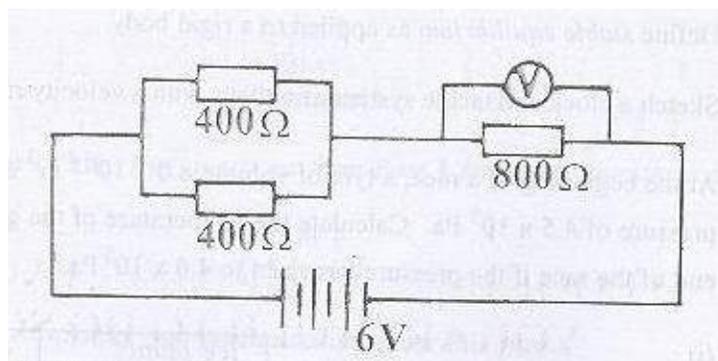
The expected solution is:

$$\begin{aligned}(\alpha) \quad M &= \frac{f_o}{f_e} \\ 5 &= \frac{100}{f_e} \\ f_e &= 20\text{cm}\end{aligned}$$

$$\begin{aligned}(\beta) \quad \text{Length of telescope} &= f_o + f_e \\ &= 100 + 20 \\ &= 120\text{cm}\end{aligned}$$

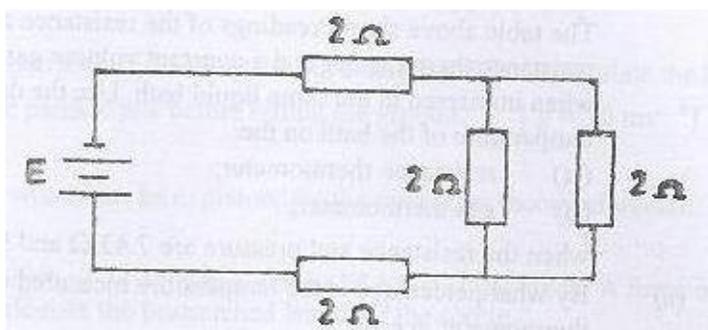
Question 11

- (a) (i) **What is a dielectric?**
(ii) **A parallel plate capacitor consists of two plates each of area $9.6 \times 10^{-3} \text{ m}^2$, separated by a dielectric of the thickness 2.25×10^{-4} and dielectric constant 900. Calculate the capacitance of the capacitor.**
[$\epsilon_0 = \text{permittivity of free space} = 8.85 \times 10^{-12} \text{ F m}^{-1}$]
- (b) (i) **Which of the following devices has a higher resistance: an ammeter or a voltmeter? Give a reason for your answer.**
(ii)



The resistance of the voltmeter in the circuit diagram illustrated above is $800\ \Omega$. Calculate the voltmeter reading.

(c)



A battery of negligible internal resistance is connected to a set of resistors as illustrated in the circuit diagram above. Determine the equivalent resistance of the circuit.

This question was popular and many candidates attempted it

- (a) (i) Most candidates correctly stated that dielectric is an insulator.
(ii) Many candidates were able to calculate correctly the capacitance of the capacitor.
- (b) (i) Candidates correctly stated that voltmeter has a higher resistance but they could not give a satisfactory reason for their answers. The expected reason is that voltmeter is connected in parallel in a circuit to allow passage of minimal current through it; and the circuit current is not significantly affected.
(ii) Most candidates did not realize that the resistance of the voltmeter connected across the $800\ \Omega$ resistor has to be considered in calculating the overall circuit resistance; and this made them give the wrong calculation.

The expected solution is:

$$\frac{1}{R_1} = \frac{1}{400} + \frac{1}{400}$$

$$R_1 = 200\ \Omega$$

$$\frac{1}{R_2} = \frac{1}{800} + \frac{1}{800}$$

$$R_2 = 400 \, \Omega$$

$$R_T = 200 + 400 = 600 \, \Omega$$

$$I = \frac{VT}{RT} = \frac{6}{600} = 0.01 \, \text{A}$$

$$\begin{aligned} \text{Voltmeter reading} &= \text{p.d. across } R_2 \\ &= 0.01 \times 400 \\ &= \underline{4.0 \, \text{V}} \end{aligned}$$

- (c) The equivalent resistance of the circuit was correctly calculated by most candidates.

$$R_P = \frac{R_1 \times R_2}{R_1 + R_2} = \frac{2 \times 2}{2 + 2} = 1$$

$$R_T = 2 + 2 + 1 = \underline{5 \, \Omega}$$

Question 12

- (a) (i) What is nuclear fission?
 (ii) State the function of each of the following materials in a nuclear fission reactor:
 (α) graphite;
 (β) boron rods;
 (γ) liquid sodium.

- (b)

n	1	2	3	4	5	∞
E _n /eV	-13.60	-3.39	-1.51	-0.85	-0.54	0.00

- (i) Draw the energy level diagram for the atom.
 (ii) Determine the wavelength of the photon emitted when the atom goes from the energy state $n = 3$ to the ground state:
 $[h = 6.6 \times 10^{-34} \, \text{J s}, c = 3.0 \times 10^8 \, \text{ms}^{-1}, e = 1.6 \times 10^{-19} \, \text{C}]$
- (c) A piece of ancient bone from an excavation site showed ${}^{14}_6\text{C}$ activity of 9.5 disintegrations per minute per $1.0 \times 10^{-3} \, \text{kg}$. If a bone specimen from a living creature shows ${}^{14}_6\text{C}$ activity of 12.0 disintegrations per minute per $1.0 \times 10^{-3} \, \text{kg}$, determine the age of the ancient bone.
 $[\text{Half-life of } {}^{14}_6\text{C} = 5572 \, \text{years}]$

- (a) (i) Candidates did not state correctly what nuclear fission is. Most of them gave partial statements. Some of them indicated energy is released during nuclear fission, but they did not add that neutron release accompanied the energy.

Candidates are expected to state that- Fission is the splitting of a heavy nucleus into lighter nuclei with the release of energy and neutrons.

- (ii) Most candidates were not able to state correctly the functions of graphite, boron rods and liquid sodium in a nuclear fission reactor. Some of them stated graphite and boron rods control the reaction, while liquid sodium cools the reactor. The expected functions are:-

Graphite – Slows down high energetic neutrons in the reaction chamber.

Boron rods – Absorb excess neutrons so as to control fission rate.

Liquid sodium – Extract/conduct excess heat from the reactor.

- (b) (i) Most candidates drew, wrongly, equally spaced energy level diagrams for the atom. It is expected that the labelled diagram indicates decreasing spaces between the energy levels, from the lower to higher energy levels.
- (ii) The wavelength was determined correctly by some of the candidates.

The expected solution is

$$\begin{aligned}\lambda &= \frac{hc}{\Delta E} \\ &= \frac{6.6 \times 10^{-34} \times 3.0 \times 10^8}{(-1.51 - (-13.6)) \times 1.6 \times 10^{-19}} \\ &= \underline{\underline{1.02 \times 10^{-7} \text{ m}}}\end{aligned}$$

- (b) Many candidates had difficulty in determining the age of the ancient bone. The expected solution was

$$\begin{aligned}\lambda &= \frac{0.693}{\frac{T_1}{2}} \\ &= \frac{0.693}{5572} \\ &= 0.0001244 \text{ year}^{-1} \\ N &= N_0 e^{-\lambda t}\end{aligned}$$

$$e^{0.0001244t} = 1.2632$$

$$0.0001244t = 0.234$$

$$t = \underline{\underline{1878 \text{ years}}}$$

PHYSICS 3

1. GENERAL COMMENTS

The standard of the paper compares favourably with that of previous years. The performance of candidates was, generally, better than that of last year.

2. A SUMMARY OF CANDIDATES' STRENGTHS

Some commendable features noted in candidates' answers were:

- (1) Candidates followed the rubrics of the papers.
- (2) Candidates chose good and easily readable scales in plotting graphs.
- (3) Large enough right-angled triangles were drawn and used in determining slopes of graphs.
- (4) Results were neatly tabulated and in a composite form.
- (5) Candidates demonstrated a good knowledge of the theory of the subject by giving precise definitions of quantities and their application in solving related problems.

3. A SUMMARY OF CANDIDATES' WEAKNESSES

Below are some weaknesses noted in candidates' answers:

- (1) Candidates recorded distances or lengths in whole numbers.
- (2) Wrong units were assigned certain physical quantities such as current, voltage and resistance.
- (3) The means of values were wrongly determined.
- (4) Physical laws were wrongly stated.
- (5) Candidates were unable to plot graphs to the accuracy of the chosen scales.

4. SUGGESTED REMEDIES

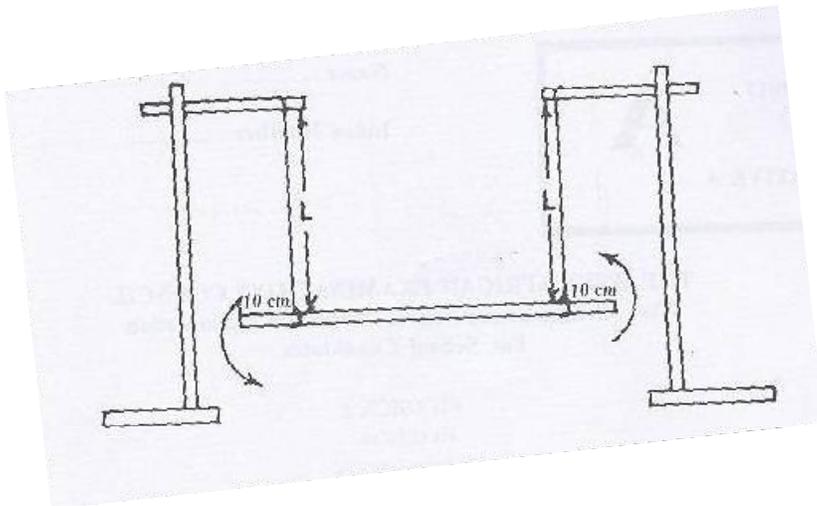
- (1) Students should be exposed to and made to use laboratory equipment frequently.
- (2) Students should be taught the acceptable number of decimal places for the instruments in the laboratory.
- (3) Students should be guided in choosing good scales for plotting graphs.
- (4) More time should be devoted to practical lessons.

5. DETAILED COMMENTS

ALTERNATIVE A

Question 1

(a)



You are provided with two retort stands, two metre rules, pieces of thread and other necessary apparatus.

- (i) Set-up the apparatus as illustrated above ensuring that the strings are permanently 10 cm from either end of the rule.
 - (ii) Measure and record the length $L = 80$ cm of the two strings.
 - (iii) Hold both ends of the rule and displace the rule slightly, then release so that it oscillates about a vertical axis through its centre.
 - (iv) Determine and record the time t for 10 complete oscillations.
 - (v) Determine the period T of the oscillations.
 - (vi) Evaluate $\log T$ and $\log L$.
 - (vii) Repeat the procedure for four other values of $L = 70, 60, 50$ and 40 cm.
 - (viii) Tabulate your readings.
 - (ix) Plot a graph with $\log T$ on the vertical axis and $\log L$ on the horizontal axis.
 - (x) Determine the slope, s , and the intercept, c , on the vertical axis.
 - (xi) State two precautions taken to ensure accurate results.
- (b)
- (i) Define simple harmonic motion.
 - (ii) Determine the value of L corresponding to $t = 12$ s from the graph in (a) above.

OBSERVATIONS

- (i),(ii),(iii) Five values of L , t and T were to be recorded to at least 1 dp and 2 dp for T .
- (iv),(v) Most candidates lost marks for failing to record $\log L$ and $\log T$ to 3 significant figures and 3 decimal places respectively.

GRAPH/SLOPE

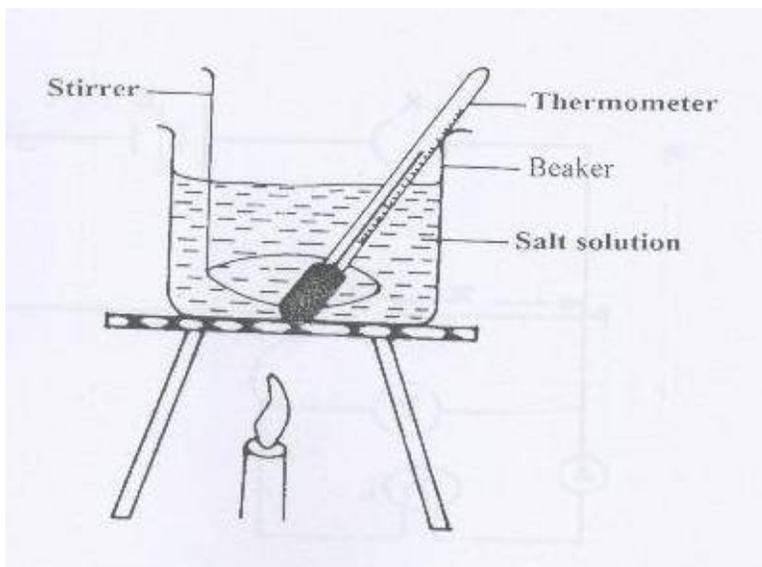
- (ii) The choice of scales for $\log L$ and $\log T$ involving negative values proved a problem for most candidates. This led to loss of marks on the graph plotting and the consequent slope determination.

PRECAUTIONS

Most candidates were able to write two precautions taken in the acceptable tense.

- (b) (i) Simple Harmonic Motion was correctly defined by most of the candidates. However, a few of them stated that “acceleration was directed towards a fixed point and inversely proportional to the displacement from the fixed point and always directed toward the fixed point.
- (ii) Candidates were able to calculate $T=12/10 = 1.2$ secs. However, most failed to read the corresponding values of $\log 1.2 = 0.079$ on the graph and to determine the corresponding anti log value, to obtain the value of L .

Question 2



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

- (i) Measure 200 cm³ of water into the beaker
 - (ii) Heat the water until it boils steadily for about 2 minutes.
 - (iii) Read and record the boiling point b_0 .
 - (iv) Add table salt of mass $M = 10.0$ g to the boiling water and stir continuously until another boiling point b_i is attained.
 - (v) Read and record b_i .
 - (vi) Evaluate $\theta_i = (b_i - b_0)$.
 - (vii) Using the same mixture, repeat the procedure four times by adding 10.0 g of salt each time to give the cumulative mass M_i of salt as 20 g, 30 g, 40 g and 50 g.
 - (viii) In each case allow the mixture to boil steadily for at least 2 minutes then read and record the boiling point b_i .
 - (ix) Tabulate your readings.
 - (x) Plot a graph with M_i on the vertical axis and θ_i on the horizontal axis.
 - (xi) Determine the slope, s , of the graph.
 - (xii) State two precautions taken to ensure accurate results.
- (b)
- (i) Define the boiling point of a liquid.
 - (ii) What effect do impurities have on the boiling point of a liquid?

OBSERVATIONS

- (i) Values of b_0 read did not agree with those recorded by their teachers and thus marks were lost.
- (iii) Five values of b_i recorded, mostly followed the trend with b_i increasing with increasing M .

GRAPH/SLOPE

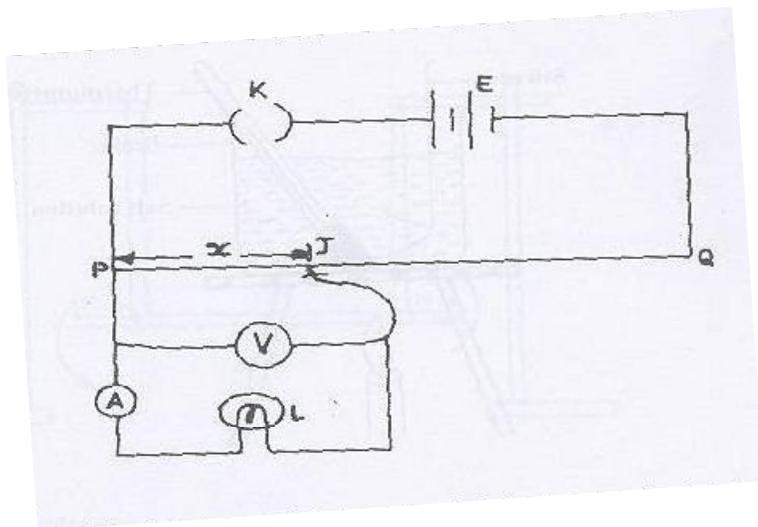
Most candidates chose good scales to draw the graphs. The slope was also correctly determined by most of them.

PRECAUTIONS – Some candidates wrongly stated “regular stirring” which was an instruction, as a precaution.

- (b) (i) Most candidates wrongly defined the boiling point of a liquid as the temperature at which the liquid boils without reference to the saturated vapour pressure and the external atmospheric pressure.
- (ii) Most of the candidates indicated that impurities increase the boiling point of a liquid.

Question 3

(a)



You are provided with cells, a potentiometer, an ammeter, a voltmeter, a bulb, a key, a jockey and other necessary materials.

- (i) Measure and record the *emf* E of the battery
 - (ii) Set-up a circuit as shown in the diagram above.
 - (iii) Close the key K and use the jockey to make a firm contact at J on the potentiometer wire such that $PJ = x = 10$ cm.
 - (iv) Read and record the voltmeter reading V and the corresponding ammeter reading I .
 - (v) Evaluate $\log V$ and $\log I$.
 - (vi) Repeat the procedure for other values of $x = 20, 30, 40, 50$ and 60 cm.
 - (vii) Tabulate your readings.
 - (viii) Plot a graph with $\log I$ on the vertical axis and $\log V$ on the horizontal axis.
 - (ix) Determine the slope, s , of the graph.
 - (x) Determine the intercept, c , on the vertical axis.
 - (xi) State two precautions taken to obtain accurate results.
- (b)
- (i) How is the brightness of the bulb affected as x increases? Give a reason for your answer.
 - (ii) List two electrical devices whose actions do not obey Ohm's law.

OBSERVATION

Most candidates either failed to record the e.m.f. E of the battery as instructed, or to the required number of decimal places or without units.

- (ii) Most candidates failed to record values of V and I to 1 decimal place.
- (v) and (vi) Most candidates lost marks for failing to record values of $\text{Log } I$ and $\text{Log } V$ to at least 3 decimal places.

GRAPH/SLOPE

With the negative values of $\text{Log } I$ and $\text{Log } V$, most candidates chose wrong scales and thus lost marks in plotting points and the subsequent slope determination.

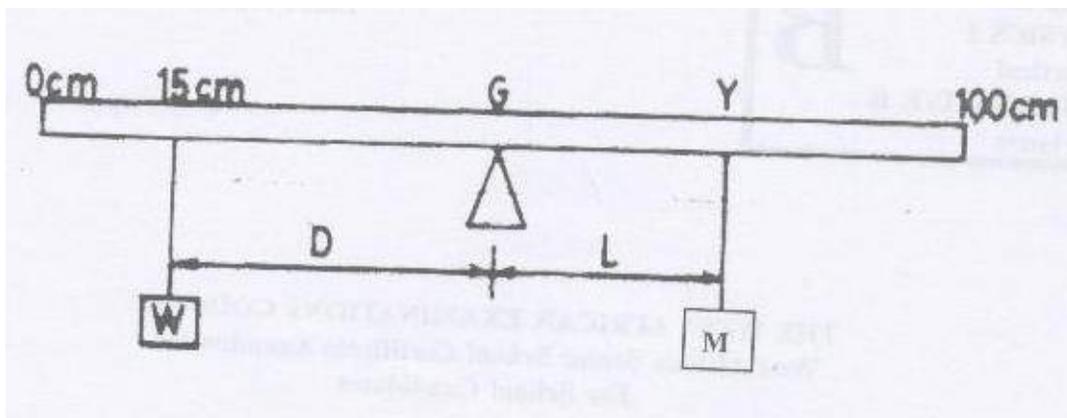
INTERCEPT

To score for intercept, candidates were to determine the antilog of values correctly used from the graph.

- (b)
 - (i) With increase in x , most candidates stated wrongly that there is an increase in resistance and therefore a decrease in current leading to a decrease in brightness of the bulb.
 - (ii) For devices that do not obey ohm's law some candidates stated wrongly semiconductors in general. To score, candidates should have stated specific semiconductors such as thermistors, transistors, diodes etc.

ALTERNATIVE B

Question 1



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

- (i) **Suspend the metre rule horizontally on the knife edge. Read and record the point of balance G of the metre rule. Keep the knife edge at the point throughout the experiment.**

- (ii) Using the thread provided, suspend the object labelled W at the 15 cm mark of the metre rule.
 - (iii) Suspend a mass $M = 20$ g on the other side of G. Adjust the position of the mass until the metre rule balances horizontally again.
 - (iv) Read and record the position Y of the mass M on the metre rule.
 - (v) Determine and record the distance L between the mass and G. Also, determine and record the distance D between W and G.
 - (vi) Repeat the procedure for four other values of $M = 30$ g, 40 g, 50 g and 60 g. In each case, ensure that W is kept constant at the 15 cm mark and the knife edge at G.
 - (vii) Evaluate L^{-1} in each case. Tabulate your readings.
 - (viii) Plot a graph of M on the vertical axis and L^{-1} on the horizontal axis.
 - (ix) Determine the slope, s, of the graph.
 - (x) Evaluate $= \frac{s}{D}$
 - (xi) State two precautions taken to obtain accurate results.
- (b)
- (i) State the principle of moments.
 - (ii) Define centre of gravity.

OBSERVATIONS

Candidates who failed to record values of G and Y lost marks in (i), (ii), (iv) and (v)

A good number of candidates were guilty of this.

Values of L^{-1} of most of the candidates were not recorded to the required 3 decimal places or more.

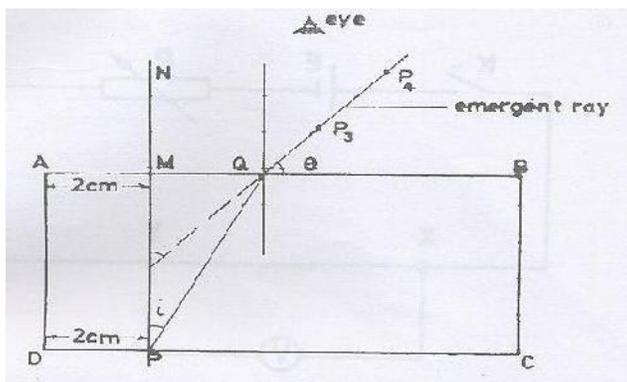
GRAPH/SLOPE

Most candidates were able to choose good scales for plotting M against L. They also correctly calculated the slope. Most candidates evaluated correctly S/D .

- (b)
- (i) To score for principle of moments, candidates were to state that “for a body in EQUILIBRIUM sum of clockwise and anticlockwise moments about a specific point were equal. Some candidates failed to indicate that the body must be in equilibrium and that sum of clockwise and anticlockwise moments about the SAME point were equal.
 - (ii) In defining centre of gravity some candidates wrongly stated that it is a point where the resultant MASS instead of WEIGHT of a body appears to act.

Question 2

(a)



You are provided with a rectangular glass prism, cellotex board, optical pins and other necessary materials.

- (i) Fix the drawing paper on the cellotex drawing board.
 - (ii) Place the rectangular glass prism on the paper and trace its outline ABCD. Remove the prism.
 - (iii) Draw two normal NMP to meet AB and DC at M and P respectively such that $|AM| = |DP| = 2.0$ cm.
 - (iv) Trace the ray PQ with two pins P_1 and P_2 and Q respectively such that angle $MPQ = I = 5^\circ$.
 - (v) Replace the prism on its outline. Trace the emergent ray with two other pins P_3 and P_4 such that they lie in a straight line with P_2 and the image of P_1 viewed through the glass prism.
 - (vi) Measure and record θ , the angle between the emergent ray and face AB of the glass prism.
 - (vii) Evaluate $\cos \theta$ and $\sin i$.
 - (viii) Repeat the procedure for four other values of $I = 10^\circ, 15^\circ, 20^\circ$ and 25° . Tabulate your readings.
 - (ix) Plot a graph of $\cos \theta$ on the vertical axis and $\sin i$ on the horizontal axis.
 - (x) Determine the slope, s , of the graph.
 - (xi) State two precautions taken to obtain accurate results.
[Attach your traces to your answer booklet.]
- (b)
- (i) State the laws of reflection of light.
 - (ii) Explain what is meant by the statement: the refractive index of a material is 1.65.

OBSERVATIONS

Most of the candidates scored for (i), (ii) and (iii). Some candidates lost marks because they either did not measure the incident angles correctly or used incident angles instead of glancing angles for q . In some cases, AM values were not equal to 2 cm.

Some candidates also lost marks for $\sin i$ and $\cos \theta$ because they failed to record values to at least 3 decimal places.

GRAPH/SLOPE

Most candidates were able to choose good scales to plot values for $\cos \theta$ against $\sin i$, and determined the slope correctly. Some candidates lost marks because they either over approximated the values or they swapped the axes.

ACCURACY

To score, values of slopes were to fall between 1.35 and 1.65.

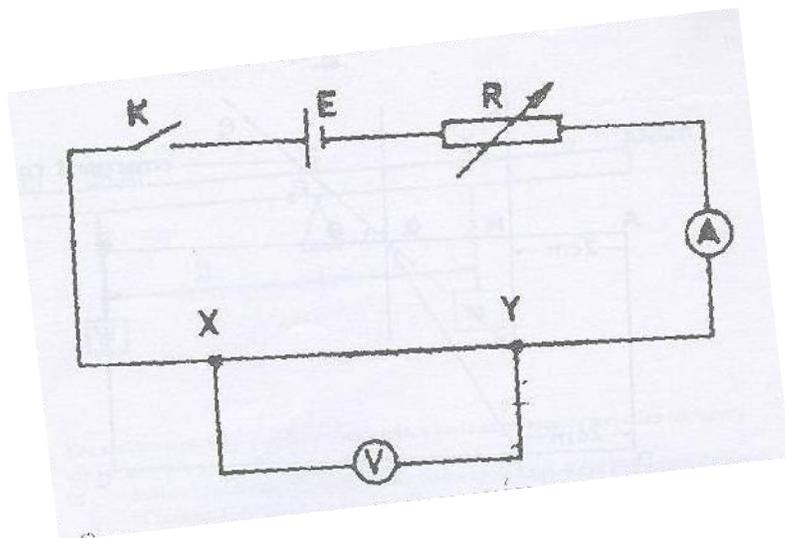
PRECAUTIONS

Most candidates scored for precautions as they stated them appropriately and in the acceptable tenses.

- (b) (i) Only few candidates were able to state the law correctly.
- (ii) Most candidates correctly explained the statement “the refractive index of a material is 1.65” as the ratio of the speed of light in vacuum or air to that in the material is equal to 1.65.

Question 3

(a)



- (i) Measure and record the length XY of the resistance wire provided.
 - (ii) Connect the circuit as shown in the diagram above.
 - (iii) With $R = 0 \Omega$, close the key K. Read and record the current I_0 and the voltage drop V_0 across the resistance wire.
 - (iv) Setting $R = 1 \Omega$, close the key. Read and record the current I and the corresponding voltage drop, V across the wire.
 - (v) Repeat the procedure for five other values of $R = 5 \Omega, 10 \Omega, 20 \Omega, 40 \Omega$ and 60Ω . Tabulate your readings.
 - (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) Mention and state the law on which the experiment in 3 (a) is based.
 - (ii) A piece of resistance wire of diameter 0.2 mm and resistance 7Ω has resistivity of $8.8 \times 10^{-7} \Omega \text{ m}$, calculate the length of the wire.

$$[\pi = \frac{22}{7}]$$

OBSERVATIONS

Candidates failed to score for (i),(ii) and (iii) for either not stating the value of XY at all or stating it to the wrong number of decimal places. The values of I_0 and V_0 were incorrectly stated or stated without correct units. In most cases, candidates' values of XY were different from the one supplied by their teachers.

Most candidates were able to record correctly values of R, I and V to the required number of decimal places and in trend.

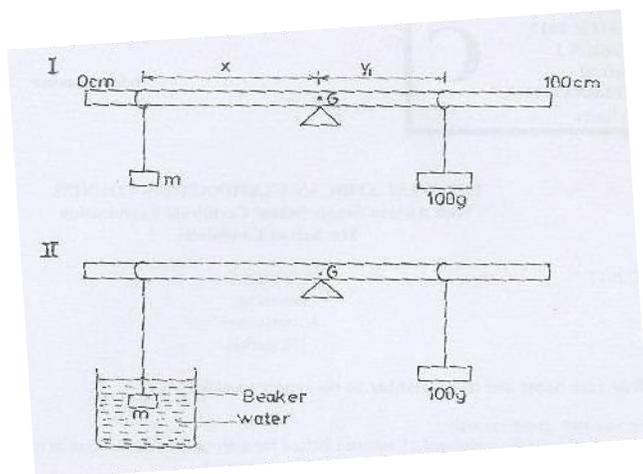
GRAPH/SLOPE – Most candidates were able to choose good and acceptable scales to plot graph of V against I and also determined the slope correctly.

- (b) (i) Most candidates failed to score for the statement of Ohm's law. They referred to a CONDUCTOR instead of a METALLIC CONDUCTOR in their definitions.
- (ii) To score for this calculation, candidates were to begin from
 $R = \rho L/A \Rightarrow l = AR/P$, since $A = \pi d^2/4$, $\Rightarrow L = R\pi d^2/4\rho$ substituting correctly gives an l value of 0.25. Most candidates solved this correctly.

ALTERNATIVE C

Question 1

(a)



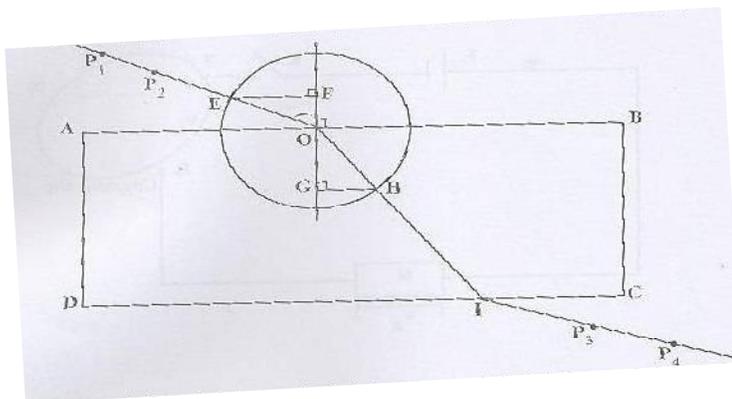
You are provided with a metre rule, which has a hole drilled at the 50 cm mark, a knife edge, an object marked m and a 100 g mass.

- (i) Pivot the metre rule, which has been drilled at the 50 cm mark, horizontally on the knife edge.
- (ii) Suspend the object marked m at the 10 cm mark of the metre rule.
- (iii) Suspend the 100 g mass on the other side of the knife edge and adjust the position of the mass until the metre rule balances horizontally as shown in Diagram 1 above.
- (iv) Read and record the distances x of m from the pivot and y_1 , of the 100 g mass from the pivot.
- (v) Repeat the procedure for four other positions of m at 15 cm, 20 cm, 25 cm and 30 cm. In each case keep the position of the knife edge fixed and adjust the position of the 100 g mass until the meter rule balances horizontally to obtain the corresponding values of y .
- (vi) Also repeat the procedure with m completely immersed in water contained in a beaker as shown in Diagram II for the positions of m suspended at the 10 cm, 15 cm, 20 cm, 25 cm and 30 cm marks of the metre rule respectively. In each case adjust the position of the 100 g mass until the metre rule balances horizontally, then read and record the new distances y_2 of the 100 g mass from the pivot.
- (vii) Evaluate $y_1 - y_2$ in each case. Tabulate your readings.
- (viii) Plot a graph with y_1 on the vertical axis against $y_1 - y_2$ on the horizontal axis.
- (ix) Determine slope of the graph.
- (x) State two precautions taken to obtain accurate results.

- (b) (i) Explain what is meant by the centre of gravity of a body and state how it is related to the stability of the body.
- (ii) State the conditions of equilibrium for a body acted upon by a number of coplanar parallel forces.

Question 2

(a)



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

- (i) Fix the drawing paper provided to the cellotex drawing board.
- (ii) Place the glass prism on the drawing paper and trace the outline ABCD of the prism.
- (iii) Remove the prism and mark a point O on AB such that AO is about one-quarter of AB.
- (iv) Draw a normal through point O. Also, draw an incident ray to make an angle of $i = 25^\circ$ with the normal at O. Fix two pins at points P_1 and P_2 on the incident ray.
- (v) Replace the prism. Fix two other pins at P_3 and P_4 such that the pins appear to be in a straight line with the images of P_1 and P_2 when viewed through the block along DC.
- (vi) Remove the prism. Join points P_3 and P_4 and produce it to meet DC at I. Also, draw a line to join OI.
- (vii) With O as centre and using any convenient radius, draw a circle to cut the incident ray and the refracted ray at E and H respectively. Keep this radius constant throughout the experiment.
- (viii) Draw the perpendicular EF and GH. Measure and record $d = EF$ and $l = GH$.
- (ix) Repeat the procedure for four other values of $i = 35^\circ, 45^\circ, 55^\circ$ and 65° . In each case measure and record d and l .

- (x) Plot a graph of d on the vertical axis against l on the horizontal axis.
- (xi) Determine the slope, s , of the graph.
- (xii) State two precautions taken to ensure accurate results.

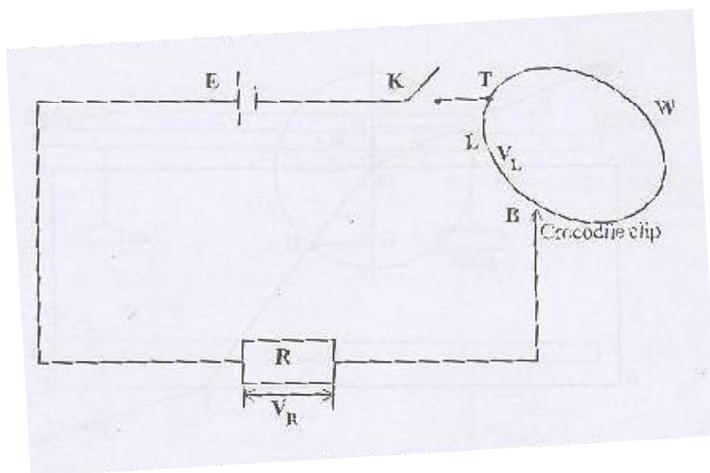
[Attach your traces to your answer booklet]

- (b) (i) State Snell's law.
- (ii) Calculate the critical angle for water-air interface.

[Refractive index of water = $\frac{4}{3}$]

Question 3

(a)



You are provided with cell E, standard resistor R, bare constantan wire W, key K, voltmeter V and crocodile clips.

- (i) Connect the two ends of the wire W to the same point T of the plug key K so that W forms a loop.
- (ii) Connect the rest of the circuit as shown in the diagram above.
- (ii) Using the crocodile clip, grip a point B on the bare wire such that $BT = L = 15$ cm.
- (iv) Close the key and measure the potential difference V_L across the wire and V_R across the standard resistor R.
- (v) Evaluate $V = \frac{V_L}{V_R}$.
- (vi) Repeat the procedure for other values of $L = 30$ cm, 40 cm, 50 cm, 60 cm and 70 cm. In each case measure V_L , V_R and evaluate $V = \frac{V_L}{V_R}$.
- (vii) Plot a graph with V on the vertical axis and L on the horizontal axis.
- (viii) Draw a smooth curve through the points.
- (ix) Record the maximum value of M for V and the corresponding value of L .

- (x) State two precautions taken to obtain accurate results.**
- (b)**
 - (i) Explain how heating affects the results of the experiment.**
 - (ii) How can the effect of heating be reduced practically in the experiment?**