RÉSUMÉ OF SCIENCES

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 Fisheries, Animal Husbandry, Biology and General Agriculture was good. Candidates for Forestry, Physics, Crop Husbandry and Horticulture, Chemistry and Integrated Science were reported to have performed averagely.

3. CANDIDATES' STRENGTHS

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

Biology
Characteristic features of mammals
Dentition
Health, Hygiene and sanitation

General Agriculture
Animal Health and Production
Farm mechanization

Crop Husbandry and Horticulture
Cultural practices in vegetable production
Importance of organic matter in crop production

Chemistry
Mole concept
Application and calculation on solubility of salts
Properties of carbon responsible for forming compounds

Physics
Sketch of velocity-time graph and calculation of total distance covered
Application of Gaw Laws

Integrated Science
Digestive system of poultry
Electricity
Soil erosion

Ecology
Animal Husbandry
Management of rangelands
Animal Health

Forestry
Exploitation of forest resources
Forest ecology and wildlife

Fisheries
Aquaculture
Roles of fisheries in national economy

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

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

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

4. CANDIDATES' WEAKNESSES

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

Biology
Biological drawing
Causes and consequences of variation
Process of photosynthesis

General Agriculture
Agribusiness
Chemical Weathering
Agriculture development

Crop Husbandry and Horticulture
Establishment of potted plant enterprise
Crop pests and diseases

Chemistry
Electronic configuration

Partition coefficient and chromatography
Redox titration

Physics
Heat transfer
Semi conductors
Nuclear physics

Integrated Science
Hydrocarbons
Animal production
Magnetism

Animal Husbandry
Marketing of animal products
Animal nutrition

Forestry
Forestry sector structure
Forestry estate

Fisheries
Roles of extension services in fisheries development
Maintenance of fish landing sites

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 Chemistry, Biology, Physics, General Agriculture and Animal Husbandry. Improper usage of the English Language negatively affected the performance of candidates for Biology, Crop Husbandry and Horticulture, General Agriculture and Integrated Science. Candidates were consequently unable to express themselves properly in their responses.

Candidates for Integrated Science, General Agriculture, Physics, Chemistry and Crop Husbandry and Horticulture seem not to have understood the demands of the question and therefore provided inadequate answers.

Other notable weaknesses reported in the sciences include:
(1) Poor drawing skills
(2) Inability to explain simple scientific occurences
(3) Inability to assign proper units to figures
(4) Inability to draw and interpret graphs

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 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 or technical terms
(3) identify and understand the scientific principles underlying everyday occurrence
(4) be allotted more time during practical lessons.

ANIMAL HUSBANDRY 2

1. GENERAL COMMENTS

The standard of the paper was comparable to previous ones. The general performance of candidates was below average.

2. SUMMARY OF CANDIDATES' STRENGTHS

(1) Logical presentation of answers by candidates
(2) Generally, candidates did not copy the questions before answering them as was the case
(3) Their handwriting was legible

The topics that were answered well are:
(i) Rangeland and its management
(ii) Newcastle disease
(iii) Oestrus

3. SUMMARY OF CANDIDATES' WEAKNESSES

(1) Language problems: This takes two forms.
(a) Sentences and expressions were sometimes meaningless
(b) Spelling mistakes were common e.g. paratable/parattable for palatable; furthers for feathers; ege for age; egge for egg; various for virus; jiant for giant, predictor for predator, tives for thieves.
Some of the spelling mistakes could be attributed to candidates whispering answers to their friends

(2) Poor definitions: Candidates approach to the definition of technical terms was casual. They must put some effort and intelligence into defining and explaining technical words.

(3) Poor understanding of the requirements of some questions. Common words like 'precautions', 'agent' were misunderstood. Candidates sometimes discuss or explain points when they are only asked to name or mention.

(4) Answering more questions than requested

The areas or topics that were poorly answered included the following:
(i) distribution of farm animals "ectoparasites and objectives of rearing farm animals
(ii) egg production, hatching and brooding
(iii) coprophaghy
(iv) Animal nutrition (silage, fats and oils, feed formulation), cereal grains as major constituent of poultry diet
(v) Agents involved in marketing animal products

4. SUGGESTED REMEDIES

(1) Candidates should cultivate the habit of reading good books to correct deficiencies in their language. Spelling drills and exercises will also help students to communicate more effectively
(2) Candidates should familiarize themselves with technical terms
(3) Candidates should endeavour to get through past WASSCE questions to know the nature of the questions and what is expected of them
(4) Candidates should carefully read the rubrics and comply
(4) Candidates should read good books to improve on their expressions and spelling skills

5. DETAILED COMMENTS

Question 1

(a) Define the term coprophagy.
(b) Mention five forage crops that could be fed to grasscutter in captivity.
(c) State four management practices which are carried out in grasscutter production.
(d) State four features of a good housing unit for rearing snails.
(e) List five activities that dogs could carry out for the benefits of humans.

Question 1 was unpopular with candidates and the general performance was poor.

(a) Most candidates were unable o define coprophaghy. They either dodged this sub-question or gave a wrong definition. Coprophaghy is not an animal or a process but an act in which an animal feeds on its faeces, not on the faeces of other animals as some candidates indicated.

(b) Candidates were able to mention only a few forage crops fed to rabbits. Even though candidates were not asked for botanical names, they wrote them but failed to follow the rules and so lost marks. Some common forage crops are Guinea grass, elephant grass, giant star grass, stylo, centro etc. it must be noted that soyabean cake, groundnut cake, copra cake, hay are not names of forage crops.

(c) Candidates were at home with the management practices carried out in grasscutter production e.g. feeding (not feed), disease control (not disease), breeding (not breed), sanitation, housing etc. some candidates wasted time discussing each of the management practices when they were not asked to do so.

(d) Candidates were required to state four features of a good housing unit for rearing snails.

Candidates were able to state the following correct answers.

- it should be spacious (not spaceful as someone stated)
- it should be well ventilated
- it should be escape proof
- it should be protected from predators

Many of the candidates failed to mention the ease of working in it, presence of growing plants to provide shelter and feed, provision of shade. The fact that some candidates mentioned the types of housing units indicated lack of understanding.

(e) This question on beneficial activities of dogs to man was poorly answered. In many instances, they answered the questions without bringing out the activities. Correct answers include hunting game, herding sheep, carrying messages, watching/guarding premises, guiding physically challenged persons.

Question 2

(a) (i) Define the term silage.
(ii) Mention two characteristics of a good silage.
(b) State four functions of fats and oils in farm animals.
(c) State two reasons why cereal grains form a major part of the diet of poultry.
(d) Explain five factors which should be considered when formulating feed for farm animals.

This was the most popular question attempted by candidates. Performance in this question was however poor.

(a) (i) Silage was quite well defined. Freshly cut forage or dehydrated forage fed to farm animals is not silage. One distinguishing feature of silage is the partial fermentation and this must be clearly stated to score.

(ii) Candidates were able to mention characteristics such as freedom from mould, palatability/acceptability, nutritious, green/yellowish green colour (and not grey or brown) leafy/high leaf to stem ratio (and not high stem to leaf ratio as some indicated)

(b) This question on functions of fats and oils in farm animals was poorly answered. Many candidates stated correctly that fats and oils provide energy. Other correct answers which were overlooked by many candidates include

- provision of fat soluble vitamins
- maintenance of body temperature
- constituent of cell membrane
- improvement in the palatability of diet

(c) As to why cereal grains form a major part of poultry diet, candidates were able to mention grains as sources of energy. Only a few mentioned that the digestive system of poultry can easily handle grains, and besides grains are highly digestible. Even though cereal grains contain some amount of protein, it is wrong to state that they are used as protein sources in animal diet.

(d) Candidates had difficulty explaining five factors that should be considered when formulating feed for farm animals. Some of the candidates did not understand feed formulation; some did not know the difference between ingredient/feedstuff and feed; others also substituted nutrients requirement by farm animals for quantity of feed fed.

The question could be better tackled in the following ways.

- nutrient requirements for farm animals differ with breed, age, type of animal, physiological state, health status. Feed must be formulated to meet the nutrient requirements
- availability of ingredient. If it is not available, what should be done to minimize cost of production

- cost of ingredients. Compare the nutrient content of the ingredient with the cost of the ingredient. What cost of ingredients will enable one to produce feed at very low cost etc.

Question 3

(a) Define each of the following terms as used in poultry production:
  (i) hatching;
  (ii) incubation;
  (iii) brooding.

(b) Mention five factors that could lead to the laying of low number of fertile eggs in poultry house.

(c) List five precautions that should be taken to ensure uniform hatching of fertile eggs in an incubator.

(d) Mention four activities that are carried out in a hatchery after hatching of eggs.

This question was the second most popular question but candidates' performance was poor.

(a) Candidates were asked to define hatching, incubation and brooding. These terms were poorly defined.

(i) Hatching was defined as the ability of eggs to hatch into chicks or act of giving birth to chickens. The correct definition is the emergence of young birds (e.g. chicks) from fertile eggs at the end of the incubation period.

(ii) Incubation was also poorly defined as an equipment or a place or putting eggs into an incubator. The correct definition is the process whereby fertile eggs are provided with necessary conditions to ensure the development of the embryo to young birds. It is important to note that only fertile eggs can develop into young birds under specified conditions.

(iii) Brooding has nothing to do with eggs and hatching and it is not a house. It is the management of chicks etc from day old till they develop enough feathers to keep them warm.

(b) A poorly answered question. The question asked for factors that could lead to the laying of low number of fertile eggs. Answers sometimes provided do not correspond with the phrase low number of fertile eggs. Consequently, they gave wrong answers like age, nutrition instead of old age, poor nutrition. Other correct answers are inadequate feed and water, pest infestation, disease infection, infrequent mating, wrong mating ratio. Candidates who did not know the demands of the question ended up discussing or explaining the factors.

(c) A poorly answered question because the word 'precaution' appeared strange to candidates.

The precautions that should be taken are:

- ensure constant supply of electricity
- ensure regular turning of eggs
- ensure that eggs set in the incubator are clean and without cracks
- ensure that conditions of temperature, relative humidity and ventilation are suitable etc.

(d) It appears candidates have little knowledge about hatchery activities and therefore found the question difficult. It is wrong to mention brooding, deworming, provision of feed and

water, removal of litter as activities carried out in the hatchery after hatching. The correct answers given by a number of candidates were sexing, vaccination, disposal of hatchery waste cleaning of the hatchery. Other activities that should be emphasized are sorting out abnormal chicks, packing of normal and healthy chicks and record keeping.

Question 4

(a) (i) Explain the term rangeland as used in animal husbandry.
(ii) Explain four management practices that could be carried out to improve a rangeland.
(b) Discuss the Newcastle disease under the following headings:
(i) two animals affected;
(ii) causative agent;
(iii) two modes of transmission;
(iv) three symptoms;
(v) two control measures.

This was quite a popular question with candidates performing better than in any other question.

(a) (i) The explanation of rangeland was poor as candidates failed to include the fact that it is an extensive area of land, that the forage grasses and legumes grow naturally. A rangeland is not cultivated as some stated.

(ii) This sub-question was quite well attempted. The candidates stated the management practices for improving rangeland e.g. irrigation, weed control, reseeding, fertilizer application. However, the points were not well explained.

(b) Newcastle disease was quite well discussed

(i) cattle, sheep and goat are not affected by the disease but rather poultry.

(ii) the disease is caused by virus and not bacterium or protozoan

(iii) the mode of transmission is not through a vector but through contaminated feed and water, through direct contact with infected animals/ or contaminated materials

(iv) candidates had little problem with the symptoms. They gave a variety of correct answers such as anorexia, greenish diarrhoea, loss of weight, neck twisting, difficulty in breathing.

(v) it is wrong to disinfect farm animals as a control measure. It is best to isolate diseased animals, carry out routine vaccination and hygienic practices.

Question 5

(a) State six causes of mortality in goat production.
(b) Explain how each of the following factors affect the distribution of farm animals in West Africa:
(i) temperature;
(ii) food availability;
(iii) disease incidence;
(iv) culture and religion.
(c) Define the term ectoparasite as used in animal husbandry.

(d) Give four objectives of rearing farm animals.

It is one of the most popular questions attempted by candidates, but the general performance was very poor.

(a) Candidates were able to state the causes of mortality of goats e.g. malnutrition, disease infection, pest infestation, predator attack, inadequate water supply, accident, ingestion of poisonous substances.

(b) This question was very poorly answered. Candidates could not explain how temperature, food availability, diseases and culture and religion affect the distribution of farm animals in West Africa. Some of them understood distribution to be the transfer of animals from one place to another instead of natural distribution in the various ecological zones. Many candidates stated the effects of these factors on farm animals. This was wrong.

For instance, the high temperature in the savannah favours the production of cereals and grasses and thus more ruminants are reared there than in the forest zone. Culture and religion do not favour the rearing of pigs in muslim populated areas as compared to sheep and goats.

(c) The definition of ectoparasite was generally poor for the following reasons
  (i) stating that they are parasites
  (ii) stating that they live outside the host instead of on the skin/body of the host
  (iii) failing to state that they cause harm to the host (This point clearly differentiates between parasitism and commensalism).

(d) This was another poorly answered question as candidates' answers were for the importance of rearing farm animals instead of objectives of rearing farm animals. The correct answers include provide employment, to provide meat/milk/eggs to provide income etc.

Question 6

(a) Discuss artificial insemination under the following headings:
  (i) two semen collection methods;
  (ii) two functions of semen diluents;
  (iii) two methods of semen storage.
(b) Name five agents involved in the marketing of animal products.
(c) (i) Explain the term oestrus as used in animal husbandry.
  (ii) State six signs of oestrus in sheep.

This is the least popular question with candidates. However, the performance of the few who answered this question was good.

(a) The question was to test candidates' knowledge of Artificial insemination in terms of (i) semen collection (ii) function of diluents and (iii) methods of semen storage. This question was poorly answered.

(i) Candidates were able to mention semen collection methods like hand massaging, use of electro-ejaculator, artificial vagina and dummy female.

(ii) some candidates were able to state the function of diluents as follows: they nourish and preserve spermatozoa and increase semen volume

(iii) With regard to semen storage, semen are normally frozen in dry ice and alcohol or in liquid nitrogen etc.

(b) Candidates were to name five agents involved in marketing animal products. A variety of wrong answers e.g. newspapers, quarantine officer, posters suggest limited knowledge of the subject. Some candidates named consumers which is wrong. Since consumers do not market animal products. The agents involved are producer, retailers, wholesalers, middlemen, co-operative societies, marketing boards.

(d) Candidates were very comfortable with this question and this enhanced their scores in

(i) oestrus was very well explained

(ii) candidates were able to state the signs of oestrus in sheep. Some of the signs are

- abnormally high body temperature (not abnormal temperature as found in some scripts)
- reddened and swollen vulva (the two adjectives must go together to score)
- slimy, whitish discharge from vulva (the colour must be correct to score)

ANIMAL HUSBANDRY 3

1. GENERAL COMMENTS

The standard of the paper compares favourably with that of previous years in terms of clarity and scope of the questions set. However, as in previous cases the performance of the candidates remain relatively the same. The spread of the questions across the entire syllabus was remarkably adhered to.

2. SUMMARY OF CANDIDATES' STRENGTHS

(1) Some candidates produced intelligent answers in very good grammar:
(2) Some candidates expressed themselves with brilliant answers to questions which showed a clear understanding of the questions.
(3) There was evidence that some of the candidates did prepare adequately for the examination.
(4) Some schools did perform well showing evidence of excellent teaching and learning
(5) Some candidates demonstrated that they had read the prescribed textbooks with the right information

3. SUMMARY OF CANDIDATES' WEAKNESSES

(1) Some candidates provided answers which were irrelevant to the questions
(2) Most candidates' ability to solve questions involving calculations was very poor
(3) Some candidates failed either to write their index numbers or wrote wrong ones
(4) There were few instances of complete deviation on the part of candidates

4. SUGGESTED REMEDIES

(1) Candidates should be taught to read the questions over and over to ensure that they understand the demand of the question
(2) Teachers should prepare candidates adequately before the examination
(3) Teachers should adhere to the syllabus religiously to avoid departure
(4) Teachers are also advised to recommend to candidates the textbooks that contain appropriate information

5. DETAILED COMMENTS

Question 1

(a) Give two reasons for including specimen A in the ration of ruminants.
(b) (i) Mention the main nutrient supplied by specimen B in the diet of farm animals.
(ii) State six deficiency symptoms of the main nutrient supplied by specimen B.
(c) State six functions of specimen C in farm animals.

(a) Only few students were able to answer why Hay is included in the diet of a ruminant by mentioning that:

(i) enhances growth of microbes
(ii) source of energy
(iii) provides bulk to enhance bowel movement
(iv) assists in rumination

Most candidates fail to answer this question.

(b) (i) Most candidates failed to state that the main nutrient in copra cake is protein, but rather mentioned fats and oils. Others also mentioned all the nutrients e.g. protein, fats and oils, minerals, vitamins all lumped up which attracted zero.

(ii) The candidates who were able to mention protein as the main nutrient of copra cake, were able to state the deficiency symptoms of protein correctly.

(c) Most candidates were able to state the functions correctly only a few rather mentioned the uses of water such as for bathing, washing instead of the required answers such as

(i) regulates the body temperature
(ii) medium for transport of waste substances
(iii) for digestion of feed etc

Question 2

(a) Name three farm animals in which:

(i) specimen D could be found;
(ii) specimen E could be found.

(b)

(i) Mention four functions of specimen D.
(ii) State three features of specimen D that enables it to perform its functions effectively.

(c) State two functions of specimen E.

(a) (i&ii) Almost all the candidates were able to mention the names of the required animals

(b) (i) An average number of the candidates were able to mention the functions of the specimen D – Rumen

(ii) Almost all the candidates could not state the features of the rumen. The few who were able could only mention one. E.g. it is very large.

Most candidates could not add that it is muscular, it is finger-like/papillae, it is divided into segments

(c) This question was answered by almost all the candidates. The only set back was that most mentioned that they produce hormones instead of they produce sex hormones

Question 3

(a) Mention two other farm animals from which:
- **(i) specimen F could be obtained;**
- **(ii) specimen G could be obtained;**
- **(iii) specimen H could be obtained.**

(b) State four ways in which specimen F is important.

(c) State one function of each of specimens G and H.

(d) List three products which could be obtained from specimen G.

(a) (i) This question was well answered by all candidates

(ii) Most candidates were able to answer this question very well. Only few repeated the animal from which the specimen was obtained. Example other animals from which the horn of a cattle could be obtained and the candidates still repeated cattle.

(b) This question was well answered by almost all the candidates.

(c) (i) Functions of the horn. Most of the candidates were able to provide the correct answer. Example for defence, for offence. Others rather mentioned the uses of the horn e.g. as trumpet

(ii) Functions of the hoof. Most candidates were able to provide the correct answer.

A few provided the uses instead of the function.

(d) Products obtained from the specimen G (Horns). Almost all students were able to provide the right answer namely – For glue, trumpet or musical instrument etc

Question 4

(a) Give four reasons why farmers keep specimen J.

(b) Mention two products that could be obtained from specimen J.

(c) If specimen J was serviced on 12th June 2017, and conceived on the same day, calculate the expected kindling date.

(d) Mention two endoparasites and two ectoparasites that could infest specimen J.

(e) State two ways of controlling ear mange on specimen J.

(a) This question was well answered by almost all the candidates

(b) Products obtained from rabbit were also well given by almost all the candidates. They were able to mention fur, pelt, bone etc.

(c) This part of the question was poorly answered probably due to their challenge in mathematics. Candidates were able to mention the gestation period of the rabbit but failed to do justice to the calculation. Teachers should assist candidates to demystify themselves from that fear of mathematics

(d) Endo-parasites and ecto parasites of rabbits were well given but for a few who rather used endo-parasites for ecto parasites and vice versa.

(e) This part was also well answered by almost all the candidates.

BIOLOGY 2

1. INTRODUCTION

The standard of the paper compared favourably with that of previous years. The general performance of candidates was slightly better than the 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 good knowledge on castes in a termite colony and the role of each caste, calculation of magnification in Biological drawing and the importance of protein in animals.
(4) Fair knowledge was exhibited in the following topics; characteristic features of class mammalian, functions of listed reproduction organs of female mammals, dentition in mammals, effects and control of air pollution on living things and explanation of Health, Hygiene and Sanitation.

3. SUMMARY OF CANDIDATES' WEAKNESSES

(1) Technical terms were wrongly spelt by many candidates.
(2) Many candidates showed lack of knowledge regarding the rubrics in Biological drawing
(3) Candidates showed lack of knowledge in the description of the process of photosynthesis, roles of mushrooms in a habitat, causes and consequences of variation, description of an experiment to measure the rate of growth in the root of a seedling and ways in which the human heart is adapted to its function.
(4) 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) Candidates should be taken through spelling drills with respect to technical terms and scientific names.
(3) Tutors should encourage their students to work sufficient tutorials and assignment on how to provide concise and accurate answers.

5. DETAILED COMMENTS

Question 1

(a) State four characteristic features of members of Class Mammalia.
(b) State two functions each of the following organs in mammals:
(i) ovary;
(ii) vagina;
(iii) uterus.
(c) Make a diagram 8 cm – 10 cm long of a typical flower showing its floral parts and label fully.

(a) This question was one of the most popular ones many candidates attempted, and their performance was quite satisfactory.

Most of the candidates listed the following characteristic features of class Mammalia;

- warm blooded/homeothermic/endothermic;
- body is covered with hair/fur/wool;
- heterodont dentition;
- presence of diaphragm;
- presence of mammary glands;
- presence of pinna/external ear;
- well-developed brain;
- well-developed sensory organs;
- they are viviparous;
- bilateral symmetrical;
- presence of four chambered heart.

(b) Many candidates found it difficult stating two functions of each of the following organs as outlined below

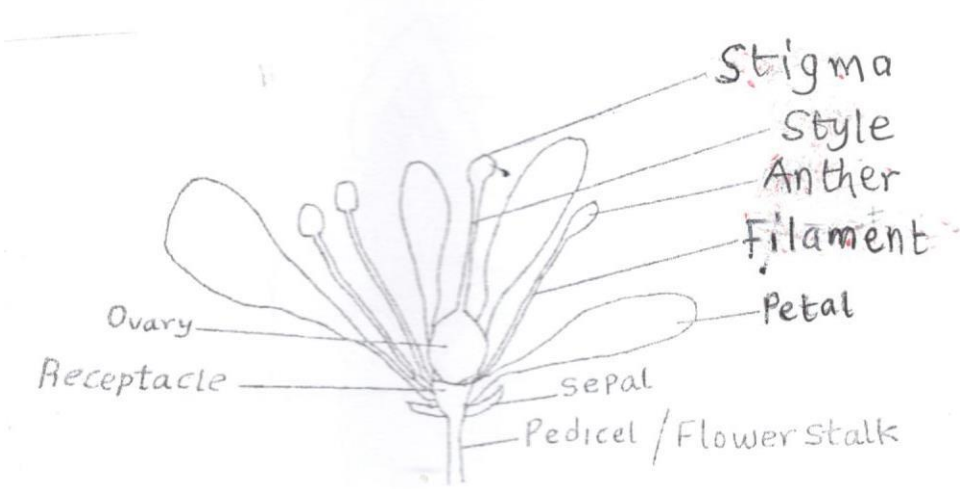
(i) Ovary
- produces mature eggs/ova
- produces female sex hormones

(ii) Vagina
- receives the penis/sperm/passage of sperms
- it serves as birth canal during childbirth
- passage of menstrual blood/menses

(iii) Uterus
- site for implementation of the fertilized egg/zygote
- accommodates the foetus/embryo
- provides a place of attachment of foetal placenta
- provides nutrients for foetus
- protects the foetus/embryo against mechanical injury

(c) Many candidates showed lack of knowledge regarding Biological drawing. The expected responses include:

Title (TL) – Diagram of a typical flower



Quality (Q)
Clarity of lines (CL)
Size (Sz) (8 cm – 10 cm)
Neatness of label (NL)

Details (D)
At least three petals shown (TP)
At least three stamens shown (TS)
Pistil shown (PS)

Labels (L)
Sepal, petal, filament, anther, style, receptacle, ovary, stalk flower/stalk/pedicel.

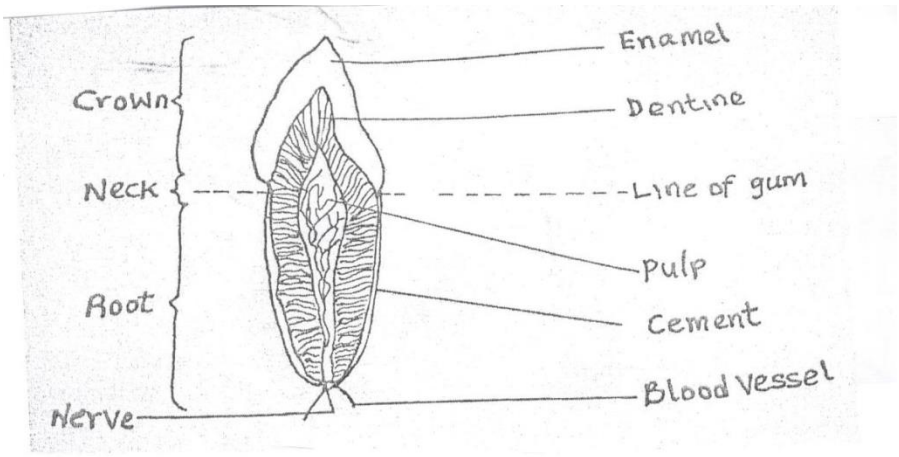
Question 2

(a) (i) What is dentition?
(ii) Make a diagram, 6 cm – 8 cm long of the longitudinal section of the canine tooth of a mammal and label fully.
(b) Describe the process of photosynthesis.

(a) This question was least attempted and few candidates who attempted it could not perform satisfactorily. Candidates were expected to provide the following answers:
(i) Dentition

It is the number, kind/type/shape and the arrangement of teeth, in the jaw/ lower and upper bones of animals.

(ii) Title (TL) – Diagram of the longitudinal section of a canine tooth



Quality (Q)
Clarity of lines (CL)
Size (Sz) (6 cm – 8 cm)
Neatness of label (NL)

Details (D)
Sharp pointed enamel (SE)
Pulp cavity containing nerves / blood vessels (PC)
Crown and root shown (CR)

Labels (L)
Enamel, dentine, pulp cavity/pulp, cement, blood vessel, nerve, root, crown, neck

(b) Candidates were expected to describe the processes of photosynthesis as presented below:

- photosynthesis occurs in two stages/light stage and dark stage;
- light stage occurs in the grana of chloroplast while;
- dark stage occurs in the stroma of the chloroplast;
- during light stage sunlight falls on chlorophyll/ which traps solar/light/radiant energy;
- which is used to break down water molecules/photolysis of water occurs;
- into hydrogen ion (H+) and hydroxyl ions (OH-);
- the hydrogen ions are retained for the next stage; but the hydroxyl ions are transformed to produce oxygen;
- during the dark reaction/stage hydrogen ions from the light/phase/stage is used to reduce carbon dioxide; to form glucose;
- using ATP/energy;
- in series of enzyme catalyzed reactions;
- the glucose is converted to starch.

Question 3

(a) (i) What is pollution?
(ii) State three effects of air pollution on living things.
(iii) State four ways of controlling air pollution.
(b) Copy and complete the table below.

	One Air pollutant	One Source
(i)		
(ii)		
(iii)		

(c) (i) What is trophic level?
(ii) State three roles of mushrooms in a habitat.

Generally, almost all candidates attempted the questions and the performance was fairly satisfactory. It is worth noting that candidates were expected to provide answers to this question as presented below:

(a) (i) Pollution

Is the release of waste substances/energy as a result of human activities into the atmosphere/environment in quantities which are harmless to human/living things/life.

(ii) Effects of air pollution on living things

- cause lung disease/irritation of skin/nose/eye
- changes in the colour of green plants
- suffocating by combining with haemoglobin/may lead to death
- greenhouse effect/global warming / depletion of the ozone layer
- reduction in plant yields/photosynthesis
- reduction in visibility

(iii) Ways of controlling air pollution

- locating industries away from urban areas/communities
- burning of smokeless/sulphur-free fuel
- using filters to remove pollutants from industrial waste/gases
- using tall chimneys to discharge the waste/gases high-up the sky
- burning of refuse in incinerators
- avoid bush burning
- tarring roads to reduce dusts
- enforcing anti-pollutant laws

(b) Table

S/N	One Air Pollutant	One Source
1	Sulphur dioxide/oxides of sulphur	Burning of fuel/coal (containing Sulphur)
2	Carbon monoxide	Incomplete combustion of fuel/exhaust gases etc. in factories/homes
3	Carbon dioxide	Exhaust fumes (fossil) fuel/burning in factories and homes
4	Oxides in Nitrogen	Chemical bonding of oxygen and nitrogen in the cylinders of internal combustion engines
5	Hydrogen sulphide	Industrial processes/refineries/coal mines/decay of organic matter
6	CFC/Chlorofluorocarbons	Aerosol sprays/air conditioners/fridges
7	Smoke	Combustion of fuel/exhaust gases/cigarettes
8	Heat	Heat waves from sun/factories
9	Dust	Quarries/untarred roads
10	Sewage	Factories/homes/offices

(c) (i) Trophic level

Is the position occupied by an organism with energy transfer in a food chain/food web in an ecosystem.

(ii) Roles of mushrooms in a habitat

- Bring about decay of dead organism
- produce manure/humus
- release nutrient to the soil
- bring about cycling of nutrients
- serve as food for some organisms

Question 4

(a) State five:

(i) causes of variation in living things;

(ii) consequences of variation to living things.

(b) Copy and complete the table below on castes in a termite colony and state one role of each caste.

	Caste in a termite colony	One role of caste in the colony
(i)		
(ii)		
(iii)		
(iv)		
(v)		

Generally, this question seemed to be a popular one, but the performance of candidates on (a) was unsatisfactory while (b) was answered very satisfactorily.
Candidates were expected to answer the questions as follows:

(a) (i) Causes of variation

- Environmental factors/temperature/light intensity/humidity/chemicals/food etc
- Crossing over of genes between chromatids of homologous during meiosis/ segregation
- Random fusion of gametes during fertilization
- Gene mutation/change in the structure of DNA of an organism
- Co-dominance/a process in which a pair of alleles contribute equally to formation of the phenotypes; incomplete dominance
- Independent assortment of genes/linkage
- Epistasis
- Polygenes/polygenic characteristics
- Lethal genes hybridization

(ii) Consequences of variation

- Variation causes differences in characteristics in every species of organisms;
- Some variations are favourable whilst others are not;
- Individuals with favourable variation adapt to the environment/survives and pass on their disadvantageous character to their offspring;
- Individuals without favourable variation are eliminated before maturity
- And such characters disappear;
- Over a long period of time/ this causes the formation of new species;
- Bringing about evolution by natural selection.

(b) Table

S/N	Caste in a termite colony	One role of caste in the colony
i	Queen	Mates with her King/lays fertilized eggs for the rest of her life
ii	King	Mates with the Queen
iii	Worker	Cleans/ventilates the termitarium/build/ repair the nest/feed other members of the nest/nurse the young/go out to collect food/gather food/tend the fungal garden
iv	Soldier	Protects the workers during food gathering/ defend the nest
v	Winged reproductive	Develop into king/queen/form new colonies

Note: Spellings for castes must be correct to score.

Question 5

(a) Explain briefly the following terms:
- **(i) health;**
- **(ii) hygiene;**
- **(iii) sanitation.**

(b) Distinguish between:
- **(i) bilateral symmetry and radial symmetry;**
- **(ii) longitudinal section and transverse section.**

(c) A student drew a rabbit which is five times larger than the drawing. If the drawing is 8 cm long, calculate:
- **(i) the actual length of the rabbit;**
- **(ii) the magnification of the drawing.**

(d) Describe an experiment to measure the rate of growth in the root of a seedling.

(e) State three ways in which the human heart is adapted to its function.

(f) State five ways in which protein is important to animals.

Candidates performance was fairly good.

(a) Explanation of terms

Health

Is the state of complete physical, mental and social well-being and not merely the absence of disease and infirmity.

Hygiene

Is the science and practice of maintaining good health through being clean and avoiding disease-causing organisms/germs/pathogens

OR

Is the act of cleanliness as a means of ensuring a healthy living.

Sanitation

Is a measure used to protect public health through proper solid waste disposal / sewage disposal and cleanliness during food processing/preparation.

OR

Refers to the promotion of public cleanliness and the provision of facilities and services for safe disposal of human wastes/ urine/faeces/sewage, garbage and waste water.

(b) Differences between

(i) Bilateral symmetry and Radial symmetry

Bilateral symmetry allows a body to be divided along only one vertical/longitudinal plane to obtain two equal halves/ are exact mirror images of each other.

(ii) Longitudinal section and Transverse section

Longitudinal section is a cut passing through the vertical axis along the length of an organ/organism.

While transverse section is a cut along the horizontal /cross-wide direction through and organ/organism

(c) (i) Actual length of a rabbit

Object length = 5 x 8 cm = 40 cm

Image length = 8 cm

(ii) Calculation of magnification

Magnification = $\frac{\text{image length}}{\text{object length}} = \frac{8\text{ cm}}{40\text{ cm}}$

$= X\frac{1}{5}$ or 0.2

Note: if there is no (x) on mark of measurement no score

(d) Experiment to measure the rate of growth in root of seedling

- take about ten seedlings;
- mark the radical of each seedling with an Indian (indelible) ink at 2 mm intervals;
- measure and record the growth at two days intervals for ten days;
- plot a graph of age on the x-axis;
- and increase in length of the intervals on the y-axis;
- determine the gradient of the graph;
- this gives the rate of growth.

(e) Adaption of the human heart to its function

- myogenic nature of heart muscles ensure continuous beating
- thinking muscle wall of left ventricle pumps blood to the entire body
- valves between atria and ventricles prevent backflow of blood during heartbeat
- Interatrial/interventricular septum separates the heart into two halves to prevent mixing of deoxygenated and oxygenated blood
- pericardial fluid protects the heart shock due to contraction
- pace maker/SAN/Sino-atrial Node stimulates the contraction of the heart

(f) Importance of proteins to animals

- formation of enzymes
- formation of protoplasm
- formation of hormones
- formation of tendons/cartilages/muscles
- formation of keratin/myosin/actin
- source of energy in the absence of carbohydrates/lipids
- used to build up cells/growth; replace old cells/repair damaged/worn out cells
- synthesis of antibodies

BIOLOGY 3

1. INTRODUCTION

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

2. SUMMARY OF CANDIDATES' STRENGTHS

(1) Precise and adequate information on fruits and their dispersal.
(2) Adequate knowledge on organization of social insects.
(3) Candidates were able to state the differences between organisms appropriately in a tabular form.
(4) More candidates ruled guidelines of their drawings.

3. SUMMARY OF CANDIDATES' WEAKNESSES

(1) Inability of candidates to identify common features of organs of plants taken from different habitats.
(2) Poor spelling of scientific terms such as succulent, venation, exoskeleton, appendages, antennae, proboscis and Arthropoda.
(3) Majority of the candidates could not produce good Biological drawings.
(4) Inability of candidates to relate observed features of organisms to their functions.

4. SUGGESTED REMEDIES

(1) Tutors should organize regular practical lessons to enable students develop skills in observation and description of biological features or organs and whole organisms.
(2) Proper teaching and usage of Biological terms and scientific words should be encouraged.
(3) It is important that candidates are taught the rubrics of Biological drawings.

5. DETAILED COMMENTS

Question 1

Study specimens A, C and E and use them to answer questions 1(a) to (c).

(a) (i) Describe briefly the stem of specimen A.
(ii) In the table below, state four observable differences between the leaves of specimens A and C.
(b) Cut part of the leaf of specimen A and squeeze it between your fingers.
(i) What is the observation?
(ii) Explain briefly the biological significance of the observations.
(c) (i) State two adaptations of specimen E to its role in the colony.
(ii) Classify specimen E into its phylum and class.
(iii) State four ways in which specimen E is of biological importance.

(a) (i) This question was poorly answered by majority of the candidates. Many candidates misunderstood the question and rather stated the class to which the specimen (*Aloe vera*) belongs by providing features common to the taxon.
Candidates were however, expected to provide the following about the stem of Aloe vera

- Short aerial stem
- With scale leaves around it
- And short underground stem
- Bearing adventitious roots
- Presence of succulent leaves

(ii) Generally, candidates gave correct observable differences between Aloe vera (Specimen A) and orange plant leaf (Specimen C) as indicated below:

Specimen A (*Aloe vera*)	Specimen C (Orange plant leaf)
- Leaf shape is lanceolate/narrow/elongated	Ovate/oval/broad leaf
- Variegated leaf	Uniformly green
- Succulent/fleshy/thick	Not fleshy/it is thin
- Spines on leaf margin	Absent/ no spine on leaf margin
- Leaf margin serrated	Leaf margin entire/smooth
- Veins not seen/parallel veneration	No veneration/veins conspicuous
- Has leaf sheath	Has petiole/leaf stalk

However, few candidates strangely added differences between stem and roots of the specimens when the question clearly referred to the leaves only.
(b) Majority of the candidates gave correct observation when the specimen is cut and squeezed between their fingers by stating watery/liquid/sap/jelly like/slimy. However, most of the candidates could not state the biological significance of the liquid to the plant.

The correct biological significance of the liquid to the plant include:

- water/jelly like substance stores water for the leaf to prevent drying out/desiccation
- protects leaves from being grazed upon/makes the leaf from infection
- makes the leaf fire-resistant

(c) Most of the candidates correctly stated adaptations of specimen E (soldier termite) to its role in the colony, its classification into phylum and class, and its biological importance. However, a few candidates mispelt “Insecta”, Arthropoda”, exoskeleton, appendages and symmetry.

Question 2

Study specimens F and H and answer questions 2(a) to (d).

(a) (i) State three observable features of specimen F.
(ii) State two physiological factors and one climatic factor that have brought about the changes that could transform specimen F to H.
(b) Make a drawing 8 cm – 10 cm long of specimen F and label fully.
(c) (i) In a tabular form, state five observable differences between specimens F and H.
(ii) State the modes of dispersal of specimen H.
(iii) Give one reason for the answer in (c)(ii).
(d) State: (i) type of fruit;
(ii) placentation of specimen H.

(a) (i) and (ii) These questions were poorly answered by most candidates. Majority of the candidates wrongly identified specimen F as mango instead of fruit of mango. Candidates lack knowledge of physiological factors responsible for the change of specimen F (unripe mango fruit) to H (Ripen mango fruit). However, a handful of candidates correctly stated the involvement of hormones such as Auxins (IAA / Indole Acid, Ascorbic acid, ethylene.

Most of the candidates however, identified warmth, temperature/sunlight as the climatic factors responsible for ripening of mango fruits.
(b) This question was well answered by most of the candidates. However, a few candidates did not abide by the rubrics of biological drawings. For example, guidelines drawn with free hands, drawing was not smooth and continuous, and magnification was not disclosed.

Candidates were expected to indicate the following on their biological drawings:
Title - Diagram / drawing of specimen F (unripe mango)
Quality
Size - 8 cm to 10 cm
Clarity of lines
Neat labels
Magnification
Details
Three layers shown
Cut edges shown in double lines
Seed shown
Labels
Epicarp, mesocarp, endocarp, fruit stalk, seed, remain in style.

(c) (i) This question was fairly well answered by most of the candidates. However, the following observable differences between specimen F (unripe mango fruit) and specimen H (ripen mango fruit) were hardly stated.

Specimen F (unripe mango fruit)	Specimen H (ripe mango fruit)
- Hard fruit	Soft fruit
- Fibres inconspicuous	Fibres conspicuous
- Mesocarp not juicy	Mesocarp juicy
- Hard epicarp	Soft epicarp
- Hard / firm mesocarp	Soft mesocarp
- Mesocarp whitish/light yellow/light green	Mesocarp is yellow/orange

(ii) Most candidates identified human beings or animals as the mode of dispersal of mango fruit.
(iii) Generally, candidates did not find much difficulty in stating attractive colour of fruit, edible/sweet to taste, succulent/fleshy and sweet/pleasant scent/odour as their reasons for the mode of dispersal of mango fruit.
(d) This question was well answered by majority of the candidates. Candidates readily identified drupe as the type of fruit and they correctly stated placentation as basal or pendulous.

Question 3

(a) (i) Name the habitat of specimen K.
(ii) State three ways in which specimen K is adapted to its habitat.
(iii) Suggest the mode of vegetative propagation of specimen K.
(iv) State one reason for the answer in (a)(iii).
(b) (i) Name the phylum and class of each of specimens M and N.
(ii) State one reason each for the answers in (b)(i).
(c) In a tabular form, state three observable structural differences between specimen M and N.
(d) Describe briefly the mode of feeding of specimen M.
(e) (i) Name the habitat of specimen N.
(ii) State one way in which specimen N is adapted to its habitat.
(f) State two observable features of specimen M that make it a vector.

Majority of candidates who attempted this question performed poorly.
(a) (i) Candidates generally failed to state specific natural habitat of specimen K (Water lettuce) as freshwater or pond. Majority of candidates wrongly stated water or aquatic habitat which is too general to be accepted as the right answer.
(ii) Most of the candidates woefully failed to relate observable structures of Water lettuce to their functions.

The expected correct structural adaptation of Water lettuce (Specimen K) to its habitat included:

- presence of hairs on the surface of leaves; to prevent blockage of stomata
- hairs on leaves store air; for buoyancy
- numerous adventitious roots; for absorption of mineral salts/water
- presence of offsets/stolon/buds; for vegetative propagation
- green colour of leaves; for photosynthesis
- leaves have air spaces; for buoyancy

Candidates should note that structure and function must correspond to score (iii) and (iv). A number of candidates correctly stated the presence of stolons/offset/ bud/creeping stem as the means of vegetative propagation of water lettuce. Candidates subsequently, cited the use of bud/stolon as the reason for the vegetative propagation of water lettuce.

(b) Majority of candidates gave correct phylum and classs of each of the specimens M and N. However, a good number of candidates lost marks because the technical names were wrongly spelt.

The expected responses include:

(i) <u>Phylum and class of specimen M (Housefly)</u>

Phylum: Arthropoda
Class: Insecta

<u>Phylum and class of specimen N (Millipede)</u>

Phylum: Arthropoda
Class: Diplopoda

(ii) <u>Reasons for classification of specimen M (Housefly)</u>

Phylum: Arthropoda

- bilateral symmetrical
- metameric segmentation
- jointed appendages
- chitinous exoskeleton

Class: Insecta

- three body divisions; head, thorax and abdomen
- three pairs of legs on the thorax
- presence of a pair of antennae
- a pair of compound eyes

Reasons for classification of specimen N (Millipede)

Phylum: Arthropoda
- bilateral symmetrical
- metameric segmentation
- jointed appendages
- chitinous exoskeleton

Class: Diplopoda
- presence of a pair of antennae
- presence of simple eyes
- two pairs of jointed legs per segment

(c) Generally, candidates did not find much difficulties in stating the observable structural differences between Housefly and Millipede.

(d) Candidates were not able to outline the mode of feeding of Housefly (Specimen M). The expected mode of feeding of Housefly include:
- Housefly is a fluid feeder;
- labium/mouth part is modified into long proboscis with labella at the tip;
- during feeding; the proboscis is lowered onto the food;
- saliva is secreted to digest the food externally;
- the dissolved/digestive food substances are drawn up through the lamella;
- into the alimentary canal of the housefly

(e) (i) In this question, most of the candidates correctly stated decaying litter/under rock/soil as the habitat of millipede.

(iii) This question was poorly answered by a number of candidates. The question tasked candidates to identify relevant structures of millipedes and state how the structure contributes to its survival.

Candidates were expected to observe the following and match them with their roles in the survival of millipede in its habitat:
- walking legs; to escape predators;
- dark brown body colour; blends with same colour of the surrounding and escape detection by predators;
- coils when touched; enables it to escape;
- release a foul smell or odour; to ward off enemies;
- presence of antennae; for sensitivity
- presence of eyes; for vision

Candidates should note that, structure and function must correspond to earn marks.

(f) Most of the candidates were able to identify hairs on the body and legs which pick and transmit disease causing organism to humans. However, features on Housefly which were hardly mentioned included:

Long proboscis/lamella and pad on legs

CHEMISTRY 2

1. GENERAL COMMENTS

Generally, the paper was of a very good standard compared to that of last year.
Introduction of some organic chemistry into the section A which is mandatory for all candidates is very laudable. Previously, because the organic chemistry was not in the section A, candidates could avoid answering/treating that section of the syllabus. This affected the general performance of the candidates as they scored low marks in the paper. This standard must therefore be maintained to enable the candidates study all the aspects of the general syllabus and avoid specialization in certain topics of their choice.

Topics such as partition chromatography under separation techniques which has never been tested before was introduced to afford the candidates the opportunity to explore the whole of the chemistry syllabus. In all, the paper was of a very good standard.

2. SUMMARY OF CANDIDATES' STRENGTHS

The major strengths of the candidates identified as far as this paper was concerned are:
(1) knowledge of the properties of carbon responsible for its ability to form many compounds;
(2) application/calculations on solubility of salts;
(3) electrochemical cells under redox reactions;
(4) industrial uses of hydrogen;
(5) properties of binary compounds;
(6) stoichiometric and its application in redox reactions and combustion of hydrocarabons;
(7) periodic properties and their trends in the periodic table;
(8) application on acids, bases and salts;
(9) diagrammatic representation of electron configurations (electron box concept) and its use in predicting the similarities and differences in the chemical properties of elements.

3. SUMMARY OF WEAKNESSES

The major weaknesses identified in the candidates' responses to the tasks involved in the questions included the following:

(1) inadequate coverage of organic chemistry (recalls, nomenclature and classification);
(2) energy and energy changes, enthalpy of neutralization of strong acid-strong base reaction and that of weak acid-strong base reaction;
(3) use of stoichiometry in deducing balanced equation of redox reactions;
(4) separation techniques such as partition chromatography;
(5) application of the Born-Haber cycle.

4. SUGGESTED REMEDIES

Suggested remedies for the weaknesses:
(1) early completion of the syllabus in terms of the curriculum;
(2) routine administration of exercises on the various topics treated;
(3) encouragement of extra learning/reading of the treated topics with self examinations;
(4) avoidance of specialization of topics in the subject.

5. DETAILED COMMENTS

Question 1

(a) What is a functional group?
(b) Define each of the following terms:
(i) aliphatic compound;
(ii) aromatic compound.
(c) Draw the structure of each of the following compounds:
(i) 3-chloro-3 methylbutan-2-ol;
(ii) 3-methylbutanoic acid.
(d) State three properties of Carbon that is responsible for its ability to form many compounds.
(e) Why is it not advisable to react a metal trioxocarbonate (IV) with a mineral acid in a sealed glass flask?
(f) If 20.2 g of a salt Q dissolves in 15.4 cm^3 of distilled water at 40°C, calculate the solubility of Q in mol dm^{-3} at 40°C.
[Mr Q = 331]
(g) Explain briefly why an increase in temperature causes the rate of a chemical reaction to increase?
(h) State two functions of a salt-bridge in an electrochemical cell.
(i) State two large-scale uses of hydrogen in the chemical industry.
(i) State one environmental effect of burning fuels.

Candidates on the average performed well on this question. However, majority of them could not answer the tasks involving the organic chemistry.
(a) & (b) required recall of terms; functional group, aliphatic compound and aromatic compound. They failed to mention that functional group is in relation to organic compounds as well while aliphatic and aromatic compounds are organic.
(b) Majority of the candidates did not recognize that drawing of the structure of organic compounds goes with showing all the bonds in the structure. The bonds in the alkyl groups (methyl) were not shown.
(c) The properties of carbon responsible for its ability to form many compounds were well stated by majority of the candidates.

(d) Almost all the candidates were able to state that the sealed glass flask will break/explode but could not realize that it was as a result of the pressure build-up from the evolution of CO_2 in the reaction of the metal trioxocarbonate (IV) with the mineral acid.

(e) The task involved in this question was application of solubility. Majority of the candidates were able to calculate the solubility of the salt from the given data.

(f) Candidates could not explain the fact that an increase in temperature increases the kinetic energy of the reactant molecules which leads to increase in collision frequency and effective collisions and the number of molecules with kinetic energy greater than the activation energy.

(g) Candidates were able to state the functions of a salt bridge in an electrochemical cell as used;

i. to connect the oxidation half-cell to the reduction half cell

ii. balance / serve as a passage for the charges from one electrolyte to the other.

(h) Vast majority of the candidates were able to state only two (2) large scale uses of hydrogen industrially i.e. in the manufacture of ammonia and hardening of fats and oil in making margarine. The other uses such as; hydrocracking/oil refinery, conversion of coal to crude oil, manufacture of plastics, as gaseous fuels and as rocket fuel were hardly mention by the candidates. A few candidates however stated other uses as; a reducing agent, manufacture of methanol, filling weather ballons and in oxy-hydrogen flame for welding and cutting metals.

(i) Environmental effects of burning fuels were perfectly answered by majority of the candidates.

Question 2

(a) Consider the following compounds: NaH, B_2O_3, CH_4, SnO. Choose from the list one;

(i) amphoteric substance;

(ii) substance whose aqueous solution is acidic;

(iii) substance whose aqueous solution is basic;

(iv) substance which is a reducing agent.

(b) (i) The enthalpy of neutralization of sodium hydroxide with hydrochloric acid is 57.5 kJ mol^{-1}, the same as the enthalpy of reaction between $H_3O^+_{(aq)}$ and $OH^-_{(aq)}$.

(ii) The enthalpy of neutralization for the following systems are:

CH_3COOH – NaOH 55.2 kJ mol^{-1}

HCN – NaOH 11.7 kJ mol^{-1}

Give reasons why the values are different from that given in b(i).

(c) In a reaction it was found that 3.0 g of a metal X was oxidized by 25.0 cm^3 of 0.10 mol dm^{-3} $K_2Cr_2O_7$ under acidic conditions.

(i) Deduce the mole ratio between X and $Cr_2O_7^{2-}$ ion.

(ii) Write a balanced equation of the redox reaction.

(iii) Give the oxidation numbers of chromium and X in both their reduced and oxidized forms. [Molar mass of X = 200.6]

(d) (i) Outline the principles involved in partition chromatography.

(ii) Describe briefly how you would use the principle of partition to separate a sample of kerosene which is known to be contaminated with water.

(e) An isotope of an element Q is represented by the symbol $^{31}_{15}Q$. What does the superscript indicates.

About 50% of the candidates attempted this question but performed poorly.

(a) Only a few of the candidates who attempted this question were able to answer this task correctly. The candidates failed to identify the chemical nature of the following compounds: NaH, B_2O_3, CH_4 and SnO as SnO being amphoteric; B_2O_3 as one whose aqueous solution is acidic and NaH as a substance which is a reducing agent and aqueous solution is basic.

(b) The candidates were unable to answer this question probably because they did not understand.

(i) The required response was that, NaOH and HCl are strong base and strong acid whose reaction is essentially between the ions OH^- and H^+/H_3O^+ to give one mole of water.

(ii) CH_3COOH and HCN reacting with NaOH are both weak acids and energies are required to complete their dissociations hence their respective ΔH of neutralizations being lower. However, in the case of HCN, in solution, it forms polymer chain through hydrogen bonding hence making it very difficult to release H^+ ion for reaction.

(c) Candidates were able to calculate the amount of each of $Cr_2O_7^{2-}$ and X that reacted. But could not find the ratio of the moles involved let alone write the balanced redox reaction equation.

(d) Majority of the candidates were unable to outline the principle involved in Partition Chromatography let alone describe how a mixture of kerosene and water could be separated.

The principle deals with the separation of components of a mixture of two immiscible solvents based on their different solubilities in the two solvents. Hence, the use of separating funnel with the denser solvent (water) settling at the bottom and the less denser solvent (kerosene) floating on top. Separation is by tapping of the lower denser solvent into a container leaving the lesser denser solvent in the funnel.

(e) This section was well answered by the candidates as they were able to identify the superscript of the symbol of an isotope as its mass number.

Question 3

(b) (i) Which two of the following gases would show the greatest deviation from the ideal behaviour? H_2, N_2, O_2, Cl_2, SO_2 and NCl_3

(ii) Give reasons for your answer in (b)(i).

(c) Explain briefly:

(i) why the first ionization energies of the group VII elements decreases down the group;

(ii) the trend in the boiling points of the group VII elements down the group.

(d) In an experiment to determine the solubility of $KClO_3$ at different temperatures, the following results were obtained:

Temperature / ^oC	0	10	20	30	40	50	60
Solubility in g/dm^{-3}	14	17	20	24	29	34	40

(i) Draw a graph of temperature (*x*-axis) against solubility (*y*-axis);

(ii) Use your graph to determine;

(α) the solubility of $KClO_3$ at 55^{o}C;

(β) how much of the $KClO_3$ will crystallize out when a saturated solution of the salt is cooled from 55^{o}C to 25^{o}C.

(e) Explain briefly the term end-point as used in titrations.

Vast majority of the candidates attempted this question but scored low marks.

(a) Majority of the candidates could not give the appropriate response. The answer is

i. No, if the reaction is an equilibrium reaction and the forward reaction is exothermic, increasing temperature will favour the backward reaction. Thus, the concentration of the product will decrease.

ii. Yes, if the reaction is an equilibrium reaction and the forward reaction is endothermic, increasing temperature will favour the forward reaction thus the concentration of the product will increase.

iii. No, if the reaction is not an equilibrium reaction, increasing the temperature will increase the rate of the reaction but amount of product will not be affected.

(b) The extent of deviation from ideal behaviour by gases is based on the attractive forces holding the molecules together or the molecular size. SO_2 and NCl_3 had dipole – dipole niterations whereas the rest (H_2, N_2, O_2 and Cl_2) had strictly vander Waals forces. Hence SO_2 and NCl_3 have the greatest deviations.

(c) The task involved here were the trend of periodic properties in the periodic table. Ionization energy decreases down the group of the halogens because atomic size increases leading to increase in screening effect and reduces attraction between the nucleus and the valence electron(s). Boiling point increases down the group VI elements because size of the molecules increases thereby increasing the strength of

the intermolecular forces (vander Waals forces) of attraction. Hence more energy is required to break the intermolecular forces to effect boiling.

(d) Majority of the candidates were able to plot the solubility curve. However, some few candidates interchanged the axes despite the fact that they were told to plot solubility as the y-axis and temperature as the x-axis. This resulted in their readings and shape of the curve being wrong.

(e) Almost all the candidates responded that there is a colour change indicating end point in a titration but failed to mention that at that point, all of one substance has reacted completely with the other substance.

Question 4

(a) (i) With the help of appropriate electron box diagrams, draw the electron configuration for the following elements Beryllium ($_4$Be); Fluorine ($_9$F) and calcium ($_{20}$Ca).

(ii) Use the electron configuration drawn in (a)(i) to explain briefly why beryllium shows chemical properties similar to calcium but different from fluorine.

(b) Arrange, without giving reasons:

(i) the elements, beryllium, fluorine and calcium in order of increasing electron affinity.

(ii) CaF_2, BeF_2, and F_2 in order of increasing covalent character of the bonding involved.

(c) The dissociation constant of a weak base CH_3NH_2 is 4.48×10^{-4} mol^2 dm^{-6} at 25^{o}C.

(i) Write a balanced equation for the dissociation of CH_3NH_2 in aqueous solution;

(ii) Calculate the:

(α) hydroxide ion concentration in 0.20 mol dm^{-3} solution of CH_3NH_2;

(β) pH of 0.20 mol dm^{-3} solution of CH_3NH_2.

(d) Consider the following hydrocarbons: $C_3H_{8(g)}$ and $C_3H_{4(g)}$

(i) Write balanced chemical equations for the complete combustion of one mole of each of the hydrocarbons;

(ii) Which of the hydrocarbons is the most economical as a fuel?

(iii) Explain briefly your answer in (d)(ii);

(iv) State the reason why one mole of each of the hydrocarbons contributes equally to the greenhouse effect.

Almost all the candidates attempted this question.

(a) The candidates were able to draw the electron configurations of $_4$Be, $_9$F and $_{20}$Ca using the electron box diagrams. However, some of them could not use the configurations drawn to explain why Be and Ca show similar chemical properties but different from fluorine. Because Be and Ca have same number of valence electrons,

their chemical properties are similar but different from that of F which has seven valence electrons.

(b) Only about 50% were able to give the correct orders in increasing electron affinity among the elements Be, F and Ca as well as that of increasing covalent character of the bonding involved in CaF_2, BeF_2 and F_2.

(c) Candidates answered this section of the question very well except that some failed to recognize that the dissociation of the weak base CH_3NH_2 in aqueous solution is reversible.

(d) Almost all the candidates were able to answer this section of the question very well. They were able to write the balanced chemical equations for the combustion of C_3H_8 and C_3H_4 and deduce the one which is most economical as a fuel to be C_3C_4 because it requires the least amount of oxygen for combustion.

(iv) Reason for contributing equally to green house effect is that they both produce the same amount of CO_2 upon combustion.

Question 5

(a) Explain briefly why CH_3COOH has a higher boiling point than its isomer $HCOOCH_3$?

(b) (i) The standard enthalpy of combustion of decane is *x* kJ mol^{-1}. Explain briefly what is meant by this statement.

(ii) Given that: $\Delta H_f^{\theta}(CO_{2(g)})$ = y kJ mol^{-1} $\Delta H_f^{\theta}(H_2O_{(l)})$ = z kJ mol^{-1}
Obtain an expression for ΔH_f^{θ} (decane) in terms of *x*, *y* and z.

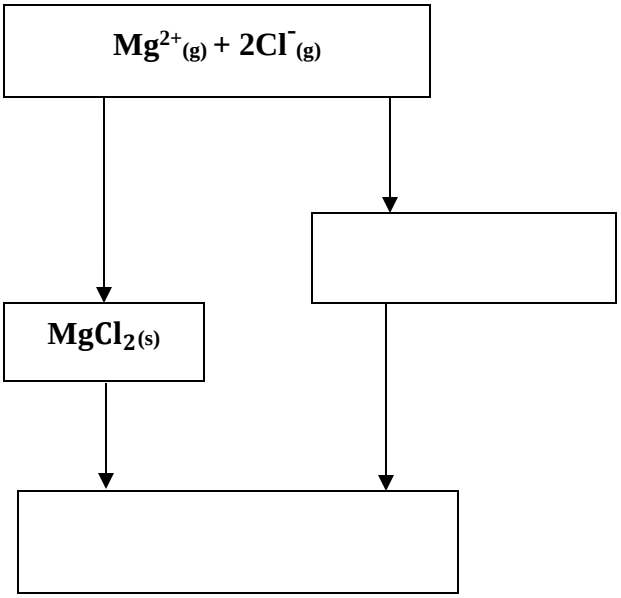
(c) (i) Define the term hydration energy;

(ii) The following table shows the enthalpy changes of some species:

Enthalpy change	Energy/ kJ mol^{-1}
Lattice energy of $MgCl_2$	-2,493
Enthalpy change of solution of $MgCl_2$	-154
Enthalpy change of hydration of Chloride ions	-363

(α) State why the enthalpy change of hydration of chloride ions is an exothermic reaction;

(β) Copy and complete the following diagram:



(γ) Calculate the enthalpy change of hydration of magnesium ions;

(δ) Explain why the enthalpy change of hydration of magnesium ions is more exothermic than that of calcium ions. [$_{12}$Mg, $_{20}$Ca]

(d) (i) What is geometric isomerism?

(ii) Write the structural formula for the geometric isomer of cis-but-2-ene;

(iii) Write an equation for the hydrogenation of but-2-ene.

Only a few of the candidates attempted this question. Their performance was poor.

(a) Candidates were to identify the type of forces holding CH_3COOH molecules together as dipole-dipole interactions and hydrogen bonding whiles that in $HCOOCH_3$ is dipole-dipole interactions. Hence, the stronger the intermolecular forces, the higher the boiling point.

(b) (i) Candidates were expected to state that combustion of one mole of decane in excess oxygen at 298 K and l atm will yield xkJ of heat.

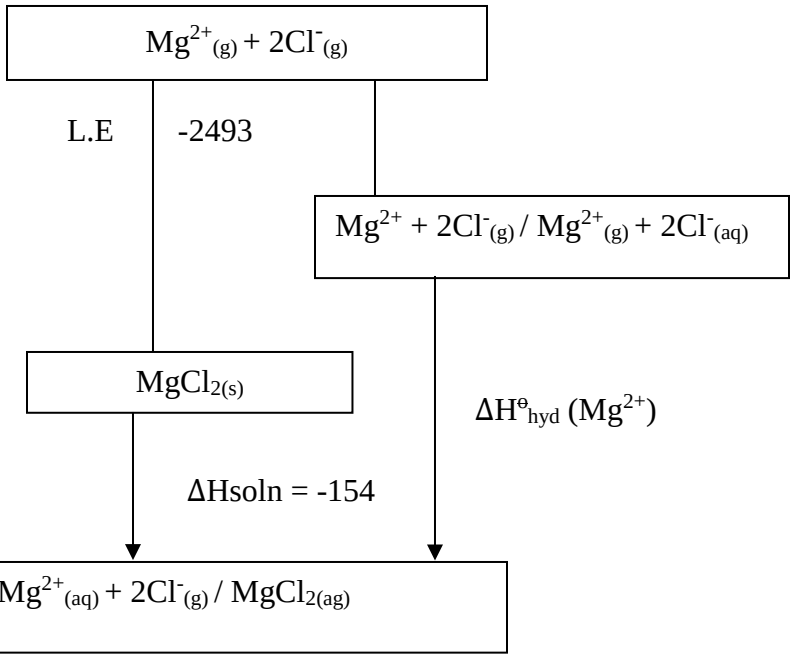
(ii) The candidates were to write the balanced chemical equation for the combustion of decane and use the data given to obtain an expression for the standard enthalpy of formation of decane based on the Hess's law of constant heat summation. $2C_{10}H_{22} + 31O_2 \rightarrow 20CO_2 + 22H_2O$

(c) (i) Candidates could not define hydration energy as the heat evolved when I mole of a gaseous ion combine with water molecules to form hydrated ions.

(ii) Candidates failed to realize of that hydration of ions involved bond formation hence an exothermic reaction. Candidates could not draw the Born Haber cycle for the hydration of $MgCl_{2(s)}$ from its constituent ions in their gaseous state. Hence could not calculate the enthalpy change of hydration of Mg^{2+} ions.

(β)

$\Delta Hy.(Cl^-) = 2(-363)$



(γ) $(-2493) + (-154) = (2 \times -363) + \Delta H_{hyd}(Mg^{2+})$

$\Delta H_{hyd}(Mg^{2+}) = -2493+(-154)-(2x-363)$

$= -1921\ kJ\ mol^{-1}$

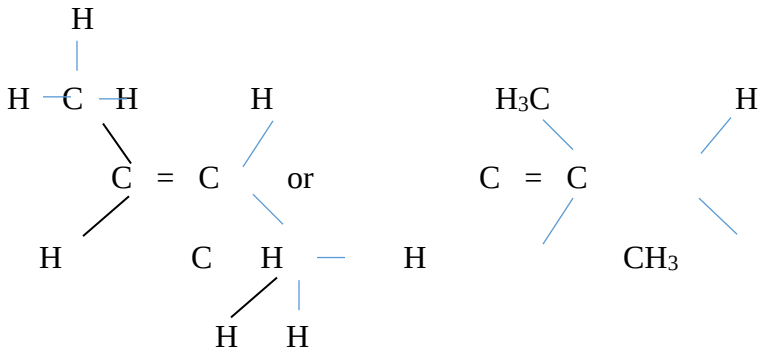
(δ) Magnesium ion is smaller / has a greater charge density / calcium ion is larger / has smaller charge density hence magnesium ion has a stronger attraction to water / has a stronger bonding with water (H_2O) / calcium ions has less attraction to water (H_2O).

(d) (i) Candidates could not explain what geometric isomerism is let alone write the formula for the geometric isomer of Cis-but-2-ene which gives a trans isomer.

Equation for the hydrogenation of but-2-ene was well done.

Geometric isomerism is the existence of two compounds with the same formula but differ in the arrangement of groups attached to the carbons containing the double bonds.

(ii)



(iii) $C_4H_8 + H_2 \xrightarrow{(Ni)} C_4H_{10}$

CHEMISTRY 3

1. GENERAL COMMENTS

The standard of the paper compares favourably with those of previous years. The candidates' performance was better than the previous years.

2. SUMMARY OF CANDIDATES' STRENGTHS

(1) The strength of the candidates is in question one where they were to titrate a solution against the other.
(2) Most candidates took burette readings to two decimal places. Most candidates also averaged consistent values.
(3) They were able to do the calculations well.
(4) Almost all candidates tabulated their burette readings very well.
(5) Most of the scientific words were correctly spelt by the candidates. However, there were a few candidates who spelt them wrongly. Examples are Fehling solution, iodine, effervescence, 'brick red', amber coloured bottle.

3. SUMMARY OF WEAKNESSES

(1) Some candidates exhibited poor knowledge of the concept of solubility and redox titration
(2) Most candidates were not able to provide reasons for basic laboratory procedures especially in Alternative C question 3.
(3) Most candidates altered their recorded titres thereby making the work untidy. Also, they used pencil to do a lot of rough work on their answer sheet of which they should have erased after work.
(4) Inadequate description of precipitates formed.
(5) Lack of relevant skills for adequate qualitative analysis
(6) Performance for question two (Qualitative Analysis) was not encouraging. E.g. some of the candidates did not adhere to the instructions. In few cases, reagents not stated in the question were used.
(7) Some candidates also failed to record some of the activities carried out (especially where they were to add distilled water)
(8) As usual, poor command of the English language affected candidates' performance where they were required to describe practical processes / activities (Question 3)
(9) A few of the candidates also failed to comply with the instruction or rubrics which made marking difficult

4. SUGGESTED REMEDIES

Tutors should start the practical work with students right from form one. Many schools wait till the third year. More practices should be done in the laboratory and exercises presented should be marked by the chemistry tutors. Refresher courses should be organized for all chemistry tutors to teach what is required of them.

(1) Teachers should explain procedures used in practical activities to candidates
(2) More practical assignment be given to candidates to practice

(3) More equipment's should be supplied to schools since the class size has increased
(4) More time should be allocated to practicals to enable candidates practice. This will enable them match theory with practicals and see the relevance of what they do in life. Trip to industries to observe the manufacture of goods and services.
(5) Clearly, more practical work needs to be done in the area of qualitative analysis.
(6) For each test performed, states of sample and reagent must be stated (e.g. $D_{(aq)} + NH_{3(aq)}$ and not simply D + NH_3).

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 a solution of potassium tetraoxomanganate (VII).
B is a solution of iron (II) chloride containing 4.80 g of the salt in 250 cm^3 of solution.

(a) **Put A into the burette. Pipette 20.0 cm^3 or 25.0 cm^3 of B into a conical flask, add 20.0 cm^3 of $H_2SO_{4(aq)}$ and titrate with A. Repeat the titration to obtain concordant titre values. Tabulate your results and calculate the average volume of A used. The equation of the reaction is: $MnO_4^-{}_{(aq)} + 5Fe^{2+}{}_{(aq)} + 8H^+{}_{(aq)} \rightarrow Mn^{2+}{}_{(aq)} + 5Fe^{3+}{}_{(aq)} + 4H_2O_{(l)}$**

(b) **From your results and the information provided, calculate the:**
- **i. concentration of B in mol dm^{-3};**
- **ii. concentration of A in mol dm^{-3};**
- **iii. number of moles of Fe^{2+} in the volume of B pipette. [$FeCl_2$ = 127 g mol^{-1}]**

Question 2

C and D are inorganic salts. Carry out the following exercises on them. Record your observations and identify any gas(es) evolved. State the conclusions you draw from the result of each test.

(a) **Put all of C into a test tube and add about 5cm^3 of distilled water. Shake thoroughly and test the resulting solution with a litmus paper. Divide the solution into three portions.**
- **(i) To the first portion add $NaOH_{(aq)}$ in drops, then in excess.**
- **(ii) To the second portion, add $NH_{3(aq)}$ in drops, then in excess.**
- **(iii) To the third portion add $AgNO_{3(aq)}$ followed by $HCl_{(aq)}$.**

(b) **(i) Put all of D in a test tube and add about 5 cm^3 of distilled water. Shake thoroughly and feel the test tube.**
(ii) To about 2 cm^3 of the solution add $Hl_{(aq)}$.

Question 3

State the observations that would be made when each of the following reactions is carried out in the laboratory:

(a) Addition of 2 cm^3 of bench H_2SO_4 to 2 cm^3 of barium chloride solution.

(b) Addition of 2 cm^3 of dilute hydrochloric acid to 1 g of powered iron (II) sulphide (FeS).

(c) Addition of 2 cm^3 of dilute hydrochloride acid to 1 g of iron filings and allowed to stand for some time.

Question 1

(a) Most of the candidates were able to perform titration and recorded their titres to 2 decimal places. There was improvement in the use of consistent titres to calculate the average titre.
Quite a good number scored the maximum points. A few candidates, however, omitted the units. Some others also used wrong units i.e. cm instead of cm^3.

(b) (i) 250 cm^3 of B contains 4.80 g of $FeCl_2$

$\therefore$ 1000 cm^3 of B will contain = $\frac{1000}{250} \times 4.8\ gdm^{-3}$

$= 19.2\ gdm^{-3}$

Concentration of B in mol dm^{-3} = $\frac{\text{Conc. in } gdm^{-3}}{\text{Molar mass}}$

$= \frac{19.2\ gm^{-3}}{127\ gmol^{-1}}$

$= 0.151$ mol dm^{-3}

(ii) $\frac{C_A V_A}{C_B V_B} = 1$

$C_A = \frac{C_B V_B \times nA}{V_A \times n_B}$

$= \frac{0.151 \times 25}{V_A \times 5}$

$= a$ mol dm^{-3}

(iii) 1000 cm^3 of B contains 0.151 mol of Fe^{2+}

$\therefore$ 25 cm^3 will contain = $\frac{0.151 \times 25.0}{1000}$

$= b$ mol

A significant number of the candidates were able to calculate the concentrations of B and A in b(i) and b(ii) as required. Some marks were lost due to incorrect significant figures of

the calculated values. Candidates must learn to leave their answers in same significant figures as those stated for the concentration and masses in the question.

Candidates handled calculation of relative atomic mass of Y very well. Except that some attached units to the relative atomic mass.

b(iii) Many of the candidates were able to deduce the expression 20.0 / 25.0 cm^3 and continued as follows

$$\frac{C_B \times 25.0 / 20.0}{1000}$$

However, many used A for C_B in the above stated expression. They could have used C_A where the expression would have been $n_B = \frac{5 \times V_A \times C_A}{1000}$

Question 2

	TEST	OBSERVATION	INFERENCE
a	C + distilled water + shaking Resulting solution + Litmus paper	C dissolved to form a blue/ green solution Solution turns blue litmus paper red	 Solution is acidic
a(i)	1st portion + NaOH in drops then in excess	Blue gelatinouss Precipitate Precipitate insoluble in excess	 Cu^{2+} present
a(ii)	2nd portion + $NH_{3(aq)}$ in drops then in excess	Light blue precipitate Ppt dissolved in excess to form deep blue solution	 Cu^{2+} confirmed
a(iii)	3rd portion + $AgNO_{3(aq)}$ + $HCl_{(aq)}$	White ppt formed Ppt insoluble	Cl^- or CO_3^{2-} or S^{2-} or SO_3^{2-} Cl^- present
b(i)	D + distilled water Touching/feel	D dissolved to form a colourless solution. Test tube feels cold on touching	 Dissolution is endothermic
b(ii)	$D_{(aq)}$ + $HCl_{(aq)}$	Effervescence of colour less odourless, gas. The gas turned lime water milky	CO_2 from CO_3^{2-} or HCO_3^-

Most candidates answered the question well and they followed the instructions given them. Many candidates had a very high score. However, some candidates did not follow the instructions given them. They were asked to add water to C and later use the solutions from C for other tests.

Some candidates scored zero since they were not expected to add $NaOH_{(aq)}$ or $NH_{3(aq)}$, or $AgNO_{3(aq)}$, to C but to solution of C.
Also when C dissolved in water, the test of solution C with litmus paper turned red showing **solution of C** is acidic but some wrote that C is acidic. Since C is a solid and they were told it consists of two salts, C could not have been an acid.

(a) Many candidates did not indicate whether distilled water was added to sample C. they appeared to be working with the solid sample instead of the solution and lost marks accordingly. Some also appeared to be confused with the term gelatinous ppt. e.g. in a(i).

1st portion + NaOH(aq) in drops some stated, 'Blue ppt', instead of 'Pale Blue gelatinous ppt'.
then for a(iii)
3rd portion + $AgNO_{3(aq)}$ 'white gelatinous ppt' instead of 'white ppt'.

Question 3

(a) White ppt of $BaSO_4$ barium tetraoxosulphate (VI) is formed.
(b) Evolution of a gas with rotten egg smell and a green solution formed.
(c) Effervescence of colourless odourless gas and light green solution turned brown after some time.

Instead of stating observations made, quite a number of the candidates wrote equations for the reactions.

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. D is a solution of a dibasic acid, H_2Y, containing 1.4 g in 500 cm^3 of solution. E is 0.105 mol dm^{-3} KOH.
(a) Put D into the burette and titrate it against 20.0 cm^3 or 25.0cm^3 portions of E using phenolphthalein as indicator. Repeat the titration to obtain consistent titre values.
Tabulate your results and calculate the average volume of D used.
(b) From your results and the information provided calculate the:

(i) concentration of D in mol dm^{-3}.
(ii) molar mass of H_2Y;
(iii) relative atomic mass of Y;
(iv) number of hydrogen ions in 1 dm^3 of D. [$N_A = 6.02 \times 10^{23}$]

Question 2

F is a mixture of two 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 the resulting solution thoroughly. Test the solution with a litmus paper.
(b) (i) To about 2 cm^3 portion of the solution, add $BaCl_2$ solution followed by $HCl_{(aq)}$.
(ii) To another 2 cm^3 portion of the solution, add $NaOH_{(aq)}$ in drops and then in excess. Heat the mixture.
(iii) To another 2 cm^3 portion of the solution, add $K_3Fe(CN)_6$ solution.

Question 3

A solid sample is suspected to be either glucose, sucrose or starch. Using only two chemical tests, describe how the solid could be identified.

Question 1

(a) Most of the candidates were able to perform the titration and recorded their titres to 2 decimal places. There was improvement in the use of consistent titres to calculate the average titre.
Quite a good number scored the maximum points. A few candidates however omitted the units. Some others also used wrong units i.e. cm instead of cm^3.

(b) (i) Most of the candidates were able to deduce the mole ratio from the given equation. However, a few were unable to make C_D subject of the formula. Again, correct evaluation to 3 sig. fig was a problem for many of them. Teachers must endeavour to bring this issue to the attention of students.

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

$$\frac{C_D V_D}{C_E V_E} = \frac{1}{2}$$

$$C_D = \frac{C_E V_E}{2V_D}$$

$$= \frac{0.105 \times 25}{2 \times V_D}$$

(ii) Molar mass of H_2Y

500 cm^3 of D contains 1.4 g of H_2Y

∴ 1000 cm^3 of D contains $1.4 \times 1000 = 2.8$ gdm^{-3}

Molar mass of $H_2Y = \frac{2.8}{a}$

$= b$ g mol^{-1}

(iii) This refers to Alternative B Question 1 b(iii)

Relative atomic mass of Y

Molar mass of $H_2Y = b$

$H_2Y = b$

$2 + Y = b$

$Y = b - 2$

$= c$

(iv) Number of hydrogen ions in 1 dm^3 of D

($N_A = 6.02 \times 10^{23}$)

Many stated the dissociation of the dibasic acid H_2Y as follows:

$H_2Y_{(aq)} \rightarrow 2H^+ + Y^-$ instead of $H_2Y_{(aq)} \rightarrow 2H^+ + Y^{2-}$

Again, many of the candidates found the number of hydrogen ions in 500 cm^3 instead of 1 dm^3 of D.

Alternative Solution to Question 1

(b) (i) Conc. of D in mol dm^{-3}

$\frac{C_DV_D}{C_EV_E} = \frac{1}{2}$

$C_D = \frac{C_EV_E}{2V_D}$

$= \frac{0.105 \times 25}{2 \times V_D}$

(ii) Molar mass of H_2Y

500 cm^3 of D contains 1.4 g of H_2Y

∴ 1000cm^3 of D contains $1.4 \times \frac{1000}{500} = 2.8$ gdm^{-3}

Molar mass of $\frac{2.8}{a}$

$= b$ g mol^{-1}

(iii) Relative atomic mass of Y

Molar mass of $H_2Y = b$

$H_2Y = b$

$2 + Y = b$

$Y = b - 2$

$= c$

(iv) Number of hydrogen ions

$H_2Y_{(aq)} \rightarrow 2H^+ + Y^{2-}$

1 mole of H_2Y contains 2 moles of H^+ ions

∴ a moles of H_2Y will contains 2 x a moles H^+ ion

Number of H^+ ions is $6.02 \times 10^{23} \times 2 \times a$

= d ion

Question 2

	Test	Observation	Inference
(a)	F + distilled water and stirring	F dissolved to form a light green solution	
	$F_{(aq)}$ + Litmus paper	Turns blue litmus to red	Solution of F is acidic.
b(i)	$F_{(aq)} + BaCl_{2(aq)}$	White ppt formed	SO_4^{2-}, SO_3^{2-}, CO_3^{2-},
	$+ HCl_{(aq)}$	Precipitate is insoluble	SO_4^{2-} present
(ii)	$F_{(aq)} + NaOH_{(aq)}$ in drops	Green gelatinous precipitate formed	Fe^{2+}
	then $NaOH_{(aq)}$ in excess + heat	Precipitate insoluble in excess Colourless gas with choking/pungent/irritating smell is given off	Fe^{2+}
		Gas turned damp red litmus paper blue/formed white dense fumes with $HCl_{(aq)}$	$NH_{3(q)}$ from NH_4^+
		Precipitate turned reddish brown	Fe^{3+} from Fe^{2+}
(iii)	$F_{(aq)} + K_3Fe(CN)_{6(aq)}$	Deep blue colouration or Prussian blue solution	Fe^{2+} confirmed

Comments on solution

Question 2 was well answered by many candidates. However, when some added water to F, the result should have been solution of F, the following tests were done on the solution of F, but some wrote that they worked on F.

When the $F_{(aq)}$ changed litmus paper from blue to red, it showed that **solution F** was acidic, but some wrote that F was acidic. (b) (iii) when $K_3Fe(CN)_{6(aq)}$ was added to $F_{(aq)}$, the resultant solution was expected to be deep blue solution and not deep blue precipitate.

(b) (ii) $F_{(aq)} + NaOH_{(aq)}$ in drops then in excess + heat.
Most of the candidates omitted heating in the test column. Candidates must be reminded that conditions for a reaction to take place are important and should always be stated where necessary.
Also, many of the candidates did not state in the observation column that precipitate turned reddish brown.

(iii) $F_{(aq)} + K_3Fe\ (CN)_{6(aq)}$: A significant number of the candidates gave the observation as 'deep blue precipitate' instead of 'deep blue colouration'.

Question 3

To a portion of the sample
(a) Add Fehlings solution /Benedict solution or Tollen's reagent and heat. Formation of brick red precipitate indicates the presence of glucose. No visible reaction indicates sucrose or starch.
(b) To another portion of the sample add few drops of iodine solution. Formation of blue black colouration indicates the presence of starch. No visible reaction indicates glucose and sucrose.

Comments on solution

The question was well answered. It was fairly simple to the candidates. However, some candidates forgot to add that the mixture must be heated with Fehling solution. With tollen's reagent expected result should be silver mirror.

Instead of describing how the possible substance could be identified, many candidates just stated test for each of the suggested substances i.e. glucose, sucrose and starch.

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.
H is 0.0900 mol dm^{-3} trioxonitrate (V) acid.

(a) Put H into the burette. Titrate it against 20.0 cm^3 or 25.0 cm^3 portions of G using methyl orange as indicator. Repeat the titration to obtain concordant titre values.

Tabulate your results and calculate the average volume of H used. The equation of the reaction is: $Na_2CO_{3(aq)} + 2HNO_{3(aq)} \rightarrow 2NaNO_{3(aq)} + CO_{2(g)} + H_2O_{(l)}$

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

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

(ii) solubility of sodium trioxocarbonate (IV) at 25°C in mol dm^{-3};

(iii) mass of sodium trioxocarbonate (IV) that would be obtained by evaporating 250 cm^3 of saturated solution to dryness;

(iv) mass of sodium ions that would be obtained by evaporating 1.0 dm^3 of the saturated solution to dryness. [H = 1.0; C = 12.0, N = 14.0; O = 16.0, Na = 23.0]

Question 2

I is a crystalline inorganic salt. Carry out the following exercises on I. Record your observations and identify any gas(es) evolved. State the conclusions you draw from the result of each test.

(a) Put half of I in a test tube and heat strongly.

(b) Put the rest of I in a boiling tube and add about 10 cm^3 of distilled water. Shake to dissolve.

(i) To about 2 cm^3 portion of the solution, add $NaOH_{(aq)}$ in drops and then in excess.

(ii) To another 2 cm^3 portion, add $NH_{3(aq)}$ in drops and then in excess.

(iii) To another 2 cm^3 portion, add all the content of specimen J provided and stir thoroughly until there is a visible change.

Question 3

(a) State what would be observed when:

(i) hydrogen gas is passed over heated copper (II) oxide.

(ii) a moist red litmus paper is introduced into a jar containing ammonia.

(iii) sodium hydroxide pellets is exposed to the atmosphere for a long time.

(b) Suggest how each of the following liquid reagents could be suitably stored in the laboratory:

(i) X which is slowly decomposed by sunlight;

(ii) Y which gives a choking or irritating smell.

Question 1

(a) Most of the candidates were able to perform the titration and recorded their titres to 2 decimal places. There was improvement in the use of consistent titres to calculate the average titre.

Quite a good number of candidates scored the maximum points. A few candidates however omitted the unit. Some others also used wrong units i.e. cm instead of cm^3.

(b) (i) Conc. of G in mol dm^{-3}

As in Alt B, most of the candidates were able to deduce the mole ratio from the equation. But again, many had problems with making Cu, subject of the formula. Some also lost the relevant mark for not stating the calculated values in the correct sig. figures.

(ii) Solubility of sodium trioxocarbonate (IV)

Most of the candidates handled this calculation well. Only a few candidates displayed lack of knowledge of the concept involved. Such students used the temperature of 25°C in the calculation.

(iii) Mass of sodium trioxocarbonate (IV) that would be obtained by evaporating 250 cm^3 of saturated solution to dryness.

Performance here was also encouraging. However, some of them used the diluted solution instead of the saturated one.
i.e. they used $m(Na_2CO_3) = a \times 106 \times 0.25$ instead of $m(Na_2CO_3) = b \times 106 \times 0.25$

(iv) Mass of sodium ions that would be obtained by evaporating 1.0 dm^3 of the saturated solution to dryness.

It was clear that many of the candidates were not comfortable with this question. Some were able to handle the dissociation of $Na_2CO_{3(aq)}$ well
i.e. of $Na_2+CO_{3(aq)} \rightarrow 2Na^+_{(aq)} + CO_3^{2-}{}_{(aq)}$
But were confused about how to obtain the mass of Na^+, i.e.
Mass of $Na^+ = 2b \times 23$ g

Here again, some used
Mass of $Na^+ = 2a \times 23$ g, the concentration of the diluted solution

Question 2

(b) I + distilled water: Many gave the observation as 'Dissolves to form a solution' instead of "Dissolves to form a blue solution.
(iii) I + Sample J: 'the solution changed from blue to colourless: not the solution changed to colourless.
Initial as well as final colour of solution must be stated.

Question 3

Candidates performance here, was very good. They, however, missed the last mark for a(iii). i.e. many only stated: solid absorbs water to form a solution instead of 'solid absorbs water to form (colourless) solution which later turns to white solid.

(a) (i) black copper (ii) oxide turns reddish brown

(ii) Red liturns paper turns blue

(iii) solid absorbs water to form colourless solution which later turns to white solid

(b) (i) X should be stress in an amber colour/ a dark brown bottle

(ii) Y should be stored in a firm chamber/cupboard/amber coloured bottle and properly corked.

(c) (i) saponification

(ii) catalytic cracking/cracking

(iii) fermentation

S/N	Test	observation	Inference
(a)	I+ stop heat	Water droplets form at the top part of the test tube. Solid terms from blue to white then to black.	Water of crystallization/sample I is a hydrated salt.
(b)	I + distilled water	Dissolves to form a time solution	Soluble salt
(i)	Solution of I + NaOH(f) in drops Then in excess	Pale blue precipitate Ppt insoluble	 Cu^{2+} present
(ii)	Solution of I + NH_3 (a) in drops Then in excess	Pale blue precipitate Precipitate dissolves to form a deep blue solution	 Cu^{2+} confirmed
(iii)	Solution of I + sample J	J dissolves, the solution changed from blue to colourless brown deposit/ brown solid formed	Displacement reaction. Cu deposited

CROP HUSBANDRY AND HORTICULTURE 2

1. GENERAL COMMENTS

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

2. SUMMARY OF CANDIDATES' STRENGTHS

(1) Effective time management as majority of the candidates were able to finish answering the five questions within the allotted time.
(2) Adequate knowledge on the importance of organic matter in crop production
(3) Fairly good knowledge on the usefulness of ornamental plants and steps involved in lawn establishment

(4) SUMMARY OF CANDIDATES' WEAKNESSES

(1) Inability to express themselves correctly using the English language
(2) Poor spelling of technical words and scientific terms
(3) Inability of candidates to state adequately ways of advertising horticultural produce and factors to consider when establishing potted plant enterprise
(4) Most of the candidates could not distinguish between tillage practices and cultural practices.

(5) SUGGESTED REMEDIES

(1) Proper teaching of agricultural terminologies and scientific words should be encouraged
(2) Regular practical and theory lessons to enable students develop skills in description and explanation of some horticultural processes
(3) Effective teaching and learning of Agribusiness, tillage practices and cultural practices.

(6) DETAILED COMMENTS

Question 1

(a) Discuss four ways in which organic matter is important in vegetable production.
(b) Explain three effects of temperature in crop production.
(c) Explain three objectives of tillage in vegetable production.

Majority of the candidates who attempted this question performed well above average.

(a) Candidates were able to state the ways in which organic matter is important in vegetable production. Most of them, however, could not adequately explain the stated ways.

(b) Most candidates could not explain the effects of temperature on crop production satisfactorily. Effects of temperature on crop production include:

- temperature affects the work of insects as pollination agents. Extreme temperatures may lead to the death of insect pollinators hence pollination of crops may be negatively affected.
- temperature influence the production of flowers in crop. High temperature could lead to the flower dry up and therefore difficult for fertilization to take place etc.

(c) Some candidates confused the objectives of tillage practices with cultural practices. As a result, most did not score full-marks.

The expected objectives of tillage practices include:

- it exposes soil borne pests to sunlight to control pest and disease attack on crops
- it controls weeds as land is tilled, all weeds are exposed
- it incorporates organic matter in the soil thereby improving the humus content of the soil etc

Question 2

(a) State three objectives of each of the following cultural practices in crop production:
(i) pruning;
(ii) earthing-up.
(b) Give four reasons for practicing crop rotation in West Africa.
(c) (i) Explain the term truck farming.
(ii) State three benefits of truck farming.

(a) Candidates had fairly good ideas about the objectives of some cultural practices.

The objectives of pruning include:

- it facilitates the movement of air on the farm
- it is done to remove diseased/damaged parts of plants
- it encourages the production of bigger fruits
- removal of overgrown plant parts to ease farm operations

The objectives of earthing-up include:

- to control weeds
- to ensure proper root development in plants to protect plants from dislodging during strong winds or to burry exposed roots
- to promote vigorously plant growth

(b) Candidates appeared to have fairly good knowledge on the reasons for practicing crop rotation. However, the following reasons were hardly mentioned.

- is a reliable method of continuous planting of different crops on the same piece of land
- it ensures a balanced programme of work throughout the season
- it ensures efficient use of plant nutrients in the soil

(c) Majority of the candidates had fairly good ideas about the explanation of truck farming. However, most of them could not state the benefits of truck farming.

The expected benefits of truck farming include:

- vegetable crops are produced at a cheaper cost

- large quantities of vegetable are produced
- high quality of crops are produced
- large tracks of land can be cultivated at a particular time
- fresh vegetables are always supplied to consumers

Question 3

(a) Explain two ways in which each of the following factors influence crop production:
(i) rainfall;
(ii) soil aeration;
(iii) ploughing.
(b) Give five reasons for the extensive cultivation of maize in West Africa.
(c) State three ways of storing maize in West Africa.

(a) Generally, candidates did not find much difficulties in explaining how rainfall and ploughing influences crop production.
However, most candidates could not adequately explain the effects of soil aeration on crop production.
The correct effects of soil aeration on crop production include the following:
- reduces toxins in the soil and promotes soil productivity
- well-aerated soil enhances activities of soil organisms and hence make soil more fertile
- well-aerated soil promotes root development and hence anchors the crop properly
- well-aerated soil promotes root development and hence allows the roots to absorb nutrients from different levels and from a wide area.

(b) Majority of the candidates were not able to state reasons for extensive cultivation of maize in West Africa. In most cases, candidates wrongly stated, "as source of income", "employment" and "foreign exchange".
The expected reasons include:
- it is a staple food in West Africa
- inputs such as seeds are readily available
- maize plants tolerate a wide range of environmental conditions
- grains can be stored for a long time
- can be cultivated on wide range of soil
- relatively more resistant to diseases
- it has many uses to both humans and farm animals

(c) Most of the candidates correctly stated the ways of storing maize but the following ways were rarely stated:
- hang maize with husk on stock in kitchen ceiling
- dry mill and store in bags

Question 4

(a) Discuss the production of tomato under the following headings:
- **(i) soil and climatic requirements;**
- **(ii) nursing of seeds;**
- **(iii) land preparation and planting;**
- **(iv) cultural practices.**

(b) Mention two varieties of tomatoes cultivated in West Africa.

Majority of candidates who attempted this question performed poorly.

(a) (i) Many candidates lacked adequate knowledge in soil and climatic requirements for the cultivation of tomato.

The expected answers include:

- rainfall of 500 – 1,250 mm should be well distributed throughout the season
- day temperatures of 23ºC – 30ºC and night temperature of 13ºC – 21ºC.
- soil should be loose and well drained
- soil pH of 5.5 – 6.8 / soil should be slightly acidic
- sandy loam to loamy soil

(ii)&(iii) Nursing of seeds, land preparation and planting were all answered by majority of the candidates.

(iv) Candidates were expected to state and discuss three cultural practices in the cultivation of tomato. However, only a few were able to state and discuss the cultural practice as follow:

Fertilizer application: - apply or incorporate organic manure into the soil prior to transplanting or apply compound fertilizer when necessary

Staking: - stake plants four weeks after transplanting

Disease control: - control diseases using recommended chemicals

Pest control: - control pests using recommended chemicals

Watering/irrigation: - provide water regularly to dissolve nutrients for plant uptake

Mulching: - to control weeds, regulate soil temperature, control soil erosion and conserve soil moisture during the dry season

Pruning/desuckering: - to obtain larger fruits

Earthing up: to cover adventitious roots to enhance anchorage

(b) This sub-question was poorly answered by majority of the candidates. Candidates either mentioned wrong varieties or wrongly spelt the right varieties which caused them valuable marks. The expected responses include the following varieties of tomato cultivated in West Africa:

- Roma V F
- Pecto mech VF
- Royal
- Burkina
- Owusu Bio
- Power
- Heinz
- Ada cocoa
- Wosowoso
- Improved zuarungu
- Tropimech
- Rio grande
- Jaguar
- Lindo
- Titao Derma

Question 5

(a) Explain four ways of advertising horticultural products.
(b) Explain four factors that should be considered when establishing potted plant enterprises.
(c) Give four examples of plants propagated by leaf cuttings.

A great majority of the candidates who attempted this question exhibited poor knowledge in Agribusiness.

(a) A lot of candidates could not clearly state ways of advertising horticultural produce. The correct ways of advertising horticultural produce include the following:

- public announcement using P.A. systems/communication centre to reach the public
- advertise through the print media, newspapers, journals or magazines, posters to reach the public
- televisions; where clientele can both see and hear
- radios; where information can get to a large group of people at the same time
- agricultural shows; new commodities are showcased to a large group of people for the first time
- internet/social media; where information spread fast
- door to door visits to showcase commodities
- billboards/signboard/banners across roads to reach the public
- display of produce in stalls/stores/ shops in market place to attract customers

(b) Majority of the candidates were not able to state and explain adequately the factors to be considered when establishing potted plant enterprise.

The correct factors to be considered include:

The site: - site should be located in an area where people love ornamental plants/market.
Source of water: - necessary for irrigation
Capital: - money to obtain land, structures and inputs
Labour: - cheap labour is needed to work for the enterprise
Tools and equipment: - All tools and equipment needed for successful work must be provided/assembled
Shed: - shed for workers must be provided
Store: - store to keep equipment
Planting materials: - plants selected must withstand environmental conditions of the area/to meet market requirement
Containers/pot: - These should be made of plastic /clay /concrete / wood.

(c) Majority of candidates gave correct examples of plants propagated by leaf cuttings. However, some of them lost marks due to wrong spellings of names of plants propagated by leaf cuttings.

Question 6

(a) Give four reasons for planting ornamental plants.
(b) State three characteristics of land that could be used for the establishment of lawns.
(c) Outline the steps involved in preparing land for lawn establishment.
(d) Mention four grasses that are used for lawn establishment in West Africa.
(e) List three methods of planting lawn grasses.

A great majority of the candidates attempted this question and exhibited a fairly good familiarity and idea about ornamental plants and lawn establishment.

(a) Majority of the candidates could state satisfactorily the reasons for planting ornamental plants, but the following reasons were rarely stated:
- to provide fresh air/air purification
- some are used for medicinal purposes
- ground covers are planted to control soil erosion
- for absorption of noise/muffling

(b) This sub-question was well answered by the generality of the candidates and scored full marks in most cases

(c) Candidates had some knowledge about the steps involved in lawn establishment. However, a few candidates could not outline the steps in a sequential manner caused them valuable marks

(d) Candidates could readily give correct names of common lawn grasses. But wrong spellings of the names of lawn grasses caused some candidates marks.

(e) Candidates were able to list the methods of planting lawn grasses.

CROP HUSBANDRY AND HORTICULTURE 3

1. GENERAL COMMENTS

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

2. SUMMARY OF CANDIDATES' STRENGTHS

(1) Most candidates exhibited detailed knowledge of the subject matter
(2) Candidates were able to give concise and precise answers
(3) Majority of the candidates were able to identify the specimens provided with their common names correctly
(4) Most candidates were able to state correctly the fungal diseases and storage pests of specimen D (*Zea mays*).
(5) Candidates exhibited adequate knowledge in the characteristics of *Panicum maximum* and *Boerhavia diffusa* that makes them survive in their environment

3. SUMMARY OF CANDIDATES' WEAKNESSES

(1) Poor spellings of horticultural terminologies and scientific terms
(2) Majority of the candidates could not adequately outline the germination percentage test of specimen D (Zea mays)
(3) Most of the candidates did not follow the rubrics in drawing the longitudinal section of specimen C (coconut). A lot of candidates could not state the title of the diagram, labelling was poorly done, and guidelines were drawn with free hands

4. SUGGESTED REMEDIES

(1) Tutors should use question and answer to drill students on scientific terms and horticultural terminologies
(2) Tutors should give exercises involving the determination of germination percentage test and its importance in the cultivation of crops
(3) Proper teaching of drawing and labelling of horticultural produce should be encouraged

5. DETAILED COMMENTS

Question 1

(a) Identify each of specimens A and B by their scientific names.
(b) Name the type of storage organ that specimen B represents. Give one reason for the answer.
(c) Mention three pests that could cause damage to specimen A in the field.
(d) State two factors that could reduce the quality of specimen B in storage.
(e) Enumerate three ways of extending the shelf life of specimen A.

(a) Majority of the candidates performed well as they correctly provided the scientific names of specimens A (*Manihot* sp.) and B (*Dioscorea* sp.). Some candidates however, did not follow the basic rules for writing scientific names. Candidates should understand that scientific names are Latin words and should therefore, be underlined, genus or generic names start with capital letters and species names with small letters.

(b) Most of the candidates correctly provided the type of storage organ of specimen B as stem tuber.

(c) Many candidates could give correct examples of the field pests of specimen A. Some examples rarely listed by candidates include the following:
- wild guinea fowls/patridges
- bush pigs
- millipedes
- mealy bugs

(d) Majority of candidates gave correct planting materials for propagating specimen B. however, some candidates lost marks in cases where names of the planting materials were wrongly spelt.

(e) Generally, candidates did not find much difficulties in stating factors that could reduce the quality of specimen B in storage.

(f) Candidates' performance on this sub-question was only fair as most of them did not understand the term "shelf life". The correct ways of extending the shelf life of specimen A (cassava) include the following:
- avoid damage/bruises/wounds during harvesting
- store in cold water
- bury in moist soil under shade
- peel and store in deep freezer
- process into powder / gari for storage
- cut into pieces and dry

Question 2

(a) Give the scientific name of the crop from which specimen C was obtained.
(b) Draw and label the longitudinal section of specimen C.
(c) Mention two varieties of specimen C that are commonly cultivated in West Africa.
(d) Name three pests of the crop from which specimen C was obtained.
(e) State three ways in which the crop from which specimen C was obtained is important.

(a) Most of the candidates readily provided the scientific name of specimen C (coconut fruit) as *Cocos nucifera.* However, wrong spellings of the name cause some of the candidates' marks.

(b) Performance of candidates on this sub-question was generally poor. Most of the candidates did not follow the rubrics in drawing the longitudinal section of coconut. It should be noted that in drawing the longitudinal section of coconut, the following are expected:

Title: Longitudinal section of specimen C (coconut)

Labels: Epicarp, exocarp, endocarp, mesocarp, endosperm and embryo.

Size: 8 cm – 12 cm

(c) Most of the candidates correctly provided the varieties of specimen C (coconut) cultivated in West Africa.

However, a few candidates misspelt Venuatu tall and Malayan greed dwarf.

(d) This sub-question was well answered by most candidates, but the following pests of coconut were rarely stated;

- errophic mite
- white grub
- black headed caterpillar
- red palm weevil

(e) Importance of crop of specimen C (coconut) were well stated by majority of the candidates.

Question 3

(a) Give the scientific name of the crop from which specimen D was obtained.

(b) (i) Outline the steps involved in determining the germination percentage of specimen D.

(ii) Give two reasons for determining the germination percentage of specimen D before planting.

(c) State three problems that could be associated with delayed harvesting of specimen D.

(d) Name two fungal diseases of the crops from which specimen D was obtained.

(e) Mention two pests that could cause damage to specimen D in storage.

(a) Most of the candidates failed to write the scientific name of specimen D (maize grains/seeds). Only a few candidates were able to identify the specimen with correct spellings as *Zea mays.*

(b) (i) Candidates' knowledge of germination percentage test is poor. They could not, therefore, give stepwise procedure for germination percentage test of specimen D.

The correct germination test includes the following:

- randomly select 100 seeds of specimen D
- arrange them on a moist tissue paper in a petri dish/flat container
- keep at room temperature for 5 – 7 days
- count the number of seeds that germinate
- calculate percentage germination = $\frac{\text{No. of seeds germinated x 100}}{\text{Total number of seeds}}$

(ii) Candidates could not adequately state the importance of germination test.

The expected responses include the following:

- it reduces wastage of seeds
- it reduces the cost of buying extra seeds for filling in or supplying
- it reduces time spent during filling in or refilling
- it reduces labour cost

(c) Many candidates were able to state the problems associated with delayed harvesting of specimen D and scored full marks in most cases.

(d) Candidate's difficulty in giving examples of fungal diseases of specimen D (maize grains) was wrong spellings of names of the diseases which caused them valuable marks.

(e) Many candidates correctly mentioned the storage pests of specimen D. however, some storage pests that were hardly mentioned include:

- lesser grain weevil
- saw-toothed grain beetle
- red flour beetle

Question 4

(a) Identify each of specimen E and F by their scientific and common names.

(b) State two characteristics of each of specimens E and F that make them survive in their environment.

(c) Enumerate four ways in which specimen E is of economic importance in crop production.

(d) Mention three methods of controlling specimen F.

(a) Only a few candidates were able to identify specimens E and F with the correct spellings of their scientific names.

The correct names of the specimens are as follow:

Specimen	Common name	Scientific name
E	Guinea grass	*Panicum maximum*
F	Pig weed	*Boerhavia diffusa*

(b) Candidates identified some characteristic features of specimens E and F which enable them to survive in their environments. However, characteristics which were rarely mentioned in candidates' responses include:

Specimen E

- ability of their seeds to remain dormant for a long time
- has underground structures called rhizome
- has salt tolerant structures

Specimen F

- has extensive root system
- profuse branding

(c) Majority of candidates correctly provided economic importance of specimen E (*Panicum maximum*) but the following economic importances were hardly mentioned:

- controls soil erosion
- serves as a hiding place for pests
- contaminates farm produce e.g. rice

(d) Most candidates correctly stated the methods of controlling specimen F (*Boerhavia diffusa*) and scored full marks in most cases.

FISHERIES 2

1. GENERAL COMMENTS

The standard of the paper was at par with that of the previous year's however the performance of these candidates was slightly lower than those of the previous years.

2. SUMMARY OF CANDIDATES' STRENGTHS

Candidates showed good understanding of the questions. They also presented their answers orderly and had legible handwritings.

3. SUMMARY OF CANDIDATES' WEAKNESSES

Candidates' weaknesses included inadequate preparation, poor explanation of terms and attempting questions where they had little information.

4. SUGGESTED REMEDIES

Candidates should prepare adequately before examination, teachers should teach proper definition of terms and candidate should select questions which they have adequate information on.

5. DETAILED COMMENTS

Question 1

(a) State three likely causes of fish mortality in fish ponds.
(b) Define each of the following types of aquaculture:
- **(i) monoculture;**
- **(ii) polyculture;**
- **(iii) integrated fish farming.**

(c) State two advantages of each of the following types of aquaculture:
- **(i) monoculture;**
- **(ii) polyculture;**
- **(iii) integrated fish farming**

(d) Give five examples of integrated fish farming.

(a) The question is similar to "what causes fish to die in a fish pond?" The weaknesses of the candidates are that they failed to realize that overstocking is a cause of fish mortality in pond just as excessive breeding. They also did not realize that it is the extreme PH values that cause mortality not the pH per se. Candidates did not also realize that it is the low concentration of dissolved oxygen and not just dissolved oxygen that causes fish mortality in ponds.

The major strength of the candidates is that they understood the question as "what causes fish to die in a fish pond?", an extended understanding of the question.
Other important causes of fish mortality in ponds which candidates should have mentioned are stress and predation.
(b) The major weakness of these candidates was that the definitions were incomplete in all the three cases.

The strength here is that candidates showed knowledge that these are concepts they have studied.
In the case of monoculture, candidates were to stress that it is a culture of **a single species** in **a rearing or same facility** and at **the same time**.

For polyculture, the emphasis should be on rearing **two or more species** in the **same rearing facility** at the **same time.**

In integrated fish farming, the critical requirements were that culture **of fish together with crops and or animals** at the **same time** in the **same farm.**

It should be noted that in all the three cases the underlined words were important and critical to make the definitions complete.

(c) In this question, candidates were to give the advantages of the various types of aquaculture.
As a weakness, candidates failed to realize that they were to give their answer in reference to all the three types of aquaculture.
The strength of these candidates was that they were able to identify all the three systems as a fish culture. The other strength is that candidates saw integrated fish farming as a way of maximizing the use of output of species to the benefit of the other species in the integration.
Candidates were to give the benefits of each system compared to the other two, but this did not come out well.
(d) Candidates were simply to list/state/give examples of integrated fish farming.
Candidates could not provide the several examples of the integration involving fish. The five examples were more than the candidates could think off.
Candidates could give at least three good examples.
It is the example of fish farming that was required. The cattle and vegetable (plant and animal) was not a good example. It must be fish and something.

Question 2

(a) (i) Name two type of fisheries.
(ii) State three roles of fisheries in the national economy.
(b) Describe three features of:
(i) fin fishes;
(ii) crustaceans.

(c) Name three fish species found in each of the following aquatic habitats:
- **(i) freshwater;**
- **(ii) brackish water;**
- **(iii) marine.**

With the exception of 2(b) candidates were only to name or state. The questions were well understood.

In question 2 (b) candidates were to describe the features of (i) Fin fishes and (ii) crustaceans. Candidates failed to see that only the external features were being demanded.
Only three features were to be described. Most of the candidates failed to describe the features correctly. They only named the features. They were to name and describe.

Question 3

(a) (i) Name four facilities that could be found at fish landing sites.
- **(ii) State four activities that could be carried out at fish landing sites.**
- **(iii) Mention two sanitation practices that could be carried out at fish landing sites.**

(b) (i) List two accessories of a fish craft.
- **(ii) Describe how each of the accessories listed in (i) is used.**
- **(iii) Mention four types of fishing crafts.**

(a) In all the sub questions, candidates were to name, state, mention and list. It was only in b (ii) where they were to describe.

In questions 3 a (i), (ii) and (iii) candidates were to recall correctly to score marks.

The biggest challenge/weakness of these candidates was that they could only answer the question if they had never visited a landing site.

Any candidate who is familiar with a landing site can easily score in those sections.

Three points were required here namely list of facilities; activities and sanitary practices at the landing site. In the case of sanitary practices, candidates gave the same forms of the same answers. E.g. “proper disposal of waste” and “proper disposal refuse” are the same point. Candidates should also be reminded that washing of gears and vessels were also sanitary practices.

(b) Candidates were to name the accessories of fishing craft and describe them. They were also to mention the types of fishing crafts.

The weakness of these candidates in answering this question was that they did not know these accessories and the crafts and could therefore not describe how the accessory is used.
Candidates did not have any strength here. They only did guess work.

Candidates needed knowledge of the accessories and fishing crafts in addition to the description of their use. Most of the candidates forgot the description of the accessories after naming them.

Question 4

(a) State four ways of maintaining planked canoes.
(b) State two solutions to each of the following problems facing aquaculture:
(i) few aquaculture specialists;
(ii) high cost of fish feed;
(iii) difficulty in land acquisition.
(c) Name four harmful fishing practices.
(d) State four ways of preventing harmful fishing practices.
(e) State two ways of correcting oxygen depletion in a fish pond.

(a) It seems that candidates did not know what a planked canoe is. Most of them might have not seen one and so could not answer the question.
(b) Candidates could not examine the factors mentioned in the question to figure out the solutions to the problems facing aquaculture in question 4 (i-iii). The question required indepth analysis of how each factor is a problem facing aquaculture. They did not have a wide range of ideas for each factor.
(c & d) These questions were well answered by candidates. Candidates had good knowledge of the points demanded by the question i. e List of harmful fishing practices and how to prevent harmful fishing practices.

(e) The question requires how oxygen concentration can be increased in a fish pond.
The greatest weakness of the candidates was that they did not know many ways by which oxygen concentration in a fish pond could be increaesed.

The strength of the candidates was in the fact that they studied the subject matter.

The important points required here are how oxygen concentration will be maintained or not fall in fish pond; and how oxygen concentration can be increased when it falls.

Question 5

(a) State two roles of extension services in fisheries development.
(b) List four fisheries-based industries in Ghana.
(c) (i) What is fishing pressure?
(ii) Explain three ways through which fishing pressure could be reduced.
(d) Discuss three ways by which fishes adapt to life in their environment.

(a) The question requires the role/ function / the part extension plays in the fisheries department. The weakness of these candidates was that they did not mention roles such as monitoring and providing information about fisheries, data collection for research and management.
(b) This question was well answered reflecting good knowledge of the subject.

(c) The question did not pose any problem as far as the understanding is concerned. Many candidates could not explain what *fishing pressure is.* They explained ways of curbing illegal fishing. They could not explain ways of reducing fishing pressure.

(d) Candidates understood the import of the question and answered the first part correctly. They mentioned only the adequate features in most cases but failed to discuss / explain how fishes adapt to the environment. This is the main thrust of the question.

Question 6

(a) (i) Mention four ways through which fish ponds be become polluted.
(ii) State four effects of polluted pond water on fish.
(b) Give four examples of supplementary feeds used in fish farming.
(c) Discuss four ways by which fish production could be increased in your country.

(a)(i & ii) The question were about how fish pond could become polluted and the effect of the polluted water on fish.

Candidates could not relate the answers to fish pond water. Instead, they related their answers to water bodies in general and not fish pond water per se.

Candidates showed strength in understanding that the question had to do with water pollution.
In giving the effect of polluted water on fish, no mention was made about the interference on feeding as an effect.

(b) The concept of supplementary feeds and what they are was not understood. Examples were far-fetched and unimaginable. Manure such as chicken droppings in not a supplementary feed. Manure is simply used to fertilize the pond to promote growth of organic food for tilapia in ponds.

(c) The question was such that far too many answers are possible. As a result, a lot of the candidates attempted it. They were to state and discuss how the number of fish produced could be increased.

The weakness displayed by most of them was that they mentioned the ways but did not discuss or explain how it led to increase in fish production.
Increase fish production was the major requirement of the question.

FISHERIES 3

1. GENERAL COMMENTS

The standard of the paper was at par with that of the previous year's however the performance of these candidates was slightly lower than those of the previous years.

2. SUMMARY OF CANDIDATES' STRENGTHS

Candidates did not exhibit any particular strength or show any particular improvement over previous years.

3. SUMMARY OF CANDIDATES' WEAKNESSES

Candidates' weakness exhibited included a lack of practical work carried out during their course of study.

4. SUGGESTED REMEDIES

Candidates should be made to do the practical activities recommended in the practical part of the curriculum.

5. DETAILED COMMENTS

Question 1

(a) Draw and label each of specimens A and B.
(b) Give two uses of specimen A in fish farming.
(c) Describe how each of specimens A and B is used in capture fisheries.

(a) Most drawings of specimen A (scoop net) were out of proportion even though they showed the essential features of the scoop net. The labels included only the handle and the net.

Most candidates did not include the ring though very important.
For the seine net most candidates showed details of the gear. The expectation was for candidates to show the outline of the gear. In the event, what they illustrated could have been a detail of a gill net.

(b) Candidates had no difficulty answering this question, an indication that they had knowledge about the use of the scoop net.

(c) The description of the use of scoop net was poorly done by candidates. Most of the candidates stated that "the scoop net is used to scoop fish"

For the seine net candidates were not able to adequately describe its use. Some candidates only described the structure of the gear but not its use.

Question 2

(a) (i) Describe how specimen C could be applied to fish ponds.
(ii) Name two other materials that could be used in place of specimen C in fish farming.
(b) Identify each of specimens D and E.
(c) Give three reasons why specimen D is used during the processing of fish.
(d) Name three other items that could be used in place of specimen E in fish preservation.
(e) Apart from specimens D and E, name five other items that are required for smoking of fish.

(a) Most candidates indicated that specimen C (Organic Manure) is applied as fish feed. As alternative to organic manure, some candidates only named other types of organic manure such as cattle dung, green manure or pig droppings instead of the expected inorganic fertilizers like NPK or urea fertilizer. Some even named compost.
(b) This sub question was invariably well answered, identifying specimens D and E as gloves and charcoal respectively. However, a few of them misspelt the gloves as" glooves"
(c) As reasons for the use of gloves, some candidates stated the prevention of injury during scaling, some however indicated that gloves prevent transfer of germs but did not indicate whether from fish to farmers' hand or vice versa.
(d) As an alternative to charcoal, most candidates provided correct answers such as gas, wood, saw dust coconut chaff.
(e) Most candidates listed alternative sources of fuel used in smoking fish instead of items like knife, salt, nose guard, overall, bowl etc.

Question 3

(a) List four materials that could be used in place of specimen F in the marketing of fish
(b) State four advantages of using specimen F in the marketing of fish.
(c) State three disadvantages of using specimen F in the marketing of fish.
(d) Identify each of specimens G and H.
(e) State four observable differences between specimens G and H.
(f) State three characteristics of specimen H which make it culturable.

(a) This question was poorly answered. Candidates were given specimen F as Cardboard Box.

As alternatives in the marketing of fish, candidates were expected to mention other containers such as basket, polythene bags, jute bags and leaves. Most candidates however mentioned plates and trays which cannot contain fish.

(b and c) Candidates answered the (b) poorly and avoided (c). This indicates that candidates had very little or no knowledge about cardboard box as a packaging material for marketing of fish. Advantages such as it is light, biodegradable, less injury to fish and disadvantages such as non-reusable and not readily available etc should have been mentioned.

(d) Most candidates were able to identify specimens G and H as Catfish and Tilapia respectively.

This sub question was well answered by most candidates. However, some candidates spelt Catfish as "cutfish" and other wrote "mudfish"

(e) Even though candidates were asked to give "observable" difference between catfish and tilapia, some listed that catfish has cartilaginous skeleton while tilapia has bony skeleton, features that were not observable.

The important points required are as follows:

Specimen G (Catfish)	Specimen H (Tilapia)
Has barbels	Does not have barbels
Does not have scales	Has scales
Has big head compared to body size	Has small head compared to body size
Has two pairs of nostrils	Has one pair of nostrils
Dorsal fin is ray	Dorsal fin is spiny
Has continuous lateral line	Has discontinuous lateral line.

(f) This sub question on the characteristics of tilapia which make is culturable was very well answered by candidates.

FORESTRY 2

1. GENERAL COMMENTS

The standard of the paper was comparable to that of the previous years. The questions covered a large spectrum of the syllabus. Meanwhile there was slight improvement in candidates' performance.

2. SUMMARY OF CANDIDATES' STRENGTHS

The Chief Examiner commended the candidates on the following strengths:

(1) adequate understanding of the questions
(2) adequate display of knowledge of the subject matter
(3) logical presentation of answers

3. SUMMARY OF CANDIDATES' WEAKNESSES

The following weaknesses were observed:

(1) Poor handwriting
(2) Presentation of irrelevant answers in some cases
(3) Poor spelling of technical terms
(4) Poor expression in some cases

4. SUGGESTED REMEDIES

(1) The quality of teaching should be improved
(2) Candidates should cultivate the habit of reading good books to correct deficiencies in their language;
(3) Candidates should familiarize themselves with technical terms
(4) Candidates should carefully read the questions and rubrics and comply
(5) Candidates should learn to write boldly and legibly so that their scripts could be easily read and fairly assessed

5. DETAILED COMMENTS

Question 1

(a) Explain each of the following activities in forestry:
- **(i) stock survey;**
- **(ii) skidding;**
- **(iii) yarding;**
- **(iv) delimbing.**

(b) State two ways in which each of the activities in (a) are important in forestry.

(c) Mention four equipment used in stock survey.

Question one was popular with candidates and the general performance was good.

(a) Candidates were at home with explanation of the activities given from (i) to (iv).

(b) The ways in which each of the activities in (a) are important in forestry were excellently stated by most candidates. E.g.

(i) Stock surveying

- helps in making informed decisions to regulate the exploitation/utilization of forest resources
- gives a clue to forest stock yield
- helps in monitoring and evaluation

(ii) Skidding

- may be cheaper as compared to yarding
- destroys some seedlings / seeds or saplings on the forest floor
- it may create trails
- it may cause soil erosion

(iii) Yarding

- less destructive
- it is expensive (initial cost is high)
- it is useful in mountainous areas

(iv) Delimbing

- makes logs easier to transport
- it improves upon the marketable portion of the log
- provides off-cuts for other purposes

(c) A few candidates were unable to mention the equipment used in stock surveying.

The correct equipment are diameter tapes, gunter's chain/tape, prismatic compass, ranging pole, pins/arrows cutlass/matchette.

Some candidates mentioned dumpy level and teodolite which are wrong.

Question 2

(a) Sketch the map of Ghana and indicate the location of each of the following vegetation types:

(i) tall grass savanna;

(ii) short grass savanna;

(iii) mangrove swamp;

(iv) wet evergreen forest.

(b) State four characteristic features of trees in the wet evergreen forest.

(c) State three characteristic features of mangroves which make them survive in their habitat.

(d) (i) Explain the term deforestation.

(ii) State five ways by which deforestation could be controlled.

This question was also very popular among candidates.

(a) Most candidates were able to sketch the map of Ghana neatly and indicated correctly the location of each of the vegetation zones as shown below.

An illustrated map of Ghana

I - Tall grass savanna
II - Short grass savanna
III - Mangrove
IV - Wet evergreen forest

(b) Many of the candidates stated the characteristics of trees in wet evergreen forest with ease.

(c) Candidates could not handle this sub-question well. They were expected to relate the characteristic features of mangroves with their ability to survive in their environment e.g.

- breathing roots which allows for gaseous exchange
- still roots for anchorage
- seeds germinate on parent-plant before germination for propagation
- leaves excrete excess salt for osmoregulations

Answers like breathing roots, stilt roots etc are wrong; they are incomplete

(d) Most candidates obtained the maximum mark for (i) and (ii).

Question 3

(a) State five ways in which forest policy is important.
(b) Explain five adverse effects of the timber industry on the environment.
(c) Mention five ways in which wildlife could be conserved.

Question 3 was unpopular with candidates and the general performance was also poor.

(a) Most candidates could not state the importance of forest policy. The following answers were expected.

Importance of forest policy

- for better management of forest resources
- to address the employment situation of rural communities
- to provide technical advice in issues concerning the development of forest lands and resources
- to provide secure environment for the survival of wildlife
- to promote ecotourism
- enhances sound environmental quality

(b) This sub-question was also problematic to most candidates. The adverse effects of the timber industry on the environment include:
- pollution of the atmosphere by saw mills
- pollution of water bodies by saw dust and fluids from machinery
- disturbance on land and the destruction of certain micro and macro organisms during extraction
- deforestation with their logging activities
- destruction of habitats and breeding grounds of wildlife causing scarcity of wildlife
- extraction of logs causes erosion in forests
- causes global warming because felled trees are unavailable to absorb atmospheric carbon dioxide

(c) Most candidates who attempted this sub-question obtained good scores.

Question 4

(a) Name four forest products that could be taken as food apart from bushmeat.
(b) Give four reasons for undertaking pricking out.
(c) State four differences between angiosperms and gymnosperms.
(d) (i) List the materials that are used in composting in mushroom production.
(ii) State one function of each of the materials listed in (i).

Candidates who attempted this question performed below average.

(a) Forest products used as food were easily mentioned by most candidates, however, a few candidates named banana, plantain and pineapple which were wrong.
(b) Candidates were able to give reasons for undertaking pricking out correctly.
(c) Differences between Angiosperms and Gymnosperms were correctly tabulated as follows:

Angiosperms	Gymnosperms
- could be either herbaceous or woody	- are only woody
- could be either wind or insect pollinated	- are only wind pollinated
- seeds are enclosed in pericarp	- seeds not enclosed
- ovules are found inside ovary	- ovules are outside ovary
- xylem made of tracheids and vessels	- xylem made up of vessels and fibres

(d) (i) Only a few candidates were able to name the materials used in composting as sawdust, wheat/rice bran, quick lime/calcium oxide (CaO) and nitrogen fertilizer correctly. They rather mentioned soil, NPK, etc, which were wrong.

(ii) Candidates were unable to give functions of the components of compost because they could not name them in the first place.

The following answers were expected:

Sawdust: - the main decomposing substance which binds the other materials together
Rice/Wheat bran: - Source of food (proteins and vitamins) for microbes
Quicklime: - Maintains pH of compost around 7 to 7.5
Nitrogen fertilizer: - Adds minerals to the compost

Question 5

(a) Explain five measures that government has instituted to promote sustainable forest management.
(b) State five effects of decreasing forest resources on the:
(i) national economy;
(ii) health of the population.

This question was also unpopular with candidates and the performance among those who attempted it was equally poor.

(a) Only a few candidates were able to obtain average scores for this sub-question.

Measures instituted by government to promote sustainable forest management include
- Ban on log export to reduce rate of felling
- felling restrictions to control indiscriminate felling
- participatory forestry to reduce encroachment and to check illegal activities in the forest

- acquisition of permits to control or regulate exploitation
- yield selection and approval to control and regulate exploitation
- felled trees should be replaced to regenerate forests
- gaps in forests to be replaced with seedlings to replenish felled trees

(b) Candidates had difficulty stating the effects of decreasing forest resources on
  (i) the national economy and
  (ii) human health and therefore obtained very poor marks.

The following answers were expected:

(i) <u>Effects of decreasing forest resources on the national economy</u>

- loss of employment
- loss of foreign exchange
- loss of timber
- high cost of timber for local construction
- loss of biodiversity (NTFPs)
- water bodies may dry up

(ii) <u>Effect of decreasing forest resources on human health</u>

- loss of medicinal plants
- accumulation of toxic gases in the atmosphere leading to health problems
- shortage of certain NTFPs which are a source of proteins and vitamins
- low supply of oxygen for respiration
- pollution of water bodies

<u>Question 6</u>

(a) Explain the term plantation as used in forestry.
(b) Give five reasons for the slow pace of plantation development in Ghana.
(c) State four activities that should be carried out to make a piece of land ready for outplanting of tree seedlings.
(d) Name four tools that are used for pruning trees.

Candidates who attempted this question performed above average.

(a) The term plantation was correctly explained by most of the candidates.
(b) Candidates were expected to give the following reasons for the slow pace of plantation development in Ghana.

- Slow rate of returns/long gestation period discourages investors and therefore only a few show interests
- land litigation issues discourage investors from going into plantation development / poor land tenure system

- climate change / variability or unfavourable environmental conditions may cause tree crop failure and hence discourage investors
- high initial cost of establishment prevent peasant farmers and persons who do not have the capital from going into it
- pests within an environment may make trees to fail and hence discourage investors
- high risk of destruction by wild fires may discourage investors
- prevalence of diseases within the environment of the plantation might compel prospective investors to give up their plans however, most of them could not provide the five reasons required of them.

(c) Candidates were able to state the activities that should be carried out to make a piece of land ready for out planting of seedlings. But a few candidates mentioned nursery establishment, harvesting and preparation of beds which were incorrect.

(d) Tools used to prune trees are cutlass/matchete, axe, chain saw, bowsaw/saw but not shears, secateurs and sickle as many of the candidates mention.

FORESTRY 3

1. GENERAL COMMENTS

The standard of the paper was comparable to that of the previous years. The questions were of high quality covering the entire syllabus. Most of the candidates performed better than that of last year.

2. SUMMARY OF CANDIDATES' STRENGTHS

The Chief examiner observed the following strengths:
(1) adequate understanding of the questions
(2) provision of simple and straight forward answers
(3) adequate knowledge of the subject matter

3. SUMMARY OF CANDIDATES' WEAKNESSES

The candidates exhibited the following weaknesses:
(1) spelling mistakes;
(2) poor handwriting.

4. SUGGESTED REMEDIES

(1) Candidates should cultivate the habit of reading books and practice the spelling of words they come across
(2) Candidates should familiarize themselves with technical terms they come across
(3) Candidates should learn to write boldly and legibly so that their scripts could be easily read and fairly assessed.

5. DETAILED COMMENTS

Question 1

(a) State four uses of each of specimens A and B.
(b) Mention one NTFP that could be obtained from the plant from which specimen B was obtained.
(c) Give four observable differences between specimens A and B.
(d) Name the planting material used in the propagation of the plants from which each of specimens A and B were obtained.

Candidates answered this question well and got good marks.
(a) Most candidates were at home with the uses of specimen A (stem of bamboo, and specimen B (Raphia frond).
(b) Most candidates were unable to mention the NTFPs that could be obtained from Raphia palm. The answers required were NTFPs which are obtained directly from the raphia palm

without having to transform them or process them before use. The answers are raphia wine (odoka), larva of palm weevil (akorkono) or brooms used to sweep rooms only (bubu).

(c) This question was tackled well by most of the candidates. Some of the correct observable differences given were.

Stem of Bamboo (Spec. A)	Raphia frond (Spec. B)
- Well defined nodes and internodes	- No nodes and internodes
- Hollow	- Solid (not hollow)
- Buds are present	- Buds are absent
- Bark cannot be easily removed	- Bark can be removed along the length
- It is woody	- Not woody

(d) Most candidates answered this question correctly and obtained the maximum mark.

Question 2

(a) Mention the habitats of each of specimen C and D.
(b) State three ways in which each of specimens C and D are of economic importance.
(c) Give five reasons why specimen D is used in plantain development.
(d) State the mode of dispersal of each of specimens C and D.

(a) The habitats of specimens C and D (water lettuce and *Cassica siamea*) respectively were given correctly by most candidates as:

Water lettuce – aquatic (water) *Cassia siamea* – terrestrial (land)

(b) Candidates were able to provide correct answers to this question. Some answers provided included

Economic Importance of:

Specimen C (Water lettuce)

- provides shade for fish in ponds
- roots serve as feed for fish
- habours vectors of some diseases
- reduces the quality of natural water body for drinking

Specimen D (Branch of *Cassia Siamea*)

- Used as fuel wood
- used to produce charcoal
- medicinal / for curing malaria
- stem used as TV pole
- for constructing hats

(c) Only a few candidates were able to give reasons why *Cassia siamea* is used in plantation establishment. Most candidates were rather stating the economic importance *of Cassia siamea*.

The reasons for using *Cassia siamea* in plantation establishment include:

- well developed rooting system
- fast growth
- coppicing ability
- fire resistant
- availability of seeds
- thrives in most soils
- survives in all ecological zones
- good for charcoal production

(d) The mode of dispersal of both Specimens C and D were correctly stated.

Question 3

(a) Mention the kingdom to which both specimens E and F belong.
(b) State four observable features that could be used to classify both specimens E and F as insects.
(c) State three roles played by each of specimens E and F as insects.
(d) Mention the role played by specimen E in the ecosystem.
(e) Mention three precautions that should be taken using specimen H.

(a) Candidates mentioned the kingdom to which specimen E (worker termite) and specimen F (worker bee) belonged correctly as Animalia.

(b) Candidates had no difficulty stating the observable features that could be used to classify both worker termite and worker bee as insects as follows:

- possession of a pair of antennae
- possession of three pairs of legs / six legs
- body divided into three parts: head, thorax and abdomen
- presence of spiracles on the body
- each pair of legs attached to a segment of thorax
- three thoracic segment

(c) Candidates had difficulty stating the roles played by worker termite and worker bee in their colonies. The expected answers were:

Specimen E (worker termite)

- construction of nest or termitarium
- feeding other members of the colony
- cleaning of the nest
- repair of the nest
- care for the king, queen and nymph

Specimen F (Worker bee)

- Feeds other members of the colony

- build the hive
- clean the hive
- ventilate the hive / aerate the hive
- trains the younger bees to fly
- collect and transport pollen into the hive
- protect the hive

(d) and (e) These questions were handled easily by candidates.

Question 4

(a) Draw and label specimen G.
(b) Give two uses of specimen G.
(c) State two precautions that should be taken when using specimen G.
(d) State two ways of maintaining specimen H.
(e) Mention three precautions that should be taken when using specimen H.

(a) Candidates drew and labelled specimen G (axe) correctly.
(b) The uses of an axe as stated by most of the candidates included: - splitting of wood, felling of trees, pruning of trees, uprooting of stumps and crosscutting of wood.
(c) This was a popular question and most candidates got the full mark.
(d) This was also very popular among candidates, some of the correct answers provided included:
- Grease metal part after use
- Store in cool dry place
- Blade should always be firmly fixed onto handle
- Store in termite free place
- Blade should be sharpened regularly

(e) and (f) These questions were tackled well by most candidates and obtained very good marks.

GENERAL AGRICULTURE 2

1. GENERAL COMMENTS

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

2. CANDIDATES PERFORMANCE

The general performance is quite satisfactory and better that the previous years.

3. SUMMARY OF CANDIDATES' STRENGTHS

(1) Effective use of time as majority of the candidates were able to finish answering the five questions within the stipulated time.
(2) Fairly good knowledge on the importance of nursery practices in crop production and physical methods of controlling pests.
(3) Precise and adequate information on roles of government in development of agriculture and animal production.

4. SUMMARY OF CANDIDATES' WEAKNESSES

(1) Poor spellings of technical words and scientific terms.
(2) Majority of the candidates could not explain the processes that occur in the nitrogen cycle and some weathering processes such as carbonation, hydration and hydrolysis.
(3) Inability of candidates to state qualities of a good farm manager and to outline the steps involved in establishing agribusiness.
(4) Majority of candidates could not distinguish between a fixed factor and a variable factor.

5. SUGGESTED REMEDIES

(1) Proper teaching of agricultural terminologies and scientific words should be encouraged.
(2) Effective teaching and learning of Recycling of nutrients, weathering processes and agribusiness should be encouraged.
(3) Tutors should organize regular practical and theory lessons to enable students develop skills in description and explanation of agricultural/scientific processes logically.

6. DETAILED COMMENTS

Question 1

(a) (i) What is land rotation?
(ii) Give three reasons why land rotation is practiced by farmers in West Africa.
(b) Explain four ways by which governments in West Africa can develop agriculture.

Majority of candidates who attempted this question performed fairly well.

(a) (i) Candidates generally provided the correct explanation of the term "land rotation".

(ii) This question was only fairly well answered by most candidates. Reasons why farmers practice land rotation include the following:

- pest build-up is avoided
- disease build-up is avoided
- cheaper way of replenishing soil fertility
- check soil erosion during fallow period

(b) Generally, candidates did not find much difficulty in stating ways by which governments in West African develop agriculture.

Ways rarely stated included the following:

- provision of incentives to farmers such as awards during farmer's day
- increasing access to agricultural education
- provision of storage and processing facilities
- increasing vegetation conservation practices

Question 2

(a) (i) What is farm mechanization?

(ii) Give three reasons why farm mechanization is important.

(iii) Mention four processing machinery used in agriculture.

(b) Mention the four stages of conducting a farm survey.

A great majority of candidates who attempted this question exhibited a fairly good familiarity and ideas about "Farm Mechanization".

(a) Even though most candidates correctly provided the explanation for farm mechanization as the use of tools, equipment and machinery to perform tasks and operations on the farm in part (ai), they could not discuss reasons why mechanization is important in part (aii).

Expected reasons why mechanization is important include:

- ensure timeliness of farm operations
- reduces drudgery/make work easier
- encourages large scale farming
- enhances the processes of farm produce
- leads to increase in productivity

(iii) Candidates' performance on this sub-question was only fair as some of them could not state simple processing machinery but wrongly stated tillage machinery. The correct simple processing machinery include; shellers, millers, dehuskers, grates, dryers, grinders, de-stoners, threshers, winnowers, pressors etc.

(b) Candidates exhibited adequately knowledge of the procedures for conducting farm survey by stating correctly;

- reconnaissance
- preliminary survey
- map preparation

Question 3

(a) Mention four processes that occur in the Nitrogen Cycle.
(b) Name two forms in which soil nitrogen is absorbed by plants.
(c) Explain four factors that affect fertilizer used by farmers.

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

(a) Most of the candidates could not outline the processes that occur in the Nitrogen-cycle. The correct processes include the following:

- nitrogen fixation i.e. free nitrogen converted to useful nitrogen
- aminization/putrefaction i.e. conversion of protein to amino acids
- ammobilization i.e. nitrate and ammonium are taken up by soil organisms so unavailable to plants.
- nitrification i.e. biological oxidation of ammonium compounds into nitrates
- denitrification i.e. nitrate salts are converted to atmosphere nitrogen

(b) This sub-question was well answered by the generality of the candidates as they correctly provided the forms in which nitrogen is absorbed by plants

(c) A fairly good number of candidates failed to state and explain adequately the factors affecting fertilizer use by farmers. It is therefore, important to note the following correct factors:

Type of crop – certain crops require large amount of particular nutrients than others
Economic/cost of fertilizer use is increased by low prices and vice versa
Management – poor soil management leads to loss of nutrients therefore requires higher quantities of fertilize and vice versa
Economic value of crop – fertilizer use is encouraged when crops have high value and vice versa
Soil factors – soil pH, nutrients status and moisture content affect fertilizer use
Climatic factors – soils in higher rainfall areas require more fertilizer

Question 4

(a) (i) What is chemical weathering?
(ii) Describe each of the following weathering processes:
(α) carbonation;
(β) hydration;
(γ) hydrolysis.
(b) (i) Enumerate four causes of soil acidity.
(ii) Give four problems associated with soil acidity in crop production.

This question was attempted by a few candidates who performed well below average.

(a) Candidates could not adequately explain chemical weathering, Carbonation, Hydration and Hydrolysis.

The expected explanation of the terms are as follows:

Chemical weathering involves reactions between rock minerals and environmental factors e.g. water, oxygen and acids that bring about decomposition and disintegration of rocks.

Carbonation involves reaction between carbonic acid and minerals to form carbonates which are soluble and therefore easily disintegrate rocks.

$CaCO_3 + H_2CO_3 \rightarrow Ca(HCO_3)_2$

Hydration is the rigid attachment of water to rock minerals to form hydrated compounds which lead to rock softening and breakdown.

$Fe_2O_3 + 3H_2O \rightarrow FeO_3.3H_2O$

Hydrolysis is the reaction between water and some rock minerals resulting in rock dissolution and breakdown.

$CaSiO_3 + 2H_2O \rightarrow H_2SiO_3 + Ca(OH)_2$

(b) (i) Majority of the candidates enumerated some causes of soil acidity but the following causes were hardly stated:

- waterlogging
- oxidation of sulphur components by bacteria biologically in soil
- acid rains
- accumulation of salts in arid areas or from irrigation water.

(ii) Problems associated with soil acidity was poorly answered by most of the candidates. The expected responses included the following:

- unavailability of certain soil nutrients e.g. P
- toxicity of trace elements i.e. Al, Zn, Mn, Cu
- inhibit activities of microbes in the soil
- stunted growth
- low productivity

Question 5

(a) State the importance of each of the following nursery practices:

(i) shading;

(ii) pricking-out;

(iii) stirring of soil.

(b) (i) List four pests of crop plants.

(ii) Describe three physical methods of controlling pests of crop plants.

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

(a) Candidates had fairly good ideas about the importance of shading, pricking-out and stirring of soil at the nursery. They therefore, in most cases scored full marks for it.

(b) (i) Many candidates correctly gave examples of pests of crop plants and scored full marks in most cases.

(ii) Candidates' performance on this sub-question was fair as most of them could only state the physical methods of controlling crop pest but could not adequately describe the stated methods.

Question 6

(a) Discuss the sikatoga disease under the following headings:
- **(i) causal agent;**
- **(ii) mode of transmission;**
- **(iii) one affected crop;**
- **(iv) two symptoms;**
- **(v) two prevention and control measures.**

(b) (i) What is plant propagation?
- **(ii) State four advantages and three disadvantages of sexual plant propagation.**

Only a few candidates attempted this question and performance was generally poor. Perhaps the topic "plant diseases' is not properly taught in schools.

(a) A lot of candidates could not clearly state causal agent, mode of transmission, affected crops, symptoms, prevention and control of sikatoga disease.

(b) (i) General performance on this sub-question was poor because candidates could not explain the term "plant propagation". The expected explanation of the term included: the following: plant propagation is the reproduction and duplication of plants from a source / mother plant or a process where plants are grown either by using vegetative parts or seed.

(ii) Majority of the candidates could state the advantages of sexual propagation but the following advantages were hardly mentioned:

- seed storage is earlier
- transportation of seed is cheaper and convenient
- seeds remain viable for a long time when properly stored

Similarly, candidates could state the disadvantages of sexual propagation.
The following disadvantages were hardly mentioned:

- Some crops when propagated by seed have long juvenile periods/late maturity
- seeds from some crops propagated sexually are very tiny and difficult to handle
- some plant produce seeds which are difficult to germinate

Question 7

(a) Explain four ways in which animal production is of economic importance in West Africa.

(b) State four characteristics of local fowls.

(c) Mention four breeds of cattle found in West Africa.

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

(a) Even though most candidates correctly stated the economic importance of animal production, they could not explain the stated points satisfactorily.

(b) Generally, candidates correctly listed the characteristics of local fowls. Their answers included "resistant to diseases" which should have been stated as "resistant to most diseases / parasites / pests. Local fowls are not resistant to all diseases/parasites/pest.

(c) Majority of the candidates gave correct examples of breeds of cattle in West Africa but lost marks in cases where the names of the breeds were wrongly spelt.

Question 8

(a) Explain the following management practices in animal production:
(i) flushing;
(ii) creep-feeding.
(b) State three advantages of carrying out each of the management practices listed in (a).
(c) Enumerate six advantages associated with the intensive system of rearing ruminants.

Performance of candidates on this question was fair.

(a) Candidates could not adequately explain flushing and creep-feeding well. An explanation of the terms are as follows:
(i) Flushing: - giving highly nutritious feed to female animals before servicing/breeding.
(ii) Creep-feeding: - A creep is an enclosure for feeding purposes made accessible to only the young but not to their mother or
Creep feeding is giving young animals highly nutritious, palatable and easily digestible feed separates from the dam.

(b) Candidates were not able to give the advantages of flushing and creep-feeding in farm animals. The expected advantages of the terms included the following:

Flushing

- raises the chance of multiple birth
- leads to increased ovulation rate/conception rate
- contributes to the synchronization of oestrus
- helps to raise percentage of young animals
- there will be enough milk to feed the offsprings
- mother able to withstand the stress and strain of pregnancy

Creep-feeding

- results in faster growth rate
- better feed conversion in animals
- speed up the weaning period
- leaves dam less suckled
- provides a sure way of nourishing young animals especially when mother milk is not sufficient for them

(c) Candidates who attempted this sub-question exhibited adequate knowledge of the advantages of practicing intensive system of rearing ruminants. They therefore scored full marks for it in most cases.

Question 9

(a) State four qualities of a good farm manager.
(b) Outline the steps involved in establishing an agribusiness.

Most of the candidates who attempted this question did not perform satisfactorily.

(a) Majority of the candidates miserably failed to state adequately qualities of a good farm manager. The qualities of a good farm manager include the following:
- should be experienced enough in managing the farm
- a good knowledge of modern agricultural practices
- have courage to make changes
- good human relations and self respect
- self confident and enthusiastic
- willing to depend on their other experts as to how to work effectively
- firm and stern to stick to his plans, decisions and actions
- committed to his work/hard working
- emotionally resilience
- high degree of morality and integrity
- a fair knowledge of market situation
- be in good health

(b) This sub-question required candidates to outline steps in establishing agribusiness.

However, most candidates rather wrongly outlined the factors to consider in establishing an agribusiness instead of the steps involved in establishing an agribusiness.

The expected steps included the following:
- decision making
- choice of agribusiness line
- sourcing for initial investment capital
- opening a bank account in a reputable bank
- close to business location
- selection of business location
- registration
- surveying the market
- acquiring the needed production resources
- commencing and managing the business

Question 10

(a) Distinguish between a fixed factor and a variable factor giving two examples in each case.

(b) (i) State the law of diminishing returns.

(ii) Explain three causes of diminishing returns in agricultural production.

(c) List two factors that cause a change in supply of agricultural produce.

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

(a) A lot of candidates could not clearly distinguish between fixed factor and variable factor. It is, therefore, useful to note the correct distinction as follows:

Fixed factor is a factor whose employment/quantity cannot be readily changed in responses to desired changes in output/market conditions e.g. building, machine, land, managerial expertise, plant where as variable factor is a factor whose employment/quantity can be changed in the short run or in response to a change in output e.g. raw material, unskilled labour, power, fuel.

(b) Most candidates were able to state the "law of diminishing returns" however, some of them could not explain the causes of "diminishing returns in agricultural production".
The correct causes include the following:
- wrong combination of factors of production
- over concentration of labour on a piece of land
- over utilization of land
- land is limited in supply

(c) Candidates were not able to state the factors that cause a change in supply of agricultural produce. The expected factors include the following:
- price of related goods and services
- technology
- the number of producers
- future expectation of producers
- natural factors/hazards
- price of produce
- price of factors of production/cost of production
- level of taxation or fiscal policies of government

GENERAL AGRICULTURE 3

1. GENERAL COMMENTS

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

The general performance of candidates was generally better than last year.

2. CANDIDATES' PERFORMANCE

The general performance of the candidates was better that last year.

3. SUMMARY OF CANDIDATES' STRENGTHS

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

(1) Most candidates were able to give precise answers.
(2) Some candidates showed detailed knowledge of the subject matter.
(3) Candidates were able to identify inorganic and organic fertilizers and correctly stated their observable differences.
(4) Most candidates were able to identify the endoparasites (Roundworm, Tapeworm and liver fluke) and ectoparasite (tick) provided.

4. SUMMARY OF CANDIDATES' WEAKNESSES

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

(1) Poor spellings of technical words and scientific terms
(2) Most candidates exhibited poor calculation skills
(3) Inability of candidates to identify accurately parts of engine such as Flywheel, dip stick and spark plug.
(4) Some candidates could not identify specimens while others spelt names of the specimen wrongly. Candidates should note that for identification of specimens, marks are only awarded for correct spelling of specimen.

5. SUGGESTED REMEDIES

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

(1) Teachers should periodically use question and answer to drill students on scientific terms.
(2) Teachers should give exercises involving calculations and identification of specimens to their students.
(3) Teachers should go to auto mechanic workshops in their locality to ask for unserviceable car engines to use as teaching aid in schools.

6. DETAILED COMMENTS

Question 1

(a) For each of the specimens A, B and C, provide the following:
- **(i) scientific name;**
- **(ii) name of one part used for propagation;**
- **(iii) family name.**

(b) Determine the population of the plant from which specimen C was obtained on a 10,000-hectare farmland, if the planting distance is 9 metres by 9 metres.

(c) State three ways in which specimen D is of economic importance.

(a) Majority of the candidates performed well in part (a) as they correctly provided the scientific names of the three specimens (pineapple fruit, tuber of yam and plantain fruit), parts of the specimens used for propagation and their family names. Some candidates however, did not follow the basic rules for writing scientific names as they did not begin family and genus or generic names with capital letters and species names with small letters and underline them. Candidates should understand that scientific names are latin names (not English) and should, therefore be underlined. Where candidates used abbreviation for species instead of the full species name, it should be 'sp' and not 'spp', since spp indicates several species within the genus. Note that 'sp' and 'spp' are not removed from sp and spp underlined.

(b) Most candidates could not calculate the plant population correctly. Candidates did not know that one (1) hectare is equal to 10,000 m^2

The correct determination of population of specimen C is as follows:

1 hectare is equivalent to 10,000 m^2

Area of farm = 10,000 x 10,000 m^2

$$\text{Plant population on the farm} = \frac{10{,}000 \times 10{,}000}{9 \times 9}$$

$$= 1{,}234{,}568 \text{ plants}$$

(c) The economic importance of specimen D (oil palm fruit) was well answered by most candidates. Candidates should, however, note that in some situations, a specimen may be helpful and harmful.

Question 2

(a) (i) Identify each of specimens E, F, G and H.
- **(ii) Name one host animal each of specimens E, F, G and H.**
- **(iii) Name one part of the host animal where each of specimens E and H could be found.**

(b) Describe two methods that could be used to control each of specimens E and H.

(c) State one effect of specimen F on its host.

Generally, the question was well answered by most of the candidates.

(a) Most of the candidates correctly provided the identity and host animals of the specimens. Some candidates wrongly identified stomach or intestine as the part of the host where specimen E (liver fluke) is located instead of bile duct in the liver/small intestine.
(b) Some candidates did not know the difference between drenching and deworming as used for ectoparasites and endoparasites. Drenching is oral administration of liquid or semi liquid formulations for deworming animals and so used for endoparasites control only.
(c) Candidates should note that the effect of specimen F (roundworm) on its host include blockage of alimentary canal, poor growth rate, general weakness or loss of healthy condition of animal among others.

Question 3

(a) Identify each of specimens J and K.
(b) State two observable differences between specimens J and K.
(c) (i) Mention three major nutrients that specimen J could supply to plants.
(ii) State two consequences of prolong application of specimen J to the soil.
(d) State four advantages of applying specimen K to the soil.

This question was well attempted by most candidates.
(a) Specimens J (inorganic fertilizer) and K (organic fertilizer) were correctly identified by most of the candidates although candidates had not done any chemical test for N, P and K.
(b) For the observable differences between inorganic and organic fertilizers, most candidates used colour and shape, but moisture level was used by only a few candidates.
(c) (i) Most candidates correctly stated the nutrients that could be supplied by inorganic fertilizer as nitrogen (N), phosphorus (P) and potassium (K).
(ii) Consequences of prolonged application of inorganic fertilizer and advantages of applying organic fertilizer were well answered by most of the candidates.

Consequences of prolonged application of inorganic fertilizer include the following:
- destruction of soil structure
- pollution of water bodies or underground water
- destruction of useful micro organisms
- increase in soil acidity etc

(d) Advantages of applying organic fertilizer include the following;
- adds almost all nutrients to the soil.
- improves soil structure.
- controls soil erosion.
- improves water holding capacity of the soil.
- regulates soil temperature.
- buffers soil against rapid chemical changes.

Question 4

(a) (i) Identify each of specimens L, M, N and O.
(ii) State one function each of specimens L, M and N.
(b) Give five reasons why specimen O is important.

This question was the most difficult for majority of the candidates.
(a) This sub-question asked for the identification of specimens, L (flywheel), M (spark plug), M (dip stick) and O (Giant African snail/*Achatina achatina*). Only a few candidates were able to identify them with correct spellings.

Most of the candidates failed miserably to provide the functions of flywheel, spark plug and dip stick.
These functions include the following:
Flywheel – keeps the engine turning during the idle or non-power strokes/maintains rotational energy.
Spark plug – produces spark that ignite the petrol and air mixture in the combustion chamber
Dip stick – is used to check level of engine oil
(b) Majority of candidates provided the reasons why specimen O (Giant African snail) is important but the following reasons were hardly mentioned;
- feeds on wide variety of agricultural crops of economic importance
- ground shell is used for painting/ white washing buildings
- ground shell in large quantity is used for liming acid soils.

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, showed a slight improvement over that of the previous year.

2. SUMMARY OF CANDIDATES' STRENGTHS

(1) Candidates were concise and straight forward in their responses.
(2) Candidates desisted from copying the questions before answering them.
(3) Steps in solving mathematical problems have improved.
(4) Candidates started new questions on fresh pages.
(5) Most candidates were able to convert units correctly and also assign correct units to physical quantities.

3. SUMMARY OF CANDIDATES' WEAKNESSES

The following were weaknesses of candidates reported by the Chief Examiner:
(1) wrong spelling of key words;
(2) lack of understanding of the demand of questions;
(3) inability to write balanced chemical equations;
(4) inability to handle questions on the Mole concept and Genetics;
(5) symbols of electric circuit components posed a serious challenge to candidates.

4. SUGGESTED REMEDIES

The Chief Examiner suggested the following remedies to the candidates' weaknesses.
(1) Vocabulary drill on scientific names/terms should be encouraged in schools.
(2) Teachers must explain the Instructions on the front page of the Answer booklet to candidates.
(3) Conventional symbols for electrical circuit symbols and devices must be taught with emphasis.
(4) Chemical equations and their balancing should be taught very well.

5. DETAILED COMMENTS

Question 1

(a) (i) What is meant by the term modern technology?
(ii) Give three reasons for the lack of improvement of technology in Ghana?
(b) (i) Explain the term convection as used in heat energy.
(ii) Explain why convection cannot take place in solids.
(c) (i) Differentiate between soil erosion and soil depletion.

(ii) Give three effects of soil erosion on agricultural productivity.

(d) (i) List three causes of indigestion in humans.

(ii) State two ways of preventing tooth decay.

Most of the candidates attempted this question.

(a) Candidates explained poorly the term modern technology. They explained technology instead of modern technology. Modern technology is the use of improved methods in the production of goods/tools/machines to make life easier. Reasons for lack of improvement of technology in Ghana were well advanced by candidates.

(b) Some candidates were able to explain the term but could not explain well why convection cannot take place in solids. The expected reason was that solid particles occupy fixed positions and can only vibrate about a mean position and therefore are not able to carry heat from one point to another.

(c) Most of the candidates could only explain soil erosion but could not bring out the difference between soil erosion and soil depletion.
The effects of soil erosion were satisfactorily articulated by candidates.

(d) Causes of indigestion and ways of preventing tooth decay were correctly stated by the candidates.

Question 2

(a) A man with normal red blood cells is married to a woman who is a sickle cell carrier. With the aid of a genetic diagram, explain the genetic constitution of their children.

(b) (i) Explain the term sublimation.

(ii) Name three substances that can sublime.

(c) Two lamps, each of resistance 3 Ω, are connected in parallel. The arrangement is then connected across a 4.5 V battery.

(i) Draw a circuit diagram for the arrangement.

(ii) Calculate the effective resistance of the lamps.

(iii) Calculate the total current in the circuit.

(d) (i) Distinguish between green manure and farmyard manure.

(ii) State three ways in which organic fertilizers are important to the soil.

This question was attempted by only a few candidates, but their performance was poor.

(a) From year to year, questions on Genetics have not been satisfactorily answered. Only few candidates drew correctly the required genetic diagram. Many candidates had difficulty with the crossing of the parental genotypes. Gametes were expected to be circled. The conclusion was generally incorrect.

(b) This sub-question was satisfactorily answered by candidates. There were a lot of wrong spelling of the names of the substances that sublime. Examples included: naptaline, camphur.

(c) Quite a number of candidates drew correctly the required circuit diagram. Some candidates showed complete ignorance of the symbols of a cell and a battery. They could also not differentiate between a series connection and a parallel connection. The calculations of effective resistance and the total current were correctly done in most cases.

(d) Majority of the candidates could not differentiate between green manure and farmyard manure even though they showed that they had an idea about what farmyard manure was. A lot of candidates were able to explain the importance of organic fertilizer to the soil.

Question 3

(a) (i) Explain the term identification as used in animal production.
(ii) Describe two methods of identifying farm animals.
(b) (i) What is a reflex action?
(ii) Distinguish between excretion and egestion.
(c) (i) List two groups of hydrocarbons.
(ii) A group of hydrocarbons has the general formula C_nH_{2n}.
(α) Name the first two members of the group.
(β) State the main reaction that members of this group undergo.
(d) State the class of lever to which each of the following simple machines belongs:
(i) broom;
(ii) claw hammer;
(iii) fishing rod;
(iv) secateurs;
(v) bottle top opener.

(a) It was evident that many candidates had an idea about the term identification, but they could not explain it clearly. Some of them used the same term to explain itself. Majority of the candidates were able to mention two methods of identifying farm animals but could not describe the methods used.

(b) The term was poorly explained by most candidates. The wrong explanation that ran through most of the scripts was, reflex action is the action which does not involve the brain or is under the control of the brain. The expected response was, reflex action is an involuntary / instantaneous movement / response to an external stimulus.

Majority of the candidates was able to differentiate between excretion and egestion. Some candidates, however, confused egestion with digestion.

(c) Candidates demonstrated high level of knowledge of the members of the group and the type of reaction they undergo.

(d) Majority of the candidates were able to state the types of levers the simple machines belong to.

Question 4

(a) (i) Define the term pressure.

(ii) A regular concrete block weighing 5 kg, has dimensions 8 cm x 20 cm x 50 cm.

Calculate the greatest possible pressure the block will exert on the ground.

[g = 10 m s^{-2}]

(b) (i) Give three reasons why poultry farms should be distanced from residential areas.

(iii) Mention two methods of preserving poultry eggs.

(c) State two causes each of the following problems associated with reproduction in humans:

(i) ectopic pregnancy;

(ii) infertility in men.

(d) Indicate whether each of the following substances is an element, a compound or a mixture:

(i) water;

(ii) iron filings;

(iii) glass;

(iv) milk of magnesia;

(v) iodine crystals.

(a) Pressure was satisfactorily defined by most of the candidates, but the subsequent calculation was poorly handled. Many candidates failed to convert centimetre to metre for the calculation. Others too could not remember the formula for Force, which is the product of mass and acceleration due to gravity. Their problem was compounded by their ignorance that the greatest pressure acted on the smallest area.

(b) This sub-question was well answered by most of the candidates.

(c) Causes of ectopic pregnancy appeared to be alien to candidates. They however demonstrated appreciable knowledge in causes of infertility in men.

(d) Many candidates were able to correctly group the given items.

Question 5

(a) A 0.04 g of copper metal reacts completely with 25 cm^3 of 0.5 mol dm^{-3} H_2SO_4.

(i) Write a balanced chemical equation for the reaction.

(ii) Calculate the molar mass of the copper metal.

(b) (i) Give two functions of the human ear.

(ii) Arrange the following media in order of increasing speed of sound in each of them: solids, liquids and gases.

(c) (i) Give two advantages of clayey soil over sandy soil.

(ii) State three symptoms of nitrogen deficiency in maize.

(d) State four ways in which biotic factors are useful in an ecosystem.

(a) Only a few candidates were able to write correctly the required balanced equation. Candidates were not able to carry out the calculation of the molar mass of the copper.

(b) (i) Hearing as a function of the ear was very popular among candidates but balancing was not known to them as a function of the ear.

(ii) The expected arrangement was Gases < Liquids < Solids. Many candidates failed to write this appropriately.

(c) Correct advantages of clayey soil over sandy soil were given by many candidates. Symptoms of nitrogen deficiency were also appropriately stated by candidates.

(d) Candidates lacked knowledge of the usefulness of biotic factors.

Question 6

(a) (i) State three ways through which AIDS is transmitted.

(ii) List three effects of drug abuse on the user.

(b) Name four endocrine glands found in humans.

(c) (i) What is a shadow?

(ii) Draw a ray diagram to illustrate a ray of light travelling from glass to air.

(d) (i) Explain the term artificial insemination as used in animal production.

(ii) State three advantages of artificial insemination in animal production.

(a) Candidates had no difficulty in stating the ways in which AIDS is transmitted. Many candidates were also able to list the effects of drug abuse on the user. A few of the candidates deviated and rather talked about drug addiction.

(b) Only a few candidates could name correctly the endocrine glands found in humans. Many of the candidates had no idea about endocrine glands. Some mentioned examples of hormones instead of glands.

(c) Many of the candidates could not tell clearly what a shadow was and the ray diagram was poorly drawn.

(d) Candidates could not explain correctly artificial insemination, but they were able to state the advantages of artificial insemination in animal production.

INTEGRATED SCIENCE 3

1. GENERAL COMMENTS

The standard of the paper compares favourably with those of the previous years. The performance of candidates is comparably better than that of the previous years.

2. SUMMARY OF CANDIDATES' STRENGTHS

Some of the notable strengths of candidates included:

(1) correct identification of specimen;
(2) correct naming of parts of illustrations;
(3) ability to read and record correctly values from instruments;
(4) stating correct function of parts of specimen;
(5) ability to give precise and concise answer to questions.

3. SUMMARY OF CANDIDATES' WEAKNESSES

It was observed by the Chief Examiner that candidates showed weaknesses in the following areas:

(1) Plotting of graph
- Inability to label the axes correctly
- Poor skills in plotting points
- Inability to draw a labelled triangle for the determination of slope of graph
- Failure to draw the line of best fit
- Poor substitution of corresponding values for slope calculation

(2) Wrongly spelling of scientific terms.

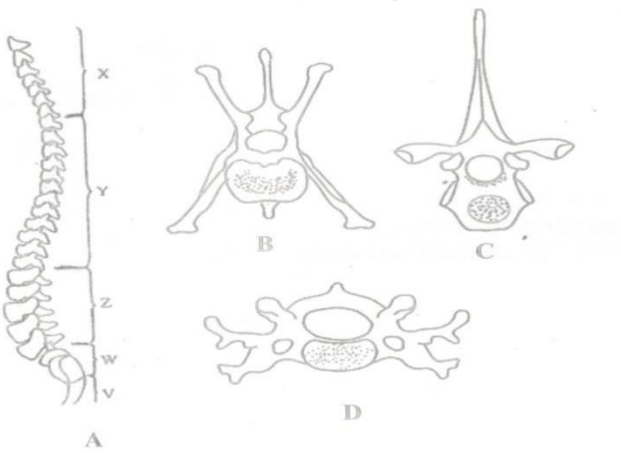
4. SUGGESTED REMEDIES

(1) Teachers must insist on correct spelling of words in general and scientific words in particular.
(2) Teachers must give more exercises in graph work. They must help candidates to label axes with the correct symbol of quantity and its unit.
(3) Candidates must be guided to choose appropriate scales for graph work.
(4) Candidates must be taught and guided to draw the line of best fit for plotted points.

5. DETAILED COMMENTS

Question 1

Fig. 1 illustrates four different bones, labelled A, B, C, D found in the human body. ***Study the illustrations carefully and answer the questions that follow.***



(a) Identify each of the bones labeled A, B, C and D.
(b) Name the part of the skeletal system to which the bone labeled A belongs.
(c) Name each of the parts labeled X, Y, Z, W and V.
(d) Count and record the number of bones in each of the parts labeled X, Y, Z, W and V.

(b) It was evident that candidates understood the question. Most of the candidates gave the correct responses. However, in some cases, candidates either swapped the answers or misspelt the words. For example, cervical and thoracic were interchanged for C and D. Some candidates spelt those words as *thorasic and cervical*.

(c) Candidates were expected to identify bone A as an example of axial skeletal system and not appendicular skeletal system as most of them did.

(c) and (d) Quite a number of candidates had the names correct but failed to complete the names with vertebra and rather left them as cervical, thoracic, etc.

A few candidates also spelt the names wrongly. For specimen A, a number of candidates counted the sacral vertebrae as 5 instead of 2.

Question 2

Fig. 2 below is an illustration of the pH values X_1, X_2, X_3, X_4 and X_5 of five different solutions on a pH scale. The solutions are vinegar, distilled water, solution of plant ashes, dilute nitric acid and ammonia solution (not listed in any order).
Study the illustrations carefully and answer the questions that follow.

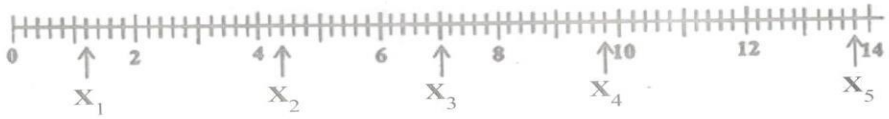


Fig. 2

(a) Read and record each of the pH values X_1, X_2, X_3, X_4 and X_5.
(b) Pair each of the pH values with the appropriate solution.
(c) Tabulate your data as shown below.

pH value	X_1	X_2	X_3	X_4	X_5
Solution					

(d) Give one reason for each pair of pH value and solution.

Most of the candidates read the pH values correctly and linked them with the given solutions appropriately. They proceeded to give correct reasons for the pairing.
Some candidates, however, interchanged nitric acid and vinegar, solution of plant ashes and ammonia solution.

In the cases where candidates failed to write the values of X_1 to X_5 or the appropriate solutions, they could not score for sub-question (d) because there was no pairing.

Question 3

Fig. 3 below illustrates the digestive system of a farm animal.
Study the illustration carefully and answer the questions that follow.

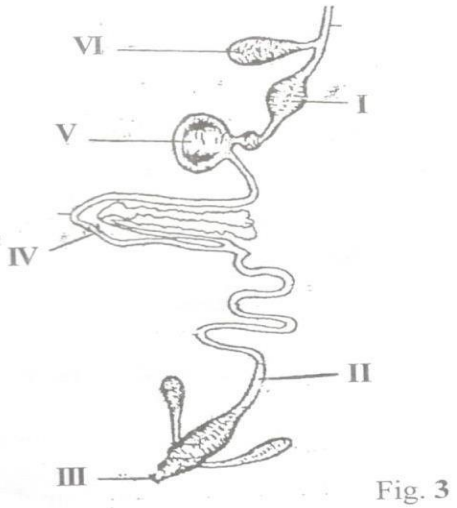


Fig. 3

(a) Identify the digestive system.
(b) Name each of the parts labeled I, II, III, IV, V and VI.
(c) State one function of each of the parts labeled I, II, III, IV, V and VI.
(d) State two features of the part labeled V that help in the performance of the function stated in (c).

(a) Candidates were expected to state that it was a monogastric digestive system since there was only one true stomach. Also, the presence of gizzard/ventriculus and crop are indications that it is the avian digestive system. Many candidates performed creditably in this sub-question.

(b) In exception of II, most candidates scored for the rest of the labels. II was the colon/ large intestine and not colo-rectum as many candidates indicated.

(c) Obviously candidates who could not answer (b) also failed (c). The expected answers for (b) and (c) were as follows:

I - Proventriculus, stores food / digest food

II - Colon, for reabsorption of water

III – Cloaca, exit/passage for excretory / undigested / reproductive material

Question 4

In an experiment to investigate the rate at which water is discharged from a container, the volume V of water left in the container after a period of time *t* is measured.

Fig. 4(a) and Fig. 4(b) illustrate the volume $V = V_1, V_2, V_3, V_4$ and V_5 and the corresponding time t_1, t_2, t_3, t_4, and t_5 respectively.
Study the illustrations carefully and answer the questions that follow.

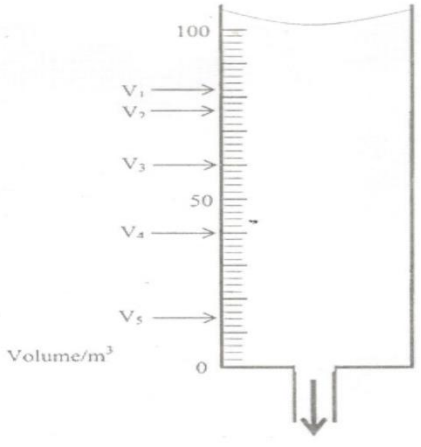


Fig 4 (a)

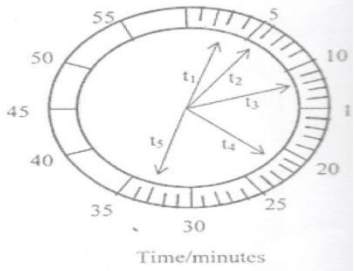


Fig 4 (b)

(a) Measure and record the volume $V = V_1, V_2, V_3, V_4$ and V_5.

(b) Read and record the time $t = t_1, t_2, t_3, t_4$, and t_5.

(c) Tabulate your results as shown as below.

Volume /Vm^3	V_1=	V_2=	V_3=	V_4=	V_5=
Time *t*/minutes	t_1=	t_2=	t_3=	t_4=	t_5=

(d) Plot a graph with V on the vertical axis and t on the horizontal axis.

(e) Determine the slope, s, of the graph.

(f) Determine the intercept on the

(i) vertical axis.

(ii) horizontal axis.

Sub-questions (a) – (c) were well answered by most candidates. A few candidates, however, reduced the values read from the scales when they attempted writing them in decimals.

Candidates who misrepresented the values scored zero for sub-questions (d) to (f). Some managed to score for correct axes and scale.

Some candidates omitted the units of the quantities on the axes.

A good scale must have regular intervals of even numbers and not odd numbers.

A number of candidates drew triangles which they used to calculate the slope. It was wrong to leave such triangles unlabelled.

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 ones.

Some candidates produced satisfactory responses to questions, but the general performance was average, compared to the previous years'.

2. A SUMMARY OF CANDIDATES' STRENGTHS

(1) The rubrics were adhered to.
(2) The classes of magnetic materials were correctly listed.
(3) Correct formulae were quoted, and correct substitutions were made.
(4) Most candidates showed appreciable knowledge on doping.
(5) Many candidates could state what acronym LASER is.
(6) Candidates were able to define binding energy in atom.
(7) Candidates listed the claim that X-rays are electromagnetic waves
(8) They also listed the peaceful uses of nuclear energy
(9) The concise and coherent answers given by some candidates should be encouraged.

3. A SUMMARY OF CANDIDATES' WEAKNESSES

(1) Some candidates lacked knowledge of some theories in Physics
(2) The materials used for the making of optical fibre were wrongly listed.
(3) Candidates have difficulty with calculations in mechanics and heat.
(4) Indices were not correctly manipulated by some candidates.
(5) Units were mixed up and calculations were not carried out in SI unit by some candidates.
(6) Some candidates gave responses that were not concise and coherent.

4. SUGGESTED REMEDIES

(1) Teachers must explain Physics theories well for students to understand and apply them.
(2) Students must prepare adequately before attempting the Physics examination.
(3) Candidates must solve past Physics examination questions.
(4) Chief examiners report on Physics must be read by candidates.
(5) Candidates must improve on their standard in English language to enable them to understand the questions better.
(6) Candidates must give concise answers to questions.

5. DETAILED COMMENTS

Question 1

(a) Define strain.
(b) A rubber band is stretched to twice its original length. Calculate the strain on the rubber band.

This question was attempted by many candidates and most of them correctly defined strain. However, a lot of them could not calculate the strain on the rubber, as demanded.

The expected responses are:

a) Strain is the relative distortion/change in shape/size of an object due to applied force.

b) Strain = $\frac{e}{l}$ (e = relative increase in length and l = original length of the rubber)

$= \frac{2l-l}{l} = \frac{l}{l}$

$= 1$

Question 2

State three materials used for making optical fibres.

Candidates were not able to list three materials used for making optic fibres. Few candidates were able to list only one.

The expected materials were:

- Glass
- Polycarbonate
- Teflon sheath
- Silica/silicon dioxide
- Sapphire

Question 3

Name three classes of magnetic materials.

This question was popular, and most candidates were able to name the classes.
These are: Diamagnetic, Paramagnetic and Ferromagnetic materials.

Question 4

(a) What is an intrinsic semiconductor?
(b) Distinguish between the p-type and n-type semiconductors.

A few candidates gave the correct answer to this question.

(a) These candidates stated correctly that an intrinsic semiconductor is a semiconductor in a pure state.

(b) They were also able to distinguish between the p-type and n-type semiconductors as the p-type is doped with trivalent element and has holes as majority charges carriers while n-type is doped with pentavalent element and has electrons as majority charge carriers

Question 5

A missile is projected so as to attain its maximum range. Calculate the maximum height attained if the initial velocity of projection is 200 m s^{-2}. [g = 10 m s^{-2}]

Some candidates used the wrong equation for solving this problem.

The expected solution is: the maximum height attained

$H = \frac{u^2 Sin^2\theta}{2g}$

$= \frac{U^2(Sin45^0)}{2x10}$

= 999.98m or 1000m

Question 6

(a) A blackbody radiates maximum energy when its surface temperature T and the corresponding wavelength λ_{max} are related by the equation λ_{max} T = constant. Given the values of the constant and surface temperature as 2.9 x 10^{-3} mK and 57 ^oC respectively, calculate the frequency of the energy spectrum.

Very few candidates attempted this question and most of them had it wrong.

The expected solution is:

$\lambda_{max} = \frac{2.9\ x\ 10^{-3}}{330}$

$= 8.8 \text{ x } 10^{-6}$ m

Frequency $f = \frac{c}{\lambda}$

$= \frac{3.0\ x\ 10^8}{8.8\ x\ 10^{-6}}$

= 3.4 x 10^{13} Hz

Question 7

(a) What does the acronym LASER stand for?
(b) What is a laser?

Most candidates were able state what the acronym LASER stands for as demanded in (a) but many could not state what laser is.

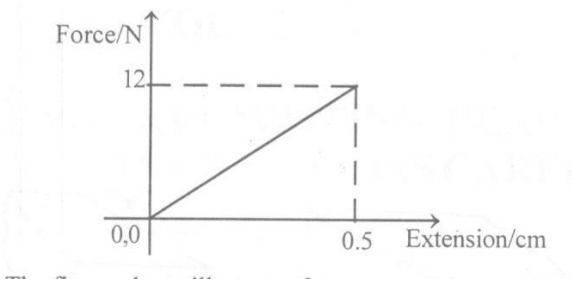
The expected answer is

(a) LASER – Light Amplification by Stimulated Emission of Radiation.
(b) Laser is a device that generates an intense beam of coherent monochromatic light.

Question 8

(a) Define uniform acceleration.
(b) Forces act on a car in motion. List the:
(i) horizontal forces and their directions;
(ii) vertical forces and their directions.
(c) A car starts from rest and accelerates uniformly for 20 s to attain a speed of 25 m s^{-1}. It maintains the speed for 30 s before decelerating uniformly to rest. The total for the journey is 60 s.
(i) Sketch a velocity – time graph for the motion.
(ii) Use the graph to determine the:
(α) total distance travelled by the car;
(β) deceleration of the car.
(d) The figure above illustrates force – extension graph for a stretched spiral spring.

Determine the work done on the spring.



The question was wrongly answered by most candidates. They did not realize that acceleration is as a result of increasing velocity. The expected response is:
Uniform acceleration is the constant time rate of increase in velocity.

Few candidates were able to list the forces and their directions.
These forces are:

(i) Horizontal forces

Thrust- forward
Friction –backward

(ii) Vertical forces

Weight of the car –acts downward
Normal reaction – acts upward

Most candidates who attempted this question could sketch the velocity time graph.

Most candidate were not able to use the graph to fine deceleration.

(ii) (α) Total distance = Area under the graph

$= {}^{1}/_{2}(60 + 30) \times 25$

$= 1125$ m

(β) Deceleration = $\frac{\Delta v}{\Delta t}$

$= \frac{25}{10}$

$= \underline{2.5 \text{ m s}^{-2}}$

Most candidates gave wrong solution to this question.
The expected solution is –
Work done = Area under the graph

$= \frac{1}{2} \times 0.5 \times 10^{-2} \times 12$

$= \underline{3 \times 10^{-2} \text{ J}}$

Question 9

(a) List two factors each that affect heat loss by
- **(i) radiation;**
- **(ii) convention.**

(b) State two factors that determine the quantity of heat in a body.

(c) Explain the statement: The specific latent heat of vaporization of mercury is 2.72×10^5 J kg^{-1}.

(d) A jug of heat capacity 250 J K^{-1} contains water at 28 ^{o}C. An electric heater of resistance 35 Ω connected to a 220 V source is used to raised the temperature of the water until it boils at 100^{o}C in 4 minutes. After another 5 minutes, 300 g of the water has evaporated. Assuming no heat is lost to the surroundings, calculate the:
- **(i) mass of water in the jug before heating;**
- **(ii) specific latent heat of vaporization of steam.**

(specific heat capacity of water – 4200 J kg^{-1} K^{-1})

(a) Most candidates were able to list one instead of two factors. The expected answers are:

(i) **<u>Radiation</u>**

- Surface area
- Temperature
- Nature of the surface.

(ii) **<u>Convection</u>**

- Nature/type of fluid
- Density/viscosity of fluid
- Thermal conductivity of fluid
- Specific heat capacity of fluid
- Exposed surface area

(b) This question was correctly answered by most candidates who attempted it.

(c) Most candidates did not realize that this phenomenon occurs at the boiling point of mercury and therefore gave wrong answers.
The statement means that 2.72 x 10^5 J of heat energy is required to change 1 kg of mercury at its boiling point to vapour (without temperature change)

(d) Candidates had difficulty in solving this problem. The expected solution is:
Heat supplied by heater = Heat gained by water + Heat gained by jug

(i) $\frac{v^2}{R} \times t = m_w c_w (\theta_2 - \theta_1) + C_j (\theta_2 - \theta_1)$

$\frac{220^2 x 4 x 60}{35} = m_w \times 4200 (100-28) + 250(100 - 28)$

$m_w = \underline{1.038 \text{ kg}}$

(ii) $m_{vLv} = \frac{v^2}{R} x\ t$

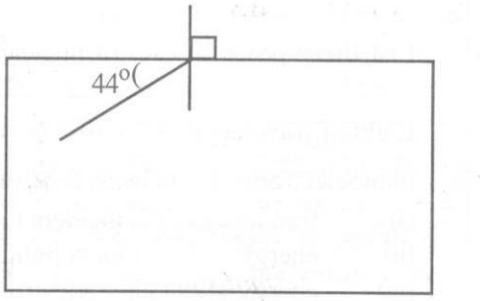
$_{Lv} = \frac{200^2}{35x.0.3} \times 5 \times 60$

$= \underline{1.38 \times 10^6 \text{ J kg}^{-1}}$

Question 10

(a) Define *diffraction.*

(b) (i) Explain critical angle.



(ii) The diagram above illustrates a ray of light passing through a rectangular transparent plastic block.

(α) Determine the value of the angle.

(β) Calculate the refractive index of the block.

(c) A pipe closed at one end has fundamental frequency of 200 Hz. The frequency of the first overtone of the closed pipe is equal to the frequency of the first overtone of an open pipe. Calculate the:

(i) fundamental frequency of the open pipe;

(ii) length of the closed pipe;

(iii) Length of the open pipe.

(Speed of sound in air = 330 ms^{-1}]

(a) Most candidates were able to define diffraction.

(b) Few of them could explain critical angle:

Critical angle, c, is the angle of incidence, in the denser medium for which the angle of refraction in the less dense medium is 90.

$$n = \frac{1}{Sin\ c}$$

(ii)

(c) Few candidates were able to solve this problem.

The expected solution is-

Closed pipe

First overtone = $3f_o$

$= 3 \times 200 = 600$ Hz

(i) **Open pipe**

First overtone = $2\ f_o = 600$

$f_o = 300$ Hz

(ii) **Closed pipe**

$f_o = \frac{3v}{4l}$

$600 = 3 \times \frac{330}{4l}$

$l = \underline{0.412 \text{ m}}$

(iii) **Open pipe**

$f_1 = \frac{v}{l}$

$600 = \frac{330}{l}$

$l = \underline{0.55 \text{ m}}$

Question 11

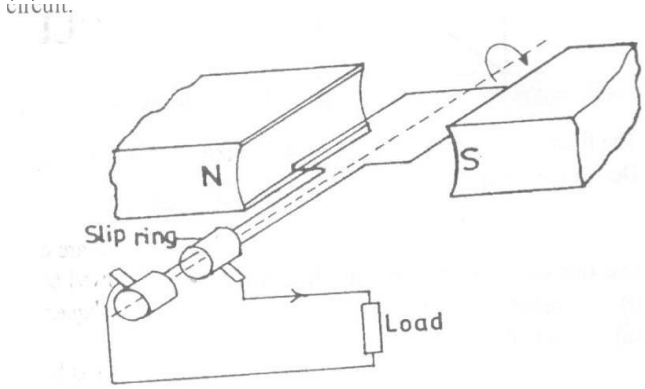
(a) Define:

(i) resistance;

(ii) impedance;

in an a.c. circuit.

(b)



The diagram above illustrates an a.c. generator. When the coil is rotated, an e.m.f. is induced in the coil.

(i) Explain why am e.m.f. is induced.

(ii) State the purpose of the slip-rings.

(iii) Name and state the law used to determine the direction of the induced current.

(iv) State two ways to increase the induced e.m.f.

(c) A lamp is rated 12 V, 6 W. Calculate the amount of energy transformed by the lamp in 5 minutes.

(a) Most candidates were not able to define resistance and impedance correctly. Some appeared not to know the difference between a d. c. circuit and an a. c. circuit. The expected responses are:

(i) Resistance is the opposition to the flow of a. c. by the resistive component.
(ii) Reactance is the opposition to an a. c. by both reactive and resistive components.

(b) Very few candidates were able to give correct responses to the questions above [in (b)].

The expected answers are:
(i) Emf is induced because the coil cuts the magnetic flux/magnetic lines of force
(ii) Slip-rings ensure that the direction of current is reversed in each half of the rotation of the coil.
(iii) Lenz law, which states that- the direction of the induced current is such as to oppose the change producing it.
(iv) The emf can be increased by
- increasing the speed of rotation.
- increasing the number of turns in the coil
- increasing the areas/diameter of coil
- efficient core design.

(c) Many candidates were able to calculate the energy transformed.
Expected solution:
$E = Pt$
$= 6 \times 5 \times 60$
$= \underline{\underline{1800\ J}}$

Question 12

(a) Define binding energy in an atom.
(b) List three evidence to support the claim that X – rays are electromagnetic waves.
(c) List three peaceful uses of nuclear energy.
(d) Light of wavelength 4.5×10^{-7} m is incident on a metal resulting in the emission of photoelectrons. If the work function of the metal is 3.0×10^{-19} J.
Calculate the:
(i) frequency of the incident light
(ii) energy of the incident light;
(iii) energy of the photoelectrons.
[Speed of light = 3.0×10^{8} m s^{-1}, h = 6.6×10^{-34} J s]

(a) Some of the candidates defined binding energy correctly.
Binding energy is the minimum work/energy required to separate the nucleons of an atom.
OR
The minimum work/energy required to remove an electron from the influence of the nucleus.

(b) Most candidates attempted sub questions (b) and (c); and they performed fairly well.

The required evidences are: X-rays

- Are not affected by electric/magnetic fields
- Can travel through vacuum.
- Can be polarized
- Causes fluorescence

(c) Peaceful uses of nuclear energy:

- Generate electricity
- Treatment of tumour
- Power submarines/rocket
- Food irradiation

(d) Few candidates solved these problems correctly. The expected solutions are:

(i) $C = f\lambda$

$f = \frac{3.0 \times 10^{8}}{4.5 \times 10^{-7}}$

$= \underline{6.67 \times 10^{14}\ Hz}$

(ii) $E = hf$

$= 6.6 \times 10^{-34} \times 6.67 \times 10^{14}$

$= 4.4 \times 10^{-19}\ J$

(iii) K.E. = E- W

$= 4.4 \times 10^{-19} - 3.0 \times 10^{-19}$

$= \underline{1.4 \times 10^{-19}\ J}$

PHYSICS 3

1. GENERAL COMMENTS

The standard of the three Alternatives A, B and C was not different as compared with those of previous years. The questions were such that candidates who had early exposure to practical lessons in physics had little or no problems in performing the experiments. Candidates with the right attitude presented their answers in an orderly manner.

There were a lot of candidates whose performance were abysmal. The right attitude to the practical examination was simply non-existent. The reason for this could either be that the candidates did not have the right calibre of physics teachers, or if they had the right teachers at post, very little time might have been allotted to practical lessons. Somehow such candidates were neglected and so they could not even produce a table for recording their readings.

2. A SUMMARY OF CANDIDATES' STRENGTHS

The following commendable features were noted in candidates' answers. It is hoped that teachers would incorporate them in their teaching.

(1) Presentation of readings in composite table.

(2) Attachment of correct units to measured quantities.

(3) Reasonable scales for plotting graph points.

(4) Reduction in the incidence of inconsistent decimal places in the columns of table of readings.

(5) Choice of reasonable scales for plotting graph points.

(6) Correct labelling of axes.

(7) Determination of slope over large area of graph

3. A SUMMARY OF CANDIDATES' WEAKNESSES

(1) Continual failure to record length/distances measured with metre rule/ruler to the required accuracy of at least 1 dp in cm.

(2) Failure to record some derived quantities to reasonable place of decimal.

(3) Inaccurately rounding off decimal values.

(4) Inability to make deductions from graph.

(5) Failure to explain some terms and write correct statement of laws and principles.

(6) Inability to distinguish between time t for a number of oscillations and periodic time T.

(7) Use of odd scales for plotting graph points.

(8) Inability to plot graph points correctly to the accuracy of chosen scale.

4. SUGGESTED REMEDIES

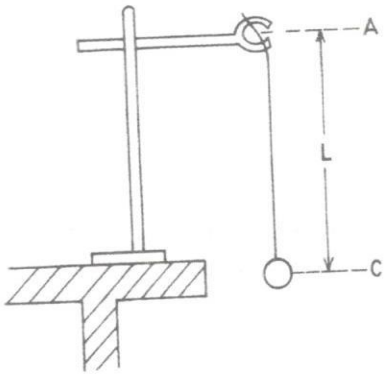
Teachers should introduce their students to practical work right from the beginning of the physics course. Early exposure of students to practical work will allow them to acquire the necessary skills before they write the final examination papers. Marking of students' practical work is also essential in this regard.

Heads of school also play important role in equipping students with the requisite practical skills. They are to see to the provision of the basic materials and equipment needed in the physics laboratory to enhance teaching and learning.

5. DETAILED COMMENTS

ALTERNATIVE A
Question 1

(a)



You are provided with a pendulum bob, a metre rule, a stop watch, a retort stand with clamp and other necessary apparatus.

(i) Suspend the pendulum bob from the clamp as illustrated in the diagram.
(ii) Adjust the pendulum such that AC = 90 cm.
(iii) Displace the pendulum bob slightly, such that it oscillates in a vertical plane.
(iv) Measure and record the time t for 20 complete oscillations.
(v) Evaluate T and $\sqrt{L}$.
(vi) Repeat the procedure for four other values of L = 80 cm, 70 cm, 60 cm and 50 cm.

(vii) Tabulate your readings.

(viii) Plot a graph with log T on the vertical axis and $\sqrt{L}$ on the horizontal axis.

(ix) Determine the slope, s, of the graph.

(x) Evaluate: $\mathbf{g = \frac{4\pi^2}{S^2}}$

(xi) State two precautions taken to ensure accurate results.

(b) (i) Determine from your graph the period of the pendulum for L = 75 cm

(ii) A simple pendulum bob is set into simple harmonic motion. Sketch a diagram of the set-up and indicate on it, the positions of:

(α) maximum velocity;

(β) maximum acceleration of the bob.

Observations:

The experiment required the measurement of time t for 20 oscillations and candidates' values fell within the expected range, 27.0 s to 39.0 s. Candidates' evaluated values of periodic time T, logT and $\sqrt{L}$ were within the required decimal places or significant figures. As usual most candidates did not record the pendulum length L to at least 1 dp in cm as expected.

Graph:

- The axes were clearly and correctly labelled with units.
- Reasonable scales were used for the axes.
- A lot of candidates did not get the line of best fit right.
- Calculation of slope was done over a large area of the graph.

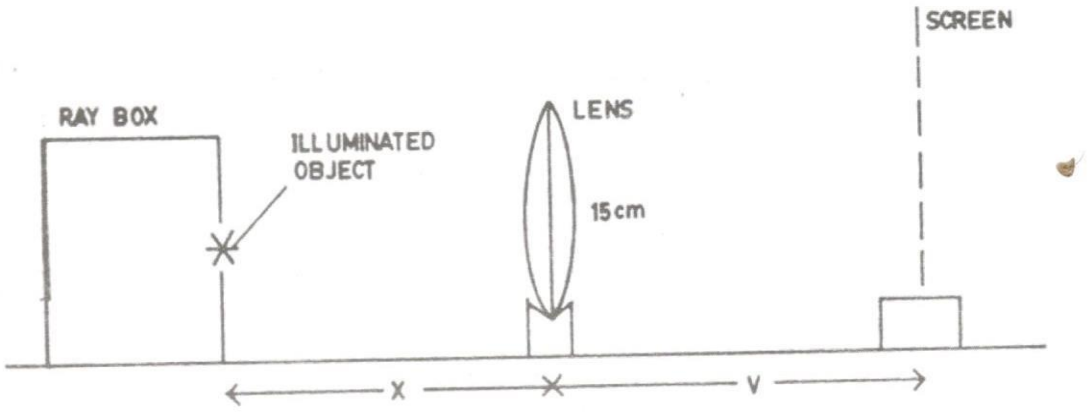
b (i) A lot of candidates could not determine from the graph the period T for L = 75 cm.

The required steps are*:*

- *Evaluation of* $\sqrt{75}$ *= 8.66*
- *Showing 8.66 on the graph*
- *Corresponding* $\sqrt{T}$ *read from graph*
- *T correctly evaluated*

(ii) the positions of maximum velocity and acceleration of an oscillating pendulum were correctly shown.

Question 2



You are provided with a metre rule, lens, screen, ray box and other necessary apparatus.

(i) Set up the experiment as shown in the diagram. Measure and record the diameter a_o of the illuminated object.
(ii) Place the object at a distance x = 25 cm from the lens. Adjust the screen until a sharp image is obtained on the screen.
(iii) Measure and record the diameter, a, of the image.
(iv) Measure and record the distance, v, between the lens and the screen.
(v) Evaluate $y = \frac{a}{a_o}$, $P = \frac{1+y^2}{y}$ and T = x + v.
(vi) Repeat the procedure x = 30 cm, 40 cm and 45 cm. In each case, determine the corresponding values of a, v, y, P and T.
(vii) Tabulate your results.
(viii) Plot a graph of P on the vertical axis against T on the horizontal axis starting both axis from origin (0, 0).
(ix) Determine the slope, s, of the graph.
(x) Determine intercept, c, on the horizontal axis.
(xi) Evaluate $k = \frac{c}{2}$.
(xii) State two precautions taken to ensure accurate results.

(b) (i) Explain the statement, the focal length of a converging lens is 20 cm.
(ii) An object is placed at a distance *x* from a converging lens of focal length 20 cm. if the magnification of the real image formed by the lens is 5, calculate the value of *x*.

***Observations**:*
*The candidates correctly measured the diameter a_o of the illuminated object, the object distances x and their corresponding image distances **v**. The quantities y, P and T were also evaluated by the candidates.*

The values of x in the question were presented as x = 25 cm, 30 cm, 35 cm, 40 cm and 45 cm, the candidates were, however, expected to record them as x = 25.0 cm, 30.0 cm, 35.0cm 40.0 cm and 45.0 cm for them to reflect the accuracy of the metre rule used to measure them. Sadly, enough a lot of candidates recorded them without any decimal points

Graph:

The candidates complied with the directives by starting both axes from the origin (0,0) and proceeded to find the intercept, c, on T axis and eventually evaluated k = ½ c. Very few candidates managed to get the accuracy mark which was based on k.

b i. The focal length of a converging lens is 20 cm.

The statement was not properly explained by the candidates. It means the distance between the principal focus and the optical centre of the lens is 20 cm.
ii. A large number of candidates could not go beyond quoting the lens formula.

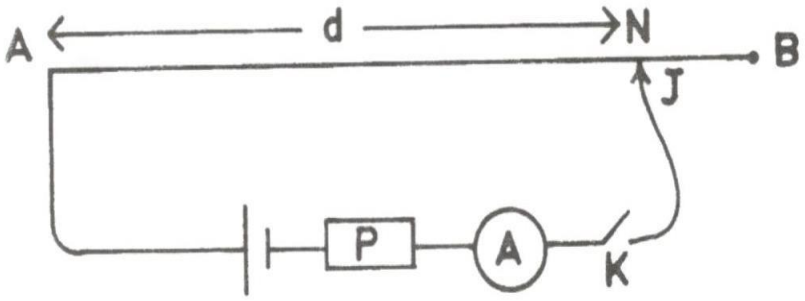
$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ $x = f(1 + \frac{1}{m})$ $x = 20(1 + \frac{1}{5})$ $x = 24$ cm

OR

$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ If $u = x$, $v = 5x$ $\frac{1}{x} + \frac{1}{5x} = \frac{1}{20}$ $x = 24$ cm

Question 3

(a)



You are provided with an ammeter, resistor, key, metre bridge and other necessary apparatus.

(i) Connect a circuit as shown in the diagram above.
(ii) Close the key and use the jockey to make contact with AB at N such that AN = d = 25 cm.
(iii) Read and record the ammeter reading I.
(iv) Evaluate I^{-I}.
(v) Repeat the procedure for values of d = 35 cm, 50 cm, 65 cm and 80 cm. in each case, record I and determine I^{-I}.
(vi) Tabulate your results.
(vii) Plot a graph with I^{-I} on the vertical axis and d on the horizontal axis.
(viii) Determine the slope, s, of the graph.
(ix) State two precautions taken to ensure accurate results.

(b) (i) Use your graph to determine the value of d when I = 1.5 A.
(ii) State two factors which affect the resistance of a wire.

Observations:

The candidates measured different lengths, d, of the metre bridge wire connected in the circuit and their corresponding ammeter readings, I. I decreased as d increased as was expected. The

candidates proceeded to evaluate I^{-1} in each case. As usual the candidates did not record the values of d to reflect the accuracy of the metre rule used for their measurement.

b i. The graphical determination of d when I =1.5 A was not correctly done by the candidates.

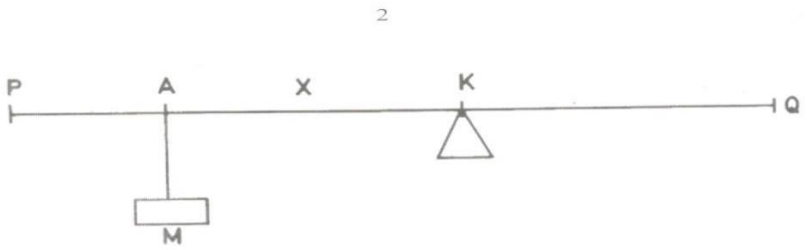
The candidates should have followed the following steps,

- Determination if I^{-1} from I = 1.5 A i.e. $I^{-1} = 1.5^{-1} = 0.67$
- $I^{-1} = 0.67$ correctly shown on the graph.
- Corresponding value of d read from the graph.

ii. Candidates expertly stated two factors which affect the resistance of a wire.

ALTERNATIVE B

Question 1



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

(i) Balance the metre rule on the knife edge and determine the centre of gravity G.

(ii) Suspend the mass M = 50 g at the point A = 5 cm mark of the metre rule and balance the whole arrangement on the knife edge.

(iii) Read and record the balance point K and determine the distance x between A and K.

(iv) Evaluate $\frac{1}{x}$.

(v) Repeat the procedure with masses M = 70 g, 110 g, 130 g and 150 g.
In each case, read k and determine x and $\frac{1}{x}$.

(vi) Tabulate your results.

(vii) Plot a graph with M on the vertical axis and $\frac{1}{x}$ on the horizontal axis starting both axes from the origin (0, 0).

(viii) Determine the slope, s, of the graph.

(ix) From your graph, read and record the value of M when $\frac{1}{x} = 0$.

(x) State two precautions taken to obtain accurate results.

(b) (i) Define moment of a force about a point.

(ii) Two parallel and opposite forces of 20 N each act on a body. If the perpendicular distance between the forces is 0.5 m, calculate the magnitude of the moment of the couple.

Observations: A lot of candidates did not record the centre of gravity G of the metre rule used in the experiment. Candidates placed different masses, M, at point A = 5cm of the rule and in each case determined the balance point K of the arrangement on the knife edge. Candidates correctly evaluated the distance x = (K – 5) for each suspended mass M.

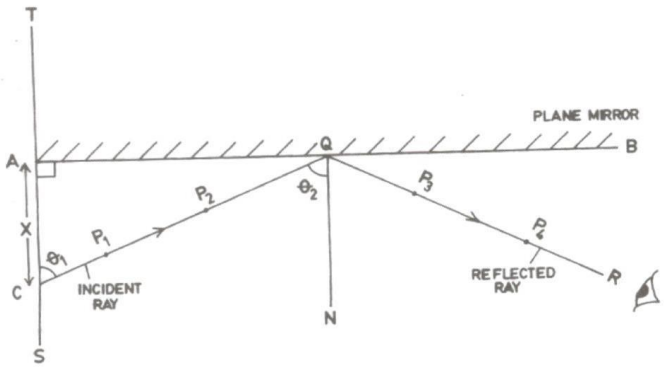
Graph. A lot of candidates correctly interpreted the value of M when $x^{-1} = 0$ as the intercept on the M axis. The intercept was at the negative part of the M axis.

A respectable number of candidates who could not read the intercept directly from the graph did not put the origin (0, 0) of the graph axes at the right place on the graph paper.

b (i) *Moment of a force about a point could not be defined by most candidates.* The correct statement is as follows: **The moment of a force about a point is the product of the (magnitude of the) force and the perpendicular distance from the point to the line of action of the force.**
(ii) The magnitude of the moment of couple in the question was correctly calculated by the candidates.

Question 2

(a)



You are provided with a plane mirror, drawing board, plain sheets, optical pins and other necessary apparatus.

Use the diagram above as a guide to perform the experiment.

(i) **Fix the drawing paper to the drawing board.**

(ii) **Place the mirror vertically with its longer side resting on the drawing paper. Drawing a straight line AB to represent the reflecting surface of the mirror. Remove the mirror.**

(iii) **Draw a normal NQ to meet AB at its midpoint Q.**

(iv) **Draw a straight line ST throughout A, to meet AB at right angles.**

(v) **Measure a distance AC = x = 1.5 cm**

(vi) **Draw a line CQ to represent an incident ray. Place two pins P_1 and P_2 on CQ.**

(vii) **Replace the mirror on AB.**

(viii) **Place two other pins, P_3 and P_4 to be on a straight line with the images P_1P_2.**

(ix) **Remove the mirror and the pins.**

(x) **Draw a straight line through the positions P_3 and P_4 to meet AB at Q.**

(xi) **Measure and record angle ACQ as θ_1 and angle CQA as θ_2.**

(xii) **Evaluate x^{-1} and tan θ_2.**

(xiii) **Repeat the procedure for four other values of x = 2.5 cm, 3.5 cm, 4.5 cm and 6.0 cm.**

(xiv) **Tabulate your readings.**

(xv) **Plot a graph with tan θ_2 on the vertical axis and x^{-1} on the horizontal axis.**

(xvi) **Determine the slope, s, of the graph.**

(xvii) **State two precautions taken to obtain accurate results.**

[Attach your traces to your answer booklet.]

(b) **(i)** **Distinguish between regular and diffused reflections.**

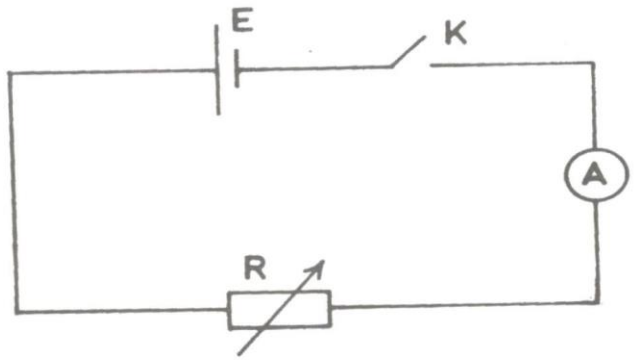
(ii) **An object is placed 25 cm in front of a plain mirror. Determine the distance of the image from the object and the size of the image relative to the object.**

Step (xi) of the question gave room for two different interpretations regarding the actual position of angle **θ_2** in the diagram used as a guide. Consequently, some candidates measured angle **CQA** as **θ_2** while others measured angle **CQN** as **θ_2**. It must be stated that both cases were accepted so the candidates did not suffer any losses. It must also be noted that the use of angle **CQN** for **θ_2** resulted in a straight line graph while angle **CQA** as **θ_2** resulted in a curve.

b. Candidates answered questions (i) and (ii) correctly.

Question 3

(a)



You are provided with an ammeter, resistance box, key and other necessary apparatus.

(i) Connect a circuit as shown in the diagram above.

(ii) Select the value of R = 1 Ω from the resistance box and record the current I of the ammeter.

(iii) Evaluate I^{-I}.

(iv) Repeat the procedure for four other values of R = 2 Ω, 4 Ω, 5 Ω and 7Ω. In each case, record the value of I and determine I^{-I}.

(v) Tabulate your results.

(vi) Plot a graph with I^{-I} on the vertical axis and R on the horizontal axis.

(vii) Determine the slope, s, of the graph and the intercept, c, on the I^{-I} axis.

(viii) Evaluate $\frac{c}{s}$.

(ix) State two precautions taken to ensure accurate results.

(b) (i) Use your graph to determine the value of I when R = 10 Ω.

(ii) State two differences between a shunt and multiplier.

The candidates were able to perform the electricity experiment. The ammeter readings and their corresponding resistances were in trend as expected.

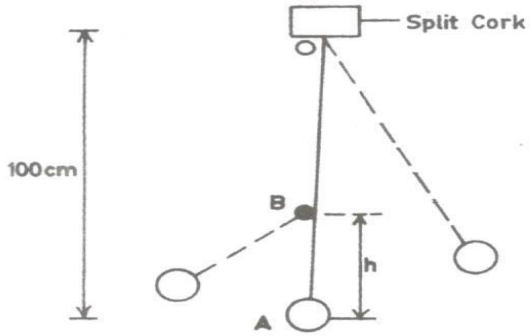
Graph: Though the question did not specify the starting point of the axes, the candidates saw the need to start from the origin (0,0) in order to determine the intercept, c, on the I^{-1} axis.

b(i) Determination of I when R = 10 Ω.

The candidates produced the graph in 3(a) without making provision for b (i). Hence a lot of candidates were unable to answer this question since R = 10 Ω was not obtainable on their graph axis.

ALTERNATIVE C
Question 1

(a)



You are provided with a retort stand with a clamp, thread, stop watch, stopper, bob and other necessary apparatus.

(i) **Suspend a simple pendulum such that its length OA = 100 cm and maintain it throughout the experiment.**

(ii) **Fix the stopper such that it just touches the string of the pendulum at B while in equilibrium position.**

(iii) **Set the distance AB = *h* = 45 cm.**

(iv) **Displace the pendulum through a small angle such that as it swings, the string makes contact with the stopper.**

(v) **Measure and record the time t for 20 oscillations**

(vi) **Determine the period T.**

(vii) **Evaluate $h^{\frac{1}{2}}$.**

(viii) **Repeat the procedure for four other values of h = 55 cm, 65 cm, 75 cm and 85 cm.**

(ix) **Tabulate your readings.**

(x) **Plot a graph with T2 on the vertical axis and h on the horizontal axis.**

(xi) **Determine the slope, s, of the graph.**

(xii) **Determine the intercept, c, on the vertical axis.**

(xiii) **Evaluate $(\frac{1}{s})^2$**

(xiv) **State two precautions taken to ensure accurate results.**

(b) **(i)** **Define amplitude of an oscillating body.**

(ii) **A body of mass of 0.5 kg revolves in a horizontal circle of radius 0.7 m with a period 0.5 s. Calculate the centripetal force acting on the body.**

Observations. The candidates measured the time t for 20 oscillations with respect to each distance h of the interrupted pendulum. They proceeded to find the periodic time T, T^2 and $\boldsymbol{h^{\frac{1}{2}}}$corresponding to each value of h.

Graph. The candidates realized the importance of starting the graph axis from the origin so as to determine the intercept, c, on the T^2 axis.

b (i). Amplitude of an oscillating body was correctly defined by the candidates.

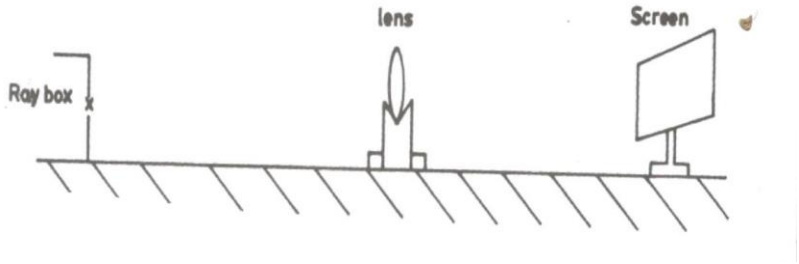
(ii) A lot of candidates had difficulty in answering the question. The solution is presented below.

Centripetal force, $F_{c} = m\left(\frac{2\pi}{T}\right)^2 r$

$= 0.5(\frac{2\pi}{0.5})^2 x\ 0.7 = 55.27N$

Question 2

(a)



You are provided with a ray box, lens holder, lens, metre rule, screen and other necessary apparatus.

(i) **Determine the appropriate focal length, f, of the lens.**

(ii) **Arrange the ray box, lens and screen in a colinear/straight line as shown in the diagram above.**

(iii) **Adjust the position of the screen such that its distance L from the ray box is 100 cm.**

(iv) **Move the lens between the ray box and the screen to a position, where a sharp image is formed on the screen. Record the position P_1.**

(v) **Now move the lens again to a position where another sharp image is formed on the screen. Record the position P_2.**

(vi) **Determine the distance $d = |P_1 - P_2|$.**

(vii) **Evaluate $\frac{d^2}{L}$.**

(viii) Repeat the procedure for four other values of L = 95 cm, 90 cm, 85 cm and 82 cm. In each case determine *d* and $\frac{d^2}{L}$.

(ix) Tabulate your results.

(x) Plot a graph with $\frac{d^2}{L}$ on the vertical axis against L on the horizontal axis.

(xi) Determine the slope, *s*, of the graph and the intercept, *c*, on the L axis.

(xii) State two precautions taken to ensure accurate results.

[Attach your traces to your answer booklet]

(b) (i) Draw a ray diagram to show how a converging lens is used as a simple microscope.

(ii) An erect image 3 times the size of the object is formed by a converging lens of focal length 15 cm. Calculate the object distance.

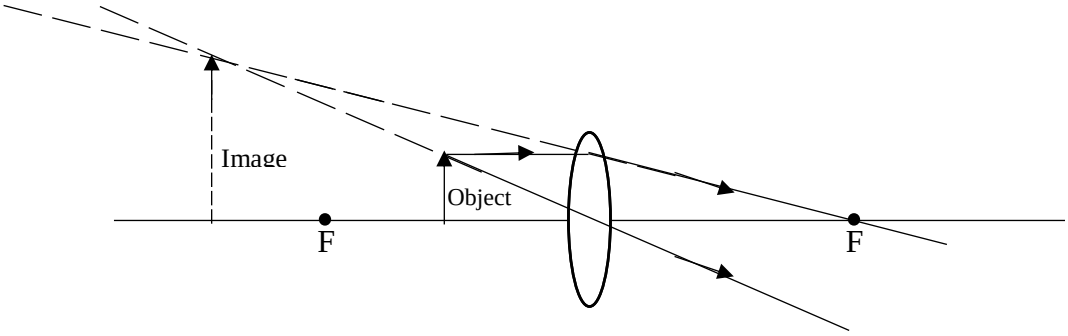
Observations

A lot of candidates did not know that the approximate focal length of a converging lens could be determined by using the lens to form the image of a distant object on a screen. The distance between the lens and screen is the approximate focal length of the lens.

For each value of L, the candidates correctly determined two positions P_1 and P_2 of the lens where clear images were formed on the screen. They evaluated $d = | P_1 - P_2 |$ and $\frac{d^2}{L}$.

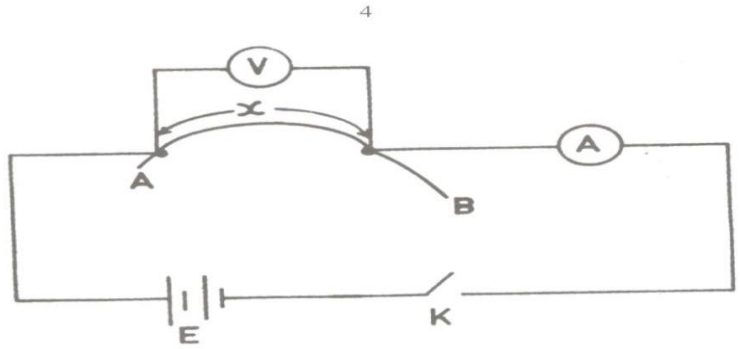
Graph. The candidates started the axes from the origin to enable them to determine the intercept on the on the L axis.

b(i) A lot of candidates could not draw a ray diagram to show how a converging lens acts as a simple microscope. Below is one such diagram.



Question 3

(a)



You are provided with an ammeter, constantan wire AB, battery E, voltmeter V, key K and other necessary apparatus.

(i) **Measure and record the emf, E, of the battery.**

(ii) **Connect a circuit as shown in the diagram above such that length AB = x = 20 cm.**

(iii) **Close the key. Read and record the voltmeter reading V.**

(iv) **Also read and record the corresponding ammeter reading I.**

(v) **Evaluate $Q = \frac{V}{I}$, V^2 and $P = \frac{V^2}{Q}$.**

(vi) **Repeat the procedure for four other values of x = 40 cm, 60 cm, 80 cm and 100 cm.**

(vii) **Tabulate your readings.**

(viii) **Plot a graph with P on the vertical axis and x on the horizontal axis.**

(ix) **Determine the slope, *s*, of the graph.**

(x) **Use your graph to determine the value of x for which P is maximum.**

(xi) **State two precautions taken to obtain accurate results.**

(b) **(i)** **State two advantages of connecting lamps in parallel in a straight circuit.**

(ii) **A lamp is rated 6 V, 0.5 A. Calculate the electrical energy transformed per second by the lamp when functioning.**

Observations: Large number of candidates who performed this experiment did not record the e.m.f, E, of the battery.

Candidates voltmeter readings, V, and the ammeter readings, I, were all in trend with the length, x, of the resistance wire connected in the circuit. The quantities Q, V^2 and P were correctly computed by the candidates.

Graph. Some candidates had very good experimental results. Their graph of P on the vertical axis and x on the horizontal axis resulted in a curve just as expected. Those candidates were able to record the value of x for which P was maximum.

The other students who did not painstakingly perform the experiment, their graphs resulted in scattered points or straight lines. Obviously, such candidates were not able to find a value for x for which P was maximum.

b. The candidates could state two advantages of connecting lamps in parallel. The electrical energy transformed per second was also easily dealt with.