

RESUME OF THE CHIEF EXAMINER'S REPORTS FOR THE SCIENCE PAPERS

1. STANDARD OF THE PAPERS

All the Chief Examiners for the Science Papers reported that the standard of the paper compared favourably with that of previous years and the questions were unambiguous.

2. PERFORMANCE OF CANDIDATES

According to the Chief Examiners, the performance of Candidates varied. Candidates for Integrated Science 2 and 3, Biology 2, Crop Husbandry and Horticulture 2, Fisheries 2 and 3 and Forestry 3 were reported to have exhibited an improved performance. The Chief Examiners for General Agriculture 2 and Animal Husbandry 3 reported that candidates performed poorer. Again other Chief Examiners including those for Physics 2 and 3, Chemistry 2 and 3, Biology 3, General Agriculture 3, Animal Husbandry 2, Crop Husbandry and Horticulture 2 and Forestry 3 rated the performance of candidates as comparable to those of previous years.

3. A SUMMARY OF CANDIDATES' STRENGTHS

- (1) Obeying the rubrics of the paper
Candidates for Integrated Science 2, Physics 3, Biology 2, General Agriculture 2, Animal Husbandry 3, Fisheries 2 and 3 were commended by the Chief Examiners for adhering to the rubrics of the papers.
- (2) Provision of concise answers
The Chief Examiners for Physics 2, Chemistry 2, Biology 3, Animal Husbandry 2 and 3 reported that candidates provided concise and precise answers to questions.
- (3) Orderly presentation of response
Most of the candidates presented their responses in an orderly manner. The Chief Examiners for Integrated Science 2 and 3, Physics 2 and 3 and Chemistry 2 and 3 commended candidates for exhibiting this trait.
- (4) Improvement in usage of the English Language
It was gratifying to note that the Chief Examiners for Integrated Science 3 and Biology 3 reported that there was an improvement in the usage of the English language by candidates
- (5) Improved practical skills
Candidates for Biology 2 and 3, General Agriculture 3 and Crop Husbandry and Horticulture were commended by the Chief Examiners for their improved practical skills.
- (6) Good computational skills
The Chief Examiners for Physics 2 and Chemistry 3 reported that candidates exhibited a high level of computational skills.
- (7) Legible handwritings
Most of the candidates were reported to have written their responses legibly which made working easy. This feature was noted by the Chief Examiners for Integrated Science 2 and 3, Chemistry 2, Biology 3, General Agriculture 2 and 3,

Animal Husbandry 3, Crop Husbandry and Horticulture 2, Fisheries 2 and 3 and Forestry 2 and 3.

4. A SUMMARY OF CANDIDATES WEAKNESSES

- (1) Non- adherence to rubrics of the papers
The Chief Examiners for chemistry 2, Biology 3 and Crop Husbandry and Horticulture 3 reported that candidates did not adhere to the rubrics of the papers.
- (2) Improper usage of the English Language
The Chief Examiners for Chemistry 2, Biology 2, Crop Husbandry and Horticulture 2 and Integrated Science 2 expressed concern over improper usage of the English Language by the candidates. They noted that examiners found it difficult to understand what the candidates wanted to put across.
- (3) Inadequate preparation
According to some of the Chief Examiners, the responses of candidates showed that they were ill – prepared for the examination. This was noted for physics 2 and 3, Chemistry 2 and 3, General Agriculture 3, Animal Husbandry 2 and 3, Fisheries 3, Forestry 2 and 3 and Integrated Science 2 and 3.
- (4) Misunderstanding of questions
Most candidates for Physics 2, Biology 2 General Agriculture 2 and Animal Husbandry 2 did not seem to understand some of the questions that were set. This was reported by the respective Chief Examiners.
- (5) Inadequate knowledge of scientific concepts
The response of candidates for Physics 2 and 3, Chemistry 3, Fisheries 2 and Forestry 2 showed that they lacked in-depth knowledge of scientific concepts
- (6) Poor spelling of scientific terms
Some candidates found it difficult to correctly spell common scientific terms. This was reported by the Chief Examiners for Biology 2 and 3, General Agriculture 2 and 3, Animal Husbandry 2 and 3, Crop Husbandry and Horticulture 3, Forestry 3 and Integrated Science 2.
- (7) Bad handwriting
The Chief Examiners for Chemistry 2 and Crop Husbandry and Horticulture 2 noted that it was difficult to mark the scripts of some candidates due to poor handwritings.

5. SUGGESTED REMEDIES

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

- (1) Teachers should endeavor to cover all topics in the syllabus.
- (2) Candidates should carefully read and understand examination questions before they attempt to answer them.
- (3) Students are advised to take lessons in mathematics seriously
- (4) Students should read good story books in order to improve upon their usage of the English Language.
- (5) Teachers should teach their students the conventions of writing scientific terms.

ANIMAL HUSBANDRY 2

1. GENERAL COMMENTS

The standard of the paper was comparable to that of previous paper. The general performance was average.

2. A SUMMARY OF CANDIDATES' STRENGTHS

The following strengths were noted:

- (1) Provision of concise answers
- (2) Legible handwriting

3. A SUMMARY OF CANDIDATES' WEAKNESSES

The Chief Examiner noted the following weaknesses:

- (1) Inadequate preparation
- (2) Poor understanding of the requirements of some questions.
- (3) Poor expressions and spellings of scientific terms.
- (4) Non adherence to rubrics.

4. SUGGESTED REMEDIES

The Chief Examiner made the following suggestions:

- (1) Teachers and candidates should endeavor to cover the salient points in the syllabus
- (2) It is important that candidates read and follow the rubrics
- (3) Candidates must familiarize themselves with the demands of various examination questions
- (4) Candidates should read good books to improve on their expressions and spelling skills

5. DETAILED COMMENTS

Question 1

- (a) List four grasses that are suitable for the establishment of pasture in Ghana.**
- (b) State four ways in which forage crops are important in animal production.**
- (c) Mention four factors to consider in establishing a snail farm in West Africa.**
- (d) Describe two types of mating in sheep.**

The question was popular with candidates and the general performance was above average.

- (a) The sub-question was straight forward and was well tackled. Most candidates wrote the common names of grasses and not the botanical names. However, some candidates also mentioned leguminous plants instead of grasses.

- (b) Generally, candidates could only give one or two correct answers. Some stated the qualities of forage crops instead of the importance of forage crops. Responses expected from candidates include the following: sources of readily available feed for ruminants; improvement of soil fertility by legumes; erosion control; animals have the opportunity to exercise themselves during grazing; used as roofing and bedding materials.
- (c) It was easily handled by candidates. Few candidates however deviated by stating the importance of snail rearing. A prospective snail farmer must consider the species of snail, the system of snail farming, availability of feed, water, land, capital, market, management skills. The environmental and soil conditions as well as the socio-cultural beliefs of the area/ community are also very important.
- (d) A variety of wrong answers were given by candidates. E.g. natural mating, artificial insemination, tapping, servicing, machine mating, continuous and discontinuous mating, cross breeding. Where candidates gave the correct answers, hand mating, pasture mating and pen mating, the descriptions were sometimes flawed.

Question 2

- (a) (i) **What is a zoonotic disease?**
(ii) **Give four examples of zoonotic diseases.**
- (b) **Mention five modes of transmission of diseases in farm animals.**
- (c) **State five ways in which worms affect farm animals.**
- (d) **Enumerate five factors that should be considered in setting up a commercial livestock farm.**

This was one of the most popular questions answered by candidates. General performance was good.

- (a) (i) & (ii) Candidates were able to define zoonotic disease and give examples. However, it should be noted that zoonotic diseases do not just affect human and animals but are diseases that could be transferred from animal to human and vice versa.
- (b) The question should not pose a problem to candidates. However, a number of candidates were careless in their presentation of their answers. They failed to realise that it is only when food, water, inanimate objects are contaminated that they can transmit diseases. Thus, simple answers like through food, water, inanimate objects are inappropriate. Some of the modes of disease transmission are as follows: direct contact with diseased animals; infection from contaminated food; water and inanimate objects; vector; air-borne and water borne infections.
- (c) This question was misunderstood by a number of candidates. They interpreted it as ways in which worms infest farm animals and therefore provided answers similar to (b). The correct answers include: depriving the host of food nutrients leading to loss in weight; damage to essential organs; blockage of blood vessels; intestines and bile duct; sucking of blood resulting in anaemia; loss of appetite; restlessness.
- (d) Candidates were at home with this question. They were able to enumerate the factors such as capital, availability of land, water, feed/pasture, good foundation stock, labour market.

Question 3

- (a) **State four precautions that should be taken to ensure the production of good quality hay.**
- (b) **Explain each of the following terms as used in livestock production:**
- (i) **zero grazing;**
 - (ii) **flushing;**
 - (iii) **stocking density;**
 - (iv) **parturition.**

This question was not very popular with candidates.

- (a) Candidate had difficulty answering this question. Instead of precautions, quite a number of them stated the characteristics of good quality hay. The precautions include harvesting grass before it flowers, and when the weather is favourable/long dry spell for drying, regular turning of the grass, protection against entry of rain water.
- (b) (i) to (iv) These questions were well tackled by candidates. It should however, be noted that in zero grazing, the herbage is cut and carried to the confined ruminants. Flushing occurs in female animals (not males) and before mating (not before parturition). Stocking density is not total animal reared on the farm. Parturition is also not the stage between fertilization and birth but the act of giving birth to the young ones.

Question 4

- (a) (i) **Define the term respiration in farm animals.**
- (ii) **Give three reasons why respiration is important in farm animals.**
- (b) **State three ways in which each of the following activities is important in commercial sheep production:**
- (i) **weighing;**
 - (ii) **castration;**
 - (iii) **dipping;**
 - (iv) **tagging.**

Another popular question which candidates thought they could easily handle but their limited knowledge and carelessness brought them down. Performance was quite poor.

(a)(i) & (ii) A number of candidates defined digestion instead of respiration. The sub-question (ii) which demanded reasons why respiration is important in farm animals posed a problem to candidates. The common answer provided was the production of energy. Generally, candidates were not very familiar with other correct answers like removal of dioxide from the body, thermoregulation and the provision of metabolic water to the body.

- (b) Generally, candidates' performance was below expectation. A number of candidates defined the terms and mentioned the tools used. Weighing, for instance helps to determine the growth rate, market value and health status of an animal. Castration is done for docility, fat deposition and to control indiscriminate mating. Dipping controls (not prevents) ectoparasites (not endoparasites), reduces skin damage and improves cleanliness of the body.

Tagging does not prevent theft of animals but it reduces it. It is also a means of identification; it aids in record keeping and in the selection of animals for breeding and culling etc.

Question 5

- (a) (i) **Name two components of the autonomic nervous system.**
(ii) **Name two parts of the central nervous system.**
(iii) **State two functions of each of the parts named in (ii).**
- (b) **Mention two ways in which farm animals obtain water.**
- (c) **Give five reasons why a farmer would rear goats instead of cattle.**

- (a) (α)(i) & (ii) This question was poorly answered indicating that the nervous system was not covered by teachers and students.
- (b) Candidates were able to mention two ways in which farm animals obtain water namely through their feed and in drinking water. Additionally, they obtain water from the dew on plant leaves and from metabolism in the body.
- (c) Candidates were able to provide good answers, even though some candidates stated the importance of rearing goats. The reasons for rearing goats include:
- low start-up capital because goats are cheaper to buy
 - goats reproduce earlier and offspring are sold earlier
 - produce more offspring than cattle
 - easier to handle
 - goats are hardier and are therefore reared country-wide
 - goats have higher scavenging ability
 - ability to browse on a variety of forage plants
 - goats have lower requirement for grazing land

Question 6

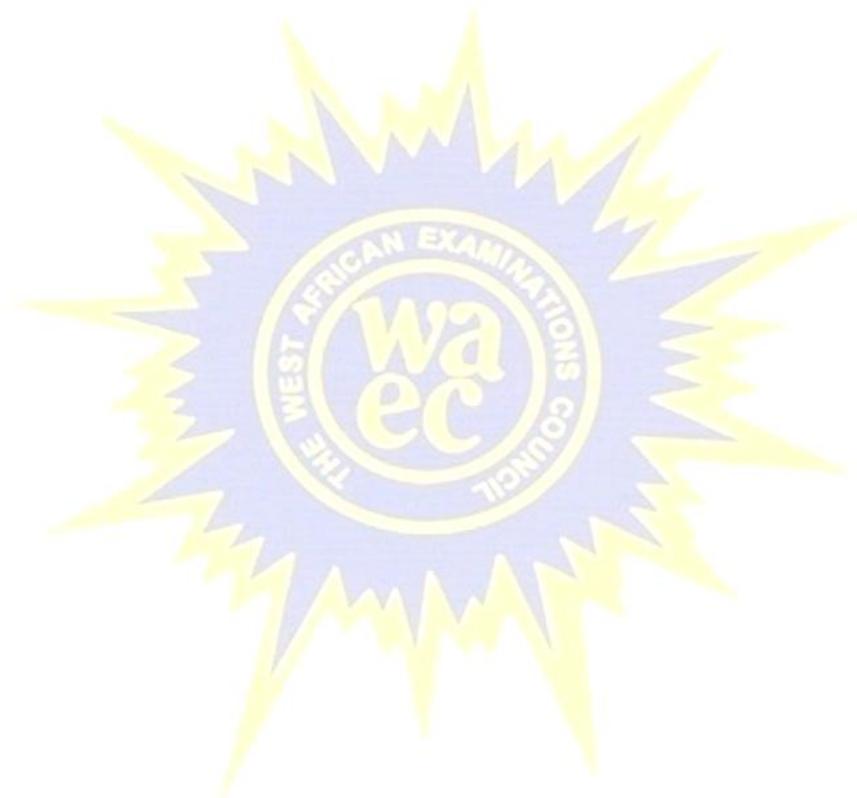
- (a) **Name five tools that could be found in a well managed cattle farm.**
- (b) **State five ways of ensuring good sanitation in a poultry house.**
- (c) **Mention four signs of oestrus in a cow.**
- (d) **Explain three conditions necessary for the successful hatching of poultry eggs.**

This was perhaps the most popular question. Generally, candidates' performance was quite good.

- (a) Candidates were able to name the tool e.g. burdizzo, dehorner, spade, knife, hacksaw/saw.
- (b) Generally, the question was understood and answers given were appropriate. Some of the correct answers are as follows:
Scrab and disinfect the house, wash and disinfect equipment, proper disposal of dead birds, use of footbath, removal of old/wet litter.
- (c) Candidates were conversant with the signs of oestrus in a cow and therefore found this question to be very easy.

Correct answers like frequent urination, restlessness, reduced appetite, mucous discharge from vulva, swelling and reddening of vulva were given. It should be noted that enlargement of udder is not associated with oestrus.

- (d) This sub-question was poorly answered. Even where the condition is stated it did not suggest that the hatching would be successful. For instance, just stating temperature or relative humidity is not enough, if not qualified with the word suitable/ optimum or else the exact temperature or relative humidity should be given. Regular egg turning and ventilation are also essential for successful hatching. Candidates failed to explain the importance of these conditions.



ANIMAL HUSBANDRY 3

1. GENERAL COMMENTS

The standard of the paper was comparable to that of previous years. The general performance of candidates was better.

2. A SUMMARY OF CANDIDATES' STRENGTHS

The Chief Examiner noted the following strengths:

- (1) Candidates provided straight forward answers.
- (2) Legible handwriting.

3. A SUMMARY OF CANDIDATES' WEAKNESSES

The following weaknesses were noticed:

- (1) Inadequate preparation
- (2) Lack of understanding of questions
- (3) Poor spelling of scientific terms

4. SUGGESTED REMEDIES

The Chief Examiner suggested the following remedies:

- (1) Teachers should endeavour to carry out more practical classes during the course of studies.
- (2) Students should be encouraged to learn the correct spelling of simple terms and technical words
- (3) Tutors should ensure that candidates understand the rudiments of the subject.

5. DETAILED COMMENTS

Question 1

- (a)
 - (i) **State three disadvantages of using specimen A (hurricane lantern) in a poultry house.**
 - (ii) **Mention two precautions that should be taken when using specimen A in a poultry house.**
 - (b)
 - (i) **Mention three feedstuffs that could be used in feeding specimen B (snail).**
 - (ii) **State three uses of specimen B.**
 - (c) **State three uses of specimen C (Kitchen knife).**
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- (a)
 - (i) Majority of the candidates provided the required of answers.
 - (ii) Similarly, most of the candidates provided the required answers. However, quite a number of them mentioned that the hurricane lantern be placed far away from the birds to prevent them being burnt instead of the provision of guards to protect the

birds. Other expected answers include avoid spillage of fuel, mend leakages and clean the globe

- (b) (i) This sub-question was also adequately answered by most candidates.
- (ii) This sub-question was also adequately answered by most candidates. However, a few of them simply referred to the use of the snail as liming, white wash, feed meal without making reference to the shell. Most of the candidates were aware of the medical use of the snail, but did not indicate that it was the fluid that was used.
- (c) There was not much problem with the use of the kitchen knife except that majority of candidates mentioned that it was used to dehorn farm animals. Some candidates provided answers relating to the dressing of the animal such as skinning, flaying, evisceration.

Question 2

- (a) (i) **Outline the steps involved in the processing of specimen D (fresh blood) into blood meal.**
- (ii) **Name two major nutrients supplied by blood meal.**
- (b) (i) **Name two types of housing units for keeping specimen E (rabbit).**
- (ii) **Mention three products that could be obtained from specimen E.**
- (iii) **Name three ectoparasites that could infest specimen E.**

- (a) This question was problematic. After stating that blood is boiled, they only stated that blood should be heated without indicating the required temperature to imply boiling. Thus most of them missed the sequence. Some of the candidates also mentioned that carbohydrates or energy is supplied by blood meal instead of protein; minerals and vitamins.
- (b) (i) Most of the candidates missed the spelling of hutch as they wrote hatch. Some also stated such answers as external system or intensive system. Expected answers are cages and hutches.
- (ii) Quite a number of candidates mentioned hide as a product of rabbit instead of pelt and hair instead of fur. Other products are meat, blood and manure.
- (i) Some candidates mentioned endoparasites. Expected answers include fleas, mites, ticks, lice and maggots.

Question 3

- (a) (i) **Mention two nutrients that could be found in specimen F (raw milk).**
- (ii) **List three way of preserving specimen F.**
- (b) (i) **State two functions of specimen G (gizzard).**
- (ii) **Describe two features of specimen G which enables it to perform the functions stated in (i).**
- (ii) **Name four farm animals that possess specimen G.**

- (a) (i) There was not much problem with this question. A few candidates mentioned amino acids instead of proteins and also mentioned only fats instead of fat and oil.

- (ii) The only problem with answers to this question was that a number of candidates mentioned heating the milk instead of boiling the milk to preserve it. Also instead of putting the milk in a refrigerator, they mentioned use of deep freezer as well as cooling the milk instead of chilling it. Some of them also wrongly mentioned that the raw milk could be processed into products like yoghurt, cheese etc.
- (b)(i) & (ii) Adequate answers were provided by most candidates. A few of them wrongly stated however that the gizzard was used to store food. Instead of stating that the gizzard had a thick muscular wall, they stated that it was simply muscular.
- (iii) Most of the candidates gave the right answer to the question, but few candidates wrongly mentioned the small ruminants as examples. Some also mention birds which were not normal farm animals.

Question 4

- (a) (i) **State three ways in which specimen H (tapeworm) is of economic importance.**
(ii) **State four ways of controlling specimen H.**
- (b) (i) **Identify specimen J (fish meal).**
(ii) **List two nutrients contained in specimen J.**
- (c) (i) **Name two ectoparasites that could infest the farm animal from which specimen K (fresh wide) was obtained.**
(ii) **State three uses of specimen K.**
- (a) (i) The answers to the question was problematic to a good number of candidates as they only mentioned the effect of the tapeworm on the host without stating its economic effect. E.g. some simply stated:- anaemia, loss of appetite, blocking of digestive tract. Expected answers include loss of weight, high cost of health care and reduces market value.
(ii) As a method of controlling the parasite most simply mentioned deworming and drenching without adding the required statement of the appropriate drug or dewormer as expected.
- (b) (i) This was adequately catered for except that instead of writing fishmeal, some wrote fresh meal.
(ii) Some candidates also mentioned that fish meal supplied carbohydrates as nutrient instead of protein, mineral, fats and oils and vitamins.
- (c) (i) Some candidates mentioned flies, mice and tapeworm instead of mange mites ticks, lice and flea.
(ii) Use of fresh hide was well answered.

BIOLOGY 2

1. GENERAL COMMENTS

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

2. A SUMMARY OF CANDIDATES' STRENGTHS

- (1) Most candidates displayed some improvement in expressing themselves well in English.
- (2) Candidates provided answers of each questions on fresh page.
- (3) Candidates showed mastery of matching corresponding points in a tabular form.
- (4) Candidates complied with the paper instructions which required that they should answer two questions only from Section A and all questions in Section B.

3. A SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Technical terms were wrongly spelt by many candidates. Technical name of species of organism started with small letter.
- (2) The drawing of the plant cell showed two layers instead of three layers
- (3) The size of the vacuole was not larger and more centrally positioned than that of the nucleus
- (4) Few candidates answered more than the required number of questions from Section A, question 5 in Section B and addition to question 6 which was meant for candidates in Nigeria, The Gambia and Liberia.

4. SUGGESTED REMEDIES

- (1) Candidates should read all instructions to the paper and follow them to the letter
- (2) Teachers should take their students through spelling drills with respect to technical terms and names.
- (3) Teachers should encourage their students to work sufficient tutorials and assignments on how to provide concise and accurate answers.
- (4) Teachers should ensure that candidates know and understand the rubrics of the subject.
- (5) Penalties should be prescribed for candidates who answer more questions that required. It is a ploy to compel Examiners marks all the answers to the questions and then select the best scored ones for them
This practice is becoming a canker as it is gross disregard to follow examination instructions.

5. DETAILED COMMENTS

Question 1

- (a) (i) List three forms in which living cells exist.
(ii) Give one example of each of the forms listed in (a)(i).
- (b) Make a diagram 6 cm – 10 cm long of a typical plant cell and label fully.
- (c) (i) In a tabular form, state three differences between a plant cell and an animal cell.
(ii) State three similarities between a plant cell and an animal cell.

- (a) Most candidates attempted the question and performance was quite satisfactory. Candidates were able to list the forms in which living cells exist and giving one example of each form.

Forms in which living cells exist	Example
Single / free living	<i>Amoeba</i> / <i>Chlamydomonas</i> / <i>Paramecium</i> / <i>Euglena</i>
Colony / Colonia	<i>Eudorina</i> / <i>Pandorina</i> / <i>Volvox</i> / sponges
Filament / Filamentous / Strand	<i>Spirogyra</i> / <i>Chladophora</i> / <i>Ulothrix</i> / <i>Oedogonium</i>
Part of living Organism	Check cell onion cell / epidermal cell / parenchyma

- (b) Candidates could not present good diagram of the plant cell. Most of them had problems with the spelling of vacuole, nucleus, cell membrane, mitochondrion. Candidates must note that a good Biological diagram is evaluated based on the following criteria.

Title: Diagram of a typical plant cell

Quality:

Size: 6cm to 10cm long

Clarity of lines: Lines not broken, lines not wooly

Neatness of labels: ruled guidelines / with no arrow heads / no crossed guidelines

horizontal labels

Details:

Define shape shown

Large central vacuole shown

Labels:

The following structures of the plant cell must be labelled on the diagram: cell wall, chloroplast vacuole, middle lamella, cytoplasm, nucleus, mitochondrion, Golgi body, cell membrane, endoplasmic reticulum and ribosome. It must be noted that every label must be spelt correctly to score.

- (c) (i) Most candidates tabulated the difference between plant cell and animal cell as shown below.

Plant cell	Animal cell
- Has cellulose / rigid cell wall	Lacks cellulose cell wall
- Has one large / central vacuole	Has numerous/small vacuoles
- Has chloroplast	Lacks chloroplast
- Has a regular/ definite shape	Usually smaller in size
- Stores food/ carbohydrate as starch	Contains glycogen granules in its cytoplasm
- Cytoplasm is less dense	Cytoplasm more dense
- Does not have lysosome	Has lysosome
- Does not have centrioles / centrosome	Has centrioles/ centrosome
- Stores lipid as oil	Stores liquid as fat

- (ii) Candidates stated the similarities between a plant cell and an animal cell as: both have cytoplasm, nucleus, vacuole, mitochondrion, Golgibody, smooth/ rough endoplasmic reticulum, cell membrane and ribosomes.

Question 2

(a) **In sequence, name the organs that constitute the alimentary canal of humans.**

(b) **State:**

(i) **three structural differences between the alimentary canal of a bird and a human;**

(ii) **three structural similarities between the alimentary canal of a bird and a human.**

(c) **Explain briefly how the dentition of herbivores is adapted for feeding.**

(d) **State two roles of pancreas in digestion.**

(a) Most candidates were able to name in sequence the organs that constitute the alimentary canal of humans as presented below:

- mouth/ buccal cavity
- oesophagus/ gullet
- stomach
- duodenum
- ileum/ jejunum/ small intestine
- caecum/ colon/ large intestine
- rectum

- (b) Candidates satisfactorily stated both the differences and similarities between the alimentary canal of the bird and human as follow:
- (i) Structural differences between the alimentary canal of a bird and a human

Bird	Human
- Beak present/ mouth modified	Beak absent/ mouth present
- Teeth absent	Teeth present
- Crop present	Crop absent
- Gizzard present	Gizzard absent
- Anal pore modified to cloaca	Anal pore modified into anus
- Shorter alimentary canal	Longer alimentary canal
- Appendix absent	Appendix present

- (ii) Similarities in the alimentary canal of a bird and human

They both have mouth, oesophagus/gullet, stomach, duodenum, small intestine, large intestine, caecum rectum.

- (c) Candidates had difficulty in explaining how the dentition of herbivores is adapted for feeding. The explanation should take the following form as shown below:
- presence of sharp/elongated/curved incisors; for cutting grass/herbs.
 - thick thorny pad; against which lower incisors bite
 - canines are absent/ presence of diastema; allows tongue to roll the cropped grass
 - broad surfaces of the check teeth/molars; for grinding/chewing/masticating
- (d) Candidates could not state the roles of pancreas in digestion as outlined below:
- produces pancreatic juices which contain enzymes;
 - sodium bicarbonate in the pancreatic juice neutralizes the HCl acid from the stomach/produces alkaline medium.
 - pancreatic amylase digests protein to peptides/peptones
 - lipase in the pancreatic juice digests fat droplets to glycerol and fatty acid

Question 3

- (a) (i) **What is a habitat?**
(ii) **Explain briefly three roles of a decomposer in an ecosystem.**
- (b) **Explain briefly energy flow in a freshwater habitat.**
- (c) (i) **State three harmful effects of microorganisms to plants.**
(ii) **State six beneficial effects of microorganisms to humans.**
- (a) (i) Candidates satisfactorily defined a habitat as the natural dwelling place of an organism or a place/locality where an organism lives successfully.

- (ii) Most candidates could not explain the role of a decomposer in an ecosystem. It must be noted that decomposers are organisms which bring about the decay of dead parts/whole of plants animals to produce manure/humus; by this they release nutrients into soil which are absorbed by the roots of plants and are used to build up a new plant tissues. They thus help in nutrient recycling and at the same time releasing offensive gases/odour which pollute the air.
- (b) Most candidates had difficulty in explaining how energy flows in a fresh water habitat. It is worth noting that common aquatic plants such as *Pistia* or *Spirogyra* or any correctly named aquatic plant use energy from the sun to photosynthesize or produce food; this food is eaten by primary consumers or small aquatic animals which would in turn be eaten by bigger aquatic animals or secondary consumers. In the process of feeding energy flows from one trophic level to another and decreases progressively; dead animals or plants also decompose leading to energy loss.
- (c) (i) Candidates must note that the harmful effects of microorganisms to plants include the following:
- they cause diseases
 - they can cause undesirable qualities in plants/plant products.
 - they cause spoilage
 - they lead to wastage
 - reduction in yield
- (ii) Candidate satisfactorily stated the beneficial effects of microorganisms to humans. These include:
- decomposers such as bacteria decay or decompose dead organisms to release nutrients
 - bacteria are used in cleaning/mopping up oil spillage
 - are used in the fermentation of foods/cocoa beans/gari/locust beans/kenkey production
 - are used to make vinegar
 - are used in making alcoholic beverages/wine/beer/spirit
 - are used in making some antibiotics/penicillin
 - are used in manufacturing insulin
 - are used in cheese/ yogurt/bread/single cell proteins
 - are used in making flax/tanning of leather
 - are used in production of some vitamins
 - are used in treatment of sewage

Question 4

- (a) (i) Explain the term **agglutination** as used in blood transfusion.
(ii) The table below represents blood transfusion between blood donors and recipients

Copy and complete the table using the keys (+) to represent compatibility and (-) to represent incompatibility.

		Recipient			
		A	B	AS	O
Donor	A				
	B				
	AB				-
	O	+			

- (b) Explain how each of the following organisms are adapted for obtaining food:
(i) mosquito larva;
(ii) Dodder plant;
(iii) grasshopper.

This question was the least attempted and poorly answered.

- (a) (i) the term “Agglutination” as used in blood transfusion is the clumping together of antigens of red blood cells/RBC with the corresponding antibodies in the plasma of incompatible blood groups or wrong blood groups.
(ii) Most candidates were able to complete the table representing blood transfusion between blood donors and recipient of various blood groups. Few candidates however, failed to use the keys given (+) to represent compatibility and (-) to represent incompatibility and lost marks.
- (b) Generally, candidates could not explain how each of the following organisms are adapted for obtaining food. It is worth noting that:
- (i) Mosquito larva
- possesses a pair of ciliated mouth brushes for creating water current to carry water with food particle into the mouth.
- Dodder plant
- possess haustoria for penetrating host plant tissue to obtain food and water.
- Grasshopper
- possesses mandibles or heavy toothed jaw-like structures for cutting/ crushing food/plant materials/vegetation
 - possess maxille which direct food to the mandibles or for cutting/grinding food
 - labium is for guiding foods or preventing it from falling off.

Question 5

- (a) Describe briefly how the capture-release-recapture method of population sampling is used to estimate population density of animals in a field.
- (b) State four ways of caring for the teeth in humans.
- (c) State three reasons why *Paramecium* is considered more advanced than *Amoeba* in the evolutionary trend.
- (d) Describe how the following stem modification serve their different purposes, giving one example in each case:
- (i) food storage stem;
 - (ii) water-storage stem.
- (e) (i) Explain the term *Respiratory quotient*.
- (ii) For each of the following respiratory quotient values in a green plant, state the type of substrate being used:

Respiratory quotient	Respiratory substrate
1.0	
0.7	
0.5	

- (f) State two ways in which the Krebs Cycle is important in respiration.
- (g) State three ways in which excessive consumption of alcohol affects the
- (i) human body;
 - (ii) society.

- (a) Candidates were expected to describe briefly how the capture – release – recapture method of population sampling is used to estimate population density to animals in a field. Candidates therefore need to describe the method in a step by step manner as presented below:
- identify the area/place to be used in the study e.g. a football field or a fish pond etc
 - Animals/named animals are captured with a device/sweep net/trap
 - counted and marked/ tagged
 - the count is recorded as first capture
 - the animals are released into the same habitat
 - and given enough time to mix randomly
 - the animals are captured the second time
 - counted and recorded as second capture
 - the number of marked animals in the second capture are recorded as recapture

The population is determined by the formula:

$$\frac{\text{First capture} \times \text{second capture}}{\text{Recaptured}}$$

- (b) Candidates could state ways of caring for the teeth in humans as indicated below:
- teeth should be cleaned using chewing stick/soft brush and toothpaste at least twice a day before going to bed/after meal
 - stains due to colanut/tobacco/tea/coffee should be removed by using appropriate mouth wash
 - constant use of teeth or chewing of moderately hard food stuffs/sugarcane/carrot/groundnut/ bones/hard biscuits help to exercise the teeth.
 - food rich in vitamins/vitamin D/minerals/calcium/phosphorus should be taken regularly
 - tooth paste containing fluoride should be used
 - sugary foods and drinks or candies should not be taken much
 - the teeth should not be used to open bottle corks/top/tap/to break hard bones
 - sharp objects or pins should not be used to pick teeth or dental floss
 - artificial teeth or dentures should always be removed or washed with germicide after each meal
 - dentures should be removed before going to bed
 - Dentists should be visited regularly or every six months
- (c) Candidates were to state reasons why *Parameciumis* considered more advanced than *Amoeba*. Candidates were expected to state that *Paramecium* has the following structures which are lacking in *Amoeba*.
- has definite shape due to the presence of pellicle
 - has definite structures/possesses cilia for locomotion
 - undergoes sexual reproduction
 - preserve of oral groove
 - presence of gullet or mouth/cytostome
 - presence of anal pore
 - presence of two nuclei which are mega nucleus are micronucleus
 - presence of trichocysts for defence and attachment
- (d) Candidates could not describe how the following stem modifications serve their different purposes as presented below:
- (i) Food Storage Stem
Some stems grow underground or above ground and are enlarged or swollen to store manufactured food. Examples are: cocoyam/ ginger/ yam tuber/ Irish potato/ sugarcane
- (ii) Water storage stem
Are plants living in dry habitat and often have swollen stem for storing water
Examples are cactus/ *Euphorbia*/ Baobab/*Opuntis* (prickly pear) sugarcane.

- (e) (i) Candidates could explain the term Respiratory quotient as the ratio of the volume of carbon dioxide produced or given off to the volume of oxygen used to arrive at the various respiratory quotients which is presented below:

$$RQ = \frac{\text{Volume of CO}_2 \text{ produced}}{\text{Volume of O}_2 \text{ consumed}}$$

- (ii) Most candidates could not state the type of substance being used to arrive at the various respiratory quotients is presented below:

Respiratory quotient	Respiratory substance
1.0	Carbohydrate/ glucose
0.7	Protein
0.5	Oil and fats or lipids

- (f) Most candidates were unable to state the ways Krebs' cycle is important in respiration. Below are some of the importance of the Krebs' Cycle:

- It brings about the breakdown/oxidation of bigger molecules
- it provides the reducing power for the hydrogen carrier system or electron transport chain
- it is an inter conversion centre
- it produces more/ larger amount of cellular energy / ATP

- (g) Candidates could state ways in which excessive consumption of alcohol affects the

- (i) Human body as outlined below:

- loss of self control/ will/ judgement
- dizziness/ staggering walk or drowsiness
- unconsciousness or adversely affects or damage the brain
- loss of appetite
- production of weak saliva/ leading to slowed / delayed starch digestion
- gastritis / painful inflammation of the stomach/ intestinal linings occur
- malnutrition level rises with vitamin deficiency
- destruction of liver cells/ cirrhosis disease
- dehydration of tissues due to oxidation of alcohol
- kidneytoxication
- reduced reproduction health/ low sperm count/ affects menstrual cycle/ loss of libido
- deformity of the new born child
- reduction in the life span/ death

BIOLOGY 3

1. GENERAL COMMENTS

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

2. A SUMMARY OF CANDIDATES' STRENGTHS

- (1) Improvement in quality of drawing
- (2) Improvement in the spellings of scientific names and technical words
- (3) Improvement in the classification of organisms
- (4) Majority of the candidates followed the rubrics and satisfied the demands of the questions
- (5) Majority of the candidates gave response to questions on differences in tabulated forms

3. A SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Failure of candidates to calculate and disclose magnification of their drawings
- (2) Many candidates failed to give correct heading to their drawings
- (3) Failure of candidates to adhere to the convention of writing scientific names
- (4) Use of the plural forms of label to a drawing when the guideline point to a single structure
- (5) Failure of candidates to relate the theory they have learnt to practical works

4. SUGGESTED REMEDIES

- (1) Candidates should be given a lot of practical exercises and assignments, and in marking teachers should emphasize on the disclosure of magnification and appropriate headings to diagrams.
- (2) Teachers should emphasize the importance of adhering to the convention of writing scientific names during lessons
- (3) Candidates should be encouraged to relate theory they have studied to their practical works
- (4) Teachers should impress upon their students to consider features that are common to both specimens before stating their differences in nature.

5. DETAILED COMMENTS

Question 1

- (a)
 - (i) **Cut a piece of specimen A. Place it on the white tile. Add a few drops of iodine solution. Record the observation and result in a tabular form.**
 - (ii) **Squeeze a few drops of specimen E on another clean white tile provided. Add a few drops of iodine solution. Record the observation and result in a tabular form.**

- (b) (i) **State two differences between specimens A and B.**
(ii) **Suggest two factors that are likely to be responsible for the state of specimen B.**
(iii) **With the aid of a hand lens/magnifying lens, observe specimen B and name an organism likely to be growing on it.**
- (c) (i) **Make a drawing 6 cm – 8 cm long of specimen C and label fully;**
(ii) **State one function each of any three parts labelled.**
- (a) Most candidates made correct observation and inference on specimen A by stating that the solution was yellow/brown in colour. However, few candidates answered it wrongly by stating “no colour change or colour remains the same”.
- (b) Candidates were able to state the observable differences between specimens A and B as indicated below:

Specimen A	Specimen B
Soft	Hard
Fresh	Stale
Has no mould	mouldy

- Few candidates however, could not spell *Rhizopus* and others also stated life cycle stages of *Rhizopus* which were not present and could not be observed.
- (ii) Candidates stated factors responsible for the state of specimen B correctly. Most candidates mentioned moisture/water/humidity/temperature/warmth.
- (iii) Candidates identified saprophytic as mode of feeding of *Rhizopus*. Few candidates however, mistaken saprophytism for saprophytic. Candidates should note that saprophytism is a biological association and not a mode of feeding.
- (c) (i) Drawing of longitudinal section of specimen C (boiled egg) was neatly done by many candidates. However, most candidates failed to give the appropriate heading to the drawings.
- (ii) This question was well answered by many candidates. Few candidates however, answered it wrongly stating non-observable features.

Question 2

Study specimens H, K, L and M and answer questions 2(a) to (e).

- (a) **Name the location of each of specimens H, K, and M in the mammalian body.**
- (b) (i) **Name the fluid in specimen L.**
(ii) **State two functions of the fluid named in (b)(i);**
(iii) **Which of the other specimens is specimen L associated with?**
- (c) (i) **State two observable differences between specimens H and K.**
(ii) **State two observable features of specimen K that adapt it to its function.**
- (d) **State one biological importance each of specimens K and M.**
- (e) **Make a drawing 8 cm – 10 cm long of specimen M and label fully.**

- (a) This question was poorly answered by many candidates. Many of them could not indicate the relative position/location of liver, lungs and kidney in the mammalian body. It is important to note that the liver is just below the diaphragm, the lung in the thoracic cavity and the kidney is attached to the dorsal wall of the abdomen.
- (b) (i) Candidates identified bile as a fluid in specimen L. However, many candidates stated bile pigment instead of bile.
(ii) Many candidates correctly stated the functions of bile as follows:
 - It emulsifies fats
 - It neutralizes the acid in the chyme
 - it provide alkaline medium for pancreatic juice to act
 - it prevents the decay of food in the small intestine
(iii) Candidates answered this question correctly stating that Specimen L, which is a gall bladder is associated with the liver
- (c) (i) A number of candidates were not able to state the observable differences between liver and lung. The expected observable differences were stated below:

Specimen H (liver)	Specimen K (lung)
More solid/ hard	Soft/ spongy
Dark red in colour	Red in colour
Smooth surface	Folded surface

- (ii) Many candidates correctly stated features of respiratory surfaces in vertebrae as follows:
 - moist surface for dissolving gases to diffuse quickly
 - thin surface wall for quick diffusion of gases/ exchange of gases
 - numerous blood vessels for quick transport of gases
(iii) Candidates satisfactorily stated the biological importance of lungs and kidneys as follows:

Specimen K (lung)

 - surface for inspired and expiration of gases/respiration

Specimen M (Kidney)

 - osmoregulation
 - production of urine/ excretion of metabolic waste
 - maintenance of acid-base balance
- (e) On the whole, the drawing of Specimen M (kidney) was poorly done. Cut surfaces were not represented with double lines. The three main regions; Cortex, Medulla and Pelvis were not clearly represented.

Question 3

Study specimens N, P and R carefully and use them to answer questions 3(a) to (c).

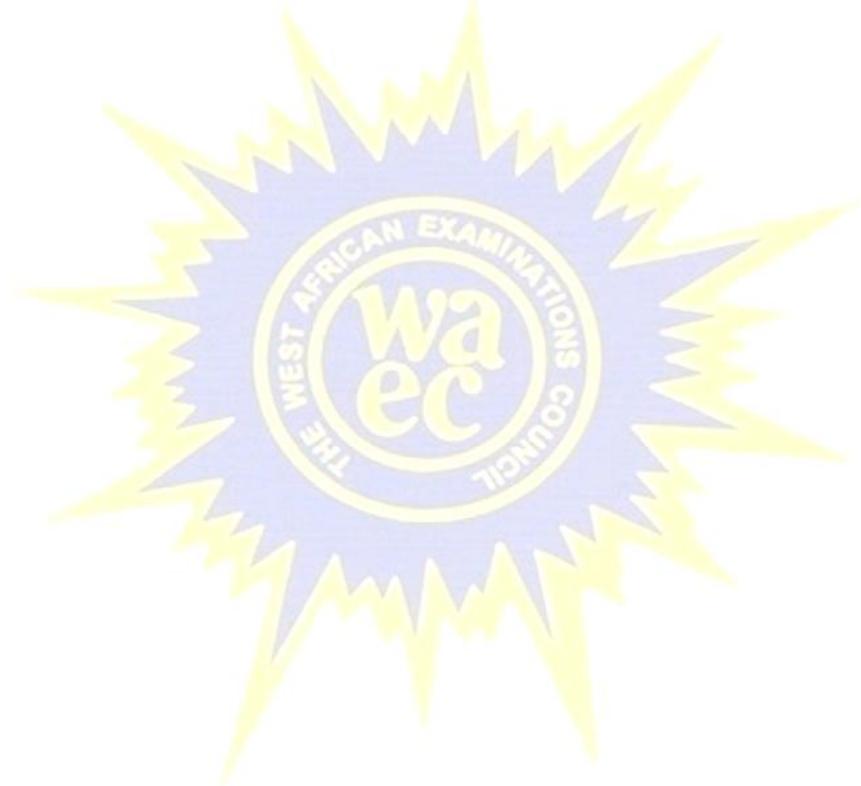
- (a) (i) Describe specimen N.
(ii) Suggest one reason why specimen N can be classified as a plant material.
(iii) What is the importance of the pigmentation in specimen N?

- (b) *With a scalpel/knife, scrape off the soft part of specimen P along the longitudinal axis onto the white sheet of paper provided.*

Press and rub the soft scraped parts onto the white sheet for about a minute and then discard the scrapped parts

- (i) **State the observation after the scraped part of the fruit was rubbed on the paper.**
(ii) **Explain the observations stated in (b)(i).**
(iii) **Describe what can be observed in specimen P after scraping off part of it.**
(iv) **State two ways in which specimen P is important to humans.**
- (c) (i) **State the class and order to which specimen R belongs;**
(ii) **Give one reason each for the answer in (c)(i).**
- (a) (i) Most candidates answered this question poorly. Candidates did not describe the Specimen N (Rheo leaf) well based on observations. Most of them could observe green and violet/ purple coloration on upper surface and lower surface respectively. Few candidates however, describe the features of the leaf i.e. margin, venation and the shape.
(ii) This question was well answered by many candidates. Having observed the specimen as a part of a leaf, they went further to cite chlorophyll/ green colouring matter of plant as a reason for concluding that Specimen M is a plant material.
(iii) Many candidates answered this question poorly. Candidates could not link the differences in pigmentations to their respective roles in the plant. The green chlorophyll was expected to be related the photosynthesis while the purple colour attract pollinators to flowers when formed on the plant.
- (b) (i) A number of candidates were not able to answer question very well. Candidates were expected to observe and describe what happens when rubbed on white paper. The paper could be stained orange or yellow and that part of the paper would be translucent.
(ii) Majority of the candidates could not match each observation with its appropriate explanation. Candidates were expected to state that yellow stain is due to yellow pigment in the palm nut fruit and the translucent spot is caused by the oil in the palmnut fruit.
(iii) This question was poorly answered by most of the candidates. Candidates were expected to scrap portion of the palm nut fruit and identify the layers of the pericarp (epicarp, mesocarp and endocarp). Candidates were also expected to describe the external features of palmnut fruit as follows:
- oval shape
- remains of stigma is hard and black
- scar at the base of the fruit.

- (iv) Candidates satisfactorily gave several uses of the palm nut fruit to human beings as follow:
- used as food
 - used as fuel
 - oil used as drug
 - oil is used for making soap
 - sources of oil
 - oil used as lubricant etc.
- (c) (i) Majority of candidates were able to state the class and order of specimen R (Grasshopper) as Insecta and Orthoptera respectively. Few candidates however misspelt Orthoptera.
The reasons for classifying the specimen R into class: Insecta and Order: Orthoptera were poorly done by candidates.



CHEMISTRY 2

1. GENERAL COMMENTS

The standard of the paper was high and was comparable to those of previous years. The rubrics were straight forward. The structure of the questions was straight forward. The questions covered the examination syllabus. The marking scheme was fair and flexible. Enough room was made to accommodate different approaches to numerical problems.

2. A SUMMARY OF CANDIDATES' STRENGTHS

The students showed good knowledge and understanding of:

- (1) Periodic properties;
- (2) Definition of various terms;
- (3) Concept of isotopes;
- (4) Differences between metals and non-metals;
- (5) Different classes of organic compounds;
- (6) Stoichiometric calculations
- (7) Solubility
- (8) Balancing of redox reactions

3. A SUMMARY OF CANDIDATES' WEAKNESSES

Weaknesses associated with the performance of candidates include:

- (1) Non adherence to rubrics;
- (2) Poor communication skills;
- (3) Ineligible hand writing;
- (4) Poor mathematical skills;
- (5) Using formula to express names of compounds;
- (6) Lack of ability to plot solubility curves;
- (7) Inability to outline how dry calcium chloride could be obtained from solution;
- (8) Poor spelling of technical terms;
- (9) Candidates left out conditions when laws were defined.

These weaknesses could be attributed to poor preparation towards the examination and non-familiarity with the syllabus.

4. SUGGESTED REMEDIES

Suggested remedies for the weaknesses:

- (1) Adherence to rubrics;
- (2) Legible handwriting;
- (3) Improve upon communication skills;
- (4) Adequate preparation for the examination;
- (5) Students should acquire text books or relevant material when preparing for examination.

5. DETAILED COMMENTS

Question 1

- (a) What are nucleons?
- (b) State Graham's law of diffusion.
- (c) Explain briefly why aluminium does not corrode easily?
- (d) State three examples of periodic properties.
- (e) State two reasons why real gases deviate from ideal gas behaviour.
- (f) List three uses of fractional distillation in industry.
- (g) What factors determine the selective discharge of ions at the electrodes during electrolysis?
- (h) State the type of reaction represented by each of the following equations:
 - (i) $C_2H_6 + Br_2 \rightarrow C_2H_5Br + HBr$;
 - (ii) $C_2H_6 + Br_2 \rightarrow C_2H_5Br$
- (i) Name the products formed when butane burns in limited supply of air.
- (j) List three methods of separating a solid from a liquid.

This question was attempted by all the students since it was a compulsory question. In part (a) most of the candidates correctly defined nucleon some however lost marks for not saying they are found in the nucleus.

In part (a), candidates were asked to define nucleons but a number of them defined nucleon number. Nucleons refers to the protons and neutrons found in the nucleus of an atom.

In part (b), candidates rightly stated Graham's law of diffusion but a number of candidates failed to state the conditions i.e. constant temperature and pressure others did not state it applies only to gases. In part (h), most of the candidates stated the type of reaction correctly some however stated the type of reactions as halogenation reaction.

In part (j), majority of candidates were able to state the three methods of separating solids from liquids.

Question 2

- (a) Consider the following atoms:



- (i) State the phenomenon exhibited by the two atoms.
- (ii) What is the difference between the atoms.
- (iii) Give two examples of elements that exhibit the phenomenon stated in (a)(i) above.
- (iv) If T is 17, write the electron configuration of the element.

- (b) (i) State two differences between metals and non-metals with respect to their:
- (α) physical properties;
 - (β) chemical properties.
- (ii) Give one example of each of the following compounds:
- (α) an amphoteric oxide;
 - (β) a hydride which evolves hydrogen when reacted with water;
 - (γ) a trioxocarbonate (IV) salt which is readily decomposed on heating;
 - (δ) a chloride salt which is readily hydrolyzed in water.
- (c) (i) State three characteristics properties of transition metals:
- (ii) Write the electron configuration of $_{30}\text{Zn}$.
- (iii) Explain briefly why zinc is not considered as a typical transition element.
- (d) Consider the reaction represented by the following equation:
- $$\text{Na}_2\text{CO}_{3(\text{aq})} + \text{MgCl}_{2(\text{aq})} \rightarrow 2\text{NaCl}_{(\text{aq})} + \text{MgCO}_{3(\text{aq})}$$
- Calculate the mass of sodium trioxocarbonate (IV) needed to produce 3.36 g of magnesium trioxocarbonate (IV).
- [C = 12.0, O = 16.0, Na = 23.0, Mg = 24.0]

This question was attempted by majority of students and the performance was fair. In part a(i), majority of the students identified the phenomenon but some of them said isotopes instead of isotopy so lost marks. In (iv), most of the students were able to write the correct electron configuration but some wrote it as 2, 8, 7 which was wrong. In part (b), most of the candidates answered the physical and chemical properties of metals and non-metals correctly. In part (c), majority of candidates were able to state the correct characteristics of transition metals, however some candidates stated that transition metals form colours which is wrong. In part (d), majority of candidates were able to calculate the mass of sodium trioxocarbonate (IV).

Question 3

- (a) (i) Define structural isomerism.
- (ii) State the class of alkanols to which each of the following compounds belongs:
- (α) $\text{CH}_3\text{C}(\text{CH}_3)_2\text{OH}$;
 - (β) $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{OH}$;
 - (γ) $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{OH}$.
- (b) (i) Write the formulae of the product(s) formed in the following reactions:
- (α) $\text{CH}_3\text{CH}_2\text{COOH} \xrightarrow{\text{K (s)}}$
 - (β) $\text{CH}_3\text{CH}_2\text{COOH} \xrightarrow[\text{Conc. H}_2\text{SO}_4]{\text{C}_4\text{H}_9\text{OH, heat}}$
 - (γ) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} \xrightarrow[\text{(excess)}]{\text{H}^+/\text{KMnO}_4}$
- (ii) Name the major product(s) of each of the reactions in (b)(i).

- (c) A gaseous hydrocarbon R of mass 7.0 g occupies a volume of 2.24 dm³ at s.t.p. If the percentage composition by mass of hydrogen is 14.3, determine its:
- empirical formula;
 - molecular formula.
- [H = 1.00, C = 12.0, Molar Volume of gas at s.t.p. = 22.4 dm³]
- (d) Draw the structures of the isomers of the alkene with molecular formula C₄H₈.

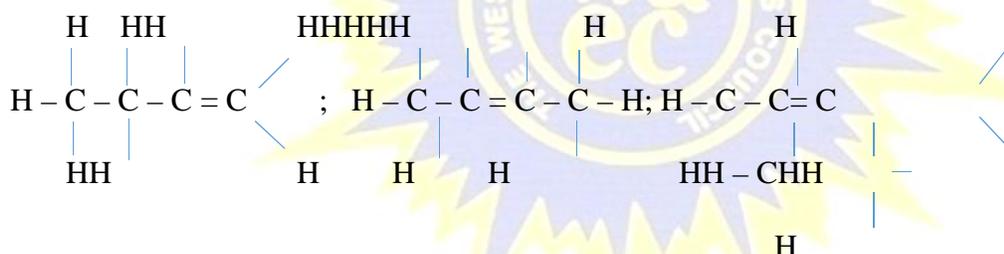
This question was popular and attempted by most of the candidates and the performance was good. In part (a), majority of students were able to define structural isomerism correctly and were also able to classify the correct class of alkanols. But few candidates defined isomers instead of isomerism. Isomers are compounds. Isomerism is a phenomenon or the occurrence or a condition whereby compounds with the same molecular formula have different structural formulae.

In part (b), most of the candidates were able to state the products of the three reactions and were able to name the products correctly.

In part (c), majority of the candidates were able to calculate the empirical and molecular formula of the compound.

In part (d), majority of candidates were able to draw structures of the isomers. However, in some cases, candidates were unable to attach all the hydrogens to some of the carbons. Candidates were expected to show all bonds in the compounds:

Structural Isomers of C₄H₈:



Question 4

- Define the term solubility.
- The table below gives the solubilities of substances P and Q at various temperatures.

Temperature / °C		0	20	40	60	80	100
Solubility, g dm ⁻³	P	10	15	26	40	63	100
	Q	30	34	37	40	44	48

- On the same axes, plot the graphs of solubility against temperature for each of the substances P and Q.
- From the graph,
 - state the solubility of P at 50°C;
 - state the temperature at which the solubility of Q is 36 g dm⁻³.
 - calculate the mass of P which would be deposited if a saturated solution of P is cooled from 70°C to 30°C.

- (c) The melting and boiling points of sodium chloride are 801°C and 1413°C, respectively. Explain briefly why sodium chloride does not conduct electricity at 25°C but does so between 801°C and 1413°C.
- (d) (i) Define each of the following terms:
 (α) nuclear fusion;
 (β) nuclear fission.
- (ii) State one factor that affects the stability of a nuclide.
- (e) Consider the following substances: AlCl₃, OH⁻, NH₃ and H₃O⁺. Classify each of the substances as nucleophiles or electrophiles.

The question was attempted by few of the candidates and the performance was fair.

In part (a), most of the students were able to correctly define solubility and a number failed to mention at a stated temperature while others did not state “maximum amount”.

In part (b), most of the candidates who attempted this plotted the graph well, some lost marks for wrong labelling and wrong axis. Others lost marks for plotting temperature on the y-axis and solubility on the x-axis.

In part (c), most candidates were able to answer correctly however some associated the conductivity to the flow of electrons and therefore lost marks.

In part (d), candidates were able to define nuclear fusion and fission correctly some of the candidates mixed up the two and therefore lost marks. In the definition of Nuclear fusion and nuclear fission, some candidates forgot to state that the two processes are accomplished by release of energy and radiations. In part (e), most of the candidates were able to distinguish between electrophiles and nucleophiles.

Question 5

- (a) (i) What is a buffer solution?
 (ii) Calculate the pH of a solution containing $4.0 \times 10^{-4} \text{ mol dm}^{-3}$ hydrogen ions.
 (iii) Indicate whether the solution is acidic or basic.
 (iv) Give one reason for your answer in (a)(iii).
- (b) The following table shows the pH ranges of the indicators K, L and M.

Indicator	K	L	M
pH range	3.0 – 4.5	6.1 – 7.5	8.0 – 9.8

Select the indicator(s) which would be suitable for titrating:

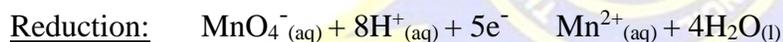
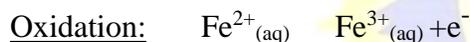
- (i) strong acid with strong base;
 (ii) strong acid with weak base;
 (iii) weak acid with strong base.
- (c) (i) An aqueous solution of iron (II) can be oxidized to iron (III) by acidified KMnO₄ solution.
 Write a balanced ionic equation for the:
 (α) oxidation half reaction;
 (β) reduction half reaction.

- (ii) Describe briefly how pure dry crystals of calcium chloride could be obtained from a solution of Calcium chloride
- (d) (i) Name the process involved in the production of amino acids from proteins.
- (ii) Consider the following salts:
 KNO_3 , CH_3COONa , NH_4Cl
 Which one would form
 (α) an acidic solution?
 (β) a neutral solution?
- (iii) Excess dilute hydrochloric acid was added to 1.50 g of calcium trioxocarbonate (IV) and the reaction lasted for 30 seconds. Calculate the rate of the reaction
 [$\text{CaCO}_3 = 100$]

The question was attempted by the majority of candidates and the performance was fair. In part (a), most of the candidates were able to define buffer solution correctly and were able to calculate the pH of the solution correctly.

In part (b), the candidates were able to identify the correct pH ranges for the given indicators. In part (c), the majority of candidates were able to correctly identify the oxidation and reduction reaction and balanced them. However, some candidates could not write the correct balanced half cell reactions.

The correct reactions are:



In part (d) the candidates were able to identify which of the salts would form acidic and neutral solutions. The candidates were also able to calculate the rate of the reaction correctly.

CHEMISTRY 3

1. GENERAL COMMENTS

Generally, the standard of the paper was high and compares favourably with question papers of the previous years. On the whole, questions were concise and well structured. Demands of individual questions were well articulated and easy to comprehend by candidates.

2. A SUMMARY OF CANDIDATES' STRENGTHS

- (1) A large number of candidates showed good understanding of the questions and demonstrated requisite experimental procedures needed to answer them.
- (2) A good understanding of the construction of table of titration was shown by candidates.
- (3) In many cases, candidates were able to construct and presented results of qualitative analysis in a tabular form.
- (4) Testing procedures, observations made and inferences drawn were well outlined in most of the cases.

3. A SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Despite the strengths mentioned and observed in several cases, some candidates were unable to present their answers or results in a systematic manner. In such cases, most of the candidates got confused and were unable to score maximum marks.
- (2) Numerical answers are usually to be expressed to three significant figures. Many candidates are confused as to how to present the numerical answers they obtain from their calculators.
- (3) Poor knowledge about calculation of amount (mole) of substances in titre volumes.
- (6) Poor knowledge of identification of cations and anions in solution.

4. SUGGESTED REMEDIES

The Chief Examiner made the following suggestions

- (1) Candidates should have a thorough grasp of the principles behind the answers they are providing in the practical questions.
- (2) such understanding helps in a systematic presentation of answers which demonstrate understanding.
- (3) results of a calculation based on a data cannot be more accurate than the data itself. It is based on this fact that candidates are required to express numerical results to 3 significant figures. Candidates in many cases do not know where to cut off or how to round up figures from their calculators. This has to be addressed
- (4) Candidates should be exposed to more practical work to obtain the necessary techniques and knowledge required.

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 $0.050 \text{ mol dm}^{-3} \text{ H}_2\text{C}_2\text{O}_4$ (ethanedioic acid).

B is a solution of KMnO_4 (potassium tetraoxomanganate (VII)) of unknown concentration.

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

- (i) concentration of MnO_4^- in B in mol dm^{-3} ;
- (ii) concentration of KMnO_4 in B in mol dm^{-3} ;
- (iii) volume of CO_2 evolved at s t p when 25.0 cm^3 of $\text{H}_2\text{C}_2\text{O}_4$ reacted completely.

[O = 16.0, K = 39.0, Mn = 55.0 Molar volume of gas at s t p = $22.4 \text{ dm}^3 \text{ mol}^{-1}$]

Question 2

C is a mixture of two salts, containing one cation and two anions. Carry out the following exercises on C. Record your observations and identify any gas(es) evolved. State the conclusion you draw from the result of each test.

- (a) Put all of C in a beaker and add about 10 cm^3 of distilled water. Stir well and filter. Keep the filtrate and the residue.
- (b) To about 2 cm^3 of the filtrate, add few drops of $\text{AgNO}_3(\text{aq})$ followed by $\text{HNO}_3(\text{aq})$. Add excess $\text{NH}_3(\text{aq})$ to the resulting mixture.
- (c)
 - (i) Put all the residue into a clean test tube and add about 5 cm^3 of $\text{NH}_3(\text{aq})$.
 - (ii) To about 2 cm^3 of the solution from 2(c)(i), add $\text{NaOH}(\text{aq})$ in drops and then in excess.
 - (iii) To another 2 cm^3 of the solution from 2(c)(i), add $\text{NH}_3(\text{aq})$ in drops and then in excess.

Question 3

- (a) What difference in physical property enables the separation of mixtures by:
 - (i) simple distillation;
 - (ii) paper chromatography;
 - (iii) fractional distillation.
- (b) Give one reason for each of the following practices during titration in the laboratory:
 - (i) white tile is placed under the conical flask;
 - (ii) burette readings are always recorded to two decimal places.
- (c) Calculate the volume of 2.5 mol dm^{-3} stock HCl required to prepare 500 cm^3 of $0.20 \text{ mol dm}^{-3} \text{ HCl}$.

Question 1

- (a) Tabulation of results and calculation of average volume of B correctly done.
- (b) (i) Most candidates calculated the concentration of B in mol dm^{-3} to two or one significant figures instead of three
- (ii) Most candidates could not calculate the volume of CO_2 released at stp

$$\text{Moles of } \text{C}_2\text{O}_4^{2-} \text{ reacted} = \frac{25 \times 0.05}{1000} = 1.25 \times 10^{-3}$$

$$\text{Moles of } \text{CO}_2 \text{ released} = 1.25 \times 10^{-3} \times \frac{10}{5} \quad (\text{from equation})$$

$$= 0.0025 \text{ mol}$$

$$\text{Volume of } \text{CO}_2 = 0.0025 \times 22.4 \text{ dm}^3 = 0.056 \text{ dm}^3.$$

Question 2

- (a) Candidates refer filtrate of C as C solid and residue as precipitate.
- (b) Most candidates wrote white solution for white precipitate and white gelatinous precipitate for silver chloride instead of white precipitate.
- (c) (i),(ii),(iii) Most candidates did not record their observations and inferences immediately after adding the solutions. The observations and inferences were mixed up.

Question 3

- (a) (i) Wide range of boiling points not just boiling as indicated by candidates.
- (ii) This was not familiar with many candidates. The correct answer is adsorption rate.
- (iii) Close range of boiling points not just boiling point.
- (b) (i) To observe colour change at the end point clearly but not to observe the colour change only.
- (ii) For accuracy of titre value most candidates interchanged the concentration terms in the expression.

(c) $C_1V_1 = C_2V_2$
 $V_1 \times 2.5 = 0.2 \times 500$
 $V_1 = \frac{0.2 \times 500}{2.5}$
 $= 40 \text{ cm}^3$

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 solution of $0.050 \text{ mol dm}^{-3}$ of an unknown mineral acid H_xY .

E is a solution of KOH containing 0.025 mole in 250 cm^3 of solution.

- (a) Put D into the burette and titrate it against 20.0 cm^3 or 25.0 cm^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:
- number of moles of acid in the average titre;
 - number of moles of base in the volume pipetted;
 - mole ratio of acid to base.
- (c) Write a balanced equation for the reaction between the acid H_xY and base KOH.
- (d) (i) State the basicity of the acid H_xY .
(ii) Suggest what H_xY could be.

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 10 cm^3 of distilled water. Stir well and filter, if necessary.
- (b) (i) To about 2 cm^3 portion of the solution, add few drops of $\text{Ba}(\text{NO}_3)_2(\text{aq})$ followed
by excess $\text{HNO}_3(\text{aq})$;
- (ii) To another 2 cm^3 portion of the solution, add $\text{NaOH}(\text{aq})$ in drops then in excess;
- (iii) Warm the resulting mixture from 2(b)(ii);
- (iv) To another 2 cm^3 portion of the solution, add $\text{NH}_3(\text{aq})$ in drops and then in excess;
- (v) To another 2 cm^3 portion of the solution add few drops of potassium thiocyanate solution [$\text{KSCN}(\text{aq})$].

Question 3

- (a) Name one gas which:
- cannot be collected over water;
 - can be dried with concentrated H_2SO_4 ;
 - changes the orange/yellow colour of $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+(\text{aq})$.
- Give one reason for your answer in each case.

(b) State the chemical process involved in the following conversions:

- (i) palm wine to ethanol;
- (ii) $\text{Pb}(\text{NO}_3)_2(\text{aq})$ to $\text{PbCO}_3(\text{s})$ using $\text{K}_2\text{CO}_3(\text{aq})$;
- (iii) $\text{NH}_4\text{Cl}(\text{s})$ to $\text{NH}_3(\text{g})$ and $\text{HCl}(\text{g})$;
- (iv) starch to glucose using hot $\text{HCl}(\text{aq})$.

Question 1

(a) This was performed well by most candidates

(b) (i) $\frac{0.05 \times V_A}{1000}$

Where V_A = average titre of acid

(ii) $\frac{0.025 \times 1000}{250} \times 25/20 = a$

= b

(iii) a : b in the simplest form. Say 1: 2

(c) $\text{H}_2\text{Y} + 2\text{KOH} \rightarrow \text{K}_2\text{Y} + 2\text{H}_2\text{O}$

(d) (i) Z

(ii) H_2SO_4

Most candidates could not write the balanced equation for the reaction.

Question 2

Most candidates produced a tabular representation of their test, observations and inferences. Candidates referred to filtrate as F solid and residue as precipitate. Observation and inferences were mixed up since they were not recorded as at the time they were made. Many candidates are still using the word gelatinous even in situations which were not true. Candidates need to know the specific situations in test for metal ions where gelatinous precipitate is formed.

Question 3

(a) (i),(ii),(iii) Name one gas required, the candidates are to give the IUPAC name of the gas not the formula or trivial name of the gas.

Most candidates wrote formula of the gas.

(i) Ammonia cannot be collected over water because it is soluble in water not because it is lighter than air.

(ii) Carbon (IV) oxide can be dried with concentrated H_2SO_4 because it does not react with H_2SO_4 not because it is heavier than air.

(iii) Sulphur (IV) oxide changes the colour of $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+(\text{aq})$ because orange Sulphur (IV) oxide is a reducing agent not because it reacts with oxygen.

- (b) (i) Fermentation not distillation
(ii) Precipitation not neutralization OR Double decomposition
(iii) Decomposition/ sublimation not cracking
(iv) Hydrolysis not polymerization

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.

C is $0.050 \text{ mol dm}^{-3} \text{H}_2\text{SO}_4$.

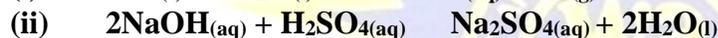
H is a solution of NaOH prepared by reacting Xg of sodium metal with distilled water to form 1 dm^3 of solution.

Repeat the titration to obtain consistent titres values.

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

The equation for the reaction are:

(a) Put G into the burette and titrate against 20.00 cm^3 portion of H using methylorange as indicator.



(b) From your results and the information given calculate the:

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

(ii) concentration of H in g dm^{-3} ;

(iii) mass of the sodium metal.

[H = 1.00, O = 16.0, Na = 23.0, S = 32.0]

Question 2

J is an aqueous solution containing one or more of the following salts: $\text{Al}(\text{NO}_3)_3$, NaCl, Na_2SO_3 and $\text{Zn}(\text{NO}_3)_2$.

Perform the following exercises on J. Record your observations and identify any gas(es) evolved. State the conclusion you draw from the result of each test.

- (a) (i) Take about 2 cm^3 portion of J and acidify with dilute HNO_3 . Add $\text{AgNO}_{3(aq)}$ followed by excess dilute $\text{NH}_{3(aq)}$;
(ii) To another 2 cm^3 portion of J, add dilute NaOH in drops and then in excess;
(iii) To another 2 cm^3 portion of J add dilute NH_3 in drops and then in excess.
(b) From your observations identify the salts in J.

Question 3

(a) Describe how 500 cm^3 of $0.1 \text{ mol dm}^{-3} \text{H}_2\text{SO}_4$ could be prepared from 100 cm^3 of a 2.0 mol dm^{-3} stock solution of the acid.

- (b) (i) State the effect of aqueous solutions of the following salts on litmus paper.
(α) NaNO_3 ;

- (β) CH_3COONa ;
 (γ) $\text{Al}_2(\text{SO}_4)_3$.
 (ii) Give a reason for each answer in (b)(i).

Question 1

- (a) Tabulation of burette readings and calculation of average volume of G was correctly done.
 (b) (i) Most candidates calculated the concentration of H in mol/dm^3 and g/dm^3 but could not correct the answer to 3 significant figures as required.
 (iii) Most candidates could not connect moles of NaOH to moles of Na in order to calculate the mass of Na dissolved in 1dm^3 .

The correct step is

$$\frac{n(\text{Na})}{n(\text{NaOH})} = \frac{2}{1} = \frac{1}{1} \text{ (from equation 1)}$$

$$\therefore n(\text{Na}) = n(\text{NaOH}) \text{ in } 1\text{dm}^3$$

$$= a \text{ mol.}$$

$$\therefore \text{Mass of Na} = a \times 23$$

$$= Cg$$

Question 2

- (a) (i) Solution J + $\text{dilHNO}_3 + \text{AgNO}_{3(\text{aq})}$ observation is white precipitate not white gelatinous as written by many candidates. The white precipitate (AgCl) should dissolve in excess ammonia and not insoluble.
 (ii) and (iii) were correctly done.
 (b) Candidates could not identify the two salts in J because of wrong inferences in (a).

Question 3

Questions are concise and demand short answers. Some candidates are unable to treat them as test of practical knowledge but handle them as theory questions. Teachers need to guide candidates in answering questions in this section. Marks may be lost by candidates due to inability to handle them as test of practical knowledge.

- (b)(i) (α) No effect on litmus paper not neutral to litmus.
 (β) Turns red litmus paper blue not turns blue litmus paper red
 (γ) Turns blue litmus paper red not neutral to litmus.
 (ii) (α) Salt is from strong acid and strong base. Most candidates wrote salt is not hydrolysed
 (β) Salt is from a weak acid and a strong base. Most candidates wrote salt is hydrolysed to form acidic solution.
 (γ) Most candidates wrote salt is hydrolysed to form neutral solution instead of salt is from a strong acid and weak base.

CROP HUSBANDRY AND HORTICULTURE 2

1. GENERAL COMMENTS

The standard of the paper was comparable to that of previous years. The questions were spread over many topics within the syllabus and this gave the candidates a wide scope. The performance of the candidates was slightly better than that of last year.

2. A SUMMARY OF CANDIDATES' STRENGTHS

The following strengths as observed by the Chief Examiner:

- (1) Orderly presentation of responses
- (2) Legible handwriting
- (3) Straight forward answers devoid of clumsiness

3. A SUMMARY OF CANDIDATES' WEAKNESSES

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

- (1) Inadequate preparation
- (2) Poor command of the English Language
- (2) Poor understanding of questions
- (3) Misunderstanding of terms in the subject

4. SUGGESTED REMEDIES

The Chief Examiner suggests that:

- (1) Teachers should explain the terms in the subject to students and use them frequently in class exercises and tests
- (2) Candidates should be encouraged to read wide and look for the meaning of new words to improve on their grammar.
- (3) Candidates should be encouraged to read the questions and understand them well before they tackle them.

5. DETAILED COMMENTS

Question 1

- (a) **What is vegetative propagation?**
 - (b) **Give five advantages of vegetative propagation.**
 - (c) **Explain two ways in which each of the following soil factors affect crop production:**
 - (i) **organic matter;**
 - (ii) **micro-organisms.**
 - (d) **List five sources of organic fertilizers.**
- (a) Most candidates were able to define it and scored the maximum marks but a few could not. Vegetative propagation is the propagation of a plant using any part or all parts of the plant except/without the seeds.

Emphasis is on except/ other than/ without/ apart from the seeds. Some candidates stated that it is the use of parts of the plant in propagating. This answer is incorrect because the seeds form part of the plant. However, vegetative propagation excludes the use of seeds.

- (b) This question was looking for the advantages of vegetative propagation and not the economic importance such as source of employment or source of income and the like that some candidates provided. Generally, the performance was between average and good.

Advantages of vegetative propagation include:

- it reduces the juvenile phase of some plants
- it is the only way to propagate plants that do not have seeds or those with few seeds
- more economical/ convenient to propagate
- it gives rise to genetically true-to-type plants
- may be used for disease indexing
- it is employed to repair damaged parts of trees
- it enhances the cultivation of more than one cultivar on a single stem/ plant
- pollination agents are not required

- (c) (i) Few candidates were able to give the concise effects of organic matter on crop production. One weakness noticed was those who provided the answer, supplies nutrients to crops. Such an answer will earn you only half of the full mark. This is because organic matter can only release the nutrients in it into the soil for crops to use when it is decomposed. The failure to include this important fact will make you lose half of the full mark. Other weaknesses noticed were those who stated that organic matter causes the soil to become compact, acidic and makes the soil lose its fertility. These are all not true. In fact, a well decomposed organic matter has no negative effect on the soil.

Ways in which organic matter affects crop production include:

- improves soil structure by binding loose soil particles together / opens up clayey soil
- supplies nutrients to crops when it decomposes
- has high buffering capacity hence minimizes fluctuations in the soil pH
- helps to regulate soil temperature to ensure suitable environment for root development
- improves soil aeration to ensure suitable environment for root development.

- (ii) This sub-question was poorly answered. Some of the wrong answers given include:-

Micro-organism create holes in the soil for aeration and water infiltration; when they die they add nutrients to the soil among others and where they give examples of micro-organisms they mention earthworms, centipedes, ants etc. which are all macro and not micro-organisms.

Ways in which soil micro-organisms affect crop production:

- they breakdown organic matter to release nutrients for crop / plant use
- some fix nitrogen / make nutrients available for crop use
- some cause diseases to plants

- (d) Generally, this was satisfactorily answered.

Question 2

- (a) (i) **What is a vocation?**
(ii) **Give four examples of vocations in crop husbandry and horticulture.**
- (b) **Describe four characteristic features of weeds that make them successful competitors in the field.**
- (c) (i) **Give two reasons for controlling weeds.**
(ii) **Describe two methods of controlling spear grass in the field.**

- (a) (i) This was one of the most poorly answered questions. Some candidates provided answers such as: a vocation is a work that one does after studying crop husbandry and horticulture and many similar answers. But we were looking for a work that one is suited to do due to the possession of a suitable skill and education and to which one must devote his or her time and energy. This failed to appear in almost the answers given for this question hence the poor performance.
- (ii) Here, candidates were to give examples of vocation in crop husbandry and horticulture. However, they gave answers like teacher, crop researcher, land scape designer, floriculturist which were all human being and not vocation. The correct answers should have been teaching, researching, landscape designing, floriculture etc. Thus it was not satisfactorily answered.
- (b) A few candidates were able to mention the features of weeds that make them successful competitors as:
- produce a lot of seeds
 - have efficient means of dispersal
 - produce underground structures to enable them survive harsh weather conditions
 - some have long dormancy periods
 - some have short life cycle
 - they employ effective means of dispersal, including explosive mechanism, wind, water, animal etc.
- (c) (i) This was satisfactorily answered.
- (ii) This sub-question was poorly answered by most candidates: some candidates were mentioning control methods like: chemical control or by spraying with a chemical or weedicide, mechanical control; slashing among others. For spear grass in particular which has specialized underground structures deep inside the soil you cannot easily control them by the methods mentioned above. The methods used for controlling spear grass include:
- timely ploughing/ hoeing / harrowing to expose the underground structures to harsh weather conditions
 - timely burning
 - the use of recommended herbicides e.g. glyphosate/ any suitable systemic herbicide etc.

Question 3

- (a) (i) **What is layering?**
(ii) **Describe three methods of layering.**
- (b) **Explain each of the following terms as used in crop production:**
(i) **pricking out;**
(ii) **training.**
- (c) **Mention four ways by which training may be carried out in plants.**
- (d) **Give the botanical name of cotton plant.**

(a) (i) This was not well answered. Most candidates who attempted it had half of the full mark because they simply stated that layering is a process of inducing root development on portions of a stem/ branch while it is still attached to the parent plant which is correct but failed to include that after the roots are formed, you have to detach that stem/ branch from the parent plant to obtain a new plant.

(ii) This was poorly answered by most candidates who attempted it and scored very low marks. They were able to mention the types of layering alright but the descriptions were very poor. Meanwhile this part carries the bulk of the marks. The following descriptions were expected:

Simple layering/ordinary layering:

- part of the main shoot is bent and put under the soil with its tip sticking out of the soil.
- incision is made just behind the bud which is buried to induce rooting
- a cut is made in the bark or a strip of bark is removed to disrupt flow of nutrients
- growth regulators may be applied to the cut surface to promote / induce root development.

Serpentine layering/Compound layering include:

- done with plants having very flexible shoots e.g. jasmine
- two or more parts of the shoot are buried in the soil while the other parts are kept above the soil resulting in two or more layers from one branch
- cuts/ strips are made on the buried portion and growth regulators applied to promote root formation

Air layering/marcotting/macottage include:

- involves preparing a cut or ring on a shoot above ground
- a rooting medium such as loamy soil or peat is put around the wounded area
- the rooting medium wrapped with polythene sheet (transparent) and tied at both ends will allow the developing root to be seen. They should be kept moist.

Mound layering:

- the plant to be layered is allowed to grow and later pruned to about 15cm from the ground level
- this results in many lateral shoots which are used for the layering
- the bases of the lateral shoots are covered with moist soil and after some time roots will develop on the parts of the shoots covered

- (b) (i) Only a few candidates were able to explain the term pricking out. In the first place the practice does not involve transplanting as some candidates stated. It is either the transfer or removal of young seedlings and not seeds from the seed bed/box/tray to a prick-out bed container/another bed at two leaves or first true leaf stage. Now the reason for this practice may also be stated and that is to space them slightly wider than at the nursery/ pricking out bed. Most candidates who attempted this sub-question failed to include at least four (4) of the points underlined above hence the low marks.
- (ii) Explanation of the term training was also poorly answered surprisingly, some candidates who attempted this question thought it involves formal training in the classroom. Training of plants is the technique or methods used to control the size, shape and direction of plant growth.
- (c) This was also poorly answered.
Ways of carrying out training in plants include:
- fix stake firmly in the ground and direct vines to climb in either clockwise or anticlockwise direction
 - fix stake close to plant and tie plant to stake to provide support
 - hang loads on branches to make the growth in more horizontal direction
 - prune/trim plants/hedges to attain the desired shape.
- (d) A few were able to give the correct botanical name for cotton as *Gossypium* sp. Botanical names go with certain norms. It involves two separate names. The genus which starts with a capital letter and the species name which starts with a small letter. Both names are then underlined separately. Teachers and candidates alike should take note of this.

Question 4

(a) **Explain each of the following terms as used in vegetative propagation:**

- (i) **scion;**
- (ii) **root stock;**
- (iii) **graft incompatibility.**

(b) **Explain five principles of landscape design.**

(c) **Mention four uses of pawpaw.**

(a) All the three were poorly explained. The following were expected:

Explanation of terms:

Scion:-

Scion is the shoot/upper part of the union which contains the buds used for the union.

Root stock:-

It is the lower part of the union which provides the roots

Graft incompatibility:-

- When the two parts (scion and stock) involved in grafting fail to produce a successful union/when the scion/budwood fails to take or grow on the stock/scion and rootstock fail to unite or
- it is the inherent failure of a scion and root stock to establish biological/ biochemical union.

- it is the inherent failure of a scion and root stock to establish biological/ biochemical union.
- (b) Here, most candidates were able to mention the principles of landscape design but the explanations were poor/bad. Thus they had only half of the marks, for the full marks, candidates were to explain the principles as follows:
 - Texture:- organic materials have various kinds of texture. E.g. barks of trees having different textures. Leaves of plants also have different textures.
 - Light and shade:- for lawns, it is advised to select trees which can allow light to pass through the canopy for shade so that the grass can best be maintained.
 - Unity:- all parts of the design must be related to one another and no scattered elements.
 - Scale:- layout must have a scale i.e. correct proportions between the various components must be observed.
 - Time:- the maturity of plants must be taken into consideration. In planting trees, ten (10) years maturity time must be considered, for shrubs, five years.
 - Space Division:- in planning or designing landscape provision for car park, playing ground, etc should be considered.
 - Colour and tone:-colours have different approaching effect and therefore can be used to give harmony to the landscape. E.g. light colours tend to invite people as they are attracted to, while dark colours have receding effect as they do not appeal to people.
 - Shape and style:- unique plant shape can be used to create a style. How one groups plants, grouping of plants or the planting of some plants singly form his style. Trees with columnar canopy may be used to reduce the effect of tall buildings. Plants with special characteristics may be grown singly as specimen or shade.
- (c) Most candidates were able to give the uses of pawpaw except that they were not specific in terms of the parts (e.g. fruits, leaves, seeds etc.) and their uses.

Question 5

- (a) (i) **What are legumes?**
 - (ii) **State four uses of groundnut.**
 - (b) **Explain each of the following terms as used in ornamental horticulture:**
 - (i) **shrubs;**
 - (ii) **ground covers;**
 - (iii) **house plants;**
 - (iv) **lawns;**
 - (v) **borders.**
 - (c) **Enumerate four morphological characteristics of the maize plant.**
- (a) (i) Only a few candidates were able to define legumes correctly. The majority of those who attempted it had about half of the full mark. This is because most of them failed to include that legumes are pulses or produce their seeds in pods.
 - (ii) This was satisfactorily answered by most of the candidates who attempted it.
 - (b) All the terms here were very poorly explained hence they lost a lot of marks. As elective

Agriculture candidates I see no reasons why they could not explain those terms. The terms were not above them.

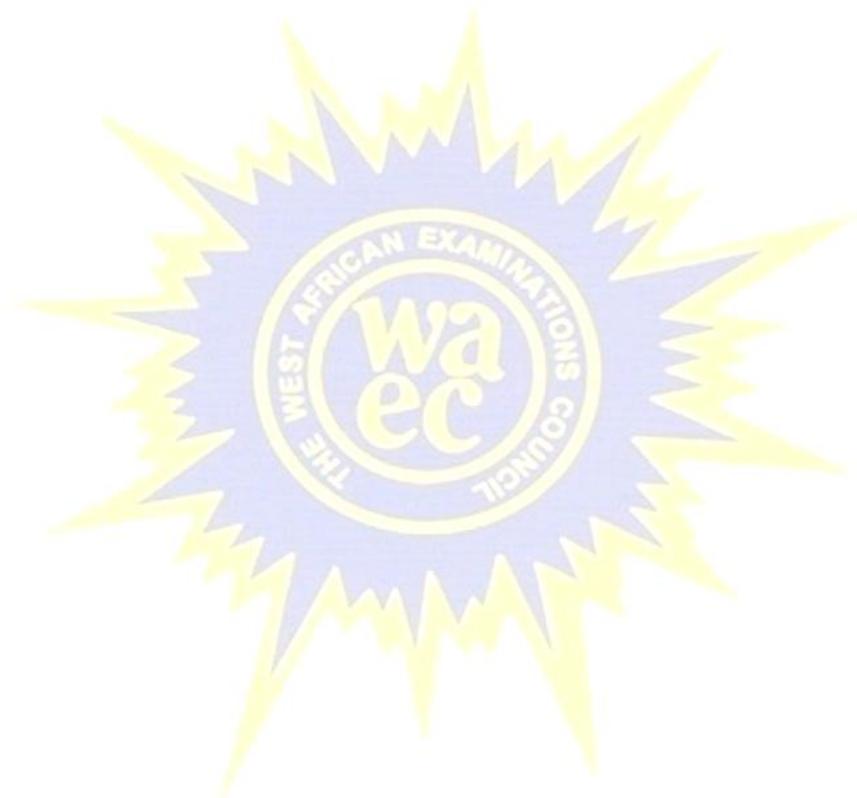
Explanation of terms

- (i) Shrubs:- Woody plants with multiple stems/ branches close to the ground and relatively short (less than 6m tall)
 - (ii) Ground covers:- Prostrate and spreading herbaceous or woody plants which require minimal care. They are used in place of grasses where grasses do not establish well.
 - (iii) House plants:- Ornamental plants that are grown indoors in houses, offices, living areas of homes, offices. E.g. verandas, balconies, porches etc.
 - (iv) Lawns:- are open places planted with grass which is regularly mowed / slashed or cut
 - open place planted with cultivated grass for beautification.
 - (v) Borders:- Portions of the landscape area where ornamental plants are planted against a wall and arranged such that they could be viewed from only two points.
 - a type of bed blocked of one or two ends by obstacles such as a wall.
- (c) Just a few candidates who attempted this question were able to give the morphological characteristics of the maize plant. The majority could not and in my view/ it was because they could not understand the word morphological.
- Morphological characteristics of maize plant include:
- has fibrous root system
 - has prop roots
 - leaves are narrow and elongated
 - leaves have parallel venation
 - stems have nodes and internodes
 - tassels form at the terminal end of the stem
 - cobs form on the stem

Question 6

- (a) **Explain the term floriculture?**
- (b) **Give two examples of each of the following types of vegetables:**
 - (i) **leafy;**
 - (ii) **fruits;**
 - (iii) **Pods and seeds;**
 - (iv) **fleshy storage structures.**
- (c) **Give two benefits of each of the following practices in vegetable production:**
 - (i) **staking;**
 - (ii) **pruning;**
 - (iii) **mulching;**
 - (iv) **thinning out;**
 - (v) **fertilizer application.**

- (a) Almost all candidates attempted this question and most of them restricted the explanation of the term floriculture to the cultivation and uses of flowers only. This was accepted because flowers form part of ornamental plants. It was satisfactorily answered.
- (b) Most candidates performed well by giving the examples except that for fruit vegetables, many of them gave examples of fruits like mango, pawpaw, oranges etc. which strictly speaking are not vegetables. Examples of fruit vegetables are tomato, cucumber, garden eggs, hot pepper, sweet pepper etc.
- (c) Almost all candidates who attempted this sub-question did well and had good marks.



CROP HUSBANDRY AND HORTICULTURE 3

1. GENERAL COMMENTS

The standard of the paper as compared to the previous years was the same. The paper was of good quality with a good structured marking scheme devoid of ambiguities. Generally, candidates performance was above average and slightly better than the previous year.

2. A SUMMARY OF CANDIDATES' STRENGTHS

The Chief Examiner observed the following commendable features; most candidates:

- (1) provided clear and straight forward answers devoid of ambiguities.
- (2) observed the basic rubric of answering each question on a fresh page
- (3) presented their responses with legible handwriting
- (4) attempted all the four questions despite the marks obtained

3. A SUMMARY OF CANDIDATES' WEAKNESSES

The following weaknesses were observed:

- (1) Wrong spelling of some technical words e.g. names of diseases of crops, scientific names etc.
- (2) Misunderstanding of questions set
- (3) Poor observational skills leading to inability to give observable differences between specimens.

4. SUGGESTED REMEDIES

The following remedies were suggested:

- (1) Candidates should take their time to read questions very well to understand what the question demands before answering.
- (2) Teachers should ensure that candidates who handle some of the specimens replace them at their appropriated positions to avoid exchange of specimens so that those who come after them do not suffer
- (3) Teachers should ensure that students handle common garden tools in their practical lessons so that they know tools which need sharpening and those that need no sharpening.
- (4) Teachers should conduct practicals often and guide students on how to observe specimens.
- (5) Students should learn how to spell new and technical words they come across in their studies.

5. DETAILED COMMENTS

Question 1

- (a) **Identify each of specimens A, B and C.**
- (b) **State one use of each of specimens A, B and C.**
- (c) **Explain three benefits that could be derived from carrying out the main operation for which specimen C is used in crop production.**
- (d) **State three ways of maintaining specimen A.**

- (a) Some candidates listed all specimens of the entire questions. They were required to have mentioned A (hand fork), B (Dibber) and C (budding knife).
- (b) Candidates answered this section very well as demanded by the marking scheme.
- (c) Candidates were able to explain three benefits that could be derived from the main operation. (i.e. budding and grafting) for which budding knife is used in crop production. They were able to state that:
 - (i) seedless plants are propagated by this method
 - (ii) plants with non-viable seeds are also propagated by the method of budding/grafting
 - (iii) the method is used for disease control in plants
 - (iv) early maturity is achieved by this method
 - (v) this method helps farmers to obtain two or more varieties on the same plant
 - (vi) it helps to obtain quality improvement of crops
 - (vii) it also helps in the improvement of yield
- (d) Candidates were able to handle this question well, but some wrote 'wash' which was not acceptable. The correct operation is 'wash and dry'. Some candidates also stated that the specimen should be sharpened instead of straightening the metal part regularly.

Question 2

Specimens D and E are materials used for soil improvement.

- (a) **Identify each of specimens D and E.**
- (b) **State two observable differences between specimens D and E.**
- (c) **State three problems associated with the uses of specimens D in crop production.**
- (d) **State three effects of applying excess quantities of specimen E to crops on the field.**

- (a) Candidates were able to identify specimens D (poultry manure) and E (sulphate of Ammonia) satisfactorily.
- (b) Most candidates drew a table to make the answers clear. However, many candidates were only able to compare one difference, i.e. the colour – i.e. while poultry manure looked brown, Sulphate of Ammonia looked white to score them two marks out of four marks.

A few candidates were able to score the maximum four marks when they compared the chemical nature of the specimens- i.e. poultry manure is organic while Sulphate of Ammonia is inorganic.

The following should have been the table:

	Poultry Manure	Sulphate of Ammonia
- Colour	Greyish / brown	Whitish
- Structure	Amorphous	Crystalline
- Uniformity / (Inclusions)	Mixture of droppings, feathers, litter etc.	No inclusions / homogenous
- Odour	Bad / offensive	No odour
- Chemical nature	Organic	Inorganic

- (c) Most candidates gave answers such as: bulky to handle/ to transport; bad odour/ offensive odour; scorches seedlings when applied fresh/ not well decomposed; nutrients are not readily available to plants when supplied. They failed to state that its application may/ could expose user to zoonotic diseases; nutrients composition not uniform hence unpredictable.
- (d) Candidates failed here when they gave such answers as: causing soil to be acidic, destroy soil structure; causing liching etc. they were expected to give the following answers. It will cause excessive vegetative growth; weak stems prone to lodging; death of plants/ wilting; suppression of flowering/ fruiting.

Question 3

- (a) **Mention three planting materials that could be used in propagating specimen F.**
- (b) **Give one reason for staking the plant from which specimen F was obtained.**
- (c) **State two properties of soil suitable for the propagation of specimen G.**
- (d) **Mention two pests and two fungal diseases that could attack the plant from which specimen G was obtained.**
- (e) **Give four uses of specimen G.**
- (a) Candidates were to mention three planting materials that could be used in propagating specimen F (yam). A great number of candidates were able to give satisfactory answers such as: seed yam, setts, mini setts, bulbils, yam seeds. The rest include tissue culture, vine cutting and regenerated tubers. Some candidates gave planting materials as: Hoe, mounds, cutlass, mattock which are simple garden tools. This indicates that some candidates do not understand the question before answering it.
- (b) Candidates were to give one reason for staking the plant from which specimen F (yam) was obtained. Candidates actually gave very good answers such as: to enable the plant stand firm; for better tuber formation. However they did not include – to minimize competition with weeds. Weak candidates said – to avoid diseases and pest attack. All these points are not relevant.
- (c) Candidates were to state two properties of soil suitable for the propagation of Specimen G (sugar cane). Good answers which some candidates wrote include: clay loam; sandy loam; well drained soil, soil with good water-holding capacity.

A few good candidates included good answers as: soil rich in nitrogen, soil slightly acidic (pH 5 – 8.5) – range (optimum pH – 6.5).

- (d) This question was answered satisfactorily by most candidates. A lot of candidates were able to give good answers like: stem borers; termites; rodents; frog hoppers; scale insects; white grubs as pests which could attack sugar cane.

Fungal diseases

Candidates who managed to pass in this area had answers such as: Red rot; Smut; Root rot. Most candidates could not mention the following correct answers: pineapple disease, Eye spot, Downy mildew as fungal diseases that could attack sugar cane.

- (e) Many candidates scored very good marks here when they wrote good answers as follows: it is chewed as food; bagasse is used as livestock feed; bagasse is used as fuel; for sugar production; molasses for alcohol production. Other uses of sugarcane include – filter mud used for fertilizer production, molasses as additive in making silage; bagasse for paper, card-board production etc.

Question 4

- (a) **Enumerate four cultural practices that should be carried out on the plant from which specimen H was obtained.**
- (b) **Name one fungal disease that could affect that plant from which specimen H was obtained.**
- (c) **Mention two uses of specimen H.**
- (d) **Name three other types of materials that could be used in making specimen J.**
- (e) **State three characteristics of a good potting medium that could be used in filling specimen J for the purpose of propagating ornamental plants.**
- (f) **Mention one problem that could be encountered when growing ornamental plants in specimen J.**

- (a) This question was answered well when candidates wrote answers such as: staking; pruning; disease control, pest control, watering and fertilizer application. The only point left out by candidates is – training to climb the stick.
- (b) Most candidates did not answer this question at all. Those who did got the answers wrong. They mentioned – chlorosis, Gumosis, which are wrong. Correct answers include: downy mildew and powdery mildew.
- (c) A lot of candidates did well when they gave the uses of specimen H (fruits of grapes) as:
- eaten fresh/ used as food
 - for juice production
 - for wine production
- (d) Candidates were to name three other types of materials that could be used in making specimen J (plastic pot). Many candidates could not handle the answers well, so they scored half marks. They gave answers as: clay pot; concrete pot; metal pot; fibre pot and plastic pot. The correct answers are as following: clay, concrete, bamboo, calabash, fibre, wood, polythene and metal.

This means clay, metal, concrete, fibre could be moulded in the form of J because plastic material was moulded to become plastic pot. Others like bamboo and calabash could be used as substitutes.

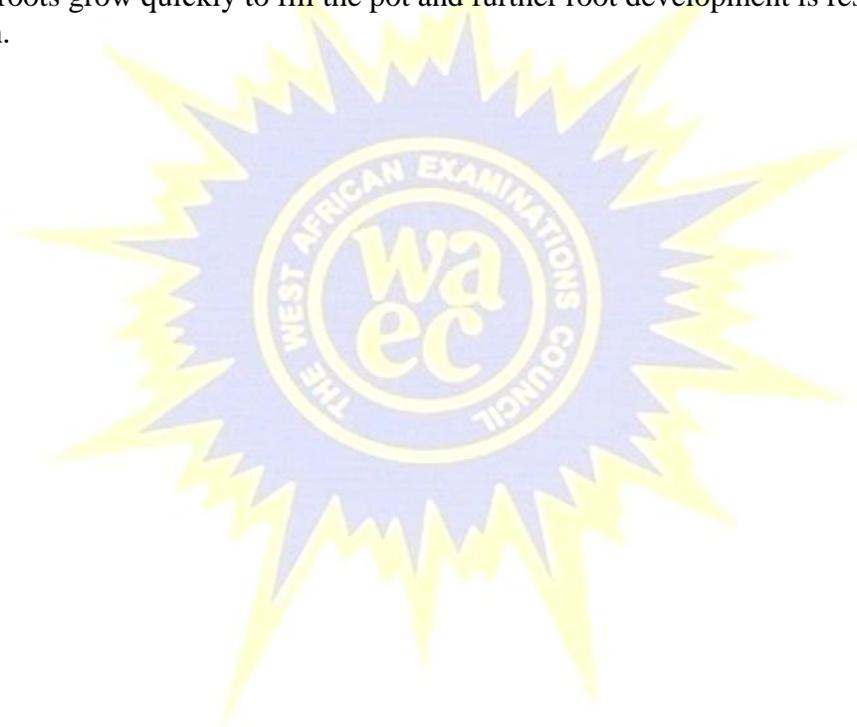
- (e) Many candidates wrote good answers such as – the medium must have good moisture retention capacity; must have good drainage properties; must have good texture; should be free from pests; must be free from diseases; should be free from weed seeds; should supply appropriate nutrients; should be firm and dense to hold the plant.

In fact the above are the requirements of the question hence candidates scored good marks.

- (f) A lot of candidates deviated in their answers. Some candidates said the sun will make the specimen crack because of the heat.

However a few candidates wrote correct answers such as:- the roots development is restricted; As the roots grow bigger, the plastic pot can break.

Candidates should have included the following correct answers – plants become pot bound; roots grow quickly to fill the pot and further root development is restricted; poor aeration.



FISHERIES 2

1. GENERAL COMMENTS

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

2. A SUMMARY OF CANDIDATES' STRENGTHS

The Chief Examiner noted the following strengths:

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

3. A SUMMARY OF CANDIDATES' WEAKNESSES

The following weaknesses were noted:

- (1) Inadequate preparation
- (2) Poor usage of the English Language.

4. SUGGESTED REMEDIES

The Chief Examiner suggested the following remedies:

- (1) Efforts should be made to teach students the correct spellings of fisheries terminologies
- (2) Students should improve upon their usage of the English Language

5. DETAILED COMMENTS

Question 1

- (a) Mention four modern methods of preserving fish.**
- (b) List four qualities of culturable fish species**
- (c) State two ways in which cultural festivals are important in the development of the fishery industry in your country.**
- (d) Describe four measures a fish farmer could adopt to check overpopulation of tilapia in a pond.**

- (a) Most of the candidates had the idea of correct answers but they wrongly spelt the terms giving it different meanings. Examples were: caning instead of canning; radiation instead irradiation.
- (b) Some candidates wrongly listed characteristics of fish. Expected answers include fast growth, adaptation to habitat and marketability.
- (c) Most candidates could not answer the question. They indicated that fishers were able to make more profit from the cultural festivals. It is a period of relaxation; stock assessment and it is also a suitable period for spawning of fish.

- (d) Most candidates stated that some of the fish in a pond should be transferred into other ponds. Expected answers include: harvesting of adult fish, rearing of monosex population and regulation of stocking density.

Question 2

- (a) **Name three materials that could be used to improve the fertility of water in a fish pond.**
- (b) **State four fishery policies in Ghana.**
- (c) **List four factors that influence that growth and development of fishes.**
- (d) (i) **Mention three habitats of fishery organisms.**
(ii) **Name two fishery organisms that belong to each of the habitats mentioned in (i).**

- (a) This sub-question was reasonably well answered, except that some candidates added stirring the water which is not relevant.
- (b) This sub-question was poorly answered. Instead of Fisheries Policies like subsidies on fuel, no duties on imported gear, environmental protection and zonation of aquaculture areas, most candidates stated fisheries laws and regulations.
- (c) Most candidates gave reasonably satisfactory answers to this sub-question.
- (d) This sub-question was satisfactorily answered. However, some candidates wrote blackish instead of brackish water. Some candidates also mentioned cut fishes instead of catfishes.

Question 3

- (a) **List four excretory products of fish.**
- (b) **Name three diseases of fish.**
- (c) **State two ways in which a business plan is important in establishing a fish farm.**
- (d) **Explain three benefits of integrating pig and rice production with fish culture.**

- (a) Some candidates listed organs (kidney, bladder) instead of the required excretory products like urea, ammonia, salts and carbon dioxide.
- (b) Very well attempted, except that a few mentioned diseases like malarias, diarrhoea.
- (c) Very poorly answered. The required answers include: helping investor to decide if or not to invest in the project, determining the profitability of the project, to identify likely bottlenecks, determine requirements to smoothly executive the project. Rather, some candidates indicated the importance of fish farming such as serving as employment avenue, earning income.
- (d) Candidates were expected to indicate among others: a source of multiple income, pest and disease control, efficient utilization of waste, efficient utilization of labour. Some candidates indicated the importance of fish farming. Some stated that pigs serve as predators of the fish or fight against malaria.

Question 4

- (a) **State four adaptive features of tilapia in aquatic environment.**
- (b) **Give two reasons for the seasonal variations in fish catch.**
- (c) **Name four endangered fishery organisms in the Atlantic Ocean.**
- (d) **Explain four ways in which a commercial fish cage culture generates employment.**

This was a very unpopular question.

- (a) Most of the candidates who attempted the question indicated the general adaptive features of fishes in water such as presence of eyes. Expected answers include presence of scales, camouflage and streamlined body shape.
- (b) Candidates performed poorly. Candidates were expected to provide answers such as variation in spawning of fish, seasonal upwelling and differences in climatic factors.
- (c) Mostly well answered by the few who answered the question.
- (d) This sub-question was very poorly answered by the few candidates who answered the question. Candidates were expected to write the following: feed production, supply of cage materials, cage construction, fish processing etc.

Question 5

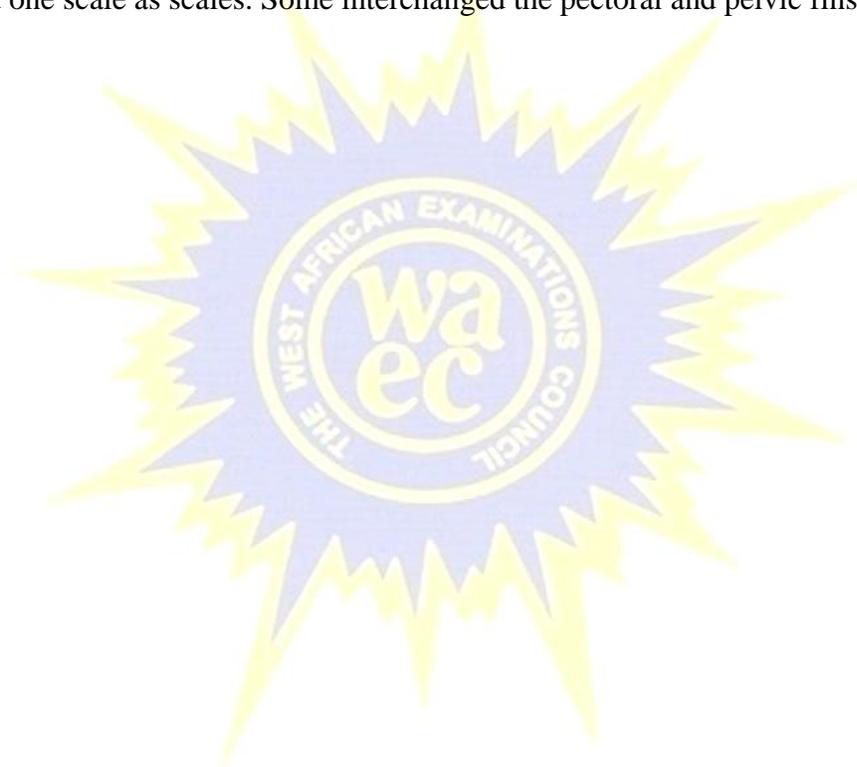
- (a) **Name five freshwater bodies in Ghana.**
- (b) **List three items of expenditure in capture fisheries.**
- (c) **Discuss site selection for fish pond construction under the following headings:**
 - (i) **topography;**
 - (ii) **soil type;**
 - (iii) **water supply.**

- (a) Candidates were expected to provide specific freshwater bodies in Ghana, such as Volta river, Densu river, Lake Volta etc. However, most candidates wrongly listed river, lake, reservoir.
- (b) Some candidates listed types of fishing gear. Others listed expenditure on items for culture fisheries rather than capture fisheries. Expected answers include: fishery vessels, fishing gear, fuel, labour.
- (c) Candidates were expected to indicate the ideal topography of sites; soil types and water availability. However, some described tests for soil, some described weather conditions, presence/ absence of sunlight etc.
Candidates should note that the site should have a gentle slope for easy drainage, soil should be sandy clay or loamy and water should be of good quality and adequate quality.

Question 6

- (a) **List five types of waste at fish landing sites.**
- (b) **Mention five measures that could be used to reduce the adoption of harmful fishing practices.**
- (c) **Draw and label the external features of a bony fish.**

- (a) This question was reasonably well answered.
- (b) The requirement was to state measures to reduce harmful fishing practices such as education of fishes, punishment of culprits, policing. However, some candidates listed the harmful fishing practices. Some strayed into aquaculture by stating fencing the pond etc.
- (c) In drawing the external features of a bony fish, some candidates drew the gills. Some showed the nostril as protrusion on the head of the fish. In labelling, most candidates labelled one scale as scales. Some interchanged the pectoral and pelvic fins.



FISHERIES 3

1. GENERAL COMMENTS

The standard of the paper was comparable to that of previous years. The performance of candidates was average.

2. A SUMMARY OF CANDIDATES' STRENGTHS

The Chief Examiner noted the following strengths:

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

3. A SUMMARY OF WEAKNESSES

The following weaknesses were identified by the Chief Examiner:

- (1) Inadequate preparation
- (2) Poor knowledge of scientific concepts

4. SUGGESTED REMEDIES

The Chief Examiner suggested the following remedies:

- (1) Teachers should cover the entire syllabus before the start of examination
- (2) Candidates should be taught the use of scientific terms and concepts

5. DETAILED COMMENTS

Question 1

The lengths (cm) of a batch of tilapia caught in a sample net from a fish pond are presented below. They are offspring of the same parents and were spawned at the same time.

**9, 13, 10, 15, 12, 11, 13, 14, 10, 16, 9, 14, 12, 15, 11, 14, 12, 13, 16
11, 13, 12, 15, 8, 14, 11, 13, 10, 15, 11, 14, 9, 11, 12, 11, 13, 12, 14, 13,
10, 14, 11, 12, 12, 10, 12, 10, 13, 11, 12.**

- (a) Draw a frequency distribution table for the lengths provided.**
- (b) Present the data obtained in (a) in a suitable graphical form.**
- (c) Describe the graph drawn.**
- (d) Explain three factors which could be responsible for the difference in lengths of the fishes caught.**
- (e) Name three fishing gear which could be used to sample the fish.**

(a) Frequency Distribution Table

This was well done. Very few candidates wrongly indicated the frequencies of some of the lengths of the fish

- (b) Most candidates drew the graph correctly. A few candidates produced bar charts and thus were not able to obtain the desired shape of the graph. (The candidates were required to produce a suitable graph)
- (c) Only few candidates correctly described the graph they had drawn. The graph was a normal distribution curve. It rises, peaks and falls.
- (d) Most candidates only stated the factors responsible for the differences in lengths of the fishes, but were unable to explain them. Expected factors include genetic, food availability, competition and environment.
- (e) The gear used for sampling were mostly correctly stated, with a few candidates wrongly stating gill nets and hook and line. The correct gear were scoop net, cast net, seine net.

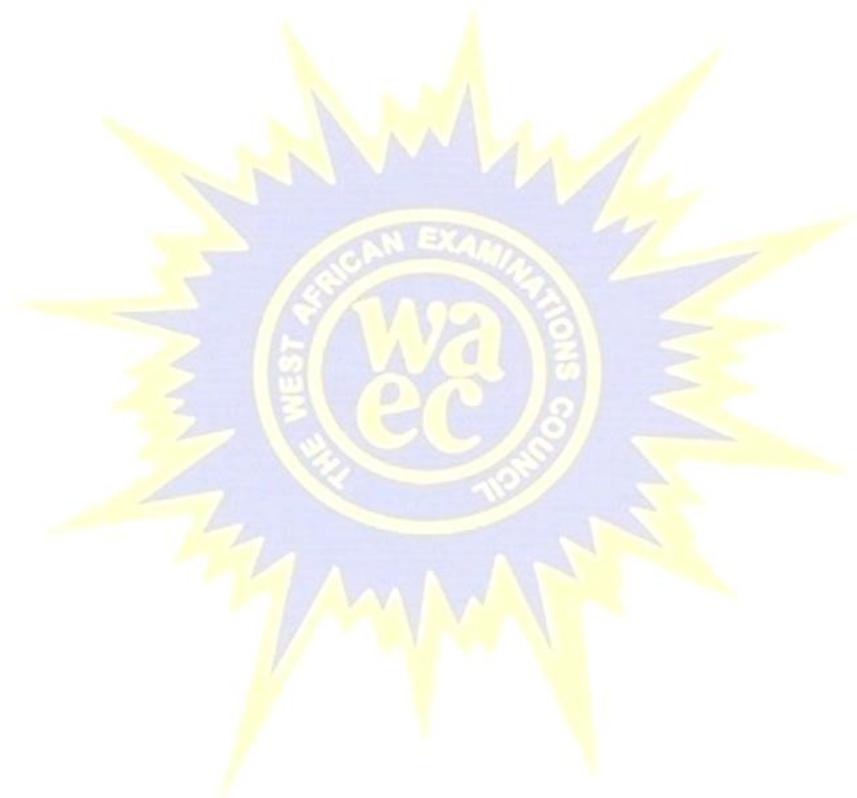
Question 2

- (a) **Identify each of specimens A, B and C.**
 - (b) **State four similarities in the external features of specimens A and B.**
 - (c) **State four similarities in the external features of specimens B and C.**
 - (d) **State two differences in the external features of specimens A and C.**
 - (e) **Sketch specimen B and indicate the three types of body measurements on the sketch.**
 - (f) **Name the habitat of each of specimens A, B and C.**
- (a) The specimens were correctly identified as Sardinella/ Sea Bream; Mackerel/ Horse Mackerel and Tilapia.
A few candidates interchange specimen B (Mackerel/Horse Mackerel) and Specimen C (Tilapia).
 - (b) The similarities in Specimens A and B were correctly stated.
 - (c) The similarities in Specimens B and C were correctly stated.
 - (d) The differences between Specimens A and C were poorly stated. Some candidates compared the sizes of the specimens. In biological organisms, since the ages of the specimens were not stated, the sizes are not relevant. Candidates were expected to consider the shape of the tail, presence of spine and body shape.
 - (e) Most candidates were able to correctly indicate the body measurements of the fish they had drawn.
 - (f) Most candidates were able to correctly indicate the habitats of the specimens provided.

Question 3

- (a)
 - (i) **Identify each of specimens D (measuring tape), E (mattack), F (shovel) and G (GVC pipe).**
 - (ii) **State one use of each of specimens D, E, F and G in pond construction.**
 - (iii) **Name four other tools required for pond construction.**
- (b)
 - (i) **Name the main nutrient supplied by each of specimens H (soyabean cake) and J (maize grain) in fish diet.**
 - (ii) **State the forms in which each of specimens H and J is used in fish feed preparation.**
 - (iii) **Name two other ingredients which could be used in place of each of specimens H and J in fish feed preparation.**

- (a)
 - (i) Most candidates correctly identified the specimens which were provided.
 - (ii) The uses of the specimens were correctly indicated except in a few cases where the measuring tape was indicated as for surveying instead as for measuring lengths.
 - (iii) This was satisfactorily answered. However, some candidates again listed some of tools provided as specimens.
- (b)
 - (i) This was satisfactorily answered.
 - (ii) Some candidates indicated that the specimens are used in a mashed form instead of powdered or grits.
 - (iii) The alternatives/ substitutes were satisfactorily stated. Some candidates wrongly suggested bone meal for protein.



FORESTRY 2

1. GENERAL COMMENTS

The standard of the paper was at par with that of the previous years. Questions were set across syllabus and were without ambiguities. Candidates' performance was below average as compared to that of last year.

2. A SUMMARY OF CANDIDATES' STRENGTHS

The Chief Examiner observed that candidates had good handwriting which made their scripts easy to mark.

3. A SUMMARY OF CANDIDATES' WEAKNESSES

The following weaknesses were observed:

- (1) Poor handling of questions from particular parts of the syllabus including Forest Estates, Forestry Sector Structure and Wildlife.
- (2) Superficial responses indicating poor preparation for the examination
- (3) Poor presentation and numbering of responses
- (4) Poor understanding of forestry terms

4. SUGGESTED REMEDIES

- (1) Teachers should ensure that all topics in the syllabus are covered before presenting candidates for the examination.
- (2) Teachers should emphasize the meanings of the various forestry terms in their lessons rather than just listing them.
- (3) Candidates should take their lessons serious and prepare very well for the examination.
- (4) Candidates should learn to present their answers well by obeying the rubrics.

5. DETAILED COMMENTS

Question 1

- (a) **State three morphological features of mushroom.**
- (b) **Outline the steps involved in growing mushroom.**
- (c)
 - (i) **Describe the technique for harvesting mushroom.**
 - (ii) **Mention four ways of preserving mushroom.**
- (d) **Describe each of the following methods of harvesting Non-Timber Forest Products:**
 - (i) **hunting;**
 - (ii) **gathering.**

This sub-questions (a) – (c) were on vocations in forestry. Candidates' performance was above average but there is more room for improvement. Most candidates provided the following answers:

- (a) Morphological features of mushroom
- possess white to light brown colour
 - have a cap
 - have a stalk/stipe that facilitates spore dispersal
 - produce extensive mycelia / hyphae for nutrition and anchorage
- (b) Steps involved in growing mushroom
- composting the substrate
 - bagging the substrate
 - sterilizing the bagged compost
 - inoculation (spawning)
 - cropping
- (c) (i) Technique for harvesting mushroom
Harvesting is done by grasping the stalk at the base / with the hand / and gently pulling out the whole mushroom
- (ii) Ways of preserving mushroom
- canning
 - freezing
 - roasting
 - boiling / steaming
 - drying
- (d) Candidates were able to describe methods of harvesting NTFPs
- (i) Hunting:- Catching / killing of wild animals for food, sport or to make money (trade). Products hunted include bushmeat, pets, birds, zoo animal etc.
- (ii) Gathering:- The process of harvesting NTFPs by collecting from the forest floor, picking/plucking of leaves, snails, fruits, firewood etc.

Question 2

- (a) **What is a virgin forest?**
- (b) **State five characteristics of a natural forest.**
- (c) **Mention six economic activities in forestry.**
- (d) (i) **Name five mammals that are endangered in Ghana.**
- (ii) **Give two examples of primates in Ghana.**

Most of the candidates who attempted this question performed satisfactorily.

- (a) Most candidates had the maximum mark for this sub-question.
- (b) This sub-question was also answered well by most of the candidates who attempted it. Some of the answers provided were:
- five layered canopy

- presence of buttresses
 - mixed stand of tree species / heterogeneous
 - presence of climbers and lianas
 - multiplicity of NTFPs
 - has its microclimate
 - abundance of litter on the forest floor
- (c) This was not satisfactorily answered, the expected answers were:
- growing of forest tree seedlings for sale
 - gathering snails, leaves and nuts from the forest for sale
 - selling sawn timber in markets as a business
 - production and sale of cane and rattan products e.g. baskets, furniture etc
 - hunting and sale of bush meat
 - production and sale of fufu mortar and pestles / utensils / accoutrements
 - production and sale of charcoal
 - sale of fuel wood
 - production and sale of honey
 - logging
- (d) (i) Many candidates failed to give the endangered mammals in Ghana as:
- | | |
|--------------|-------------------|
| - lion | - Diana monkey |
| - elephant | - colobus monkeys |
| - chimpanzee | - bush baby |
| - leopard | - bossman's potto |
| - Bear | - chimpanzee |
| - gorilla | |
- (ii) Examples of primates in Ghana include:
- Bush baby
 - Bossman's potto
 - chimpanzee
 - colobus monkey
 - gorilla

Question 3

- (a) Name four protective measures which could be adopted to control the over-exploitation of forest resources.
- (b) (i) What is extinction?
(ii) State two causes of extinction of forest resources.
- (c) Name four ways of controlling deforestation.
- (d) (i) What is plant succession?
(ii) Give two disadvantages of taungya system.
- (e) Explain each of the following terms as used in forestry:
(i) beating up;
(ii) thinning.

- (a) Students were unable to give the protective measures which could be adopted to control over-exploitation of forest resources. Correct answers should include ban on log export, star rating of species, different stumpage fees, felling restriction, participatory forestry etc.
- (b)
 - (i) Students found it difficult to explain extinction as the situation where an organism is out of existence.
 - (ii) This question was also difficult to tackle. Natural disaster, natural selection, excessive hunting and distribution of an organisms habitat were answers to mention.
- (c) Ways of controlling deforestation were correctly given.
- (d)
 - (i) Candidates found it difficult to explain plant successive as the establishment of a series of plant communities in a particular habitat over a period of time eventually resulting in the establishment of a climax community.
 - (ii) Disadvantages of taungya system were excellently provided.
- (e) Candidates were able to explain (i) beating up and (ii) thinning.

Question 4

- (a) **State the main function of each of the following organizations:**
 - (i) **TIDD;**
 - (ii) **WD;**
 - (iii) **FSD.**
- (b) **Give three reasons why TUC is important in forestry.**
- (c) **Explain each of the following terms as used in forestry:**
 - (i) **habitat;**
 - (ii) **ecosystem;**
 - (iii) **ecotone;**
 - (iv) **niche.**

This question was generally unfavourable to most candidate who attempted it.

- (a) This question was poorly answered, the following answers were expected:
The main functions of
 - (i) TIDD:-
 - Regulates the production of timber / lumber for use in Ghana and for export.
 - timber exportation
 - plywood exportation
 - veneer and plywood development
 - promotion of timber trade on or in international market
 - maintains uniformity of price
 - (ii) WD:-
 - Maintenance of ecosystem for the protection of wild animals through the establishment of parks and other nature reserves and issuance of permit / licenses for hunting or for the international pet trade.
 - Promotes marine turtle breeding grounds

- (iii) FSD:-
Conservation or protection of forest ecosystems through the establishment of forest reserves / plantation establishment to compliment natural forests.
- regulating harvesting of timber from both forest reserves and off-reserves
 - vetting and registering all timber contractors
- (b) This was another unfavourable question. Reasons why TUC is important are:
- it regulates logging as a business
 - it ensures the regeneration and conservation of forests
 - gives the premise for international wood trade and comparison of standards
 - provides employment opportunity
 - generates income for district assemblies
- (c) Most candidates successfully explained the given terms as:
- (i) Habitat
This is the natural home/ the living place of an organism
- (ii) Ecosystem
A natural unit consisting of living and non-living elements interacting to produce a stable system
- (iii) Ecotone
This refers to the transition zone between two vegetation zones. E.g. forest and savannah
- (iv) Niche
A function within an ecological system to which an organism is especially suited.

Question 5

- (a) (i) **Outline the processes involved in producing a log from a tree.**
(ii) **Name four tools used in producing a log from a tree.**
- (b) **Mention the trade names of each of the following tree species:**
- (i) *Terminalia ivorensis*;
 - (ii) *Naucleadiderrichii*;
 - (iii) *Pericopsiselata*;
 - (iv) *Ceibapendandra*.
- (c) **State four ways of controlling bushfires.**
- (d) **State four activities that are prohibited at Ramsar sites.**

Almost all candidates who attempted this question performed creditably. This was a popular question to candidates and most of them obtained high marks.

(b) This posed a challenge to most candidates. The expected answers are:

	<u>Tree Species</u>		<u>Trade Name</u>
(i)	<i>Terminalia ivorensis</i>	-	Emire
(ii)	<i>Naucleadiderrichii</i>	-	Kusia / opepe
(iii)	<i>Pericopsiselata</i>	-	Kokrodoa
(iv)	<i>Ceibapentandra</i>	-	ceiba

(c) This was an easy one to most candidates. Ways of controlling bushfires are:

- green belts should be established
- there should be rural watch dog/ fire volunteer squads
- bush fire laws preventing farming, hunting and tapping of palmwine in certain parts of the year should be enforced
- offenders should be prosecuted and sanctioned

(d) Candidates performed poorly with this question. The following was expected:
Prohibited activities at Ramsar sites include:

- removal of any vegetation or calculation of any portion of the core area / zone (except with the written consent of executive director of wildlife division).
- deposit of any litter at the areas designated
- sand winning, quarrying activities or removal of soil from the site
- hunting, capturing, harming or deliberately disturbing any wild animal
- unsupervised grazing of livestock
- starting of bush fire within a distance 1km from the boundary of the site

Question 6

(a) **What is a flower?**

(b) **State two functions of each of the following parts of a plant:**

(i) **root;**

(ii) **leaf.**

(c) **Mention four nursery practices that are carried out in forestry.**

(d) **Define each of the following forestry terms:**

(i) **extraction;**

(ii) **logging;**

(iii) **skidding.**

(e) **Give two reasons why draught animals may be used during extraction of timber.**

(a) Candidates could not state what a flower is, a flower is the reproductive part of a plant, simple.

(b) Functions of the root and leaf were correctly given by most candidates.

(c) Nursery practices in forestry were also correctly given as:

- breaking of seed dormancy
- pricking out
- transplanting
- watering
- weeding / weed control
- shading
- hardening off
- stumping

(d) Candidates defined the terms with a few problems, the following was expected.

Definition of forestry terms

(i) Extraction

The act or process of transporting logs from the felling site to a landing.

(ii) Logging

The act or process of felling and extracting timber from forests especially in the form of logs

(iii) Skidding

Terrain transport in which logs are dragged to a landing rather than suspended in the air or carried in a vehicle

(e) Reasons why draught animals are used during extraction are:

- cheap means of transport
- good for very limited space
- better for some rough terrain
- no disturbance of soil

FORESTRY 3

1. GENERAL COMMENTS

The standard of the paper as compared to the previous years was of a good quality with a good structured marking scheme devoid of ambiguities. Generally, candidates' performance was above average and better than the previous year.

2. A SUMMARY OF CANDIDATES' STRENGTHS

The following commendable features were observed:

- (1) Legible handwriting
- (2) Straight forward answers
- (3) Good observational skills

3. A SUMMARY OF CANDIDATES' WEAKNESSES

Notable among the candidates' weaknesses observed were:

- (1) Poor spelling of scientific terms
- (2) Poor command of the English language
- (3) Poor drawing skills

4. SUGGESTED REMEDIES

The following remedies are suggested:

- (1) Students should take the spelling of scientific terms seriously
- (2) Students should read wide and speak the English language frequently
- (3) Teachers should teach students how to draw and label specimen in science

5. DETAILED COMMENTS

Question 1

- (a) **Mention the means by which specimen A propagates its self.**
- (b) **Give four reasons why specimen A should be controlled on a plantation.**
- (c) **State four methods of controlling specimen A.**
- (d) **Give three characteristics of specimen A that make it invasive.**

Generally, questions one and two were answered better than questions three and four.

- (a) A number of candidates could not answer it well. It asked about the means by which chromolaena (Acheampong weed) propagates itself. This does not mean the process. The answer is simply by seed. Some plants propagate by their leaves, stem or by spores.

- (b) Reasons for controlling chromolaena (Specimen A) are:
- it competes with crops for water, light, nutrients and space
 - it harbour pests that are harmful to other crops
 - it makes movement and other operations very difficult
 - it can therefore increase production cost or reduce yield of crops
- (c) This sub-question was answered satisfactorily.
- (d) A few candidates could state as
- fast growing
 - produce light seeds that could easily be carried by wind
 - produce numerous seeds
 - hardy, and thrives in many ecological zones
 - secretes chemicals that could kill/ keep off other plants (allelopathy)

Question 2

- (a) **Identify each of specimens B and C.**
- (b) **Draw and label specimen B.**
- (c) **State two ways in which specimen B is important in forestry.**
- (d) **State the main function of specimen C in the forestry ecosystem.**
- (e) **Name the habitats of each of specimens B and C.**
- (f) **Indicate the trophic level of specimen B.**
- (a) Most candidates had the maximum mark for this sub-question.
- (b) Scientific drawings are not like artistic drawing
The outline should be sharp, painting is not necessary. There should be a heading for the drawing. The use of special arrows (↖) is not allowed, rather the normal arrows (-) is used. The arrow should touch the part of the object being labelled.
- (c) the ways in which specimen B (giant snail) is important in forestry are as follows:
- it destroys nursery plants
 - its droppings fertilize the soil
 - it supports as food to the forester
 - as employment
- (d) It asked about the main function of specimen C (mushroom) in the forest ecosystem. The answer is decomposer and not its uses as many students were thinking.
- (e) This was answered well by most candidates.

Question 3

- (a) **Identify specimen D.**
- (b) **Name the type of leaf possessed by specimen D.**
- (c) **Give four reasons why specimen D is suitable for use in agroforestry.**
- (d) **Identify specimen E.**
- (e) **State four uses of specimen E.**

- (a) Most candidates were able to identify specimen D (*Cassia siamea*) correctly.
 - (b) Candidates failed to describe the type of leaf borne by specimen D (*Cassia siamea*). The answer should be compound pinnate.
 - (c) It asked for the reasons for using cassia siamea (specimen D) in agroforestry. This is not mainly the uses. Some other plants could be grown for the same uses but why is it that cassia siamea is preferred. We are talking about the natural advantages. The actual reasons are:
 - It fixes nitrogen in the soil
 - it has high coppicing ability grows fast
 - produces a lot of litter
 - it easily establishes itself
- Sub-questions (d) and (e) were answered nicely by almost all the candidates.

Question 4

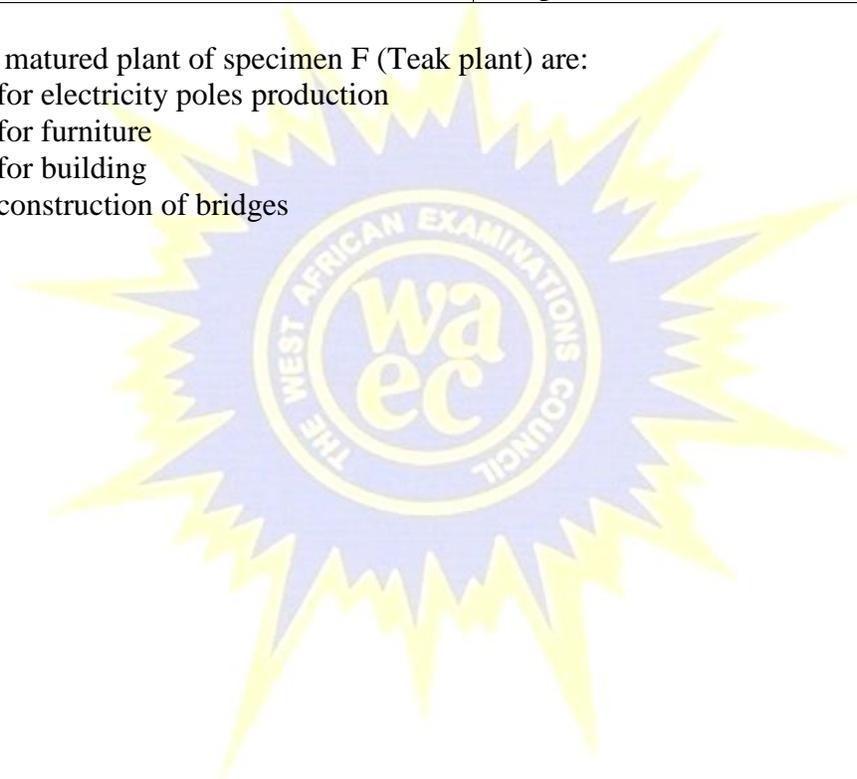
- (a) **Name the habitat of specimen G.**
 - (b) (i) **Mention the kingdom to which specimen G belongs.**
(ii) **Give two reasons for the answer in (b)(i).**
 - (c) **State two ways in which specimen G is of economic importance.**
 - (d) **State four observable difference between specimen F and G.**
 - (e) **Give three uses of a mature plant of specimen F.**
- (a) Most candidates correctly gave the habitat of specimen G (Farm plant) as arboreal/terrestrial)
 - (b) (i) Many candidates could not spell the kingdom PLANTAE. A number of them spelt it planteae which is wrong.
(ii) A greater percentage of the candidates could not answer this sub-question properly. The reasons for kingdom plantae are:
 - possession of true leaves root and stem
 - made of many cell (green pigment)
 - leaves containing chlorophyll/ green pigment
 - (c) A few candidates considered economic importance as things which were only beneficial. The right answers were:
 - it serves as weed
 - has medicinal values
 - controls soil erosion
 - harbours wild animals
 - purifies the atmosphere

- (d) About 90% of the candidates could not state the differences between the fern and the Teak. They failed to give corresponding answers. The correct answers were as shown in the following table:

Differences

Specimen F (Teak)	Specimen G (Fern)
Broad leaves	Narrow and small leaves
Taproot/ true roots	Narrow and small leaves
Prominent stem	False root
Absence of sorion leaves	Absence of true stem
Has smooth/ entire margin	Presence of sorion leaves
Rough texture leaf	Has serrated margin/ toothed margin/ smooth texture leaf

- (f) Uses of matured plant of specimen F (Teak plant) are:
- for electricity poles production
 - for furniture
 - for building
 - construction of bridges



GENERAL AGRICULTURE 2

1. GENERAL COMMENTS

As usual, this year's paper is of a good standard and compares favourably with papers in previous years. Candidates' performance is generally only satisfactory and above average.

2. A SUMMARY OF CANDIDATES' STRENGTHS

The Chief Examiner noted the following strengths:

- (1) Good understanding of rubrics
- (2) Correct numbering of questions and their sub-questions
- (3) Ability to answer the required five questions within the stipulated time
- (4) Correct usage of Agricultural terminologies by a fairly good number of candidates

3. A SUMMARY OF CANDIDATES' WEAKNESSES

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

- (1) Wrong spelling of scientific words and terminologies
- (2) Poor expressions of the English Language
- (3) Failure to answer a question from each of the five parts of the paper
- (4) Poor understanding of tasks posed by questions leading to deviations.

4. SUGGESTED REMEDIES

The following recommendations were offered

- (1) The subject should be properly taught and more practical lessons should be organized for in-depth understanding
- (2) Reading habits should be encouraged among students as a way of improving their understanding of English Language

5. DETAILED COMMENTS

Question 1

- (a)
 - (i) **What is the land tenure system?**
 - (ii) **State two advantages and five disadvantages of communal land tenure system.**
- (b) **List three ways in which crop rotation is important in agriculture.**
 - (a)
 - (i) Most candidates knew that the Land Tenure is a system of land ownership. Only a few of them added that it also include acquisition and disposal of land governed by laws and conventions.
 - (ii) Candidates were generally able to state the advantages and disadvantages of communal land tenure system correctly.
 - (b) This sub-question on crop rotation posed little or no problem to most candidates.

Question 2

- (a) **List four uses of wind power.**
- (b) **State four benefits that could be derived from irrigation.**
- (c)
 - (i) **State two uses of draught animals on the farm.**
 - (ii) **Mention four factors that affect the efficiency of draught animals in agricultural production.**
 - (iii) **State two reasons why the use of draught animals may be preferred as a source of farm power.**

Most candidates avoid this question probably because of its many sub-questions.

- (a) Except of a few cases, candidates understood the question as tasking tem to state the uses of wind power. Some of their responses include:

- wind aids seed dispersal
- it causes wind erosion
- it aids pollination of flower

Expected responses include the following:

- wind is used for winning cereal produce
- it is used for drying farm produce
- it is used in pumping water

- (b) A lot of candidates knew what irrigation is but not all such candidates could state its benefits. A common response by candidates that irrigation increases crop yield was not acceptable because that is not peculiar to only irrigation.

Expected responses include:

- it provides soil moisture for the growth of crops
- it softens hardpans
- fertilizer can be applied through irrigation water.

- (c) (i) Responses given by some of the candidates suggest that they did not know what draught animals are. Such wrong responses include the following:

- they work on farms
- they make agricultural work easier

Expected responses include the following:-

- they are used in tilling the soil
- used in planting seeds
- used in carting farm produce

- (ii) Most candidates answered this question satisfactorily as they correctly mentioned the factors as follows:

- breed of animal
- age of animal
- climate under which they work
- health status of animal

- (iii) This sub-question was poorly answered by most candidates. Expected responses include:

- use of draught animals is environmentally friendly
- there is less operational cost
- their use does not lead to the formation of hard pans.

Question 3

- (a) **List four factors that affect soil formation.**
- (b) **State four reasons why knowledge of soil profile is important to a farmer.**
- (c) **State one deficiency symptom of each of the following plant nutrients:**
 - (i) **potassium;**
 - (ii) **nitrogen;**
 - (iii) **phosphorus;**
 - (iv) **sulphur.**
- (d) **Discuss two ways in which each of the following factors influences the weathering of rocks:**
 - (i) **temperature;**
 - (ii) **water.**

- (a) Most candidates were able to list the factors which affect soil formation, namely, climate, topography, parent material, vegetation/ relief and time.
- (b) A good number of candidates gave correct reasons why a knowledge of soil profile is important to farmers. But they could not state the reason convincely.
A knowledge of soil profile:
 - gives an indication of the fertility level of soil
 - shows the depth of the top soil which, in turn, guide farmers in growing shallow-rooted or deep-rooted crops etc.
- (c) Candidates did not answer this question satisfactorily enough. Many candidates repeated one correct deficiency system for all the given soil elements that is “there is stunted growth”.
- (d) Candidates’ knowledge of low temperature and water influence rock weathering was only superficial as demonstrated in their responses to this question. The topic “Rock weathering” should be properly taught by teachers.

Question 4

- (a) (i) **What is a mulch?**
(ii) **List four problems associated with the use of organic mulches on the farm.**
 - (b) **State four roles of organic matter in the maintenance of soil fertility.**
 - (c) **Discuss three factors that affect the use of fertilizer.**
- (a) (i) Most candidates explained the term “mulch” as a process of covering soil surface with suitable materials to conserve moisture rather than as material used in covering soil surface to conserve moisture.
(ii) Many candidates exhibited little or no knowledge of the problems associated with the use of organic mulches on farms.
Expected correct responses include:
 - facilitation of the growth and spread of weeds
 - serving as a habitat for pests
 - serving as a habitat for pests
 - organic mulches are prone to catching fires

- (b) Candidates generally answered this question well. Correct responses such as listed below were given.
- increase soil fertility
 - improve soil structure
 - check soil erosion
 - regulate soil temperature
- (c) This sub-question was poorly answered by most of the candidates. Expected general factors to discuss include:
- crop factor
 - soil factor
 - climate
 - management factor

Question 5

- (a) (i) **What are weeds?**
(ii) **List six harmful effects of weeds.**
- (b) **State two objectives for carrying out each of the following nursery practices:**
(i) **shading;**
(ii) **stirring the soil.**
- (c) **List four classes of crop pest.**

This question was generally well answered by most candidates.

- (a) (i) Except in a few cases, candidates wrote that weeds are unwanted plants growing at unwanted places and scored no mark for their efforts. Actually weeds are plants that grow among cultivated plants or at places where they are not wanted.
- (ii) Candidates' performance on this question was fairly good. Most of them stated the harmful effects of weeds on crops as follow:
- compete with crops for growth requirements such as soil nutrients, soil moisture, sunlight and space
 - harbour crop pests
 - increase cost of production through their control
 - reduce quality of farm produce

(b) Only a few candidates could not give correct responses as the objectives of the two nursery practices of shading and bed stirring. The question was generally well answered.

- (c) Only a few candidates listed classes of crop pest correctly. The expected classes of crop pest include:
- rodents
 - birds
 - insects
 - monkeys
 - nematodes

Many candidates however, wrongly listed classes of insect pests such as:

- boring insects
- biting insects
- piercing and sucking

A few other candidates also wrongly listed field pest and storage pest.

Question 6

- (a) (i) **What is weed dormancy?**
(ii) **State four methods of breaking dormancy in seeds.**
- (b) **Mention six advantages of vegetative propagation.**
- (c) **State four advantages of sowing seeds in drills.**

- (a) (i) Varying wrong responses were given by a fairly good number of candidates for the meaning of seed dormancy. Others made fairly satisfactory attempts at its meaning. Seed dormancy refers a condition in which viable seeds fail to germinate even though all the conditions necessary for germination are available.
- (ii) Performance on methods of breaking seed dormancy was only average. The right methods include:
- stratification i.e. moist chilling
 - physical scarification
 - acid scarification / chemical scarification
 - heat treatment
- (b) Most candidates could not mention the required number of advantages of vegetative propagation. Its advantages include the following:-
- it is a means of propagating seedless plants
 - propagated plants are true-to-true
 - seed dormancy problems are non-existent
 - provides means of repairing damage to trees
- (c) This question was poorly answered by those who attempted it. They demonstrated a near complete lack of knowledge of the tasks posed by the question. Advantages of sowing seeds in drills include:
- seeds/ seedlings are not easily washed away during rainfall or irrigation
 - young roots are well below soil surface
 - seedlings easily distinguished from weeds
 - ease of cultural practices
 - defective seedlings can easily be identified

Question 7

- (a) (i) **Explain the term brooding as used in poultry production.**
(ii) **State five routine activities that are carried out in a brooder house.**
- (b) **Mention four advantages of creep feeding.**
- (c) **Name four equipment that are required in a deep litter poultry house.**

- The performance of candidates who attempted this question was only average.
- (a) (i) The meaning of the term “brooding” was not explained well by most candidates. Such candidates explained the term as siting of hens on eggs to hatch which is incubation.
Rather, brooding is the confinement of chicks and providing them with heat/warm, food and water until they grow enough feathers.
- (ii) Candidates who failed to take note of the word “routine” mixed up routine and periodic activities in their responses. This caused them valuable marks. Some expected responses are
- daily inspection of chicks/ birds
 - provision of clean feed
 - provision of clean water
- (b) Candidates’ knowledge of creep feeding was fairly good. Most of them therefore stated its advantages correctly. Advantages such as faster growth of young animals, shortening weaning and leaving dam less suckled, were found in their responses.
- (c) This question which required of candidates to simply recall poultry equipment was well answered. Examples of such equipment are:
- feeding trough
 - water trough
 - laying nests
 - roosting proches

Question 8

- (a) **State three advantages and five disadvantages of the extensive system of keeping pigs.**
- (b) **Mention four ways of controlling liver fluke in ruminants.**
- (c) **State four effects of parasites on livestock production.**

Candidates performed well in answering this question.

- (a) Most candidates know the advantages of extensive system of keeping pigs as well as their advantages.

The advantages include:

- little initial set-up capital
- less labour-intensive
- little operational cost
- enough exercise for pigs

The disadvantages include the following:

- exposure of pigs to adverse weather conditions
- poor record keeping
- reduced growth rate
- loss due to theft

- (b) Candidates performed poorly on this question as they had little or no idea about the life cycle of the liver fluke to enable them correctly mention ways of controlling them in ruminants.
Even though most of the candidates mentioned deworming or drenching as correct control measure, they hardly knew of the following:
- destruction of fresh water snails
 - practicing rotational grazing
 - avoiding grazing on wet pastures
- (c) This question was well answered by candidates. They had the option of stating the effects of endo or ectoparasites on livestock production. They, therefore, had wide ranges of responses to state and score maximum points.

Question 9

- (a) **Explain each of the following methods of agricultural extension:**
- (i) **group method;**
 - (ii) **mass method;**
 - (iii) **individual method.**
- (b) **State characteristics of an effective extension system.**
- (c) **Explain each of the following activities that are undertaken in agribusiness management:**
- (i) **budgeting;**
 - (ii) **coordinating;**
 - (iii) **planning.**

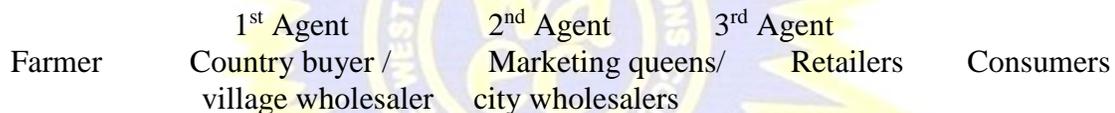
Generally, candidates did not perform well on this question.

- (a) Candidates who showed adequate knowledge of the extensional teaching methods as individual, group and mass methods were adequately rewarded with marks, particularly, in cases where responses were supported with examples of the method.
- (b) Most candidates performed poorly in answering this question probably as a result of inadequate knowledge about differences between qualities of extension agent, functions of extension agents and the characteristics of effective extensive system.
Most candidates gave responses bothering on either qualities or functions of extension agents instead of the characteristics of effective extensive system which is the task posed by the question/
Expected responses are
- strong administrative support
 - good transportation system
 - adequate financial support etc
- (c) Only a few candidates answered this question and performed very poorly. In their responses, they showed little or no knowledge of the agric business of planning, coordination and budgeting.

Question 10

- (a) State three problems associated with the marketing of agricultural produce in West Africa.
- (b) Mention three ways in which each of the following marketing functions is important:
 - (i) processing;
 - (ii) distribution;
 - (iii) assembling.
- (c) Outline a marketing channel for tomato involving three marketing agents.

- (a) Only a few candidates correctly stated the problems of Agricultural marketing. Instead of the problems such as poor transportation system, poor financing of marketing functions and services and inadequate storage and processing facilities, candidates' responses dwelt more on the characteristics of agricultural produce such as perishability.
- (b) Candidates did not answer this question well. They were deficient in the knowledge of the marketing functions, namely processing, distribution and assembling. Their responses on the importance of the functions in the marketing chain.
- (c) Candidates who attempted this question performed very poorly. They showed inadequate knowledge on marketing channels and agents who operate within them.
The required responses to the question is illustrated below.



GENERAL AGRICULTURE 3

1. GENERAL COMMENTS

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

2. A SUMMARY OF CANDIDATES' STRENGTHS

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

3. A SUMMARY OF CANDIDATES' WEAKNESSES

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

- (1) Candidates exhibited poor calculation skills
- (2) Few candidates failed woefully in providing scientific names for the specimens provided
- (3) Candidates exhibited poor construction of sentences that made it difficult for examiners to comprehend what they were trying to state.

4. SUGGESTED REMEDIES

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

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

5. DETAILED COMMENTS

Question 1

- (a) **Identify specimen A by its common and scientific names.**
- (b) **A farmer plants specimen A at a planting distance of 100 cm by 20 cm with two plants per stand. Calculate the plant population per hectare.**
- (c) **Mention three signs of maturity of specimen A.**
- (d) **Give three reasons why the produce of specimen A should be harvested early.**

- (a) Majority of the candidates were able to identify the common name of the specimen – Cowpea correctly but failed to state its scientific name correctly or state it without underlining. E.g. vignaunguiculata
Few candidates however, stated “Beans” as the common name of specimen A.
- (b) Most of the candidates had the calculation of the plant population per hectare wrong despite the fact that the planting distance and the number of seeds per stand were given. The expected calculation is as follow:
Area per plan = 1m x 0.2m = 0.2m²
And 1ha = 10,000m²
If 0.2m² = 2 plants
 $\therefore 10,000\text{m}^2 = \frac{10,000 \times 2}{0.2}$
= 100,000 plants population per hectare
- (c) Only few candidates were not able to state the signs of maturity of the specimen A (cowpea). Some of the signs include:
- leaves turn yellow/ brown and fell
 - pods turn yellow/ brown
 - seeds may rattle when pod is shaken
- (d) Majority of the candidates answered this section well. Expected reasons for early harvesting of the specimen A (Cowpea) were:
- lost of viability of seeds
 - grains may turn mouldy when the weather is humid
 - to avoid pests/ weevil infestation
 - to reduce birds/ rodents eating fruits

Question 2

- (a) **Identify each d specimens B and C.**
- (b) **Mention two farm animals on which**
(ii) specimen B could be found.
(iii) specimen C could be found.
- (c) **State three functions performed by each of specimens B and C in farm animals.**
- (d) **Name three parasites that could reduce the quality of specimen C.**
- (a) Majority of the candidates were able to correctly identify the specimens B as feather and C as skin.
Few candidates however, identified B as “Further” instead of Feather and C as “Fur” instead of skin.
- (b) Majority of the candidates were able to correctly state the animals on which specimens B and C were found.
- (c) This question was poorly answered by many candidates. Candidates were expected to state the functions performed by specimens B and C on farm animals. These include:

Specimen B (Feather)

- for protecting the animal
- for keeping the body warm
- for brooding
- for flight / flying etc

Specimen C (Skin)

- for protecting internal organs of animals
- for keeping the body warm
- for excretion etc

However, many candidates stated their industrial functions such as skin is used to manufacture belts, bags, shoes and feather used to manufacture pillows.

- (d) Majority of candidates correctly stated the pests found on the specimen C correctly, that could reduce its quality. However, few candidates wrongly mentioned mosquitoes, roundworms and tapeworms instead of lice, mites, ticks and fleas.

Question 3

Specimens D and E are different types of soils.

- (a) **Perform an experiment to determine the texture of each of specimens D and E using the wet feel method. Outline the procedure.**
- (b) (i) **State the observations from the experiment.**
(ii) **Identify each of the specimens D and E based on the observations made in (i).**
- (c) **Suggest two practices that a farmer could adopt to improve the quality of specimen D for vegetable production. Give reasons for your suggestions.**
- (d) **Mention three problems a farmer could encounter if the farmland contains a high amount of specimen E.**

- (a) Majority of the candidates could not present the sequential procedure for determination of soil texture.

Expected procedure for determination of soil texture is as follow:

- place each of the crushed specimens D (sandy soil) and E (clayey soil)
- add few drops of water to each sample until they are wet
- mould each of the soil samples into ball shape
- form/ roll the sample that formed a ball into a cylindrical shape
- bend each of the cylinder shaped soil sample into a U-shape
- form a ring from each U-shaped sample

- (b) Only few candidates had the observation correct by stating that specimen D had a gritty/coarse sand texture and specimen E had smooth/slippery texture. Specimens D and E were therefore identified as sandy and clayey soils respectively.

- (c) Majority of candidates provided the correct answers for improving specimen D (sandy soil) for vegetable production as follows:

- adding organic manure
- cover cropping
- mulching
- adding inorganic fertilizer

- (d) Most candidates provided wrong answers to this question. Candidates were expected to state problems farmers could encounter with large amount of specimen E (clayey soil)
Some expected answers include:
- poor workability
 - poor drainage/ waterlogging/ flooding
 - poor aeration/ reduced respiration of roots/ microbial activities

Question 4

- (a) **Identify each specimens F, G and H.**
(b) **Name three parts of specimen F.**
(c) **State one function of each of the parts of specimen F named in (b).**
(d) **State one use of each of specimens F, G and H.**
(e) **State one way of maintaining each of the specimens F, G and H.**

- (a) Majority of candidates correctly identified the specimens

F - Watering can
G - Hand trowel
H - Sickle

Few candidates however, had the spelling of the specimens wrong. For example “sickle” was wrongly spelt as “sickel” and “Watering can” was wrongly spelt as “water can”.

- (b) Most of the candidates named the three parts of the specimen F (Watering can) correctly. Expected answers are Rose, tank, handle, spout.
- (c) Most of the candidates stated the functions of the parts of the specimen F (Watering can) correctly.
Few candidates failed to state the functions of Rose include:
- breaks liquid into fine spray
 - helps spread liquid on crops/soil
- (d) Almost all candidates stated correct uses of specimens F (watering can), G (Hand trowel) and H (Sickle).
Only few candidates gave a wrong uses of sickle such as:- for harvesting rice/ for cutting forage grass/ crops.
- (e) Majority of the candidates stated the correct ways of maintaining each of the specimens F, G and H.

INTEGRATED SCIENCE2

(1) GENERAL COMMENTS

The standard of the paper was within candidates' level of knowledge and compares favourably with those of previous years. The questions were within the scope of the syllabus and the rubrics were very clear and simple. The performance of candidates has shown a slight improvement over the recent past years'.

(2) A SUMMARY OF CANDIDATES' STRENGTHS

The Chief Examiner commended candidates on following qualities exhibited in their answers to the questions.

- (1) Answers to questions were numbered appropriately and well-spaced out.
- (2) Answers were provided in very clear, legible handwriting.
- (3) Most candidates followed the instructions on the question paper.
- (4) Most of the candidates were able to express themselves very well in the English language.
- (5) A good number of the candidates were able to tabulate answers to questions that required differences between two things.

3. A SUMMARY OF CANDIDATES' WEAKNESSES

The following weaknesses of candidates were noticed by the Chief Examiner.

- (1) Poor spelling especially of scientific words, one-word answers and scientific terms.
- (2) Where differences between concepts were required, points did not correspond in some cases.
- (3) Failure to use S.I. units in calculations.
- (4) Failure to indicate correct units for final answers.

4. SUGGESTED REMEDIES

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

- (1) Vocabulary drill at the beginning of lessons to emphasize the spelling and meaning of scientific/technical terms should be encouraged.
- (2) Conscious effort should be made by teachers to take students through fundamental units and derived units
- (3) Teachers should be encouraged to hold demonstration lessons to enhance students' understanding of concepts.

5. DETAILED COMMENTS

Question 1

- (a) (i) Name the four parts of a complete flower.
(ii) Which two of the parts mentioned in (i) are the reproductive parts of the flower?
- (b) (i) Arrange the following components of the electromagnetic spectrum in order of increasing wavelength: red light, blue light, microwaves, x-rays.
(ii) State one use of
(α) microwaves.
(β) x-rays.
- (c) (i) What is ionic bond?
(ii) Name the type of bond in each of the following compounds:
(α) calcium oxide;
(β) methane;
(γ) copper (II) oxide;
(δ) methanol
- (d) State two functions of each of the following nutrients:
(i) nitrogen;
(ii) phosphorus.

- (a) This sub-question was attempted by majority of the candidates. Candidates were able to name the four parts of a complete flower. However, some got the spelling of corolla, Androecium and gynoecium wrong.
- (b) (i) There was the evidence of the knowledge of the electromagnetic spectrum, but the order of increasing wavelength was a challenge to many candidates. They failed to recognize that x-rays have the least wavelength followed by blue light, with microwave having the highest wavelength.
(ii) Majority of candidates stated correctly one use each of microwaves and x-rays.
- (c) Many candidates answered this sub-question well, even though some failed to state that ionic bond involves transfer of electrons. Many candidates also misspelt covalent as either convalent or covelent.
- (d) Quite a number of the candidates were able to state two functions of nitrogen but only a few of them could state two functions of phosphorus.

Question 2

- (a) (i) Give two examples of a mixture of:
(α) two immiscible liquids;
(β) two miscible liquids.
(ii) Name one apparatus used in the separation of two immiscible liquids.
- (b) (i) What is centre of gravity of the body?
(ii) Describe briefly how the centre of gravity of a rectangularly shaped cardboard may be determined using a knife edge.
- (c) (i) State two ways in which photosynthesis is beneficial to humans.

(ii) State three differences between photosynthesis and respiration.

- (a) (i) Many candidates attempted this question. They either got the spelling of the liquids wrong or gave examples of solids such as sugar and salt instead of sugar solution and salt solution.
- (ii) Few candidates identified the apparatus as separating funnel instead of separating funnel.
- (b) (i) This sub-question was poorly answered by most of the candidates. They could not differentiate between mass and weight.
- (ii) This sub-question was also poorly answered by most candidates. Many candidates had no knowledge of an equipment called knife edge used in determining the centre of gravity of an object. They wrote a wrong procedure in determination of the centre of gravity of the object.
- (c) (i) Most of the candidates stated correctly the ways in which photosynthesis is beneficial to humans.
- (ii) Majority of the candidates answered this question correctly. Few candidates, however, defined photosynthesis and respiration instead of stating the differences between them. In some cases, the points did not correspond even though their knowledge of the two processes was not in doubt.
- (d) This question was poorly answered by many candidates. Candidates stated physical methods, cultural methods and chemical methods without explaining them. Some named post-harvest control measures while others named insecticides instead of pesticides.

Question 3

- (a) (i) **What is momentum?**
- (ii) **A vehicle of mass 1600kg moves with a speed of 75 m s⁻¹. Determine the magnitude of its momentum.**
- (b) (i) **Explain why water is considered a polar substance.**
- (ii) **State three main sources of water contamination.**
- (c) **Name four important items that need to be provided in a brooder house before the arrival of day-old-chicks.**
- (d) (i) **Name three ways by which disease-causing organisms enter the human body.**
- (ii) **State two ways by which the housefly spread diseases in humans.**
- (a) Only few candidates attempted this question. Some of them defined momentum as the product of mass and speed instead of mass and velocity. The few who did the calculation correctly, unfortunately could not state the unit of momentum correctly. Most of them wrote the unit as kg/m s⁻¹ instead of kg m s⁻¹.
- (b) (i) Candidates who attempted this sub-question deviated and attempted explaining why water is a universal solvent. They were expected to explain that water is polar because of the unequal distribution of electrical charges on the molecule with the electron pulled nearer to the O₂, making the hydrogen acquiring a positive charge.
- (ii) Candidates answered this question satisfactorily.

- (c) The sub-question was well answered by candidates but some of the candidates misspelt some words, e.g, Hoover for hover, trof for trough, liter for litter, etc.
- (d) (i) This sub-question was well answered by candidates.
(ii) Most of the candidates who attempted this question included in their correct statements a wrong statement that houseflies transmit diseases through biting of humans.

Question 4

- (a) (i) **Differentiate between staking and pruning as used in crop production.**
(ii) **Name three crops that require staking during cultivation.**
 - (b) (i) **Distinguish between voluntary action and involuntary action.**
(ii) **State one function each of the following parts of the human eye:**
(α) **pupil;**
(β) **lens;**
(γ) **retina.**
 - (c) **State the general molecular formula for each of the following families of organic compounds:**
(i) **alkanes;**
(ii) **alkenes;**
(iii) **alkynes;**
(iv) **alkanols.**
 - (d) (i) **What is meant by the term upthrust?**
(ii) **A balloon inflated with hydrogen gas rises and floats in the atmosphere. Explain the observation.**
- (a) (i) Candidates were able to explain pruning but failed to state that staking is applied to crops with weak stems.
(ii) Some candidates gave wrong crops such as watermelon, plantain, banana, etc. Others wrongly spelt tomatoes variously as tomatos, tomatoe, and tomatos.
- (b) (i) This sub-question was well answered by many of the candidates, but a few of them had a challenge expressing themselves clearly.
(ii) Many of the candidates could not state correctly function of each of the structures given. Some wrote that the retina sends impulses to the brain. They were expected to state that the retina acts as a screen on which images are formed.
- (c) Most of the candidates could not answer this question appropriately. They were unable to write the formulae C_nH_{2n+2} and $C_nH_{2n+1}OH$.
- (d) The question was poorly answered by the candidates. Candidates showed lack of knowledge of the concept of upthrust and so could not use it to explain why a balloon inflated with hydrogen could float in the atmosphere.

Question 5

- (a) Explain the following terms as used in soil management:
- soil resources;
 - soil conservation.
- (b) (i) What is a musical note?
(ii) State the characteristic of sound that differentiates instrument playing the same note.
- (c) (i) Name four organs in the human body that excrete waste.
(ii) Name one waste excreted by each of the organs named in (i) above.
- (d) Write the chemical formula for each of the following compounds:
- potassiumtrioxosulphate (IV);
 - trioxonitrate (V) acid;
 - copper (I) sulphide;
 - potassiumtetraoxomanganate (VI);
 - Sulphur (VI) oxide.

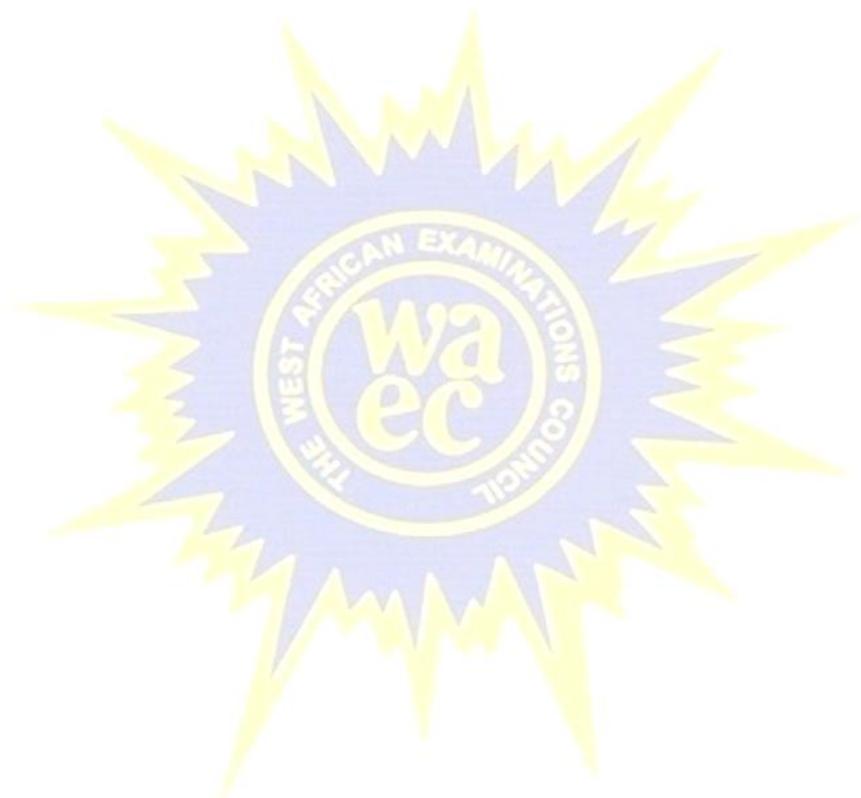
- (a) This sub-question was satisfactorily answered by most of the candidates.
- (b) Candidates' performance in this sub-question was commendable even though some candidates were not definite in stating the quality/timbre as the characteristic of sound that makes one to distinguish between different instruments playing the same note.
- (c) This sub-question was very well answered by most of the candidates. However, some candidates wrote 'lever' for liver; 'langs' for lungs and 'kindney' for kidney.
- (d) Candidates lacked the knowledge to calculate oxidation states of atoms in a compound and so could not write the correct formula required

Question 6

- (a) (i) State two differences between alternating current and direct current.
(ii) The power rating of an electrical appliance is 750 W. Calculate the energy consumed using the appliance for one hour.
- (b) (i) What is weathering of rocks?
(ii) State three physical processes that occur during weathering of rocks.
- (c) (i) Tabulate three differences between food chain and food web.
(ii) Construct a food chain using any three of the following organisms:
Grass, human, lizard, locust, goat, lion.
- (d) Differentiate between acid salt and normal salt.

- (a) (i) Majority of the candidates were only able to state one difference between alternating current and direct current.
(ii) The calculation on energy was satisfactorily answered by majority of the candidates.
- (b) This sub-question was very poorly answered by most of the candidates. Candidates could not explain how temperature, wind and water influence the weathering of rocks.
- (c) Candidates showed a good knowledge of food chain and food web.

- (d) Very few candidates were able to answer this sub-question correctly. Most of the candidates failed to indicate that the hydrogen atoms replaced by the metal in the formation of normal salt or acid salt is from the acid.



INTEGRATED SCIENCE 3

1. GENERAL COMMENTS

The paper was of comparable in standard to those of the previous years. The questions were clear and straightforward.

The performance of candidates was slightly better than those of recent past years.

2. A SUMMARY OF CANDIDATES' STRENGTHS

The main strengths of candidates include the following.

- (1) Good arithmetic and manipulative skills.
- (2) Ability to give differences between objects using tables.
- (3) Ability to identify diagrams and name the various parts of the diagrams.
- (4) Very good skills in plotting graphs.
- (5) Correct numbering of questions.
- (6) Legible handwriting.

3. A SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Some candidates showed evidence of inadequate or no practical work.
- (2) Wrong spelling of technical and scientific words.
- (3) Correct labeling of axes and choice of scale for graph are problems for candidates.

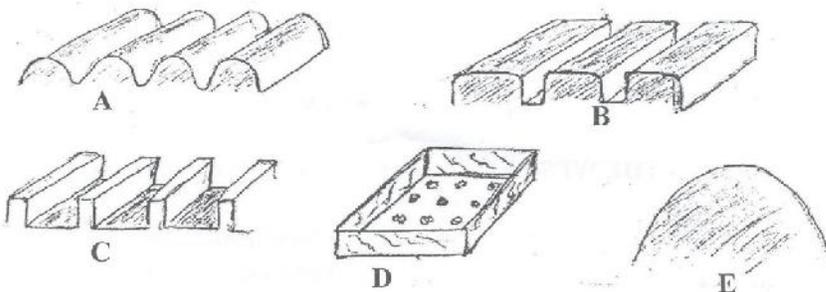
4. SUGGESTED REMEDIES

- (1) There is the need for teachers to expose candidates to simple practical work.
- (2) Teachers must expose candidates to the laboratory equipment, their correct use and correct names and correct spelling of the names.
- (3) Candidates should be taught how to choose scales and generally the skills for graph work.

5. DETAILED COMMENTS

Question 1

The diagrams below illustrate five types of seedbed labelled A, B, C, D and E.
Study the diagrams carefully and answer the questions that follow.



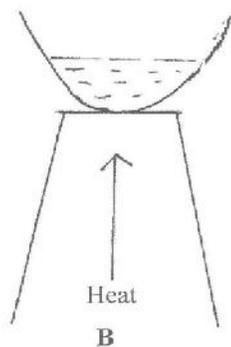
- (a) Identify each of seedbeds labelled A, C, D and E.
- (b) State two advantages each of using the seedbeds labelled D and E.
- (c) Give two differences between the seedbeds labelled B and C.
- (d) Mention and describe one methods of sowing seeds on the seedbed labelled B.
- (e) Name two field crops that could be propagated on each of the seedbeds labelled A and E.

- (a) Most of the candidates were able to identify the seed beds as required. However, some gave wrong spelling of the words.
- (b) Very few candidates were able to state the advantages of using the seed bed labelled C.
- (c) This sub-question was very poorly answered. Candidates were expected to tabulate the differences but only few of them did so.
- (d) This sub-question was very well answered by majority of the candidates, even though some could not spell broadcasting correctly.
- (e) Most of the candidates answered satisfactorily this sub-question.

Question 2

The diagrams below illustrate three different laboratory set-ups, A B and C, used in the separation of mixtures.

Study the diagrams carefully and answer the questions that follow.



- (a) Name the separation method represented by each set-up labelled A, B and C.
- (b) Which of the set-ups is used
 - (i) to obtain clear water from suspension of chalk in water?
 - (ii) to separate two immiscible liquids?
 - (iii) for crystallization?
- (c) State the modifications that could be made to the set-up labelled B in order to separate a mixture of iodine and sand.
- (d) Name two mixtures that could be separated using the set-up labelled C.

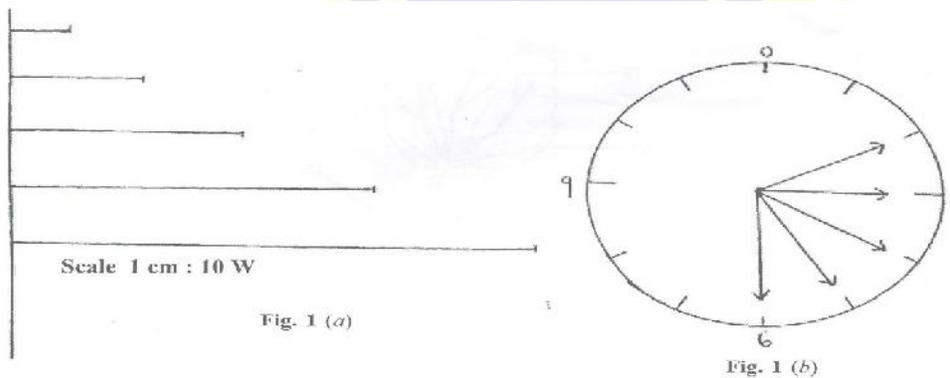
- (a) Most of the candidates were able to identify the seed beds as required. However, some gave wrong spelling of the words.
- (b) Very few candidates were able to state the advantages of using the seed bed labelled C.
- (c) This sub-question was very poorly answered. Candidates were expected to tabulate the differences but only few of them did so.
- (d) This sub-question was very well answered by majority of the candidates, even though some could not spell broadcasting correctly.
- (e) Most of the candidates answered satisfactorily this sub-question.

Question 3

The power ratings of different electrical appliances made of the same metal were studied by determining the electric current passing through them.

The power ratings $P = P_1, P_2, P_3, P_4, P_5$ and the corresponding current $I = I_1, I_2, I_3, I_4, I_5$ are illustrated in Fig. 1(a) and Fig. 1 (b), respectively.

Study Fig. 1 (a) and Fig. 1 (b) carefully and answer the questions that follow.



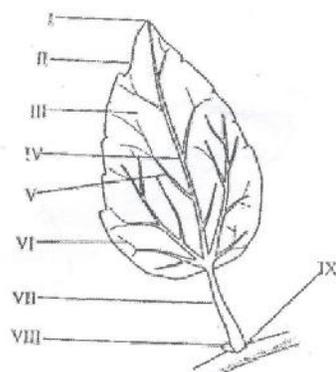
- (a) Measure and record the raw power rating $p = p_1, p_2, p_3, p_4, p_5$ in centimetres.
- (b) Convert the raw power rating to actual power rating $P = P_1, P_2, P_3, P_4, P_5$ using the scale provided.
- (c) Read and record the corresponding electric current $I = I_1, I_2, I_3, I_4, I_5$.
- (d) Tabulate your results as shown below.

<i>Raw power rating p/cm</i>	$p_1 =$	$p_2 =$	$p_3 =$	$p_4 =$	$p_5 =$
<i>Actual power rating P/W</i>	$P_1 =$	$P_2 =$	$P_3 =$	$P_4 =$	$P_5 =$
<i>Electric current I/A</i>	$I_1 =$	$I_2 =$	$I_3 =$	$I_4 =$	$I_5 =$
I^2/A^2	$I_1 =$	$I_2 =$	$I_3 =$	$I_4 =$	$I_5 =$

- (e) **Plot a graph with actual power rating P on the vertical axis and I^2 on the horizontal axis.**
 - (f) **Determine the slope of the graph.**
- (a) Majority of the candidates were able to measure and record the raw power ratings. They also were able to read and record the corresponding electric current in sub-question (c).
 - (b) Most of the candidates converted correctly the raw power ratings into actual power ratings using the given scale factor. Some candidates could not convert the raw values but used them for the graph. Others chose to divide the raw values by the scale factor.
 - (d) Most of the candidates were able to tabulate the result as required.
 - (e) A good number of the candidates was able to plot the expected graph using correctly labelled axes. Good scales were also chosen for the axes. A few however were not able to plot the graph because of poor choice of scale and wrong axes.
 - (f) Candidates who drew the graph correctly also showed a good knowledge of calculation of slope of graphs.

Question 4

The diagram below is an illustration of an organ found in a flowering plant. Study the diagram carefully and answer the questions that follow.



- (a) **Identify the organ illustrated.**
 - (b) **Name each of the parts labelled I, II, III, IV, V, VI, VII, VIII.**
 - (c) **State two observable features of the organ which adapt it for its functions.**
 - (d) **State the function of each of the parts labelled VII and IX.**
- (a) A good number of the candidates were able to identify the organ correctly as a leaf.
 - (b) Candidates have difficulty providing the names of the parts of the leaf. The performance of the candidates in this sub-question was very poor.
 - (c) This sub-question was very poorly answered. Almost all the candidates failed to state the observable features of the organ that adapt it to its function.
 - (d) The function of the part labelled VII was stated correctly by most of the candidates, with insignificant number of candidates being able to state the function of the part labelled X.

PHYSICS 2

1. GENERAL COMMENTS

Standard wise, this paper compares favourably with the previous years. Performance of candidates did not differ that significantly from the previous years'.

2. A SUMMARY OF CANDIDATES' STRENGTHS

- (1) Correct recall of formulae and theories.
- (2) Adherence to the rubrics of the paper.
- (3) Accurate evaluations of given values.
- (4) Correct units of measurements.

3. A SUMMARY OF CANDIDATES' WEAKNESSES

- (1) Incorrect explanations to scientific phenomena.
- (2) Wrong manipulations of S. I. units: multiples and submultiples.
- (3) Inadequate preparation for the paper.
- (4) Incorrect definitions.

4. SUGGESTED REMEDIES

- (1) A lot of trial questions during the course.
- (2) Solving past Examination Questions
- (3) Reading through Chief Examiners Reports.

5. DETAILED COMMENTS

Question 1

State the dimension of:

- (a) **impulse;**
- (b) **acceleration;**
- (c) **work.**

The dimensions of impulse, acceleration and work were required but many of the candidates rather stated units of the quantities.

Question 2

A projectile is fired with a velocity of 20 m s^{-1} at an angle of 40° to the horizontal.

Determine the components of the velocity of the projectile at its maximum height.

The question required calculation of the components of the velocity of the projectile at the highest point. That is $v_y = 0$; $v_x = u \cos \theta$.

Many of the candidates answered this question correctly. Others simply did not understand the concept. It must be noted that, in projectile motion, the horizontal component of the velocity remains the same throughout the motion, since g has no effect on the horizontal direction.

Question 3

State three different materials that can be used to demonstrate Brownian motion.

Materials to demonstrate Brownian motion was required, but a number of candidates described the whole process of Brownian motion. Others simply gave examples of Brownian motion. Materials required included, dust particles, pollen grains, potassium permanganate crystals, etc.

Question 4

An electron enters perpendicularly into a uniform magnetic field which has a flux density of 0.12T. This results in a magnetic force of 9.6×10^{-12} N on the electron. Calculate the speed of the electron as it enters the magnetic field

$$[e = 1.6 \times 10^{-19} \text{ C}]$$

A good number of the candidates answered this question correctly.

Question 5

List three uses of rockets

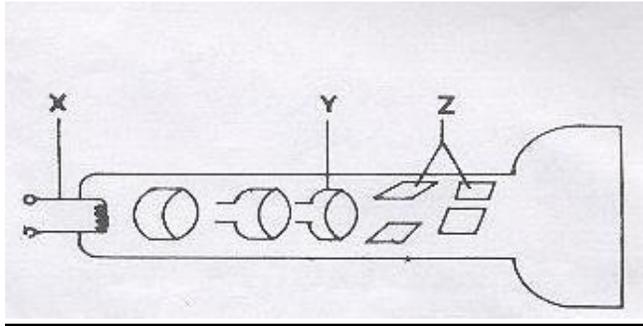
Even though a number of candidates answered this question correctly, some candidates confused the use of rockets with the use of satellites. Candidates were expected to state that they are used for space exploration, warfare and launching of artificial satellites.

Question 6

- (a) **What is doping?**
- (b) **Explain how doping improves the conductivity of a semi-conductor.**

- (a) *Doping* was well explained by most of the candidates.
- (b) The effects of doping were not satisfactorily explained by most of the candidates. Some rather described the formation of n-type and p-type semiconductors. Some effects of doping are: it increases the number of charge carriers hence increasing the electrical conductivity; it reduces the forbidden gap hence charges with less energy overcome it and move to the conduction band.

Question 7



The diagram above illustrates a cathode ray tube. Identify the components X, Y and Z.

Majority of the candidates identified correctly the parts of the CR tube.

Question 8

- (a) Explain the term *net force*.
- (b) State the principle of conservation of linear momentum and state one example of it.
- (c) A ball of mass 200 g released from a height of 2.0 m hits a horizontal floor and rebounds to a height of 1.8 m. calculate the impulse received by the floor.
[$g = 10 \text{ m s}^{-2}$]

- (a) Even though many of the candidates explained net force very well, others wrote “the sum of all forces acting on a body” instead of writing “the vector sum of all forces acting on a body”.
- (b) The principle of conservation of linear momentum was correctly stated by most of the candidates. Some candidates, however, did not state that the system must be closed or isolated.
- (c) The impulse $ft = m(v - u)$ is the required equation to be used. Although some students quoted the equation correctly and also used $v_1^2 = u_1^2 + 2gh_1$ to find v_1 the downward journey, they failed to recognize that the velocity with which the body bounces on hitting the floor becomes its initial velocity u_2 in the equation $v_2^2 = u_2^2 - 2gh_2$. The few candidates who found both v_1 and u_2 correctly, were able to calculate the Impulse $= mv_1 - (-mu_2)$. Some candidates, unfortunately, could not properly designate the upward journey with negative velocity and as such evaluated the final answer using $m(v_1 - u_2)$.

- (d) (i) The appropriate equation to use is $v = \pm \sqrt{r^2 - y^2}$,
Where r is the amplitude and $y = 10 \text{ cm}$.
Solving gives $r = 0.2 \text{ m}$.
- (ii) The v_{\max} for SHM $= \dot{S}r = 2\pi fr$.

Most of the candidates could not evaluate the v_{\max} correctly because they wrongly substituted the value of y for r .

- (iii) The maximum $PE = \frac{1}{2}kA^2 = \frac{1}{2}m(\xi r)^2$.
Since in *SHM* the maximum $PE =$ maximum KE , the expected
 $PE_{\max} = KE_{\max} = 1.42 \times 10^{-1} \text{ J}$.

Question 9

- (a) **Explain the terms:**
(i) **thermal equilibrium;**
(ii) **fundamental interval.**
- (b) **List two uses of the hydraulic press.**
- (c) **Name the material used to reset the steel index in the Six's maximum and minimum thermometer.**
- (d) (i) **A nursing mother prepared her baby's milk mixture at 85 °C, in a feeding bottle. In order to cool it at 40 °C, she immersed the bottle in an aluminium bowl of heat capacity 90 JK⁻¹ containing 500 g of water at 26°C. If the mass of the mixture is 300 g, calculate the specific heat capacity of the mixture. Neglect heat losses and heat capacity of the bottle.**
[Specific heat capacity of water = 4200 J kg⁻¹ K⁻¹]
(ii) (α) **Name two ways through which the bottle loses heat.**
(β) **Name two industrial processes in which heat exchanger is used.**
- (a) (i) Thermal equilibrium was well explained by most of the candidates. Some candidates did not indicate that the bodies must be in thermal contact in order for the heat exchange to take place. Other candidates just explained thermal equilibrium.
(ii) Most of the candidates answered this sub-question correctly. Few of the candidates explained interval using the word interval.
- (b) This sub-question was very well answered by the candidates.
- (c) This sub-question was also well answered by the candidates.
- (d) (i) Candidates answered this sub-question satisfactorily.
(ii) Quite a number of candidates stated evaporation and radiation instead of conduction and convection, which are the correct ways.

Question 10

- (a) **Define *critical angle*.**
- (b) **How are anti-nodes created in a stationary wave?**
- (c) **The angle of minimum deviation of an equilateral triangular glass prism is 46.2°. Calculate the refractive index of the glass.**
- (d) **An illuminated object is placed in front of a concave mirror and the position of a screen is adjusted in front of the mirror but no image is obtained on the screen. Give two possible reasons for this observation.**

- (e) **An illuminated body is placed at a distance of 75 cm from a converging lens of focal length 30 cm.**
- (i) **Determine the image distance.**
 - (ii) **If the lens is replaced by another converging lens the object has to be moved 25 cm further away to have its sharp image on the screen. Determine the focal length of the second lens.**
- (a) (i) The critical angle was very well defined by most of the candidates. A few candidates, however, did not mention the relative densities of the media involved.
- (b) Many of the candidates confused the creation of antinodes with the creation of stationary waves. The antinode creation occurs when the incident and reflected waves are 180° out of phase after superposition.
- (c) The refractive index was correctly calculated by most of the candidates.
- (d) Most of the candidates gave correct reasons why an image could not be formed on the screen in the practical arrangement described. Some candidates rather described the formation of virtual images.

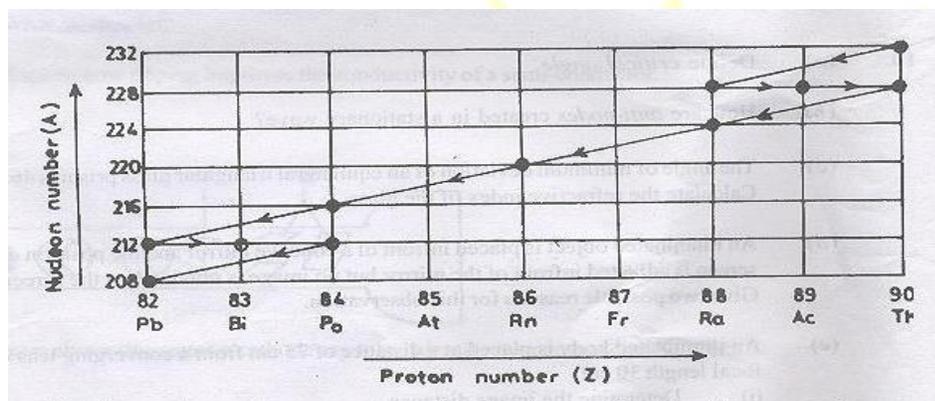
Question 11

- (a) **Explain briefly dielectric strength.**
- (b) **An electromagnetic wave has its wavelength shorter than those of radiowave and microwave but longer than that of visible light.**
- (i) **Identify the wave.**
 - (ii) **Name one suitable detector for the wave.**
 - (iii) **Name one source of the wave.**
- (c) **An oil drop carrying a charge of $1.0 \times 10^{-19} \text{ C}$ is found to remain at rest in a uniform electric field of intensity 1200 N C^{-1} . Calculate the weight of the oil drop.**
- (d) **An RLC series circuit consists of a 100 Ω resistor, a 0.05 H inductor and a 25 μF capacitor. A mains voltage of 220 V, 50 Hz is applied across the circuit. Calculate the:**
- (i) **impedance;**
 - (ii) **current.**
- (a) Dielectric strength was not properly explained by many of the candidates. They used voltage instead of potential gradient or electric field strength.
- (b) The identification of the wave the name of the source was very well tackled by most of the candidates. Some candidates wrote thermocouple instead of thermopile as the detector of electromagnetic waves.
- (c) This sub-question was very well answered by most of the candidates.
- (d) This sub-question was also very well answered by most of the candidates.

Question 12

- (a) Explain the following terms:
- mass defect;
 - binding energy of a nucleus.
- (b) (i) Assuming the wave nature of an electron, what is the effect of decreasing the speed of a photoelectron on its
- wavelength?
 - energy?
- (ii) A particle of mass 4.4×10^{-23} kg moves with a velocity of 105 m s^{-1} . Calculate its wavelength.

$$[h = 6.6 \times 10^{-34} \text{ J s}]$$



The diagram above shows part of a radioactive decay series. Use it to answer the following:

- Name a pair of isotopes;
 - Name the isotopes with which the series starts;
 - Write down a nuclear equation for two examples each of:
 - wavelength?
 - energy?
- (a) The terms *mass defect* and *binding energy* were well explained by most of the candidates.
- (b) Most of the candidates answered this sub-question satisfactorily.
- (c) This sub-question was well answered by most of the candidates.

PHYSICS 3

1. GENERAL COMMENTS

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

2. A SUMMARY OF CANDIDATES' STRENGTHS

Some commendable features noted in candidates' answers are:

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

3. A SUMMARY OF CANDIDATES' WEAKNESSES

Below are some weaknesses noted in candidates' answers:

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

4. SUGGESTED REMEDIES

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

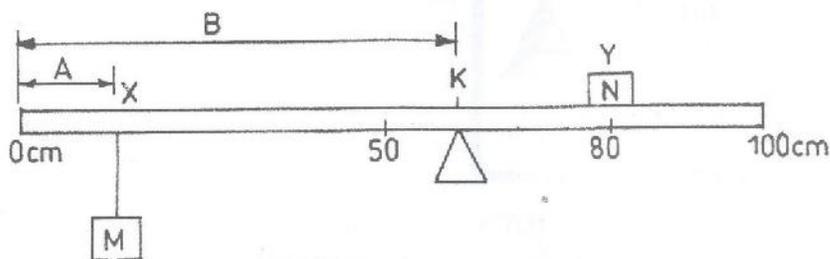
5. DETAILED COMMENTS

ALTERNATIVE A

Question 1

(a)

1. (a)



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

- (i) Determine and record the centre of gravity of the metre rule.
- (ii) Fix the 100 g mass marked N at a point Y, 80 cm mark of the rule using a sellotape.
- (iii) Suspend another 50 g mass marked M at X, a distance $A = 10$ cm from the 0 cm mark of the rule.
- (iv) Balance the arrangement horizontally on the knife edge, as illustrated in the diagram above.
- (v) Measure and record the distance B of the knife edge from the 0 cm mark of the rule.
- (vi) Repeat the procedure for four other values of $A = 15$ cm, 20 cm, 25 cm and 30 cm.
- (vii) Tabulate your readings.
- (viii) Plot a graph with B on the vertical axis and A on the horizontal axis.
- (ix) Determine the slope, s , of the graph.
- (x) Also determine the intercept, c , on the vertical axis.
- (xi) Evaluate:
 - (α) $k_1 = \left(\frac{1-2s}{s}\right) 100$
 - (β) $k_2 = \frac{2c}{s} - 160$
- (xii) State two precautions taken to obtain accurate results.

(a) OBSERVATIONS

Candidates were expected to record the centre of gravity of the metre rule to at least one decimal place and within a tolerance of ± 1 cm. Most of the candidates were able to do this correctly. In some instances, however, candidates either did not record the centre of gravity at all or recorded with no decimal point or recorded with no unit.

A composite table of the values of A and B was drawn in most cases.

GRAPH

To obtain a good graph, candidates were to start only the horizontal axis from zero but not the vertical axis. Candidates who started both axes from the origin, had their values plotted in a very restricted space.

SLOPE AND INTERCEPT

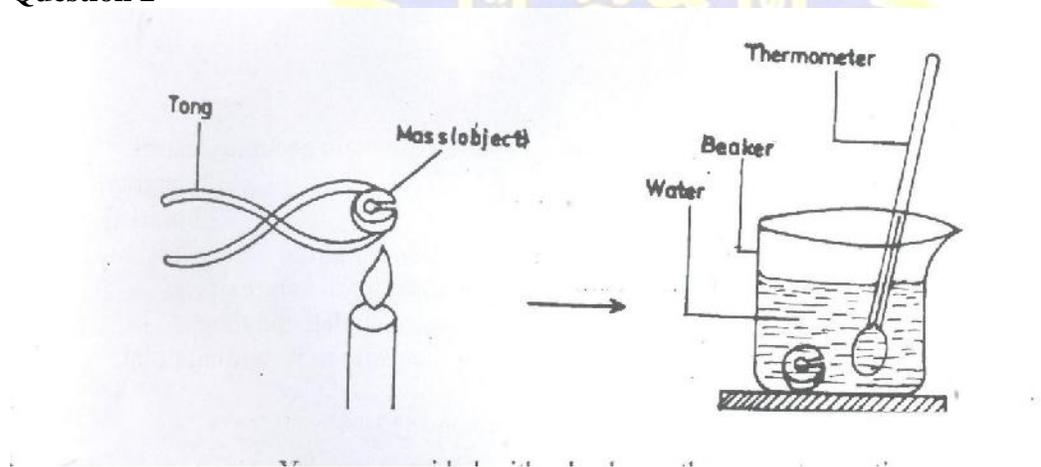
Most of the candidates were able to calculate the slope and determine the intercept correctly.

PRECAUTIONS

Most of the candidates stated correctly the precautions in acceptable language

- (b) (i) A few candidates were able to define moment of a force about a point correctly.
- (ii) This sub-question was very poorly answered by most of the candidates. They failed to recognize that the conditions required were for a body acted upon by non-parallel co-planer forces. Candidates rather stated the conditions for parallel co-planer force.

Question 2



You are provided with a beaker, a thermometer, a stirrer, a measuring cylinder, a Bunsen burner, a wire gauze, a 50 g mass, a pair of tongs, water, tripod stand and other necessary materials.

- (i) Using the measuring cylinder, measure 150 cm^3 of water into the beaker.
- (ii) Record the volume v of the water in the beaker.
- (iii) Calculate the mass m of the water, given that $m = \rho v$ and $\rho = 1 \text{ g cm}^{-3}$
- (iv) Measure and record the initial temperature, θ_0 , of the water in the beaker.
- (v) Hold the 50 g mass with the pair of tongs in the flame of the Bunsen burner for 2 minutes.

- (vi) Quickly transfer the 50 g mass to the water in the beaker.
 - (vii) Stir gently and record the highest temperature, θ_1 , attained.
 - (viii) Evaluate $\theta = (\theta_0 - \theta_1)$.
 - (ix) Empty the content of the beaker and repeat the procedure above for other values of $v = 200 \text{ cm}^3, 300 \text{ cm}^3$ and 350 cm^3 .
 - (x) Tabulate your readings
 - (xi) Plot a graph with m on the vertical axis and θ on the horizontal axis.
 - (xii) Determine the slope, s , of the graph.
 - (xiii) Evaluate $k = \frac{50}{s}$.
 - (xiv) State two precautions taken to obtain accurate results.
- (b)
- (i) Define heat capacity.
 - (ii) An electric kettle rated 1.2 kW is used to heat 800 g of water initially at a temperature of 26°C . Neglecting heat losses, calculate the time taken for the kettle to heat the water to its boiling point.

(Take boiling point of water = 101°C
Specific heat capacity of water = $4200 \text{ J kg}^{-1} \text{ K}^{-1}$)

(a) OBSERVATIONS

Four values of v and m were to be read and recorded in the units of cm^3 and g respectively. Some candidates lost marks for not following this instruction.

Values of θ_0 , θ_1 and $(\theta_1 - \theta_0)$ were to be recorded to follow the trend that, as v increases θ_1 decreased. This was largely seen in most of the scripts.

GRAPH

The nature of the question required a cooling curve and as such, candidates should have been instructed to plot a smooth curve through the plotted points.

SLOPE

In the absence of instruction to candidates to plot a smooth curve, candidates were compelled to draw a straight line through the plotted points and the slope was also determined normally.

EVALUATION

Most of the candidates were able to substitute the value of s and evaluated correctly

$$k = \frac{50}{s}$$

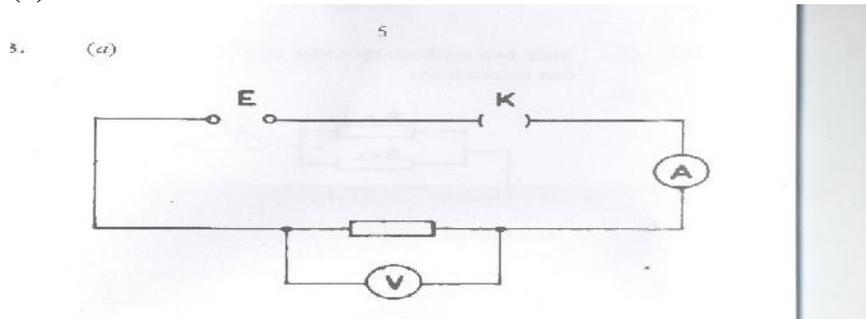
PRECAUTIONS

Candidates were expected to state that they stirred continuously to ensure even distribution of heat. Most of them merely stated that they stirred.

- (b)
- (i) Heat capacity was correctly defined by most of the candidates.
 - (ii) Most of the candidates were able to solve the question correctly.

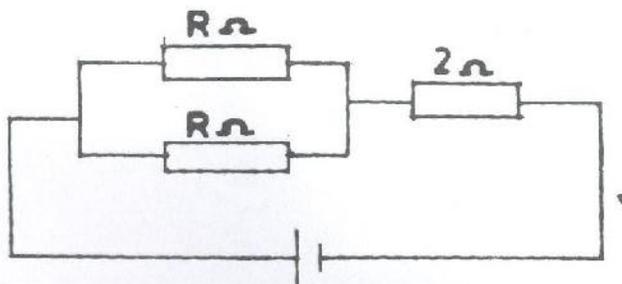
Question 3

(a)



You are provided with a variable d.c. power supply E, a $2\ \Omega$ standard resistor, a key, an ammeter, a voltmeter and other necessary materials.

- (i) Set up a circuit as shown in the diagram above with $E = 1.5\ \text{V}$.
 - (ii) Close the key, K.
 - (iii) Take and record the voltmeter reading V.
 - (iv) Take and record the corresponding ammeter reading I.
 - (v) Evaluate V^{-1} and I^{-1} .
 - (vi) Repeat the procedure for four other values of $E = 3.0\ \text{V}$, $4.5\ \text{V}$, $6.0\ \text{V}$ and $7.5\ \text{V}$.
 - (vii) Tabulate your readings.
 - (viii) Plot a graph with V^{-1} on the vertical axis and I^{-1} on the horizontal axis starting both axes from the origin (0, 0).
 - (ix) Determine the slope, s, of the graph.
 - (x) Also determine the intercept, c, on the vertical axis.
 - (xi) State two precautions taken to obtain accurate results.
- (b)
- (i) State two methods by which an electric current can be produced.
 - (ii)



Calculate the value of R in the circuit diagram shown above, given that the effective resistance of the circuit is $4.0\ \Omega$ and the internal resistance of the cell is negligible.

(a) OBSERVATIONS

Most of the candidates recorded values of E, V and I correctly and in trend, that is, as E increases both V and I increase.

A good number of the candidates failed to record V^{-1} and I^{-1} to at least three decimal places.

GRAPH, SLOPE AND INTERCEPT

It has been mentioned several times that values to be plotted should not be over approximated. Candidates do over approximate derived values for easy plotting. Certainly this year is no exception. The fact is that the chosen scale dictates the number of decimal places to approximate values.

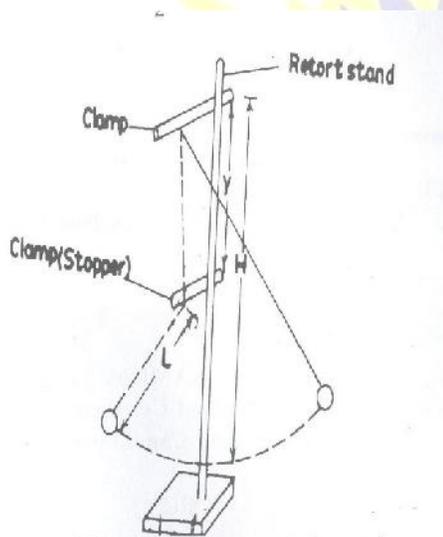
Candidates who used powers of 10 notation for chosen scales, forgot to use it in the calculation of the slope. The recorded intercept was also affected.

- (b) (i) Most of the candidates answered this sub-question correctly.
(ii) A lot of the candidates failed to answer this sub-question correctly. They were not able to write the correct expression for the equivalent resistance.

ALTERNATIVE B

Question 1

(a)

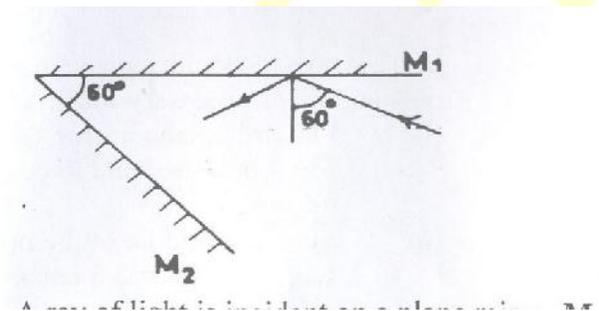


You are provided with a pendulum bob, a string, a meter rule, retort stand with two clamps, a stop watch and other necessary apparatus.

- (i) Set up a simple pendulum of length $H = 120$ cm.
- (ii) Fix the second clamp on the retort stand to serve as a horizontal stop, such that the clamp is just in contact with the pendulum string in the equilibrium position, as illustrated in the diagram above.
- (iii) Adjust and record the position of the stopper such that $y = 20$ cm and $L = 100$ cm.
- (iv) Set the pendulum in motion in a plane at right angles to the stopper such that at each return the string makes contact with the stopper.
- (v) Measure and record the time t for 20 oscillations.
- (vi) Determine the period T .
- (vii) Evaluate \sqrt{L} , $\sqrt{L + y}$ and $X = (\sqrt{L + y} + \sqrt{L})$
- (viii) Keeping H constant repeat the procedure for four other values of $L = 90$ cm, 80 cm, 70 cm and 60 cm.

You are provided with a plane mirror, cellotex board optical pins and other necessary materials.

- (i) Place the plane mirror vertically on the sheet of paper provided and trace its outline. Remove the mirror.
 - (ii) Mark the middle of the mirror as M and a point E such that $ME = 2.5$ cm as illustrated in the diagram.
 - (iii) Draw two normal $MN_1 = EN_2 = 7$ cm.
 - (iv) Mark a point L_1 on EN_2 such that $y = EL_1 = 2.5$ cm.
 - (v) Draw a line from point L_1 to M and place two pins P_1 and P_2 on this line.
 - (vi) Replace the mirror on its outline.
 - (vii) Locate the images of P_1 and P_2 in the mirror and fix two other pins P_3 and P_4 such that they are in a straight line with the images of P_1 and P_2 .
 - (viii) Remove the mirror and the pins.
 - (ix) Draw a straight line through the pin holes P_4 and P_3 and produce it to meet M.
 - (x) Join points N_2, N_1 and produce it to meet the reflected ray at R.
 - (xi) Measure and record the distances $y = EL$, $r = RN_1$ and $q = MN_1$.
 - (xii) Evaluate y^{-1} and $J = \frac{r}{q}$.
 - (xiii) Repeat the procedure for four other values of $y = EL = 3$ cm, 4 cm, 5 cm and 7 cm.
 - (xiv) Tabulate your readings.
 - (xv) Plot a graph with J on the vertical axis and y^{-1} on the horizontal axis.
 - (xvi) Determine the slope, s, of the graph.
 - (xvii) Evaluate $k = 2s$.
 - (xviii) State two precautions taken to obtain accurate results. (Attach your traces to your answer booklet.)
- (b) (i) List two characteristics of the image of an object formed by a plane mirror.
- (ii)



A ray of light is incident on a plane mirror M_1 at an angle of 60° as illustrated in the diagram above. Determine the angle of reflection on plane mirror M_2 .

(a) OBSERVATIONS

Candidates produced and attached five complete and neat traces of measured values of r in the expected trend with the values of y .

Candidates were not consistent in the recording of y^{-1} . The distance $q = MN$ was not recorded by most of the candidates. The handful of candidates who recorded q did not add unit of measurement.

GRAPH AND SLOPE

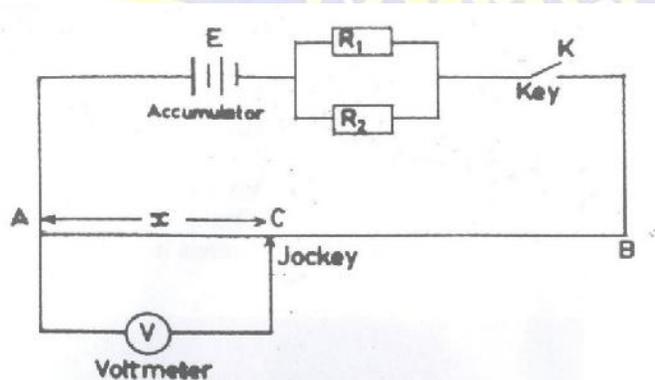
These were correctly done by most of the candidates. They proceeded to substitute the value of s into $k = 2s$ and evaluated k appropriately.

- (b) (i) Almost all the candidates were able to state correctly the characteristics of the image formed in a plane mirror.
- (ii) This sub-question was poorly answered by most of the candidates. They failed to realize that the reflected ray from M_1 will strike M_2 normally, and thus be reflected from M_2 along the same path, giving the angle of reflection at M_2 to be zero.

Question 3

(a)

3. (a)



- (i) You are provided with a voltmeter V , a battery E , two standard resistors R_1 and R_2 , a potentiometer AB , a key K , a jockey and other necessary materials.
- (ii) Set up a circuit as shown in the diagram above.
- (iii) Close the key K .
- (iv) Make a contact with the potentiometer wire AB using the jockey at a point C such that $AC = x = 20$ cm.
- (v) Read and record the voltmeter reading V .
- (vi) Evaluate x^{-1} and V^{-1} .
- (vii) Repeat the procedure for four other values of $x = 30$ cm, 40 cm, 50 cm, 60 cm and 80 cm.
- (viii) Tabulate your readings.
- (ix) Plot a graph with V^{-1} on the vertical axis and x^{-1} on the horizontal axis, starting both axes from the origin $(0, 0)$.
- (x) Determine the:

- (α) slope, s , of the graph;
 (β) intercept, c , on the vertical axis.
 (xi) State two precautions taken to obtain accurate results.
- (b) (i) State two devices in which Ohm's law does not apply.
 (ii) A current of 1 A is supplied to two resistors of resistances 2 and 3 connected in parallel.
 Calculate the current in each resistor.

(a) OBSERVATIONS

Most of the candidates were able to record five values of x and V to at least one decimal place and in the correct trend. The values of x^{-1} and v^{-1} were not evaluated and recorded to at least three decimal places by most of the candidates.

GRAPH, SLOPE AND INTERCEPT

Majority of the candidates did very well as far as the drawing of the graph, calculation of the slope and determination of the intercept were concerned.

PRECAUTIONS

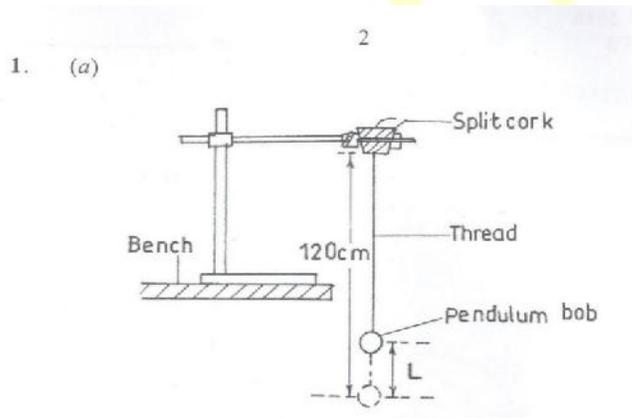
The precautions were stated correctly and in the acceptable language by most of the candidates.

- (b) (i) A few candidates were able to state correctly two devices which do not obey Ohm's law.
 (ii) Most candidates were able to answer this sub-question correctly.

ALTERNATIVE C

Question 1

(a)



You are provided with a pendulum bob, a string, a retort stand, clamp, boss head, a split cork and other necessary materials.

- (i) Suspend the bob on the retort stand so that the bob is 120 cm from the point of suspension.
 - (ii) Reduce the length of the pendulum by $L = 20$ cm as illustrated in the diagram above.
 - (iii) Displace the bob slightly from its equilibrium position and then release such that the pendulum begins to swing.
 - (iv) Read and record the time, t , for 20 oscillations.
 - (v) Determine the period, T , of the oscillations.
 - (vi) Evaluate T^2 .
 - (vii) Repeat the procedure for four other values of $L = 30$ cm, 40 cm, 50 cm and 60 cm.
 - (viii) Tabulate your readings.
 - (ix) Plot a graph with T^2 on the vertical axis and L on the horizontal axis, starting both axes from the origin (0, 0).
 - (x) Determine the:
 - (α) slope, s , of the graph;
 - (β) intercept, c , on the horizontal axis
 - (xi) Evaluate: $k = \frac{4\pi^2}{s}$ [Take $\pi = 3.14$]
 - (xii) State two precautions taken to obtain accurate results.
- (b)
- (i) Define simple harmonic motion.
 - (ii) explain how the period of oscillation of the pendulum of a clock is affected by temperature.

(a) OBSERVATIONS

Five values of L and t were to be read and recorded to at least 1 decimal place. The trend is, as L increases t decreases. Most of the candidates did this correctly. Five values of $T = \frac{t}{20}$ and T^2 were to be evaluated and recorded to at least 2 decimal places and 3 decimal places respectively. Most of the candidates did not record the values of T^2 to at least 3 decimal places.

GRAPH, SLOPE AND INTERCEPT

A good number of the candidates drew good graphs, calculated the slope correctly and determined the intercept accurately. The substitution of s into $k = \frac{4\pi^2}{s}$ and its evaluation were also accurately done.

PRECAUTIONS

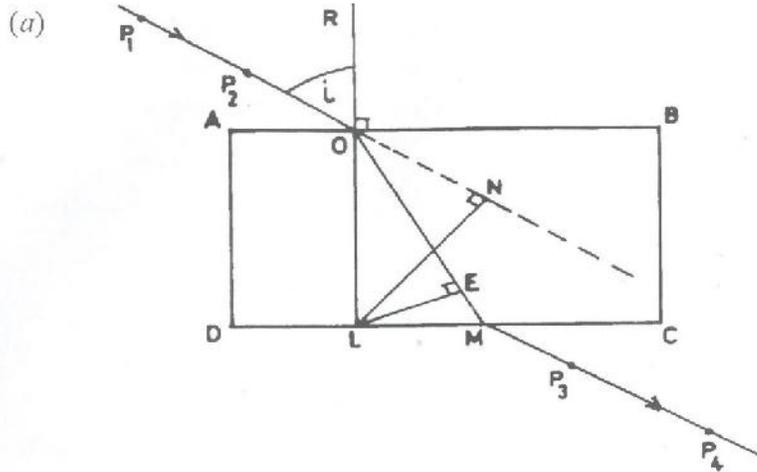
Most of the candidates stated correctly the precautions in an acceptable language.

- (b)
- (i) Simple Harmonic Motion was correctly defined by most of the candidates.
 - (ii) This sub-question was poorly answered by most of the candidates. They failed to realize that the pendulum of a clock, being metallic, expands with increase in temperature. Since the period $T = 2\pi\sqrt{\frac{l}{g}}$, an increase in l results in an increase in T

and vice versa. Most of the candidates stated that temperature has no effect on the period of oscillation of the clock.

Question 2

(a)



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

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

- (i) Trace the outline ABCD of the glass block on the sheet of paper attached to the cellotex board.
- (ii) Remove the block and mark a position O such that AO is about one quarter of AB.
- (iii) Draw the normal ROL and the incident ray such that $i = 20^\circ$.
- (iv) Fix two pins at points P_1 and P_2 on the incident ray.
- (v) Replace the block and fix two other pins at points P_3 and P_4 such that the pins appear to be in a straight line with the images of the pins at P_1 and P_2 when viewed through the block from the side DC of the block.
- (vi) Remove the block and join the points P_3 and P_4 producing the line to meet DC at M.
- (vii) Draw a line to join points O and M.
- (viii) Draw the normal LE and LN to the refracted ray and the extended incident ray, respectively.
- (ix) Measure and record the lengths LE and LN.
- (x) Repeat the procedure for four other values of $i = 30^\circ, 40^\circ, 50^\circ$ and 60° .
- (xi) Tabulate your readings.
- (xii) Plot a graph with LE on the vertical axis and LN on the horizontal axis.
- (xiii) Determine the slope, s , of the graph.
- (xiv) Evaluate: $k = \frac{1}{s}$.
- (xv) State two precautions taken to obtain accurate results.
(Attach your traces to your obtain booklet.)

- (b) (i) State Snell's law.
 (ii) The bottom of a pond 4 m deep, appears to be displaced by 1 m when viewed from above. Calculate the refractive index of water in the pool.

(a) OBSERVATIONS

Five complete traces were to be drawn for the given angles of incidence i . Most of the candidates were able to do this satisfactorily. A good number of the candidates also recorded in trend five values each of LE and LN. The trend was, as i increased both LE and LN increased.

GRAPH, SLOPE AND EVALUATION

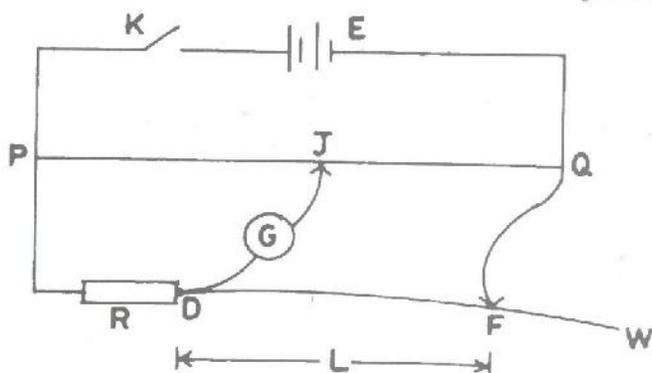
Candidates who attempted this question plotted the graph, determined the slope and evaluated $k = \frac{1}{s}$.

Since the candidates were not very careful in performing the experiment, their k value varies from the expected refractive index of the material of the prism used.

- (b) (i) Snell's law was not correctly stated by majority of the candidates. Candidates should bear in mind that there are two different optical media and must indicate that the light is moving from one medium to the other.
 (ii) The expression for the refractive index $\eta = \frac{\text{real depth}}{\text{apparent depth}}$ was correctly quoted by most of the candidates but they were not able to proceed to obtain $\eta = 1.33$.

Question 3

(a)



You are provided with a potentiometer PQ, a power source of emf E, a standard resistor of resistance R, a galvanometer G, a length of bare wire W, a crocodile clip F, a micrometer screw gauge and other necessary apparatus.

- (i) Connect a circuit as illustrated in the diagram above.
 (ii) Measure a length $DF = L = 20$ cm of the bare wire.
 (iii) Close the key K and obtain a balance point J on the potentiometer wire.
 (iv) Measure and record the balance length $PJ = y$.
 (v) Evaluate y^{-1} .

- (vi) Repeat the procedure for give other values of $L = 40 \text{ cm}, 50 \text{ cm}, 60 \text{ cm}, 70 \text{ cm}$ and 80 cm .
 - (vii) Tabulate your readings.
 - (viii) Measure and record the diameter d of the bare wire.
 - (ix) Calculate the cross-sectional area A of the wire. (Take $\pi = 3.14$)
 - (x) Plot a graph with L on the vertical axis and y^{-1} on the horizontal axis, starting both axes from the origin $(0, 0)$
 - (xi) Determine the slope, s , of the graph and the intercept, c , on the vertical axis.
 - (xii) Given that $c = \frac{RA}{\gamma}$, determine the value of γ .
 - (xiii) State two precautions taken to obtain accurate results.
- (b) (i) In the experiment above, if $L = 75.0 \text{ cm}$, use your graph to determine the value of y .
- (ii) State two factors that determine the resistance of a wire.

(a) OBSERVATIONS

Candidates correctly measured the balance lengths $PJ = y$ corresponding to the six given values of $DF = L$. The measured values of y decreased with increasing values of L as was expected. Regrettably, most of the candidates recorded the values of L as whole numbers without decimal point. Values of y^{-1} were recorded to the required number of decimal places.

The diameter of the bare wire was measured and recorded by most of the candidates but they were not able to calculate the cross sectional area of the wire.

GRAPH

Most of the candidates plotted good graphs, starting both axes from the origin $(0, 0)$, determined the slope and intercept on the vertical axis.

- (b) (i) The y^{-1} corresponding to $L = 75 \text{ cm}$ was correctly shown and read on the graph and recorded correctly by a good number of the candidates. However, they could not proceed to determine y .
- (ii) Almost all candidates who attempted this question had no problem stating the factors that determine the resistance of a wire.