

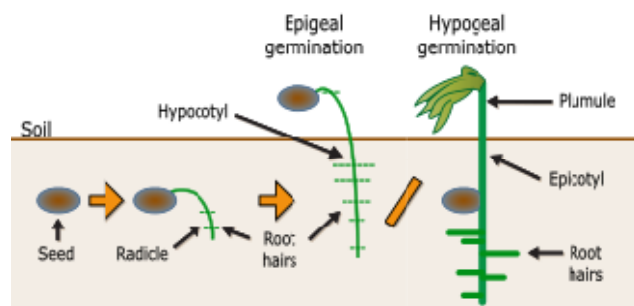
ELITE EXAMINATIONS BUREAU 2019
Uganda Advanced Certificate of Education
PRINCIPLES AND PRACTICES OF AGRICULTURE
Paper 2 (THEORY)

SECTION A: (20 MARKS)

1. a) i) Define hypogeal germination.

(1 mark)

Hypogeal germination implies that the **cotyledons stay/remains below the ground**. The **epicotyl (part of the stem above the cotyledon) grows**, while the hypocotyl (part of the stem below the cotyledon) stays the same length. In this way, the epicotyl pushes the plumule above the ground.



ii) List the factors necessary for germination.

(1½ marks)

- ❖ **Suitable Temperature** - Most flowering plants germinate best in cool-weather, as they germinate best at temperatures that range from 7 to 18 degrees Celsius. Colder temperatures delay germination and may cause seed decay due to the soil's initial spring dampness. Planted too late into the warm months, the seeds germinate poorly, if at all, when daytime temperatures exceed 23.8° C.
- ❖ **Water** - In addition to heat, flowering plants need moisture to germinate. While dormant, flowering plant (eg., pea seeds) store food in their endosperms, or inner tissues, and in their cotyledons, or first leaves. As they absorb water, this food is released and converted into energy needed by the developing embryo. Pea seeds deprived of water shrivel and die, while those that receive too much water become water-logged and start to decay. Proper watering ensures that the soil around the bases of the pea vines is damp but not saturated, with additional watering scheduled during dry spells.
- ❖ **Air** - In the dormant condition the seeds respiratory rate is very low and so oxygen is required in very small quantities. But for germination, oxygen is needed in large quantities. The seeds obtain oxygen that is dissolved in water and from the air contained in the soil. If soil conditions are too wet, an anaerobic condition persists, and seeds may not be able to germinate.
- ❖ **Sunlight**- Some seeds need light for germination, while in some seeds germination is hindered by light. E.g., germinating pea seeds do not need light to complete the first stage of their growth, all of which takes place below the soil. A small root is the first thing to emerge on one end of the seed,

followed by a small sprout bearing two small leaves called a cotyledon. Once the cotyledon rises above the soil, light becomes a crucial factor in the pea plant's proper development. At least 6 hours of direct sunlight are needed at this stage to encourage the plant to produce its own food through the process known as photosynthesis.

b). It is a common practice to soak seeds in water before planting. Suggest three reasons why soaking seeds in water before planting may stimulate them to germinate more rapidly.(3 marks)

- ❖ Soaking seeds before planting helps to break down the seed's natural defenses such as the seed coat which then allows it to germinate/sprout faster.
- ❖ soaking the seeds quickly boost the moisture content around the seeds, which signals to the seed that it is now safe to grow.
- ❖ Some types of seeds contain germination inhibitors that are designed to prevent a seed from germinating inside the fruit. These inhibitors must be leached away before a seed can germinate. Thus, soaking seeds speeds up the leaching of the inhibitors as compared to natural rainfall.

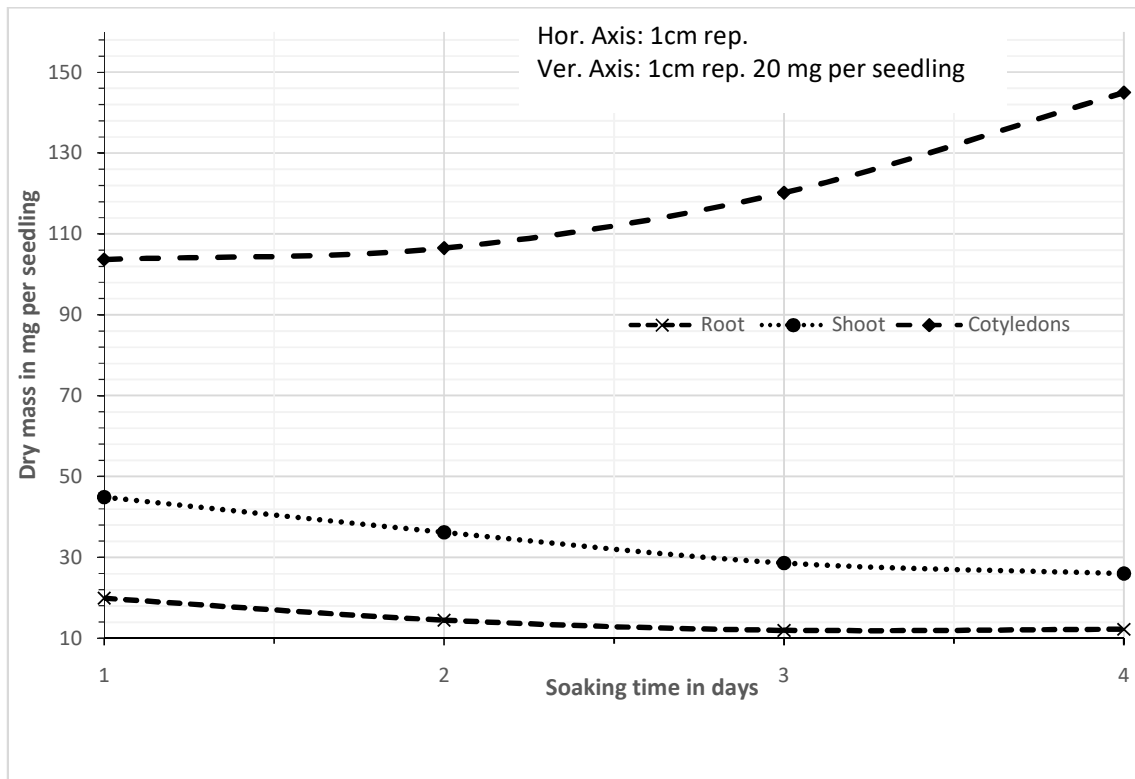
c) The table below indicates the effect of soaking Cowpea seeds for different periods on the % germination and the subsequent dry mass of the roots, shoots and cotyledons. The dry mass measurements were made 14 days after the period of soaking

Soaking time/days	1	2	3	4
% germination	99	98	75	66
Dry mass (mg seedling – 1)				
Root	19.9	14.5	12.0	12.3
Shoot	25.0	21.7	16.6	13.7
Cotyledons	58.8	70.3	91.6	119.0

(i) Plot a suitable graph to represent the data in table above.

(08 marks)

A graph indicating the effect of soaking Cowpeas for different periods on the % germination and subsequent dry mass of roots, shoot and cotyledons.



(ii) What is the effect of prolonged soaking on;

Seeds and their ability to germinate

(02 marks)

- ❖ Seed soaking significantly reduces the emergence time of seeds as demonstrated by the decline in the dry mass of the roots and shoots.

Development of seedlings

(02 marks)

- ❖ It facilitates rapid development of the seedlings as indicated by the increasing accumulation of dry mass in mg per seedling.

(iii) Suggest a possible explanation for the above effect.

(02½ marks)

- ❖ Soaking stimulates and produces enzymes like amylase and lipase which activate storage materials in seeds. Rehydration causes early emergence due to the fact that all pre-germinative processes for germination had already occurred in seed.

SECTION B (20MARKS): CROP PRODUCTION

2. (a). What is germination efficiency?

(02marks)

Germination efficiency is the percentage of seeds in which the germination process reaches the end, in the experimental conditions, by means of the emergence of one live embryo.

Germination percentage/rate is an estimate of the viability of a population of seeds. The equation to calculate germination percentage is: $GP = \frac{\text{seeds germinated}}{\text{total seeds}} \times 100$. The germination rate provides an measure of the time course of seed germination.

(b). Explain the factors that affect germination efficiency

(07½ marks)

The most important factors include inherent dormancy, water, oxygen, suitable temperature, and sometimes light or darkness. Various plants require different variables for successful seed germination. Often this depends on the individual seed variety and is closely linked to the ecological conditions of a plant's natural habitat.

- ❖ **Water:** Water constitutes a basic requirement for germination. Mature seed are often extremely dry and need to absorb, through a process of imbibition, a significant quantity of water, relative to the dry weight of the seed. Generally, the minimum water content required in the grain for wheat germination is 35% to 45% by weight.
- ❖ **Gaseous environment:** Air is composed of around 20% oxygen, 0,03% carbon dioxide and 80% nitrogen, and the seed of most plant species germinate well in an environment providing this mixture of gases. Oxygen is required by the germinating seed for aerobic respiration, the main source of the seedling's energy until it grows leaves, which will enable photosynthesis.
- ❖ **Temperature:** Soil temperature plays a significant role in the rate at which germination proceeds. Although germination may occur between 4°C and 37°C, optimal temperatures range from 12°C to 25°C. The rate of water absorption or imbibition, the diffusion of respiratory gases and the rate of chemical reactions involved in the metabolism of the seed are all affected by temperature.
- ❖ **Immaturity:** Harvesting and storage of immature seeds with high moisture content may promote the growth and development of storage microflora within the seed lot. The subsequent microbial activity then increases the temperature, thus affecting both mature (normal) and immature seed. As an indirect result, problems with germination can be expected when such seed is planted.
- ❖ **Mechanical damage:** Mechanical damage can be problematic, especially in dry years, when the embryo is exposed and thus vulnerable to physical damage. Mechanical damage due to harvest, handling and other processes, is an important factor affecting the general quality of seed.
- ❖ **Inherent factors such as dormancy:** Seed dormancy refers to a condition that prevents germination even though the seed experience optimal environmental conditions suitable for germination. In nature, seed dormancy is an important regulator, enabling/supporting seasonal synchrony, the widening of the range for germination, utilisation of erratic opportunities and exploitation of other organisms to facilitate seed dispersal.

(c). Describe one chemical method of testing for seed viability

(11½ marks)

Tetrazolium chloride seed testing: The Tetrazolium Chloride (TZ) test is often called the quick germination test. It's a chemical test used to determine seed viability, and results are usually available within 24 to 48 hours.

Tetrazolium chloride seed testing: The TZ test is often called the quick germination test. It's a chemical test used to determine seed viability, and results are usually available within 24 to 48 hours.

How is a TZ Test Done? 1. Preparation

- ❖ A seed lot (10 or more seeds) is soaked in water overnight. They may be pre-moistened, in which case the seeds are allowed to imbibe water between a moistened germination paper blotter.
 - ❖ The seeds are then dissected, either longitudinally or transversely, with a scalpel so that the embryo is exposed to the tetrazolium chloride solution. One half of this seed is used for the test and the other half is discarded.
2. Staining
- ❖ A solution of tetrazolium chloride (a salt) is added to water to form a colorless solution.
 - ❖ The seeds are placed in a 1% solution (for legumes and grasses that are not bisected), or a dilute 0.1% solution for bisected grasses and cereals.
 - ❖ Seed coats of legumes must usually be removed or peeled back before examination. Care must be taken to prevent breaking of radicles and other damage to the seeds.

How are TZ Tests are Evaluated? Dehydrogenase enzymes present in living tissue reduce the tetrazolium chloride to formazan, a reddish, water-insoluble compound. This reaction occurs in or near living cells, which are releasing hydrogen in respiration processes. Depending on size, all seeds are examined under a microscope at 10-30 power. Larger seeds, such as peas, may be examined without a microscope. Analysts look for three things:

- ❖ **Sound tissues** produce a normal red color (positive test for a viable seed) and resist the penetration of tetrazolium. The rate of hydrogen released in sound tissue is slow in comparison to that in partially weakened tissues.
 - **Weak living tissues** produce an abnormal color. These tissues have lost some of their initial resistance to the penetration of tetrazolium. Respiration is accelerated and formazan is produced rapidly. During the early stages of deterioration, these tissues become darker red (bruised) quicker than sound, healthy tissues.
 - **Dead tissues** do not stain, remaining usually white (aged tissue) because the lack of respiration prevents the production of formazan.
- ❖ **Reporting**
 - The number of seeds showing positive results is counted and expressed as a percentage of the total seed lot

3. a) Explain how organic matter affects soil fertility.

(06 marks)

- ❖ Organic matter contributes to plant growth through its effect on the physical, chemical,
- ❖ and biological properties of the soil. It has a :
- ❖ *nutritional* function in that it serves as a source of N, P for plant growth
- ❖ *biological* function in that it profoundly affects the activities of microflora and micro-faunal organisms
- ❖ *physical* and *physico-chemical* function in that it promotes good soil structure, thereby improving tilth, aeration and retention of moisture and increasing buffering and exchange capacity of soils.
- ❖ Humus also plays an indirect role in soil through its effect on the uptake of micronutrients
- ❖ by plants and the performance of herbicides and other agricultural chemicals.

- ❖ Availability of nutrients for plant growth
- ❖ Organic matter has both a direct and indirect effect on the availability of nutrients for plant growth. In addition to serving as a source of N, P, S through its mineralization by soil microorganisms, organic matter influences the supply of nutrients from other sources (for example, organic matter is required as an energy source for N-fixing bacteria).
- ❖ Effect on soil physical condition, soil erosion and soil buffering and exchange capacity
- ❖ Humus has a profound effect on the structure of many soils. The deterioration of structure that accompanies intensive tillage is usually less severe in soils adequately supplied with humus. When humus is lost, soils tend to become hard, compact and cloddy.
- ❖ Aeration, water-holding capacity and permeability are all favorably affected by humus.
- ❖ The frequent addition of easily decomposable organic residues leads to the synthesis of complex organic compounds that bind soil particles into structural units called aggregates. These aggregates help to maintain a loose, open, granular condition. Water is the better able to infiltrate and percolate downward through the soil. The roots of plants need a continual supply of O₂ in order to respire and grow. Large pores permit better exchange of gases between soil and atmosphere.
- ❖ Effect on soil biological condition: Organic matter serves as a source of energy for both macro- and micro faunal organisms.
- ❖ Numbers of bacteria, actinomycetes and fungi in the soil are related in a general way to humus content. Earthworms and other faunal organisms are strongly affected by the quantity of plant residue material returned to the soil.

b) What practices can be done to increase soil aggregation?

(04 marks)

- ❖ Tillage: Conservation practices that reduce the amount of soil disturbance such as zone or strip tillage, or no-till planting methods can reduce the loss of organic matter and aggregate destruction.
- ❖ Organic Matter Additions: Adding organic materials, such as manure or mulch residues, can provide the soil with both nutrients and organic matter, while improving aggregate stability over time. The latter is a result of greater amounts of organic carbon combined with greater microbial activity, enhancing the production of aggregate glues.
- ❖ Crop Rotation Main crop selection, crop rotation, and use of cover crops can also impact aggregate stability. Thus, cover and sod crops in a rotation contribute to organic matter buildup over time. This addition of organic matter promotes aggregate stability.

c) Explain the factors that influence symbiotic nitrogen fixation?

(10 marks)

- ❖ pH
- ❖ Salinity
- ❖ Moisture content
- ❖ Temperature
- ❖ Level of microbial population and activity
- ❖ Organic matter content
- ❖ Soil Texture

SECTION C: (20 MARKS): ANIMAL PRODUCTION

4. a) Describe how you would prepare a brooder house to receive one day old chicks.

(12 marks)

- ❖ The brooder house, equipment, drinkers, feeders should have been properly washed and disinfected.
- ❖ Clean and disinfect the poultry house or brooding area, feeders, and waterers at least two weeks before hatchlings are due to arrive.
- ❖ Repair windows, doors, ventilators, or any part of the poultry house or brooding area that needs attention.
- ❖ Eliminate any drafts, especially those caused by cracks in the walls or poorly fitting doors and windows.
- ❖ Put down the bedding material two days before hatchlings are due to arrive.
- ❖ Turn on the heat lamp or brooder the day before hatchlings are due to arrive. This will give the brooding area time to warm up.
- ❖ The brooder house should be fumigated two weeks before chicks arrival.
- ❖ Three hours before receiving the chicks, the brooding pen should be spread evenly with wood shavings about 3-5cm. The brooder guide should be used to prevent mortality.
- ❖ The brooder house should be cleaned to remove old litter and then disinfected.
- ❖ New litters 5-10cm high should be put in and covered with absorbent materials/newspapers.
- ❖ Equipment should be cleaned, disinfected and tested to make sure that they are working.

- ❖ The brooder is lit about 6 hours before the chicks arrive.
- ❖ Feed and water should be placed into shallow containers.

b) Explain the factors considered when planning vaccination of birds. (08 marks)

- ❖ Stress levels of the animal: Depending on the intensity and duration of the stress, the animal either recovers its normal state or undergoes a decompensation phase which is characterized by the depletion of the organism's reserves, impairment of the vital organs (kidneys, heart) and suppression of the main functions (notably the immune defense system), which can lead to the death of the animal.
- ❖ Level of feed contamination esp. with mycotoxins: Mycotoxins have an adverse effect on vaccination either by acting directly on the immune system or by weakening the birds and by mobilizing their immune defenses, thus making them less receptive to vaccination.
- ❖ Level of infection esp. with respect to bacterial infections/healthy status of the animal: In principle, one should only vaccinate healthy animals, vaccinations should be avoided when an antibiotic treatment is being given to control an infectious bacterial disease.
- ❖ Type of vaccine to be used: The selected vaccine must be suited to the type of animal production, to the epidemiological situation and must correspond to the overall risk to which the farm is exposed.
- ❖ The date of vaccination: The vaccination date must be accurately determined for each vaccination, based either on historical data (the previous production cycles) or on serological analyses. The vaccination programme must then be incorporated into the farm's sanitary programme, alongside the other treatments (coccidiostats, vitamin supplements and antibiotic) so that they can be integrated without overlap and so that all incompatibilities can be avoided.
- ❖ Technique of vaccination: It is essential that clear and thorough explanations are given to all the personnel who actually administer the vaccine, and that the instructions are understood.
- ❖ Equipment to be used for vaccination: The equipment to be used must be checked and prepared prior to the vaccination operation. It is useful to draw up procedures that list the necessary administration material (including spares) and that describe how the preparation (cleaning, greasing) and the checks should be carried out (calibrating the syringes).

5. a) Explain the factors that reduce the quality of meat. (10 marks)

1. Animal Factors

- ❖ Species: Meat obtained from different species of animals have species specific meat quality.
- ❖ Breed: Within the same species, different breeds of animals differ in meat quality. The best quality beef is often obtained from traditional beef breeds of cattle like the Hereford and Aberdeen Angus.

- ❖ Age: As used in meat grading standards, maturity is defined as the physiological age of the animals or birds from which carcasses are produced. Maturity or age at slaughter is very closely related to meat tenderness.
- ❖ Location of muscles: Location of muscles in the carcass is also important as there are distinct differences in tenderness between muscles. Muscles of the limbs, neck, etc. (where the workload) are more become tougher due to high degree of movement with the advancement of age compared to muscles of loin which require little or no mobilization (movement) during day-to-day activities.
- (a) Sex: Sex of the animal determines the rate and extent of fat deposition, growth rate as well as development of some odourous compounds in the body related to sexual maturity which affect the quality of meat. In general, males have less intramuscular fat than females.

2. Management Factors

- ❖ System of rearing: Among the management factors, the most important is the system of animal rearing. These are: intensive systems, extensive system and the semi-intensive system which is in-between intensive and extensive system of animal rearing, where animals are grazed and also supplemented with concentrate feeds.
 - ❖ Feeding: Feeding of high energy carbohydrate diets leads to faster growth and fat deposition in all livestock. Feeding of meat animals with fish meal, certain plants such as sting weed, certain strains of clove and other legumes may produce meat with abnormal flavour (taint). Use of high concentration of animal manure as a source of organic nitrogen may also lead to tainting of meat.
 - ❖ Treatment: Some volatile chemicals such as turpentine, linseed oil, ammonia (gas) used in veterinary practices may lead to tainting of meat. Of course, this can be managed by chilling of affected dressed carcasses for 24 hours. Care must be taken to provide adequate gap between medication and slaughter, so that veterinary drug residues are not present in the meat.
- ## 3. Ante-mortem Factors
- Important ante-mortem factors affecting meat quality are transportation of live animals, lairage management, pre-slaughter handling and stunning.
- ❖ Pre-slaughter handling: Pre-slaughter handling of meat animals include the process of loading at farm, the journey to the abattoir lairage and subsequent handling up to the point of slaughter. During completion of these processes animals are subjected to wide variety of 'stressors', which adversely affect the meat quality.
 - ❖ Transportation: The transportation phase of livestock marketing can be one of the most important event affecting meat quality.
 - ❖ Stunning/immobilization method: The type of stunning method used can affect meat quality, either by short-term pre-slaughter stress or by affecting bleeding (exsanguination). Therefore, stunning process is not completely free from stress, but definitely reduces stress responses compared to exsanguination without stunning. The severity of stress of stunning process is usually expressed in

muscles by the degree of glycogen depletion. These differences in glycogen content in muscles will determine the ultimate pH and the physical properties of meat as discussed earlier.

- ❖ Temperature is a major factor determining the rate of post-mortem chemical reactions in muscles. Therefore, temperatures at which freshly dressed carcasses/meats are stored have a profound effect on the functional and eating qualities of meat.
- ❖ Ingress of Contaminants: Contamination during slaughter and subsequent handling of meat determines the wholesomeness of meat to a greater extent. Stunning instruments, knives, scalding tank (in case of pig and poultry) are major sources of contamination of dressed carcasses, if proper cares are not taken during their use.

b) Describe the factors that cause loss of quality of hides and skins.

i). When the animal is still alive.

(05 marks)

- ❖ Poor branding such as deep marks on valuable parts
- ❖ Parasites bites such as ticks, mites etc.
- ❖ Injury sustained from fights, barbed wires and poor roping.

ii). During slaughter

(05 marks)

- ❖ Poor thawing of the animal leading to internal bleeding of the animals within the skin and hides
- ❖ Bruising of the skin due to dragging of the animal on the ground
- ❖ Loss of hair due to dragging of the animal
- ❖ Incomplete bleaching leaving blood clots in the veins leading to delayed dry of the skin and hide.

SECTION D: (20 MARKS): AGRICULTURAL ENGINEERING

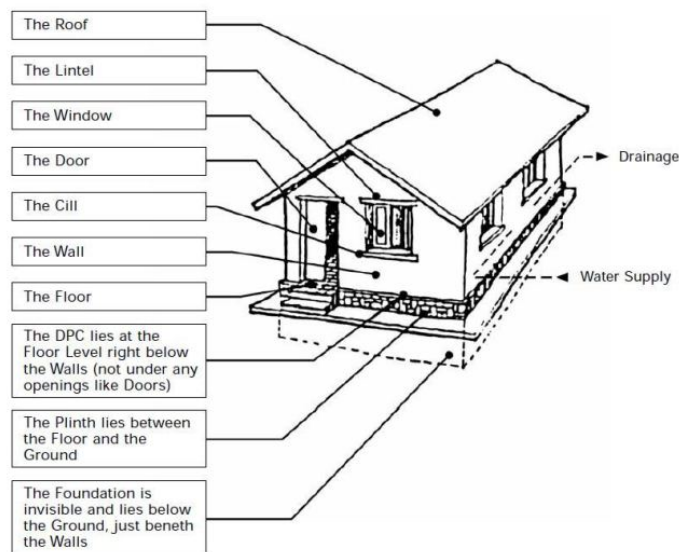
6. (a) Outline the role of farm structures in agricultural production.

(12marks)

- ❖ Protect animals from rain, wind and sun heat
- ❖ To confine animals where diseases and parasites are easily watched and controlled
- ❖ To supply animals with adequate clean water
- ❖ To keep or store some of the farm
- ❖ Produce and in put
- ❖ Protect machinery, tools and equipment from bad weather.

(b) With the aid of a labelled diagram, describe the structure of a typical modern farm building.

(08marks)



- ❖ **Footings and foundations:** A foundation is necessary to support the building and the loads within or on the building. The combination of footing and foundation distributes the load on the bearing surface, keeps the building level and plumb, and reduces settling to a minimum. When properly designed, there should be little or no cracking in the foundation, and no water leaks. The footing and foundation should be made of a material that will not fail in the presence of ground or surface water
- ❖ **Walls:** Good-quality walls provide strength and stability, weather resistance, fire resistance, thermal insulation and acoustic insulation.
- ❖ **Floors:** Building floors may be as simple as compacting the soil present on the site before the building is constructed, or as complex as attractively finished hardwood parquet. A well-chosen, well-built floor offers protection from vermin and rodents, is easy to clean, and is dry, durable and a valuable asset to a building.
- ❖ **Roofs:** A roof is an essential part of any building, in that it provides the necessary protection from rain, sun, wind, heat and cold. The integrity of the roof is important for the structure of the building itself, as well as for the occupants and the goods stored within the building.
- ❖ **Doors:** Doors are essential in buildings to provide security and protection from the elements, while allowing easy and convenient entry and exit. Farm buildings may be served adequately with unframed board doors, while homes will need more attractive, well-framed designs that close tightly enough to keep out dust and rain and allow only minimal air leakage.
- ❖ **Windows:** Windows provide light and ventilation in a building and allow the people inside to view the surrounding landscape and observe the activities in the farmyard. In sitting rooms and work rooms where good light and ventilation are important, the window area should be 5–10 percent of the floor area of the room. Windows sometimes need to be shaded to reduce heat radiation, or closed to keep out driving rain or dust. In addition, screening may be needed for protection from insects.

- ❖ Stairs and ladders: The angle, which is governed by the height and the horizontal distance available, will determine the most suitable means of moving from one level to another.
- ❖ Electrical installations: Electrical energy can be put to many uses, and an increasing number of farms will benefit from electrification as the electrical supply network expands into the rural areas or generators are installed at farms.

7. (a). State factors that influence the choice of power to use on a farm. (03 marks)

- ❖ Availability or accessibility to capital
- ❖ Level of mechanization on the farm
- ❖ Tastes and preference of the farmer.
- ❖ Size of the farm
- ❖ Socio-cultural factors.
- ❖ Topography/terrain of the farm.

(b). Explain the factors that influence power output in work animals (12 marks)

- ❖ Feeding/Nutrition regime/level of animals
- ❖ Health status of the oxen
- ❖ Proper handling of oxen/avoid overworking/beating
- ❖ Level of training of the animals
- ❖ Skills of the operator.
- ❖ Prevailing climatic conditions in terms of ambient temperatures.
- ❖ Animal disease and parasite incidences in the area.
- ❖ The amount of vegetation; heavy vegetation interferes with the free movement of the animals and as a result reduces power output.
- ❖ The topography of the land; very rough and ragged terrain interferes with the free movement of the animals and makes it difficult for the animals to pull the equipment, output thus is low.
- ❖ The yoke used for hitching; poorly designed yokes providing limited contact with the neck and hump decrease power output. A well designed yoke with other encircling at the neck and breast strap harness increases power output from the animal.

(c). State the characteristics of an animal suitable for work. (05 marks)

- ❖ Right age of the animal.
- ❖ Sex of the animals: They are mostly males, as these are naturally larger than females, and are usually castrated since steers are easier to manage than bulls.
- ❖ Should have a prominent hump for harnessing with a yoke.
- ❖ Temperament: A calm temperament is one of the most important requirements for an ox. They must have a willingness to respond to commands and be content to do the same sort of work day after day so long as they are well-fed and cared for.

- ❖ Level of training: working animals are normally trained as calves to accept a yoke and work as a pair. Each ox is always on the same side of the yoke. They must learn verbal commands for stop, go, back up, left and right and understand commands given by touch through a pole.
- ❖ Body conformation: An animal used for draft must have a build well suited for pulling. It should be low to the ground, have powerful shoulders and legs, and have a broad frontal dimension that will accommodate the placement of a harness. It must be big enough to deliver, alone or in a pair, the power needed to pull equipment for an extended period of time. It must also be able to exert the concentrated or "instantaneous" effort needed to overcome temporary increases in the draft requirement caused by roots, rocks, hard soil, or inclines.

SECTION E (20 MARKS): AGRICULTURAL ECONOMICS

8. (a) Suggest reasons for resettlement of populations in Uganda.

(10 marks)

- ❖ Resettlement is a planned transfer of people f To relieve some areas of the population pressures
- ❖ To promote agricultural mechanization i.e. encourage farmers to unite and engage in economic activity as a group and promote better utilization of resources such as land, tractors, and others.
- ❖ To prevent re-infestation by tsetse flies i.e. the resettlement programmes of 1955 to 1961 was to prevent re-infestation of cleared areas of Busoga and Kigumba by tsetse flies.
- ❖ To assess the feasibility and economic returns from setting up a large irrigation like the setting up of Mobuku irrigation scheme in Kasese.
- ❖ To resettle the displaced especially refugees mainly from Rwanda, S. Sudan and DRC.

(b) Explain factors to be considered when planning a settlement scheme

(10 marks)

- ❖ Proper planning; careful planning prior to the establishment of a settlement scheme is very essential. The following should be taken care of during the planning process. Objectives of the scheme; suitability of the proposed enterprises; thorough analysis of available data; availability of social services; the number and origin of prospective settlers; the social and cultural x-tics of settlers.
- ❖ Selection of settlers.
- ❖ Land holdings
- ❖ Land tenure system
- ❖ Supportive services
- ❖ Efficient communication
- ❖ Viability of the enterprises to be undertaken.

9.a) What is meant by production function?

(2 marks)

- ❖ Production functions describe the technical relationship between outputs and amount of inputs used assuming that all other factors that affect production are kept constant and only one factor is allowed to change.

b) The table below shows production of millet at various levels of NPK fertilizer applied.

Fixed factor of land (1 ha)	Variable input (NPK in kgs)	Total yield (Millet in 90 Kg bags)	Marginal product(millet in 90 bags)	Average product (Millet in 90 bags)
1	30	10	10	.33
1	60	27	17	0.45
1	90	42	15	0.47
1	120	56	14	0.47
1	150	63	7	0.42
1	180	65	2	0.36
1	210	65	0	0.25
1	240	60	-5	0.25
1	270	52	-8	0.19

i). Copy and complete the table above by calculating the marginal product and average product.

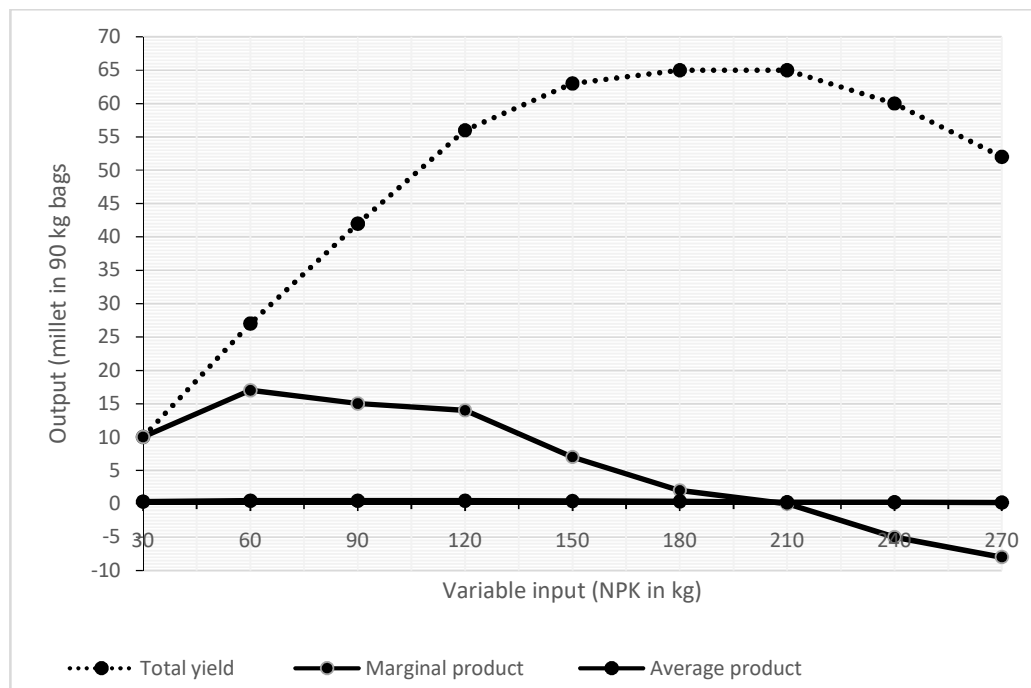
(8 marks)

ii) Use a graph paper and draw the total physical production, average physical production and marginal physical production curves and on the graph indicate:

i. the levels of production

(07½ marks)

Graph showing relationship between millet output/production and variable input of NPK



c) State the law being illustrated by the curves drawn on the graph. (01 mark)

- ❖ The law of diminishing returns states that; *"if successive units of one variable input are added to fixed quantities of other inputs (fixed input) a point is eventually reached where additional product (output) per additional unit of variable input declines."*

d) Mention three types of production function common in farming business. (1 ½ mark)

- ❖ *Increasing Returns: In this type, each additional unit of input results in a larger increase in output than the preceding unit. This shows that resources are underutilized.*
- ❖ *Constant Returns: The amount of the product increases by the same amount for each additional input; that is constant returns to input factor. Again here resources are underutilized.*
- ❖ *Decreasing (Diminishing) Returns: Here, each additional unit of input results in a smaller increase in output than the preceding unit. Resource use is stretched to the maximum. It is the most commonly encountered form in agricultural enterprises.*