THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

134/1 SCIENCE AND PRACTICE OF AGRICULTURE 1

(For school Candidates Only)

Time: 2:30Hours **ANSWERS** **Year: 2016**

Instructions

1. This paper consists of **ten (10)** questions in sections A, B and C
2. Answer **five (5)** questions choosing at least one question from each section.
3. Each question carries twenty marks

1. (a) Differentiate:
(i) Dry air cleaner from wet air cleaner.
(ii) Camshaft from crankshaft.
(iii) Bottom dead center from top dead center.

Answer:

(i) Dry air cleaner vs. wet air cleaner:
- A dry air cleaner uses a dry filter, typically made of paper or fabric, to trap dust and debris from the incoming air. It relies solely on the physical properties of the filter to clean the air.
- A wet air cleaner uses a liquid, often oil, in its mechanism. Air passes through the liquid, and the oil traps dust and debris, making it suitable for heavy-duty and dusty environments.

(ii) Camshaft vs. crankshaft:
- A camshaft controls the opening and closing of engine valves. It operates in synchronization with the crankshaft and is responsible for the timing of the intake and exhaust strokes.
- A crankshaft converts the reciprocating motion of pistons into rotational motion, which drives the wheels and other engine components.

(iii) Bottom dead center vs. top dead center:
- Bottom dead center (BDC) refers to the lowest position of a piston in its cylinder during its stroke. It is the point farthest from the cylinder head.
- Top dead center (TDC) refers to the highest position of a piston in its cylinder during its stroke. It is the point closest to the cylinder head.

1. (b) A given tractor engine has six cylinders with the bore of 150 mm, the stroke is 120 mm while the crankshaft speed is 1800 rpm. Calculate total air displacement of the engine per minute.

Answer:

The formula for total air displacement is:
Total air displacement = $\pi \times (\text{bore}/2)^2 \times \text{stroke} \times \text{number of cylinders} \times \text{crankshaft revolutions per minute}$.

Step 1: Convert bore and stroke into meters.
Bore = 150 mm = 0.15 m
Stroke = 120 mm = 0.12 m

Step 2: Substitute values into the formula.
Total air displacement = $\pi \times (0.15/2)^2 \times 0.12 \times 6 \times 1800$

$= 3.1416 \times (0.075)^2 \times 0.12 \times 6 \times 1800$

$= 3.1416 \times 0.005625 \times 0.12 \times 6 \times 1800$

= 7.63 m^3 per minute.
Total air displacement = 7.63 m^3 per minute.

(c) Three gear wheels A, B, and C are in three parallel shafts. Gear A has 14 teeth, meshes with B which has 37 teeth, and meshes with C which has 49 teeth. If the speed of gear wheel A is 1800 rpm, calculate the speed of gear wheel C.

Answer

Step 1: Relationship of speeds and teeth:
The speed ratio between two meshing gears is inversely proportional to their number of teeth.
Speed of A / Speed of B = Number of teeth of B / Number of teeth of A.
Speed of B / Speed of C = Number of teeth of C / Number of teeth of B.

Step 2: Calculate speed of B:
Speed of B = Speed of A × (Number of teeth of A / Number of teeth of B).
Speed of B = 1800 × (14 / 37).
Speed of B = 680.54 rpm.

Step 3: Calculate speed of C:
Speed of C = Speed of B × (Number of teeth of B / Number of teeth of C).
Speed of C = 680.54 × (37 / 49).
Speed of C = 513.59 rpm.
Speed of gear wheel C = 513.59 rpm.

2. (a) What is Farm Structure?
Answer:

Farm structure refers to the physical constructions and facilities built on farms to enhance agricultural activities. These structures include barns, silos, irrigation systems, greenhouses, fencing, and storage facilities. They provide support for farm operations such as housing livestock, storing equipment, and preserving harvested crops.

(b) Briefly explain seven factors to be considered when selecting a site for a farm structure.
Answer:

- Topography: The land should be relatively flat to ease construction and ensure stability. Steep slopes may require additional reinforcement.
- Soil type: The soil must have sufficient strength and drainage capacity to support the structure. Weak or waterlogged soils should be avoided.
- Accessibility: The site should be easily accessible by roads for transportation of equipment, inputs, and outputs.

- Proximity to utilities: The site should be near water sources, electricity, or other essential utilities for efficient operations.
- Climatic conditions: Weather patterns, such as rainfall and wind direction, should be considered to ensure the structure's durability and suitability.
- Proximity to farm operations: The structure should be close to the main farm activities to reduce travel time and costs.
- Drainage: The site should have good drainage to prevent waterlogging, which can weaken the foundation.

(c) State six factors used to determine the type of materials used for wall construction.
Answer:

- Durability: Materials should withstand environmental conditions and last long.
- Availability: Locally available materials are often preferred to reduce costs.
- Cost: The material should fit within the budget without compromising quality.
- Strength: The material should be able to support the weight of the structure.
- Climatic conditions: The material must suit the local climate, e.g., heat resistance in hot areas.
- Maintenance: Materials requiring low maintenance are often chosen for economic reasons.

(d) Briefly describe the following methods of timber treatment by chemicals:
(i) Sap displacement method
(ii) Pressure or vacuum treatment
(iii) Hot and cold soaking

Answer:

(i) Sap displacement method: This involves replacing the sap in freshly cut timber with a preservative solution. The process uses gravity or a pump to force the preservative into the wood.

(ii) Pressure or vacuum treatment: This method involves placing timber in a pressure or vacuum chamber. The chamber applies pressure or vacuum to force preservatives deeply into the timber cells, providing long-term protection.

(iii) Hot and cold soaking: Timber is alternately soaked in hot and cold preservative solutions. The heat causes the wood to expand, and cooling causes it to contract, allowing the preservative to penetrate deeply.

(e) Briefly explain three structural requirements of farm stores.
Answer:

- Proper ventilation: Farm stores must have adequate airflow to prevent moisture buildup, which can cause spoilage or damage to stored goods.
- Strong foundation: A solid foundation ensures stability and prevents the store from collapsing under the weight of stored items.

- Pest control: The structure should be designed to prevent the entry of pests such as rodents and insects to protect the stored items.

3. (a) Analyse five importance of irrigation.

Answer:
i. Enhances crop yield: Irrigation ensures a constant water supply, which is crucial for crop growth, especially in dry regions or during droughts.
ii. Enables multiple cropping: By providing water throughout the year, irrigation allows farmers to grow multiple crops annually, increasing productivity.
iii. Improves soil fertility: Controlled irrigation reduces soil erosion and maintains soil fertility by retaining essential nutrients.
iv. Expands cultivable land: Irrigation makes it possible to cultivate land that would otherwise be unsuitable due to lack of water.
v. Supports livestock: Irrigation provides water for livestock, essential for maintaining their health and productivity.

3. (b) Outline eight uses of water on the farm.

Answer:
i. Irrigation of crops.
ii. Drinking water for livestock.
iii. Cleaning farm equipment and tools.
iv. Mixing chemicals for pest control and fertilizers.
v. Processing agricultural produce.
vi. Cooling systems in greenhouses.
vii. Aquaculture or fish farming.
viii. Domestic use for farm workers, such as cooking and cleaning.

3. (c) State six disadvantages of overhead irrigation.

Answer:
i. Water wastage due to wind drift and evaporation.
ii. High initial cost of installation and maintenance.
iii. Uneven water distribution in windy conditions.
iv. Promotes leaf diseases due to wet foliage.
v. Requires high-quality water to avoid clogging of nozzles.
vi. High energy consumption for pumping water.

3. (d) Briefly explain four conditions necessary for surface irrigation.

Answer:

i. Flat or gently sloping land: Surface irrigation works best on flat or slightly sloping land to allow even water distribution.
ii. Properly prepared soil: Soil must be free from obstructions such as rocks and weeds to ensure smooth water flow.
iii. Adequate water supply: A sufficient amount of water is required to ensure that the entire field receives adequate moisture.
iv. Appropriate soil type: Loamy or clay soils with good water retention capacity are ideal for surface irrigation.

3. (e) Explain four agricultural practices that lead to pollution of water sources for irrigation.

Answer:
i. Excessive use of fertilizers: Runoff from over-fertilized fields can contaminate water sources with nitrates and phosphates.
ii. Improper disposal of pesticides: Chemicals from pesticides may seep into water bodies, harming aquatic life.
iii. Livestock waste runoff: Animal waste washed into streams or rivers can introduce pathogens and nutrients into water sources.
iv. Soil erosion: Poor land management practices can result in sediment-laden runoff that clogs water sources.

4. (a) Give three reasons why farmers use tools and equipment.

Answer:
i. Increases efficiency: Tools and equipment help farmers perform tasks faster and more efficiently.
ii. Reduces labor costs: Mechanization reduces the reliance on manual labor, lowering costs.
iii. Enhances productivity: Using appropriate tools ensures better crop management, leading to higher yields.

4. (b) Define the following terms:

(i) Riveting:
Answer: Riveting is a method of permanently joining two or more pieces of material, usually metal, using a rivet that expands when placed through a hole and hammered or pressed.

(ii) Soldering:
Answer: Soldering is a process of joining two or more metal parts by melting a filler metal (solder) into the joint, without melting the base materials, to create a strong electrical or mechanical connection.

4. (c) Differentiate the uses of:
(i) Riveting machines from hand drills and bits.
Answer: Riveting machines are used to fasten materials using rivets, while hand drills and bits are used to create holes in materials for fastening or other purposes.

(ii) Spoke shave from files.
Answer: Spoke shaves are used to shape and smooth curved surfaces, while files are used for smoothing and finishing flat or irregular surfaces.

(iii) Wood chisel from cold chisel.
Answer: Wood chisels are designed for carving or cutting wood, while cold chisels are used for cutting and shaping metal.

(iv) Try square from Mason's square.
Answer: Try squares are used in carpentry for marking and checking right angles on wood, while Mason's squares are used in masonry for ensuring straight and level construction.

(v) Pipe cutter from pipe wrench.
Answer: Pipe cutters are used to cut pipes cleanly and accurately, while pipe wrenches are used to grip and tighten or loosen pipes.

4. (d) What is the importance of forging?
Answer: Forging improves the strength, durability, and reliability of materials by shaping them under high pressure and heat, aligning the internal grain structure to withstand stress.

Name four equipments which assist forging.
Answer:
i. Forge furnace
ii. Hammer (power or hand)
iii. Anvil
iv. Tongs

5. (a) (i) Briefly explain two categories of the implements drawn by the tractor depending on the attachment method.

Answer:
i. Mounted implements: These are implements attached to the tractor through a three-point linkage system. They are fully supported by the tractor and lifted hydraulically for transportation or during operation. Examples include plows and harrows.

ii. Trailed implements: These are implements pulled behind the tractor and supported by their own wheels. They are attached to the tractor through a drawbar or hitch system. Examples include trailers and seed drills.

(ii) What is meant by primary tillage?
Answer:
Primary tillage refers to the initial soil preparation process after harvesting or before planting. It involves breaking and loosening the soil to a suitable depth to create a favorable environment for planting crops. It is often done using plows or disc harrows.

(iii) riefly describe the functions of the five primary tillage implements.

Answer:
i. Moldboard plow: Used for turning over and breaking the soil, burying weeds, and crop residues to prepare the field for planting.
ii. Disc plow: Cuts and turns the soil, especially in fields with hard or rocky surfaces. It is suitable for rough and heavy soils.
iii. Chisel plow: Loosens and aerates the soil without inverting it, preserving soil moisture and reducing erosion.
iv. Subsoiler: Breaks up compacted soil layers below the surface, improving water infiltration and root penetration.
v. Rotary tiller: Pulverizes the soil into fine particles, creating a smooth seedbed for planting.
(b) Briefly describe five areas where agricultural mechanization can be applied.

Answer:
i. Land preparation: Mechanized tools such as tractors, plows, and harrows are used to prepare fields for planting, improving efficiency and reducing labor.
ii. Planting: Equipment like seed drills and planters ensure uniform seed placement and depth, increasing crop establishment rates.
iii. Crop protection: Machines such as sprayers are used to apply pesticides and fertilizers evenly, protecting crops and enhancing growth.
iv. Harvesting: Combine harvesters and threshers are used to harvest crops quickly, reducing post-harvest losses and saving labor.
v. Post-harvest handling: Equipment such as dryers, graders, and packaging machines help process and store crops efficiently, reducing spoilage and maintaining quality.

(c) Explain four factors which limit the effectiveness of mechanization in agricultural production.

Answer:
i. High initial costs: Purchasing and maintaining machinery can be expensive, making it unaffordable for small-scale farmers.
ii. Lack of technical skills: Farmers may lack the knowledge and skills required to operate and maintain agricultural machinery.
iii. Poor infrastructure: Inadequate road networks and power supply hinder the transportation and operation of machines.
iv. Small farm sizes: Fragmented and small plots make it difficult to use large machinery effectively, reducing mechanization efficiency.

(d) Examine three factors that might influence the method used to clear land and the type of equipment that might be used.

Answer:

i. Size of the land: Larger areas may require heavy machinery such as bulldozers or tractors, while smaller plots can be cleared using hand tools like machetes or hoes.
ii. Type of vegetation: Dense or forested areas may need chainsaws and bulldozers, while lightly vegetated areas can be cleared using slashers or brush cutters.
iii. Soil condition: Wet or swampy soils may require specialized equipment like track-mounted machines, while dry soils can be cleared with conventional tractors or graders.
6. (a) A cubic-shaped oven-dried soil sample of 14 g came up with a 2 cm side after measurement. If its particle density is 2.65 g/cm³, determine its percentage pore space.

Answer:
Step 1: Calculate the total volume of the soil sample.
Total volume = side³ = 2 cm × 2 cm × 2 cm = 8 cm³

Step 2: Calculate the bulk density (BD).
Bulk density (BD) = Mass of soil / Total volume
BD = 14 g / 8 cm³ = 1.75 g/cm³

Step 3: Calculate the percentage pore space.
Formula: P = (1 - (BD / PD)) × 100
P = (1 - (1.75 / 2.65)) × 100
P = (1 - 0.6604) × 100
P = 0.3396 × 100
P = 33.96%

Answer: Percentage pore space = 33.96%

(ii) With a reason, suggest the type of soil in (a)(i).

Answer:
The soil is likely sandy soil because sandy soils typically have lower bulk densities and higher pore spaces compared to clay or loamy soils.

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6. (b) i. Give a brief account of soil structure as it is used in soil studies.

Answer:
Soil structure refers to the arrangement of soil particles (sand, silt, and clay) into aggregates or clumps. These aggregates influence water infiltration, root penetration, and aeration in the soil. In soil studies, soil structure is crucial for understanding its ability to support plant growth, store water, and allow root development.

ii. Briefly explain four points on the importance of soil texture.

Answer:
i. Water retention: Fine-textured soils like clay retain more water, while coarse soils like sand drain water quickly.
ii. Nutrient availability: Soil texture determines the soil's capacity to hold and supply nutrients to plants.
iii. Root penetration: Loamy soils with balanced textures allow better root growth compared to compacted clay soils.
iv. Soil aeration: Sandy soils promote aeration for root respiration, while clay soils may limit oxygen availability.

6. (c) Enumerate five benefits of phosphorus application in plant growth and development.

Answer:
i. Enhances root development: Phosphorus promotes the formation of strong root systems, improving plant stability.
ii. Increases flowering and fruiting: It supports the development of flowers, seeds, and fruits.
iii. Boosts energy transfer: Phosphorus is a key component of ATP, providing energy for metabolic processes in plants.
iv. Improves crop yield: Sufficient phosphorus enhances overall plant productivity and yield.
v. Accelerates maturity: It helps plants mature faster, reducing the time required for harvest.

6. (d) Given the following plant symptoms, state the nutrient deficiency in each case:

(i) Purplish coloration of foliage.
Answer: Phosphorus deficiency.

(ii) Abnormally dark green foliage and premature shedding of blossoms and floral buds.
Answer: Nitrogen deficiency.

(iii) Slow growth, stunted growth, and chlorosis of leaves in the middle near the midrib.
Answer: Potassium deficiency.

(iv) Poor grain, fruits, and seed development.
Answer: Zinc deficiency.

(v) Wilting of the entire plant.
Answer: Water deficiency or drought stress.

7. (a) Define the following terms as used in soil chemical properties:

(i) Primary minerals

Answer: Primary minerals are naturally occurring inorganic substances found in the soil, derived from the weathering of parent rock material. Examples include feldspar and quartz.

(ii) Secondary minerals
Answer: Secondary minerals are minerals formed from the chemical weathering of primary minerals. They are usually smaller and include clay minerals and oxides of iron and aluminum.

7. (b) Explain the importance of secondary minerals in agricultural production.

Answer:
i. Source of nutrients: Secondary minerals release essential nutrients such as potassium, calcium, and magnesium, which are crucial for plant growth.
ii. Water retention: Clay minerals, a type of secondary mineral, improve soil's ability to retain water.
iii. Soil fertility: They enhance soil structure and cation exchange capacity, making nutrients more available to plants.
iv. Buffering capacity: Secondary minerals help stabilize soil pH, reducing the impact of acidic or basic substances.

7. (c) Outline three ways in which charges present in soil colloidal particles originate.

Answer:
i. Isomorphous substitution: Replacement of one ion with another of similar size in the crystal lattice creates a net charge.
ii. Broken edges of particles: Clay particles develop charges at their broken edges due to exposure to water and other chemicals.
iii. Adsorption of ions: Soil colloids attract and hold charged ions from soil solution, contributing to their overall charge.

7. (d) i. Briefly explain six significance of soil pH.

Answer:
i. Nutrient availability: Soil pH determines the solubility and availability of essential nutrients.
ii. Microbial activity: Optimal pH promotes the growth of beneficial microorganisms in the soil.
iii. Toxicity reduction: Neutral pH minimizes the toxicity of harmful elements like aluminum and manganese.
iv. Root development: Proper pH ensures a suitable environment for root penetration and nutrient uptake.
v. Fertilizer efficiency: Nutrient uptake from fertilizers is optimized at specific pH levels.
vi. Crop specificity: Certain crops require specific pH ranges for optimal growth.

ii. Point out three detrimental effects of overliming in plant growth.

Answer:

i. Micronutrient deficiency: Overliming can reduce the availability of nutrients like zinc, iron, and manganese.
ii. Soil alkalinity: Excess lime raises pH to levels unsuitable for most crops.
iii. Reduced crop yield: Overliming may create an imbalance in soil nutrients, affecting plant health and productivity.

iii. Enumerate four important soil characteristics which influence the efficiency of a liming material.

Answer:
i. Soil texture: Clay soils require more lime compared to sandy soils due to their higher buffering capacity.
ii. Soil pH: The initial pH determines the amount of lime needed to achieve the desired pH.
iii. Organic matter content: High organic matter affects lime requirements and efficiency.
iv. Cation exchange capacity (CEC): Soils with high CEC require more lime to neutralize acidity effectively.

8. (a) Write a concise account on the meaning and importance of international trade.

Answer:
International trade refers to the exchange of goods and services between countries. It allows nations to specialize in the production of goods where they have a comparative advantage and import goods they cannot efficiently produce.

Importance:
i. Economic growth: International trade boosts a country's economy by increasing production and creating employment opportunities.
ii. Access to resources: It allows countries to access raw materials, technology, and products that are unavailable domestically.
iii. Enhances competition: Exposure to international markets fosters innovation and improved quality of goods and services.
iv. Revenue generation: Exporting goods increases foreign exchange earnings and contributes to national income.
v. Strengthens international relations: Trade promotes cooperation and reduces the likelihood of conflicts between nations.

8. (b) State four means of reducing marketing costs.

Answer:
i. Improving infrastructure: Good road networks and transportation facilities reduce the cost of moving goods to the market.
ii. Adopting modern technology: Using digital platforms for marketing reduces the need for physical advertising and intermediaries.
iii. Direct marketing: Eliminating middlemen allows producers to sell directly to consumers, reducing costs.
iv. Bulk sales: Selling in large quantities reduces packaging and handling costs.

8. (c) Briefly explain two requirements which make a market purely competitive.

Answer:
i. Large number of buyers and sellers: A purely competitive market has many buyers and sellers, ensuring no single entity can influence market prices.
ii. Homogeneous products: Goods and services sold in the market are identical, with no differentiation, leading to fair competition.

8. (d) State four factors influencing the farmers' share of the final consumer price.

Answer:
i. Transportation costs: High transportation costs reduce the farmer's profit margin.
ii. Number of intermediaries: More middlemen in the supply chain lower the farmer's share of the final price.
iii. Quality of produce: Higher quality products fetch better prices, increasing the farmer's share.
iv. Market access: Farmers with direct access to markets can sell at competitive prices, increasing their earnings.

9. (a) Briefly explain the following terms as used in the valuation of farm assets:
(i) Inventory:
Answer: Inventory refers to the list of all goods, materials, and resources available on the farm, including crops, livestock, and machinery, for production or sale.

(ii) Salvage value:
Answer: Salvage value is the estimated residual value of an asset at the end of its useful life, after depreciation.

(iii) Depreciation:
Answer: Depreciation is the reduction in the value of an asset over time due to wear and tear, obsolescence, or usage.

(iv) Valuation:
Answer: Valuation is the process of determining the monetary worth of an asset or the entire farm based on current market conditions.

9. (b) Give three methods of calculating depreciation with their appropriate formulae.

Answer:
i. Straight-line method:
Formula: Depreciation = (Cost of asset - Salvage value) / Useful life.

ii. Declining balance method:
Formula: Depreciation = Book value × Depreciation rate.

iii. Sum-of-years-digits method:
Formula: Depreciation = (Remaining life of asset / Sum of years) × (Cost of asset - Salvage value).

9. (c) The initial cost of acquiring a tractor was found to be Tsh. 4,000,000/=. Its written-off value was found to be Tsh. 1,000,000/= after five years of its useful life. By using the straight-line method, calculate yearly depreciation and find the value of the tractor on 31st December of the fourth year.

Answer:
Step 1: Calculate yearly depreciation.
Formula: Depreciation = (Cost of asset - Salvage value) / Useful life.
Depreciation = (4,000,000 - 1,000,000) / 5
Depreciation = 3,000,000 / 5
Depreciation = Tsh. 600,000/= per year.

Step 2: Calculate the value of the tractor at the end of the fourth year.
Value = Cost of asset - (Depreciation × Number of years used).
Value = 4,000,000 - (600,000 × 4)
Value = 4,000,000 - 2,400,000
Value = Tsh. 1,600,000/=
Yearly depreciation = Tsh. 600,000/=. Value of tractor at the end of fourth year = Tsh. 1,600,000/=.

9. (d) Briefly describe four product-product relationships.

Answer:
i. Competitive relationship: Two products compete for the same resources, and an increase in one reduces the availability of resources for the other, e.g., growing maize and beans on the same land.
ii. Supplementary relationship: Two products do not compete for resources, and one does not affect the production of the other, e.g., producing milk and wool from the same livestock.
iii. Complementary relationship: An increase in the production of one product leads to an increase in the production of another, e.g., intercropping maize and legumes improves soil fertility, benefiting both crops.
iv. Joint relationship: Two products are produced together and cannot be separated, e.g., wool and mutton from sheep.