FIRM FOUNDATION COUNTRY SCHOOL

Plot 8 Southwood, Chegutu, Zimbabwe

CONTACT: +263 77 643 4036/ +263 78 114 7858

CANDIDATE NAME

CANDIDATE CLASS

AGRICULTURE **0600**

HOLIDAY WORK 2026

FORM TWO

INSTRUCTIONS

- Notes can be printed or hand written, if printed they should be pasted in the note book
- Exercise to be written in the test exercise book
- Notes and exercise to be submitted soon after check-in

CROP PROTECTION

PEST CONTROL

Pest can be controlled by the use of chemicals, cultural, physical and biological & biotechnological methods.

Chemical pest control

Chemical pest control involves the dusting, spraying or fumigation with a chemical called a pesticide, which is destructive to a particular pest.

Pesticides can be classified based on

- Mode of entry
- Chemical composition
- Types of pests which they attack and their function

Classification base on the mode of entry
This classification is based on the ways pesticides come in contact or enter the target pests.These pesticides are grouped as:

- Systemic
- Contact
- Stomach
- fumigants

1. Contact Pesticides

These are also called non -systemic pesticides. They kill pests upon direct exposure or when they come in contact with the body of the pest .They are absorbed through the skin or cuticle thus disrupts the pest's nervous system, respiration, or cuticle integrity.
Examples: Pyrethroids, organophosphates, carbamates, lampda
Key Features:

- Require thorough coverage of leaves, stems, or soil.
- Effective against chewing insects and surface feeders.
- Short residual effect; pests not directly sprayed may survive.

Limitations: Easily washed off by rain, less effective against hidden or systemic feeders.

2. Systemic Pesticides

These are molecules which are absorbed by one part of a plant for examples leaves, stem or roots and then trans located to other parts of the plant through vascular tissues (xylem and phloem), thus only one part of the plant needs to be treated and all the other parts become contaminated
Key Features:

- Protects against sucking insects (aphids, whiteflies) and borers feeding inside plant tissues.
- Longer residual activity compared to contact pesticides.
- Can control pests even if spray coverage is incomplete.

Limitations: Risk of residues in edible plant parts; overuse can lead to pest resistance and environmental contamination.
Examples: Neonicotinoids, Acetamiprid

3. Stomach pesticides

These must be eaten by the target pest, they can be sprayed, or dusted on the crop or on the actual pest. These pesticides will kill only those pests which actually consume the plant or parts of the target plant.
They are used to control biting insects such as locust and leaf miners.

Fumigants
These are pesticides which act on or kill the target pests by interfering with their breathing process. These pesticides come in the form of either a liquid or volatile liquids. When they are applied they change into poisonous gases. These noxious vapors enter the body of pests through their respiratory system and cause death by poisoning.

N.B Contact pesticides are best for quick knockdown of outbreaks, especially where pests are visible and localized (e.g., caterpillars on maize leaves).
- Systemic pesticides are more effective for persistent or hidden pests, common in tropical crops like cassava, cotton, and citrus.

BIOLOGICAL PEST CONTROL

Biological pest control uses living organisms such as predators, parasitoids, and pathogens to suppress pest populations, while biotechnical methods rely on advanced tools like pheromones, sterile insect techniques, and genetic engineering to disrupt pest reproduction or behavior. Both approaches are vital in tropical agriculture for reducing reliance on chemical pesticides and promoting sustainable farming.

Biological control involves the use of natural enemies to regulate pest populations.

1. Predators

These are organisms that feed directly on pests.
Examples: Ladybird beetles feeding on aphids, lacewings consuming whiteflies.
Strengths: Rapid reduction of pest numbers, eco-friendly.
Limitations: Predator populations may decline if pest density is low.

2. Parasitoids

These are insects that lay eggs inside or on pests; larvae consume the host.
Examples: Trichogramma wasps parasitizing caterpillar eggs.
Strengths: Highly specific to target pests, effective in tropical crops like maize and cotton.
Limitations: Slow action compared to chemical pesticides.

3. Pathogens

Microorganisms (fungi, bacteria, viruses) that infect and kill pests.
Examples: Bacillus thuringiensis (Bt) against caterpillars, entomopathogenic fungi against locusts.
Strengths: Safe for humans and beneficial insects.
Limitations: Effectiveness depends on environmental conditions (humidity, temperature).

Biotechnical Methods of Pest Control

Biotechnical approaches use scientific innovations to manipulate pest behavior or genetics.

1. Pheromone Traps

- Synthetic sex pheromones lure pests into traps.
- Use: Monitoring pest populations or mass-trapping moths in maize and cotton fields.
- Strengths: Non-toxic, highly specific.
- Limitations: Works best for certain insect species.

2. Sterile Insect Technique (SIT)

- Male pests are sterilized (often by radiation) and released to mate with wild females, producing no offspring.
- Example: Used against fruit flies in tropical horticulture.
- Strengths: Long-term suppression of pest populations.
- Limitations: Expensive and requires large-scale implementation.

3. Genetic Engineering & RNA Interference (RNAi)

- Crops are genetically modified to resist pests (e.g., Bt cotton).
- RNAi technology silences essential pest genes, leading to death.
- Strengths: Provides systemic protection, reduces pesticide use.
- Limitations: Risk of resistance development, regulatory and ethical concerns.

Cultural Pest Control Methods

1. Crop Rotation

- Planting different crops in successive seasons to break pest life cycles.
- Example: Rotating maize with legumes reduces stem borer and soil-borne pests.
- Benefit: Prevents buildup of host-specific pests.

2. Field Sanitation

- Removing crop residues, weeds, and volunteer plants that harbor pests.
- Example: Destroying stubble after harvest to reduce bollworm survival.
- Benefit: Eliminates breeding sites and alternate hosts.

3. Adjusting Planting and Harvesting Times

- Altering sowing dates to avoid peak pest populations.
- Example: Early planting of sorghum to escape shoot fly infestation.
- Benefit: Reduces pest damage by avoiding synchronization with pest life cycles.

4. Intercropping and Mixed Cropping

- Growing two or more crops together to confuse or repel pests.
- Example: Maize intercropped with beans reduces fall armyworm incidence.
- Benefit: Diversifies habitat, making it harder for pests to locate hosts.

5. Trap Cropping

- Planting a more attractive crop nearby to lure pests away from the main crop.
- Example: Planting mustard near cabbage to attract diamondback moths.
- Benefit: Concentrates pests for easier control.

6. Use of Resistant Varieties

- Selecting crop varieties bred for pest resistance.
- Example: Striga-resistant maize varieties in tropical Africa.
- Benefit: Reduces reliance on pesticides.

7. Tillage and Soil Management

- Deep plowing exposes soil-dwelling pests to predators and sunlight.
- Example: Controlling cutworms and root grubs.
- Benefit: Disrupts pest habitats.

8. Irrigation and Fertilizer Management

- Proper water and nutrient management to strengthen plant resistance.
- Example: Avoiding excessive nitrogen that attracts aphids.
- Benefit: Healthy plants are less vulnerable to pest attack.

Physical Pest Control Methods

1. Handpicking and Manual Removal

- Collecting and destroying visible pests (e.g., caterpillars, beetles).
- Benefit: Immediate reduction of pest numbers.
- Limitation: Labor-intensive, suitable for small-scale farms.

2. Mechanical Barriers

- Using nets, screens, fences, or row covers to prevent pest entry.
- Example: Netting to protect vegetables from birds or insects.
- Benefit: Prevents infestation without chemicals.

3. Trapping

- Employing light traps, sticky traps, or baited traps to capture pests.
- Example: Light traps for moths in maize fields.
- Benefit: Effective for monitoring and reducing pest populations.

4. Soil Solarization

- Covering moist soil with transparent plastic sheets to trap solar heat.
- Effect: High temperatures kill soil-borne pests, nematodes, and pathogens.
- Benefit: Eco-friendly, improves soil health.

5. Burning and Heat Treatment

- Destroying crop residues or exposing pests to heat.
- Example: Burning stubble to eliminate stem borers.
- Benefit: Reduces pest carryover between seasons.

6. Flooding

- Submerging fields to kill soil-dwelling pests.
- Example: Used in rice cultivation to suppress weeds and pests.
- Benefit: Effective against certain insect larvae and nematodes.

7. Cold Storage

- Using low temperatures to suppress pest activity in stored grains.
- Benefit: Prevents multiplication of storage pests like weevils.

8. Mechanical Cultivation

- Plowing or hoeing to expose and destroy soil pests.
- Benefit: Breaks pest habitats and reduces populations.

Disease Control Methods

A disease is any alteration in the state of a plant which disturbs the functioning of the plant or plant parts .A pathogen is an organism that causes a disease. Diseases are caused by microorganisms such as bacteria, and viruses. The propagation and growth of these micro-organisms are determined by temperature, moisture, dispersal agents, and soil ph.

Bacterial diseases

- Bacterial wilt in tomatoes
- Bacterial blight
- Fire blight
- Soft rot

A well-known bacterial plant disease is Bacterial Blight of Rice caused by Xanthomonas oryzae pv. oryzae. It infects rice leaves through wounds or natural openings, leading to severe yield losses in tropical regions. Prevention relies on resistant varieties and good field hygiene, while control involves cultural practices and limited chemical use.

Bacterial Blight of Rice (Xanthomonas oryzae pv. oryzae)

1. Mode of Infection

- The bacteria enter rice plants through stomata, hydathodes, or wounds caused by insects or mechanical damage.
- They multiply in the vascular tissues (xylem), spreading systemically through the plant.
- Infection is favored by warm, humid conditions common in tropical climates.

2. Harmful Effects

- Symptoms:
- Water-soaked lesions on leaf tips and margins.
- Yellowing and wilting of leaves.
- “Kresek” phase in young plants: rapid wilting and death.
- Impact:
- Severe yield reduction (up to 50% in epidemics).
- Poor grain filling and reduced quality.
- Increased vulnerability to secondary infections.

3. Prevention

- Resistant Varieties: Planting rice cultivars bred for resistance (e.g., IR varieties).
- Seed Health: Using certified, disease-free seeds.
- Field Sanitation: Removing crop residues and volunteer plants that harbor bacteria.
- Water Management: Avoiding continuous flooding that favors bacterial spread.
- Balanced Fertilization: Avoiding excessive nitrogen, which makes plants more susceptible.

4. Control Measures

- Cultural Practices:
- Crop rotation with non-host plants.
- Proper spacing to reduce humidity around plants.
- Chemical Control:
- Limited use of copper-based bactericides or antibiotics (though effectiveness is variable and environmental risks exist).
- Biological Control:
- Use of antagonistic bacteria (e.g., Pseudomonas fluorescens) to suppress pathogen growth.
- Integrated Pest Management (IPM):
- Combining resistant varieties, sanitation, and biological agents for sustainable control.

Fungal diseases

- Powdery mildew
- Botrytis(grey mould)
- Fusarium wilt
- Smut
- Rust

A classic fungal plant disease is Powdery Mildew caused by Oidium mangiferae. It is widespread in tropical regions and can severely reduce fruit yield and quality if not managed properly.

Powdery Mildew

1. Mode of Infection

- The fungus produces airborne spores (conidia) that land on young leaves, flowers, and fruits.
- Spores germinate on the plant surface and form a white powdery mycelial growth.
- Infection occurs under cool, dry conditions with high humidity at night, common in tropical climates.
- The fungus penetrates epidermal cells and extracts nutrients, weakening plant tissues.

2. Harmful Effects

- Symptoms:
- White powdery patches on leaves, flowers, and young fruits.
- Flower drop and poor fruit set.
- Fruits may become deformed, cracked, or shriveled.
- Impact:
- Reduced photosynthesis due to leaf damage.
- Yield losses up to 60% in severe outbreaks.
- Lower fruit quality and market value.

3. Prevention

- Resistant Varieties: Planting mango cultivars less susceptible to powdery mildew.
- Field Hygiene: Pruning overcrowded branches to improve air circulation.
- Monitoring: Regular inspection during flowering and fruiting stages.
- Balanced Fertilization: Avoiding excessive nitrogen that promotes tender growth susceptible to infection.

4. Control Measures

- Cultural Practices:
- Proper spacing of trees to reduce humidity.
- Removal of infected plant parts to limit spread.
- Chemical Control:
- Spraying fungicides such as sulfur dust, copper-based compounds, or systemic fungicides (triazoles).
- Biological Control:
- Use of antagonistic fungi like Ampelomyces quisqualis that parasitize powdery mildew.
- Integrated Management:
- Combining resistant varieties, pruning, and fungicide sprays at critical growth stages (flowering and fruit set).

Viral diseases

Groundnut rosette
Maize streak virus
Maize mosaic virus

A major viral disease of maize is Maize Streak Virus (MSV), transmitted by leafhoppers. It is one of the most destructive viral diseases in tropical Africa, causing severe yield losses if not managed properly.

Maize Streak Virus (MSV)

1. Mode of Infection

- The virus is transmitted by leafhoppers (Cicadulina spp.), which acquire the virus while feeding on infected plants.
- Once infected, the insect remains a carrier for life, spreading the virus to healthy maize plants.
- The virus multiplies inside plant cells and disrupts normal growth, especially in young plants.

2. Harmful Effects

- Symptoms:
- Distinctive streaks of pale yellow or white lines running parallel along maize leaves.
- Stunted growth and reduced tillering.
- Poor cob formation and small, shriveled grains.
- Impact:
- Severe yield losses (up to 100% in susceptible varieties).
- Early infection leads to complete crop failure.
- Reduces food security in tropical regions where maize is a staple.

3. Prevention

- Resistant Varieties: Planting maize cultivars bred for resistance to MSV.
- Field Hygiene: Removing volunteer maize plants and weeds that host leafhoppers.
- Crop Rotation: Avoiding continuous maize cultivation to break the virus cycle.
- Early Planting: Sowing maize early in the rainy season to reduce exposure to high leafhopper populations.
- Seed Health: Using certified, virus-free seeds.

4. Control Measures

- Cultural Practices:
- Proper spacing to reduce leafhopper movement.
- Intercropping with non-host crops to limit virus spread.

- Vector Control:
  - Limited use of insecticides against leafhoppers (though not always economical for smallholders).
  - Integrated Management:
  - Combining resistant varieties, early planting, and sanitation for sustainable control.

Cultural disease control Methods

1) **Crop Rotation**
   - Breaks life cycles of soil-borne pathogens.
2) **Field Sanitation**
   - Removing diseased plant debris and volunteer plants.
3) **Adjusting Planting Dates**
   - Avoiding peak periods of pathogen activity.
4) **Resistant Varieties**
   - Using cultivars bred for disease resistance.
5) **Balanced Fertilization & Irrigation**
   - Prevents stress that makes plants more vulnerable.
   - **Strengths:** Low-cost, sustainable, widely applicable.
   - **Limitations:** Requires planning and farmer discipline.

Physical Methods

1) Heat Treatment
- Hot water treatment of seeds or planting material to kill pathogens.

2) Soil Solarization
- Covering soil with plastic sheets to trap solar heat and kill pathogens.

3) Mechanical Removal
- Uprooting and destroying infected plants.

4) Cold Storage
- Prevents multiplication of pathogens in stored produce.

Strengths: Environmentally safe, effective for localized problems.
Limitations: Labor-intensive, not always practical for large-scale farming.

Biological Methods

1) Use of Antagonistic Microorganisms
- Example: Trichoderma fungi suppress soil-borne pathogens.

2) Biological Seed Treatment
- Coating seeds with beneficial microbes like Pseudomonas fluorescens.

3) Biocontrol Agents
- Viruses, fungi, or bacteria that attack plant pathogens.

- **Strengths**: Eco-friendly, sustainable, preserves biodiversity.
- **Limitations:** Slower action, effectiveness depends on environmental conditions.

THE USE OF FARM CHEMICALS

Types of Farm Chemicals

1. Pesticides
- Kill or control insect pests.
- Examples: Contact pesticides (pyrethroids), systemic pesticides (neonicotinoids).

2. Herbicides
- Control weeds competing with crops.
- Examples: Glyphosate, atrazine.

3. Fungicides
- Prevent or treat fungal diseases.
- Examples: Copper-based fungicides, triazoles.

4. Fertilizers
- Supply essential nutrients (N, P, K) to crops.
- Examples: Urea, ammonium nitrate, superphosphate.

Benefits of Farm Chemicals
- Increase crop yields and food security.
- Protect crops from pests, weeds, and diseases.
- Improve soil fertility and plant growth.
- Enable large-scale commercial farming.

Harmful Effects
- Environmental Pollution: Chemicals can contaminate soil, water, and air.
- Health Risks: Improper handling may cause poisoning or long-term health issues.
- Resistance Development: Overuse of pesticides leads to resistant pests and pathogens.
- Loss of Biodiversity: Non-target organisms (bees, fish, and beneficial insects) may be harmed.

✅ Safe Use and Control
- Apply chemicals at recommended doses and intervals.
- Use protective clothing when spraying.
- Store chemicals safely, away from food and water sources.
- Rotate chemical types to prevent resistance.
- Combine with cultural, biological, and physical methods in Integrated Pest and Disease Management (IPM).

SAFE HANDLING OF FARM CHEMICALS

Safe handling of farm chemicals is critical to protect farmers from acute poisoning, long-term illnesses, and environmental contamination. The use of specifically designed protective clothing—such as chemical-resistant suits, gloves, boots, and masks—provides a vital barrier against harmful exposure.

Importance of Safe Handling
- **Health Protection**: Farm chemicals (pesticides, herbicides, fertilizers) can cause skin burns, respiratory issues, cancers, and neurological disorders if mishandled.
- **Environmental Safety**: Improper handling leads to soil degradation, water contamination, and harm to wildlife.
- **Economic Sustainability**: Preventing accidents reduces medical costs, lost labor time, and crop damage.
- **Legal Compliance:** Many countries, including Zimbabwe, require adherence to occupational safety standards in agriculture.

Methods of Safe Handling

1. Proper Storage
- Keep chemicals in locked, labeled containers away from food and water sources.
- Store in cool, ventilated areas to prevent leaks or explosions.

2. Safe Mixing and Application
- Always read and follow manufacturer instructions.
- Use measuring tools instead of bare hands.
- Mix chemicals in well-ventilated areas or outdoors.

3. Personal Hygiene
- Wash hands and face thoroughly after handling.
- Avoid eating, drinking, or smoking during chemical use.
- Shower and change clothes immediately after spraying.

4. Disposal Practices
- Dispose of empty containers safely—triple rinse and puncture before discarding.
- Never reuse chemical containers for food or water.

Protective Clothing:
Specially designed protective clothing is essential because ordinary clothes absorb chemicals.

Protective Gear	Purpose	Design Features
Coveralls / Suits	Full-body protection	Multi-layer laminated fabric, taped seams, elastic cuffs, hooded design
Gloves	Prevent skin absorption	Chemical-resistant materials (nitrile, neoprene) |
Boots	Protect feet from spills	Waterproof, non-slip, chemical-resistant
Respirators / Masks	Prevent inhalation	Filters for pesticide vapors and dust
Goggles / Face Shields	Eye protection	Anti-fog, chemical splash resistant

Note: Protective clothing must be comfortable, durable, and resistant to chemical penetration, though workers should be aware of heat stress risks in hot climates .

⚠ Risks & Precautions
- Heat Stress: PPE can trap heat; farmers should take breaks, hydrate, and work during cooler hours.
- Improper Fit: Loose or damaged clothing reduces effectiveness.
- Neglecting PPE: Many accidents occur because workers skip protective gear due to discomfort or cost.

✓ Key Takeaways
- Always use PPE when handling farm chemicals—it is the most effective safeguard.
- Combine protective clothing with safe storage, mixing, disposal, and hygiene practices.
- Farmers in Zimbabwe and elsewhere should prioritize training and awareness programs to ensure consistent safety standards.

Safe Handling of Farm Chemicals

1. Importance
- Protects human health from poisoning, burns, and long-term illnesses.
- Ensures crop safety by preventing overdosing or underdosing.
- Safeguards the environment (soil, water, air, wildlife).
- Maintains economic sustainability by reducing waste and accidents.

2. Correct Dilution and Mixing
- Read labels carefully: Follow manufacturer's instructions for concentration.
- Measure accurately: Use calibrated measuring cups or scales, never guess.
- Mix in ventilated areas: Preferably outdoors, away from food and water.
- Add water first: Then chemical, to reduce splashing and ensure proper mixing.
- Avoid direct contact: Use stir sticks or mechanical mixers, not bare hands.

3. Precautions Before Application
- Wear protective clothing: Coveralls, gloves, boots, goggles, respirator.
- Check equipment: Ensure sprayer is clean, calibrated, and leak-free.
- Weather check: Avoid spraying on windy or rainy days to prevent drift.
- Prepare emergency supplies: Soap, clean water, first aid kit nearby.

4. Precautions During Application
- Spray downwind: Keep chemicals away from operator and sensitive areas.
- Maintain steady speed and pressure: For even coverage.
- Avoid eating, drinking, smoking: Prevent ingestion of residues.
- Stay alert: Watch for leaks, spills, or equipment malfunction.

5. Precautions After Application
- Wash thoroughly: Shower and change clothes immediately.
- Clean equipment safely: Rinse sprayer three times, using rinse water in the field (not near water sources).
- Store chemicals properly: In locked, labeled containers away from children and animals.
- Dispose containers correctly: Triple rinse, puncture, and bury or send to approved disposal sites.

6. Avoidance of Pollution When Cleaning Spraying Equipment
- Never wash near rivers, wells, or ponds: Prevent contamination of drinking water.
- Use designated cleaning areas: Preferably lined pits or biobeds.
- Recycle rinse water: Apply it to the crop field, not into drains.
- Prevent runoff: Avoid cleaning on slopes or bare soil.
- Keep records: Document cleaning and disposal practices for compliance.

✓ Key Takeaway: Safe handling of farm chemicals requires correct dilution, protective clothing, strict precautions, and pollution-conscious cleaning practices. This protects farmers, consumers, and the environment alike.

Safe storage of farm chemical

Importance of Safe Storage
- **Protects Human Health:** Prevents accidental poisoning of farmers, children, and livestock. Toxic chemicals can cause severe illness or death if ingested, inhaled, or touched.
- **Environmental Protection**: Reduces risk of soil, air, and water contamination from leaks or spills.
- **Prevents Accidents**: Proper storage avoids fires, explosions, and chemical reactions.
- **Maintains Effectiveness:** Chemicals stored correctly remain potent and safe to use, avoiding waste.
- **Legal Compliance:** Many agricultural safety laws require secure storage of hazardous substances.

Safe Storage Methods

1. Designated Storage Area
- Use a locked, well-ventilated room or cabinet away from homes, food, and animal feed.
- Keep chemicals separate from fertilizers and flammable materials.

2. Proper Containers
- Store in original labeled containers—never transfer to food or drink bottles.
- Ensure lids are tightly sealed to prevent leaks.

3. Segregation of Toxic Chemicals
- Highly toxic chemicals (e.g., organophosphates, fumigants) should be stored in clearly marked, separate sections.
- Use warning signs such as “Danger – Toxic Chemicals”.

4. Temperature and Light Control
- Avoid direct sunlight and extreme heat, which can degrade chemicals or cause pressure build-up.

5. Access Control
- Limit access to trained adults only.
- Keep keys away from children and unauthorized persons.

6. Emergency Preparedness
- Have spill kits, fire extinguishers, and first aid supplies nearby.
- Post emergency contact numbers clearly.

⚠ Precautions for Toxic Chemicals
- **Extra labeling**: Use bold hazard symbols and color codes.
- **Double containment:** Place toxic chemical containers inside secondary trays or bins to catch leaks.
- **Regular inspection**: Check for corrosion, leaks, or damaged packaging.
- **Record keeping**: Maintain an inventory log to track usage and prevent overstocking.

✅ Key Takeaway:
Safe storage of farm chemicals—especially toxic ones—is about protecting people, animals, and the environment. It requires secure facilities, clear labeling, restricted access, and strict adherence to safety protocols.

Agriculture Exercise (Total: 25 Marks)

1. List three cultural methods of pest (3)
2. Describe two biological methods of pest control (4)
3. List and three preventive measures farmers can take to reduce disease outbreaks in crops. (3)
4. Explain the importance of correct dilution and mixing of farm chemicals. (2)
5. State three precautions farmers should take before, during, and after chemical application. (3)
6. List three safe disposal methods for empty chemical containers. (3)
7. List three safe storage practices farmers should follow when handling toxic chemicals. (3)
8. What are the dangers of storing chemicals in food or drink containers? (4)