Crop Production
LEVEL – I

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Introduction to the Module

This module covers knowledge, skills and attitude requière to prepare materials, Tools and Equipment for horticultural crop production wok, undertake horticultural production wok, handle materials and equipments and record and document.

LG #5	LO #1- Prepare Materials, Tools and Equipment for Horticultural Crop Production

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying and checking inputs, materials, tools and equipment
- Manual handling and techniques for loading and unloading
- Selecting and checking suitable Personal Protective Equipment (PPE)
- Identifying and reporting OHS hazards

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify the required inputs, materials, Tools and Equipment.
- Check insufficient or faulty materials, tools and equipment.
- Use correct manual handling and techniques for loading and unloading to minimize damage to the load, person and vehicle.
- Select and check Suitable Personal Protective Equipment (PPE).
- Identify and report OHS hazards.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”
7.

Information sheet 1

Introduction

Definition of horticulture: -

The term horticulture is derived from two latin words *hortus* ‘garden’ and *colere* ‘to cultivate’. So horticulture is defined as garden cultivation. On the other word, horticulture may define as the process of cultivating, processing, and sale of fruits, vegetables, nut, ornamental plants and flowers. Even medicinal plants, beverage plants (tea, coffee), and spices are considered as horticultural crops.

Horticulture is a sub-sector of agriculture which plays significant role in economy, human nutrition, gender mainstreaming and employment. Horticultural commodities include fruits, vegetables, flowers, spices and condiments, which have grown steadily and turn into a major segment in agricultural trade. Horticulture crops often have high cash value and are intensively cultivated on relatively small areas. The high cash value of horticultural crops justifies a large input of capital, labour and technology per unit area of land.

Generally, horticulture is an art as well as a science. It deals with a combination of the botanical and agricultural aspects of plants. Basic principles of physics, chemistry, and biology are used by horticulturists to understand and manipulate plant life. Biotechnology is now finding direct applications in horticulture.

Divisions of horticulture

- **Pomology:** The word Pomology comes from two wards "pomum" and "logos" ; "pomum" means fruits and "logos" means knowledge. The scientific study and cultivation of fruits is called Pomology. On the other word, Pomology may be defined as the science of growing, storing and processing of fruits is called Pomology.
- **Olericulture:** Olericulture is one of the branches of Horticulture that deals with the vegetables. The word olericulture is derived from the Latin word Oleris which means pot

herb and the English word culture which means cultivation. Thus olericulture means cultivation of pot herbs.

- **Floriculture:** Floriculture is a branch of horticulture that specializes in the science of cultivation of flowers. Flowers are cultivated under protected, semi-protected and field conditions. Floriculture is a vast field that includes cultivation and production of all types of ornamentals, viz., croton, cacti, orchids, grasses and bamboos.
- **Landscape and nursery industry:** - Nursery & Landscape is a discipline of horticulture concerned with the growing and maintaining landscape plants and related products, the use of equipment, and landscape design concepts.

1.1. Identifying and checking inputs, materials, tools and equipment's

Depending on the type of fruit or vegetable, several devices are employed to harvest produce. Commonly used tools for fruit and vegetable harvesting are secateurs or knives, and hand held or pole mounted picking shears. When fruits or vegetables are difficult to catch, such as mangoes or avocados, a cushioning material is placed around the tree to prevent damage to the fruit when dropping from high trees.

Having the right tools, knowing how to use them and management decisions relating to the selection of horticultural tools and equipment, choice of practice, market availability, and availability of storage facilities among others are essential factors which can affect horticultural operations and production profits in several ways to improve productivity and efficiency, It is necessary to have comprehensive knowledge of horticultural tools and implement performance.

Horticultural tools can be classified into two categories as either handheld tools or power driven tools. The main aim of introducing the various horticultural tools and equipment is to enable the students have deep understanding on different types of tools and equipment used for a variety of horticultural practices, including nursery establishment and management, grafting/budding, pit digging and planting, inter-tillage and weed management, training and pruning, fertilizer and irrigation water application, plant protection, harvesting and handling of fruits.

Harvesting bags with shoulder or waist slings can be used for fruits with firm skins, like citrus and avocados. They are easy to carry and leave both hands free. The contents of the bag are emptied through the bottom into a field container without tipping the bag. Plastic buckets are suitable containers for harvesting fruits that are easily crushed, such as tomatoes. These

containers should be smooth without any sharp edges that could damage the produce. Commercial growers use bulk bins with a capacity of 250-500 kg, in which crops such as apples and cabbages are placed, and sent to large-scale packinghouses for selection, grading, and packing.



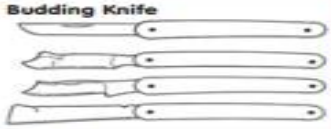
Figure1. Materials, tools and equipments

Flip Chart 1-1 Horticultural tools and equipment and their use

No.	Horticultural tools	Description and their use
1	Hoe 	• Long handled with flat and perpendicular blade at the end. • Used to remove weeds by agitating and grooming the soil surface, • Used to dig, move and hill soil during preparation for planting
2	Mattock 	• For digging hard soils
3	Axe 	• Axe is multipurpose cutting tool used for felling and delimbing of trees, splitting of logs for firewood and dressing of logs for timber conversion.
1	Trowels (planting/ digging) 	• A small hand held tool • Used to dig small hole and transplant vegetable seedlings
2	Rake (Leveling) 	• A long handled tool used to - Create a fine tiltandlevel the seedbeds - Collect plant debris and stones from the seedbed surface, - Break soil clumps and spread fertilizers or compost
4	Spade 	• A long handled tool traditionally used for • Digging, shoveling soil and compost, • Moving shrubs of plants

5	Meter (Measuring tape) 	• Made from steel or wooden and used for lay out of seedbed, plots and plant spacing
6	Watering can Watering can 	• A portable water container used for watering smaller areas and containers

7	Peg 	• Used for securing net, line or fleece to the ground
8	String (Garden Twine) 	• Used for lay outing activities and tying plants to stakes • Available in natural jute and coated
9	Shovel 	• A highly versatile and widely used garden tool. • Used to dig large holes and transport heavier materials such as wet soil and rocks • Its sharp edges can cut the roots and sods as well as break up compacted soil.
10	Aerator 	• Effective to reduce soil compaction by removing small plugs in soil • Used to aerate soi
11	Forks 	• Used for digging of soils in situations where the use of spade may be difficult for turning of soils, • Used to till large areas of soil and break up compacted clods, • o rake out weeds and stones
12	Gloves 	• Used to protect hands and fingers from cuts, blisters, calluses, sun damages, abrasions and dirt

13	Shears 	• Shears for different purposes (Pruning, Harvesting)
14	Machete 	• A large, strong blade usually around half a meter long. • Effective in cutting small branches and heavy underbrush
15	Footwear 	• Used to protect feet from stones, falling items or tools
16	Budding Knife 	• A small knife designed for budding - grafting with a single eye or bud
17	Cultivators 	• Used to break up compacted soil, spread fertilizers and compost, remove shallow rooted weeds without disturbing the roots of surrounding plants
18	Basket 	• Used for collection of harvested produces
19	Wheelbarrow 	• Used for transportation of seedlings, planting materials, growing media as well as other small loads

20		• Clip and pick fruit picker
22		• Fruit Tree Picking Pole with Basket
23		• Hydraulic platform (fruit picking lift) for harvesting, pruning and spraying operations in orchards
24		• Different types ladders (that fold out into an A-shape) commonly used in fruit or chards (tree pruning, harvesting etc.) • There are also ladders that sit straight against a stabilizing object (used for prun ing and harvesting tree fruits).
25		• Crates (plastic, wooden) used for collecting harvested fruits

Figure 2 Functions and descriptions of materials, tools and equipment

Check all materials, tools and equipment

Checking and reporting of faulty and insufficient materials of all type is the first step

Check all the tools and equipment's before use, ask question like:-

- Are all the materials functional and sufficient in number?
- Are all clean of any contaminants?
- Check and report to your supervisor how much of the materials he/she provided in the list are functional and how much of them are faulty.
- Are the functional tools and equipment's sufficient enough to the horticultural crop work with the available labor power?
- After reporting the faulty and functional materials your supervisor will guide you what to do if there is insufficiency of material for that particular horticultural crop work.

To identify all materials used in horticultural crop works and separate faulty once follow the following steps:

a. Use a list of materials provided by your supervisor and then classifies the materials according to their purpose as materials used during land preparation, cultivation or harvesting, etc. Your supervisor will provide you with list of materials used in horticultural crop
b. Know the name of the materials listed in your supervisors list
c. Go to horticultural crop store or plant science department material store and identify all the materials physically one by one
d. Describe the use or purpose of each material
e. Check wear and tears of each material
f. Separate a materials which doesn't have best match with handle, broken, have hole on containers, not sharp/can be easily broken, or can't function relative to the purpose of the work or any other unspecified reasons.
g. Count the number of faulty, functional or material that can be maintained very easily.
h. Finally report to your supervisor the categories of material based on their purpose, the total number of each category, the number of faulty materials and also if the functional materials are sufficient in number for the intended horticultural crop.

1.2. Manual handling and techniques for loading and unloading

To do the horticultural crop work we need to properly prepare the working materials in a working area for this purpose materials should be transported from where they are stored to the working site. In this regarded, the required type and their sufficient number is already decided by the supervisor, hence these materials will be counted and will be loaded on a transporting vehicle and in the working site these materials will be unloaded.

Proper handling of the items or materials during loading and unloading

We already separated faulty materials not to be transported to working area, However while loading and unloading, we should take the necessary care not to break, holing, etc. and not to make any of these materials faulty for the next time work, by properly handling materials. We can prolong the time of service they can give and also minimize the cost of buying new materials

in replacement to faulty once. Therefore the care we should take during loading and unloading includes the following does and undoes.

- Do not throw materials from ground on to the vehicle(Can be any transporting system)
- Do not throw materials from vehicle on to ground
- Hold and place materials one by one rather than making more than one or two
- When placing materials on the vehicle place them in stable position
- Place materials on ground in stable position
- Place similar materials together on the vehicle while loading and on ground when unloading

Taking care of vehicle (may be any transporting system) is mandatory during loading and unloading. As already mentioned in the above topic, if materials will not be loaded properly, it is not only the materials that will be affected but also the vehicle as well. If we through materials from ground on vehicle we could break the glasses of the vehicle, we might hurt the loading surface and lead to fast depreciation of the vehicle. We might also create a problem when unloading materials improperly.

The first principle in loading and unloading materials is hold the material properly in both hands, Keeping balance and safely placing the materials on vehicles or on ground, For these purpose, at least two or more people are necessary one or more on the vehicle and one or more on ground.

1.3. Selecting and Checking Suitable Personal Protective Equipment's (PPE)

Definition

PPE, as defined by the Occupational Safety and Health Administration (OSHA). OSHA is "specialized clothing or equipment worn by an employee for protection against injury by blunt impacts, chemicals, infectious materials etc.

Types of PPE Used

- ***Gloves*** – protect hands
- Overall– protect skin and/or clothing

- Masks and respirators– protect mouth/nose and respiratory tract from airborne infectious agents

- Goggles – protect eyes
- Face shields – protect face, mouth, nose, and eyes
- Ear protectors- protect ear
- Steel capped boots/shoes protect legs

Factors Influencing PPE Selection

When you are selecting PPE, consider three key things

I. **Type of exposure anticipated-such as:-**
   - Splash/spray versus touch
   - Category of isolation precautions

II. **Durability and appropriateness of the PPE for the task:-**

III. **Fit:** - PPE must fit the individual user, and it is up to the employer to ensure that all PPE are available in sizes appropriate for the workforce that must be protected.

Dos and Don'ts of Glove Use

- Work from "clean to dirty"
- Limit opportunities for "touch contamination" - protect you, others, and the environment
- Don't touch your face or adjust PPE with contaminated gloves
- Don't touch environmental surfaces except as necessary

Change gloves

- During use if torn and when heavily soiled (even during use on the same patient)
- After use on each patient

Key Points about PPE

- Do before going to worksite
- Use carefully – don't spread contamination
- Remove and discard carefully, after finishing work
- Immediately perform hand hygiene

Sequence for Removing PPE

- Gloves
- Face shield or goggles
- Gown
- Mask or respirator

Hand Hygiene

- Perform hand hygiene immediately after removing PPE.
- Wash hands with soap and water or use an alcohol-based hand rub

Checking suitability of personal protective equipment

Checking involves many things such as the checking in faultiness of the personal protective equipment, checking the size, and checking the sufficiency in number of the materials for the available work force. If one of these is missing based on the level of the risk that occurs the expected risk could occur. Therefore don't precede a job until the problems with the PPE will be solved. The size of PPE should be fit with your size, if the PPE is faulty it should be maintained or a new one should be provided, and if the number is not sufficient only people with the PPE should work the job.

Providing OHS requirements according to workplace information

Any work in the agricultural or horticultural industries may be dangerous in some way. It is important to know about your workplace's occupational health and safety procedures. As an employee you have a responsibility to:

- Follow your workplace's occupational health and safety procedures
- Follow manufacturers' guidelines for machinery and equipment
- Respond to a situation where someone is put at risk of injury (as long as you do not endanger yourself)
- Report any incidents or situations which cause you or other people injury, or put you or others at risk.

Environmental issues

In agricultural and horticultural workplaces hazards including dust, noise, chemicals, machinery and organisms can affect the health and safety of workers and other people in the surrounding environment. Examples are wind-borne chemical drift, chemicals getting into water supplies and drainage and dust blowing into a neighbor's premises. Horticultural workers should recognize their duty of care to others and ensure that no harm is caused to off-target sites or downstream properties, and those that work there.

Occupational health and safety (OHS) risk

Safety in the horticultural Industry*:* Strategic approaches to reducing farm injury risk are multifaceted and include:

- Identifying elimination and substitution options
- Improving design and engineering solutions
- Administrative or work practice solutions, including education and skills development
- Identification of requirements for personal protective clothing and equipment
- Identification of incentives for adoption of improved systems
- Ensuring compliance with regulatory requirements for supply of safe plant and equipment and safe operation in the farm workplace.

While providing the support there are possible risks that may endanger your health and safety, the dangers could be those which cause physical injury during land preparation, loading, unloading, mounting different plowing implements to tractors, etc.

In agricultural crop work support, there are jobs or activities that might harm your health and safety, hence you need to take care of those hazards by using the appropriate personal protective equipment, and by taking all the necessary care as it has been said "prevention is better than cure"; even sometimes the risk may not be cured letting the person to die. Great care should be taken when transferring chemicals from its main container to spraying equipment's.

1.4. Identifying and Reporting Occupational Health Safety (OHS) Hazards

Definition:

Occupational health and safety (OHS) is concerned with health and safety in its relation to work and the working environment.

Aims of occupational health

Occupational health should aim at:-

- The promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupation.
- The prevention amongst *w*orkers of departures from health caused by their working conditions.
- The protection of workers in their employment from risks resulting from factors adverse to health.
- The placing and maintenance of workers in an occupational environment adapted to his physiological and psychological capabilities.
- To summarize the adaptation of worker to man and of each man to his job.

Hazards associated with horticultural crops production

These may be introduced into fresh fruit and vegetable products at numerous points in the production chain as a result of bad agricultural practices. Hazards associated with production flow that could be harmful to the consumer.

There are four main types of hazards associated with horticultural crop products

- Biological
- Chemical
- Physical
- Ergonomical

- **Biological hazards**

✓ **Micro-organisms,** such as bacteria, viruses, parasites toxic or poisonous plants, or animal materials are often referred to as biological hazards. Some fungi are able to produce toxins and also are included in this group of hazards.

✓ **Micro-organisms** able to cause human disease may be found on raw produce. Sometimes they are part of the fruit or vegetable micro flora as incidental contaminants from the soil, dust and surroundings. In other instances they get introduced onto the produce through poor production and handling practices, such as the use of untreated manure, the use of contaminated irrigation, water, unsanitary handling practices etc.

- Microbiological risk reasons for occurrence

✓ Slurry spread
✓ Pathogens present (or numbers too high)
✓ Contamination from livestock and human sewage
✓ Waste water
✓ Salmonella (pathogenic bacteria)
✓ Poor quality control at harvest
✓ Inadequate pre-harvest container and equipment cleaning
✓ Harmful and domestic animals
✓ Inadequate temperature control during storage
✓ Decaying matter (Poor stock management)
✓ Parasitism
✓ Poor waste management

- **Chemical hazards**
  - ✓ Chemical contaminants in raw fruits and vegetables may be naturally occurring or may be added during agricultural production, post-harvest handling and other unit operations. Harmful chemicals at high levels have been associated with acute toxic responses and with chronic illnesses.

  - ✓ Examples of chemical hazards:

    - Pesticides (insecticides, herbicides, fungicides, rodenticides etc.)
    - Fertilizers
    - Antibiotics
    - Heavy metals
    - Oils and grease

- Chemical hazards risk reasons for occurrence
  - ✓ Residues of non-approved pesticides
  - ✓ Wrong pesticide selection
  - ✓ Incorrect dosage (concentration)
  - ✓ Harvest interval not observed

- ✓ Poor calibration of sprayer
- ✓ Sprayer drift
- ✓ Inadequate cleaning between uses
  - Contamination of produce due to pesticide storage conditions
  - Spillage of pesticides on produce
  - Use of contaminated water to mix spray
  - Oils, grease and fuel contamination
  - Inappropriate use of produce containers to store pesticides, fertilizers or oil
  - Lack of inspection and servicing equipment
  - Heavy metals

- **Physical hazards (foreign bodies)**
  - ✓ Examples of physical hazards include
    - Residual soil and stones found on fruits and vegetable
    - Packaging remaining from harvesting (wood, metal, etc.)
    - Packing materials and storage facilities, e.g. packaging plastics and cardboard
    - Foreign matter collected during harvesting
    - Glass and sharp objects
    - Personal effects: jewels, hair, pens
- Physical hazards risk reasons for occurrence
  - ✓ Soil presence in finished products
  - ✓ Machinery
  - ✓ Dirty packaging materials
  - ✓ Inadequate inspection of field equipment and packing facilities
  - ✓ Inadequate maintenance of containers and machinery
  - ✓ Discarded rubbish, e.g. bottles, cigarette butts
  - ✓ Inadequate cleaning schedule
  - ✓ End product contains: jewelers and pieces of clothing
  - ✓ Staff untrained in personal hygiene
  - ✓ Inappropriate working clothes

- **Ergonomic hazards**

Ergonomic (human engineering) is a way of thinking and planning work so that it is organized to suit the abilities and needs of the people doing it. Despite progress in technology, there is still a lot to be done before machinery and equipment increasing with the wide spread use of various display units and inspection work are designed for use by people. As a result of poor design, for example, people often suffer from lower back pain and injury to muscles and joints, visual problems are increasing with the wide spread use of various display units and inspection work .

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer and encircle on it (2 marks each)

1. The scientific study and cultivation of fruits is called ----------.
   A. Horticulture B. Floriculture C. Olericulture D. Pomology
2. The budding knife is an important hand tool of a gardener, which consists of folding blade and handle with two edges.
   A. True B, False

3. Which one of the following is not true about the principle of loading and unloading materials is----------

   A. Hold the material properly in both hands
   B. Keeping balance
   C. Safely placing the materials on vehicles or on ground
   D. Place different materials together on the vehicle or ground

Test II: Answer the following questions briefly and accordingly

1. What is horticulture (2 marks)
   ---
2. Write the steps to identify all materials used in horticultural crop works and separate faulty once (4 marks)? ----------
   ---
3. What are the three main types of hazards associated with fresh produce (3 marks)?

A. ---------- B. ---------- C. ----------

4. Write the correct Sequence for removing personal protective equipment's (PPE) (2 marks
   ---

Note: **Satisfactory rating -19 marks Unsatisfactory rates- below 19 marks**

You can ask your teacher for the copy of the correct answers

Operation Sheet -1

1.1. Techniques of identification of materials, tools and equipments

A. Materials, tools and equipment's

i. Flip chart (color print pictorial display of PPE)
ii. Personal protective equipment's (PPE)
iii. Water and soap
iv. Note book
v. Pen
vi. Trowel
vii. Spade
viii. Rake
ix. Seed
x. Fertilizer, etc.



Figure. Materials and tools on flip chart

B. Procedures

1. Use a list of materials provided and then classifies the materials according to their purpose during land preparation, cultivation or harvesting, etc.
2. Know the name of the materials listed in your supervisors list
3. Go to horticultural crop store and identify all the materials physically one by one
4. Describe the use or purpose of each material
5. Check wear and tears of each material
6. Separate a materials which doesn't have best match with handle, broken, have hole on containers, not sharp/can be easily broken, or can't function relative to the purpose of the work or any other unspecified reasons.
7. Count the number of faulty, functional or material that can be maintained very easily.
8. Finally report to your supervisor the categories of material based on
    - their purpose,
    - the total number of each category,
    - the number of faulty materials and also
    - if the functional materials are sufficient in number for the intended horticultural crop.

1.2. Techniques for loading and unloading

A. Materials required

- Vehicle or any transporting system
- Personal protective equipment's (PPE)
- Hand cart
- Water and soap.
- Lifter
- Ladder
- Boot
- Goggle
- Hat
- Glove

B. Procedures

1. Go to the store and check that the different agricultural crop work materials are already there the vehicle provided and you are also ready to load materials by

2. Wearing the suitable personal protective equipment's.
3. Then group yourself in pair of two person or more persons.
4. Open the back or the side of the carriage for easy loading if necessary, for loading the materials you should take care of the vehicles glasses or the vehicle could be carriage and a tractor.
5. Let one person or one group be on the vehicle and the other group on ground.
6. Let the group on ground take materials from store and give it for his counterpart on the vehicle, note material should be taken one by one, or if suitable two by two or more if suitable
7. Let the group or person on the vehicle receive the material from the person on the ground and place it on the vehicle. Note the materials should be placed orderly and safely, by note throwing the materials on the vehicle.
8. Finally close the back side of the carriage and move to the site of agricultural crop work or unload the materials
9. Use the same procedure above for unloading

LAP TEST-1	Performance Test

Name……. ID……..

Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 1 hour. The project is expected from each student to do it.

Task-1 Perform identifying and preparing materials tools and equipment's

Task -2 Perform loading and unloading in horticultural crop work practices

LG #6	LO #2- Undertake Horticultural Crop Production Work

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Undertaking horticultural crop work
- Observing and applying workplace policy and procedures
- Maintaining a clean and safe work site

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Undertake horticultural crop work in a safe and environmentally appropriate manner according to workplace guidelines.
- Observe and apply workplace policy and procedures in relation to workplace practices, handling and disposal of materials

- Maintain a clean and safe work site.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the "LAP test"

Information sheet- 2

2.1. Undertaking horticultural crop work

2.1.1. Factors that affect horticultural crop production

Favorable agro climatic conditions

I. Environmental factors

It includes: - **Temperature, Relative humidity, Solar radiation, Wind velocity and direction Evaporation etc.**

- **Solar Radiation**: solar energy is the source of energy for all physical processes taking place in the atmosphere. The intensity, quality, duration and direction of light affects plant growth and development.

  ✓ **Duration of light:** This is a considerable importance for the farmer in selecting a crop variety. The length of the day has greater influences than light intensity.

Plants can be classified as:

- **Short day plant**: which develop and produce flowers normally when the photoperiod is less than a critical maximum (<12 hours of illumination)
- **Long day plants:** which develop and produce flowers normally when the photoperiod is greater than a critical minimum (>12 hours of illumination).
- **Day- neutral plants:** which are found to be unaffected by photoperiod.

E.g. tomato, cotton, etc.

Note: The relative length of day and night not only ***influence flowering*** but also affect the processes like ***initiation of leaves and tillers***.

✓ **Direction of light**: shoots, roots and leaves show different orientation to the direction of light

- **Temperature**: It is the degree of sensible **heat or cold** within the atmosphere. The instrument that measures temperature is called **thermometer.** It depends upon ***latitude, altitude, proximity to the sea, prevailing winds***, etc. it decreases in general from the equator towards the poles. Every plant community has its own ***minimum, optimum and maximum temperatures*** known as their cardinal temperatures. The temperature below the minimum and above the maximum limits is lethal to the crop growth and development.

In general, Influence of temperatures on crop plants are:

✓ seed germination
✓ crop growth and development
✓ pollination
✓ seed setting & ripening

- **Wind:** is the movement of air in a horizontal direction over the surface of the earth.

It affects plant growth and development mechanically and physiologically. For good wind **pollinating plants** bright sunny weather with gentle wind for **good seed set** required.

- **Rain fall:** The amount and distribution of rainfall influences the crops considerably. Crops differ in their requirement of rainfall. Excess rainfall is detrimental to crop growth as it affects soil fertility and productivity

✓ Excess amount of rainfall results in:-

- Flooding water logging
- Soil erosion
- Favors diseases and insect pests

✓ Rainfall analysis helps in taking decisions on:-

- Time of planting
- Time of harvesting
- Irrigation scheduling
- Leveling effect

- **Relative humidity**: It is defined of the ration between the actual quantity of water vapor in a given volume of air and the amount of water vapors could be held by that mass of air at the same temperature and under the same atmospheric pressure. It is expressed in percentage. In general, relative humidity has an influence on:

✓ **Leaf growth:** Under high amount of relative humidity, turgor pressure will occur due to less transpiration. Moderately, ample relative humidity can **favor leaf growth enlargement**.

✓ **Photosynthesis:** When relative humidity is low, transpiration increases **causing H_20 deficient** in the plant which causes partial or full closer of stomata and increase its resistance/blocking the energy of Co_2. Thus, photosynthesis is affected.

✓ **Pollination**: When relative humidity is high **pollen may not be dispersed** from anther. Moderately, ample air humidity is favorable to seed set in many crops–provided soil moisture supply is adequate.

- **Pests:** High relative humidity **favors incidence of insect pests and diseases**.
- **Grain yield:** Very high or low relative humidity is **not conducive for grain yield.**

II. Topography and soil factors

A. Topography

Topographic features or landscape of an area such as degree of slope and soil types has a marked effect on crop growth. Relatively level topography or plain has a distinct advantage in producing field crop by favoring mechanical field equipment. Thus, land selected for producing field crop should be flat or gentle slope.

Land with steep slope will later leads to erosion problem. In the absence of favorable slope, one can use the sloppy land for producing field crops, if and only if, the landscape allows construction of conservation structure to minimize the erosion, that would otherwise, leads to heavy erosion after eliminating the original vegetation of the land. Therefore, it is highly recommended that do not produce field crops on land with a steepness of more than 15% without any effective method controlling soil erosion. Generally topography is associated with land cultivation difficulties, soil erosion, and poor transport networks and facilities. Horticultural crop production can be mechanized, depending on the topography of the land used.

B. Soil factors

Soil factors are another very important condition for producing field crops. Most of the crops perform well on deep, fertile, well drained soils with a moderate PH range.

Soil fertility and plant nutrients

Soil fertility: - the inherent capacity of the soil to supply nutrients to plants in suitable proportion and adequate quantity to produce crops of economic value and to maintain the health of the soil without deterioration.

Soil productivity: - the capacity of the soil to produce crops with a specific management system and is expressed in terms of yields.

Essential plant nutrients

- Plants need 20 elements for their growth and development.
- Macronutrients: - C, O, H, N, P, K, Ca, Mg and S.
- Micronutrients: - Fe, Mn, B, Z, Cu, MO and Cl.

2.1.2. Steps of good horticultural crop work

Horticultural works should be conducted on appropriate instructions and direction.

In agricultural crop work there are a serious of steps that must followed by the workers. The farmers must conduct those steps in order to get a good result. The steps include:

A. Site selection
B. Land preparation
C. Seed sowing /Planting
D. Managing crops
E. Harvesting
F. Grading
G. Packaging
H. Loading-unloading and Transporting
I. Storing

A. Site selection

Site selection is the process of examining multiple options and assessing their relative advantages and disadvantages. Site selection comes after the needs assessment is completed. If you select a site before the need's assessment, you may compromise on key design aspects due to site limitations. Site selection is the single most important factor in horticultural crop production and can make a pronounced difference on how well and abundantly fruit will grow. Planting location can have a significant effect on potential production.

Land availability, land use, public sentiment and other community issues can have dramatic influence on site selection. In any site selection process, local involvement and judgments regarding the relative significance of selection criteria are important.

B. Land preparation

Land preparation is clearing and removal of bushes on the surface of the land, this is performed differently, but the two main practices are, one or two ploughing followed by harrowing, ridging and mulching. The size of the land, costs and machines available dictate the methods to use for land preparation.



Figure 3. Ploughing of lands

i. **Seed sowing**

Seed sowing is defined as placing the seed in soil to germinate and grow into plant, but planting is putting the plant to propagules in soil for growing plants. Propagules are seedlings, roots, tubers, leaves, or cuttings.

ii. Weeding

The act of removing wild plants from a place where they are not wanted

Methods to control your weeds

iii. **Mowing and Cutting**- Mowing and cutting can decelerate the production of seed and can limit the growth of weeds

iv. **Weed Pulling**

v. **Stabbing**

vi. **Mulching**

vii. **Tilling**

viii. Soil Solarisation

ix. Flooding

C. Soil fertility and plant nutrients

- **Soil fertility: -** the inherent capacity of the soil to supply nutrients to plants in suitable proportion and adequate quantity to produce crops of economic value and to maintain the health of the soil without deterioration.
- **Soil productivity: -** the capacity of the soil to produce crops with a specific management system and is expressed in terms of yields.

Essential plant nutrients

- Plants need 20 elements for their growth and development.
- Macronutrients: - C, O, H, N, P, K, Ca, Mg and S.

Micronutrients: - Fe, Mn, B, Z, Cu, MO and Cl. Good agricultural practice(GAP) related to soil fertility improvement include:

- **Maintaining soil organic matter through mulching title**
  - ✓ Higher organic matter in the soil creates porous soil and improves the aerations.
  - ✓ Organic matter improves soil moisture.
  - ✓ Soil organic matter acts as buffer against adverse environmental effects such as higher temperature and drought.

ii. Crop rotation

Definition: Crop rotation is the practice of planting different crops sequentially on the same plot of land to improve soil health, optimize nutrients in the soil, and combat pest and weed pressure.

- Planting crops with different requirements in rotation, such as leguminous and cereals, also intercropping deep-rooted crops with shallow-rooted ones.

iii. Aerate the soil

- Aeration – by double digging, adequate ground cover and mulching provides both soil micro-organisms and plant roots with much needed oxygen to breathe.
  - ✓ Provide drainage- Too much water can cause serious damage to the soil and plants; by applying mulching, adding humus to the soil and ridging can help prevent water logging.

iv. Protect the land from soil erosion and degradation

- ✓ Practices that can help to protect against soil erosion and minimize the loss of topsoil are strongly encouraged such as:
  - ✓ Terracing
  - ✓ Conservation tillage
  - ✓ Planting bunch grasses
  - ✓ Planting tree hedges and shelter belts
  - ✓ Planting perennial crops such as fruit trees with cover crops.

v. Application of organic and inorganic fertilizer

Definition: Fertilizers are generally defined as "any material, organic or inorganic, natural or synthetic, which supplies one or more of the chemical elements required for the plant growth." Most fertilizers that are commonly used in agriculture contain the three basic plant nutrients: nitrogen, phosphorus, and potassium.

Depending on the source of materials, fertilizers can be divided into two categories:

- Organic fertilizer- Application of compost, manure and other organic fertilizer in a recommended amounts, timing and methods are appropriate to agronomic and environmental requirements. Raw materials used for the production of organic fertilizers include:

✓ Animal manure
✓ Post-harvest material
✓ Organic waste

- Inorganic fertilizer: application of nutrients which is manufactured or synthetic fertilizer in a recommended amount, time and methods. These include: UREA, DAP, NPS etc.

D. **Irrigation**

Irrigation is the process of applying water to soil, primarily to meet the water needs of growing plants. Water from rivers, reservoirs, lakes, or aquifers is pumped or flows by gravity through pipes, canals, ditches or even natural streams. Applying water to fields enhances the magnitude, quality and reliability of horticultural crop production.

The main methods of irrigations are

- Surface irrigation- Water flows over the soil by gravity.
- Sprinkler irrigation- applies water to soil by sprinkling or spraying water droplets from fixed or moving systems
- Drip/micro irrigation- applies frequent, small applications by dripping, bubbling or spraying, and usually only wets a portion of the soil surface in the field.

- Sub irrigation- where the water table is raised to or held near the plant root zone using ditches or subsurface drains to supply the water

E. Pest management

Pest management is an important component of crop production. Pests can have a detrimental effect on horticultural operations by affecting the quantity, quality and ultimately, the marketability, of the crops grown. A pest is any animal, insect, weed or disease etc. that attacks a crop. Control methods may include:

- chemical control – using pesticides and insecticides to control pest animals
- Physical control – using mechanical tools, equipment and machinery to capture, exclude or destroy pest animals
- Biological control – using animal-specific diseases to control pest animal populations or protecting livestock with guardian animals.
- Cultural control- methods of pest management include use of resistant varieties, tillage, mulching, hand weeding and hoeing, pruning, trapping and hand picking of insects and weeds, and the use of physical barriers such as row covers and sticky bands.

F. Harvesting

Harvesting is the operation of gathering the useful part or parts of the plant. Harvesting time is the final stage of fruit development and determines the fruit quality. It is important to harvest fruits and vegetables at the proper stage of maturity in order to maintain their storage quality, as well as their nutrient quality and freshn ess for prolonged period of time. Maturity index for fruits and vegetables are described in the following:

- Skin color
- Optical methods (measure the degree of maturity of fruits based on the chlorophyll content of the fruit which is reduced during maturation).
- Shape
- Size
- Aroma
- Leaf changes
- Abscission
- Firmness

2.2. Observing and Applying Workplace Policy and Procedure

Agriculture is one of the risk full occupations for human health and safety. People are always exposed to health risks and injuries because agricultural practices involve tools and equipment's that may cut and create wounds and injure body and harmful chemicals such as pesticides.

- Occupational health and safety is a discipline with a broad scope involving many specialized fields. In its broadest sense, it should aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations.
- The prevention among workers of adverse effects on health caused by their working conditions.
- The protection of workers in their employment from risks resulting from factors adverse to health.
- The placing and maintenance of workers in an occupational environment adapted to physical and mental needs.
- The adaptation of work to humans.

In other words, occupational health and safety encompasses the social, mental and physical well-being of workers that is the "whole person".

2.3. Maintaining a clean and safe work site

Identification of work plays are a central role in people's lives, since most workers spend at least eight hours a day in the workplace, whether it is on a plantation, in an office, factory, etc. Therefore, work environments should be safe and healthy. Yet this is not the case for many workers. Every day workers all over the world are faced with a multitude of health hazards, such as:

- Dusts
- gases
- bad smell
- smoke
- noise
- vibration
- Extreme temperatures.

Work-related accidents or diseases are very costly and can have many serious direct and indirect effects on the lives of workers and their families. For workers some of the direct costs of an injury or illness are:

- The pain and suffering of the injury or illness
- The loss of income
- The possible loss of a job
- Health-care costs.

It has been estimated that the indirect costs of an accident or illness can be four to ten times greater than the direct costs, or even more. An occupational illness or accident can have so many indirect costs to workers that it is often difficult to measure them. One of the most obvious indirect costs is the human suffering caused to workers' families, which cannot be compensated with money.

Self-check 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer and encircle it. (2 marks each)

1. Which one of the following is not true bout maintaining soil organic matter through mulching to undertake horticultural crop work?

A. It creates porous soil
C. It improves the aerations
B. It improves soil moisture
D. It creates compaction of soil

2. Which one of the following is the first step to undertake horticultural crop work/ practices?

A. Site selection
C. Seed sowing /Planting
B. Land preparation
D. Harvesting

Test II: Answer the following questions briefly and accordingly

1. Write the three main raw materials used for the production of organic fertilizers (3 marks)?

A. ----------
B. ----------
C. ----------

2. List at least 4 different practices that can help to protect against soil erosion and minimize the loss of topsoil (4 marks)? ----------
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Note: **Satisfactory rating – 11 marks** **Unsatisfactory rates- below 11 marks**

You can ask your teacher for the copy of the correct answers

Operation *Sheet -2*

2.1.Techniques for undertake horticultural crop work

A. Materials and equipment's

- Flip chart (color print pictorial display of tools and equipment)
- Various materials, tools and equipments for different activities
- Personal protective equipment's (PPE)
- Water and soap
- Note book
- Pen
- Fertilizers and compost
- chemicals

B. Procedures

- Carefully follow the instruction given by your instructor
- Check the site is suitable or not for the horticultural crop production activities.
- Check the presence of materials, tools and equipments in the store and they are ready to work
- Apply less hazardous chemicals and calibrate with the recommended rate amount
- Record your observations (based on the checklist)

LAP TEST-2	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 2 hours. The project is expected from each student to do it.

Task -1. Perform horticultural crop work

` LG #7	**LO #3- Handle materials and equipment**

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Storing waste materials in designated area
- Checking tools, equipment and machinery
- Cleaning and storing materials, equipment and machinery

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Store waste material generated during horticultural work in a designated area
- Check tools, equipment and machinery for wear/damage, and prepared for storage according to workplace policy and procedures
- Clean and store materials, equipment and machinery.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks

5. Perform Operation Sheets
6. Do the "LAP test"

Information sheet- 3

3.1. Storing waste materials in designated area

Definition of terminologies

Handling: is the action of one that handles something or a process by which something is handled in a commercial transaction especially the packaging and shipping of an object or material (as to a consumer)

Disposal: is defined as getting rid of or giving away or a device installed in the drain of a kitchen sink to grind up garbage that is then flushed down the drain.

Materials should be handled in a safe manner and disposed properly after and before work.

It should be:-

- Stored
- Transported and
- Cleaned

Horticultural works create much kind of wastes, among those wastes crop residues and waste pesticides and chemicals take the leading part. Crop residues have good advantage if we properly manage them where as waste pesticides and chemicals have hazardous effect on environment, microorganisms, plants and animals.

Crop residue

Crop residue is defined as the vegetative crop material left on a field after a crop is harvested, pruned or processed. As much as possible farmers are encouraged to work crop residues back into the soil or compost them for use as a soil amendment. Recycling crop residues helps prevent erosion and preserve or improve soil quality.

Hazardous (waste pesticides)

Special waste is waste which has hazardous properties and is subject to additional controls to protect the environment and human health. Examples of special waste include: waste pesticides and chemicals which have hazardous properties; waste oils from farm machinery.

Materials handling in agriculture is concerned with the movement and handling of materials and products in a systematic manner from point of origin to destination. Movement may be in any direction horizontal, vertical or any combination of the two. Handling of agricultural materials and products is important, not only because of the work involved, but also because of its effect on costs, product quality and management. Materials handling costs account for as much as 25 percent or more of the total production cost for certain agricultural crops. These costs can be lowered with efficient materials handling systems in which the components are integrated to provide a smooth flow of materials.

The tools, equipment's, and materials should be returned to store on completion of the work after they have been cleaned and checked. Any dirt (soil, and other) adhering with the tools and equipment's should remove before storage. Similar tools should be stored separately without mixing with other tools which help you to identify easily. During performing work, some tools, equipment's and materials can be broken, detached the handle from the main part, so such damaged tools should be maintained if the problem is simple. The broken tools should be identified and store alone until maintained. When materials are broken highly and not be maintained by other experts, they should be disposed of according to supervisor's instruction.

3.2. Checking tools, equipment and machinery

The tools, equipment's, and materials should be returned to store on completion of the work after they have been cleaned and checked. Any dirt (soil, and other) adhering with the tools and equipment's should remove before storage. Similar tools should be stored separately without mixing with other tools which help you to identify easily. During performing work, some tools, equipment's and materials can be broken, detached the handle from the main part, so such damaged tools should be maintained if the problem is simple. The broken tools should be identified and store alone until maintained. When materials are broken highly and not be maintained by other experts, they should be disposed of according to supervisor's instruction.

3.3. Cleaning and storing materials, equipment and machinery

Cleaning is the removal of dirt and organic substances from surfaces of tools and equipments. A clean and organized work area is essential to any agricultural mechanics project. Knowing where to find tools, supplies and materials will save time and useful in maintaining the proper inventory of tools and materials. A work place area that is cluttered and disorganized will not only be unsafe, but also will hinder the proper maintenance of tools and equipment. A disciplined approach to daily cleaning and organizing will save time and effort in the long run and help ensure that accidents are prevented.

Starting the gardening season off right requires a thorough check of your garden equipment. Ideally it should be cleaned and evaluated after each use but we all know that doesn't always happen. Rust, broken parts and dull blades are an inevitable part of using these helpful implements.

Consistent horticultural tool care is more effective when the equipment is stored in favorable conditions. Garden tools should be stored indoors where possible, in a clean dry environment. They should be stored upright or hanging where air can circulate freely.

You should invest in good waterproof covers for items that must be stored outdoors due to lack of storage, such as lawnmowers. Caring for garden tools can be money and time saving chore when done on a biannual schedule.

Self-check 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer and encircle on it.(4 point)

1. Horticultural works create much kind of wastes, among those wastes crop residues and waste pesticides and chemicals take the leading part. (1 mark)

A. True B. False

Test II: Answer the following questions briefly and accordingly (4 marks)

1. Write the advantages of crop residues regarding to soil fertility, if we manage properly?

Note: **Satisfactory rating - (5 marks each)** **Unsatisfactory rates- below (5 marks each)**

You can ask your teacher for the copy of the correct answers

Operation Sheet -3

3.1 Techniques of storing waste materials in designated area

A. Materials tools, and equipment's

- Flip chart (color print pictorial display of tools and equipment)
- PPE
- Spade
- Wheel barrow
- Shovel
- Water
- Note book
- Pen

B. Procedures

- Select waste material's storage site
- Prepare waste material's storage
- Store waste material's properly
- Record your observations (based on the checklist)
- Report your work

LAP TEST-3	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 1 hour. The project is expected from each student to do it.

Task-3.1 Perform handling materials and equipment

LG #8	**LO #4- Record and document**

Instruction sheet 4

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Reporting problems or difficulties.
- Recording and reporting materials, equipment and machinery condition
- Reporting work activities and outputs

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Report problems or difficulties in completing work to required Standards of the industry.
- Record and report materials, equipment and machinery condition after work.
- Report work activities and outcomes in Standard format.

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Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

Information sheet- 4

4.1. Reporting problems or difficulties

Reporting is informing all information related to the work to a person who concerns about. It helps to the supervisor and other concerned persons to know the standard of the work and at what level the work activities are found and also help to supply solution by concerned people if problems are there.

There are a number of problems occurred during horticultural crop production, of which some of them are as follows:

a. Faultiness of the tools and equipments
b. Lack of materials for maintaining tools and equipments
c. Lack of personal protective closes
d. Unsuitability of personal protective closes
e. Lack of materials, tools and equipments during the work
f. Lack of agricultural inputs,
g. Loss of tools and equipments during the work
h. Damage to the vehicle etc.

The problems occurred during undertaking crop work should be reported to the supervisor so that there will be solution for the coming work cycle.

A. Documenting and recording relevant information

Record-keeping and documentation are important processes that facilitate:

- Continuity of care
- Accountability
- Service improvement
- facilitate communication
- to provide relevant client information
- to conduct evidence-based research

What should be documented?

✓ History and needs of customer.

- ✓ Services provide.
- ✓ fees charged and subsidies received
- ✓ Client outcomes

C. **Best practices for documentation**

To ensure consistency, it is best to bear in mind the following when documenting case notes:

- Concise.
- Relevant information in appropriate detail,
- Accurate.
- Up-to-date.
- Meaningful.
- Internally consistent.

Notes should be structured according to a preset format

4.2. Recording and reporting materials, equipment and machinery condition

Definition of terminologies

Recording is the state or fact of being recorded or something that records: such as, something that recalls or relates past events or an official document that records the acts of a public body or officer and an authentic official copy of a document deposited with a legally designated officer.

Reporting is the presenting of news in newspapers, on radio, and on television, etc. in an honest way and impartial political reporting.

Crop reporting is the description of the crop in the growing stage, mentioning the present condition involving yield status and pest management with comments for improvement.

Documentation is the act or an instance of furnishing or authenticating with documents. It is the use of historical documents or conformity to historical or objective facts.

Workplaces rely on large amounts of information from many different sources to operate effectively. Most of that information is recorded either manually (on paper) or electronically (on

computer). Work schedules, product catalogues, orders and receipts, time sheets and memos are all examples of written information, or records, found in most workplaces.

The Golden Rules for working with recording documents are:

- write clearly and legibly
- do not rush
- fill out documents following appropriate SOPs, policies and procedures
- use the right document for the job
- if in doubt - ASK for advice
- do not guess
- process and file documents in the appropriate manner
- Keep waste paper bins well away from desktops - documents have a habit of falling!
- use paperclips sparingly - papers come apart and extra pages may be picked up by the clip Use staples not pins (ouch!).

4.3. Reporting work activities and outputs

Work activity is the systemic entity of purposeful, cooperative human action, where several actors work in an organized way upon a shared object of work to transform it into an intended outcome, by using different kinds of means of work and means of cooperation and coordination.

A work report is a formal document that discusses information about a specific topic related to an aspect of your job. Most work reports are addressed to a particular audience, such as a manager. Depending on the type of work report, you may be given a report brief that outlines what you should include in your report.

How to write a work report

- Identify your audience.
- Decide which information you will include
- Structure your report.
- Use concise and professional language
- Proofread and edit your report.

Once the hazards are identified it should be recorded. The record should include the type crop work, how the risk occurs, and the likely solution, etc. The table below can serve as a recording format, or you can make a better recording format.

No	Type of crop work activity	The type risk		Possible solutions	
		Man	Environment	Man	Environment

On completion of crop work out comes like productivity, production, strengths of production, weaknesses of production, and problems of production should be reported to you supervisor according to instructions and formats given from the supervisor. The work outcomes can vary depending on objective; it can be fruit, seeds, leafy parts, stem parts, flowers, lawns, etc. Reporting work out come helps you to get feedback by your supervisor so that you can leave your weakness and encourage your strength. It also helps the supervisor to get full information about the production. The reporting format may vary but it can be as follows:

No	Work outcomes	Productivity (kg/hectare)	Production (kg/hectare)	Problems	Expectations

Self-check 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer and encircle on it (2 marks each)

1. Reporting work out come helps you to get feedback by your supervisor so that you Can leave your weakness and encourage your strength.
   A. True B. False
2. The removal of dirt and organic substances from surfaces of tools and equipment's is refers to ----------.
   A. Waste materials C. Composting
   B. Cleaning D. Mulching

Test II: Answer the following questions briefly and accordingly (2 marks each)

1. Tools and equipment should be stored and disposed according to:
   i. ----------
   ii. ----------
   iii. ----------

Note: **Satisfactory rating - (10 marks each)** **Unsatisfactory rates- below (10 marks each)**

You can ask your teacher for the copy of the correct answers

Operation Sheet -4

4.1. **Methods of recording and reporting work activities and out puts**

A. Materials, tools, and equipment's

- Flip chart
- Marker
- Ruler
- Note book
- pen

B. Procedures

- Observe the work activities carefully
- Record the problems or difficulties
- Record and report materials, equipments and machinery according to their functionality
- Report work activities and outputs

LAP TEST-4	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 1 hour. The project is expected from each student to do it.

Task-4.1 Perform recording and documenting the work activities

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