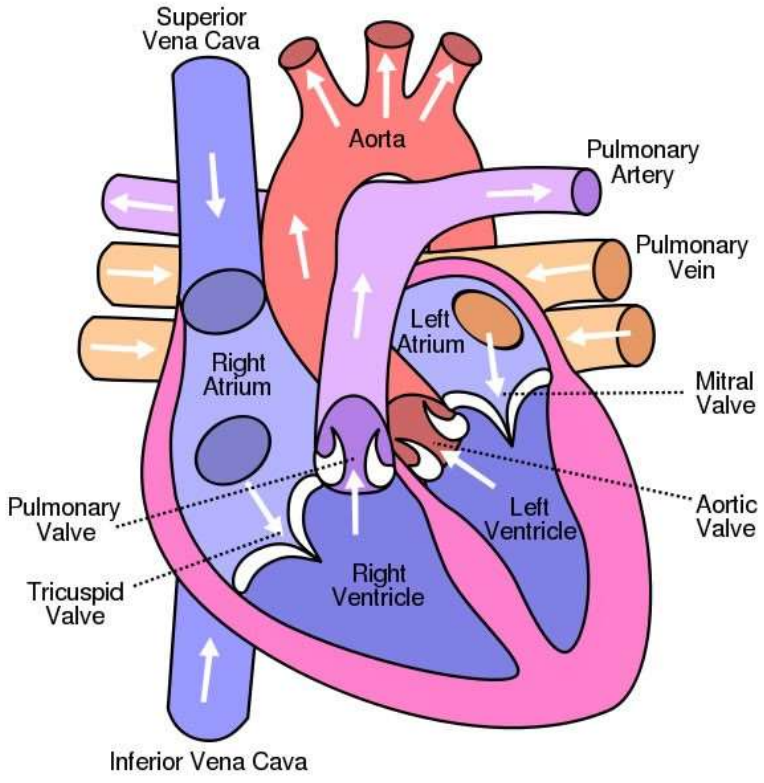
ASBAT
Education Consult

Revised Lesson Notes

Science - P.7



FULL YEAR

CONTENTS

TERM 1

P7

SCIENCE NOTES

TOPIC ONE: MUSCULOSKELETAL SYSTEM

MUSCULOSKELETAL SYSTEM

- This is the body system made up of bones, muscles, tendons, cartilages and ligaments

Elements of the musculoskeletal system

- Bones
- Muscles
- Tendons
- Cartilages
- Ligaments

SKELETON

- This is the structure that supports the body of an organism
- This is the supportive structure of an organism

TYPES OF SKELETONS

- Endoskeleton
- Exoskeleton
- Hydrostatic skeleton

ENDOSKELETON

- This is a type of skeleton found inside the body of an organism

✓ It is made up of **bones** and **cartilage**

✓ It is common in all **vertebrates**

Name any three body parts mainly made up of cartilage

- Trachea (wind pipe)
- Nose
- Outer ear (pinna)

Examples of organisms with endoskeleton

- Human Being
- Goat
- Monkey
- Duck
- Frog
- Toad
- Tilapia
- Turtle
- Tortoise
- Chameleon

EXOSKELETON

- This is a type of skeleton found outside the body of an organism

✓ It is made up of a hard covering called **cuticle**

✓ The hard cuticle consists of **calcium** and **phosphorous**

✓ It is common in all **arthropods**

Examples of organisms with exoskeleton

- housefly
- mosquito
- cricket
- spider
- tick
- crab
- lobster
- prawn
- millipede
- centipede

Write down two functions of exoskeleton to an organism

- It supports the body of an organism
- It protects the soft parts of an organism

Mention one disadvantage of an exoskeleton to an organism.

- It prevents increase in size (it prevents growth)

How do organisms with exoskeleton grow (increase in size)?

- By moulting (ecdysis)

What is moulting?

- This is the shedding of the outer skin in some animals
- This is the shedding of cuticle (exoskeleton) in arthropods

Why do insects undergo moulting?

- To increase in size (to grow)

HYDROSTATIC SKELETON

- This is a type of skeleton where the body of an organism is filled with a fluid under pressure

✓ The fluid enables an organism to move and have shape.

Examples of organisms with hydrostatic skeleton

- Earthworm
- Tapeworm
- slug
- snail
- squid
- octopus
- tapeworm
- sea urchin
- star fish
- jelly fish

FUNCTIONS OF THE SKELETON TO AN ORGANISM

- It gives the body shape
- It supports the body
- It helps in body movement (locomotion)
- It protects delicate internal organs
- It provides surface for muscle attachment
- It produces blood cells in the bone marrow
- It stores and releases mineral salts and fats

How does the circulatory system benefit from the skeleton?

- The ribs protect the heart
- The bone marrow help in making blood cells

A TABLE SHOWING PARTS OF SKELETON AND THE BODY ORGANS PROTECTED

PART OF SKELETON	ORGAN(S) PROTECTED
Skull (cranium)	▪ Brain ▪ Eyes ▪ Tongue ▪ Ears ▪ Nose
Ribcage	▪ Heart ▪ Lungs
Pelvis	▪ Kidneys ▪ Female reproductive organs
Backbone (spine or vertebral column)	▪ Spinal cord

HUMAN SKELETON

- This is a frame work of bones in the human body

✓ The skeleton of an adult human is made up of **206 bones**

✓ A new born baby has **300 bones**

Why do new born babies have more bones than adults?

- Some bones fuse together as a person grows

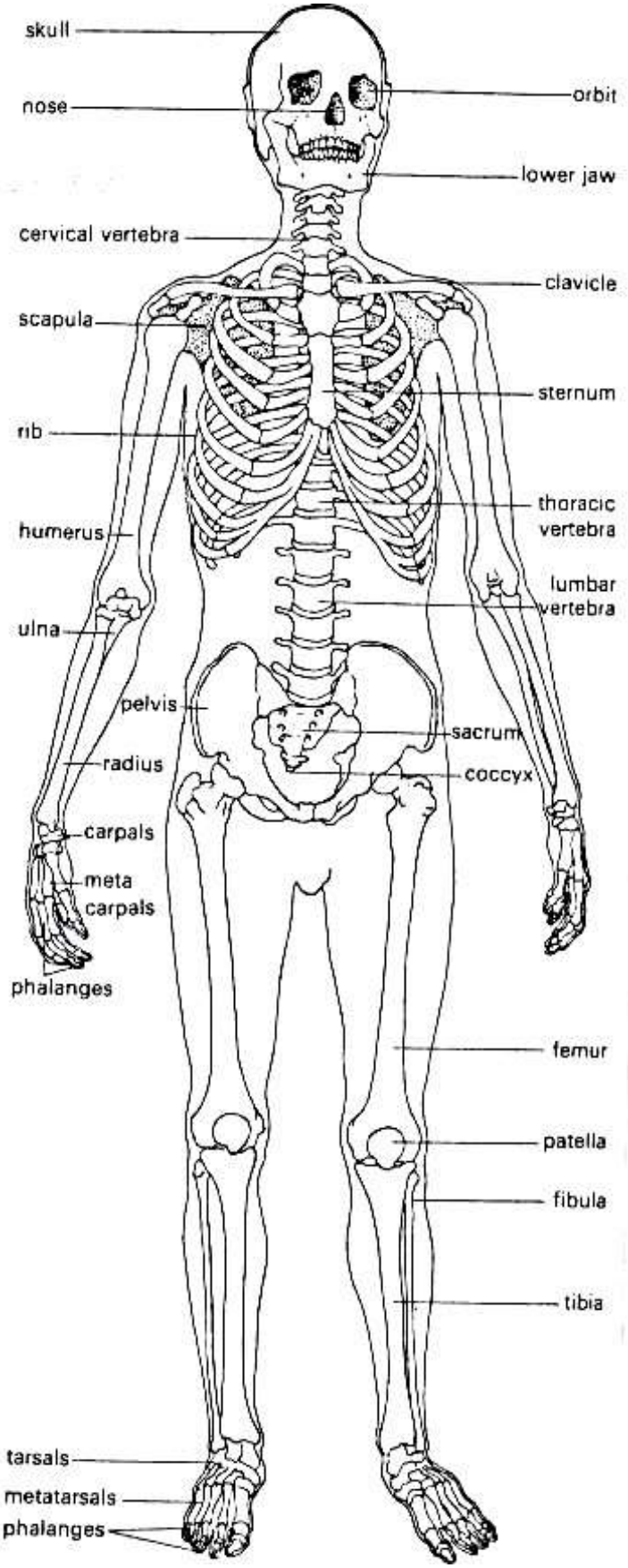
Why is the human skeleton called frame work of bones?

- It is made up of many bones but all working together

Name the four main parts of the human skeleton.

- Skull
- Backbone
- Limbs
- Limb girdles

THE STRUCTURE OF THE HUMAN SKELETON



REGIONS OF THE HUMAN SKELETON

- Axial skeleton
- Appendicular skeleton

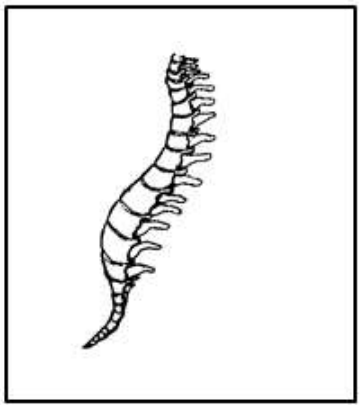
AXIAL SKELETON

- It consists of the **skull** and **backbone**
- It provides attachment for the ribs

Backbone

- It is also called **spine/vertebral column**
- It protects the spinal cord
- It has 33 bones
- Bones of the backbone are called **vertebrae**

A diagram showing a backbone



Name the five regions of the backbone

- **Cervical region:** It is found in the neck and has **7** vertebrae
- **Thoracic region:** It is found in the chest and has **12** vertebrae
- **Lumbar region:** It is found in the abdomen and has **5** vertebrae
- **Sacral region:** It is found in the pelvic girdle and has **5** vertebrae
- **Coccyx region:** It is found in the tail and has **4** vertebrae

SKULL

- It protects the brain, eyes, tongue, ears and nose
- It has 22 bones
- It is made up of the cranium and mandible and maxilla
- The brain is enclosed in the part of skull called cranium

APPENDICULAR SKELETON

- It consists of limbs and limb girdles
- Limbs include; legs and arms
- Limb girdles include; pelvis (pelvic girdle) and pectoral girdle (shoulder girdle)

BONES

- This is the hardest tissue in the body of vertebrates

✓ The **femur** is the longest bone and the **stapes (stirrup)** in the ear is the shortest

By what process are bones formed?

- Ossification

Name the class of food required for proper growth and formation of bones

- Mineral salts

Name two mineral salts that make bones strong.

- Calcium
- Phosphorus

Identify the vitamin that helps in strong bone formation.

- Vitamin D

How does Vitamin D help in formation of strong bones?

- It increases absorption of calcium into the bones

TYPES/CLASSES/GROUPS OF BONES

✓ Bones are classified according **to their shape**

- Long bones
- Short bones
- Flat bones
- Irregular bones
- Sesamoid bones

LONG BONES

- These are found in limbs (arms and legs)

Examples of long bones

Long bones	Body parts where they are found
Humerus Radius Ulna	Arms
Femur Fibula Tibia	Legs

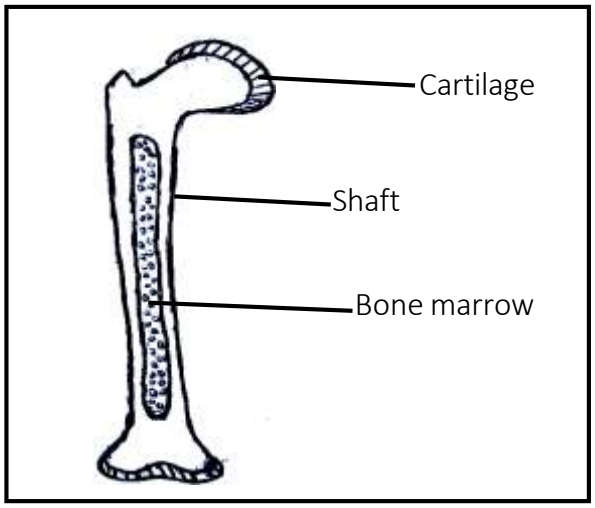
Name the longest and strongest bone in the human body.

- Femur

Importance of long bones in the human body

- They help in body movement
- They support body weight

A diagram showing parts of a bone



Importance of each part of a bone

Shaft

- It stores the bone marrow

Bone marrow

- It is where blood cells are made
- It stores fats

Cartilage

- It reduces friction at a joint
- It absorbs shock

SHORT BONES

- They are cube shaped
- These are found in the hands, feet, wrists, ankles and ear.

Examples of short bones

Short bones	Body parts where they are found
Carpals	Wrists
Metacarpals	Hands
Tarsals	Ankles
Metatarsals	Feet
Phalanges	Fingers and toes
Ossicles (hammer, anvil and stapes)	Ear (Middle ear)

Name the shortest bone in the human body

- Stapes (stirrup)

Importance of short bones in the human body

- They provide support and stability with little movement
- They absorb shock

FLAT BONES

- These are thin bones with broad surfaces

Examples of flat bones

- Scapula (shoulder blade)
- Sternum (breastbone)
- Bones of the skull (cranial bones)
- Pelvis
- Ribs

Importance of flat bones in the human body

- They provide places for muscle attachment
- They protect the internal organs

IRREGULAR BONES

- These are bones with complex shapes

Examples of irregular bones

- Vertebrae (bones of the backbone)
- Jawbones (maxilla and mandible)
- Sacrum
- Coccyx

Importance of irregular bones in the human body

- They protect the internal organs
- They give the body shape

SESAMOID BONES

- These are small round bones embedded in tendons

Example of sesamoid bone

- Patella (knee cap)

Importance of sesamoid bones in the human body

- The patella allows smooth movement of a knee
- The patella protects the knee joint (protects the tendon and ligament at the knee joint)

BONES AND THEIR SCIENTIFIC NAMES

Bone	**Scientific name**
Thigh bone	Femur
Upper arm bone	Humerus
Shoulder blade	Scapula
Backbone	Spine/vertebral column/spinal column
Kneecap	Patella
Hipbone	Pelvis
Breastbone	Sternum
Skull	Cranium
Collarbone	Clavicle
Lower arm (little finger/pinkie)	Ulna
Lower arm (thumb)	Radius
Lower jawbone	Mandible
Upper jawbone	Maxilla
Wrist bone	Carpal
Ankle bone	Tarsal
Palm of hand	Metacarpals
Sole (arch) of foot	Metatarsals
Bones at the tip of toes and fingers	Phalanges

BONE MARROW

- This is a soft tissue found in the boneTypes of bone marrow
- Red bone marrow
- Yellow bone marrow

Red bone marrow

- It is found in short bones
- It is where red blood cells, white blood cells and platelets are made

Besides red bone marrow, where else are white blood cells made?

- Spleen
- Lymph nodes

Yellow bone marrow

- It is found in shaft of long bones
- It stores fats

FUNCTIONS OF BONE MARROW

- It is where red blood cells, white blood cells and platelets are made
- It stores fats

JOINTS

- A joint is where two or more bones meet in the body

State the importance of joints.

- They allow body movement

Mention the two main categories/groups of joints

- Immovable joints
- Movable joint

IMMOVABLE JOINTS

These are joints which do not allow any movement

- Immovable joints are sometimes called **fixed joints**

Give a reason why immovable joints do not allow any movement

- The bones are tightly fixed together

Example of immovable (fixed) joint in the human body

- Suture joints (joints of the skull/cranial joints)
- Gomphosis (joint between the tooth and jaw bone)

Name one part of the human body where immovable joints are found

- Skull

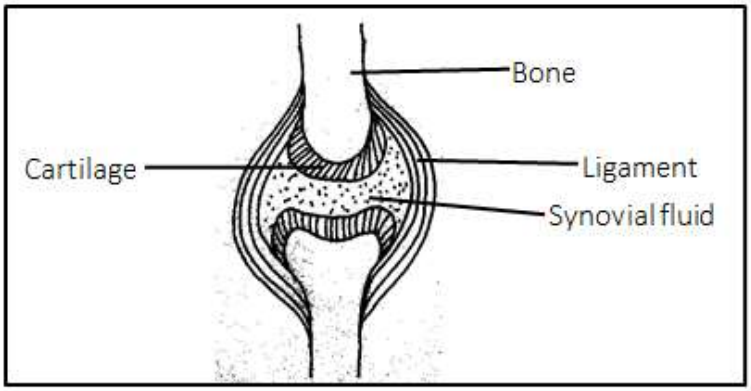
MOVABLE JOINTS

- These are joints which allow movement

Examples of movable joints

- Hinge joint
- Ball and socket joint
- Pivot joints
- Gliding joints

A DIAGRAM SHOWING A JOINT (MOVABLE JOINT)



FUNCTIONS OF EACH PART OF AMOVABLE JOINT

SYNOVIAL MEMBRANE (SYNOVIUM)

- It produces the synovial fluid

SYNOVIAL FLUID

- It reduces friction at a joint

How does the synovial fluid reduce friction at a joint?

- By making the joints slippery (by lubricating the joint)

CARTILAGE

✓ This is a thick non-vascular tissue found at the end of joints

- It reduces friction at a joint
- It absorbs shock at a joint

How does a cartilage reduce friction at a joint?

- By preventing bones from rubbing each other

How is a cartilage able to reduce friction at a joint?

- It is smooth and slippery

LIGAMENT

- This is a structure (tissue) which joins bone to a bone

Function of a ligament

- It joins a bone to a bone

TENDON

- This is a structure (tissue) which joins a muscle to a bone

Function of a tendon

- It joins a muscle to a bone

TYPES OF JOINTS

- Hinge joint
- Pivot joints
- Suture joints
- Ball and socket joint
- Gliding joints

HINGE JOINTS

- These are joints that allow movement in one direction (plane)

✓ They allow movement in 180^0

Why hinge joints are called so?

- They allow movement similar to that of a door on its hinges

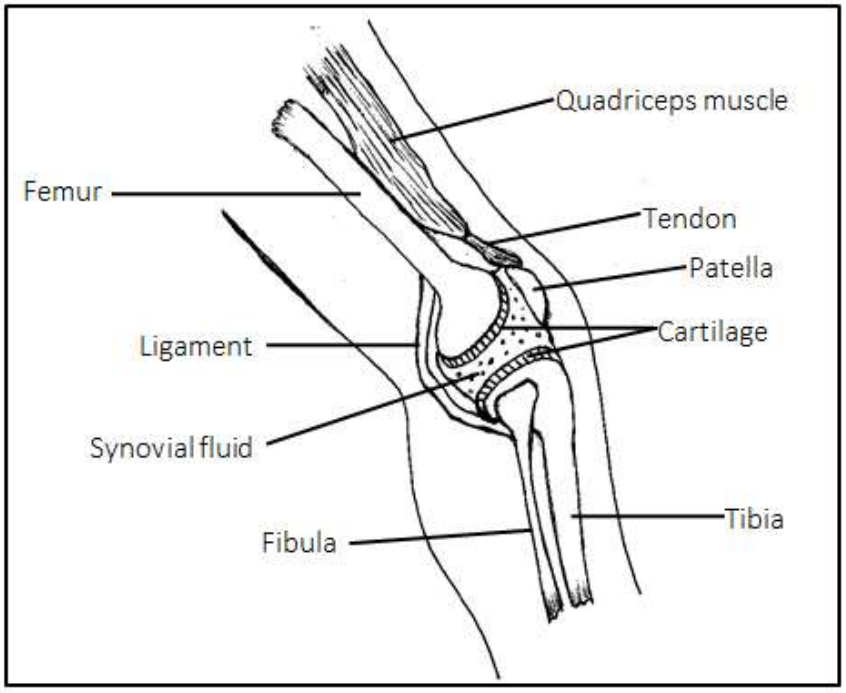
Examples of hinge joints

- Elbow joint
- Knee joint

Parts of the body with hinge joints

- Elbow
- Knee

A DIAGRAM SHOWING A HINGE JOINT



Importance of the knee cap (patella)

- It protects the knee joint
- It allows smooth movement of the knee joint

BALL AND SOCKET JOINTS

These are joints which allow movement in all directions

- These are joints which allow movement in 360^0

Why ball and socket joints are called so?

- The ball shaped end of a bone fits into a socket shaped end of another bone.

Mention four forms of movement allowed by ball and socket joint

- Forward
- Backward
- Circular form
- Side ways

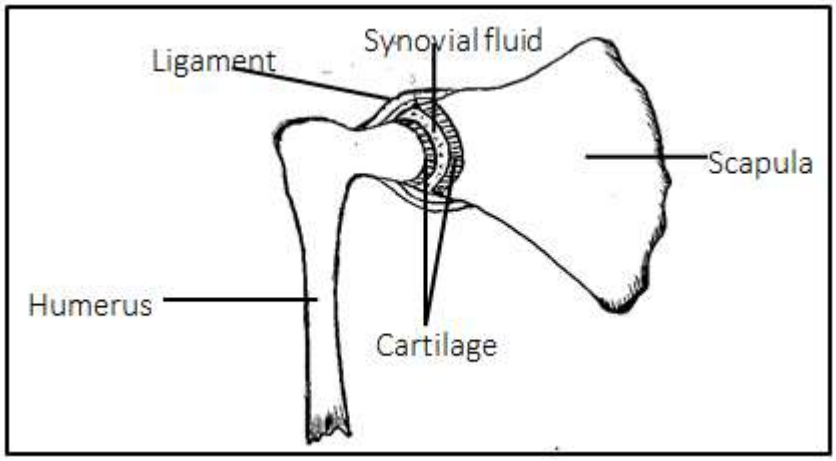
Examples of ball and socket joints

- Shoulder joint
- Hip joint/pelvis joint

Parts of the body with gliding joints

- Shoulder
- Hip/pelvis

A diagram showing a ball and socket joint



GLIDING JOINTS

- These are joints formed by bones that move smoothly over the surface of each other
- They are sometimes called plane joints

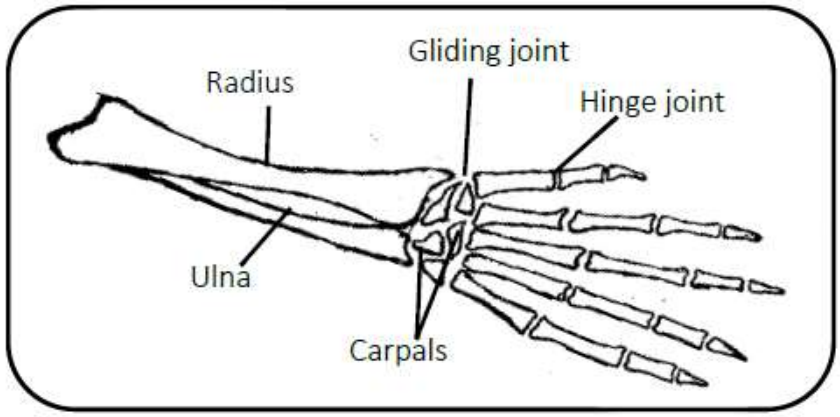
Examples of gliding joints

- Wrist joint
- Ankle joint

Parts of the body with gliding joints

- Wrist
- Ankle

A diagram showing a gliding joint



PIVOT JOINTS

- These are joints which allow rotation of certain body parts on other parts

Example of pivot joint

- Neck joint

Part of the body with pivot joints

- Neck

Bones that make up the pivot joint at the neck

- Atlas
- Axis

How are pivot joints useful to people?

- They help us to nod our heads (help us to move our heads up and down)

SUTURE JOINTS

- These are joints between the bones of the skull

Why are suture joints called immovable joints?

- They do not allow any movement

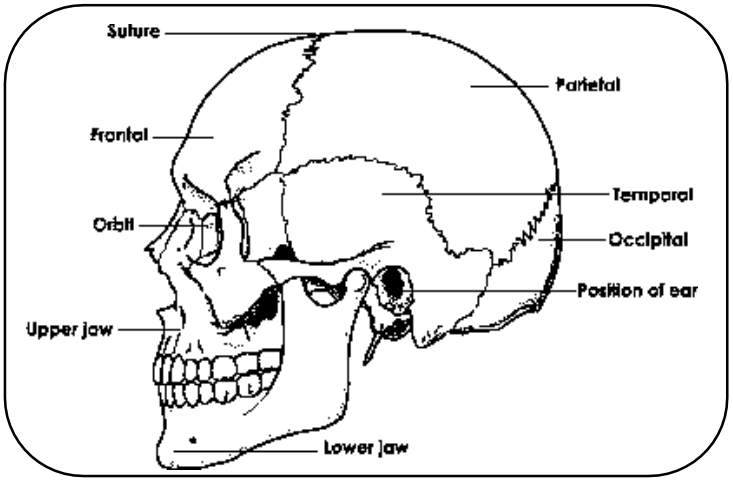
In which part of the body are suture joints found?

- Skull

Why are suture joints saw-like?

- To prevent any movement

A DIAGRAM SHOWING SUTURE JOINTS



Bones that make up suture joints (examples of cranial bones)

- Frontal bone
- Parietal bone
- Temporal bone
- Occipital bone

Where in the skull are eyes found?

- In the eye sockets (orbits)

CONDITIONS THAT MAY MAKE JOINTS FAIL TO FUNCTION PROPERLY

- Dislocation
- Sprain
- Fracture
- Strain

Name the disease that causes stiffness and swelling of the joint.

- Arthritis (Lyme disease)

MUSCULAR SYSTEM

- This is the body system made up of muscles

MUSCLE

- This is an elastic tissue in the body of animals

How do muscles work?

- By contracting and relaxing

TYPES OF MUSCLES

- Voluntary muscles (skeletal muscles)
- Cardiac muscles
- Involuntary muscles (smooth muscles)

VOLUNTARY/SKELETAL MUSCLES

- These are muscles whose movement is controlled by one's will (brain)

Why are voluntary muscles also called skeletal muscles?

- They are attached to the bones (skeleton)

FUNCTIONS OF SKELETAL (VOLUNTARY) MUSCLES

- They help in body movement
- They help to maintain body posture

EXAMPLES OF VOLUNTARY/SKELETAL MUSCLES

- Biceps (muscle of forearm)
- Triceps (muscle of forearm)
- Quadriceps (muscle of thigh)
- Hamstrings (muscle of thigh)
- Abdominal muscle (muscle of abdomen)
- Deltoids (muscles of shoulders)
- Pectoral muscles (muscles of chest)
- Gluteal muscles (muscles of buttocks)

Name the muscle that connects the scapula to the radius

- Biceps

Name the muscle that connects scapula, the humerus and ulna

- Triceps

INVOLUNTARY/SMOOTH MUSCLES

- These are muscles whose movement is not controlled by one's will (brain)
- ✓ Their movement is automatic
- ✓ We have little or no control over them.
- ✓ They are also called **visceral muscles**

Why are involuntary muscles also called smooth muscles?

- They have a smooth uniform appearance when seen under microscope

Functions of smooth (involuntary) muscles

- They aid movement of substances in body organs
- They protect the digestive, respiratory and circulatory organs

Examples of the involuntary/smooth muscles

- Muscles of the alimentary canal (gut)
- Muscles of the reproductive system
- Muscles of the blood vessels
- Muscles of the excretory system
- Ciliary muscles of the eye
- Sphincter muscles of the urinary system

CARDIAC MUSCLES

- These are muscles whose movement is made by muscles themselves
- ✓ They are the special muscles of the heart
- ✓ They do not receive impulses from the nervous system
- ✓ They only stop working when the person is dead

Why are cardiac muscles also called myogenic muscles?

- Their movement is made by the muscles themselves

What special name is given to the muscles of the heart?

- Cardiac muscles

FUNCTION OF CARDIAC MUSCLES

- They enable the heart to pump blood

Example of cardiac muscles

- Muscles of the heart

Name the blood vessel that supplies heart muscles with food nutrients and oxygen.

- Coronary artery

ANTAGONISTIC MUSCLES

- These are muscles that work in pairs and oppose the action of each other
- This is a pair of muscles that oppose the action of each other

Examples of antagonistic muscles

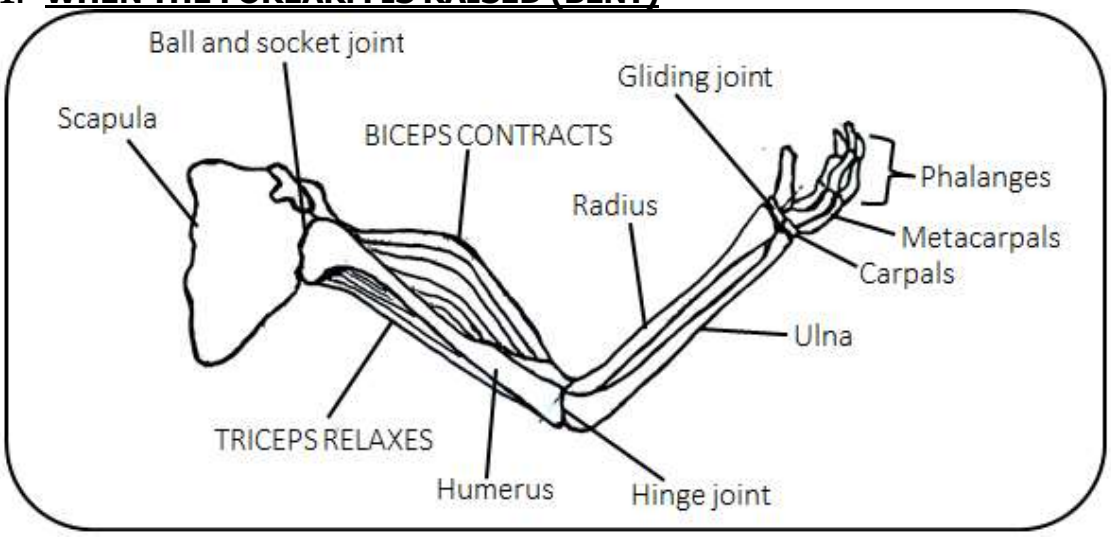
- Biceps and triceps muscles
- Quadriceps and hamstrings

Why biceps and triceps are called antagonistic muscles

- They work in pairs and oppose the action of each other
- They oppose the action of each other

A DIAGRAM SHOWING THE ANTAGONISTIC MUSCLES OF THE FOREARM

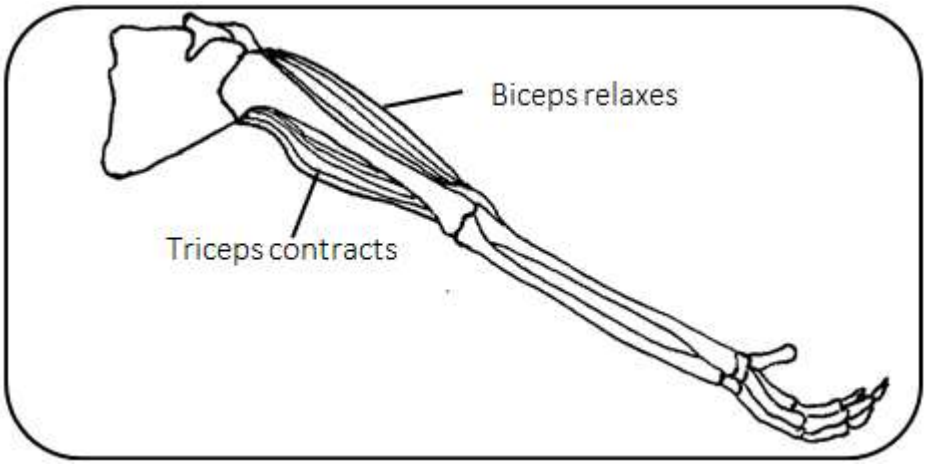
1. **WHEN THE FOREARM IS RAISED (BENT)**



What happens to biceps and triceps when the forearm is raised (bent)?

- The biceps contracts
- The triceps relaxes

2. **WHEN THE FOREARM IS STRAIGHT**



What happens to biceps and triceps when the forearm is straight (lowered)?

- The biceps relaxes
- The triceps contracts

FLEXOR MUSCLE

- This is a muscle which contracts to bend the limb (arm)

Why is biceps called a flexor muscle?

- It contracts to bend the arm

EXTENSOR MUSCLE

- This is a muscle that contracts to straighten the limb (arm)

Why is triceps called an extensor muscle?

- It contracts to straighten the arm

FUNCTION OF MUSCLES

- They help in body movement
- They help to join bones in the body
- They enable us to do heavy duties
- They protect some internal organs
- They help in tissue respiration to produce energy

DISEASES OF THE SKELETAL AND MUSCULAR SYSTEM

Diseases of the skeletal system

- Poliomyelitis
- Rickets
- Tuberculosis/Spinal tuberculosis
- Cancer of bones
- Leprosy
- Osteomyelitis

Diseases of muscular system

- Tetanus
- Leprosy
- Poliomyelitis

POLIOMYELITIS (POLIO)

- It is an immunizable waterborne disease
- It is caused by a virus

Name the germ (virus) that causes polio

- Poliovirus

Which vector spreads poliomyelitis?

- Cockroach

How does poliomyelitis spread?

- Through drinking contaminated water
- Through eating contaminated food

Sign of poliomyelitis

- Paralysis of the limb
- Stiffness of the back
- Stiffness of the neck

Symptoms of poliomyelitis

- Muscle weakness
- Vomiting
- Neck pain
- Headache
- Fever
- Back pain

Effect of poliomyelitis to an individual

- It leads to lameness

Ways of preventing and controlling poliomyelitis

- Immunization using polio vaccines (IPV & OPV)
- Drinking boiled water
- Proper use of latrines (proper disposal of human wastes)
- Wash hands with clean water and soap before eating food

TUBERCULOSIS

- It is an immunizable airborne disease
- If it is not detected and treated early, it can spread from the lungs to the bones and spine
- It is caused by a bacterium

Name the germ (bacterium) that causes tuberculosis

- Mycobacterium tuberculosis

Which part of the human skeleton is mainly affected by spinal tuberculosis?

- Backbone (spine)

How does tuberculosis spread?

- Through inhaling contaminated air
- Through drinking contaminated milk from tubercular cows

Name the respiratory organ mainly affected by Tuberculosis

- Lungs

Signs of tuberculosis of bones/spinal tuberculosis

- Hunchback (humpback)
- Cold abscess
- Paralysis of the legs

Symptoms of tuberculosis of bones/spinal tuberculosis

- Backache
- Pain in the spine while walking
- Pain at joints

Ways of preventing and controlling tuberculosis

- Immunization using BCG vaccine
- Drink boiled or pasteurized milk
- Isolate and treat the infected persons

RICKETS

- It is a deficiency disease that affects bones

What causes rickets?

- Lack of Vitamin D in the diet

Besides vitamin D deficiency, give other cause rickets?

- Lack of Calcium and phosphorus in the diet

Signs of rickets

- Bow-legs or knock-knee legs
- Poor teeth formation
- Common fractures

Symptom of rickets

- Weak bones of the legs

Way of preventing and controlling rickets

- Feeding on food rich in vitamin D, calcium and phosphorus
- Sunbathing during morning

LEPROSY

- It attacks both muscles and bones
- It is caused by a bacterium

Name the germ (bacterium) that causes leprosy

- Mycobacterium leprae

Which vector spreads leprosy?

- Cockroach

Name the human body organ mainly affected by untreated leprosy.

- Skin

How does leprosy spread?

- Through direct body contact with an infected person

Effects of leprosy

- Loss of fingers and toes
- Loss of fingernails and toenails
- Wasting of muscles

Ways of preventing and controlling leprosy

- Isolate and treat the infected person
- Avoid sharing towels, basins, clothes and beddings with an infected person
- Treat early cases with antibiotics

OSTEOMYELITIS

- It is a bacterial disease
- It causes inflammation of the bone and bone marrow

TETANUS

- It mainly affects muscles
- It is caused by a bacterium found in the soil

Name the germ (bacterium) that causes tetanus

- Clostridium tetani

How does tetanus bacterium enter the human body (how does tetanus spread)?

- Through fresh cuts and dirty wounds
- Through cutting the umbilical cord with dirty instrument

Signs of tetanus

- Stiff muscles
- The baby refuses suckling the mother's breasts
- Spasms when touched

Symptom of tetanus

- Difficulty in breathing

Why tetanus is called LOCK JAW disease?

- It makes the jaws of a baby stiff

Ways of preventing and controlling of tetanus

- Immunization with DPT vaccine or TT vaccine
- Early treatment of the infected person
- Always keep cuts and wounds clean

DISORDERS OF THE SKELETAL AND MUSCULAR SYSTEM

Disorders of skeletal system

- Fracture
- Dislocation

- Deformation of bones
- Backache

Disorders of muscular system

- Strain
- Sprain
- Muscle cramp
- Hernia
- Prolapse

Dislocation

- This is the displacement of a bone from a joint

Sprain

- This is an injury on a ligament (this is a stretched ligament)

Strain

- This is an injury on a muscle or tendon (this is a stretched muscle)

Signs of strains, sprains and dislocation

- Swelling of the injured part
- Difficulty in moving the injured part

Symptom of strains, sprains and dislocation

- Pain at the injured part

First aid for sprains and strains

- Rest the injured part
- Apply ice pack on the injured part
- Wrap a clean bandage around the injured part
- Elevate the injured part

First aid for dislocation

- Rest the injured part
- Apply ice pack on the injured part
- Provide a crutch to let the casualty walk
- Use a stretcher to carry the casualty who cannot walk

Hernia

- This is when muscles move from their position and are constricted within a narrow opening

Prolapse

- This is when muscles are weakened and unable to support tissues

Deformation of bones

- This is the growth of bent bones

FRACTURE

- This is a broken or cracked bone in the body

Causes of fractures

- Falls
- Heavy blows
- Unnecessary jumping
- Car knocks
- Fighting

What disorder of the skeletal system occurs due to excessive stress on bones?

- Fracture

General signs of fractures

- A snap of the bone is felt
- Swelling of the fractured part
- Difficulty in moving the fractured limb

Symptom of fractures

- Pain on the fractured part

TYPES OF FRACTURES

- Compound fracture (open fracture)
- Simple fracture (closed fracture)
- Comminuted fracture
- Greenstick fracture
- Depressed fracture
- Complicated fracture

COMPOUND FRACTURE

- This is the type of fracture where a broken bone breaks and comes out of the skin (flesh)

Signs of compound fracture

- The broken bone is seen outside the skin
- Bleeding on fractured part

SIMPLE FRACTURE

- This is the type of fracture where a bone breaks and remains inside the skin (flesh)

Signs of simple fracture

- The broken bone may be seen near the skin
- Swelling of the fractured part
- Bruise at the injured part

Symptom of simple fracture

- Pain on the fractured part

GREENSTICK FRACTURE

- This is the type of fracture where a bone is bent but broken on one side
- It is common in babies

Why is green stick fracture common in babies (young children)?

- They have weak bones

COMMINUTED FRACTURE

- This is when a bone breaks into many pieces
- A broken bone is crushed

DEPRESSED FRACTURE

- This is when a bone of the skull is pushed inside

COMPLICATED FRACTURE

- This is the type of fracture where a bone breaks and damages an internal body organ e.g lungs, heart or intestines
- It can occur when a rib is broken

FIRST AID FOR FRACTURES

- Tie splints around the fractured part To keep the broken bone in one position
- Use arm sling to hold the broken arm in one position
- Use a stretcher to carry a casualty who cannot walk
- Provide a crutch (walking stick) to help the casualty in walking (for stability when walking)

Why are antibiotics applied on a compound fracture?

- To prevent bacterial infections

Why is it dangerous for the first aider to attempt putting broken/displaced bone in its position?

- It can lead to further injuries

EQUIPMENT USED TO GIVE FIRST AID TO FRACTURES

- Arm sling
- Stretcher
- Crutches/walking stick
- Wheelchair

Splints

- To keep the broken bone in one position

Stretcher

- It is used to carry a casualty who cannot walk

Why is a stretcher not kept in a first aid box?

- It is too big to fit in a first aid box

Crutch/walking stick

- It helps a casualty with a broken leg to walk

How do crutches help a casualty with a broken leg in walking?

- By reducing the body weight put on the broken leg

Arm sling

- To keep the broken arm in one position

POSTURE

- This is the position of the body in everything we do

OR

- This is the way of positioning the body when an action takes place

Importance of good posture

- It prevents deformation of bones (helps in proper bone formation)
- It prevents back and chest pain
- It prevents dislocation
- It helps the body organs to function properly

Dangers of bad posture

- It leads to deformation of bones
- It leads to back and chest pain
- It leads to dislocation
- It leads to abdominal pain and indigestion

WAYS OF MAINTAINING (KEEPING) MUSCULOSKELETAL SYSTEM HEALTHY

- Performing regular physical exercises
- Feeding on food rich in calcium, phosphorus and vitamin D
- Maintaining good posture
- Immunizing children against tetanus, polio and tuberculosis
- Avoid unnecessary climbing of trees

IMPORTANCE OF PERFORMING PHYSICAL EXERCISES

- It makes the joints flexible
- It reduces the risk of heart attack
- It makes the heart muscles grow stronger
- It breaks fatigue (body weakness)
- It makes food digestion easy
- It reduces the risks of sprains and strains
- It helps the heart to pump more blood to the muscles

THEME: MATTER AND ENERGY

MATTER

- This is anything that occupies space and has weight.

Properties of matter.

- Matter occupies space
- Matter has weight
- Matter is made up of molecules

Name any four states of matter

- Solid state (solid)
- Liquid state (liquid)
- Gaseous state (gas)
- Plasma

Plasma consists of partially ionized gas and electrons (e.g. sun and stars)

ENERGY

- This is the ability to do work

TYPES OF ENERGY

- Kinetic energy
- Potential energy

Kinetic energy

- This is the type of energy possessed by a body in motion (moving object)

Potential energy

- This is the type of energy possessed by a body at rest (stationary object)

FORMS OF ENERGY

- Heat energy
- Sound energy
- Light energy
- Electrical energy (electricity)
- Magnetism
- Mechanical energy
- Chemical energy

ELECTRICITY

- This is the form of energy produced by the flow or presence of charged particles

Why is electricity regarded as a form of energy?

- It can do work (it does work)

Name the two charged particles involved in electricity

- Electrons
- Protons

An atom

- This is the smallest indivisible particle of an element

Molecule

- This is a group of two or more atoms joined together

Name the three atomic particles (particles which make up an atom)

- Protons
- Electrons
- Neutrons

Protons and **neutrons** are found in the nucleus of an atom

Electrons are found on the shell/orbit/energy level around the nucleus of an atom

Electrons

- These are negatively charged particles of an atom

Protons

- These are positively charged particles of an atom

Neutrons

- These are uncharged particles of an atom (neutrally charged particles)

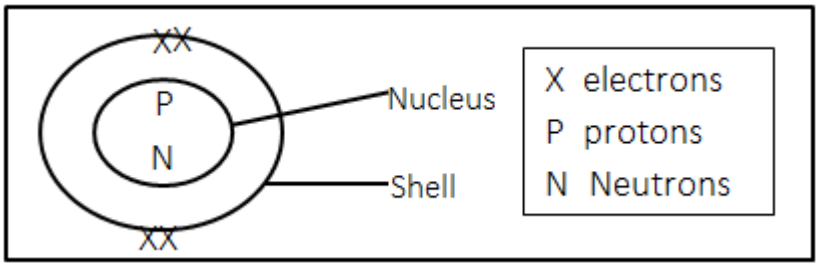
When does a body (an atom) become positively charged?

- If it loses an electron

When does a body (an atom) become negatively charged?

- If it gains an electron

A diagram showing an atom

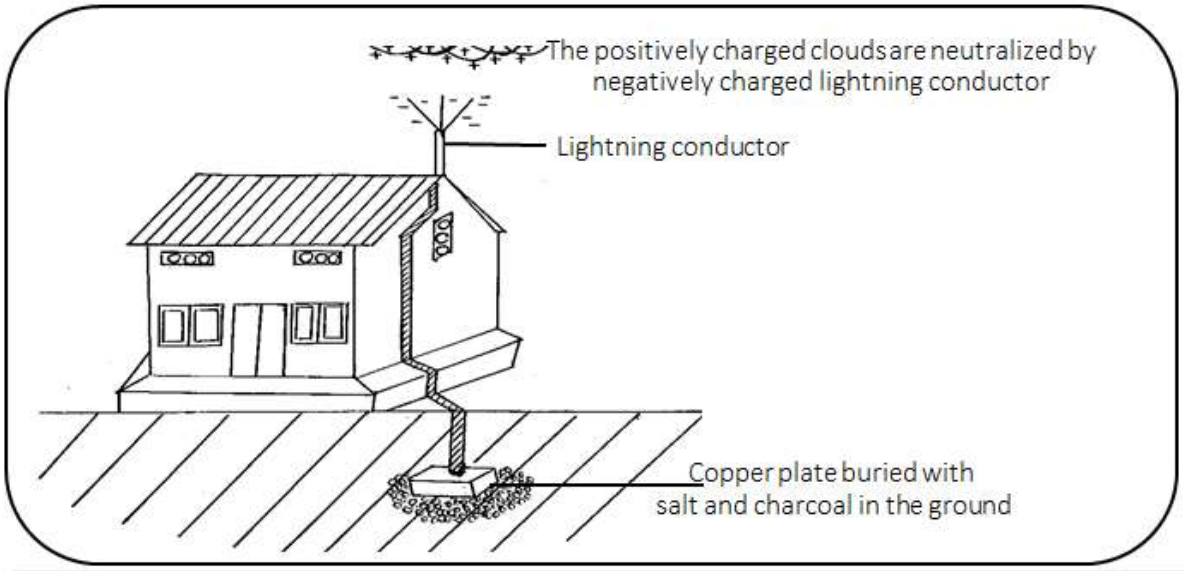


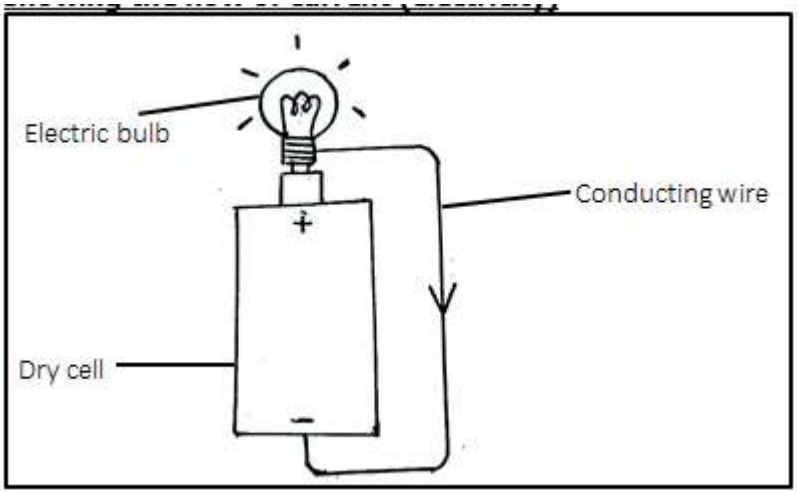
USES/IMPORTANCE/APPLICATIONS OF ELECTRICITY

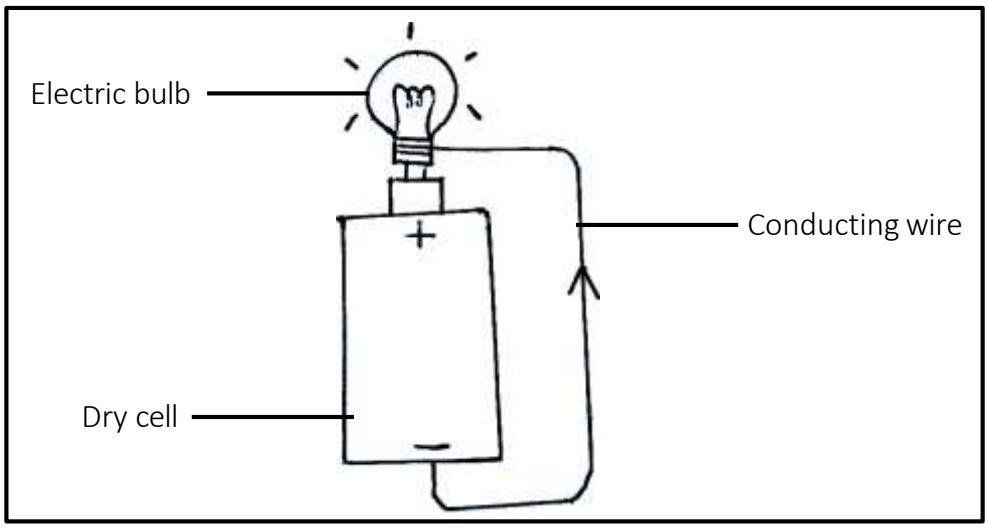
- It is used for cooking
- It is used for ironing
- It is used for lighting in houses and compounds
- It is used for charging phones
- It is used for security in electric fences
- It is used to make electromagnets
- It is used to power elevators (lifts) in buildings
- It is used to run machines in factories/industries

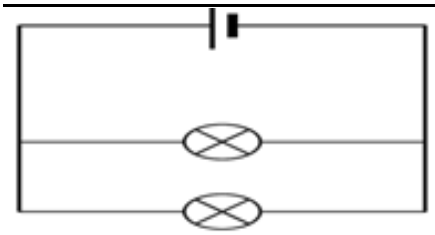
ADVANTAGES OF USING ELECTRICITY

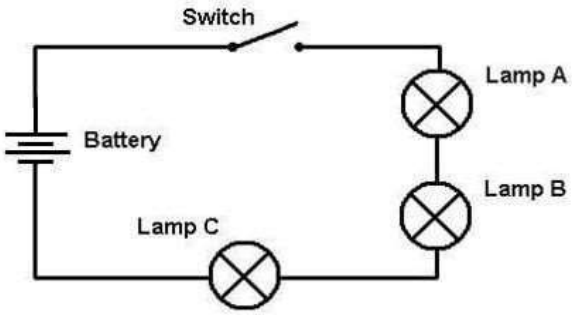
- It is quick to use (It saves time)
- It is clean to use (it produces clean and neat work)

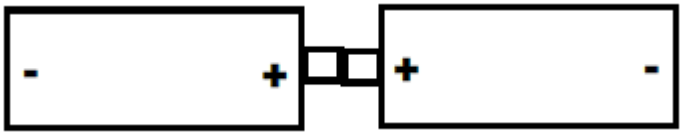

The positively charged clouds are neutralized by negatively charged lightning conductor
Lightning conductor
Copper plate buried with salt and charcoal in the ground

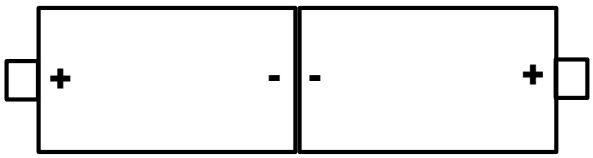

Electric bulb
Conducting wire
Dry cell

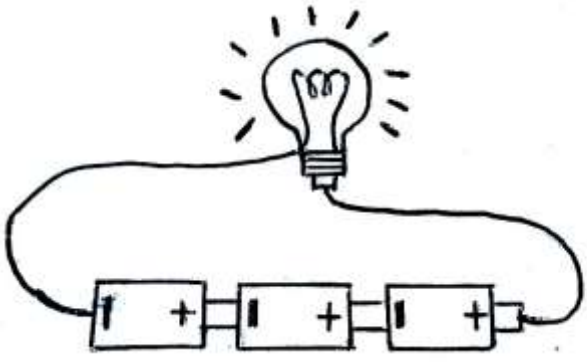

Electric bulb
Conducting wire
Dry cell

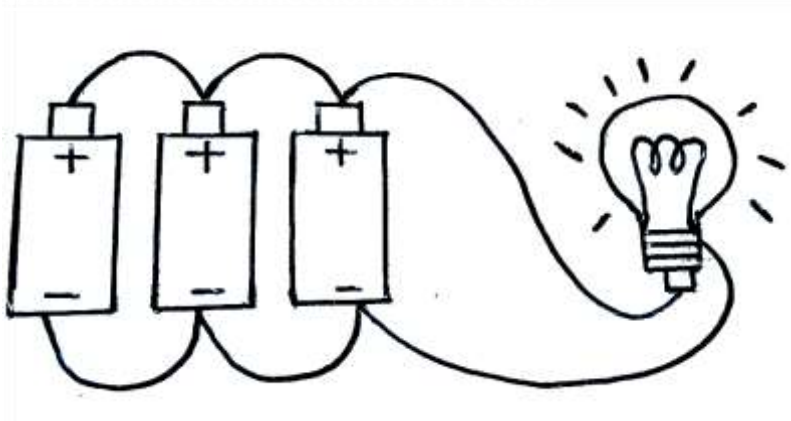


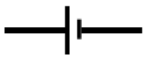
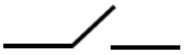
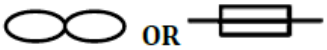
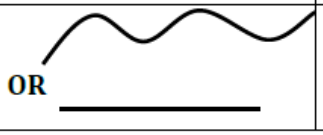
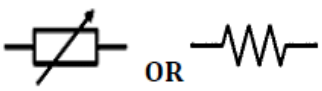

Switch
Lamp A
Battery
Lamp B
Lamp C

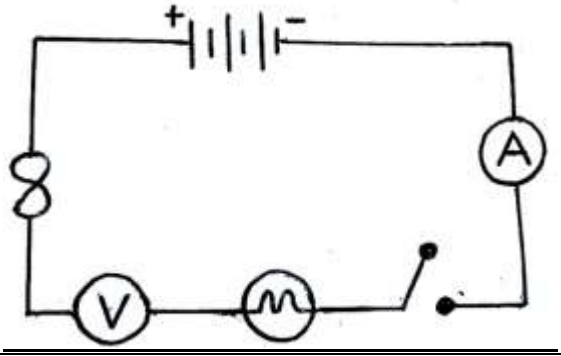
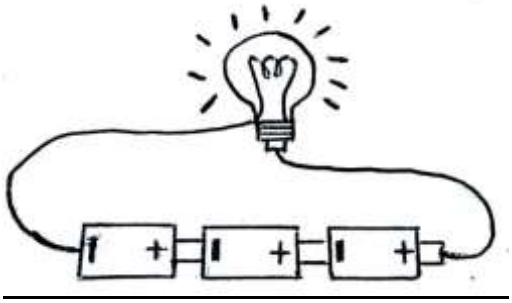

-
+
+
-


+
-
-
+


+
+
+



COMPONENT	SYMBOL	FUNCTION
Dry cell (battery)		▪ It produces electricity ▪ It changes chemical energy to electrical energy
Bulb		▪ It produces light ▪ It changes electrical energy to heat and light energy
Switch		▪ It breaks or completes the circuit at one's will
Fuse	 OR	▪ It breaks the circuit in case of high voltage (too much flow of current)
Wire/conductor	 OR	▪ It conducts electricity in the circuit
Ammeter		▪ It measures electric current
Voltmeter		▪ It measures voltage (potential difference/electromotive force)
Ohmmeter		• It measures electrical resistance
Resistor	 OR	▪ It regulates electric current that flows in the circuit

 + − A V M	

_____

_____

_____

_____

_____

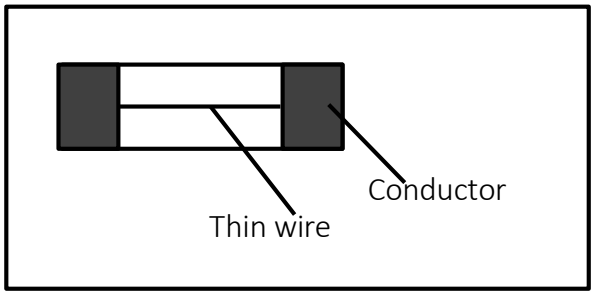
_____

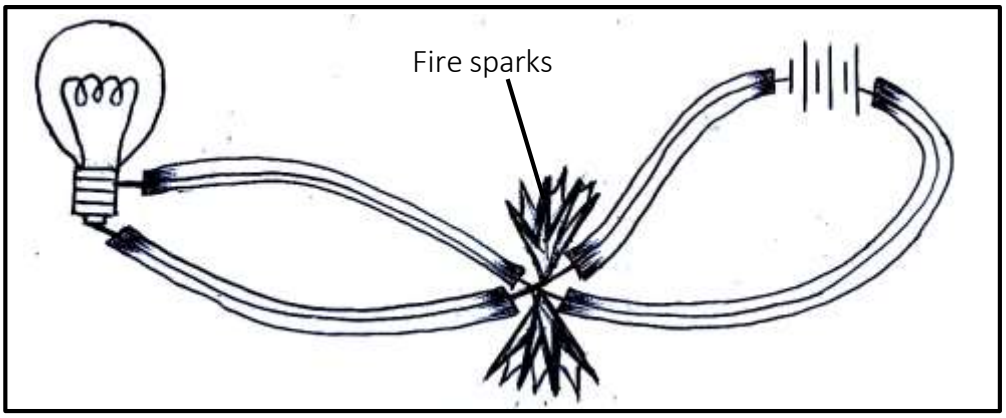
_____

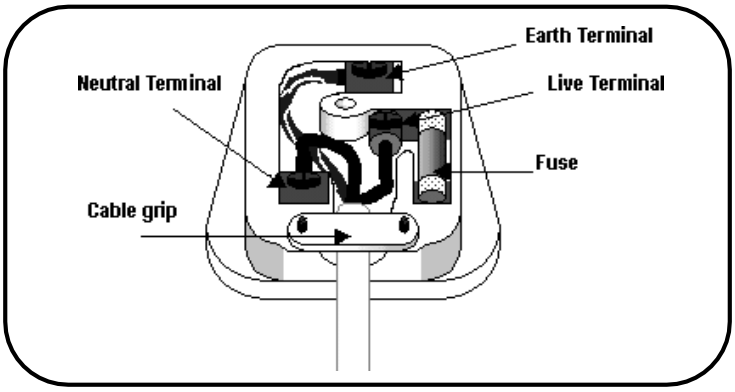
_____

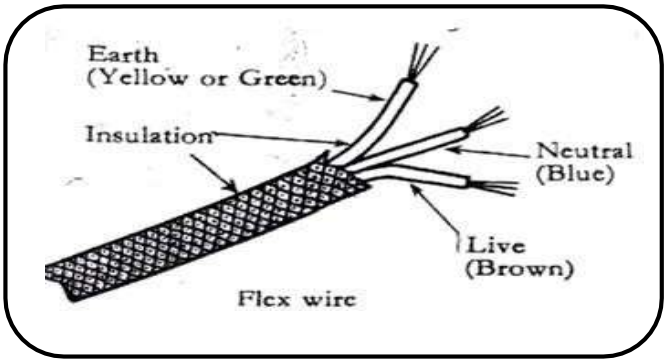
_____

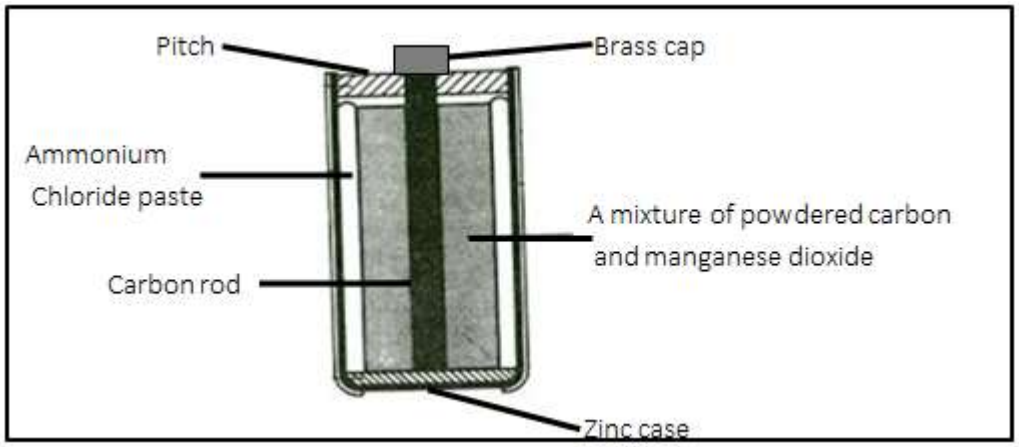
_____

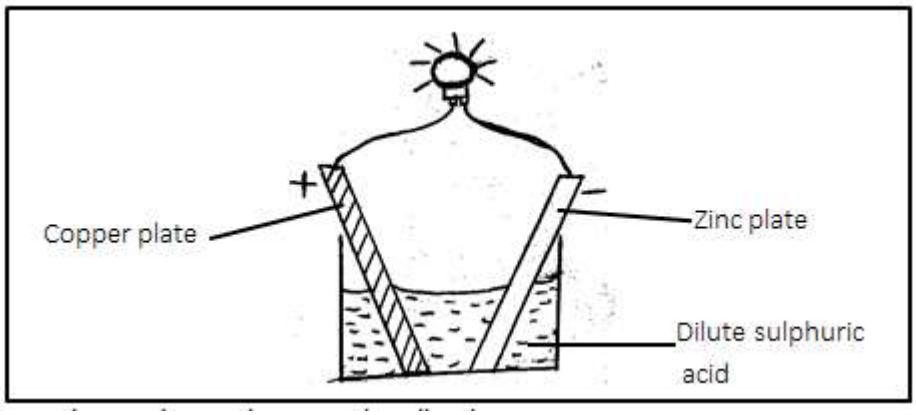

Conductor
Thin wire

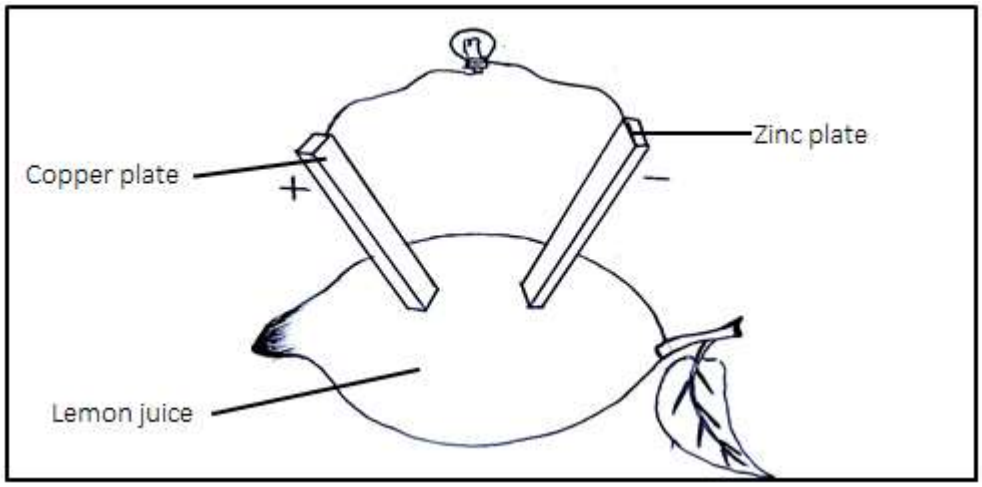

Fire sparks

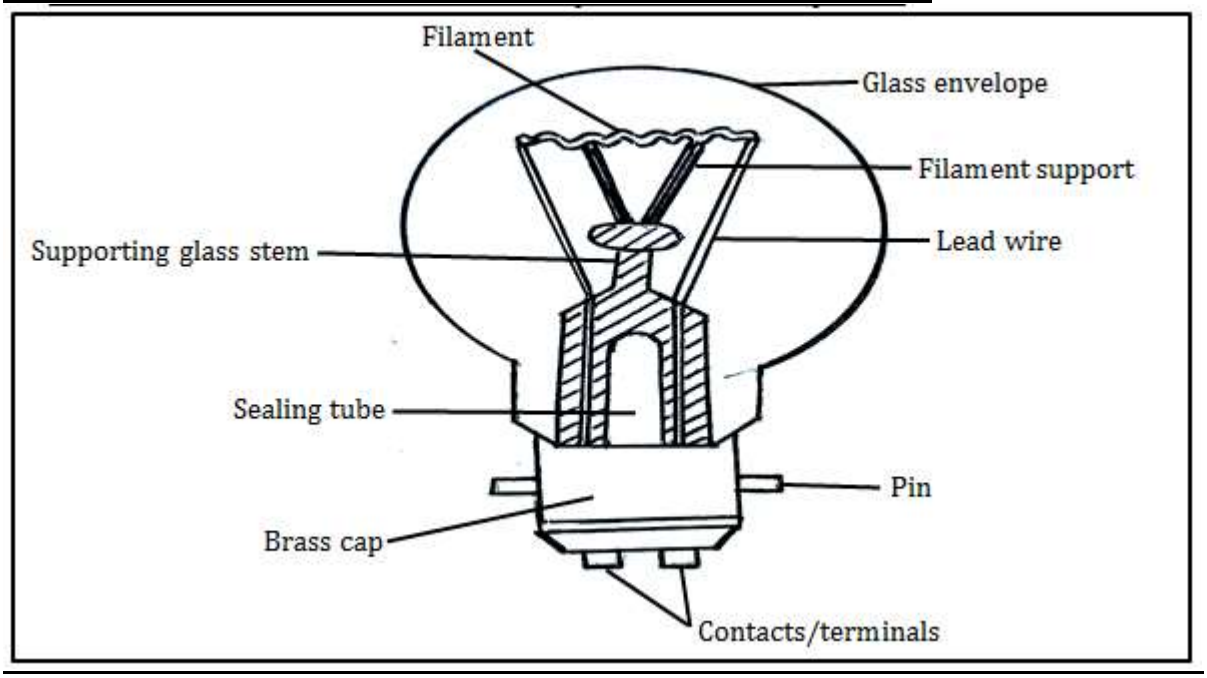

Earth Terminal
Neutral Terminal
Live Terminal
Fuse
Cable grip


Earth
(Yellow or Green)
Insulation
Neutral
(Blue)
Live
(Brown)
Flex wire


Pitch
Brass cap
Ammonium
Chloride paste
A mixture of powdered carbon
and manganese dioxide
Carbon rod
Zinc case


Copper plate
Zinc plate
Dilute sulphuric acid


Copper plate
Zinc plate
Lemon juice


Filament
Glass envelope
Filament support
Supporting glass stem
Lead wire
Sealing tube
Pin
Brass cap
Contacts/terminals

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

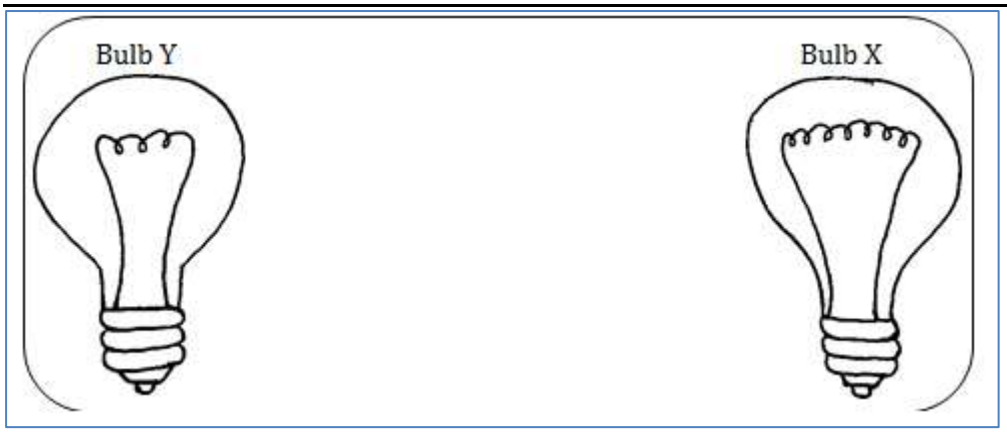
_____

_____

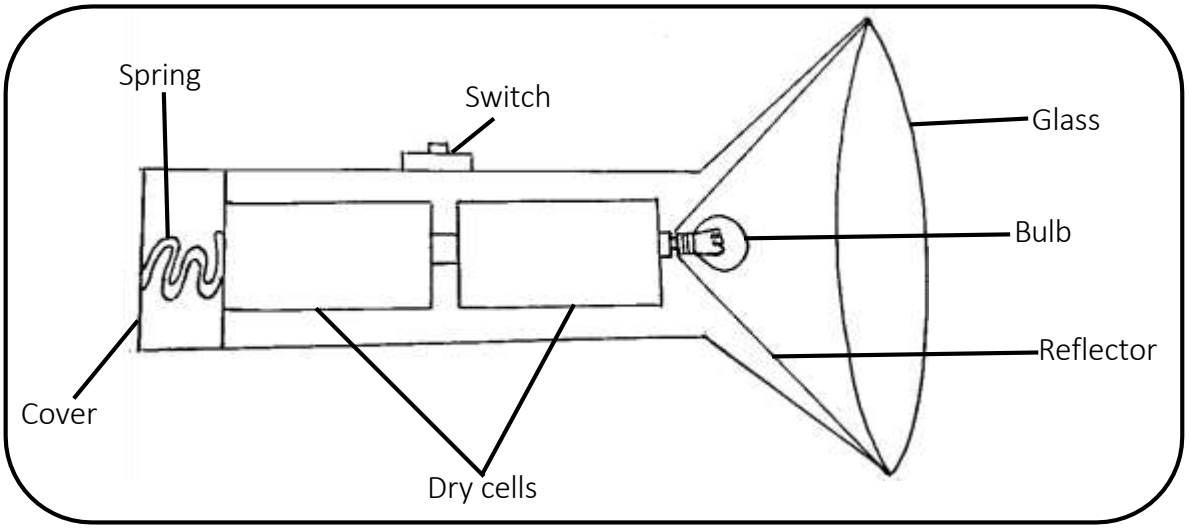
_____

_____

_____


Bulb Y
Bulb X

_____


Spring
Switch
Glass
Bulb
Reflector
Cover
Dry cells

_____

_____

_____

_____

_____

_____

_____

_____

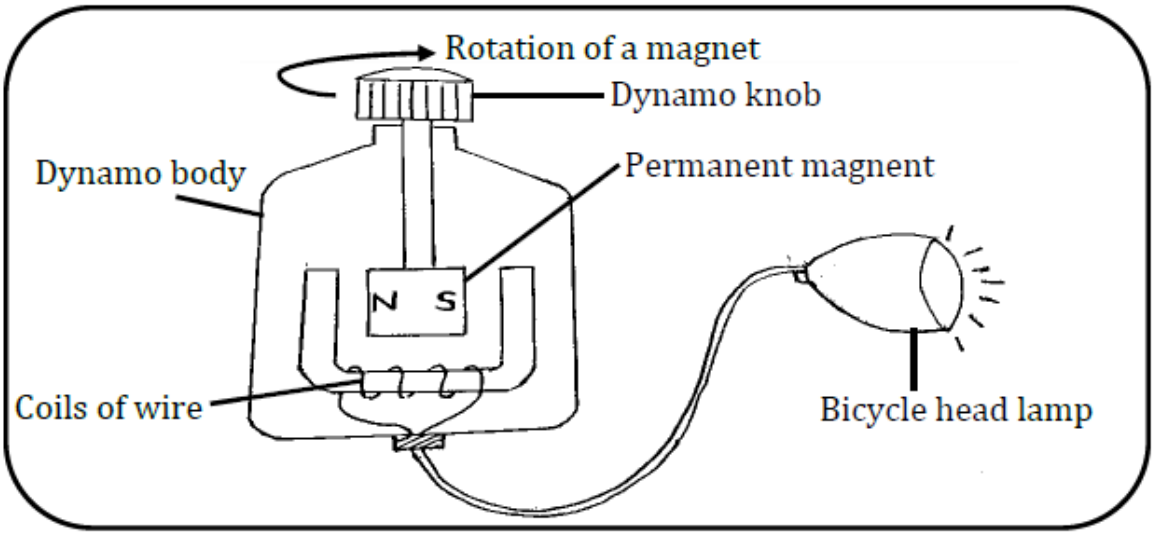
_____

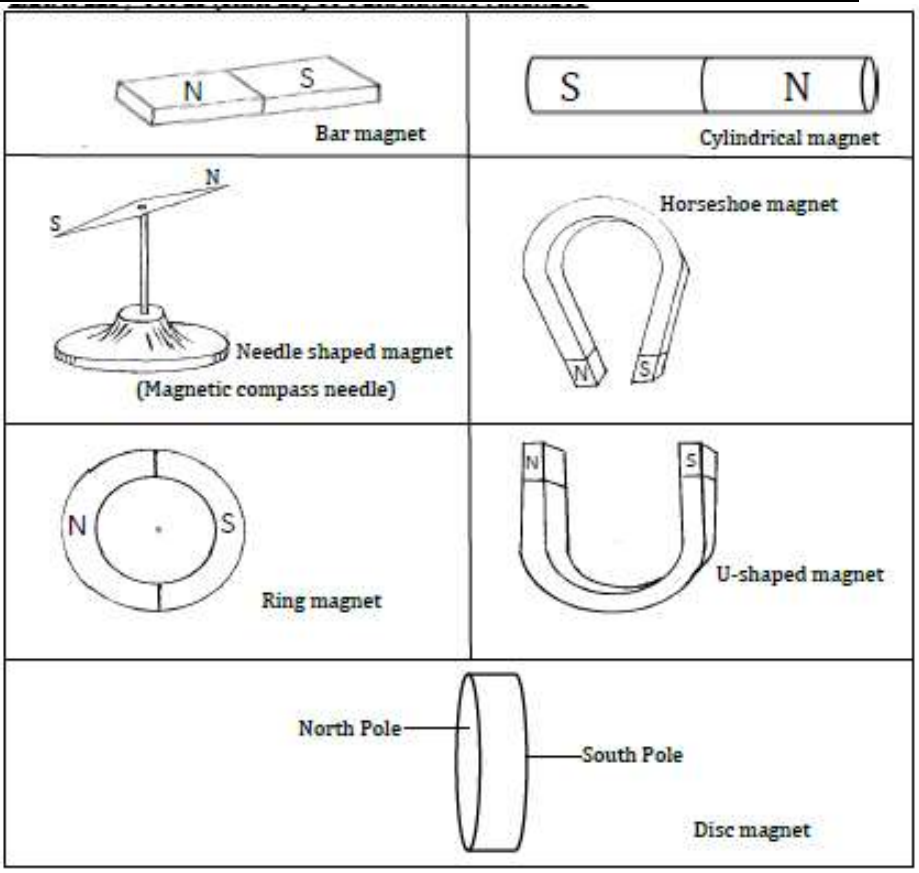
_____

_____

_____

_____


Rotation of a magnet
Dynamo knob
Dynamo body
Permanent magnent
N
S
Coils of wire
Bicycle head lamp


N
S
Bar magnet
S
N
Cylindrical magnet
N
S
Needle shaped magnet
(Magnetic compass needle)
Horseshoe magnet
N
S
N
S
Ring magnet
N
S
U-shaped magnet
North Pole
South Pole
Disc magnet

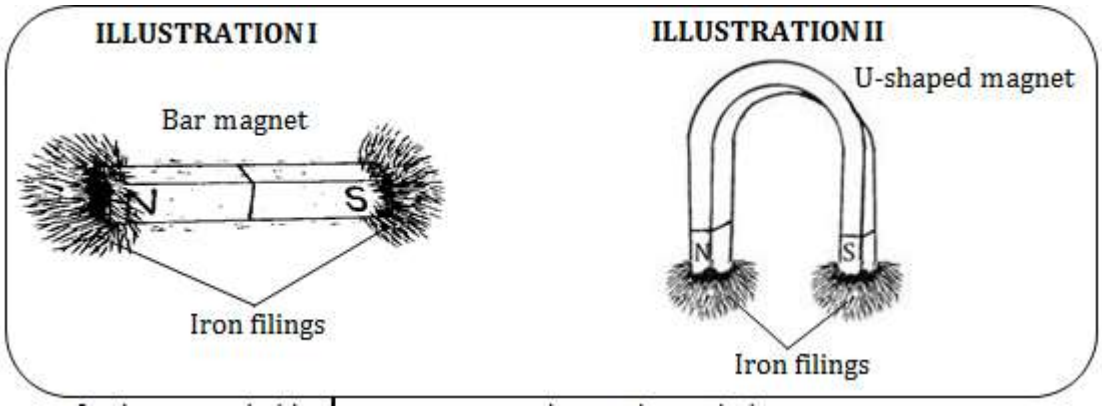


ILLUSTRATION I
Bar magnet
N
S
Iron filings
ILLUSTRATION II
U-shaped magnet
N
S
Iron filings

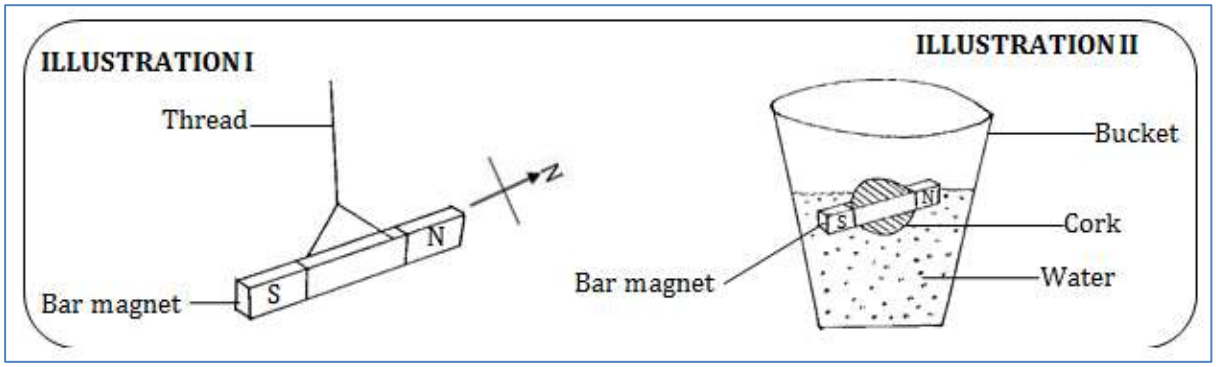


ILLUSTRATION I
Thread
N
S
Bar magnet
ILLUSTRATION II
Bucket
N
S
Cork
Bar magnet
Water

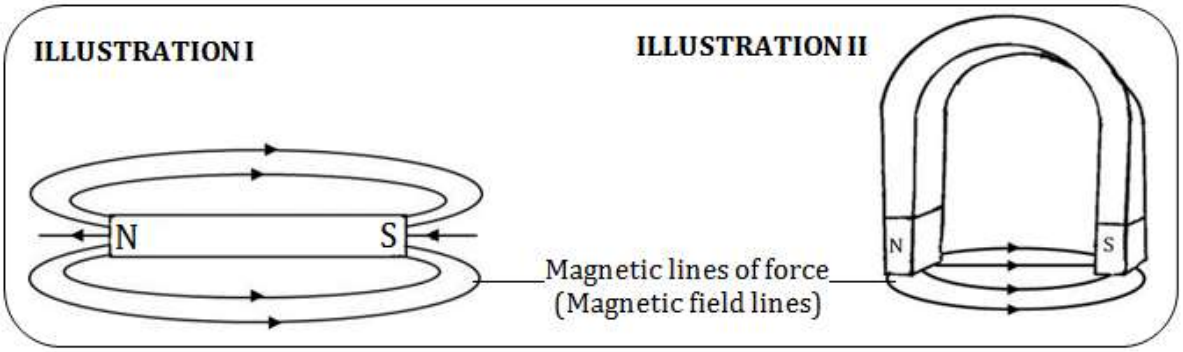
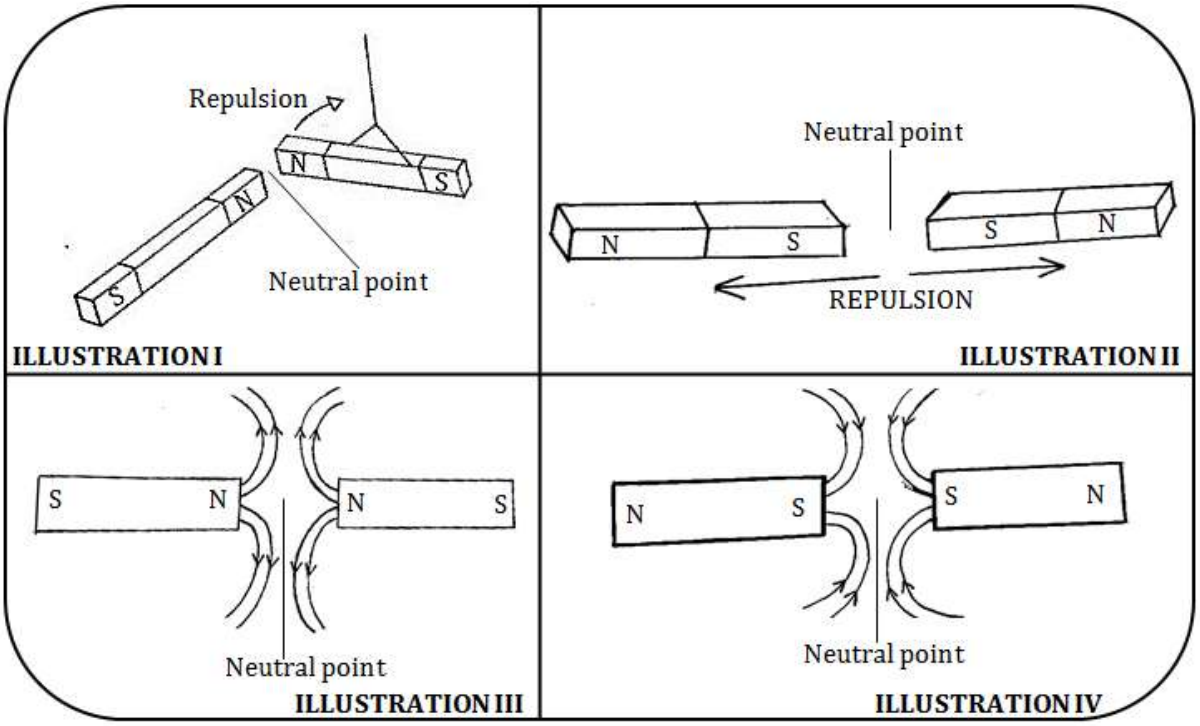
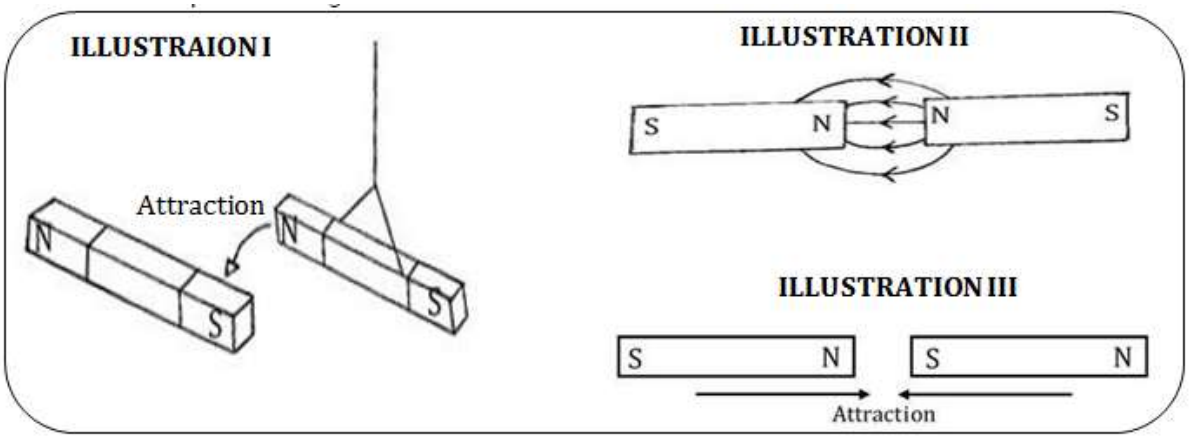


ILLUSTRATION I
N
S
Magnetic lines of force
(Magnetic field lines)
ILLUSTRATION II
N
S


Repulsion
N
S
N
S
Neutral point
ILLUSTRATION I
Neutral point
N
S
S
N
REPULSION
ILLUSTRATION II
S
N
N
S
Neutral point
ILLUSTRATION III
N
S
S
N
Neutral point
ILLUSTRATION IV


ILLUSTRAION I
Attraction
N
N
S
S
ILLUSTRATION II
S
N
N
S
ILLUSTRATION III
S
N
S
N
Attraction

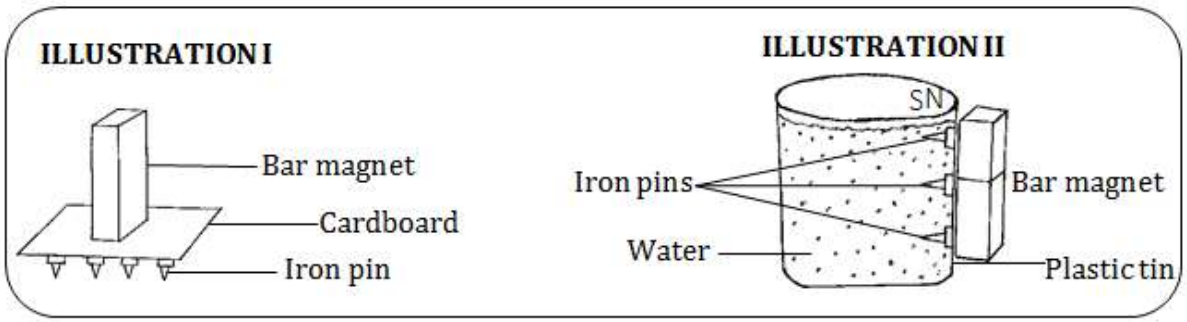
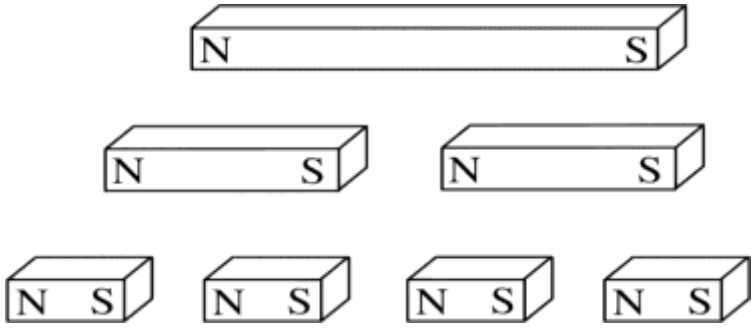


ILLUSTRATION I
Bar magnet
Cardboard
Iron pin
ILLUSTRATION II
SN
Iron pins
Water
Bar magnet
Plastic tin


N
S
N
S
N
S
N
S
N
S
N
S
N
S

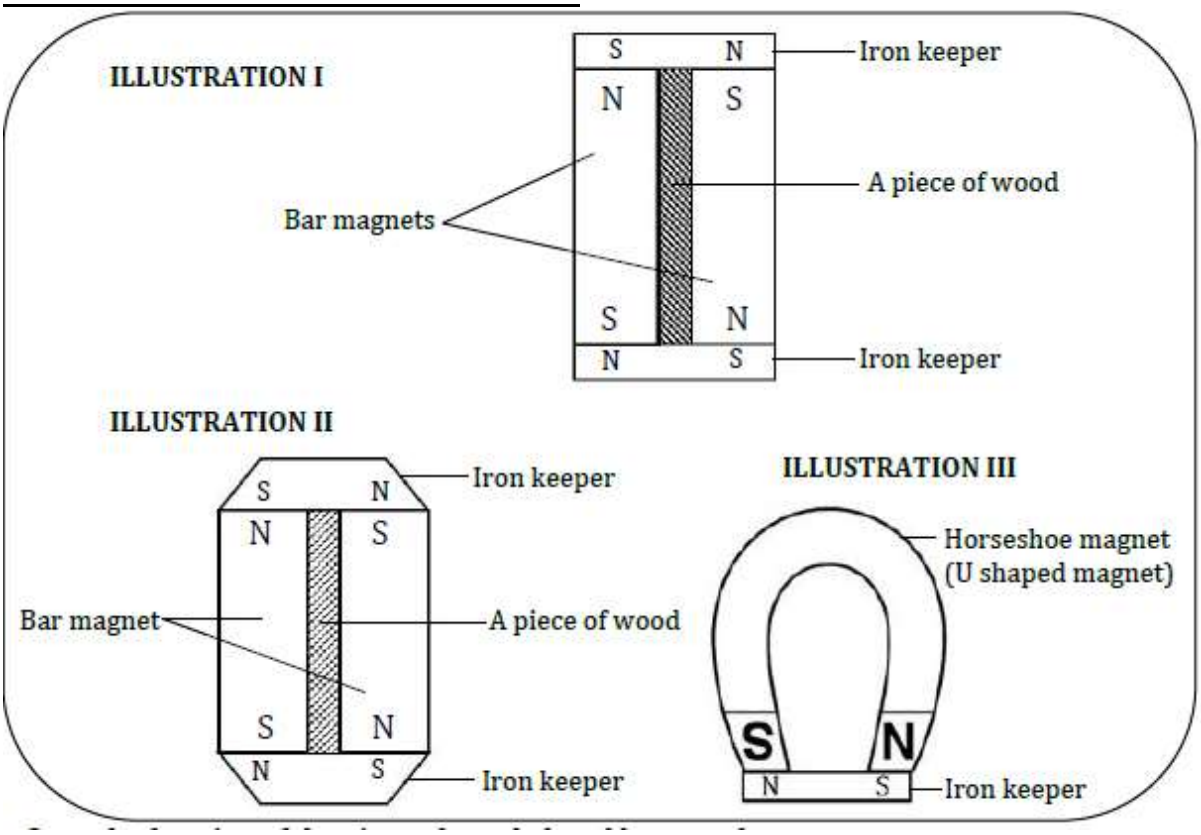
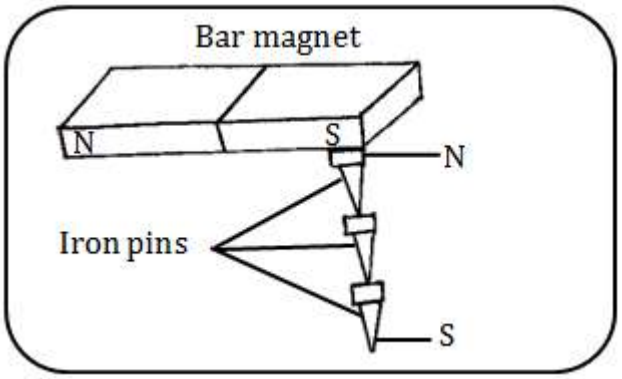
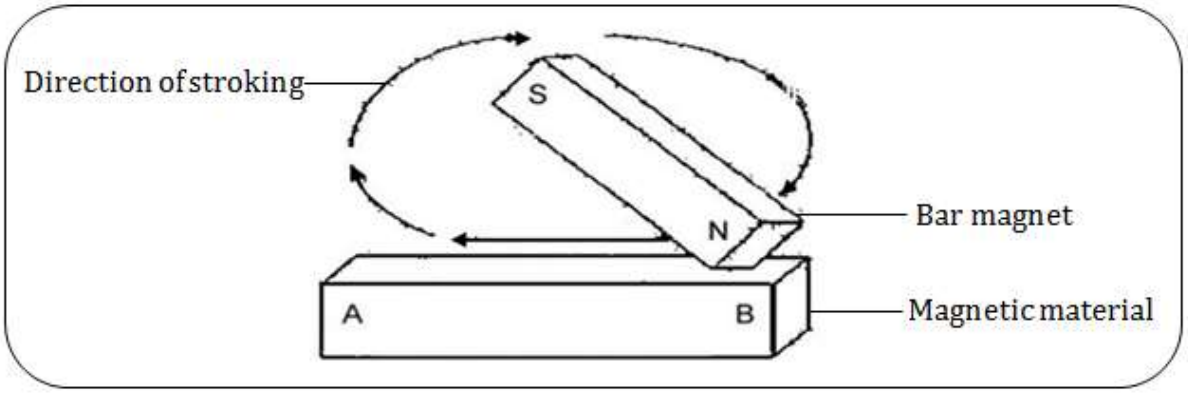
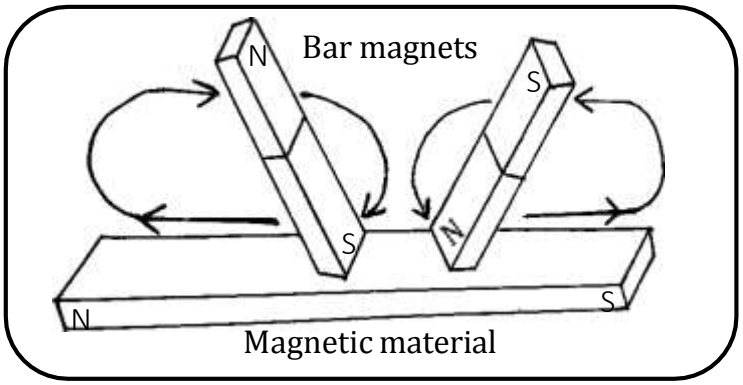
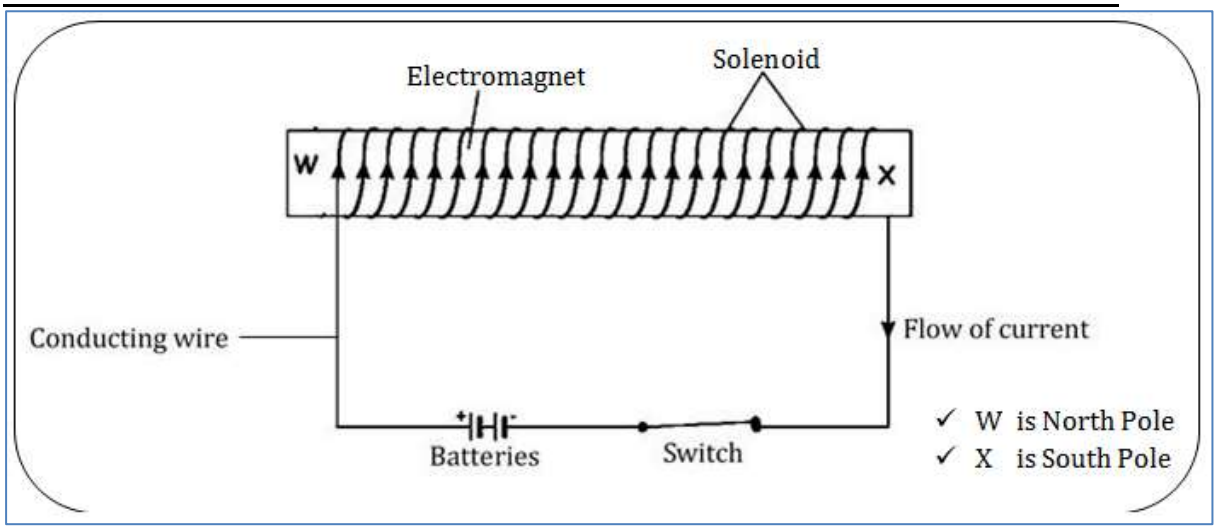


ILLUSTRATION I
S
N
Iron keeper
N
S
A piece of wood
Bar magnets
S
N
N
S
Iron keeper
ILLUSTRATION II
S
N
Iron keeper
N
S
Bar magnet
A piece of wood
S
N
N
S
Iron keeper
ILLUSTRATION III
Horseshoe magnet
(U shaped magnet)
S
N
N
S
Iron keeper


Bar magnet
N
S
N
Iron pins
S


Direction of stroking
S
N
Bar magnet
A
B
Magnetic material


Bar magnets
N
S
S
N
N
S
Magnetic material


Electromagnet
Solenoid
W
X
Conducting wire
Flow of current
Batteries
Switch
✓ W is North Pole
✓ X is South Pole

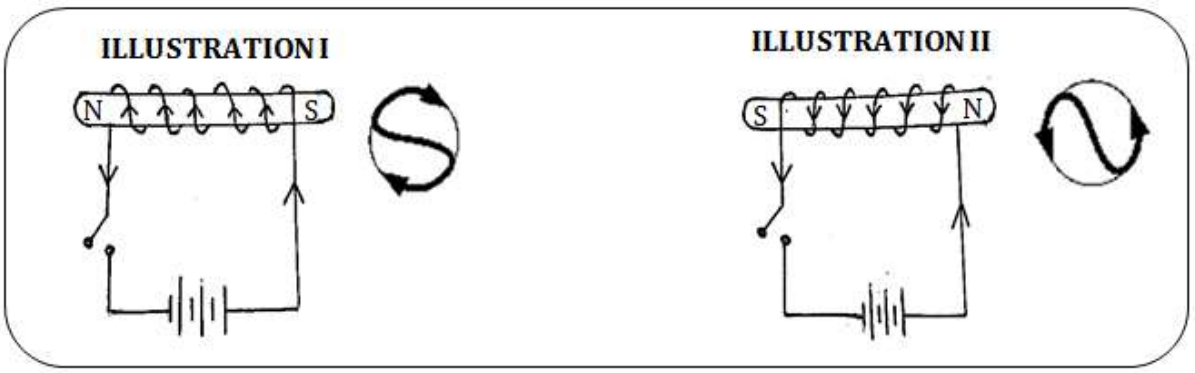


ILLUSTRATION I
N
S
ILLUSTRATION II
S
N

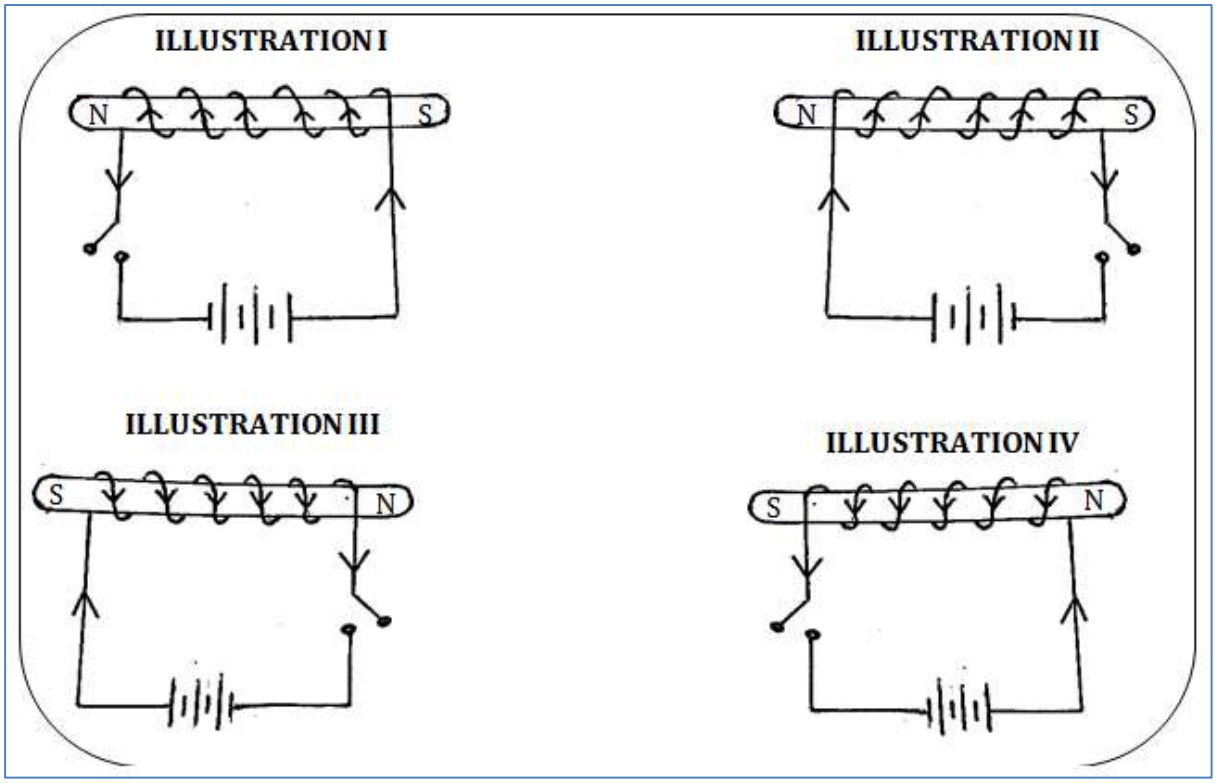


ILLUSTRATION I
N
S
ILLUSTRATION II
N
S
ILLUSTRATION III
S
N
ILLUSTRATION IV
S
N

_____

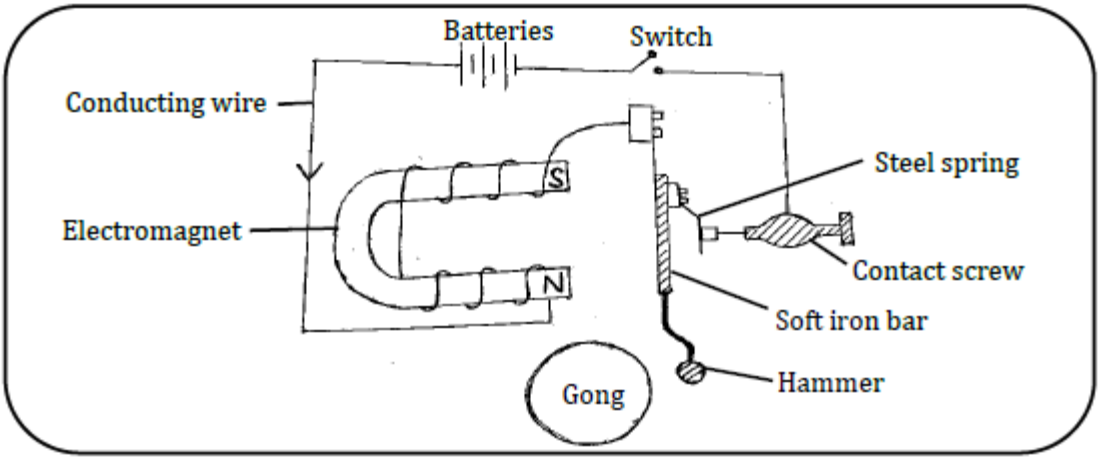
_____

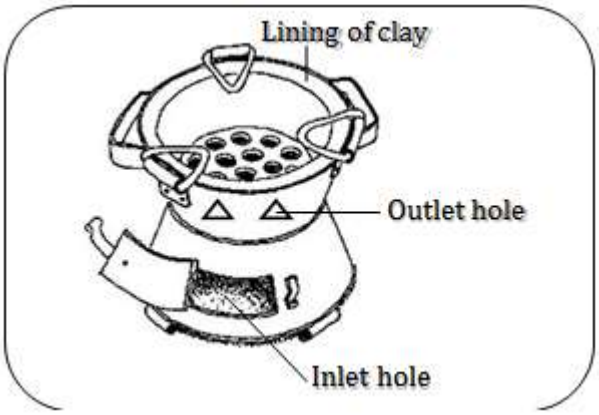
_____

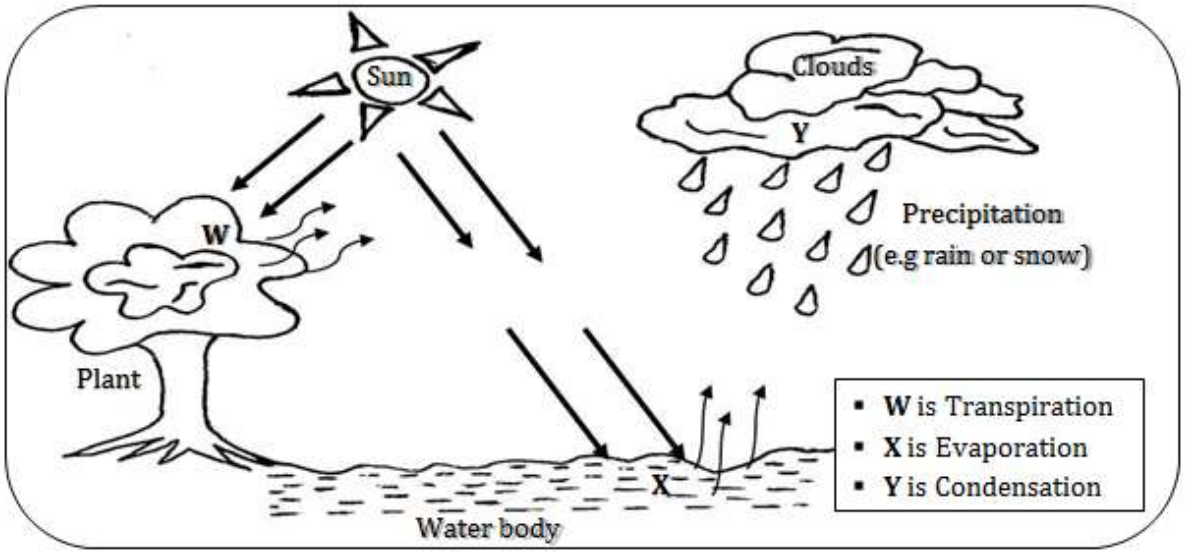
_____

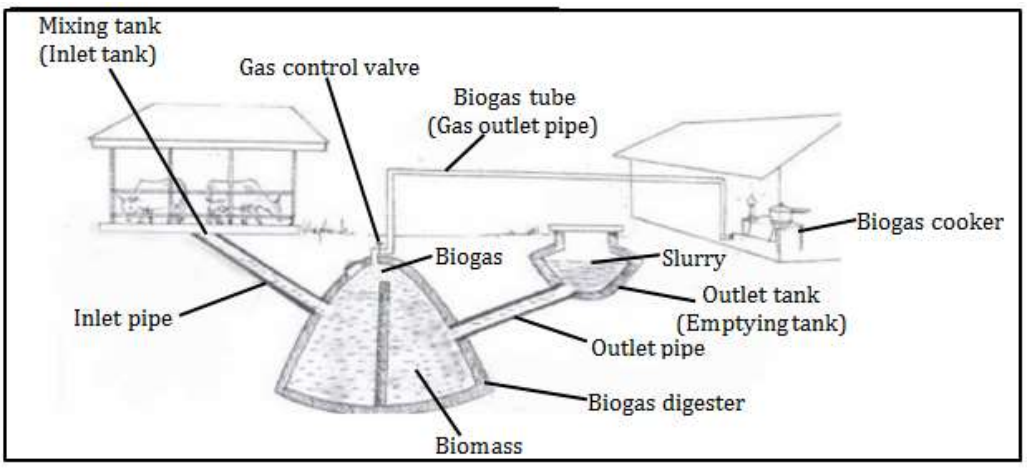
_____

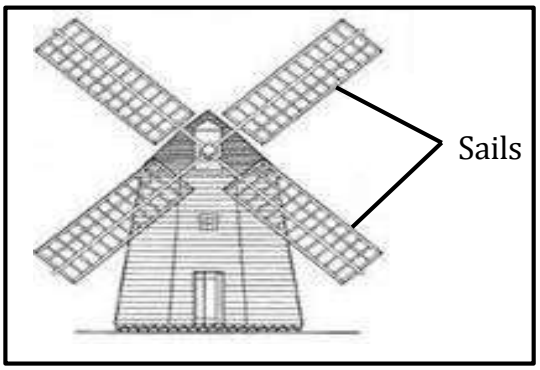
_____


Batteries
Switch
Conducting wire
Steel spring
Electromagnet
S
N
Contact screw
Soft iron bar
Hammer
Gong


Lining of clay
Outlet hole
Inlet hole


Sun
Clouds
Y
Precipitation
(e.g rain or snow)
W
Plant
X
Water body
W is Transpiration
X is Evaporation
Y is Condensation


Mixing tank
(Inlet tank)
Gas control valve
Biogas tube
(Gas outlet pipe)
Biogas cooker
Biogas
Slurry
Outlet tank
(Emptying tank)
Inlet pipe
Outlet pipe
Biogas digester
Biomass

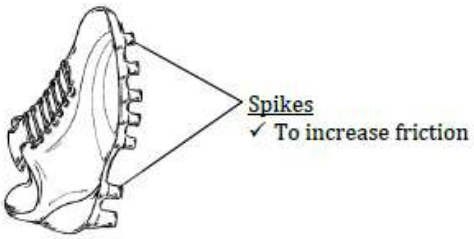

Sails

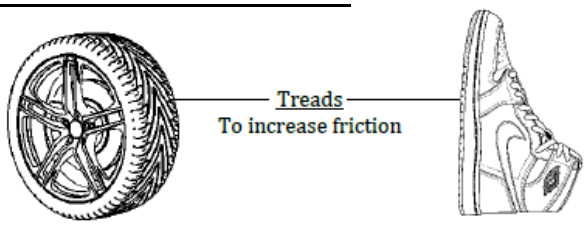
TERM 2

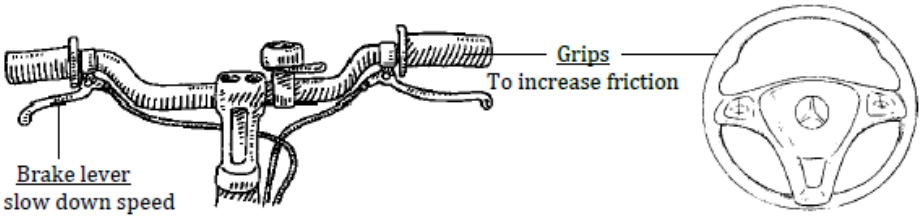
P.7

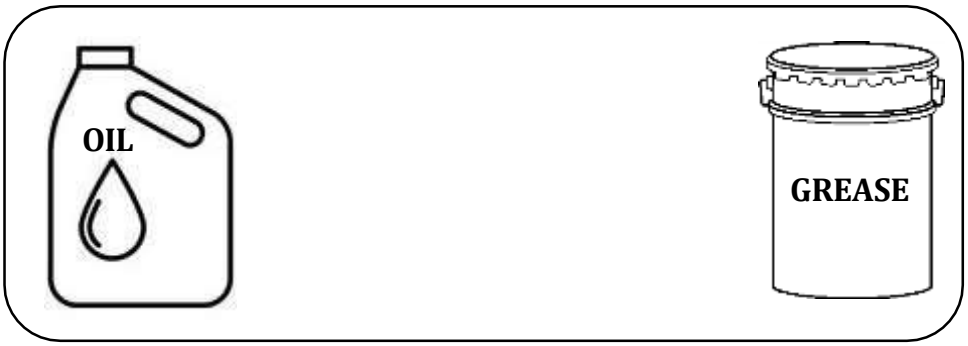
SCIENCE

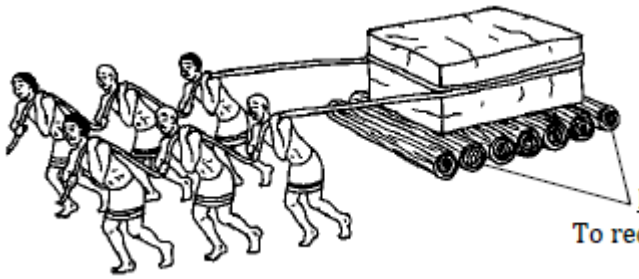
NOTES

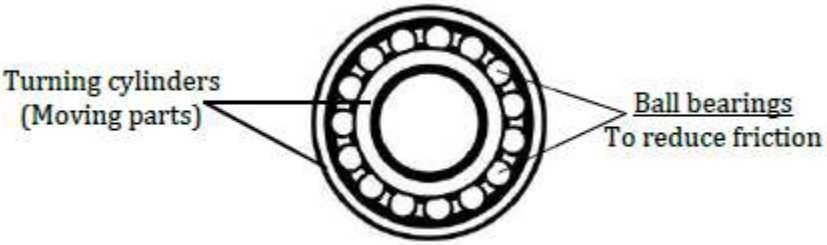

Spikes
✓ To increase friction

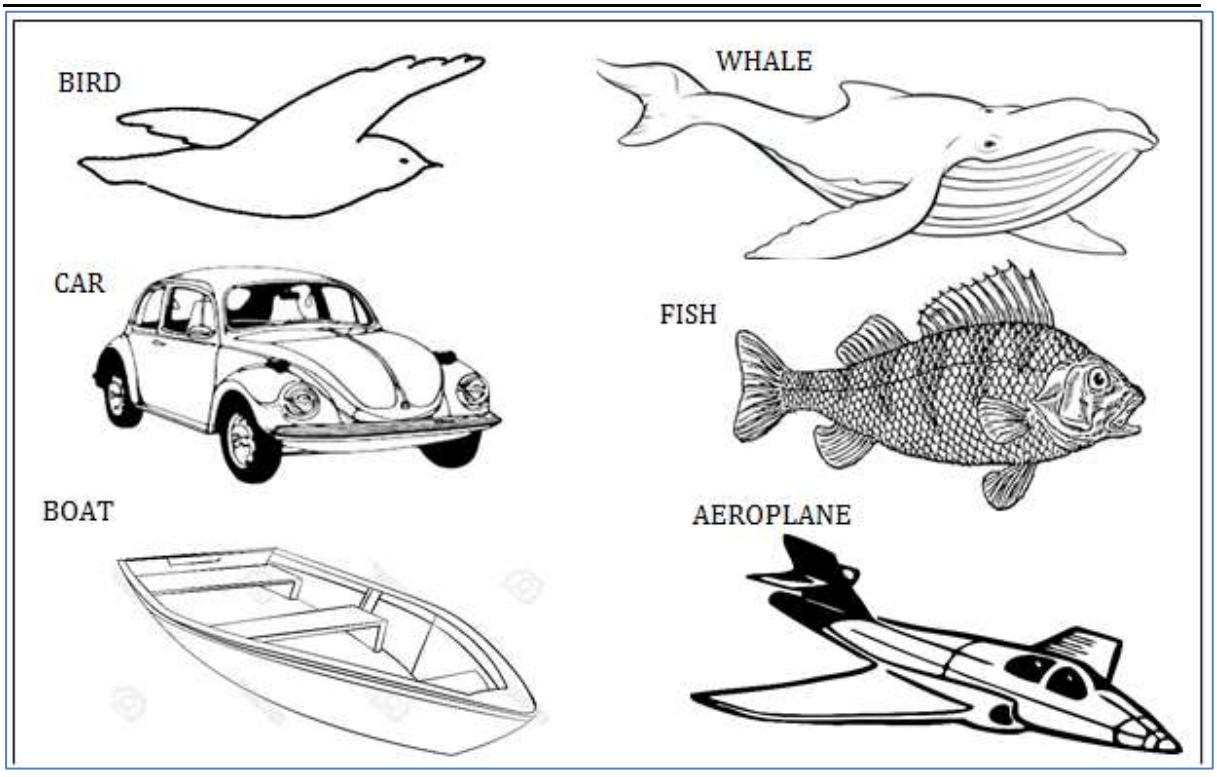

Treads
To increase friction

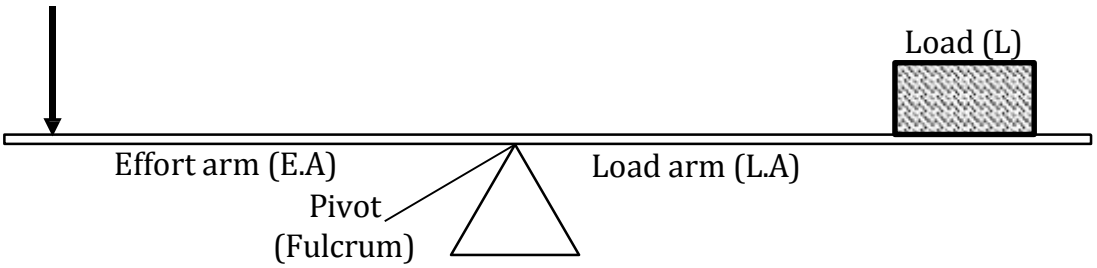

Grips
To increase friction
Brake lever
To slow down speed

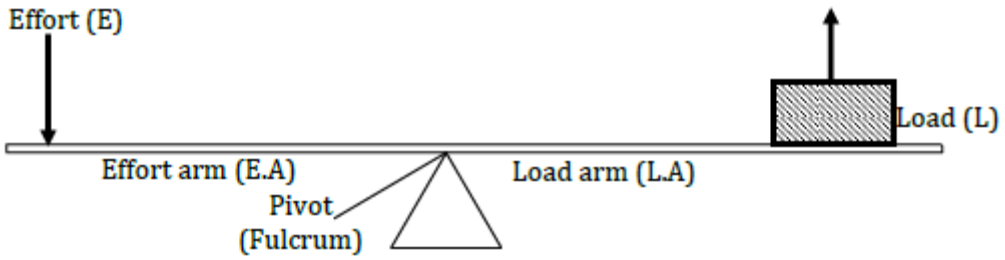

OIL
GREASE

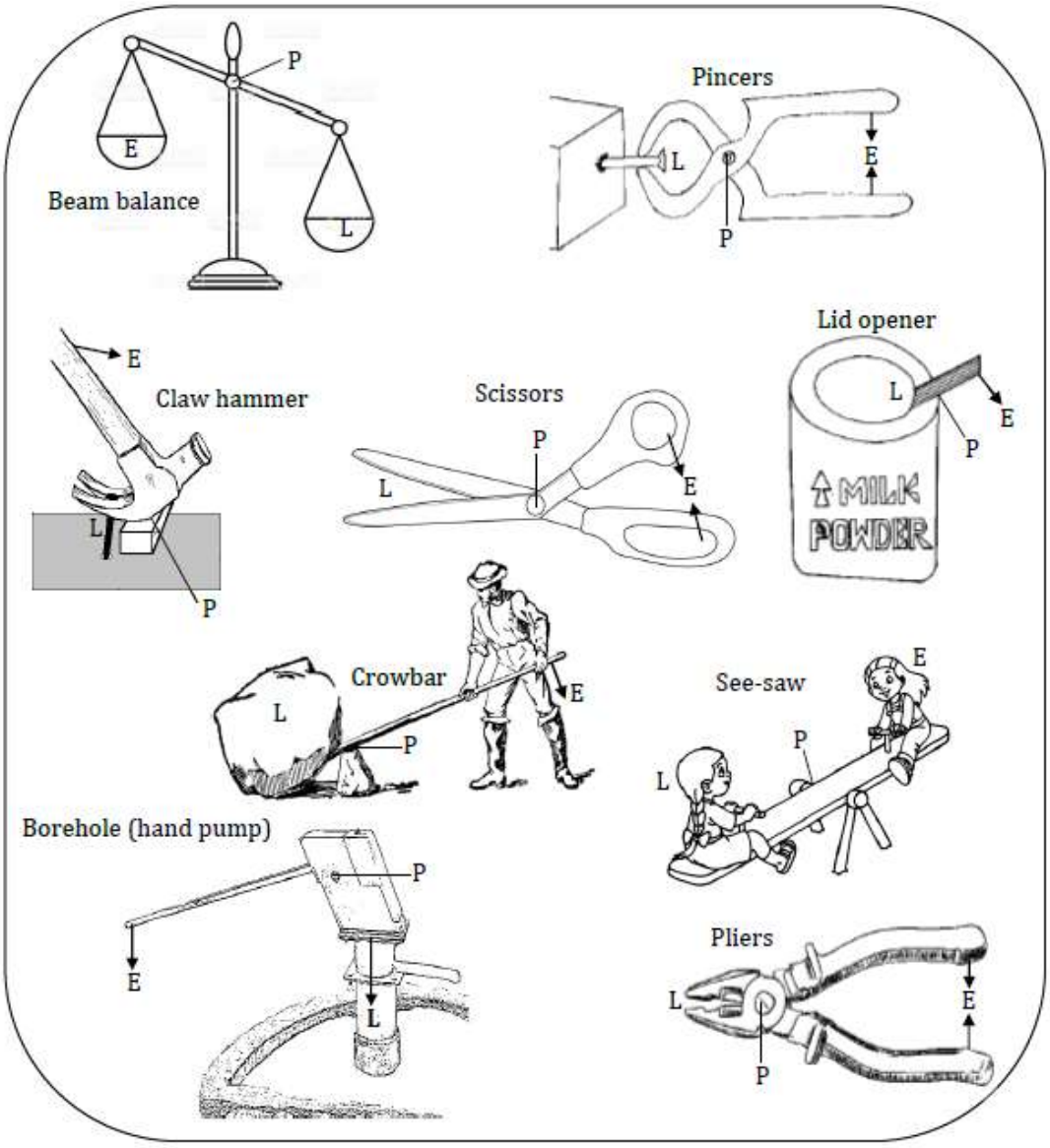

Rollers
To reduce friction

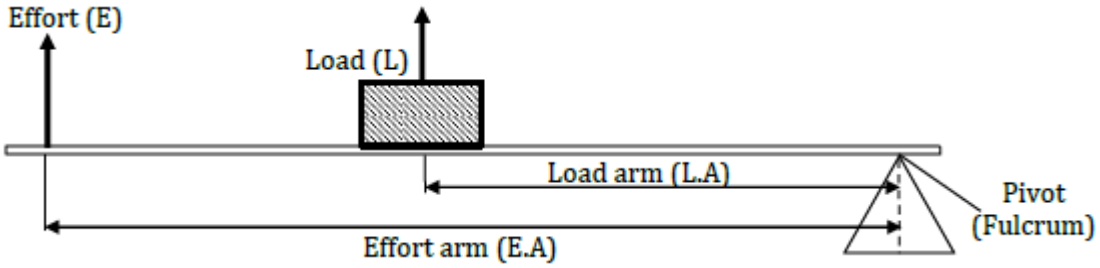

Turning cylinders
(Moving parts)
Ball bearings
To reduce friction

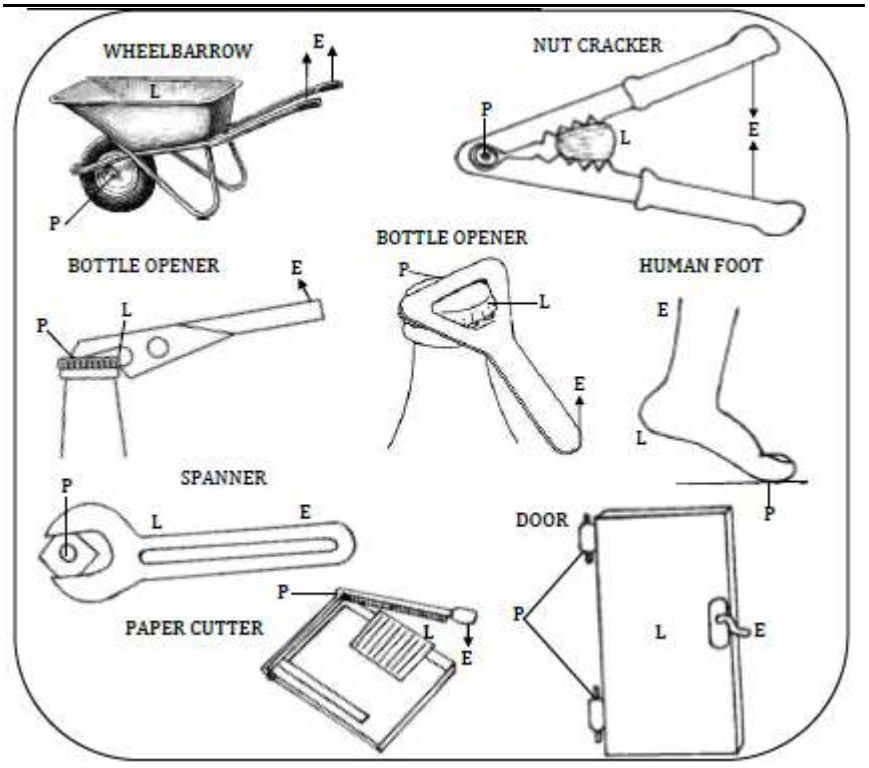

BIRD
WHALE
CAR
FISH
BOAT
AEROPLANE

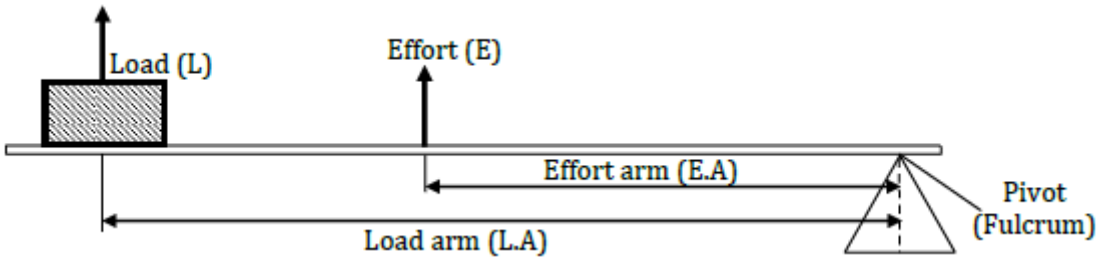

Load (L)
Effort arm (E.A)
Load arm (L.A)
Pivot
(Fulcrum)

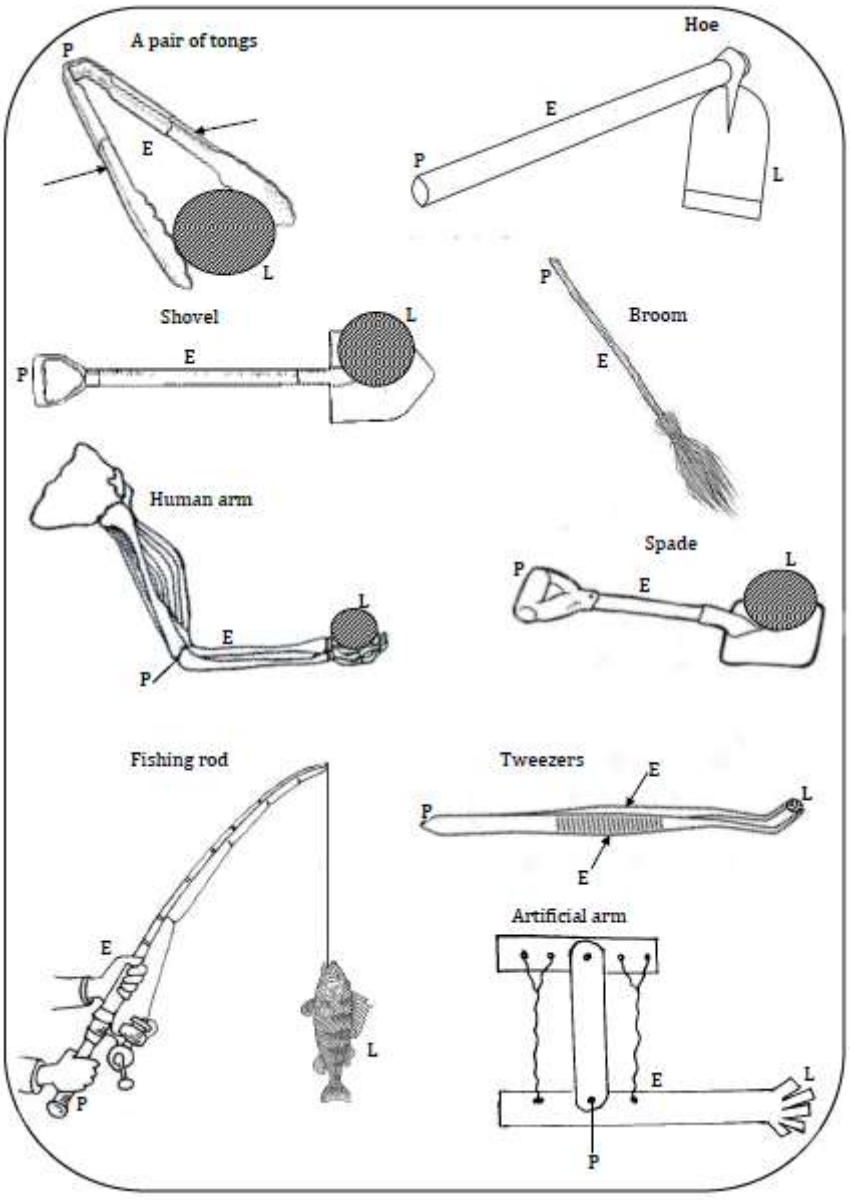

Effort (E)
Load (L)
Effort arm (E.A)
Load arm (L.A)
Pivot
(Fulcrum)

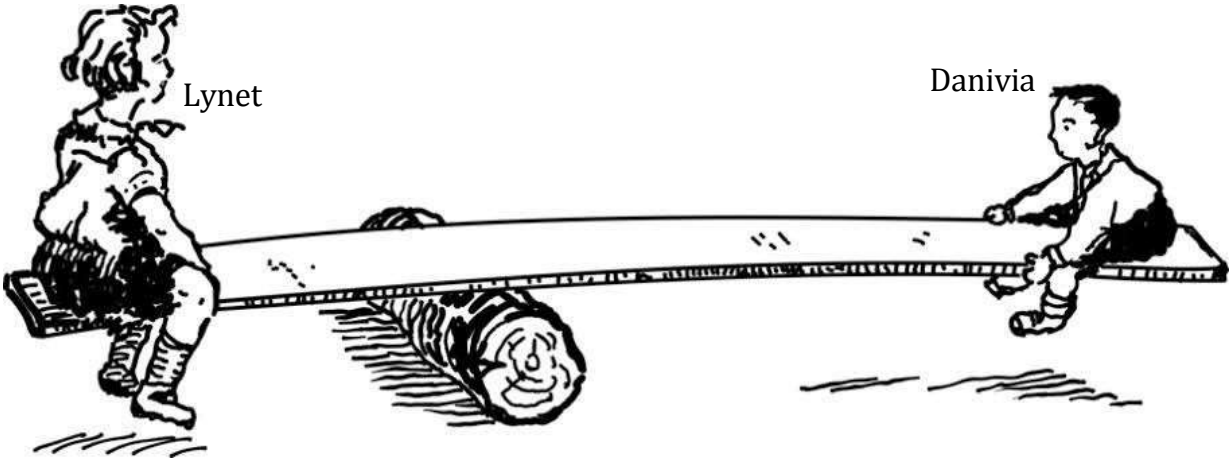

P
E
Beam balance
L
Pincers
L
E
P
E
Claw hammer
L
P
Scissors
P
L
E
Lid opener
L
E
P
MILK
POWDER
Crowbar
L
P
E
See-saw
E
P
L
Borehole (hand pump)
P
E
L
Pliers
L
E
P

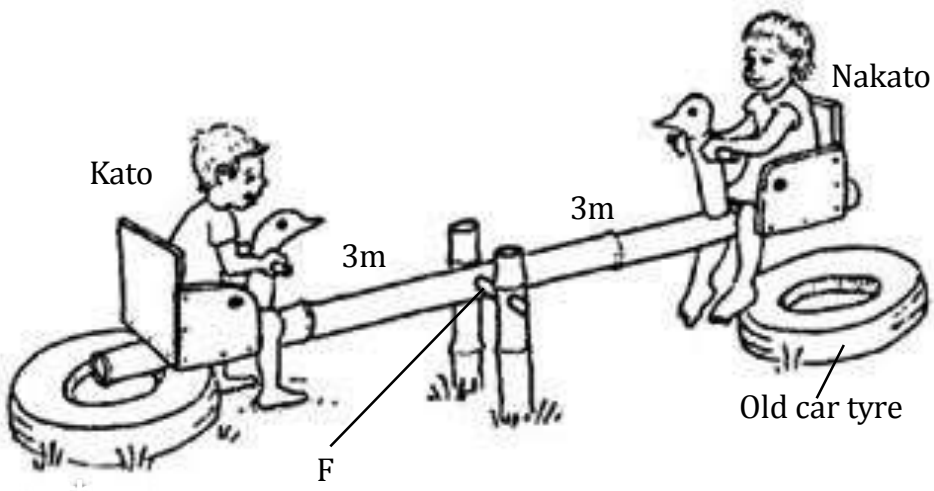

Effort (E)
Load (L)
Load arm (L.A)
Pivot
(Fulcrum)
Effort arm (E.A)

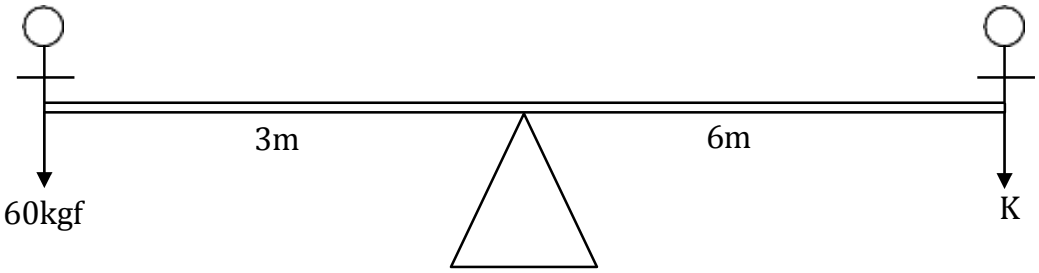

WHEELBARROW
E
L
P
NUT CRACKER
P
L
E
BOTTLE OPENER
P
L
E
BOTTLE OPENER
E
P
L
HUMAN FOOT
E
L
P
SPANNER
P
L
E
PAPER CUTTER
P
L
E
DOOR
P
L
E

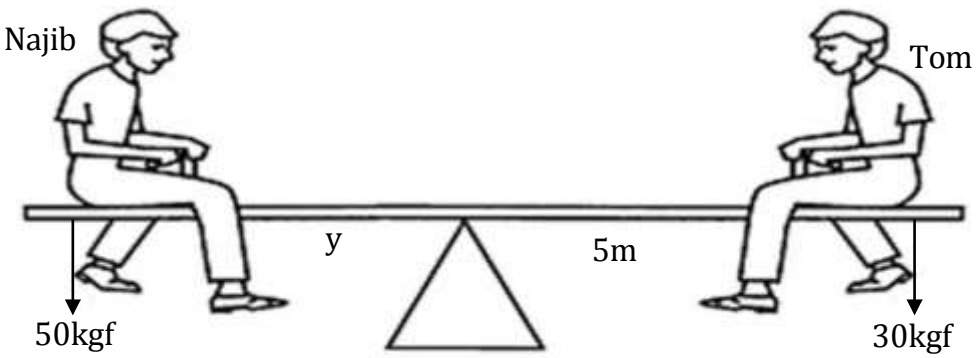

Load (L)
Effort (E)
Effort arm (E.A)
Load arm (L.A)
Pivot
(Fulcrum)

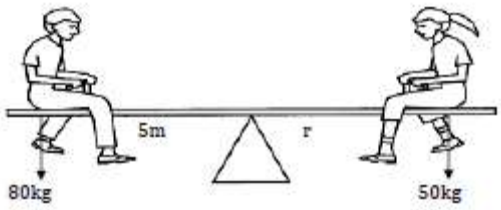

A pair of tongs
P
E
L
Hoe
E
P
L
Shovel
L
E
P
Broom
P
E
Human arm
L
E
P
Spade
P
L
E
Fishing rod
E
P
L
Tweezers
E
P
L
E
Artificial arm
E
L
P

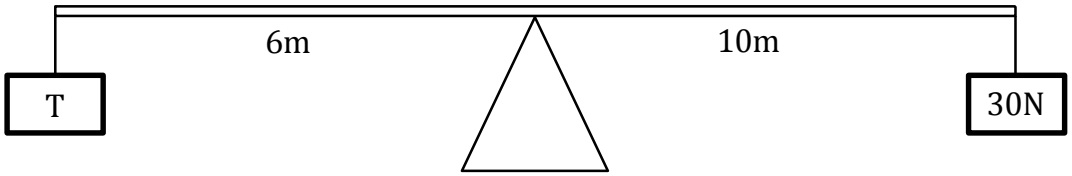

Lynet
Danivia

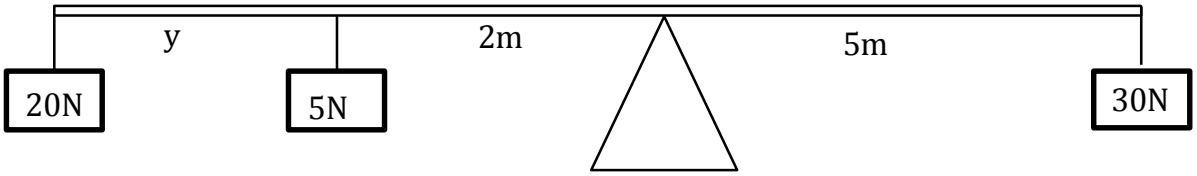

Nakato
Kato
3m
3m
F
Old car tyre

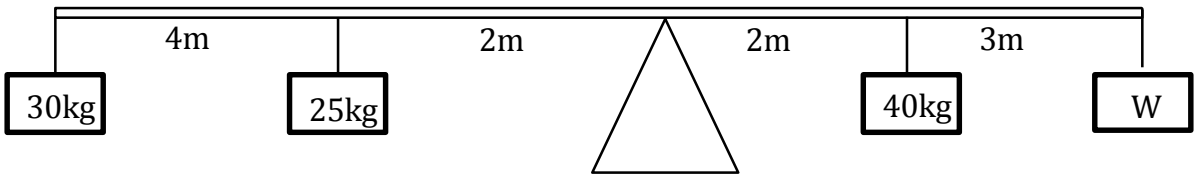

3m
6m
60kgf
K

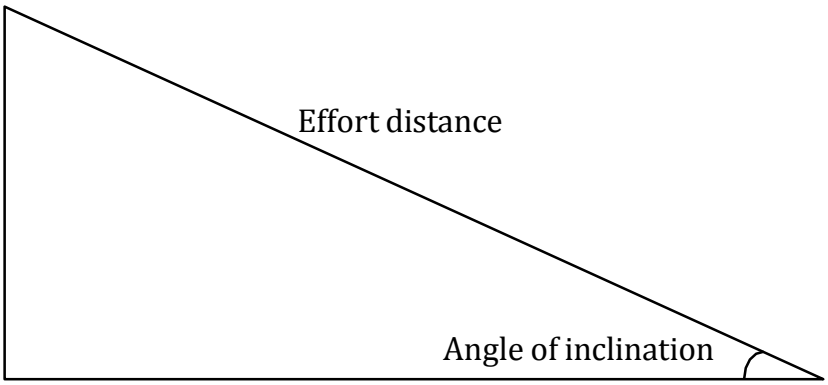

Najib
Tom
y
5m
50kgf
30kgf

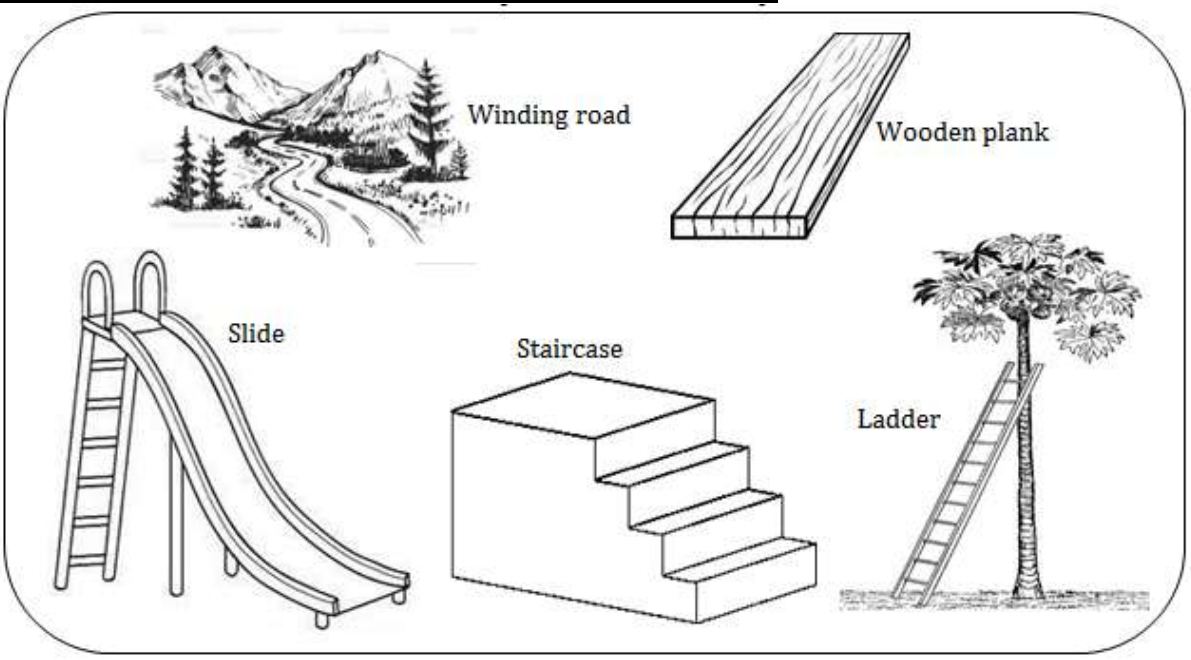

5m
r
80kg
50kg

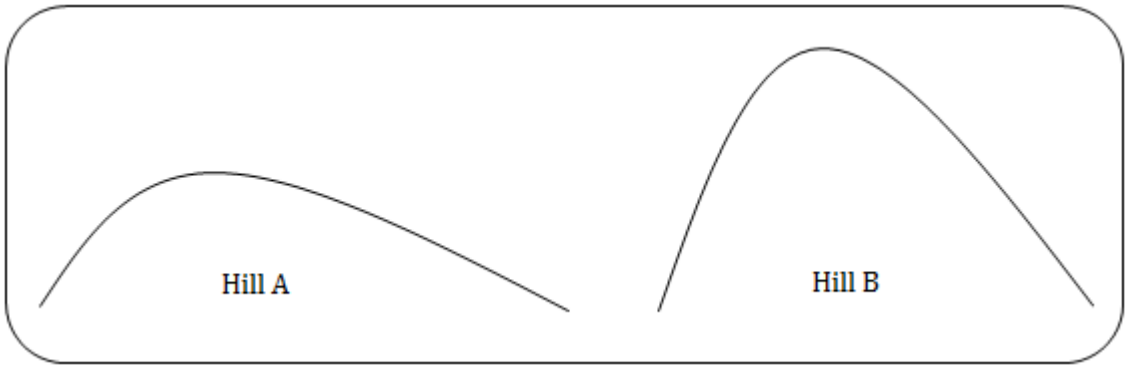

6m
10m
T
30N

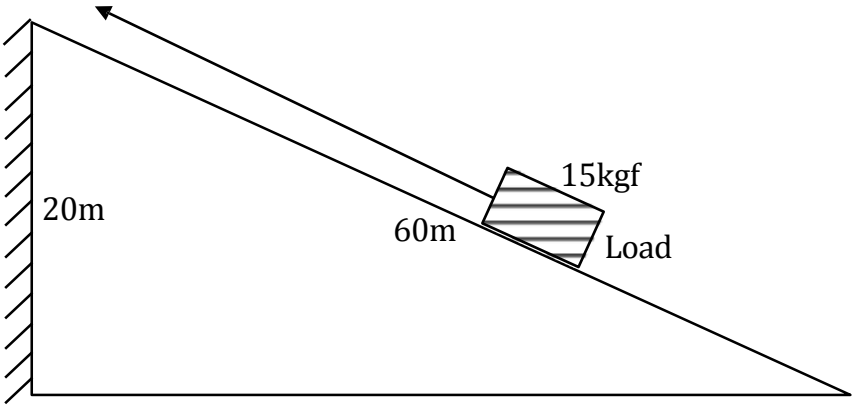

y
2m
5m
20N
5N
30N

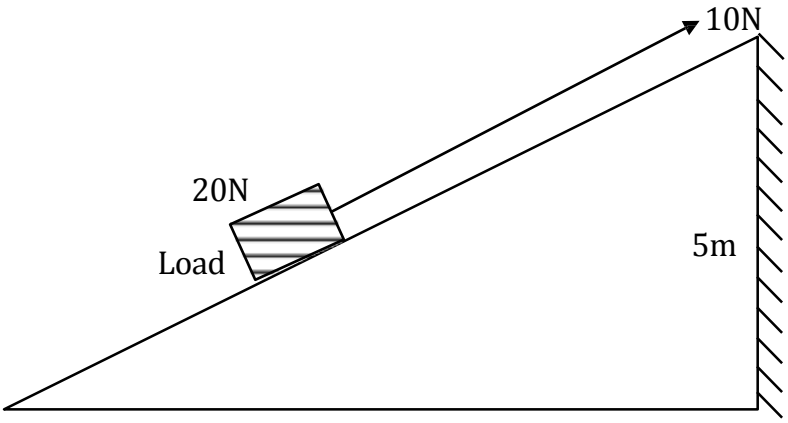

4m
2m
2m
3m
30kg
25kg
40kg
W

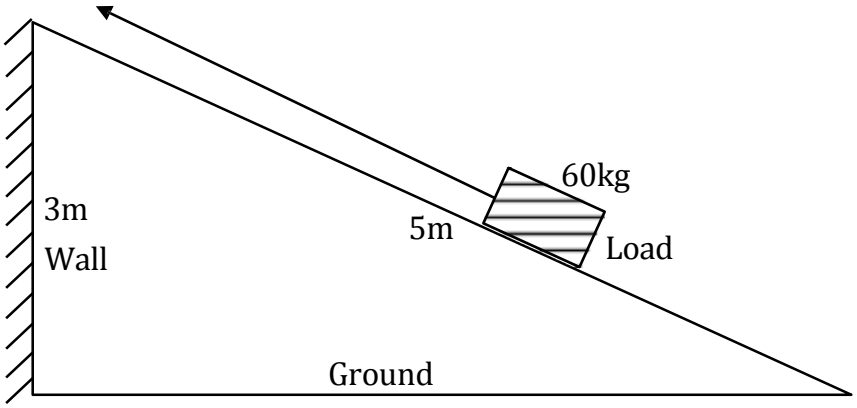

Effort distance
Angle of inclination

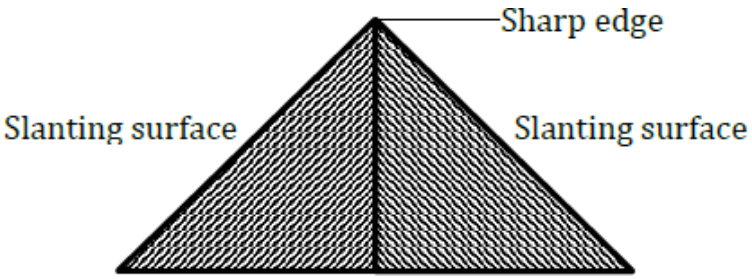

Winding road
Wooden plank
Slide
Staircase
Ladder

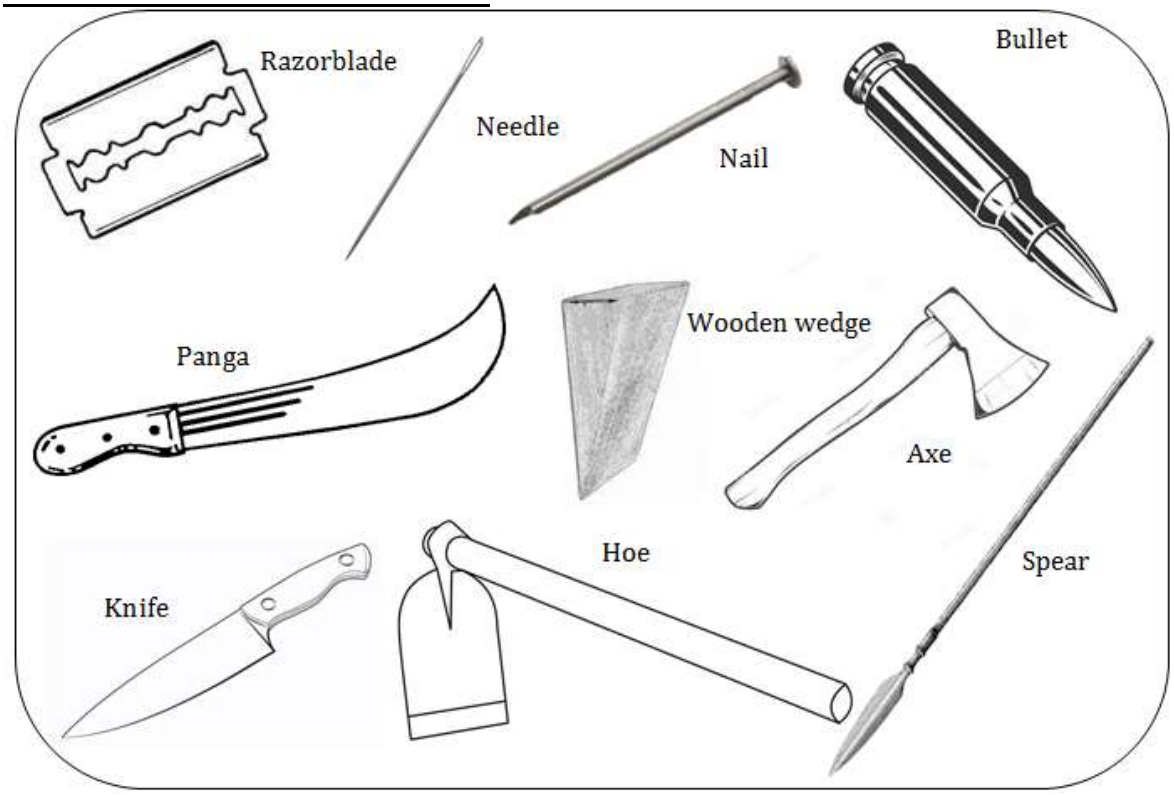

Hill A
Hill B

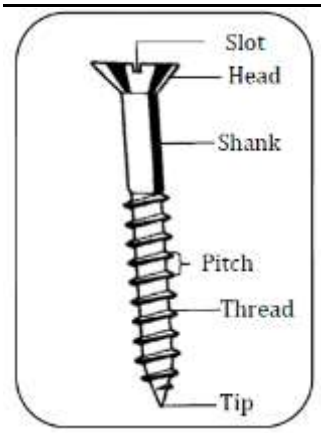

15kgf
20m
60m
Load

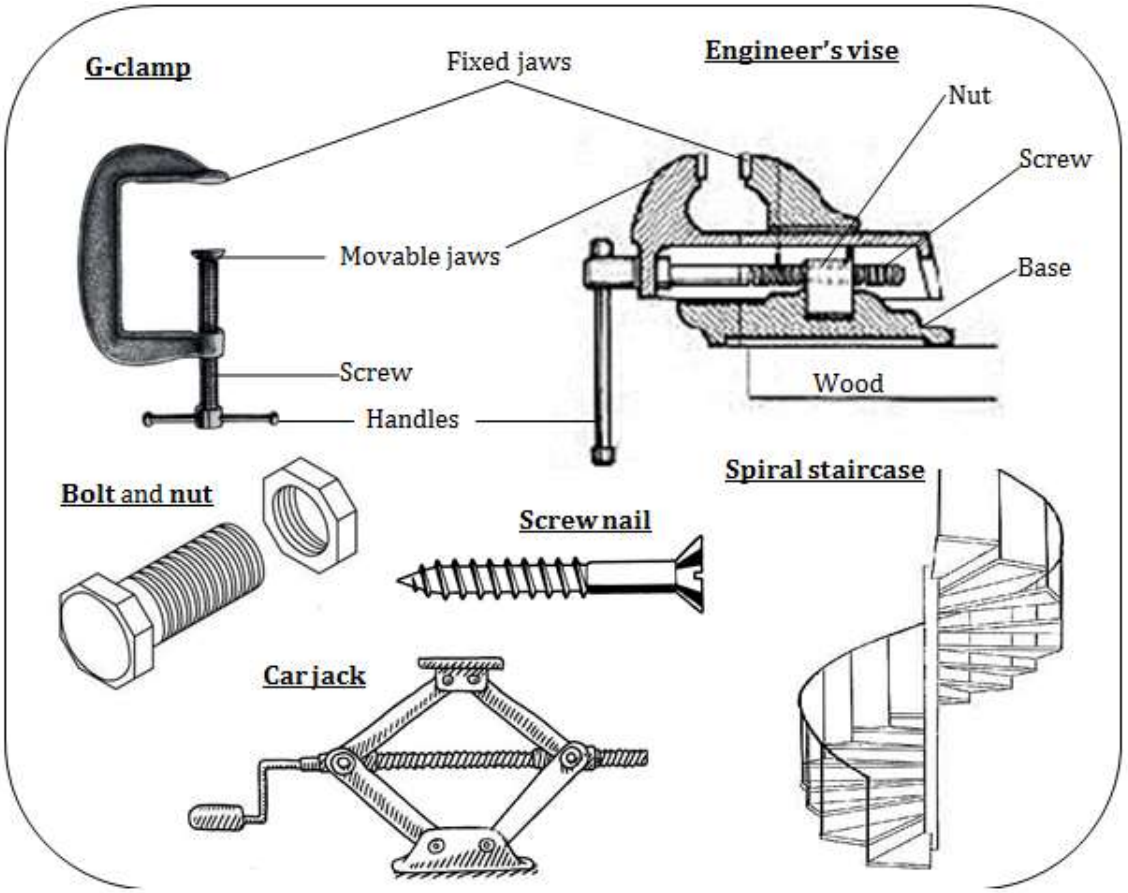

10N
20N
Load
5m

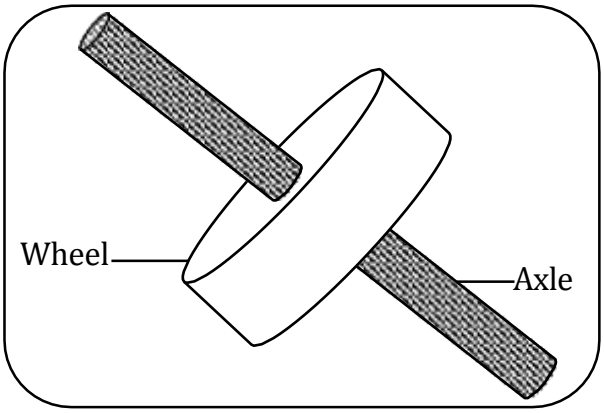

60kg
3m
Wall
5m
Load
Ground

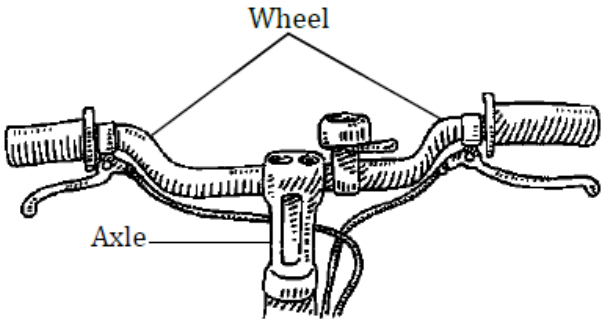

Sharp edge
Slanting surface
Slanting surface

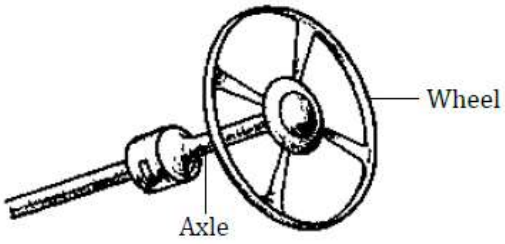

Razorblade
Needle
Nail
Bullet
Panga
Wooden wedge
Axe
Knife
Hoe
Spear

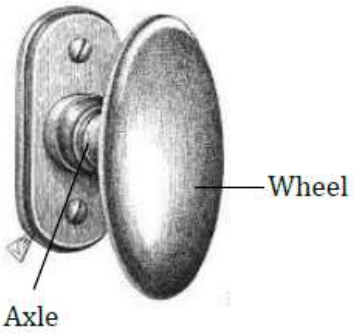

Slot
Head
Shank
Pitch
Thread
Tip

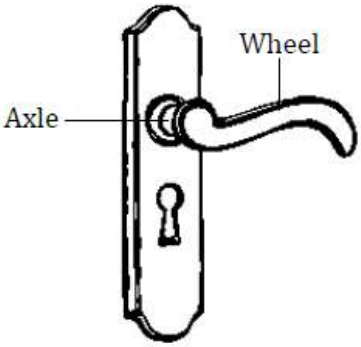

G-clamp
Fixed jaws
Movable jaws
Screw
Handles
Engineer's vise
Nut
Screw
Base
Wood
Bolt and nut
Screw nail
Car jack
Spiral staircase

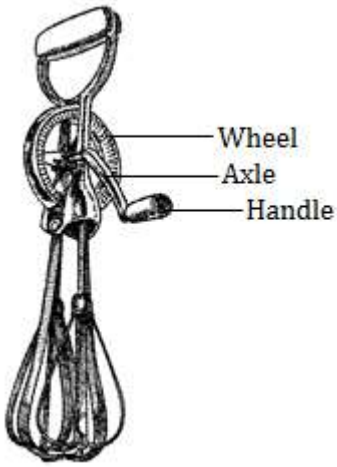

Wheel
Axle

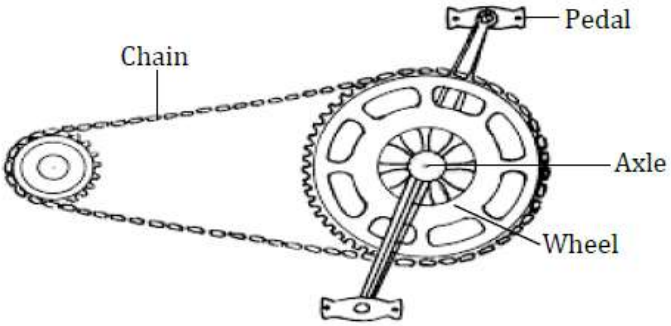

Wheel
Axle


Wheel
Axle

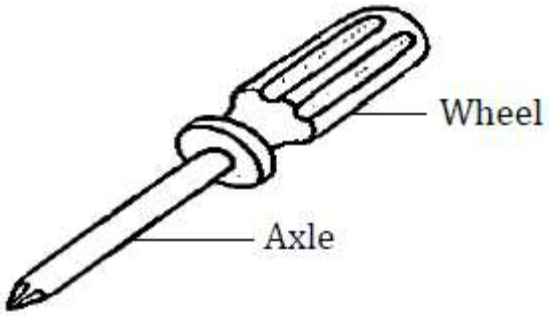

Wheel
Axle

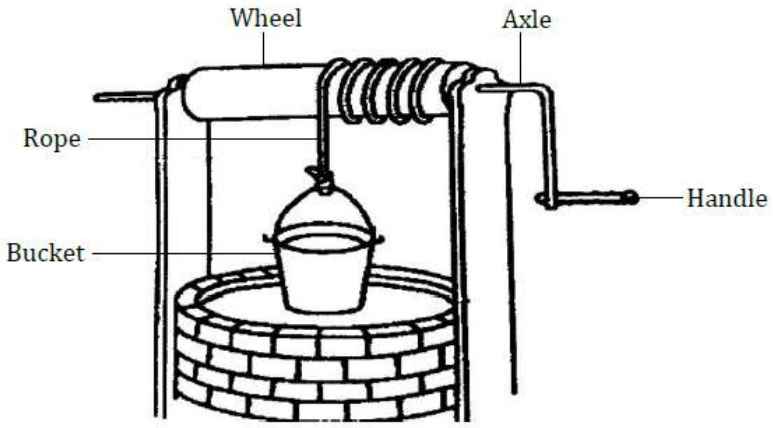

Wheel
Axle


Wheel
Axle
Handle


Pedal
Chain
Axle
Wheel


Wheel
Axle


Wheel
Axle


Wheel
Axle
Rope
Handle
Bucket

_____

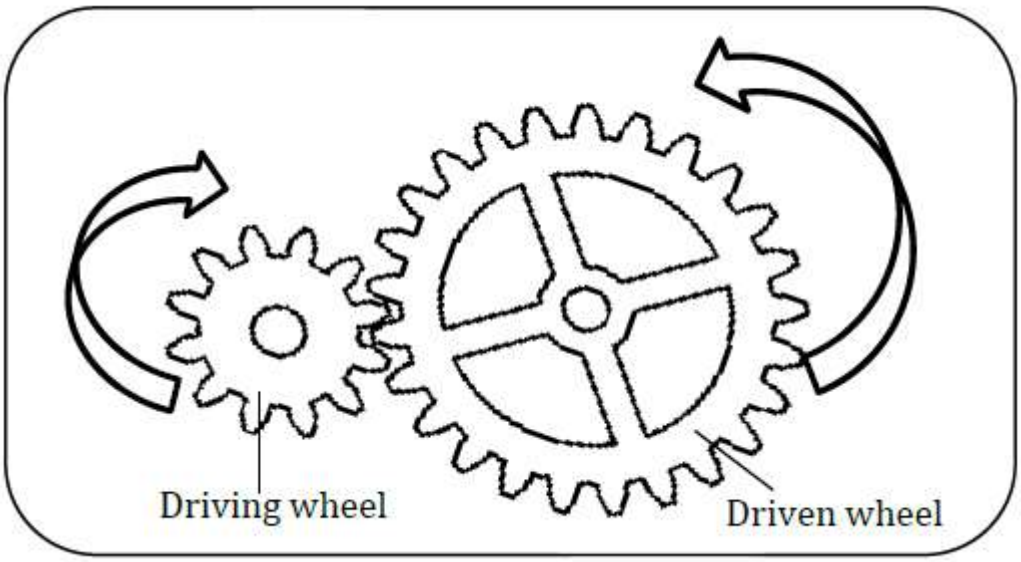
_____

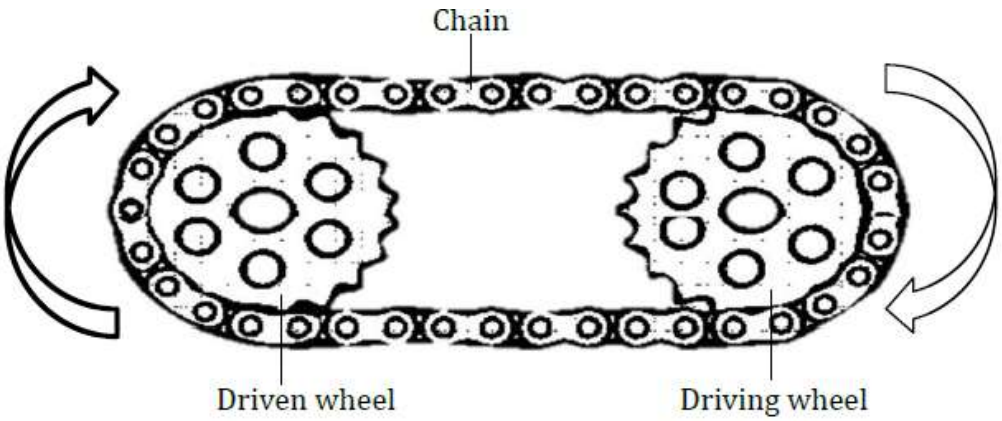
_____

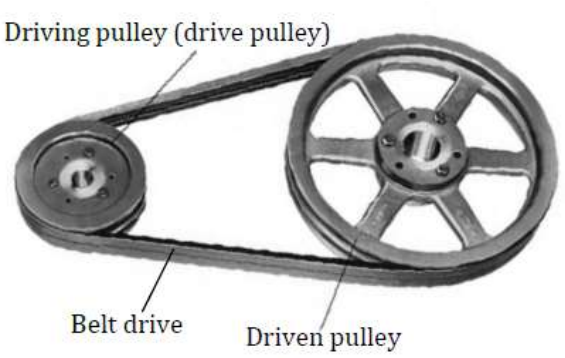
_____

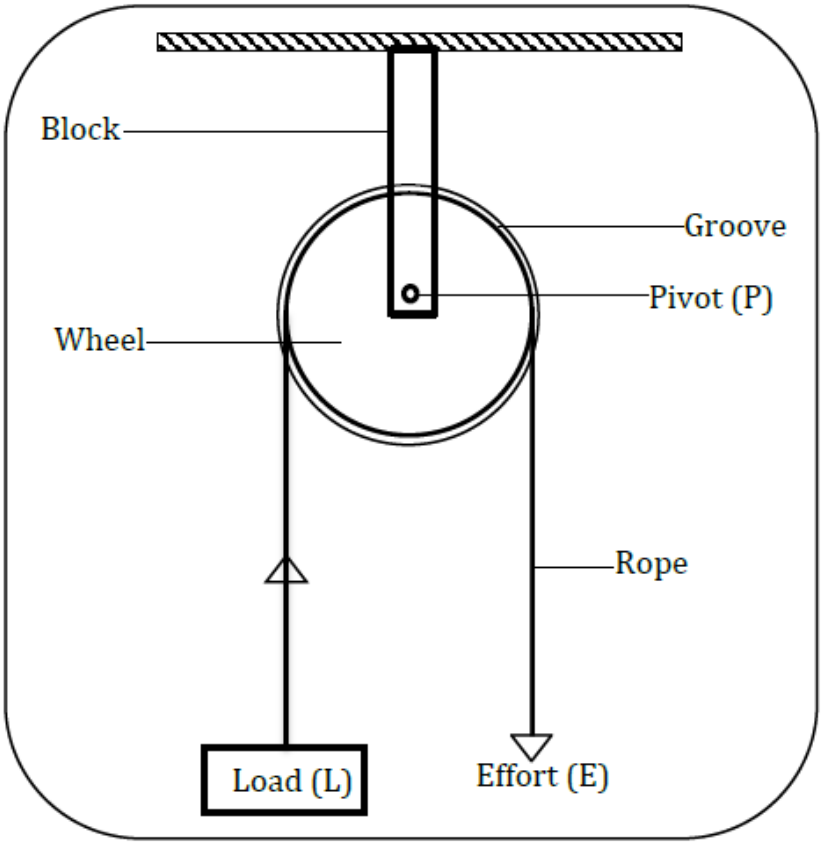
_____

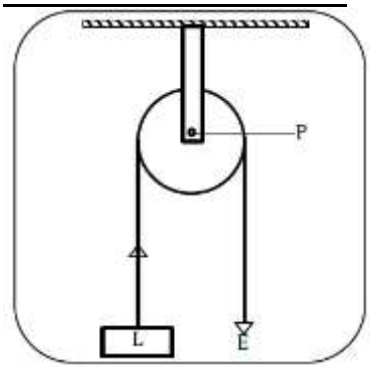
_____


Driving wheel
Driven wheel


Chain
Driven wheel
Driving wheel


Driving pulley (drive pulley)
Belt drive
Driven pulley


Block
Groove
Pivot (P)
Wheel
Rope
Load (L)
Effort (E)



$$MA = \frac{L}{E} \quad \text{but; } L = E$$

$$= \frac{E}{E}$$

$$M.A = 1$$

MA = Load / Effort

1 = 50kgf / E

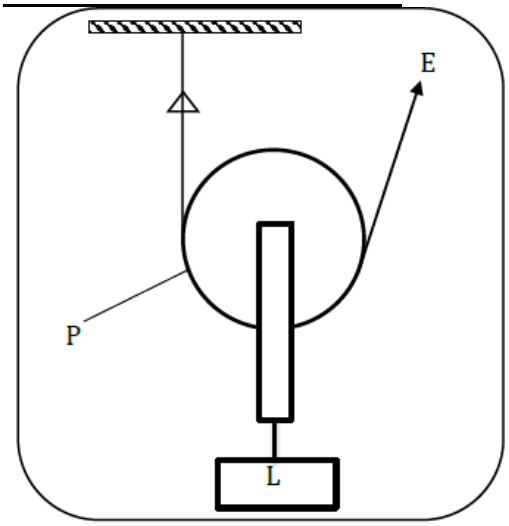
E = 50kgf

MA = $\frac{L}{E}$ but; MA = 1
L = 85N

1 = $\frac{85N}{E}$ E = ?

E x 1 = $\frac{85}{E}$ x E

E = 85N



MA = $\frac{L}{E}$ but; L = 2E

= $\frac{2E}{E}$

M.A = 2

$$M.A = \frac{L}{E}$$

$$2 = \frac{50kgf}{E}$$

$$E \times 2 = \frac{50kgf}{E} \times E$$

$$2E = 50kgf$$

$$\frac{2E}{2} = \frac{50kgf}{2}$$

$$E = 25kgf$$

$$M.A = \frac{L}{E}$$

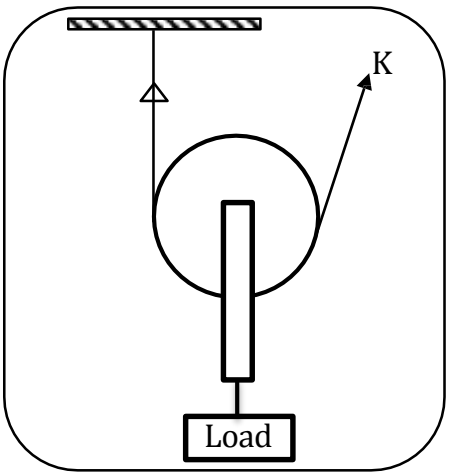
$$2 = \frac{90N}{E}$$

$$E \times 2 = \frac{90N}{E} \times E$$

$$2E = 90N$$

$$\frac{2E}{2} = \frac{90N}{2}$$

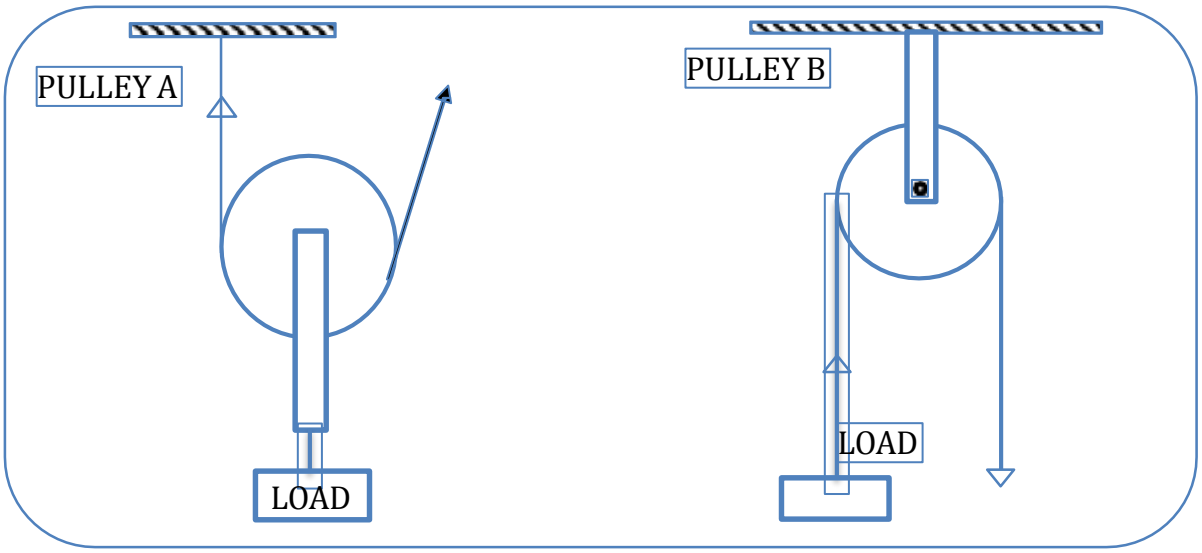
$$E = 45N$$

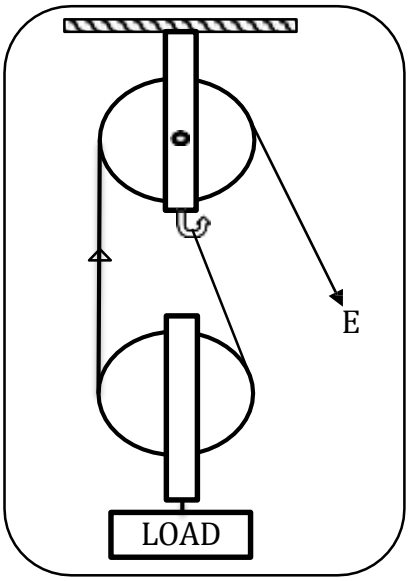


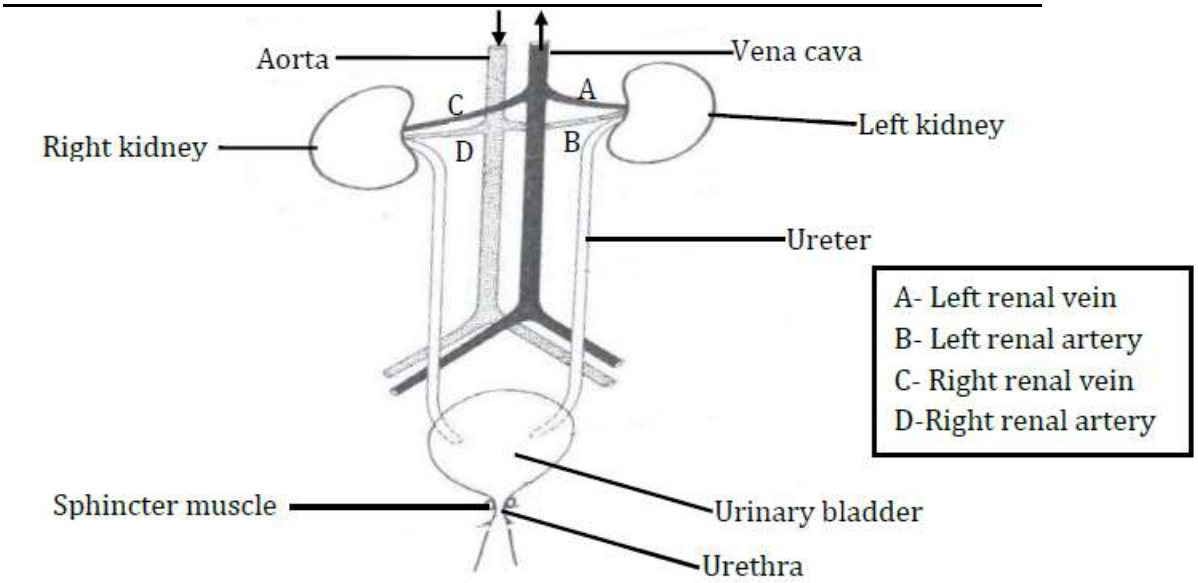
$$M.A = \frac{ED}{LD}$$

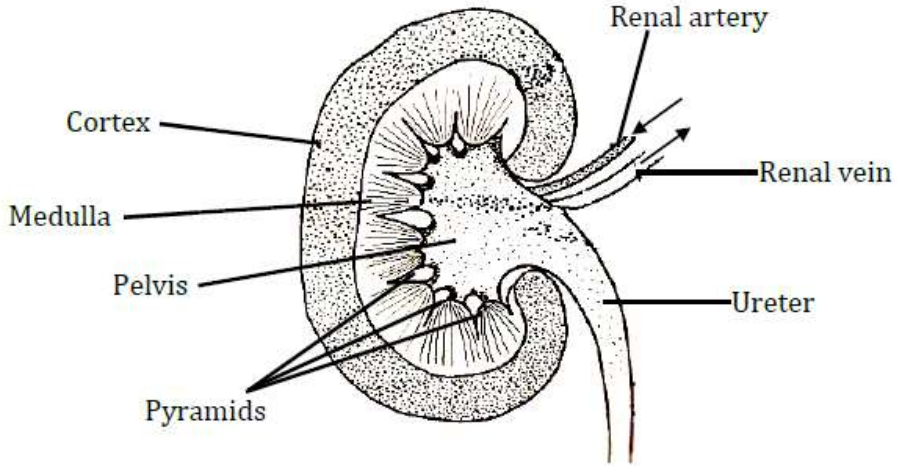
$$40m \times 2 = \frac{ED}{40m} \times 40m$$

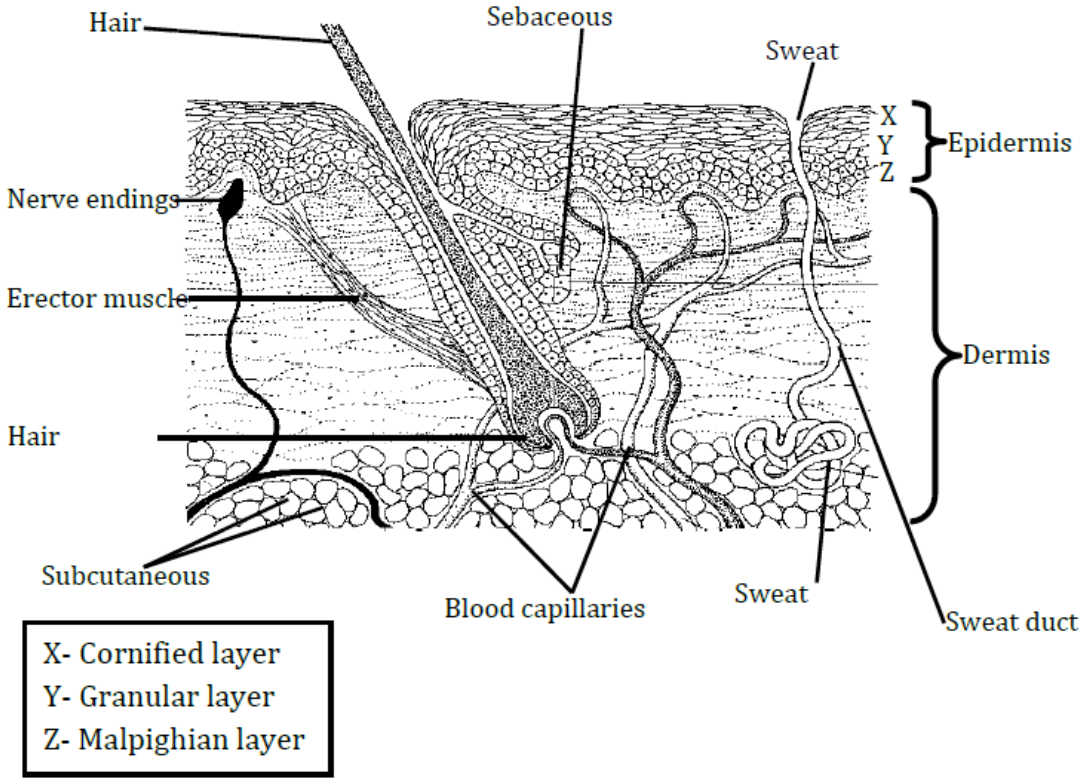
$$80m = ED$$

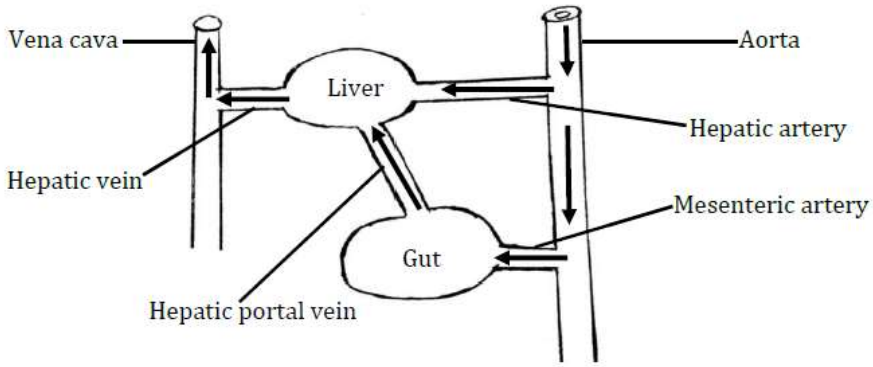

PULLEY A
LOAD
PULLEY B
LOAD

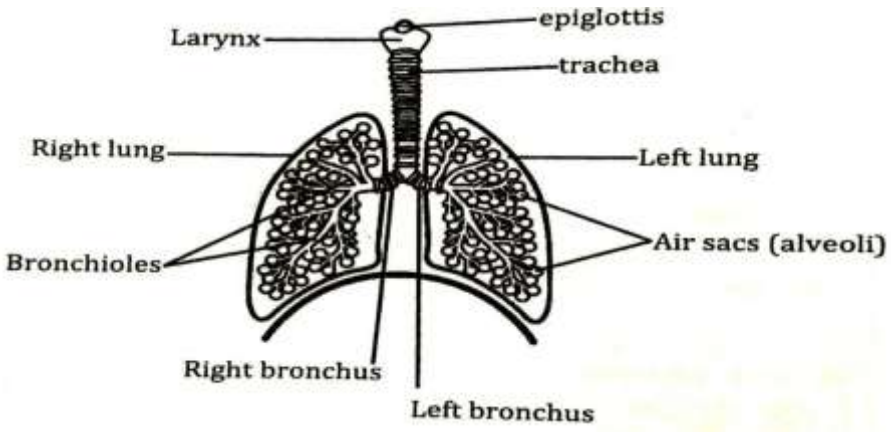

E
LOAD

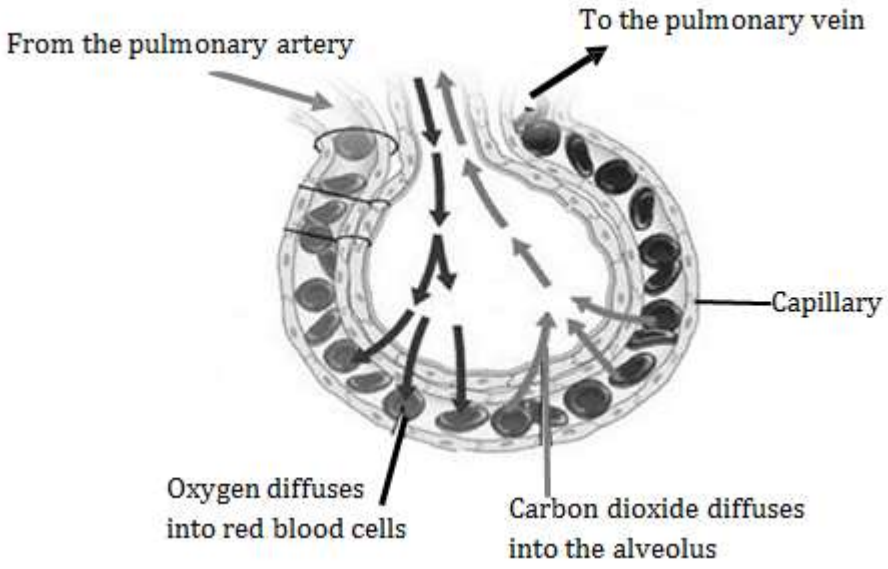

Aorta
Vena cava
A
C
Left kidney
Right kidney
D
B
Ureter
A- Left renal vein
B- Left renal artery
C- Right renal vein
D-Right renal artery
Sphincter muscle
Urinary bladder
Urethra

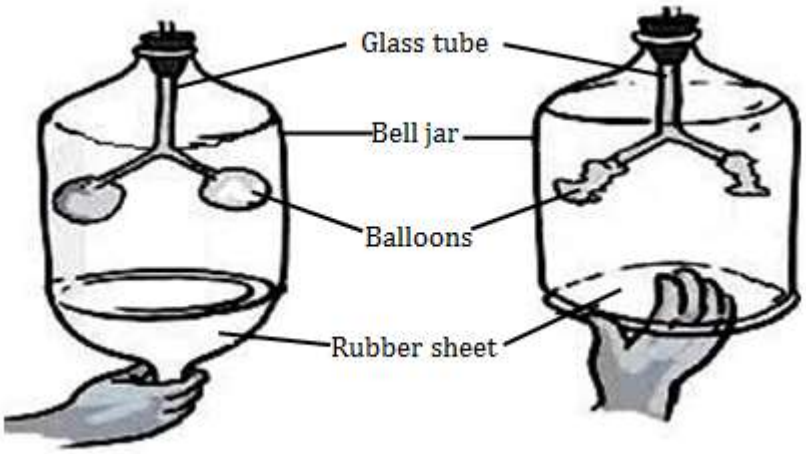

Renal artery
Cortex
Renal vein
Medulla
Pelvis
Ureter
Pyramids


Hair
Sebaceous
Sweat
X
Y
Z
Epidermis
Nerve endings
Erector muscle
Dermis
Hair
Subcutaneous
Blood capillaries
Sweat
Sweat duct
X- Cornified layer
Y- Granular layer
Z- Malpighian layer


Vena cava
Liver
Aorta
Hepatic artery
Hepatic vein
Mesenteric artery
Gut
Hepatic portal vein


Larynx
epiglottis
trachea
Right lung
Left lung
Bronchioles
Air sacs (alveoli)
Right bronchus
Left bronchus


From the pulmonary artery
To the pulmonary vein
Capillary
Oxygen diffuses into red blood cells
Carbon dioxide diffuses into the alveolus

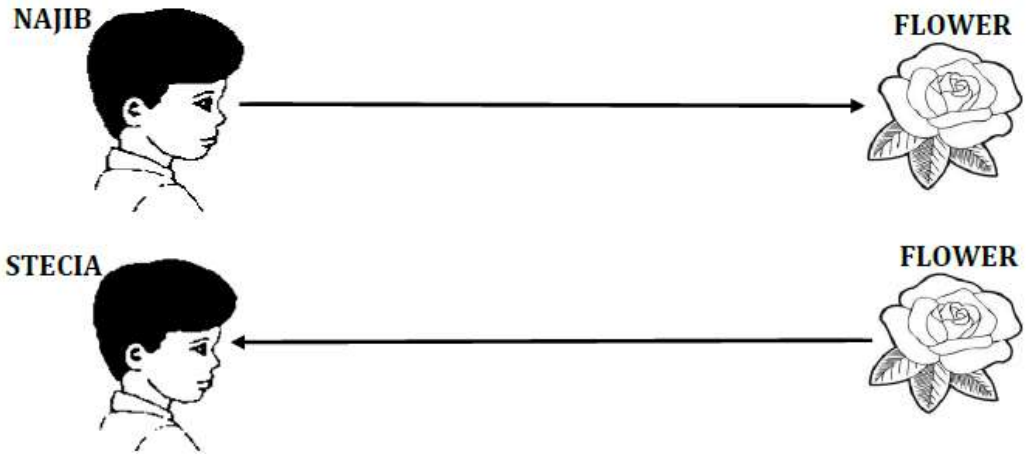

Glass tube
Bell jar
Balloons
Rubber sheet

Glucose (Food) + Oxygen ⟶ Energy + Carbon dioxide + Water vapour

⟶ } byproducts/waste products

_____

_____


NAJIB
FLOWER
STECIA
FLOWER

_____

_____

_____

_____

_____

_____

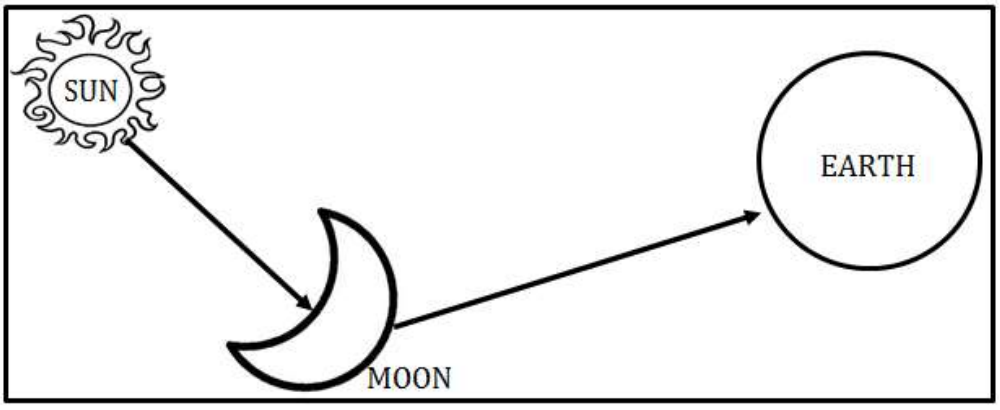
_____

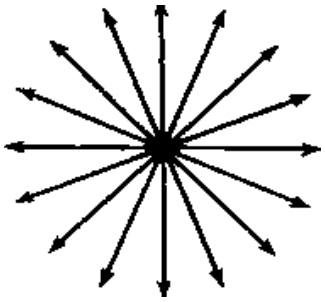
_____

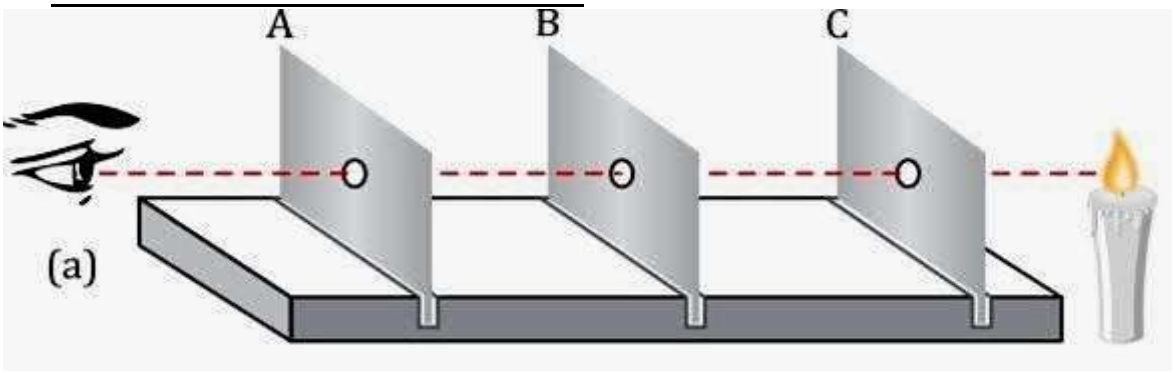
_____

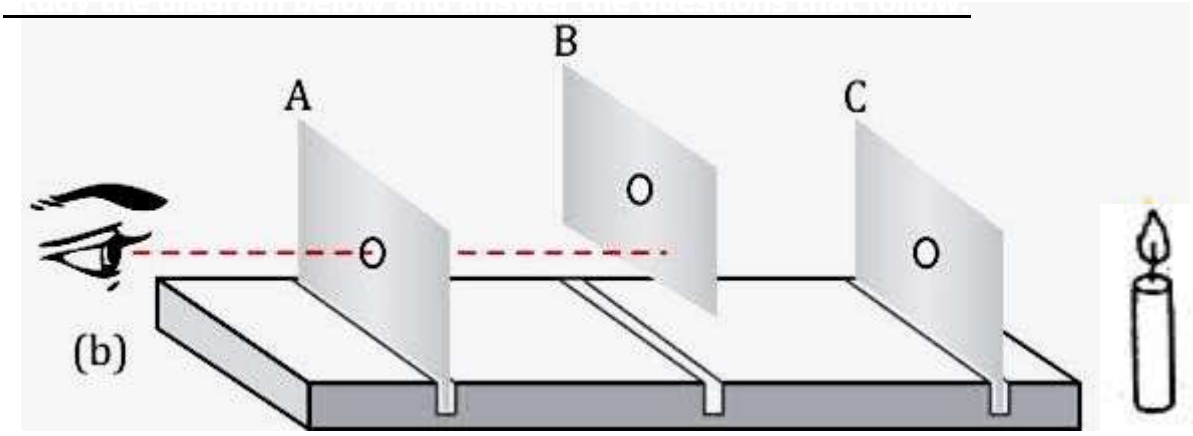
_____

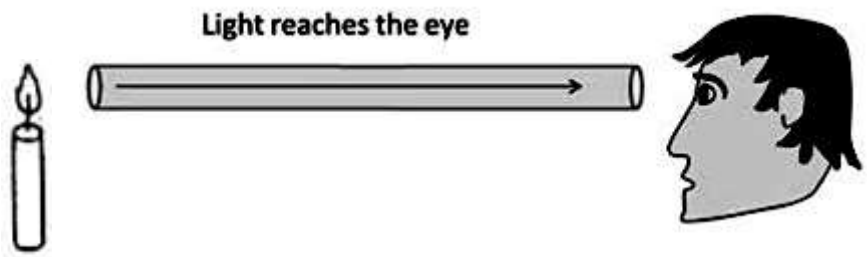
_____

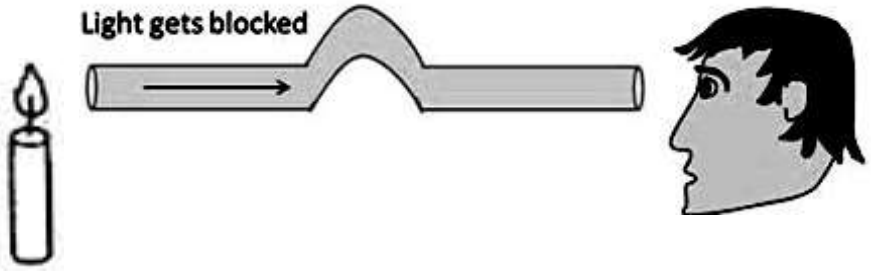

SUN
EARTH
MOON

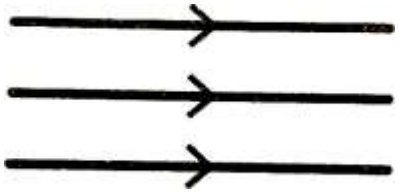



A
B
C
(a)


B
A
C
(b)


Light reaches the eye

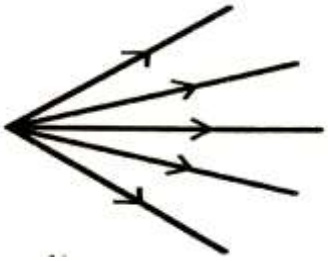

Light gets blocked



_____

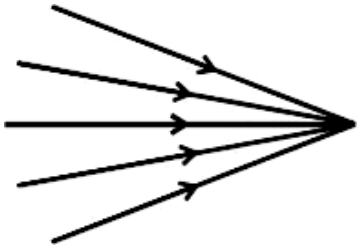
_____

_____



_____

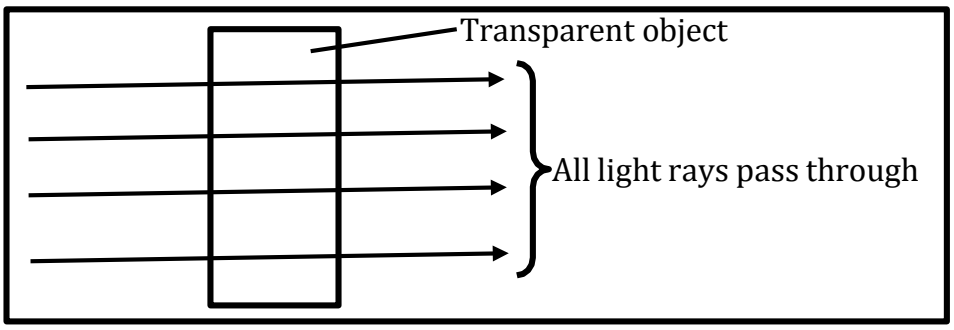
_____

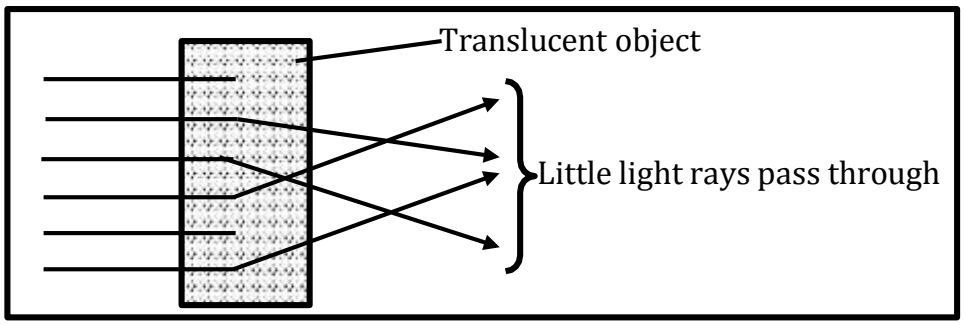


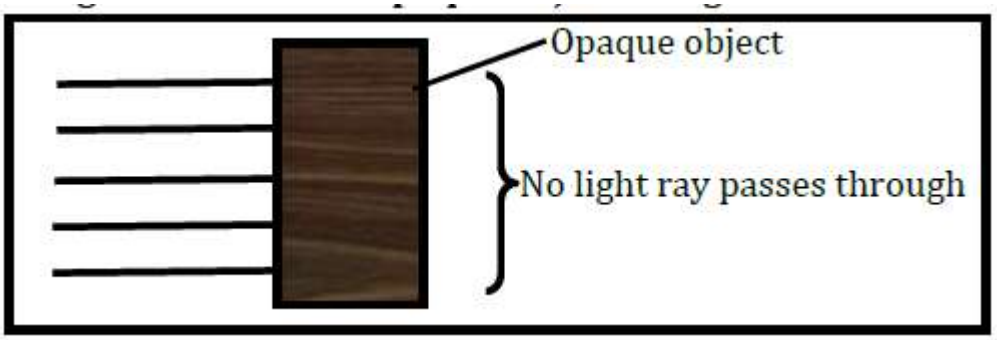
_____

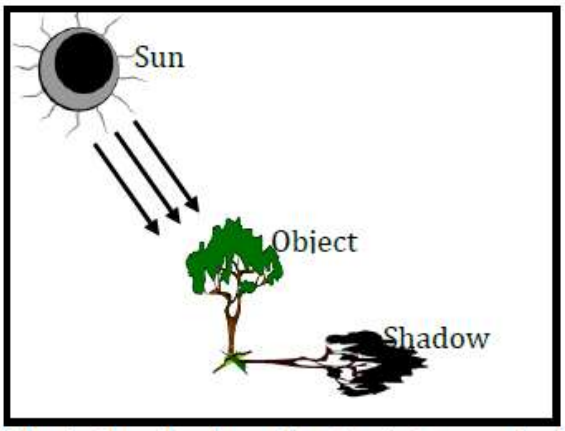
_____

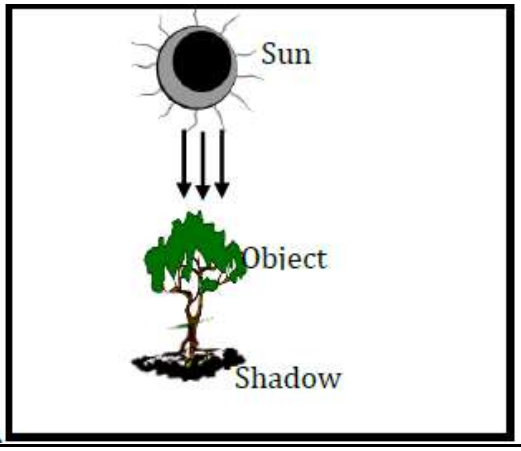
_____

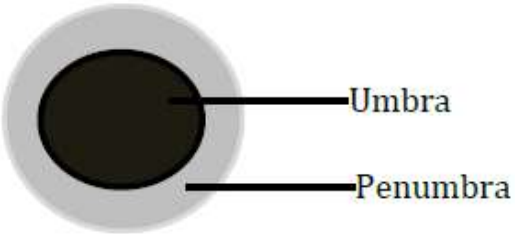

Transparent object
All light rays pass through

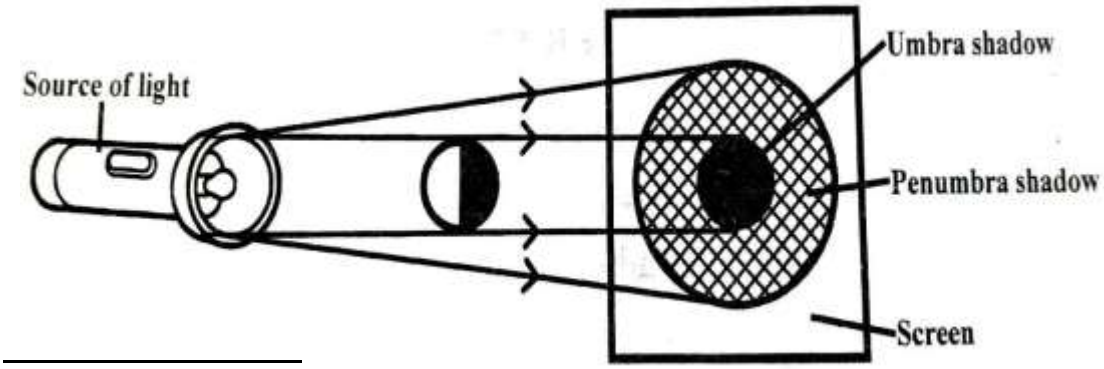

Translucent object
Little light rays pass through

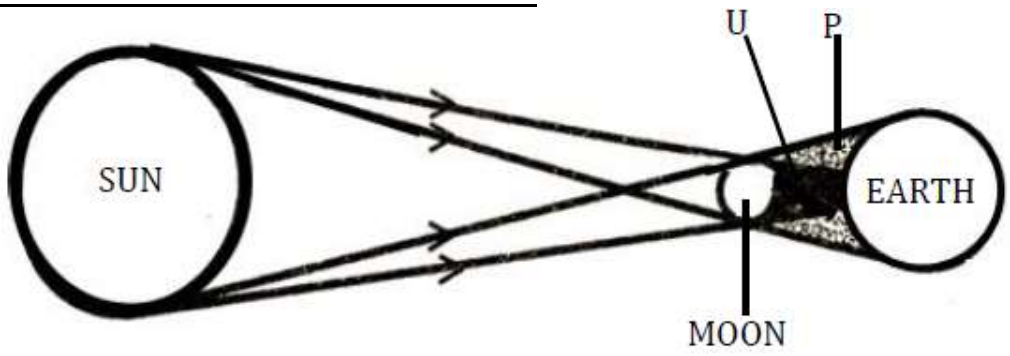

Opaque object
No light ray passes through

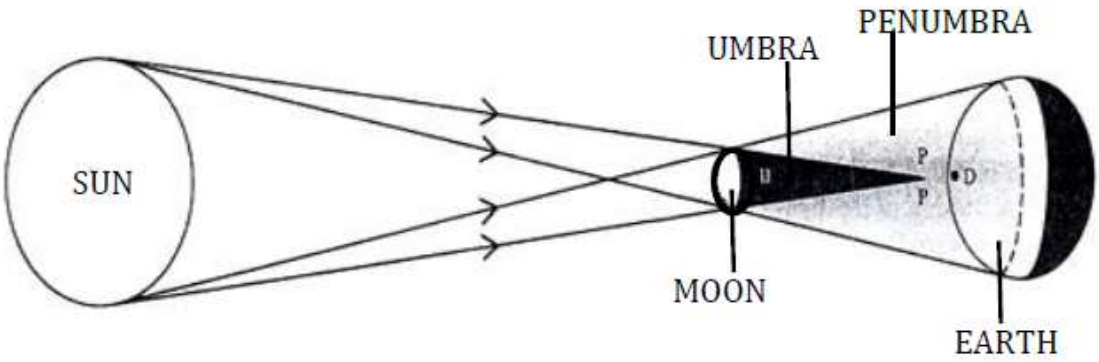

Sun
Object
Shadow

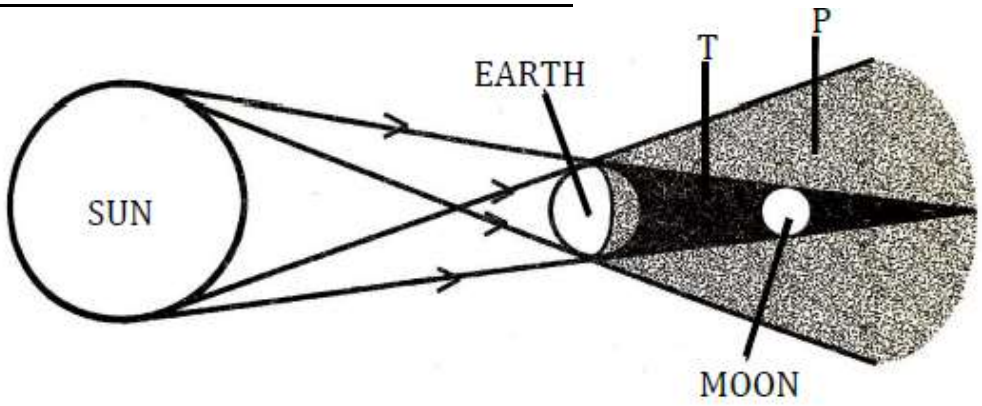

Sun
Object
Shadow

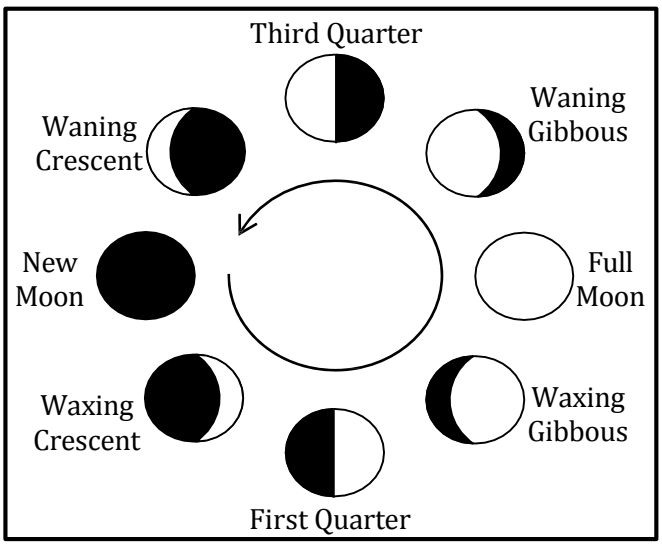

Umbra
Penumbra

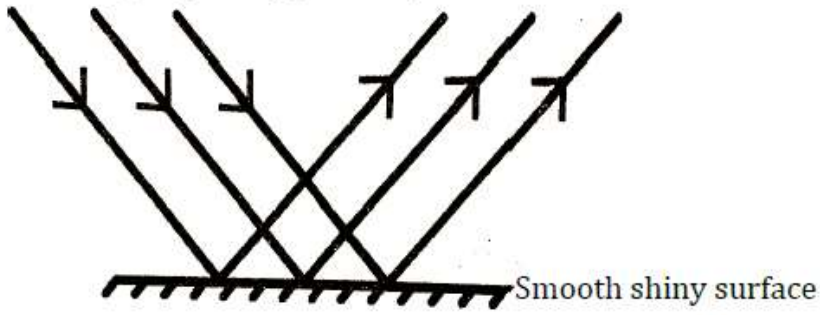

Source of light
Umbra shadow
Penumbra shadow
Screen

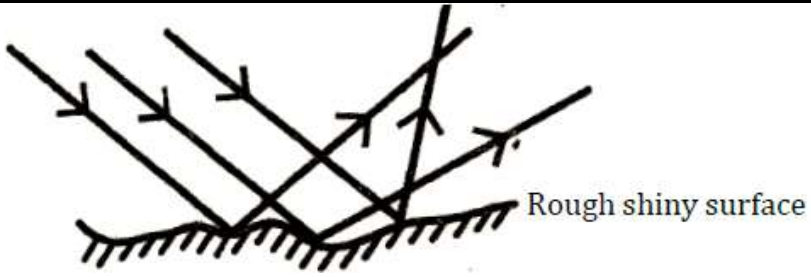

U
P
SUN
EARTH
MOON

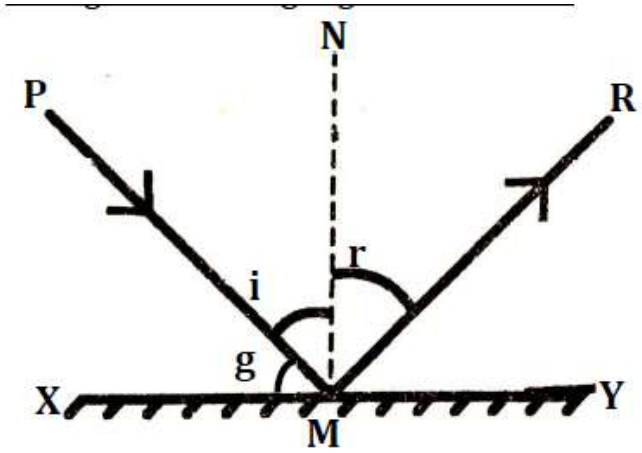

PENUMBRA
UMBRA
SUN
P
U
P
D
MOON
EARTH


P
T
EARTH
SUN
MOON

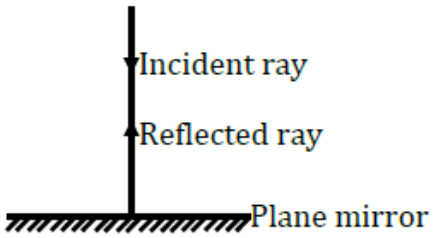

Third Quarter
Waning Crescent
Waning Gibbous
New Moon
Full Moon
Waxing Crescent
Waxing Gibbous
First Quarter

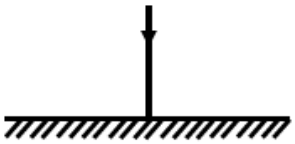

Smooth shiny surface

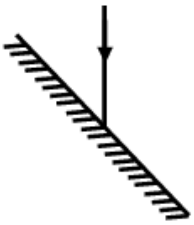

Rough shiny surface

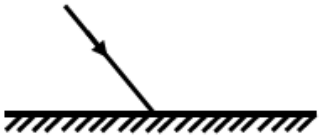


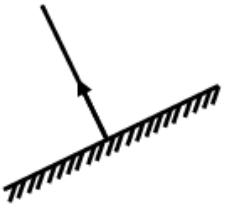
XMY -Plane mirror
M -Point of incidence
PM-Incident ray
RM-Reflected ray
NM-Normal
i-Angle of incidence
r-Angle of reflection
g -Glancing angle

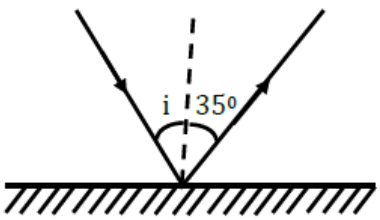








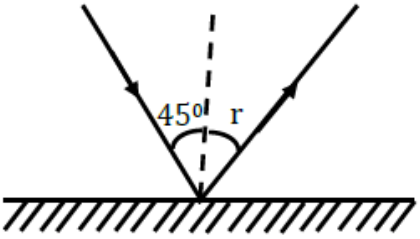




$i + 35^0 = 90^0$

$i + 35^0 - 35^0 = 90^0 - 35^0$

$i = 55^0$



Since; i = r

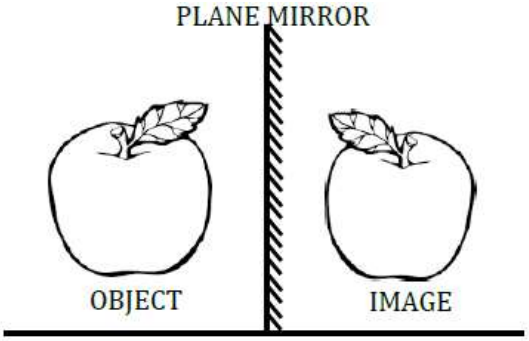
$r = 45^0$.

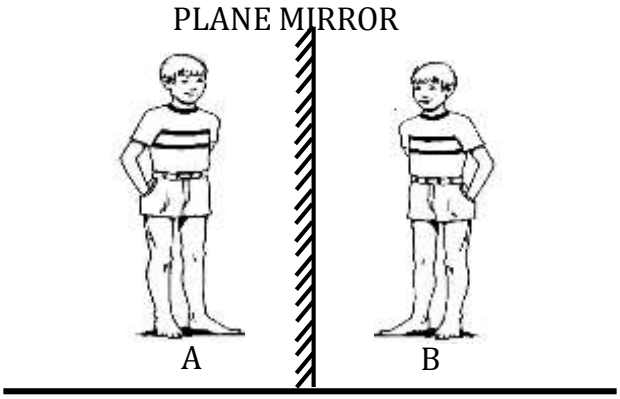

PLANE MIRROR
OBJECT
LIGHT
IMAGE

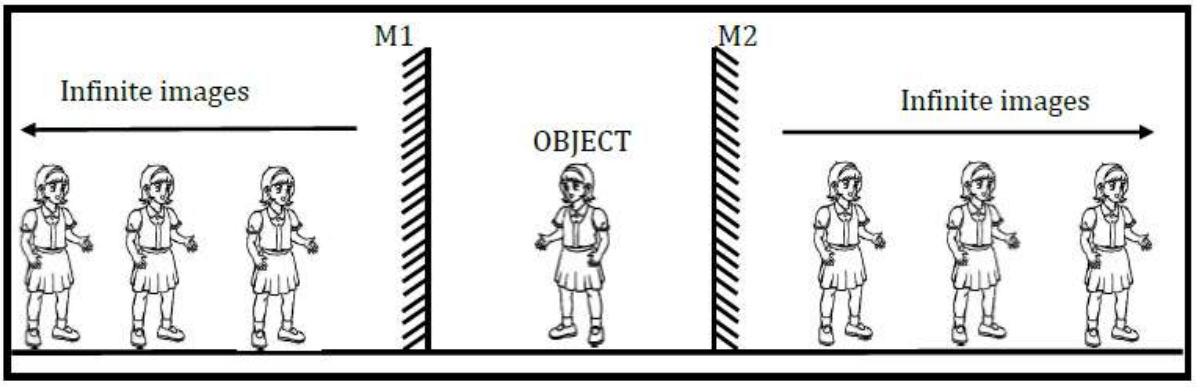

AMBULANCE

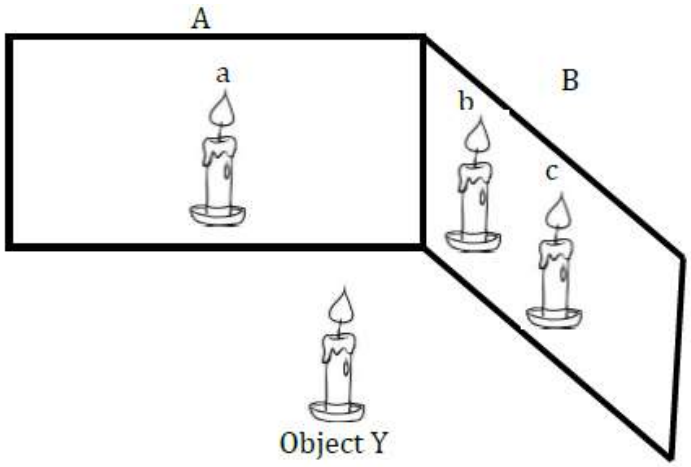

PLANE MIRROR
OBJECT
IMAGE
PLANE MIRROR
IMAGE
OBJECT

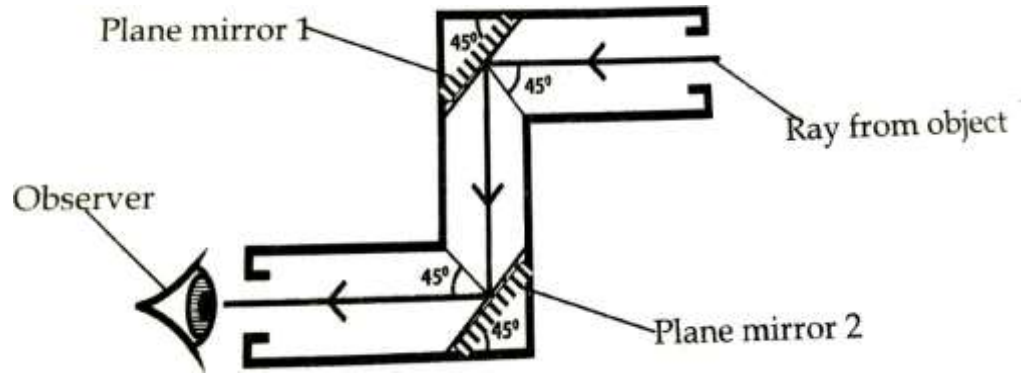

OBJECT
MONEY
IMAGE

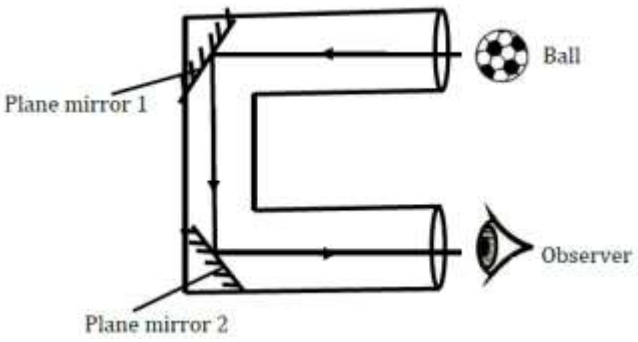

PLANE MIRROR
OBJECT
IMAGE


PLANE MIRROR
A
B


M1
M2
Infinite images
OBJECT
Infinite images


A
a
B
b
c
Object Y


Plane mirror 1
45°
45°
Ray from object
Observer
45°
45°
Plane mirror 2


Ball
Plane mirror 1
Observer
Plane mirror 2

_____

_____

_____

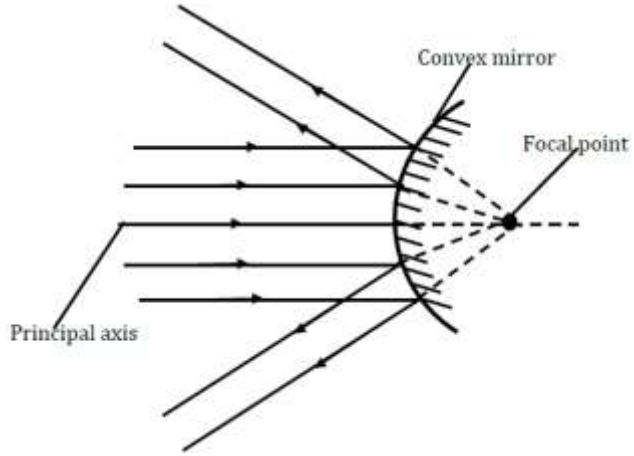
_____

_____

_____

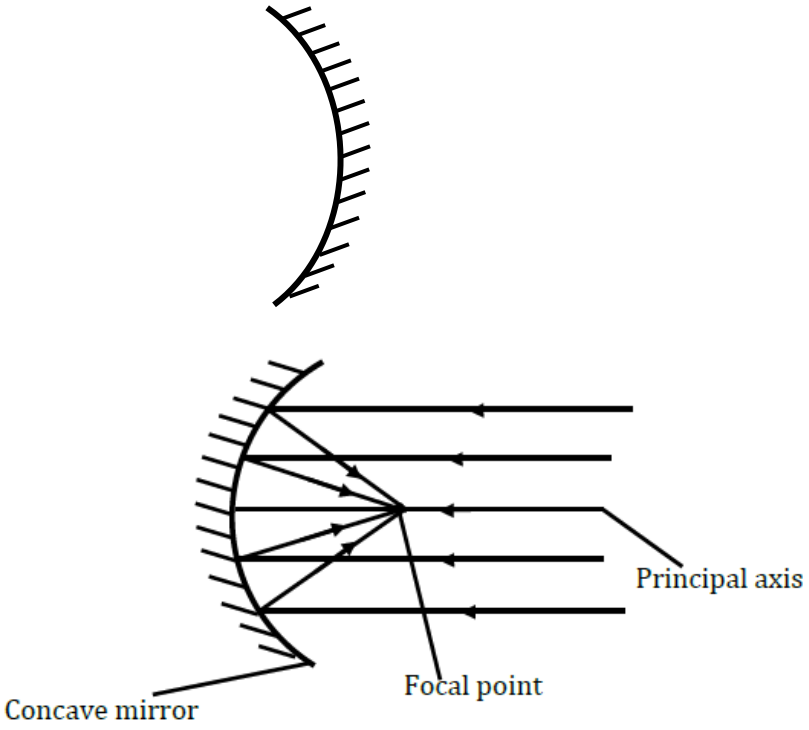
_____

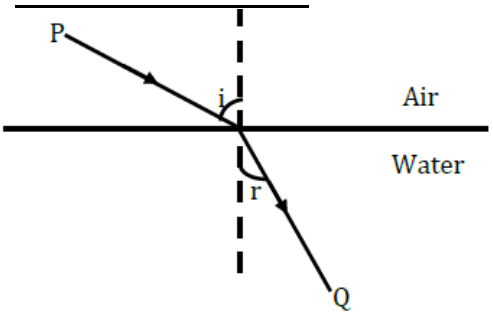
_____


Convex mirror
Focal point
Principal axis

_____

_____


Principal axis
Focal point
Concave mirror



Naming the rays of light

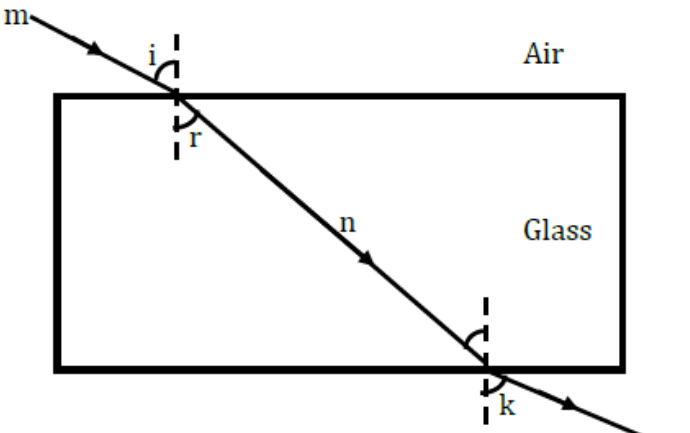
P ---- Incident ray

Q---- Refracted ray

Naming the angles

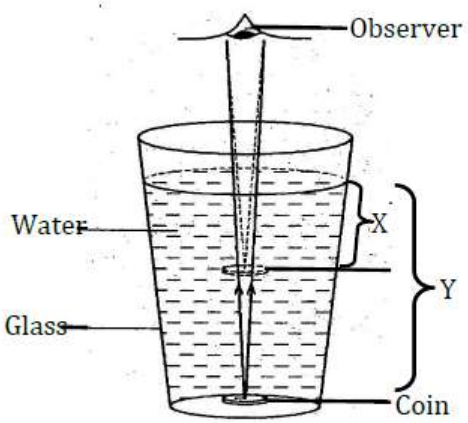
i ---- Angle of incidence

r ---- Angle of refraction



Naming the rays of light

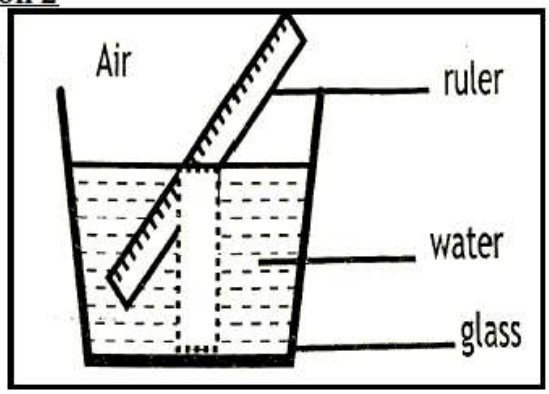
- m ---- Incident ray
- n ---- Refracted ray
- x ---- Emergent refracted ray



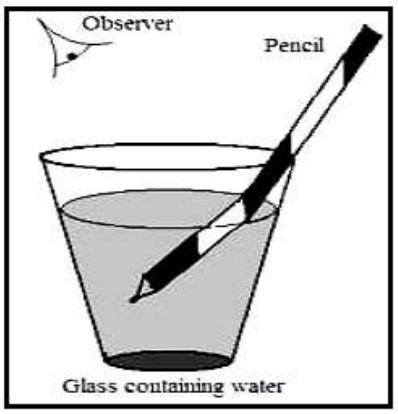
X- Apparent depth
Y- Real depth

Illustration 2

A



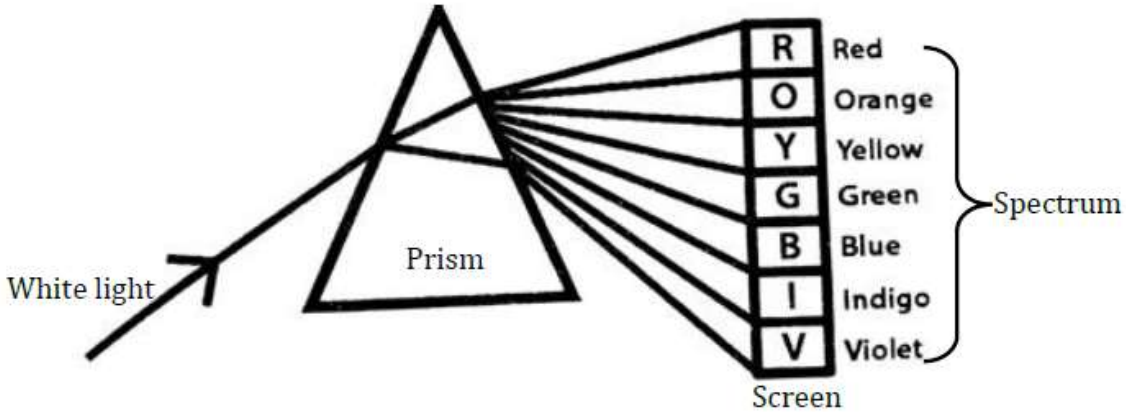
B

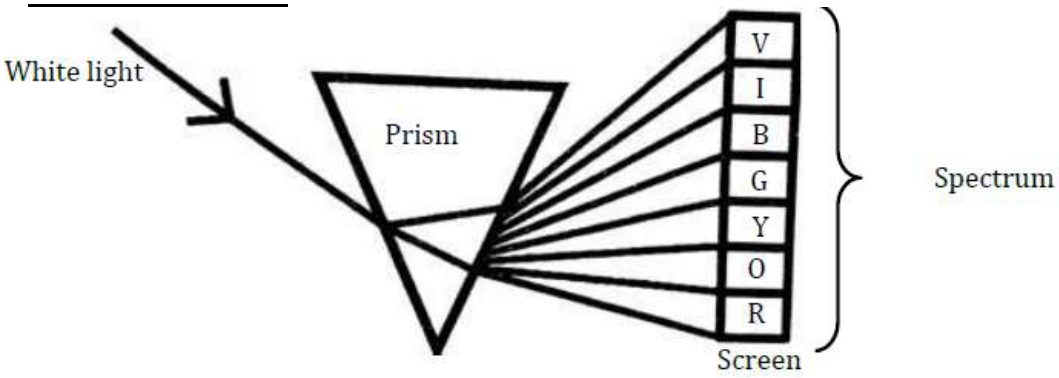


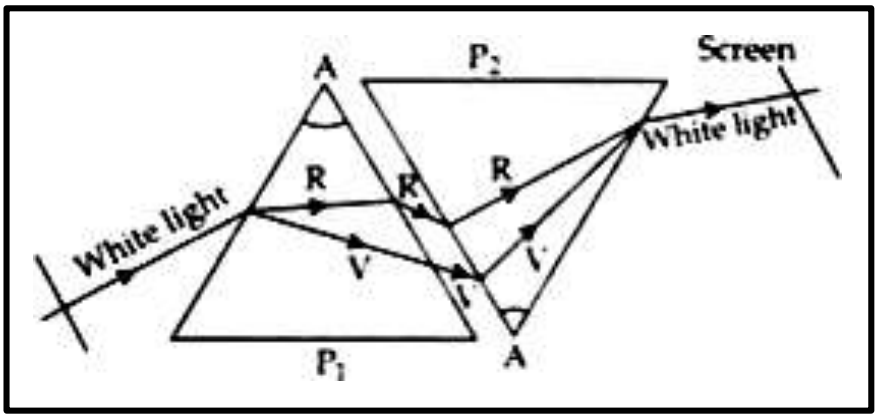
- Red
- Orange
- Yellow
- Green
- Blue
- Indigo
- Violet

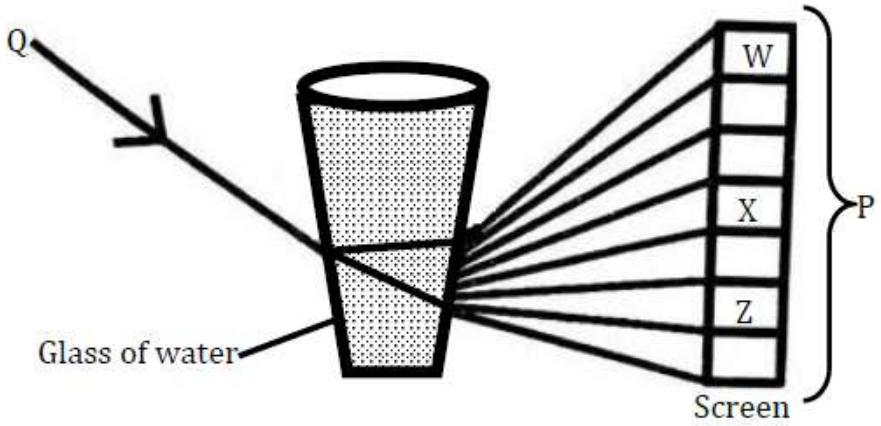
MNEMONICS FOR THE ORDER OF SPECTRUM

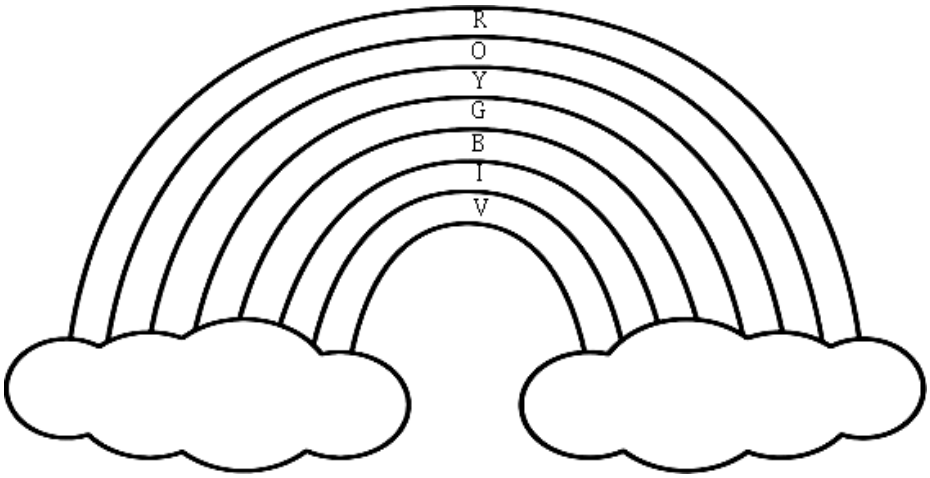
1. Richard Okello Your Girl Betty Is Vomiting
2. Richard Of York Gave Birth In Vain
3. Read Only Your Golden Book In Venus

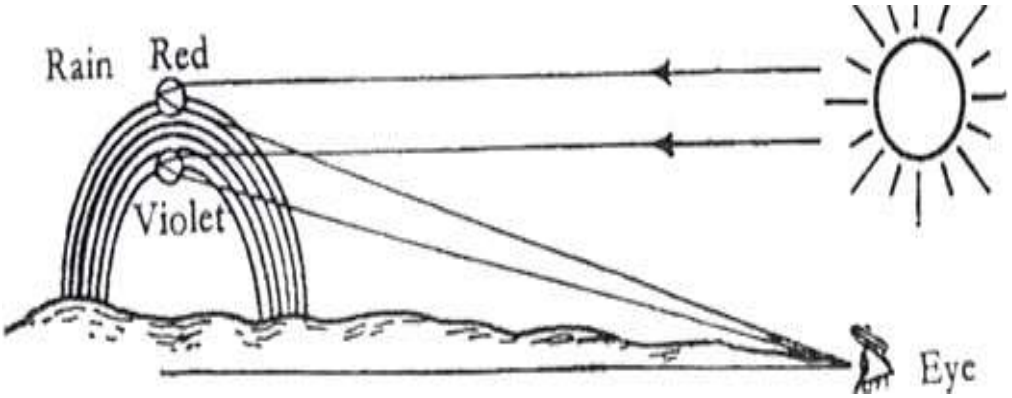


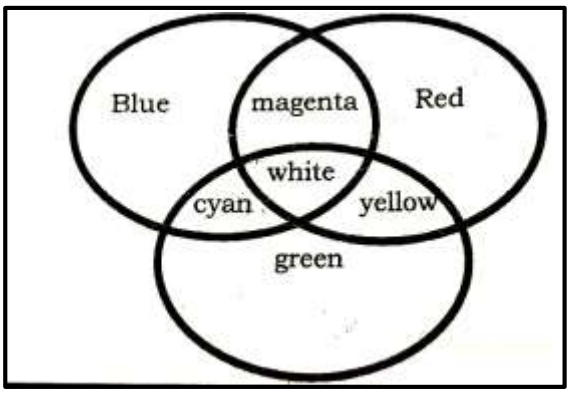


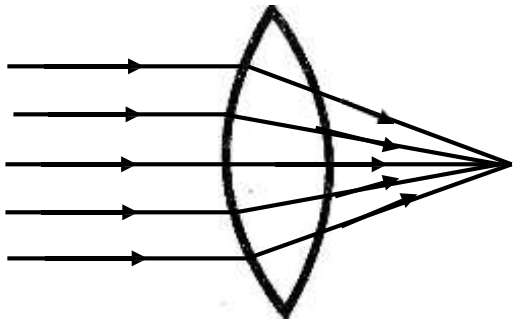

A
P_2
Screen
White light
R
R
R
White light
V
I
I
P_1
A

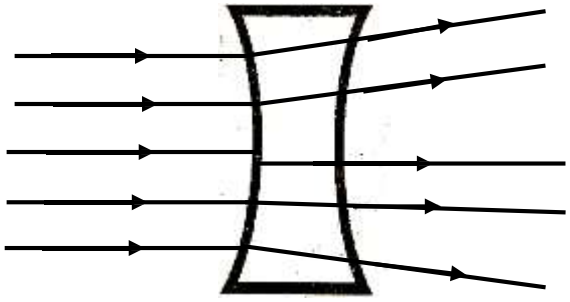

Q
W
X
Z
P
Glass of water
Screen

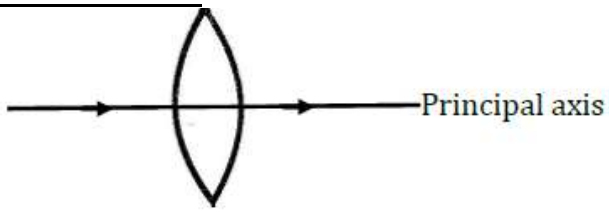

R
O
Y
G
B
I
V

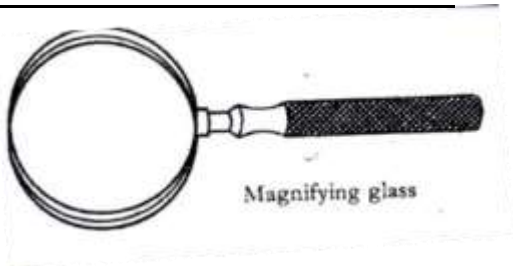

Rain
Red
Violet
Eye

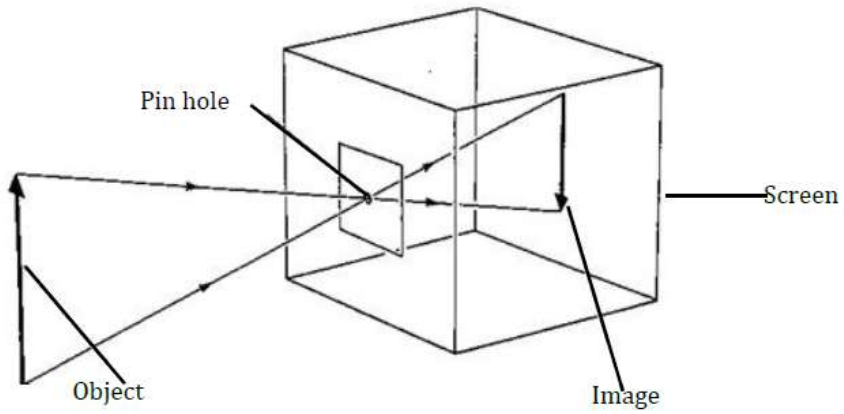

Blue
magenta
Red
white
cyan
yellow
green

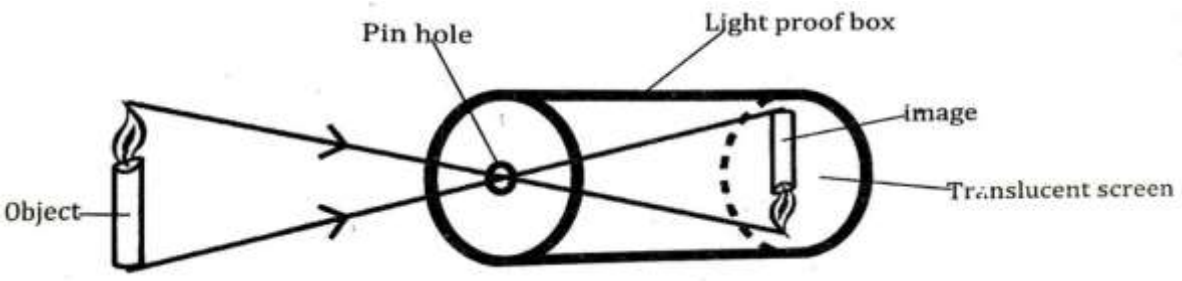




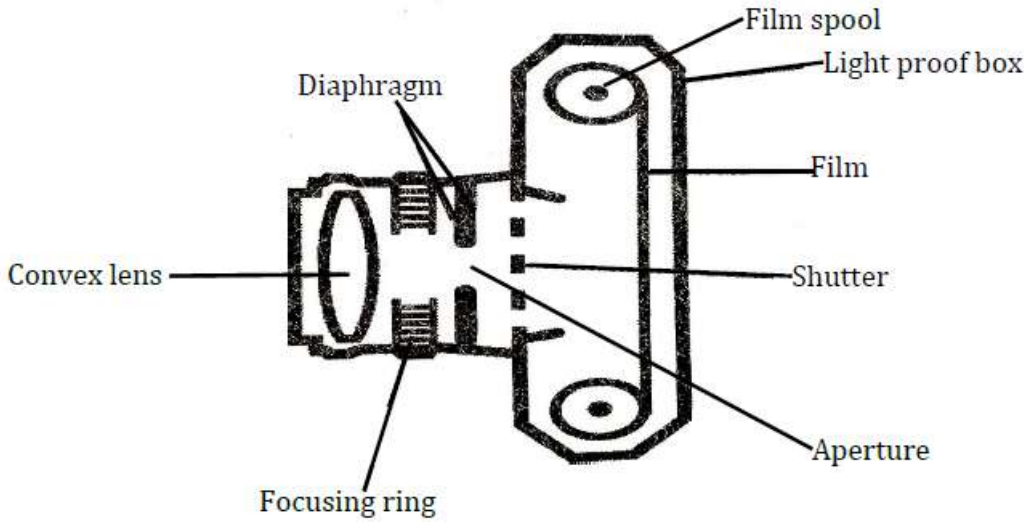

Principal axis


Magnifying glass

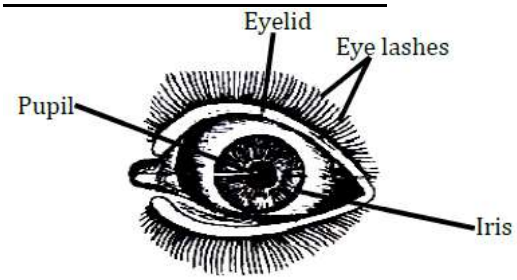

Pin hole
Screen
Object
Image

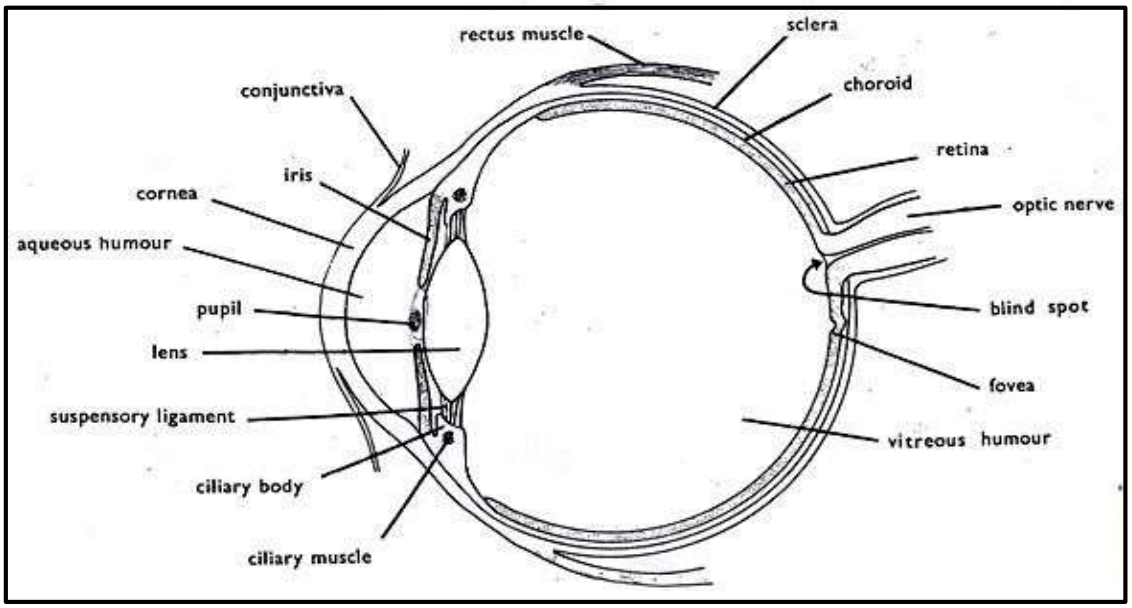

Pin hole
Light proof box
image
Translucent screen
Object

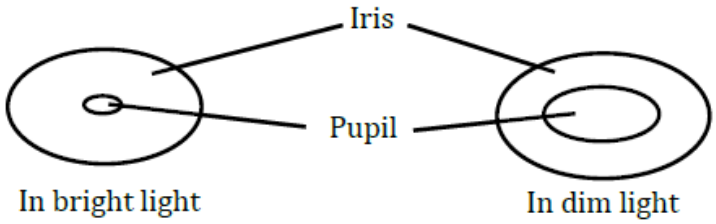
RID


Film spool
Light proof box
Diaphragm
Film
Convex lens
Shutter
Aperture
Focusing ring

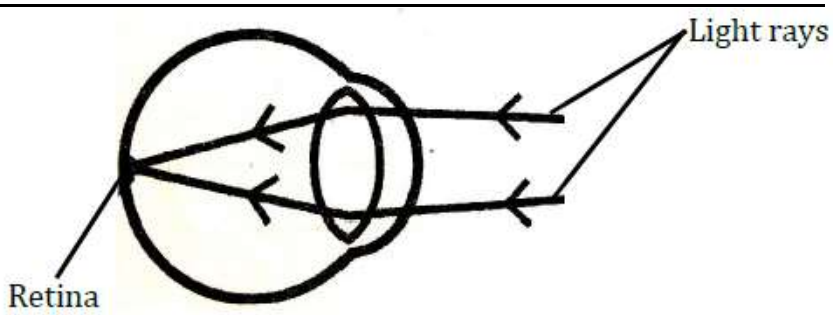
RID

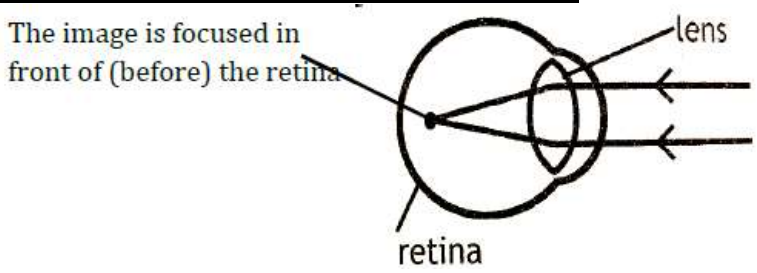

Eyelid
Eye lashes
Pupil
Iris

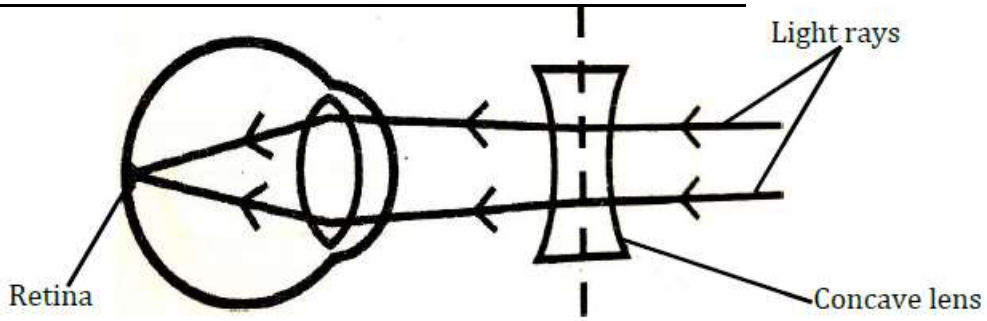

rectus muscle
sclera
conjunctiva
choroid
retina
iris
cornea
optic nerve
aqueous humour
blind spot
pupil
lens
fovea
suspensory ligament
vitreous humour
ciliary body
ciliary muscle

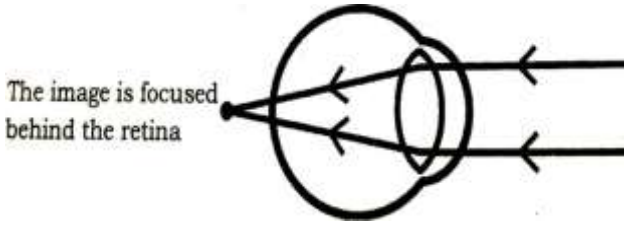

Iris
Pupil
In bright light
In dim light

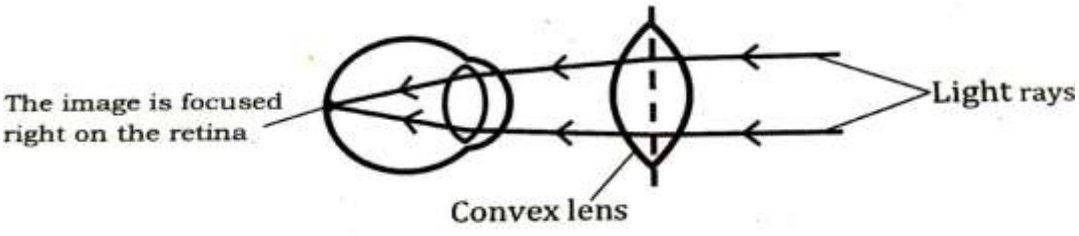
RID


Light rays
Retina


The image is focused in
front of (before) the retina
lens
retina


Light rays
Retina
Concave lens


The image is focused
behind the retina


The image is focused
right on the retina
Light rays
Convex lens

TERM 3

SCIENCE NOTES

_____

_____

_____

_____

_____

_____

_____

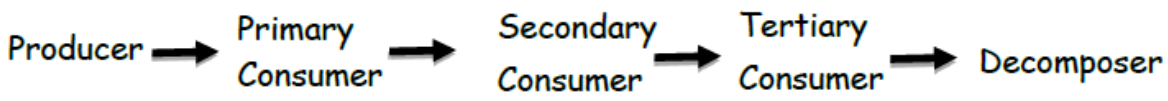
_____

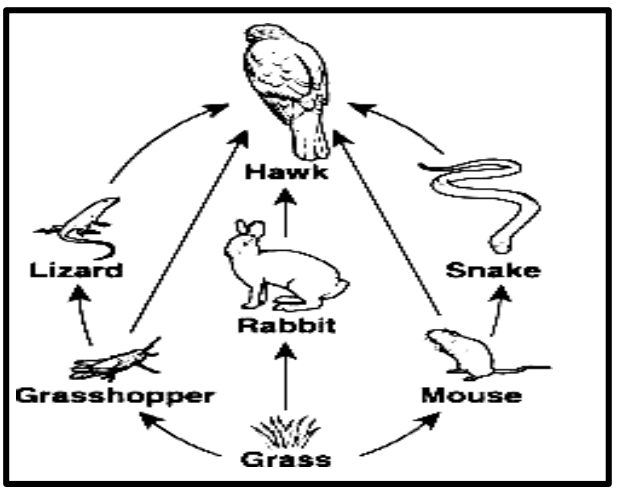
_____

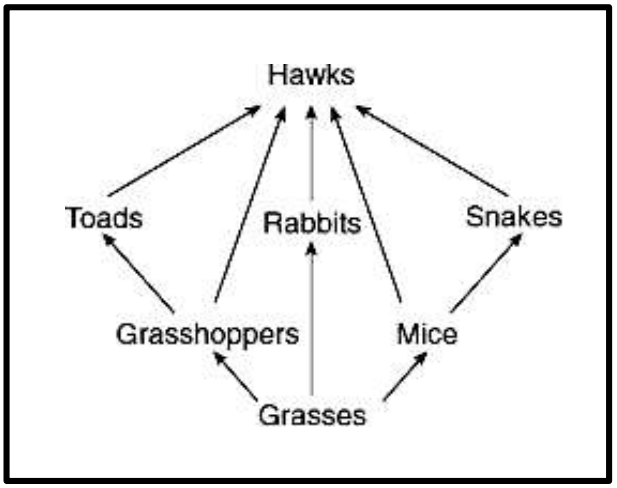
_____

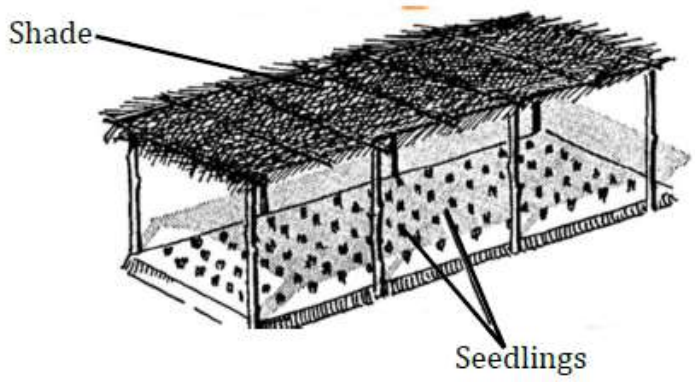
_____

_____


Producer
Primary Consumer
Secondary Consumer
Tertiary Consumer
Decomposer


Hawk
Lizard
Snake
Rabbit
Grasshopper
Mouse
Grass


Hawks
Toads
Rabbits
Snakes
Grasshoppers
Mice
Grasses


Shade
Seedlings

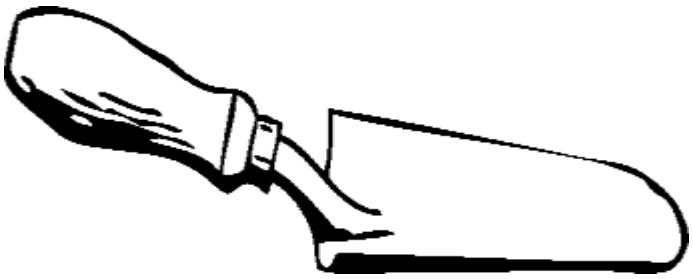
_____

_____

_____

_____

_____



_____

_____

_____

_____

_____

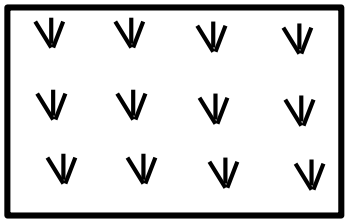
_____

_____

_____

_____

_____

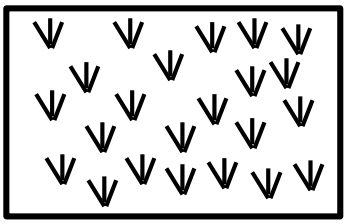


_____

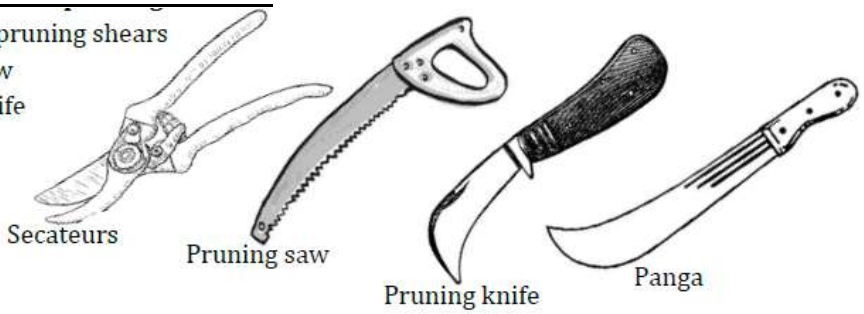
_____

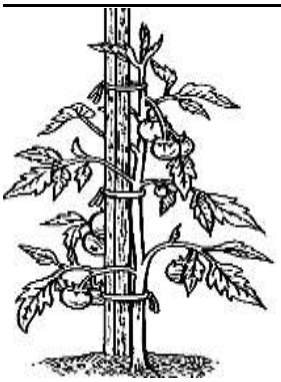
_____

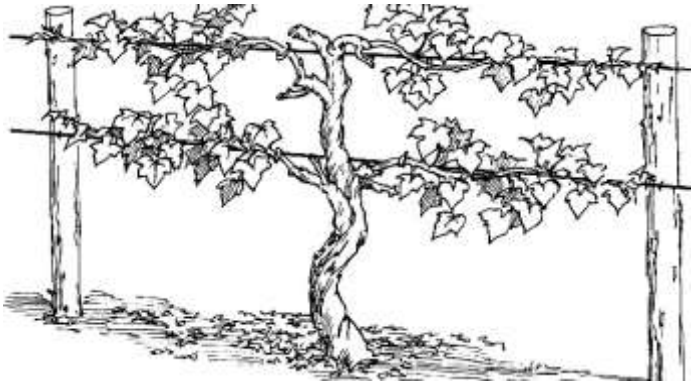
_____



- Secateurs/pruning shears
- Pruning saw
- Pruning knife
- Panga







_____

_____

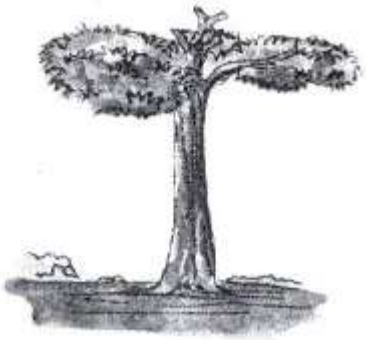
_____

_____

_____

_____

_____



_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

ASBAT
Education Consult

+256 7802423415, +256 705225627

info@asbatdigitallibrary.org

www.asbatdigitallibrary.org

We Are Located Along KTS Road, Plot 3 Makerere UniversityAfter Infectious Diseases Institute.