TOPICS COVERED

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  - WHAT IS PHYSICS?
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  - PHYSICS AND OTHE SUBJECTS.
  - CAREER OPPORTUNITIES IN PHYSICS.
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  - STORAGE AND USES OF MAGNETS.

UNIT ONE
PHYSICS AS SCIENCE

What is science?

- Is the systematic study of things in nature, changes involved and reasons for the change.
- Can also mean a body of knowledge gained as a result of system of observation and experimentation.

Which are the branches of science?

- Social science
  - Psychology
  - sociology
- Natural science
  - Life science
    - Functional biology
    - Cellular biology
  - Physical science
    - Physics
    - chemistry
  - Earth/ space science
    - Astrology
    - geoscience
- Formal science
  - Mathematics
  - Logic

What is physics?

- Is the study of matter and natural forces.
- Can be studied using scientific approach.

Mention any branch of physics you Know.

- Mechanics
- Electronics
- Electricity and magnetism
- Oscillation and waves
- Properties of matter
- Nuclear physics

How is physics related to other subjects?

- Uses chemistry in some of its operations such as fuel used in transport requires chemistry knowledge to extract.
- Some products of physics are used in biology such as microscope for seeing very small organisms.
- Geography uses some instruments developed by physicist such as barometer, wind gauge.
- Agricultural instruments also use instruments made by physicist e.g. sprinkler, sprayers.
- The use of carbon dating in history is the principle developed by physicist.

Which career opportunities are related with physics?

- Engineering and technology
- Laboratory technology
- Mapping and surveying
- Civil engineering
- Electrical engineering
- Mechanical engineering
- Instrumentation technology
- Electronics and telecommunication engineering
- Architecture
- Environmental engineering
- Aeronautical engineering

UNIT TWO
SCIENTIFIC INVESTIGATION

Define scientific investigation.

- Is the systematic process of testing ideas or finding out an answers to a question and observation.

What are the stages of scientific investigation?

- Identification of a problem through observation
- Change the problem into a question
- Developing the hypothesis
- Experimentation. The experiment should have the following steps:
  - Title of experiment
    - Gives the aim of the experiment.
  - Apparatus and materials
    - Is a list of all materials to be used
  - The procedure to be followed
    - Is step by step outline of how the experiment will be done.
    - Should have quantities that will be measured and instruments to use
    - Values of quantities to be held constant should be indicated.
  - Observation
    - Whatever is being observed must be recorded.
    - Results can be presented using
      - Tables
      - Charts
      - Graphs
  - Analysis of the results
    - Involves drawing graphs, calculating some quantities.
  - Conclusion
    - Is where a statement indicating whether the hypothesis was correct or not.
    - Sources of errors are also indicated and possible ways of minimizing them.
  - explanation
- Explanation
  - Is a statement that justifies your answer.

What are the contributions of physics to development?

- Fundamental laws and principles from reliable information.
  - Design and development of devices and appliances
  - Development and manufacturing of communication equipment such as cars, satellites, radios

- Discovery and development of transport such as very fast electrical trains, ships.
- Manufacturing of efficient robots and other gadgetry.
- In medicine, better surgery equipment is developed and use of safer diagnostic technique.
- Recreation and sports has been improved by discovery of better equipment for recreation and training.

Mention some milestones of advancements that have been achieved.

- Computers
- The internet
- Digital sound
- Digital video
- Artificial satellites
- Jet engines
- Solar power
- TV
- Space crafts
- Electron microphone
- GPS

UNIT THREE

LABORATORY AND SAFETY MEASURES

What is a laboratory?

- Is a room or space where chemistry and other science experiments are done.

What are safety rules?

- Are rules set aside in the laboratory to make sure that the laboratory is a good place for working and keeping both chemicals and apparatus.

Why should one follow safety rules when working in the laboratory?

- To prevent damage of materials and chemicals.
- To prevent people from being injured.
- To prevent death of people working in and around the laboratory.
- To prevent damage of the laboratory.

Mention any safety laboratory rules you know.

- Do not enter without teacher's permission.
- Enter in an orderly manner.
- Do not rush or scramble when entering.
- Avoid unnecessary movement in the laboratory.
- Do not taste, eat, drink or smell anything in the laboratory.
- Do not perform unauthorised experiment.
- Always switch off all electrical outlet, taps, and gas burners when not in use.
- Never disturb a friend who is doing an experiment.
- Keep any flammable substance away from flames.
- Read the instruction on the bottle of reagent carefully before using it.
- See the warning symbol on the bottle or container before using the contents.
- Clean all materials soon after use.
- Wash hands before leaving the laboratory.

How can one protect oneself when working in the laboratory?

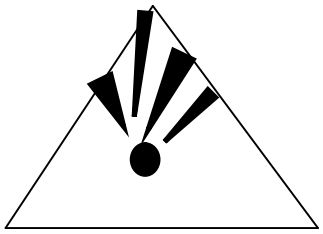
- By wearing a laboratory coat to protect clothes from dirt and chemicals.
- By wearing plastic goggles to protect eyes from solid particles, splashing liquids and strong light.
- By wearing gloves to protect hands from corrosive chemicals.
- By holding hot objects with holders such as a pair of tongs, improvised holders such as a piece of folded paper.
- By tying long hair at the back.
- By preparing irritating gases in the fume chamber or open space.

What are hazard symbols?

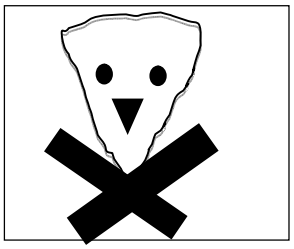
- Are all symbols drawn on the bottle or container of a substance that carries specific warning to the user of the substance.

Give examples of warning symbols and their meanings.

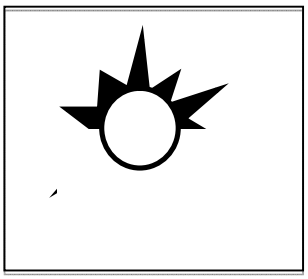
- Explosive material
  - Explosive substance can detonate any time.
  - Should be handled with care and according to instructions.



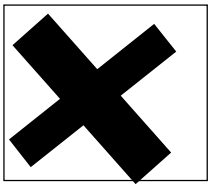
- Toxic
  - Poisonous substance.
  - Can cause death
  - If poured on your skin, wash with a lot of water.



- Oxidation
  - Can explode in the presence of an oxidising agent.



- Irritant
  - Harmful substance make your skin and health endangered.
  - Do not come in contact with it.
  - Avoid inhaling it more especially asthmatic people.



UNIT FOUR

MEASUREMENTS

What are SI units?

- Are units commonly used by all scientists throughout the world.
- It was adopted by modern scientific literature.
- It is short form for System International D'Unites'.

How are physical quantities represented?

- Are represented using symbols and units.
- Physical quantities can be meaningless without units.

Mention the two main types of quantities.

- Basic quantities.
- Also called fundamental quantities.

Which are the basic quantities, their units and symbols used?

- Length measured in metres (m).
- Mass measured in kilogram (kg).
- Time measured in seconds (s).
- Temperature measured in Kelvin (K).

Mention the derived quantities, units used and their symbols.

- Area measured in square metres (cm^2).
- Density measures in kilograms per cubic metre ($\frac{kg}{m^3}$)
- Amount of substance (concentration) measured in moles per cubic metre ($\frac{mol}{m^3}$)

Define SI prefixes

- These are prefixes used to represent a certain value.
- Examples may include:

Prefix	symbol	Magnitude
atto	A	10^{-18}
femto	£	10^{-15}
pico	Ƥ	10^{-12}
nano	ϩ	10^{-9}
micro	U	10^{-6}
mill	M	10^{-3}
centi	C	10^{-2}
deci	D	10^{-1}
deca	Da	10^{1}

hecto	H	10^2
kilo	K	10^3
Mega	M	10^6
Giga	G	10^9
Tera	T	10^{12}
Peta	P	10^{15}
Exa	E	10^{18}

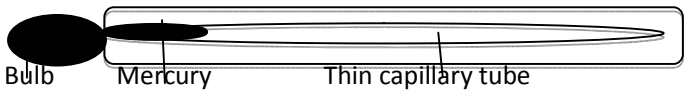
Give any example of laboratory apparatus.

- Measuring cylinder
  - Is a glass ware.
  - Some are made up of plastics.
  - Used for measuring volumes of liquids.
  - Are of different volumes.
- Burette
  - Is a glass ware.
  - Some are made up of plastics.
  - For measuring accurate or exact small volumes of liquids during chemical reactions.
- Pipette
  - Is a glass ware.
  - Some are made up of plastics.
  - For transferring or measuring small exact quantities of liquids into the burette.
- Volumetric flasks
  - Is a glass ware.
  - Some are made up of plastics.
  - For preparing accurate volumes of liquids.
  - Are of different capacities.
- Beam balance
  - For measuring mass of a substance.
  - Can be beam balance or electronic balance.
- Stop watch
  - For measuring duration of time.
- Tubes
  - Is a glass ware.
  - Some are made up of plastics.
  - Can be test tubes, ignition tubes or boiling tubes.
- Beakers
  - Is a glass ware.
  - Some are made up of plastics.
  - Are of different volumes.
  - Have many uses which include
    - ✓ Boiling liquids

        - ✓ Holding liquids
- Flasks
    - Is a glass ware.
    - Some are made up of plastics.
    - Usually used to hold liquids when heating or during reaction.
    - These include
        - ✓ Conical flasks
        - ✓ Round-bottomed flask
        - ✓ Flat-bottomed flask
- Evaporating dishes
    - Used to evaporate water from solutions in order to recover the dissolve solid.
    - Usually made up of porcelain.
- Deflagrating spoon
    - Used to hold substance when burning
- Spatula
    - Used to scoop small quantities of solid chemicals from the container.
- Tongs
    - Used to hold hot crucible or crucible cover.
- Tripod stand
    - Used in support apparatus when boiling or heating liquids.
- Wire gauze
    - Usually placed on the tripod stand to hold beakers when boiling liquids.
- Stand and clamp
    - Stand is used to mount apparatus.
    - A clamp is used to hold apparatus.
- Liebig condenser
    - Cools the vapour as it passes through the centre of the condenser during distillation.
- Funnels
    - Thistle funnel
        - ✓ Used to add liquids into flasks at once.
    - Dropping funnel
        - ✓ Used to add liquids into flasks in small quantities.
    - Separating funnel
        - ✓ Used to separate immiscible liquids.
    - Filter funnel
        - ✓ Used to pour liquids into containers with small mouths
        - ✓ Also used to filter solutions containing undissolved solids.
        - ✓ A filter paper is placed inside the funnel to hold undissolved solids.
    - Dropper or teat pipette.
        - ✓ Used to deliver a little liquid when required in drops into another container.
    - Heating apparatus

- ✓ For heating liquids and substances.
- ✓ These include
  - ❖ Spirit lamp
  - ❖ Candles
  - ❖ Kerosene stove
  - ❖ Electric heater
  - ❖ Bunsen burner

- Thermometer
  - ➢ For measuring temperature.
  - ➢ Can be ordinary or clinical thermometer.
- Types of thermometers
  - ➢ Liquid – in – glass thermometer.
  - ➢ Electrical resistance thermometer.
  - ➢ Digital thermometer.
  - ➢ Constant volume gas thermometer.
  - ➢ Thermocouple thermometer.
- Liquid-in-glass thermometer
  - ➢ ses mercury or coloured alcohol.
  - ➢ Liquid is filled into the base of the thermometer called a bulb.
  - ➢ Bulb is connected to the calibrated capillary tube through which the liquid rises with increase in temperature.
- Mercury-in-glass thermometer
  - ➢ Is the one in which its thin walled bulb is filled with mercury.

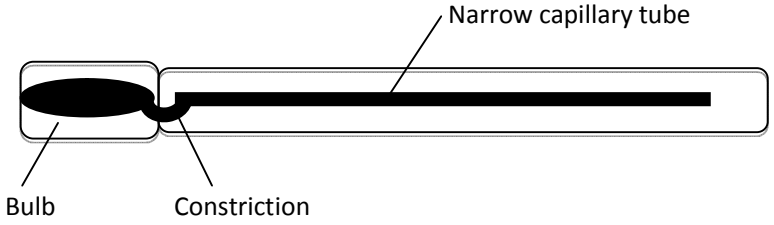


  - ➢ Pre cautions when constructing it.
    - ✓ The walls of the bulb should be thin to ensure that mercury can be heated easily.
    - ✓ Quantity of mercury should be small so that it should take little time to warm up.
    - ✓ The thin capillary tube should be of uniform cross-section so that the mercury level changes uniformly along its length.
  - ➢ Advantages of using mercury as thermometric substance
    - ✓ Mercury is shiny opaque liquid that its meniscus can easily be seen and readings taken without difficulties.
    - ✓ Mercury does not wet glass so it cannot stick to the sides of the capillary tube.
    - ✓ Mercury is easily obtained as a pure substance.
    - ✓ Mercury has a large increase in volume for $1^{o}C$ rise in temperature.
    - ✓ Mercury-in-glass thermometer has a wide range of temperature since mercury freezes at $-39^{o}C$ and boils at $357^{o}C$.
    - ✓ Mercury has ability to transfer heat energy easily.

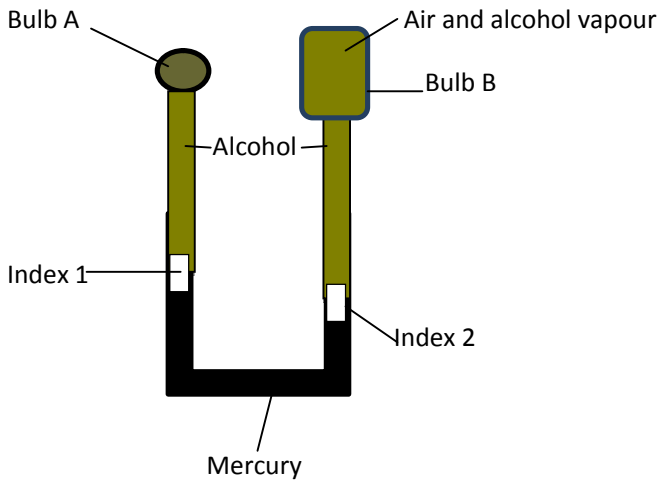
- Disadvantages of using mercury as a thermometric substance.
  - ✓ Usually t is only the bulb which is in contact with the body when taking the temperature.
  - ✓ There is a change in initial pressure due to the different positions of the thermometer i.e. the reading of the mercury level is lower when the tube is vertical as compared to the reading when in horizontal position.
  - ✓ Mercury takes some time to contract to the original volume. The same thermometer cannot be used to measure a low temperature soon after high temperature.
  - ✓ They may be non-uniformity in the capillary bore of tube.
  - ✓ It is no suitable to measure temperature.

- Alcohol – in – glass thermometer
  - This uses coloured alcohol instead of mercury.
  - The volume of alcohol changes uniformly and easily when heated.
  - The change is six times that of mercury.
  - The range of temperature that can be measured with this thermometer is limited i.e. boils at 78^oC and freezes at -112^oC.
  - It is ideal for measuring low temperatures.
  - Advantages of using alcohol as a thermometric substance
    - ✓ Has a very low freezing point of 112^oC hence its suitable in thermometer to record very low temperatures.
    - ✓ Can be coloured brightly by adding dye that makes it clearly visible through the glass.
    - ✓ Has uniform expansion and contraction than even mercury.
    - ✓ Is good thermal conductor, cheap and easily available.
  - Disadvantages of using alcohol as a thermometric substance
    - ✓ Alcohol sticks to the walls of the glass thus wetting it. This makes it difficult to read the temperature accurately.
    - ✓ Alcohol has low boiling point and cannot be used to measure high temperatures.

- Clinical thermometer
  - It is an instrument designed to measure human body temperature.
  - It has the following:
    - ✓ A thin walled bulb containing mercury.
    - ✓ A capillary bore is very narrow and uniform diameter.
    - ✓ Has a limited range from 35^oC to about 43^oC.
    - ✓ The normal body temperature is about 36.9^oC.

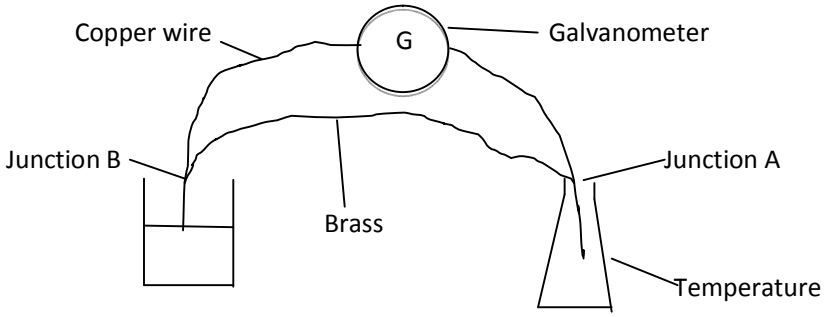


- Six's Maximum and Minimum Thermometer
  - Is used to measure maximum and minimum temperature of a place during the day.
  - Was invented by physicist called John Six.
  - It has a U-tube connect to two bulbs.
  - The U-tube contains mercury.
  - The two bulbs contain alcohol which occupies the full volume of one bulb leaving the other bulb with a space.
  - Has two indices fitted with light fine spring.



  - When the temperature is very high, mercury pushes the index$_2$ to the maximum.
  - The position index$_2$is the maximum.
  - Use the magnet to reset the indices to the same level.
  - When the temperature is very low, mercury pushes the index$_1$ up.
  - The position of index$_1$ is the minimum.
- Thermocouple thermometer
  - This uses the thermocouple effect.
  - Was discovered by a German physicist called Thomas Seebeck (1170-1831).
  - He used the relationship between heat flow and electric current.
  - He discovered that when two ends of metal pieces are at different temperatures,
    - ✓ electric current flows from the hot end to the cold end.
    - ✓ The amount of current that flows depends on the temperature difference between the two ends.
    - ✓ Different amount of electric current flows through different types of metals.
  - The current can be measured by connecting a galvanometer at some point in the loop.
  - The value of current can be used to determine the temperature at one end if the temperature at the other end is known.

- Thermocouple thermometer is used to measure very high temperature which ordinary thermometers cannot measure.



- Uses of thermocouple
  - ✓ Is used in industries to determine if the required temperature is reached.
  - ✓ Can be used in homes, offices and business places as the temperature sensor in thermostats.
  - ✓ Are used as flame sensor in safety devices.
  - ✓ Are used to measure very high temperature.

UNIT FIVE
PARTICULAR NATURE OF MATTER

What is matter?

- Is anything that occupies space and has mass.
- Is made up of tiny moving particles invisible with our naked eyes.

Which are the three states of matter?

- Solids
- Liquids
- Gases

What are the properties of solids?

- Have definite shape
- Have definite volume.
- Have very high density.
- Cannot be compressed.
- Have very strong intermolecular forces.
- Particles only vibrate.

What are the properties of liquids?

- Takes the shape of container.
- Have definite volume.
- Have medium density.
- Cannot be compressed.
- Have weaker intermolecular force compared to solids.
- Vibrate stronger but within a fixed position.

What are the properties of gases?

- Fills the container.
- Takes the shape of the container.
- Very low density.
- Can be compressed.
- Have weak or no intermolecular forces.
- Always in motion to any direction at any speed.

What is diffusion?

- Is movement of particles from region of high concentration to the region of low concentration.
- Is the spread out of particles of a substance from region of concentration to the region of low concentration.

UNIT SIX
CHANGE OF STATE OF MATTER

What is temperature?

- Is the degree of hotness or coldness.
- Is measured in degrees Celsius (^{o}C).
- But its SI unit is Kelvin (K).

What is heat?

- Is a form of energy.
- Is shown using change in temperature.

What are the effects of heat on matter?

- When heat is supplied or removed,
  - Kinetic of particles change in any state of matter.
  - State of matter changes
  - Volume of substance changes
  - Density changes.
  - Force between particles changes.
  - State of matter changes.

Define the following terms:

- Melting
  - Change of state of matter from solid to liquid.
  - Temperature at which it changes is called melting point.
- Evaporation
  - Change of state of matter from liquid to gas.
  - The temperature at which it changes is called evaporation point.
  - It is equal to the boiling point.
- Freezing
  - Change of state of matter from liquid to solid.
  - The temperature at which it changes is called freezing point.
- Condensation
  - Change of state of matter from gas to liquid.
  - The temperature at which it changes is condensation point
- Sublimation
  - Change of state of matter direct from solid to gas.
- Deposition
  - Change of state of matter direct from gas to solid.

Mention factors that can affect boiling point of a liquid.

- Pressure
  - At standard atmospheric pressure, pure water boils at $100^{o}C$.
  - Boiling point can change with change in pressure acting upon its surface.
- Impurities
  - Lowers the boiling point and increases the melting point.

Which are the applications of pressure in everyday life?

- Pressure cooker

Mention factors which affect the rate of evaporation.

- Temperature
  - Increase in temperature increases the rate of evaporation.
  - Molecules gain more kinetic energy.
- Surface area.
  - Evaporation takes place on the surface of the liquid.
  - Increase in surface area increases evaporation rate.
- Pressure.
  - Decrease in pressure on the surface of liquid increases the rate of evaporation of a substance.
- Draught (air current).
  - Air current moving on the surface of the liquid increases the rate of evaporation.
- Nature of liquid.
  - Boiling of the substance depends on the nature of the liquid..
  - The liquid that has low boiling point evaporates fast than that with high boiling point.

Explain the similarities and differences between evaporation and boiling.

- The similarity is that
  - in both processes liquid changes its state to vapour.
  - in both latent heat of vaporisation is required.
- The differences are
  - Evaporation takes place at all temperatures while boiling takes place at fixed temperature called boiling point.
  - Evaporation takes place at the surface of the liquid while boiling takes place throughout the mass of the liquid.
  - Once evaporation takes place, there is a fall in temperature which causes a cooling effect while once boiling takes place, the temperature of the liquid remains at constant.
  - Evaporation is a slow and a calm process while boiling is a rapid and a noisy process.

Mention some applications of cooling effect caused by evaporation

- Water in clay pots is colder than the one in metal pot because its latent heat escapes.
- Methylated spirit sprayed on the skin , the skin feels cold because the methylated spirit has lower boiling point and can change from liquid to vapour quite easily.
- Human being sweat on hot day or after a severe exercise while the dog pant because their bodies are not porous.
- When we want to perspire in hot days, we sit below an electric fan where cooling is done due to rapid evaporation.
- In hot weather, sprinkling of roads with water reduces dust particles from the road and cooling effect by evaporation.
- When we expose ourselves to wind with wet clothes, we feel cold due to rapid evaporation.
- Refrigerator uses cooling effect caused by evaporation.

UNIT SEVEN

FORCE

What is force?

- Is a pull of a push.
- To pull is to make the body move towards you while to push is to make the body move away from you.

What is the effect of force?

- Change state of the body (causes the body to start or stop moving).
- Changes the shape of the body (deforms the body)
- Can cause the body to turn (e.g. see-saw).
- Can cause rotation of the body (e.g. steering wheel)
- Can cause heating effect (e.g. friction)
- Friction force cause noise (sound)

How is force measured?

- Is measured using a spring balance.
- Is measured in Newtons (N).
- SI unit for force is Newton.

What is the effect of balanced forces?

- Balanced forces cause no motion.
- The body is at equilibrium.

Which are the effects of unbalanced forces?

- The body moves towards where greater force is going.
- There is always change in motion.

Define resultant force.

- It is the sum of two or more forces.
- If forces are to the opposite direction, the forces do subtract.

What is frictional force?

- Is the force that opposes motion.
- Has the following advantages:
    - Can provide grip on the ground e.g. soles our shoes and tyres of cars.
    - For braking e.g cars use pads made from material that offer a lot of friction.
    - Conveyer belt in factories do not slip because of friction.
    - Nails are able to hold pieces of wood tightly together because of friction.

- Nuts, bolts, screws jacks make use of friction to work.
- Writing on the paper uses friction.

- Has the following disadvantages
  - A lot of energy is wasted.
  - Cause wearing out of bodies.
  - Bodies can be burnt.

Which factors can affect friction?

- Surface areas in contact
- Smoothness of the bodies in contact
- Angle at which the bodies in contact slant.

Define the following terms:

- Mass
  - Is the quantity of matter in a substance.
  - Is measured by beam balances.
  - Is measured in kilogrammes (kg)
  - The SI unit is kg.
  - Mass a body does not change.
- Weight
  - Is the pull of gravity over the body.
  - Measured by spring balance.
  - Measured in Newtons (N).
  - SI unit is newton.
  - Changes from place to place

UNIT EIGHT
WORK

What is work?

- Is the product of force and distance moved in the direction of the force
- Work in science is done only when there is a displacement caused in a certain direction.
- Work done = force x distance
  W = fd
- Force is measured in newton while distance is measured I metres.
- Therefore work is measured in newton metre.
- Newtonmetre is called joule
- Work is measured in joules.

Example

Calculate the work done on a block if the block is pulled steadily through a distance of 3m by a force of 60N.

W = F x d

W = 60N x 3m

W = 180joules

Exercise

1. A bucket of mass 2kg is pulled out of a well, 50m. Find the work done against force of gravity.

2. A builder climbs a staircase of height 4m. Find the work done by the builder in raising herself through this height if her mass is 60kg.

How do you work out work done against frictional force?

- Find work done by the applied force (F_a) by multiplying F_a x d.
- Then find work done by frictional force (F_r) by multiplying F_r x d
- Find the difference between the two i.e. (F_a x d) – (F_r x d)
- What you find is the useful work i.e. work that shows a displacement.

UNIT NINE

ENERGY

Define the term energy.

- Is the ability to do work.
- Is also measured in joules (J).

Which are the sources of energy?

- Renewable sources
  - Solar energy
    - ✓ Energy from the sun.
    - ✓ Is used by both plants and animals
    - ✓ Comprises of light and heat
    - ✓ Light energy can be trapped in solar cells and stored in accumulators as electrical energy.
  - Geothermal energy
    - ✓ Is the higher temperature found in some regions of the earth.
    - ✓ Water trapped between rocks is heated and may be released to the earth.
    - ✓ This vapour can be used in generating electricity.
    - ✓ This type of electricity is called geothermal electricity.
  - Biomass and bio gas energy
    - ✓ Is obtained from degradation of organic materials such as animal and agriculture wastes.
    - ✓ Biogas may trapped using a biogas plant.
  - Tidal energy
    - ✓ Caused by gravitational force between the earth and the moon.
    - ✓ The high-level of water at high-tidal is trapped.
    - ✓ This is used as a source of potential energy
  - Wind energy
    - ✓ A number of machines can be driven by wind.
    - ✓ Examples include wind mills, water pumps, dynamos.
- Non-renewable sources
  - Fossil energy
    - ✓ Energy trapped by the plants from the sunlight during photosynthesis long ago.
    - ✓ During decaying, the plants are converted to coal, oil or natural gases.
    - ✓ These are extracted for human use. E.g. fuel for motor vehicles.
  - Nuclear energy
    - ✓ Is available in limited quantities.
    - ✓ This energy is risk and can cause damage of life.

- ✓ Common source include uranium, radium, plutonium and hydroxonium.
- ✓ These are radioactive elements i.e. they emit rays which can harm human beings.
- ✓ Nuclear reactors are used to produce this energy.

Mention some forms of energy.

- Mechanical energy
  - ➢ Potential energy
    - ✓ Elastic potential energy or strain energy
  - ➢ Kinetic energy
- Chemical energy
- Sound energy
- Electrical energy
- Nuclear energy
- Light energy

What are transducers?

- Are energy converters.
- Can transform energy from one form to another.

State the law of conservation of energy

- States that energy can neither be created nor destroyed but can be converted from one form to another.

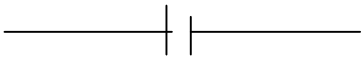
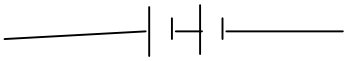
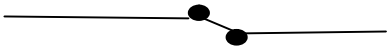
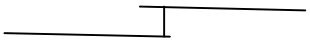
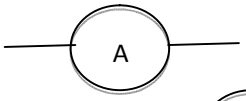
UNIT TEN

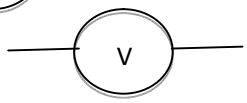
ELECTRIC CURRENT

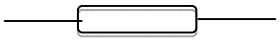
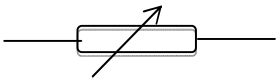
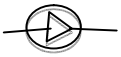
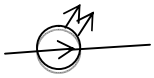
What is electric current?

- Is the flow of charges in a circuit.
- A circuit is a complete path through which charges flow.

Name the following basic circuit symbols

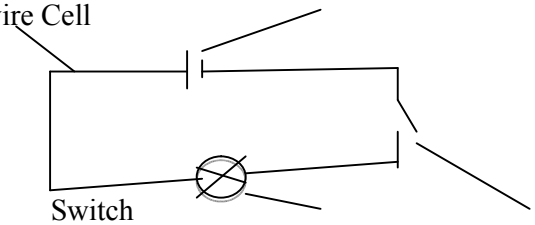
- Cell 
- Battery 
- Power supply 
- Open switch 
- Close switch 
- Wire joined 
- Connecting wire
- Lamp 
- Ammeter 

- Voltmeter 

- Resistor 
- Variable resistor 
- Diode 
- Thermostat 
- Light depending resistor 
- Light emitting diode (LED) 

COMPONENTS OF A CIRCUIT

Connecting wire Cell



Bulb Switch

ARRANGEMENT OF BULBS AND CELLS IN AN ELECTRIC CIRCUIT

- Bulbs in series circuit
  - The current is the same at every point.
  - If the bulbs are of the same voltage, the give the dimmer amount of light.
- Bulbs in parallel circuit
  - Current is different at different points.
  - The sum of the current in the bulbs is equal to the current in the circuit.
- cells in series circuit
  - Increase in cells in series increases voltage in the circuit.
  - Emf is equal to the sum of pd.
- cells in parallel circuit
  - Increase in cells in parallel circuit does not change the voltage.
  - The voltage is the same at every point.

ELECTRIC CURRENT

CURRENT ELECTRICITY:

It is defined as the rate of flow of electrical charge at a point in a circuit.

i.e. $I = \frac{Q}{t}$ where I is current, Q is charge and t is time. Where charge is in coulombs(C) and time to be in seconds (s). The unit I = C/s = 1ampere(A).

POTENTIAL DIFFERENCE (pd):

It is amount of work required to move a positive charge from a point in an electrical field on to another.

i.e. work done is E, charge is Q and voltage is V,

$E = QV$

But $Q = It$, $\therefore E = ItV$

But E = W (work done), $\therefore W = QV = ItV$

$V = \frac{W}{Q} = \frac{W}{It}$

ELECTROMOTIVE FORCE (emf):

It is the potential difference produced by a battery when attached to an infinite resistance.

DIRECTION OF THE FLOW OF ELECTRIC CURRENT

- Is always shown using an arrow in an electric circuit.
- Conventionally it is from positive terminal to the negative terminal of the cell.
- In the circuit the arrow points to the positive terminal.

MEASUREMENT OF ELECTRIC CURRENT

- Is measured using an instrument called an ammeter.
- An ammeter is connected in series in the circuit.
- Milliammeter and microammeter measures very small amount of current.

CONTROLLING CURRENT BY BULBS

- Connecting more bulbs in series makes the bulbs show dim light.
- This causes hindrance to the flow of electric current.
- Connecting the bulbs in parallel circuit makes the bulbs to give equal amount of light.
- These bulbs gives less hindrance to the flow of electric current than the two bulbs in series.
- The hindrance in electric current is called electric resistance.
- The device that offers electric resistance is called resistor.
- Resistor can be fixed and variable.

CURRENT IN SERIES CIRCUIT

- It is the same at every point.

CURRENT IN PARALLEL CIRCUIT

- The total current is equal to the current in all the components.
- Current in components must be added to find current in the circuit.

UNIT ELEVEN

VOLTAGE

VOLTAGE

- Is the work done in moving one coulomb of charge from one point to another.
- The SI unit of voltage is volt (V).
- Volt = $\frac{joule}{coulomb}$
- The voltage is also known as the potential difference between two points.

THE VOLT

- Is the energy needed to move one coulomb of charge from one point to another.
- Is measured using voltmeters.
- Voltmeter is connected in parallel in the circuit because it has high resistance.

VOLTAGE IN SERIES CIRCUIT

- Is divided among the components.
- Adding voltage in all components gives the total voltage in the energy source.

VOLTAGE IN PARALLEL CIRCUIT

- Is equal at every point in a circuit.
- That is why electricians use parallel circuit in wiring houses.
- This makes the components gives equal output e.g. bulbs give equal brightness.

UNIT TWELVE

ELECTRICAL RESISTANCE

ELECTRICAL RESISTANCE

- Is the opposition to the flow of electric charges in the circuit.
- Is the ration of voltage and current i.e. Resistance = $\frac{voltage}{current}$
- Its SI unit is ohms using the instrument called ohmmeter.
- The device that offers resistance is called aresistor.
- Different materials have different resistance.

FACTORS AFFECTING THE RESISTANCE OF MATERIALS

- Length of wire
  - The longer the wire the higher the resistance and the shorter the wire the lower the resistance.
- Thickness of wire (cross section of wire)
  - The thicker the wire the lower the resistance and the thinner the wire the higher the resistance.
- Temperature at which the wire is
  - Increase in temperature increases the resistance of the wire.
- Material of the wire
  - Different materials have different resistance.

UNIT THIRTEEN

EFFECTS OF ELECTRIC CURRENT

- Heating effect
  - Heat energy is generated when elect current passes through an electric conductor.
  - This can be demonstrated by
    - ✓ Immersing heater in cold water
    - ✓ Feeling with your palm on an electric bulb which has been on for some time.
    - ✓ Using a coil of wire connected to a circuit immersed in water boils the water.
- Factors affecting heating effect of an electric current
  - Differences in amount current passing through the conductor at the same time.
  - The same amount of current passing different types of conductors.
  - The same amount of current passing through same coil for different amounts of time
- Application of heating effect of electric current
  - Brought about the invention of the following
    - ✓ Filament lamp
    - ✓ Electric heater
      - Radiant electric heater
      - Electric iron
      - Electric kettle
    - ✓ Fuse
      - Is fitted in the live wire.
      - Acts as an automatic switch when undesirable current passes through the circuit.
- Magnetic effect of an electric current
  - The magnetic field is produced around the current carrying conductor
- The direction of a magnetic field
  - Can be observed using a compass needle.
  - Can be demonstrated using
    - ✓ Right hand grip rule
      - One holds the conductor with a right hand and with all the fingers including the thumb.
      - The thumb points to the direction of the current.
      - The fingers point to the direction of the magnetic field.
    - ✓ Right handed corkscrew rule
      - The sharp pointed part points to the direction of the current.
      - The grooves point to the direction of the magnetic field.
- simple electromagnet
  - have a coiled copper wire.

- Inside it, place an iron bar e.g. a nail.
- Connected the coiled wire to the circuit and switch on.
- The bar inside the coil becomes a magnet.
- The electromagnet can be used
  - ✓ In an electric bell
  - ✓ In telephone receivers
  - ✓ In simple d.c. electric motor

- Chemical effect of an electric current
  - In electroplating
    - ✓ Is plating process that uses electric current.
    - ✓ The layer of material is deposited on top of another material.
    - ✓ Is done to improve appearance of durability.
  - In electrolysis
    - ✓ Is the manufacture of pure metal from a compound solution.
  - Electrolytic capacitors
    - ✓ Is made by the electrolysis of ammonium borate.
    - ✓ Are widely used in radio receivers.
- Chemical cells
  - Consists of two different metals called electrodes and conducting liquid called electrolyte
  - This stores electrical energy.
  - Chemical cells are classified as
    - ✓ Primary cell
    - ✓ Secondary cell
- Primary cell
  - Has zinc and copper plates as electrodes and dilute sulphuric acid as the electrolyte.
  - Positive zinc ions dissolve into sulphuric acid leaving electrons on the zinc plate.
  - These electrons are a source of the electric current from zinc to copper plate.
  - Hydrogen ions leave the solution and are deposited on the copper plate.
  - Copper plate becomes positively charged and hence can attract electrons from zinc.
  - Has the following defects;
    - ✓ Polarisation
      - Accumulation of hydrogen gas bubbles around the copper plate makes it difficult for the electrons to flow.
      - This cause the bulb to give dim light.
      - Can be minimised by adding a depolariser such as potassium dichromate.
      - A good depolariser should not react with the electrolyte.

- ✓ Local action
    - Reaction of zinc and sulphuric dissolves and exposes hidden impurities of carbon and iron.
    - These impurities form small cells called local cells.
    - These local cells cause the zinc to be used up even when the current is not supplied.
    - This is called local action.
    - Local action can be minimised by applying a layer of mercury on the zinc plate in the process called amalgamation.

- Dry Leclance' Cell
    - Consists of a carbon rod which is surrounded by manganese (IV) oxide mixed with carbon powder dipped in ammonium chloride paste and a zinc case.
    - Zinc is converted in zinc chloride and hydrogen gas is produced.
    - Manganese (IV) oxide converts the hydrogen produced into water.