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SECOND TERM E-LEARNING NOTE

SUBJECT: PHYSICS **CLASS: SS 1**

SCHEME OF WORK

WEEK	TOPIC
1.	Heat Energy, Concept of Heat and Temperature, Effects of Heat and Uses
2.	Thermometer and Its Type, Evaporation and Boiling
3.	Expansion of Solid, Effect and Applications of Expansion
4.	Expansivity and Its Application – Linear, Area and Volume. Anomalous Expansion of Water. Real and Apparent Expansivity
5.	Heat Transfer – Conduction, Convection, Radiation and Their Applications
6.	Electric Charges – Production, Types, Distribution and Storage
7.	Gold Leaf Electroscope and its Uses. Lighting and Lighting Conductor
8.	Fields – Concept and Types of Field. Gravitational and Magnetic Field, Force of Gravity
9.	Electric Field – Line of Forces, Properties of Line of Force, Description and Properties of Force Field
10.	Production of Continuous Electric Current

REFERENCE BOOK

- New School Physics By M.W Anyakoha
- Senior Secondary School Physics By P.N Okeke

WEEK ONE

TOPIC: Heat Energy, Concept of Heat and Temperature and Effects of Heat

CONTENT

- ✓ Concept of Heat
- ✓ Temperature
- ✓ Effect of Heat on bodies.

Concept of Heat

Heat is a concept of physics that deals with the study of relative motion of fluid (liquid and gas) from one body to another. It is a form of energy that can be transferred from one body due to temperature differences.

Temperature

Temperature is the degree of hotness and coldness of a body or an object. It is a scalar quantity, measured in Kelvin. Heat and Temperature are similar but not the same

Differences between Heat and Temperature

1. Heat is a measure of the total internal energy of a body while temperature is the degree of hotness or coldness of the body.
2. Heat takes place due to temperature difference while temperature occurs due to slight change of substance.
3. Heat is measured in joules while temperature is measured in Kelvin / Celsius.

Effect of Heat

When heat is applied to a body the following effect may occur

1. Expansion: when heat is applied, volumes increases while density decreases.
2. Change in temperature: When heat is added on a body, the temperature increases
3. Change of state: melting, freezing, condensation, evaporation etc.
4. Thermion emission: Addition of heat on metal may result in the emission of electron from the surface of the metal
5. Photo electric emission: The emission of electron when sufficient light of high frequency is illuminated on a metal surface e.g. zinc plate.

EVALUATION

1. Differentiate between heat and temperature.
2. Mention five effect of heat.

Reading Assignment

www.google.com (click on google search, type "concept of heat", click on search) and New School Physics pg36.

WEEKEND ASSIGNMENT

1. Which of the following is not an effect of heat? A. expansion B. contraction C. change of state. D. increase in weight
2. Temperature can be measured in the following units except A. degree celsius B. kelvin C. degree Fahrenheit D. centigrade-meter
3. When heat is extracted from water it changes from liquid to gas. What is this process called.....
4. The process of by which a gas is converted to a solid is called .....
5. Fahrenheit is a unit of .....

THEORY

1. Differentiate between heat and temperature.
2. Mention five effect of heat.

WEEK TWO

TOPIC: Thermometer and Its Type. Evaporation and Boiling

CONTENT

- ✓ Thermometer and Their Thermometric Substance
- ✓ Fixed Point of Thermometer
- ✓ Evaporation and Boiling

Thermometer and Their Thermometric Substance

Thermometric substances are substances which changes in proportion to temperature.

S/N	THERMOMETER	THERMOMETRICAL SUBSTANCE	PHYSICAL PROPERTIES

1.	Liquid in glass	Mercury or alcohol	Change in volume with temperature
2.	Constant volume gas thermometer	Gas	Change in pressure with temperature
3.	Thermoelectric thermometer	Two different metal (iron and copper)	Change in potential difference due to temperature difference
4.	Resistant thermometer	Resistant wire	Change in resistant with temperature
5.	Bimetallic thermometer	Two dissimilar metal (brass and iron)	Differential expansion of two metals of the bimetallic stripes

ADVANTAGES OF MERCURY AS A THERMOMETRIC SUBSTANCE

1. Mercury does not wet glass
2. Mercury response quickly to slight change in temperature
3. The liquid does not vaporize easily
4. Mercury is opaque Hence, it can be seen easily
5. It has a regular or uniform expansion.

DISADVANTAGES

1. Mercury is expensive
2. Mercury can not be used to measure very low temperature because it's freezing point - 39°C

ADVANTAGES OF ALCOHOL AS A THERMOMETRIC SUBSTANCE

1. Alcohol is less expensive than mercury
2. It has larger expansion on heating than mercury (it expands 6 times more than mercury).
3. It can be used to measure very low temperature.

DISADVANTAGES

1. It is not opaque and so most be colored
2. It vaporizes easily
3. It wet glass
4. It has an irregular expansion
5. It has low boiling point of 78°C

CONSTANT VOLUME GAS THERMOMETER

1. It gives more accurate measurement of temperature than any other thermometer
2. It is very sensitive and can measure wider range of temperature

DISADVANTAGES

1. It is very expensive and so require handling with special care
2. It is very cumbersome

EVALUATION

1. What advantage does a constant volume gas thermometer has over other thermometers?
2. Mention five types of thermometer, their thermometric substance and physical property.

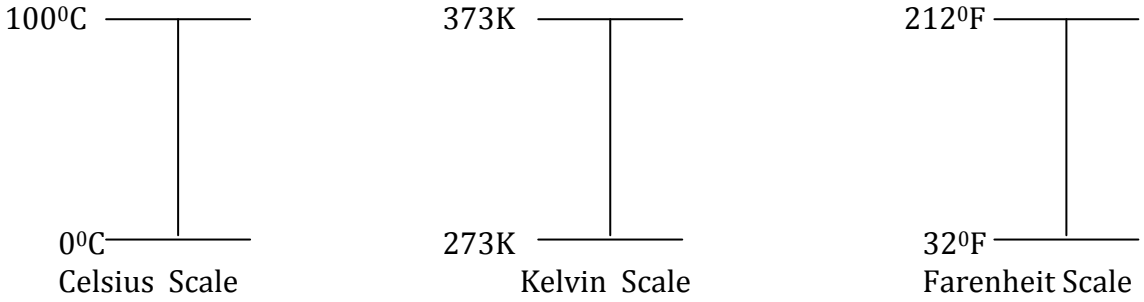
FIXED POINT OF THERMOMETER

Fixed temperature point are two reference temperature (usually upper and lower fix point) chosen, when preparing a scale for reading temperatures.

Upper Fixed Point: is the temperature of steam from pure water at the normal atmospheric pressure.

Lower Fixed Point: is the temperature of mixture of pure ice and water at normal pressure.

Fundamental Intervals: is the interval between the upper and lower fixed point.



REASON WHY WATER IS NOT USED AS A THERMOMETRIC

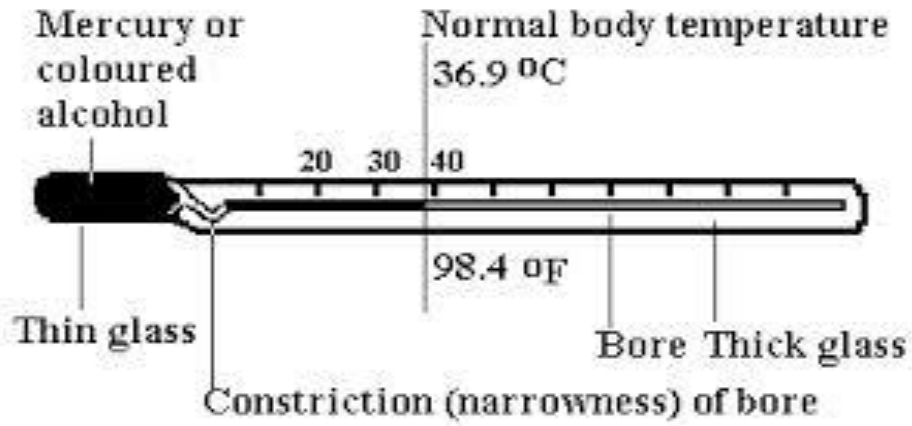
1. Water wet glass
2. They are colour less
3. It does not expand uniformly
4. It has small range of expansion (0˚C to 100˚C)

CLINICAL THERMOMETER

It is used for measuring the temperature of human body. The body temperature ranges from (35˚C to 45˚C). It is not advisable to sterilize a clinical thermometer in boiling water because a short range of 35˚C to 43˚C which shall result to

1. Cracking or breaking of thermometer due to excessive expansion of the mercury.
2. Malfunction of the thermometer due to over expansion of the capillary tube and the mercury inside the bulb.

23.7.02 Clinical thermometer



Evaporation and Boiling

Evaporation is the process where a liquid turns into vapor below its boiling point. Evaporation takes place at all temperature. Wind assist evaporation.

Boling is the change from liquid to vapor at the boiling point. It occurs throughout the entire volume of the liquid. Wind has no effect on boiling.

EVALUATION

1. Why is water not used as a thermometric substance?
2. Differentiate between evaporation and boiling.

Reading Assignment

www.google.com (click on google search, type "temperature & its measurement", click on search) and New School Physics pg 202 - 209

WEEKEND ASSIGNMENT

1. The clinical thermometer is characterized by having a A.wide range of temperature B. wide bore C. long stem D. constriction
2. A short response time is obtained in a liquid - in-glass thermometer when the A. bulb is large and thick walled B. bulb is small and thin walled C. stem is long and thin D.bulb is thin walled and the liquid is a good conductor of heat.
3. Change in volume with temperature is the physical propety of ……. thermometer A. constant volume gas B. liquid-in-glass C. resistant D. thermoelectric
4. Convert 27^0C to kelvin A. 290K B. 300K C. 300^0C D. 310K
5. The following are units of temperature except A. kelvin B. degree Celsius C. ampere D. Fahrenheit

THEORY

1. Mention five types of thermometer, their thermometric substance and physical property.
2. Why is it not advisable to sterilize a clinical thermometer in boiling water?

WEEK THREE
TOPIC: Expansion of Solid, Effect and Applications of Expansion
CONTENT

- ✓ Effect and Application of Thermal Expansion of Solid
- ✓ Advantages and Disadvantages of Thermal Expansion of Solid

Effect and Application of Thermal Expansion of Solid

1. When hot water is poured in a glass tumbler, it might crack due to the uneven expansion of the inner wall of the tumbler.
2. The cracking noise of zinc roof during the day and night.
3. Thermal expansion of solid is used in the construction of bridges in which one side is fixed and the other is placed on rollers to allow for expansion.
4. The stopper of a bottle can be removed due to the expansion of the glass.
5. In the construction of concrete pavement, little spaces are left within the concrete to allow for expansion.
6. Gaps are left in the construction of railway tracks to give room for expansion.
7. Bimetallic stripes are use in thermostat for controlling or regulating the flow of electric current.

Advantages and Disadvantages of Thermal Expansion of Solid
Advantages

1. Fire alarm e.g. electric bell
2. The fittings of wheels in rims
3. Bimetallic thermometer
4. Red hot rivet in ship building
5. Bimetallic stripes used in thermometer e.g. electric cooker etc

Disadvantages

1. Cracking of drinking glass when hot liquid poured inside
2. If the balance wheel of a watch expands the time will be fast and if the balance wheel of a watch contrasts the time will be slow
3. Expansion of metal of concrete bridges which can lead to eventual after a long period
4. Sagging of overhead wire due to contraction in winter season
5. Expansion of railway tracks thereby forming distant railway tracks.
6. Bursting of water metal pipes.

EVALUATION

1. Mention four effect of thermal expansion of solid.
2. Mention four the advantages and disadvantages of thermal expansion of solid.

Reading Assignment
www.google.com (click on google search, type “expansion of solid”, click on search) and New School Physics pg 37 – 42.

WEEKEND ASSIGNMENT

1. Gaps are left in the construction of railway tracks to give room for ……..
   A. contraction B. evaporation C. expansion D. vaporization

2. When hot water is poured in a glass tumbler, it might crack due to the …… of the inner walls of the tumbler A. even expansion B. uneven expansion C. uneven contraction D. even contraction
3. The stopper of a bottle can be removed due to the …… of the glass A. contraction B. expansion C. evaporation D. none of the above
4. The following are advantages of thermal expansion of solids except A. bimetallic thermometer B. fire alarm C. sagging of overhead wire D. fitting of wheels in rims
5. If heat is removed from solids they A. contract B. evaporate C. expand D. none of the above

THEORY

1. Mention four effects of thermal expansion of solid.
2. Mention four the advantages and disadvantages of thermal expansion of solid**.**

WEEK FOUR

TOPIC: Expansivity and Its Application – Linear, Area and Volume. Anomalous Expansion of Water. Real and Apparent Expansivity

CONTENT

- ✓ **Linear Expansivity of Solid**
- ✓ **Area Expansivity of Solid**
- ✓ **Cubic Expansivity of solid and Liquid**
- ✓ **Anomalous Behavior of Water**

Linear Expansivity

Linear expansivity of a solid can be defined as increase in length per unit length, per unit degree rise in temperature. It is denoted by (α) and measure in per Kelvin or per degree Celsius.

Mathematical representation

$$\alpha = \frac{L_2 - L_1}{L_1(\theta_2 - \theta_1)} \quad \text{_____ (i)}$$

Linear expansivity (α)= $\frac{\text{increase in length}}{\text{Unit length x temp change}}$

L_1 is the original length — θ_1 is the initial temperature

L_2 is the final length — θ_2 is the final temperature

$\blacktriangle L = L_2 - L_1$

$\blacktriangle \theta = \theta_2 - \theta_1$

$$\alpha = \frac{\blacktriangle L}{L_1 \blacktriangle \theta} \quad \text{_____ (ii)}$$

$$\alpha = \frac{L_2 - L_1}{L_1 X \blacktriangle \theta}$$

$L_2 - L1 = \alpha L_1 \blacktriangle \theta$

$L_2 = L_1 + X L_1 \blacktriangle \theta$

$L_2 = L_1 (1 + X \blacktriangle \theta)$

N.B. $\blacktriangle L = L_2 - L_1$

$\blacktriangle \theta = \theta_2 - \theta_1$

1. A brass rod is 2m long at a certain temperature. What will be the length for a temperature rise of 100K , if the linear expansivity of brass 18 x 10-6K^{-1}

SOLUTION

$L1 = 2m$, $L_2 = ?$, $\blacktriangle\theta = 100K$, $\alpha = 18x1o\text{-}6k\text{-}1$
$L_2 = L1\ (1 + \alpha\blacktriangle\theta)$
$L_2 = 2\ (1 + (18 \text{ X } 10\text{-}6 \text{ X } 100)$
$= 2(1 + 0.00018$
$= 2\ (1.OOO18)$
$= 2.0036m$

Area Expansivity
The area/superficial expansivity is the increase in area of per unit area per degree rise in temperature. It is donated by (β) and measured in per Kelvin and per 8C

$$\beta = \frac{A_2 - A_1}{A_1 (\theta_2 - \theta_1)}$$

Recall; $L_2 = L_1 (1 + \alpha \blacktriangle \theta)$
Similarly $b_2 = b_1 (1 + \alpha \blacktriangle \theta)$
$A_2 = L_1 (1 + \alpha \blacktriangle \theta) \text{ X } b_1 (1 + \alpha \blacktriangle \theta)$
$= L_1b_1 (1 + \alpha \blacktriangle \theta) (1 + \alpha \blacktriangle \theta)$
$A_2 = A_1 (1 + 2 \alpha \blacktriangle \theta + (\alpha \blacktriangle\theta)^2$
$A_2 = A_1 (1 + 2 \alpha \blacktriangle \theta)$
$A_2 = A_1 (1 + \beta \blacktriangle \theta)$

EVALUATION
1. A brass rod is 2m long at a certain temperature. What will be its length for a temperature rise of 90K, if the linear expansivity of brass is $1.8 \text{ x } 10\text{-}6K^{-1}$
2. Prove that $A_2 = A_1(1 + \beta\blacktriangle \theta)$.

Volume/Cubic Expansivity
It is denoted by (Y). It is the increase in volume per unit volume per degree rise in temperature

$$Y = \frac{V_2 - V_1}{V1\ (\theta_2 - \theta_1)} \quad \text{\_\_\_\_\_ (i)}$$

$Y = 3\alpha$ _____ (ii)
Relationship between α: β: Y: = 1: 2

Real and Apparent Cubic Expansivity of Water
Real or absolute cubic expansivity (Yr) .The real / absolute of the liquid is the increase in volume by unit volume per degree rise in temperature.
Apparent Cubic Expansivity (Ya)
The apparent cubic expansivity is the increase in volume per unit rise when heated in an expansible vessel.
$Yr = Ya + Y$

Anomalous Behaviour of Water
Most liquid except water expand when heated. This abnormal behavior of water is what is refer to as anomalous expansion of water. When water is heated from 0^0C, it contracts until it reaches 4^0C and beyond this point, water expands normally. The anomalous expansion of water takes place between 0^0C and 4^0C.

EVALUATION

1. With the aid of a diagram, explain the anomalous behavior of water.
2. Describe an experiment to determine the apparent cubic expansivity of a liquid

Reading Assignment

New School Physics pg 38 – 40,43 – 46

WEEKEND ASSIGNMENT

1. The anomalous expansion of water takes place between/at ……..A. 1^0C and 4^0C B. 0^0C and 4^0C C. 4^0C and 25^0C D. all temperature
2. The SI unit of linear expansivity is …… A. per Celsius B. per Fahrenheit C. per Kelvin D. per Joules
3. If the linear expansivity of a solid is 1.8 X 10^{-6} k^{-1}, the area expansivity will be A.0.9 X 10^{-6} B. 3.6 X 10^{-6} C. 1.8 X 10^{-6} D. 5.4 X 10^{-6}
4. A metal of length 15.01m is heated until its temperature rises by 60^0C. If its new length is 15.05, calculate its linear expansivity
   A. 0.0004/K B. 0.00004/K C. 0.004/K D. 0.04/K
6. The increase in volume of 10cm^3 of mercury when the temperature rises by 100^0C is 0.182cm^3. What is the cubic expansivity of mercury A. 0.000182/K
   B. 0.0000182/K C. 0.000187/K D. 0.000178/K

THEORY

1. Explain the anomalous behavior of water
2. If a cube metal box made of iron of side 2cm is to be used for construction, and the expected temperature difference is 90^0C. What will be the expected change in volume of the cube box if the linear expansivity of iron is 1.25 X 10^{-5}.

WEEK FIVE

TOPIC: Heat Transfer – Conduction, Convection, Radiation and Their Applications

CONTENT

- ✓ Conduction
- ✓ Convection
- ✓ Radiation
- ✓ Thermo Flask

Heat can be transferred by conduction, convection or radiation.

CONDUCTION

This is the process of transfer of heat through a material by vibration of the molecules fixed in position. N.B. Metals that allow heat to pass through them are said to be good conductors of heat. Though all metals are classified as good conductors, they differ in an ability to conduct heat. Non metal (wood / plastic) are bad conductors that does not allow heat to pass through it. Thermal conductivity is simply the ability of a metal to conduct heat.

PRACTICAL APPLICATION OF CONDUCTION OF HEAT

1. Kettle, pans and other utensils made of metals are provided with wooden or ebonite utensils so that heat from to utensils is not conducted.
2. House old source pans are made of metals because metals are good conductors of heat and electricity.
3. Thick brick walls are used in the construction of storage rooms. Bricks are bad conductors of heat, so it will not allow heat to enter the storage room.
4. A stone floor feels cold to the feet than a rug or a carpet on the same floor feels warm.

CONVECTION

Convection is the process by which heat energy is transferred in a fluid (liquid or gas) by actual movement of the heated fluid. The direction of the motion of a filter paper indicates the circulation of heated water. Circulation of a liquid is called CONVECTION CURRENT.

APPLICATION OF CONVECTION

Convection in liquid

1. Domestic water-boilers.
2. Cooling process of a motorcar vehicle.
3. Land and sea breezes.

Land and sea breezes

Convectional current set up in land and sea breezes. They occur mainly in coastal regions.

Sea breeze

During the hot season, heat from the sun passes straight from the air with little effect. The land is heated by the sun more quickly than the sea becase:

(i) It is a good absorber of heat.
(ii) It is a good radiator.
(iii) It has low specific heat capacity.

The air near the land thus warms up and rises while air from the sae moves into the land to replace the risen air. Air from the higher atmosphere moves from the sea and then a circulation current is set up. The breeze from the sea is known as ***the sea breeze***.

Land breeze

During the night, land is not heated by the sun, so it cools very quickly. Temperature of the sea drops only slightly and since it has been heated to a very high temperature, it

retains more heat as a form of energy. As a result of this, the sea is warmer than the land at night. Convectional current is therefore set in the opposite direction in the day as a result of breeze blowing from land to the sea. This breeze from the land is called ***land breeze***.

Convection in gases

1. Chimneys in Kitchens
2. Ventilation of industrial buildings (up-cast and downcast)
3. Bonfires
4. Room radiators- when in use, the hot air rising from it can produce a shadow in the room by the sun due to convection.
5. Glider lift- lift for aircraft used in flying sport. It is done by positioning the aircraft towards the roofs of factories where air above is warmer than any other place. The rising convection current is called thermal
6. Wind- convection currents in air when hot air rises from the equator and replaced by a colder or denser air from the polar region. Wind depends on earth's rotation, large masses of land and sea over which it passes and temperature.
7. Air conditional are placed at the top of wall in the room and not on the floor so that the hot air which are less dense rises and are cooled while the colder air which are denser sink down hence. This continuous process of rising and cooling of warm and cold air set up convectional currents which cools the room.

RADIATION

Radiation is the process by which heat is transferred or conveyed from one place / point to another without heating the interview medium. In radiation molecules are not involved, it differs from another method because it does not require a medium for heat to be transferred. Heat from the sun reaches us by this method. The energy given out as radiant heat is known as RADIANT ENERGY. This energy displace electrical and magnetic properties and it said to be electromagnetic radiation and the name is INFARED.

RADIATION CAN BE DETECTED BY

1. Radiometer
2. Thermo-pile
3. Leslie cube

Dark surface is good absorber of heat and poor emitter of radiation. Highly polished surface are good emitter of radiation and poor emitter of heat.

APPLICATION OF RADIATION

1. It is not advisable to wear a dark shirt in the tropical sun.
2. Roofs of factories are coated with aluminum paint.
3. Shinning roofs and outside walls are painted with light colour in hot climate to keep the house cool.

Cooking utensils are darkening at the bottom and polished in the upper surface. The blacking surface will allow the heat while the silver surface won't allow the heat to go out.

EVALUATION

1. Define the following terms A. conduction B. Convection C. Radiation
2. State two application of radiation.

Thermos Flask

A thermos flask is used to keep the temperature of its content constant. The essential **Feature of a thermos flask are as follows:**

1. Cork stopper – Prevent heat loss by conduction, conduction and Evaporation
2. Vacuum in the double wall – Reduce heat loss or gain by conduction and convection
3. Silvered wall surface – Minimize heat loss by radiation
4. Cork support – Prevent heat loss by conduction

Thermos flask is also known as vacuum flask.

EVALUATION

1. Define the following terms A. Conduction B. Convection C. Radiation
2. With the aid of a diagram, explain how the construction of a thermos flask minimizes heat exchange with the surrounding

Reading Assignment

New School Physics pg 46 – 53

WEEKEND ASSIGNMENT

1. The silver surface of a thermos flask minimizes heat loss by A. conduction B. radiation C. convection D. evaporation
2. Is it advisable to wear a dark shirt in the tropical sun? A. yes it is B. No it is not C. Cannot say D. All of the above
3. The following are good conductors of heat except A. steel B. aluminum C. copper D. wool
4. The thermal conductivity of copper is greater than lead A. true B. false C. cannot say D. none of the above
5. A stone floor feels warm to the feet but a rug or a carpet on the same floor feels cold A. true B. false C. cannot say D. none of the above

THEORY

1. Define the following terms A. Conduction B. Convection C. Radiation.
2. With the aid of a diagram, explain how the construction of a thermos flask minimizes heat exchange with the surrounding.

WEEK SIX

TOPIC: ELECTRIC CHARGES→ Production, Types, Distribution and Storage

CONTENT

- ✓ Production of Charges
- ✓ Types of Charges
- ✓ Distribution of Charges
- ✓ Storage of Charges

❖ Production of Charges

If a plastic pen is rub vigorously on the hair or on a coat and it is hold near a very small piece of paper, the paper will be attracted by the pen. Some substances are found to poses the ability to attract light objects once they are rubbed. The light object as well as the rubbed material are said to be charged or electrified with static electricity.

Electrostatics is the study of charges at rest. It is a type of electricity that does not move from one point to another in the substance in which it is produced.

❖ Types of Charges

There are two types of charges – positive and negative charges.
Positive charge is obtained when a glass rod is rubbed with silk, or cellulose acetate with silk, while negative charge is obtained when an ebonite rod is rubbed with fur or polythene with fur.

These two rods with positive and negative electrification attract each other when brought close. Repulsion occurs if two similar rods are brought close.

FUNDAMENTAL LAW OF ELECTROSTATICS

The law states that like charges repel, unlike charges attract.

CONDUCTORS AND INSULATORS

Conductors are materials that allow electrons to pass through them easily. Examples of conductors are metals, damp air, graphite, acids, salt solutions, the earth, and the human body.
Insulators are materials that do not allow electrons to pass through them easily. Examples of insulators are plastic, polythene, Bakelite, ebonite, paper, dry hair, silk, oils, glass, sulphur and wood.

EVALUATION

1. State the fundamental law of electrostatic.
2. What is electrostatic?

❖ Distribution of Charges

Experimental works have shown that charges are distributed where there is a sharp curve. The densities of these charges are greater at the surface of sharp curve. The charge per unit area of a charged surface is called surface density.

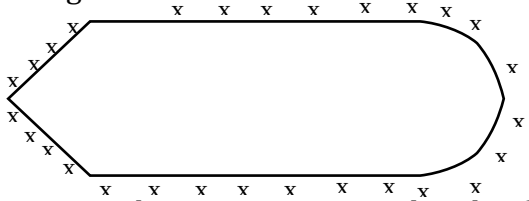


Fig. 2.3 Charge Distribution is greater at the edge (sharp edge)

❖ Storage of Charges

The electrophorus is a device for transferring and storing charges. It produces electric charges by electrostatic induction. Another device for the storage of electric charges is the capacitor

EVALUATION

1. With the aid of a diagram, explain charge distribution.
2. Name two devices that can store charge.

Reading Assignment

New School Physics pg 56 – 58, 63 – 65

WEEKEND ASSIGNMENT

1. Electophorus and capacitor can store charges A. true B. false C. cannot say D. none of the above
2. When an ebonite rod is rub with fur, the fur becomes A. positively charge B. negatively charge C. neutral D. none of the above
3. The ebonite rod in question 2 becomes A. positively charge B. negatively charge C. neutral D. none of the above
4. Like charges A. attract B. repel C. disappear D. evaporate
5. Charges are unusually concentrated at places where the surface is …….. A. straight B. sharply curved C. oval in shape D. none of the above

THEORY

1. State the fundamental law of electrostatic.
2. What is electrostatic?

WEEK SEVEN

TOPIC: Gold Leaf Electroscope and Its Uses. Lighting and Lighting Conductor.

CONTENT

- ✓ **Gold Leaf Electroscope**
- ✓ **Lighting and Lighting Conductor**.

Gold Leaf Electroscope

The gold-leaf electroscope is an instrument used for testing positive and negative charges. It consists of a metal (brass) rod to which a thin gold-leaf (or aluminium leaf) is attached. The rod is surmounted by a brass disc or cap and insulated from the metal case. The leaf is protected from outside influences (like drought) by enclosing it in an earthed metal case with glass windows.

Generally, the gold-leaf can also be used to test the conducting properties of materials.

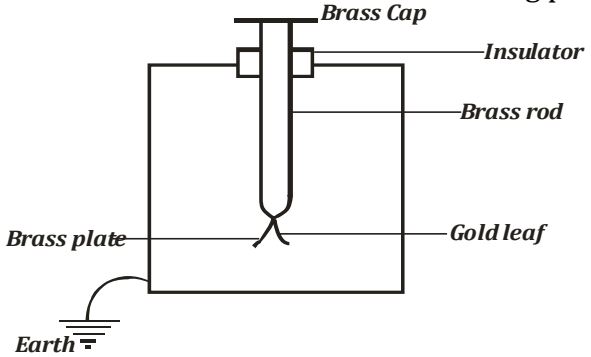


Fig. 2.1 Gold-leaf electroscope

Uses of Electroscope

1. It is used to test whether a material is a conductor or an insulator. The material is made to touch the cap. Rapid collapse means that the charges escape easily and hence the material concerned is a good conductor. A slow collapse means that it is a poor conductor. No collapse means that it is an insulator.
2. Use to test charges whether the charge is positive or negative. The gold leave electroscope to test the sign of the charge of an object. If an unknown charge is brought near to a charged electroscope and the leaf diverges more, the unknown charge is similar to the charge on the electroscope.

CHARGING AN INSULATED BODY

A neutral insulated body can be charged by two methods

i) Contact method and
ii) By induction

1. Contact Method: - The method is achieved by bringing a charged object in contact with it. By so doing the neutral insulated body acquired the same type of charge as that on the charged object.
2. Induction Method: - This method is simply a process of charging a neutral body by placing a charged body near it without any contact between the two.

This process is as explained in the following steps below:

i) Bring a positive charge close to an insulated body to be charged. (Note: insulation as used here is by placing body on an insulated stand to avoid the charge induced from leaking away). Negative charges on insulated body are attracted towards the inducing charge while the positive charges are repelled away from it.
ii) Earth the insulated body by momentarily touching it so that the positive charge conducts away

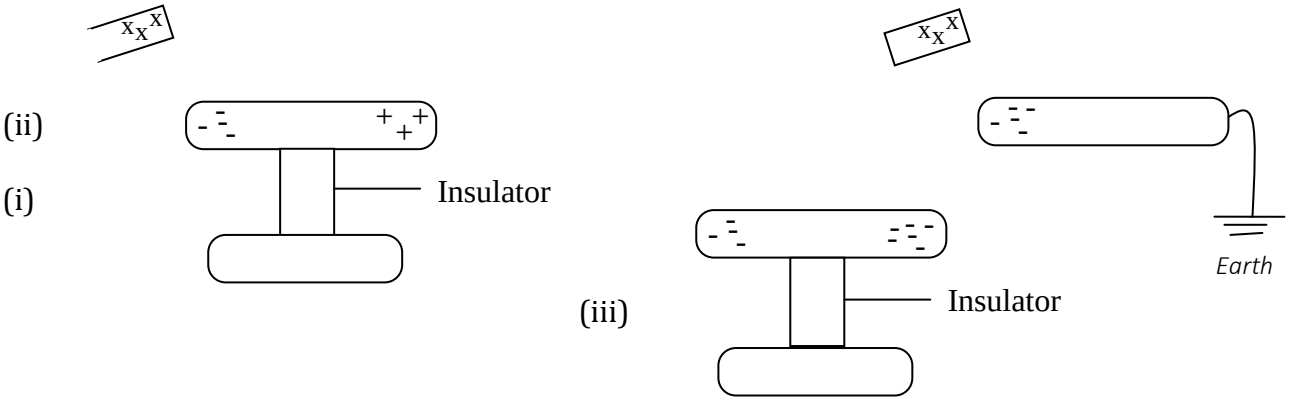


Fig. 2.2 charging by induction

iii) Remove inducing charge: From observation, the negative charge will spread round leaving the body is a negatively charged body. If the inducing charge is negative, then the body will acquire a negative charge after taking the steps above.

EVALUATION

1. State two uses of an electroscope.

2. Draw a well label diagram of an electroscope.

❖ **Lighting and Lighting Conductor**

The atmosphere is known to contain ions or charged particles, which have been produced by radiation from the sun and by what is known as cosmic radiation, which enters the atmosphere from outer space.

Lighting is a sudden discharge or neutralizing of electric charges, and it occurs when charges build up in a cloud.

The lighting conductors are long metal strips running from the spike end of a conductor on the top of a building. They are used to prevent building from destruction when struck by thunder or lightning. The conductor is a long metal rod installed or connected to the earth by means of a cable. The sharp outer point of the top gains an induced charge opposite to that in the thundercloud. The charge ionizes the nearby air and the charged air molecules flow upwards from the point. This discharges the cloud before a lightning flash occurs.

EVALUATION

1. What is the function of lighting conductors?
2. Define lighting.

Reading Assignment

New School Physics pg 58 -63

WEEKEND ASSIGNMENT

1. …… is a device use to detect charge A. Electrophorus B. Capacitor C. Electroscope D. Inductor
2. A lighting conductor is used to protect a building from lighting damage. A. true B. false C. cannot say D. none of the above
3. ……. is the sensitive part of an electroscope A. The casing B. The cap C. The gold leaf D. The brass rod
4. The casing of an electroscope is earthed so as to screen the leaf from outside interference A. positively charge B. negatively charge C. neutral D. none of the above
5. Capacitor is a device that …….. charges A. produces B. emits C. store D. none of the above

THEORY

1. Explain the two uses of an electroscope.
2. Draw a well label diagram of an electroscope.

WEEK 8

TOPIC: FIELD – CONCEPT AND TYPES OF FIELD. GRAVITATIONAL AND MAGNETIC FIELD. FORCE OF GRAVITY

CONTENT

- ✓ **Concept of Field**
- ✓ **Types of Field**
- ✓ **Gravitational Field**

❖ Concept of Field

Field can be defined as the region or space under the influence of some physical agency such as gravitational, electricity and magnetism.

❖ Types of Field

Fields are of various types namely: gravitational, magnetic and electric field.

❖ Gravitational Field

Gravitational field is any region or space around a mass in which the gravitational force of the mass is felt.

If we throw up massive objects, it is our common observation that they move up to their highest points, stay stationary very briefly and eventually move downwards, falling faster and faster until they hit the ground level. The up and down movements objects on the earth's surface are subject to the influence of the gravitational field.

Force of Gravity

The force of gravity is the pull of attraction between the earth, itself and objects on or near it.

Newton's Law of Universal Gravitation

Newton's law of gravitation states that the force of attraction between two bodies of mass M_1 and M_2 is inversely proportional to the square of their distance R, between their centres and it is directly proportional to the product of their mass.

Mathematical expression

$$F \alpha \frac{M_1 M_2}{R^2} \qquad F = \frac{GM_1 M_2}{R^2}$$

Where F is the gravitational force on either particle, M_1 and M_2 are their masses, R is the distance between them, and G is a universal gravitational constant, whose numerical value depends on the units in which the force, mass, and length are expressed.

Acceleration Due to Gravity

The acceleration of objects due to the earth's gravitational attraction is called the acceleration due to gravity. It is represented by the symbol g whose average value is about $9.81ms^{-2}$.

Without air resistance, different mass or objects released from rest at the same point will fall to the ground at the same time (free fall).

EVALUATION

1. Define field.
2. State Newton's law of gravitation.

Magnetic Field

The region or space around a magnet in which the influence of the magnet can be felt or detected is called a magnetic field. If a white sheet of paper is placed over a magnet and iron fillings are sprinkled on the paper, it will be observed that the iron filings will arrange themselves in a definite pattern which illustrates the magnetic lines of force of the magnet. A similar pattern can be obtained by using the compass needle to plot the magnetic lines of force.

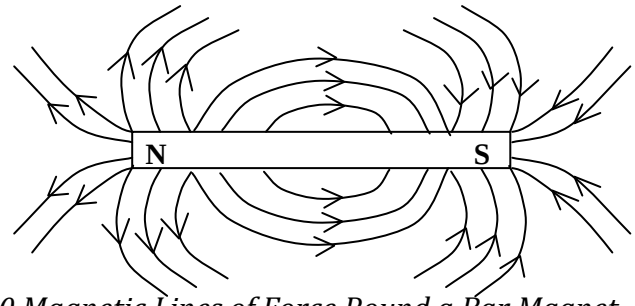


Fig 3.0 Magnetic Lines of Force Round a Bar Magnet

Lines of Force

A line of force is an imaginary line drawn in such a way that its direction at any point, that is the direction of the tangent, is the same as the direction of the field at that point.

EVALUATION

1. Define magnetic field.
2. Define gravitational field.

Reading Assignment

New School Physics pg 67 - 70

WEEKEND ASSIGNMENT (THEORY)

1. Define A. gravitational field B. acceleration due to gravity. How does acceleration vary with latitude

2. A. Explain what is meant by a field as used in physics. B. Mention three types of field known to you

WEEK NINE

TOPIC: Electric Field – Line of Forces, Properties of Line of Force, Description and Properties of Force Field

CONTENT

- ✓ **Electric Field**
- ✓ **Line of Force and properties**

❖ **Electric Field**

Electric field is defined as any region where a charge experiences a force of electrical origin. There are two types of charges namely : positive and negative charges.

Lines of Force

An electric field has been defined as a region where an electric force is experienced. Electric fields can be mapped out by electrostatic lines of force. An electrostatic line of force may be defined as a line whose tangent is in the direction of the force on small positive charge at that point. Arrows on the lines of force show the direction of the force on a positive charge. The force on a negative charge is in the opposite direction.

Since the direction of a field varies from point to point, lines of force are usually curves.

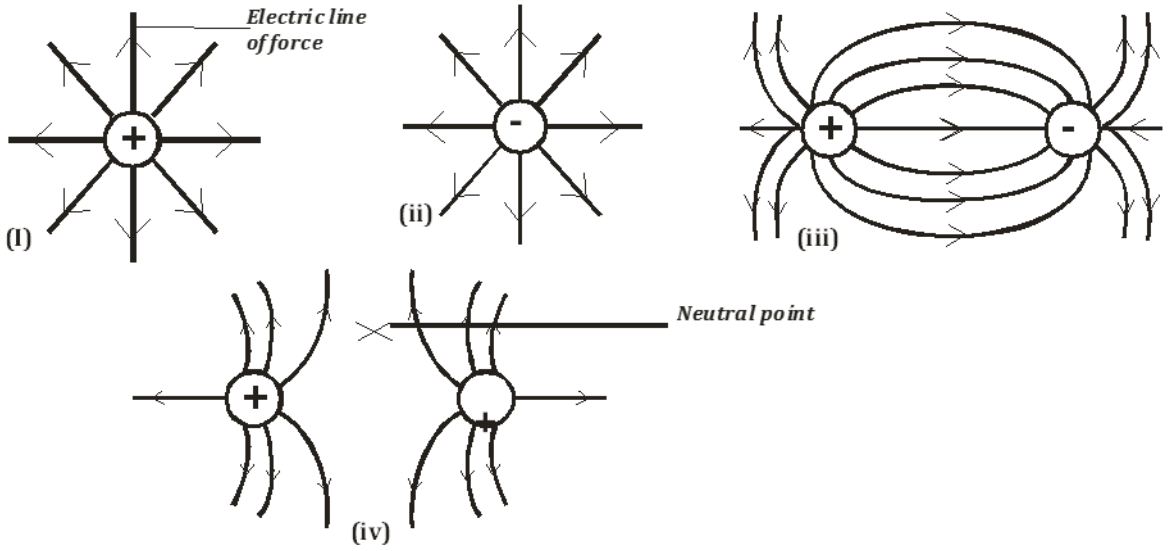


Fig 4.1: Lines of Electrostatic force

(i) Isolated positive charge (ii) Isolated negative charge
(iii) Unlike charges – positive and negative charges (iv) like charges – positive and positive charges

Properties of Lines of Force

1. Lines of force never intersect.
2. Lines of force are usually curves, as the direction of a field varies from point to point.
3. In a uniform field, the lines of force are straight, parallel and uniformly spaced.
4. No lines of force originate or terminate in the space surrounding a charge.
5. Every lines of force in an electrostatic field is a continuous line terminated by a positive charge at one end and a negative charge at the other end.

Coloumb's Law states that the force experience by two charges Q1Q2 separated by a distance r is directly proportional to their product of their charges and inversely proportional to the square of their distance apart. It is also known as inverse square law.

Q1 ⟷ Q2

$F \alpha Q1Q2$

$F\alpha \ 1/r2$

$F \alpha \frac{Q1Q2}{r^2}$

$F = K\frac{Q1Q2}{r^2}$ _____ (i)

$K = 9 \times 10^9 \ Nm^2 \ C^{-2}$ / f/m

$K = \frac{1}{4\Omega\epsilon_0}$

(Permitivity of Free Space vacuum)

EVALUATION

1. State four properties of line of force.
2. State coulomb's law.

❖ **Electric Field Intensity (E)**

It is simply the force per unit charge. It is a vector quantity and measured in

$E = F/Q$ _____ (iii)

❖ **Electric Field Potential (V)**

It is the work done in moving a unit positive charge from it point of infinity to a point in the field. It can also be defined as work done per unit charge, it is a scalar quantity and measured in joules per coloumb or volt.

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

❖ **Flux Density D.**

It is denoted by D. It is simply charge by unit area. It is measured in Cm-2/ Clm^2

$$D = \frac{Q}{A}$$

EVALUATION

1. Define A. electric field intensity B. electric field potential
2. Differentiate between electric potential and electric potential energy

Reading Assignment

New School Physics pg 72 & 73

WEEKEND ASSIGNMENT

1. The SI unit of flux density is A. Cm^2 B. Cm C. Cm^{-2} D. C
2. Electric potential is a scalar quantity A. true B. false C. cannot say D. none of the above
3. Electric field intensity is a scalar quantity A. true B. false C. cannot say D. none of the above
4. The SI unit of electric potential energy is ……. A. volt B. Joules per coulomb C. Joules D. Cm^2
5. Line of force are maginary A. true B. false C. cannot say D. none of the above

THEORY

1. The force acting on an electron carrying a charge of $1.6X10^{-19}$ C in an electric field of intensity $5X10^8$ Vm^{-1}.
2. 1f 20MJ of work is done in moving a 5μC of charge between two points in an electric field, the potential difference between the two points is?

WEEK TEN

TOPIC: PRODUCTION OF CONTINUOUS ELECTRIC CURRENT

CONTENT

- ✓ Production of Continuous Current From Mechanical Energy.
- ✓ Production of Continuous Current From Chemical Energy
- ✓ Production of Continuous Current From Heat Energy
- ✓ Production of Continuous Current from Solar Energy.

❖ **Production of continuous energy from mechanical energy**

When a force is applied at a prime mover, the prime mover drives the amature/ rotar. As the amature is rotating in the magnetic field system , the amature cuts the magnetic flux produce by the magnet. Hence E.M.F will be induced in the coil of the amature based on faraday's law of electromagnetic induction.
The induced E.M.F can be supplied to an external load.

❖ **Production of Continuous Current from Chemical Energy**

A cell consist of two dissimilar metals separated by solution of various acids or salt. The metal are known as the electrodes and the solutions are the electrolyte. The positive electrode is known as the anode. The negative electrode is the cathode.
A cell is a device for converting chemical energy into electrical energy.

EVALUATION

1. With the aid of a diagram, describe how continuous current can be generated from mechanical energy.
2. With the aid of a diagram, describe how continuous current can be generated from chemical energy.

❖ **Production of Continuous Current from Heat Energy**

The ends of two dissimilar metal joined are inserted in cold and hot water and a galvamometer to detect the flow of charges. Due to temperature difference at both end current will flow in the connection. The greater the difference in temperature between the hot and cold junction, the greater the current flow.

❖ **Production of Continuous Current from Solar Energy**

If solar energy is made to fall on a photo electric cell, solar energy will be converted to electric energy directly by photo electric effect.

EVALUATION

1. With the aid of a diagram, describe how continuous current can be generated from mechanical energy.
2. With the aid of a diagram, describe how continuous current can be generated from chemical energy.

Reading Assignment

New School Physics pg 75 - 77

WEEKEND ASSIGNMENT

1. Cell convert chemical energy into _____ energy A. mechanical B. electrical C. solar D. atomic
2. DC generator convert A. electric to mechanical energy B. mechanical to electric energy C. solar to electrical energy D. none of the above

3. Thermocouple consist of two A. similar metals B. dissimilar metals C. alloys metals D. none of the above.
4. The feature that produces magnetic flux in a generator is _____ A. Amature B. magnet C. stator D. prime mover
5. Conversion of mechanical energy into electrical energy in a dc generator is base on what principle A. moment B. faraday's law of electromagnetic induction C. coulomb's law D. fundamental law of electrostatic.

THEORY

1. With the aid of a diagram, describe how mechanical energy is converted to electrical energy.
2. With the aid of a diagram, describe how heat energy is converted to electrical energy.