PHYSICS SS1 SECOND TERM SCHEME OF WORK

PHYSICS: SS1

WK	TOPIC	CONTENTS
1.	Heat Energy	1) Concept of temperature 2) Effects of heat – (i) change of state (ii) Expansion
2.	Heat Energy	Expansivity
3.	Heat Energy	Transfer of heat (i) Conduction (ii) Convention (iii) Radiation
4.	Electric Charges	(i) Production of Charges (ii) Types of Charges (iii) Distribution of charges (iv) Storages of charges
5.	Description and Properties of Field. Gravitational Field	(i) Concepts of field – (a) Gravitational field (b) Magnetic field (c) Electric field (d) Property of a force field. (ii)Acceleration due to gravity
6.	Electric Field	. Electric lines of Force Potential difference and electric current (2) Production of electric currents.
7-9.	Electric Field	(i)Electric Circuits (ii) Electric conduction through materials. (iii) Ohm's law (iv)Resistor in parallel and in series
10	Electric Field	
11	Particle Nature Of Matter	-Structure of matter (i) Evidence of the particle nature of matter (ii)Simple atomic structure -Molecules (i) Their nature (ii) Their size -Brownian Motion -Diffusion -States of water (i) Solid (ii) Liquid (iii) Gas
12	Crystal Structure	-Arrangement of atoms in crystal structure -Distinction between crystalline and amorphous substances

WEEK 1

HEAT ENERGY

Introduction:

If a small amount of hot water is poured into a cup of warm water, the water in the cup becomes slightly warmer. Heat from the hot water has added something to the warm water. Therefore, we say that temperature of the warm water has increased.

Heat and Temperature:

Heat is a transfer of energy due to temperature difference. The unit of heat energy is joule.

Temperature is a property of an object which determines which way heat will flow when it is placed in contact with other object OR

Temperature is the degree of coldness or hotness of a body that determines the direction of heat flows. The unit of temperature is degree Celsius (^{0}C), Kelvin (K) or degree Fahrenheit (^{0}F)

Effects of Heat

The following are effects of Heat:

1. Expansion
2. Change of state
3. Sagging of wire
4. Changing of temperature
5. Distortion of twisted wires.

Differences Between Heat Energy and Temperature

	Heat	Temperate
1.	It is energy due to temperature differences	It is the degree of hotness or coldness of a body
2.	Its unit is joule	Its unit is degree Celsius (^{0}C) is Kelvin (k)
3.	It is measured using calorimeter	It is measured with thermometer.

Temperature Measurement

The instrument for measuring temperature is called thermometer

Thermometric Substance: The substance used in thermometer is called thermometric substance example alcohol and mercury.

Thermometric Property: The physical property of a substance used in thermometer is called thermometric property.

Types of Thermometric

	Types of Thermometer	Thermometric Substances	Thermometric Property
i.	Liquid in glass thermometer	Mercury or alcohol	Change in volume
ii.	Gas thermometer	Gas	Change in gas pressure at constant volume
iii.	Thermo-electric thermometer	Two different wires	Current flow due to temperature differences
iv.	Resistant thermometer	Resistance wire	Increase in the resistance of wire due to heat.

Calibration of Thermometer

In the calibration of thermometer, two fixed reference points are considered which are the upper and lower fixed points. The upper fixed point is the temperature of steam boiling at normal atmosphere pressure. The lower fixed point is the temperature of pure ice and water at normal atmospheric pressure.

Calibration of lower fixed points

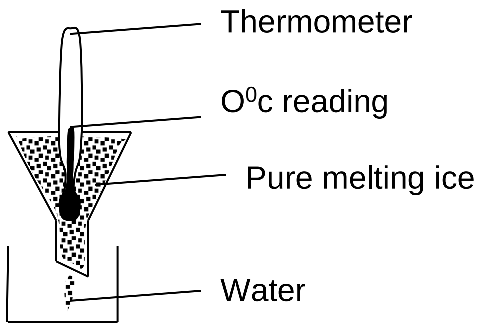


Figure A

Calibration of upper fixed points

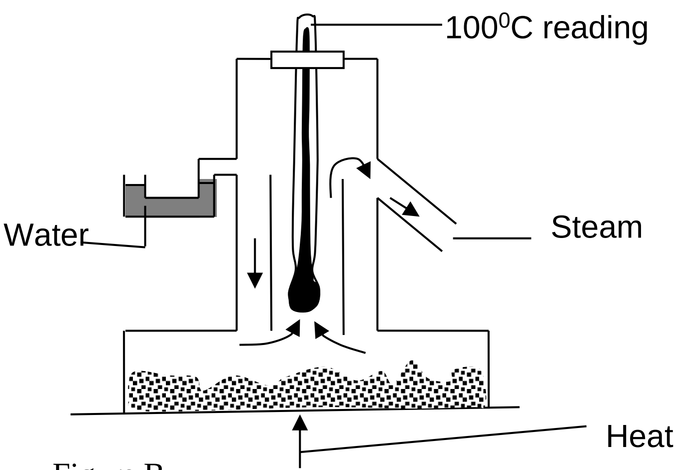
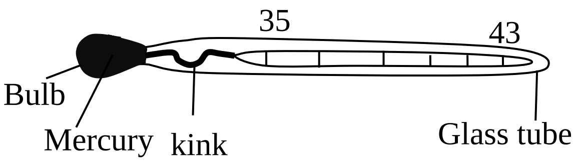


Figure B

For diagram A and B, the upper and lower fixed points are obtained when the mercury threads remains constant after a period of time.

Functions of Part of Clinical Thermometer



A. Kink: Enable temperature reading to be taken when the thermometer is taken out of the human body.

B. **Bulb:** Houses the mercury

C. **Narrow Bore:** Brings about increases in the length of mercury due to temperature changes.

D. **Glass Tube or Stem:** Protects the bulb, kink and bore.

	Advantages of alcohol	**Disadvantages of Alcohol**
1.	Freezes at 115^0C. It is used to measure low temperature	1. Boils at 78^0C. It cannot be used to measure high temperature.
2.	Expansivity of about six times that of mercury.	2. Vaporizes easily
		3. Not easily seen, needed to be colored.
		4. Wets glass easily. The leads to low reading
		5. Has port conductivity. Therefore, responds slowly to temperature changes.

Advantages and Disadvantages of Mercury

All the advantages of alcohol as thermometric substances are the disadvantages of mercury and the disadvantage of alcohol are the advantages of mercury.

Evaluation:

1. Write short notes on heat and temperature
2. Differentiate between thermometric substance and thermometric property.
3. What are the advantages and disadvantages of mercury as thermometric substance?

WEEK 2

EXPANSIVITY

Introduction:

Temperature changes affects metals and other solid everyday. Experience shows that metals expand when heated and contract when cold.

Linear expansivity

This is defined as increase in length, per unit length for each degree rise in temperature.

$$\alpha = \frac{L_2 - L_1}{L_1(\Theta_2 - \Theta_1)} = \frac{L_2 - L_1}{L_1\Theta}$$

Where α is linear expansivity in per Kelvin, L_2 and L_1 are final and initial length in meter respectively.

Θ is change in temperature it $\Theta = \Theta_2 - \Theta_1$

Linear expansion is also known as coefficient of expansion.

Example: The length of copper rod at 50^0C is 2.0016m and 2.0064m at 200^0C. find the linear expansivity of copper.

Solution

$$\alpha = \frac{L_2 - L_1}{L_1\Theta}$$

L_1 = 2.0016m

L_2 = 2.0064m

Θ = 200 – 50 = 150^0C

$$\alpha = \frac{2.0064 - 2.0016}{2.0016x150} = \frac{0.0048}{300.24} = 0.000016/K$$

Area Expansivity (β)

Area expansivity is defines as increase in area per unit area for each degree rise in temperature.

Mathematically, $\beta = \frac{A_2 - A_1}{A_1\Theta}$

Where A_2 and A_1 are final and initial area

Θ is change in temperature

$A_2 = A_1 (1 + \beta\Theta)$

The relationship between area and linear expansivity is:

$\boxed{\beta = 2\alpha}$

Cubic expansivity (γ)

Real or absolute cubic expansivity of a liquid is defined as increase in volume per unit volume for each degree rise in temperature. It is denoted by gamma (γ_r)

Apparent cubic expansivity of a liquid is the increase in volume per unit volume for each degree rise in temperature when the liquid is heated in an expansible container. It is denoted by the symbol (γa).

Cubic expansivity is defined as increase in volume per unit volume for each degree rise in temperature of the containing vessels (γ)

Mathematically, $\gamma_r = \gamma_a + \gamma$

Also, γ = 3α

Anomalous Expansion of Water

Water and other few substances do not always expand when heated. Ice at – 8^0C expands slightly when heated until it reaches temperature of 0^0C. The Ice melts and contract until temperature of 4^0C and then it begins to expand like any other liquid as the temperature rises from 4^0C to 100C. This behavior of water is called anomalous expansion of water. During anomalous, mass remains constant but volume decreases and reached minimum value at 4^0C, the density (mass / volume) increases and reached maximum value at 4^0C.

Effects of Expansion

I Cracking of glass bottle or tumbler due to uneven expansion

II Expansion of railway track when heated

III Creaking noise of a galvanized iron sheet during a hot sunny day.

Application of Expansion

It is used in bimetallic strip that found it application in electric iron or refrigerator and it is called thermostat

Evaluation:

1. A steel rod has a diameter of 5cm at 30^0C. At what temperature will it fit exactly into a hole of constant diameter 4.997cm [coefficient of linear expansion of steel is 11×19^{-6} /C
2. Calculate the increase in volume when 1500 cm3 is heated from 0^0C to 4^0C [$\alpha = 1.2 \times 10^{-5}$ /C]
3. The length of a side of a metallic cube at 20^0C is 5cm. Find the volume of the cube at 120^0C [$\alpha = 4.0 \times 10^{-5}$ /K]

WEEK 3

TRANSFER OF HEAT

Introduction:

Hot water and cold water don't give the same feelings when touched. This is due to the amount of heat they have.

Heat is a transfer of energy due to temperature difference between two bodies that are in contact. They are basically three (3) modes of heat transfer. These are conduction, convention and radiations.

Conduction

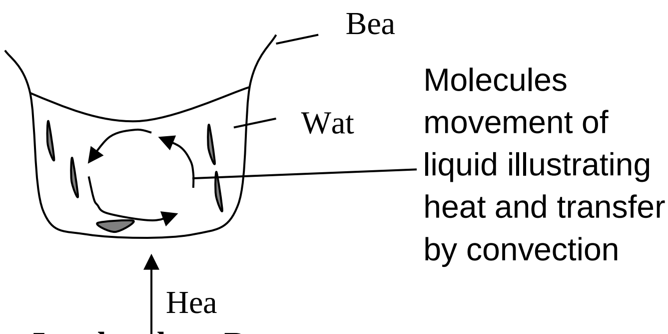
Conduction of heat is a process by which heat is transferred from one end of solid to another end without actual displacement of the molecules of the solid.

All metals are good conductors of heat and non – metal such as rubber, cotton and wood are poor conductors of heat and they are called insulator.

Application of conduction is seen in a cooking pot on top of a burning stove and a spoon or metal immersed in hot water.

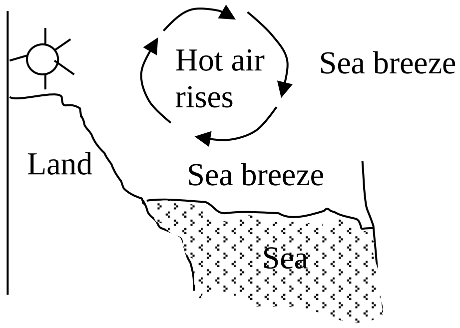
Convection

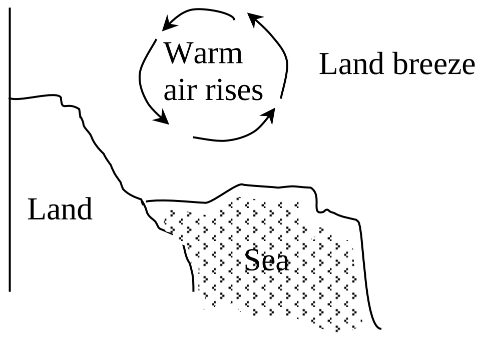
Convection is the process of heat transferred in a liquid or gas by the actual displacement or movement of the molecules of liquid or gas.



Land and sea Breeze

Land and sea breeze are natural convection current. In the day time, the sun heats the land to a higher temperature than the sea. The air above the land is warmed and rises up. Its place is taken by cooler air above the sea. Air higher in the atmosphere completes the circulation and so a sea breeze blows. At night, the sea temperature drops, slightly since it is warmed to a considerable depth during the day. On the other hand, the land temperature drops greatly at night. At night therefore, a convection current is obtained in the opposite direction to day time and this is the land breeze.





Radiation

Radiation is the process by which heat is transferred from one place to another without heating any intervening medium. It requires no material medium. Heat from the sun gets to us through radiation.

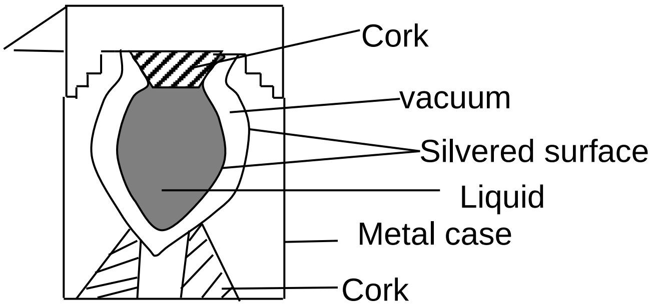
The instrument for comparing radiation from different surfaces is called Leslie cube or thermopile. A dull surface is a good radiator and absorber of heat while a polished surface is a poor radiator and absorber of heat.

Practical Consequence of Radiation

1. It is not advisable to wear a black jacket in a tropical sun since it is a good absorber of heat.

2. In tropical area mostly, we use shining roofs and paint the out walls with light colour.
3. In sunny countries, solar panel is used to collect radiation heat from the sun and heat water.

Thermos flask



a). Cork: Prevent heat loss due to convention

b). Silvered wall: Prevent heat loss due to radiation

c). Vacuum: Prevent heat loss due to convection and conduction

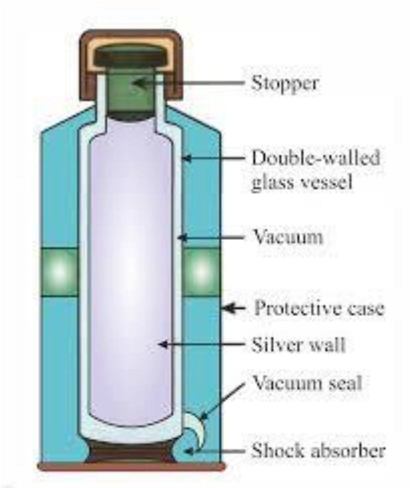
Evaluation:

I. Explain the functions of parts of the body of thermos flask

II. Explain the mode of heat transfer you known

III. State the similarities and differences between conduction and convection.

IV. Explain the principle working of land and sea breeze.



ELECTRIC CHARGES

Introduction:

Electrostatic are the charges that are built on the surface of a material. These charges are not in motion.

When a plastic rod is rubbed on a wool or glass rod rubbed on a silk or cotton. The rod can attract a small piece of paper. This is due to static charges (electrostatic)

Types of Charges

1. There are two types of charges, which are negative and positive charges.
   An ebonite rod rubbed on a fur has a negative charge while a glass rod rubbed on a silk or wool has a positive charge.

NB The kind of charge on a material depends on the material it is rubbed with.

Conductor and Insulator

An electric conductor is a material that allows the free flow of electron from one point to another point. Metals are good conductor. An insulator is a substance that does not allow the free flow of electron from one point to another e.g. glass, silk and wool.

Method of Charging A Body

There are three method of charging a body. These are:

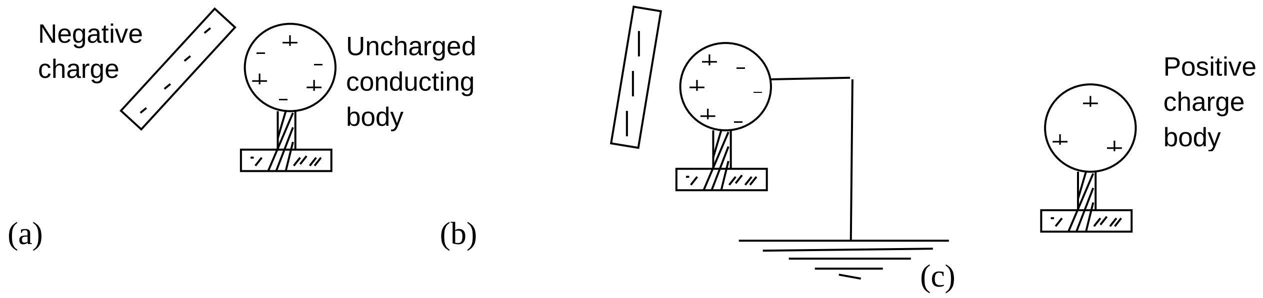
i. Charging by friction
ii. Charging by induction
iii. Charging by contacts.

Charging by Friction

If you rub your pen vigorously on your hair and bring it closer to a piece of paper, it will attract the paper. This is an example of charging by friction.

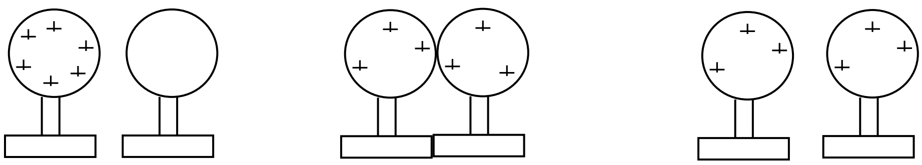
Charging by Induction

This is a method of charging a body by bringing it near a charge body without contact.



Charging by Contact

This is a method of charging a body by actual contract on another charged body. When separated, both bodies carry charges of the same sign and equal charges.



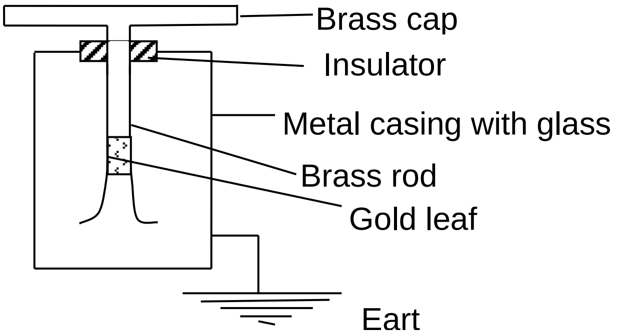
Before contact During contact After contact

Gold leaf Electroscope

Gold leaf electroscope is use in studying electrostatic principles. It is a device for detecting the presence of a charge and the type of charge on a body.

Detecting the Presence of Charge on A Body

If a charged body is brought near the cap of uncharged electroscope, the leaf diverges from the metal. When the charged body is removed, the leaf collapse, showing that the induced charged is temporary. If the charged body has contact with the cap of the gold leaf electroscope, when the charged body is removed, the leaf does not collapse. An indication that it has been charged by contact.



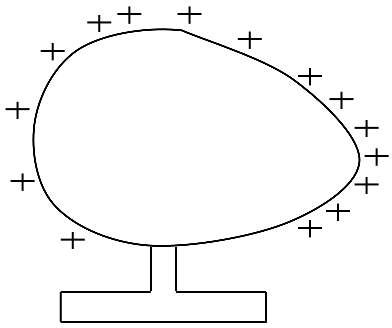
Gold Leaf Electroscope

Test for the Sign of the Charge on A Body

If a charged body having the same charge on the electroscope is brought near it, the leaf diverges further on the other hand, the divergence is reduced if the charge on the body is of opposite sign to that on the electroscope.

Distribution of Charges on a Conductor.

Charges reside on the outer surface of a conductor and it an ellipse. Charge density is greatest where the surface is sharply curve. From the diagram below the curve and his the greatest charges.

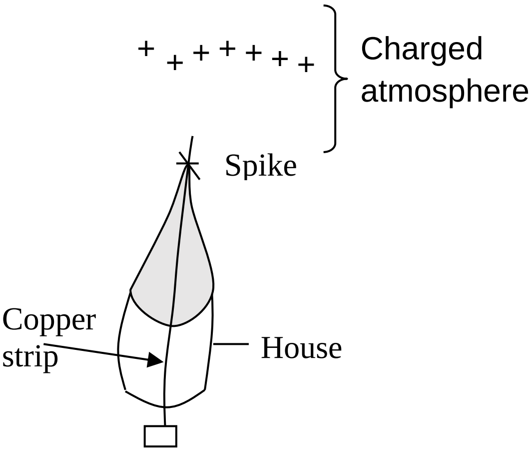


Charge distribution on a shaped

conductor

Lighting Conductor

A lighting conductor consist of a thick copper stripe fixed to an outside wall of a building where it ends in spike. The other end of the plate is buried below the earth surface. When a negatively charged cloud moves overhead, it attracts positive charges to the spike. The air around the spike is further ionized leading to huge avalanche of positive ions. These ions slowly neutralized the negative charges in the cloud and reduces the possibility of lighting. However, if lighting still strikes, the negative electrons are attracted towards the spike and are carried harmlessly down the earth through the conducting copper stripe.



Action of a Lighting Conduct.

WEEK 5

DESCRIPTION OF FIELD AND PROPERTIES OF FIELD AND GRAVITATIONAL FIELD.

<u>Introduction:</u>

A field is a concept used in physics to explain or describe the space or region or area where the effects of an object is experienced by another objects.

There are three types of field which are gravitational, magnetic and electric field.

<u>Gravitational Field</u>

Gravitational field is the region within the earth's atmosphere where every object within this region experience the downward pull of the earth force.

Isaac Newton discovered a universal law known as newton's law of gravitation. This law stated that the force of attraction between two masses M and m is directly proportional to the product of their masses and inversely proportional to the square of their distance apart.

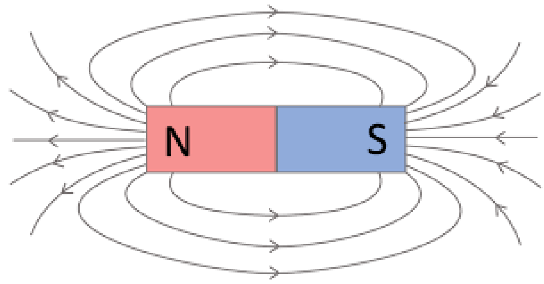
<u>Magnetic Field</u>

Magnetic field is the region around a bar magnet where magnetic force is experienced by a metals.

Magnetic lines of force or magnetic flux are imaginary lines that represent the direction and strength of the field at that point.

Conventionally, the direction of magnetic flux at any point is chosen to be from north pole to south pole.

Line of force between unlike poles



Line of force due to bar magnet

<u>Electric Field</u>

An electric field is a region in which there would be force upon a charge brought into that region.

The magnitude of the field is called the electric field strength or intensity. The electric intensity or strength (E) at any point is defined as force per unit charge acting on a small charged place at that point.

<u>Evaluation</u>

1. What is field
2. Mention and explain the field you know

ACCELERATION DUE TO GRAVITY

<u>Introduction:</u>

Gravitational field previously is defined as a space or region within the earth atmosphere where an object feels the impact of force due to gravity (downward pull of the earth). The acceleration of a body falling under the force of gravity is called acceleration due to gravity (g). It varies from place to place slightly but has been given a constant value of 9.8mls conventionally.

<u>Variation of Acceleration due to Gravity (g)</u>

The acceleration of free fall due to gravity, "g" is the acceleration impacted on a body due to its own weight.

The earth is not a perfect sphere. Points on the earth's surface near the equator are further from the center that points on the polar axis of the earth. This is because the earth is not a perfect sphere, hence, distance from polar axis is less than distance from equator. Acceleration due to gravity is observe to be greater in magnitude at the poles than at the equator. Hence “g” varies from place to place.

Weight and Its Variation:

Weight of an object is the gravitational pull on an object. It is dependent on acceleration due to gravity. It is given by

W = Mg i.e. weight= Mass x acceleration due to gravity (g) since “g” various form place to place, weight of an object varies from place to place due to variation in g.

Evaluation

i. Explain in detail, how does acceleration due to gravity various from place to place
ii. Why is weight not constant?

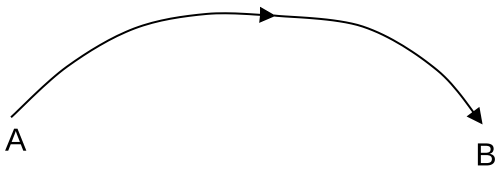
WEEK 6

TOPIC: ELECTRIC LINES OF FORCE AND PRODUCTION OF CHARGES

Introduction:

Electric field is a region where a charged body experiences an electric force.

The direction of electric lines of force or field at any point is given by the direction of the force acting on a small positive charge placed at the point.



Lines of Force

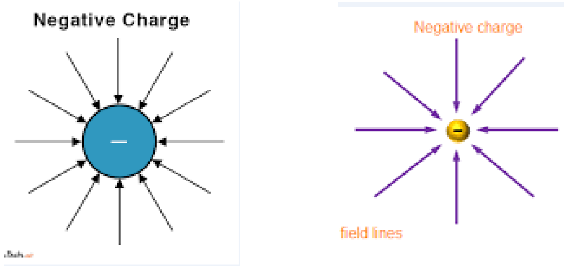
The curve line such as AB represents on electric lines of force. The arrow indicates the direction of motion of a small positive charge placed at such point and hence the direction of the field of lines of force of such points.

Electric Lines of Force

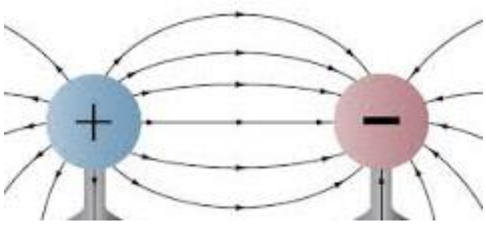
Electric lines of force are imaginary lines drawn in an electric field in such a way that the direction at any point gives the direction of electric field at that point.

Patterns of electric lines of force.

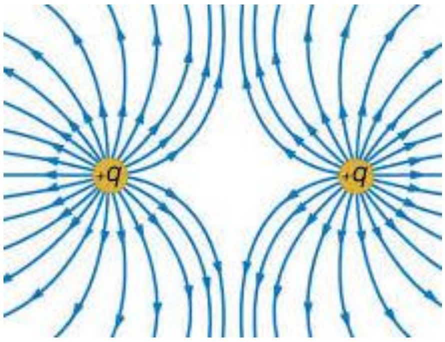
Lines of force around a positive charged body



Lines of force around a negative charge body



Lines of force of unlike charges.



Lines of force due to like charges.

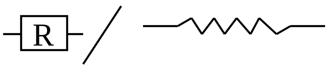
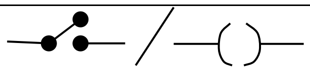
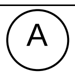
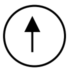
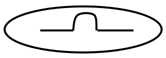
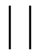
Properties Of Field Lines

1. Lines of force start at on the positive charges and end on the negative charges.
2. Lines of force do not cross each other
3. In a uniform field, the lines of forces are straight, parallel and uniformly space.
4. Lines of force are continuous in any region with free charges
5. Lines of force indicate the direction of electric field.

PRODUCTION OF CHARGES

The discovery of electricity brought about invention of modern some modern gadgets.

<u>Electric Components</u>

	Electric Symbol	Name	Function
1.		Resistor	Opposes the flow of current
2.		Rheostat or Variable Resistor	Opposes the flow of current
3.		Key/switch	Break or complete the flow of current
4.		Ammeter	Measures the amount of current
5.		Voltmeter	Measures the potential difference between two points
6.		Galvanometer	Detects and measures small amount of current.
7.		Cell	It produces electric current
8.		Lamp	Bulb placement
9.		Capacitor	Produce charges
10.		Inductor	Stores charges when current passes through it.
11.		Alternating E.M.F	Produces alternating current.

Electric Current (I)

Electric current is a measure of flow of charge with time mathematically, I = Q/t

Where Q is quantity of charge in Coulomb (c)

t is the time taken for the flow of charge in second.

I is the current in coulomb per second (c/s) or amperes (A)

The SI unit of current is amperes (A)

Example a charge of 20C flows for 4s what is the magnitude of the currents?

Solution

I = Q/t

Q = 20C

T - 48

I = 20/4 = 5A

Production of Current

Electric Current can be produced by the following methods:

i. Mechanical,
ii. Chemical
iii. Thermoelectric effect.
iv. Solar method

i. Mechanical Methods: Of producing current entails the conversation of mechanical energy (kinetic energy) into electric energy by special equipment.

ii. Chemical Method: of producing currents entails the conversion of chemical energy stored in the equipment to electrical energy. Example of devices that stores chemical energy are touch and car batteries.

iii. Thermoelectric Effect: is another method of producing current. It involves bringing the two ends of two different metals or wires together and subject the two ends to different temperature.

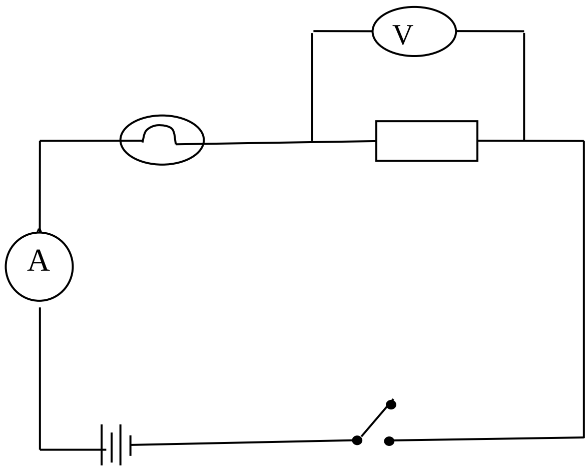
iv. Solar Method Is a method that involves the use of solar panel to convert energy from the sun to electric energy that produces current.

ELECTRIC CIRCUIT

Potential difference is the work done when one coulomb of charge moves from one point to another. The unit of potential difference is volts.

Electric Circuit

Electric circuits is an electric diagram showing the positioning of electric components. It shows how component should be or will be connected together.



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Circuit Diagram

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Evaluation

1. Draw electric lines of force due to a positive charge, negative charge, negative and positive, positive end positive.
2. Enumerate properties of field lines.
3. Draw, name and write the functions of 5 electric component that you know.
4. What is current?

5. A current of 20A flows for 5s, calculate the magnitude of the charge.
6. What is an electric circuit?
7. List and identify electric components.

WEEK 7 -9

ELECTRIC CONDUCTION THROUGH MATERIALS OHMS LAW

Introduction:

The invention of electricity has pave way for modern facilities, like radio, television and other electric electronics. The motion of electric charges through a conductor when an electric field (potential gradient) is maintained in a conductor constitute electric current.

Electric Conductor

Any materials that allows the passage of electric current is called a conductor. The three materials that conduct electricity are:

(a) Solid (metal)
(b) Liquid (Electrolyte)
(c) Gases (ionized gas)

In metals, the electric charges carried are free electrons. In liquid conductor (electrolyte), the electric charges carrier are ions. In an ionized gas, the electric charges carriers are ions and electrons.

Basic Quantities of Electricity

The three basic quantities in the study of electricity are:

i. Potential difference (V)
ii. Current (I)
iii. Resistance (R)

Potential Difference (v)

The potential difference between any two points in an electric field is the work done in moving a unit positive charge from one point to another. The instrument for measuring potential differences is called voltmeter. The unit of potential difference is volts (v). Voltmeter should be connected in parallel to a cell or battery or load to be measured. It is a high resistance meter and must never be connected in series.

Current (I)

The instrument used in measuring current is called ammeter. The unit of current is amperes (A). Ammeter should be connected in series to a cell or battery in a circuit.

Ohm's Law

Ohm's law states that the current passing through a metallic conductor is directly proportional to the potential differences between any two points provided the temperature remains constant.

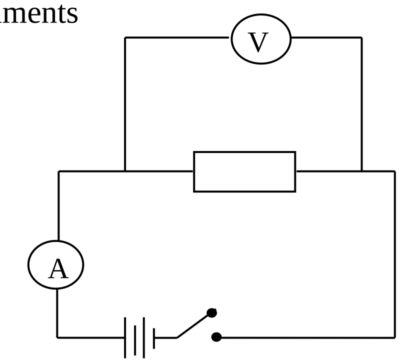
Mathematically, Ohm's law is stated as V = IR

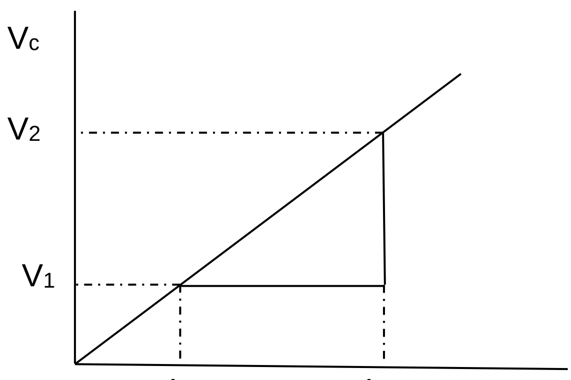
Where V is potential difference in volts (V)

I is current in Amperes (A)

R is constant known as the resistance in ohm (Ω)

Diagrammatical representation of ohm's law experiments





The slope of the graph i.e change in voltage over change in current is equal to resistance (R) of the wire in ohm's

Electric Resistance (R)

Electric resistance is defined by ohm as the ratio of voltage against current i.e. (v/1). The symbol of electric resistance is R and its unit is ohm (Ω) . Resistor is an instrument that opposed the flow of current

Calculation I

An electric conductor has a resistance of 5Ω when a current of 2A passes through it. What is the voltage development?

Solution

V = IR

I = 2A

R = 5Ω

V = ?

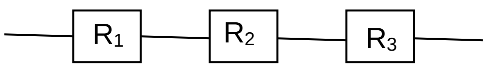
V = 2 x 5 = 10v

:. V = 10V

Parallel and series Connection of Resistors

Series Connection

When resistors are connected end to end in such a way that the same amount of current passes through them, the resistors are connected in series. Different voltages are developed. The effective resistance or total resistance i.e. $R_T = R_1 + R_2 + R_3 +\ldots\ldots$

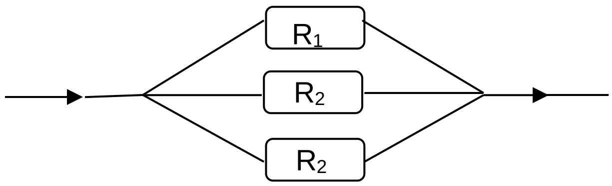


Series Connection of Resistors

Parallel Connection

When resistors are connected side by side such that different current passes through them but same voltage is developed, the resistors are connected in parallel. The effective resistance

$$= \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R3} + \ldots\ldots$$



Calliulation II

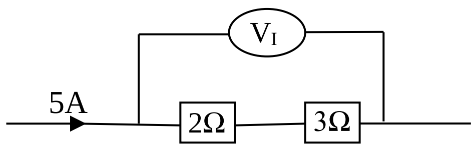
Two resistors of resistance 2Ω and 3Ω are in series in a circuit when a current of 5A passes through them.

Calculate

1. Total voltages developed in the circuit,
2. Voltages developed in each of the resistors.

Solution

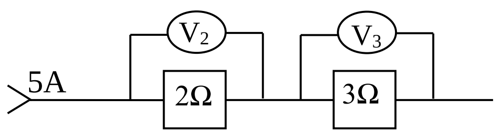
1



V = IR
I = 5A
R = $R_T = R_2 + R_3$
i.e R_T = 2 +3 = 5Ω
:. V_T = 5 x 5 = 25v

:. V_1 = 25V

2



a. V_2 = $1R_2$

5 x 2 = 10V

b. V_3 = $1R_3$

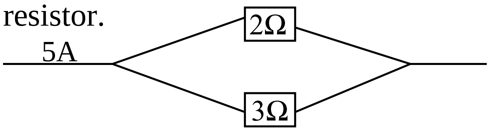
5 x 3 = 15V

Note. V_T = $V2 + V_3$

i.e. V_T = 10 x 15 = 25V

Calculation 3

If in calculation II, the resistors are in parallel, calculate the voltage developed and current in each resistor.



V = IR

I = 5A

R = R_T

a.

V_2 = $1R_2$

But $= \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

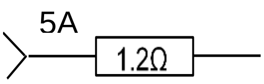
$$\frac{1}{R_T} = \frac{1}{2} + \frac{1}{3} = \frac{3+2}{6} = {}^{5}/_{6}$$

1 x 6 = 5 x R_T

6 = $5R_T$

RT = 6/5 = 1.2Ω

V = $1R_T$



5 x 1.2 = 6v

ii. V_{R2} = I_2R_2

V_{R2} = 6V

R_2 = 2Ω

$$I_2 = {}^{V_{R2}}/_{R_2} = {}^{6}/_{2} = 3A$$

I_2 = 3A

V_{R3} = I_3R_3

V_{R3} = 6V

R_3 = 3Ω

$$I_2 = {}^{V_{R3}}/_{R_3}$$

$$I_3 = {}^{6}/_{3} = 2A$$

Internal Resistance (r)

The internal resistance of a cell (r) is the resistance offered by the electrolyte or chemicals to the motion of the current. It is denoted by the symbol (r) closed to the cell.

Terminal potential difference (P.D) and Electromotive Force (EMF)

Terminal Potential difference is the potential difference across the terminals of the cell when it is delivering current to an external resistor while electromotive force is the potential difference across the cell when it is not delivering current to an external resistor.

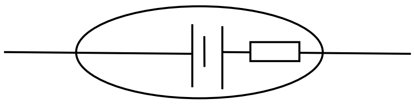


Diagram showing the position of internal resistor.

Relationship Between E, R. r and I

The relationship between Electromotive Force (E), external resistance (R), Internal resistance r and current (I) is given by

$$I = \frac{V}{R+r} = {}^{V}/_{R}$$

Identical Cells Connection (Parallel and Series)

When identical cells are connected in series, the effective e.m.f i.e. nE and the effective internal resistance is given by nr.

n is the number of cells.

When identical cells are connected in parallel, the effective e.m.f is that of one cell and the effective internal resistance is given by r/n. Where n is the number of cells.

Calculation

1. A cell of e.m.f 12V and r = 0.5Ω is connected across a resistor with a resistance of 5.5Ω. Calculate the magnitude of the current flowing and list voltage.

Solution

$$I = \frac{E}{R + r}$$

E=12v,

r = 5.5Ω

r=0.5Ω

I = ?

$$I = \frac{12}{5.5 + 0.5} = \frac{12}{6} = 2A$$

:. I = 2A

Lost voltage

$$Re\ c\ allI = \frac{E}{R + r}$$

I (R + r) = E

IR + Ir = E

But IR = V

i.e. V + in = V

Ir = E – V

Ir or E-V is the lost voltage

Lost voltage = 2 x 0.5 = IV i.e. Ir.

Or

12 - 11 = 1v i.t for v-v (v = IR = 2 x 5.5 = 11V)

Resistivity

Every electrical conductor has a resistance. The resistance of a materials in form of wire is directly proportional to the length (L) of the materials and inversely proportional to the cross-sectional area (A)

Mathematically

$$R\alpha\, {}^{L}/_{A}$$

$$R = {}^{PL}/_{A}\ ButA \rightleftarrows\rightleftarrows= \pi d\ {}^{2}/_{4}$$

,

$$\therefore R = 4p\ {}^{L}/_{\pi d2}$$

ρ is a constant known as the resistivity of the material in Ohm meter (Ωm)

d is the diameter of the wire in metres

L is the length in metre

R is the resistance in ohm.

Evaluation

A battery of three cells in series, each e.m.f 2v and internal 0.5Ω is connected to a 2 resistor in series with a parallel combination of two 3Ω resistors. Drawn this circuit diagram and calculate

a) The effective external resistance.
b) The current in the circuit
c) The lost volts in the battery
d) The current in one of the 3Ω resistors.

WEEK 10

ELECTRICAL ENERGY, BUYING AND SELLING OF ELECTRICAL ENERGY

INTRODUCTION

Work is done whenever Q coulomb of electricity flows between two points whose potential difference is V volts. If the work done is in joules,

W= QV (joules)

Recall that Q=It

Thus, w = It × V

=IVt

Also recall that V=IR

$W = I^2Rt = V^2t/R = IVt$

Electrical energy can be converted to other form of energy such as

I. Light energy e.g. glowing of bulb
II. Mechanical energy: this is achieved through electric motor e.g. washing machine
III. Heat energy e.g. in electric stove
IV. Sound energy e.g. in music from record player

ELECTRICAL POWER

Electric power is defined as the rate of doing work or the energy expended per second in a device.

Mathematically, p = work done/time taken = w/t

Recall that $W=I^2Rt = V^2t/R = IVt$

P = w/t = IVt/t= IV

$=I^2Rt/t=I^2R$

$=V^2t/R/t=V^2/R$

$P = I^2R = V^2/R = IV.$

The S.I unit of electrical energy is joule per second (J/s) or simply Watts (w)

A watt is the power used in an electric circuit when one joule of work is done in one second.

Higher units of power are kilowatts (kW) Megawatt (MW)

$1\ kW = 1000watts = 10^3W$

$1\ MW = 1000000 = 10^6W$

Example

An electric heated is marked 1000W, 240V

What do you understand by the mark?

This means that the heater consumes a power of 1000W or an energy of 1000 joules per second when in a circuit which maintains a potential difference of 240 volts across it.

MARKETING OF ELECTRIC POWER IN NIGERIA

This is handle by power companies of Nigeria who measures and sells energy in units of kilowatts-hour (kWh).
It is very important to know that one kilowatt-hour (kWh) is the work done or energy consumed by an appliance or appliances when one kilowatt or 1000W power is used by appliance(s) for one hour.

When an electric bulb marked 200W is used to light up an apartment for 15 hours, the energy consumed in kilowatt-hour is given by

Energy= 200/1000 × 15 = 3kWh

If power company charges ₦16.44k per kWh, the amount for 3kWh will be ₦16.44 × 3 = ₦49.32k

SAFETY DEVICE (FUSE)

A fuse is a short piece of conduction wire of low melting point connected to the wire of a circuit. When current higher than the stipulated current value flows in the circuit to which the fuse is

connected, the fuse wire is suddenly melted by the heat developed in it, thereby cutting off further current flow which may destroy the wiring or the appliance connected to the fuse.
For safety to be continuous achieved, the fuse should be rated. Fuse rating is the maximum allowable safe current allow to flow in it prior to it breaking. If an electric iron is marked 2000W is to be connected to a 250V main supply,

Fuse rating = power/voltage= 2000/250 =8A

Evaluation : A landlord has eight 40W electric bulbs , four bulbs and two 100W bulbs in his house. If he has all the points on for five hours daily and power company charges N16.44k per unit, his bill for 30 days is?

The maximum power dissipated by 100Ω resistor in a circuit is 4W. Calculate the voltage across the resistor.

WEEK 11

PARTICLE NATURE OF MATTER

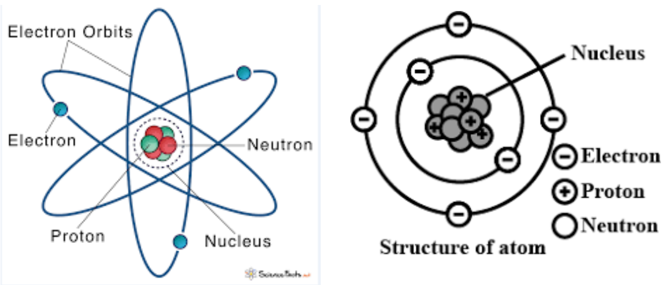
Any physical substance has mass and occupies space. Hence, the universe is made up of matters of different kinds. Matter is anything that has mass and occupies space.

PROPERTIES OF MATTER

I. Matter has mass.
II. Matter occupies space or has volume.
III. Matter is attracted by force of gravity.

ATOM

An atom is the smallest particle of an element. The atomic theory assumes that all matter is made up of atoms.it was later discovered that atom is made up of three sub-particles namely electron, neutron and proton. Proton and neutron formed the nucleus and electron revolves around the nucleus on an orbit.



Atomic Structure

MOLECULES

Most substances or elements do not exist as single atom. They combined together with atoms of themselves or another to form molecules. Molecules is defined as the smallest particle of a substance which can have a separate existence and still retain the properties of that substance.

MOLECULAR SIZE

The size of a molecule is relatively small. It is of the order of10^{-9} -10^{-10}m (10^{-7}-10^{-9} cm). Lord Raleigh in 1890 was the first person to estimate the approximate size of a molecule. He argued that when a drop of oil is gently dropped on a still water surface, the oil will spread out on top of the water until the thickness of the oil film is one molecule thick. The formula for calculating the oil thickness is given by

I.e. thickness of oil = volume/area= $V/\pi(^{d}/_{2})^2 = 4V/\pi d^2$

V is the volume of the oil = $4\pi R^3/3$

D is the diameter of the oil film.

EVIDENCE OF PARTICLE NATURE OF MATTER

The particle existence of matter is evident and supported by

I. Osmosis
II. Diffusion
III. Brownian motion

BROWNIAN MOTION

Robert Brown a biologist discovered an experimental evidence to prove that matter is made up of particles. The movement of this particle is known as Brownian motion or movement. Brownian motion can be observed more frequently and easily by looking at the random movement of smoke particle suspended in the air.

Evaluation: Explain how you will estimate the size of an oil molecule

Give a brief description of an atom

The nucleus of an atom is made up of ………. , …………… and …………..

STATE OF MATTER

Matter is anything that has mass and occupies space.

States of matter

There are three states of matter which are;

I. Solid state.
II. Liquid state.
III. Gaseous state.

Kinetic theory of matter postulate that matter is made up of atoms and molecules.

In solid, the molecules are closely held together by intermolecular forces and they vibrate about a fixed position. When solid are heated, at a particular temperature called the melting point, they move about changing to liquid. The process of liquid changing to solid is called freezing or solidification. Solid has definite shape and volume.

In liquid, the intermolecular forces are weaker than in solid and the molecules are free to move at random. When liquid are heated, the molecules evaporate but at a temperature called the boiling point, the molecules are transformed from liquid to gas. The process of liquid changing to gaseous state is known as vaporization and the reverse is called condensation. Liquid has no definite shape but has definite volume.

In gas, the intermolecular forces of gas are negligible .Thus, the molecules of gas move in all direction .Gas has neither shaped nor volume. The collision of the gas molecules with the wall of the container constitute gas pressure.

PARTICLE NATURE OF PHOTON

Photon (light) has dual nature i.e., it has the nature of wave and that of particle. For the purpose of this scope, the particle nature of photon will be discuss. Photon is considered as packet of energy which behaves like particle. The particle nature of photon is evident in photoelectric-effect (photo electricity) and Campton effect.

PARTICLE PROPERTIES OF PHOTON

I. They cause fluorescence in zinc substance e.g. zinc sulphide
II. They cause the liberation of electrons when they fall on certain substances
III. They ionized gases
IV. They are not deflected by electric and magnetic field
V. They travelled on a straight path or line.

WEEK 12

Crystal Structure

When a salt solution (super saturated solution) is left in a beaker and the temperature is cooled down gradually, it is observed that some quantities of solid salt is deposited on the string hanging down into the salt solution. This salt solution is called crystal.

A crystal is a piece of solid matter that in which the atoms, molecules or ions are arranged in a regular repeating pattern or lattice.

Crystallization is the process of formation of crystals.

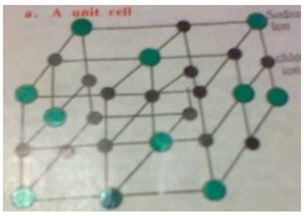
STRUCTURE OF CRYSTALS

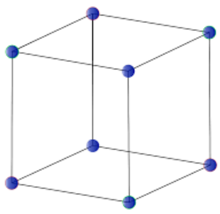
WE can image crystals as being made up of minutely small blocks (atoms and molecules). We cannot actually see the atoms or molecules with our naked eyes because they are very small. The pattern of arrangement of atoms however is revealed by X-ray.

There are:

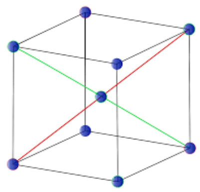
I. Simple lattice
II. Body centered lattice
III. Faced centered lattice

In a simple cubic crystals, atoms and molecules are placed at the corner s of imaginary cubes stacked side by side like building blocks. An example of this type of crystal is that of a common salt (NaCl)

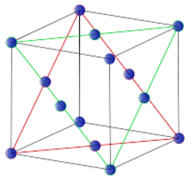




Simple cubic crystal



Body-Centered crystal



Face-Centered Crystal

Example of a body with faced centered cubic crystal is zinc sulphide while that of body centered cubic crystal are chromium, iron and platinum salts.

AMORPHOUS SUBSTANCE (NON CRYSTALLINE)

Amorphous substances are substances that lack the regular arrangement of atoms and molecules. They are called non-crystalline e.g. are glass and plastic.

CHARACTERISTIC OF AMORPHOUS SUBSTANCE

I. They are not crystalline i.e. they lack definite arrangement of atoms.
II. The do not have definite freezing and melting point.
III. They soften gradually when heated
IV. They are usually insoluble in water.

Evaluation

I. Name types of crystal structure you know and write short note on them.
II. List characteristics of crystals