

THIRD TERM E-LEARNING NOTE

SUBJECT: PHYSICS

CLASS: SS 1

SCHEME OF WORK

WEEK	TOPIC
1	Electric Circuit (DC).
2	Resistors and Cells in Series and Parallel.
3	Electrical Energy and Power
4	Safety Device – Fuse
5	Atomic Structure, Diffusion and Osmosis
6	Crystal Structure of Matter – Amorphous and Crystalline Substances
7	Surface Tension
8	Capillarity
9	Elasticity
10	Energy Stored in an Elastic Material
11	Revision
12	Examination

REFERENCE BOOKS

- New School Physics By M.W Anyahkoha
- New System Physics By Dr. Charles Chow.

WEEK ONE

TOPIC: ELECTRIC CIRCUIT

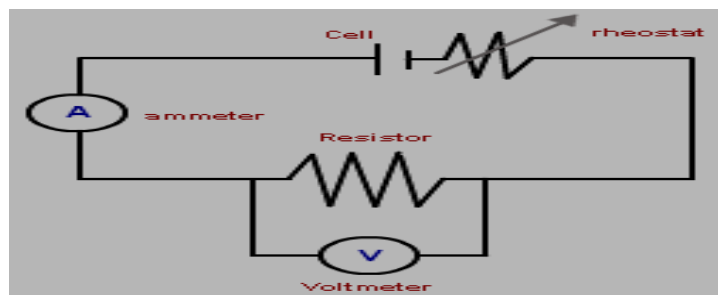
CONTENT

- Definition and functions of electric circuit and its components
- Definition of some physical quantities in dc circuit
- Verification of ohm's law

Before explaining electric circuit, let us define some terms

1. Conductors: They are materials which allow electrons to pass through them easily e.g. metal, graphite, acids, salt solution etc.
2. Semi conductors: They are materials whose resistivity is mid way between good conductors and insulators e.g. germanium, silicon etc
3. Insulators: They are materials which do not allow electrons to pass through them e.g. paper, plastic, glass, oil, cotton, dry hair, polythene etc

Electric Circuit: An electric circuit is a complete path provided for the flow of electric current. The circuit diagram below is a symbolic representation of such circuit.



Functions of dc circuit components

- Cells are chemical devices which produce electric force/pressure that pushes the current to flow.
- Switch / key is a device used to start or stop the current flow.
- Ammeter measures the electric current flowing in a circuit
- Voltmeter measures the potential difference across the terminal of a load
- Rheostat varies the flow of current
- Resistor is a component that limits or regulate the flow of electric current

EVALUATION

1. Define electric circuit
2. State the functions of the components that make up a circuit

DEFINITIONS OF SOME PHYSICAL QUANTITIES

Electric Current (I): it is the measure of the rate of movement (flow) of charged particles along an electrical conductor (a circuit). It is simple electric charge (Q) in motion which consists of moving electrons.

$$I = Q/t \text{ (1a) where } t - \text{time (s)}$$

$$Q = It \text{ (1b)}$$

Potential Difference (V): Potential difference between two points in a circuit is the work done (W) when one coulomb of charge moves from one point to another.

$$W = Q (V_B - V_A) = QV \text{ (2a)}$$

$$V = W/Q \text{ (2b)}$$

Electromotive Force (E): e.m.f of a cell is the p.d between the terminals of the cell when it is not delivering any current to the circuit.

Internal Resistance (r): r of a cell is the resistance offered by the electrolyte to the motion of the current.

Resistance (R): R is the ratio of the potential difference (p.d) across the conductor to the current flowing through it. Its unit is the ohm (Ω)

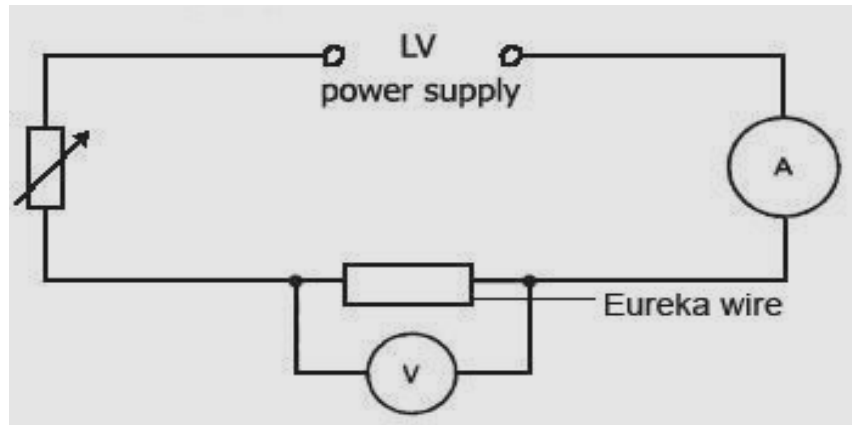
Ohm's Law

Ohm's law states that the electric current in a given metallic conductor is directly proportional to the potential difference applied provided that the temperature and other physical factors remain constant i.e $V \propto I$

Verification of ohm's law.

Aim: To show that metallic/ohmic conductor obeys ohm's law

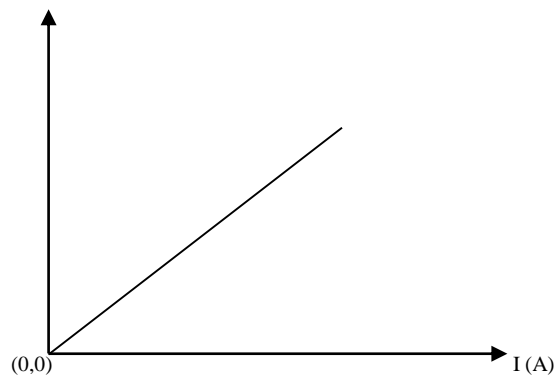
Apparatus: voltmeter, ammeter, rheostat, battery, key, pieces of wire and ohmic conductor x



Procedure: set up the apparatus as shown above

Observation: As the rheostat is been varied, the reading of the voltmeter is also changing. Also, the current in the ammeter is increasing with increase in potential difference.

Graph :
V (v)



$$\text{Slope} = \Delta V / \Delta I = R$$

Where R is the constant of proportionality and it is called resistance (R)

Conclusion: ohmic conductors obey ohm's law.

i.e. $V = IR$ _____ 3(a)

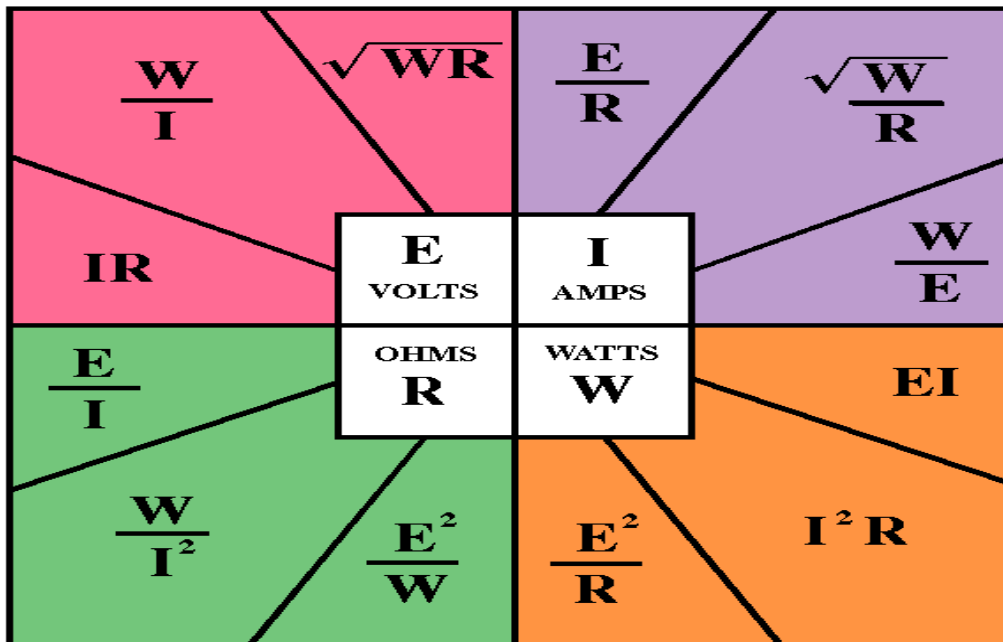
$I = V/R$ _____ 3(b)

$R = V/I$ _____ 3(c)

NB : The relationship between I, E, R & r is that

$I = E / R + r = V/R$ 4

OHMS LAW



EVALUATION

1. Define the following terms (a) Electric current (b) Potential difference (c) Internal resistance
2. state ohm's law

GENERAL EVALUATION

1. State the seven fundamental quantities and their units.
2. State three apparatus each for measuring mass, distance and time

READING ASSIGNMENT

Read more on electric circuit – New school physics (pg 77 - 80)

WEEKEND ASSIGNMENT

1. The SI unit of electric current is (a) ampere (b) volts (c) ohm's (d) coulomb
2. The SI unit of electric charge is (a) ampere (b) volts (c) ohm's (d) coulomb
3. The SI unit of potential difference is (a) ampere (b) volts (c) ohm's (d) coulomb
4. The SI unit of resistance is (a) ampere (b) volts (c) ohm's (d) coulomb
5. Ohm's law states that (a) $V=IR$ (b) $Q=It$ (c) $R=IV$ (d) $W=QV$

THEORY

1. Define the following terms (a) Electric current (b) Potential difference (c) Internal resistance
2. Show graphically how the resistance of a resistor can be obtained from a graph.

WEEK TWO

TOPIC: RESISTORS & CELLS CONNECTED IN SERIES & PARALLEL

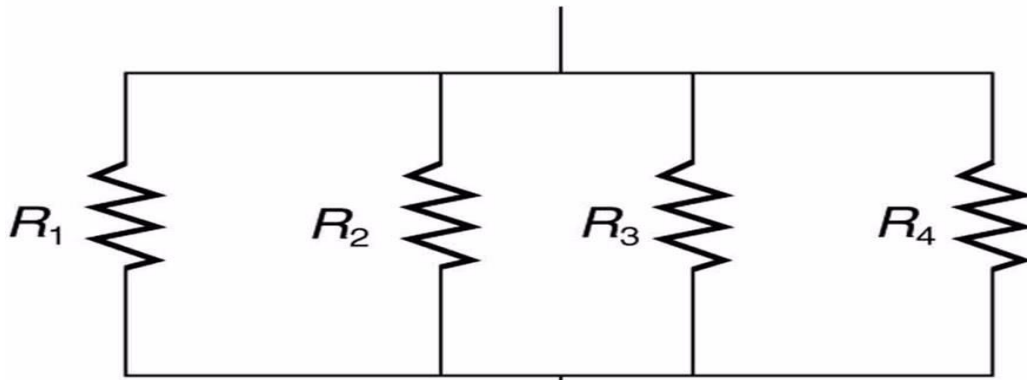
CONTENT

- Resistors in series and parallel

- Cells in series and parallels
- Resistors in series: These are end to end connection.



Series Connection



Parallel Connection

CHARACTERISTICS

- ✓ Same current flow through each resistor $I_T = I_1 = I_2 = I_3$
- ✓ Potential difference across each resistor is different $V_1 \neq V_2 \neq V_3$
- ✓ P.d are additive $V_T = V_1 + V_2 + V_3$
- ✓ Power are additive
- ✓ Applied voltage equals the sum of different p.d $V_T = V_1 + V_2 + V_3$
- ✓ Resistance are additive.

$R_T = R_1 + R_2 + R_3$ _____ for 3 resistors

$R_T = R_1 + R_2 + R_3 \dots + R_n$ ____ for n numbers or resistors

RESISTORS IN PARALLEL

These are side by side connection.

CHARACTERISTICS

- ✓ Different resistors have their individual current
- ✓ P.d across each resistor is the same $V_T = V_1 = V_2 = V_3$
- ✓ Branch current are additive $I_T = I_1 + I_2 + I_3$
- ✓ Conductance are additive
- ✓ Power are additive

$1/R_T = 1/R_1 + 1/R_2 + 1/R_3$ ____ for 3 resistors

$1/R_T = 1/R_1 + 1/R_2 + 1/R_3 \dots + 1/R_n$ ____ for n numbers of resistors

EVALUATION

1. Differentiate between resistors connected in series and parallel
2. State the relationship between resistance and conductance

Cells in series: end to end connections

$$E_T = E + E + E = 3E$$

For n cells; $E_T = n E$

$$E_T = E_1 + E_2 + E_3$$

Cells in parallel: side by side connections

$$E_T = E + E + E/3 = 3E/3 = E$$

Calculations

If 2Ω , 3Ω , and 5Ω resistors are connected in (a) series (b) parallel, calculate the equivalent resistance

(a) $R_T = 2 + 3 + 5 = 10\Omega$

(b) $1/R_T = 1/2 + 1/3 + 1/5 = 15 + 10 + 6/30 = 31/30$

$$R_T = 30/31\Omega$$

EVALUATION

1. If 2Ω , 2Ω , and 1Ω resistors are connected in (a) series (b) parallel, calculate the equivalent resistance
2. Calculate the potential difference across a resistor of resistance $2K\Omega$ that allows a current of $1mA$ to pass through it

READING ASSIGNMENT

Read more on series & parallel connections of resistors & cells – New school physics (pg 79)

GENERAL EVALUATION

1. State four types of motion and give an example each
2. What is the cause of motion.?

WEEKEND ASSIGNMENT

1. If four identical cells each 2volts are connected in series, the equivalent pd is
(a) 2v (b) 4v (c) 6v (d) 8v
2. If four identical cells each 2volts are connected in parallel, the equivalent pd is
(a) 2v (b) 4v (c) 6v (d) 8v
3. If 2Ω , 2Ω , and 1Ω resistors are connected in series the equivalent resistance (a) 5Ω
(b) $\frac{1}{2}\Omega$ (c) 4Ω (d) 2Ω
4. If 2Ω , 2Ω , and 1Ω resistors are connected in parallel the equivalent resistance (a) 5Ω
(b) $\frac{1}{2}\Omega$ (c) 4Ω (d) 2Ω
5. Two resistors of resistance 1Ω are connected in parallel to a 2Ω resistor, the equivalent resistance is (a) 4Ω (b) 3Ω (c) 2Ω (d) 1Ω

THEORY

1. A battery of 15v and internal resistance 5Ω is connected to a resistor of 20Ω . Calculate the value of (a) electric current (b) terminal voltage (c) lost voltage.
2. If 8c of charge passes through a wire at a steady rate in 2s. Calculate the Current.

WEEK THREE

TOPIC: ELECTRICAL ENERGY AND POWER

CONTENT

- Electrical Energy
 - Electrical Power
 - Buying Electrical Power
-

ELECTRICAL ENERGY

Energy = Work (Joules)

$$W = QV \text{_____} (1)$$

But $Q = It$

$$W = VIt \text{_____} (2)$$

From ohm's law $V = IR$

$$W = I^2 R t \text{_____} (3)$$

From ohm's law $I = V/R$

$$W = V^2 t / R \text{_____} (4)$$

$$W = QV = VIt = I^2 R t = V^2 t / R$$

ELECTRICAL POWER

Power = work done/time taken (watt) ____ (5)

$$P = QV/t = VI = I^2 R = V^2 / R \dots\dots\dots (6)$$

EVALUATION

1. The headlamp of a car takes a current of 0.4A from a 12v supply. Calculate the energy produced in 5 minutes.
2. State four factors that affect the resistance of a conducting wire.

BUYING OF ELECTRICAL ENERGY

Commercial power is consumed in kilowatt- hour (kWh)

NB 1kwh = 3.6×10^6 J = 3.6MJ

Cost = Pct/ 1000.....(7)

P – Power (w) NB : $P(W)/ 1000 = P (KW)$

c – Cost per kWh (unit) it means that it is in kWh

T – Time (hr)

EVALUATION

1. Find the cost of running two 100w amplifier, ten 50w television and twenty 60w lamp for 24hrs, if the electrical energy cost 60k/unit
2. A landlord has eight 40w electric lighting bulb, four 60w bulb and two 100w bulb. If he has all the point on for 5hrs, what is the bill for 30 days?

READING ASSIGNMENT

Read more on electrical energy & power – New school Physics (pg 81-82)

GENERAL EVALUATION

1. Define frictional force
2. Give three ways of reducing friction.

WEEKEND ASSIGNMENT

1. Electrical energy is measured in (a) watt (b) kilowatt-hour (c) kilowatt (d) none of the above
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2. If a p.d of 240v is applied across a lamp that supplies energy at the rate of 60w. What is the value of current? (a) 0.2A (b) 0.25A (c) 0.3A (d) 3A
3. The resistance of the filament in question 2 is ____ (a) 96Ω (b) 48Ω (c) 960Ω (d) 900Ω
4. Calculate the conductance of a conductor having a resistance of 10Ω (a) 0.1 (b) 1 (c) 10Ω (d) 0.01Ω
5. The SI unit of resistivity is ____ (a) Ω/M (b) Ω^2/M (c) ΩM (d) none of the above.

THEORY

1. Find the cost of running two 100w amplifier, ten 50w television and twenty 60w lamp for 24hrs, if the electrical energy cost 60k/unit
2. A landlord has eight 40w electric lighting bulb, four 60w bulb and two 100w bulb. If he has all the point on for 5hrs, what is the bill for 30 days If electric energy cost 80k per KWhr.

WEEK FOUR

TOPIC: SAFETY DEVICE – FUSE

CONTENT

- Fuse
- Types of Fuse
- Detecting Fault in a Circuit

FUSE

Fuse is a protective device, designed to melt at the passage of excess electric current through it. It can also be defined as a device for opening circuit, by means of a conductor designed to melt when an excessive current flows along it. The conductor actually designed to melt is called fuse element.

Fuse element is the part of the fuse that is designed to melt and then open the cct

Current rating of a fuse: it is the minimum current which the fuse will carry for an indefinite/unlimited period without deterioration of the fuse element

Fusing current: is the minimum current that will cause the fuse element to heat up and melt/rapture or blow.

Fusing factor is the ratio of the fusing current upon the current rating.

Fusing factor = fusing current/ current rating

EVALUATION

1. Define the following terms (a) fuse (b) fuse element (c) current rating of a fuse
2. State the relationship between fusing factor, fusing rating and current rating

TYPES OF FUSE

- ✓ Re-wire able fuse
 - ✓ Cartridge fuse
 - ✓ High breaker capacity fuse
 - ✓ Others
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DETECTING FAULT IN ELECTRIC CIRCUIT

- ✓ Merger tester – insulation resistance test
- ✓ Test bell – polarity test
- ✓ Earth-loop impedance tester – test for earthing
- ✓ Continuity tester – test for continuity

EVALUATION

1. List three types of fuse
2. Mention four ways of detecting fault in an electric circuit

READING ASSIGNMENT

Read more on safety devices – New school physics (pg 83-84)

GENERAL EVALUATION

1. Define the term scalar and vector quantities. Give two examples each
2. A rectangular box of dimension 6cm x 10cm x 2cm weighs 15N. Calculate the density of the box.

WEEKEND ASSIGNMENT

1. Fuse is a protective device, design to (a) stick (b) melt (c) disappear (d) repel
2. The conductor designed to melt is called (a) fuse element (b) fuse (c) resistor (d) cartridge fuse
3. The following are examples of fuse except fuse (a) re-wire able (b) merger (c) cartridge (d) high breaking capacity
4. Which of the following correctly gives the relationship between linear speed v & angular velocity ω of a body moving uniformly (a) $v = \omega r$ (b) $v = \omega^2 r$ (c) $v = \omega r^2$ (d) $v = \omega/r$
5. The motion of the prongs of a sounding tuning fork is (a) random (b) translational (c) rotational (d) vibratory

THEORY

1. Define the following terms (a) fuse (b) fuse element (c) current rating of a fuse
2. Mention four ways of detecting fault in an electric circuit.

WEEK FIVE

TOPIC: MATTER, ATOMIC STRUCTURE, STATES OF MATTER, DIFFUSION, OSMOSIS, BROWNIAN MOTION

CONTENT

- Atomic Structure
- Molecular Theory of Matter
- Diffusion and Osmosis

MATTER

Matter is defined as anything that has mass and occupies space. All substances are made up of matter. It exists in three states namely, solid liquid and gas. Examples of solids are ice, brick, metal, concrete, wood etc. examples of liquid are water, milk, oil etc while that of gas are oxygen, nitrogen, CO_2

STRUCTURE OF MATTER

Matter is made up of discrete particles namely atom, molecules and ion.

- (i) Atom: An atom is the smallest particle of an element which can have a separate existence. Atom is made up of a nucleus and a revolving electron around an orbit or shell. The nucleus consists of proton and neutron. The proton is positively charged, electron is negatively charged and neutron is neutral (i.e. has no charge). The number of protons equates the number of electrons. An atom that contains the same number of protons and electrons is said to be electrically neutral.
- (ii) Molecule: A molecule is a group of atoms of the same or different elements joined in simple proportion. They come together to make up matter

BROWNIAN MOTION

- ✓ Molecules exist
- ✓ Molecules are continually in motion

EVALUATION

1. Explain the structure of matter
2. What is the importance of Brownie's motion

MOLECULAR THEORY OF MATTER

Using kinetic theory explain the (i) definite structure of solid (ii) shape of liquid (iii) gas

- (i) Solid: Matter consists of molecules which are tightly held together by intermolecular forces to make the molecules to vibrate about their mean positions, giving the solid definite shape. If the solid is heated, the total energy is divided among the molecules to make them vibrate faster. Eventually, they move so fast that they break loose from their fixed position.
- (ii) Liquid: The molecules of a liquid can move about within the given volume of the container. Hence, liquid has its own size but no shape. If the liquid is heated, its molecules gain kinetic energy and move faster, until eventually molecules can escape from the surface. The liquid then vanishes and turns to gaseous state.
- (iii) Gas: The molecules of a gas are also in constant motion like the liquid but comparatively far apart. They move at high speed, colliding with one another and with the walls of their containing vessel. They fill the vessel and exert pressure on the walls of the container. The pressure of the gas is caused by the collision of the molecules with the walls of the container.

DIFFUSION AND OSMOSIS

DIFFUSION: Diffusion is the process by which different forms of matter (fluids) mix intimately with one another owing to the kinetic nature of their molecules. It is also the tendency of a gas to mix with another and fill an empty space as a result of the constant random motion of the molecules.

The rates of diffusion or factors affecting diffusion are (i) density (ii) mass (iii) temperature (iv) pressure (v) concentration

Also, Graham's law of diffusion states that at constant temperature, gas diffuse at rates inversely proportional to the square root of their vapour densities.

$$R \propto 1/\sqrt{M} \rightarrow R = K/\sqrt{M} \quad ; K = R\sqrt{M}$$

$$\text{Hence, } R_1\sqrt{M_1} = R_2\sqrt{M_2} = \dots = R_n\sqrt{M_n}$$

$$\text{Hence, } R_1/R_2 = \sqrt{M_2}/\sqrt{M_1} \quad \text{where } R - \text{rate of diffusion, } M - \text{relative molecular mass. NB :}$$

(i) $R = \text{volume (gas)}/\text{time}$

(ii) Relative molecular mass is twice its vapour density

OSMOSIS: This is the movement of water molecules from the region of higher concentration to a region of lower concentration through a semi-permeable membrane.

EVALUATION

1. Using kinetic theory, explain the definite structure of solid
2. State four factors that affect the rate of diffusion

READING ASSIGNMENT

Read more on atomic structure, diffusion and osmosis – New school physics (pg 87-92)

GENERAL EVALUATION

1. State Archimedes principle
2. State the law of floatation

WEEKEND ASSIGNMENT

1. The following are examples of theory except (a) concrete (b) oil (c) brick (d) metal
2. The nucleus of an atom consist of (a) proton and electron (b) neutron and electron (c) proton and neutron (d) none of the above
3. Positive ions are called ____ (a) camions (b) anions (c) molecules (d) atom
4. When is atom said to be electrically neutral (a) when the number of proton equals the number of neutron (b) when the number of protons equals the number of electrons (c) when the number of proton is greater then the number of electron (d) when the number of neutron equals the number of electron
5. Ion is a form of ____ (a) atom (b) molecules (c) matter (d) none of the above.

THEORY

1. Using kinetic theory, explain the definite structure of solid
2. State four factors that affect the rate of diffusion

WEEK SIX

TOPIC: CRYSTAL STRUCTURE OF MATTER- AMORPHOUS AND CRYSTALLINE SUBSTANCES

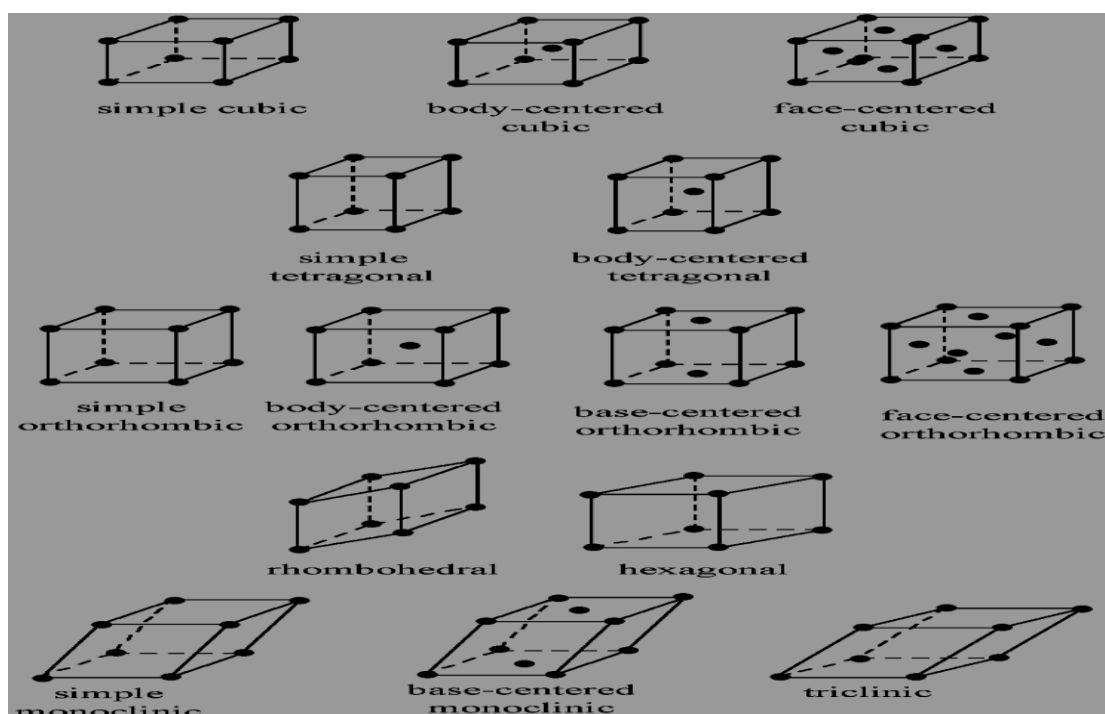
CONTENT

- Crystal Structure
- Crystalline and Amorphous Substance

The term crystal structure is generally used to describe the internal structure of solids. The particles of a solid are orderly arranged in parallel planes. In other words, solid crystals consist of particles arranged in parallel planes. Crystals are built up from simple structural units called unit cells. A unit cell (also called a space lattice) is made up of few atoms, ions or molecules. There are seven types of unit cells. Each type gives rise to a crystal system. They include cubic, rhombic, monoclinic, triclinic, tetragonal, rhombohedra and hexagonal crystal system. X- ray analysis of crystal shows that three pairs of opposite parallel faces bund the unit cells in all crystal systems, except in hexagonal system. We can draw three imaginary lines between the centres of the opposite parallel faces.

These imaginary lines represent three axes of symmetry. The length of these axes of symmetry and the angles between them determines the system to which a crystal belongs. This is demonstrated using cubic and monoclinic crystal systems.

In a cubic crystal system, the axes of symmetry have equal length and at right angles to each other. This type of crystal system is found in copper, sodium chloride, silver, gold, iron, sodium, potassium etc. however, the type of cubic crystal system found in copper, silver, gold and sodium chloride is different from the type found in sodium, iron and potassium. The former is called face centred cubic, while the later is called body centred cubic. In a monoclinic system, the axes are not equal in length and only two of them are at right angles to each other. These crystal systems are in sugar, washing soda, ferrous sulphate etc.



EVALUATION

1. What is a unit cell?
2. With the aid of diagram, distinguish between cubic crystal system and monoclinic crystal system.

DIFFERENCES BETWEEN CRYSTALLINE AND AMORPHOUS SUBSTANCES

On the basis of internal structure of solid, we can classify a solid as either a crystal substance (e.g. common salt) or an amorphous substance (e.g. glass). The differences between the two substances are:

CRYSTALLINE SUBSTANCE	AMORPHOUS SUBSTANCES
1. Have a definite internal arrangement of particles.	Have a haphazard distribution of particle
2. Have a cleavage planes along which fracture when struck	Do not have cleavage planes
3. Meets sharply at a definite temperature	Do not meet sharply at a definite temperature when heated.
4. Regarded as true solid	Regarded as super cooled liquids
5. Have a long range order of arrangement	Have short range order of particles of arrangement

6. Are efflorescence substance

Are not efflorescence substance

EVALUATION

1. Differentiate between crystalline and amorphous substances
2. Define crystal lattice

READING ASSIGNMENT

Read more on crystal structure of matter – New School Physics (pg99- 101)

GENERAL EVALUATION

1. A body of mass 25Kg moves on a horizontal straight road with a velocity of 15m/s. calculates the height above the road at which it possesses a potential energy equal to its kinetic energy. [$g = 10\text{m/s}^2$]
2. An engine of a car of power 80KW moves on rough road with velocity 32m/s the force required to bring it to rest is?

WEEKEND ASSIGNMENT

1. Crystal structure is generally used to describe (a) the external structure of solids (b) the internal structure of solids (c) the internal structure of liquids (d) the external structure of liquids
2. Particles of a solid are orderly arranged in ____ planes (a) parallel (b) horizontal (c) vertical (d) none of the above
3. Unit cell is also known as (a) monoclinic system (b) polycyclic system (c) space lattice (d) none of the above
4. ____ substance has a definite internal arrangement of particles (a) Amorphous (b) Crystalline (c) Elastic (d) Atomic
5. ____ are not efflorescence substance (a) Amorphous (b) Crystalline (c) Elastic (d) Atom

THEORY

1. Differentiate between crystalline and amorphous substances
2. Define crystal lattice

WEEK SEVEN

TOPIC: SURFACE TENSION

CONTENT

- Definition of surface tension
- Effect of surface tension
- Application of surface tension
- Reduction of surface tension

SURFACE TENSION

1. Is the property of a liquid to make its surface behave as though it is covered by an elastic skin.
 2. Is the force per unit length? $Y = F/2L$
 3. Is the force acting parallel to the surface of the liquid?
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EFFECTS OF SURFACE TENSION

1. Soap bubbles are spherical in shape
2. Water skaters are able to walk on the surface of water
3. Razor blade or needle gently placed on the surface of water floats
4. Spilled mercury on glass surface form spherical droplets

EVALUATION

1. Define surface tension
2. State the three effects of surface tension

APPLICATION OF SURFACE TENSION

1. Use in the manufacturing of rain proof or water proof
2. Absorption of ink with blotting paper
3. Rising of oil in lamp wicks
4. Movement of melted wax into the neck of a burning candle

REDUCTION OF SURFACE TENSION

1. Adding impurities such as detergent/soap, alcohol, oil, camphor, kerosene, grease
2. By heating the liquid.

EVALUATION

1. State three applications of surface tension
2. State two ways of reducing surface tension

READING ASSIGNMENT

Read more on surface tension – New school physics (pg102-103)

GENERAL EVALUATION

1. A platinum-resistance thermometer has a resistance of 5Ω at 0°C and 9Ω at 100°C . Assuming that resistance changes uniformly with temperature. Calculate the resistance of the thermometer when the temperature is 45°C
2. Give two reasons why water is considered an unsuitable liquid for thermometers.

WEEKEND ASSIGNMENT

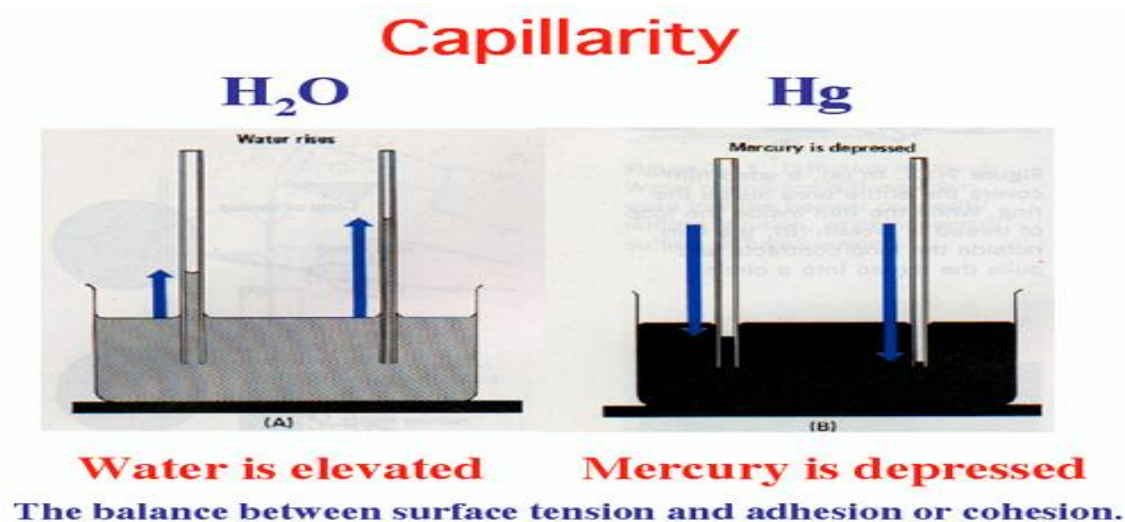
1. Define surface tension. State the three effects of surface tension
 2. (a) State three applications of surface tension (b) Two ways of reducing surface tension
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WEEK EIGHT

TOPIC: CAPILLARITY

CONTENT

- Definition of Capillarity
- Cohesion and adhesion
- Application of capillarity



Capillarity is defined as the tendency of liquids to rise or fall in narrow capillary tubes.

Cohesive force is the force of attraction between molecules of the same substance

Adhesive force is the force of attraction between molecules of different substance or it refers to the force which makes molecules of different substance to attract.

APPLICATION OF CAPILLARITY

Adhesion of water to glass is stronger than the cohesion of water, hence, when water is spilled on a clean glass surface, it wets the glass. The cohesion of mercury is greater than its adhesion to glass, hence, mercury spilled on glass forms small spherical droplets.

EVALUATION

1. Differentiate between cohesion and adhesion
2. Explain the rise of water in a glass capillary tube using kinetic theory

READING ASSIGNMENT

Read more on capillarity – New school physics (pg104-105)

GENERAL REVISION

1. A metal rod of length 40.0cm at 20⁰C is heated to a temperature of 45⁰C. If the new length of the rod is 40.05cm, calculate its linear expansivity.
2. State two (2) disadvantages of thermal expansion of solids.

WEEKEND ASSIGNMENT

1. The blade of a wooden hoe feels cold to the touch in the morning than the wooden handle because the (a) blade is a better conductor of heat than the handle (b) handle is a

- better conductor of heat than the blade (c) blade is placed at a lower temperature than handle (d) handle contains store energy in the form of heat
- Which of the following statement is not correct? (a) a sea breeze is due to convection in air (b) cotton material are better than woollen ones for use in the same weather (c) convection current plays an important role in the cooling of the engine of car (d) the vacuum space in the flask helps to reduce heat loss by radiation.
 - The inside of a vacuum flask is always coated with silver to reduce heat loss by (a) convection (b) conduction (c) radiation (d) evaporation
 - Which of the following colours of surface will radiate heat energy best? (a) red (b) white (c) black (d) yellow
 - A hot metal in a vacuum can lose heat by (a) conduction (b) convection (c) radiation (d) conduction and convection

THEORY

- Differentiate between cohesion and adhesion
- Explain the rise of water in a glass capillary tube using kinetic theory

WEEK NINE

TOPIC: ELASTICITY

CONTENT

- Definition of elasticity
- Hook's law
- Tensile stress, tensile strain and young modulus

Elasticity is the tendency of a material to regain its original size or shape after deformation or after it has been compressed or extended.

Hook's law states that provided the elastic limit is not exceeded, the extension in an elastic material (wire) is proportional to the force applied i.e $F \propto e$

$$F = Ke \dots\dots\dots 1$$

Where K is force constant, stiffness or elastic constant

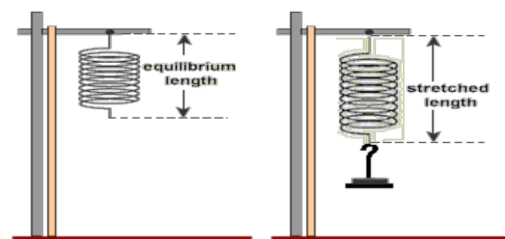
Force constant is the amount of force that causes a unit extension. It is the ratio of force to extension of an elastic material.

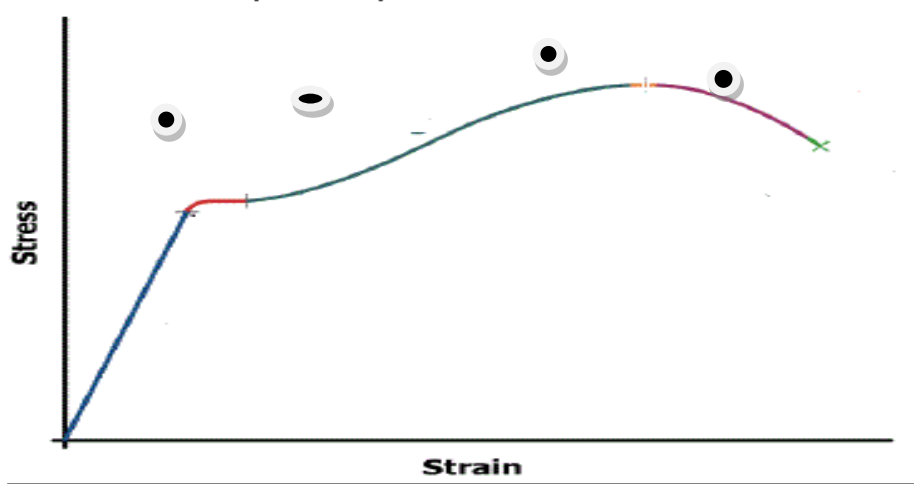
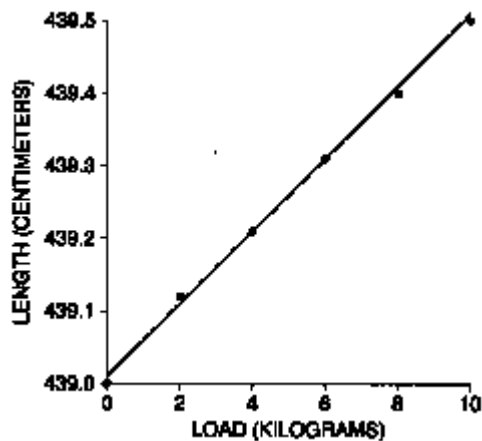
K → force constant, stiffness or elastic constant



Hooke's Law

- Hooke's Law gives the relationship between the force applied to an unstretched spring and the amount the spring is stretched.





OE → proportional limit

E → elastic limit

Y → yield point

EY → elastic deform

YM → plastic deform

Hook's law applies up to the elastic limit. For load beyond L the wire (material) stretch permanently. The point where small ↑ in load produces large extension is known as yield point. Breaking point is the point where the wire cannot withstand any further increase in load.

Yield point: it is the minimum stress/load acting on an elastic material beyond which plastic deformation sets in.

Elastic limit is the maximum load (force) which a body can experience and still regain its original size.

EVALUATION

1. Define (a) elastic limit (b) elastic constant (c) yield point (d) breaking point
2. State Hooke's law of elasticity

Tensile stress is the force acting on a unit CSA of a wire/rod or force per unit CSA of a wire or rod.

Tensile stress = Force/Area2

Tensile strain is the extension per unit length

Tensile strain = extension/Original length3

Young modulus can be defined as the ratio of tensile stress to tensile strain

Young modulus = tensile stress/ tensile strain.....4

EVALUATION

1. Define young modulus of elasticity
2. A spiral spring extends from a length of 10.01cm to 10.10cm when a force of 20N is applied on it. Calculate the force constant of the spring

READING ASSIGNMENT

Read more on elasticity – New school physics (pg 93-96)

GENERAL EVALUATION

1. Explain the anomalous behaviour of water.
2. State three ways of producing static electric charges

WEEKEND ASSIGNMENT

1. The SI unit of tensile stress is (a) N/m (b) Nm (c) N/m² (d) m²
2. The SI unit of tensile strain is (a) N/m (b) Nm (c) N/m² (d) none of the above
3. Young modulus of elasticity is the ratio of tensile stress to tensile strain provided the load does not exceed the (a) breaking point (b) elastic limit (c) yield point (d) stress limit
4. A piece of rubber 10cm long stretches 6mm when a load of 100N is hung from it. What is the strain? (a) 60 (b) 0.6 (c) 6×10^{-2} (d) 6×10^{-3}
5. Hooke's law states that (a) $F \propto A$ (b) $F \propto e$ (c) $E \propto F$ (d) $E \propto A$

THEORY

1. A wire is gradually stretched by loading it until it snaps (a) sketch a load- extension graph for the wire
2. indicate on the graph the elastic limit (E), yield point (Y) and breaking point (B)

WEEK TEN

TOPIC: ENERGY STORED IN AN ELASTIC MATERIAL CONTENT

- Force in a bar
- Energy stored in a wire
- Energy stored per unit area

FORCE IN A BAR

When a bar is heated and then prevented from contracting as it cools, a considerable force is exerted at the end of the bar. Given a bar of a young modulus E , a cross sectional area A , a linear expansivity of magnitude α and a decrease in temperature of Θ , then

$$E = \text{stress/strain} = F/A/e/L$$

$$= F/A \times L/e$$

$$E = FL/Ae$$

$$F = EAe/L \dots\dots\dots 1$$

Recall, Linear expansivity α = change in length/original length x temperature change

$$\alpha = e/L \times \Theta$$

$$e = \alpha L \Theta$$

$$F = EA\alpha e L \Theta / e L$$

$$F = EA\alpha \Theta \dots\dots\dots 2$$

EVALUATION

1. Show that $F = EA\alpha\Theta$ when a bar is heated and then prevented from contracting as it cools
2. A steel rod of cross sectional area 2cm^2 is heated to 100°C and then prevented from contracting when it cooled to 10°C . find the force exerted on the steel = $12 \times 10^{-6}/\text{K}$ and young modulus is $2 \times 10^{11}\text{N/m}^2$

ENERGY STORED IN A WIRE

The application of force on any wire provided the elasticity limit is not exceeded is proportional to the extension provided.

Consequently, the force in the wire has increase from zero to F

Average force = $F + O/2 = F/2$

Recall work done = Average force x distance

$W = f/2 \times e = \frac{1}{2} Fe$ 3

Substitute eqn 1 into 3

$W = EAe^2/2L$4

ENERGY STORED PER UNIT VOLUME

$W_v = \frac{1}{2} \times \text{Stress} \times \text{Strain}$5

This implies that $W_v = Ee^2/2L^2$

Substance which lengthens considerable and undergo plastic deformation until they break are known as ductile substance. E.g lead, copper, wrought iron.

Substance which break after the elastic limit is reached are known as brittle substance e.g glass and high carbon steel. It should be noted that brass, bronze and many alloys appears to have no yield point. By this we mean that this material increase in length beyond the elastic limit as the load is increased without the sudden appearance of a plastic stage.

EVALUATION

1. A uniform steel wire of length 4m and are of cross section $3 \times 10^{-6} \text{m}^2$ is extended by 1mm. Calculate the energy stored in the wire if the elastic limit is not exceeded (young modulus = $2 \times 10^{11} \text{n/m}^2$)
2. A spiral spring is compressed by 0.02m. Calculate the energy stored in the spring if the force constant is 400n/m^2

READING ASSIGNMENT

Read more on elasticity – New school physics (pg96-98)

GENERAL EVALUATION

1. A body moving with uniform acceleration has two points [5,15 and 20,60] on the velocity time graph of its motion. Calculate its acceleration.
2. A body of mass 50Kg is moving in a circular path of radius 4m with a uniform speed 20m/s. determine its centripetal force

WEEKEND ASSIGNMENT

1. Young modulus of elasticity is the ratio of tensile stress to tensile strain provide the load does not exceed the (a) breaking point (b) elastic limit (c) yield point (d) stress limit
2. A piece of rubber 10cm long stretches 6mm when a load of 100N is hung from it. What is the strain? (a) 60 (b) 0.6 (c) 6×10^{-2} (d) 6×10^{-3}
3. A force of 1.8N extends a wire by 0.4cm. What force will extend the wire by 1.25cm if the elastic limit is not exceeded. (a) 5.625N (b) 4.500N (c) 3.125N (d) 2.25N
4. Calculate the work done to stretch a string by 40cm if a force of 10N produces an extension of 4cm in it. (a) 0.2J (b) 2.0J (C) 20.0J (d) 200.0J
5. Which of the following is not the consequence of a force field? (a) weight (b) surface tension (c) gravitational pull (d) magnetic force

THEORY

1. A steel rod of cross sectional area 2cm^2 is heated to 100°C and then prevented from contracting when it cooled to 10°C . find the force exerted on the steel = $12 \times 10^{-6}/\text{K}$ and young modulus is $2 \times 10^{11}\text{N/m}^2$
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