KINETIC THEORY OF MATTER

It is the theory that tries to explain how matter behaves. It is based on the following assumptions
1. Matter is made up of very tiny particle invisible with our naked eyes and to microscope.
2. The particles of matter are in constant random motion. The motion increase with temperature. Small particle move faster than the large one
3. There are forces of attraction between the particles

State of matter
Matter exist in three states these are gas, liquid and solid

Solids
Properties of solids
1. They have fixed shape, volume , density
2. They are closely packed
3. They have strong IMF (Intermolecular forces)
4. The particles vibrate on a fixed position
5. They have regular shape

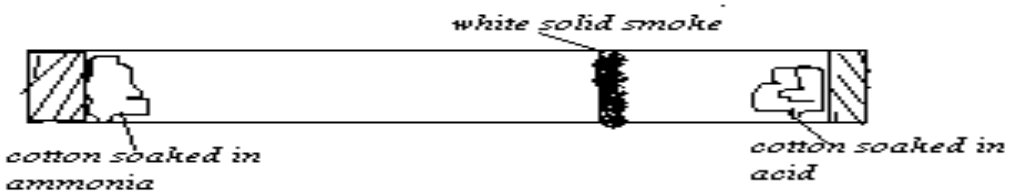
Liquid
1. They fairly close to each other
2. They have quite strong IMF
3. They move in a straight line (rectilinear motion)
4. They take the shape of the container

Gases
1. Particles are far apart
2. They have week IMF
3. The move in straight kind at very high speed randomly
4. They have no any structure

Evidence of existence of particles

1. **Diffusion**
   It is the movement of particles from high concentration to low concentration. It takes place in haphazard and at a random way.
   For example if the liquid of bromine is dropped into a jar containing air the jar is covered , the liquid of bromine vaporise and after some times the bromine vapour can spread evenly through he gas jar.

2. **Diffusion of ammonia and sodium hydrogen chloride**
   Experiment 1
   Evidence of existence of particles
   Se the apparatus as show below



Procedure

1. Hold a stopper of ammonia bottle near the open acid bottle. Observe what happens
2. Make sure that the glass tube is dry inside and out
3. Soak a pinch of cotton wool in ammonia solution and put it into the other end of the tube. Close the end of the tube with other cork
4. At once soak the other in acid (hydrochloric acid) put it on the other end as showdown on the diagram above and close the side with a cork
5. Place the tube direct sunlight on the bench (or clamp it horizontally) and wait for moment.

Expected Results

A white solid will be formed. This will formed because the Ammonia reacts with an acid to form ammonium chloride which is white in colour.

Discussion

Since the particles move and meet at a certain point. This provide example that particle move from one point to another.

GAS PRESSURE

Pressure is defined as force per unit area

P= F/A

Gas pressure is measured in following units

1. Atmospheres (atm)
2. Millimetre of mercury (mm Hg)
3. Newton's per square Metre called Pascal

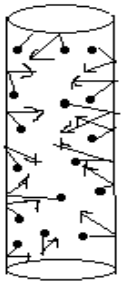
1 atm = 1.0132×10^5 Nm^{-2} = $1.0132X10^5$ Pascal = 760mmHg

How temperature affect molecular motion

Temperature increase the kinetic energy since the heat energy is converted to kinetic energy in a particle. Since the kinetic energy has increase this makes particles to move fasts than before. When temperature increase molecule to move faster than before since heat energy is also increased which increases the kinetic energy.

How pressure is caused

When air particle are closed in a contained. The particle move rapidly and randomly hitting the wall of the container



According to kinetic theory of matter it states that matter has a kinetic energy. It also said that particle in gas move randomly and in rapid speed. This causes the gas particle hit the wall of the container frequently. This cause the pressure inside the container.

FACTORS THAT AFFECT GAS PRESSURE

a. Temperature

When the temperature is increase the kinetic energy of the particles also increases. This means that the particle will be hitting the walls of the container more often than before. The

temperature increases the kinetic energy in the gas particles which in turn increase pressure in the container.

b. Volume of the container

The pressure of the gas increase and the volume of the container decreases. This mean that particles will hit the walls of the container more often than before because the gases particle will travel short distance to hit the walls of the container due to small space. In large container particles travel long distance to hit the wall of the container whichreduces the number of collision per seconds.

c. Number of particle in the container(concentration)

Increase the number of particles number of times the molecules will hit the walls per second.

TEMPERATURE

It is the measure of how hot or cold a substance is

Temperature scales

There two temperature scales that are commonly used in science and these are

1. **The Celsius scale**
   It uses Degree Celsius on the scale.
2. **Kelvin scale**
   It uses Kelvin and denoted by K

Temperature conversion

0°C = 273K

Change the follow in degree to Kelvin's

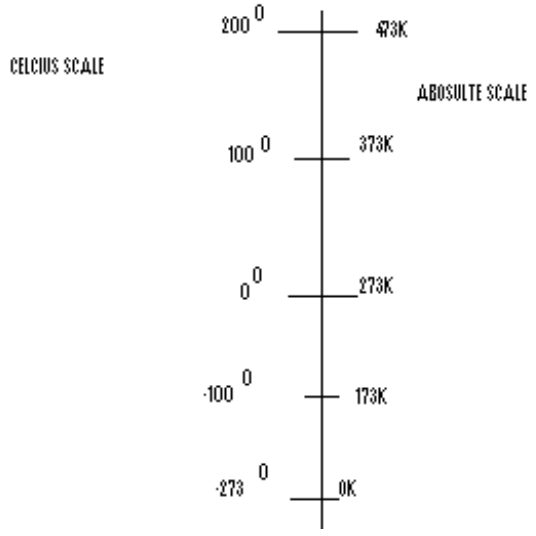
15°C (b) 78 C°

a). K = 273 K + 15 = 298K

b). K = 273K + 78 = 351

Absolute temperature

It correspond to Kelvin scale of measuring temperature. In absolute temperature only positive value are allowed. When temperature is zero it is considered that the quantity being measured(tempered) is consider completely absent.



Absolute zero temperature

It is the temperature which is considered no a single particle vibrates and all substance has no internal kinetic energy. At this temperature, all substance has no internal energy and it correspond to 0K on Kelvin scale and -273°C of Celsius scale.

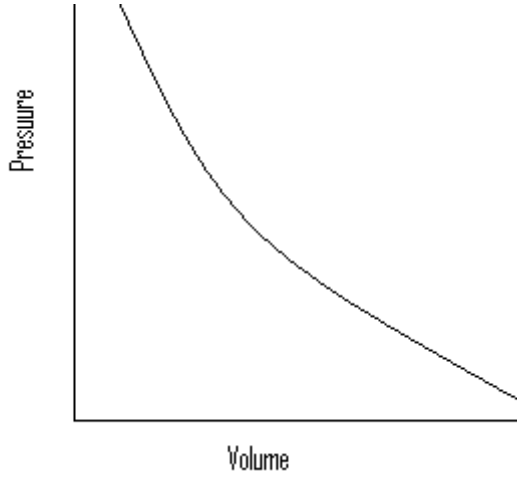
GAS LAWS

Boyle's Laws

It is the law that tries to link the relationship between volume and pressure when temperature is kept constant

It state that pressure of fixed mass of the gas is inversely proportional to its volume if the temperature is kept constant.

Graphically



Volume α 1/pressure

$V \alpha 1/P$

$V = k/P$ where k is a constant of proportionality

therefore $k = PV$

$P_1V_1 = P_2V_2$

Example

If a certain mass of gas has the volume of $7.50 \times 10^{-5} m^3$ at a pressure of 15.0kpa. What will be the volume of the gas if the pressure is altered to 25.0kpa without changing the temperature.

Given: $P_1 = 15.kp$

$V_1 = 7.5 \times 10^{-5} m^3$

$P_2 = 25.0Kpa$

$V_2 =$

$P_1V_1 = P_2V_2$

$15.0 \times 7.5 \times 10^{-5} = 25.0 \times V_2$

$V_2 = \frac{15 \times 7.5 \times 10^{-5}}{25.0}$

$= 4.50 \times 10^{-5}$

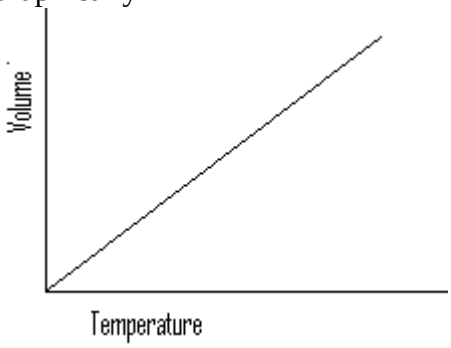
Therefore the volume of the gas at 25kp is $4.5 \times 10^{-5} m^3$

Charles laws

It is the law that tries to link the relationship between volumeand temperature if temperature is kept constant

It state that at fixed mass of gas,Volume is directly proportional it temperature if pressure is kept constant,

Graphically



Mathematically

$V \alpha$ temperature

$V \alpha T$

That is $V = kt$ where k is constant

therefore $V/T = k$

In general

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Example:

Mr Kanyambita inflate the tire to 25kpa which to a volume of $500cm^3$ at temperature of 300K. Later in the day the temperature increase to 320K . find the volume of the tire at a new temperature?

Given:

$V_1 = 500cm^3$ $T_1 = 300K$ $T_2 = 320K$ $V2 = ?$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{500}{300} = \frac{V_2}{320}$$

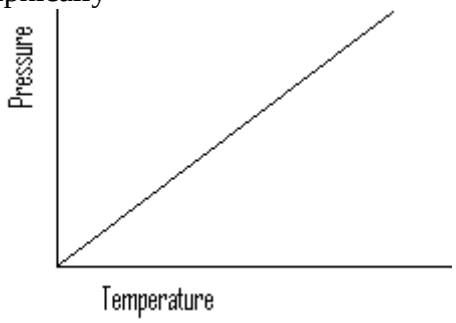
$$V_2 = \frac{500 \times 320}{300}$$

$V_2 = 533.33cm^3$

Pressure law

This law link up the relationship between pressure, temperature if volume is kept constant. It state that for a fixed mass of gas, pressure is directly proportional to its absolute temperature when the volume is kept constant.

Graphically



$P \alpha T$

$P = kT$ where k is a proportionality constant

$P/T = k$

Therefore $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

Example: The pressure of the air in a bicycle tire is 240kpa at 300K. What will be the pressure in the bicycle tire if the temperature is raised to 350K

Given

$P_1 = 240k \quad T_1 = 300$

$P_2 = ? \quad T_2 = 350K$

$\frac{P_1}{T_2} = \frac{P_2}{T_1}$

$\frac{240}{300k} = \frac{P2}{350}$

$P_2 = \frac{240 \times 350}{300}$

$= 280kpa$

Ideal gas law / General gas law

This combines three laws, Charles law, Boyle law and the pressure law. This is applicable only when the gas is no liquefier because the intermolecular force influencesthe influence the behaviour of the gases at that point.

The equation is used to determine changes when one or two things have changed.

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} = \text{Constant}$ where

Example: The volume of the gas at 27°C with 320mmHg is 20 L. . Find the temperature when the volume will be 30Land the pressure is 480mmHg

Given:

Original pressure = 320mmhg

Original volume = 20L

Original temperature = 27°C
Final temperature = ?
Final pressure = 480mmHg
Final volume = 30L

$$\frac{320 \times 20}{27} = \frac{480 \times 30}{T}$$

$$T = \frac{480 \times 30 \times 27}{320 \times 20}$$

$= 60°C$

Example 2: A balloon, volume $0.5m^3$, contain hydrogen at a pressure of $2x10^5$ Pa is released from the ground when the temperature is 17°C . What will be the volume when it reaches a height where the pressure inside balloon is $1,5x\ 10^5$ Pa and the temperature is 6°C

Given:

Original pressure = $2x10^5$

Original volume =$0,5m^3$

Original temperature = 17°C

Final temperature = 6C

Final pressure = $1.5x10^5$

Final volume = ?

$$\frac{2 \times 10^5 \times 0.5}{17} = \frac{1.5 \times 10^5 \times V_2}{6}$$

$$\frac{2x10^5 \times 0.5 \times 6}{17 \times 1.5 \times 10^5} = V_2$$

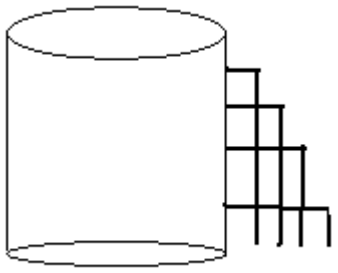
$$0.23m^3 = V_2$$

PRESSURE IN LIQUIDS

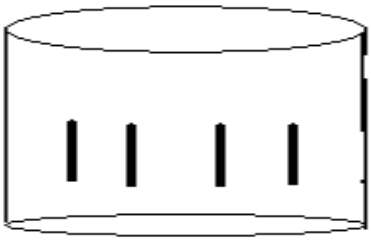
Properties of liquid pressure

Liquid pressure has the following properties

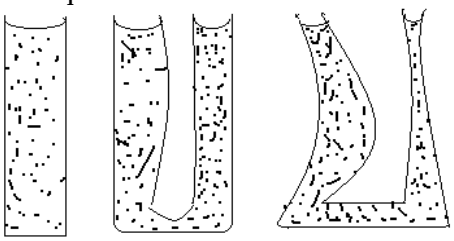
1. Pressure increase with depth because the farther you go the greater the weight of the liquid above that exert force on the surface particles.



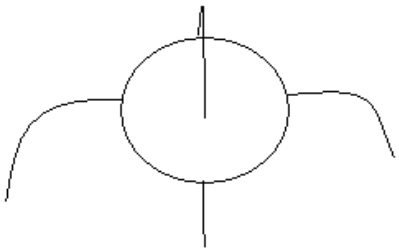
2. At certain depth of the liquid the pressure is the same at all point at that level and in all direction



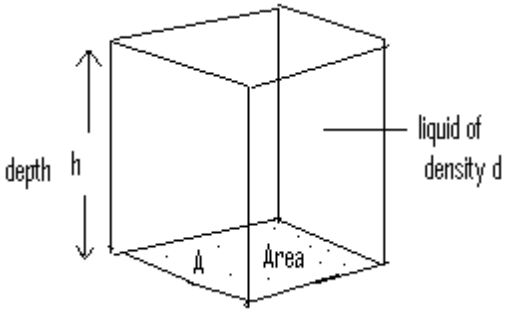
3. Liquid find its own level.



4. Pressure does not depend on the shape of the container
5. Any external pressure is transmitted to all parts of the liquid.
6. Pressure act at right angle to the container



Pressure formula in fluids



Pressure = F/ d
P = F /A

From the figure above
V = A x h where A is the area of cross section of the base
But density (d) = mass(M) / volume (v)
Mass of liquid = d x v = d xAxh
Recall that weight of substance = mg
Therefore mass of a substance is d. A. h .g
But the weight of the liquid is distributed over all parts of the liquid

$P = \frac{F}{A} = \frac{W}{A} = \frac{d.\ A\ .h\ .g}{A}$

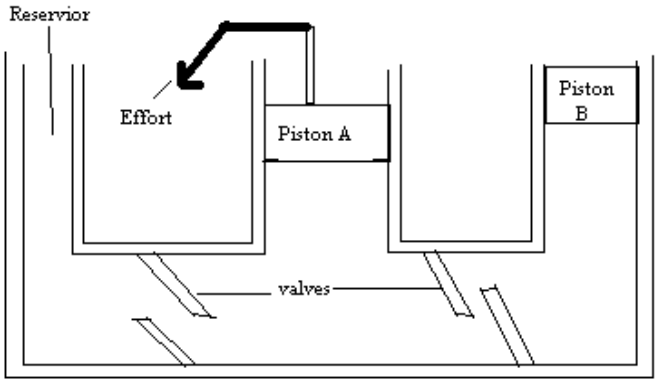
Therefore pressure (P) = d . h. g since A (area) cancel each other . Where d is the density of liquid in kg/m3 , h is the height of the liquid in the container, and g is the gravitational acceleration which is equal to 10m/s/s

Example
What is the pressure containing on the base of the container 76 cm long containing Mercury with a density of 13600kg/m^3. Take g as 10m/s/s

Solution
Given:
Density = 13600kg/m^3
height of the container = 76cm
g = 10m/s/s
Pressure = d. h. g
P = 13600 x 0.76 x 10
= 103360pa

Uses Of Liquid Pressure

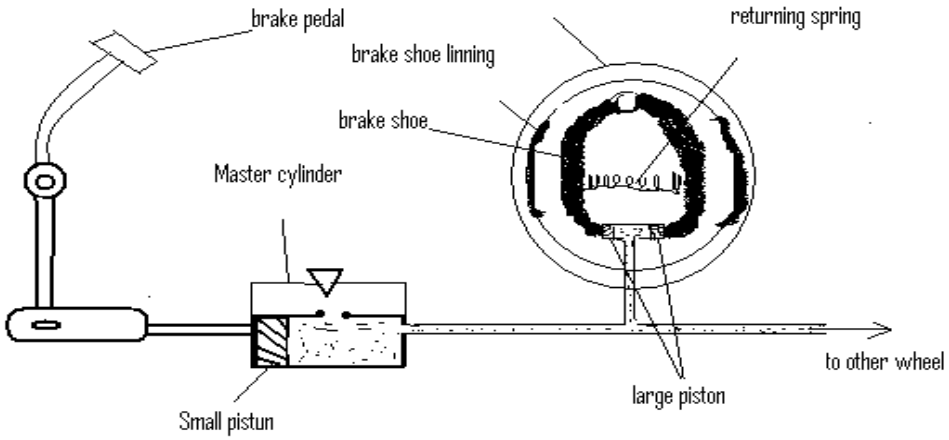
1.. Hydraulic Jack
It has a platform on top of piston B and is used in garages to lift cars. See the figure below.



B is raised a long way when A moves up and down repeatedly.

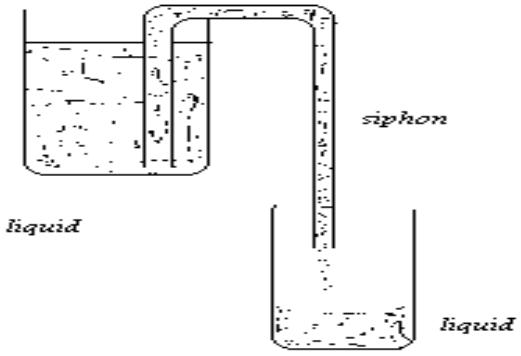
2. Hydraulic Car Brakes

When the brake pedal is pushed down , a small piston in a master cylinder forces brake fluid through narrow pipes leading to the four wheels. Here the fluid pushes on pistons in slave cylinders, and the pistons move brake pads or shoes against metal drums or discs attached to the wheels and stop the car



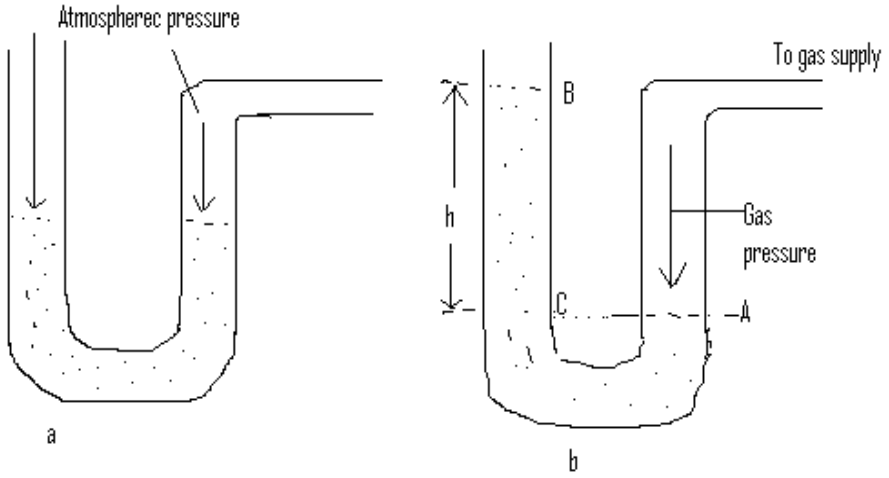
3. The knowledge of liquid pressure can be applied when designing a dam to calculate the pressure at various depths below the water surface and making strong walls. Before building a dam, engineers calculate the total force of water that will press against its face. To do this , they compute the pressure half-way down from the surface, called <u>average pressure</u> .This average pressure multiplied by the area of the whole face of the dam gives the total force exerted against it by the water.
4. Water tanks are also placed at high altitude so that water goes to hoses or offices with great pressure.
5. Pumps. When the tight fitting piston is drawn back along the barrel the pressure in the barrel is reduced and the atmospheric pressure drive the liquid in and when the piston is hushed down it drive the liquid out of the small nozzle at high pressure.

Siphons , the container containing liquid is placed is place top where the container where liquid will be transferred is placed place below. The air in the tube is removed so to create a low pressure and is replaced with the liquid while one end. After filled both ends is closed using a finger and dipped into the tank and another end to the container. The pressure below the tank pushes the liquid out the tube to the container below .



MANOMETER

It is instrument that can be used to measure differences in gas or liquid pressure. It is filled with mercury. One end is Connected to the gas supply while the other is open to atmospheric pressure.



It uses the principle that say that external pressure is transmitted to all parts of the liquid and that the pressure in au table is the same at any point .

Each surface of the liquid is acted on equally by the atmospheric pressure and the levels are the same in A.

I f one side is connected to , for example , the gas supply , the gas exerts a pressure on surface A and level B rises up which can be measured by the ruler. The pressure difference pushes the mercury or the liquid round the u tube and there is a height difference between mercury levels as a result as shown in B.

Pressure of gas = atmospheric pressure + pressure due to liquid column BC.

The pressure of the liquid column BC equals the amount by which the gas pressure exceeds atmospheric pressure. If for example, the height difference were 30 mm Hg and atmospheric pressure were 760mm Hg, the pressure of the gas would be 790mmHg.

Note :

If the difference between the mercury levels is too small to measure accurately, water or oil can be used in the manometer instead of mercury.

To find the pressure exerted on liquid use the formula P = d.h. g (in Pa) where h is the vertical height of BC (in m) and d is the density of the liquid (in kg /m^3).

Measuring Lung Pressure Using Manometer

Lung pressure can be measured by connecting one end of the manometer to the mouth and try to breathe out very hard. Air from the lungs can exert pressure on the liquid in the manometer. This can cause difference in levels.

To find the pressure exerted on the liquid or Lung pressure = atmospheric pressure + pressure due to the liquid column or use the following formula P = dhg and density should be in kg/m^3

Pascal s Law:

It states that pressure applied to a confined fluid acts equally in all directions.

Note: Hydraulic devices are the applications of Pascal s law.

The word ***hydraulic*** refers to any device that operates by applying pressure to a liquid.

Examples of hydraulic machines are:

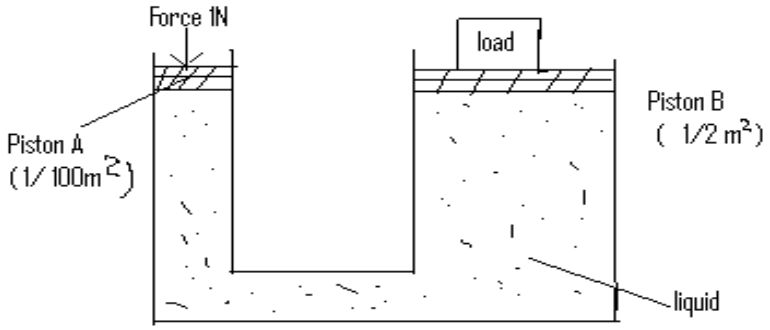
1. Hydraulic presses for baling cotton, extracting oils from seeds, shaping automobile bodies, punching holes in steel plates and moulding articles from plastics.
2. Hydraulic brakes on automobiles and airplanes
3. automobile lifts used in service stations.
4. Barber chairs.
5. Pneumatic devices are operated by a compressed gas.

6. Can be applied in hydraulic machines such as hydraulic car jack and hydraulic car brakes.

Hydraulic machines work by using liquids under pressure rather than levers or wheels.

They make use of two properties:

a. Liquids are virtually incompressible;
b. If pressure is applied to a trapped liquid, the pressure is transmitted to all parts of the liquid.



Suppose a downward force of 1N acts on piston A of area $1/100m^2$. The pressure transmitted through the liquid is :

Pressure = Force/Area = 1N / 1/ $100m^2$ = 100Pa.

This pressure acts on piston B of area 1/ 2 m^2. The total upward force or thrust on B is given by:

Force = Pressure x Area = 100Pa x 1/ 2 m^2 =50N.

A force of 1N thus produces a force of 50N which can be used to lift heavier load.

CONTRACTION AND EXPANSION OF SOLIDS:

Expansion is an increase in volume or size of an object.

Solids expand upon being heated. This is due to increased motion of particles which force each other a little farther apart according to the Kinetic theory.

Contraction is a decrease in volume of an object. When an object is cooled, the particles or molecules come closer together.

APPLICATION OF CONTRACTION AND EXPANSION OF SOLIDS:

1. **For separating materials**. The expansion of solids can be applied to unscrew the bottle top which is too tight by placing the bottle top in hot water for a moment. The top expands before the heat reaches the bottle, which makes it a looser fit.
2. **For joining materials**.

a).**Shrink-fitting**:

Both expansion and contraction can be used to make a tight fit between tow pieces of metal. For instance, this can be used to fix the axle into a wheel. The axle can be shrunk by cooling in liquid nitrogen at -196^0C until the gear wheel can be slipped on to it. On regaining normal temperature the axle expands to give a very tight fit.

b **Riveting metal plates**:

Contraction is applied. In ship –building , steel plates are riveted. A white-hot rivet is placed in the rivet hole and its end hammered flat. On cooling, it contracts and pulls the plates together.

3. **Bimetal Thermostats**.

Both contraction and expansion can be applied in Bimetallic Thermostats.

A thermostat is a device which controls temperature of an appliance or room.

Thermostats are fitted to refrigerators . electric irons, immersion heaters, ovens and to some room heaters.

4**. Bimetallic Thermometer**

It contains a bi-metal strip in form of a long spiral. The center of the spiral is attached to a pointer. The other end is fixed. When the temperature rises, the strip coils itself into an even tighter spiral and the pointer moves across the scale

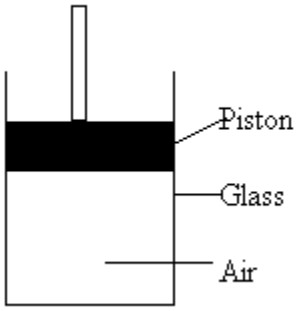
Exercise

EXERCISE

2003

Question 4

a. (i) Explain the term absolute temperature?
   (ii) convert 25°C to Kelvin scale.
b. Figure 3 shows a gas tube fitted with a piston



i. What will happens to the volume and pressure of the gas when the piston is pressed down the glasstube?
ii. Explain your answer to 4.b.i
iii. A container with the cross-section of $3m^2$ is filled with $9cm^3$ of water. Calculate the pressure on the bottom of the container. If the density of water is $1g/cm^3$
iv. Give any two uses of liquid pressure in every day life.

c. In terms of kinetic theory of matter explain why increasing temperature cause the candle melt.

2004

Question 1

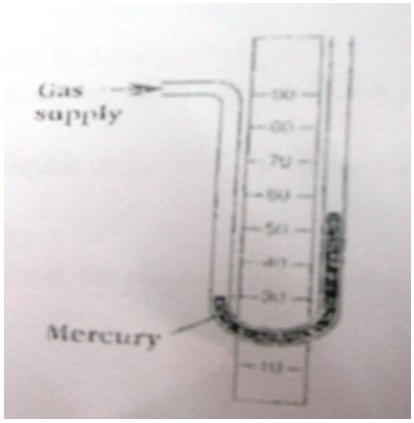
a. Table 3 shows the results in an experiment to verify a gas law

Volume (cm^3)	10	12	14	16	18
Pressure (kpa)	200	169	144	127	114

i. Plot the graph to show the relationship between pressure and volume
ii. What relationship is being demonstrates by this graph
iii. Which variable would kept constant in this investigation

b. (i). A pressureof 50000 pa is exerted by the column of water at the base of the container. Calculate the height of water.
   (ii) Exp0lain why the base of the dam is thicker than the top
   (iii) Two identical were filled with liquid mercury with a density of 13.6g/cm3) and water with the density of 1g/cm3. Which container base feels greater pressure? Explain your answer.

c. Figure 1 is an instrument used to measure gas pressure.

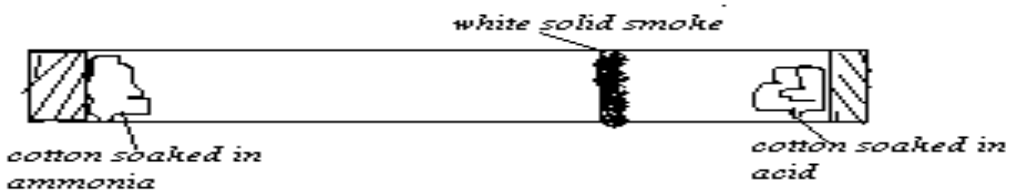


i. Name the instrument
ii. Read the pressure difference in mmHg
iii. What is the pressure of the gas supply if the atmospheric pressure is 755mm and the pressure difference is 30mm

2005
Question 1

a. (i) define the term "diffusion"
(ii) In which sate of matter does diffusion occurs quickly?
(iii) Give a reason for you answer

b. Figure 1 is a diagram of a sealed glass tube containing two cotton. One is soaked in concentrated ammonium and the other soaked in concentrated hydrochloricacid. Gases from the solutions along the tube and white cloud where they meet.

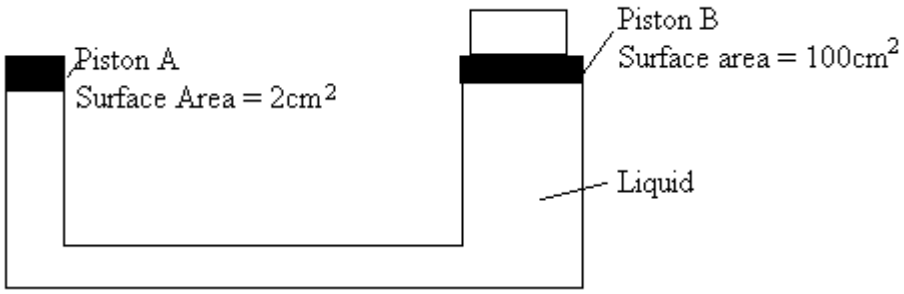


i. Which of the gases light
ii. Give reason for your answer to b.i
iii. When the experiment is done on the sunny day, it takes a shorter time for the white cloud to be formed. Give a reason why it happen like that.

c. The volume of the air container is $6cm^3$ and has the pressure of 4 atm when te temperature is 27°C Calculate the pressure if the volume is $3cm^3$ and the temperature if 177°C

2006
Question 3 e

e. At atmospheric pressure, mercury barometer reads 0.76 m. If one atmospheric pressure is equal to 10100pa. Calculate the density of mercury.
f. Figure 2 is a diagram showing a hydraulic system being used to raise a load



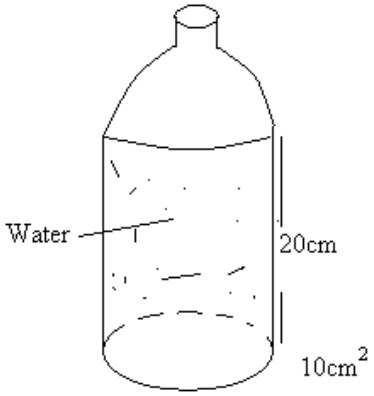
i. Calculate the pressure piston A exert on liquid

ii. How much pressure does the liquid exert on piston B

2007

Question 6

a. Given any two properties of liquid pressure
b. Figure 5 is a diagram of as bottle containing water



Calculate the pressure of water on the bottom of the bottle . (Density of water $1g/cm^2$)

c. Mention the term absolute temperature
d. Convert 546K to degree Celsius

2008

Question 8

a. Explain why the candle wax melt when it is heated
b. With an aid of a diagram describe how manometer works'

2009

Question 6.

d. (i) define Gas pressure

ii. Give any three uses of gas pressure

iv. Why does the gas pressure in closed container increases when the temperature increases?

e. Table 2 shows a results of an experiment in that was done to demonstrate a gas law

Pressure (pa)	0.9	1.1	1.3.	1.5
Temperature (°C)	0	50	100	150

i. Plot the graph oif pressure against temperature
ii. Use the graph to find the pressure of the gas when the temperature was 120°C.

2010

Question 1

a. (i) What liquids is used in hydraulic machine
(ii) Give three examples of hydraulic machine

b. (i) Define absolute zero
(ii) Agas occupies a volume of $200cm^3$ at 273K. calculate the temperature of the gas in Kelvin if the volume increases to $300cm^3$ at constant pressure.

2011

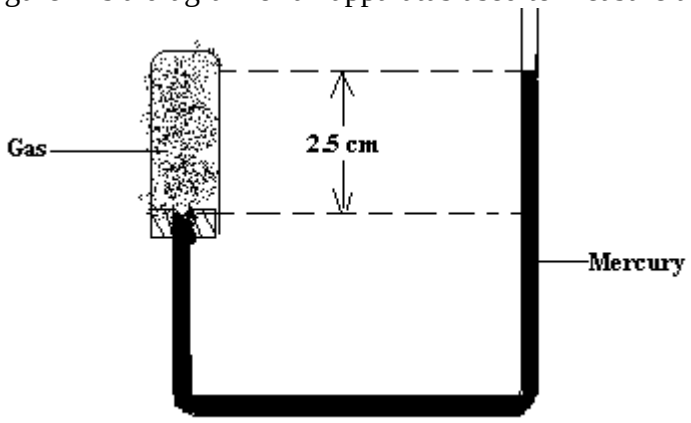
Question 6

a. State any two factors that affect gas pressure
b. Explain why the walls of the dam is built thicker at the bottom
c. A rectangular container whose base is $9cm^2$ is filled of water with a volume of $27cm^3$. Calculate the pressure exerted by the water at bottom of the container in N/cm^2(acceleration due to gravity = 10m/s/s)

2012

Question 1

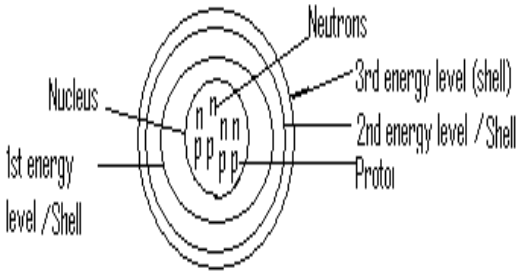
a. State the kinetic theory of matter
b. Figure 1 is a diagram of an apparatus used to measure the pressure exerted by gas



Calculate the pressure exerted by the gas if the atmospheric pressure is 765mmhg
8c. In term of kinetic theory of mater explain why ice melt when put in the sun

ELEMENT AND CHEMICAL BONDING

STRUCTURE OF AN ATOM
Atom is the simplest particle that made matter
It consist of electrons , protons and neutrons



Electrons
They are negatively charged particle that revolve around the nucleus in their orbital's.
It is located in energy levels and exist in the lowest energy levels\
They have negligible mass and the move from one energy level when given extra energy

Protons
They are positively charge particle that are found in nucleus.
They have the mass of 1 amu (atomic mass unit)

Neutrons
They are located in nucleus and has a mass of 1 amu
They have no charge

In a neutral atom the number of electron is equal to the number of protons

Atomic Number (Z) .
It is the number of protons in an atom
In an neutral atom the number of proton is equal to the number of electron

Atomic mass number (N)
The sum of proton and neutron in an atom is called the mass number (N)

Atomic mass number — 12

Atomic number — 6 C

Example : An element X has the atomic mass number of 31. It has also 16 neutron . Find the number of protons and electron in the atom
Number of proton plus the number of neutron is equal to the atomic mass number

31 = 16 + Z

z = 15
Therefore number of electron is equal to 15

A negatively charge particle has charge of negative 3 and has 17 protons. Find the number of electron in the atom

Since it is a negatively charged particle it means it has gain some electron. Therefore to find the number of electron in the particle add 3 on the number of proton

The answer is 14 electrons

NB: If it is a cation add the number of charge from the number of proton for anion subtract the number of the charge on the number of protons

Why atom of different element differ
Atom differ because of the following factors
1. Different atoms has different masses
2. Different atom has different changes on their nuclei and different number of electrons
3. Different atom has different relative atomic mass (RAM)

THE PERIODIC TABLE
During the building of the periodic table two things are looked at
1. One quantity should keep on increasing
2. The other quantity should keep on repeating itself

Electron configuration
It is the arrangement of electron in energy levels

Energy level	Number of electron to fill energy level
1	2
2	8
3	8
4	18
5	32

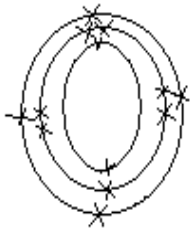
How to place electron in energy levels
1. Lowest energy level or hells are filed first ie nearest to the nucleus
2. Energy level are filled depending on the number of electron it hold
3. Energy level can be partly or completely filled by filling gradually one by one

Example

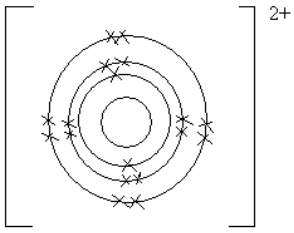
Element	Atomic number	Electron configuration
Hydrogen	1	1
Helium	2	2
Lithium	3	2,1
Beryllium	4	2,2

Boron	5	2,3
Carbon	6	2, 4
Nitrogen	7	2, 5
Oxygen	8	2,6
Fluorine	9	2,7
Neon	10	2,8
Sodium	11	2,8,1
Magnesium	12	2,8,2
Aluminum	13	2,8, 3
Silicon	14	2,8 ,4
Phosphorus	15	2, 8, 5
Sulphur	16	2, 8 ,6
Chlorine	17	2, 8 , 7
Argon	18	2, 8, 8
Potassium	19	2,8,8,1

Example
Draw the electron configuration for element with 14 protons



The electron configuration for a certain element is shown below



a). Write its electron configuration
b). How many proton are there in the element
c). What could be possible name for the element

Solution
a). Number of electrons = 18 + 2 = 20
b). Number of protons = 18 + 2 = 20
c). The possible name is calcium

How a periodic table is built
It is built by placing elements with similar electron configuration in the same column and placing element with increasing electron configuration.

H(1)							He(2)
Li(2,1)	Be(2,2)	B (2,3)	C (2,4)	N (2,5)	O (2,6)	F (2,7)	Ne (2,8)
Na (2,8,1)	Mg (2,8,2	Al (2,8,3)	Si (2,8,4)	P (2,8,5)	S (2,8,,6)	Cl (2,8,7)	Ar (2,8,8)
K (2,8,8,1)	Ca (2,8,8,2)					Br (2,8,8,7)	Kr (2,8,8,8)

The vertical columns are called Group or families and are made by electron with similar electron configuration
The horizontal columns or rows are called period or energy levels

GROUPS IN THE PERIODIC TABLE AND THEIR PROPERTIES
Group one elements
They have 1 electron in their out most shell. They are also called alkali metal because they react with water to form alkaline solution

Examples of group one element include.
Lithium 2,1
Sodium 2,8,1
Potassium 2,8,8,1
Physical Properties of Group 1 Elements
1. They are soft and can easily cut by a knife
2. They are ductile, how easy a metal can be draw into a wire
3. They are malleable, how easy metal can be hammered into any shape
4. They are shiny when freshly cut
5. They have low density and float on water
6. They are good conductor of heat and electricity

CHEMICAL PROPETIES
With air
They react with oxygen to produce a white oxide of similar molecular formula

$4Na\ (s) + O_2 \longrightarrow 2Na_2O\ (s)$
$4Li(s) + O_2 \longrightarrow 2Li_2O\ (s)$
$4K\ (s) + O_2 \longrightarrow 2K_2O\ (s)$

With Halogen
They react with group 7 E.g chlorine to halides salts. To initiate the reaction alkali metal should be heat first. The reaction should be done in a fume board always because it produces a white smoke

which bis poisonous

$2Na\ (s) + Cl_2 \longrightarrow 2Nacl\ (s)$

$2Li\ (s) + Cl_2 \longrightarrow 2Licl\ (s)$

$2K(s) + Cl_2 \longrightarrow 2Kcl\ (s)$

With water

When apiece of alkali metal is plugged into a beaker containing water. It react violently with water producing a hissing sound .

$2Na\ (s) + H_2O \longrightarrow 2Na\ OH + H_2\ (s)$

$2LI\ (s) + H_2O \longrightarrow 2Li\ OH + H_2\ (s)$

$2K\ (s) + H_2O \longrightarrow 2K\ OH + H_2\ (s)$

Similarities of group 1 elements

1. They are soft and can easily cut by a knife
2. They are ductile, how easy a metal can be draw into a wire
3. They are malleable, how easy metal can be hammered into any shape
4. They show silvery lustre when fleshy cut
5. They have low density and float on water
6. They are good conductor of heat and electricity
7. All react with water to produce alkaline solution
8. All react with air to produce oxide
9. All react with chlorine or halogen to produce a halide salt

NB all group one elements has the same properties because they have one electron in their out-most shell that take part in chemical reaction and tend to loose that electron

Difference between group one elements

1. Metal become softer to cut down the group
2. Metals burn easily in air down the group
3. They react easily with halogen or chlorine down the group
4. They react easily with water

Why the difference

The reactivity increases because the number of shells increases down the group which makes the electron to move far from the nuclei and experience very little nucleus attraction. Since electrons are held loosely they form weak metallic bond and can be easily broken.

GROUP 7 – THE HALOGEN

They are found on the left side of the period table

Examples of Group 7 element include
Hydrogen 1
Fluorine 2, 7
Chlorine 2, 8,7
Bromine 2,8,8,7

Physical Properties

1. They are typical nonmetals and are typical molecular substance
2. They exist as diatomic substances
3. They have low melting and boiling points. Chlorine and Fluorine are gases at room temperature

while Bromine is liquid and Iodine is a solid
4. They are slightly soluble in water
5. They have choking smell
6. The form molecular compound with other nonmetals for example Hydrochloric acid

CHEMICAL PROPERTIES

They are the most reactive Nonmetals. Halogen tends to gain electron. Reactivity increase up the group because the smaller halogen has strong nuclear charge that attract electron fast compared with halogen that have large atom. Fluorine is the most reactive non metal

With group1

They react violently with sodium and other group one and the reaction is exothermic

$\mathbf{2K(s) + Cl_2 \longrightarrow 2Kcl\ (s)}$

$2K(s) + Br_2 \longrightarrow 2K\mathbf{Br}\ (s)$

$2K(s) + I_2 \longrightarrow 2KI\ (s)$

$2K(s) + F_2 \longrightarrow 2KFl\ (s)$

With other metals

Powdered aluminum and iodine

$2Al(s) + 3I_2 \longrightarrow 2AlI_3\ (s)$

With other non metal

React with white phosphorus and catches fire by itself E.g in chlorine giving a mixture of products

$2P(s) + 3Cl_2 \longrightarrow 2\ PCl_5\ (s)$ Phosphoruspentachloride

and $2P(s) + 3Cl_2 \longrightarrow 2\ PCl_3\ (s)$ Phosphorustrixhloride

With hydrogen

They react with hydrogen to produce hydrogen halide

$H_2 + F_2 \longrightarrow 2HF$ explode when mixing

$H_2 + Cl_2 \longrightarrow 2HCl$

$H_2 + Br_2 \longrightarrow 2HBr$

$H_2 + I_2 \longrightarrow 2HI$

TEST FOR HALIDES

Silver nitrate is used to test presence of of halides. Silver nitrate produces precipitate with different colours

$Cl^-(aq) + Ag^+(aq) \longrightarrow Ag\ Cl\ (s)$ white

$Br^-(aq) + Ag^+(aq) \longrightarrow Ag\ F\ (s)$ pale yellow

$I^-(aq) + Ag^+(aq) \longrightarrow Ag\ I\ (s)$ yellow

PREPARATION OF HALIDES

They prepared by reacting a halide salt with manganese dioxide and concentrated sulphuric acid. . The halide salt should be sodium or potassium

$2NaCl + MnO_2 + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O + MnSO_4 + Cl_2$

$2NaCl + MnO2 + H2SO4 \longrightarrow Na2SO4 + 2H2O + MnSO4 + Cl2$

$2NaBr + MnO_2 + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O + MnSO_4 + Br_2$

$2NaF + MnO_2 + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O + MnSO_4 + F_2$

$2NaF + MnO_2 + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O + MnSO_4 + F_2$

USES OF HALOGENS

Halogen has several uses as follows

Fluorine

It is a pale yellow gas and has the following uses

1. Used in rocket propulsion
2. Used in making uranium fluoride to separate uranium 238 and 235
3. Used as fluro carbon for refrigerant, aerosol propellants anesthetic and fire extinguishers
4. Used in drinking water and toothpaste to reduce tooth-decay

Chlorine

1. Used in manufacturing of PVC pipe
2. Used to kill bacteria and viruses in drinking water
3. Used as bleach in laundries
4. Used as sterilizing fluid in dilute solution

Bromine

1. Used in making disinfectants
2. Used as a medicine
3. Used as fire retardants

Iodine

1. Used as medicine
2. Used as disinfectants
3. Used as photography chemical

GROUP 8 – INERT GASES OR NOBLE GASES

They are gases and exist as mono atomic substance.

Example

Helium 2

Neon 2,8

Argon 2,8,8

They are nonreactive substance because they out shell is completely filled and can not share or transfer electron to other compounds

They have low melting and boiling points

Although they are nonreactive they have important uses

Examples

Argon

1. Used in bulb to prevent tungsten to react with air
2. Used to provide inertness in arc welding in production of titanium metal

Neon

1. Used in advertising sign it glow red when electricity is passed
2. Used in neon- helium gas laser for operation
3. Used in Geiger Muller tube to detect radioactivity

Helium

1. Provide an inert atmosphere for welding

2. As coolant in nuclear reactor
3. With 20% oxygen as breathing gas used by deep see divers
4. To inflate tire of big tires of aircrafts
5. Low temperature research

NB

1. Atomic radius. It is distance from the center of the nucleus to the out most shell of an atom
2. Bonding radius it is the distance between to bonded atom nuclei

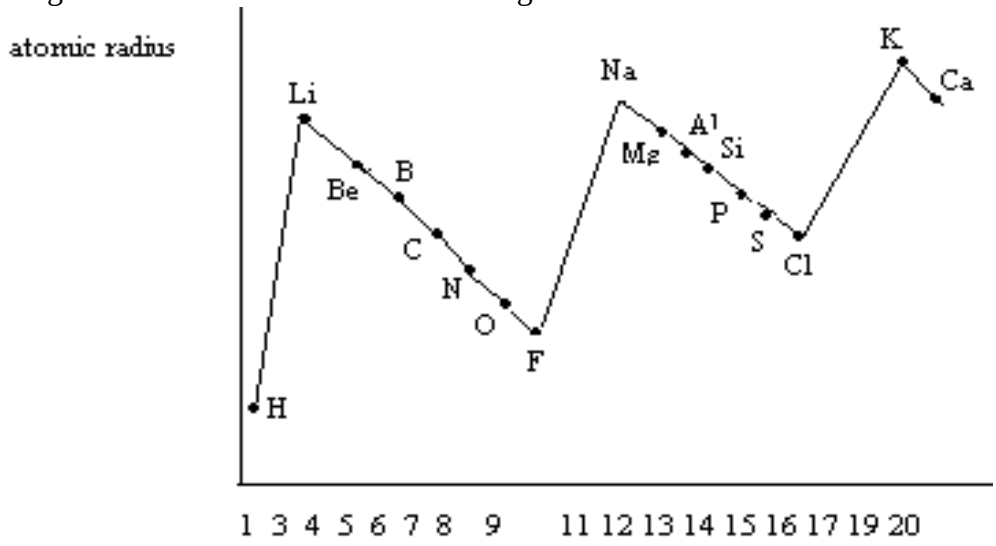
SOME NOTICED CHANGES IN THE PERIODIC TABLE

Observation 1

The covalent radius increases a from one period to another. For example as we move from lithium to saodium the atomic radius increase the same as in sodium to potassium.

Explanation to the observation

This so because as we move from one period to another the number of shells increases and the effective nuclear charge decreases and electron are loosely held making them to have large atoms . The nuclear charge decreases due increase in shielding effect of electron due to increase in number of shells



Observation 2

Moving along the period the covalent and atomic radius decrease for example moving from lithium to fluorine.

Explanation to observation

The decrease in atomic radius is so because of the increase in number of protons which pull electron towards the nucleus making the toms to become small. Increase in atomic number increases the effective nuclear charge like fluorine has greater effective nuclear charge of +7 while lithium has an effective nuclear charge of 1. This increase in effective nuclear charge pull electron more strongly towards the nucleus making the atoms to become smaller that atomic with small effective nuclear charge.

NB: Fluorineis the most reactive nonmetal and has highest negativity because it has smallest atom and with effective nuclear charge. This so because as we move along group -7 reactivity increase as move up the group and also the effective nuclear charge increase as we move from left to right.

COMPOUND FORMATION

The compounds are formed depending on what the elements do with their electrons

Valences in element
Valence is the number of bond an atom can form with other atoms.
Valence electron is the number of electron that can take part in chemical bonding and is always equal to the number of electrons in the out most shell
Chemical bond are formed either by transferring electron or sharing electrons

Group	1	2	3	4	5	6	7	8
Atom	Li	Be	B	C	N	O	F	Ne
Valence	1	2	3	4	3	2	1	0

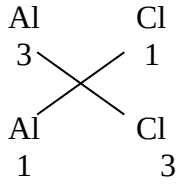
Metal tend to loose electron while gain electron from metals and difficult for them to loose

The number of electron to be lost or gain is equal to the valence electrons

For example the valence electron for Al which is group 3 is 3 while Neon which is group 8 is 0

Metalloid or group 4 elements tend to share the electron because it is difficult for them to gain or loose electrons.
If non metal form a compound with another nonmetal they share there electrons

Example of compound formation



The compound formed is $AlCl_3$

CHEMICAL BONDING
Bond is the force of attraction that exist between two adjacent atoms

Why elements form bond
Bonds are formed because reactants want to:
1. Want to be at lower potential energy
2. Having a more stable situation
3. To experience more attractive forces
4. To fill the octet or to complete their valence.

Types of chemical bonding

Metallic bonds
This is a force of attraction between fixed metal ions in a piece of metal and free delocalized electrons that move and surround them atoms.

How a metallic bond are formed
When a metal is gaseous state, electrons are found inside the electron shells of specific atom and are known as localized electron

When gaseous metal is cooled the atom come closer to each other electrons are attracted by the different atom nucleus which make electron not to be found in their specific electron shell and are said

to delocalise.

> Metallic bond are formed when gaseous atoms allow their electron to be delocalised on reaching solid state and feel force of attraction from different metal ions

Atoms loose their electron and become positively charges which attract free electron forming bonds

Characteristics of metals

1. The y are good conductor of heat and electricity
2. They are ductile and malleable
3. They have high Melting points and Boiling points
4. They are strong
5. They are insoluble in water

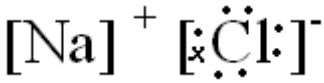
Ionic Bond

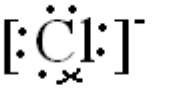
It is the electrical attraction between oppositely charged ions.

How it is formed

It formed when electron are transferred from one atom to another creating two different charge which later attract one another.

Examples of ionic bonds

Nacl 



$AlCl_3$ 

Characteristics of ionic compound

1. They are made up of ion not atoms
2. They conduct electricity in molten state or in solution form
3. They have high Melting point and Boiling point
4. They are brittle at room temperature
5. They are soluble in water

Covalent bonds

It is the force of attraction that is exists because of sharing of electrons by two adjacent nonmetallic atoms. Each adjacent atom donates an electron to form a pair that will be shared among them.
Covalent bond are formed when two adjacent atom share electron.
Bonding between hydrogen and chlorine

H- Cl

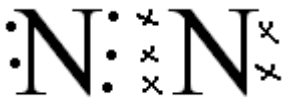
Double covalent bonds
It is formed when two pairs of electron are shared
Each atom donate a pair of electron
For example CO_2 C = C

O = C = O

Triple bonds
Three pair of electrons are needed. Each electron donate three electron to form a bond

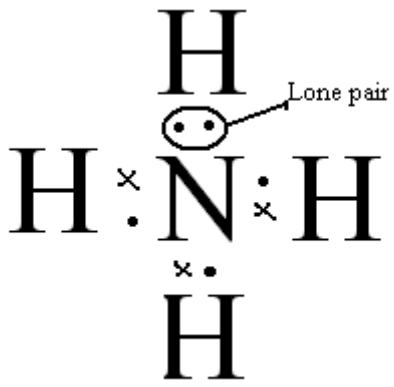
Example N_2 $N \equiv N$

or

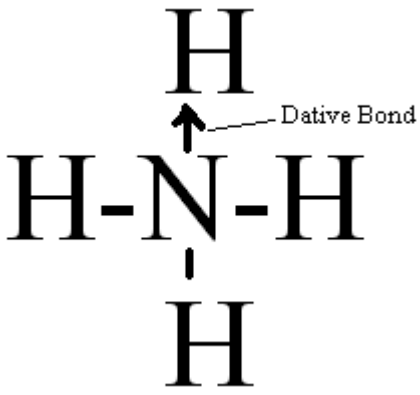


Co-ordinate or dative bonds
It the covalent bond which is formed when pair of shared electron is provided by one of the bonded atom.
The atom that provide electron is called a donor and that accept electron is acceptor. An arrow is used to represent dative bond.

Example lone pair from nitrogen that make the dative bond NH_4^+



or



Characteristics of covalent compounds
1. They poor conductor of heat and electricity
2. They have low Melting point and Boiling points
3. They low solubility in water

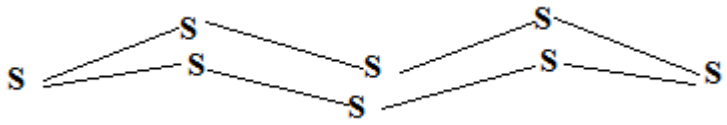
Polar and non polar bonds
Halogen has high electronegative.
Electronegative is the ability of an element to pull electron towards itself when it has been bonded to another element.

Elements such as fluorine, chlorine iodine, bromine and oxygen tend to pull electron towards them self when other have form a bond with other elements.
The electrical negativity increases up group seven element because of the effective nuclear charge increases up the group.

This make the molecule to have to different partial charge end. One end partially negative while the other partially positive.

This unequal sharing of electron is referred as polarization and the bond formed is between ionic and covalent is called a polar bond
Example of polar bond
$\delta +$ H – Cl $\delta -$

SULPHUR S
It belong to group 6 .
Sulphur molecule
Sulphur molecules has eight atoms arrange in S shaped ring



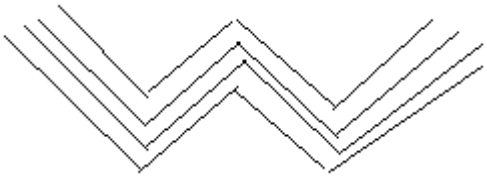
Occurrence:
1. It occurs in nature as a free element or combined with other elements in sulfides and sulfates.
2. It can be found in places where volcanoes were formerly active.

Note : Sulphur can be mined in the ground and purified**.**
Generally , Sulphur is mined or extracted using the Frasch process, named after its inventor Hermann Frasch**.** In the process, superheated water at 170^0C and hot compressed air are forced underground through pipes-forcing water and molten Sulphur to the surface.

Allotropic Forms of Sulphur:
It can exist in several different solid and liquid allotropic forms just as oxygen can exist in different forms.

Rhombic Sulphur (Alpha or Octohedral Sulphur)

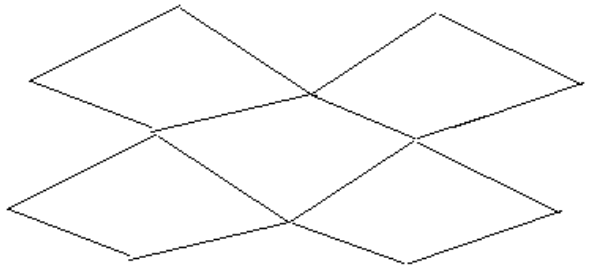
It is solid form of Sulphur and is stable at ordinary temperatures below 96^0C.
It consists of eight- membered rings of Sulphur atoms. .
Crystals of rhombic Sulphur may be prepared by dissolving roll Sulphur in carbon tetrachloride or xylene and then allowing the solvent to evaporate slowly.
It is the most stable form of sulphur because the S_8 molecules are closely packed and is interlocked



Monoclinic Sulphur Beta or Prismatic Sulphur:

It is stable above 96^0C
Monoclinic Sulphur crystals have two crystal axes at right angles to each other.
It can be prepared by first melting some Sulphur in crucible at as low temperature as possible. It is then allowed to cool slowly until a crust begins to form.

Its crystals when cooled below 95^oC gradually change back into rhombic Sulphur.
Monoclinic sulphur is not stable because the molecules are not closely pack and a change in temperature less that 95ºC cause it to change to rhombic sulphur



Lamda Sulphur

It is a liquid allotropic form of Sulphur produced at temperatures just above the melting point of Sulphur.
It has a straw –yellow colour.
It has almost spherical shape of 8 Sulphur molecules which enable it to roll over easily.

Mu- Sulphur

It can be prepared by heating lambda Sulphur to about 200 ^{o}C It is back liquid.

Note: This temperature. 96C is called the ***Transition Temperature***. Both allotrope (rhombic and monoclinic Sulphur) are stable at this temperature.

Amorphous Sulphur:

It is rubber plastic. It is dark brown.
It is made by poring boiling Sulphur into cold water

Uses of Sulphur

1. Used in production of Sulphur dioxide used in production of sulphuric acid
2. Used in vulcanization of rubber
3. Production of chemical used in detergents
4. Manufacturing of gun powder , fire work and matches
5. In preparation of skin ointment and drugs
6. Manufacturing of hydrogen carbonate use in bleaching
7. Used in manufacturing of plastic flowers
8. For making Sulphur concrete in area while acid is mostly used
9. As fungicide (lead arsenate) to control blights, mildews and other diseases of plants.
10. Used in making dyes

Physical Properties of Sulphur

a) It is yellow odorless solid.
b) It is insoluble in water.
c) It is twice as dense as water.
d) It is soluble in carbon disulfide and carbon tetrachloride
e) Does not conduct electricity.

Chemical Properties of Sulphur

It reacts with both metals and non metals.

- It can react with oxygen.

$S(s) + O_2 \longrightarrow SO_2(g)$.

- It can react with magnesium

$Mg(s) + S(s) \longrightarrow MgS(s)$ magnesium sulfide

Sulphur dioxide

it is produced by reacting Sulphur with oxygen

$S(s) + O_2 \longrightarrow SO_2(g)$.

physical properties of Sulphur dioxide

1. It is colourless gas with strong choking smell
2. It is heavier than air
3. It is soluble in water
4. It bleaches when is is damp or in solution

Chemical properties

1. It react with water too form sulphuric acid

   $H_2O + SO_2 \longrightarrow H_2SO_4$
2. It oxidises metal compound and nonmetal compound

   E.g aluminum, nitric acid

Uses of Sulphur dioxide

1. Used in bleaching wool , silk, and wood pulp for making paper
2. Used as sterilizing agent in making soft drinks and jam and drying fruit
3. Used in manufacturing of sulphuric acid

PRODUCTION SULPHURIC ACID H_2SO_4.

Preparation of Sulphuric Acid.

It is made by either the **:**

i. Contact process or ii Chamber process

THE CONTACT PROCESS:

Stage 1

Sulphur dioxide is prepared by burning Sulphur or by roasting iron pyrites (FeS_2) to produce Sulphur dioxide

$S(s) + O_2 \longrightarrow SO_2(g)$.

The Sulphur dioxide is purified to remove impurities which might poison the catalyst.

Stage 2

The purified Sulphur dioxide is mixed with air, and passed through heated iron pipes which contain the catalyst (Divanadium pentoxide)V_2O_5 to produce Sulphur trioxide.

$SO_2(g) + O_2 \longrightarrow SO_3(g)$.

Note :

1. The close contact of the Sulphur dioxide and the catalyst gives the contact process its name.
2. Sulphur trioxide(SO_3) is anhydride of sulphuric acid, and it is an intermediate product in the manufacture of sulphuric acid. It is solid at room temperature.

Stage 3

The Sulphur trioxide is dissolved first in concentrated sulphuric acid to form oleum (fuming sulphuric acid):

$SO_3(g) + H_2SO_4(l) \longrightarrow H_2S_2O_7(l)$ oleum.

Stage four

The oleum is then diluted with the correct amount of water to produce concentrated sulphuric acid.

$H_2S_2O_7$ (l) +H_2O (l) ⟶ $2H_2SO_4$(l).

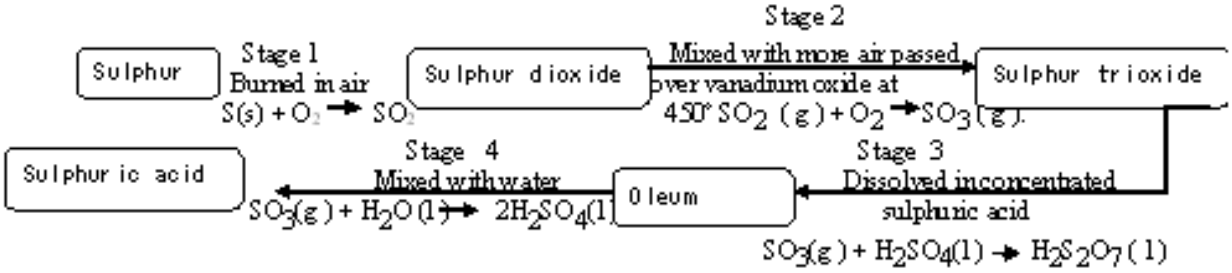
Note:

If sulphuric trioxide is added directly to water, sulphuric acid is produced, But ,this is not done on a large scale because the reaction is too exothermic or violent and boils the acid produced. Thick mist is produced. The acid mist is very difficult to deal with.

SO_3(g) + H_2O (l) ⟶ $2H_2SO_4$(l).

Very highly concentrated pure sulphuric acid is produced by the contact process.

The contact process can be summarized as follows



The Chamber Process:

Sulphur dioxide is converted to sulphuric acid by the action of nitrogen dioxide (NO_2) and water.

$H_2O + SO_2 + NO_2$ ⟶ $H_2SO_4 + NO$

Note: This method is used for making sulphuric acid for commercial uses that do not require very pure or highly concentrated acid E.g for the production of super phosphate fertilizer.

PROPERTIES OF SULPHURIC ACID:

Physical Properties:

1. Concentrated sulphuric acid is a dense oily liquid which is also called oil of Vitriol.
2. Pure sulphuric acid is colourless, though commercial acid may be brown , black or yellow due to the presence of impurities
3. Concentrated sulphuric acid has a boiling point of 338^0C.

Note : You must never add water to sulphuric acid , but acid to water. A great deal of heat is evolved because of the formation of the hydrates:

H_2SO_4 . H_2O and H_2SO_4 .$2H_2O$.

<u>Chemical Properties</u>:

1. It react with any metal compound to produce hydrogen chloride gas is produced
2. It reacts with any metal nitrate to produce nitric acid vapour. But the mixture must be heated to initiate the reaction..
3. Hot concentrated sulphuric acid react with carbon and Sulphur to produce carbon dioxide and Sulphur dioxide respectively. In each case the acid is reduced to water and Sulphur dioxide .See the equations below:

   C (s) + 2 H_2SO_4 (l) ⟶ CO_2 (g) +$2SO_{2(g)}$ + $2H_2O$(l).

   S (s) + 2 H_2SO_4 (l) ⟶ $3SO_{2(g)}$ + $2H_2O$(l).
4. It reacts with sugar and turns it back. If concentrated sulphuric acid is added to a sample of sugar the sugar turns yellow, then brown and finally black. The black residue is carbon formed when the acid has removed hydrogen and oxygen. Similar reactions take place when other carbohydrates are used.

5. Sulphuric acid ionizes in dilute water in two stages as follows:

$$H_2SO_4 + H_2O \longrightarrow H_3O^+ + HSO_4^-.$$

$$HSO_4^- + H_2O \longrightarrow H_3O^+ + SO_4^{-2}.$$

USES FO SULPHURIC ACID:

1. It is used in the manufacture of fertilizers such as ammonium sulphate and super phosphate fertilizers. The acid is used to convert the rock phosphate- calcium phosphate ($Ca_3(PO_4)$) into a more soluble product .i.e. super phosphate.
2. It is used in the preparation of other acids and various sulphates. For instance, Hcl. can be prepared by treating common salt with sulphuric acid.
3. Removing the surface oxide (pickling) from metals.
4. Making rayon.
5. Making synthetic soap less detergents.
6. Making drugs, dyes, paints , photographic films.
7. It is used in car batteries.

SULPHATES:

They are salts produced using sulphuric acid.

All sulphates are soluble in water except barium sulphate ($BaSO_4$) and lead sulphate ($PbSO_4$).

Calcium sulphate ($Ca\ SO_4$) is only slightly soluble in water.

Sulphates are less easily decomposed by heating than nitrates or carbonates.

USES OF SULPHATES:

i. Magnesium sulphate ($Mg\ SO_4$) is used in medicine as laxative.

ii. Ammonium ($(NH_4)_2\ SO_4$) sulphate is used as fertilizer.

iii. Barium sulphate ($BaSO_4$) as "Barium metal" is used in diagnostic medical X-ray studies.

iv. Calcium sulphate ($Ca\ SO_4.1/2H_2O$) as " Plaster of Paris" is used to set bones.

TEST FOR PRESENCE OF SULPHATES:

By a simple test-tube reaction:

- Add few drops of dilutes hydrochloric acid to the unknown. then
- Add few drops of barium chloride.

Result:

A white precipitate of barium chloride is an indicator of presence of a sulphate.

Exercise

2003

Question 3

a. Table 1 shows the first 20 elements of the periodic table

H							He
Li	Be	B	C	N	O	F	Ne
Na	Mg	Al	Si	P	S	Cl	Ar
K	Ca						

i. Work out the atomic number of a Si

ii. Work out the electron configuration of K given that it atomic number is 19

iii. Draw the electron dot and cross diagram of CO_2

iv. How aluminum (Al) attain stability as inert gas configuration

v. Explain why the melting point of group (VII) elements increases with the increases in atomic number

Question 6

a. Why are metal good conductors of heat

b. The table 2 shows the atomic number, melting point, boiling point and atomic radii of some halogen. Use it to answer the question that follows.

Name of element	Atomic number	Melting point	Boiling point	Atomic radius (mm)
Fluorine	9	-220	-188	0.07
Chlorine	17	-101	-34	0.10
Bromine	35	-7	59	0.11
Iodine	53	114	184	0.13

i. Which element is a liquid at 25˚C

ii. Why does iodine have biggest radius

iii. Work out the effective nuclear charge of fluorine

iv. Mention any two chemical properties of halogens

c. (i) Give one natural source of sulphur

ii. Mention any two chemical properties of halogen n

6e. State two difference between ionic bonding and covalent bonding

2004

Question 1

Table 1 show the particle in an atom of four elements

Element	Protons	Neutrons	Electrons	Mass number
Hydrogen(H)	1			1
Carbon (C)		6	6	12
Nitrogen (N)	7	7		
Sodium (Na)		12	11	

i. Copy and complete the table by filling the missing numbers

ii. Which elements in the table will easily form ionic bond

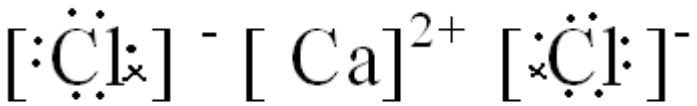
iii. Give a treason for you answer to 1 aii

iv. Work out the molecular formula mass of Methane (CH_4)

v. What kind of bonding are involved in methane

vi. Explain your answer to 1 a.v.

b. The dot and cross diagram of calcium chloride is shown below



i. Write the chemical formula of calcium chloride

ii. Explain the meaning of the sign 2+ on Ca atom

c. Table 2 shows elements represented by letter Q , R, L , M, X, Y and Z in the same periodic table

Group	I	II	III	IV	IV	V	VI I	VIII
Element	Q	R	L	M	X	W	Y	Z

i. Explain the increase of melting point and boiling point from chlorine to iodine

ii. What would happens if the solution of iodine is mixed with solution of potassium bromide

4d . Figure 4 is a diagram showing nuclei of two atoms

i. Explain why these atom reacts in the same way
ii. What are atoms of this type called
iii. In what period of periodic table could each belong
iv. Explain your answer to 4d iii

2006
Question 2

a. Halogens such as bromine, chlorine and iodine are prepared by re4acting alkali metal salt with concentrated sulphuric acid in a presence of catalyst \. Name any salt where each of the following can be prepared
    1. Bromine
    2. Chlorine
    3. Iodine
b. Sate two properties of halogens
c. Draw the electron shell diagram for a fluorine atom ($^{19}_{9}F$)
d. i. arrange the $^{127}_{53}I$, $^{35.5}_{17}Cl$ and $^{80}_{35}Br$ in order of increasing reactivity
   ii. Explain difference in reactivity of elements in 2 d .i
e. State any chemical properties of sulphur
f. Explain with the aid of diagram why rhombic sulphur is more stable that monoclinic sulphur

2007
Question 5

a. Table 1 shows the atomic number and electron configuration of some elements

Element	Atomic mass	Electron configuration
A	18	2,8,8
B	10	2,8,
C	20	2,8,8,2
D	12	2,8,2
E	2	2
F	9	2,7

    i. Identify element that comes from period 2
    ii. Which two element can form positive ions
    iii. Give a reason for your answer 5a. ii
    iv. Give one property of element A

2008
Question 1

a. Element x has a mass of 39 amu and atomic number 19
    i. How many protons are in the atom
    ii. What would happen if element X react with water
    iii. Give a reason for you answer to a. ii. above
b. Magnesium and chlorine can be represented as $^{24}_{12}Mg$ and $^{35.5}_{17}Cl$ respectively
    i. What are the valences of magnesium and chlorine
    ii. What is the molecular formula of the compound formed as result of magnesium reacting with chlorine

c. Draw the dot and cross diagram of carbon dioxide (CO_2) given that carbon is in group 4 and oxygen is in group 6 of the periodic table
d. What type of bonding exist in carbon dioxide
e. Give a reason for your answer in 1 d above
f. Table 1 show the melting points of metals, A ,B ,C and D

Table 1

Metal	Melting point
A	240
B	3370
C	1539
D	120

i. Which metal would be suitable for filament of the bulb
ii. Give a reason for your answer to 1.f. i.

g. Sulphuric acid (H_2SO_4) is used as hydration agent.
i. Name the products in the hydration of sucrose ($C_{11}H_{22}O_{11}$)
ii. Give four uses of sulphuric acid

200 9
Question 1

a. Define the electron configuration
b. Figure 1 is a graph of atomic radius across the period against the number for some element in the periodic table
i. To which group of the periodic table does element O belong
ii. Give a reason for your answer to bi.
iii. Why there s a sudden increase in atomic radius from F to Na?
iv. In term of atomic radius explain why they is a difference in reactivity between F and Cl
c. (i) .Mention two use of sulphur
ii. Give two physical properties of sulphur
d. Table 1 shows the number of valence electron and valence of some elements

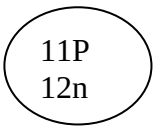
Element	Number of valence electron	Valence
Li	1	1
Be	2	2
N	5	3
O	6	2

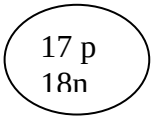
i. How element N can attains stable electron configuration?
ii. Give a reason for your answer
iii. What is the formula of the compound that is formed between Li and O
iv. Give a charge of Be

2010

a). (i) State the three properties of metals
ii. Explain why potassium is more reactive than sodium

b. Figure 1 shows a diagram of atomic number and mass number elements R and Q





i. Write the electron configuration of element R and Q
ii. To which period and group of the periodic table does the element R belong

iii. Draw a dot and cross diagram of the compound that would be produced when R react with Q

c. Explain why helium, which has 2 valence electron is taken as a group 8 element
d. State any two use of sulphates

2011
Question 4

a. State three ways how atoms attains stability
b. Explain how ionic bonds are formed
c. Table 1 shows the atomic number of boiling points of some element represented by letters D, Q, T , X and Z

Table 1

Element	Atomic number	Boiling point
D	3	1342
Q	13	2467
T	16	445
X	18	-186
Z	19	760

i. Identify any two letter represent element which belong to period n3 of the periodic table
ii. Which element is in gaseous state at room temperature (25˚C)?
iii. What type of bonding would exist when element Q react with element T
iv. Write down the chemical equation for the reaction that would occur between D and T.

2012
Question 6

a. The table below shows electron configuration of elements R,S T, U and V.

Element	Electron configuration
R	2,7
S	2,8,6
T	2,8,2
U	2,4
V	2

i. Which element in the table belongs to period 2 of the periodic table?
ii. Give a reason for your answer
iii. Give a pair of elements that would form an ionic compound when they react
iv. Draw an electron dot and cross diagram for the compound formed when S combine with U

b. State any three physical properties of halogens
c. Explain what happens id chlorine is mixed with potassium bromine solution

FORCE AND MOTION

VECTOR AND SCALARS

SCALARS
Scalars are quantities with magnitude only without direction

Example of scalar quantities
Charge, Energy, Frequency, Length, Mass, Power, Pressure, Speed , Temperature, Time, Volume

Vectors
Vector quantities that have both magnitude and direction

Examples of vector quantities
Acceleration, Displacement, Electric field , Electric current, Force , Magnetic flux density, Moment, Momentum, Torque, Velocity, Weight

Presentation of vectors
Vectors can be represented using the following ways

1. By using a line with an arrow. The arrow point to direction of the vector and should be proportional to the magnitude of the vector quantity

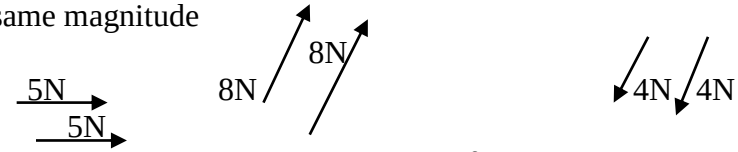
2. By using a bold face letters

3. By using a letter with an arrow on top of the letters E.g $\overrightarrow{AB}$
4. Using small letter **a** $\rightarrow$

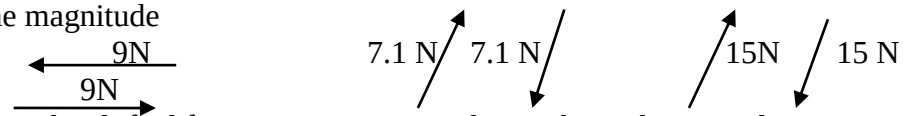
PROPERTIES OF VECTORS

1. Property of equality: Vectors are said to be equal if they are pointing in the same direction and have the same magnitude

Example



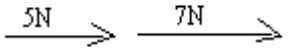
2. Negative property : Two vector are opposite if they are pointing in the opposite direction and have the same magnitude



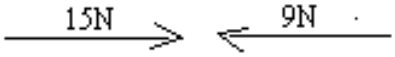
3. Vector can be shifted from one point to another without changing direction
4. Parallel property: Two vectors are parallel if they are pointing in the same direction and are equidistant from one another
5. Vector can be multiply or divided by the scalar quantity
6. Vectors can be added or subtracted

ADDITION OF VECTORS

Vector lying in the same plane pointing in the same direction or opposite direction can be simply added

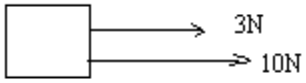
Example1 

7N + 5N = 12 N

Example2 

15N- 9N = 6N

Note that in this example vector are pointing in opposite direction we need to subtract to get the resultant vector

Example 3 

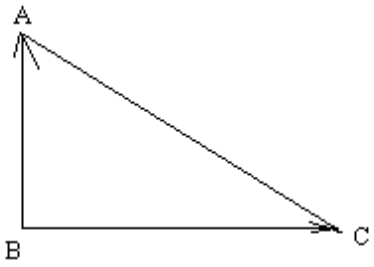
3N + 10N = 13N

ADDING VECTOR AT AN ANGLE

Using Pythagoras theorem

This method is used to add vector that act at right angle to each other .

The Pythagoras theorem state that the sum of the square of opposite side is equal to the square of the third side (the hypotenuse side)



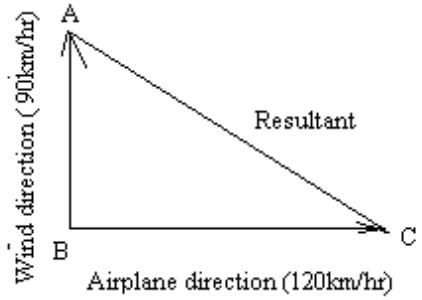
$AB^2 + BC^2 = AC^2$

T he direction is given by using the angles deviated from the horizontal

Example.

Find the resultant when the air plane flies due to east and a velocity of 120 per hr and is heading wind that is traveling at velocity of 90km per hour to the north direction

First draw the diagram



Using Pythagoras

$$AB^2 + AC^2 = BC^2$$
$$90^2 + 120^2 = BC^2$$
$$8100 + 14400 = BC^2$$

$BC^2 = \sqrt{12500}$

BC = 150 km /hr

To find the direction of the resultant use tan x = 90/120

$$\text{Tan } x = 0.75$$

$$\text{Tan}^{-1}\ 0.75$$

$$= 36.9 \text{ degrees}$$

Therefore the airplane will travel at a velocity of 150 km/ hour at a direction of 36.9 degree

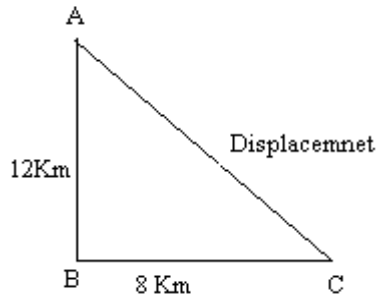
By scale drawing / graphical method

A Suitable scale is used to calculate the resultant of the vectors acting an angle

Examples

Cyclists traveling due to south 12km from point A and later turn east and travel a distance of 8km. Find the shortest distance and direction where the cyclist from the starting point.

Let our scale be 1 cm represent km on the a paper



Length of 12 km on a paper is 3cm

Length of 8km on the a paper is 2cm

A

Draw AB as follows

Then draw BC

Join the point A and C

To find the resultant

Measure AC using a ruler and multiply the value with the scale

Measure angle BAC to find the direction of the cyclist

NB this method works better when you are adding vector that are acting at an angle of 90 degrees

Triangle Rule Tip to Tip

This is the method where one vector comes on the head of another vector to from a triangle

Step to follow when doing triangle rule

Step1. First draw the 9 N vectors to a scale using the ruler.

Step2. Shift the 6N vector so that it tail lies on the head of 9N vector and

Step 3. Then draw vector so that the head is on head of the 9N and the tail is on 4N

NB tail ⟶ head of vector

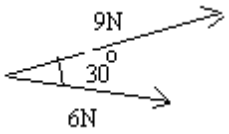
Parallelogram rule

It state that if two force are acting at a point are represented in the size and direction by the side of the parallelogram drawn from the point , their resultant is represented in the size of the direction by

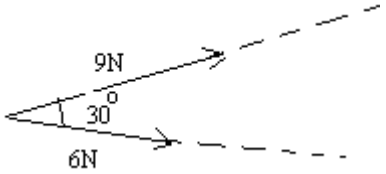
the diagonal of the parallelogram drawn from the point

vector are used as the side of the parallelogram and complete the parallelogram and draw vectors from the tail to head and measure the length and convert using the scale

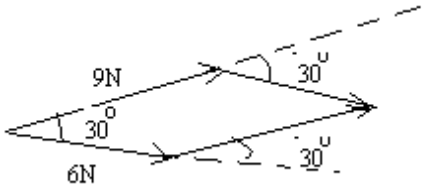
Example
Find the resultant of the following vector



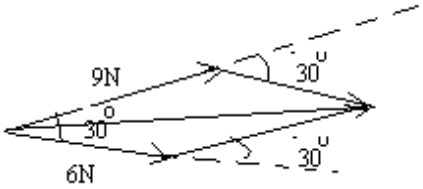
First choose the suitable scale for example 1cm to represent 3N
Draw two vectors to a scale using a ruler at an angle of 30˚



Mark off length of each vector
Complete the parallelogram with the adjacent side

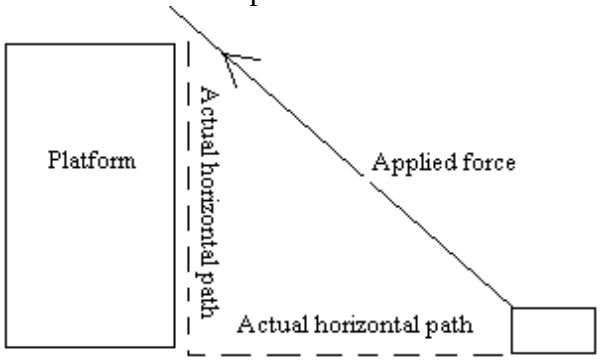


Like
Draw the diagonal from point you started



Measure the diagonal

RESOLUTION OF VECTORS
When you are pulling the object at and angle the object move horizontally until it reaches where you are and later raises up



It shows that the they are two forces that act on the object that is being pulled at angle e.g. the

horizontal and vertical force. These two forces are called vector components

They are two vector components the horizontal component and vertical component.

In resolution of vector these two components are determined.

HOW TO RESOLVE VECTOR

They are two ways how vector can be resolved.

Graphical method and buy using trigonometric ratios

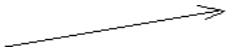
To find the components use the following formulas

GRAPHICAL METHOD

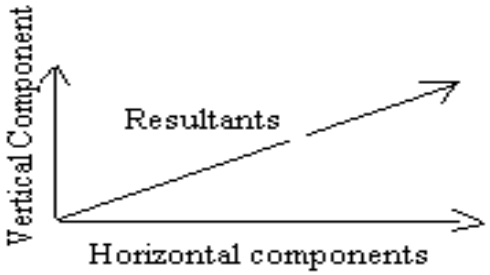
Parallelogram rule can work in reserve.

The single vector act as the diagonal of the parallelogram. To resolve follow the following steps

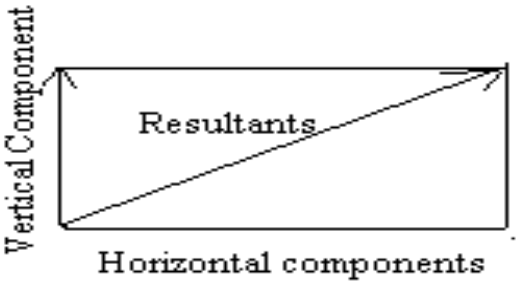
1. Draw the given vector to scale which will act as the diagonal



2. Draw two lines that should be perpendicular to each other from the origin of the vector like



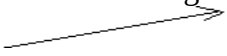
3. Draw another two lines so that you complete the diagram to form a parallelogram like this



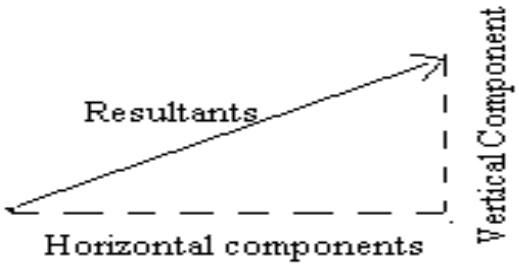
4. Measure the length of the vertical line to fine the magnitude of the vertical components of the vector and the horizontal line to fine the magnitude of the horizontal vector component

By using a triangle rule

1. Draw the single vector to act as the hypotenuse of the triangle like follows



2. Draw a line to scale from the origin of the vector. Draw another line to complete the triangle by it should act at right angle from the end point of the first line to meet the tip of the vector. Like this

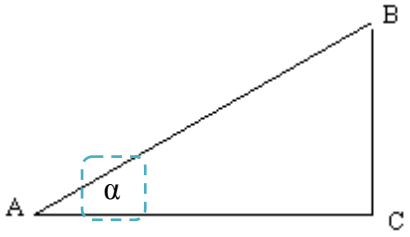


3. Measure the length of the line draw. The vertical represent the vertical component while the horizontal represent the horizontal component.

Resolving by calculation using the trigonometric Ratios

Trigonometric ratios can be used to find the magnitude of the components of the vector if one angle is given.

Consider the right angled triangle below



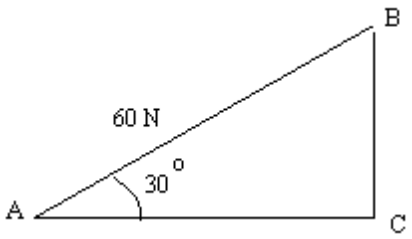
Cos α = Adj/ Hyp
Cos α= AC/ AB

AB Cos α = AC

and
Sin α = OPP/ HYP
Sin α = BC/ AB
AB Sin α = BC

But AB is the resultant vector R , BC is the vertical component and AC is the horizontal component
Therefore
R Sin α = vertical component
R Cos α = Horizontal component

Example
A force of 60N is at an angle of 30 degree to the horizontal . Find the perpendicular vectors



Vertical vector =R sin 30
60 sin30
60 x 0.5

30 N

Horizontal vector = Rcos30

60 x 0.8660

1.1.1.1.51. 9615 N

52N

Example 2

Resolve the following vector into their vectors component

a) 

b). 45N 

Horizontal component = 20 Cos 90

= 20 x0

= 0

Vertical components = 20sin90

= 20x1

= 20

Horizontal components = 45Cos180

= 45x1

= 45N

Vertical components = 45Sin180

= 45x0

= 0

NB. Perpendicular vertical vector has no horizontal components this is a reason why the body just move upwards when you are pulling at 90 degree angle and the vertical component is equal to the vertical vector likewise the horizontally lying vector.

LINEAR MOTION

Distance and Displacement

Distance is the actual path length traveled by a body and is scalar quantity while displacement is the shortest distance or the straight line distance in a particular direction

Speed and Velocity

Speed is the rate of change in distance with time while velocity is the rate of change of displacements

Mathematically speed = $\frac{\text{distance covered}}{\text{time taken}}$

s = d/t where d is distance covered and t is time take

Velocity = $\frac{\textbf{D}\text{isplacement}}{\text{time taken}}$

Example. A millipede moves a distance of 7m in 3,5 s. what its average speed?

Answer .

Speed = d/t

= 7m /3 = 2 m/s

Acceleration

It is the rate change in velocity

Acceleration = $\frac{\text{change in velocity}}{\text{time taken}}$

$a = \frac{(v-u)}{t}$ where v is the final velocity and u is the initial velocity and t is time taken

Example. A cyclist increase her velocity from 8m/s to 14m/s in 3 seconds. Find the acceleration of the cyclist

a = (v-u) /t
= (14 – 8)/3 = 6/3 = 2m/s/s

Example 2 ; a car traveling at 30m/s changes its speed suddenly to 5m/s in 5seconds find ite acceleration?

a = (v-u)/t
= (5-30)/5
= -25/5
= -5m/s

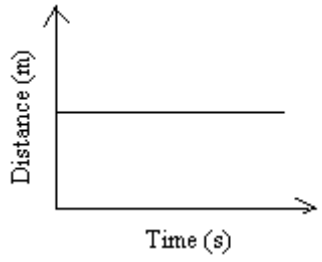
NB: Acceleration is positive if the object increases speed and is negative if the cyclist reduce speed. Negative acceleration is called ***deceleration***or ***retardation***

MOTION GRAPHS

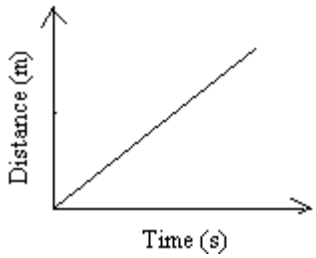
Motion of object can be represented on the graph. The pattern of the graph can tell the type of the motion taken by the object

DISTANCE - TIME GRAPHS

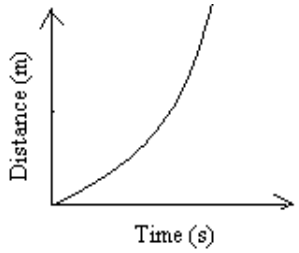
Graph of stationery object



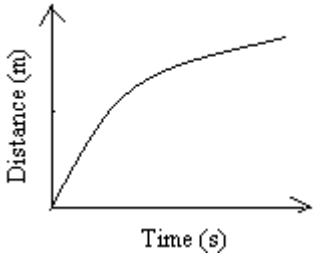
Graph of object moving at constant speed



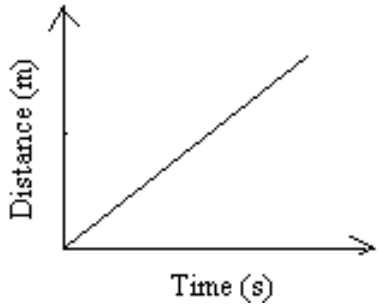
Graph acceleration object



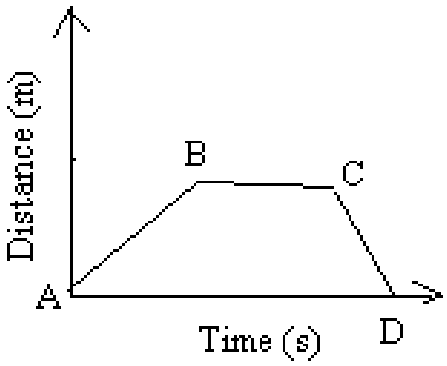
Graph of deceleration object



Speed from distance time graph



INTERPRETATION OF DISTANCE TIME GRAPH



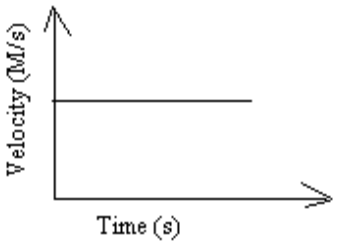
Part of the graph	Interpretation
AB	The object move with constant speed
BC	The object was are rest (stop)
CD	Change direction. It was going in the opposite direction it turn back

From graph B we can see that distance is directly proportional to time taken

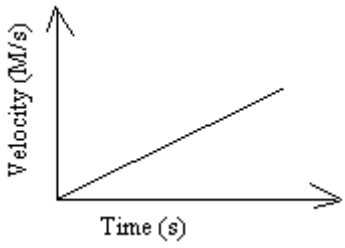
Mathematically S t
S = Vt where V
Proportional constant
Slope of graph line
Speed of object
Distance traveled per unit time

SPEED - TIME GRAPH

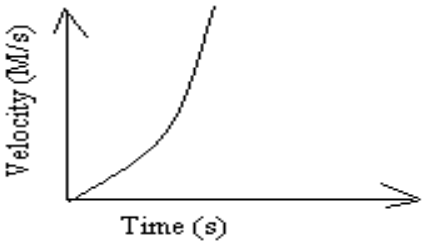
Graph of object moving at constant speed



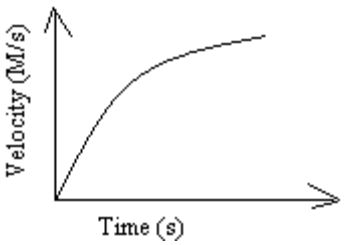
Graph of object moving at constant acceleration



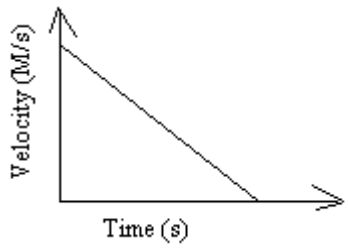
Graph of object moving at variable Acceleration



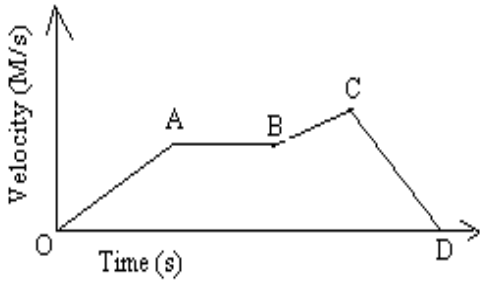
Graph of object moving at variable deceleration



Graph of object moving at constant deceleration



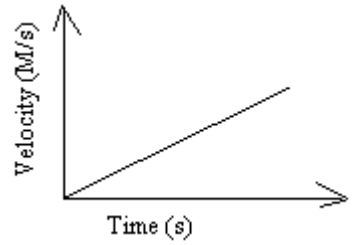
Interpretation from Speed -time graph



Interpretation

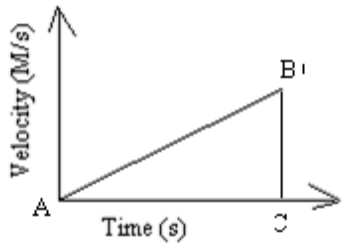
Part of the graph	Interpretation
AO	Constant acceleration
AB	Constant velocity , zero acceleration
BC	Constant acceleration
DC	Deceleration

SLOPE OF SPEED- TIME GRAPH



From graph speed(V) is directly proportional to time taken
V = at where **a**
is the change in speed
Proportional constant
Acceleration of object
Speed per unit time

AREA UNDER SPEED TIME GRAPH

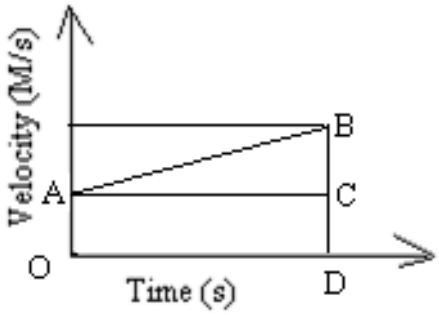


Area of triangle ABC = ½ (base x height) = ½ AC x BC
But from the graph AB = time (t) and AC is speed (V)

Substituting in the formula of area of triangle we get area of triangle = ½ (v x t)

But speed multiply by time is distance covered
Therefore Distance (S) = ½ (v x t)
S= ½ vt
NOTE: The area under speed-time graph is equal to the distance traveled

Acceleration formula



IMPORTANT EQUATION FROM SPEED -TIME GRAPH

S= ½ vt
S= ½ (u+v)t
average speed V = (v+t) /2
a = (v-u)/t
$S = ut + ½ at^2$.

Total distance = area under the graph line
but are of trapezium = ½ (sum of parallel sides x perpendicular distance)
Area = ½ (OA+ DB) x OD
But AO = u , DB = v and OB = t
Then area = ½ (u+v) t
but area is distance S
Therefore S= ½ (u+v)t

Arranging the equation S/t = (u+t)/2
and S/t is average speed. Therefore average speed is ½ (U+V)

We know that the area of the triangle is ½ (vt)
But v= at
substitute V for at we get $½ at^2$. ….....1
But the area of the rectangle is L x B where L is the time taken and B is the initial speed on the object according to the above graph
Area = ut----------2
combining 1 and 2 we get
$S = ut + ½ at^2$.

Example.
A boy runs from the rest down the slope 50 m long. The time take to reach the eand point was 10second.
a). Calculate the boys average speed
b). What was the boy's speed at the end of 10 seconds

Average speed = total distance /time
V = 50/10 = 5m/s

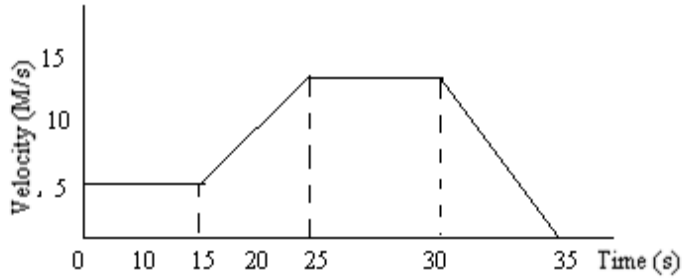
Average speed at the end of 10s = $\frac{\text{final speed + initial speed}}{2}$

$V = \frac{v+u}{2}$

but the initial speed is zero
therefore $5 = \frac{v+0}{2}$

2x5 = v
v = 10 m/s

Example 2
Below is speed- time graph of motorist



Find total distance covered by the motorist
Divide the graph as above for simple calculation and later add the area of each segment

Area section A is the same as area of rectangle
Distance = 5x 15 = 75m

Distance for segment B = ½ (5+10)5 = 50 m
Distance for segment C = ½ (15+ 10) 10 = 75m

Total distance = 75 +75 +50 = 200m

LINEAR MOTION EQUATION

We know that acceleration = $\frac{v-u}{t}$

$a = \frac{v-u}{t}$ or v = u +at ..... equation 1

Average velocity = $\frac{\text{displacement}}{\text{time taken}}$

$V = \frac{u+v}{}$ or S/t or $S = \frac{(v+u)t}{}$ ..... equation 2

2 2

If we substitute equation one in into equation two for v

$$S = \frac{[u + (u+at)]t}{2}$$

$$= \frac{(u + u + ut)t}{2}$$

$$= \frac{ut + ut + ut^2}{2}$$

$$= \frac{2ut + ut^2}{2}$$

$$= 2ut/2 + ut^2/2$$

$$= ut + ½ ut^2$$ …..... equation 3

Rearranging equation one we get $t = (v-u)/a$

substituting in equation 2

$$S = \frac{(u+v)}{2} \times \frac{(v-u)}{a}$$

multiplying both side with 2as

$2as = (v+u)(v-u)$

$2as = v^2 - u^2$

$v^2 = 2as + u^2$

Example.

A car starts at rest and reaches the velocity of 30m/s in 5 minutes. Assume that the acceleration was constant, calculate:

a) The acceleration of the car
b) The distance covered in this time interval

Solution

First list what have been given to know the best equation you can use

$u = 0$ (at rest), $V = 30m/s$, $t = 5$ minutes, $a = ?$, $S = ?$

a). $= (v-u)/t$

$= (30 – 0) /5$

$= 6m/s/s$

b). $S = ut + ½ at^2$

$= 0x5 + ½ x6x5^2$

$= 0+75$

$= 75m$

Example 2. A cyclist moving a speed of 15m/s accelerates at 2m/s/s for 30 seconds. She then traveled at constant speed for 40 second and finally decelerate uniformly at 4m/s /s and stops. Find the maximum speed and total distance covered by the cyclist

Solution

There are three stage taken by the cyclist:

first stage:

u = 15m/s , a = 2m/s/s , t = 30 s s =? v = ?

v= u+ at = 15m/s + 2m/s/s x 30 = 15m/s+ 60m/s = 75m/s

Distance covered in first stage

S = ut +½ at

= 15x 30 + ½ x2x 30 x30

= 450 + 900

= 1350m

Second stage

v= 75m/s t = 40s

S = vt

= 75x 40

= 3000m

Third stage

u= 75m/s , v = 0 a = - 4m/s/s

$v^2 = 2as + u^2$

$s = \frac{v^2 + u^2}{2a}$

$= \frac{0 + 75 \times 75}{2 \times -4}$

= 5625 /-8

= 703.125m

Total distance covered = 703.125 + 3000+ 13500

= 5053.125

NEWTON LAWS OF MOTIONS

Newton First Law of Motion

It states that a body will remain at rest or continue to move at constant speed in a straight line if there is no unbalanced force. Or a body at rest will remain at and a body moving at constant speed will do so at straight line provide that the they no any external force acting on it

Implication of the first law

a) Force is something that is capable of changing the state of rest or the uniform speed of the body
b) Matter has inbuilt resistance to change its state of motion
c) An external force is needed to change the state of rest / motion of the body
d) For the body to be at rest or at uniform speed the resultant force should be equal to zero
e) If the body has zero acceleration either the body is at rest or at constant speed

The tendency of the body to maintain its state of rest or uniform speed in a straight line is called ***inertia***

NEWTON SECOND LAW OF MOTION

It is also called the law of acceleration because it describe the motion of body when unbalanced force act on it

It states that the rate of change of momentum of a body is proportional to the resultant force or the rate of change in acceleration of the body resulting from an applied force is proportional to that force and inversely proportional to the mass of the body

Implication of second law

The law indicates that force can be measured by multiplying the acceleration of the body for the known mass

F = mass x acceleration
= 1kg x 1/s/s
= 1kgm/s/s
= 1 N

I Newton is the force that cause a body of 1 kg to accelerate 1m/s/s

Application of the second law

example1.

A horizontal force of 20N is applied to the mass of 2kg on frictionless surface. Find the acceleration of the body

F= ma
a = F /m
a = 20/2kg
= 10m/s/s

A body moving at 20m/s along a straight line is brought to rest after traveling 40 m. find the breaking force if the mass of the body if 15kg

First find the acceleration of the body

$$a = \frac{u^2 - v^2}{2s}$$

$$a = \frac{0 - (20 \times 20)}{2 \times 40}$$

$$= -\frac{400}{80}$$

$$= -5 m/s/s$$

f= ma
= 15 x 5
= 75N

Momentum and Newton second law

Momentum is
The ability of the body to move ahead or forward
To keep on going
Having enough movement, or push

Factor affecting the momentum of the body

Amount of velocity
Mass of the body

Momentum = mass x velocity
M= m x v

We know that the acceleration = $\frac{\text{change in velocity}}{\text{time}}$

$a = \frac{(v - u)}{t}$

But from Newton's second Law

F = ma where m is the mass of the object and a is the acceleration of the body.

Substituting a with (v-u)t in Newton second law we get equation (F = Ma)

$F = m\left(\frac{(v - u)}{t}\right)$

$F = \frac{mv - mu}{t}$

From equation above we can say force is the rate of change in momentum since (Mv – Mu) is change in momentum of the body that is moving.

Example

A lorry of mass 20000kg is traveling at 30m/s. The driver apply brakes and the lorry stops after 5 s. find the average braking force

$F = \frac{mv - mu}{t}$

$= \frac{20000(0-20)}{5}$

$= -80000$ N

Rearranging $F = \frac{mv - mu}{t}$

$Ft = mv - mu$

From the rearrangement we can say that Ft is rate of change in momentum called the impulse and is measured in Ns

Application of Newton second law and momentum

1. Crumple zone in cars to safeguard passengers.
2. Seatbelt to reduce time taken by stretching to reduce time of collision
3. Air bag on the steering wheel which protect the driver

NEWTON THIRD LAW OF MOTION

It states that every action there is an equal opposite force of reaction

IMPLICATION OF THE THIRD LAW

1. Force act in pair as a result of the interaction of the bodies

The reaction and action force are equal in magnitude and opposites in direction and they act on different bodies

The force is created irrespective of motion

From the third law we can say

$F_1 = F_2$

But $F = \frac{mv - mu}{t}$

$F.t = mv - mu$

Ft is known as impulse or rate of change

In momentum since they are equal and oppose force

The impulses of opposite forces should be the same after collision

Law of conservation of momentum

It state that when two bodies act on each other , their total momentum stays the constant if no out side force act on it .
Total momentum before collision = total momentum after collision

$m_1v_1 = m_2v_2$

Example 1
A bullet of the mass 10g and traveling at velocity of at velocity of 100m/s hit the wood having a mass of 1kg. Find the final velocity of wood after collision

Answers
$m_1v_1 = m_2v_2$

$\frac{10g \times 100}{1000} = \frac{1000 \times v_2}{1000}$

$v_2 = 1000/1000$

$v_2 = 1m/s$

Example 2
Two bodies A and B are going in opposite direction. A has a mass of 5kg and is traveling at velocity of 3m/s while B has a mass of 3kg with velocity of 2m/s/s. Accidentally the collide to each other and stick to each other. Find the final velocity after collision

Solution
Velocity 3m/s Velocity 2m/s

Before collision
Momentum of body A = 5kg x 3m/s = 15kgm/s
Momentum of body B = 3kg x 2m/s = 6kgm/s

Total momentum = Momentum of body A – Momentum of body B
Total momentum = 15kgm/s- 6kgm/s
= 9kgm/s

After collision
Total mass of the body = 8kg
Total momentum before collision = Total momentum after collision

Mv = 9kgm/s
8kg x V = 9

$v = \frac{9kgm/s}{8kg}$

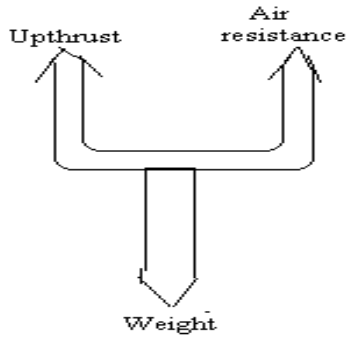
v = 1. 125m/s

Application of the third law
The jet and jet engine are designed I such way that it produces the gas which travels backward pushing the rocket forward

Falling bodies

When an object is falling there are two force act on the object
Air resistance
Weight

Air resistance or up thrust force pushes the object upward while weight pushes the object downwards



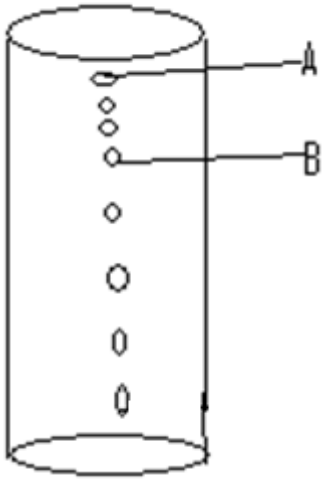
At first they are two unbalanced force, the object accelerate. The weight of the object is greater than the upward force, up thrust. W eight > Up thrust

At sometime the two force balance each other upward force is equal to down force (weight = up thrust force) . At this point the object move at constant speed and it is called***Terminal Velocity****until* it lands on the ground

Factor that affect speed of free objects

1. **Size of object**: Large object has small terminal velocity because the air resistance s always greater that the it mass. Small object has high terminal velocity because their surface area is small which make air resistance or retardation force to be small
2. **Weight of object**: Light object experience high resistance and has very small terminal velocity compared to heavy objects which accelerates longer distance
3. **Medium:** Some medium has little resistance eg in vacuum and air. While liquid with large molecules has high resistance which make the object move very slowly

Falling in liquids



From the surface of liquid (from point A) the object will accelerate until it reaches B . the object will accelerate because there is unbalanced forces acting on the object.

The weight of the body which is acting downward is greater that the upward force which is exerted

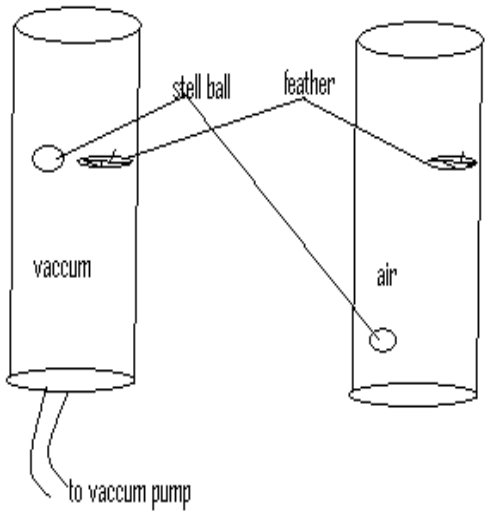
friction of the liquid and the up thrust.
Up thrust + friction force < Weight of the ball
U+ Fr < W

From point B to the bottom of the container the object will move with the constant speed until it reach the base of the container. During this period the weight is equal to the sum of the upthrust force and the friction force exerted by the atoms of the liquid.

Like
Upthrust + friction force = weight
U + Fr = W
NB the following factor affect the motion of the object in liquids
1. Viscosity, liquids which are viscous exert large friction force compared to liquids which are not viscous. In viscous liquid the object get its constant velocity very late while in
2. Initial speed of the object in the liquid
3. Size of the object

Free falls
It is the falling of the object due to force of gravity without any external influence such as up thrust , weight air resistance

Falling in vacuum
If a feather and steel ball is through to pass through the vacuum.



The speed will be the same because the upthrust force and friction force is negligible compared in air. No friction force will be exerted on the two body hence they will move on the same and reach the constant speed once they are in vacuum space

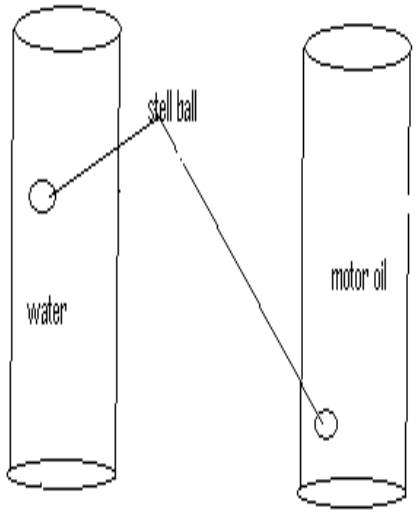
While if a fetcher and a steel ball fall in container with air the steel ball will land fast that the feather.

This so because the feather will experience more fiction force or the upward force is greater that the downward force causing the feather to move very slowly.

There is great downward force acting on the steel ball that the upward force hence it will land fast than the feather.

Falling in different liquids

To show that different liquids has different resistivity or to show that media affects the speed of the object falling in liquids set you apparatus as follows



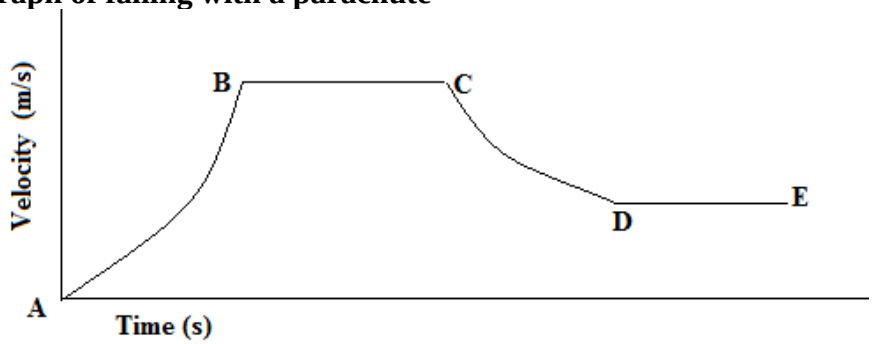
Using transparent jars of the same size and identical ball bearings throw the two ball bearing at the same time and observe which one will land first.
The one that will land first has low resistance while the one will land last has high resistance.
On the above experiment oil has high resistance therefore it will land last and water it will land first.

Falling with parachute

Once the parachutist has jumped from the airplane, with the parachute unopened.

The parachutist accelerates because they are two unbalanced forces acting on her.
Like up thrust + friction < weight
U + Fr < W
Later get her constant velocity because the two force are balanced like
U + Fr = W
When the-parachute is opened she decelerates because the are two unequal balance force. The upward force is greater than weight because the parachute trap air that will reduce her speed.
Like U + Fr > W
This makes the parachutist to decelerate
Later the parachutist will gain a new constant velocity lower that the first one which make him to land safety

Graph of falling with a parachute



Between A and B the paratuchist accelerate because there is tow un balanced forces , weight is greater that up thrust force since the parachute is un open .

Between B and C the parachutist gain a constant speed since thre is two balance force acting, the weight is equal to up thrust force.

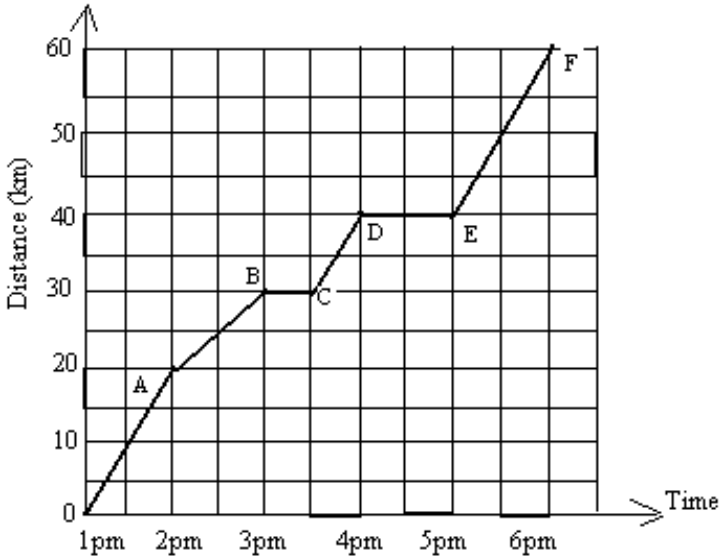
Between C and D the parachutist decelerate when the parachute is open the upthrust force is greater than weight .

Between D and E the parachutist gain constant speed until landing since upthrust is equal to weight

Exercise

2003

1. b. Figure2 is distance – time graph for cyclist. Use it to answer the question that follows



i. What is the total distance travelled by the cyclist
ii. How long it will take the cyclist to cover the distance?
iii. Describe the motion of the cyclist from 20Pm to 4:30 pm?
iv. Calculate the average speed of the cyclist during the first 2hours of the journey

c. state whether "distance " is a scalar or vector quantity . give a reason for your answer.

2004

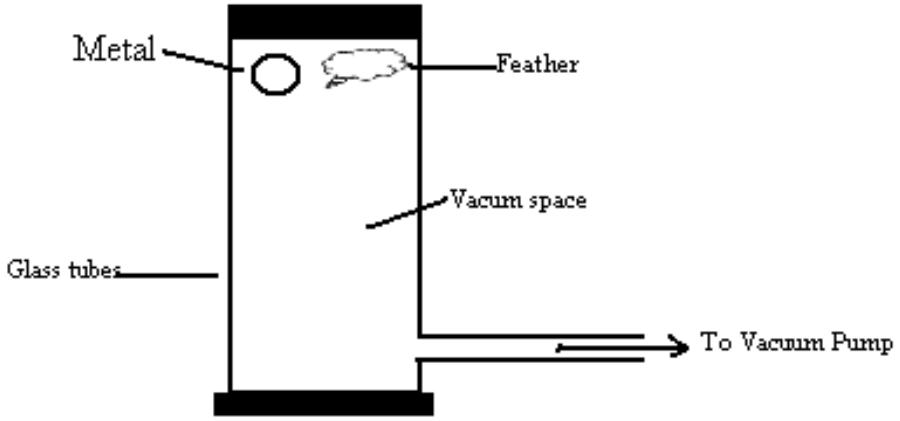
Question 8

a. Explain how you can find the speed of an athlete
b. State two sources of errors in 8a.

2005

Question 4

a. Forces of 40N and 50N are acting at right angles. Draw to scale the diagram to find out the resultant force. (Use 1 cm to represent 10N)
b. Figure 3 is a diagram showing a set up in an experiment that was carried out to investigate how a feather and a metal would fall in a vacuum



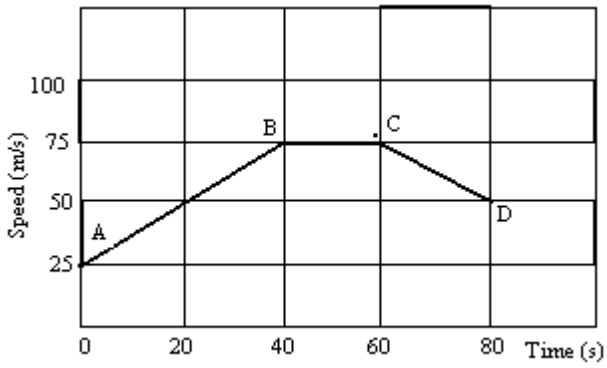
i. Name the resultant force acting on the ball
ii. State the direction of the resultant force
iii. If the feather and the ball wre allowed to fall at the same time. Draw the diagram to show the position
iv. Explain you answer to b. ii. Above.

2006
Question 6
a. Define acceleration
b. The speed of runner dropped from 80m/s to 60m/s in 4 second
   i. Calculate the average deceleration of the runner
   ii. If the runner maintained the deceleration in 6b.i. After how long did the speed reach zero

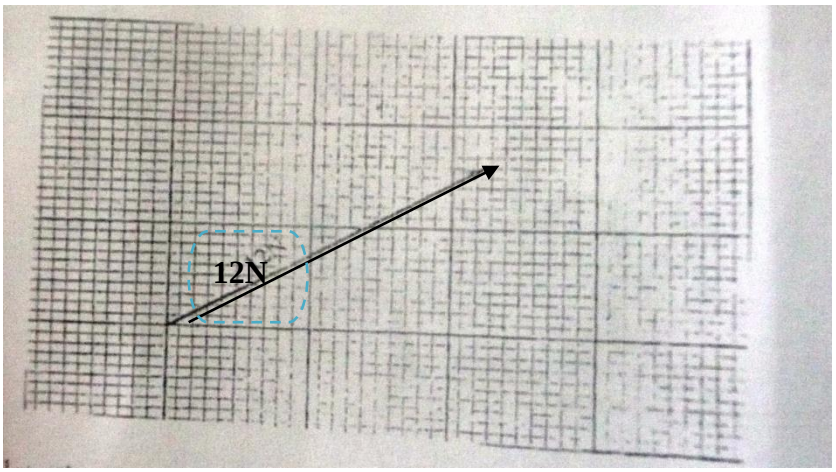
Question 8.
a. A metal ball released on the surface of lubricating oil in a tall glass tube. Explain changes in velocity as it falls through the bottom of the tube
b. Derive the formula that that pressure of the liquid depend on its density and depth

Question 4 PPII
Explain how you can find the density of cooking oil given empty clear and water

2007
a. Figure b3 shows a sped time graph of car in motion



i. Describe the motion of the car from point A to D
ii. Calculate the distance covered when the car moves from point A to B
b. Figure 4 shows the resultant of two forces

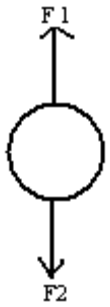


i. Complete the diagram to show the vertical and horizontal components
ii. Calculate magnitude of the horizontal components

2008

Question 6

a. State two factors that affects the terminal velocity of free falling in air
b. Figure 6 is a diagram showing an object falling at terminal velocity. F_1 and F_2 are forces acting on the object



i. Name the force F_1 and F_2
ii. What would be the relationship between magnitude of F_1 and F_2 at terminal velocity
iii. State the Newton second law of Motion.

c. An object of mass 2000kg accelerate uniformly from rest to a velocity 20 m/s in 4 seconds . calculate
i. Acceleration of the object
ii. Force required to produce the acceleration in 6c.i.

Question 4 PPII

a. Describe and experiment that could be carried to determine the average speed of a an athlete given the following materials: tape measure, stop watch and a whistle
b. State two source of errors

2009

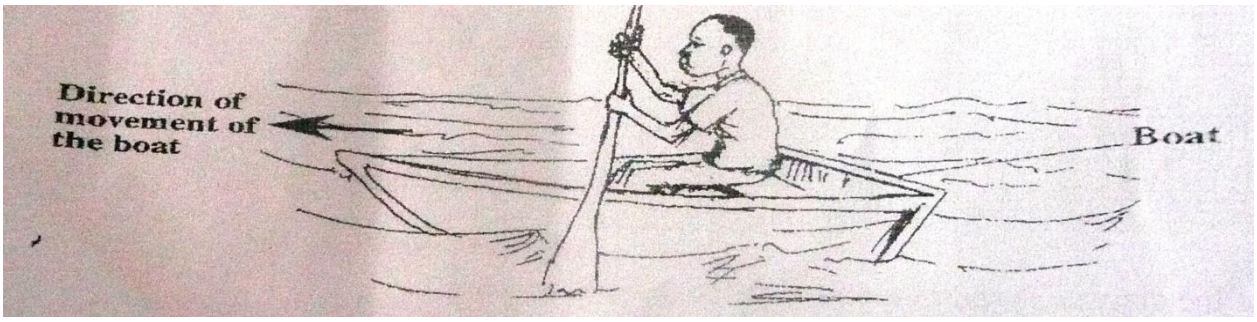
Question 6

a. Define resultant vector
b. Why the speed a scalar quantity while velocity a vector quantity?
c. Two forces of magnitude 240N and 240N are being used to pull a boat at and angle of 60˚ to each other. Find the resultant force using a scale diagram (use 1 cm to represent 100N)

2010

Question 3

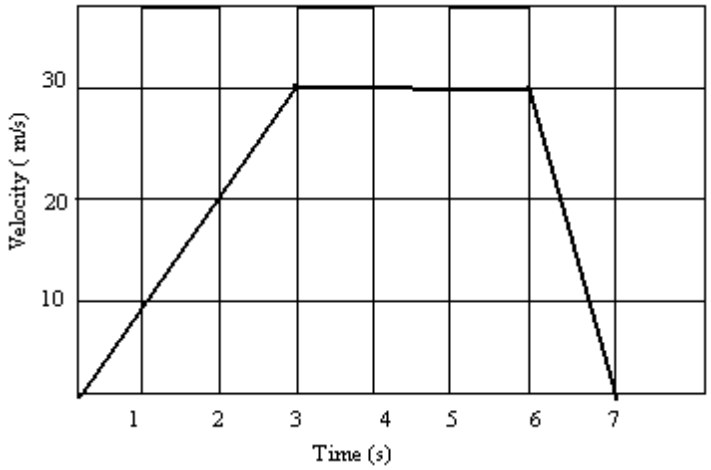
a. Mention any two examples of scalar quantities
b. Explain how vectors are represented on a paper
c. Figure 3 is diagram showing rowing of a boat on a lake



i. Explain how rowing cause the boat to move
ii. Which Newton's law of motion is demonstrated in this diagram?

2011

a. What is meant by free fall of an object
b. State forces acting on the object in air
c. Figure 1 is a velocity time graph showing a journey made by a cyclist



Calculate the average sped of the cyclist

2012
Question 7

a. State Newton's third law of motion
b. Give two properties of vector quantities
c. Mention one method of adding vectors acting at angles to each other.
d. A car decorates at the rate of 3m/s/s for 5 minutes. If the initial speed is 20m/s , calculate the final speed

ORGANIC CHEMISTRY

This is the study of chemistry of the compound that are finding in living organism. This include all compounds with carbon atoms in their molecular structure excluding simple ones like carbon dioxide, carbon monoxides and carbonates

All compound that contain carbon atom are known as organic compounds

Why carbon form many compounds

Carbon has valence of four and can therefore form four bonds. Carbon atom can join up with other carbon atoms to form long chains of carbon atom inside molecules of different compounds. It form skeleton where

other atoms are attached.

TYPES / CLASSES OF ORGANIC COMPOUNDS
They are categorised depending of the type of atoms attached to it. There are three classes and these are
Hydrocarbons
They contain carbon and hydrogen atoms in their molecules . Their main source petroleum. Hydrocarbon are obtained from petroleum by fractional distillation

Types of hydrocarbons
They are two types of hydrocarbon
Aliphatic hydrocarbons
Are hydrocarbon that do not contain a benzene ring in their molecular structure
Examples include Alkanes, Alkene and alkynes
Aromatic hydrocarbons
They contain benzene ring in their molecular structure
Examples is arenes ,
Oxycarbons:
They contain oxygen in their molecular structure Examples include ,alkanols, aldehyde, ketone , carboxylic acids
Nitro carbons
They contain nitrogen in there structures. Example include amines

HOMOLOGOUS SERIES
It is the collection of organic compound with similar properties and related formulae and structures.

PROPERTIES OF HOMOLOGOUS SERIES
All homologous series has the following properties

1. Functional group: the determine the physical and chemical properties of members of the homologous series
2. General formula: it is used to determine the formula of different members in the homologous series
3. Common nomenclature: this is the system of naming of homologous members

It use the following prefix

Number of carbon atoms	Prefix
1	Meth-
2	Eth-
3	Prop-
4	But-
5	Pent-
6	Hex-
7	Hept-
8	Oct-
9	Non-
10	Dec-

4. Difference among successful members: in all homologous series they have a difference of -CH2- between successful members
5. Increase in size: moving along each homologous series, size and masses of the molecular increases, strength of IMF increases
6. Chemical properties: all members have the same chemical properties.

ALKANES

It belongs to hydrocarbon and contains hydrogen and carbon atoms only

It has no functional group and contains only single bond of C-H and C- C only. This makes Alkanes not to be reactive or to be inert because they have strong intermolecular forces and strong covalent bonds

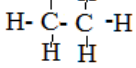
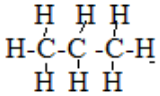
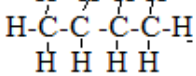
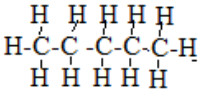
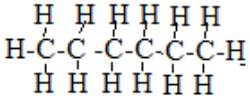
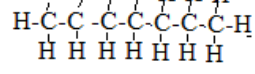
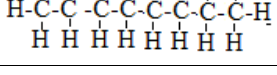
The general formula for Alkanes is C_NH_{2N+2}. Where N is the number of carbon atoms. This is used to calculate formulae of Alkanes

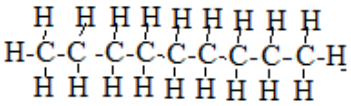
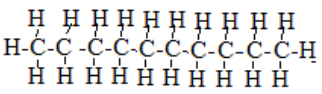
Examples: Find the molecular formula for Alkane with 5 carbons

C_NH_{2N+2} substituting N for 5 it becomes $C_5 H_{(5X2)+2}$ then the formula is $C_5 H_{12}$

System of naming

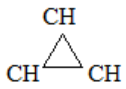
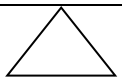
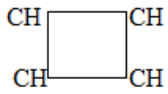
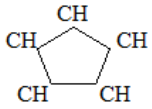
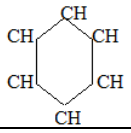
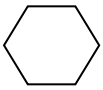
It has the same prefix with other homologous but the suffix is -ane

No Of C	Formula	Structure formulae	Name
1	C_1H_4		Methane
2	C_2H_6		Ethane
3	C_3H_8		Propane
4	C_4H_{10}		Butane
5	C_5H_{12}		Pentane
6	C_6H_{14}		Hexane
7	C_7H_{16}		Heptane
8	C_8H_{18}		Octane

9	C_9H_{20}		Nonane
10	C10H22		Decane

CYCLOALKANES

They have the general formulaCNH2N. The carbon atoms form a ring. The system of naming is the same but cyclo is added to corresponding Alkanes name e.g. cyclo-propene

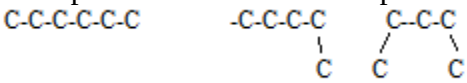
Name	Structural formula	Molecular formula	Symbol
Cyclopropane		C_3H_6	
Cyclobutane		C_4H_8	
Cyclopentane		C_5H_{10}	
Cyclohexane		C_6H_{12}	

ISOMERISM OF ALKANES

Conformations

Conformations are compounds with the same molecular formula and structure formula

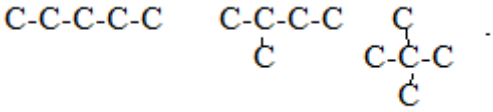
Examples of conformation of pentane



NB Conformation has different shapes but when stretched the form the same shape

Isomers

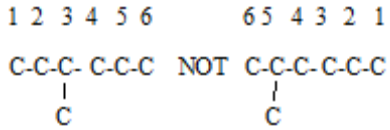
Isomers are compounds with the same molecular formula but with different molecular structures, examples of pentane isomers



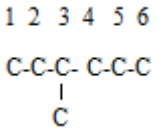
RULES TO BE FOLLOWED WHEN NAMING ISOMERS

1. Locate or number the carbon chain with longest carbon atoms or the parent chain. Numbering should start to nearest first junction in the parent chain.

Example



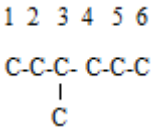
2. Count the number of the carbon in the parent chain to give the basic name for example



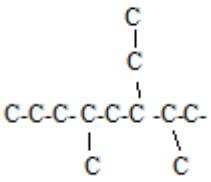
I has six carbon the basic name is hexane

3. Name any group attached to the parent chain using the following prefix and state the number on the junction

Prefix	Structure
Methyl	$-CH_3$
ethyl	$-C_2H_5$
propyl	$-C_3H_5$
butyl	$-C_4H_9$
Pentyl	$-C_5H_{11}$



The branch is on carbon 3 and it has i carbon atom , the branch name is methyl
Name of the isomer is 3 methyl hexane
the
Example. h
Name the following isomer



Answer : 4-ethyl -1,5dimethyl octane

NB .

1. If they are more that one branches arrange them in alphabetical order.
2. If the are two or more similar branch use the following prefix

No of branch	Prefix
2	Di
3	Tri
4	Tetra
5	pent

Physical properties of Alkanes

Alkanes has the following physical properties

1. They have low Melting and Boiling points . Smaller Alkanes are gases at room temperature while other are liquid at room temperature . The Mpts and Bpts increase as the chain increase or size of the molecule increases which increases IMF
2. They have low density compare to other organic compounds
3. They are insoluble in water and are soluble in other organic solvent like carbon tetrachloride
4. They have love viscosity compared to other organic compounds

Chemical Properties

Since Alkanes are saturated they are nonreactive but they react with substance that are reactive them self E.g oxygen and radical

Combustion of Alkanes

They burn in air with clean, luminous, non sooty flame to give carbon dioxide and water. It absences of enough air it undergo incomplete combustion. Flame is need to initiate the reaction

Complete combustion

It produces hot blue flame used for cooking

Alkanes + oxygen $\longrightarrow$ carbon dioxides + water

$2C_2H_6 + 7O_2 \longrightarrow 4\ CO_2 + 6H_2O$

Incomplete Combustion

It gives yellow flame in candles and lamps

$2C_2H6 + 3O_2 \longrightarrow 4\ C + 6H_2O$

NB : A flame is needed to initiate the combustion reaction of Alkanes since it increases the kinetic and speed of the molecules which make the bond to be broken during collision and start reaction

Substitution Reaction of Alkanes with Halogen

Ultra violet light rays are need to break the bonds in the halogens to initiate reaction. The reaction produces a haloalkane

Substitution reaction with chlorine

Ultra violet light rays breaks the bond between the Cl-Cl to initiate the reaction. The Cl radical are very reactive and substitute the hydrogen atom from the Alkanes and produce chloroalkane .

For examples.

$CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$ the product is a mono- chloro-methane

The reaction can go further to produce dichloromethane

$CH_3Cl + Cl_2 \longrightarrow CH_2\ Cl_2 + HCl$

If chlorine is in excess the reaction can go further to produce trichloro-methane ($CHCl_3$) and later tetrachloro-methane (CCl_4)

NB; trichloro-methane is mostly used in hospitals as anesthetics. All halogen can undergo similar reaction as a chlorine.

Halo- alkanes has the same physical and chemical properties as Alkane burn they do not burn in air

Nitrification of Alkanes

Alkane reacts with concentrated nitric acid at high temperature of 300 degree Celsius to produce nitro ethane and water

$C_2H_6 + HNO_3 \longrightarrow C_2H_5NO_2 + H_2O$

PREPARATION OF ALKANES

Fractional distillation of crude oil

Crude oil as different liquids that are separated by fractional distillation. First gaseous alkanes are released and later liquid and finishing with solids

CRACKING

Long chain are broken down into small chains and more useful one

TYPES OF CRACKING

Thermal crackling/pyrolysis

This is achieved by heating the long chains to the temperature of 140 degree Celsius and 700 degree Celsius.

Long chain $\longrightarrow$ smaller chain Alkanes + Alkanes and hydrogen

Ethane used in polymerisation is produced in this way

Catalytic cracking

Long chain Alkanes are passed over a catalyst on the temperature of 450 to 500 degree Celsius

Long chains $\xrightarrow{\text{catalyst}}$ Smaller chain Alkanes + alkenes and hydrogen

Bio gas generator

Animal manure and straw are allowed to decay an aerobically to produce methane gas which can be used for cooking

Laboratory preparation of methane gas

Methane is prepared by heating sodium ethanoate and soda lime

$CH3\ COONa\ (s) + NaOH\ (s) \longrightarrow CH_4 + Na_2CO_3\ (s)$

Uses of Alkanes

1. Used as fuel in motor vehicles eg gasoline
2. Used in cooking eg methane gas
3. Used in gas welding
4. Used for lighting purposes
5. Used as lubricants
6. Used as waxes
7. Halogenoalkanes are used as solvents in paint stripper

ALKENES

They belong to hydrocarbon. They contain hydrogen and hydrogen atoms only.

Alkene has C=C (carbon -carbon double bond) as its functional group .

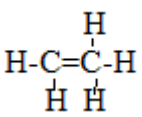
They are unsaturated hydrocarbon because of the presence of the double bond since other atoms can be added across the double bond to become saturated.

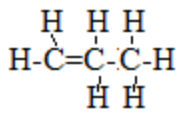
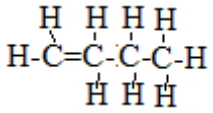
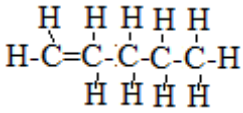
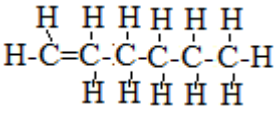
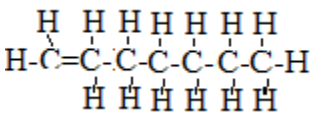
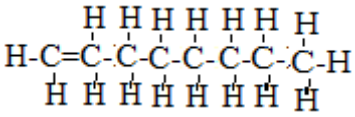
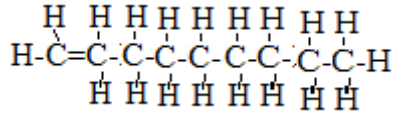
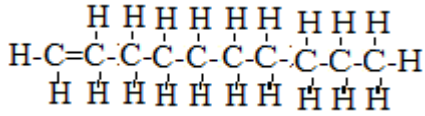
Their general formula is C_NH_2N

Because of the presence of the double bond the smallest Alkene is ethene with two carbon atoms.

System of Naming Alkenes

It is the same as Alkenes but it only differs on suffix where it ends with -ene

No Of C	Formula	Structure formulae	Name
2	C_2H_4		Ethene

3	C_3H_6		Propene
4	C_4H_{18}		Butene
5	C_5H_{10}		Pentene
6	C_6H_{12}		Hexene
7	C7H14		Heptene
8	C8H16		Octene
9	C9H18		Nonene
10	C10H20		Decene

NB: according to IUPAC rules the position of the double bond should be included in the name
Start numbering from the near where there is a double bond

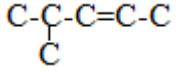
Example -C=C-C-C-C-C-C-C-C-C- dec-1-ene
C-C-C=C-C-C- hex-3-ene
C- C-C-C=C-C-C- hept-3-ene

Isomers of Alkanes

In isomer of Alkene the position of the double is included in the name

Examples

C=C-C-C-C Pent-1-ene
C-C=C-C-C pent-2-ene



2methyl but-2-ene

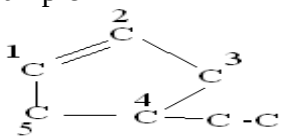
NB In molecule with functional group numbering should start to point nearest to functional group

PHYSICAL PROPERTIES OF ALKENES

1. They have low melting and boiling points like Alkanes and smaller Alkenes are gases are room temperatures
2. They have low density
3. They are insoluble in water

Compounds with two functional group of Alkenes are referred as **alkadiene**s while these with three functional group are referred as **alkatrienes**
The prefix di, tri are used to should the number of the functional group present
Example
C-C=C-C=C-C Hex -1,4 -diene
C=C-C-C=C-C=C-C Oct-1,4,6-triene

Cycloalkane
They are Alkene with ring and double bond
To name cyclo Alkanes the ring should be numbered so that the double bond is given number of 1 and 2 The direction of numbering is chosen so that the substitute receive the lowest number
Example



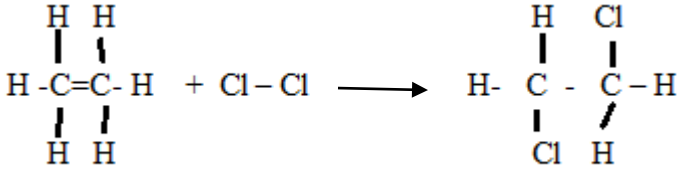
4 ethyl3methyl cyclopentene
NB The position of the double bond is not include because the position is already know to be 1 and 2

CHEMICAL PROPERTIES OF ALKENES
Combustion
Alkane burn with a sooty flame because they are unsaturated and contain more carbon atoms to hydrogen ratio.

Complete combustion
Burn with hot blue flame forming carbon dioxide and water
Ethene + oxygen $\longrightarrow$ carbon dioxide and water
$C_2H_4 + 3O_2 \longrightarrow 2\,CO_2 + 2H_2O$

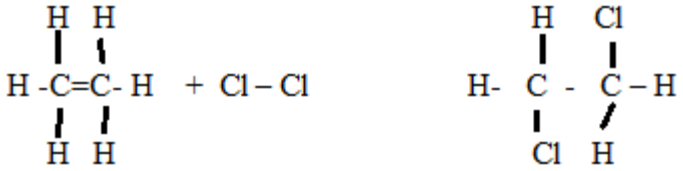
Incomplete combustion
It burn with yellow cooler flame and produces carbon or carbon monoxides
$C_3H_6 + 3O_2 \longrightarrow 3\,CO + 3H_2O$

ADDITIONAL REACTION
Because of the presence of the double bond Alkene molecule makes them to undergo additional reaction where on of the double bond breaks and other atoms can be added across the double bond.
Additional reaction with halogens
Bromine and chlorine instantly decolourising when added to Alkene. This shows that bromine and chlorine are added across the double bonds.



1,2 dichloroethane ($C_2H_4Cl_2$)

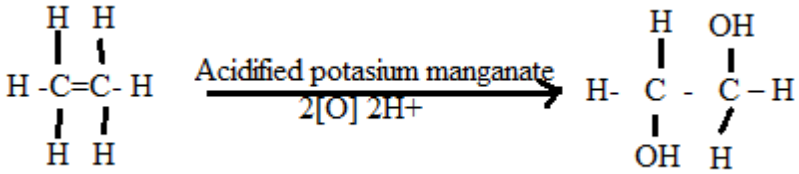
With bromine



1,2 dibromoethane (($C_2H_4Br_2$)

Addition with potassium manganate (VII)

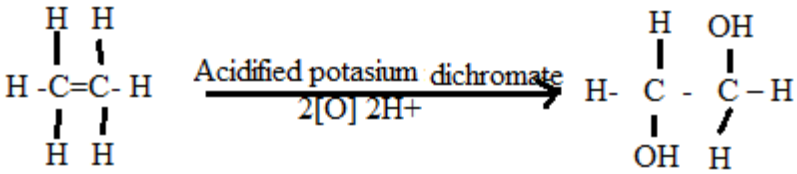
When added to Alkene, acidified potassium manganate(VII) change from purple to colourless .
Potassium manganate act as an oxidation agent adding oxygen across the double bond



Etha-1,2-diol

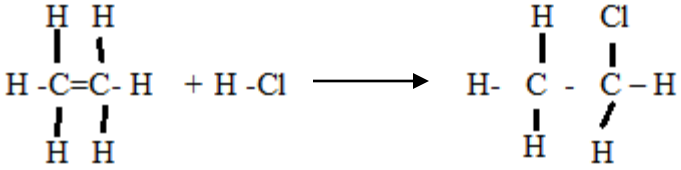
With Acidified potassium dichromate (VI)

It changes from orange to green. It acts as oxidising by adding oxygen across the double bond.



Addition of hydrogen chloride

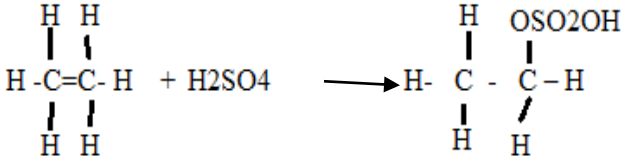
The additional occur instantly across the double bonds



chloroethane

Concentrated sulphuric acid

When concentrated suphuric acid bulbed in alkene it is added instantly on the double bond

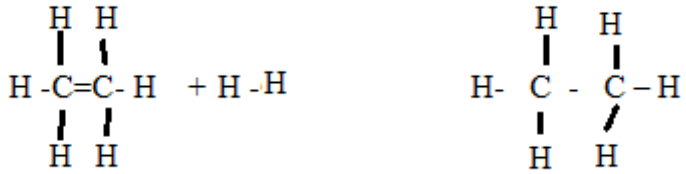


(Ethyl hydrogen sulphate ($C_2H_3CH_2\ SO_4\ H$)

Addition of Hydrogen (Hydrogenation)

The reaction takes place using a nickel catalyst under high temperature ranging from 140 to 400 degree

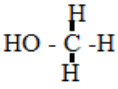
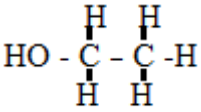
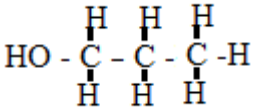
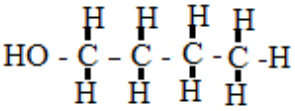
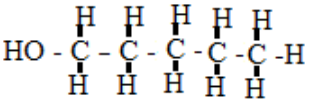
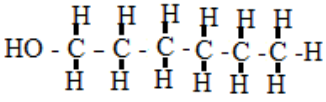
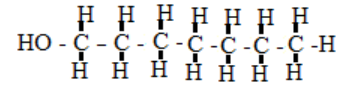
Celsius to break strong bond in hydrogen molecule to form corresponding alkanes

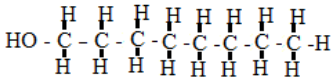
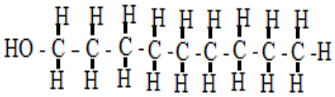
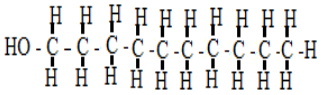


Preparation of Alkene
They are prepared by cracking of Alkanes

Test for Alkenes
Chlorine water, bromine, acidified potassium dichromate (VII) , potassium chromate can be used to test the presences of Alkenes because they is a change in colour during the reaction
Few drop of each is added to test tube contain samples. For example to test the presence of alkenes using bromine solution, add 5 drops of bromine solution to 15 drops of samples or unknown liquids.

ALKONOLS
They belong to oxycarbons and they contain -OH (hydroxyl group) as their functional group The General formula for the alkanols is $C_NH_{2N+1}OH$
System of Naming of alkanols the naming system is the same but the end name is -anol

No Of C	Formula	Structure formulae	Name
1	C_1H_3OH		Methanol
2	C_2H_6 OH		Ethanol
3	C_3H_5OH		Propanol
4	C_4H_9OH		Butanol
5	$C_5H_{11}OH$		Pentanol
6	$C_6H_{13}OH$		Hexanol
7	$C_7H_{15}OH$		Heptanol

8	$C_8H_{17}OH$		Octanol
9	$C_9H_{19}OH$		Nonanol
10	$C_{10}H_{21}OH$		Decanol

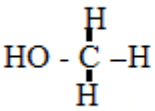
Classes of alcohols

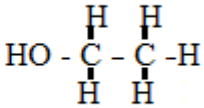
They classified to the position of the functional group (hydroxyl group) is attached in the molecule

Primary alcohols

The hydroxyl group is attached to carbon atom with two other hydrogen attached

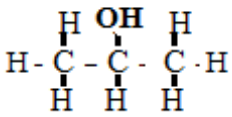
Examples





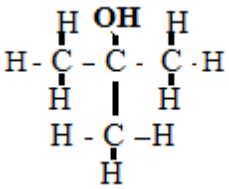
Secondary alcohol

The hydroxyl group is attached to carbon attached to two carbon atom and one hydrogen atom attached



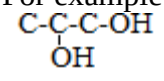
Tertiary alcohol

The hydroxyl group is attached carbon no other hydrogen is attached, it is attached to carbon attached to other two three carbons

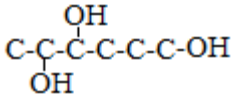


NB: alkanols with two functional group are called alkadiol while with three function group are called alkatriols

For example :



propan1,2 diol

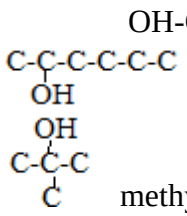


Hexan-1,4,5 triol

ISOMERISM IN ALCOHOLS

Alkanols from propanol going down the group has more that one structure

Example of isomer of butanol



Physical Properties of Alkanols

Due to presence of OH which give to rise of hydrogen bonding and stronger intermolecular forces alkanols has the following physical properties

1. Smaller alkanols are liquid at room temperature
2. They have high melting and boiling points
3. They are more viscous than Alkane and Alkene an these with more than one -OH are more viscous
4. Smaller alkanols are soluble in water but large alkanols from pentanol are insoluble while butanol is partially soluble

Chemical Properties

Combustion

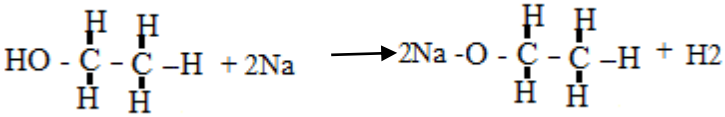
Alkanols burn completely in air because in their molecule they already oxygen

$2C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$

Reaction with sodium

The reaction produces hydrogen gas and sodium ethoxide

Ethanol + sodium $\longrightarrow$ sodium ethoxide + hydrogen gas



Reaction with ethanoic acid – Esterfication

The reaction takes place on the presence of concentrated sulphuric acid to initiate the reaction

Ethanol + ethanoic acid $\longrightarrow$ ethyl ethonoate (ester)+ water

$C_2H_5OH + C_2H_3COOH \longrightarrow C_2H_3COOC_2H_5 + H_2O$

REACTION WITH ACIDIFIED POTASIUM DICHROMATE (VI)

EXPERIMENT

Oxidation of ethanol to ethanoic acid by acidified potassium dichromate

Materials

Ethanol

Potassium dichromate (VI) 2 molar

Dilute sulphuric acid

A test tube in a rack

2 dropers

Syringes 5 ml

Test tube holder

Burner and matches

Thermometer

Procedure

a. Put about 5ml of potassium dichromate 2 m solution into a test tube
b. Add 2ml of dilute sulphuric acid

c. Warm the mixture to about 50Cby putting the test tube onto burner
d. Add 1 ml ethanol to tube using a syringe
e. Leave the test tube standing for same time about 5 minute and observe any changes

Results
Potassium dichromate solution turns green from orange
Conclusion
This show that ethanol has been oxidised. Potassium dichromate acts as oxidising agent for ethanol. Ethanol is oxidized in two stages
In the first stage ethanal is produced

C_2H_5OH $\xrightarrow{\text{acidified potassium di chromate}}$ C_2H_3CHO
Later is oxidize to ethanoic acid
$C_2H_3CHO \longrightarrow C_2H_3COOH$
In general
Primary Alkanol $\longrightarrow$ Aldehyde as intermediate effect $\longrightarrow$ carboxylic acid

Reaction with Concentrated Sulphuric Acid – Dehydration

The reaction produces ethene since water is removed from the molecule. The reaction can be ether partial dehydration to form an ether or complete dehydration to produce ethene
$C_2H_5OH \longrightarrow$ Ethene + H_2O

NB: The relative size of –OH determine the flame colour, speed of reaction and solubility in water
The colour change from blue to yellow, the reaction slow down and the solubility decrease because as the size of the molecule increase the relative size of OH decreases compared to the hydrocarbon chain

Uses of alkanols (Ethanol)

1. They are used as motor vehicle fuel blending agent eg ethanol
2. Used in manufacturing of ethyl ethanoate and ester for fruit flavoring for sweets and drinks
3. As a solvent
4. In manufacturing of cosmetics
5. Is used as fuel for motor vehicles
6. As a social drink

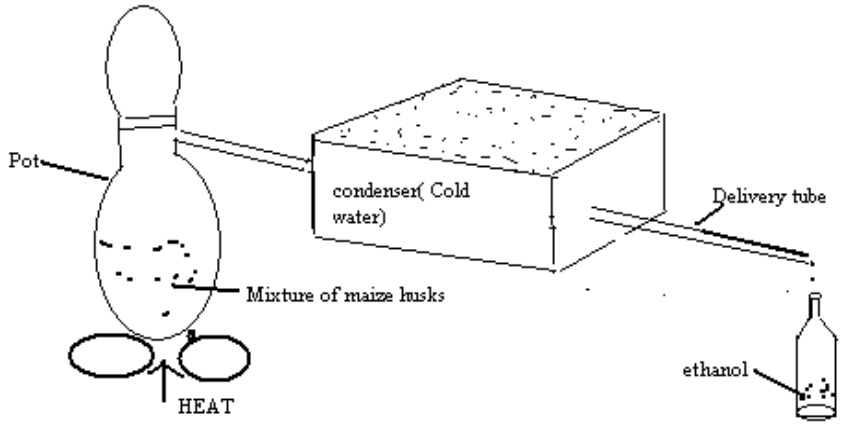
Test for Alkanols
They are two tests for alkanols
Solubility test where water is used to test smaller chain alkanols and sodium test where a small piece of sodium is plugged into a solution of Alkanols

PREPARATION OF ETHANOL
They are two ways how ethanol can be produced
By fermentation of sugar and dehydration of ethene from petroleum

FERMENTATION OF SUGAR
Fermentation is the process in which sugar and starch are decomposer anaerobically by bacteria and yeast in process producing ethanol and energy. Bacteria produces a enzyme called sucrase which convert sucrose to glucose /fructose .
Sucrose + bacteria $\longrightarrow$ glucose + fructose
Yeast produce the enzyme called Zymase which convert Fructose / Glucose to Ethanol and Carbon dioxide
Glucose $\xrightarrow{\text{Yeast}}$ Ethanol + Carbon dioxide + energy

Ethanol is prepared my fermenting sugar with yeast.

The mixture of ethanol and maize husk is later undergo distillation process to produce ethanol



Hydration of Alkene

Ethene is mixed with a steam of water and is passed over a catalyst . Ethene is hydrated in the process whereby a water molecule is added across the double bond to produce ethanol.

The product solution of water and ethanol is separated by fractional distillation

Why Production of Ethanol from Starch is Preferred that Hydration of Alkenes

The following are reasons

1. It uses renewable resources like corn and sugarcane while hydration uses oil which is non-renewable resource.
2. It is good ways to use waste organic material like maize husks.
3. It uses cheap local available materials.

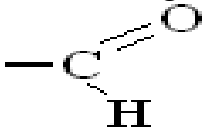
Disadvantage

i. Large volume is need to produce a litre of ethanol
ii. It is slow compare to hydration of ethene
iii. It does not produce pure ethanol compared to ethanol produced from hydration of ethene

CARBOXYLIC ACIDS

They are oxycarbons because they contain oxygen in their molecule.

Their functional group is carboxylate (-COOH)



Their general formula is $C_NH_{2N-1}COOH$

In carboxylic acid number of a carbon is equal to N-1 because one of the carbon atom is attached to the functional group.

For example

Write the molecular formula of carboxylic acid with N = 6

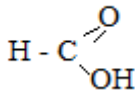
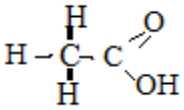
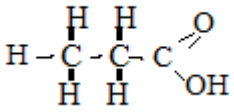
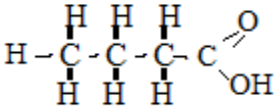
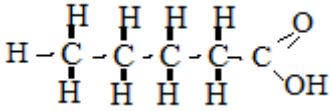
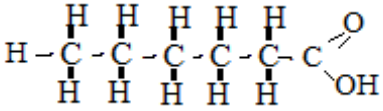
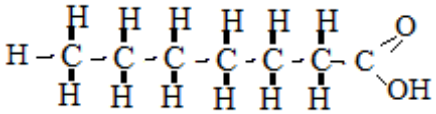
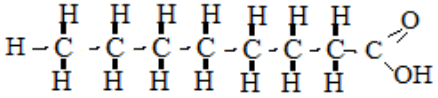
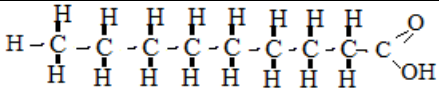
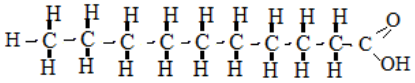
Since one carbon is in the functional group N = 6-1 = 5

The formula for that compound is $C_5H_{2x5}COOH = C_5H_{11}COOH$ and the name is Hexanoic acid

System of naming

Like other homologous series the prefix is the same but the suffix is -anoic acid

No Of C	Formula	Structure formulae	Name	

0	H COOH		Methanoic acid	
1	CH_3COOH		Ethanoic acid	
2	C_2H_5COOH		Propanoic acid	
3	C_3H_7COOH		Butanoic acid	
4	C_4H_9COOH		Pentanoic acid	
5	$C_5H_{11}COOH$		Hexanoic acid	
6	$C_6H_{13}COOH$		Heptanoic acid	
7	$C_7H_{15}COOH$		Octanoic acid	
8	$C_8H_{17}OH$		Nonanoic acid	
9	$C_9H_{19}COOH$		Decanoic acid	

Natural source of carboxylic acids

1. Citrus fruits example acetic acid
2. Milk
3. Vinegar
4. Anti bite
5. Tomatoes
6. Human sweat

Uses of carboxylic acid

1. In textile processing
2. Grain preservative formic acid
3. Additive to bread making calcium propanoate
4. Additive to butter butanoic acid
5. As food preservative eg benzoic acid

Physical properties of carboxylic acids

Due to presences of Carboxylate as functional group which give the carboxylic acid strong intermolecular forces and hydrogen bonding. The strong intermolecular forces and the hydrogen bonding tend to pull the molecule more closer to each other carboxylic acid has the following are physical properties

1. The highly soluble in water
2. They are solid room temperature
3. They have high density
4. They have high viscosity
5. They have high melting point and boiling points

Note :

Small carboxylic acid exist as liquid while large one exist as solid at room temperature because they have strong intermolecular forces and the hydrogen bonding tend to pull molecules closer to each other hence the liquid and solid state while alkanols the intermolecular forces are pull electron closer top each other but no like as in carboxylic acid hence most opf them exist as liquid at room temperature.

Alkane and alkenes they solely depend on weak intermolecular forces as which fails to pull molecules closer to each other hence the gaseous state.

Carboxylic acid has the highest melting and boiling point because it has strong intermolecular forces called hydrogen bonding that need a lot of energy to break them compared to alkanols, alkanes, alkenes.

Hydrogen bond is bond that is formed when hydrogen is bonded to most electronegative atom like oxygen, fluorine , nitrogen. Hydrogen bond are stronger than intermolecular force but they are weaker that chemical bonds.

In carboxylic acid oxygen pull electron toward itself as a result around oxygen tend to partially negative.

Carboxylic acid tend to form two hydrogen bonds while alkanols forms a single hydrogen bond

CHEMICAL PROPERTIES OF CARBOXYLIC ACIDS

Acid reaction

They are weak acids and they donate H+ from the functional group

$C_2H_5COOH + NaOH\ (aq) \longrightarrow C_2H_5COONa + H_2O(l)$

Ionization of water

Carboxylic acid ionises water and give a pH value less than 7 which is acidic condition

$C_2H_3COOH + H2O \longrightarrow C_2H_3COO^- + H_2O + H+$

CONDUCTIVITY OF CARBOXYLIC ACIDS

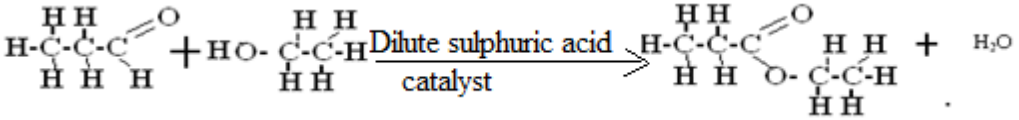
Because carboxylic acid ionise in water it conduct electricity compare to Alkanols, Alkene and Alkanes which does not ionise in water.

React with alkanols (esterfication)

The reaction takes place on the presence of dilute sulphuric acid to initiate the reaction

Ethanol + ethanoic acid $\xrightarrow[\text{catalyst}]{\text{dilute sulphuric acid}}$ ethyl ethonoate (ester)+ water

$C_2H_5OH + C_2H_3COOH \xrightarrow[\text{catalyst}]{\text{dilute sulphuric acid}} C_2H_3COOC_2H_5 + H_2O$

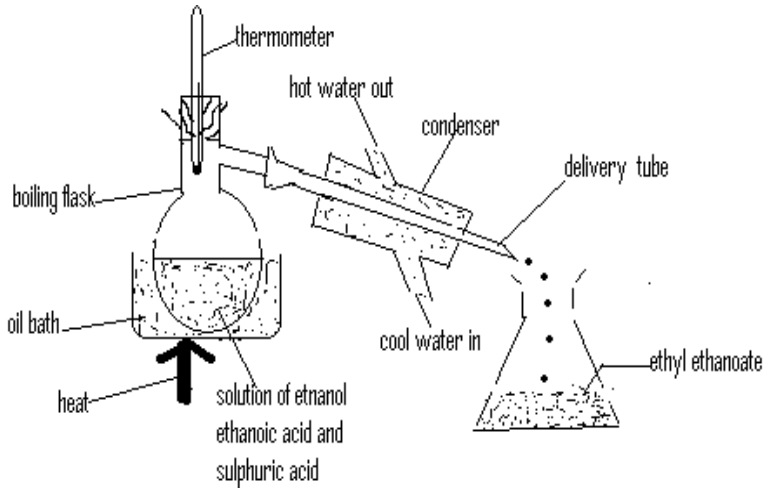


NB: Esterfication is the process of preparing esters by reacting alcohol/ alkanols with carboxylic acids

How ethyl ethanoate is prepared

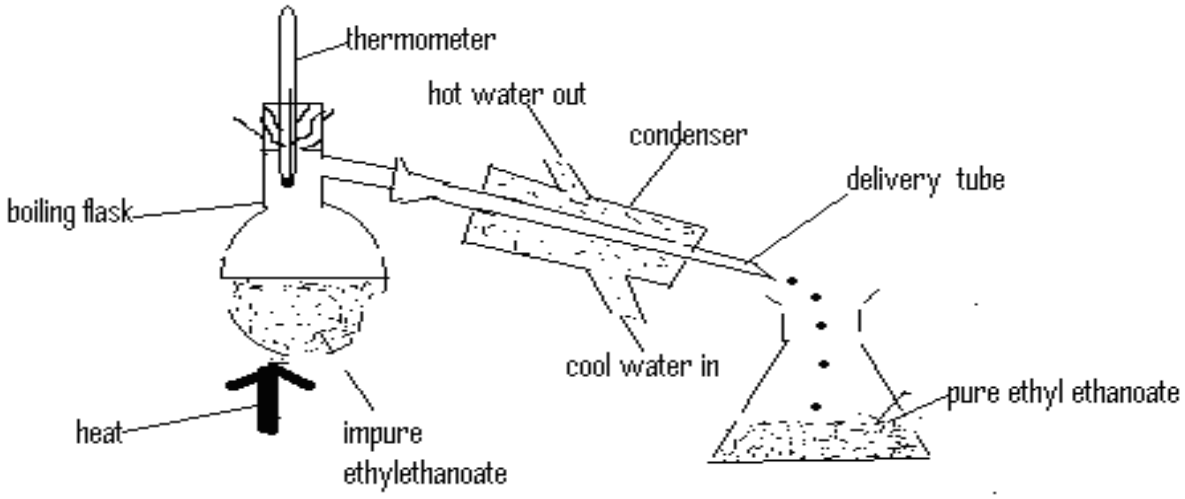
It is prepared by reacting ethanol with ethanoic acid in dilute sulphuric acid.

Using the distillation apparatus the mixture is distilled to produce ethylethanoate.



The reaction is reversible and is at equilibrium the distillate contain excess ethanol and ethanoic acid to remove excess acid sodium hydroxide is added to neutralise it and sodium ethanoate is produced in the process.

Excess ethanol is removed by adding anhydrous calcium chloride to produce calcium ethnocide. . Ethyl ethanoate is is removed by using separation funnel. Later the impure ethylethanoate is distilled at a temperature of 74ºC to obtain pure ester



Uses of ester.

1. Artificial fruit flavouring

Name of ester	smell	Prepared from	
		Alcohol /alkanols	Carboxylic acids
Octyl ethanoate	Orange	Octanol	Acetic acid
Butyl ethanoate	Banana	Butanol	Ethanoic acid
Ethyl butanoate	Pineapple	Ethanol	Butanoic acid
Methyl anthranilate	Grape	Methanol	2 aminobenzoic acid
Isobutylpropanoate	Rum	Iso butyl alcohol	Propanoic acid
n-propyl acetate	Pears	n-propyl alcohol	Butanopic acid
Benzyl butyrate	Flower	Benzyl alcohol	Butanoic acid

2. Used as substitute for cotton
3. Used for bonding region in glass fibre
4. For making food roasting
5. For yatch nails

6. For making perfume

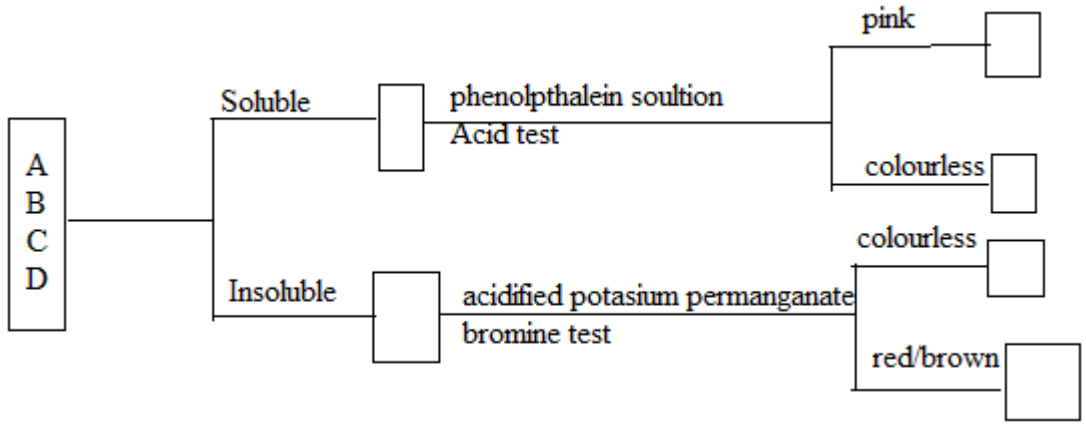
Test for carboxylic acid

Acid test is used to test the presence of carboxylic acid
The following indicator can be used to test the presence of carboxylic

Indicator	Colour in acid	Colour in bases
Litmus	Red	Blue
Methylorange	Red	Yellow
Phenolphthalein	Colourless	Red
Bromothymolnblue	Yellow	Blue

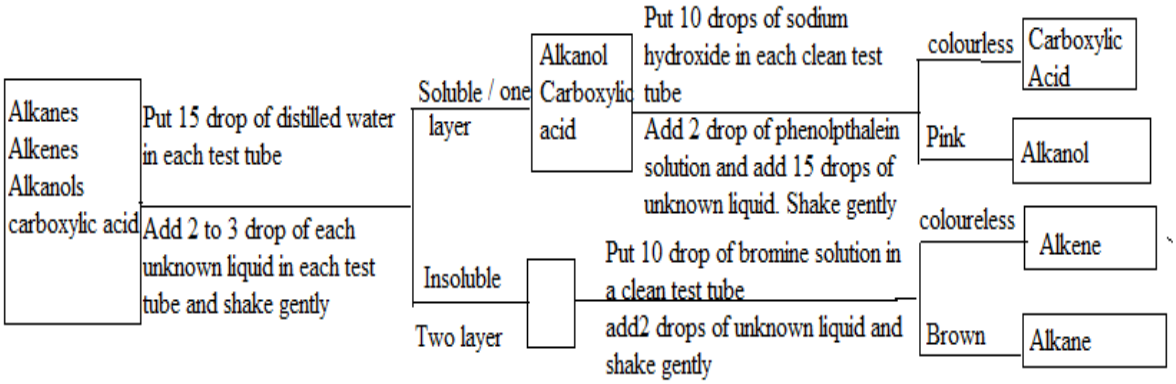
FLOW DIAGRAM
Experiment
Identification of alkanes alkenes, alkanols and carboxylic acid
Materials
4 test tube in a rack
Ethanol labelled A
Paraffin labelled B
Ethanoic acid (vinegar) labelled C
Vegetable oil (cooking oil) labelled D
Sodium hydroxide or lime water (calcium hydroxide) m in a dropper bottle
Phenolphthalein solution in a dropper bottle
Distilled water
Procedure

a. Add 15 drop of distilled water in each test tubes
b. Add at least 10 drops of the test liquid A, B, C and D inn a separate test tube and shake
c. Record the results in appropriate inn the flow diagram
d. Rinse the test tube with water followed by distilled water
e. Select the soluble liquids only. Put 15 drops of sodium hydroxide /lime water into test tube followed by two drops of phenolphthalein indicator. Add 6 drops of each soluble tested liquid in test separately. Record the results in appropriate place in the flow diagram
f. Select those insoluble liquids only. Place 15 drops of potassium permangate or bromine solution inn the two clean test tubes. Add 2 drops of each the liquids separately. record your results in appropriate in the flow diagram



om
Identify the homologous series from each liquid A, B C and D

In general the flow diagram look like this



POLYMARISATION

Monomers

They are small molecules that join together to form long chains

Polymer

They are long chain molecules made by joining together many small molecule called monomers

Co-polymer:

It is a polymer formed by the polymerisation of a mixture of two or more different monomers.

Types of polymers

They are two types of polymers

1. Natural polymers
2. Synthetic polymers

Natural polymers

They are biochemical molecules than have long change

Example of natural polymers

Polymer	Monomers	Where it is found
Proteins	Amino acid	Wool, silk, muscles , etc
Starch	Glucose	Potato, cereal crops
Cellulose	Glucose	Paper, wood dietary fibre
DNA	Nucleotides	Chromosomes , genes

Synthetic polymers

They are made by joining small molecule to form long chain molecules

Example of synthetic polymers

Polymer	Monomer	Where it is found
Poly (ethene)	Ethene	Bags, washingup bowls , etc
Poly(chloroethne) PVC	Chloro ethene	Fabric coating, electrical insulation, etc
poly(phenylethene) (polystyrene)	phenlethene	Toys, expanded polyestyrene
Polyesters	Ethene-1,2-diol and benene1-2-dicaboxylic acid	Skirt, shirts , trousers

Factors that Affect the Properties of Polymers

It depends on the type of the molecular chain it contain

1. Chain length: they have long chain with an average of 50 monomer units. . The chain length determines the melting and boiling points of polymers.. Most polymers have high melting and boiling point compared
2. Intermolecular forces: The size and strength depend on the chain type and molecule type that made the monomer. Polymers formed from condensation polymerisation tend to have high melting and boiling point compared to polymers that come from additional polymerisation since they tend to form hydrogen bond
3. Branching : non branched polymers are closely packed while branched polymers are not closely packed. Branched polymers melt easily and have weak tensile strength.
4. Cross- linking: they are rigid and form hard material than straight chain polymers.

Types of polymerization

They are two type of polymerization

Additional polymerisation and condensation polymerisation

Additional Polymerisation.

One type of monomer molecules undergoes addition reaction repeatedly.

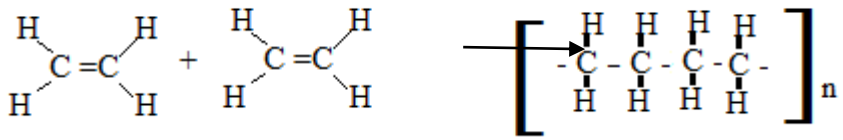
Molecules with double bonds are particularly used in additional polymerisation E.g ethene . One the double bond break enabling the free bond to link with one another forming a chain.

Examples of additional polymers

polyethene polystyrene PVC poly(propene) Polytetrafloroethane (PTFE) Acrylic

POLYETHENE

It is made using ethene as a monomer. The ethene molecules undergo reaction where the double bond break and join to another ethene molecule to form polythene .



Polythene molecule

Properties of polyethene

1. They are easily moulded
2. It is excellent electrical insulator
3. It does not corrode
4. It is tough
5. It is not affected by weather
6. It is durable

Types of polythene

Low density polythene

They are boiled at 105 degrees Celsius and soften in boiling water.

It has branched chain which made them not to be closely packed.

They are fairly readily melted and easily b deformed.

They always soften in hot water

Used.

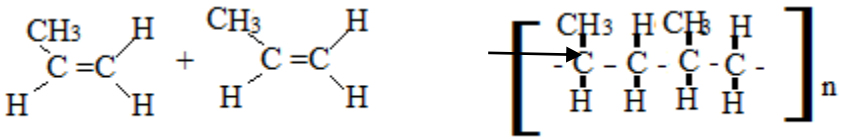
1. For making films, sheeting for bags, wrappers ,
2. For making moulded article like washing –up bowls and squeezy bottles

High density polythene

1. They are made at low temperature and pressure under the influence of catalyst.
2. They are closely packed because they have few branches
3. They do not melt easily and they are rigid.

Uses.
They are used for moulding bleach bottles, milk -bottle crates

Poly(propene) (Polypropylene)
The use propene as a monomer. The double bond break which give a way for other bond to be formed by joining the propene monger to form poly (propene).



Poly propene

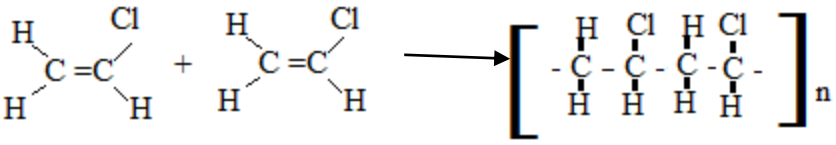
Properties of poly propene

1. Its chain are packed together closely

Uses of poly propene

1. They are used in mouldings and film
2. they also used to made fibre
3. they are used to make ropes

Poly(chloroethene) (Polyvinyl)
Chloromethane undergo addition reaction to produce PVC



poly vinyl chlorine

Characteristics of PVC

1. They are versatile
2. They have strong IMF due to presence polar c-cl bond. And this made them very strong material

uses:

1. Used in coating fabric and covering wires and cables.
2. used in making water pipes

Other additional polymers

Polymer	Monomer	Monomer formula	Monomer common	Properties	Uses

			name		
poly(phenylethene	phenylethene	C6H5CH=CH2	Styrene	Brittle (but cheap)	Expanded [polystyrene for insulation plastic toys
poly(tetrafluoroethene)PTFE	tetrafluoroethene	$CF_2=CF_2$	Tetrafluoroethylene	Very stable anti-stick properties	Non-stick coating on pans insulator
poly(methyl-2-methyl-propnoate) (perspex) Acrylic	methyl-2-methyl-propnoate	CH_3 C-$COOCH_3$ CH_2	Mythyl methacrylate	Transparent	As substitute for glass
Poly(propenenitrile) Acrilan	propenenitrile	$CH_2=CHCN$	Acylonitrine	Strong fibre properties	Making textile (wool)

Condensation polymerisation

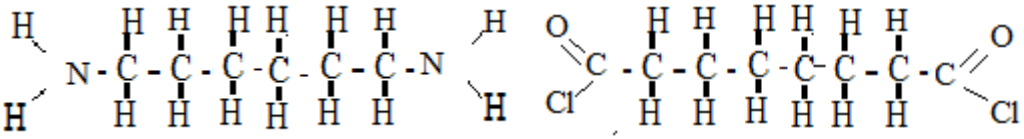
It involves reaction of two monomer where a small molecule mainly water molecule is released to form a bond between the two large molecules.

It usually happens on a two types of monomer.

Examples of condensation polymerisation

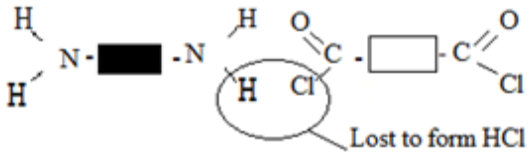
Nylon

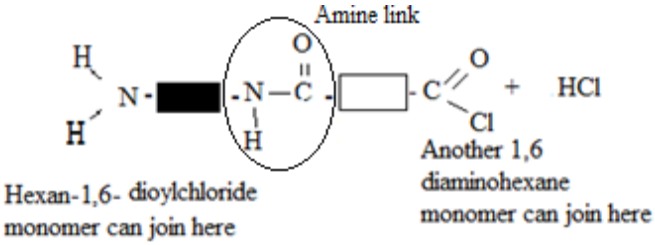
Two monomer 1,6 diamono hexane and hexa-1-dioyl chloride join each other by eliminating hydrogen chloride by amide link.



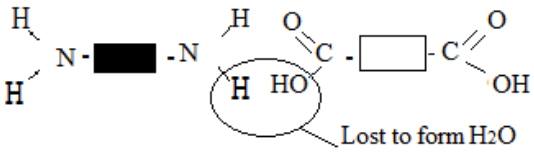
Hexane-1 , 6 diamine hexa-1-6 dioyl chloride

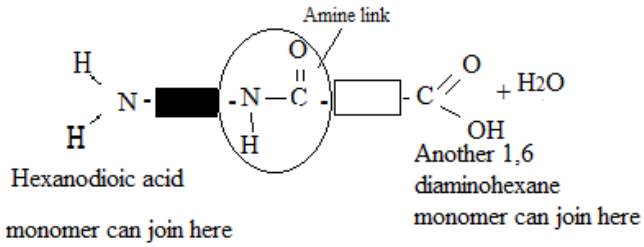
The two monomers join each other as follows





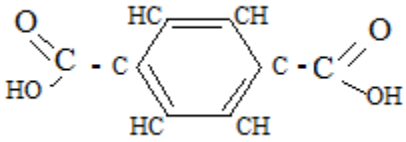
In absence of the hexa -1,6 dioylchloride as monomer, Hexanedioic acid can be used can be used and the reaction produces water like

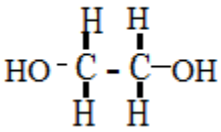




TERYLENE

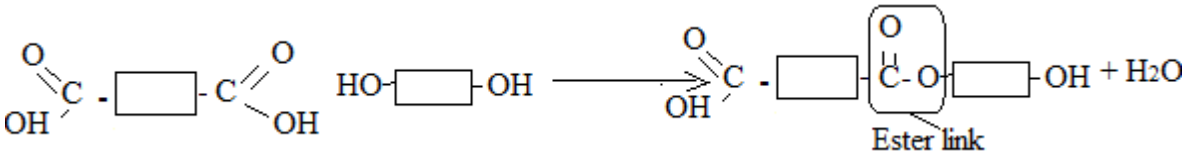
Terylene is made by condensation polymerisation of monomers bezene 1,4 dicarboxylic acid [$HOOC(C_6H_4)COOH$] and ethano1,2 diol [$HO(CH_2)_2OH$] by an ester link





Benzene 1,4 dicarboxylic acid Ethan-1, 2 diol

The function group of is the one that take place in polymerisation



Other examples of condensation polymerisation

bakelite - terylene - urea-formaldehyde

Many substances which occur in living organisms such as proteins and polysaccharides polymers

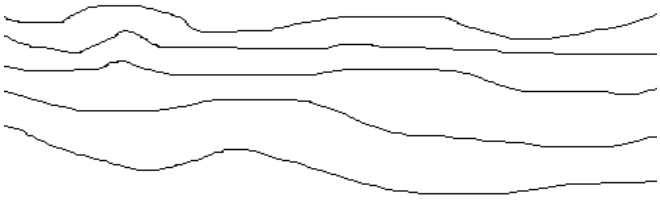
Plastics (Synthetic polymers)

Plastics are a material that comes mobile when heated.

Types of plastics

Thermoplastic (Thermo softening plastic):

They are made by straight chain polymers.



The chain can slide over each other

Properties of thermosetting plastics

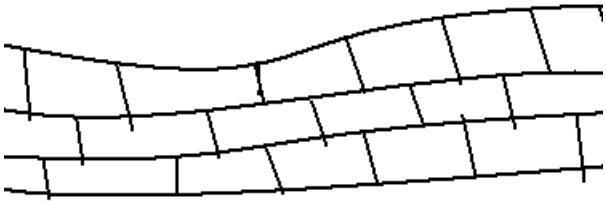
1. It is a material which softens on heating and hardens on cooling , the process being capable of repetition
2. They are flexible and do not easily break
3. Melt at low temperatures
4. Can be folded into a shape after they are made

Examples are:

Lucite , Teflon, nylon, polystyrene , plastic eye glass frames

3 Thermosetting materials:

They are made by strong bond between the chain to form cross-linking structure



Properties

1. They will break or char down at high temperatures rather that melt
2. They are rigid and break rather than bend
3. Once they are moulded into a shape while they are made they can no be changed later.

NB thermosetting plastics materials can acquire plasticity during the first heating and cannot be soften on re-heating . This is due to a formation of a molecular network structure between the long chain molecules which produce a rigid 3- dimensional network.

Examples are:

Bakelite- radio cabinets –Formica –polyesters –cassein.

Properties of plastics

1. Some are hard, light and durable and can be used in the manufacturing of the body of a car.
2. Some have excellent heat and electrical resistance and can be used as insulators.
3. Some are non- biodegradable.
4. They are water-proof
5. Some are flexible
6. Some soften upon being heated.

Uses of plastics

1. Some are used in textile industry e.g. nylon and polyesters
2. As plastic bags, containers, water piping, film and sheets such as pol(ethylene)
3. For carpets, bearings such as nylon
4. For tyre cord soft drink bottles such as terylene
5. For buttons, knife handles, pens, switches, camera & telephone equipment such as Bakelite

Laboratory preparation of plastic nylon (polamide)

Procedure:

a. Dissolve about 1 ml of decan-1,10-dioyl chloride in 10ml of tetrachloromethane in a 100ml beaker. Add a trace of azobenzene to colour this solution.
b. In a separate beaker , make a solution of 1g of 1,6-diaminohexane in 20ml of sodium hydroxide solution.
c. Carefully pour the solution from (b) on top of the solution made in (a) , taking care to avoid mixing the two solutions.

Result: nylon forms at the interface of the two solutions.

Advantages of synthetic polymers over metallic materials

1. Some plastic are hard light and durable and can be used to make body of cars while some metals are hard , heavy and not durable
2. They have excellent heat and electrical resistance compared to metals as a results they are used and insulator while metal are good conductor of heat and electricity and can not be used a insulators
3. They are water proof and can not attacked by rusting while metals can be easily attacked by rusting like iron

4. They melt at low temperature hence they can be easily recycled while metals melt at high temperature hence expensive to recycle
5. The are cheaply produced while metals are expensive to produce

Disadvantages of synthetic polymers

1. Some are toxic and can cause death to animals and even people
2. They pollute environment since most of them are un bio degradable nor photo degradable
3. Some can not be recycled
4. They release chlorofluorocarbons during manufacturing that damage ozone layer
5. They are use non renewable resources like petroleum once depleted they will no longer exist.

Advantages of natural polymers

1. All can be recycled
2. They com from renewable resource like trees
3. The are environmental friendly
4. They are non toxic
5. They are biodegradable and photo degradable

Disposal of plastics and wastes.

Burning them.

Plastics are burnt in incinerator. But it has the disadvantage that it increase pollution of air through releasing of chlorofluorocarbon into the atmosphere

Using landfills

Plastic are buried in the soil. The disadvantage ids that plastic take long time to decompose and they pollute the soil. Any pant that grow on that landfill of plastic dries prematurely

Re-cycling

Plastics are recollected and heated in the factory and made into new one.

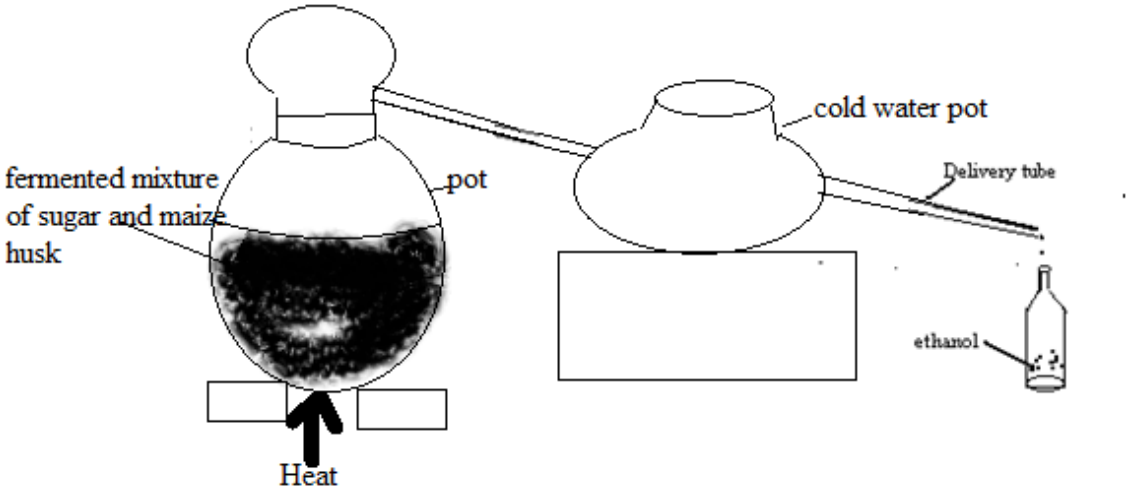
The disadvantage is that other plastic can not be recycled and the process is expensive

Exercise

2003

Question 5

a. (i)Name the compound $C_7H_{15}OH$
   ii. What is the general formula of the compound in 5 a.i ?
   iii. Draw the structure of the $C_7H_{15}OH$
b. Figure 4 shows one indigenous way of preparing alcohol



i. Name the process illustrated in figure 4
ii. Name the alcohol collected in receiving bottle
iii. The alcohol in figure 4 is produced by fermentation
1. Define fermentation
2. Write the word equation from fermentation

c. Ethanoic acid (CH_3COOH) react with ethanol (C_2H_5OH)according to the following equation

$$CH_3COOH + C_2H_5OH \xrightarrow[\text{Heat}]{\text{conc. Sulphuric acid}} CH_3COO\,C_2H_5 + H_2O$$

i. What is the name of this reaction
ii. Name the two products of this reaction
iii. Give one use of $CH_3COO\,C_2H_5$

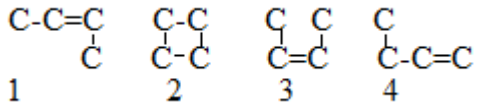
d. Draw and name the isomers of pentane (C_5H_{11})

2004

a. State one use of each of the following polymers
1. Plastics
2. Carbohydrates

b. State any two ways of disposing plastics s

c. The following are structural formulae of four molecules with molecular formula C_4H_8



i. Name the molecules 1 and 2
ii. Which two structures is conformation of each other?

d. Table 4 shows the molecular formulae and the boiling point of some compound

TABLE 4

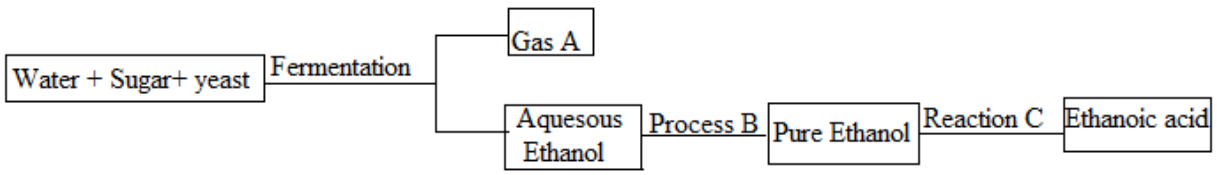
Compound	Molecular formula	Boiling point (ºC)
A	C_2H_4	-104
B	C_2H_5OH	79
C	CH_3COOH	118
D	H_2O	100
E	C_2H6	-89

i. Which compounds in the table are hydrocarbons
ii. Which compounds in the table are soluble in water
iii. Which compounds in the table are gases at room temperature
iv. Explain why the boiling point of compound D is higher than the boiling point of E
v. Describe a test which can be done to distinguish C and D

2005

Question 5

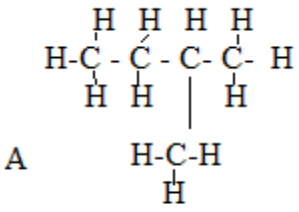
a. Figure 5 is a diagram showing how ethanol and ethanoic acid are prepared



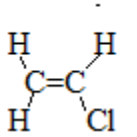
i. Give the names of
   1. Gas A
   2. Process B
   3. Reaction C

ii. Name the substance that is used in reaction C

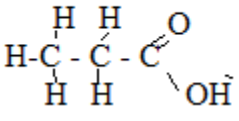
b. The following are structures of some organic compounds



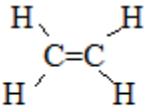
A



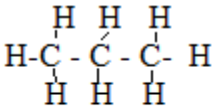
B



C



C



D

i. Name compound A

ii. Which compound is soluble in water? Give a reason for your answer

iii. Write letter reperesneting any three compounds that would not react with potassium , group 1 element

iv. Which of the two compound A and E would have lower boiling point? Give a reason for you answer?

v. Compound C is monomer. Write the equation to show it polymerisation

c. Describe a test that could be used to distinguish compound D from E

d. Write the isomers of the substance A

e. Give two advantages of thermoplastics

2005

Question 1

a. Given below are general formulae of some homologous series reperesented by letters P, Q, R and S

   P: C_NH_2N

   Q: C_NH_{2N+2}

   R: $C_NH_{2N+1}OH$

   S: $C_NH_{2N+1}COOH$

   i. Name the homologous series represented by letter Q and S

   ii. Which general formulae represent hydrocarbons

   iii. Draw the structure of compound with three carbon atoms in homologous P

   iv. Name the compound drawn in 1 a. iii.

   v. Explain how a compound of homologous series Q could be distinguished from a compound of homologous series R

b. i. Write down all structural isomers of pentane

   ii. name the isomers

c. Ethene (c2h4) react with bromine in additional reaction.

   i. Draw the structure of the product formed

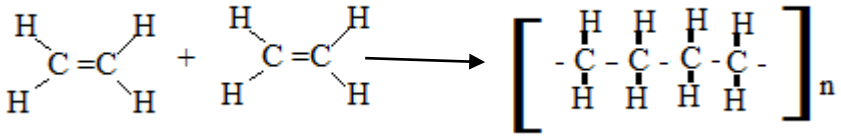
   ii. Name the product formed

iii. Why is additional reaction important in industries? Give two reasons

2007

Question 1

a. Polymerisation of ethene can be summarised by the following equation



i. Name the polymerisation represented by the equation

ii. Describe how the polymer is formed from ethene molecule

iii. Give two examples of artificial polymers

b. The following are chemical formulae of some organic compound :

A. $CH_3CH_2CH_2CH_2OH$

B. $CH_3CH_2CH_2CH_3$

C. $CH_3CH_2CH_2COOH$

D. $CH_3CH_2CH=CH_2$

E. $CH_3CH_2\ H_2CH_3$

i. Identify one compound which is an alkanols

ii. Which compound belong to the same homologous series

iii. Explain why solution of compound C conduct electricity

iv. Draw a full structure of compound D

v. Name compound D

c. i. Give three differences between thermosetting and thermoplastic polymers

ii. State two ways of disposing plastics waste to avoid pollution

d. Give three advantages of plastic over metallic materials

Question 7

a. Draw full structure of ethanol (C_2H_5OH) and water (H_2O)

b. Explain the difference in boiling between water and ethanol

c. With an aid of diagram explain, describe an experiment tha can be done to separate a mixture of ethanol and water

Question 3 PPII

Construct a flow diagram that could be used to identify acetic acid, ethanol, hexane and hexane using test that make use of distilled water, bromine solution, sodium hydroxide solution and phenolphthalein solution.

2008 a

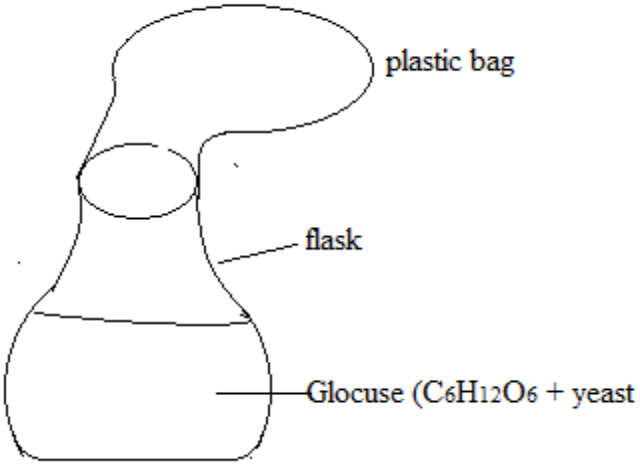
Question 5

a. Define isomer

b. i. Draw the structural formula for two isomers of butane (C_4H_{10})

ii. Name the isomers draw in 5bi

c. Figure 5 is a diagram of experiment set up.



i. Name the process that could occur in the flask

ii. Write down the balance equation of the process named in 5.c.i

d. State any two disadvantages of synthetic polymers

e. Table 2 shows boiling point and solubility of some alkanols

Name	Boiling point	Solubility
Methanol	65	Most soluble
Ethanol	78	Soluble
Propanol	97	Partially soluble
Butane	117	Insoluble

i. Explain why boiling point of alkanols increases from methanol to butanol

ii. Explain why ethanol is more soluble in water than propanol

f. i. Complete the following equation to show reaction between methane and chlorine

$CH_4 + Cl \longrightarrow$ _____

ii. Name this type of reaction

iii. give one use of alkanes

2009

Question 5

a. State any three use of ethanoic acid

b. i. Why ethanoic acid is regarded a electrolyte?

ii. Write the ionisation reaction of ethanoic acid (CH_3COOH) in water (H_2O

iii. Why does sodium metal react with ethanol in the same way as it does with water?

c. i. Write the general formulae for carboxylic acid

ii. What is the formula of smallest carboxylic acid?

iii. How would the boiling point of butane compared with smallest carboxylic acid

iv. Explain your answer to 5 ciii.

2010

Question 4

a. i. What are polymers

ii. mention any two uses of polyethene

b. Give any three properties of plastics

c. i. Give three properties of carboxylic acids

ii. Mention any natural sources of carboxylic acid

d. i. Define isomers

ii. Draw the structural formulae of butanol (C_4H_9OH)

iii. write the condensed formula of pentane

e. Ethanol(C_2H_5OH) reacts with ethanoic acid(CH_3COOH) according to the following chemical equation

$C_2H_5OH + CH_3COOH \xrightarrow{\text{conc. Sulphuric acid}} \_\_\_\_\_ + H_2O$

i. Compete the equation

ii. Name the process in which ethanol reacts with ethanoic acid

2011

Question

a. i. Give any two properties of polymers

ii. Explain how condensation polymerisation is formed

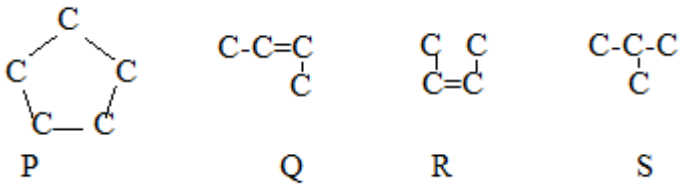
b. Mention any two properties of alkanols

c. Ethanol (C_2H_5OH) changes to ethanoic acid (CH_3COOH) in the presences of atmospheric oxygen

i. What is the function of atmospheric oxygen

ii. Write the equation for the reaction

d. Figure 3 shows the structure of some organic compound P, Q R and S



I. Name the organic compound labelled P and Q

II. Identify the structure which is isomers to compound Q

III. Give a reason for you answer in 5 c ii.

IV. Explain how the compound p could be distinguished from compound r using bromine solution

2012

Question three

The following are the general formula of organic compound A and B

A: $C_NH_{2N+1}COOH$

B: $C_NH_{2N+1}OH$

a. To which family does compound **B** belong

b. Mention any three properties of compound **A**

c. State any three uses of compound **B**

d. Mention the product formed when compound **A** and **B** react

e. Work out the molecular formula of the compound **A** if **n** is **5**

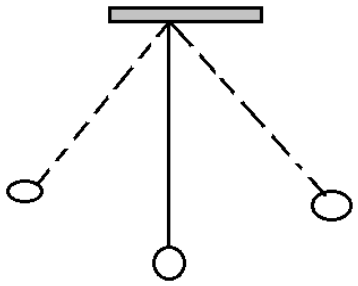
f. Describe how compound A could be distinguished from compound B

OSCILLATION AND WAVES

Oscillation
It is to and fro movement of the body on a fixed point

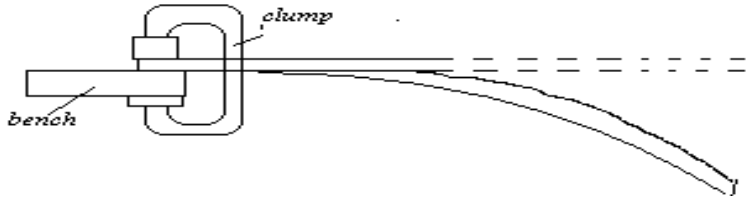
Example of oscillating object

Pendulum
It has swinging mass that move to and fro on a fixed

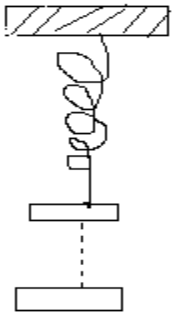


Vibrating pendulum

Cantilever
It made of ruler clumped to a table as below



The spring



Characteristic of oscillation system
Vibrating object has the following characteristics

1. **Amplitude (x)**
   It is the maximum displacement of a vibrating particle from its rest position. The unit is cm or m

2**. Period (T)**
It is the time taken for 1 complete vibration or cycle. Its unit is second
T= total time taken/ no. of complete vibration.

3. Frequency (f)

It is the number of complete vibrations or cycles performed in a second.
Its unit = cycles /second or vibrations / second.
The special unit is called Hertz (Hz)
1 Hz = 1 cycle / sec.

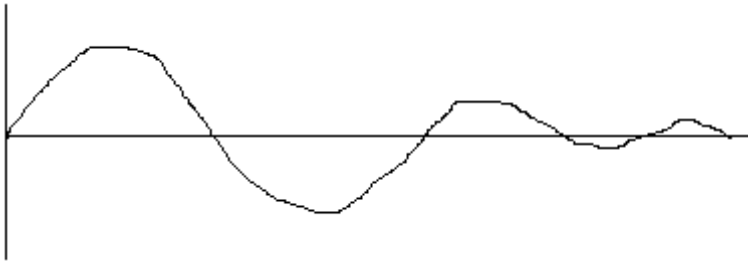
How to measure the frequency of an oscillating object

The following steps are followed

1. Set the pendulum for example or vibrating string. Pull it aside while your time has set to zero of stopping clock. Release the pendulum about 10cm.
2. As the oscillation swing bob reaches you or starting position count three two and one then zero
3. Once you count zero start the watch at the same time and continue counting until you reach 10.
4. Repeat with another set of reading almost three time and find the average of the readings.

Damped Oscillations:

These are dying oscillations.
Due to friction the oscillations do not continue forever as a result it dies gradually



Friction is present in two forms here:

1. Rubbing between the holding clamp and the moving spring ,string or ruler.
2. Air resistance to the moving part in each system.

The overall effect is that the swings die away as the total mechanical energy (P.E + K.E) , gets less and less. The amplitude decreases with time.

Factors affecting Frequency of Oscillating Systems
Spring
1. M**ass on spring**

Experiment 1. Investigating effect of mass on the frequency of oscillating pendulum

Materials
Spring
Masse like 50g, 100g 250g and 250g
Clamp stand
Ruler
Stop watch

Procedure

a. Hang the spring on the retort stand and hang a 50g mass
b. Pull the spring down ward about 10cm and release it
c. Record the time taken to complete 10 completed oscillations in the table below
d. Repeat procedures a to c with 100g, 150g, 200g, and 250g

Table of results

Mass on the spring(g)	Time taken for 10 complete oscillation	Number of vibration per second (frequency) number of vibration /time
50g		
100g		
150g		
200g		
250g		

e. Plot the graph of mass against frequency

Observation of results.
Small mass has take a short time to complete one circle since small effort is applied compared to heavy mass which need a lot of force to be pulled which increase time hence reducing the frequency

2. Material of spring :
some material are elastic and are pulled widely which means that it take lengthy time to come back to original position while other are elastic which mean they take short period to complete its circle

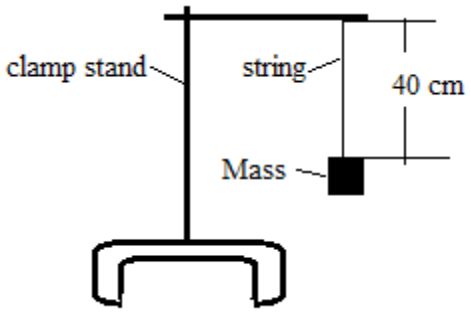
3. Number of springs or the strength of the spring:
Increasing the number of springs increases the force that pulls the mass up and down compared to small number of springs.

Factors that do not affect the frequency of the spring
➔ Length of spring
➔ Changes in amplitude

Factors that affect the frequency of the pendulum
Length of pendulum

Experiment2. To investigate the effects of changing the length of pendulum on frequency of vibrating pendulum
Materials
A clamp
60cm string
1 mitre ruler
A mass of 50 g
A stop watch

Procedures
1. Set the apparatus as shown below



2. Tie the string to a clamp so that the distance should be 40cm from the clamp hand to mass
3. Pull the mass to one side about a distance of 10 cm and leave to vibrate freely

4. Record the time taken to make 10 complete vibration
5. Calculate the number of vibration performed in 1 second
6. Repeat procedure 2 to 5 with 30, 20 and 10 cm length of string and record your answer in the table below

Length of string (cm)	Time take for 10 complete vibration	Number of vibration per second (frequency)

7. Plot the graph of vibration per second /frequency against length of a string
8. Plot the graph of 1/frequency against length

Observation / conclusion

The frequency of pendulum decrease as the length increases because the bob take long period to complete on oscillation and also the effect of air resistance is high which reduces the frequency of oscillating pendulum

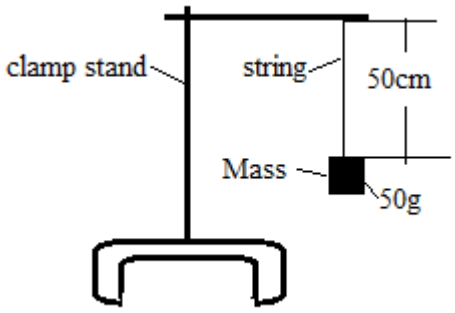
Material of pendulum: It the string is E.g wire

Experiment effect of change in amplitude on frequency of oscillating body

Materials
A string
Meter ruler
Stop watch
Mass 50g,
Clamp stand
Stop watch

Procedures

1. Set the apparatus as shown below



2. Tie the string to a clamp so that the distance should be 50cm from the clamp hand to 50g mass
3. Pull the mass to one side about a distance of 10 cm and leave to vibrate freely
4. Record the time taken to make 10 complete vibration
5. Calculate the number of vibration performed in 1 second
6. Repeat procedure 2 to 5 with 15cm, 20, 25 and 30cm amplitude and record your answer in the table below

Amplitude (cm)	Time take for 10 complete vibration	Number of vibration per second (frequency)

7. Plot the graph of vibration per second /frequency against amplitude

Observation / conclusion

As the amplitude increases the frequency decreases because the bob takes long period to complete oscillation.

Factors that do not affect frequency

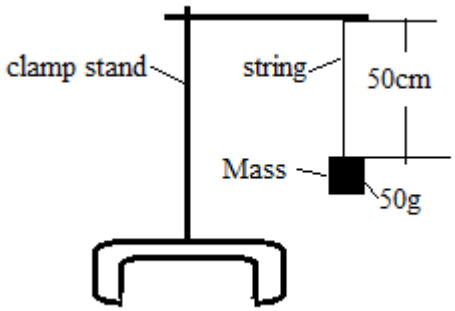
Experiment 3

Effect of mass of the frequency of oscillating pendulum

Materials
A string
Meter ruler
Stop watch
Masses 50g, 100g, 150g, 200g 250g
Clamp stand
Stop watch

Procedures

1. Set the apparatus as shown below



2. Tie the string to a clamp so that the distance should be 50cm from the clamp hand to 50g mass
3. Pull the mass to one side about a distance of 10 cm and leave to vibrate freely
4. Record the time taken to make 10 complete vibration
5. Calculate the number of vibration performed in 1 second
6. Repeat procedure 2 to 5 with ,100g 150g, 200g, 250g and record your answer in the table below

Mass of the bob (g)	Time take for 10 complete vibration	Number of vibration per second (frequency)

1. Plot the graph of vibration per second /frequency against length of a string

Observation / conclusion.

A s the mass increase the frequency remain the same. This show that mass does not affect the frequency of oscillating bodies

Small change in amplitude

Cantilever
Factor affects it

I. Mass on end: The frequency increase with decrease in mass and decrease with decrease in mass.
II. Material of cantilever: Some material are rid and die easily compared to flexible materials
III. Length of the cantilever: The frequency increase as the length decreases and decreases the length increases.

Factor that do not affect the amplitude of cantilever

Amplitude changes

WAVES

A wave is any disturbance that carries energy and momentum from its source.

Note: The particles of the medium do not move, but they just oscillate (vibrate) , passing on energy to next particles.

Types of Waves:

There are two types of waves
Mechanic wave and electro magnetic waves

MECHANICAL WAVES

This is waves that require medium for their propagation

For mechanical wave to move it requires the following things:

1. An elastic medium that can be disturbed
2. An energy source to provide a disturbance to the medium
3. Some physical connection through adjacent particle of medium that can influence each other

TYPE OF MECHANICAL WAVES

There are two type of mechanical wave

1. **Longitudinal Waves**

These are waves in which the direction of vibration of particles is parallel to direction of a wave.
It is formed when the particles of the medium are displaced in the direction parallel to the direction of the travel wave.

Example mechanical wave

1. Sound wave.
2. Vibrating spring

How longitudinal waves are formed

They are formed when an object vibrates; air particles near it vibrate too creating a series of compressions and rarefactions.

NB. Compressions are high-pressure regions.
Rarefactions are low-pressure regions.

2. **Transverse Waves**:

These are waves in which the direction of particles is perpendicular (at right angles) to the direction of a wave.

Examples transverse wave

Water waves

Light waves.

It happens when periodically repeating the disturbance of this type transmitted through the medium

CHARACTERISTICS OF WAVES:

1. A wave transfer energy but there is no net transitional of matter
2. Mechanical wave have particles with inertia and elasticity
3. The particles oscillate in the same way as the neighbours do

Difference between longitudinal wave and transverse wave

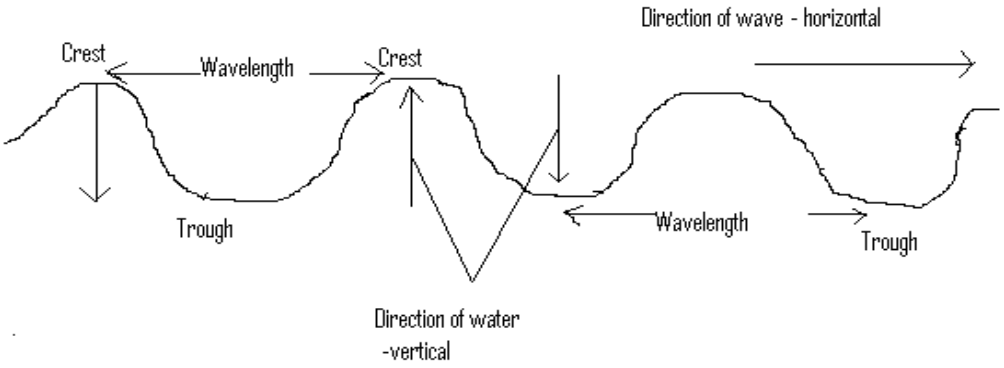
Transverse wave	Longitudinal wave
Oscillation are at right angles to the direction of wave	Oscillation are in line with direction of wave
Can travel through a vacuum	Can not travel in vacuum since it need medium
Produces crest and trough	Produces compression and rarefaction

TERMINOLOGIES USED IN WAVES

Wavelength (λ)

It is the distance between two successive crests or troughs or is the distance between the particle that are in phase. The unit is cm or m .

The symbol is λ (lamda.)



Wave Speed (V)

It is the distance covered by a wave per unit time (second)
The unit can be m / s or km /s.

Phase (*E*)

Is the position and motion of particle at instant having the same disturbance

Particles are said to be in phase if they have the same displacement , speed, and move in the same direction. Things are said to out of phase (in anti-phase) if they have different displacements , speed or move in different directions .

Frequencies

Is the number of complete wave generated per second

Amplitude (a)

It is the maximum displacement of a particle of the particle from their equilibrium position

Period (T)

It is the time require for one wavelength to pass point. It is the time for the required for a disturbed particle by a wave to execute one complete oscillation

Relationship Between Frequency (f) and Periodic Time (T)

f=1/T: T = 1/f
Proof:
Suppose a vibrating object (pendulum) makes 5 vibrations in 4 seconds.
- This means f = 5 vibrations / 4 seconds = 1.25Hz
-This also means T = 4 seconds / 5 vibrations = 0.8 second.

f = 1/ T = 1 / 0.8 = 10/ 8 = 1.25 Hz
T = 1/ f = 1/ 1.25 = 100 / 125 = 0.8 second.

WAVE EQUATION

Wave speed (V) = Distance / Time = Wavelength / Periodic Time
$V = \lambda / T$

$V = \lambda / 1/f = \lambda f$

$V = \lambda f$

$V = \lambda f$ is called Wave Equation. It shows the relationship between V , λ and f.

$\lambda = V / f$; $f = V / \lambda$.

Examples.

1. A radio wave has a frequency of 12MHz and a wavelength of 25m . Calculate the velocity of the wave.
2. The speed of a radio wave is 300 000km/ s. If the radio broadcasts on 90.2 MHz, what is the wavelength of the radio wave?

Solutions:

a) Convert all the units into standard units i.e in Hz , m , m / s .

$V = \lambda f = 25 \times 12MHZ = 25 \times 12\ 000\ 000Hz = 300\ 000\ 000\ m / s$

2 $V = \lambda f$ Then $\lambda = V / f$

$\lambda = V / f$

$= \frac{300\ 000\ km / s}{90.2\ MHz}$

$= \frac{300\ 000\ 000\ m/ s}{90\ 200\ 000Hz}$

$= 3.3\ m$

Electromagnetic Waves

These consist of a disturbance in the form of varying electric and magnetic fields. The electric and magnetic fields oscillate at right angles to the direction and at right angles to each other.

No medium is necessary and they travel more easily in a vacuum than in matter.

Examples are : light (VIBGYOR) –Radio signals (or waves)

- X-Rays – Gamma rays

All electromagnetic waves have the following properties:

1. Can travel through a vacuum.
2. Are transverse.
3. Have a velocity of $3 \times 10^8 m / s$
4. Can be refracted\
5. Normally travel in straight lines.
6. Can be reflected.
7. Undergo diffraction
8. Carry no charge
9. Obey the wave equation.
10. Undergo interference

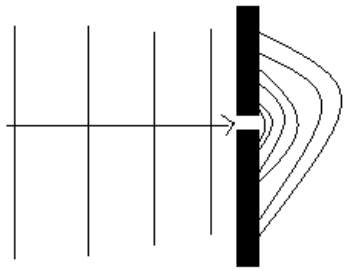
11. Transfer energy from one place to another

Some Properties Of Mechanical Waves:

Diffraction:

It is the bending or spreading out of waves as they pass around obstacles or through an opening (gap) into two regions

The greatest diffraction happens when the gap is narrow and the and the wavelength is large enough



Water waves passing through the gap a spread out in all directions and the wave fronts produced are circular.

Note: Diffraction is only significant if the size of the gap is comparable (about the same size as) with the wavelength of the waves.

If the gap is wider compared with the wavelength , waves continue straight on , some spreading out occurs but it is less obvious .

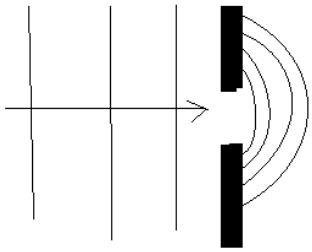
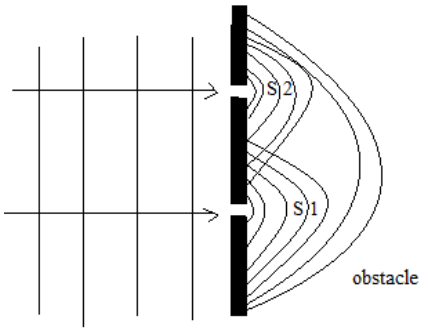


Diagram showing less diffraction when the gap is wide.

Note: When designing harbor, engineers apply the knowledge of diffraction by making a model.

Diffraction in double slit

When the wave passes though the double slit it diffract and later interfere on another forming a big wave. The big wave are formed because interference is constructive since the waves have the same amplitude, same frequency ate constant phase as a result they reinforce each other as the effect the amplitude double



Interference:

It is the combination of waves to give a larger or small wave.

It is formed when two or more wave from different sources re superposed.

At points where a crest from one wave arrives at the same time as a crest from the other wave , a bigger wave is formed. The waves are said to be in phase.

At points where a crest and a trough arrive together , they cancel out (if their amplitudes are equal) .The waves are exactly out of phase due to traveling different distances.

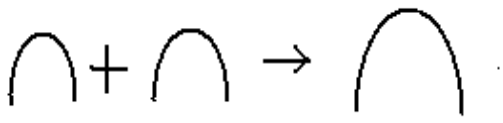
TYPES OF INTERFERENCE:

Constructive Interference:

It happens when two waves superposed with the same amplitude, the same frequency at constant phases.

Waves reinforce one another the effect the amplitude doubles

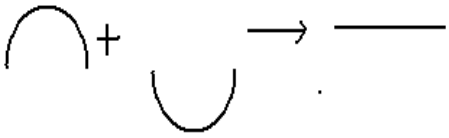
A crest of one wave coincides with the crest of another wave.



Diagrams showing constructive interference.

Destructive Interference:

It is formed by superposing of two waves that are out phase but of same amplitude. Waves cancel one another . A crest of one wave coincides with a trough of another wave.



Refraction:
It is changing of direction of the wave as it is passing from one medium to another. The bending occur on the boundary of the two media

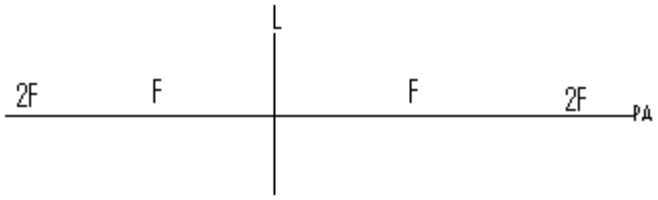
Reflection:
It is the bouncing back of a wave
The wave that approaches the boundary is called the incident wave and the one that bounces back is the reflect wave.

LIGHT
Definition of term
1. **Principal axis(PA):** I is imaginary line that passes through the centre of a lens and is perpendicular to the lens

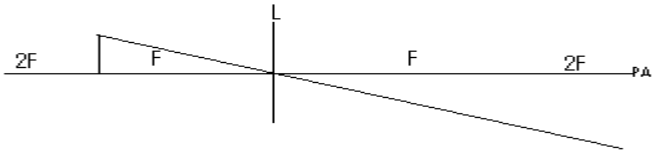
Optical centre (c) : It is the point in the lens where the principal axis and the plain of the lens meet
Focal length f: Is the distance between the principal focus to the optical point
Principal focus: F Is the point through which ray parallel to the principal axis converge with the convex lens
Image distance v : It is distance between the image and the lens
Object distance u: Is the distance between the lens and the object

Drawing construction rays
It helps to determine where image will be formed by the convex lens.

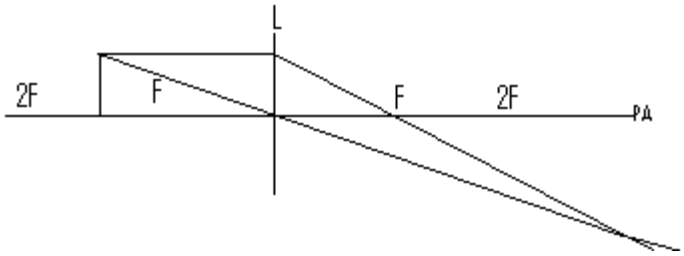
How to construct ray diagram
1. Draw the lens and the principal axis perpendicular to each other like this



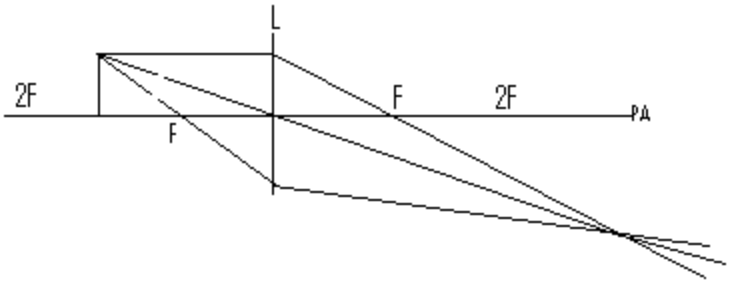
2. Draw the ray from the top of the object travels through the centre of the lens



3. Aray from the top of object parallel to principal axis to strike the lens. On emerging from the lens it should pass through principal focus F on the other side of the lens

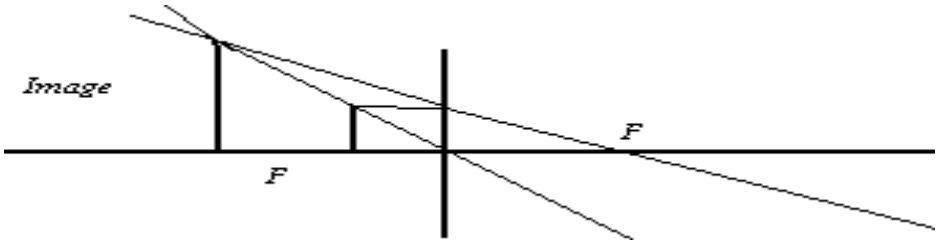


4. Draw the ray from the top of the object passing through F and should travel parallel after emerging from Len



CHARACTERISTICS OF IMAGES FORMED BY A CONVEX LENS:

1. **Object between lens and F:**

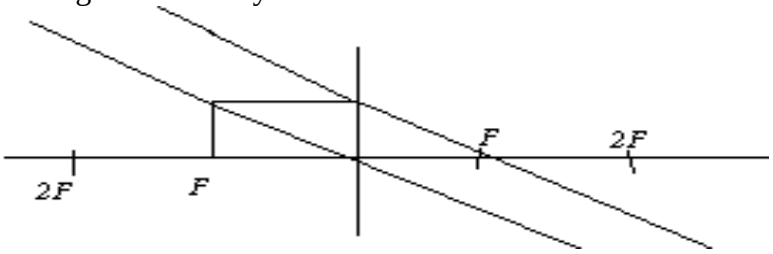


The image is

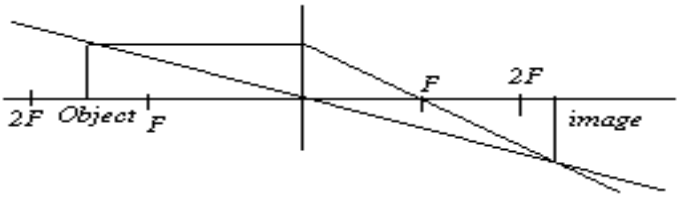
1. Behind the object.
2. Virtual.
3. Erect.
4. Magnified.

2. **Object at F:**

The image is at infinity.



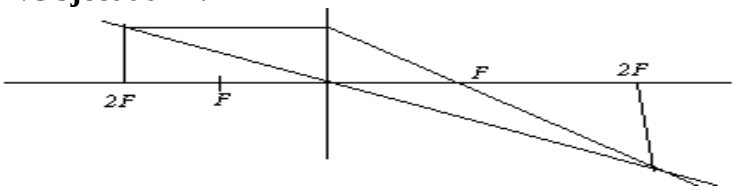
3. **Object between F and 2F:**



The image is;

i). Beyond 2F,
ii). Real
iii). Inverted
iv). Magnified.

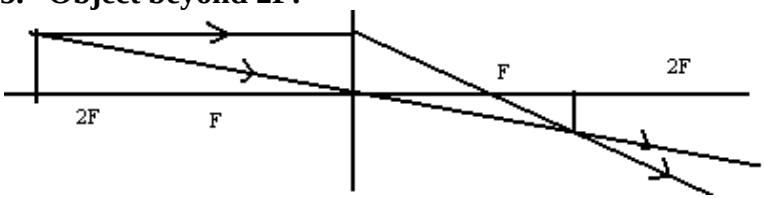
4. **Object at 2F:**



The image is,

i. At 2F
ii. Real
iii. inverted
iv. Same size as object.

5. Object beyond 2F:



The image is

i) Between F and 2F
ii) Real
iii) Inverted
iv) Diminished

DIFFERENCE BETWEEN THE REAL IMAGE AND VURTUAL IMAGE

Real images	**Virtual image**
Incase of the mirror, the image lies behind the mirror	Incase of mirror, the image lies in front of the reflecting surface
The light rays at a focal point behind the mirror	The light ray meets at a focal point in front of the mirror
It appears inverted (depending on the type of lens e.g convex , concave)	It is usually appears erect
It can be obtained on a screen	In can't be formed on a screen
In case of lens the image lies on the other side of the lens	Incase of lens the image lies on the same side of object

THE LENS FORMULA

1/u +1/ v = 1 / f

Example:
An object 2cm high stands on the principal axis at a distance of 12 cm from a convex lens. If the focal length of the lens is 9 cm, what is the position and nature of the image?

Solution:
1/u +1/ v = 1 / f: But u =12 cm; f = 9 cm; v = ?
1 / v = 1 / v – 1 / u
= 1 / 9 – 1 / 12
= 4 - 3 / 36
v = 36cm

Calculating Image positions Using Lens Formula:
In using the equation, note the following:
1. If the lens is convex , f is taken as positive.
2. If the lens is concave , f is taken as negative.
3. When v is positive , the image is real.
4. When v is negative , the image is virtual.

Note:
The equation can also be used for curved mirrors.
Converging lenses and mirrors have positive focal lengths.
Diverging lenses and mirrors have negative focal lengths.

Example:
An object 2cm high stands on the principal axis at a distance of 9cm from a convex lens. If the focal length of the lens is 6cm, what is the position and nature of the image?

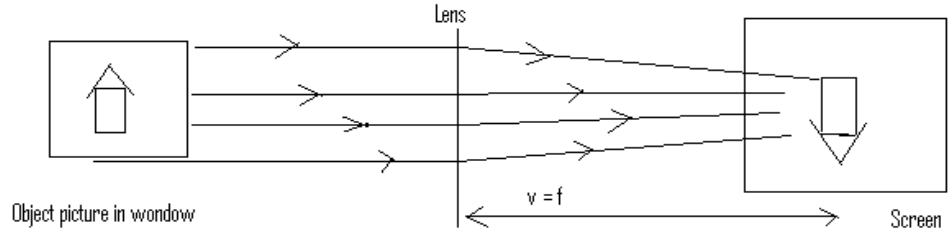
Solution:
1/u +1/ v = 1 / f: But u =9cm; f = 6cm; v = ?
1 / v = 1 / v – 1 / u
= 1 / 6 – 1 / 9
= 1 / 18
v = 18cm
the image is rel and inverted.

Measuring the Focal Length of a Convex Lens

i . Plane mirror Method
1. A plane mirror is placed behind the lens and a bright object in front.
2. The object is in this case a set of illuminated cross-wires, and its position is adjusted until its sharp image appears on the screen beside the object.

When this happens , rays of light from the object are parallel when they strike the mirror and are reflected as a parallel beam.
Light from the object must travel back along nearly the same path and hit the mirror normally.
The object is then at the lens principal focus (F).E.g The cross-wires and the card mark the position of the principal focus of the lens.

Distant Object Method:
1. A window across a large room is used as an object.



2. U is large and the rays enter the lens almost parallel to each other.
3. Move the lens until a sharp image of the window is formed at the other side of the room or screen.
4. The distance between the lens and the screen is roughly f .
5. Measure the length of the lens – screen distance using a ruler

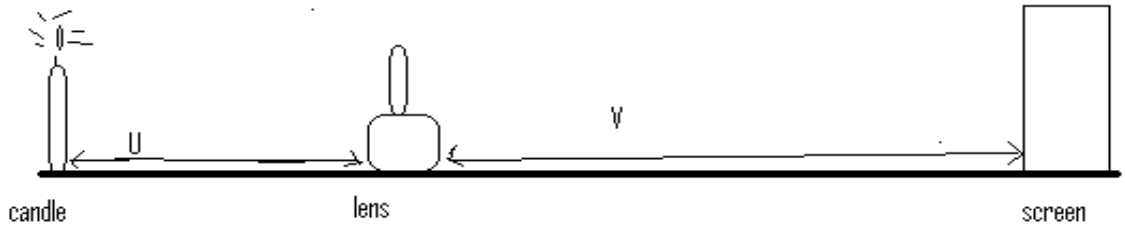
HOW TO FIND THE FOCAL LENGTH OF CONVEX LENS USING GRAPHICAL METHOD

MATERIALS

Convex lens
Lens holder
Screen
Candle
Matches
Meter ruler

Procedure

a. Arrange the apparatus as shown below

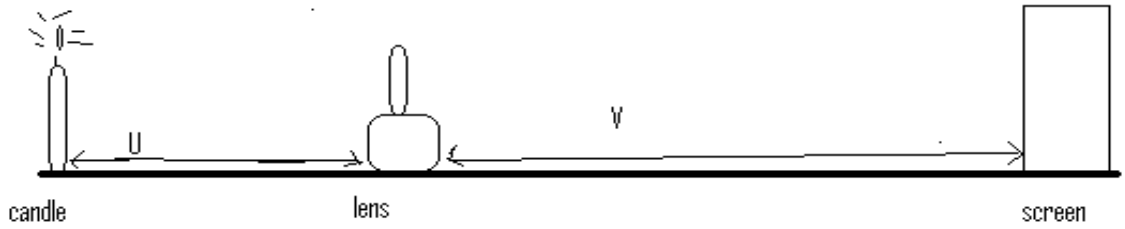


b. Light the candle
c. Move the object at a distance of 15cm away from the lens
d. Move the screen until you focus the image on the screen
e. Measure the image distance from the screen to the lens and record on the table below
f. Repeat procedure c toe with 20cm , 25cm, 30cm, 35cm and 40 cm length
g. Record the results in the table below

Object distance (U)(cm)	Image distance (V) (cm)	V+ U	1/V	1/U
15				
20				
15				
20				
25				
30				
35				
40				

Measurement of Object and Image Distances:

The lens is set up in front of an illuminated object so that a real image is formed on a white screen placed on the opposite side as shown below



1. Move the object to different distance from the lens o vary the value of u so that the screen is also adjusted to give a new focused image on the screen.
2. Measure the distance of u and v using a ruler

Optical Instruments

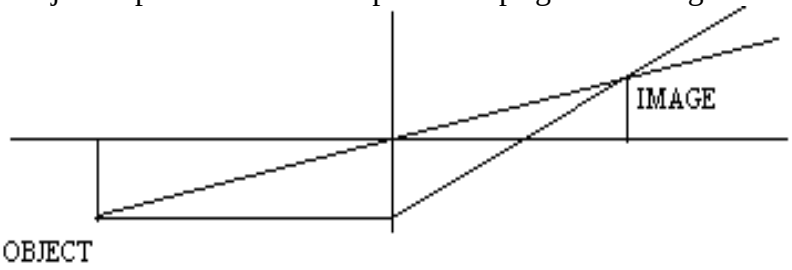
These are instruments which use light.

The Projector

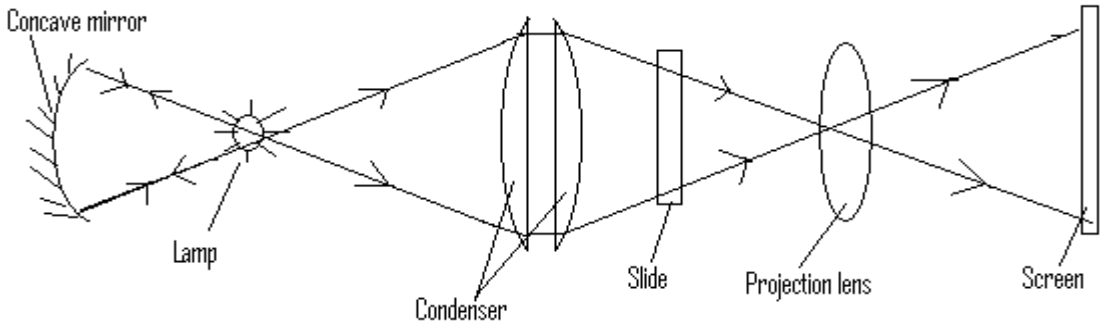
The projector consists of concave mirror, illuminate source of light , condenser lens , slide or film lens and screen (wall or white surface).

Optical ray diagrams

The object is placed inverted to produce upright real image



The slide projector



P**arts of projector and their function**

The Projection Lens

It is mounted in a sliding tube , so that it may be moved to and fro.
It is used to produce a focused, magnified real inverted image on the screen.
It has a long focal length.

Concave Mirror

It reflects light back.

Condenser

It consists of two plane-convex lenses of shorter focal length .
It collects light which would otherwise spread out and be wasted, and
It causes light to converge through the slide on to the projector lens in order to obtain a brilliant picture on the screen.
The condenser converges and condenses (concentrates) much light onto the slide or film

Lamp/ bulb

The bulb or lamp is either a carbon electric arc or a quartz iodine lamp to give a small , but very high intensity source of light.
It is situated at the centre of the curvature of a small concave mirror.
It is used to illuminate the film (object).

Note: The object is on the film or slide and the image ifs formed on the screen.

Slide or Film

The object is usually a film or slide whose image can be shown on the screen
The film is placed upside down in the projector. In this way, the image appears upright to the viewer. However, the image still remains inverted.

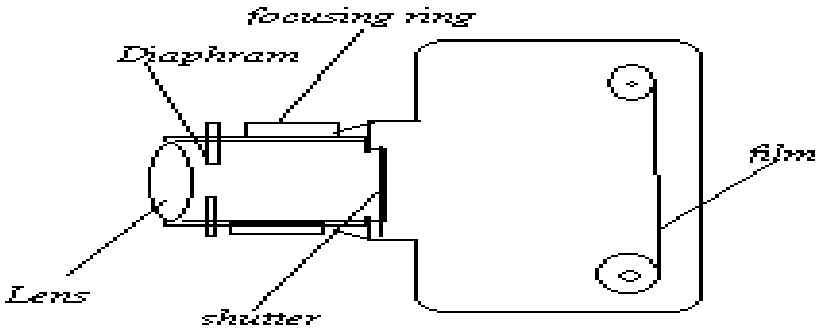
Magnification of the Image on the screen:

$M = v / u$.
To obtain higher magnification; v must be increased and u must be reduced.
This can be done by:

i. Moving the screen away from projection lens.
ii. Moving projection lens nearer to the film object, or moving the film object nearer to the projection lens.

1. Light or Lens Camera

It is a light-tight box in which a convex lens forms a real image on the film.
The image formed is smaller than the real object.



Parts of the camera and their functions

Camera lens

It has a converging lens to focus the image from outside the camera.
It is used to form a small, real inverted image on a piece of photographic film.

The shutter

It controls the amount of light entering the camera by opening and closing the hole at different times
The closing and opening allows certain amount of light to enter through the hole

The amount of exposure depend on the amount of light available in high intensity the time is short compared in dark

Diaphragm
It controls the amount of light to enter the camera through the aperture. It opens when they is need of light to take a picture.

Film
It act a screen
The film, which is normally kept in total darkness, contains a light sensitive chemical called silver bromide. The film is found at the back of the camera and acts like a screen.
The camera has provision for adjusting the distance between the lens and the film.

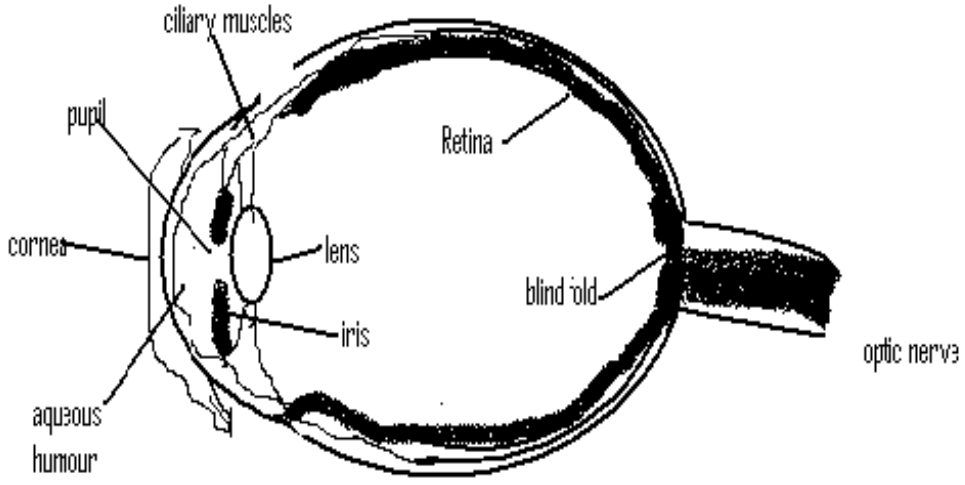
Controlling light entering the Camera:
The diaphragm and shutter regulate the amount of light energy admitted through the lens.
1. **Diaphragm :** An adjustable ring of sliding plates called the diaphragm alters the diameter or aperture of the hole through which light passes.
2. **The Shutter** : The shutter controls light entering the camera by opening and closing the hole at different speeds.

Note:
1. Sometimes exposure time can be varied and are given in fractions of a second, e.g 1 / 1000 , 1 / 60 , e.t.c. Fast moving objects require short exposures.
2. Exposure time is the time of opening the shutter to allow certain amount of light enters.
3. The shorter the exposure time, the smaller the amount of light incident on the film.
4. In bright sunlight, a short exposure time would be used. In dark conditions, a longer exposure time would be used.

Focusing the Camera:
In simple cameras , the lens is fixed. In other cameras , the lens position is altered by turning the screw mount of the lens or expandable box with accordion –like sides. This changes the lens –film distance i.e the image distance.

THE EYES

The eye uses the converging lens as eye lens. The image if focused on the retina



FUNCTION OF DIFFERENT PART OF THE EYE
Iris

It control the amount of light entering the eye. In bright light the iris draw closer to allow little light to pass and in dark it widen up to allow more light to pass.

It control the size of the pupil like in bright right it make pupil to contract and became small and little light can pass while in dark it widen up to allow more right to pass

The eye lens
It used to focus the image onto the retina

Pupil
It admit light it allow light to pass

Cornea
It protect the eye
It is transparent to allow light to pass through it

Retina
It is dark in colour found on the back of the eye to absorb light
It used as a screen where the image can be formed from the outside the eye

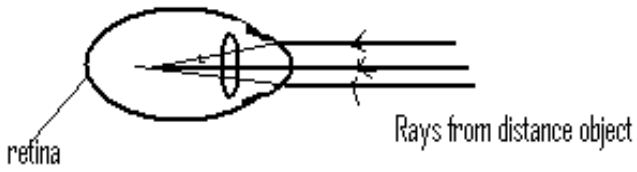
Optic nerve
It acts as the observer and carry the message to the brain for interpretation

Ciliary muscle
They are connect to eye lens so that they can change the shape of of the eye lens depending on the amount on light entering

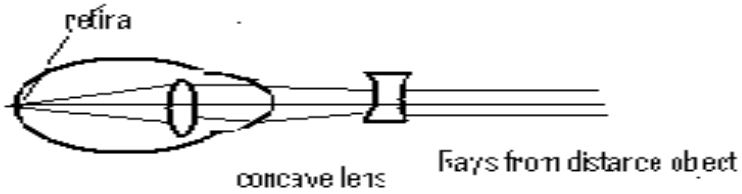
Accommodation of the eye
It the ability of the eye to focus a light from object placed at different position onto the retina and seen it clearly.

This is done by changing the eye lens shape.
When the eye see a distance object, the ciliary muscle contract and the eye lens became thin and focus the image onto the retina
When it want to focus the nearer object the ciliary muscle relax and the eye lens flattens to focus the image on the retina

Defect of the eye
Short sight
It cause because the eye ball is too long and the light rays are focused before it reaches the retina



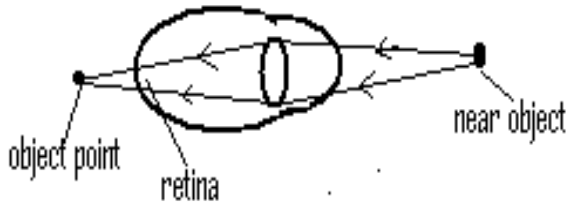
How to correct the defect
The defect can be corrected by using the diverging lens. The diverging lens diverge light light rays a little so that they should meet at the retina



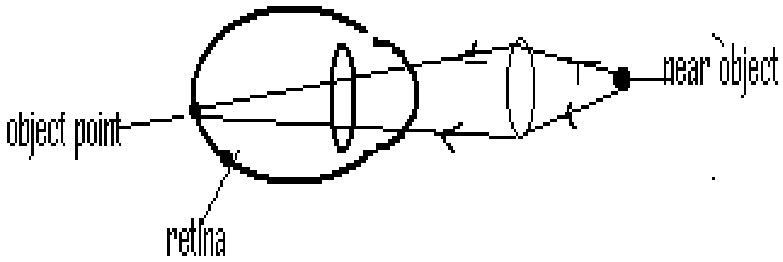
Long sight

The image is formed behind the retina.

This is caused by relaxation of the eye lens making it to have long focal length.



To correct the situation convex lens should be used to help to converge light to enter the eye causing them to meet the retina.



Comparison Between The Camera and Eye

Similarities:

1. Both have a converging lens
2. Both have their inside black
3. Both have a sensitive material where the image is formed like the eye has the retina and the camera has the film
4. Both have a mechanism to control light entering. I.e. the eye has the iris and the camera has the shutter and the diaphragm.

Differences:

1. Focal length change in eye while is fixed in the camera
2. Eye is normally always open the camera is always close expect the time taking picture
3. The eye has fixed image distance while camera image distance changes

Exercise

2003

1 (c)

i. What is the difference between a transverse wave and longitudinal wave?

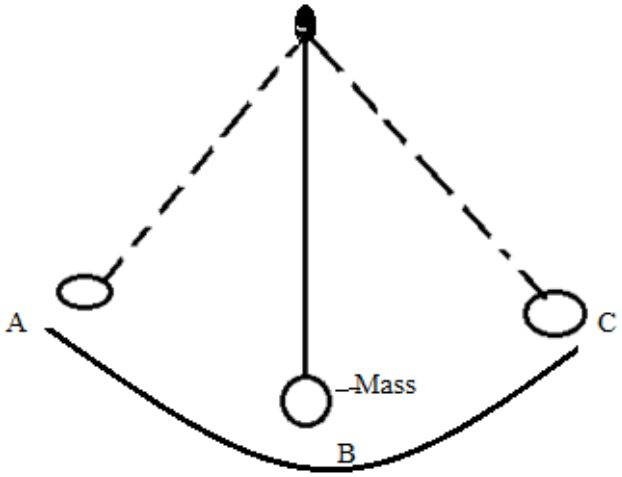
ii. Give any two characteristics of a wave

2004

Question 5

a. Define the term oscillation in relation to swinging pendulum

b. Figure 3 is a diagram of simple pendulum. The mass vibrate between point A and C through B

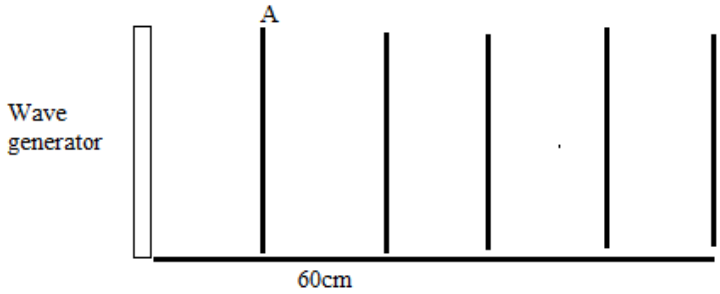


i. What happens to the speed of a mass as it moves from position
1A to B
2. B to C
ii. What is the speed of the mass at C?
iii. What happens to frequency and amplitude of oscillation of the pendulum as time increase
iv. State the energy changes of the mass as it changes from A to C

c. What happens to the frequency of the pendulum when the length of the string is changed
d. An object 2cm high is placed 7.5c in front of converging lens of focal length 5cm
i. Calculate the image distance
ii. Describe the nature of image
iii. Calculate the magnification of the image.

2005
Question 6

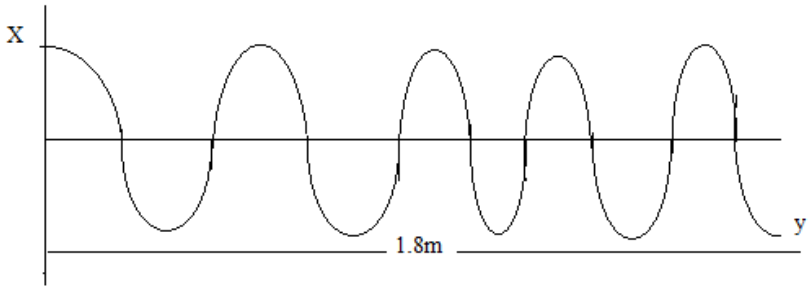
a. The figure below show the crest of straight ripples of water surface produced in a riplle tank by generator



i. What kind of wave are represented by the crest
ii. What is the wave length of the ripples if there are 5 complete waves in a distance of 60cm
iii. What is the frequency of the ripples if four crest pass through point a in one second

b. What would happen if the waves moved from deep water to shallow water? Explain you answer?
c. Give a reason for answer
d. Describe constructive interference in water waves
e. What types of waves are radio waves

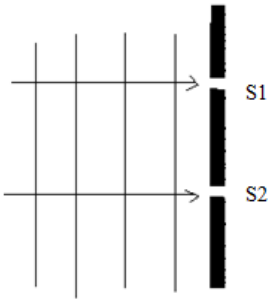
2006
Question 6
c. Figure 4 is a diagram showing a wave on a rope xy



i.Calculate the wavelength

ii.If the rope xy is swung up and down 20 times in 2 seconds. Calculate the average speed of the wave

e. Figure 5 is a diagram showing to show water waves approaching two slits S1 and S2



i. Complete the diagram to show waves emerging on the other side of obstacle

ii. State two properties of the waves that demonstrated in the completed diagram

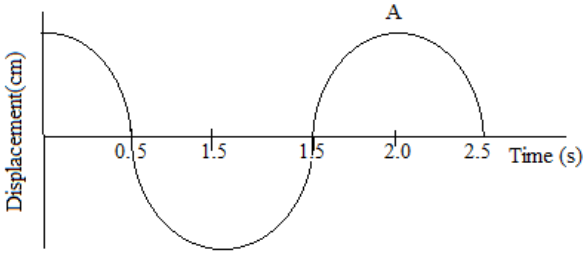
iii. What would happen to wave emerging on the other side of the obstacle if the width of S1 and S2 were increased

2007

Question 2

a. Give factors that affect the frequency of vibrating spring

b. Figure 1 is a diagram of a wave



i. Name the part labeled A

ii. Calculate the frequency of the wave

iii. Calculate the velocity of the wave if its wave length is 50m

c. (i) State any three similarities between the camera and human eye

ii. What is the function of aperture in the camera?

d. An object is placed 15cm away from convex lens of focal length 10cm

i. Calculate the magnification of image

ii. What is the nature of image

2008

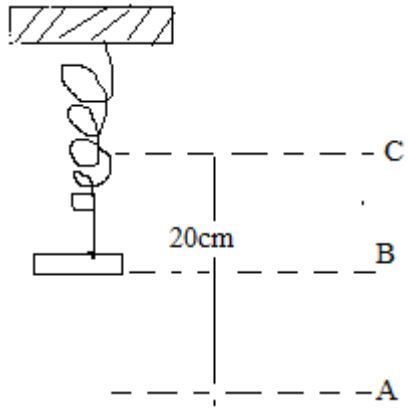
Question2

a. (i). Define the focal length of convex lens

ii. State two ways of determining the focal length of convex lens

iii. An object 10cm high is placed 25cm from the centre of convex lens of focal 10cm. Draw a ray diagram to show the position of the image formed. (Scale 1cm to represent 5cm)

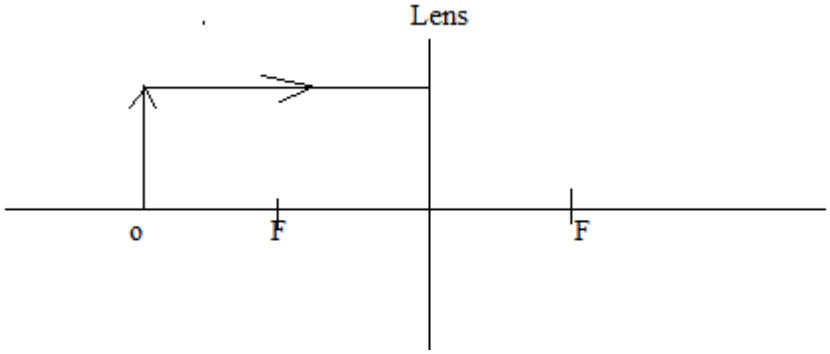
b. Figure show a diagram showing a mass hanging. If the mass is pulled to point A and released it vibrates between point A and C through the rest position B



i Calculate the initial amplitude
iiAt which point does the vibrating mass have highest kinetic energy
iiiDescribe how the potential and kinetic energy changes as mass is vibrating from A to C
ivGive two reason why mass eventually stop vibrating

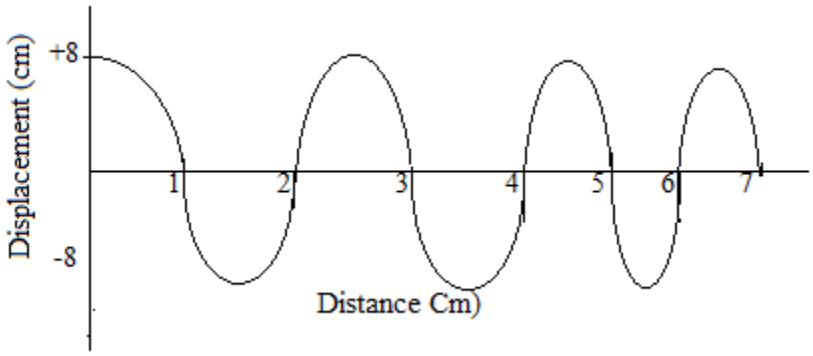
2009.
Question 2

a) Figure 2 show the part of the ray diagram



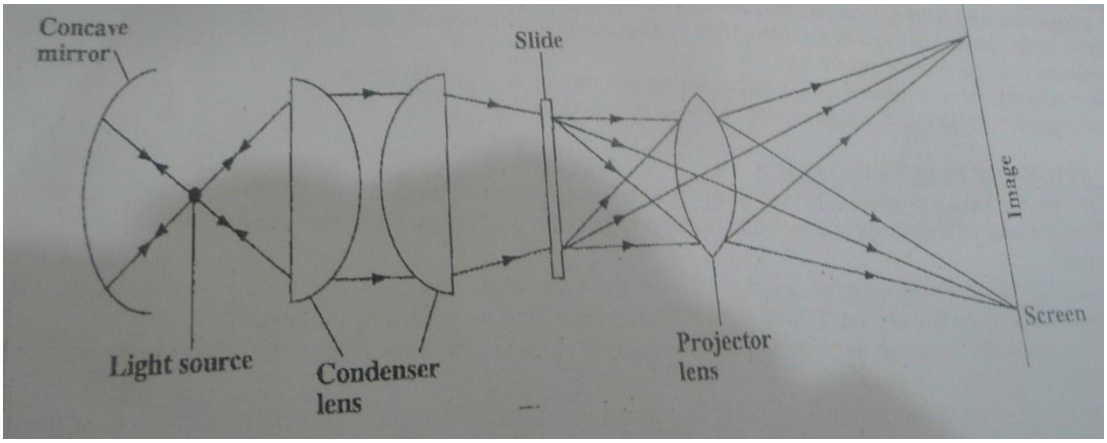
i. Complete the ray diagram to show the position of image
ii. Calculate magnification

b) Figure 3 is a diagram of the wave with a frequency of 2Hz



i. Name the type of the wave shown in figure 3
ii. Give any two properties of waves.
iii. What is the wave length of the wave?

c) Figure 4 is a diagram of a slide projector



i. State the function of each of the following condenser lens, projector lens , can cave mirror
ii. Describe the nature of image formed

2010
Question 6

a. State any three difference between real image and virtual image
b. An object is placed 30cm in front of converging lens of focal length 10cm. Use the lens formula to calculate

1. Image distance
2. Magnification

Question 7

a. State any two factors that affect the frequency of oscillating pendulum
b. Mention two characteristics of oscillating system

2011
Question 7

a. State the difference between transverse and longitudinal wave
b. Explain how focal length of a convex lens can be determined using a distance object
c. State any difference between the camera and human eye

Question 8
b. with an aid of labeled diagram explain the difference between waves passing through narrow and wide gaps

2012
Question 4

a. Define oscillation
b. (i) What type of wave is produced by vibrating string
(ii). Calculate the frequency of a wave with a wave length of 2m and speed of 6m/s
c. State the difference between interference and diffraction of waves

Question 8.

a. With the aid of diagram explain how destructive interference in water waves occurs
b. Explain why waves refract when travelling from one medium to another

CHEMICAL EQUATION AND REACTION

Chemical equation

It is the writing that represents what happens in chemical reaction

It is written inform of letter to show the reactant and products. The left hands side represents the reactant while the left hand side is for products

Rules for writing chemical equations

1. Be sure that the reaction can take place as the experiment fact
2. Make sure you have written the correct formulae of reactants and products
3. Balance the number of atoms on the both side of the equation by multiplying molecules and adding new atoms
4. In brackets after each reacts and products state the physical state like solid, gas. Or ,liquid
5. Never change the formulae of substance in order to balance it

Balancing equation

Write the equation using correct formulae for example

$Na\ (s) + O_2 \longrightarrow Na_2O\ (s)$

balance the atoms in both side

$Na\ (s) + O_2 \longrightarrow Na_2O\ (s)$

Number of the sodium in left side = 1 in the right side 2 , number of oxygen in the left hand side = 2 while in the left is 1.

To balance multiply by 4 on sodium in left hand side and 2 in the right hand side to balance

$4Na\ (s) + O2 \longrightarrow 2Na2O\ (s)$

RELATIVE ATOMIC MASS (RAM)

It is the number of times an atom is heavier than a hydrogen atom or 1/ 12 the of a Carbon atom.

$$\text{Relative Atomic Mass} = \frac{\text{Mass of 1 atom of element}}{\text{Mass of 1 atom of hydrogen}} \quad \text{.no unit.}$$

Relative molecular mass (RMM)

It is the sum of all relative atomic mass in a molecule?

Relative formula mass (RFM)

It is the sum of all relative atomic masses in molecular formula

Example :

Find the RFM for

1. Water (H_2O) ;
2. Copper sulphate ($CuSO_4$).

(RAM : Cu = 64 ; S = 32 ; O = 16 ; H =1)

Solutions:

1. RFM = 2 X (1) + 1 X (16) = 2 + 16 = 18
2. RFM = 1 X (64) + I X (32) + 4 X (16 = 160

THE MOLE CONCEPT AND AVOGADRO NUMBER (L)

Moles

A mole is a collective term used to describe a quantity of material, just as a dozen is used .
One of substance contains approximately 6 x 1023 particles of that substance
This number is called Avogadro s number (L) .

Mole calculations

Number of moles = $\frac{\text{Mass of Element in Grams}}{\text{Relative Atomic Mass in Gram}}$

N = m / RAM

Number of Moles in Molecule = $\frac{\text{Mass of the Substance}}{\text{Relative Molecular Mass}}$

It is conveniently arranged that 1 mole of atoms of any element has a mass equal to the Relative Molecular mass but with units of g .
Example:
RAM of sodium Na =23. Therefore mass of 1 mole of sodium atoms = 23 g.

Example 1:

Calculate the number of moles in

i. 46 g sodium metal (Na)
ii. 20 g sodium hydroxide (NaOH). (RAM: Na = 23 ;O =16 ;H = 1 ; cu = 64).

Solutions:

i. Number of moles = Mass / RAM

= 46 /23
= 2 .

ii. Number of moles = mass in g / RFM

= 20 /40
= 0.2

Example 2

How many grams are in?

a. 2 moles hydrogen
b. 0.2 mole copper (RAM : H = 1 ; cu = 64)

Solution

(a) Mass = no. of moles x RFM
= 2 X 2 = 2 g.
(b) Mass = no. of moles x RAM
= 0.2 X 64 = 13. 8 g

REACTION MASSES

Consider the chemical equation below

$C + O_2 \longrightarrow CO_2$

From the equation we can say the following

1. 1 atom of carbon react 1 molecule of oxygen to produce 1 molecule of Carbon dioxide.
2. 1 mole of carbon react with 1 mole of oxygen to produce 1 mole of Carbon dioxide
3. 12g of carbon will react with 32 g of oxygen to produce 44 g of carbon dioxide

Imagine we start with 6 gram of carbon dioxide. How many grams are required of oxygen and what will be the mass of carbon dioxide?

From the equation
12 g of carbon react with 32 grams of oxygen
So 6 gram will react with x g ram of oxygen

$32/12 = x/6$
$32x\ 6 / 12 = x$
$X = 16$ grams

Example 1.
Methane burn in air to produce water according to the following equation
$CH_4 + O_2 \longrightarrow CO_2 + 2H_2O$
If 32g of methane was used up in burning
Calculate

a. Mass of oxygen required
b. The mass of water formed

From the balance equation
1 mole of methane reacts with 1 mole of oxygen to produce 1 mole of carbon dioxide and 2 moles of water.
Relative molecular of methane = 12 + 4 = 16
Relative molecular mass of carbon dioxide = 12+ 16x2 = 44
Relative molecular mass for oxygen = 16 x 2 = 32
Relative molecular mass of water = 16 + 2= 18. since they are two molecule = 2x 18 = 36

So 32g will react with y gram of oxygen

$16/32 = 64/y$
$16y = 32x\ 64$
$y = 128g$

Form the balance equation above
16 g of methane produces 36 gram of water
Therefore 32 g of methane will produce x gram of water
$16/32 = 64/ x$
$16x = 32x36$
$= 72$ g

Therefore 32 gram will react with 128 grams of oxygen and produce 72 g of carbon dioxide
Note:
Before doing calculation make sure that equation is well balanced
First calculate the RMM or RAM of reactants and products
Use the RMM and Ram to calculate the masses

Reacting masses and balance equations

Reacting masses can be used to balance equation

Example:

A stream of chlorine gas was passed over and reacted with 2.24 of heated iron filings. The mass of chlorine used up was 4.26 g. Work out the balance equation of the reaction.

(Hint Ram for iron is 56 and chlorine is 35.5)

Number of moles in iron = 2.24/56

= .04

Number of moles for chlorine = 4.26/ 35.5

= 0.12

0.12 moles of chlorine react with 0.04 moles of iron

Therefore 1 mole of iron will react with x moles of chlorine

$\frac{0.4}{1} = \frac{0.12}{x}$

$\frac{0.12}{0.04} = x$

3 moles = x

Therefore 1Mole of iron will react with 3moles of chlorine.

$Fe + 3Cl \longrightarrow Fcl3$

Molar Volume and reacting masses

1 Mole of gas occupies 22.4dm3 at Standard Temperature and Pressure (STP) and 4.0 dm^3 at room temperature and pressure. The temperature is 25 °C and pressure is 1atm.

Example1 :

Calculate the volume of oxygen gas O2 occupied by

(i) 2 moles (ii) 0.2 mole of the gas at room temperature and pressure

Solution:

(i) volume of oxygen = no . of moles x 24 dm3

= 2 x 24 dm3

= 48 dm3

(ii) volume = Number of moles x 24 dm3

= 0.4 x 24 dm3

= 9.6 dm3

Example2

Gaseous propane (C_3H_8) born in oxygen to produce carbon dioxide and and gaseous water

i. Work out the balance equation of the reaction
ii. How many moles are there in 66g of methane?
iii. How many mole of oxygen is required to complete the combustion of 66g of propane
iv. If the same mass of propane are burnt in excess oxygen. What volume of carbon dioxide will be produced at STP
v. If the same mass of propane are burnt in excess oxygen. What volume of water vapour will be produced at RTP

Solution

1. Write down the balance equation as follows

C_3H_8 (g) + $5O_2$ (g) ⟶ $3CO_2$ (g) + $4H_2O$ (g)

Calculate the relative molecule masses as follows:

RMM of propane = 3x12 + 8 = 44

RMM of carbon dioxide = 3(12+ 2x16) = 132

RMM of oxygen = 5(2x16) = 160

RMM of water = 4(2 + 16) = 72

Number of mole in 66 gram = m/ RMM

N = 66/44

= 3/2 = 1.5 moles

From the reaction equation.

1 mole of methane reacts with 5 Moles of oxygen

Therefore 1.5 moles will react with y mole of Oxygen

1/1.5 = 5/y

Y= 1. 5 x 5

y = 7.5 moles

1Mole of Methane produces 3 x 22.4 $dm^3$of Carbon dioxide

1.5 moles will produce x dm^3 of Oxygen

X = $\frac{3x\ 22.4}{1}$ dm^3

3x 22.4dm^3 = x

100.8 dm^3 = x

66g of methane produces 100.8 dm^3

1mole of methane produce 4 x 24dm^3 of water

1.5 moles will produce x dm^3 of water

$\frac{1}{1.5} = \frac{4x\ 24}{x}$

1.5x 4x 24dm3 = x

144 dm3 = x

66g will produce 144dm^3 of water if burn in excess

COMPOSITION CALCULATION

Step to follow

1. Work out the relative formula mass using Ram
2. Work out the masses of the elements in the compound from RFM
3. Express the percentage mass of elements X in the compound

Percentage mass of x = $\frac{\text{Mass of x in the compound x 100\%}}{\text{RFM of the compound}}$

Example

Calculate the % composition of potassium nitrate

The formula is KNO3

K + N + 3O

RMM= 39 + 14 + 3(16) = 101

Percentage of K = 39 x100/101= 38. 62%

Percentage of N = 14 x 100/100 = 13. 86

Percentage of O = 48 x 100/101 = 47.52%

EMPIRICAL FORMULA

It is a formula of a substance showing simplest ratio of atoms.

Example:

Calculate the empirical formula of organic compounds containing 92.3% carbon and 7.7 % hydrogen by mass. (RAM: H = 1 ; C = 12) .

Since is by percentage by mass

It mean that carbon has a mass of 92.3 grams and hydrogen has a mass of 7.7 g

First calculate the number of moles of each element

Number of mole in carbon = 92.3/12

= 7.7 mole

Number of mole in 7.7 g of hydrogen = 7.7/ 1

= 7.7 mole

Find the ratio of atoms by dividing by the highest common factor of number of moles calculated

Ration of carbon = 7.7/7.7

= 1

Ration of hydrogen = 7.7/7.7

= 1

The empirical formula is CH

Or use the following method

	C	H
% by mass	92.3	7.7
in 100 g	92.3 g	7.7 g
Moles	92.3 g	7.7 g
	1 2	1
	= 7.7	7.7
Ratios of moles	1	1

Empirical formula = CH

CONCENTRATION

It is the amount of solute dissolved in a solvent.

Ways of expressing concentration

1. Mass per unit volume

$$\text{Concentration} = \frac{\text{Mass of solutes}}{\text{Volume of solution}}$$

This is expressed in g/l , g/cm^3 or g/cm^3

2. Mass per unit mass

$$\text{Concentration} = \frac{\text{Mass of solute}}{\text{Mass of solution (solvent)}}$$

It is expressed as solute per 100g of solvent

3. Moles per unit volume

$$\text{Morality} = \frac{\text{Number of moles}}{\text{Volume of solution in litres / } dm^3}$$

Percentage of solvent

It is expressed as percentage volume of solution. This is commonly used in beverage to show the percentage of alcohol.

$$\text{Concentration} = \frac{\text{Volume of solute (if liquid)} \times 100\%}{\text{Volume of solution}}$$

Or concentration = $\frac{\text{Mass of solute} \times 100\%}{\text{Mass of solution}}$

MOLARITY

Morality is a way of expressing concentration.

1 molar solution (1 M) is a solution prepared by dissolving 1 mole of a substance in 1 litre (dm3) of distilled water .

Example:

Calculate the morality of solution prepared by dissolving 40 g sodium hydroxide (NaOH) in 500 ml of water . (RAM: Na = 23 ; O = 16 ; H =1)

Solution:

Morality = $\frac{\text{Number of moles}}{\text{Volume in dm3 .}}$

Number of moles = $\frac{\text{mass of substance in g}}{\text{RFM}}$

But RFM = 1 X (23) + 1 X (16) +1 X (1) . = 40 .

Therefore number of moles = 40 g / 40 = 1.

Therefore morality = 1 mole / 500ml
= 1 / 0.5 dm^3
= 2 M .

STANDARD SOLUTION

Standard solution is a solution whose concentration is known.

Example 2 molar solution, a 5 molar solution, 0.1 molar solution .

Making standard solution

How to make a 1molar of sodium carbonate

1. Heat gently the solute you want to dissolve e. g sodium carbonate until all water evaporate . Left the dish contain the sodium carbon in a dissector contain a dry agent silica gel.
2. Weigh the mass of the weight bottle and record it as mass 1.
3. Measure the mass of solute E.g. sodium carbonate by adding it using a spatula. The mass to be measure should be the mass of weighting bottle plus the mass of solute. For example for 1M of sodium 106 g should be measured plus the weight of the bottle.
4. Add enough distilled water to cover the particle of solute. Stir it with a glass stirring rod until all solute dissolves.
5. Clean the stirring rod using distilled water and transfer the washing and the solution into 1000 cm3 volumetric flask using the funnel
6. Add distilled water until the mark on the neck. Use the washing from the washing bottle to top up the solution level to the mark of the volumetric flask
7. A special stopper should be fitted on the mouth of the volumetric flask

HOW TO MAKE A SOLUTION FROM ANOTHER KNOWN SOLUTION

Example.

How to make 0.5 molar in 500cm^3 solution from 2 molar of NaOH

1. Using the formula $M_1 \times V_1 = M_2 V_2$. or $C_1V_1 = C_2 V_2$.

Calculate the required volume of the solution that will be diluted .

0.5 x 500 = 2 xy. Where y is the volume of solution to distilled

$125cm^3$ = y

2. Using a measuring cylinder measure exactly $125cm^3$ of 2 molar sodium hydroxide
3. Transfer the 2 molar sodium hydroxide to $500cm^3$ volumetric flask.
4. Wash the measuring cylinder and transfer the washing to the volumetric flask using the funnel
5. Add the distilled water until it reaches the mark of $500cm^3$ and take a cork and fit on it.

TITRATION

It is the gradual addition of a solution (liquid) to another solution (liquid) usually using a burette .

Application of titration:

The following are application of titration

1. To determine the concentration of unknown solution.
2. To make exact volume of a solution.

USING TITRATION TO DETERMINE CONCENTRATION OF UNKNOWN:

This can be used to determine the concentration of an acid or base.

A base or acid of known concentration is titrated to the solution whose concentration is not known until neutralization takes place.

Phenolphthalein indicator is added either to the acid or base. At end point of titration (when a certain acid reacts with the base), colour change takes place (from pink or purple to colourless or colourless to purple). The volumes of the acid and base neutralized are used to calculate the concentration of the unknown.

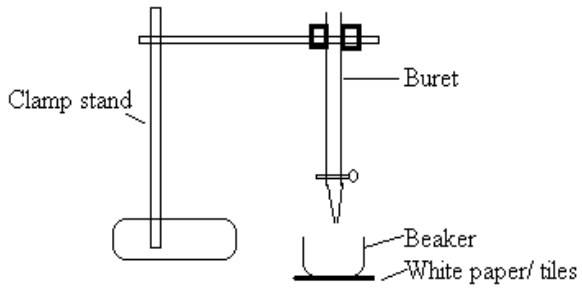
Experiment: To find the concentration of hydrochloric acid from known solution by titration

Material

Burette
Conical flask
Measuring cylinder
Wash bottle
Dropper
Hydrochloric acid
1 Molar sodium hydroxide
Distilled water
Phenolphthalein indicator

Procedures

1. Set the apparatus as below



2. Measure exactly 25 ml of Sodium hydroxide and put it in a conical flask.
3. Add few drops of phenolphthalein indicator
4. Add gradually an acid from the burette while you are shaking until it reaches the end point when the colour just starts changing to colourless. Read the volume of the acid used
5. Repeat procedure 1 to 3 to obtain other values.
6. Add all the reading of the acid and find the average.

The following formula is used to calculate the concentration of the unknown acid:
Morality of acid (M_1) x Volume used (V_1) = Morality of a base (M_2) X Volume of a base (V_2).
Number of moles of acid

i.e . $\frac{M_1 \text{ x } V_1}{N_1} = \frac{M_2 V_2 .}{N_2}$

EXAMPLE:
Calculate the concentration of 20 ml Sodium hydroxide used to neutralize 40 ml of 0.2M Hydrochloric acid.
Solution:

$\frac{M_1 \text{ x } V_1}{N_1} = \frac{M_2 V_2 .}{N_2}$

Balanced chemical equation for the neutralisation process is :

$HCl (aq) + NaOH (aq) \longrightarrow NaCl (s) + H_2O (l)$.

Therefore $N_1 = 1$ and $N_2 = 1$. Applying the equation we have:

0.2M x 40 ml = M2 x 20 ml . Since N1 = N2 =1

Therefore $M_2 = \frac{0.2M \text{ x } 40 \text{ ml}}{20 \text{ ml}}$

= 0.4M.

Other ways of finding concentration of unknown solution
Distillation

Simple distillation

The volume of the solution is measured later the solution is gently heated so that the solvent is collected. The solute after distillation is dried and measure on triple beam balance. The mass of solute is used to calculate the concentration of the solution

Fraction distillation

This method is used to find the concentration of liquid in liquid solution for example the concentration of ethanol in water. The solution undergoes fractional distillation where by the solution with lowest

boiling point is collected. Later it measured to find its volume and the concentration ids calculate
Evaporation Method
The volume of the solution is first measure and later the solution is gently heated until all solute evaporate. Later the solutes are cooled and weighed to find its mass. The concentration is calculated ad expressed as mass per volume or moles per litre
Freezing method
The volume of the solution is measure and later cooled until ice is formed. Later the solutes are dried to obtain the solute which are later measure so that the concentration can be found
NB: Titration and evaporation are commonly methods used to find the concentration of solution because it gives accurate results compare to distillation and freezing.

CHEMICAL REACTIONS:

A chemical reaction is the rearrangement of atoms to form a new substance or product.
A chemical reaction can be characterized by:
Change of colour.
Evolving of light
Evolving of heat
Production of sound.
Evolving of gases or fumes or steam.

TYPES OF CHEMICAL REACTIONS:
There are several types of reactions depending on different criteria used. E.g.

Displacement Reaction:
In this reaction an element or ion can be displaced by another element or ion.

Acid –base reaction:
In this reaction an acid is neutralized by a base to form a salt and water.

Oxidation –Reduction Reaction:
In this reaction one reactant is oxidized and the other reactant is reduced.
Exothermic Reaction:
It is a reaction in which heat energy is liberated and the temperature rises. In exothermic reactions , more energy is produced from the formation of new bonds than the energy required to break the existing bonds.
Example.
Burning of carbon.

$$C(s) + O2(g) \longrightarrow CO2(g)$$

Endothermic Reaction:
It is a reaction in which heat energy is absorbed from the surroundings and the temperature falls.
In endothermic reactions, more energy is required to break old bonds than is liberated when new bonds are formed.
Example:
Formation of hydrogen iodide from hydrogen and iodine.

$$H_2(g) + I_2(l) \qquad HI(g)$$

Precipitation Reaction:
It is a reaction in which a precipitate (solid) is formed from two soluble solutions.
Example.

Formation of silver iodide by mixing potassium iodide and silver nitrate solutions.

$KI(aq) + AgNO_3(aq) \longrightarrow AgI(s) + KNO_3(aq)$

Note:

1. For a chemical reaction to take place , there is braking of old bonds in reactants followed by formation of new bonds in products
2. For bonds to be broken, energy has to be supplied.
3. When bonds are formed, energy is released.

HEATS OF REACTIONS:

Heat of reaction is the amount of heat released or gain when the 1 mole of substances reacts together

TYPE OF HEAT REACTION

1. Heat of combustion
2. Heat of Neutralisation

3. Heat of Formation.

Note:

The energy change that accompanies a chemical reaction is due to changes in chemical energy or bonding energy between reactants and products

Heat of Formation:

It is the heat liberated or absorbed when I mole of a substance is formed from its constituent elements.

Heat of Combustion:

It is the heat liberated when 1 mole of a substance is completely burnt in excess oxygen.

Heat of Neutralisation:

It is the heat liberated when 1 mole of an acid reacts with 1 mole of bases

Enthalpy (Δ H)

It is the heat of reaction.

If the reaction is exothermic, Δ H is negative.

If the reaction is endothermic, Δ H is positive.

Heats of reaction can be categorized into the following

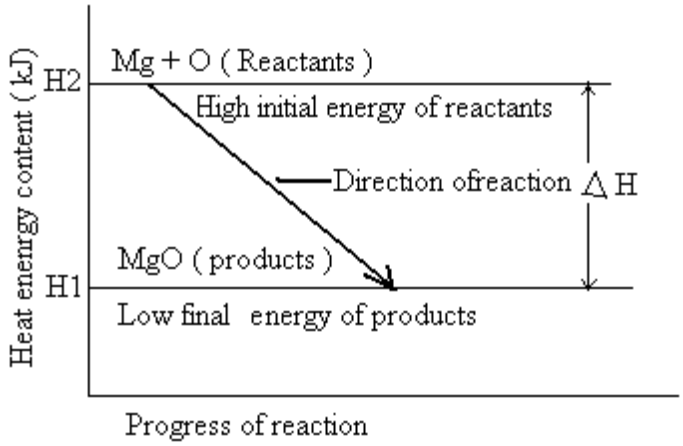
Exothermic and Endothermic heat of reaction

Exothermic heat of reaction

It the heat of reaction that cause the heating effect on the surrounding. The reaction gives off heat from the system to the surrounding.

They always gain of heat by the surrounding so that the reactant can move from high energy to low energy. The change in heat energy is always negative.

Energy Diagram for exothermic reaction



Δ H = Final energy (energy of product) – initial energy (Energy of reactants)

Endothermic reaction

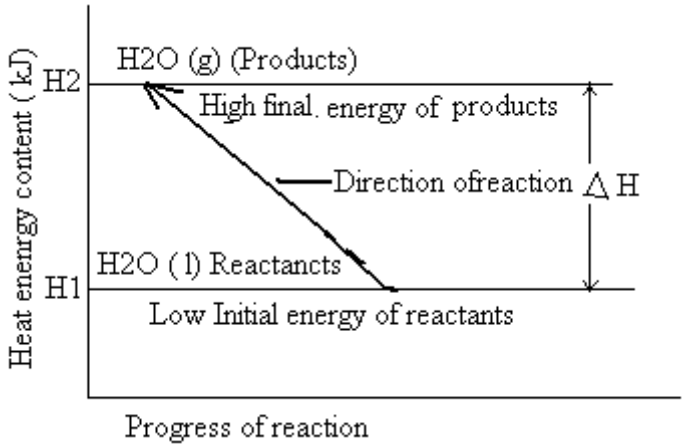
It is the change in physical or chemical which cause the cooling effect to the surrounding

The reactants take heat energy from the surrounding so that they can move from low energy level to high energy level.

The energy is taken so that it is used to break bond and rearrange atoms in the reactants

The change in heat is always positive.

Energy diagram for endothermic reaction



NB The heat energy used to break bond is greater and is in excess, the reaction will release the extra energy in form of heat hence exothermic but if the energy is small and extra energy is taken from the surrounding and cause the drop in temperature in the surrounding the reaction ids endothermic.

Exothermic mainly happen in formation of bond because atom tend to loose extra energy to the surrounding so that they can be in stable low energy state while endothermic happens in breaking of bond because energy is required to break bonds what's why they always energy drop in the surrounding in endothermic reaction.

Heat Reaction Equation

For exothermic reaction the equation can be written in the following ways:

Writing the equation in full and the heat of reaction separate

$2Mg + O_2 \longrightarrow MgO\ (s) \quad \Delta H = -18kj$

Or the heat of reaction written as part of equation

$2Mg + O_2 \longrightarrow MgO\ (s) + 18kj$

In endothermic reaction the following ways can be used

By either writing the equation in full and the heat of reaction separate

$NaCl(s) \longrightarrow Na^+ + Cl^- \quad \Delta H = +776kj$

or as part of the equation

776kj + NaCl(s) $\longrightarrow$ Na+ + Cl-

Experiment

Materials

2Test tube in a rack

Measuring cylinder

Thermometer

Spatula

Tap water

Ammonium chloride

Sodium hydroxide **Procedure**

1. Pour equal volume in each test tube approximately 5ml
2. Measure the initial temperature of water in each test-tube and record the results
3. Add half spatula of ammonium chloride in one and shake gently
4. Record the temperature of the ammonium chloride solution and record the results
5. Repeat step 3 and 4 using sodium hydroxide

Expected results

Solution	Initial temperature	Final temperature	Temperature change (Final temperature- initial temperature)
Ammonium chloride	30	19	-11
Sodium hydroxide	30	49	19

Conclusion

Dissolving hydroxide is exothermic and release heat to the sounding while ammonium chloride is endothermic and it get heat from the sounding

SPECIFIC HEAT CAPACITY

It is the amount of heat taken in or given out when 1 kg of substance change the temperature by 1degree Celsius.

$S = H/M\Delta T$

$H = SM\Delta T$

Example 1.

Find amount of heat need to raise the amount of temperature of 500g of water from 30 °C to 35 °C of water. (Hint specific heat capacity of water = 4.2J/g-°C)

$H = SM\Delta T$

$H = 4.2 \times 500 \times 5$

$= 31500J$

Calorific value

It is the amount of heat given out during the complete combustion of one gram of fuel

Example: During experiment, to determine the calorific value fuel a Student at certain Private secondary school burnt 2g of Gawasha to find its calorific value. They find that it raise the temperature by 15 degree of 100g of water. .

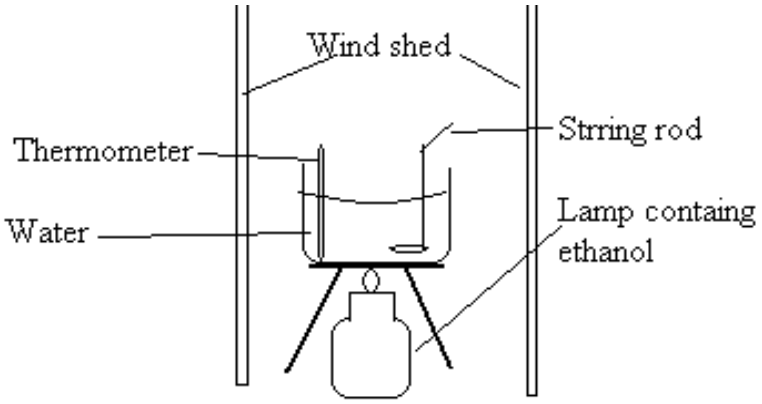
Find the amount of heat require to raise the temperature by 15 degree of 100gram

The calorific value of Gawasha

Solution
H = SMΔT
= 100 x 4.2 x 15
= 6300J

The calorific value
If 2g produce 6300j of heat energy,
1 gram will produce 2/1 = 6300/x
= 6300/ 2
= 3150J /g
Finding out the Heat of Combustion /Calorific of an alcohol

1. Set the apparatus as below



2. Weigh the small spirit lamp containing the alcohol. But the lamp should be covered after the weighing to prevent evaporation of the alcohol.
3. Put water of a certain mass in a metal can. Record the initial temperature of the water.
4. Light the lamp and put it underneath the can. The can should be heated until the temperature rise to a certain level .E.g. about 60˚C.
5. Then re- weigh the spirit lamp to find the mass of the alcohol burnt.

Heat produced when the alcohol is burnt = Heat gained by the water.
But heat gained by water = mass of water in kg x temperature rise x specific heat capacity of water.
X g of alcohol produces Heat gained by water.
This has to be compared to the heat that can be produced by 1 mole of the alcohol mass of 1RFM of the alcohol. E.g. For ethanol (C_2H_5OH)1 mole weighs 46 g.

ELECTRON TRANSFER

REDUCTION AND OXIDATION REACTION (REDOX REACTIONS)

OXIDATION:
It is a reaction in which there is
1. Increase in oxygen content.
2. Loss of electrons
3. Increase of charge on the atom or ion.

Example of oxidation:
Burning magnesium in air, magnesium oxide is formed. In this cases magnesium gain oxygen and is said to oxidized .

$2MgO(s) + C\,uO(g) \longrightarrow 2MgO(s) + Cu.$

Example 2. $Zn^{\circ}(s) + Cu^{+2}(aq) \longrightarrow Zn^{+2}(aq) + Cu^{\circ}(s)$

1. Zinc has lost electrons
2. Has increased its charge from 0 to +2

Therefore Zinc has been oxidized

From the equation we can say that

REDUCTION

Reduction is defined as

1. Gain in electron
2. Loss in oxygen
3. Decrease in oxidation number

For example

$2CuO + C(s) \longrightarrow 2\,Cu0(s) + CO_2(g)$

From the equation

Copper has lost oxygen

Therefore cooper has be reduced

Example 2.

$Zn^{\circ}(s) + Cu^{+2}(aq) \longrightarrow Zn^{+2}(aq) + Cu^{\circ}(s)$

From the equation we can say

1. Copper has decreased its charge from +2 to 0
2. Copper has gained electrons

Therefore copper has being reduced

Redox reaction without oxygen

Consider the following equation

$Zn^{\circ}(s) + Cu^{+2}(aq) \qquad Zn^{+2}(aq) + Cu^{\circ}(s)$

From the equation

Zinc has lost two electron and has also increase its charge from 0 to +2 there for it has been oxidized

Copper has gain two electron and it charge has decrease from +2 to 0 therefore it has been reduced by gaining an electron

Oxidation number

It is the number given by the charge on a molecule or an atom.

For example Cu^{+2} the oxidation number is +2

Rules of assigning oxidation numbers

1. All elements has oxidation number of zero when they are neutral
2. Oxygen has oxidation number -2 except when in gaseous state then its charge number is zero
3. Hydrogen has charge number of hydrogen is +1 except when it is an element
4. All molecules the total charge is zero
5. For charge ion the sum of the separate charges inside the ion must equal to final charge on its self

Example

What is the oxidation number of S in SO_2

From rule 2 oxygen has oxidation number of -2
Therefore 2 oxygen molecule has 2x-2 = 2
From rule 4 t the sum for a molecule is zero

Therefore S+ (-4) = 0
S= +4
The Charge for S is + 4
Example 2
Work out the oxidation number of MnO4-
From rule 5
MnO_4^-
Mn + 4(-2) = -1
Mn -8 = -1
Mn = +7

OXIDASING AND REDUCING AGENT
Oxidasing agent is a substance that cause another substance to oxidised
Oxidizing agent has the following properties

1. It gains electron
2. It loses in oxygen
3. It decreases its oxidation number

Reducing agent is the substance that causes another substance to be reduced.
The reducing agent has the following properties

1. It increase in oxygen content.
2. It gains oxygen
3. It increase its of charge

Example: In the following equations identify a reducing agent and oxidation agent

1. $Zn^{\circ}(s) + Cu+2(aq) \longrightarrow Zn^{+2}(aq) + Cu^{\circ} (s)$
2. $2Mg^{\circ} (s) + O_2(g) \longrightarrow 2MgO(s)$.
3. $Zn^{\circ} (s) + 2Ag +(aq) \longrightarrow Zn^{+2} (aq) + 2 Ag^{\circ} (s)$.
4. $Cl_2 + Br^- \longrightarrow 2Cl^- (aq) + Br_2 (aq)$

Solution

1. Copper is oxidation agent because it has increase it charge while Zinc is reducing agent because its charge has be reduced and has donated electrons
2. Magnesium is reducing agent because it has gain oxygen and has reduced oxygen to form magnesium oxidised while oxygen is a oxidizing made magnesium to be oxidised
3. Zinc is reducing agent sagent because it has increase it charge while silver is oxidation agent because its charge has be reduced
4. Bromine is oxidation agent because it has increase it charge while chlorine is oxidation agent because its charge has be reduced

ELECTRON TRANSFER

DISPLACEMENT REACTION

It is a reaction whereby one atom or ion displaces the other .

Consider the following reaction
When magnesium is placed in silver nitrate solution

1. Magnesium rod start to dissolve
2. The rod start to be cover with shiny silvery – black coatings

When zinc rod is placed in copper sulphate solution the following are observed
1. Zinc dissolve and a black brown coating of cooper is seen formed at zinc rod
2. The blueness of copper disappear after some time

When silver rod is placed in sodium chloride nothing happens

From the above observation
We can say
Magnesium displaces silver
Zinc displaced copper
Silver failed to displace sodium

From observation 1
Magnesium was dissolving according to equation
$Mg° - 2e^- \longrightarrow Mg^{+2}(aq)$

The electron was transferred or handed over to silver as follow
$Ag^{+2}(aq) + 2e^- \longrightarrow Ag°(s)$

Combining the two half equation

$Mg° (s) - 2e^- \longrightarrow Mg^{+2}(aq)$
$Ag^{+2}(aq) + 2e^- \longrightarrow Ag°(s)$

Overall equation
$Mg° (s) + Ag^{+2}(aq) \longrightarrow Mg^{+2}(aq) + Ag° (s)$

We can see the reason of formation of silver solid on magnesium rod

DISPLACEMENT TABLE OF METALS

It is a table with a list of metals showing how they displace each other in chemical reactions.
Metals at the top can displace metals lower down.

K	Potassium
Na	Sodium
Li	Lithium
Ca	Calcium
Mg	Magnesium
Al	Aluminum
Zn	Zinc
Fe	Iron
Sn	Tin
Pb	Lead
H	Hydrogen
Cu	Copper
Ag	Silver

Direction of reactivity

Experiment: To investigate the displacement reaction

Materials:
Zinc metal
Copper metal.
Iron
Magnesium metal
Lead metal
Magnesium sulphate solution.
Copper sulphate solution
Lead sulphate solution
Iron sulphate solution
Zinc sulphate solution
4 Test tubes

Procedure

1. Fill each test tube with magnesium Sulphate and put all metal given in each test tube like.
2. Put each metal in each test tube expect magnesium metal record what happen in the table below
3. Clean the metals with a sandpaper after use
4. Do the same with copper sulphate now exclude copper metal
5. Repeat the same with zinc sulphate, lead sulphate and iron sulphate.

Expected results

	Magnesium sulphate	Cupper sulphate	Zinc sulphate	Lead sulphate	Iron sulphate
Magnesium metal		Disolve	Disolves	Disolves	Disolves
Copper metal	No reaction		No reaction	No reaction	No reaction
Lead metal	No reaction	Disolves	No reaction		No reaction
Iron metal	No reaction	Disolves	No reaction	Disolves	
Zinc metal	No reaction	Disolves		Disolves	Disolves

The order of displacement will be as follows
Magnesium > Zinc > Iron > Lead > Cupper

ACTIVITY SERIES / ELECTROCHEMICAL SERIES

Any metal can either gain electrons from one metal or donate electrons to another metal. It show how many electron a metal can lost or gain

$K - e \longrightarrow K^+$
$Na - e \longrightarrow Na^+$
$Li - e \longrightarrow Li^+$
$Ca - 2e \longrightarrow Ca^{2+}$
$Mg - 2e \longrightarrow Mg^{2+}$
$Al - 3e \longrightarrow Al^{3+}$
$Zn - 2e \longrightarrow Zn^{2+}$
$Fe - 2e \longrightarrow Fe^{2+}$
$Sn - e \longrightarrow Sn^{+}$
$Pb - 2e \longrightarrow Pb^{2+}$
$H_2(g) - 2e \longrightarrow 2H^+$
$Cu - 2e \longrightarrow Cu^{2+}$

$Ag - e \longrightarrow Ag^{+}$

OVERALL EQUATION OF DISPLACEMENT REACTION

It can be written by:

1. Writing down the half equation of the metal higher in the series
2. Writing down in reverse the half equation of the second lower metal in the series
3. Add up the two half equations.

EXAMPLE:

Placing zinc in silver nitrate solution:

$Zn^{\circ}(s) - 2e \longrightarrow Zn^{+2}(aq)$.

$2Ag^{+}(aq) + 2e^{-} \longrightarrow 2Ag^{\circ}(s)$.

Combining them we have:

$Zn^{\circ}(s) - 2e + 2Ag^{+}(aq) + 2e^{-} \longrightarrow Zn^{+2}(aq)\ 2Ag^{\circ}(s)$

Canceling electrons we have:

$Zn^{\circ}(s) + 2Ag+(aq) \longrightarrow Zn +2(aq) + 2Ag^{\circ}(s)$.

COROSION / RUSTING

Corrosion is the process whereby metals dissolve and wear away in presence of oxygen and water.

The metal is oxidized as it loses electrons.

Oxygen acts as an oxidizing agent as it accepts electrons.

Most metals form oxides when they corrode.

But when iron is the metal that dissolves, the corrosion is called rusting.

Examples of rust:

i $Pb - 2e^{-} \longrightarrow Pb^{+2}(aq)$

ii $Fe - 2e^{-} \longrightarrow Fe^{+2}(aq)$

How rust is formed

Iron ionize according to

$Fe - 2e^{-} \longrightarrow Fe^{+2}(aq)$

The electron are gained by water and oxygen

$2H_2O(l) + O_2 + 4e^{-} \longrightarrow 4OH^{-}(aq)$

The hydroxyl ion (OH^{-}) react with iron ions and water and air as follows

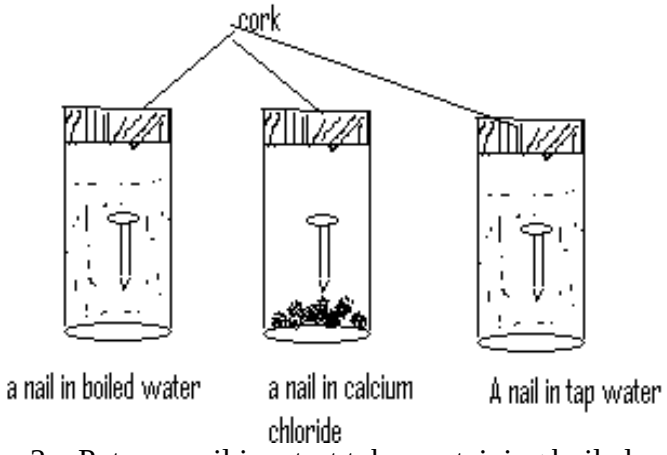
$4Fe(OH)_2(s) + 2H_2 + O_2(g) \longrightarrow 4Fe(OH)_3(s)$ (rust)

Conditions for rusting

1. Presence of water
2. Presence of oxygen from air
3. Presence of electrolyte e g sea water or acid solution

How to show that air and water cause rusting

1. Set the experiment as show below



2. Put one nail in a test tube containing boiled water without air and label it as test tube A
3. Take another nail and put it calcium chloride powder to dry the air label it as test tube B
4. Take another nail and put it in tap water which contain air label it as test tube C.
5. Seal the three test tubes with wax to stop air entering the test tube.

Results

Test tube	Results
A with boiling water	No rusting
B with Calcium chloride	No rusting
C with tap water	Rusting take place

Conclusion
Rusting need air and water to occur.

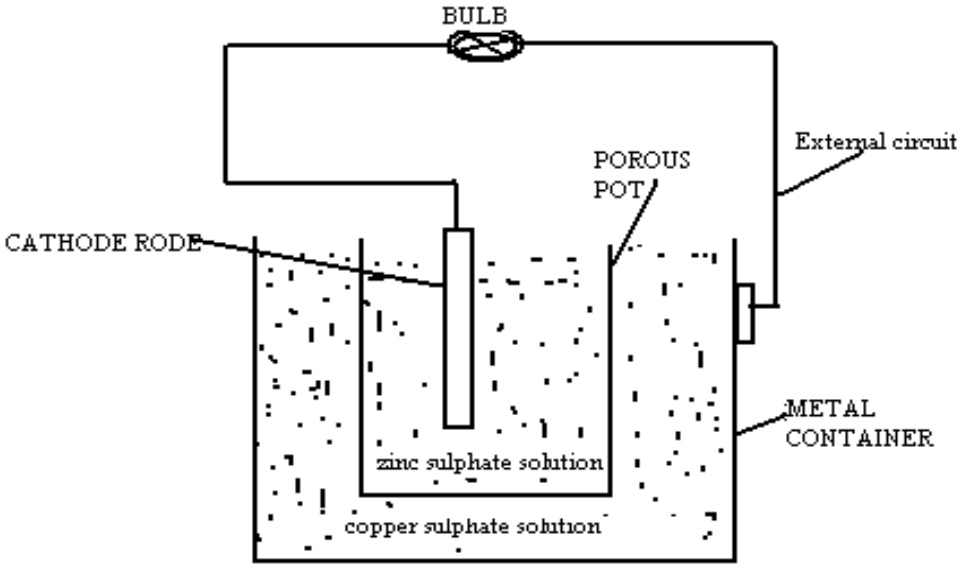
Methods used to prevent rusting

1. Painting: This prevents water to react with the metal
2. By applying oil or grease—this prevents water to react with the metal
3. Electroplating i.e. covering a metal with another metal. This prevents iron from being attacked by water and air.
4. Alloying, iron is mixed with another metal for example tin e.g. stainless steel. The metal to be used for alloying commonly come from lower metals in the displacement series so that when iron loses the electron the electron should be gained by the lower metal not water which prevent rusting.
5. **Sacrificial protection.**
   A magnesium ball is connected to an iron pipe. Iron does not dissolve; instead magnesium dissolves and donates electrons to iron. Here magnesium is sacrificed in order to prevent iron from rusting. Magnesium is higher than iron in the Activity series so it dissolves first and donates electrons to iron. A large ball of magnesium or aluminum can protect an iron pipe many kilometers long and for many years before being used up.

SIMPLE CELLS (ELECTROCHEMICAL CELLS)
It is formed when two different metals are placed in electrolyte liquid and is joined by the external wire. It cause the spontaneous redox reaction to occur when bringing current

Part of the electrochemical cell

The simple cell has the following parts



Porous pot

1. It separate the two solution so that they should no general mixing
2. It allow current (ions) to pass from one solution to another completing the circuit

Metal container:
It is used to hold a solution plus it act as anode. It is made by the type of the solution of the metal that will be displaced

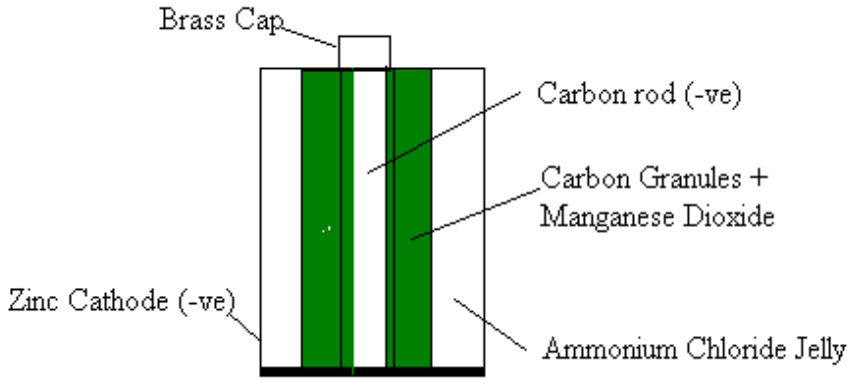
The cathode rod:
It is made by the metal with is on top on the displacement series.
It is dipped in the solution containing the ions of the same metal.
It where oxidation happens, the anode dissolves

NB
Metals that are farther apart in the Activity Series or Voltage Series give higher voltage.
In the cell, a higher metal dissolves to release electrons and ions. Electrons can flow through the circuit if metals are connected through a wire.

Polarization and Depolarization
Polarisation is the effects that cause the electric current to die away in a cell.
Cause of polarisation
In any electrolyte water also ionize as follows\
$H_2O \longrightarrow H^+ + OH$
The anode attracts the hydrogen ion to be discharged. As a result there is formation of hydrogen gas around the anode that act as an insulator preventing other ion to be discharged as a result it current dies gradually

Depoloraisation
It is the process of trying out to avoid the cell no to die out
Potassium dichromate is used to as a depolarizer by reacting with hydrogen ion to form water.

The dry cell
Part of the dry cell and their function



The solid carbon rod
Act as the anode of the cell. It receive electron from zinc plate
The zinc casing
It act the cathode which corrode and release electron to the external circuit

The Manganese dioxide Black powder:
Act as oxidation agent that act as depolarizer by converting hydrogen gas into water by adding oxygen
Moist Graphite granular
It helps manganese oxide to conduct electricity. The mixture is moist to allow ion to pass
Ammonium chloride Jelly
It allows the movement of ions and therefore passes the electric current through the cell
The brass cup
It act as a positive electrode

PROTON TRANSFER

LOWRY BRONSTED THEORY OF ACIDS AND BASES:
Lowry Bronsted theory of acid and bases tries to expand the meaning of acid and bases rather than the ordinary meaning which say that acid and base are substance that produces water when they react. The theory tries to explain why some substance behaves as acid although they do not produce water when they undergo acid base reaction.
According to Lowry bronsted theory of acid and bases an acid is any substance that can donate or give away proton awhile a base is any ion or a molecule that can accept a proton

In Lowry bronsted theory an acid is a proton donor. It provides protons or H^+ ions while a base is a proton acceptor.
NB: The hydrogen ion is simply a proton. This is because a hydrogen atom contains a proton and an electron. As H^+, the electron is removed. The acid can act as a proton donor if there is a base (proton acceptor).
Example of Lowry Bronsted acid and base reaction
$HCl\ (g) + NH_3(g) \longrightarrow NH_4(s)$.

HCl is donating H^+ to NH_3
Therefore HCl is L/B acid is a proton donor

NH^3 is accepting H^+ to form NH_4^+
The ammonium is a L/B base because it has accept a proton from HCl

$NH4^+ + Cl^- \longrightarrow HCl + NH_3$

From the equation

NH_4^+ is behaving as an acid while Cl^- behaving as a base

IONIC EQUATION:

It is an equation which shows the ion which causes acidity H^+(aq) reacting with the ion which causes alkalinity OH^-(aq) to produce neutral water.

The equation summarises the reaction between any acid and alkali in aqueous solution.

Eg.

HCl (aq) + NaOH (aq) $\longrightarrow$ NaCl (aq) + H_2O(l).

H^+ (aq)- (aq) + Na^+ (aq + OH^- (aq) $\longrightarrow$ Na^+ (aq)+ Cl^- (aq)+ H_2O(l).

By taking out spectator ions: we have;

H^+ (aq) + OH^- (aq) $\longrightarrow$ H_2(l)

NB. Spectator ions here are those which are unchanged on either side.

WATER AND LOWRY BRONSTED SYSTEM

Water as base

Water molecule can accept a proton: e.g.

HCl (aq) + H_2O(l) $\longrightarrow$ H_3O^+(aq) + Cl^- (aq).

The water molecule accept hydrogen proton to form a $H_3O^+$is a hydronium ion or oxonium ion.

During the reaction water tend to accept a proton from an acid. In this situation it act as a L/B base

HNO_3(aq) + H_2O $\longrightarrow$ H_3+(aq)+ NO_3-(aq)

H_2SO_4(aq) + H_2O $\longrightarrow$ H_3+(aq) +HSO_4- (aq)

Water as acid

Water can donate a proton. Eg.

H_2O(l) +NH_3 (aq) $\longrightarrow$ NH_4^+(aq) + OH^-(aq).

H_2O + H_2 O $\longrightarrow$ H_3O^+(aq)+ OH^-(aq).

NB 1 A reaction with water is called hydrolysis.

2. Substance which can behave both as L/B acid and L/B base is called Amphoteric.

CONJUGATE ACIDS AND BASES:

These are pairs of acids and bases.

CONJUGATE BASE

To find a conjugate base subtract H^+ from its conjugate acid.

Example

Conjugate acid			Conjugate base
H_2SO_4	- H^+	$\longrightarrow$	HSO_4^-
HCl	- H^+	$\longrightarrow$	Cl^-
H_3O+	- H^+	$\longrightarrow$	H_2O
CH_3COOH	- H^+	$\longrightarrow$	CH3COO-
NH_4+	- H^+	$\longrightarrow$	NH_3

To find a conjugate acid add H^+ the conjugate base.

In an L/B ACID-BASE EQUATION, the conjugate acid and its conjugate base are on opposite sides.

STRENGTH OF AN ACID AND A BASE:

Strong acids are acids which completely ionize when dissolved in water. Examples are:

1. Hydrochloric acid (HCl).
2. Sulphuric acid (H_2SO_4)

Weak acids are acids which do not completely ionize when dissolved in water. Some of the molecules remain un-ionized. Examples are:

1. Ethanoic acid (CH_3COOH).
2. 2. Carbonic acid (H_2CO_3)
3. Sulphurous acid (HSO_4^-)
4. Hydrofluoric acid (HF)

A strong base is a substance which ionizes completely when dissolved in water.
Examples are:

1. Sodium hydroxide (NaOH).
2. Potassium hydroxide (KOH).

A weak base is a substance that does not ionize completely when dissolved in water. Examples are:
1. Ammonia (NH_3). 2. Ammonium hydroxide (NH_4OH).

NB 1. For a strong acid or base, there is a single arrow in the ionic equation. For instance,
i. HCl ionizes as follows:

$HCl\ (g) \xrightarrow{water} H^+(aq) + Cl^-(aq)$.

ii. NaOH ionizes as follows:

$NaOH\ (aq) \xrightarrow{water} Na^+(aq) + OH^-(aq)$.

2. For a weak acid or base, there are two arrows in the ionic equation. Because there is formation of reactants and products at the same time. For instance;
Ethanoic acid ionizes as follows:

$CH_3COOH \rightleftharpoons H^+(aq) + CH_3COO^-(aq)$

ii Ammonium hydroxide ionizes as follows :

$NH_4OH \rightleftharpoons NH_4(aq) + OH^-(aq)$

DIFFERENCE BETWEEN STRENGTH AND CONCENTRATION OF AN ACID

The strength of an acid tells how easily it ionizes (dissociates) to produce hydrogen ions.
The concentration of an acid indicates the proportions of water and acid present in aqueous solution.
NB 1. A strong acid is still strong even when it is in dilute solution.
2. A weak acid is still weak even when it is concentrated.

DETERMING THE STRENGTH OF AN ACID OR BASE:

1. **BY USING CONDUCTIVITY APPARATUS.**

By passing electricity through the acid or base. The size of current can be higher if the acid or base is stronger. The size of current can be lower if the acid or base is weaker.

2. BY USING PSCALE:
   1. UNIVERSAL INDICATOR.

This can be used to find the pH value of the acid or base.
Few drops of the indicator can be added to the solution and there can be a colour change
The colour of the reaction mixture can be matched with the colour on the chart of the indicator. The pH

value can read on the chart.

2. The pH Meter can also be used to find the pH value of the acid or base.

When its two electrodes are dipped in the solution, the Ph of the solution value can be shown.

IONS IN SOLUTION

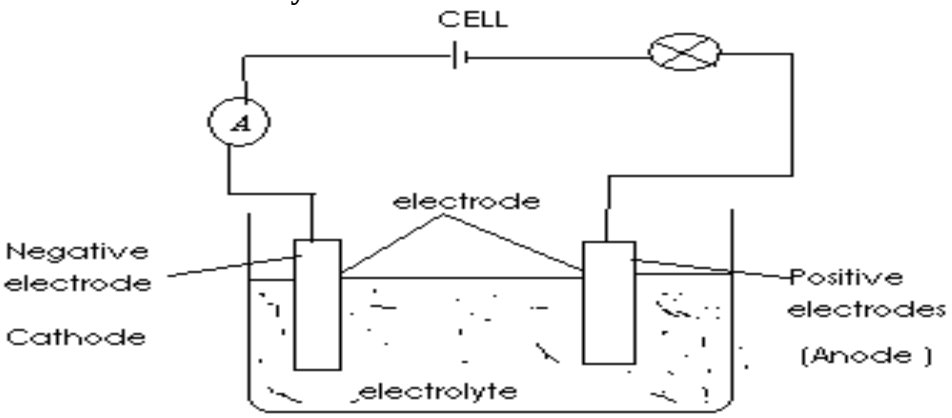
The conductivity circuits

Conductivity is the ability of a substance to allow electric current to pas through it.

Uses of the conductivity circuits

1. To show that a current flows in all parts of the circuits
2. To find the kind of electrolyte present in a beaker from the the reading of the ammeter.
3. as apparatus of electrolysis

Parts of the conductivity circuits



Electrodes.

It is a path where electric current enter and leave the solution.

It is made of nonreactive metal like graphite, platinum

They are two electrolyte, the positive electrode call the anode which is connect to the positive terminal of the cell and the negative electrode which is called the cathode and is connect to the negative terminal of the cell

The anode attract the negatively charged ions called the **anions** while the cathode attract the positive charged ions called the **cations.**

Electrolyte

It is the substance that will conduct electric current by mean of ions in liquid form.

It is usually made by the substance that conduct electricity in molten form

Type of electrolytes

Strong electrolytes

Large current pass through the solution because it has many ions present in the solution

Strong electrolyte dissociate complete in water when dissolved. They complete dissolve in water.

Weak electrolyte

They partially allow current to flow through the conductivity circuits. They have few ions that carry electric current. They do not completely dissociate in water and are partly soluble in water.

Non electrolyte

The do no conduct electricity because they have no ions that can carry electric current through the conductivity circuit. They do not dissociate themselves in water and are insoluble in water.

ELECTROLYSIS

It is a process whereby current passes through the liquid or solution and breaks down the liquid into its individual components.

ELECTROLYSIS OF SOLUTION

All metals ions are discharged at the cathode.
All Non-metals are produced at the anode except hydrogen ion .

NB: Reactive metals are not formed at the cathode, except electrolysis of sodium chloride using a mercury cathode

Factors that affect the electrolysis of a substance

1. **Amount of current**: ions are discharged when current is high. Compared to low current
2. **Type of the Electrolyte**: Strong electrolyte are discharge easily and fast compare to week electrolytes
3. **Depth of electrode**: if the electrode are dipped deep in the solution they provide a large surface are for the ions to be discharged compare to small and shallow dipped electrodes
4. **Concentration of the solution:** Very concentrated solution provides enough ions that will be discharged compared to dilute solution.
5. **Distance between the electrodes.** The electrodes are far from one another , ions travels long distance to be discharged compared to electrode that are closer to each other.

Electrolysis of copper sulphate using copper electrodes

At the node

The anode dissolves.
This mean that electron are given into the solution

$Cu^{\circ}(s) - 2e^- \longrightarrow Cu^{2+}(aq)$

At cathode

Copper is deposited
This means that copper solids are formed

$Cu^{2+} + 2e^- \longrightarrow Cu^{\circ}(s)$

The colour of the solution remain the same because anode dissolves into solution maintaining the colour of the solution

Preferential discharge of ions at the cathode

When sodium is dissolves in water
There are two ions in the solution Na^+ and Cl^-
But during electrolysis of sodium chloride
Hydrogen gas is released from the cathode not sodium

This means that they are two ions that are attracted towards the cathode, sodium ion and hydrogen ions

In aqueous solution water dissociate itself as follows

H2 H++ OH-(aq)

Therefore H+ions are attracted toward to cathode to be discharge because they need H+ need lowest energy to be discharged compared sodium. Hydrogen ion is lighter compared to sodium ion and travel to the cathode to be discharged.

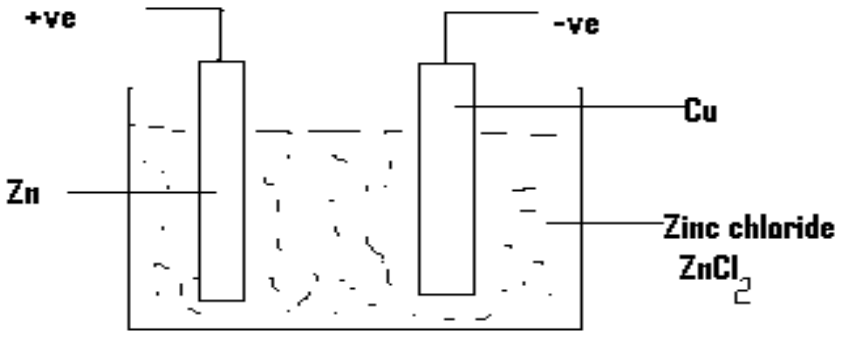
Factor that affect preferential discharge
the following factors can decide which one should be discharged first
1. the ion should have lowest energy for discharge
2. the ion should be in high concentration
3. the nature of the electrode. If the anode is made of the material like the electrolyte it will be preferred to be discharged.

NB. If the concentrations of the negative ions in solution are approximately the same, the order of discharging is :
OH- aq
I-
Br- aq Ease of discharging decreases going down
Cl- aq
NO3- aq
SO4-2 aq

USES OF ELECTROLYSIS
1 Electroplating
2.Purification of copper
3. Extraction of metals such as sodium, aluminum
4. Manufacture of sodium hydroxide through electrolysis of sodium chloride either using the diaphragm cell or the Kellner Solvary cell. In both cases , the products are sodium hydroxide, hydrogen and chlorine.

ELECTROPLATING:
It is a process of forming a very thin layer coating of a metal on the surface of another metal using electrolysis.
Reason for electroplating materials.
1. T o prevent rusting or corrosion
2. For decorative purposes.
3.To repair worn out machinery.

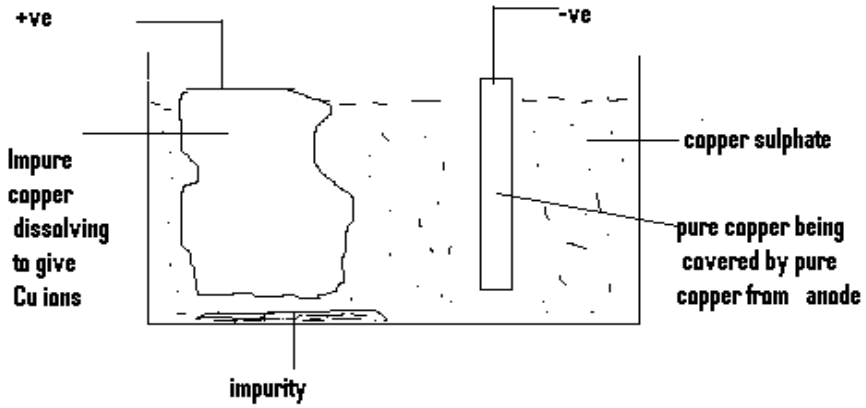
CONDITIONS FOR ELECTROPLATING:
1. The metal to be coated is taken as a cathode.
2. The covering metal is made the anode.
3. The electrolyte should be a soluble salt of the metal used to cover another metal.
NB. For effective plating , the cathode must be clean and free from grease.
Example of electroplating
Coating copper with zinc.



Zinc dissolves. The zinc ions move towards the (Cu) and they gain electrons to become zinc atoms.
Zn0(s) - _____ Zn+2aq : at anode : Zinc dissolving

Zn+2aq + 2e- _____ Zn0(s) : at cathode : zinc coating copper.

.PURIFICATION OF COPPER:
the impure copper is made the anode while the pure copper is made the cathode . The impure copper dissolves. The pure copper is formed art the node as shown in the diagram



Cu0(s) –2e- _____ Cu+2aq : on anode.
Cu+2aq + –2e- _____ Cu0(s) : on cathode

Exercise
2003
Question 3

a. (i). What is a mole?
   ii. a solution was made by dissolving 8 g of sodium hydroxide in 100cm3 of water. Calculate the morality of the solution (RAM: Na = 23, O = 16 H = 1)
b. Copper (Cu) reacts with silver ions (Ag^{+}) according to the following equations
   Cu° (s) + 2Ag +(aq) ⟶ Cu^{+2} (aq) + 2 Ag° (s) .
   i. What is the meaning of zero (o) sign on Cu°
   ii. Pick out the oxidizing and reducing agent from the equation
   iii. Write the half equation of the reaction

6d. (i). What is meant by empirical formula?

iii. Work out the empirical formula of the compound that has the following percentage composition by mass of element (C = 40 %, H = 6.67% and O = 53.33%) RAM : H = 1 O = 16 and C = 12

Question 8

a. What is the difference between an exothermic reaction and endothermic reaction?
b. Given that the reaction between methane and oxygen to produce carbon dioxide and water is exothermic and dissolving of ammonium nitrate is endothermic. Draw energy level diagram to illustrate this
c. Describe how 250cm^3 of 1 molar cooper sulphate could be prepared using hydrated copper sulphate crystals ($CuSO_45H_2O$) (the molar mass of $CuSO_45H_2O$ is 250)

2004

Question 7

a. Describe how the concentration of 20cm^3 of sodium chloride can be determined using evaporation method
b. Suggest the sources of errors
c. 100cm^3 solution of concentration 20g/l is diluted by raising the volume to 250cm^3 with distilled water. Work out the concentration of new solution.

2005

Question 7

a. Draw the diagram that could be used to electroplate an iron nail with cooper using copper chloride
b. Explain what happens during the process of electroplating of the iron nail in (a). Support the explanations with relevant chemical equations.

Question 4 PPII

a. Define the following terms
   i. Oxidation
   ii. Reduction
b. With an aid well labeled diagram , describe the experiment you would carry to show both air and water are necessary for rusting

2006

Question 5

a. (i) . Name the ion responsible for acid condition properties in a substance
   ii. Why is carbonic acid a weak acid while hydrochloric acid a strong acid?
b. Calculate the volume of 0.1M sodium hydroxide that is needed to neutralize 20cm^3 of 0.1 hydrochloric acid
c. (i). What does the symbol $\rightleftharpoons$ mean in a chemical equation
   iii. Complete the following chemical equations
      1. HSO_4^- (aq) + _____ $\rightleftharpoons$ H_3O^+ (aq) _____ (aq)
      2. H_3PO_4(aq) + _____ $\rightleftharpoons$ _____ (aq) + $H_2PO_4^-$(aq)
d. The following is the part of activity series

Lithium (Li)
Sodium (Na)
Magnesium (Mg)
Lead (Pb)
Hydrogen (H)
Copper (Cu)
Silver (Ag)

Increasing reactivity

i. State whether copper (Cu) will react with a solution of magnesium sulphate ($MgSO_4$)
ii. Explain your answer
iii. Which element is most reactive
iv. Give a reason for you answer

e. (i). Write the half equation for the reaction between silver nitrate ($AgNO_3$) and sodium (Na)
ii. Name the reducing and oxidizing agent

2007
Question 3

a. Ammonium is example of strong bases
   i. What is a strong base?
   ii. Write a chemical equation to show the ionization of ammonium in water
i. Identify conjugate acid base pair from the equation in 3 a.ii.

b. (i) Draw the energy level diagram for the following chemical reaction
$NaOH\ (aq) + HCl\ (aq) \longrightarrow NaCl + H_2O\ (l)\ \Delta H = -57 Kj/\ Mol.$
i. Is the reaction in 7 b ii. Endothermic or exothermic?
ii. Give a reason for your answer
iii. What is the meaning of (aq) and (l) in the equation?

c. A 300mg tablet was completely dissolved in 10ml of water , If the molecular formula of the drug is $C_9H_8O_4$
i. Calculate the number of moles in the tablet
ii. Calculate the concentration of the solution

6e. the following ids a part of reactivity series
Magnesium (Mg)
Aluminum (Al)
Zinc (Zn)
Iron (Fe)
Copper (Cu)

Increasing reactivity

i. Which of the two elements will displace zinc (Zn) from its oxides?
ii. Give a reason for your answer

f. The following are half equation for the reaction between magnesium (Mg) and Silver nitrate ($AgNO_3$)
$2Ag^+\ (aq) + 2e \longrightarrow 2\ Ag^\circ\ (s)$
$Mg^\circ (s) - 2\ e \longrightarrow Mg^{2+}\ (aq)$

i. Write the chemical equation for the reaction
ii. Name the reducing and oxidizing agent

2008

Question 7

b. What is the difference between oxidation and reduction in term of electron transfer
c. Explain how each of the following prevent rusting in iron
   i. Painting
   ii. Galvanizing

3PPII

a. Define a standard solution
b. Explain how 500cm^3 sodium chloride solution can be prepared using sodium chloride solution crystals. The explain should include al then necessary mathematical calculation. (relative atomic mass of Na = 23 and Cl = 35)

2009

5 f. Silver nitrate (Ag^+ react with Fe according the following equation

$$Fe^{\circ}(s) + 2Ag^{+}(aq) \longrightarrow Fe^{+2}(aq) + 2\,Ag^{\circ}(s)\,.$$

i. What is the meaning of the symbol 2+ on iron
ii. What is the oxidation number of silver before reaction
iii. Which substance has been reduced?
iv. Give a reason for your answer in 5f iii. Above

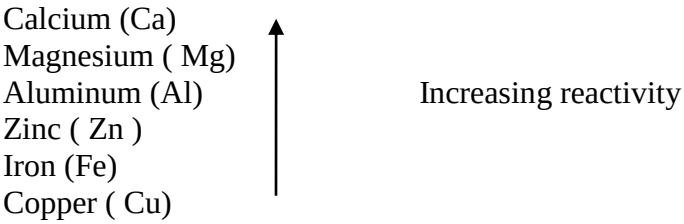
Question 8

a. What is a electrolyte
b. With the aid of the diagram describe an experiment you can carried out to compare electrical resistance of potassium nitrate solution and potassium chloride solution.

2010

Question 2

a. State two advantages of electroplating a metal
b. Below is a part of displacement series metals



i. Which metal would displace all others metals from their solution
ii. Give a reason for your answer
iii. What would happen if magnesium metal was placed in copper sulphate solution

c. Water react with carbonate ion according to the following equation

$$H_2O\,(l) + CO_3^{2-} \rightleftharpoons OH^-\,(aq) + HCO_3^-\,(aq)$$

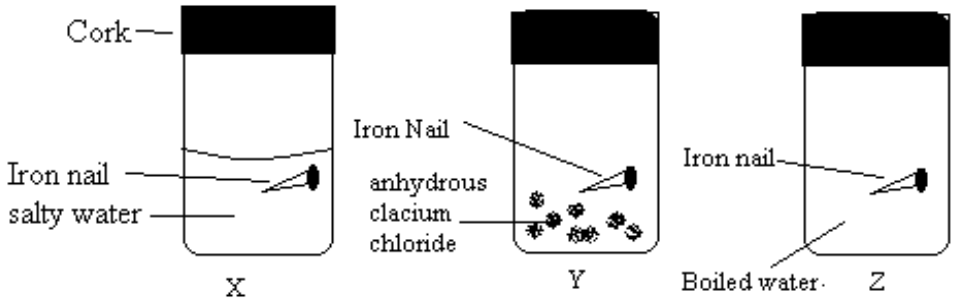
Give one conjugate acid base pair in the reaction

d. Define oxidation in term of oxygen content in a substance
e. The chemical equation below shows the displacement reaction between zinc (Zn) and lead nitrate ($Pb(NO_3)_2$)

$$Zn\,(s) + Pb(NO_3)_2 \longrightarrow Zn(NO_3)_2 + Pb$$

Name the reducing and oxidation agent in the reaction

f. Figure 2 is a diagram showing a set of experiment to investigate conditions for rusting of iron

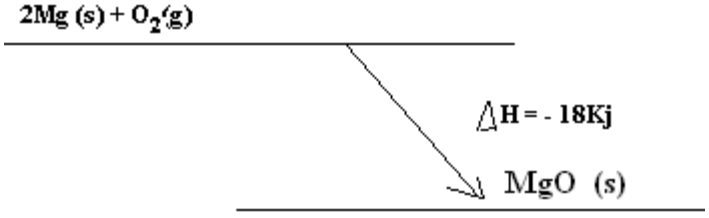


i. Why was anhydrous calcium chloride used in test tube Y
ii. Why was water5 in test tube Z boiled?
iii. State any two condition necessary for rusting

2011
Question 3
a.(i). Define Molar volume of a gas
ii. Calculate number of mole of sulphur dioxide occupying 120dm^3 at room temperature and pressure
b. (i) define acid according to Lowry Bronsted theory
ii. Describe how a hydronium (H_3O^+) ion is formed

c. Explain why bond breaking is endothermic while bond making is exothermic
d. (i) Mention any two ways of preventing corrosion in metals
(ii). Calculate the oxidation number of nitrogen (N) in nitrate (NO_3^-) give n that the oxidation number of oxygen (O) is – 2

2012
Question 5
a. Define electroplating
b. Iron (Fe) displaces copper (Cu) from copper sulphate solution ($CUSO_4$)
i. Write down a balanced equation for the reaction
ii. What is the reducing agent in the reaction?
iii. Give a reason for your answer
c. What is the difference between oxidation and reduction?
d. (i). define concentration of a solution
ii. The volume of sodium hydroxide solution (NaOH) of concentration 20g/l is increased from 60Cm^3 to 600cm^3 by adding distilled water. Calculate the concentration of the new solution in g/l
e. Figure 3 is an energy level diagram for the reaction between magnesium (Mg) and oxygen gas (O_2)



i. Is the reaction exothermic or endothermic
ii. Give a reason for your answer
iii. State the meaning of the arrow in the diagram

ELECTRICITY, MAGNETSIM AND ELECTROMAGNETIC INDUCTION

Electricity is flow of electrons the negative

TYPES OF ELECTRICITY

1. Static Electricity 2. Current Electricity

Static Electricity:

It is electricity due to static charges. Examples

i. Rubbing plastic ii. Electricity in a capacitor.

Electrostatics**:**

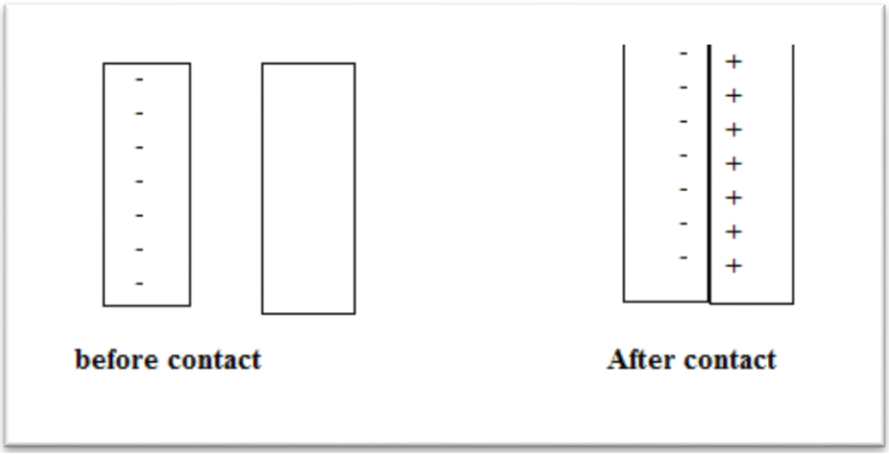
It is static electricity or stationary electric charges.

An object becomes electrically charged if it has too many or few electrons.

WAY OF MAKING STATIC ELECTRICITY

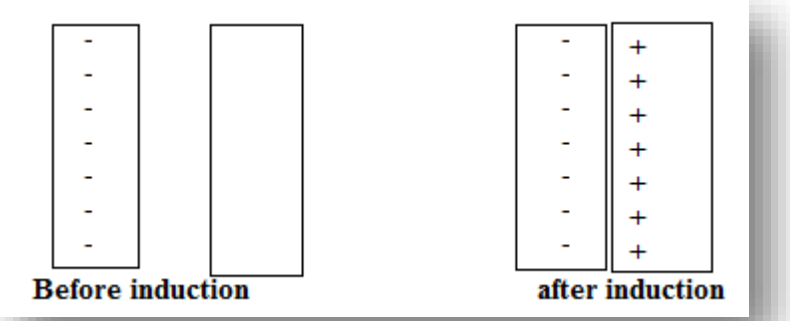
1. **By contact**

   The charged material is brought close to uncharged material. The charged material come into contact with uncharged object



2. By induction

   The charged material are is brought close to uncharged material. The charged object is just brought closer to un charge object.



3. By friction or by rubbing
   Uncharged material is rubber by a polythene material by the hair

Electric Field

Static charges create a field of force in the space around them. This field is called Electric field. The electric field can be mapped using bits of hair , just as magnetic field can be mapped with iron fillings.
Static charges obey the inverse square law: i.e.

The force between them becomes 1 /4 th as much if they are moved twice as far apart.
Electric charges can be detected using a device called Electroscope.

APPLICATIONS OF ELECTROSTATICS

1. They are used in electrostatic filters to clean air. The smoke pass through the negatively charged metal plate where they attain the negative charge and are attracted towards the positively charged plate leaving the smoke free of particles.
2. The are used in some photocopiers , light reflected from the white parts of the paper cause the charge on the drum to disappear from corresponding parts of the drum which later attracts the toner.
3. Ink jet printer, ink is passed through oppositely charged particles and the amount of reflection depends on charge and Pd across the plates.
4. They are used in paint –spraying: The car body is given the negative charge while the positive paint is give positive charge. This ensures even distribution of paint on the body of the car.
5. They are applied in electrostatic loud-speakers: Charged air molecules vibrate directly by electrostatic forces.
6. They are important in the operation of many electronic devices such as : Capacitors; cathode –ray tube ; which are used in radar, television and electrical test equipment

DANGERS OF ELECTROSTATICS

1. It cause lighting which cause the lost of properties and life of people.
2. Refueling. It can cause fire when the body of the vehicle or aircrafts charged by rubbing in the air.
3. Operating theatres - charged object attract germ and dust into the body of the patient during operation.
4. Computers- they are easily damaged by electrostatic

CURRENT ELECTRICITY

It is the electricity that flows due to flow of electrons.
Sources:
Cells (batteries) – solar panel – electric generators – thermocouple.

Some terms used in Current Electricity:

Electric Current (I)

It is the flow of electrons in a complete round path called circuit.
It is measure in units called Amperes (A).
It is measured using an instrument called an Ammeter.

Voltage (V)

It is the electromotive force used to drive electrons in a circuit.
It is also the potential difference drop across an element.
It is measured in units called volts (v).
It is measured using an instrument called a voltmeter

Electrical resistance (R)

It is the opposition of a conductor to current.
It is also the opposition to the flow of electrons in a circuit.

Factors Affecting Resistance of Conductor:

1. **Length of a conductor**:

As the length increases, resistance increases. The electrons travel a long way during the process they bump into many atoms.

2. **Cross –section area**.

As the cross-section area decreases, resistance increases,
The passage for the flow of electrons becomes less so electrons bump into many atoms.

3. **Temperature of the conductor**:

As the temperature increases, resistance decreases. The kinetic energy of the atoms increases the vibration of atom like atoms tend to vibrate with large amplitude which block electrons. But in semiconductors the resistance decreases at temperature increases because the kinetic energy by electron so that it jump from valence band to conduction band.

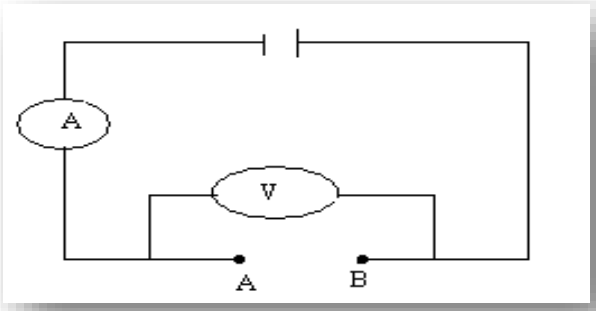
4. **Nature of the material**:

Naturally, some materials have high resistance while other materials have lower resistance. For example: Silver is a best conductor, but copper is the next best and nichrome has higher resistance.

Expriment1

The effects of length on resistance of the wire

Set the circuit as below



Connect the wire between AB . Note the reading of the ammeter and the voltmeter.
First connect 100cm wire and note the reading of the ammeter
Repeating by measuring the reading of ammeter and voltmeter with 80cm, 60cm.40cm and then 20cm

NB the same circuit can be used to verify with difference cross section area
Results

Length	Voltage (V)	Current (I)	Resistance (V/I)
100	3.3	0.47	7
80	3.1	0.52	6
60	2.8	0.56	5
40	2.4	0.6	4
20	2.1	0.7	3

From the result we can see that length is directly proportional to the resistance of the wire
like
$R \quad L$
$R = kL, k = R/L$
if there two length of the same wire.
Then $\frac{R_1}{L_1} = \frac{R_2}{L_2}$
Example:A 20cm wire has Resistance of 3ohms . Find the resistance of the same wire if the length is 70cm.
Given : $R_1 = 3$, $L_1 = 20cm$, $L_2 = 70cm.$, $R_2 = ?$

$\frac{R_1}{L_1} = \frac{R_2}{L_2}$

$\frac{3}{20} = \frac{R_2}{70}$

$\frac{(3x70)}{20} = R_2$

$10.5 \text{ ohms} = R_2$

From experiment it show that resistance directly proportional to the square of diameter of the wire.
$R \quad d^2$
$R = kd^2$
if the are two wire of the same type then

$\frac{R_1}{d^2_1} = \frac{R_2}{d^2_2}$

Example
Find the resistance of nichrome wire with a diameter of 3mm if a 2mm wire ha resistance of 5ohms

$\frac{R_1}{d^2_1} = \frac{R_2}{d^2_2}$

$\frac{5}{2^2} = \frac{R_2}{3^2}$

$\frac{5 \times 9}{4} = R_2$

11.25ohms $= R_2$

OHM S LAW:

It state that voltage is directly proportional to current

Mathematically

$V \quad I$

$V = kI$

k is proportionality constant called resistance ®

therefore

$V = RI$

$R = V / I$

Resistance (R) is measured in units called ohms(Ω).

RESISTORS:

These are conductors or electronic devices intended to have resistance.

Some resistors are made either from wires of special alloys or from carbon.

FINDING VALUES OF RESITORS:

Resistance of resistors can be found using Colour code and Resistance code.

Resistors colour code

It is the method used to indicate the resistance of a resistor . Chosen colours are used to represent the numerical values

The resistor has colored bands or rings printed on it. Each band or rings are printed on a resistor, each representing a number.

The first band is for the 1st digit; -

The second band is for the second digit.

The third band is for the number of zeros.

The fourth band or absence of a band is for tolerance .There is an allowance that resistance can vary from the marked value.

Colour	Tolerance
Brown	1.00%
Red	2.00%
Gold	5.00%
Silver	10.00%

No colour	20.00%

Colour	Number
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

Example:

Find the resistance of a resistor whose colour code is Red-yellow- orange silver.
Solution
Red = 2 , yellow 4 and silver is 10% tolerance
Therefore
Resistance is 24000
Tolerance = 10/100 x 24000
= 2400Ω
Therefore Resistance = 24000- 2400 = 21600 OR
= 24000 + 2400 =26400.Ω
The true value of resistance is between 26400Ω and 21600 Ω

Resistance Code:
Resistance values are printed on the resistor using letters.
Letters R and K indicate the position of a decimal point in the resistance value. As shown below;

Code	Resistance Value
R45	0.45
5R4	5.4
5K4	5.4 k
22K	22k

Tolerance for the Resistance Code:

Letter	Tolerance	Letter	Tolerance
F	1%	K	10%
G	2%	M	20%
J	5%		

Example1

It mean the resistor has a resistance of 5.7 □ the tolerance of 20%

example 2

The resistance of the resistor is 4700 ohms or 4.7 kilo ohms

RESISTANCE IN CIRCUITS

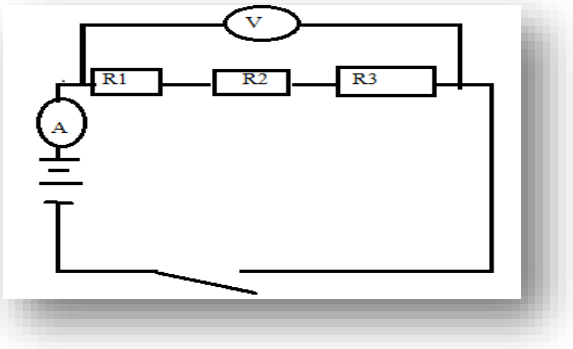
Resistors in series
Resistance is placed end to end in a straight line.Resistance increases when resistors are connected in series. This because each resistor, one after the other, resists the electrons as there is only one conducting path.

Investigation
Investigating the behavior of resistors connected in series
Materials
3 carbon resistors
2 cells
Switch
9 connecting wires
Ammeter

Voltmeter

Procedure

1. Measure the resistance of each resistor and find the sum
2. Connect the three resistors as below



3. Note the ammeter and voltmeter reading and record it
4. Divide the voltage by current to find the resistance
5. Compare the two results
   OBSERVATION: From the experiment it has been seen that the sum of individual resistor is equal to the total resistance in series.

How to find total resistance in series

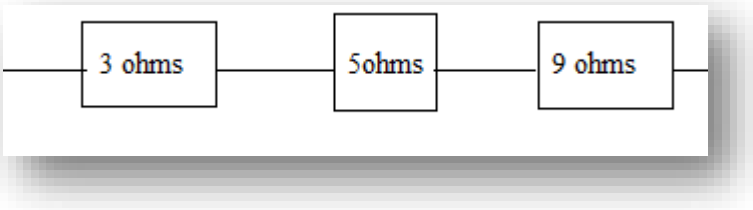
From Junior certificate physical science you learn that current is the same at any point in series circuit. You also learn that voltage from the cell is equal to the sum of voltages in each components in series circuit.
Like $V_s = V_1 + V_2 + V_3$

From Ohm law we know that V= RI

Then substituting V for RI we get
$R_sI = R_1I + R_2I + R_3I$

diving teach term by I since it is the same in each component we get
$Rs = R_1 + R_2 + R_3$
We can conclude that resistance or resistors in series is additive. i.e.

$Rs = R_1 + R_2 + R_3$ +- - - - + R_n. where n = the n^{th} resistor .
Example. Find total resistance of the resistors in the circuit below.



Rs = (3 + 5 + 9) ohms
Rs = 17ohmResistors in Parallel:
Each resistors are connected in each junction or each conducting path .

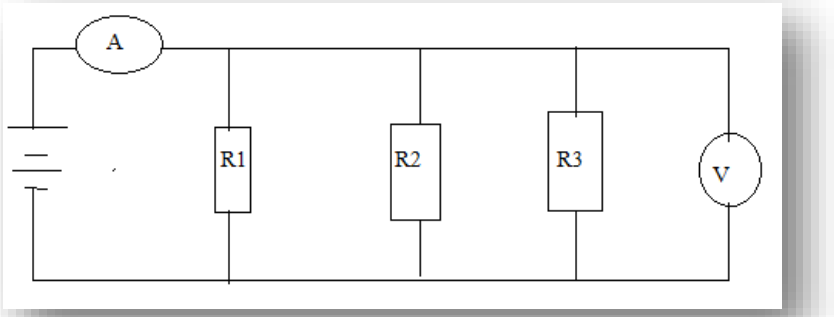
Resistance decreases when resistors are connected in parallel because is that in a parallel circuit there are more conducting paths so more electrons flow per unit time.

Investigation: The behavior of resistors in parallel

Materials
3 carbon resistors
2 cells
Switch
9 connecting wires
Ammeter
Voltmeter

Procedure

1. Measure the resistance of each resistor
2. Calculate the reciprocals of each resistance and find the sum
3. Connect the three resistors as below



4. Note the ammeter and voltmeter reading and record it
5. Divide the voltage by current to find the resistance
6. Compare the two results

Observation: You have observed that the total resistance in parallel is equal to sum of reciprocals of all resistance connected in the circuit

From Junior certificate physical science you learn that current arriving at the junction is equal to the current leaving the junction in other words current from the cell is equal to sum of currents in junctions. You also learn that voltage is the same in each component connected in parallel circuit.

$I_S = I_1 + I_3 + I_3$
From ohms law I = V/R
substituting V/R for I

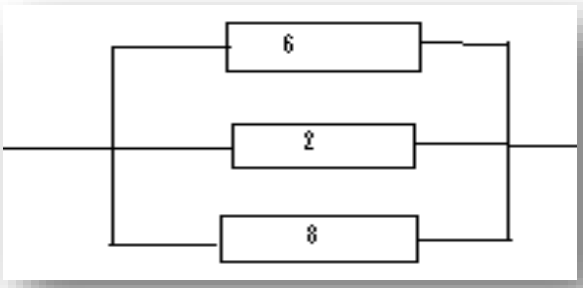
$$\frac{VV\ \ VV}{R_S = R_1 + R_2 + R_3}$$

Dividing each term by V

$$\frac{V\ V\ V\ V}{VR_S = VR_1 + VR_2 + VR_3}$$

$1/R_s = 1/R_1 + 1/R_2 + 1/R_3$
To find the total resistance in parallel circuit add the reciprocals of each resistor in parallel.

For example, Find the total resistance for the resistors in the diagram



The total resistance R_t =1/R1 + 1/R2 +1/R3

1/ R = 1/8 + 1/6 + ½

$= \frac{3+ 4 + 12}{2\ 4}$

19/24

R = 24/19

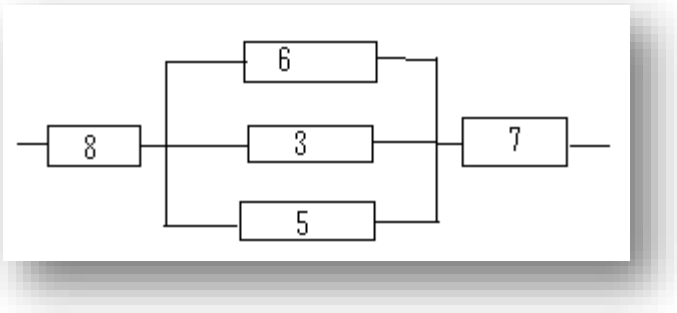
= 1.263 OHMS

example 2

A certain student connected 3 ohm, 5 ohm and 6 ohm in parallel circuit. She later add two resistance with values of 7 and 8 ohm in series circuit. Find the total resistance in the circuit

Solutions

First draw the diagram



Find the total resistance in parallel and later add the total resistance in parallel

1/R = 1/3 + 1/5 + 1/6

$= \frac{10 + 6 + 5}{30}$

= 21/30

R = 30/21

= 1.43 ohms

total resistance in series = 7+8

= 15

total resistance in the circuit is 15 +1.43

= 16.43 ohms

ELECTRICAL POWER IN CIRCUITS

Power = $\frac{\text{Energy used up}}{\text{time taken}}$

Electrical power = work done (W) = V.I and is measured in watts

But we know that R = V/I and rearranging the formula it gives V= RI

substituting in the equation for V we get $W = RI^2$

and also I = V/R the substituting for I in the equation we get $W = V^2/R$

Note

W = P.t when given time and power

W = VI is used when given voltage and current

$W= RI^2$ is used when given resistance and current

$W= V^2/R$ is used when given voltage and resistance

Example:

Find the electrical power dissipated in a resistor if the voltage supplied is 4V and the size of current flowing is 3A.

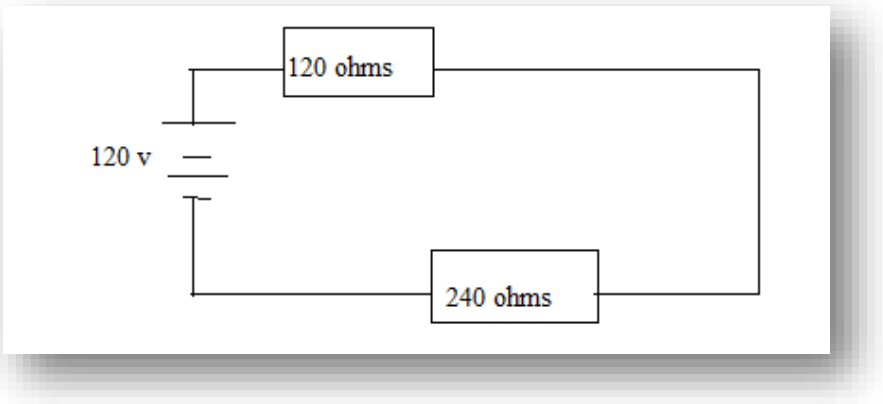
Solution:

P = VI = 4V x 3A = 12 W.

Example 2. Resistance of 240 ohm and 120 ohm are connect in series then in parallel across 120 volts . Find

a. The current in each resistance?
b. The power dissipated in each resistance

In series circuit



Total resistance = $R_1 + R_2$

= 120 +240

= 360 Ω

by ohms law. I =V/R

= 120/360

= 1/3

For 120 ohm resistor power = 120 x1/3x1/3

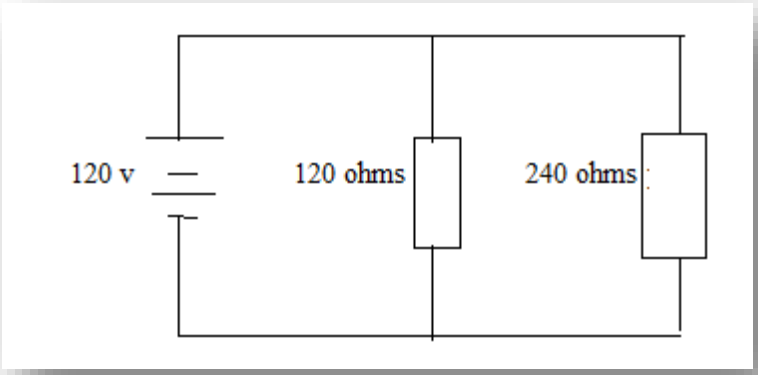
= 120/9

= 13.3 watts

For 240 resistor power = 240x 1/3x1/3

= 240/9
= 26.6 ohms

In parallel circuit



The total resistance
1/R = 1/120 + 1/240
= 3/240
R= 80
Current = 120/80
= 3/2 A
In parallel circuit large current flow in small resistance therefore the two resistance will share each other in the ratio of 1:2
Hence current in 120 ohm is 1A while in 240 is ½ A
But power = Voltage x Current
Power in 120 = 120 x 1
= 120W

In 240 ohms = 240 x1/2
= 120W
Or
We know that voltage is the same in any breach in parallel circuit
Current in 120 resistors = 120/120
1A
Current in240 resistor = 120/240
= 0.5A

Power = voltage x current
Power I 120 resistor = 120 x 1
= 120W

Power in 240 resistor = 240 x 0.5
120W

POWER TRANSMISSION
They two possible ways of transmitting power over long distance
1. By high current low voltage
2. High voltage low current

Transmitting at high current low voltage
When current is transmitted in such manner they high loss of power due to heating effect of the cable

which will lost to sounding air in cables. The consumer will receive very few amount of power.

Transmitting at high voltage low current

The consumer receive high power because there is little heating effect in the cables and the drop is very minimal.

Therefore to avoid power loss in cable power is transmitted at high voltage low current on a long distance.

ELECTRICAL ENERGY:

Power = Energy / Time.

Energy = Power x Time.

But Power = VI

Therefore Energy = V. I.t used when given voltage and current plus time

or Energy = RI^2t used when given resistance current and time

Energy = V^2/R used when given resistance voltage and time

Example:

Find the amount of energy used by a bulb for two hours if the voltage supplied is 100V and the size of current flowing is 5A for 2 hour .

Solution:

Energy = Power x Time .

But power = voltage x current = 100V x 5A = 500W.

NB Time must be in seconds.

Therefore Energy = 100V x 5A x 2 hours.

= 100V x 5A x 2hours x 60 minutes x 60 seconds.

= 3 600 000 joules.

Example 2. A heater is placed in 300g of water in a plastic jug. Find the temperate change if the current following in heater is 10A and has a resistance of 5 ohm for 5 minutes

solution

Energy = RI^2t

= 5 x 10 x10 x 5x60

= 15000 joules

$H = Sm\Delta T$

$\Delta T = H/ Sm$

= 15000/ 4.2 x 300g

= 119.05°C

COST OF ELECTRICAL ENERGY:

Electricity Boards use the kilowatt – Hour (KWh) as unit for charging electrical energy not joules.

1kWh is the amount of energy supplied in one hour to an appliance whose power rating is 1 Kw.

1 kWh = 3 600 000J

Example:

What is the total cost of leaving 2 light bulbs rated 100W each . switched on for 5hours at K1 per unit?

Solution:

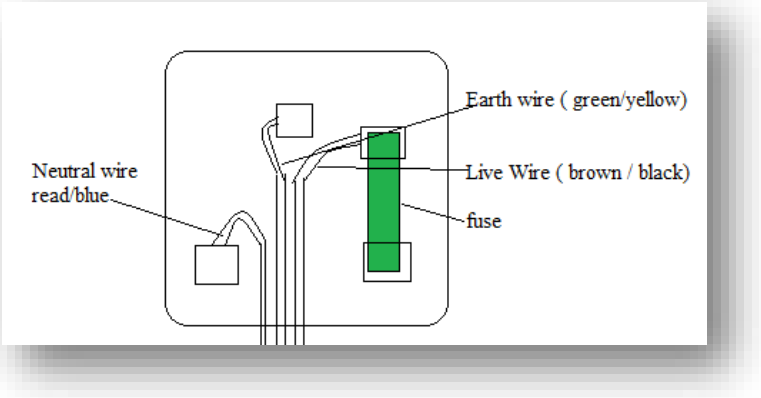
Energy = (2 x 100W) x 5hours =200W x 5hours = 0.2Kw x 5h = 1kWh

Therefore Total Cost = 1 unit x K1 = K1.00.

HOUSE HOLD ELECTRICITY

In all houses components are always in parallel .The rating are as follows:
Lighting: The maximum current is 5A while for security light the fuses ranges up to 10 A
Sockets and heating equipments e.g. geysers, cooker, hotplates their fuse ranges from 13 A to 30 A

The three pin Plug



Live wire

It is the wire that caries current. It is the wire that gives shock when you touch it.

Neutral wire

It complete the circuit by attaching it to the earth by connects the wire to the earth

Earth wire

It protect the user from the Shock when you have touch by hand. The wire is connect to the earth and metal body of appliance.
When they a shock the earth metal carries current from the body of the appliance to the earth since it has low resistance rather than passing through you.

A fuse

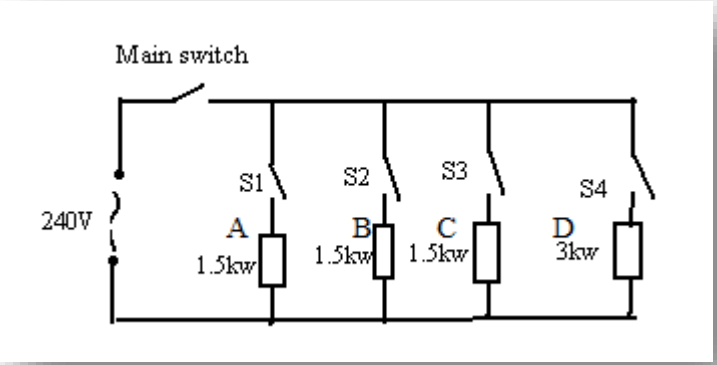
It is a thin piece of wire which overheat melts if the current is too high. It is placed in the live wire inside the plug. When current is too high it melt and break the circuit.

NB: other electrical appliances made of plastics do not have earth wire because the casing as the earth.

Fuse value

The value tells the maximum current the fuse can allow.

Example
The following electrical appliances are connect in parallel, heater with three ring rated of 1.5 kW , woven with a rating 3.0Kw the Ac supply is 250V (2009 Maneb Revisited)



Calculate:
1. The current through A and its resistance
The appropriate fuse for the circuit

Solution
1. for ring A
V= 250 , Power = 1.5 Kw , I =? R = ?
P = VI
I = P/V
I = 1.5 x1000/250
I = 6A
The resistance in A
by Ohm law R = V/I
R = 250/6
= 41.7 ohms

2. To find the appropriate fuse find the total power by adding
Total power = (1.5 + 1.5 + 1.5 + 3)Kw
= 7.Kw
But I = W/V
I = 7.5 x1000/ 250
= 30A
The best fuse should more that 30A but it should not exceed 35A.

MAGNETISM:
It is the study of behaviour of magnets

Magnets:
These are materials which attract other objects that contain iron or steel. Some magnets occur naturally, while others are artificially made.

Man-made Magnets:
1. Alloy Magnets :
These contain metals E.g. iron , nickel, copper , cobalt and aluminum.
2. Ceramic Magnets:
These are made from powders .e.g. iron o

Magnetic force:
The force exerted a magnet is called Magnetic force or Magnetism.

Magnetic Field:

It is the space or region under the influence of magnetic forces.

The magnetic field consists of imaginary field lines which originate from the north pole and moves towards the south pole in form of circles.

The field lines are closest at the poles as such magnetism is strongest at the poles or ends.

Note:

The law of magnetic poles states that :

Like Poles Repel; Unlike Poles Attract.

Magnetization (Making a magnet):

It is the process of making a substance (magnetic material) to behave as a magnet

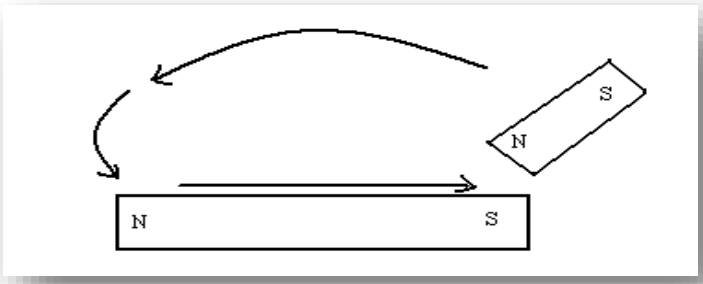
Magnets can be made in various ways such as through:

1. **Stroking:**

An object can be magnetized by being hit slightly by a permanent magnet. This make electron to point in the same direction which make the metal to attract another magnetic materials. Here there are two forms of stroking:

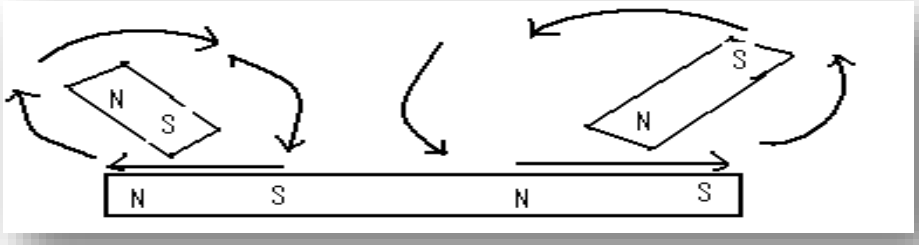
(a**). Single Stroking:**

In single stroking, one magnet is used to magnetize an object E.g. steel. Hitting starts from one end and ends on the other end. During each time , the magnet is moved over certain distance. The pole attained is opposite to that of a magnet used.

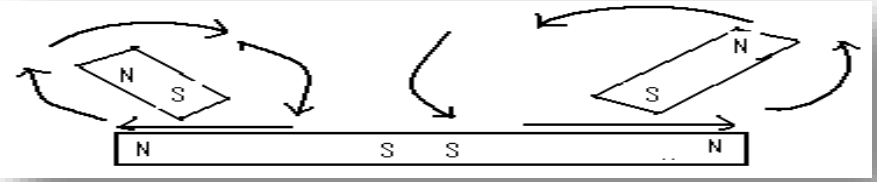


(b) Double Stroking:

In double stroking , two permanent magnets are used ,but , stroking starts at the centre and each magnet is moved outwards.



NB: It two like pole are used as follow . The magnet has the same pole on the ends as is said to have consequent poles



2. **Electrical Method**:
Direct current is allowed to pass through a solenoid with an object to be magnetized inside for few seconds.

Demagnetisation (Making a magnet lose magnetism)
It is the process of making magnets to loss its magnetic force

A magnet can be demagnetised in various ways. These include:

1. Ac. **Method**
The alternating current always changes its direction. This make the electron spins to keep on changing direction or alignment inside in the wire, hence the object loses it magnetic force due to the changing direction of electron spins since for object to behave as magnetic electron should point in the same direction. While in direct current electron point in the same direction.

2. **Heating**: Another method of destroying magnetism is to heat the magnet to redness and then allow it to cool while it is lying in an East- West direction. Heating cause electron to in excited state and tend to be pointing in different direction. Since cooling is done while the magnet is pointing in west and east direction this makes the magnet to lose it poles hence the material fails to attain its pole and became demagnetised. Heat treatment will spoil the steel. So this method is not recommended.

3. **Hammering** this break the magnet into small piece which make magnet to lose its pole vibration or rough treatment such as dropping by stopping current to flow

ELECTROMAGNETISM:
It is magnetism achieved in a conductor when current flows. The magnetic field has the following features.
1. The magnetic filed lines are in circles
2. The fields is strongest close to the wire
3. Increasing the current increase the strength of the field

How to increase magnetic force in a conductor
The magnitude of magnetic force in electromagnets can be increased by
1. By increasing the size of current
2. By wounding the wire into a long coil called solenoid.
3. By inserting magnetic material into the solenoid.

How to detect the direction of field lines.
They are two ways how the direction of field line can be detected

1. Maxwell s Screw Rule
The law state that imagine a right- handed screw being turned so that it bores its way along the wire in the same direction as current The direction of turning gives the direction of the field.

2. By right -hand grip rule

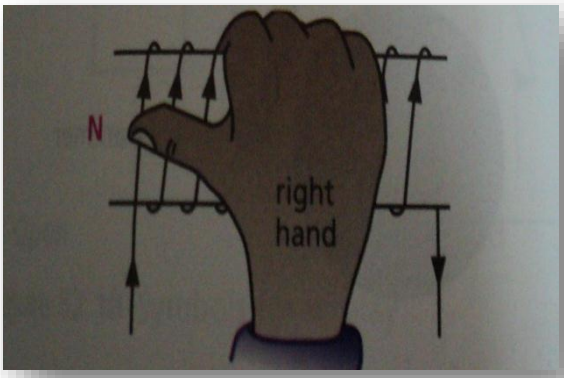
It state that imagine you are gripping a wire with you right hand and thumb point to direction of current then the rest of finger point to direction of the fields.

Field due to a Current in a Solenoid:

The coil becomes as it has a N pole at one end and a S pole at the other

How to detect the poles of the solenoid

It can be detected using the right hand grip rule by imagining that you are gripping the coil with your hand so that your fingers point in the convention current direction of current you thumb will point to the north pole of the coil



Note:

Rule for the Polarity of a Coil Carrying Current:

When viewing one end of the coil, it will be of N pole if the current is flowing in an anticlockwise direction, and of S pole if the current is flowing in a clockwise direction.

USES OD ELECTROMAGNETS:

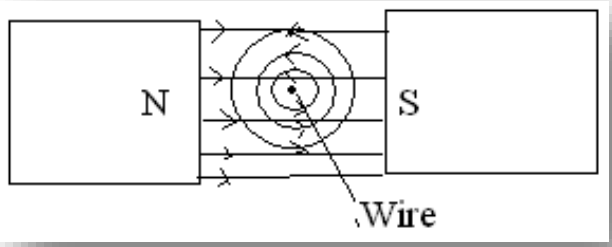
They are used in:

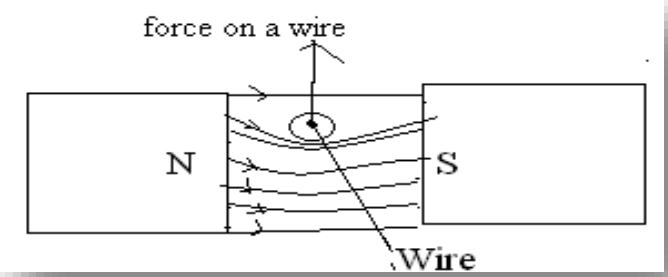
i. Electric bell
ii. Magnetic relay
iii. Loud speakers,
iv. Electric motors.
v. In the ear piece of telephone.
vi. To lift heavy scrap metals.

FORCE ON A CONDUCTOR IN A MAGNETIC FIELD:

When a current –carrying conductor is placed in a magnetic field, a force is produced.

If a stiff copper wire is put at right angles to the field provided by U-shaped magnet , and current allowed to flow through the wire ; the wire moves upwards. This indicates that there is upward force acting on it. See the diagram below.





How the force is created

The wire carrying conductor create a magnetic force in already existing magnetic filed by the permanent magnetic. The two magnetic forces cross each other causing repulsion force which causes the wire to be pushed away from the magnetic field cause by permanent magnet.

How to know the direction of force, current and magnetic field.

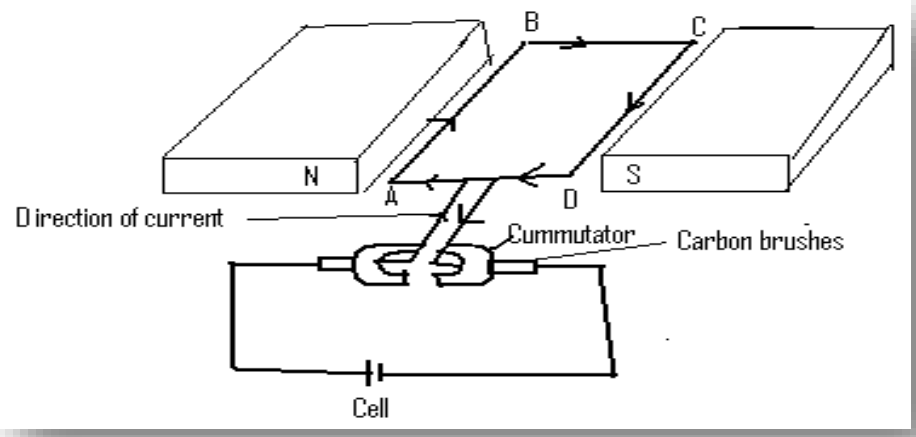
The direction of current ,force and the magnetic field can be determine by the **Fleming's left hand** rule which states that the thumb finger point to the direction of force or thrust , second finger point to the direction of current and the first finger point to the direction of field if the fingers are hold at 90 degree angle

Note:

1. If the direction of either the current or field is reversed , the wire moves downwards.

Electric Motor

It is made by two permanent magnet and a loop within the the magnetic field which is attached to the direct electric current through two brushes made of carbon.



How it works

When current flow into the loop for example through AB direction the wire is pushed upward according to Fleming right hand rule by the magnetic fields set by the permanent magnets. Since it is a loop the current also flow through from C to D which cause magnetic force to push the wire down wards.

On the loop they are two force that is acting on it , the upward force on wire carrying into the magnetic field (AB) and the force acting downward on the wire carrying current outwards.

Due to inertia, the wire overshoot and are reconnected to brushes and are re-pushed by the magnetic force in the same way. The repeatedly pushing of the wire create a continuous movement of loop in the magnetic field.

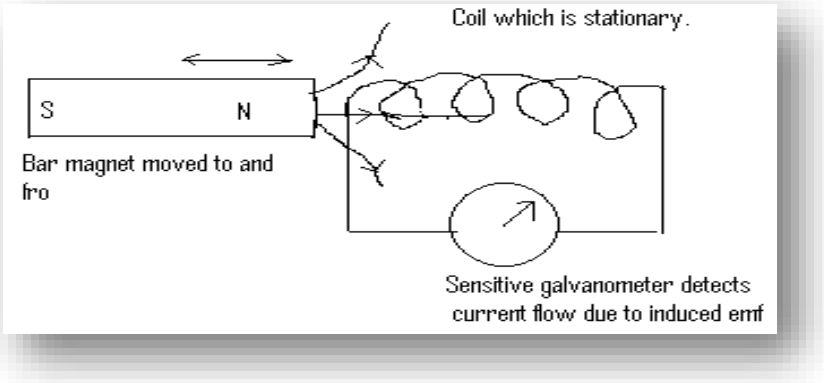
How to Increase the movement in electric motor

It can be increased by:

1. Increasing the number of turn in the coil
2. Increasing current
3. Increasing the strength of the magnetic field

ELECTROMAGNETIC INDUCTION:

It is the effect of producing electromotive force (emf) in a wire when the wire is moved across a magnetic field.



The emf produced is present only while the wire is moving, and cutting through magnetic lines. Similarly, when the magnet is moved to and fro in a coil, emf is induced in the coil

How to increase induced EMF (voltage)

1. Moving the wire at a higher speed.
2. Using a stronger magnet.
3. Increasing the length of the wire in the magnetic field. E.g. by looping the wire through the field several times.(making more turns)

Faraday s Law of Electromagnetic Induction:

It states that :

The emf induced in a conductor is directly proportional to the rate at which the conductor cuts through the magnetic field lines.

DIRECTION OF INDUCED CURRENT:

The following are ways how the direction of induced current can be predicted

1. **LENZ S LAW**

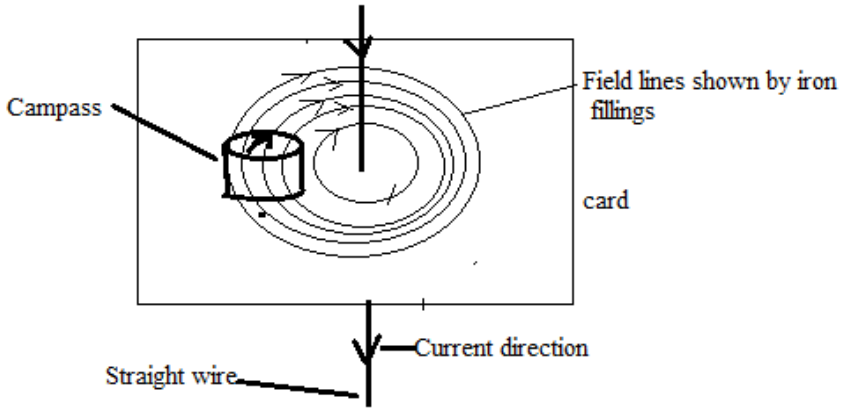
The law helps to predict the direction of the induced voltage.
It states that induced current always flows in a direction such that it opposes the change producing it. During production of induced current the direction of movement of a magnet or a solenoid change the current always changes direction to oppose the change producing it.

2. **The Fleming's right rule**

It state that ,if the thumb, second finger and the first finger is ,mutually perpendicular to each other, then if the thumb represent the direction of motion of and the first finger represent the magnetic field , the second will represent the direction of induced current
This law helps to predict the direction of the induced EMF in a generator or a dynamo

3. Magnetic compass

The magnetic needle tend to point to the direction of the magnetic field set by the conductor



Like

4. Iron fillings
   The tend to point to the direction of the induced magnetic filed set by the conductor

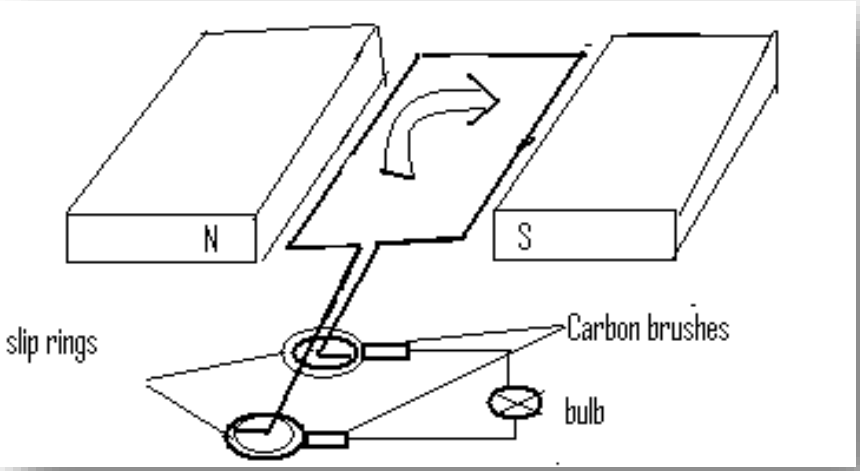
APPLICATION OF ELECTROMAGNETIC INDUCTION:

Electromagnetic induction is applied in:

i. Generators to produce electricity E.g. in bicycle dynamos HEP stations and other electricity generators..
ii. Transformers to step up or down voltage.

The bicycle dynamo (electric Dynamo)

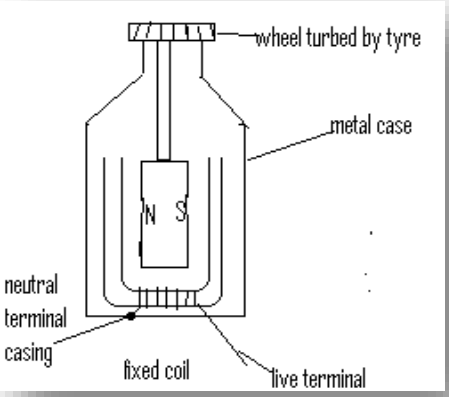
It is a device that convert the mechanical energy of movement to electric energy.



How it works

The rotating coil cut the magnetic field lines set by the permanent magnet. this induces current in the coil.

When the loop is horizontal lied it produced highest amount of voltage. When it is vertical the voltage is almost zero.



In a bicycler dynamo ,the permanent magnet rotate in the creating moving magnetic field. This changing magnetic field is being cut and re-cut by the permanent coil creating current

How to increase induced Emf in a dynamo

Induced Emf can be increase by:

1. Increase the speed of rotation
2. Number of turn in the coil
3. Increasing the strength of magnetic field

The difference between the electric motor and a dynamo(generators)

1. The electric motor used current to induce the movement in the coil while generator used movement to induce current.
2. The generator or a dynamo uses slip ring while the a electric motor uses commutators.

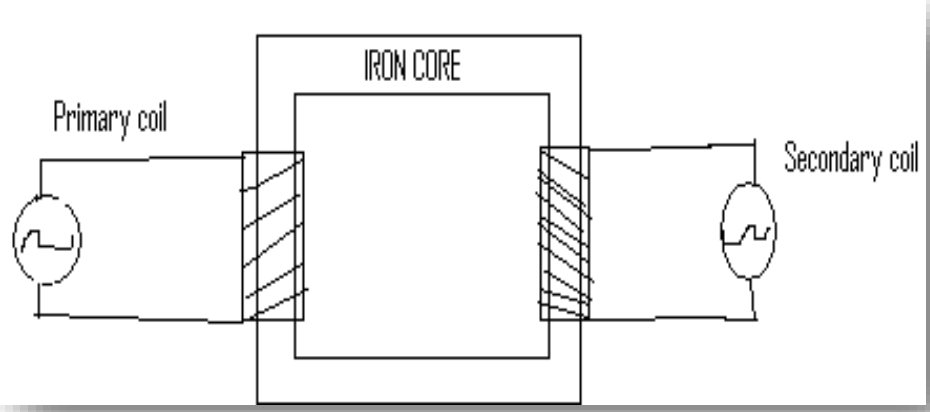
TRANSFORMERS:

It is a device that acts a voltage multiplier. It change small amount of voltage to high voltage and

high voltage to very low amount of current.

A transformer consists of a primary coil and secondary coil wound on a magnetic core.

The primary coil acts as the electromagnet, and the core guides the magnetic field so that field lines pass through the secondary coil. It is used to change or transform ac voltage from one value to the other.



How a transformer works

The ac supply is connected to the primary coil and emf is induced in the secondary coil.

The changing ac in the primary coil produces the changing growing and falling magnetic field that cuts and re-cuts he secondary coil repeatedly- thereby producing an alternating current (ac) in the secondary coil

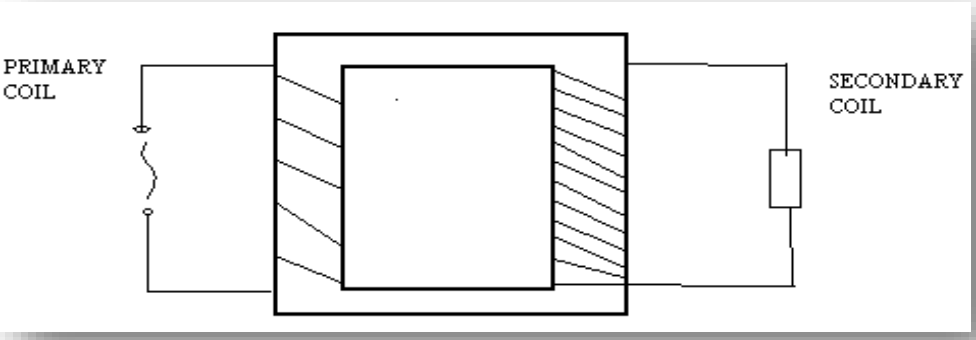
As current flows forwards and backwards through the primary coil , it sets up an alternating magnetic field in the core. This induces an alternating emf and current of the same frequency in the secondary coil.

If D.C supply is used, no emf can be produced in the secondary coil induced because direct current does not set changing magnetic field that can be cut and re-cut by the secondary coil

Types of transformers.

1. **Step –up Transformer**

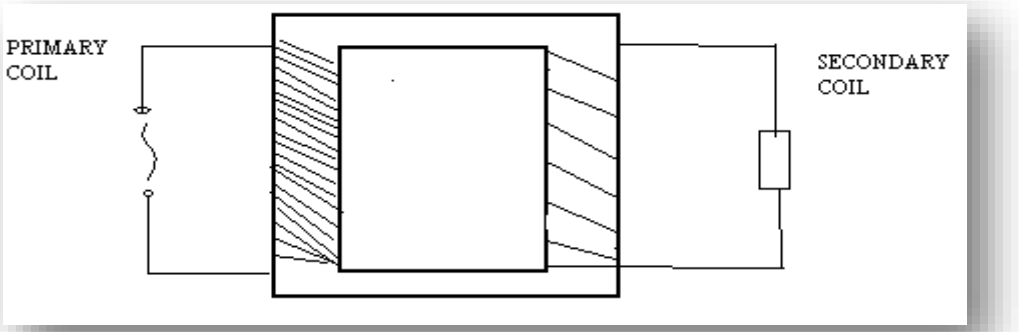
It has fewer turns in the primary coil, but has more turns in the secondary coil. It it act a voltage multiplier by incrementing the amount of induced voltage



How it work

The small number of turns in primary coil set the rise and following magnetic field which are cut by secondary coil. Since they more turn in the secondary this increase the number of cuttings per second hence increasing the voltage in the secondary coil

2. **Step –down Transformer.**
It has more number of turn in primary coil that in the secondary coil. It reduces the amount of current from high to low voltage.



How it works
Since they more turn in the primary coil which set the rising and falling magnetic. The small number of turns in secondary coil make some of magnetic filed line not be cut or lost this reduces the induced current.

ENERGY LOSSES IN TRANSFORMERS:
Energy loss in transformers occurs due to:

1. **The resistance of windings:**

The windings of copper wire do have some resistance and heat is produced by the current in them.

2. **Eddy currents:**

The core itself is a conductor in a changing magnetic field. As the moving field lines of force from primary coil cut the iron core , small currents are induced in the coil. These currents flow in small circles, like eddies (whirlpools) in water when stirred. These currents are called Eddy Currents.

3. Leakage of Field Lines
All the lines produced by the primary coil may not cut the secondary coil, especially if the core has an air-gap or is badly designed.

4. **Magnetization and Demagnetization of the Core.**

Work has to be done to alter sizes and direction of domains and heat is released in the process.

Ways of reducing energy losses in transformer

1. Energy losses due to resistance of winding can be minimized by keeping the coil resistance low by making the coils from thick copper wire
2. These eddy currents are reduced by using a laminated core made of sheets, insulated from each other to have a high resistance vanish
3. Energy losses due to leakage of field lines can be reduced by proper design of the transformer.
4. Energy losses due to magnetization and demagnetization can be reduced by making the core from soft magnetic material such as iron which is easily magnetized and demagnetized. E.g. silicon, iron or steel alloy.

Note:
Laminated core: The core is made from thin sheets of soft iron which are insulated from each other .e/g/ using high resistance varnish to cut down the eddy current flows. A core made in this way is said to be laminated (layered)

Note:
Very large power transformers have to be oil- cooled to prevent overheating.

TRANSFORMER CALCULATIONS:

Assuming the transformer is 100% efficient energy is conserved. Then:

Power in Primary coil = Power in Secondary coil.

i.e. $V_P \times I_P = V_S \times I_S$. where; V_P = primary voltage; V_S = Secondary voltage;

I_P = Primary current; I_S= Secondary current.

If current and voltage are to be on one side each; then rearranging, we have:

$V_P / V_S = I_S / I_P$. or $I_S / I_P = V_P / V_S$.

If you have being given voltage and number of turn the following formula is applicable

$\frac{\text{Secondary voltage}(V_S)}{\text{Primary Voltage}(V_P)} = \frac{\text{Secondary Turns } (N_S)}{\text{Primary Turns } (N_P)}$

$(V_S) / (V_P) = (N_S) / (N_P)$.

When you have been given current , and number of turn the following formula must be used

$\mathbf{N_p \times I_p = N_s \times I_s}$

Examples1

Calculate the number of turns on the secondary of a step down transformer , which would enable a 12V bulb to be used with a 240V ac mains power, if there are 480 turns on the primary.

What current will flow in the secondary when the primary current is 0.5A.Assume there are no energy losses.

Solutions:

V_P =240V; V_S =12V; N_P =480; N_S ? Using:

$V_S / V_P = N_S / N_P$; Then:

$N_S = V_S / V_P \times N_P$.

= 12V x 480 turns / 240V

= 24.

Therefore the number of turns on the secondary = 24.

2. V_P = 240V; V_S =12V; I_P = 0.5A; I_S = ? Using:

$V_P / V_S = I_S / I_P$;

Then:

$I_S = I_P \times V_P = / V_S$.

=0.5A x 240V /12V

=10A.

Therefore the current that will flow in the secondary is 10A.

Example 2: A transformer has 2000 turns on the primary coil. The voltage applied to the primary coil is 240V ac. How many turns are on the secondary coil if the output voltage is 48V ac?

Solution:

V_P = 240V; V_S = 48V ; N_P =2000 ; N_S = ?.

Using:

$(V_S) / (V_P) = (N_S) / (N_P)$

Then:

$N_S = V_S / V_P \times N_P$

$= 48V \times 2000 \text{ turns} / 240V$

$= 400.$

Therefore the number of turns on the secondary coil is 400.

Transformer efficiency

Efficiency is the ratio of the useful output to the input.

$$\text{Transformer efficiency} = \frac{\text{output energy} \times 100\%}{\text{input energy}}$$

Example; A transformer is used on the 240V ac supply to deliver 9.0A at 80V to a heating coil. If 10% of the energy taken from the supply is dissipated in the transformer itself , what is the current in the primary windings?

Solution:

Power delivered to the heating coil = $V_S \times I_S$.

$= 9.0A \times 80V$

$= 720W.$

But power delivered to the coil = 100% - 10% = 90% because 10% is wasted in the transformer.

90% of power = 720W.

But input power = 100%.

$$\text{Therefore input power} = \frac{720W \times 100\%}{90\%}$$

$= 800W.$

Primary current = power / voltage

$= 800W / 240V$

$= 3.3A$

ELECTRONICS

It the study of how tiny electrical circuits and devices that are used to make these circuits

BAND THEORY

This theory tries to explain why other substance conducts electricity while other do not conduct electricity.

How bands are formed

When atoms are in gaseous state they are isolated and they occupy defined energy levels. As the atoms are cooled, the atoms are they are brought together. Electrons wave from different atoms over lap and the each energy level broadens into bands of energy which is shared by all atom.

There two bands that are formed and are separated by the gap called the ***forbidden gap***

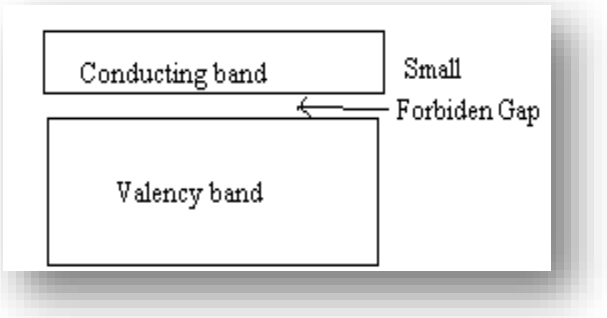
The conduction band

It is the out most bands. Where electrons go to.

Forbidden gap

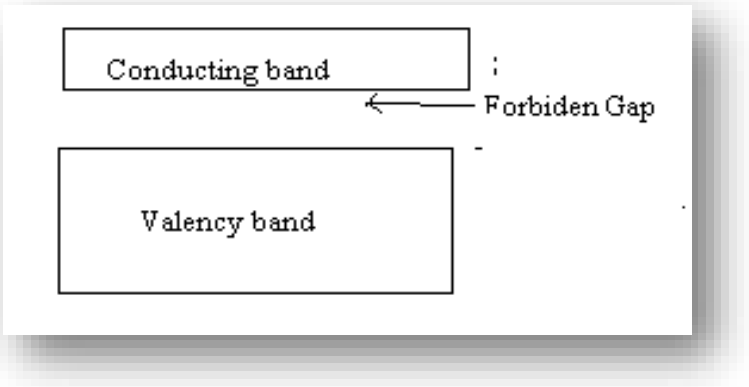
It separates the conduction band and the valence band

Valence band
It the inside band where electrons come from
Arrangement of bands in conductors (metals)
In conductors E.g metal electrons are free to move since they are not bonded to any atom.



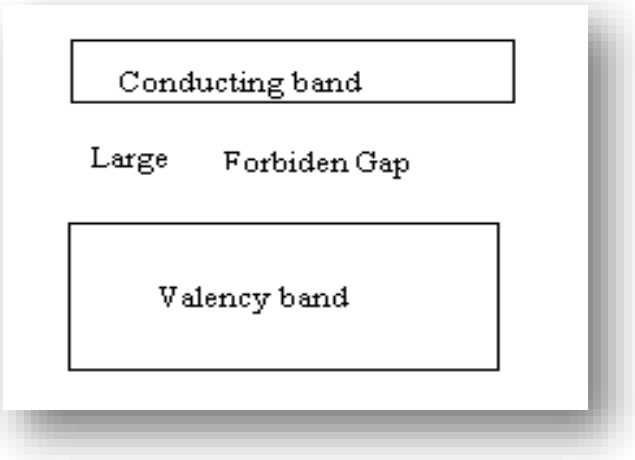
The slightest difference in metal make electron to move
They have smallest forbidden gap between the valence electron and the conduction band. This makes electron easy to jump from the valence electron to conduction band making them good conductors.

Arrangement of bands in semiconductors
They have a medium forbidden gap between the valence electron and the conduction band.



For the electron to move from the valency band to conduction band they need extra energy to lift the electrons to the conduction band.
At absolute zero temperature the valence band is totally filled while the conduction band is empty and no conduction can occur.
As the temperature increases the electrons can gain some extra energy to jump from the valence band to conduction band making current to flow.

Arrangement of band in non metals
They have large forbidden gap and the valence band is full and the conduction band is empty . This makes insulator not conduct electricity at any temperatures



SEMI CONDUCTORS

They are materials that partly conduct electricity. Example of such material include, carbon inform of graphite, silicon,

Types of semiconductors

They are two types of semiconductors,

INTRINSIC SEMICONDUCTORS

They are semiconductors naturally conduct electricity

Extrinsic semiconductors

They are semiconductors that conduct electricity when and impurity is added.
The impurity can be either a proton or an electron

TYPE OF EXTRINSIC SEMICONDUCTORS

Negative type semiconductors (n- type)

The energy carrier is the negative electrons. An electron is doped into the natural semiconductor. The impurity has an extra electron from a pentavalent element E.g Phosphorus, nitrogen . For example an atom of phosphorus is introduced in the lattice of a semiconductor. The introduced electron can be easily thermal excited to the conduction band making electricity to flow.

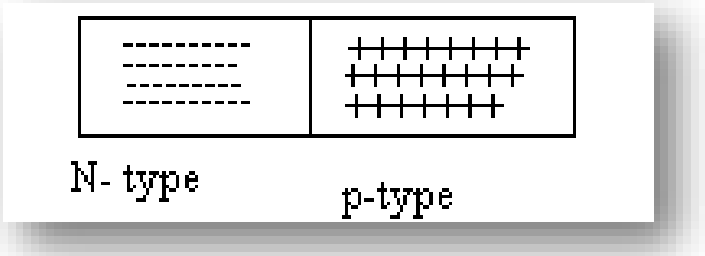
The positive type (p-types)

The conduction is done due to positive charge carrier. The impurity has a deficiency number of electron compared to the semiconductor . For example boron is introduced into the lattice of group natural semiconductor. This introduces an extra hole into the valence band. This hole is used to transfer current.

NB the process of adding an impurity to a semiconductor is called ***Doping***

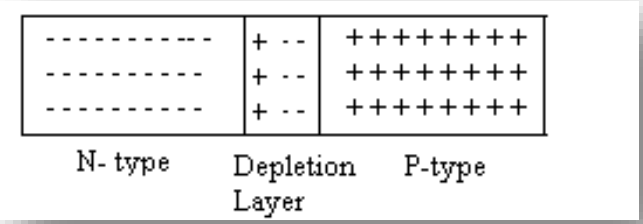
Semiconductor diodes

They are made by joining the p -type semiconductor and the n -type semiconductor.

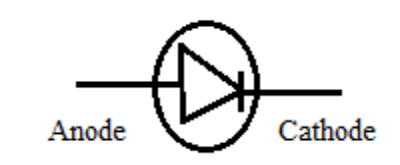


When the two semiconductors has been joined , the electron from the n-type are trapped by the p

side holes and the conduction band has no electrons in it and also the p hole has also been filled. This thin layer created is called the depletion layer. Charge carrier can not flow across the depletion layer.

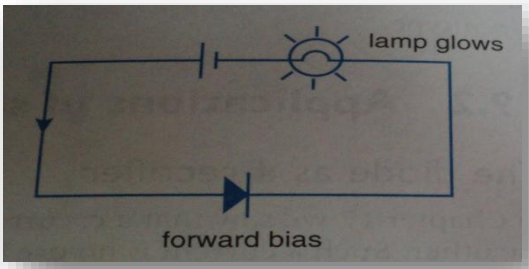


The positive type semiconductor makes the anode of the diode while the n type make the cathode of the diode



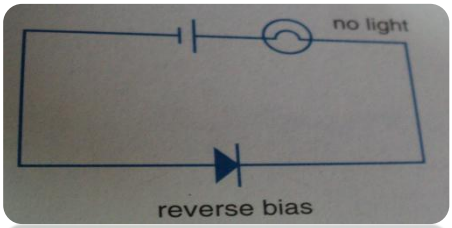
Forward bias

The p-type should be connected to positive side of the cell so that the effect of the depletion layer and n- type should be connected to negative side of the cell. In other word the anode should be connected to the positive side of the cell while the cathode should be connected to negative side. This makes the depletion layer to be canceled out and current should flow rapidly. The depletion layer is canceled because like charges repel each other and unlike charges attract each other. Since the negative semiconductor is connected to the negative side of the cell and the positive semiconductor to the positive terminal of the cell this make the electron in n- type to repel with other electron from the cell as a result the electron are attracted toward the depletion layer cancelling it out. The diode in forward biased it conduct electron by electron in the n-type chip and by means of holes in the p- type chip.



Reverse bias

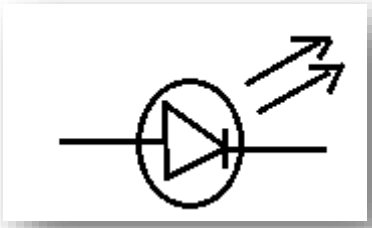
The p type is connected to the negative side of the cell while the n-type is connected to negative side of the cell or in other words the anode is connected to negative side of the cell and the cathode is connected to the positive side of the cell . This increases the depletion layer because the p types contain the negative ions. These negative ions prevent the electron to enter the depletion layer and no current can flow



Types of diodes

Light limiting diodes LED

They are made by gallium arsenide phosphide. It emit red, yellow or green light depending on ton its composition.



Its uses

1. They are used as numerical display in electronic calculators, clocks cash register and measuring instruments.
2. They are used as indicators in electrical equipments .it show is current is following into the equipment E.g. in computer and radios
3. The are use as bulb of LED torches (china torches)

Zener diode

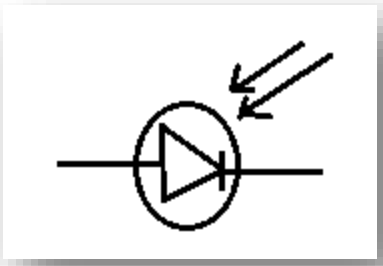
They are made up of silicon junction.

Uses of Zener diodes

1. They are used as power stabilizer in circuits by making current to flow in one direction
2. They are used as rectifiers where it changes Ac to direct current
3. They are used in Analogue Modulator radio when combine by a capacitor to act as a tuner.

Photo diode

It has a transparent window through which light can enter

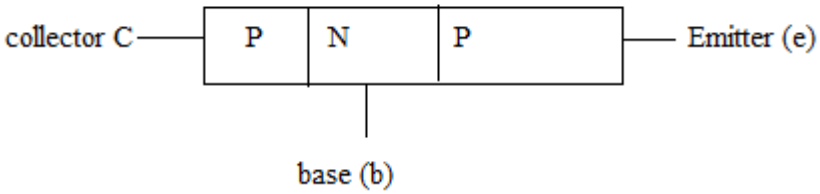


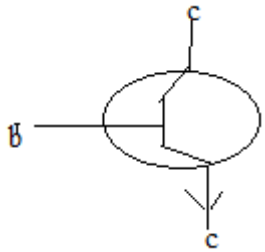
Uses
They are used as optical fiber receiver which generates a pulse of current every time a beam of light is interrupted.

TRANSISTORS
They are made up of two type p-n junction in the same crystal. They are made up of germanium because it with stand high temperature but due to easy mass production of silicon n n-p-n diode the germanium is less preferred. It uses three connections, the base, the collector and the emitter. When connected to a circuit, current enters through the emitter and leave through base but convectional current enter through the base and collector and leave via the emitter.

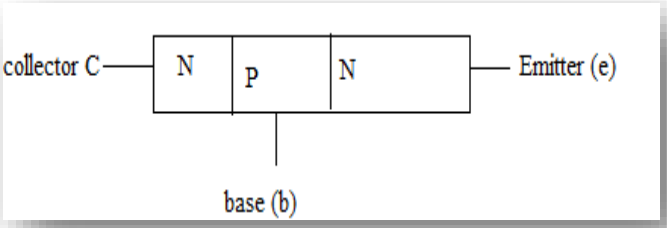
Types of transistors
Transistors are grouped depending on the arrangement of the p-n junctions

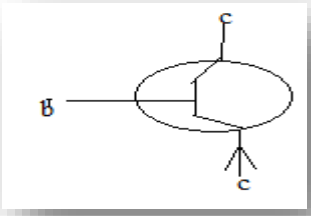
P-N-P JUNCTION TRANSISTORS
They made in such way that the middle chip that form the bases is the semiconductor of the n type while the emitter and collector are made up of the p- type





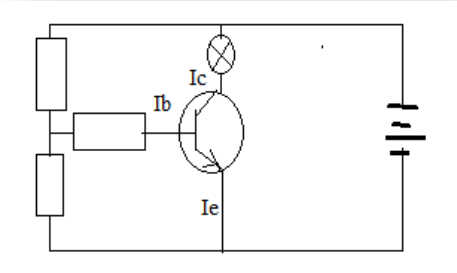
The n-p-n junction diode
The middle plate is the p-type while the two end plates are the n-type

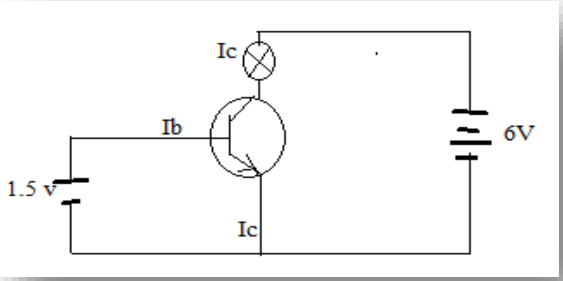




NB. The arrow in transistor symbol shows the direction of convection current.

USES OF TRANSISTORS
They are used as voltage amplifier
The transistors combine by three resistors or a small current is introduced through the base as shown below

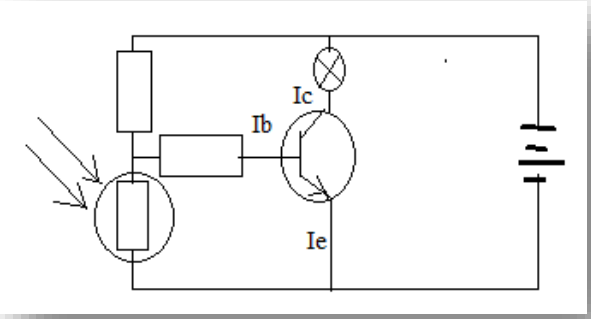




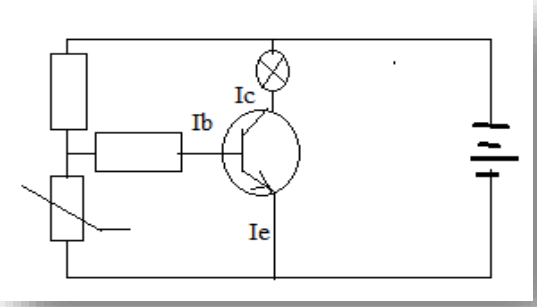
When a small current is introduced at the base the big signal comes out from the collector circuit. In both circuits Ib + Ic = Ie which is current which has be amplified. The resistors prevent large current to pass through the base rather it should pass through the collector via the emitter and only small current should pass through the base.

They are used as a switch

When a transistor is combined with a light sensitive resistor or thermostats it act as a switch the circuit is set like follows



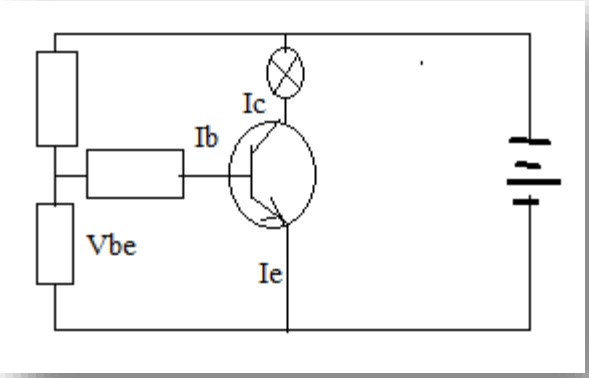
When the light intensity increase the resistance increases stopping current to flow and switches off the collector remitter current. When the light intensity decrease the resistance switching on the collector remitter current.



When the temperature increases the resistance increases stopping current to flow and switches off the collector remitter current. When the temperature decrease the resistance switching on the collector remitter current.

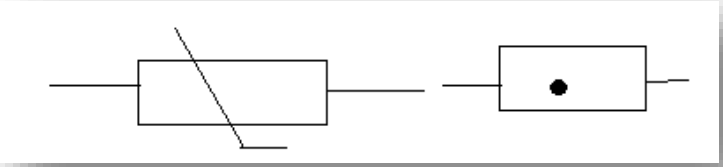
Transistor as potential divider

The circuit is set as follows



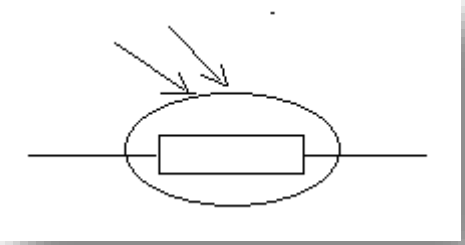
The emitter base Voltage can be changed from zero to maximum values. When emitter base voltage is at zero the no current flow through the transistors. But when the emitter base voltage is at maximum the current flow the transistors. In this way the transistor acts as a potential divider.

THERMISTORS
It is a semiconductor device that its resistance changes as the temperature changes.



The resistance decreases as the temperature increases.
They are use as temperature change sensor in electronic equipment
They also use as electronic thermometer in refrigerators

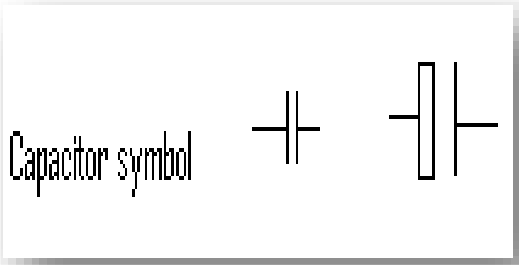
LIGHT DEPENDENT RESISTORS
Their resistance decreases as the intensity of light decreases.



Uses
They are used in photographic expose meter
They are use in series with the resistors to provide an input for transistor or in logic gates

CAPACITORS:
A capacitor is an electronic device that stores charge.
It consists of two parallel plates separated by an insulator called dielectric.

Note: There are several types of capacitors.
CAPACITANCE (C)



CAPACITANCE (C)

It is the ability to store charge.
Capacitance is given by the formula: C = Q/ V:
where C = capacitance; V = voltage in volts; Q= charge;

Capacitance increases if :

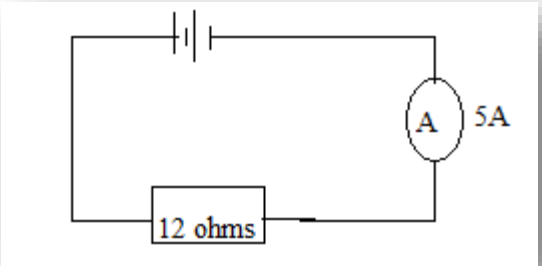
i. The area of the plates is increased.
ii. The separation between the plates is decreased.
iii. If the insulator (dielectric) is a solid and not air.

USES OF CAPACITORS:

1. They are used to separate DC signals from ac signals E.g. as used in radios, TVs and computers.
2. They are used to smoothen (filter) DC signals in rectifiers used in radios, TV and computers.
3. They are used to filter frequencies E.g. in radio and amplifiers in tone control circuits.
4. They are used in some cameras for flashing when taking photographs.

Exercise
2003
Question 1

a. Figure 1 is a diagram of electric circuit



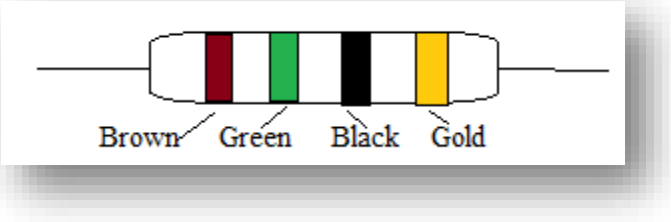
i. What kind of energy is produced in 12Ω resistor as electric current flows through it?
ii. Calculate the amount of energy produced in the resistor if the electric current flow through it for 10 minutes

Question 7

a. Briefly explain how a piece of iron is magnitised by stroking
b. (i) describe how a step up transformer works
ii. Explain two ways in which energy in transformer loss are minimized

2004

a. Explain why voltmeter is connected in parallel while an ammeter is connected in series
b. Figure 2 is a diagram of resistor



Brown = 1 Green = 5 Black = 0

Gold =5%

What is the value of the resistor?

c. (i) Explain the difference between an electric motor and an electric generator

ii. State any two factors which affect the amount of voltage produced by a generator

d. (i) What is a semiconductor?

ii. Draw a circuit diagram in which a bulb , a cell and a diode are connected in series such that the diode is forward biased

e. What is meant by doping

f. State two function of transistors

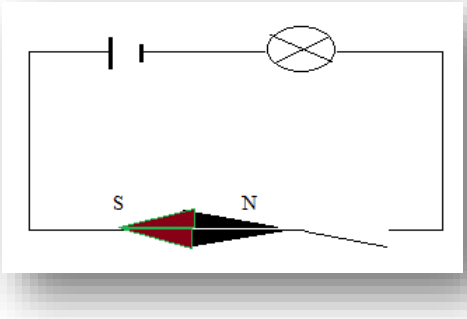
g. (i) is the head lamp of a motor car connected in series or parallel

ii. Give a reason for your answer to 4gi.

2005

Question 1

d. Figure 2 is a diagram of a compass needle placed under a connecting wire



i. Draw the arrow on the diagram to show current and compass direction when stwitch is closed

e. Mention any two devices that use electromagnets

Question8

a. A 6kw power is feed to transmission cable of a resistance 3Ω. Calculate the power wasted in cables if the power transmit 300V

b. Describe an experiment that could done to find out if electrical resistance of the wire varies directly with length

3PPII

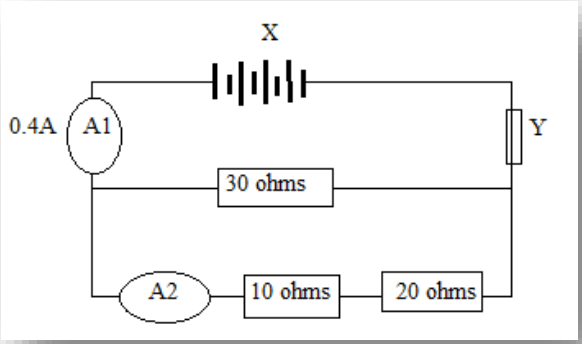
a. With an aid of a labeled diagram explain how a step down transformer works. in your diagram , show the coil in primary and secondary coil and current source

b. Explain how fuse works

2006.

Question 4

a. Figure 3 is a circuit diagram



i. Name the components labeled X and Y
ii. Calculate the total resistance
iii. Calculate the current in the 30Ω resistor
iv. Work out the voltage across the 10Ω resistor

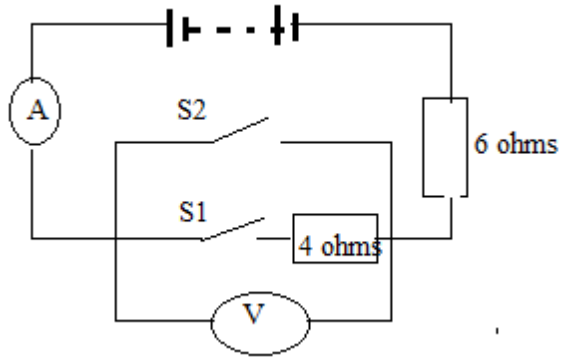
b. (i). Define kilowatt – hour
ii. The power rating of a television is 150W. How much power in kilowatt- hour will use if it runs for 10hour
iii. If the cost for power is K5.00 per kilowatt hour, what will be the cost of running the television in 4dii. For 10 hours per day for 2 days

Question 3 ppII
Describe an experiment that could be carried in order to determine the length of nichrome wire that could be used to make 1.5 resistors

2007
Question 4
b. A current of 2A flows through an electric heater connected to a voltage of 240 V. calculate the:
i. Resistance of the element
ii. Power dissipated by the heater
iii. Cost of running the heater for three hours if the cost of electricity s K5.00 per Kw-hr

c.(i) Give two advantages of alternating current over direct current.
ii. State any two causes of energy loss in transformer
iii. How can each energy loss mentioned above can be minimized

d. Figure 2 is a diagram of electric circuit

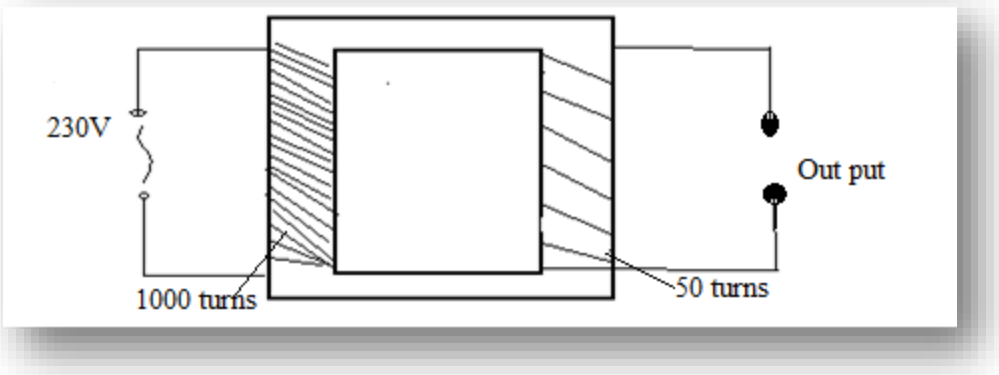


i. If S1 is closed and S2 open, calculate the reading of the ammeter and voltmeter
ii. What will be effect on the voltmeter reading if both switches are closed?
iii. Give a reason for your answer

Question 4 PPII
With an aid of diagram, describe an experiment that could be done to identify unknown substances W, X and given that are diode, and insulator, a resistors but not necessary in that order.

2008.
Question 4

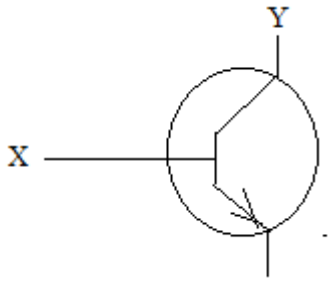
a. Figure 2 is a diagram of transformer



i. Name the type of transformer shown in the diagram
ii. Give a reason for your answer to 4ai
iii. Calculate the out put of the transformer

b. (i) what is a semiconductor
ii. Explain how the temperature of semiconductors affects their electrical conductivity

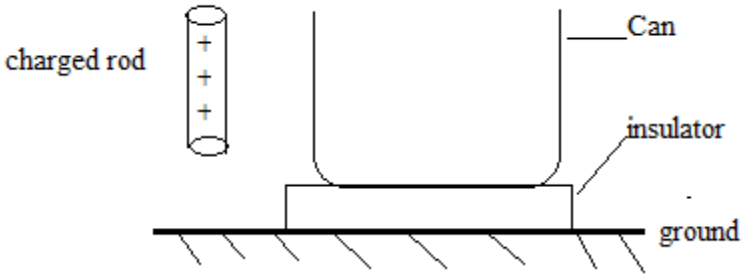
c. Figure 3 is a diagram of a transistor



i. Name the parts marked X and Y
ii. Give any two uses of transistors

d. i. Why diode some times referred as rectifier?
ii. Draw a circuit consisting of cell bulb and a diode such that it is forward biased

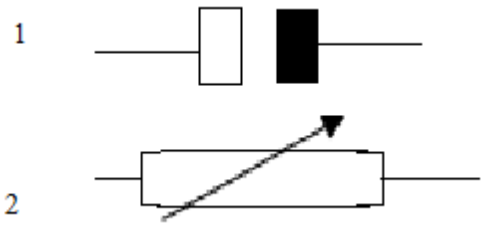
e. Figure 4 is a diagram showing a charged rod brought to a metal can standing on an insulator



i. complete the diagram by indicating the induced charges on the can
ii. Why was the can placed on an insulator?

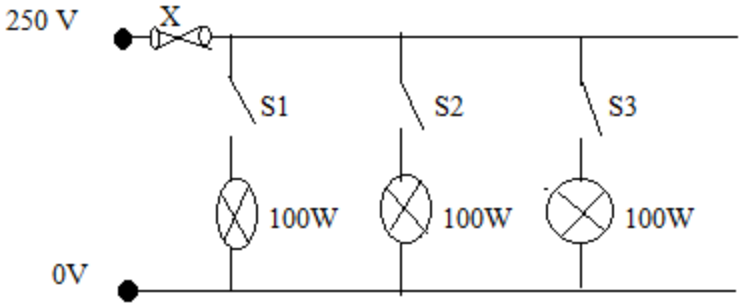
2009.
Question 4

a. What do the following electrical symbols stand for



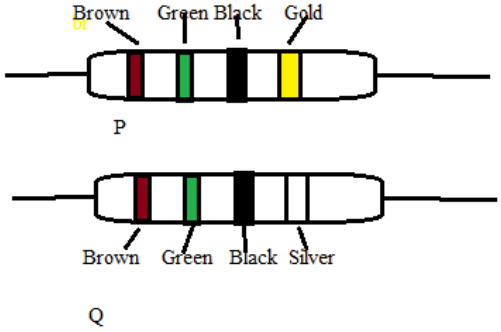
b. In a circuit a 6 Ω resistor and 3 Ω resistor are connected in parallel and 8Ω resistor is connected in series with them.
   i. Draw a circuit diagram using the given information
   ii. Calculate the total resistance in the circuit.

c. Figure 5 is a diagram of electric circuit for a house



   i. What type of circuit is shown in the diagram
   ii. Give a reason why this type of circuit is preferred for wiring house
   iii. Explain the importance of including device X in the circuit in the figure
   iv. Give one appliance where device X is used

d. Figure 6 is a diagram showing colour codes and the resistors marked P and Q



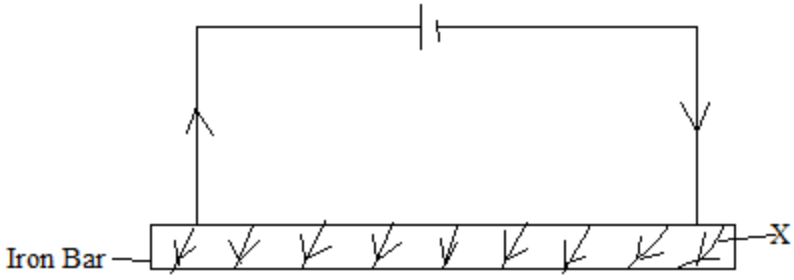
Colour	Number
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5

Tolerance
Gold = 5% silver = 10%

   i. What is the resistance of resistor P
   ii. What is the advantage of using resistor P in a circuit that resistor Q

2010
Question 6.

a. Mention any two appliances that uses the principle of electrostatics
b. Figure 4 is a diagram of electric circuit.

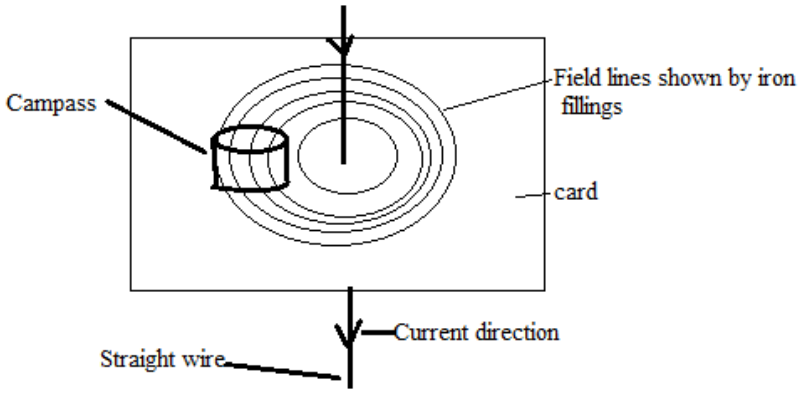


i. Name the parts labelled X
ii. What would happen if the part labelled X is brought closer to iron fillings
iii. Give a reason for your answer to 6bi.
iv. What is the role of iron bar in the circuit

c. Define electrical power.
d. An electric bulb is marked 240V , 60w
   i. What is the meaning of 240, 60W
   ii. Calculate the heat dissipated by the bulb, in joule , if it operate for 8 minutes
e. A step down transformer has 1200 turns in the primary coil and 50 turns in the secondary coil. Calculate the voltage in the secondary coil if the voltage in the primary coil is 240V
f. Explain how the transformer works

2011
Question 2

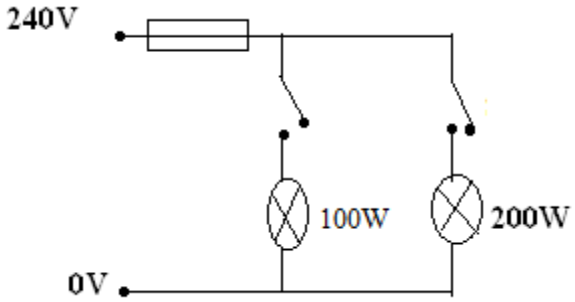
a. Give one type of semiconductors
b. Explain why the difference in total current between similar resistor connected in parallel and in series
c. Give one method of demagnetising permanent magnet
d. Figure 2 is a diagram showing an experiment on electromagnetism in which a current carrying wire passes through the centre of the card board on which iron filling were sprinkled



i. Draw an arrow in the compass to show the direction of field lines
ii. What would happen to the direction of compass needle if the direction of current is reversed
iii. Give a reason for your answer

2012
Question 2

a. State two ways of inducing electromotive force (Emf)
b. Mention any one application of electromagnetism
c. Figure 2 is a diagram of an electric circuit



i. What is the function of the part labelled Z
ii. State any two advantages of the circuit in the figure above
iii. Which bulb would use more current if two switches were closed
iv. Give a reason for your answer

d. Calculate the power dissipated in an electric heater in which 4A of current flows when connected to a 230V supply

8e. explain how a piece of a steel could be magnetised by single touch stroking method .

NUCLEAR PHYSICS

ISOTOPES
They are atom of the same element that have the same number of proton but different number of neutrons or are elements with the same mass number but different atomic mass number

For example hydrogen exists in three forms namely. Protium, deuterium and tritium

Name	Number of neutrons	Symbol	Representation
protium	0	$_{1}^{1}H$	Hydrogen -1
deuterium	1	$_{1}^{2}H$	Hydrogen-2
Tritium	2	$_{1}^{3}H$	Hydrogen- 3

NUCLIDE
Are atoms with which have different nuclei. This different may due to different in atomic mass, atomic number or number of protons.
All isotopes are nuclide

TYPES OF NUCLIDE
Nuclides are categorized according to their stability. They are two type of nuclide.

STABLES NUCLIDE
Are nuclide s that does not undergo spontaneous decay to became the nucleus of different elements

UNSTABLE NUCLIDE
Are nucleus that spontaneously undergoes decay to become the nucleus of different elements

Unstable nucleus undergoes the process of transmutation and radioactive decay.

TRANSMUTATION
It is the process where by the nucleus of an atom undergoes transformation into a nucleus of different elements
In transmutation a nucleus can gain or loose a proton to become a nucleus of another element
For example carbon 14 nucleus can lose an electron and change a neutron into a proton and become Nitrogen 14

RADIOACTIVITY
It is the ability of unstable nucleus to undergo spontaneous decay.

NB: The radioactive active decay is said to be spontaneous because it is not affected by environmental factors such as temperature, pressure, or presence of catalyst. It is not dependent to other chemical reagents or physical factors being present. It takes place without any intervention.

WHY ELEMENT UNDERGO RADIOACTIVE DECAY
To gain stability since its elements ant to be stable
To release extra energy from the nucleus

CHARACTERISTICS OF RADIOACTIVE SUBSTANCES

1. They continuously undergo decaying into simpler atoms as a results radiation
2. Radiations from radioactive substance produce bright flashes of light when it hut a certain compound.
3. They cause ionization of air molecules like they knock out electrons from molecules of air leaving with positive charge
4. Radiations from radioactive substance can penetrate the photographic film leaving it black
5. Radiations from radioactive substance can destroy the germination power of seed of plants , kill bacteria and burn or kill animal cells and plants.

TYPES OF RADIOACTIVE DECAY

E

1. **Natural radioactive decay**

It is radioactive decay that occurs naturally without the aid of human. Tit occurs in naturally existingelements radioactive elements such as -uranium -polonium –radon –thorium.
NB All elements beyond bismuth in the Periodic table are radioactive.

ARTIFICIAL RADIOACTIVY

They occur by human aid where atomsare slowly bombardment in the nuclear reactor.
A proton or a neutron is used to bombard the nucleus of a stable nucleus. This makes the nucleus to become unstable and undergoes nuclear decay

RADIATION

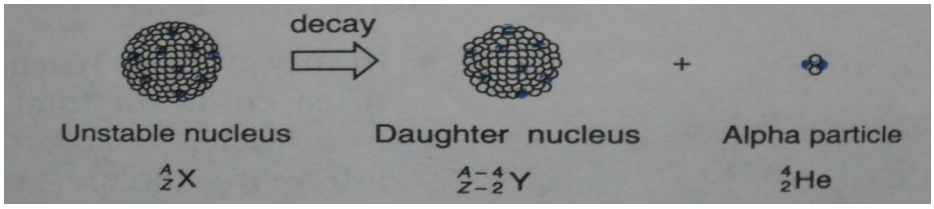
It is a particle or energy released due to decay of a radioactive substance.

TYPES OF RADIATIONS

These include: alpha particles, beta particles and gamma rays .

ALPHA PARTICLES (α - Particles)

An alpha particle is a nucleus of Helium atom and is made up of two protons and two neutrons.
When an atom decays by alpha particles - emission its nucleon number decreases by 4 and its proton number by 2.



For example
Radium decaying to radon.

$^{226}_{88}Ra \longrightarrow {}^{222}_{86}Rn + {}^{4}_{2}H$

Properties of alpha particles:

1. They carry a positively charge because they contain protons without electrons
2. They all travel at approximately the same speed 1/10 the speed of light.
3. Thy are the most strongly ionizing power of the nuclear radiations
4. They tend to attract electrons away from nearby atoms.
5. They are the least penetrating- they can be stopped by a thick sheet of paper.
6. Collisions with atoms finally brings them to rest
7. They can be deflected by magnetic and electrostatic fields.

BETA PARTICLES (β-particles)

In a beta –decay,a neutron changes to a proton and an electron. The proton remains in the nucleus and the electron is emitted as a beta- particle.

The proton number increases by 1 since it has one more proton.

But, the new nucleus has the same mass (nucleon) number. E.g.

Radioactive carbon called carbon-14, decays by b- emission to nitrogen .

$^{14}_{6}C \rightarrow {}^{14}_{7}C + {}^{0}_{-1}e$

In beta decay a proton in the nucleus is converted to a neutron and a positron .E.g. $^{64}Cu_{29}$

$^{64}Cu_{28} + {}_{+1}e^{0}$

NB. Positrons are subatomic particles with the same mass as an electron , but positive charge . The symbol for a positron is $_{+1}e0$

NB. Beta decay can either release a positive particle or a negative particle. If the decay release a positive particle a positron the decay is know as positive beta decay while if and electron is released the decay is callednegative beta decay.

Properties of beta particles:

1 They are electrons emitted with varying speeds which can be high as 9/10 of the speed of light .
2 They have e negative charge .
3 They are lighter than alpha particles .
4 They can be stopped by a few mm of aluminum or Perspex
5 They are less ionizing power compared to alpha particle
6 They are more penetrating.
7 They show much greater deflections than alpha particles because of their lower mass.

(g-) GAMMA RAYS

These are electromagnetic waves of very short – wave length.

They result from energy changes inside atomic nuclei, as distinct from X- rays which are caused by energy changes outside .

A gamma photon is emitted at the same time as an alpha or beta particle.

After emitting alpha and beta particles , some nuclei are left in an excited state. Rearrangement of the protons and neutrons occurs and a burst of gamma rays is released.

Properties of Gamma rays

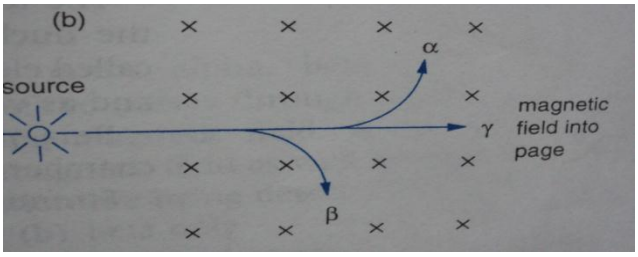
1. The are the most penetrating .Their intensity is greatly reduced by several cm of lead , but are never completely absorbed .
2. They are the least ionizing
3. They are not deflected being electromagnetic waves or electric field

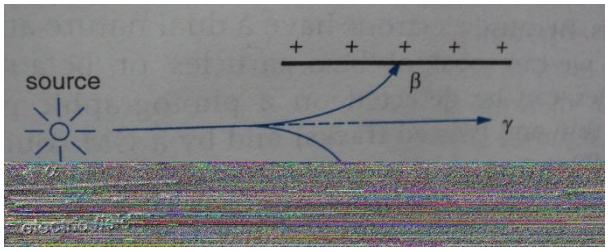
COMPARISON OF ALPHA, BETA AND GAMMA RADIATIONS

RADIATIONS TYPE	IONISING POWER	PENETRATING POWER	RANGE IN AIR (m)	ELECTRIC CHARGE	ABSORBED BY
ALPHA	high	Low	0.05	+2	Paper
BETA	medium	Medium	3	-1	5mm aluminum
GAMMA	low	High	100	0	3cm lead halves intensity

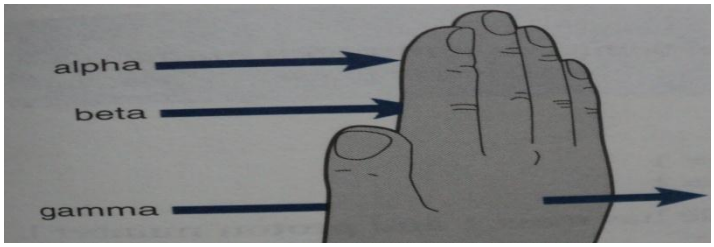
DEFLECTION OF NUCLEAR RADIATIONS IN MAGNETIC FIELD

Like any stream of moving charged particles,alpha and beat particles are deflected in magnetic or electric fields .Beta particles show much greater deflections. Gamma rays are not deflected being electromagnetic.





Penetration power of radiation on human body



NUCLEAR EQUATIONS

Are equation that represent the decay process of a nucleus.

In nuclear equations, the following point should always be remembered

1. In any nuclear equation, the total mass number on the left hard side should be equal to the atomic mass in the left hand side
2. In any nuclear equation, the total atomic number on the left hard side should be equal to the atomic number in the left hand side
3. Determine the decay products that will be produced a balanced equation
4. Write the balance equation
5. Don't concentrate on the charge because in nuclear physic we are concerned with nucleus not the atom

EXAMPLE :

What is products are formed when a neutron is bombards a nitrogen atom?

$^{14}_{7}N + ^{1}_{0}N \longrightarrow ^{14}_{6}C + ^{X}_{Y}$

total atomic mass number 15 = 14+ 1 so x = 1

total atomic number 7= 6+y so y =1

So the equation is

$^{14}_{7}N + ^{1}_{0}N \longrightarrow ^{14}_{6}C + ^{1}_{1}H$

DETECTING NUCLEAR RADIATIONS:

Most methods of detecting alpha, beta particles and gamma rays are based on the fact that that these have an ionising effect .These include :

PHOTOGRAPHIC PLATES

The photographic film is blackening when exposed to amount of radiation. The amount of blackening determines the level of exposure. This method is used by people who work with radiation to check the amount they are exposed to.

IONIZATION DETECTOR

The ionization detector detect the amount of air ionized by the radiations and measure the amount of radiation

SPARK COUNTER

It has positively charged wire grid and the negatively charged metal plate. When the radiations pass between them it ionizes and the electron which cause large current to suddenly pass through the air under high voltage causing a spark which is heard or registered by the electronic device

CLOUD CHAMBER

It enables tracks of charged particles to be seen .

When air containing vapour, E.g. alcohol , is cooled enough , saturation occurs . If ionising radiation passes through the air, further cooling causes the saturated vapour to condense on the air ions created . The resulting white line of tiny liquid drops shows up as a track when illuminated .As the alcohol vapour spreads downwards, it is cooled

Each time an alpha particle is shot ,it ionises the air in its path and alcohol readily condenses around these ions .A narrow cloud made up of millions of tiny alcohol droplets forms along the track of alpha particle..The track is visible because it reflects light from the lamp

BUBBLE CHAMBER

Radiation leaves a trail of bubbles in liquid hydrogen .

A magnetic field is usually applied across the bubble chamber which causes charged particles to move in circular paths .

The higher density of atoms in the liquid gives better defined tracks, than obtained in a cloud chamber .

ELECTROSCOPE

A charged electroscope discharges a radiation source is brought near the cap.

Radiation from radium knocks electrons out of surrounding air molecules leaving them as positively charged air ions .The air ions are attracted to the cap or repelled depending on the charge on the the cap. As a result in either case, the charge on the electroscope is neutralize or lost

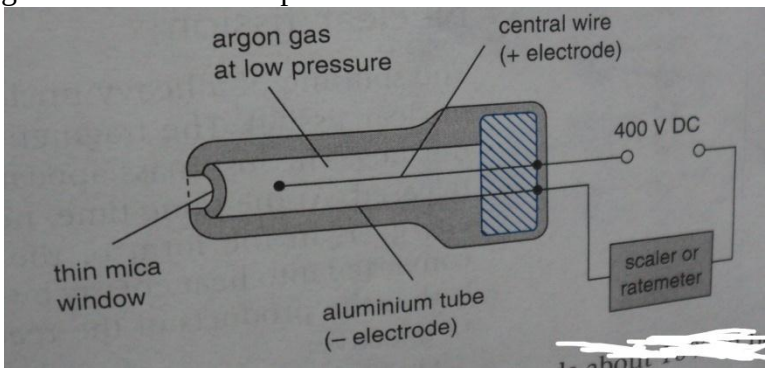
GEIGER –MULLER TUBE

When radiation enters a GM tube , either through a thin end window made of mica or through the wall if it is very penetrating , it creates argon gas ions and electrons . These are accelerated towards the electrodes and cause more ionisation by colliding with other argon gas atoms .

On reaching the electrodes , the ions produce a current pulse which is amplified and fed to either to a scale or rate meter.

The scale counts the pulses and shows total received in a certain time.

The rate meter gives the counts per second or minute, or count rate directly. It usually has a loud-speaker which gives a click for each pulse.



SCINTILLATION COUNTER

It consists of fluorescence crystal placed in contact with a photomultiplier. When ration strike the crystals , light is emitted by the photomultiplier and amplified by electronic circuits and is shown on the fluorescence screen

NUCLEAR REACTIONS

Nuclear reaction is any process in which a particle penetrates a nucleus and changes it in some way .

Nuclear reactions involve rearrangement of protons and neutrons in nuclei so that new elements are formed.

In a nuclear reaction the total mass of all the product particles is slightly less than the total mass of the reactant particles. This loss of mass appears as a large quantity of energy released in form of heat.

Uses of nuclear reactions:

1. For the provision of energy to make electricity.
2. For destructive purposes – Nuclear bombs release large amounts of energy .
3. Used to generate power heart pacer machines

Types of Nuclear Reactions

A NuclearFission

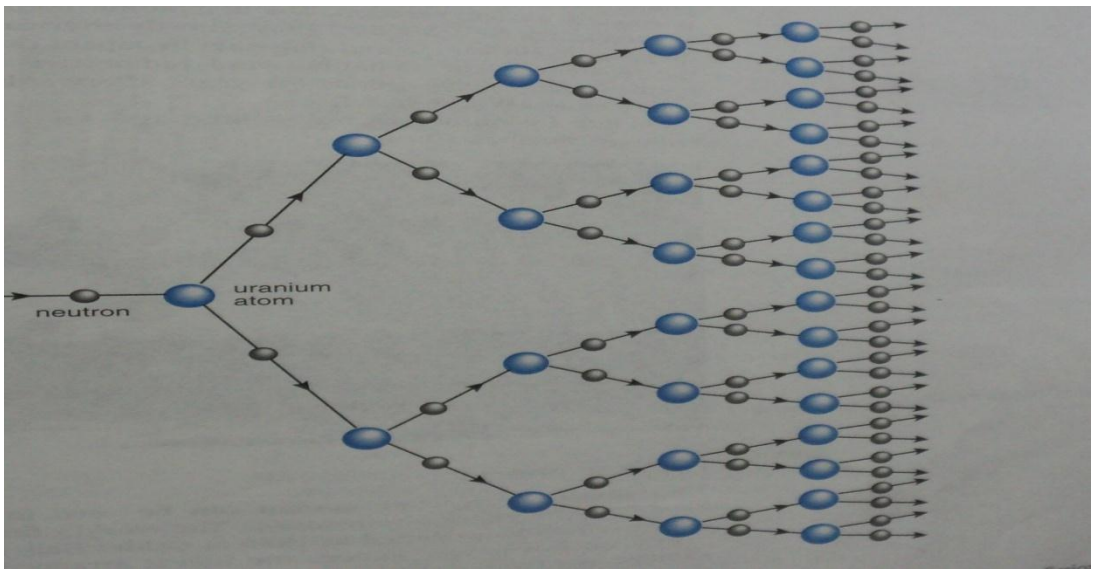
It is the splitting of an atom of a heavy element into atoms of lighter elements , with the release of energy

Fissile isotope is bombarded by neutrons. As a result of interaction between neutrons and atoms of the isotope , fission of some atoms occurs.

More neutrons are produced by the nuclear fission than are absorbed .

If neutrons from the fission of one nucleus go on to split other nuclei , a chain reaction may result .

In practice , neutrons are lost by escaping without causing further fission .



This *must exceed* a certain *critical value* to sustain the chain reaction. This is called *critical mass* .

In other words critical mass is the minimum mass of a radioactive element E.g. Uranium –235 necessary for any atomic explosion.

Example of Fission reaction

Uranium –235 can split into barium and krypton with 2 or 3 neutrons.

$_{92}U^{235} + {}_{0}n^{1} \longrightarrow {}^{90}_{36}Kr + {}^{144}_{56}Ba + 3\,{}^{1}_{0}n$.

NB . The barium and krypton nuclei are themselves radioactive .

Nuclear Reactors

They consist of a pressure cylinder containing the following :

Nuclear fuel elements :

The fuel is made from uranium dioxide .

Graphite core :

It acts as a Moderator

This slows down fission neutrons for a chain reaction to be maintained . This is because slow neutrons are more effective in causing fission , unlike fast moving neutrons which are not absorbed by uranium 238 .

Control rods :

These are boron –steel control rods . The boron absorbs neutrons .

Fission rate is controlled by raising or lowering boron –steel control rods .

If the rods are raised , more neutrons are able to cause fission , and the temperature rises .

The reactor can be shut down by keeping the rods in the lowered position .

NB Carbon dioxide gas is pumped through the core and carries off heat to the heat exchanger where steam is produced .

Fusion Reaction

It is the combining of lighter nuclei to form heavier elements .

Heat energy is supplied first . Therefore the reaction is also called ***Thermonuclear reaction.***

A lot of heat energy is generate compared to the heat released in fission reaction .

Example of fusion reaction :

Isotopes of hydrogen (Deuterium and Tritium) combine to form Helium .

$^{2}H_{1} + {}^{3}H_{1} \rightarrow {}^{4}H_{2} + {}_{0}n^{1}$

NB . The sun is powered by fusion reaction . High energy converts hydrogen into helium .

Research is being carried on fusion reaction to find out if it can be used to generate power

RADIOACTIVE DECAY : HALF –LIFE (DECAY RATE)

Half –life of a radioactive substance is the average time for half the atoms in a given sample to decay.

The rate of decay is unaffected by temperature or chemical change .

Half life equation formula

The rate of decay is fixed for any given nuclide and is directly proportional to the number of nuclei present.

Given mass of the a substance use the proportionality to find the half life of the substances.

Example

A radio active substance has the half life of 20 minutes. What fraction of the substance will reaming after 1 hour?

After 20 minutes fraction left = ½

After 40 minutes fraction left= ½ x ½ = ¼
after 1 hour fraction left = ½ x ¼ = 1/8

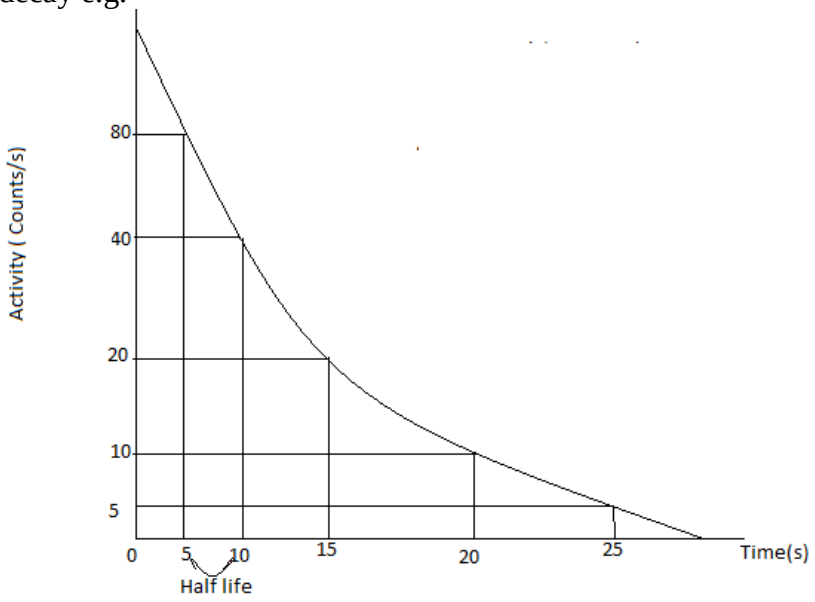
Example 2
Quarter of the uranium sample present in rock. Find the age of the rock assuming that uranium has half life of 4500million years

Solution
After 4500million the fraction remain is ½ of the sample
There fore ¼ of the sample it means we should multiple the half life by two to get the age of the rock
2 x4500 = 900 million years

ACTIVITY:
It is the average number of disintegrations (i.e. decaying atoms) per second .
Half –life is also the time taken for the activity of a given sample to fall to half its original value .
Half –life or Activity can be measured by finding the count rate using GM tube .
Half –life vary from millionth of a second to millions of years .

Element or nucleus	Half-life
Tin	1 700 000 000 billion years
Thorium	14 billion years
Uranium	4.5 billion years
Carbon	5566 years
Radium	1622 years
Scandium	85 days
Barium	86 minutes
Nitrogen	7.4 seconds
Helium	2.4×10^{-21} seconds

DECAY CURVE
It is a curve that illustrates how elements decay .This can be used to show the rate of disintegrations or decay e.g.



APPLICATIONS OF RADIOACTIVITY
It has a large number of uses in industries .These include :

Medical uses

1. Treating cancer by subjecting a patient to controlled amounts of gamma rays from a Cobalt –60 source.
2. Used in studying the function of thyroid gland by drinking iodine-31
3. To detect blood clot in the body where the patent is injected sodium 25 into the blood system and detect where it stops, tracing brain tumors and also to detect internal bleeding.
4. It help to make picture of organs in the body by use of gamma camera and are later detected gamma ray from the pictures what form a picture on the screen
5. Sterilising equipment and instruments using gamma rays.

Industrial use

1. Controlling thickness of paper , rubber , metals and plastics accurately
2. Controlling the filling of packets and containers.
3. Tracing fluid flow in pipes .
4. Used in textile industrial where beta radiation fix various chemical onto cotton fibre
5. Used to trace the flow of liquid in chemical factory
6. Used to preserve food where the food is exposed to gamma ray
7. Used to detect hidden flaws in metals castings

Agriculture use

1. Tracing uptake of fertilizers by plants .
2. They are used to control the screw worm fly pest in South America
3. It help to reveal the rate of photosynthesis by growing plant in the air containing carbon 14
   NB isotope with short halve life is used in agricultural studies so that the before the plant became mature and ready to by consumed the radioactive decay has already completed and it can not harm the consumer

Energy Source

1. Used in generation of electricity. Energy produced by radioactive fission of uranium-235 is used in nuclear power station to provide electricity.
2. Used as source energy in artificial peacemaker for heart
3. generate power

Radio dating (Archeology)

Carbon 14 is used in dating in Archeology

NB The uses of a radioactive isotope depend on its half –life . If the half –life is too short or too long it can have little practical application.

Dangers and Safety:

Gamma rays are the most dangerous because they can penetrate to tissues deep in the body

The danger from alpha particles is small , unless the source enters the body .

1. The ionising effect produced by radiation causes damage to cells and tissues and can also lead to the mutation of genes and deformity .
2. Beta and gamma radiations can cause radiation burns i.e. redness and sores on the skin and delayed effects such as : Eye cataracts - cancer
3. Large exposure can lead to death .
4. Damage to blood system may lower the resistance to some diseases.
5. It can sterility

Safety

The following safety precautions:

1. The source should be handed with forceps provided and never touch with hands
2. They should never be pointed towards a person

3. Food should not be taken where the source are being used because it may contaminate food.
4. Never smoke near radioactive source
5. wear rubber gloves , and hands should be washed after the source has been put away safely
6. Personnel operating nuclear reactors and the surrounding communities are protected from excessive radiations by proper shielding –steel and other operational safe –guards .
7. Wastes of nuclear reactors are stored in containers in caves and abandoned mines . Some containers are sunk in the sea .

Exercise

2003

Question two

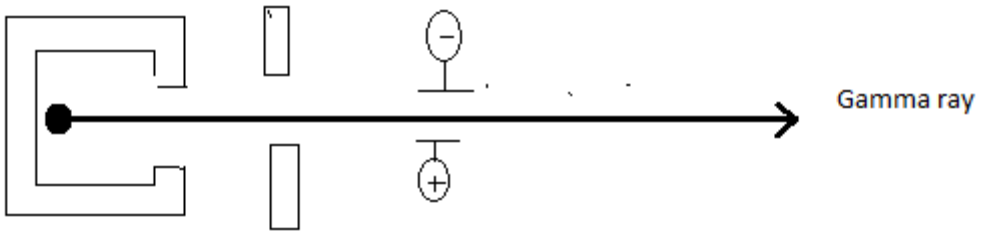
a. What is an isotope?
b. Chlorine has two isotope $^{35}_{17}Cl$ and $^{37}_{17}Cl$.
   i. Give the number of neutron in $^{35}_{17}Cl$
   ii. Given that two isotopes are present in ordinary chlorine in the ratio of three to $^{35}_{17}C$ l one atom of $^{37}_{17}Cl$. . Calculate the atomic mass of chlorine
c. How would the chemical properties of the two isotopes compared? Give a reason for your answer.
d. (i) What is radioactivity
   (ii) When the nucleus of radium emit an alpha particle it decays to radon according to the following equation $^{226}_{88}Ra \longrightarrow {}^{222}_{86}Rn + {}^{4}_{2}He$
1. Beside radon, name the other particle is produced when radium decay?
2. How does the mass of decaying atom compared with the masses of the products?
3. Name the alpha particle in this equation

e. Explain how the gamma rays are emitted
f. Give one sources of gamma rays

2004

Question 6

a. State any two safety precautions when handling radioactive substances
b. (i) describe "alpha particle" and "beta particle"
   (ii) Explain why gamma radiation is used sterilization of medical equipments
c. (i). the radon-222 isotope is formed from beta decay of uranium -226(Ra). Write nuclear equation of the reaction
   ii. Figure 4 is a diagram showing a radiation passing through an electric field



   Draw and label in the diagram the apath taken by alpha and beta – particles
   iii. Explain the behavior of
d. The particles shown in the diagram 6 c ii

2005

Question 4

c(i). The half life of a radioactive substance is 3 hours. What mass of the substance would remain after 12 hours if the initial mass was 20 g

ii. Why it is important to muse radioisotopes with shorter half life as tracers in agriculture.

2006

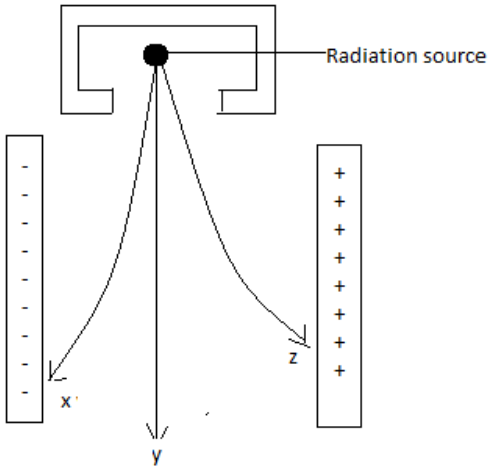
Question 3

a. Define nuclear fusion
b. Name the two particles that are found in the nucleus
c. Two radioactive samples showed the following characteristics:

	Effects on gold leaf electroscope	Effects on card board
A	No effect	Sample passed through
B	Discharged	Sample blocked

i. Identify samples A and B
ii. Why does the particles emitted by B get blocked by card board

d. Figure 1 is a diagram showing radiation passing through an electric field



i. Name the particle taking path X Y and Z
ii. Explain why particles Z will be deflected towards the positive plate

2007

Question 8

Describe the following radioactivity process: alpha decay, beta decay and gamma emission . in your description include atomic number penetrating power , ionising ability and behavior in magnetic and electric field

2008

Question three

a. Define nuclear fusion
b. The equation below shows the fusion of heavy hydrogen

$^{2}_{1}H + {}^{2}_{1}H \longrightarrow {}^{3}_{2}H + {}^{1}_{0}n$

i. Name the products
ii. Identify the type of fusion

c. Uranium $^{239}_{92}U$ decays in the series of stages as follows

Stage 1 $^{238}_{92}U \longrightarrow {}^{234}_{90}Th$

Stage 2 $^{234}_{90}Th \longrightarrow {}^{234}_{91}P$

i. Which particle is emitted at each stage?
ii. Apart from the particles mentioned in 3c I what else is emitted at each stage

d. State three safety precaution that must be followed when handling radioactive substances
e. When a source of radiation id placed in front of Geiger Muller counter, the initial count is 128. After 16 minutes, the count rates is 8. Calculate half life of the source.

2009

Question three

a. Define radioactivity

b. Name the three types of radiation
c. Mention any instrument that are used to detect radiation
d. (i)How does the chemical properties of the isotopes uranium $^{238}_{92}U$ and $^{234}_{92}U$ compared
ii. Give a reason for you answer in 3di
e. Mention any one natural source of radiation
f. A radioactive source has a half live of 30 minutes. Calculate the fraction left after 2 hours

2010

Question 5

(ai). Name two particles found in the nucleus of an atom

ii. State two characteristics of radioactive substances

b. State any two uses of nuclear radiation

c.Table 1 shows the activity of radioactive element with time

Activity (disintegration per second)	40	30	20	10
Time (days)	0	4	8	16

i. Plot the graph of activity against time
ii. Use the graph to find the time taken for the activity to drop from 20 to 15 disintegration per seconds
iii. Name the particles emitted when radium $^{236}_{88}Ra$ decays to ($^{222}_{88}Ra$)ear f

2011

di. Define nuclear fission

ii. Write two symbols representing an isotope of hydrogen

e. Explain why charged electroscope is not suitable for detecting beta decay

f. Thorium ($^{232}_{90s}Th$) decays by alpha emission to radium ($^{228}_{88}Ra$)

1. What do numbers 228 and 88 represent in
2. Write down the equation for the decay of Thorium

2012

6d.

i. Name any two types of radioactivity
ii. Define half life of a radioactive element
iii. Mention any three properties of an alpha particle

8.d. Eexplain any two uses of nuclear radiation

REFERENCES

1. Abbott A.F (1989) 5th ed. Physics Heinemann Educational publishers.
2. Chicago Bruce Banyard and etl (1983) ***Fundamental Physic***. Long-man Publication. Cheshire.
3. Child Ann (2000) *Macmillan Secondary Chemistry* . Macmillan Publisher Limited Malaysia
4. Earl B. and Wilford LDR (2004) 2nd ed . *GSCE Chemistry* John Murray publisher Limited London
5. Duncan Tom, 2nd ed. GSCE physics for Today a d Tomorrow. John Murray Publishers.
6. Freemantle Micheal (2000) *Chemistry in Action* Prosperous Printing Co. Ltd HongKong.
7. Gallagher Rose and Ingram Paul . (2000) *Complete chemistry* . Oxford university press .New York
8. Gerrish h. Howard, (1968) *Electricity And Electronic.* The Good Heart – Wilcox .Co. Inc Illinois
9. Hill Graham and Holman John (2000) 5th ed. *Chemistry in Contex*t , Nelson Thones ltd Cheltenham
10. Malawi institute of education *Malawi school teaching syllabus* Zomba
11. Maneb Unpublished past paper
12. Pople Stephen (2001) *Complete physic* , Oxford University press Milan
13. Rowel Gilbert and Sydney Herbert (2004) *Physic*. Cambridge university press. Cape town
14. Salvatore Tocci and Claudia Viehlland ,(1998) ***Holt chemistry visualizing matter***. Holt Rinehart and Winston publication Chicago
15. Taylor Micheal (2008) *Macmillan Secondary Physics,* Macmillan publishers Ltd Oxford
16. Wallis Keith . 3rd*Chanco Physical Science for Malawi BK2* Chancellor College Publication Zomba
17. Wallis Keith .(1992) *2nd Physical Science for Malawi BK1* Lilongwe
18. Www.itute.com