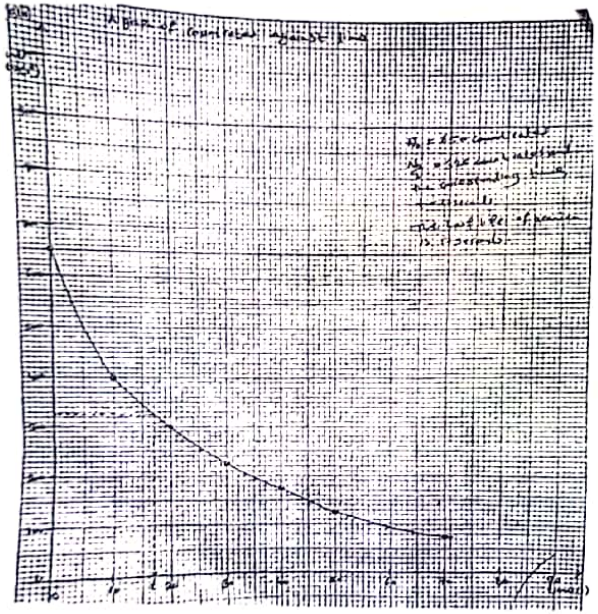
SOLUTIONS TO PHYSICS SEMINAR HELD AT ST. JOSEPH'S S.S.S. NAGGALAMA 2023

MODERN PHYSICS

1. (i) Half –life is the tine taken for a radioactive substance to decay to half its original number of atoms or mass.

Radioactivity is the spontaneous disintegration of a radioactive substance giving out alpha particles, beta particles and gamma rays .

ii)



(b)I) $^{60}_{27}C \longrightarrow {}^{56}_{26}Y + {}^{4}_{2}He + {}^{0}_{-1}e + energy$

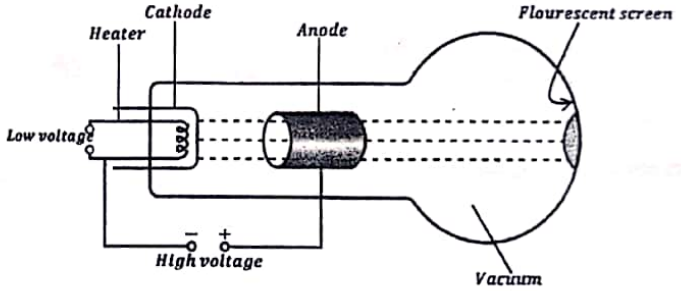
ii) Y has 26 protons

Y has 30 neutrons

Y has 26 electrons

c) i) Cathode rays are streams of Fast moving electrons

ii)



The heater connected to the low voltage source heats the cathode to give out electrons thermionically. The electrons are attracted to the anode and accelerated by the p.d connected between the anode and the cathode to form the cathode rays that make the fluorescent screen to glow on striking it.

di)Alpha particles have higher charge and larger mass therefore they are slow moving particles. They get enough exposure time with the surrounding air molecules thus turning the air molecule into a pair of opposite charged ions.

ii)To prevent collision between the fast moving electrons and matter (air particles). This reduces the speed of the electrons hence reduction in their kinetic energy. .

To prevent ionization of the air molecules.

2.(a)i) Atomic number is the number of protons in the nucleus of an atom.

ii)Radio isotopes are atoms of the same radioactive element with the same atomic number but different mass number.

b)An alpha particle is helium nucleus while a beta particle is fast moving electron emitted by a radio active substance.

ii) $^{235}_{92}U + {}^{0}_{1}n \longrightarrow {}^{141}_{56}Ba + {}^{92}_{36}X + 3{}^{0}_{1}n + energy$

The type of reaction is nuclear fission

C(i)The alternating voltage is connected to y-plates with the time base off(voltage not applied on the x-plates)

The voltage gain connected to y-plates is set eg $5vcm^{-1}$(y sensitivity)

A vertical trace is formed on the fluorescent screen .

The length of the vertical trace is measured (peak to peak length)

The peak voltage ,Vo=1/2 length x voltage gain

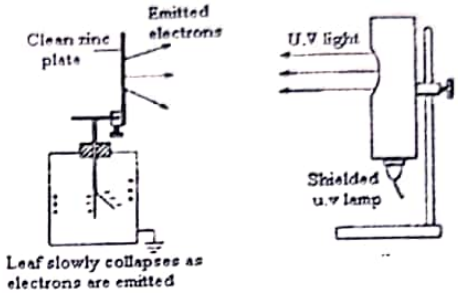
ii) Cathode ray oscilloscope is more sensitive since it uses the spot of light not a pointer.

Cathode ray oscilloscope measures both large and small voltage.

Cathode ray oscilloscope measures both alternating voltage (a.c) and direct voltage (D.C)

di)Photo-electric effect is the process of producing electrons from a metal surface when electromagnetic radiations of high enough frequency fall on it.

ii)



A clean zinc plate is placed on the cap of a negatively charged gold leaf electroscope therefore the zinc plate is negatively charged by contact method.

Radiations of high enough frequencies eg u-v radiations are allowed to fall onto the zinc plate.

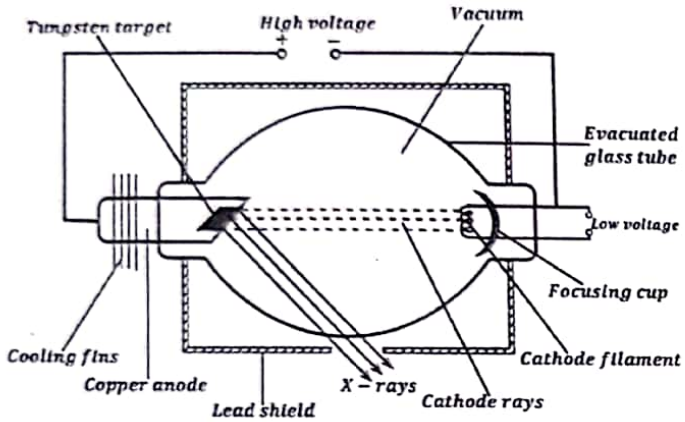
The gold leaf is seen to fall gradually. This implies that the electroscope is losing electrons through the zinc plate. This demonstrates photo electric effect.

3.(a)i) Gamma rays are electromagnetic waves of shortest wavelength produced by radioactive nuclide.

(ii) X-rays are electromagnetic waves of short wavelength produced when fast moving electrons are stopped by a metal target. .

b(i)Thermionic emission is the process of producing electrons from a metal surface when heated.

(ii)



The cathode filament is heated by the current supplied by the low voltage source to emit electrons by the process called thermionic emission .The electrons are attracted to the copper anode and accelerated by the high p.d between the cathode and anode. The electrons therefore gain kinetic energy .On striking the metal target ,a small fraction of the kinetic energy is converted into x-rays and the rest of the kinetic energy is converted into heat which is conducted by the copper anode and absorbed by the cooling fins.

precaution

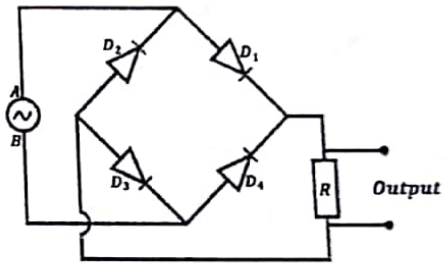
The x ray tube should be enclosed by the lead shield leaving only one exit for the produced x-rays .Lead absorbs stray x −rays to avoid un necessary exposure to x-rays .

C) Intensity of x-rays is increased by increasing the current used to heat the cathode filament (filament current) such that more electrons are produced. It is also increased by increasing the p.d across the tube.

Penetrating power of x-rays is increased by increasing the accelerating p.d connected between the anode and cathode. The types of x-rays are : soft x-rays and hard x-rays.

d(i)Rectification is the process of converting alternating current or voltage to direct current.

(ii)



During the first half cycle when A is positive and B is negative, diodes D1and D3 conduct current and it flows though the resistor R. Diodes D2 and D4 do not conduct current.

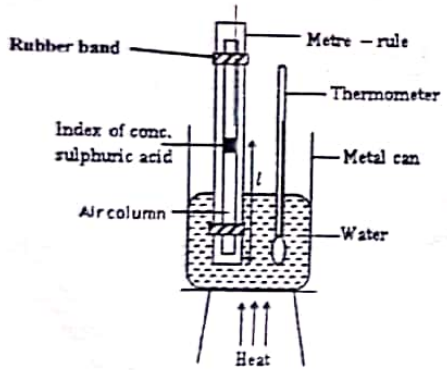
- During the next half cycle when B is positive and A is negative, diodes D2 and D4 conduct current and it flows through the resistor R. Diodes D1 and D3 do not conduct current.
- Hence current flows through R during both half cycles in the same direction and therefore A.C is converted to D.C giving a full wave rectification.

HEAT

4. (a) (i) Charles law states that volume of fixed mass of a gas at constant pressure is directly proportional to absolute temperature.

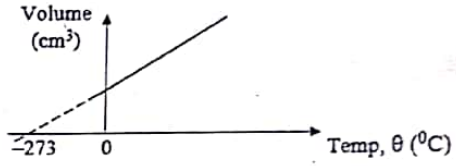
(ii) According to Kinetic theory, a gas is made up of molecules which are in a continuous random motion, when it is cooled the Kinetic energy of molecules reduces and the gas molecules come to a close proximity to each other, at a temperature of $-273^{o}C$, the molecules cease to move and have zero kinetic energy.

(b)



- The water is heated strongly and stirred to ensure that the air reaches the same temperature of the water.
- The length of the air column l is measured and recorded for each temperature.

- For a number of different temperatures, θ the corresponding lengths of the air column, l are measured and recorded and results are tabulated including values of volume V, where V = Al. Where A is the cross sectional area of the capillary tube.
- A graph of volume V against temperature, θ is plotted



- A straight line is obtained which shows that volume of fixed mass of gas at constant pressure is directly proportional to temperature which is Charles's law.

(c) $T1 = 0 + 273 = 273K$ $\quad T2 = 273 + 273 = 546$

$V1 = 1l$ $\quad V2 = 1/4\ l$

$P1 = 1 \times 10^{5}Nm^{-2}$ $\quad P2 =$

Using $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$$\frac{1 \times 10^5\ 1l}{273} = \frac{P_2 \times \frac{1}{4}l}{546}$$

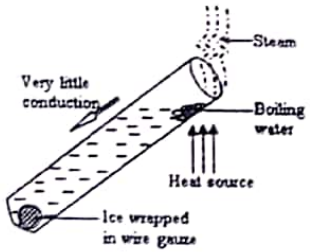
$$P_2 = 800{,}000Nm^{-2}$$

(a)

- Ideal gases obey gas laws while real gases do not obey gas laws
- In Ideal gases Intermolecular forces are negligible while in real gases Intermolecular forces are significant
- Volume of a molecule is negligible in ideal gases while Volume of a molecule in real gases significant compared to the volume of the container.

5.(a) (i) **Conduction of heat** – transfer of heat from a region of high temperature to the region of low temperature without the bulk movement of matter itself.

(ii)



- Ice wrapped in wire gauze is placed at the bottom of the test tube
- The test tube is filled with water and then heated from the top while in slanting position

- The water at the top of the test tube started boiling while the ice at the bottom of the test tube didn't melt.
- This is because there was little conduction of heat to the bottom of test tube and this shows that water is a poor conductor of heat.

(b) (i) The level of water in glass tube falls and the air bubbles are seen coming out of the other end of the tube in water.

(ii) This is because when the flask is heated, the air inside the flask expands and exerts pressure on the water level in the tube hence pushing the water downwards.

(c) $l\theta = 22mm$

$l100 = 134mm$

$l\theta = 68mm$

Using $\theta = \left(\frac{l_\theta - l_0}{l_{100} - l_0}\right) \times 100^\circ C$

$\theta = \left(\frac{68 - 22}{134 - 22}\right) \times 100^\circ C$

$\theta = \frac{46}{112} \times 100^\circ C$

$\theta = 41.1^\circ C$

(d) (i) During daytime, both the sea and the land are heated equally by radiations from the sun, the land has a smaller specific heat capacity than the sea, thus heats up faster than the sea hence the sea remains cooler than the land. At night, the land loses heat faster than the sea thus the sea feels warmer than the land.

(ii) Qualities of a good thermometric property

- A good thermometric property should vary linearly and continuously with temperature.
- It should vary over a wide range of temperatures
- It should be sensitive to small temperature changes

6. (a) (i) Specific capacity is amount of heat required to raise the temperature of 1Kg mass of substance by 1 K.

Latent heat is the quantity of heat required to change the physical state of a substance at constant temperature.

(ii) 4200J of heat energy is required to raise the temperature of 1kg of water by 1K.

(b) $M = 2000g = \left(\frac{2000}{1000}\right) = 2kg$

$\theta_1 = 20^oC$

$\theta_2 = 30^oC$

$\Delta\theta = \theta 2 - \theta 1 = (30 - 20) = 10^oC$

$Q = 22000\ J$

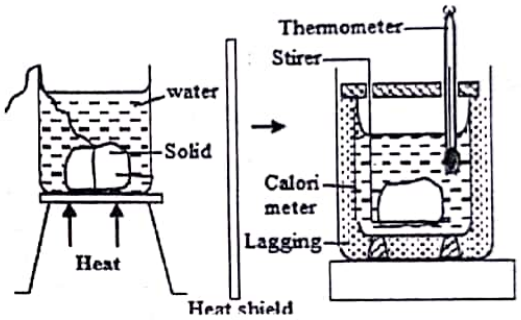
$\theta = mc\ (\theta_2 - \theta_1)$

$22000 = 2 \times C \times 10$

$\frac{20C}{20} = \frac{22000}{20}$

$C = 1100Jkg^{-1}K^{-1}$

(C)



- A solid of mass ms, and unknown specific heat capacity Cs is heated in boiling water to a temperature θ_3.
- It is then quickly transferred into a calorimeter of mass Mc, and specific heat capacity, Cc containing water of mass Mw and specific heat capacity Cw at a temperature θ_1.
- The mixture is then stirred uniformly until a final steady temperature θ_2 and is recorded.
- Assuming no heat is lost to surrounding and no heat is absorbed by stirrer and the thermometer.
- Heat lost by a hot solid = Heat absorbed by white + heat observed by calorimeter

$$Cs = \frac{MwCw\ (\theta_2 - \theta_1) + McCc\ (\theta_2 - \theta_1)}{Ms\ (\theta_3 - \theta_2)}$$

(d) (i) Saturated vapour pressure – Pressure exerted by the vapour which is in dynamic equilibrium with its own liquid.

(ii) Unsaturated vapour pressure increases with increase in temperature as this is as a result of increased collisions of vapour molecules with walls of container.

(i) Evaporation	Boiling
- Occurs at any temperature	Occurs at constant temperature
- Occurs at the surface	Occurs within the liquid
- Causes cooling	Doesn't cause cooling
- Depends on surface area	Doesn't depend on surface area.

MECHANICS

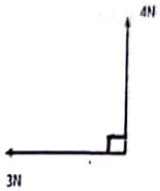
7.(a) Scalar quantity are quantities specified by magnitude only while vector quantities are quantities specified by both magnitude and direction

Scalar quantities include distance, speed, mass, pressure, work, power

Vector quantities include displacement, velocity, acceleration, force

b(i) $F_Y = 4N$

$F_x = 9 - 6 = 3N$



Resultant force ,F = $\sqrt{(f^2_x + f^2_y)}$

$= \sqrt{3^2 + 4^2}$

$= 5N$

From $F = m\,a$

$5 = 10a$

Acceleration, $a = 0.5\ ms^{-2}$

(ii) $S = ut + \frac{1}{2}at$

$= 0 \times 20 + \frac{1}{2} \times 0.5 \times 20^2$

$= 100\ m$

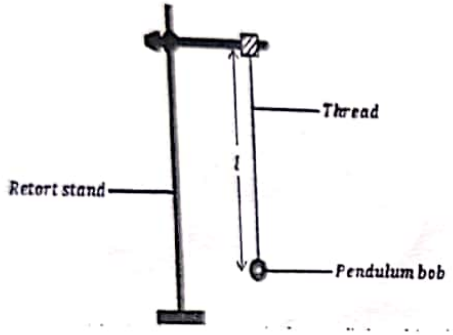
C(i) The principle of conservation of linear momentum states that when two or more bodies collide, total momentum before collision is equal to total momentum after collision provided no external force acts on the system

(ii)

- Rocket propulsion/ launching of rockets
- Billiard balls
- Motor boats
- Air escaping from the balloon

- Gun recoil

(d)



- A simple pendulum is made by attaching a length, l, of thread to a small mass
- The thread is held firmly by clamping on a stand
- He bob (small mass) is given a small horizontal displacement
- The time taken to complete 20 oscillations is measured by the stop clock and period, t calculated
- The experiment is repeated for various lengths, l of the thread and results recorded in a suitable table including values of T^2
- A graph of T^2 is plotted against l
- The slope, S, of the graph is calculated
- The acceleration due to gravity is then calculated

From $$g = \frac{4\pi^2}{S}$$

8.(a) Force is the pull or push that changes the body's state of rest or uniform motion in a straight line while pressure is the force acting normally per unit area

(ii)

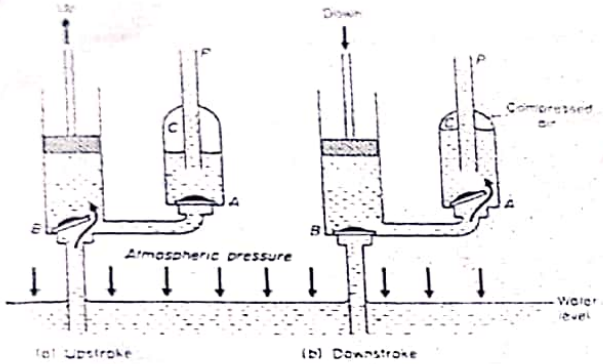
- weight of the solid/ applied force
- Area of contact with the surface

(b) The area of the sharp end of the needle is smaller than that of the nail and since pressure is inversely proportional to area, the needle exerts greater pressure than the nail, the needle easily and deeply penetrates the skin, hence producing more pain than the needle

C(i) Atmospheric pressure is the force acting normally per unit area on the earths surface by the weight of air above it

(ii)

- Common pump (lift pump)
- Force pump
- Rubber sucker
- Siphon
- Syringes



A force pump is used to raise water to the a height more than 10m . it consists of a pump with a solid plunger and foot valve B connected by a pipe to a chamber C through the valve A

On the upstroke, valve A closes and atmospheric pressure pushes water up in to the pump through valve B

On the down stroke valve B closes and water is forced into the chamber C through the valve A by the pressure due to mechanical force exerted on the plunger

The exit pipe P projects into the chamber C so that some air becomes trapped at the top of the chamber. This air is compressed and acts as a cushion, thus preventing a sudden jolt to the pump when the water pump P falls slightly and sharply closes valve A at the beginning of the upstroke. C also helps to expel water on the upstroke

(d) Pressure difference due to air = pressure difference due to mercury

$h_a\rho_a g = h_1\rho_m g - h_2\rho_m g$

$h_a\rho_a = (h_1 - h_2)\rho_m$

$h_a \times 1.25 = (0.75 - 0.60) \times 13600$

$h_a = 1632\ m$

the height of mountain = 1632 m

9.(a) Archimedes' principle states that when a body is wholly or partially immersed in the fluid, it experiences upthrust which is equal to weight of the fluid displaced

(ii)The law of flotation states that floating body displaces its own weight of the fluid in which it floats

(b)weight of air , $W_a = \left(\frac{237.5}{1000}\right) \times 10 = 2.375\ N$

Weight in liquid $W_l = \left(\frac{212.5}{1000}\right) \times 10 = 2.125\ N$

Weight in water , $W_w = \left(\frac{206.3}{1000}\right) \times 10 = 2.063\ N$

Relative density , $R.D_l = \left(\frac{\text{upthrust in liquid}}{\text{upthrust in water}}\right)$

$= \left(\frac{Wa - Wl}{Wa - Ww}\right)$

$= \left(\frac{2.375 - 2.125}{2.375 - 2.063}\right)$

$= 0.8013$

Density of the liquid = $R.D_l \times$ Density of water

$= 0.8013 \times 1000$

$= 801.3\ kgm^{-3}$

$$\text{Relative density of the solid} = \frac{\text{weight in air}}{\text{upthrust in water}}$$

Relative Density of solid = $\left(\frac{2.375}{2.375 - 2.063}\right)$

R D = 7.6122

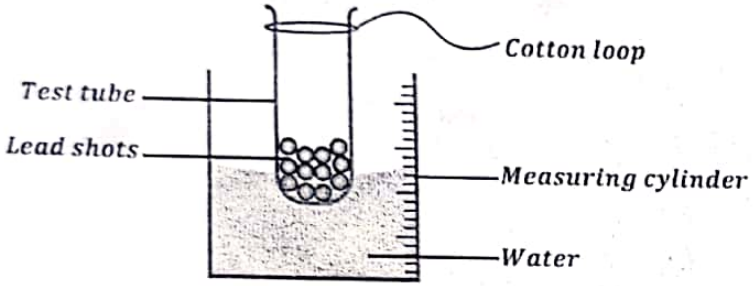
Density of solid = R D s x density of water

= 7.6122 x 1000

= 7612.2 kgm^{-3}

(ii) A ship is made hollow and contains air. Therefore, the average density of the ship is less than that of water

(c)



- A measuring cylinder is about half filled with water and original reading of volume V_1 noted
- A test tube with a cotton loop attached, is then placed in the measuring cylinder and lead shots added to the test-tube little at a time until the test tube floats upright
- The new water level reading V_2 in the measuring cylinder is taken
- Volume of water displaced $V = V_2 - V_1$
- Mass of water displaced $m = \rho (V_2 - V_1)$
- Weight of water displaced $W = \rho(V_2 - V_1)g$
- The test tube is removed from the cylinder, dried and then weighed using the cotton loop to attach it to the spring balance hook

- The experiment is repeated several times, each time adding little extra shot
- It is observed that in all trials the values of weight of lead shot and test tube, agree with corresponding values of weight of water displaced, then the law of flotation is obeyed

d(i) To be able to see smoke particles clearly.

(ii) This is because when an air particle hits a smoke particle, the smoke particle is seen as white speck able to move in the same direction as that of air particle that hit it. And when another air particle hits the smoke particle, it changes it direction to that of second air particle and so on exhibiting Brownian motion

(iii)The smoke particles are seen as bright specks undergoing continuous random motion called Brownian motion due to tiny air particles colliding with tiny smoke particles.

10. (a)i . Work is the product of force and distance moved in direction of the force

(ii) Power is rate at which work is done

b(i) Power developed , $P = \frac{\text{WORK DONE}}{\text{TIME TAKEN}}$

$= \frac{\text{FORCE X DISTANCE}}{\text{TIME TAKEN}}$

$= \frac{2500 \times 3}{1.5}$

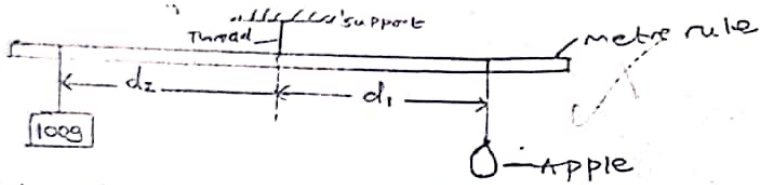
$= 5000\ W$

(ii) $P = \frac{F \times D}{t}$

$5000 = \frac{6000 \times 5}{t}$

t = 6 seconds

C(i) moment of a force about a point is the product of the force and perpendicular distance of its line of action from that point



- Using a piece of thread, a meter rule is suspended on a supported and adjusted until it balances horizontally
- A 100g mass is suspended on one side of meter rule and the apple on the other side
- The masses are adjusted until it balances again
- Distances d1 and d2 are read and recorded
- The force F on 100g is calculated
- Let w be the weight of the apple

Using the principle of moments

Sum of clockwise moments = sum of anticlockwise moments

$W \times d1 = Fxd2$

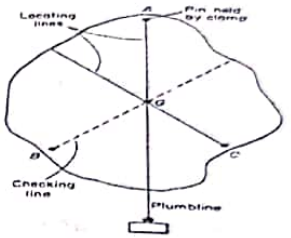
$mg = \frac{F \times d2}{d1}$

$m = \frac{F \times d2}{gd1}$

m is the mass of the apple

(iii)The sum of clockwise moments about a point must be equal to sum of anti clockwise moments about the same point

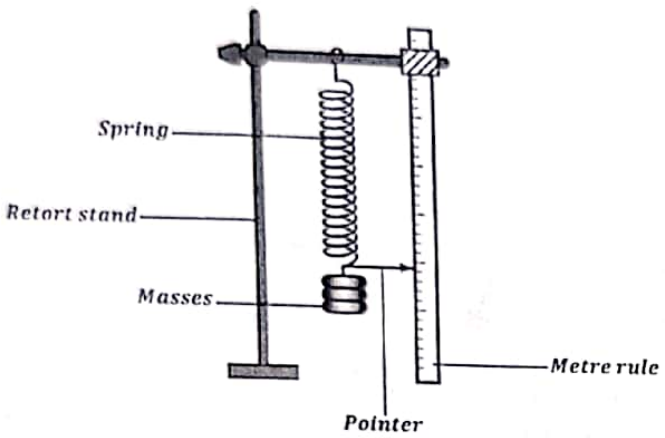
The algebraic sum of forces acting on a body is zero



- Three small holes are made at well-spaced intervals round the edge of the card board
- A stout pin is then put through one of the holes and held firmly by a clamp and stand so that the card board can swing freely on it
- A suitable plumb line is hung from the pin and the position of the thread of the plumb line is marked on cardboard by two small pencil crosses . These crosses are joined by a pencil line
- The experiment is repeated with a card board suspended by one of the other holes and as a check, card board is suspended by the third hole
- The point of intersection, G is the position of Centre of gravity

11.a(i)Hooke's law of elasticity states that the extension of an elastic material is directly proportional to the applied force provided the elastic limit is not exceeded

ii)



- A spring is suspended from a clamp
- A pointer is attached to the lower end of the spring
- A meter rule is clamped besides the pointer
- The initial pointer reading Po is noted
- The mass is attached onto a spring and new pointer reaching P1 noted
- The corresponding extensions, e is calculated from e = P1 - Po
- The experiment is repeated with varying masses
- The results are put in a suitable table including values of force, F = mg on each mass
- A graph of F against e is plotted
- A straight line through the origin is obtained, hence extension produced is directly proportional to the applied force

(b)Let m be the mass of the scale pan

$F1 = (m + 0.1) \times 10$; $e1 = 6cm$

$F2 = (m + 0.2) \times 10$; $e2 = 10cm$

$$\frac{F1}{F2} = \frac{e1}{e2}$$

$$\frac{10(m+0.1)}{10(m+0.2)} = \frac{6}{10}$$

$$\frac{(m+0.1)}{(m+0.2)} = 0.6$$

$$m = 0.005\ kg$$

$$m = 50g$$

C(i) Uniformly accelerated motion is the type of motion in which velocity changes by equal amounts in equal time intervals or where the rate of change of velocity is constant

(ii) $V = U + at$

$S = ut + \frac{1}{2} a t^2$

$V^2 = U^2 + 2as$

Where U is initial velocity

V is final velocity

a is acceleration

s is distance travelled

t is the time taken

(iii)

$a = 0.2ms^{-2}$

$U = 0 ms^{-2}$

$S = 1000\ m$

$V^2 = u^2 + 2as$

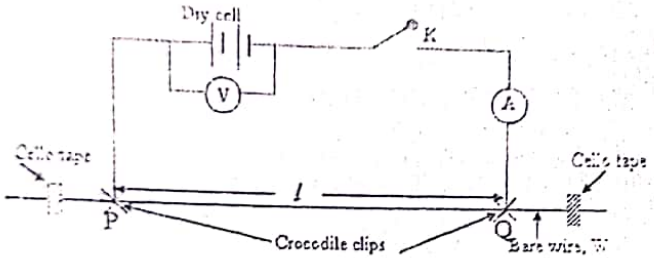
$V^2 = 0^2 + 2 \times 0.2 \times 1000$

$V^2 = 400$

$V = 20\ ms^{-2}$

ELECTRICITY

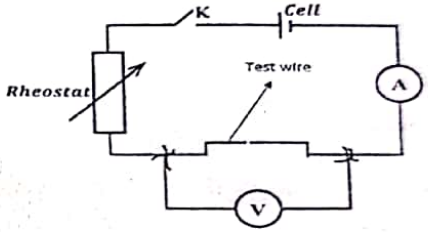
12.(a)is the opposition to flow of current through an electrical component.



- A bare wire is stretched on a meter rule and connected to the circuit as shown
- Starting with suitable length ,L, of the wire , switch k is closed , the ammeter reading I and voltmeter reading V is noted
- The experiment is repeated for various values of length , L, and the corresponding values of V and I are noted
- Results are tabulated

- A graph of V against I is plotted which gives a straight line
- The slope, S, is determined
- The resistance of a length of resistance wire R = S

ALTERNATIVELY



- The test wire of given length , L, is connected in the circuit as shown
- Switch K is closed , and using a suitable setting of a rheostat , the ammeter reading I and voltmeter reading , V is noted
- The above procedure is repeated for different values of V and I by adjusting the rheostat
- The results are tabulated
- A graph of V against I is plotted
- Slope S is determined
- The resistance of a length of resistance wire R = S

b(i) $V = I R$; R – resistance of conductor

(ii)

- Length of conductor
- Cross sectional area of conductor
- Temperature of the conductor

(c) (i) $P = V I$

$2000 = 250\ I$

$I = 8\ A$

(ii) $V = I R$

$250 = 8\ R$

$R = 31.25\ \Omega$

(iii) Assuming all electrical power is dissipated as heat (passive resistor)

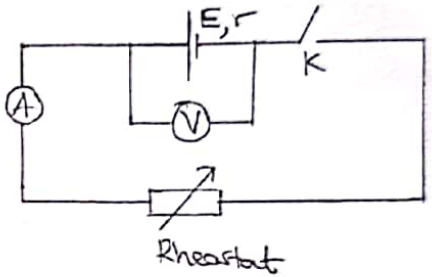
Heat produced $= P \cdot t$

$= 2000 \times 60$

$= 120{,}000\ J$

13a(i) Electromotive force is the potential difference across the terminals of a cell in an open circuit

Is the work done to transfer 1 C of charge around the complete circuit in which the cell is connected .



- The electrical circuit is set up as shown
- Switch k is closed
- Using the suitable setting of rheostat , the ammeter reading I and voltmeter reading , V is noted
- The experiment is repeated for different values of V and I by adjusting the rheostat
- The results are tabulated
- A graph of V against I is plotted which gives a straight line
- The slope S of the graph is determined
- Internal resistance , $r = -S$

b(i) The reading of A_1 and A_2 is the same since the current flows through them (they are in series)

(ii) The reading of V_1 will decrease since potential difference is directly proportional to current and the current is reduced by increasing effective resistance

c) for 0.25A,

$E = I(R + r)$

$E = 0.25(2 + r)$.....(i)

For 0.3A

$= \frac{2 \times 2}{2+2}$

$R = 1\ \Omega$

$E = I(R + r)$

$E = 0.3(1 + r)$.....(ii)

(i) ÷ (ii)

$\frac{E}{E} = \frac{0.25(2+r)}{0.3(1+r)}$

$r = 4\Omega$

$E = 0.25(2 + 4)$

$E = 1.5\ V$

d) From electrical power $P = V\ I$

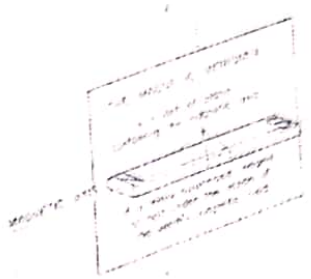
$I = \frac{P}{V}$, at high voltage the current that flows through the cables is small, that minimizes the power losses in form of heat by $I^2 R$

MAGNETISM, ELECTROMAGNETISM AND ELECTROSTATICS

14. a(i)Magnetic median is a vertical plane in which a freely suspended magnet sets itself.

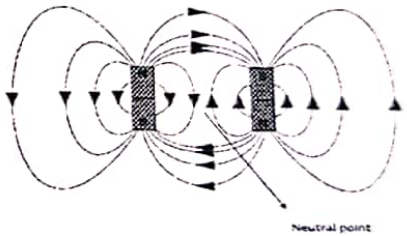
Angle of dip is the angel between the earths resultant magnetic field and the horizontal.

ii)



- A bar magnet is suspended from a string, allowed to swing freely until it settles.
- The north pole will face towards the north and the south pole will face towards the south direction.
- A piece of paper arranged with sides parallel to the magnetic axis is brought behind the bar magnet.
- The vertical plane of the paper is the magnetic meridian.

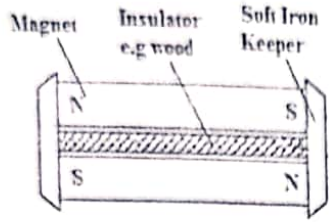
b)



c) Determining the direction of magnetic field

measurement of magnetic field strength

d)



- Unlike poles of a magnet are placed adjacent to each other with small pieces of soft iron across their ends.
- An insulator is then fixed between the magnets.
- The keepers are magnetized by induction forming a closed loop of magnets with no exposed free poles. This eliminates self-demagnetization.

e) Consequent poles are double like poles at the Centre and ends of magnetic material formed as a result of double stroking using like poles of a permanent bar magnets.

15. ai)Conductors are materials which allow electricity to pass through them due to presence of free mobile electrons While insulators are materials which do not allow electricity to pass through them because they have no free mobile electrons.

ii) When a pen is rubbed with hair heat is generated, the heat enables the electrons to move from one material to another. The material that gains electrons becomes negatively charged and one that loses becomes positively charged.

b)A steel ball is placed on an insulating support .A negatively charged rod is brought near the rod.

Positive charges are induced at the end near the charged rod while negative charges are repelled at the remote end.

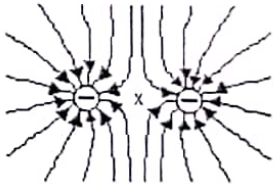
With the charged rod still in position, the remote end is earthed. Negative charges flow to the earth.

The earthing is disconnected and the rod is removed, charge distribution occurs leaving the steel rod positively charged.

c) Dry weather

Insulating environment.

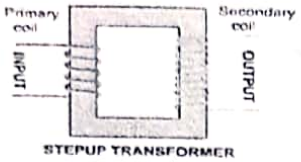
d)



x- neutral point

A neutral point is a point in electric field where the resultant electric force is zero.

16. a)i)



STEPUP TRANSFORMER

Alternating voltage is applied across the primary coil which causes alternating current to flow through the coil.

A changing magnetic field from the primary coil links to the secondary coil through the soft iron core.

An emf is induced in a secondary coil higher than the voltage across the primary coil.

ii)Energy loss due to eddy currents .

- Energy loss due to joule heating caused by resistance of the wires of the coils.
- Hysterisis loss
- Magnetic flux leakage.

bi) On closing the switch more iron fillings are attracted to soft iron rod than the steel rod because soft iron is easily magnetised unlike the steel rod.

ii)Less iron fillings remain clinging on the soft iron rod and more on the steel rod .This is because the steel rod does not easily lose magnetism unlike the soft iron rod .

d)Potential difference across the milliammeter = potential difference across the shunt.

$I_m R_m = (I - I_m)R_s$

$1.5\times10^{-3}\times2.0 = (2 - 1.5\times10^{-3})R_s$

$R_s = 0.15\Omega$

A shunt of resistance 0.15Ω must be connected in parallel with a milliameter.

WAVES

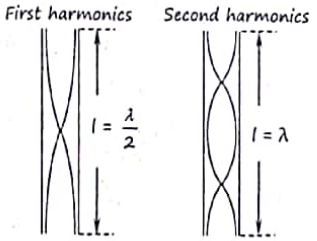
17. (a)Ultrasound is sound of high frequncy beyond human hearing capacity.

(b)
- Ultrasound is sent out by the detecting vessels and is reflected by other sea vessels.
- The reflected ultrasound is received and used to form an image of the reflecting vessel on an oscilloscope screen.

- Ultrassound is sent downwards from the bottom of a ship and it is reflected from the bottom of the sea.

- The wave travel to and from the bottom of the sea is used to calculate the depth of the sea automatically.

(c)



(i)

From $v = f\lambda$

$v = 256 \times 2l$

$v = \underline{512l}$

From v = fλ

512l = f x l

f = 512Hz

(ii)

From v = fλ

320 = 256 x 2l

$l = \frac{320}{2 \times 256}$

l = 0.625m

(d)

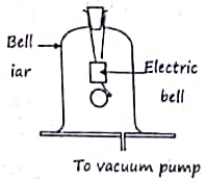
-An electric bell is enclosed in a bell jar.

-The bell jar is connected to a vacuum pump.

-When the bell is switched on, sound is heard and the hammer is seen striking the gong.

-When the vacuum pump is started, the loudness of the sound slowly decreases until it dies out completely even when the hammer is seen striking the gong.

-When is introduced back into the bell jar, sound is heard and the hammer is seen striking the gong. This shows that sound is a mechanical wave.



18. (i) Amplitude is the maximum displacement of wave particle from its rest position.

(ii) Frequency is the number of complete oscillations made per second.

(iii)

$Amplitude = 5.2cm$

$Wavelength = 14x2 = 28cm$

(b)

- Fill a resonance tube with water held vertically.
- Place a vibrating tuning fork near its open end.
- Open the tap so that water flows out as length of air column increases until a loud sound is heard. Resonance is then said to occur.

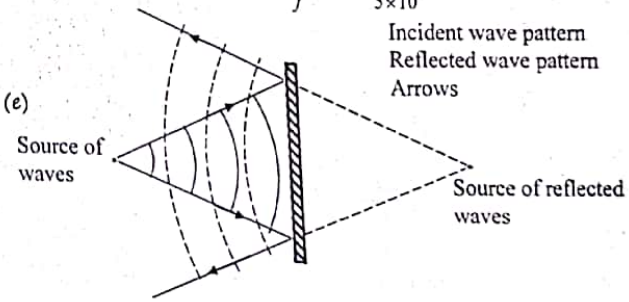
(c) (i) Velocity $= \frac{distance}{time} = \frac{2d}{t} = \frac{2 \times 540}{3} = 360\ m\ s^{-1}$

(ii) The factors are;

- Temperature of the air.
- Direction of wind
- Humidity

(d) $v = f\lambda \Rightarrow \lambda = \frac{v}{f} = \frac{3 \times 10^8}{5 \times 10^6} = 60\ m$

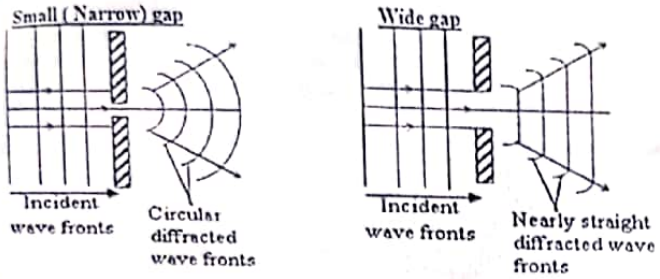
(e)



19. (a)(i) A pulse is a single disturbance that moves through a medium from one point to another.

(ii) A wave front is a surface on which the wave disturbance is in same phase at all points

(b)



C(i)

Longitudinal waves-These are waves in which particles of a medium vibrate parallel to the direction of propagation of a wave.

Transverse waves- These are waves in which particles of a medium vibrate perpendicular to the direction of propagation of a wave

(ii)

Longitudinal waves-Sound

Transverse waves-Light

(d)

- They are transverse waves.
- They can travel through a vacuum.
- They travel at a speed of light
- They carry energy.
- They can be reflected, refracted and diffracted.

(e)

(i) $number\ of\ loops = \frac{48\ cm}{6\ cm} = 8\ loops$

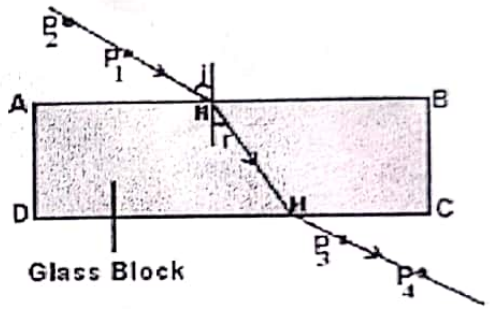
(ii) $wavelength = 2x6cm = 12cm$

LIGHT

20. a(i) The incident ray , refracted ray and the normal at the point of incidence all lie in the same plane

The ratio of the sine of angle of incidence to sine of angle of refraction is constant for a given pair of media

(ii)



- A plane sheet of paper is fixed on a soft board using thumb pins
- A glass block is placed on the paper and its outline ABCD is drawn
- A normal NO is drawn along AB at point N about 2 cm from A
- A line PN is drawn at angle I to the normal
- Fix optical pins P1 and P2 along PN
- By viewing through the block along face CD , fix P3 and P4 such that they appear to be in a straight line with P1 and P2
- Remove the glass block , optical pins and join the points with a straight line to point N
- Measure and record angle r
- The procedure is repeated for different values of i

- Values of i, r, sinr , sini are tabulated
- A graph sin i against sin r is plotted
- The slope is determined and this gives the refractive index

b(i) Power of the lens is the reciprocal of focal length of a lens in metres

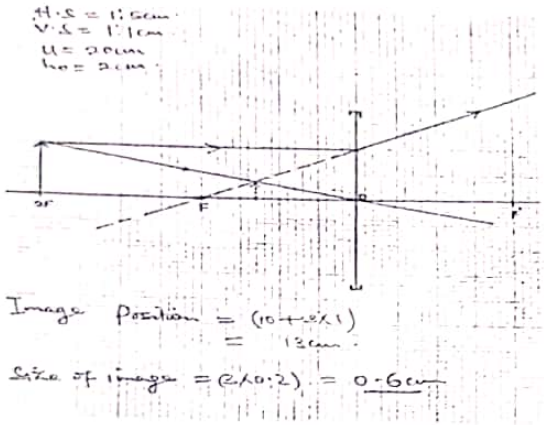
(ii) Principal focus is the point on the principal axis where rays originally parallel and close to it converge / diverge after refraction

(c)

h_o = 2 cm

U = 40 cm

F = 20 cm



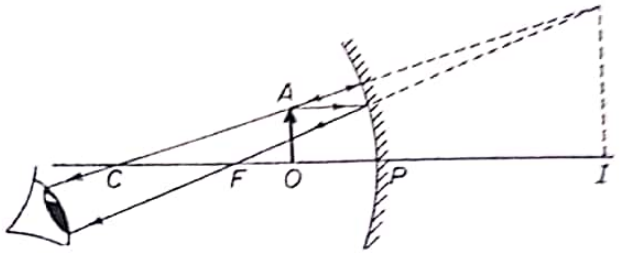
(d)light should be travelling from a more optically dense medium to less dense medium

The angle of incidence must be greater than the critical angle

2.1. a(i) focal length is the distance measured from the principal focus to pole

Radius of curvature is the distance from the pole to the Centre of curvature

b)



- An object O is placed between the principal focus F and the pole of the mirror
- The reflected rays appear to come from a appoint behind the mirror
- The image is magnified

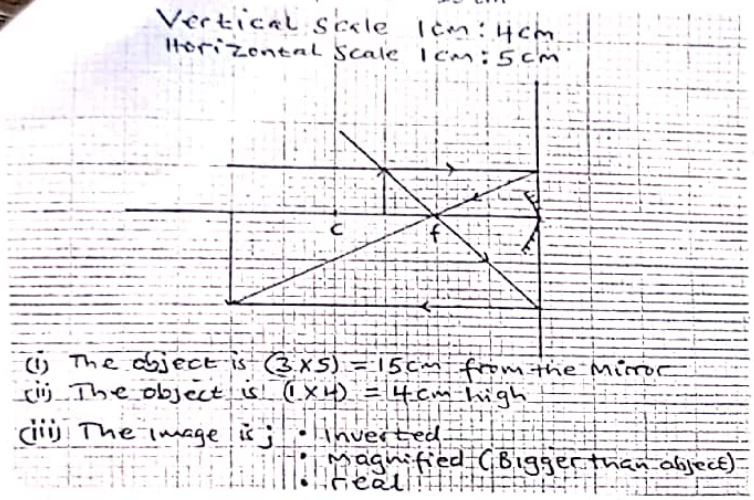
c ; h_o = 2cm

U = 20 cm

F = 15 cm

Vertical Scale 1cm : 4cm

Horizontal Scale 1cm : 5cm



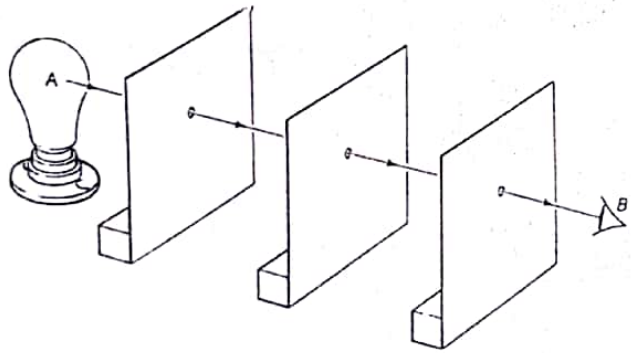
(i) The object is (3 x 5) = 15cm from the Mirror

(ii) The object is (1 x 4) = 4cm high

(iii) The image is;
- Inverted
- Magnified (Bigger than object)
- real

(d) Both light and heat are electromagnetic waves which are obstructed by the moon and hence do not reach the earth

22. (a) Reflection is bouncing back of light on meeting the obstacle



- Three card boards are arranged with their holes in a straight line such that they are some distance apart
- Pass the string through to ensure they are in a straight line
- When the eye is placed at B, light from the source at A is seen
- If one of the card boards is displaced such that the holes are not in a straight line, no light is seen at B
- This shows that light travels in a straight line

c) The image distance behind the plane mirror is equal to object distance in front of the mirror

the image of the chart is 2.5m behind the mirror

the total distance between and the image of the chart is 4.5m

d(i) critical angle is the angle of incidence in the more dense medium for which the angle of refraction in the less dense medium is 90°

(ii)from $n_g = \frac{1}{\sin C}$

A material with high refractive index has a small critical angle value and vice versa

e(i) long sight is a defect where a person can see distant objects clearly but near objects are blurred, this is due to having a short eye ball and long focal length

(ii)it can be corrected by wearing glass that have convex lenses such that rays can be converged be converged before reaching the eye