

RESPONSES TO THE O'LEVEL PHYSICS SEMINAR ITEMS HELD AT ST. JOSEPH'S S.S.S –NAGGALAMA ON 28TH JUNE 2025

ITEM 1.

- (a) Distance of the ambulance from the learners = $speed \times time$
 $= 330 \times 4 = 1320 \text{ m}$

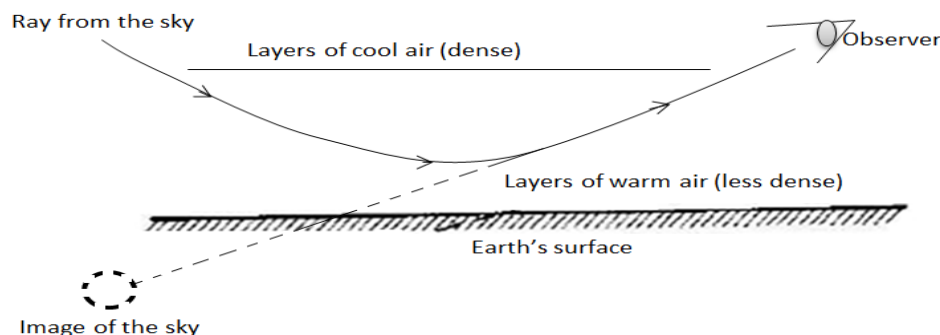
The fact that 1320m is less than 2000m (2km), then the learners were able to hear the sound. The sound heard kept on increasing because the distance between the learners and the ambulance kept on reducing as it approached them. This increased the intensity of sound received by the learners hence a loud sound was heard.

- (b) What the learners observed on the tarmac road was mirage. This was as a result of refraction and total internal reflection of light from the sky.

On a hot afternoon, layers of air near the earth's surface heat up and they become warm hence less dense than those high above the earth's surface which are cool hence denser. Light from the sky towards the earth's surface move from a region of dense air (cool region) to a region of less dense air (hot region) hence are refracted away from the normal (earth's surface).

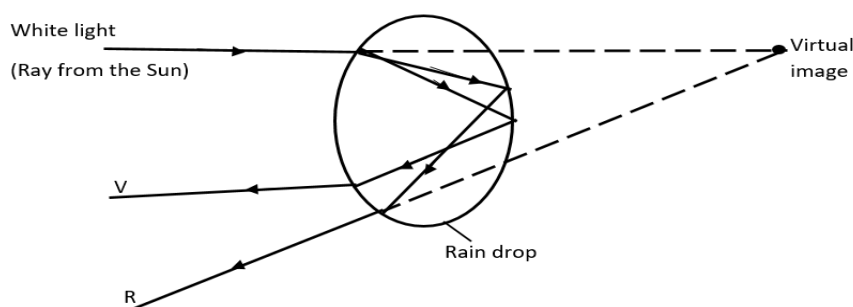
At some point, the angle of incidence exceeds the critical angle and the rays are reflected back in the denser medium hence total internal reflection.

The sky then seems to have been reflected from the earth's surface and gives the appearance of a pool of water known as a virtual image of the sky ahead of the learners, a phenomenon called **mirage**.

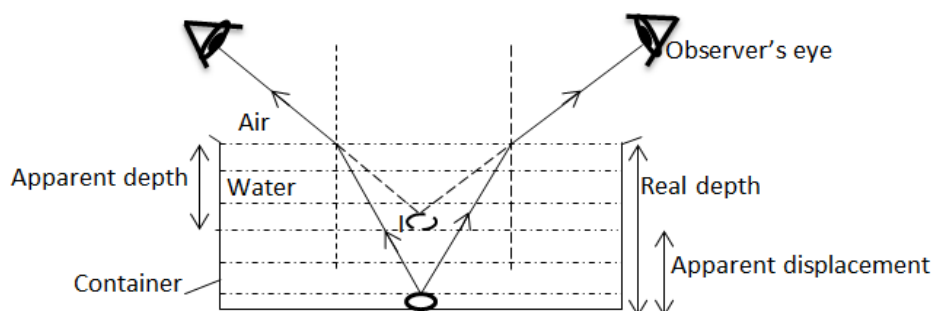


On the other hand, the learners saw a rainbow in the sky. This was due to dispersion of white light. The semi-circular distribution of colours in then sky is

due to the spherical shape of the raindrop. White light from the sun is dispersed and refracted by the rain drop into different colours which emerge at different angles corresponding to different colours towards the learners. The curved nature depends on the position of the learners on the earth's surface. The rainbow appears on the opposite side because of Total Internal Reflection. Since there is reflection, an image is formed on the opposite side to the source of light



- (c) Light from the bottom of a swimming pool to the eyes of the learners travel from a denser medium (water) to a less dense medium (air) hence are refracted away from the normal at the water- air boundary and appear to be coming from point I. To the learners, the bottom of the swimming pool appears to be at point, I which is shallower than the real depth of the swimming pool just as the pool attendant told them.



ITEM 2.

- a) Because there are several tiny particles in the universe/atmosphere which scatter light. Red light is least scattered and it has long wave length. This implies that its intensity is almost constant over several kilometres. Hence it can be seen.
- b) A lamp converts electrical energy into heat and light. The white light produced by the bulb is incident on the red glass enclosing it. Other colours of white light are absorbed by glass and only red light is transmitted through the glass and red light is observed.
- c) It's due to difference in the speed of sound.

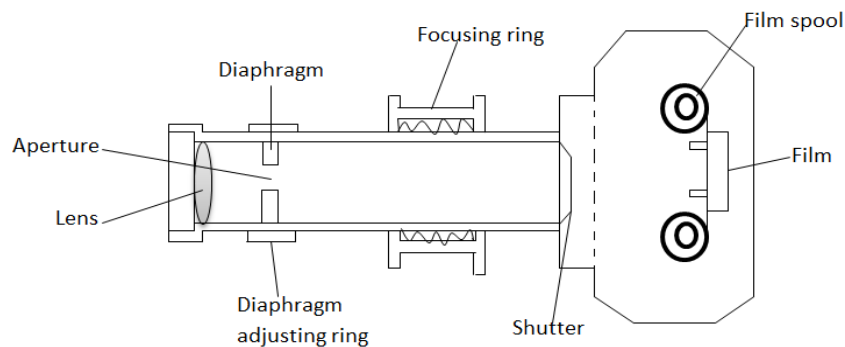
During morning hours: Velocity, $V_1 = \frac{2d}{t} = \frac{2 \times 480}{3} = 320 \text{ ms}^{-1}$

During afternoon hours; Velocity, $V_2 = \frac{2d}{t} = \frac{2 \times 480}{2.9} = 331.03 \text{ ms}^{-1}$

The variation in speed of sound is due to variation in the temperature of the medium (air). When the temperature increases, the speed of sound increases. For example, in the morning the speed of sound was 320 ms^{-1} as compared to 331.03 ms^{-1} in the afternoon.

d) The image was captured using a lens camera.

Mode of operation.

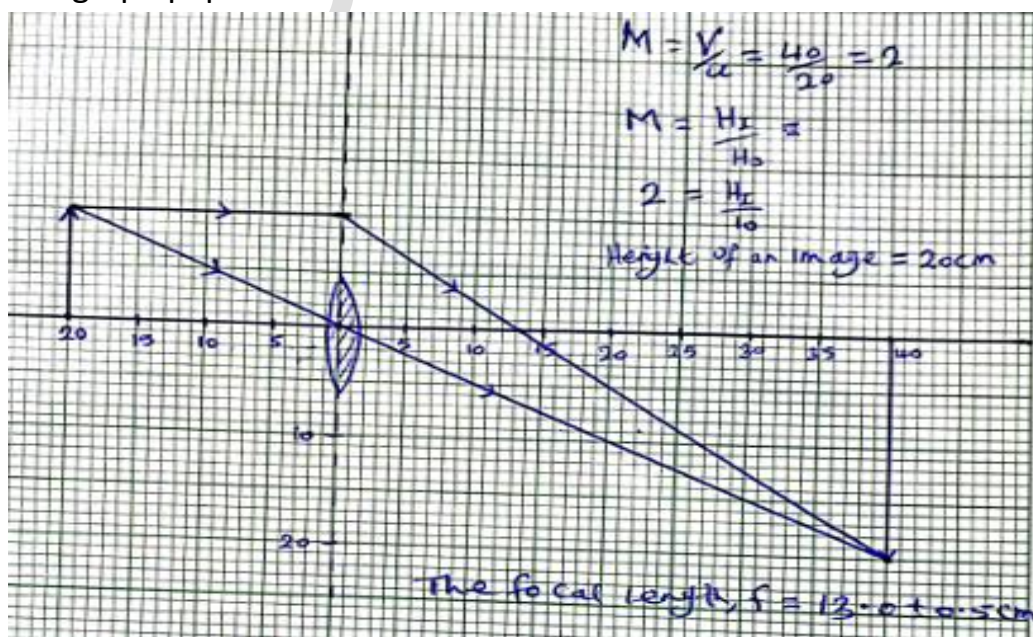


The mast is focused onto the film by the lens at the moment when the shutter opens.

The diaphragm controls the amount of light reaching the film.

The focusing ring adjusts the distance between the lens and film to form a clear diminished image on the film.

e) On the graph paper



ITEM 3.

- a)** They provide a steady and predictable source of heat over long periods, through radioactive decay, which is crucial for long duration mission.
- Unlike solar energy, radioactive sources don't rely on sunlight, solar energy reduces in the absence of the sun.
 - Radioactive sources have no mechanical moving parts, making them highly reliable in the harsh conditions.
 - A small amount of radioactive material can produce a significant amount of energy, which is important for space craft design where weight and space are limited
- b)** Radioactive Thermoelectric Generator (RTG) uses radioactive materials such as Plutonium- 238, which decays and large amount of heat energy is released.

The heat, released from the radioactive decay is contained within the RTG and used to heat a portion of the thermocouples.

Thermocouples are made of two dissimilar metals joined together.

When a temperature difference exists between the two junctions of the thermocouple, it generates a voltage and a flow of current.

The generated electricity is then used to power various systems, such as space craft instruments or other devices requiring a power source.

- c)** It ensures that the radioactive material decays slowly, producing a more stable and long-lasting energy source throughout the mission.

A material with too short half life would lose its power quickly, making it unsuitable for missions lasting decades or centuries. Also, materials with short half -life can produce too much heat too quickly, posing risks to space craft system.

- d)** Let the initial mass be, m_0

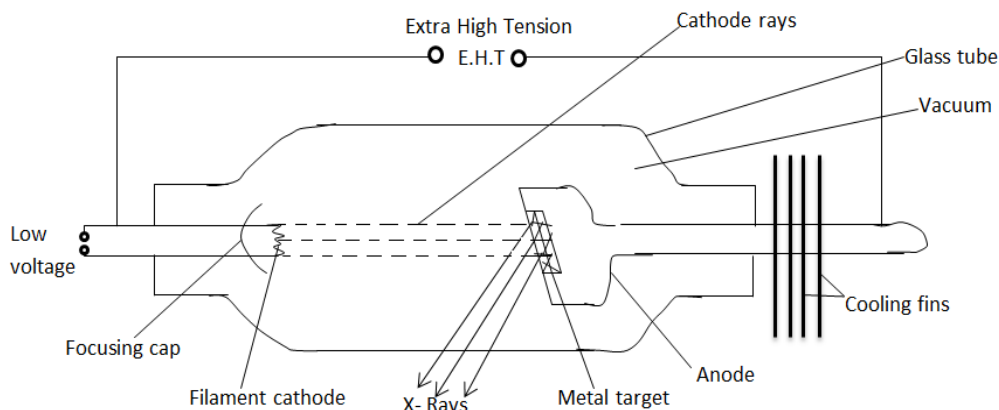
$$m_0 \rightarrow (87.7 \text{ years}) \frac{m_0}{2} \rightarrow (87.7 \text{ years}) \frac{m_0}{4} \rightarrow (87.7 \text{ years}) \frac{m_0}{8}$$

$$\begin{aligned} \text{Percentage of materials remaining} &= \frac{\text{Quantity remaining}}{\text{Original quantity}} \times 100 \% \\ &= \frac{\frac{m_0}{8}}{m_0} \times 100\% = 12.5 \% \end{aligned}$$

ITEM 4.

a) The radiations were X-rays and were produced using an X-ray tube.

Action of X-ray machine



The cathode is heated by a low voltage supply to emit electrons by thermionic emission. A high pd is applied across the tube to accelerate the electrons towards the anode. When the fast-moving electrons (Cathode rays) strike the tungsten target, they are decelerated rapidly and X-rays are formed. About 99% of their kinetic energy of electrons is converted into heat energy and the rest is converted into X-rays. The heat is conducted away by the copper anode which is cooled by the cooling fins.

b) The patient is positioned so that the area of the suspected injury is directly between the X-ray machine and the Photographic film or plate.

In a matter of seconds, the image is captured on the film.

On assessing the image, a darker line is due to X-rays passing through the fracture with less absorption while the white image of the bone is due to most of the X-rays being absorbed by the bone.

c) Velocity of X-rays, $V = 3 \times 10^8 \text{ ms}^{-1}$

Wavelength, $\lambda = 1.0 \times 10^{-10} \text{ m}$

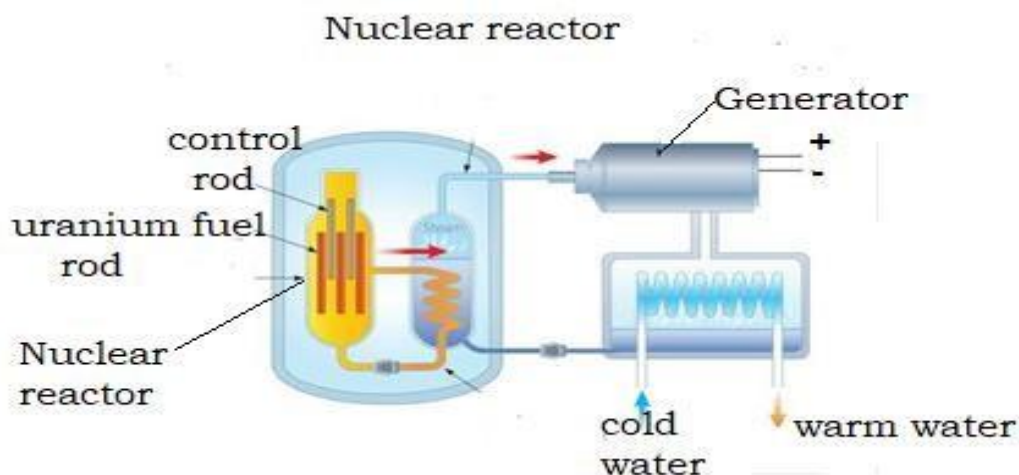
Using; $V = f\lambda$

$$f = \frac{V}{\lambda} = \frac{3.0 \times 10^8}{1.0 \times 10^{-10}} = 3.0 \times 10^{18} \text{ Hz}$$

The frequency of X-rays emitted is $3.0 \times 10^{18} \text{ Hz}$

ITEM 5.

a) Electricity is produced at a plant using a nuclear reactor.



How electricity is produced in the nuclear plant:

When the reactor is switched on, a neutron hits a uranium atom in the fuel rod. This causes the atom to split and release energy in form of heat, and more neutrons. The neutrons released hit other uranium atoms and cause them to split further, through nuclear fission. To slow down the reactions, control rods are used since they absorb neutrons. The fission of uranium atoms releases a lot of heat and which is absorbed by the coolant usually, water that flows around the fuel rod. The steam from water at high pressure turns turbines generating electricity.

b) The workers should wear coats made up of lead since lead absorbs these radiations

- Warning signs should be put on rooms containing radiations to create awareness among the workers about the presence of radioactive materials.
- The radioactive materials should be stored in thick lead boxes and thick walls made of concrete to prevent exposure of radiations.
- The workers should avoid eating or drinking from the rooms where radioactive materials are stored.
- Workers who have wounds, must cover them when dealing with radioactive substances.

c) Original mass $1\text{ kg} = 1000\text{g}$

Half life, $t_{1/2} = 2\text{ years}$

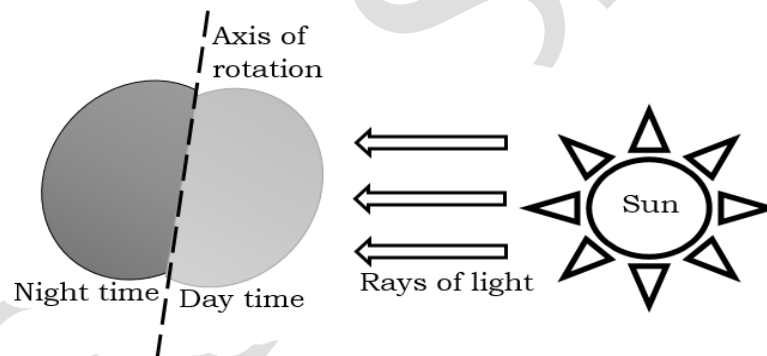
Mass	Number of half-lives (n)	Time, $T = nt_{1/2}$
1000	0	0
500	1	$1 \times 2 = 2$
250	2	$2 \times 2 = 4$
125	3	$3 \times 2 = 6$
62.5	4	$4 \times 2 = 8$
31.25	5	$5 \times 2 = 10$

The material will take eight years to be replaced, this is because after 8 years, the material will be less than 50 g.

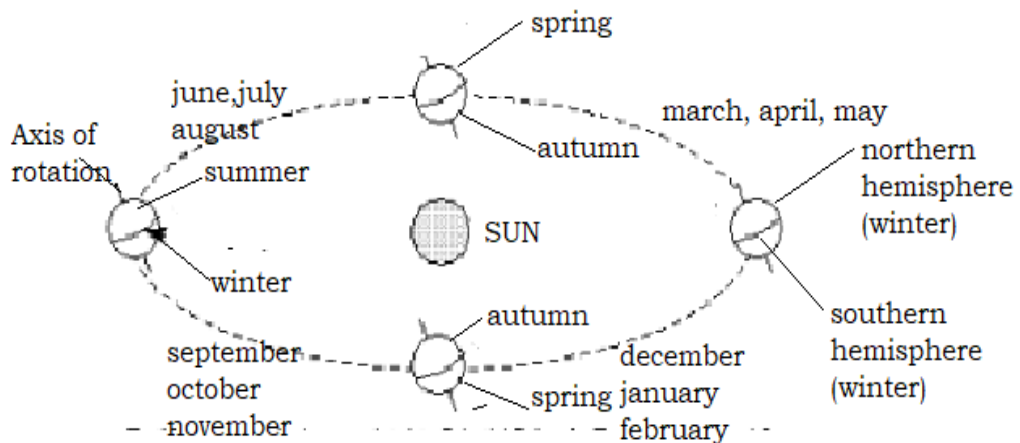
ITEM 6.

- a) The difference in time is due to earth's rotation about its axis.

Part of the earth, facing the sun receives heat and light and it experiences day while the part facing away from the sun does not receive light and heat (darkness) and hence experiences night.



- b) Seasons are formed due to the tilt of the earth's axis and earth's revolution around the sun. The earth's axis is tilted at an angle of about 23.5° relative to the orbit around the sun.



As the earth revolves around the sun, over a period of a year, the tilt causes differences parts to receive varying amounts of sunlight at different times.

When the hemisphere is tilted towards the sun, it receives more light energy from the sun, longer day time, and warmer temperature hence summer.

When the hemisphere is tilted away from the sun, it receives less mounts of light energy, shorter daytime, cool temperatures and hence winter.

When the sun is overhead the equator, light from the sun is spread uniformly over the hemisphere, hence experiencing Autum and spring.

Effects of change in seasons

- Fluctuation in prices of different commodities.
 - Change in dressing code
 - Allergies
 - Disrupted sleep patterns
 - Seasonal illness
 - Social isolation.
 - Distraction in routines.
 - Severe temperatures, snow storms, wild fires.
 - Increased energy consumption.
 - Influence out door activities e.g. sports activities and tourism.
 - Influences social and cultural events.
 - Animal behaviour
 - Influences infrastructure and planning
- c) The sun radiates enormous amounts of energy, through nuclear fusion. The earth receives a small fraction of this energy, that is vital for other energy conversions for life sustainability on earth.
- Solar energy helps in photosynthesis by providing light energy for plants to convert carbon dioxide and water into glucose. This is essential for plant growth and survival.
 - Solar energy is important in transpiration of plants through heating air and causing water and nutrients through the plants
 - Solar energy is useful in germination by providing warmth necessary for seeds to sprout and begin growing.
 - Solar energy aids in evaporation of water bodies which is crucial for water cycle.

- Solar energy is absorbed by solar panels which directly convert sunlight to electricity.
- Solar heat energy collects sun's heat to provide heating like in solar concentrators.

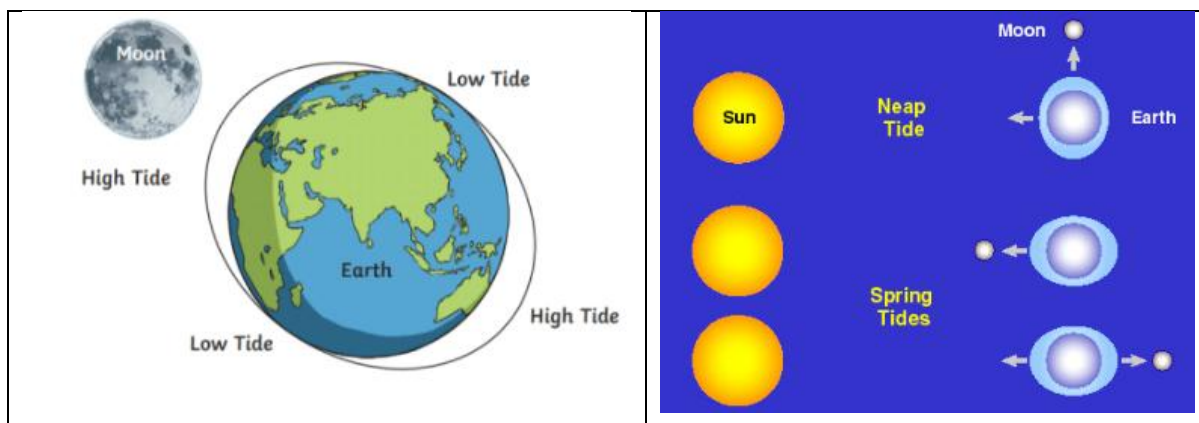
ITEM 7.

- a)** The possibility of being day and night in one country is due earth's rotation about its axis. Part of the earth, facing the sun receives heat and light and it experiences day while the part facing away from the sun does not receive light and heat (darkness) and hence experiences night.
- b)** The fall and rise in water levels is called ocean tides.

Ocean tides are due to gravitational pull between the earth and the moon or between the earth and the sun. The gravitational pull between the earth and moon is stronger than that between the earth and the sun. Because the moon is nearer the earth than the sun. This pull causes bulge of water towards the moon and the side away from the moon due to inertia forming high tides. The sides of the earth, that are neither facing sun nor the moon have water shrink forming low tides. During new moon, the earth, moon and the sun are in a straight line with the sun and the moon on one side of the earth. This creates higher high tides and lower low tides called spring tides. During full moon, the moon, and the sun are on the opposite side of the earth, forming high tides called spring tides. In the first quarter and third quarter of the moon, the interaction of gravitational pull creates low high tides and high low tides called neap tides.

Effects of Ocean tides:

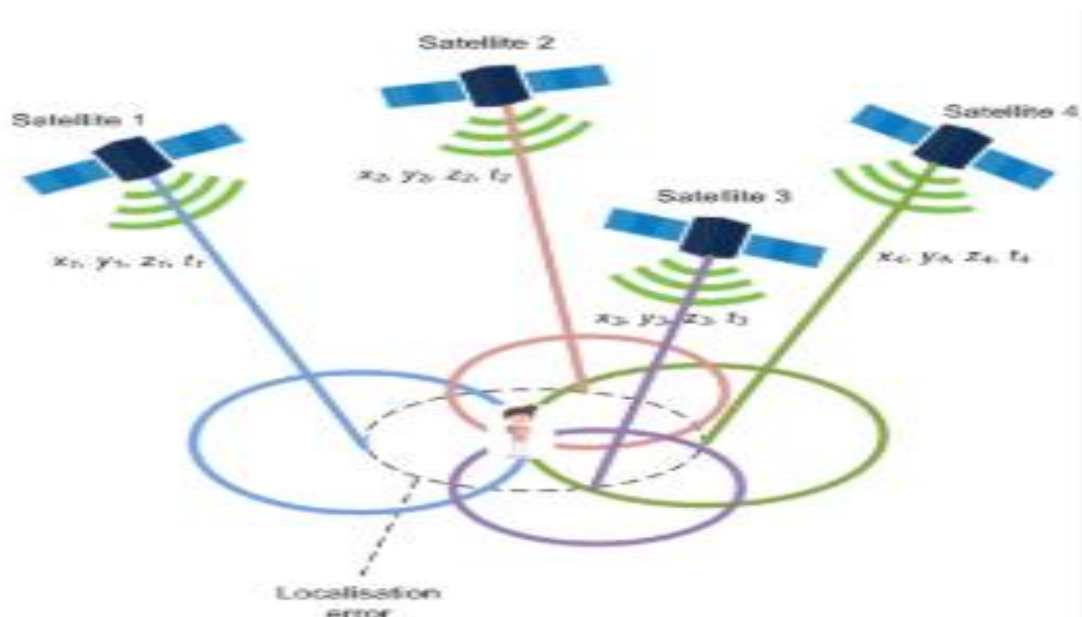
- Cause flooding
- Disrupting recreation activities
- Disrupting transport
- Generation of electricity
- Disrupting tourism
- Disrupting aquatic life



- c) The cause of dry spell in Australia, when there was ice and snow in Europe was due to change in seasons. Seasons are formed due to the tilt of the earth's axis and earth's revolution around the sun. The earth's axis is tilted at an angle of about 23.5° *relative to the orbit around the sun*. As the earth revolves around the sun, over a period of a year, the tilt causes differences parts to receive varying amounts of sunlight at different times. When the hemisphere is tilted towards the sun, it receives more light energy from the sun, longer day time, and warmer temperature hence summer. When the hemisphere is tilted away from the sun, it receives less mounts of light energy, shorter daytime, cool temperatures and hence winter. When the sun is overhead the equator, light from the sun is spread uniformly over the hemisphere, hence experiencing Autum and spring.

ITEM 8.

- a) A set of three or more satellites launched into medium earth orbits (MEO) continuously send signals to the earth's surface. When the GPS app is turned on, it receives signals from each satellite, The time taken for the signals to reach the smart phone is measured using atomic clocks in the satellite. Each satellite, then draws a circle on earth with the receiver at one of the positions along the circle. The radius of the circle is the distance from the satellite to the smart phone. The point of intersection of the three circles is the location of the smart phone user. When the user moves, the new set of circles is drawn, to locate new positions, the fourth satellite uses the data to determine speed, time, and distance to the destination of the journey.



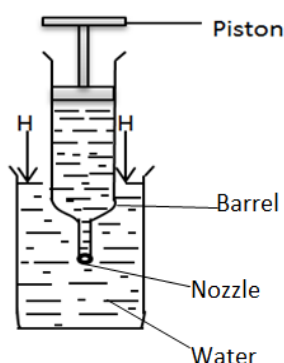
- b)** Collection of dust and gas particles called nebula collapses due to their own gravity pull to form a protostar. Due to increase in temperature and pressure, hydrogen molecules undergo nuclear fusion to form helium with release of energy in form of light and heat. At this point, the main sequence stage of the star is reached. And the formed star is in the state of stability where inward gravitational pull balances with the outward force due to pressure.
- c)** The fluctuation of light from the star is twinkling. Light from the star passes through different layers of the air in the atmosphere at different temperature and optical densities. This causes light to be refracted away from the observer and towards the observer resulting into fluctuation in the intensity hence twinkling.
- d)** The star appears brighter because it is closer to the earth as compared to other stars. Size of the star. The star could be bigger than others and hence more amounts of solar energy is radiated due to large amount of hydrogen gas undergoing nuclear fusion. Temperature, the higher the temperature the brighter the star.

ITEM 9.

(a) $Pt = mc\theta \Rightarrow 1500t = 0.1 \times 4200 \times (75 - 20) \Rightarrow t = 15.4s.$

The water boiled within 15.4 seconds less than the required time for medication thus the patient received medication in time.

- (b)** The syringe consists of barrel to which a needle is connected. Inside the barrel is a plunger/piston used to create a partial vacuum.



When the plunger is pulled outwards, a partial vacuum is created inside the barrel that helps to reduce the pressure inside the barrel. The atmospheric pressure then pushes the liquid into the syringe through the needle

$$(c) \quad P = \frac{F}{A} \Rightarrow P \frac{15}{2.5 \times 10^{-4}} = 60\text{kPa}$$

Since the pressure is greater than 50kPa, the medicine will enter the blood stream.

ITEM 10.

- a)** As a rope rubs against the wheel's groove, heat is generated at the points of contact due to friction which makes the rope become warm.

The hands become hard and rough because;

- Gripping the rope continuously while pulling a jerrycan of water irritates the top layer of the skin causing it to thicken due to friction thus the hands feel hard and rough.
- Constant gripping also removes moisture from the hands (dries out the skin) making the hands feel rough and cracked.

- b)** Volume of water; = 20L = 20 x 1000 = 20,000cm³

$$\text{Density of water} = 1000\text{kgm}^{-3} = 1\text{gcm}^{-3}$$

$$\text{Mass of water, } m_w = \rho V = 1 \times 20,000 = 20,000\text{g} = 20\text{kg}$$

$$\text{Work done against gravity} = mgh = 20 \times 10 \times 10 = 2000\text{ J}$$

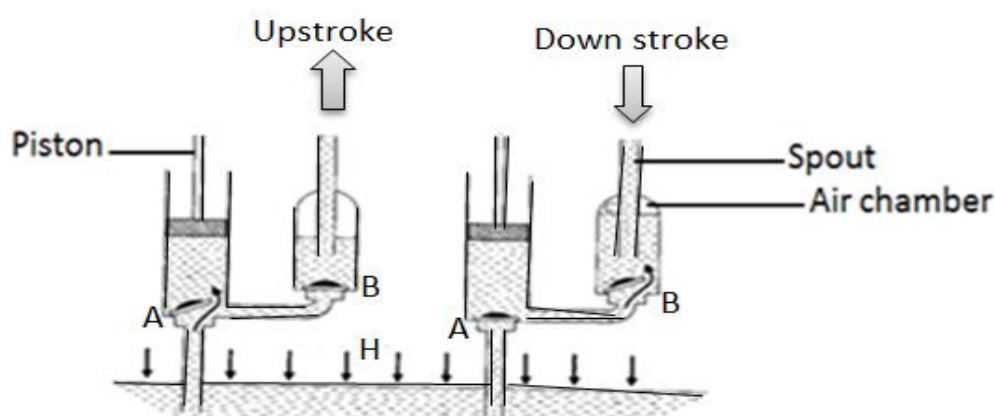
While lifting a jerry can of water, the body's chemical energy is converted into mechanical energy, The body does work of 2,000J against force of gravity, therefore the body gets tired because of a lot of energy spent in overcoming the force of gravity. Part of the mechanical energy is converted into heat energy in the muscles thus causing the body to sweat.

- (d)** The machine being requested by the villagers is a force pump. Is used to raise water from underground to the land surface.

The pump has two valves, the inlet and outlet valve. These valves open and close when the piston moves up and down

During the upstroke, the piston moves upwards and creates a vacuum in the cylinder. The pressure in the cylinder reduces and inlet valve B opens since the pressure below it is greater than the pressure above it. The water enters the cylinder.

During the down stroke, the pressure in the cylinder increases and the inlet valve B closes due to weight of water above it. The out let valve A opens and the water is issued to the land surface.



ITEM 11.

(a) The electrical appliance is a pressure cooker;

A pressure cooker is tightly sealed and therefore can't allow steam to escape easily. The steam trapped inside the cooker increases the steam pressure which raises the boiling point of water beyond 100°C thus enabling cooking occur faster.

(b) Mass of tea, $m_t = \rho_t V_t$; $\rho_t = 1000 \text{ kg m}^{-3} = 1 \text{ g cm}^{-3}$; $1\text{L} = 1000 \text{ cm}^3$

$$\text{Volume, } V_t = \frac{1}{4} \times 1000 = 250 \text{ cm}^3$$

$$m_t = 1 \text{ g cm}^{-3} \times 250 \text{ cm}^3 = 250 \text{ g} = 0.25 \text{ kg}$$

Heat gained by ice = heat lost by the tea

$$m_i l_f + m_i c_w (30 - 0) = m_t c_t (85 - 30)$$

$$m_i \times 334000 + m_i \times 4200 \times 30 = 0.25 \times 4200 \times 55$$

$$460,000 m_i = 57,750$$

$$m_i = 0.1255 \text{ kg}$$

Therefore, mass of ice required to reduce the temperature of tea was 0.1255 kg.

(c) Causes of hotness in room during day time are;

- Poor ventilation causes hot air to get trapped inside the room making the room become warmer
- Heat absorbed by the walls and roofs during the day, is radiated in wards increasing the temperature of the room
- Heat radiated from the electrical devices like TVs, computers and bulbs also increase the temperature inside the room.

Possible Solutions:

- Install ventilators on the rooms
- Install fans in the rooms
- Using insulating materials for the walls
- Outside surfaces of the walls of the room should be painted with white bright colours to reflect heat away.
- The unused electronic devices like bulbs should be turned off.

(d) On a hot day, the body releases sweat on the surface of the skin. It evaporates as it absorbs latent heat of vaporisation from the body. The latent heat is continuously withdrawn from the body which make the body temperature fall to the normal thus causing cooling.

ITEM 12.

a) Kinetic energy of the plane → heat and sound energy in the brakes and between the wheels and the ground.

b) Initial K.E = $\frac{1}{2}mu^2 = \frac{1}{2} \times 2 \times 10^5 \times 85^2 = 722,500,000J$ or $7.23 \times 10^8 J$

Therefore, the initial K.E of the plane is $7.23 \times 10^8 J$

For it to stop, Total resistance force, $F_R = ma \Rightarrow a = \frac{F_R}{m}$

$$a = \frac{6.0 \times 10^5}{2 \times 10^5} = 3 \text{ ms}^{-2}$$

The deceleration is 3 ms^{-2}

$$\text{From } V^2 = U^2 - 2aS$$

$$0^2 = 85^2 - 2 \times 3 \times S$$

$$S = 1,204 \text{ m}$$

Therefore, the plane requires 1,204 m to stop.

c) Total heat generated = $mc\Delta\theta$ But $\frac{30}{100}$ of K.E = $mc\Delta\theta$

$$\frac{30}{100} \times 722,500,000 = 800 \times 450 \times \Delta\theta$$

$$\Delta\theta = 602.1^\circ \text{C}$$

The temperature rise of the brake material during emergency stop is 602.1°C

d) Failure to brake again

Unnecessary heat and fire

ITEM 13.

a) For TV, $I_1 = \frac{P}{V} = \frac{75}{120} = 0.625 \text{ A}$

For Flat iron, $I_2 = \frac{P}{V} = \frac{6000}{120} = 50 \text{ A}$

Total current drawn by both devices; $I = I_1 + I_2 = 0.625 + 50$

$$\text{Total current,} = 50.625 \text{ A}$$

The fuse is not effective for supporting both the T.V and the flat iron together. This is because the total current required is higher than the fuse's rating which was 5A.

b) Resistance of each bulb; $R = \frac{V^2}{P} \Rightarrow R = \frac{120^2}{60} = 240 \Omega$

Total resistance of 4 bulbs in series

$$R_{\text{total}} = 4 \times 240 = 960\Omega$$

Total current in series connection; $I_{\text{total}} = \frac{120}{960} = 0.125 \text{ A}$

$$\begin{aligned} \text{Total resistance for 4 bulbs in parallel } \frac{1}{R_{\text{total}}} &= \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} \\ &= \frac{1}{240} + \frac{1}{240} + \frac{1}{240} + \frac{1}{240} = \frac{4}{240} \end{aligned}$$

$$R_{\text{total}} = 60\Omega$$

Total current in parallel; I_T

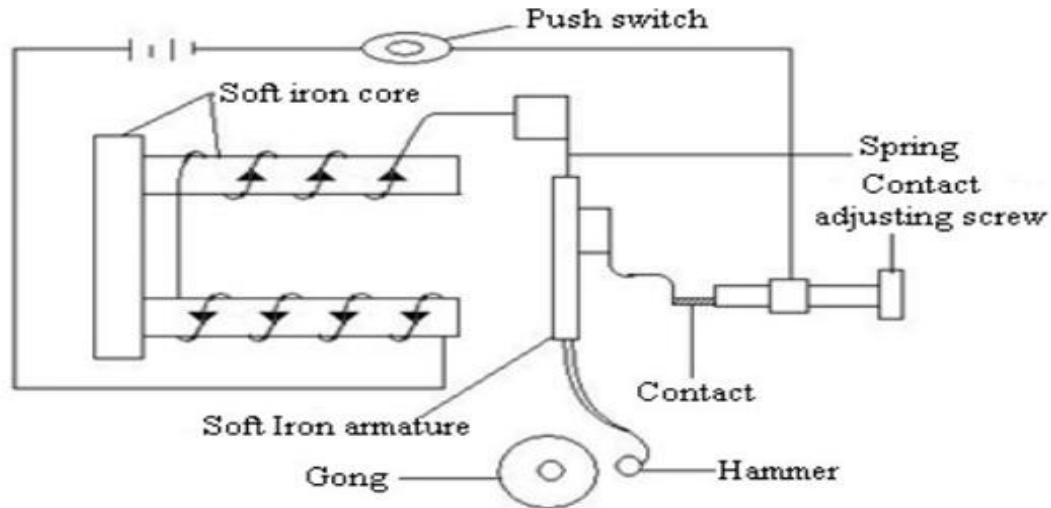
$$I_T = \frac{120}{60} = 2 \text{ A}$$

The bulbs should be connected in Parallel because;

- Overall Resistance of the circuit is lower thus allowing more current to flow through the bulbs.
- Each bulb operates independently therefore if one bulb fails, the others will continue to function

- Each bulb receives the full voltage of the power source, ensuring consistent brightness.
- c) The sound was produced by the electric bell.

How it works:



When the switch is pressed, current flows through the electromagnet which becomes magnetised.

It attracts the soft iron armature and hence breaking the contacts. This makes the hammer to strike the gong and sound is heard

As the armature moves, the contact is broken and current stops flowing causing the electromagnet to lose magnetism.

The spring pulls the armature again to its original position and contact is made again.

The process is repeated on and on hence a continuous sound is heard.

d) Cost of electricity = electrical energy consumed x time x cost per unit

$$= \frac{75}{1000} \times 5 \times 680 = \text{Ugsh. } 255$$

The cost of keeping the Tv operating for 5 hours is UGX. 255

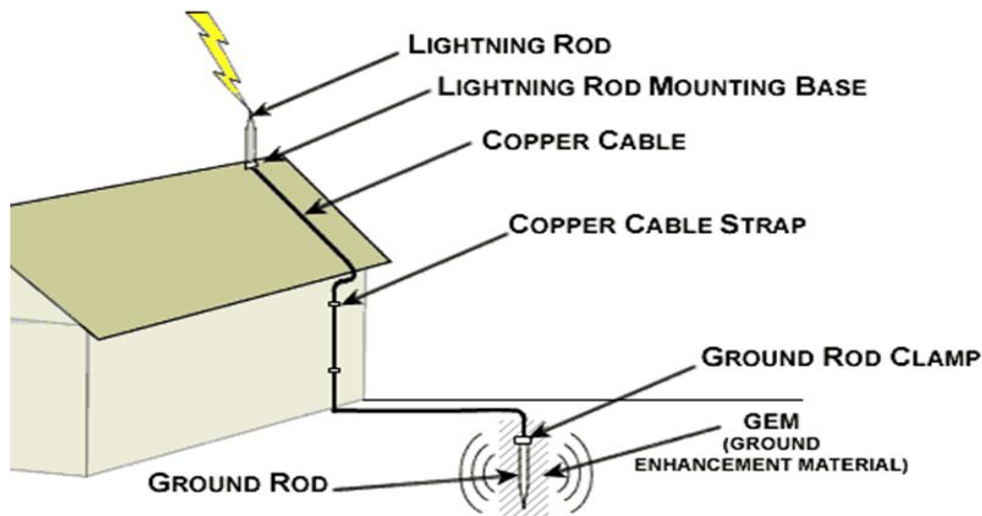
ITEM 14.

(a) (i) Lightning is a giant spark of electricity (electric discharge) in the atmosphere between clouds, the air, or the ground.

Safe guarding themselves from lightning

- Switch off all electronic devices during thunderstorm
- Avoid staying outdoors during thunderstorm
- Avoid taking shelter under tall trees during thunderstorm

- Wearing of rubber shoes during thunderstorm
- Installing a Lightning rod (lightning conductor/ lightning arrester):



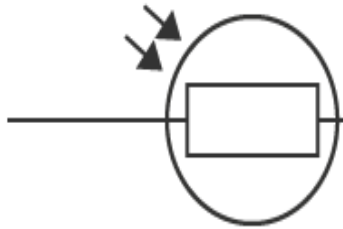
This is the most direct measure to protect your home. A lightning rod captures lightning and directs electrical energy safely to the ground, away from your home because It provides a specific path of least resistance through which excess charges can travel.

- **System of Grounding :**
A grounding system well-designed is crucial. It ensures that the energy captured by the lightning rod is effectively dissipated into the ground. Have your grounding system checked and maintained regularly.
- **Wiring and Electrical Conduits:**
Make sure your electrical installation is in good condition. Old cables or faulty installations increase the risk of damage in the event of lightning.

(ii) Earthing provides a path for excess electrical current to flow safely to the ground in the event of a system fault or overload, reducing the risk of fire, electrocution and damage to equipment.

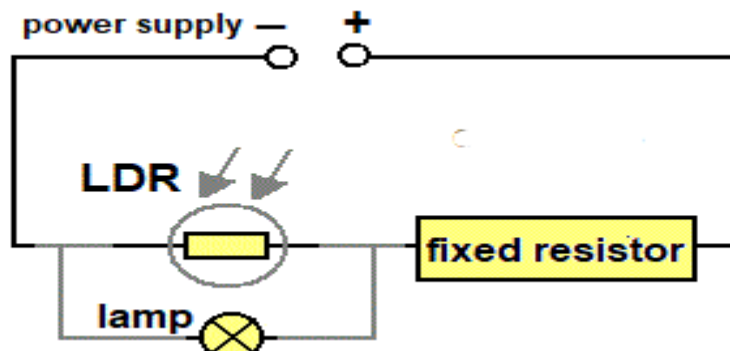
- Ensures that the voltage in the system is stable and remains within safe limits. This is especially important in systems with sensitive equipment that voltage fluctuations can easily damage.
- Earthing is also crucial for proper operation of protective devices such as circuit breakers, fuses and surge protection devices.
- Earthing discharges the house.

(b) A **light dependent resistor (LDR)** is a component that has a (variable) resistance that changes with the light intensity that falls upon it. This allows them to be used in light sensing circuits.



In the dark and at **low light levels**, the **resistance of an LDR is high**, and **little current** can flow through it, much current flows through the bulb (lamp), so it lights bright. In **bright light (day)**, the **resistance of an LDR is low**, and **more current** can flow through it, and less current flow through the bulb (lamp), it dims or goes off.

Circuit diagram on how it works



Alternatively, a thermistor, a transistor and a relay can be used

$$(c) \frac{N_P}{N_S} = \frac{V_P}{V_S} \Rightarrow \frac{1500}{500} = \frac{V_P}{240} \Rightarrow V_P = \frac{1500 \times 240}{500} = 720V$$

$$\text{Power input} = V_P \times I_P = 28.7 \times 720 = 20664W$$

$$\text{Efficiency} = \frac{\text{Power output}}{\text{Power input}} \times 100\% = \frac{20000}{20664} \times 100\% = 96.7\%.$$

Since the efficiency is within the acceptable range, the transformer would be considered good for use.

d) Factors that affect the efficiency of transformers

- The heating effect of current in a coil. Power is lost as heat $I^2 R$ whereby I is the current flowing through the coil and R is the resistance of the coil

Methods to minimize

- ✓ Use thick copper wires of low resistance.
- ✓ Use coolant to decrease the temperature of the transformer.

- Heating effect due to eddy currents in the iron core. When the magnetic field in the iron core fluctuates, eddy currents are generated in the iron core.

Methods to minimize

- ✓ Use a laminated iron core whereby each layer is insulated with enamel paint to prevent the flow of eddy currents. The high resistance between layers of the iron core decreases the prevalence of eddy currents and heat.
- Energy loss due to hysteresis. The energy used in the magnetization and de-magnetization of the iron core each time current changes its direction is known as **hysteresis**. This energy is lost as heat which subsequently heats up the iron core.

Method to minimize

- ✓ Use a soft iron core that is easily magnetized and de-magnetized.
- Flux leakage. Some of the induced magnetic flux from the primary coil is not transmitted (linked) to the secondary coil, therefore the e.m.f in the secondary coil is decreased.

Methods to minimise

- ✓ The secondary coil (windings) is intertwined tightly with the primary coils.
- ✓ The iron core should form a closed loop.

ITEM 15.

- a) There are two possible forms of connection i.e in series and parallel connection. For series connection: Total Resistance, $R = R_1 + R_2 + R_3$

$$R = 4 + 0.20 + 0.35 = 4.55 \, \Omega$$

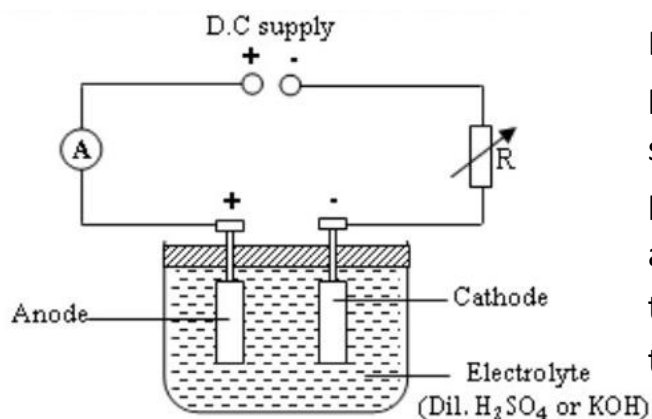
For Parallel connection: Total Resistance, $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$$\frac{1}{R} = \frac{1}{4} + \frac{1}{0.2} + \frac{1}{0.35}$$

$$R = 0.1233 \, \Omega$$

I advise the car owner to use parallel connection because it gives a very low resistance of $0.1233 \, \Omega$ whereas the series connection gives a very high resistance of $4.55 \, \Omega$.

- b)** The car owner should recharge the battery using a D.C source of higher emf than a battery.



During the charging process the positive terminal of the charger should be connected to the positive terminal of the battery and the negative terminal of the charger to the negative terminal of the battery.

This should be done until when the battery gasses or it should be checked using the hydrometer to find out whether the acid has regained its relative density. The above connection makes current to pass through the battery in a direction opposite to that in which it delivers.

- c)** Through maintaining the acid level using distilled water to avoid exposing the electrodes
- Charging it regularly i.e avoid over discharging
 - Avoid short circuiting its terminals
 - Avoid over charging it
 - Terminals must always be kept clean.

ITEM 16.

- a) Lightning** is a giant spark of electricity in the atmosphere or between the atmosphere and the ground.

How It Occurs

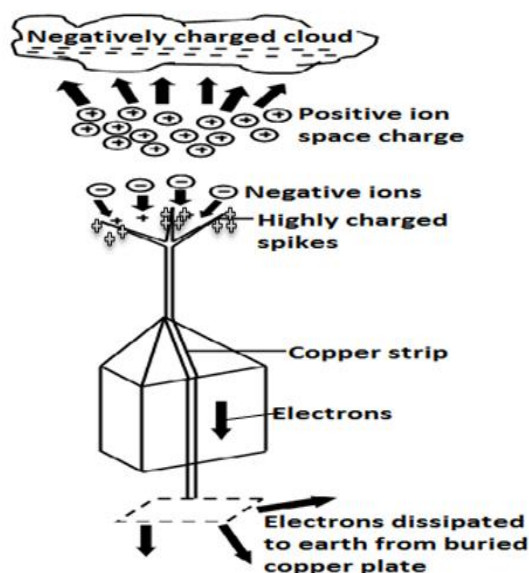
During a storm, clouds are in relative motion, and so get charged by friction. An electric field exists between these charged clouds.

As the storm progresses, charges accumulate on the clouds and at a certain point, the insulation between the two clouds breaks down and a big current flow between them is produced.

These big current heats up the air around it which becomes very hot and in turn gives off a spark of a light called **Lighting**.

Therefore, when lightning strikes, a large pulse of current is created and it ignites the building and other flammable materials, thus causing fire.

- b)** The device to be used is a **lightning conductor** (lightning arrester) which comprises of metal spikes, copper strip and copper plate.



When a negatively charged cloud passes over a building with a lightning conductor, induces a large opposite charge on the spikes and a negative charge on the copper plate. The negative charge (electrons) on the plate is immediately lost to the earth.

At the spikes, there is a high charge density, which creates a strong electric field intensity on the conductor and ionizes the air molecules surrounding it producing negative and positive ions.

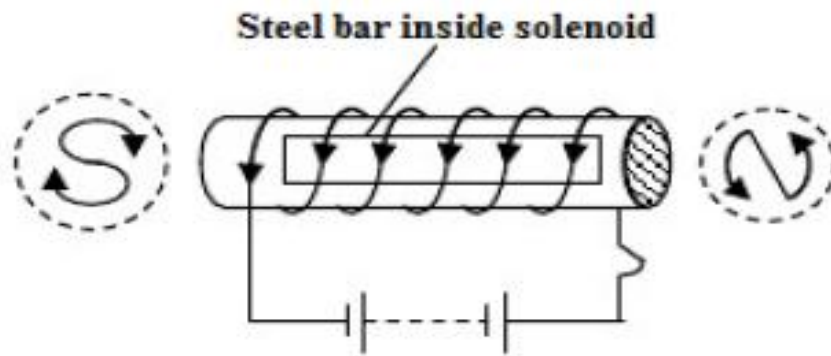
The negative ions are attracted to the spikes and become discharged by giving up their electrons. These electrons pass down through the copper strip to copper plate which dissipates them to the earth.

At the same time, positive ions are repelled upwards as an electric wind. These neutralize (discharge) some of the negative charges on the cloud.

The excess negative charges on the clouds can also be easily and harmlessly conducted to the earth through a copper strip since it provides a path with very low resistance.

In this way, the lightning conductor (arrester) safe guards a tall building from being struck by lightning.

- c)** Iron is more easily magnetized than steel but it also loses its magnetism more quickly than steel. To separate steel from iron, an electromagnet is constructed which will act as our magnetic separator. It consists of a soft iron inserted in a solenoid connected to a direct current supply as shown below



When the system is switched on, current flows through the solenoid and iron bar gets magnetized. The separator formed is inserted in a heap containing both steel and iron, the system is withdrawn and directed to a place where iron is to be collected. It is switched off, iron falls fast and the remaining are quickly shaken to a place where steel would be collected.

Effectiveness; From $V = IR \Rightarrow I = \frac{V}{R} = \frac{240}{50} = 4.8 \text{ A}$

Hence the separator bought was effective since 4.8 A is less than 5 A (fuse rating of the separator).

=END=

"THANK YOU ONCE MORE FOR HONOURING OUR INVITATION"

SJSSN

THANK YOU FOR COMING

IT HAS BEEN A PLEASURE; YOU HONOURING OUR INVITATION

NOTE THAT EVERY YEAR, WE HAVE THIS ALWAYS

BE REMINDED THAT THE A'LEVEL SEMINAR FOR 2025 IS ON
11TH OCTOBER

FOR MORE INFORMATION ABOUT OUR ANNUAL SEMINARS

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