

EXPECTED SEMINAR RESPONSES FOR O-LEVEL PHYSICS SEMINAR
SLATED FOR 14TH JUNE 2025 AT NTUNGAMO HIGH SCHOOL IN
CONJUNCTION WITH SEPTA

Item 1

- a) Distortion of sound was due to echoes & reverberation. It came about due to mixing of the reflected sound (echo) with the original sound from the hall. Echoes are formed when sound is reflected from a hard surface/wall/the reflecting surface. The reflecting surface must be at least 17 metres or must return to the source in after 0.1 second.

The distortion can be minimised by covering the walls of halls with sound absorbing materials such as heavy curtains, cushions, and carpets.

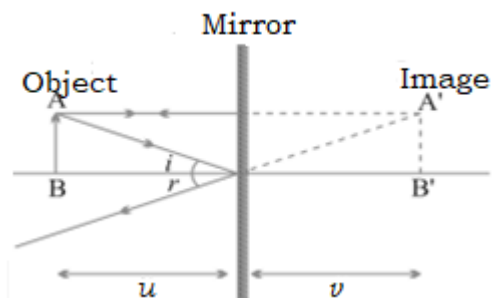
- b) Using bright colours for walls and ceilings that reflect more light such as white, and light blue

Using reflective accessories in the hall such as mirrors, glass and metallic finishes, light coloured furniture and textiles.

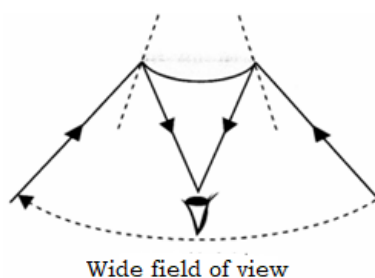
Installing glass windows and sheer or light-coloured curtains that allow entry of natural light into the hall.

- c) In the bathrooms, plane mirrors should be installed on the walls to enable clear viewing of people irrespective of their distances from the mirror since the image is always;

- Same size as the object
- Same distance and as the object
- Erect
- Virtual



For checking under the cars, convex mirrors should be connected onto a long handle, so as to enable the security team to place it underneath the cars; because they give a wide field of view that would enable any illegal material hidden below the car to be exposed as illustrated below;



Item 2

- a) At night, the sound from the resort was louder than day due to refraction of sound. Hence the cause of discomfort for the natives at night. The temperatures of air are lower at night; the ground therefore becomes cooler which makes the layers of air close to the ground to be cooler than those above the ground. This makes sound to be refracted towards the ground enabling it to travel through longer distances hence being heard from further away.

While during day time, temperatures are high which makes the layers of air closer to ground warmer than those away from the ground. Sound is therefore refracted away from the ground reducing its distance of travel and audibility.

- b) Using the formula; $\lambda = \frac{v}{f}$

$$\lambda = \frac{330}{120} = 2.75m$$

Therefore; the sound was harmful since its wavelength was greater than 2m

- c) The appearance of the costumes kept on changing since;
- In presence of blue flash disco lights, their costumes appeared dark because all light from disco lights was absorbed by the yellow costumes and none was reflected.
 - In presence of green flash lights, their costumes appeared green with black strips. This is because green colour was reflected by the yellow costumes because yellow colour was part of yellow colour (R+G)

Item 3

Count rate for uranium alone = $(6600 - 200) = 6400$ counts per hour

Half-life = 2 days

$$6400 \xrightarrow{2} 3200 \xrightarrow{2} 1600 \xrightarrow{2} 800 \xrightarrow{2} 400 \xrightarrow{2} 200 \xrightarrow{2} 100$$

$$Time = 6 \times 2$$

$$= 12 \text{ days}$$

(b) Natural resources

- Cosmic rays (radiation that reaches the Earth from space)
- Rocks and soil (some rocks are radioactive and give off radioactive radon gas)
- Living things (plants absorb radioactive materials from the soil and these pass up the food chain)

Artificial sources include

- Radioactive waste from nuclear power stations
- Medical X-rays
- Nuclear missiles (bombs when exploded release radiations into the environment)

(c) Environmental effects of uranium mining;

- Contamination of soil
- Local thermal pollution from waste affects marine life (water pollution)
- Creates radioactive wastes which remain radioactive and dangerous to human health for thousands of years
- Dust pollution. Mining operations generate dust may contain radioactive particles impacting air quality
- Uranium mining releases radon gas which can travel long distances in air
- Long-term waste storage. Waste is radioactive and safe disposal is very difficult and expensive
- Disrupts ecosystem e.g underground mining disturbs large areas of land, leading to habitat loss for plants and animals
- Uranium mining and milling contribute to greenhouse gas emissions.

Item 4

Item 5

(a) Assume Z is p_qZ , then from the equation of reaction,

$$235 + p = 144 + 90 + 2$$

$$p = (144 + 90 + 2) - 235$$

$$p = 1$$

$$\text{Also } 92 + q = 56 + 36 + 0$$

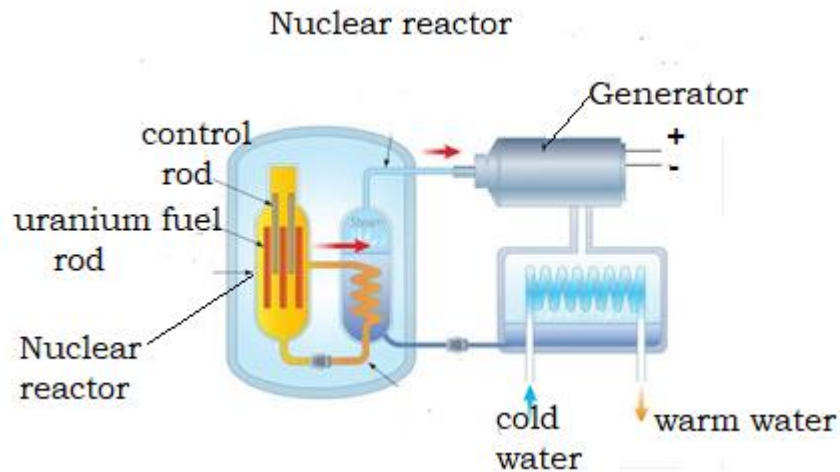
$$q = (56 + 36 + 0) - 92$$

$$q = 0$$

Hence Z is 1_0Z which is a neutron.

${}^{139}_{56}Z$ is an isotope of X since they have the same atomic number but different mass number.

(b) The cheap electricity is nuclear power generated in a nuclear reactor at a power plant by a controlled nuclear fission reaction as follows;



- Uranium fuel (raw material) is prepared in form of pellets that are arranged in a fuel assembly(ies) which form a nuclear core
- When neutrons collide with uranium, nuclear fission takes place with release of more neutron and heat energy.
- The heat energy generated is transferred to a coolant like water or gas that circulates and transfers it to the steam generator upon being heated hence producing steam.
- The steam produced drives the turbines that are connected to the generator there by making them to spin.
- The connected generators to the spinning turbines covert their mechanical energy to electrical energy which is transmitted to the power grid and distributed to homes and industries for consumption.

(c) Dangers associated with radioactive substances

- Cause cancer
- Cause mutation
- Affect soil fertility through pollution
- Can cause sterility

Safety measures include;

- Avoid unnecessary exposure
- Wearing protective gears when at work
- Using tongs to handle radioactive substances
- Storing them in lead containers
- Proper waste management e.g by properly disposing wastes.

Item 6

- (a) This is due to rotation of the earth about its axis. The part of the earth facing the sun experiences day time whereas the opposite side experiences night time. This complete rotation of the earth about its axis takes about 24 hours. This is why Joan was experiencing day time in Kampala while her Aunt is experiencing night in Sydney.

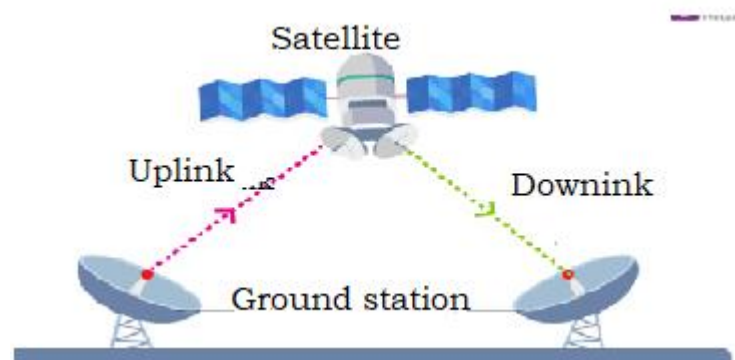
- (b) Cameras and microphones record the event in real time. The footage is then sent to a studio. In a television studio, videos, pictures and sound are converted into electromagnetic signals and sent to a ground station. These signals are then sent to the communication satellite in a geostationary orbit through an uplink process.

The satellite transponder receives the signals, amplifies them and changes the frequency to avoid interference with the incoming signals.

The satellite transponder retransmits the signals to the ground station. The signals are received by a satellite dish through a downlink process where they are decoded and then converted to light and sound again.

This whole process takes place very fast since electromagnetic waves take place at a speed of light.

Illustration



Item 7

- (a) Changes in seasons are brought about by the earth's axial tilt of 23.5 degrees to its orbital plane and its revolution around the sun.

As it revolves around the sun throughout the year plus areas being at different latitudes (distances from the equator).

The areas close to the sun experience hot days, longer daytime than night time there by experiencing dry season or summer.

The areas on the opposite side experience cold seasons, shorter days than nights hence experiencing wet or winter seasons. When the sun is overhead (equinox). The length of days is equal to night hence spring.

- (b) The colours of stars depend on their surface temperature. The hotter the star the more blue it is and the colder the star, the more red it is.

Intermediate colours white and yellow have moderate temperature.

Brightness of stars depends on the following

- Distance from the earth. Stars closer to the earth are brighter than those that are far from earth
- Surface temperature. Hotter stars are brighter than colder stars.
- Size of the star. Bigger stars with a larger surface area from which light is emitted tend to be brighter than smaller stars of smaller surface area
- Age of the star. Young stars are blue and brighter than in red giant phase because young stars have high rates of nuclear fusion.

What makes stars shine brightly;

- The energy released during nuclear fusion is what makes the stars to shine.
- This energy is produced at the centre of the star where the pressure is very high. Hydrogen atoms fuse together to form helium (nuclear fusion). The nuclear fusion process releases a huge amount of energy in the form of light and heat which makes the star to shine brightly.

Heat & mechanics

Item 8

(a) Conductor's query.

Yes, the engine has a cooling system that uses water as a coolant. Water is chosen for being readily available and also majorly that with its high specific heat capacity of $4200\text{Jkg}^{-1}\text{K}^{-1}$, it makes it absorb a good quantity of heat without highly rising in temperature thereby being used as a coolant as compared to other liquids.

Passengers' queries

The passenger should kindly go by the driver's request for safety. This is because when the luggage is loaded at the bottom, this will make the bus have a lot of weight at the bottom, as a result its centre of gravity is lowered, this increases the stability of the bus thereby moving safely without giving chance to eventualities. On the other hand, if the passengers insist and put their luggage at the top rack, this will shift the weight upwards and will rise the centre of gravity of the bus thereby making it unstable which may lead to toppling of the bus.

- (b)** The passengers should also bear and fasten seat belts. This will help overcome the effect of Inertia as passengers may jerk forward and jerk backward when the bus sets off and also breaks immediately. This is because their bodies will be reluctant to changing their state of rest or uniform motion in a straight line when acted upon by an external force, as explained in Newton's first law of motion.

To analyse this wrangle, we shall find the distance the bus covered while decelerating uniformly to rest if it exceeds the 443m, between the bus and the sign post then the driver will be on wrong.

Method 1

Given

$$u = 79.2 \text{ km hr}^{-1} = \frac{79.2 \times 1000}{3600}$$

$$= 22 \text{ ms}^{-1}$$

$$\text{Deceraaltion} = \frac{0 - 22}{40}$$

$$= -0.55 \text{ ms}^{-1}$$

Therefore, the distance covered; from $s = ut + \frac{1}{2}at^2$

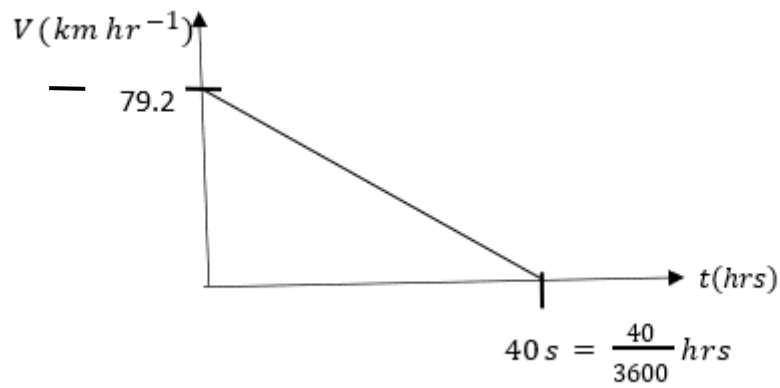
$$s = 22 \times 40 - \frac{1}{2} \times 0.55 \times 40^2 = 440 \text{ m}$$

,

Therefore, since the distance covered is less than 443m, then the bus stopped before reaching the signpost and therefore did not knock the signpost.

Method 2

We can also draw a velocity -time graph and use it to find the distance covered.



$$\text{The distance under graph} = \frac{1}{2}bh = \frac{1}{2} \times \frac{40}{3600} \times 79.2 = 0.44 \text{ km} = 440 \text{ m}$$

Item 9

(a)

A metallic spoon with a plastic handle: The spoon is metallic for long lasting and has a plastic handle to act as an
insulator so as to limit the transfer of heat to the handler that may inconvenience while using
A percolator (electric kettle) labelled 240V , 3000W with a capacity of 2l , with plastic casing. The percolator has an inside still coil for heating the contents and the outside plastic to avoid heat loss through conduction to the out side and also a plastic handle to prevent both electric and heat shock.
A stainless-steel sauce pan, deeper than its width with a lid. The sauce pan is made of stainless steel to prevent rusting and also to easily conduct heat to the contents while cooking. Its also deeper than its width to limit the width of the surface area exposed to the atmosphere, this limits heat loss by radiation and convection.

(b) We shall look for the time the percolator will take to boil the water and then compare with the 5 minutes.

From assumption that

Energy supplied by heater = heat absorbed by water to boil.

power $\times$ time = $mc\Delta\theta$.

Volume of 2l = $\frac{2}{1000} = 0.002m^3$.

Hence the mass $m = \rho \times v = 1000 \times 0.002 = 2kg$.

Therefore : $3000t = 2 \times 4200 \times (100 - 25)$. $3000t = 630,00$.

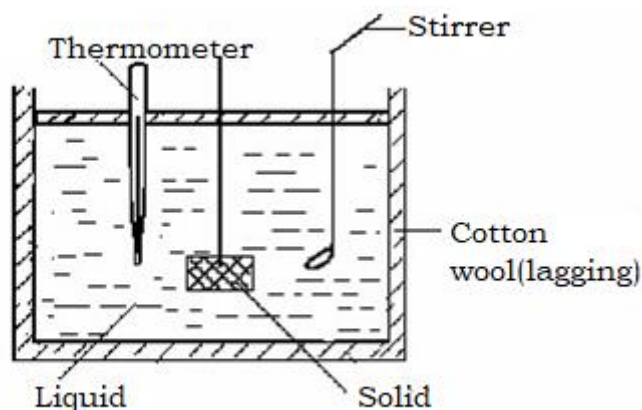
$t = 210s = 3.5 \text{ minutes}$

Hence the percolator will be able to boil the water within the required time since it takes only 3.5 minutes to boil the water

(c) An experiment to find the specific heat capacity of water by method of mixtures.

- A solid of known mass m_2 is heated in boiling water to a known temperature say θ_2 .

- Then it is transferred very quickly into water of mass m_1 in a calorimeter of known mass m_3 and known specific heat capacity c_3 , initially at a temperature θ_1 with its content.
- The mixture is stirred gently until a common temperature θ is reached as in figure below

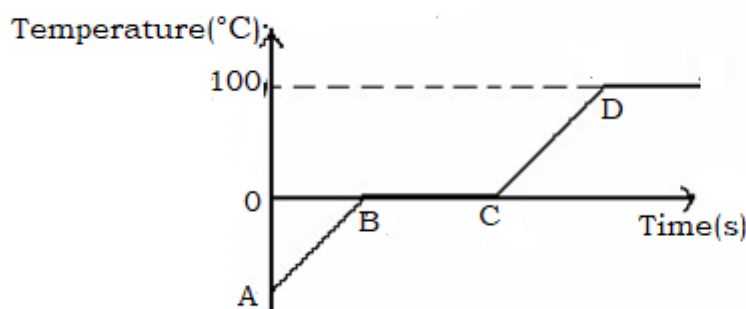


Assuming that no heat is lost to the surrounding then, the specific heat capacity of water c_1 is obtained from:

Heat lost by solid = Heat gained by liquid + Heat gained by the calorimeter

$$m_2 c_2 (\theta - \theta_2) = m_3 c_3 (\theta_1 - \theta_2) + m_1 c_1 (\theta_1 - \theta_2)$$

Item 10



- Along AB the temperature of ice rises from A to B as it is heated.
- Along BC the temperature remains constant when the ice melts at 0°C and the ice consumes latent heat as per its specific latent heat of fusion
- Along CD the temperature of melted ice into water now rises from C to D.
- Along DE the temperature remains constant at 100°C during boiling of water as it absorbs latent heat of vaporisation to change to vapour.

- The reverse of the above process takes place when the water cools or when heat extracted from it.

(b)

Total time = time taken to boil ice (t_1) + time taken on road (t_2) + 25 minutes.

For t_1 , assume heat supplied by heater = heat used to boil heat ice + heat used to convert ice into water + heat used to boil water.

$$1270.5t_1 = 0.5 \times 2100 \times 3 + 0.5 \times 336000 + 0.5 \times 4200 \times 100.$$

$$t_1 = 300s = 5 \text{ minutes for } t_2. \text{ Since the acceleration is zero,}$$

$$t_2 = \frac{3000}{20}$$

$$= 150 \text{ seconds} = 2.5 \text{ minutes}$$

$$\text{Total time} = 5 \text{ min} + 2.5 \text{ min} + 25 \text{ min} = 32.5 \text{ minutes}$$

$$\text{hence time of reaching} = 7: 25 \text{ Am} + 00: 32.5 = \mathbf{07: 57. 5Am}$$

hence, he was able to reach in time at **07: 57. 5Am** before the set off time 08:00Am.

Height of the mountain h will be got from the pressure difference.

$$\frac{780-738.7}{1000} \times 13600 \times 10 = h \times 1.25 \times 10$$

$$5589.6 = 12.5h.$$

$$h = 442.368m$$

Since the mountain is 442.368m, then the climber will climb the same height.

Electricity and electromagnetism

Item 11

(a) Given that the unit cost of electricity = Ugx 750.

Item	Flat iron	Washing machine	Bulb
Quantity	2	1	3
Time in hours	2	3	10
Power in kW	1.2kW	2.2kW	0.1kW
Total cost per day in Ugx	$= 2 \times 2 \times 1.2 \times 750$ =3600	$= 1 \times 3 \times 2.2 \times 750$ =4950	$= 3 \times 10 \times 0.1 \times 750$ =2250

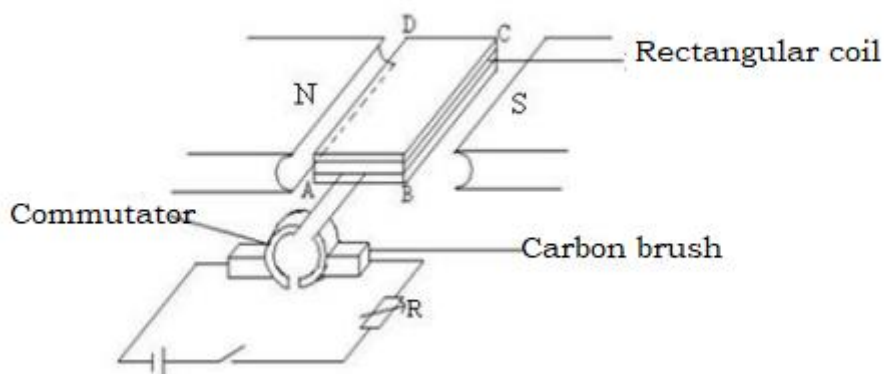
Total cost after 30 days = $(3600 + 4950 + 2250) \times 30$

= Ugx 324000

The man was not being cheated.

(b) The rotating device is a motor which receives electrical energy and converts into mechanical energy by rotating or turning.

Illustration



How it works

- When the current flows in the coil, side BC experiences a downward force and AD an upward force.
- The two equal and opposite forces constitute a couple which causes the coil to rotate.
- When the coil reaches the vertical position, the brushes lose contact with the commutator and current is cut off.

- However, the coil continues to rotate past this vertical position because of the momentum previously gain.
- The current in the coil therefore reverses, as the brushes change contact with the commutator
- Side AD now experiences a downward force whereas BC experiences an upward force hence the coil continues to rotate as long as the current is flowing.
- The rotation of the motor makes the drum agitate(stir) the clothes and water thereby removing dirt and stains.

Electricity costs can be minimized through

- Switching off devices that aren't in use
- Using iron boxes instead of flat irons
- Using alternative cheaper sources of energy e.g solar and charcoal e.t.c
- Using energy saving machines.

Item 12

From $efficiency = \frac{I_s V_s}{I_p V_p} \times 100$

$$= \frac{300 \times 120}{500 \times 240} \times 100$$

= 30% which is significantly low

- (i) Thick transmission wires are preferred in transmitting electricity because they have a lower resistance to flow of current which reduces energy losses due to heating during transmission.
- (ii) The inefficiencies in a transformer arise as a result of energy losses due to;
 - Eddy currents induced in the soft iron core due to changing magnetic flux linking the core which may result into unnecessary heat. Such energy loss can be minimized through using a laminated core.
 - Resistance in the windings. Some of the energy is dissipated in form of heat due to electrical resistance in the wire. This can be minimized by using thick copper wires of low resistance.
 - Hysteresis loss or magnetic reversals. These arise due to constantly magnetizing and demagnetizing. Each time the direction of magnetization of the frame changes, some energy is wasted in overcoming internal friction. This can be minimized by using a soft iron core which can easily be magnetized and demagnetized.
 - Magnetic flux leakage. This can be minimized by winding the secondary coil on top of the primary coil.

Item 13

- (a) (i) Lightning is an electric discharge that occurs when two electrically charged regions collide with each other forming sparks with release of energy.

How it occurs

- Within the clouds, ice crystals and water droplets collide with each other thereby getting charged by friction with the upper cloud being positively charged and the lower cloud negatively charged
- The negatively charged cloud at the bottom induces an opposite charge (positive) on the ground which concentrates on pointed bodies like trees or tall buildings.
- Once the cloud becomes highly charged, negative charges rush down towards the earth thereby attracting positive charges on the ground hence pulling them upwards.
- When these two charges meet, a strong electric current is generated (discharge) which is depicted as a bright flash of light called lightning.
- During the discharge, the thermal energy generated (due to rapid expansion of air) is converted to partly sound energy depicted as thunder. So, thunder and lightning weren't a punishment from gods as previously adopted.

- (iii) A lightning conductor should be installed in the church structure because;

- When a negatively charged cloud passes over the spikes of the lightning conductor, it induces positive charges at the spikes of the conductor.
- At the spikes, there is high charge density due to the high concentration of charges.
- This high charge density causes ionization of air molecules around forming positive and negative ions.
- The positive charges on the spikes repel away the positive ions and attract the negative ions which come to neutralize the positives on spikes.
- The repelled positive ions also move upwards to the cloud and neutralize some of the negatives on the clouds.
- The remaining excess charges (electrons) are conducted away by the copper plate to the ground hence reducing the effect of lightning.

Illustration

