

ST. JULIAN HIGH SCHOOL, GAYAZA

GRAND O' LEVEL PHYSICS SEMINAR 2025

Theme:

"Demystifying the Physics of the New Lower Secondary School "

ITEMS

Key Activities:

- Scenario interpretation skills
- Physics Theory Answering techniques
- Physics Practical Answering techniques
- Learner- Centered Discussions

Date: 14th June 2025

Organized by:

Venue: Main Hall

Department of Physics

Time: 8:00 AM – 5:00 PM

St. Julian High School, Gayaza

"Unlocking the mysteries of the universe through science, thought, and innovation."

MODERN PHYSICS

1. The government of Uganda plans to set up a Nuclear power plant to reduce the energy production cost. The following ideas were fronted by a Members of Parliament but he couldn't explain their rationale;

- All the workers at the plant were to wear safety wear.
- A detailed procedure of how the radioactive materials produce electricity was required.
- Assuming **1kg** of radioactive material with a half-life of **two (2)** weeks was to be used, a clear time frame was required as to when a replacement will be required.

Hint: *The radioactive material will only be used to produce electricity when the mass of the material is more than 50g*

Use your Knowledge of Physics to help provide a suitable response to the Member of Parliament about the raised Concerns.

2. The security department of a supermarket are worried about the number of items that get stolen from the shelves. One of them has suggested they install an X-ray machine at the exit of the supermarket and another member was worried saying that it produces dangerous rays that could pose a risk to the lives of the workers.

You have been approached by the staff to guide them on how the checking of the bags should be done safely taking into account the necessary precautions.

Hint

- Wavelength of soft X-rays = $5 \times 10^{-9}m$
- Wavelength of hard X-rays = $0.1 \times 10^{-9}m$
- Velocity of light in a vacuum = $3 \times 10^8ms^{-1}$

Use your knowledge of physics to help the workers understand how the X-rays can be used safely to reduce the losses.

EARTH AND SPACE AND DIGITAL ELECTRONICS

3. While on a one-month trip to the coast in another country, a tourist was able to observe the following
- At night, the sky was dark and filled with many stars of different colors and brightness. He wondered how they came into existence and why they varied from each other and how they are important for human life
 - The moon appeared almost every day but kept varying in appearance.
 - The area he was in was in a wet season while his home area had been in a dry season for about three months. This made him wonder.
 - The water levels kept increasing in level but reduced after about two hours.

The tourist wanted to know if it was possible to make a telephone call to his family and he has also approached you to explain to him about his other issues.

Use your knowledge of Physics to

- (a) Help the tourist understand the observations he made.
 - (b) Help the tourist understand how it is possible to make telephone calls to his home country.
 - (c) Help the man identify ways in which the stars are useful to human life.
4. A man who operates a hotel on a dusty busy street wanted to have a system where the door opened only when a client wanted to come in or get out. One regular client who always sat by a glass window observed that the moon is only visible in the evening when its dark but never at lunch.
- Using your knowledge of Physics;
- (a) To help the client understand their observation.
 - (b) To help the hotel owner understand how to solve the problem of opening and closing the door without hiring a person.

LIGHT AND WAVES

5. At a certain military camp, the officers were surprised when light from the sun started dimming. At exactly 11: 34 *am*, the sky was dark which left many of the military officers scared.

On communicating with their headquarters in another country, they were told the sky had been normal throughout the day.

One of the officers offered to explain to them what led to the gradual darkness using a slide projector. It had a lens of focal length 10cm that would be placed 40cm away from the slide. He wondered if it would produce a magnification of 4 which would be big enough for everyone to see.

You have been approached to help the officer prepare slides to help the officer understand the strange phenomenon.

Hint: *The sky became fully bright after 90 minutes.*

Use your knowledge of physics to;

- (a) Explain the strange phenomenon that happened.
 - (b) Help the officers understand why the people at their headquarters did not see the strange phenomenon
 - (c) Help the volunteer determine if the projector produced required image.
6. A certain driver is surprised by a number of things, and strange occurrences seen on a certain day;
- The colour of the sky changed from red in the morning to blue in the afternoon.
 - While driving, he kept seeing pools of water that disappeared as he came closer to them.
 - As he approached an area that was cloudy, he noticed flash of lightning in the sky after which he heard a loud thunderous sound.
 - On looking into the side mirror of his truck, he saw a big truck approaching him and wondered how the mirror was able to produce an image of the truck.

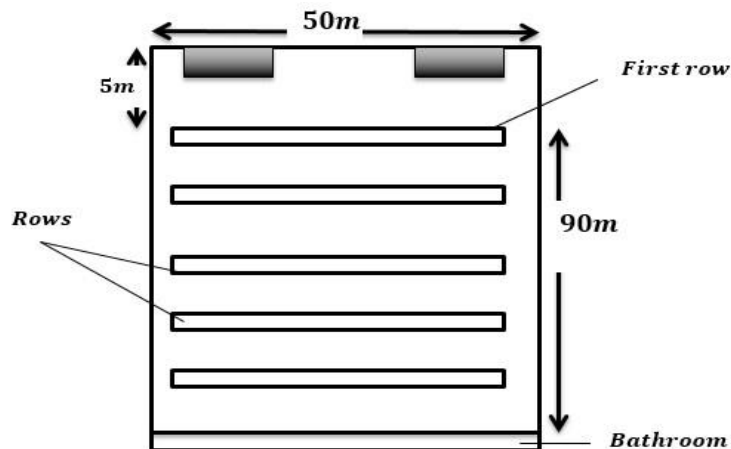
Hint

- *Velocity of light in a vacuum = $3 \times 10^8 \text{ms}^{-1}$*
- *Velocity of Sound in air = 340ms^{-1}*
- *Wavelength of red light = $7.50 \times 10^9 \text{m}$*
- *Wavelength of blue light = $4.90 \times 10^9 \text{m}$*
- *Assume lightning strike occurred 1km from the driver.*

Use your knowledge of Physics to;

- To explain why the color of the sky kept changing.
 - Why the pools of water on the road kept on disappearing?
 - To explain why he saw the flash of lightening before hearing the sound of Thunder
 - Explain how the mirror was able to show an image of the truck.
7. A certain conference hall is faced with a number of factors both from its clients and the community

The figure below shows a structure of the hall.



- People that sit in the front row complained that they hear two sounds from the speakers **(the original one and another faint one)**

- Other speakers were put in the sides of the hall in addition to the ones at the front, making the sound distorted.
- After switching on the lights, they noticed that some areas had regions that were very bright while others were dark.
- The bathroom was painted with a dark blue paint and a plane mirror installed. A make-up artist complained dimly lit and a mirror that made images larger than the objects needed to be installed.

Use your knowledge of Physics to;

- (a) Explain to the people at the front why they hear two sounds and why there was distortion when other speakers were added.
- (b) Explain how the problem of the make up artist can be solved.

MECHANICS AND HEAT

8. A number of issues have sprung up at a construction site following the laying of a concrete slab
 - One of the supervisors wearing sharp pointed shoes with an area of **40 cm^2** , found it hard to walk on a newly laid wet surface as compared to other wearing fiat shoes of **60 cm^2**
 - One of the builders proposed that the concrete slab on the first floor needed to be reinforced unlike the one on the ground floor. The owner of the site did not agree with him but the builder had no satisfactory explanation on his proposal.
 - Lifting of concrete blocks to use on the first floor has become hard and tedious. The workers claim the distance of **8 m** is very high for them to throw the blocks. Some of them who attempted ended up breaking the concrete blocks as they hit the ground with very loud sound.

In an effort to respond to one of the complaints, an engineer suggested a pulley system of four wheels be connected to a platform on which two blocks each of **8 kg**

could be put. The engineer was worried on the efficiency of the pulley system being less than **100%** and how much effort will be required to lift the blocks

Hint

- *Both supervisors have a mass of 70kg*
- *Acceleration due to gravity is 10ms^{-2}*
- *20% of the work input is wasted in the pulley system*

Use your knowledge of Physics to;

- Explain to the supervisor why it was harder for one of them to walk on the newly laid wet concrete surface.
 - To help the home owner understand the builder's proposal of reinforcing the concrete on the first floor.
 - Explain to the builders how to use the pulley system, and improve its efficiency
 - Help the workers determine the minimum effort required to lift the blocks.
9. In a certain restaurant, the refrigerator recently broke down. A mechanic said that a volatile liquid (isobutene) poured due to damage on one of the condenser coil and therefore the fridge could no longer cool food stuffs put in it.

The workers were also surprised when they noticed that **1kg** of water at **0°C** requires less time to reach **100°C** than a **1 kg** block of ice at the same temperature despite the fact that the same amount of heat and identical cooking pots are used. One of the managers advised them to keep the water in a plastic container as compared to a metallic one in order to keep it warm for a longer time

The manager also told the workers to reduce on the noise made by the wheel barrow when carrying foodstuffs as many clients had raised complaints about the irritating sound

Specific Heat Capacity of water = **$4200\text{Jkg}^{-1}\text{K}^{-1}$** .

Specific latent heat of fusion = **$340,000\text{Jkg}^{-1}$**

Use your knowledge of Physics to:

- (a) Help the workers understand how the volatile liquid is used to cool the food stuffs in the refrigerator
- (b) Explain to the worker why less time was required to heat the water to 100°C than ice.
- (c) Help the manager understand the cause of the noise and how it can be reduced.

ELECTRICITY AND MAGNETISM

10. A certain concrete mixer performs its role by the help of a DC Motor to help it keep rotating. The motor recently broke down due to damaging of its coil of resistance 2Ω . It was replaced by another of 4Ω but its efficiency was lower. One of the workers has approached you to help understand how the motor works, what led to the lowering of the efficiency of the motor and how the efficiency of the motor could be improved.

Hint:

The motor is connected to a 40V lead acid accumulator

Use your knowledge of Physics to satisfactorily explain to the worker.

11. A builder was worried about a number of items specified by an electrician during the wiring of the house;
- The electrician insisted on the earth wire being connected to a metallic rod surrounded by charcoal and salt.
 - The electrician also suggested that the laundry machine be connected to a fuse in order to safeguard it.

He however did not specify its rating or how it does so. The builder went to an electronics shop. to buy a fuse but was told only two were available one rated **10 A** and the other **18A**.

The electrician also had no time to estimate weekly cost of using the laundry machine of rating **240 V, 4000W**.

Just when the electrician was leaving, he told the builder to remind the house owner to include a lightning Conductor on the house. The builder informed his colleagues of the items that had been listed by the electrician and inquired from if anyone had knowledge about them but none could.

They have approached you because you stay in the neighbor hood to help them.

Use your knowledge of Physics to help the builder understand the information given to the him.

TRIAL QUESTION

12. In a certain village with no Hydro Electric Power connections, a certain homestead uses a lead acid accumulator to supply power.

Inside their house, they have three bulbs each of resistance **2Ω** used to provide light in the house. The people in the house are required to connect the bulbs in such a way that helps in prolonging the battery life. They were approached by their neighbours who told them the voltage of the battery would be stepped up by a transformer to be used to power an oven that requires **240V** for it to work.

The people in the house were also curious to know how the battery produces power, how the bulbs should be connected and have demanded to know if the power from the battery can be stepped up

Hint: The lead acid accumulator Supplies only 24V.

Use your knowledge of Physics to;

- a) Help the people understand how the battery produces current
- b) Help the people in the house connect the bulbs such that battery life is prolonged.
- c) Help the people in the house if the voltage can be stepped up or not.

PHYSICS PRACTICALS QUESTIONS

13. An entertainment hall owner uses a projector to display images on a screen. During the hall's setup, the projector lens accidentally fell and broke. The projector manual states that the appropriate lens should have a focal length between 8.0cm and 12.0 cm. A replacement lens has been provided, but its suitability is uncertain. You have been asked to apply your knowledge of physics to investigate and determine whether the replacement lens meets the required specifications and can be used in the projector.
14. Recently, more students have been receiving inaccurate results in their Physics experiments. They suspect that the internal resistance of the cells being used might be higher than the acceptable range of 0.8Ω to 1.5Ω . However, the students are unsure how to verify this. They have asked for your assistance.

Use your understanding of Physics to investigate and determine whether the internal resistance of the cells falls within the acceptable range and if the cells are suitable for use in practical work.