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PHYSICS  
Paper 1  
July 2024  
2½ hours



## ACEITEKA JOINT MOCK EXAMINATIONS 2024

Uganda certificate of education

PHYSICS

Paper 1

Theory

Time: 2 hours 30 minutes

### INSTRUCTIONS TO CANDIDATES:

- This paper consists of two sections; **A** and **B**. It has **seven** examinations items.
- Section **A** has **three** compulsory items.
- Section **B** has **two** parts **I** and **II**. Answer **one** item from **each** part.
- Answer **five** items in all.
- Any additional item(s) answered will not be scored.
- All answers **must** be written in the booklet provided

## SECTION A

Answer **all** the items from this section

1. With the intention of producing electricity by 2030, the Ugandan government is preparing to construct its first nuclear power station. The goal of this large-scale initiative is to meet the nation's increasing energy needs in a sustainable manner while lowering its dependency on fossil fuels. However, due to worries about the safety of nuclear power, there has been a lot of public criticism. Many people are unaware of the various benefits of nuclear energy and are concerned about the possibility of explosions if energy production is not controlled, the impact of background radiation on human health, and the long-term risks posed by radioactive waste with long half-lives.

**Task:** A well-known local radio station has invited you as physics student to address the public's worries and provide an explanation of the science behind nuclear energy production in a nuclear reactor in a controlled way.

2. The science club at a Secondary School has initiated a national science literacy campaign. As part of this effort, they are hosting a series of outreaches aimed at primary school students to foster a better understanding of astrophysics and its relevance to everyday life. The focus of their discussions will include energy production in stars, the importance of the Sun's energy, the variation in stars' colours, the life cycles of stars, and the importance of space exploration.

**Task:** As a student of physics, you have been requested by the school science club to deliver in one of the outreaches to primary school students. Your task is to educate them on

- (a) How the sun produces energy needed for life to survive?
  - (b) the variation in colour and brightness of stars in the Milky way in terms of their size and distance from the earth
  - (c) the different stages in the life cycle of a star
  - (d) the purpose of the international <sup>space</sup> station <sup>(ISS)</sup> and its role in space exploration.
3. A new company has just been built next to your home, and while they have hired security guards, the security cameras they intended to purchase are currently out of stock. At the moment, they were looking for a basic tool that would enable them to view over the wall and what is outside when they are inside the perimeter fence. In addition, the company has been advised to install a laser rather than a regular lightbulb for nighttime security.

Hint;

- Available is a mirror and a glass prism.
- the laser chosen for the security system has a wavelength of  $532 \times 10^{-9} \text{m}$ .
- Speed of light in a vacuum is  $3 \times 10^8 \text{ms}^{-1}$
- Frequency of laser suitable for security system should be less than  $6 \times 10^{14} \text{Hz}$ .

**Task:** As a physics student:

- (a) Choose between a mirror and a glass prism for the design of the simple instrument. Explain your choice with reasons and use a diagram to illustrate the design and operation of the simple instrument.
- (b) Explain to the company how light from the regular light bulb is different from a laser and advise on whether the laser they purchased is suitable for their needs.

## SECTION B PART I

*Answer one item from this part*

4. An ambulance is transporting critical medicine from the city Centre to an upcountry district. The medicine must be kept refrigerated, and the mini refrigerator in the ambulance is chargeable. However, the ambulance runs out of fuel, and the driver stops a passing pickup truck for help. The pickup truck driver offers to give some fuel, but when checking the battery, the ambulance driver realizes it is draining quickly. The refrigerator indicates it has only 3 hours of operational time left. The remaining distance to the destination is 150 km.

The only method they can use to get fuel from the pickup is through a pipe.

The amount of thermal energy required to maintain the refrigerator's internal temperature should be higher than 450000J

**Task:** As a learner of physics, you have been requested to;

- (a) Explain using diagram how the driver can get fuel using a pipe from the pickup truck to his tank.
- (b) Advise the driver on the minimum average speed the driver needs to maintain to ensure the medicine remains properly refrigerated upon arrival.



- (c) Establish whether there is enough energy to maintain the refrigerator's internal temperature if the refrigerator's power rating is 50 W.

5. Two cars collided at a junction: one car was traveling northward and the other southward. The driver of the southbound car claims that the northbound driver was over speeding. The traffic police are not sure of who is at fault. A witness stated that the cars travelled together after the collision. One of the drivers was not wearing a seatbelt. To identify a vehicle which was over speeding or braking heavily before the crash, the risen tyre temperatures can provide physical evidence. The police used an uncalibrated thermometer to measure the temperature of the tyres as follows:

Length of the mercury thread when in contact with the tyre: 40cm

Length of the mercury thread at the ice point: 10cm

Length of the mercury thread at the steam point: 80cm

**Additional Information:**

- Mass of the car travelling northward: 2000kg
- Mass of the car travelling southwards: 1800kg
- Velocity of the car travelling southwards before the collision: 70km/hr.
- Common velocity of the two cars after the collision: 35km/hr.
- Speed limit on this road: 70km/hr.

**Task:** As a learner of physics,

- (a) Guide the police on <sup>which of the two cars</sup> whether the pickup was over speeding.
- (b) Advise the driver who was not putting on the seat belt on how it can safeguard his live
- (c) Assist the police to get the correct tyre temperature.

## PART II

Answer **one** item from this part

6. A building has been struck by lightning, causing damage to its electrical system, including a fuse, a copper wire used as an earth connection, and a small transformer that was functioning as a voltage regulator. The building's owner has decided to replace only the transformer for now and plans to address the fuse and earth connection later. However, he is uncertain if the newly purchased transformer will perform adequately. The previous transformer had a power

output of over 80W. The building owner has also refused to install a lightning conductor.

**Hint:**

- The new transformer is designed to work on a 240V, 60W supply. Primary coil has 300 turns and secondary coil has 200 turns and its efficiency is 80%

**Task;** As a student of physics, you been requested to explain to the owner of the building

- (a) How installing a lightning <sup>conductor</sup> will protect his building
- (b) Whether the newly bought transformer is suitable for the building's needs
- (c) the dangers associated with delaying the replacement of the fuse and the re-establishment of a proper earth connection.

7. A business person has started a large-scale business and wants to understand his daily power usage. He also needs guidance on choosing a generator, saving power, and ensuring his workers are knowledgeable about wiring and maintenance. He has the following electrical instruments.

12 security bulbs (5W each) operating for 12 hours a day

A 65W refrigerator operating for 24 hours a day

A 3000W juice making machine operating for 5 hours a day

**Tasks:** As a student of physics, you have been requested to;

- (a) assist him to know his daily power usage from the listed electrical instruments
- (b) choose a suitable generator for his business needs and explain the operation of the chosen generator with a labelled diagram.
- (c) Describe to his workers the insulator colour codes used in domestic wiring.
- (d) Provide suggestions on how he can save energy.

**THE END**