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PHYSICS
Paper 1
Jul/Aug.2025
2½ hours



UGANDA TEACHERS' EDUCATION CONSULT (UTEC)

Uganda Certificate of Education

PHYSICS

Paper 1

Theory

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

This paper consists of two sections; A and B It has seven examination 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.

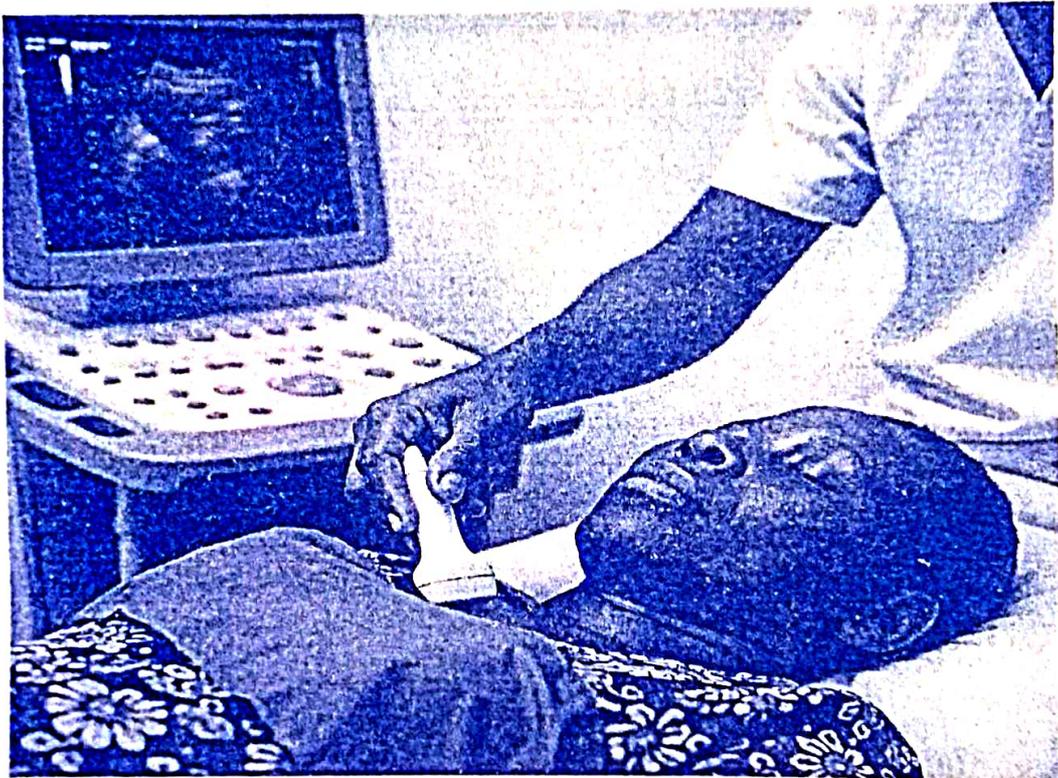
All answers must be written in the booklets provided

SECTION A

Attempt all items in this section;

Item 1

At Namasale Health Centre, efforts to detect internal health conditions in patients were often delayed due to the absence of affordable imaging tools. In response, a physician from a nearby school decided to support the facility by developing a basic scanning system using school laboratory resources. Their idea was to create a safe and cost-effective model for detecting and viewing internal features of the human body.



To test the idea, he directed a focused green beam, measuring about 532 nanometers in length, onto a polished surface. Alongside this, he produced a series of rapid vibrations through the air that stretched about 2.83×10^{-5} metres between successive compressions. These two forms of energy moved at remarkably different speeds - one covering about 300 million metres in a second and the other taking about 1 second to cover only 340 metres.

Curious about the reliability of the slower-moving signal, his co-physician suggested they could verify its speed using a nearby wall and measuring the time it took for the echo to return. Meanwhile, you proposed using a more common source of light that produced a wider mixture of colours, arguing it was more accessible.

Your ultimate goal was to determine whether the two forms of energy could be applied in health-related scanning and detection processes.

Tasks:

- a) Using suitable calculations and reasoning, determine whether each of the two energy forms described is appropriate for the scanning and detection roles intended by the learners.
- b) Describe how you could experimentally confirm the speed of the slower-moving disturbance using available surroundings.
- c) Mention two modern uses of the faster-moving signal in everyday life beyond health services.
- d) State three differences between the two energy forms investigated by the learners, considering how each travels and behaves.

Item 2

A government health and safety agency received complaints of unusual illnesses among miners working deep underground. Preliminary findings suspected the cause to be radiation exposure from an unknown source.

A private investigative company was contracted to carry out a radiation analysis of the mining site. Their report showed the presence of a radioactive element.

They shared the activity readings taken at regular time intervals, and informed the agency that the site would only be considered safe for human activity when the radiation level fell to background readings, which was 28 counts per minute.

As a precaution, the agency ordered an immediate halt to mining operations, recommending that no miner should return until radiation levels reached the safety threshold. The decision sparked dissatisfaction among the miners who argued that the site appeared safe enough. One affected worker who had earlier gone to hospital was subjected to a body scanning procedure to assess internal damage and wanted to know how such radiation was produced and whether the scanning technology posed any risk or had further applications.

Activity(count per min)	80	70	60	50	40	30	20	10	2
Time(months)	0	1.5	2	3	5	7	10	15	25

Tasks:

As a Physics learner:

- Use the data provided to predict the time when miners can safely return to the site.
- Justify the agency's decision to delay mining activities despite visible calmness at the site.
- Demonstrate how radiation is generated for use in medical scanning technologies and illustrate at least two beneficial applications of such technologies in society.

Item 3

During the national revision week in Bukomansimbi District, many learners depended on educational radio programs to prepare for their final examinations. These programs, broadcast via satellite, were a valuable resource, especially in remote areas. One evening, a father, eager to help his children revise, tried to tune in to one such program transmitted on a frequency corresponding to a wavelength of 3 cm. Despite several attempts, the radio failed to capture the broadcast. The father checked and confirmed that the highest frequency his radio could process was 9.5 GHz. Frustrated, he stepped out of the house to cool off. While outside, he noticed a bright, rounded moon and several glowing objects scattered across the night sky. His son, a student with a keen interest in astronomy, joined him. He explained that the moon's visibility and brightness were due to the reflection of energy from the sun. He went on to share how this natural energy source plays an important role in sustaining life on Earth and how different objects in space can be seen without special instruments under the right conditions.

Tasks:

- Determine whether the father's radio could receive the satellite signal.
- Based on the father's description, suggest the most likely phase of the moon he observed and give a reason for your answer.
- Name any three components of the solar system that can be seen with the naked eye and briefly explain why they are visible.

- d) Describe three ways in which solar energy reflected by the moon contributes to life on Earth and the functioning of natural systems.

SECTION B:

Attempt **one** item from each part.

Part I

Item 4

In Kibingo Town Council, a government initiative was underway to distribute essential documents to villages ahead of a civic exercise. With limited time and transport available, Jonathan, a dedicated youth volunteer, hired a taxi early in the morning to help in the distribution.

The driver, eager to beat the morning traffic, took off suddenly from the roadside. Jonathan, who had not fastened his seatbelt properly, was thrown backward due to the force of the start. The taxi gained speed over a short period and moved steadily across several parishes. As they approached the final destination, the vehicle slowed down sharply to avoid hitting a group of school children crossing the road. Jonathan lurched forward, hitting his forehead on the seat in front.

After the trip, the driver charged Jonathan 35,000 shillings, justifying the cost based on the total stretch covered. Jonathan, unsure whether the fee was fair, decided to rest by a stream near the health centre while waiting for first aid. There, he dipped his feet into the stream and noticed a significant difference in temperature between the hot rocky ground and the cool water, even though both were under the same sunshine.

Tasks:

- a) Using the information provided, sketch a suitable diagram showing how the vehicle changed its speed during the journey.
- b) Decide whether the driver's charge was fair. Assume that vehicles in the area charge 1,000 shillings for every kilometer covered.
- c) Give a scientific explanation for Jonathan's experiences at the start and end of the journey.
- d) Explain why the surface of the ground felt much hotter than the water in the stream, despite both being exposed to the same environmental conditions.

Item 5

In Kisoro District, the local council organized an inter-district mountain climbing event to raise awareness about the impact of climate change on ecosystems in highland areas. One of the student participants, Musasizi, from a nearby school, was selected to represent his district. The event was scheduled to start at exactly 8:30 a.m. at the foot of the mountain.

Musasizi woke up at 7:25 a.m., but he had no access to clean, boiled water to make his morning tea. He quickly placed 500 grams of frozen water, which was at -3°C , into a container and connected it to a 1270.5 W electric device provided at the homestay where he was lodging. His plan was to heat the water for tea, take about 25 minutes to eat and prepare, then ride a bicycle across the 3 km stretch to the venue. He could cycle at a constant speed of 20 m/s.

Upon reaching the venue, Musasizi was told by the organizers that the air was thinner at the summit of the mountain, with a pressure reading of 738.9 mmHg, compared to the typical value of 780 mmHg at the base. Fascinated, he began to ask questions about how conditions change with elevation and how such changes are measured by professionals in the field of environment and weather forecasting.

Tasks:

- a) Based on the time available and the activities described, determine whether Musasizi would arrive at the venue in time for the event.
- b) Using the provided values, calculate the height of the mountain climbed by participants, based on the pressure difference between the base and the summit.
- c) Sketch a suitable diagram to represent how the temperature of the frozen water would change from -3°C until it reaches boiling point during heating.
- d) Suggest a suitable tool that scientists could use to measure pressure in such environmental studies and explain why the pressure at the base of the mountain is always greater than at the summit.

Part II

Item 6

In Soroti Municipality, a locally owned packaging company invested in a new device imported from abroad to improve production speed and efficiency. However, shortly after installation, the technical team discovered that the machine required a supply of 110.4 volts and operated at 5 amperes, yet the local grid provided a standard supply of 240 volts.

To avoid damage to the new equipment, the company's technician explored the possibility of modifying an existing power regulation system using a coil with 100 turns. He aimed to adjust the electrical input appropriately without replacing the entire setup. The imported device also contained a component that produced sound during operation, which functioned using a single directional flow of electricity.

The machine was expected to run for three hours daily. The company estimated the energy cost based on the national rate of 960 shillings per unit and allocated 12,000 shillings weekly for electricity expenses. Due to frequent power blackouts in the area, the owner also considered installing a backup energy storage system using a rechargeable chemical cell and wanted advice on how to maintain it effectively and maximize its lifespan.

Tasks:

- a) Based on the intended voltage adjustment, calculate the number of turns required in the second coil to make the regulation system suitable for the new device.
- b) Determine whether the allocated weekly budget of 12,000 shillings will cover the electricity cost of running the device as scheduled.
- c) With reference to the component that produces sound, explain how it operates using the one-way flow of electrical energy.
- d) Suggest practical ways of caring for the backup storage system to ensure it remains functional and durable.

Item 7

In Pader District, rising levels of metallic waste in trading centres and around households had become a concern for residents. To address the problem, a group of Students from a local secondary school launched a community recycling initiative. The goal was to reduce environmental hazards by collecting and sorting metallic materials for reuse and safe disposal.

One student, Odong, was particularly interested in finding efficient ways to separate iron-containing objects from general waste. Inspired by cranes used in scrapyards and devices used in school laboratories, he set out to build a lifting tool using materials he could access locally.

He wound a 500-turn coil around a nail, measured its resistance to be 2×10^{-2} ohms, and powered it with a 9-volt battery.

During testing, he observed that while his setup could lift some small metallic items, it struggled with heavier pieces.

Odong became curious about how to improve the pulling strength of his device and also wanted to learn where such lifting tools are applied in modern equipment. He hoped the project would help reduce metal litter in his community while inspiring other students to engage in hands-on environmental solutions.

Tasks:

- a) Based on the information provided, calculate the maximum amount of electric flow through the coil Odong used.
- b) Suggest two modifications Odong could make to improve the effectiveness of his device in lifting metallic materials.
- c) Describe the working of one device commonly used in homes or industries that operates using the same principle as Odong's tool.
- d) Explain how using such lifting tools can promote environmental sustainability and reduce pollution in the community.

END