NAME: …… STREAM: ……

P510/1
PHYSICS
Paper 1
Aug, 2026
3 Hours

END OF TERM II EXAMINATIONS 2026

Uganda Advanced Certificate of Education

S.5 PHYSICS

Paper 1

3 Hours

INSTRUCTIONS:

- This paper consists of two sections ***A*** and ***B***. You are required to attempt the items in **section A** and two (02) more items in ***section B*** choosing only ***one (01)*** item from each of the parts ***I*** and ***II***.
- Write your answers on the answer sheet(s) provided, **beginning the solution of each item on a fresh page.**
- Attach the question paper on your answer sheet(s).

SECTION A (COMPULSORY SECTION)

ITEM 1

A group of enthusiastic radiography students were told that in their first experimental investigation, they were to explore how **specific charge** may be determined using a Bain bridge spectrometer. Being new to the field, they didn't know the meaning of specific charge and kept wondering how it would be determined using the said spectrometer.

During one of the experimental investigations, their lecturer accelerated a beam of positive ions using a potential difference of $\mathbf{2000}\boldsymbol{V}$ and made them to enter into are region of uniform magnetic field. While in the field the ions described a circular path of radius r. In the second experiment, an electron of energy $5kV$ was directed into a region of uniform electric field intensity $\mathbf{1.6 \times 10^4 Vm^{-1}}$. For the experiment to be successful, the electron should not collide with wall of tube $\mathbf{0.3}\boldsymbol{m}$ in front of the point where the electron enters the field.

As a take home assignment, the lecturer also tasked them to state the uses of the essential parts of the cathode ray oscilloscope. However the learners didn't how to go over the task.

Hint;

- Charge to mass ratio of the ions is $8.5 \times 10^7 Ckg^{-1}$.
- To stay safe, the students are not advised to experiment with magnetic fields whose flux density exceeds $0.25T$.

Task:

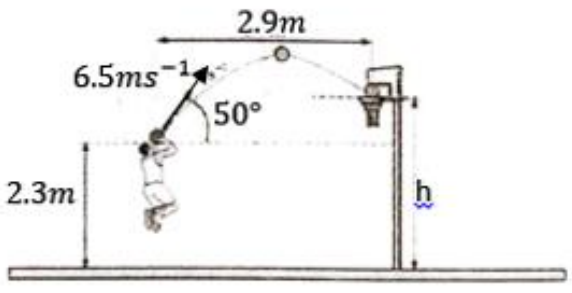
Analyse the scenario and;

(a) address the students' concerns.

(b) comment on the success of the experiment and the safety of the students during the experiment.

ITEM 2

Baguma and Simon are two basket ballers who possess unique skills that their team nearly relies on them. One day during a basketball training session, Simon threw the ball with an initial velocity of $6.5ms^{-1}$ at an angle of $50°$ to the horizontal. The ball was initially $2.3m$ above the ground. When released, it travelled a distance of $2.9m$ to reach the top of the basket. The figure below shows how the ball moved from the instant Simon threw it.



The coach said he will be satisfied if the time taken for the ball to reach the basket did not exceed $0.5s$.

The coach is also interested in the vertical position h of the basket from the ground and would like to know the, ways other than more practice, how the player would ensure the ball takes a shorter to land in the basket.

Later that evening, as Baguma was heading home after training, he notices that a bus had been involved in an accident. At the scene, a traffic officer was investing the cause of the accident. It was discovered that the bus was moving at $20ms^{-1}$ when the driver suddenly applied the brakes to avoid hitting a boy $50m$ away, bringing the bus to a stop in $4s$. One of the passengers inside the bus hit his head against the metal in front getting hurt. The driver of the bus insists that the passenger was at fault for not wearing a seatbelt but didn't know how to explain his argument scientifically.

The officer is interested in knowing whether the boy was eventually hit by the bus.

Task:

Analyse the scenario and address all the concerns.

SECTION B

PART 1

Choose only ***one (01)*** item from this part.

ITEM 3

During a joint Physics and medical technology workshop held at a university in Kampala, students were introduced to practical applications of optics in scientific instruments and healthcare equipment.

Before the sessions started, the students decided to prepare tea for breakfast. To determine whether the water had boiled, one student placed the hot junction of a thermocouple in the water and the e.m.f was found to be $\mathbf{4.438}\boldsymbol{mV}$. If the e.m.f of the thermocouple at the triple point of water is $\mathbf{3.25}\boldsymbol{mV}$

In the, Physics laboratory, students use a device to detect very small electric currents. The device uses a tiny mirror attached to a coil, which reflects a beam of light on a scale. However, some students are an able to explain how a small rotation of the mirror produces a large deflection of the light spot and how to obtain the relationship between the angle of rotation of the mirror and the angle through which the reflected ray turns.

At the optics station, students investigate the formation of images in a plane mirror and are asked to describe the size nature and position of the images formed. They are also guided on how to derive the relation $r = 2f$ for a spherical mirror under suitable conditions, but many find it difficult to link ray diagrams to the mathematical derivation.

To further test their understanding, students are given a concave mirror problem where an object is placed $20cm$ from the mirror of focal length$15cm$. They are required to calculate the position and deduce the nature of the image formed but some students are unable to use the formula and interprete the results.

In the medical application session, a dentist demonstrates how a concave mirror is used to view enlarged images of teeth during examination. Students are asked to explain why concave mirrors are preferred in dentistry and how they help in producing a magnified and well-illuminated image.

Task:

Analyse the scenario and address all the issues involved.

ITEM 4

In a given health center, a technical team is trying to utilise free energy from the sun to sterilize medical equipment using a large solar concentrator made of a highly polished concave metal surface. To ensure the concentrator is perfectly aligned with the sun throughout the day, the technician needs an optical device to measure the elevation of the sun.

Once aligned, the technician needs to find the exact spot where the sunlight concentrates in order to place a $0.5kg$ metal container filled with $2.0kg$ of water. He wants to see a mathematical proof that links the perfect spot for the container's position and the radius of curvature of the concentrator.

On a clear day, the sun provides $1800W$ of power to the system and this power raises the temperature of the water from $25℃$ to $100℃$. The centre also has an electrical heater that heats the same amount of water in $200\ seconds$.

During the process, the team noted that their liquid in glass thermometer and resistance thermometer were giving different readings and only agreed at $100℃$.

HINT:

- $Specific\ heat\ capacity\ of\ the\ metal\ cntainer\ is\ 900Jkg^{-1}K^{-1}$.
- $Specific\ heat\ capacity\ of\ water\ is\ 4200Jkg^{-1}K^{-1}$.

Task:

(a) Suggest and educate the technician on the operation of the device he can use to ensure that the concentrator is perfectly aligned with the sun.

(b) With justification, propose a mathematical derivation that identifies the light gathering point based on the curvature of the concentrator.

(c) Recommend and justify the heating method to be used for emergency cases to sterilize surgical tools.

PART II

Choose only ***one (01)*** item from this part

ITEM 5

At a meteorological research station on Mt.Elgon, researchers study atmospheric electricity, particularly during thunderstorms common in the region. The scientists use specialised equipment to measure electrostatic fields in the atmosphere and correlate them with the weather patterns. One of the researchers on internship observed bright flashes in the sky and these were shortly followed by a loud sound but lacked scientific information for this phenomenon and was amused why he observed the flashes just before the sound. He consulted his supervisor who told him that the flashes and sound were caused by a physical process that can also be utilised in the operation of the Photocopier. He further informed him that that process can be dangerous and precautions were needed to keep one safe during the occurrence. He then requested you to help the researcher on internship understand the processes that lead to the occurrence of the flashes of light and loud sound, how one can stay safe during the process and the application of the process in the operation of the photocopier.
As you were explaining, your keys with a steel key holder accidentally fell but did reach the ground as they were attracted to a substance in form of a metal bar as they were falling. The researcher was amused the more and requested you to provide a clear explanation for his observation,

Task:

As a learner with a knowledge of Physics, respond to the request of the;

- supervisor.
- researcher on internship.

ITEM 6

A group of senior five students in a Physics innovation club are tasked to design a simple electric heater using locally available materials. They choose a $1.0m$ long nichrome wire of diameter $0.72mm$ and wind it into a coil. The coil is fully immersed in $200cm^3$ of water, both initially at $25℃$. A steady current of $5.0A$ is passed through the coil. The students observe that just after $8\,minutes$, the water just begins to boil at $100℃$. They assume that all the electrical energy supplied by the coil is used to heat the water and there are no heat losses.

One of the students is concerned about the why the wire becomes hot when a current flows through it. Some group members argue that this is due to the drift velocity of the electrons in the wire and are asked to derive the expression for the drift velocity but they are unable to do so.

The students are required to determine the initial resistance of the nichrome coil at $25℃$, the total electrical energy supplied during heating and the mean temperature coefficient of resistance of nichrome between $0℃$ and $100℃$.

The design requirement for the heater states that the resistance of the wire used should not exceed 5.25Ω at $25℃$, the heat energy supplied should not be less than $63000J$ and the temperature coefficient of resistance should not be less than 2.2×10^{-3}.

The students are also confused about why some materials have positive temperature coefficient of resistance while others have a negative one. In addition, they don't know how the temperature coefficient of resistance of the nichrome wire can be determined experimentally in a school laboratory setting. Although, they sought guidance from the laboratory technician, they still failed to understand the procedure.

Task:

Analyse the scenario and help the students to;

(a) determine whether the nichrome wire meets the requirements of the heater and address all the concerns in the scenario.

(b) explain the concepts and laboratory procedures that the students have failed to understand.

*****END*****