MARANANTHA PHYSICS SEMINAR 2026

COMPOSITION PHYSICS PAPER ONE (1) (535/1)

THEORY

Section A

This is comprised of three (3) **compulsory items** set from three elements of construct as highlighted in the table below. An element of construct combines many topics and therefore if you're preparing you can use the table below as your checklist to ensure that you leave no stone left unturned.

S/N	ELEMENT OF CONSTRUCT	TOPICS COVERED
1.	**LIGHT AND WAVES** *Understands how waves are generated, propagated and their applications in everyday life.*	1. Nature of light; reflection of light at plane surfaces 2. Reflection of light at curved surfaces 3. Refraction, dispersion, and color 4. General wave properties 5. Sound waves
2.	**ATOMIC MODELS AND NUCLEAR PROCESSES** *The learner understands the structure of atoms, nuclear processes and their application in everyday life.*	1. Atomic models 2. Nuclear processes
3.	**EARTH, SPACE PHYSICS AND DIGITAL ELECTRONICS.** *Learner understands solar system, galaxies, stars, satellites and communication in everyday life.*	1. The solar system 2. Stars and galaxies 3. Satellite and communication 4. Digital electronics (logic gates)

Section B

This is comprised of two parts that **Part I** and **Part II**. In **each part two** items are set and you are supposed to pick **one** item from each part.

PART	ELEMENT OF CONSTRUCT	TOPICS
I	**MECHANICS AND HEAT** *The learner understands the effect of force and heat on properties of matter.*	1. Measurements in physics especially measurement of length, mass and time 2. States of matter 3. Effects of forces 4. Temperature measurements 5. Heat transfer 6. Expansion of matter 7. Work, energy and power 8. Turning effects of forces, center of gravity and stability. 9. Mechanical properties of matter. 10. Pressure in solids and liquids. 11. Linear and non- linear motion. 12. Heat quantities and vapor.
II	**ELECTRICITY AND MAGNETISM** *Appreciates electricity and magnetism in everyday life.*	1. Magnets and magnetic fields. 2. Electrostatics. 3. Introduction to current electricity 4. Voltage, resistance and ohm's law 5. Electromagnetic effects 6. Electric energy distribution and consumption

Note: The elements of construct are not given in the order of items in the paper.

COMPOSITION OF PHYSICS PAPER TWO (2) AND THREE (3) (535/2&3) PRACTICAL.

- This paper comprises of three assessment area that is say; **mechanics**, **light** and **electricity**.
- The paper **has only two items** and the learner has to answer only **ONE** item in **2 hours.**
- The learner is advised to use 1 hour maximum to write the laboratory report up to the level of interacting with materials to get results. Then use maximum 30 minutes getting results and then the remaining time should be used to analyze data and drawing conclusion and advise.

ELEMENT OF CONSTRUCT	TOPIC (s)	COMMON EXPERIMENTS
SCIENTIFIC INVESTIGATION *Appreciate scientific investigation in physics.*	Mechanics	1. Determining unknown mass of a solid 2. Determining unknown mass of a metre rule 3. Determining density of a solid 4. Determining density of a liquid 5. Determining Relative Density (R.D) of a solid/liquid. 6. Determining the force constant of a helical spring
	Light	1. Determining the refractive index of a glass material 2. Determining the critical angle of a glass material 3. Determining the focal length of a concave mirror and convex lens 4. Determining the radius of curvature of a concave mirror and convex lens 5. Determining the power of a concave mirror and convex lens 6. Determining the magnification of a concave mirror and convex lens
	Electricity	1. Determining the resistance of a conductor 2. Determining the internal resistance of a dry cell 3. Determining the e.m.f, E of a dry cell 4. Determining the power dissipated by a conductor or appliance

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LIGHT AND WAVES

Item 1

Two dressing mirrors in one of the school dormitories broke due to carelessness of the learners. For fear of the teacher discovering the damage they caused, they picked two curved glasses on an old car parked in the school compound each of focal length 50cm. The glasses were silvered on one side and nailed on the walls one in a room congested with beds and mattresses and another in an empty room. They were surprised to hear a prolonged sound of the hammer in an empty room which was not the case in the congested room. They also realized that the mirrors they made produce only tiny images of any individual standing in front of them regardless of the distance.

They realized that the mirrors made were not dressing mirrors but they could not identify them.

The light in the corridor was replaced by a yellow flood light but the learners are surprised to see that their green and blue uniforms with red sweaters change to different colours which surprised the learners.

The learners have approached you for assistance.

Task.

Help them to understand

a) The type of mirrors they made and use an illustration to describe how it works.
b) By drawing to scale, the height and magnification of a person of 150cm tall standing 2000mm from the mirror.
c) The colors of their uniforms under flood light.
d) Briefly explain two applications of the mirrors made.

Item 2

Along a road near a school, there is a sharp bend which is regarded as **a black spot** because of the many accidents that occur at that point. This is mostly at night and during rainy and foggy conditions. The local community members plan to contact the learners of the nearby school to advise them on the features that need to be installed to reduce the activities because no road sign is in place. The school has a new multipurpose hall but the school community has noticed the sounds from the presenters are **distorted** and the messages **are not clear**. When one learner produced a loud sound while standing at one extreme end of the hall the echo was received after **0.2 seconds** but could not use this information to estimate the length of the hall. You have been contacted for help

Hint: speed of sound is **320ms^{-1}**

Task

Help the community to understand

a) The type of road signs and features that should be installed at the corner
b) Why visibility is compromised during the stated conditions
c) The modifications that can improve on the challenges in the hall
d) The size of the hall

ATOMIC PHYSICS

Item 1

In one of the villages in Wakiso district, clay bricks are made as one of the major economic activities. Large and deep holes develop where the clay is picked. It has been noticed that many of these people have developed both simple and complicated health challenges. Also, records from the nearest health center IV indicate that most of the patients recorded are from the brick making community.

When samples of clay were tested, results indicated that a radioactive substance with a count rate of 800 counts per day and a half-life of one week was present. Experts also found that a count rate of 70 counts per day was noted in the area without an obvious source.

Two recommendations were made which included abandoning the brick making activity in that area and isolating the victims from their homes for some time and no convincing reason was given.

Task

You have been asked to help the people to;

a) Understand the likely challenges they are to experience in case they continue making bricks in that area.
b) Understand when they are likely to go back home after being isolated.
c) Understand the usefulness of the substance found in the clay.

Item 2

The ministry of health plans to establish a modern cancer diagnosis and treatment centre. A radioactive isotope technatium 99 (Tc-99) with a count rate of 160 counts per second and half-life of 6 hours is to be used for imaging , diagnosis and treatment of thyroid and other organs. Before the project starts the technical team had to sensitize the community and check on the site where radioactive waste will be damped. They realized that the site had a background count rate of 8 counts per second. The community members raised the following concerns but the technical team had no time to explain to the community

1. How the safety of patients, workers and the community members exposed to radioactive waste will be catered for
2. The meaning of the equation $^{99}_{43}Tc \longrightarrow {}^{99}_{44}Ru + \mathbf{Y} +$ Energy
3. Why should an element with a shorter half life more suitable
4. For those who stay near the damping site maybe requested to abandon their land. The community members have contacted you for help.

Task
Help them understand
a) How the patients workers and community members be catered for
b) The nature of **Y** in the equation.
c) Why technetium be used.
d) In case the unit is closed for how long should the community members wait before setting back.

SPACE PHYSICS
Item 1
Uganda is one of the African countries planning to participate in an African Space programme which aims at Launching a Satellite in the geostationary orbit for weather monitoring, environment studies and communication services. Some stake holders and policy makers would like to be given the benefits of such a satellite before spending such large sums of money and why in particular should the satellite be placed in that orbit.
The public also wonders whether this Satellite may not be a risky object which may accidently drop down immediately on the earth's surface which may lead to loss of Life and property. The government plans to establish a public observatory center where learners can view and research more about stars and other celestial objects. In a bid to minimize high costs of electricity in the facility, a bulb in the room should be connected to a circuit having a logic gate such that it lights automatically whenever a person enters the room or when it becomes dark. The public has contacted you for assistance.

Task.
Help them to understand
a) The advantages of such a satellite to Uganda.
b) Why the satellite should be placed in that orbit?
c) How it may not be possible for such a Satellite to cause loss of Life and property.
d) The type of logic gate to be used including a truth table

Item 2
A Ugandan telecommunication company relies on satellites to provide internet and mobile phone services across the country. In one of the cities in Uganda, a center has been established with solar powered telescopes for a learner to study stars and other celestial bodies. During their study, a group of learners failed to come up with reasons why the earth remains in its orbit around the sun despite its high speed through space, how the sun generates solar energy and how the company is able to offer services across the country. The Learners also observed that some stars near the moon are of different colors and some are brighter than others but could not come up with reasons for such occurrences. For Security reasons, the door to the Centre is operated by a system connected to a circuit with a logic gate that enables it to open when a valid access card is inserted and a correct password, entered. The learners wanted to understand how the system works but nobody could help them. The Learners have approached you for assistance.

Task
Help them to understand:
a) How the sun is able to make the telescopes work.
b) How Communication is possible across the Country.
c) why the stars observed appear as indicated
d) The type of logic gate used and how it works including its truth table.

MECHANICS AND HEAT

Item 1

Amos is a young man who works as office manager and he in most cases is requested to prepare breakfast tea for his bosses by boiling 2Litres of tap water of density 1200 kgm^{-3} from 25^oC to 87^oC using an open boiler of power 2kW and preparing some eggs.

The offices were partitioned using plywood and Amos used nails to hang calendars, business licenses and other documents. The office has been shifted to the top floor of a tall building where the partitions are made of glass and aluminum frames and Amos has been advised to use rubber suckers to fix all the documents instead of using nails but he has no idea of how rubber suckers work.

His bosses now complain that Amos does not perform his duties as he used to do because he used to take only 5 minutes to have the tea ready and boil the eggs but now he takes a lot of time to prepare the same quantity of tea and eggs. This has confused Amos and he is worried because he cannot explain the cause of this and he may lose his job.

Amos has contacted you for assistance.

Hint:

Specific heat capacity of tap water = 4000$Jkg^{-1}K^{-1}$.

Task:

Help him to understand:

a) how the device he was told to use to fix the documents on glass works (use an illustration)
b) why the eggs at the new offices take long to get ready
c) Whether the time his bosses claim that he used to take to prepare the tea was correct.
d) Explain briefly two applications of the concept used by the device in (a) above.

Item 2

Your school constructed one of the tallest classroom blocks in Uganda and the S.3 class is at the top most floor.

A teacher gave them an assignment to design an instrument by use of the idea of atmospheric pressure to determine the height of their classroom from the ground floor but the learners failed to gather the information to do the assignment.

One day, a group of learners claimed that the cooking oil used to prepare food seems not to be pure because the taste and smell of the food indicates that it is not pure oil.

The teacher told them that this can be proved easily by use of the Hare's apparatus.

When a sample of oil in a beaker and water in another beaker was used, the results indicated that the oil column was 25mm while that of water was 20mm but the learners could not make any meaning out the results and failed to ascertain the oil purity.

In order to improve on the learning environment, every class has been provided with a new clay pot and a Jerrycan both containing drinking water. The learners observed that the outer surface of the pot was ever wet and the water in it was at a lower temperature than the water in jerrycan which they cannot explain.

The learners have contacted you for assistance.

Hint;

Density of pure cooking oil = 800kgm^{-3}.

Density of pure water = 1000kgm^{-3}

Acceleration due to gravity, g = 10 ms^{-2}.

Task:

Help the learners to

a) Understand the design and working of the instrument needed to determine the position of their classroom above the ground.
b) Understand the kind of cooking oil used.
c) Understand the cause of the difference between the water in the pot and in the jerrycan.

ELECTRICITY AND MAGNETISM

Item 1

When you visited your uncle in one of the developing towns in Uganda, you found when the authorities had ordered for the breaking and removal of all kiosks in a bid to clean and organize the town better.

The process left many sharp rusty metals and pieces of glass that have proved hard to pick and your uncle is wondering the method to use to clean the place.

Of recent the D.C motor of your uncle's grinding mill heats up so much and produces a lot of noise which is worrying your uncle. He does not know how it works and how its efficiency can be improved.

The uncle also realized that when 240V and current of 30A flows for 5 minutes in the motor, it does work of 2.7×10^6 J.

Your uncle has contacted you for help.

Task.

Help your uncle to understand

a) The design of the device that can be used to pick the metals and why it may not be suitable for removing the pieces of glass.
b) How the motor is able to spin the milling machine in one direction?
c) (i) The cause of the noise and how this noise can be reduced.
   (ii) The efficiency of the motor
d) Where the motors are used other than milling.

Item 2

In the absence of the physics teacher, learners of S.4 requested the administration to allow them have a close study of the generator. During their study, they noted that the A.C generator has terminals for both A.C and D.C out puts. The learners wonder how this can be made possible.

The officer in charge of the generator briefly informed the learners that it uses 10litres of diesel each containing 1760KJ of chemical energy stored in it to light 20 security bulbs each of 10W and 10 classrooms each with 4 bulbs of 5W each working in the night from 7:00pm to 6:00am. The learners failed to use the information to determine the efficiency of the system as they had wanted.

The learners also wanted to determine the expenses on electricity in one week in case a generator is not used for one week.

Hint

Each unit of electricity costs Shs.1000.

The learners have contacted for assistance.

Task;

Help them to understand;

a) The structure and how the device under study work.
b) (i) The efficiency of the system.
   (ii) The cause of the inefficiency of the system and how this can be improved.
c) The school expenses on electricity in one week.
d) Briefly describe two applications of the concept used by the above system.

Item 3

Mr. Mukasa, a poultry farmer in has recently hired a technician to design a modern automated brooder house for rearing day-old chicks which require a constant warm environment. If the room gets too cold below room temperature, the chicks huddle together, which can lead to suffocation, if it gets too hot, they suffer from heat stress and die.

The technician designed a diagram, **figure 1** showing the different components and their connection but left before explaining how it works and yet Mr. Mukasa would wish to understand how the system works. The technician advised Mr. Mukasa to replace the 2 pin plug with a fused 3 pin plug with a clear explanation. After 30 days Mukasa realized that the bulb in the system had been on for 100 hours and wonders how much it has costed him on his prepaid meter. He has approached you for assistance

Hint:

Each unit of electricity costs ugx.900

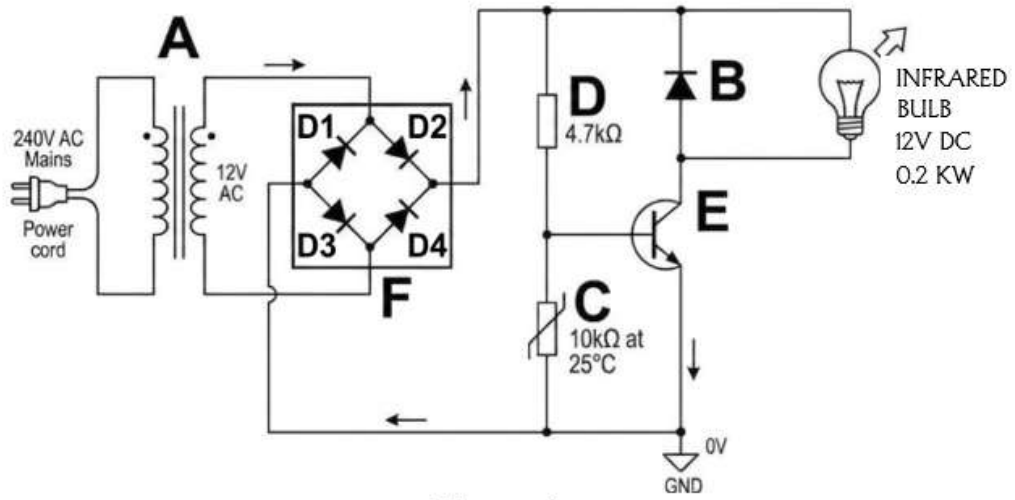

Figure 1

Task:

Help Mr. Mukasa to understand;

a) How the above circuit works by identifying and briefly explaining the use of each elect onic component A, B, C, D, E, and F in the circuit diagram.
b) Why the 3 pin plug is preferred and why it should be fused.
c) By briefly explaining how the entire system can achieve the intended objective.
d) The cost of operating the system for the 60 days

535/2/3 ITEMS 2026.

SET ONE

1. During a bicycle riding competition, the shock absorber of the Sports bike of your friend got damaged and the mechanic advised him to purchase a spring of force constant ranging from $60{,}000Nm^{-1}$ to $120{,}000Nm^{-1}$ to replace it. Your friend bought a spring of unknown force constant, so he needed to confirm if it is fit for replacement in the damaged shock absorber but didn't have the sufficient knowledge to do so, and approached you for help.

Hint.

The spring constant of the spring required to be replaced in the shock absorber is 3000 times that of the spring available in the physics laboratory.

Task.

You are provided with a spring from the physics laboratory; use it to advise your friend.

2. During a physics lesson, the teacher used a projector to display the information he was explaining to students, unfortunately one of the students accidentally destabilized the table where the projector was placed and it fell down. When the teacher was trying to put back the projector in position, he discovered that its' lens of power ranging from 8.0D to 12.0D got damaged and needed to be replaced. The teacher tasked the student who caused the damage to immediately go and buy the lens to be replaced in the projector. The student went to the shop and bought a lens but was not sure whether it was fit for replacement in the damaged projector.

Task

You are provided with a lens with similar properties as the one bought by the student, use it to advise the student.

SET TWO

3. Your parent is constructing a new house in the village and he was advised by the Engineer to buy a glass of refractive index ranging from 1.4 to 1.7 to fit in the windows. He went and bought glasses but was not sure if it was of the required refractive index, so he approached you for help.

Task.

You are provided with a glass block with similar properties as the glass material bought by your parent, use it to advise your parent accordingly.

4. During a Physics practical lesson, Mukisa, one of the students in the class broke a metre rule of mass ranging from 70g to 150g. As the school policy was, he was told to buy a similar metre rule to replace the broken one. Mukisa went and bought a metre rule but was not sure if it was fit for replacement of the damaged metre rule so he approached you for help.

Task

You are provided with a metre rule with similar properties as the one bought by Mukisa, use it to advise him accordingly.

SET THREE

5. Your uncle's flat iron got damaged and he was advised by the mechanic to purchase a resistance wire of resistance ranging from 10Ω to 65Ω to replace the damaged one. Your uncle purchased a resistance wire of unknown resistance and didn't have the sufficient knowledge to determine it, so he approached you for help.

Task.

You are provided with a resistance wire of similar properties as the one bought by your uncle, use it to advise him accordingly.

6. Keshara purchased maize flour to be used to prepare porridge for the family for breakfast at their home and its known that they need between 200g to 300g mass of maize flour to be mixed with soya and milk but on reaching home, the mother doubted if the flour was of the required mass, and needed to confirm but didn't have the sufficient knowledge to do so, so she approached you for help.

Task.

You are provided with a metre rule and an object whose quantity is equal to that of the maize flour purchased by Keshara, use it to advise her mother.

We have a destiny