THE SECOND ANNUAL NATIONAL O-LEVEL PHYSICS SEMINAR HELD ON 12TH JULY 2025 AT HOLY CROSS LAKEVIEW S.S.S, JINJA, AND ORGANISED IN CONJUNCTION WITH SEPTA

ELEMENTS OF CONSTRUCT AND THEIR CHAPTER BREAKDOWN

1. Physics 535/1 (Theory paper)

Construct: *Appreciates physics in everyday life*

Item	Element of construct	Topics covered
SECTION A: Compulsory		
Item one	**Understands how waves are generated, propagated, and their application in everyday life**	Nature of light; reflection of light at plane surfaces
		Reflection of light at curved surfaces
		Refraction, dispersion, and color
		Lenses and optical instruments
		General wave properties
		Sound waves
Item two	**Understands the structure of atoms, nuclear processes, and their application in everyday life.**	Atomic models
		Nuclear processes
Item three	**Understands solar system, galaxies, stars, satellites & digital communication in everyday life**	The solar system
		Stars and galaxies
		Satellites and communication
		Digital electronics (logic gates)
	SECTION B	
	PART I	
Item four and five	**Understands the effect of force and heat on the properties of matter**	Measurements in Physics
		States of matter
		Effects of forces
		Work, energy, and power
		Turning effect of forces, center of gravity, and stability
		Pressure in solids and fluids
		Mechanical properties of Materials and Hooke's law
		Linear and non-linear motion
		Temperature measurements
		Heat transfer
		Expansion of solids, liquids, and gases
		Heat quantities and vapors

Item Six and Seven	**Appreciates electricity and magnetism in everyday life**	**PART II**
		□ Magnets and magnetic fields
		□ Electromagnetic effects
		□ Electrostatics
		□ Introduction to current electricity
		□ Voltage, resistance and Ohm's law
		□ Electric energy distribution and consumption □ Digital Electronics (potential dividers)

NOTE:

- Section A will comprise of three compulsory items
- Section B comprises of Part I and Part II each having two questions and a learner answers one question from each part.
- In total five questions must be attempted by the learner.
- The paper is for 2 hours 30 minutes

2. Physics practical 535/2/3

Construct: Appreciates scientific investigation in physics

Item	Element of Construct	Sections
Item One or Two	**Appreciates Scientific Investigation in Physics**	□ Mechanics
		□ Optics
		□ Electricity

NOTE:

- The exam duration is 2 hours.
- There are two examination items in this paper.
- Students select one item from the options provided.
- The two items can cover either Mechanics and Electricity, Electricity and Optics, or Mechanics and Optics.
- Learners are encouraged to practice all three sections: Mechanics, Heat, Electricity, and Optics.
- Avoid focusing solely on specific themes, as any item may come from anywhere

SEMINAR ITEMS

Light and wave

ITEM ONE

During a market Survey, the entrepreneurship club members visited a newly open Supermarket where the shop attendant told them that they are experiencing minor thefts of items such as sweets, pens, perfumes, and many other items. The shop has one entrance, and the storage shelves are located at the corners of different sides of the shop. The attendant sits near the doorway. The investor has no money to install expensive CCTV Cameras, and yet the vice should be stopped. However, none of the club members had any idea of what should be done. When the club members visited one point along the bank of the Nile River, they noted that one boat was used to transport people across the Nile. It was also noted that when the boat is on one side of the river and it is needed on the other side, a whistle is used to call, and it takes 0.5 seconds for the sound to be received. The students wanted to know the estimated width of the river at that point, but no one had an idea. But one of the club members is your best friend.

Hint;

Speed of Sound = $340ms^{-1}$

Task:

Use your physics experience to:

a) Explain with the aid of an illustration the type of mirror that can be used to stop the theft, giving reasons for your choice

b) Explain any other application of the mirror used in (a) above

c) Help the learners in the club understand the width of the Nile River at that point.

d) Why is a whistle preferred over a direct call?

ITEM TWO

Your friend who is a S.3 learner visited his home village after some years and it was strange for him to realize that an old woman he used to be close to had difficulties recognizing him even when he moved closer to her, which was not the case before. During their discussion, the old woman told him that her sight challenge worsens every year. Because of her challenges, she could not pick water from far and decided to sink a deep well in her compound but the people working failed to reach the water table because of the hard rock they found but they must be paid for the work so far done at a rate of shs. 5000. per meter. The old woman and the people who worked failed to agree on how much they should be paid. When your

friend went to check on the hole dug, he kept on talking, but he could hear a similar sound coming out of the hole, which left him disturbed.

Hint

Speed of Sound = $330ms^{-1}$

The time taken to receive the echo was 0.36 s.

Task

a) Make your friend and the old woman understand her challenge and how it can be minimized.

b) Help her and the workers understand the exact amount of money that should be paid.

Nuclear and Atomic Physics

ITEM THREE

During a study tour to a small-scale gold mining site in one of the districts in Uganda, the learners talked to the local miners who happily told them that gold mining is a good venture, but many of them have failed to make noticeable developments because a lot of money they get is spent on treating themselves and the people in their homes. After all, most of them are always sick with different challenges. When the Learners visited the local health center, records indicated that many miners and people in the community complained of skin irritation, persistent fatigue, and unexplained sickness, such as nodding disease. On their way back to school, the learners picked some rock Samples from the site and, using a G-muller tube connected to a rate meter, they discovered that the rocks naturally emit radiations.

Hint

The data recorded from the rate meter is presented in the table below.

Count rate (per minute)	240	200	150	100	80	45
Time (days)	0	4	9	14	16	20

Task

As a responsible person, use your knowledge of physics to:

a) i) Explain to the miners to understand the cause of their failure to achieve the desired developments

ii) Explain to the miners how their challenges can be mitigated.

b) Use the data obtained to:

i) Determine the half-life of the element in the rock samples

ii) The count rate after 22 days

iii) Obtain other relevant information.

ITEM FOUR

The National Water and Sewerage Cooperation has recently experienced water losses because the volume of water supposed to be delivered from the source to the next city council has reduced. The managers suspect leakages in the main water pipe delivering water. The workers were instructed to mix 0.125 mg per litre of iodine-131 in the water and allow it to move along the pipe before the engineers could start tracing the leakage. The statement surprised the workers because they had no idea why they were doing it. The workers have been instructed not to supply water to the people until the mass of iodine-131 reduces to the recommended value of 0.02 mg per litre, which is the quantity naturally present in fresh water, without telling them when the water will be safe for drinking. While they were resting after the day's work, one of the workers told his friends that he had stopped using his TV with a CRT to one he called "Flat Screen" without explaining the difference between the two types.

Hint

Half life of iodine-131 is 8 days

Task

As a physics learner, use the available information to:

a) Explain to the workers how the leakage can be traced.

ii explain to the workers why iodine-131 is preferred.

b Help the workers know the period to be spent without supplying water to the public

c Explain the mode of operation of CRT-TV

Space physics

ITEM FIVE

In February 2020, farmers in the Karamoja sub-region received information through radio, TV, and SMS on their phones that (desert locusts) had crossed from Kenya and were leading towards Karamoja. The Government of Uganda together with FAO used satellites stationed 35,000km above an island
in Lake Victoria and other technologies to destroy the large swarms of locusts to reduce their destruction that could result into famine within a short time which left every one surprised. One of the officers working with the FAO used a van whose engine could only start if three conditions were satisfied: the switch was on, the seat

belt was fastened, and a thumb was pressed on a button. In a discussion, the officer from FAO told them that the security system uses logic gates but did not provide details to the group of people that were amazed by the nature of the vehicle.

Hint

The radius of the Earth is approximately 6300 km at the equator.

Task

Use your knowledge of physics to:
a. Explain to the locals how this would be bad destruction was reduced in a short time using the methods employed
b. understand the relative speed of the satellites used to overcome the challenge
c. Draw a single circuit diagram involving a logic gate and the corresponding truth table.

ITEM SIX

In a certain rural school, they have no electricity and therefore, teachers can't use projectors, charge phones or students can't read well in the evening because they use dim kerosene lamps. In one of the physics lessons, the teacher told them that the sun, which is in a plasma state and lies at the center of the solar system**, is the major provider of energy**. This surprised the learners, but the teacher never gave them a chance to discuss how this information could be useful in their schools. When the area MP visited the school, the learners asked him to find a way of solving their challenge of electricity by securing for them a solar system, but he
had little knowledge of it. Therefore, he challenged the S.4 learners, where you belong to find the size of the panel and battery in terms of watt-hour (Wh) that can power 4 LED lamps, each of 15W, and a small computer that uses 60W so that They can work for 5 hours each evening.

Hint:
1 Astronomical unit (AU)=149,600,000 KM
Speed of light =3.0x10 ms^{-1}
Average surface temperature of the Earth = 27 °C
Surface temperature of the sun = 5500°C

TASK:

Use your physics knowledge to:
a) Explain to your friends how energy in the sun is produced
b) Understand the statement the teacher made that surprised the learners.
c) Understand the average rate at which temperature is reduced from the sun to the earth.
d) Help the MP understand the power of the system he can secure for the school.

Mechanics and Heat

ITEM SEVEN

Two Senegalese tourists went mountain climbing in Uganda. They were warned before climbing that if they climbed higher than 43,000 meters, they might experience nose bleeding. At sea level, the barometric reading is 76 cmHg, while at the top of the mountain, it is 72.12 cmHg. They made tea and cooked some food when they got to the top, but they had trouble getting the food cooked. Given that 294kJ of energy was supplied to boil 1litre of water initially at 26°C, the Specific heat capacity of water is 4200/kg, Density of air is 1.2 kg m^{-3}.and the Density of mercury is 13600 kg m^{-3}.

Task: As a physics student, help the tourists to
(a) Know whether they will bleed at the peak of the mountain using the mathematical approach, and explain why?
(b) Determine the temperature at which the water boils at the top of the mountain and explain the implications of this on boiling.
(c) Design an instrument that could be used to measure the pressure of the atmosphere to be used by the climber to avoid the eventualities as they approached the top of the mountain. (Available apparatus: bowel, a one-meter-long glass tube, and mercury)

ITEM EIGHT

A visitor chose to stay in Uganda for a certain amount of time after visiting a particular hotel in Kampala. During his stay at the hotel, he complained that he could always sweat too much because the room he was sleeping in was hot during the day. The tea was served at 85°C, but he only drinks tea at a maximum temperature of 30°C, and the food was consistently delivered late. The hotel attendant was instructed to purchase a cooking appliance that speeds up the process of boiling water with a boiling point higher than 100°C and to use tiny ice cubes at 0°C to cool the tea to the proper temperature.

HINT

. Capacity of tea-cup=1/4 Litre
.Density of tea=1000kgm^{-3}
. Specific heat capacity of tea = 4200JkgK^{-1}
• Specific latent heat of fusion of ice, l_f = 334000Jkg^{-1}

Task: As a Physics learner, help the hotel attendant to:
(a) Understand the electrical appliance he should buy and how it makes cooking faster.
(b) Determine the mass of ice needed to reduce the temperature of the tea
(c) Understand the possible cause of hotness in the room during the day and suggest possible solutions to this challenge
(d)Explain to the tourist how sweating regulates the body temperature

ELECTROMAGNETISM & ELECTRICITY

ITEM NINE

A project of domestic house wiring (circuit) was shown and demonstrated on a large soft board with various electrical components and colored wires by group 1 during the school visitation for the purposes of disseminating their projects. Using two pairs of fresh, dry cells connected in series in a cell holder, an iron rod, and connecting wires with a resistance of 20 Ω, Group II members showcased and demonstrated a project to create an electromagnetic device for transporting metal scrap in recycling facilities. Since the cells had a limited lifespan, the device stopped working after a short time. But the parents were not scientifically knowledgeable about the students' projects, and one parent attempted to explain the failure of the device but failed to explain it clearly.

Task: As a physics student, help the parents to:
(a) Understand the color codes, main features of the circuit displayed, and their relevance in the circuit. (Include a clearly well labelled diagram)
b) Design of the device and methods to improve its strength.
c) How best can the cells be arranged to prolong their life span if a current greater than 0.70A could ensure its efficiency?
Hint: Emf of each =1.55V, and internal resistance =0.1Ω

ITEM TEN

A certain landlord recently finished constructing a block of 2 houses and consulted an electrician to connect the houses to the electricity grid. The electrician informed him that the voltage of the electricity needed to be stepped down from 13kV to 240V before connecting the house. This took sometime before it could be effected. The landlord became annoyed as he thought the electrician wanted to cheat him so he decided to

hire another person who promised to do the job and appeared to be cheaper. The houses were connected in a way that a breakdown in one house could affect all the houses. The tenants complained that the current was so low and some of their appliances could not work. The tenants have threatened to vacate the houses if the landlord does not address the problem. When all the appliances in the houses are connected, the effective resistance in all the houses are 10Ω and 12Ω. As a learner of Physics, use your knowledge of Physics to;

a) Explain to the landlord why stepping down voltage is required and how it is done.
b) Explain why stepping down process could be slow.
c) Show with evidence the modifications that could be made to ensure that more current flows in the houses

Practical items(535/2/3)

Item 1

A manufacturer is designing an electric heater whose efficiency depends on the resistance of the heating element from a nichrome wire. The heater is expected to produce an output of 1000w when connected to a 240v ac supply. As a learner of physics, find out the possibility of using the nichrome wire which is in the laboratory.

Item 2

The projector of the school has been brought to a workshop where you volunteer as a technician because its converging lens whose power is between 100D and 300D has got broken. Using scientific investigation, help the ICT teacher as a learner of physics to find out whether the lens available in the Physics laboratory can be used to fix the projector or not.

Item 3

Your friend has just bought a quarter kilogram of sugar from a shop keeper who she thinks has given her less sugar yet has no weighing scale but there is a standard mass of 100g. Using your knowledge of Physics and assuming the principle of moments applies, carry out scientific investigation to find out the right quantity of the sugar.

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