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O-LEVEL PHYSICS SEMINAR SLATED FOR 14TH JUNE 2025 AT NTUNGAMO HIGH SCHOOL

ELEMENTS OF CONSTRUCT AND THEIR CHAPTER BREAK DOWN

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 colour
		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
	SECTION B	
	PART I	
Item four and five	**Understands effect of force and heat on properties of matter**	Measurements in Physics
		States of matter
		Effects of forces
		Work, energy, and power
		Turning effect of forces, centre of gravity, and stability
		Pressure in solids and fluids

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		□ Linear and non-linear motion
		□ Temperature measurements
		□ Heat transfer
		□ Expansion of solids, liquids, and gases
		□ Heat quantities and vapours

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

2. Physics 535/2/3 (practical papers)

Construct: Appreciates scientific investigation in daily physics.

- This will consist of two items from any two of the themes, mechanics, electricity or light

SEMINAR ITEMS

PHYSICS 535/1 (THEORY PAPER)

LIGHT AND WAVES

ITEM 1

During the construction of a school main hall, one of the engineers was asked to raise challenges that could arise after the hall's construction, and they noted that; There could be a distortion of sound as a result of two sounds being heard, the hall could be dimly lit because of the paint colour used to paint the walls, irritating noise from the hall during events could immensely disrupt the peace of neighbours in the community especially at night, complaints could arise from the kind type of mirrors installed in the bathrooms and complaints would have risen from fears due to insecurity from not checking under cars

Task: As a student of Physics;

a) Explain what could cause the distortion of sound and structural adjustments that can be made to ensure the distortion is minimized.
b) How the amount of light intensity in the room could be improved.

c) With clear reasons, establish the type of mirrors that should be installed in the bathrooms and those that should be used to check under the cars.

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ITEM 2

The natives near a certain Resort presented a number of complaints to the owner and among them included; That the sound was too loud especially at night and could damage their ears. In response, he said that the sound from his music system was of wavelength 2.0cm which was not harmful. At the resort, entertainers had yellow costumes with black and red strips on their arms who could entertain customers at night in presence of disco lights flashing blue and green colours. The costumes kept on changing their appearance and this excited majority of the customers. One of them tasked his friend to explain what could be the cause of the above appearance of costumes.

Hint: Speed of sound in air =330 ms^{-1}

Task: As a student of Physics;

a) Explain why sound from the resort disturbs the natives at night than during the day
b) Determine if sound in the cinema was harmful to the ears of the clients given its frequency was 120 Hz.
c) Help your friend to explain the observations about the costumes.

ATOMIC AND NUCLEAR PROCESSES

ITEM 3

Locals in a certain mining area raised concerns about the discomfort in their environment. Many complained of severe fever and headaches which worried their leaders. A team of scientists sent to make a study reported that the back ground radiation in the area was 200 counts per hour. Their report also indicated that the area contained radioactive uranium that had had an activity of 6600 counts per hour inclusive of background rate and half-life of 2 days. On receiving the report from the scientists, the government ordered the locals to vacate their area and instructed them to return when the radiation levels from uranium falls below the background radiation.

Task: As a student of physics,

(a) Help the locals know the time they will have to wait before returning to their home area.
(b) Suggest the possible sources of background radiation
(c) State the environmental effects of Uranium-mining

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ITEM 4

At a national referral hospital, radioactive iodine, I-131 is used in treatment of thyroid cancer as the first dose. The data displayed on one of the radiation detector machines is shown below;

Activity (counts per min)	1000	800	640	510	410	330	260	200
Time (hours)	0	2	4	6	8	10	12	14

A patient is brought to the hospital for treatment. Unfortunately, the medical radiographer to identify the machine to use is absent. He left a note that the second dose should be given when its half-life is less than 8 hours. If the medical intern offers to carry out the treatment but does not recall what half-life means.

Hint: For safety, the radiation level from the machine should be equal to 250 counts per minute for treatment to be commenced.

Task: As a student of Physics;

(a) Help the intern doctor to determine when the second dose will be given to the patient

(b) Establish the time he has to wait before commencing the treatment.

ITEM 5

In a bid to obtain alternative sources of energy world-wide, a number of nuclear plants have been constructed to provide a cheap source of electricity. One evening a woman was watching international news on BBC and the news reporter said that nuclear plants use radioactive substances such as Uranium as the fuel and it reacted as shown below;

$$^{235}_{92}U + Z \rightarrow {}^{144}_{56}X + {}^{90}_{36}Y + 2{}^{1}_{0}n$$

The woman could not tell how it was possible to get electricity from Uranium.

Task; As a student of Physics, help the woman to:

(a) Identify Z in the reaction and establish whether an element $^{139}_{56}W$ was an isotope of element X.

(b) Establish how such cheap electricity would be obtained (Explain using a well labelled diagram).

(c) Identify the dangers associated with such radioactive substances and how they can be handled

EARTH AND SPACE PHYSICS

ITEM 6

Joan whop stays in Kampala decides to call her aunt who lives in Sydney at 5:00pm. Her aunt asked her why she was calling her in the middle of the night. Joan was surprised to

know how it could be day time in Kampala and night time in Sydney. At the same time, her mom was watching London marathon live from their sitting room which surprised her the more.

Task. As a student of physics, help Joan to understand;

a) How it can be day time in Kampala and night time in Sydney
b) How an event in one country can be broad cast live in another country.

ITEM 7

Tourists leaving America in the month of December due to extreme coldness got surprised when they found too much heat in Uganda and were interested in knowing why it happens like that. On their way, one of the young tourists observed stars of different colors and wondered their brightness, and what makes them shine brightly.

Task: As a learner of physics,

a) Explain to the tourists what causes the difference in the weather between the two places.
b) Help the young tourist understand why stars have different colours and brightness and what makes them shine brightly.

HEAT AND MECHANICS

ITEM 8.

While loading passengers, the bus driver told his conductor to refill engine water level and passengers to put their luggage at the bottom and fasten their belts but some of them didn't like the advice as they wanted to put them at the top rack and also feel the vibe without seat belts. The conductor also wondered why the water was again used in the engine. As the bus was moving at $\mathbf{79.2}\boldsymbol{Kmh^{-1}}$, the driver saw was approaching a a police warning sign post **441.5m** away, he applied the breaks for **40 seconds** to stoppage. Police traffic officer wanted to fine the driver accusing him of knocking the signpost but the driver insisted he didn't.

Task:

Using your knowledge of physics, clear the conductor and passenger's queries and also clear the wrangle between the driver and police traffic officer.

ITEM 9

A mother went to buy the following items

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1	A metallic spoon with a plastic handle
2	A percolator (electric kettle) labelled $\mathbf{240}\boldsymbol{V}, \mathbf{3000}\boldsymbol{W}$ with a capacity of $\mathbf{2}\boldsymbol{l}$, with plastic casing
3	A stainless-steel sauce pan, **deeper** than its **width** with a lid.

A mother was disturbed with the design of the utensils above and also wondered whether the electric kettle above could boil the water initially at an average temperature of **25**℃ within at most **5 minutes** since it's only the time she always had to prepare the tea. The shopkeeper said dint know but he knew is that the time required by the liquid to boil would depend on its **specific heat capacity,** which the mother still didn't know.

Support material:

- The density of water is $1000kgm^{-3}$ or $1gcm^{-3}$
- Specific heat capacity of water is 4200 $Jkg^{-1}k^{-1}$

Task

As a student of physics:

(a) Help the caterer appreciate the materials used to make the utensils.

(b) Advise the mother whether the kettle will serve the purpose.

(c) Help the mother know more about the factor that the shopkeeper said it affects the time to boil and describe a clear experiment to find that of water.

ITEM 10

A mountain climber has a competition at exactly 08:00Am, and wakes up at **7:25am**. He finds no water and decides to get $500g$ of ice in fridge at −3℃ as he is in a hurry and heats it using a $\mathbf{1270.5}\ \boldsymbol{W}$ heater to boiling as tea.

He takes 25 minutes after boiling tea and then sets off using a bike at a uniform speed of $20ms^{-1}$ to the starting point $3km$ away from home. On briefing he was told at the top of the mountain they would feel an atmospheric pressure of $\mathbf{738.9}\boldsymbol{mmHg}$ less than that on the ground $\mathbf{780}\boldsymbol{mmHg}$, which he so much wondered and wanted to prove

Support material

- Density of air is 1.25kgm-3
- Specific heat capacity of water is 4200 $\mathbf{JKg^{-1}K^{-1}}$
- Specific latent heat of fusion of ice $3.36X10^{5}Jkg^{-1}$
- Specific heat capacity of ice 2100 $JKg^{-1}K^{-1}$

- Density of mercury $13600kgm^{-3}$

Task

(a) Using a suitable graph, explain to the student the different phases ice under went

(b) Advise the student whether he will reach in time for the competition and let him know the distance he will climb to reach the top of the mountain.

ELECTRICITY AND ELECTROMAGNETISM

ITEM 11

A business man who operates a laundry business in one of the main trading centres in our district was charged ***Ugx 300,168*** and is challenged with this high electricity bill every month and feels cheated. He claims to operate ***two*** flat irons rated ***1200W*** for ***2*** hours per day, a washing machine -***2200W*** for **3** hours per day and **3** bulbs rated ***100W*** for ***10*** hours per day. He thinks the rotating device in the washing machine(motor) over consumes power and therefore wishes to know how it operates.

Task:

As a learner of physics,

a) Help the business man to know if he was being cheated or not given that unit cost of electricity is ***Ugx 750.***

b) Explain to the business man to the how the rotating device in the washing machine works

c) Advise on the possible means these costs can be minimized.

ITEM 12

The local leaders in a certain town plan to replace the available transformer and thick transmission cables as recommended by the committee to meet the power demands in the developing town. However, some officials claim that the available transformer isn't just efficient enough due to energy losses but can still meet the power demands if a technical team is hired to improve its efficiency.

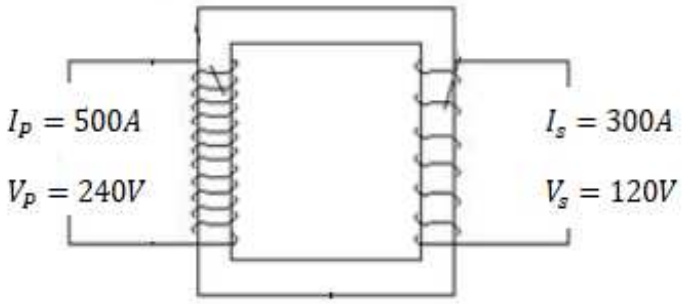


Fig 1 showing the available transformer

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Task: As a learner of physics

a) Help the local leaders to know how efficient their transformer is.

b) Explain to the local leaders

(i) Why thick transmission wires are preferred?

(ii) The possible causes of inefficiencies in the transformer and the possible ways they are likely to use to improve its efficiency.

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ITEM 13

Traditionally, some societies believed thunder and lightning to be a punishment and dissatisfaction from the gods or a curse from ancestors. They therefore offered sacrifices of living animals pleading to the gods or ancestors to forgive them and also as a way of chasing thunder and lightning curse.

However, this seemed to have been a wrong approach due to misconception they had because thunder and lightning persistently occur even to date evidenced with the demolishing of the church structure by thunder and lightning recently.

Task: As a learner of physics,

(a) Clearly explain

(i) The misconception they had on their occurrence

(ii) How the church structure can be safe guarded not to be demolished on the same cause.

PHYSICS 535/2/3 (PRACTICAL PAPERS)

ITEM 14

An architect was tasked to design a 13 – storey commercial house along one of the busy streets in a town. According to the architect, the design consideration of the structure takes into account the force of gravity acting on each part of the house so as to ensure long term stability after construction work is completed.

Gravity acting on the building depends on acceleration due to gravity whose value at the proposed site of the house is in the range $9.8ms^{-2}$ to $10ms^{-2}$.

Task:

As a student of physics working closely with the architect, carry out a scientific investigation to determine the gravitational strength at the site where the commercial house will be erected.

ITEM 15

A group of scouts went on an expedition to a remote desert location. Upon arrival, they realized the need to set up a camp fire so as to cook some of the raw food they had carried along. Unfortunately, none of the scouts remembered to carry afire starting tool like a match box or cigarette lighter. However, one of them had a magnifying glass which when directed towards to the sun could set the dry grass on the ground on fire. The scouts didn't know whether to place the magnifying glass at 15.0cm or 20.0cm above the dry glass in order to start the fire.

Task:

As a learner of physics, carry out a scientific investigation to determine the distance from the dry grass on ground where the magnifying glass could be placed in order to start fire.

ITEM 16

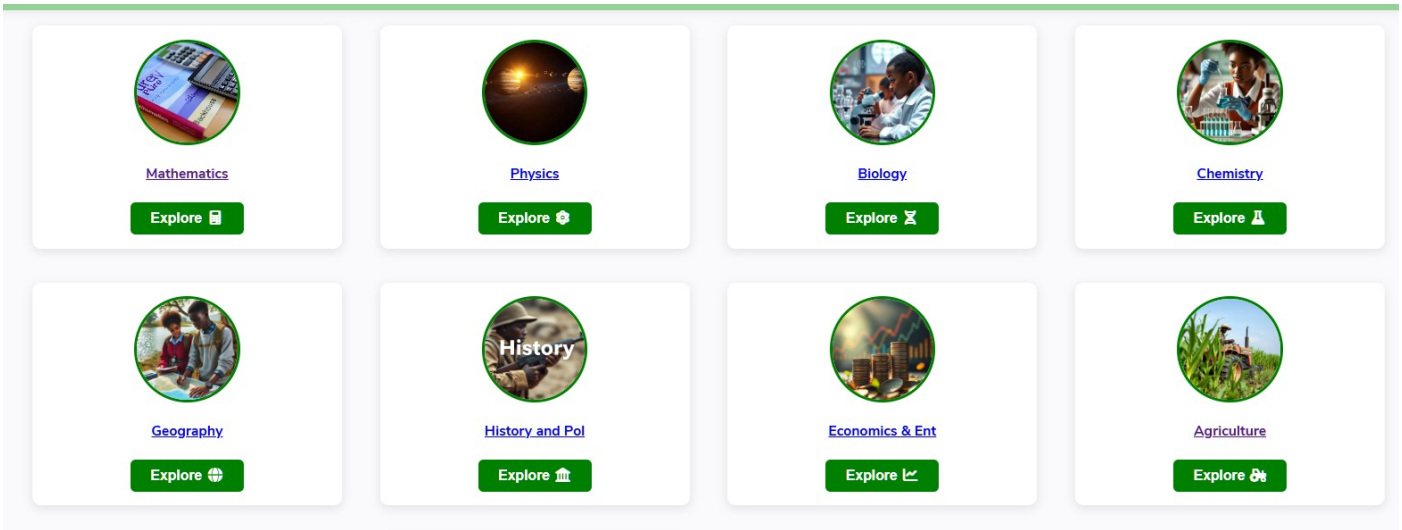
A wholesaler dealing in dry cells checks their quality by considering their internal resistance to be to the maximum of 0.5Ω after manufacturing for a good quality otherwise they are of poor quality. The wholesaler receives the consignment but the person in charge of checking their internal resistance is away and the wholesaler is challenged whether the cells are of good quality.

Task: As a learner of physics, help the wholesaler to ensure that the purchased dry cells are of good quality.

END

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