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O-LEVEL PHYSICS SEMINAR SLATED FOR 21ST JUNE 2025 AT

ST JOSEPH OF NAZARETH HIGH SCHOOL KAVULE-KATENDE-MPIGI

IN CONJUCTION WITH SEPTA

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 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
	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, center of gravity, and stability
		☐ Pressure in solids and fluids
		☐ Mechanical properties of Materials and Hooke's law
		☐ Linear and non-linear motion

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		☐ 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

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
		☐ Light
		☐ 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 light or Mechanics and light.

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- Learners are encouraged to practice all three sections: Mechanics, Heat, Electricity, and Light.
- Avoid focusing solely on specific themes as any item may come from any where

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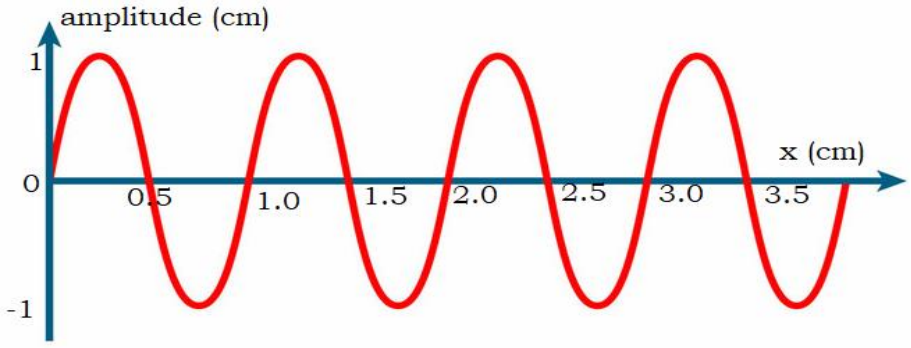
SEMINAR ITEMS

SECTION A

ITEM 1

Learners of S.4 visited Kasenyi landing site and made critical observations which seemed unusual to them without valid scientific reasons. They observed the following;

- A magical pool of water along the way to the landing site on a tarmac road.
- The fish in the water appeared nearer and bigger than when outside.
- A stand-by computerized system housed on the lake shores for recording the nature of waves on the lake so as to alert the fishermen whether the lake was safe for fishing.
- A radar that emits radio waves to aid in search and rescue of vessels in distress.



The figure above shows a wave form from a computerized system

Hint:

- The frequency of the computerized system was, $f = 180\ Hz$, and fishing would only continue if the velocity of the water waves in the lake was less than $7.2\ kmh^{-1}$.

Task: As a learner of physics; assume that the learners have approached you for help with the above information;

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(a) Explain to the learners to understand the observations above.

(b) Establish whether fishing was possible on that day.

(c) Explain the properties and applications of the electromagnetic waves used by the radar.

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ITEM 2

One weekend during a premier league match, parents observed that their son always watched the matches on a plasma TV at a close range only. This made the parents concerned about their son's sight and they visited medical personnel who recommended that the student should wear eye glasses with power in the range of (5D-10D). While in hospital hall, they heard sounds of crying patients from the next room which was with closed door and this left them wondering how they sound was able to reach them.

Task: As a learner of physics help the students to;

(a) Explain the cause of such a sitting arrangement and the possible measures taken to correct the situation.

(b) Explain how sound waves were able to reach them despite crying patients being in a closed door.

(c) Establish if the student's sight was restored if he was given an eye lens of focal length, *f=10 cm.*

ITEM 3

Residents from a nearby village complained of too bright laser light from a night club which was situated about 8 miles away, they claimed that laser light could be dangerous to their eye. In response, the management of the club said the normal bulbs had been replaced by laser lights which produce light of wave length **532*nm*** which is safe to use. Inside the hall, disco lights flashing red and blue light were used and the performers were putting on costumes made of white T-shirts and yellow hats on their heads. The appearance of the costumes kept on changing in presence of disco lights and this surprised the audience and they wondered how such incidence can happen.

Hint; 1nm = 1 x10^{-9}m.

The use of lasers above 7.5 X 10^{14} Hz is not acceptable.

Task; Use your knowledge of physics to;

a) Determine if the light from the newly installed lights were dangerous.
b) Explain why light from the lasers could reach further than that from the normal bulbs.
c) Explain why the appearance of costumes kept on changing.

ITEM 4

A girl was in her father's car going for a Family-Day-Out in Jinja. The weather was hot and the sky was clear. She bought a curved mirror from a hawker who was passing by to see if her makeup was still on, and got surprised by the big-size and the nature of her ear ring when the mirror was further moved closer to herself. She tried relating the incidence to the driving mirrors fixed onto the car but she got confused more because of the difference in the size & appearance of the images. Along the way, she switched on the car radio but the signal of frequency **93.3MHz** was not clear. At night, on their way back home she again switched on the radio but this time the signal was very clear. When she reached home, she immediately called her friend to share her experiences.

HINT:

- Velocity of radio waves is $v = 3.0x10^{8}ms^{-1}$
- Hawker's curved mirror had focal length of , $f = 15\ cm$
- The girl's ear ring was of height, $2\ cm$ placed $9\ cm$ in front of a hawker's curved mirror.

Task: As a learner of physics help the girl to;

(a) Identify the type of mirror fixed on her father's car & show how it forms its images.
(b) Use the information provided above to come up with a scale ray diagram to determine the distance of the image of the ear ring from the mirror.
(c) What advice can you give the girl so that she can clearly see herself irrespective of the position of the mirror.
(d) (i) Explain the behavior of the radio signals during her travel.

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(ii) Know the suitable wavelength at which the radio was broadcasting.

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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; 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

ITEM 6

Natives of a certain area complained of severe fever, sudden loss of hair and headaches which worried their leaders. The local authority of the area contacted the government and a team of scientists were sent to make a study about the area. After the study, they 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 an activity of 6600 counts per hour inclusive of background radiation and half-life of 2 days. On receiving the report fr om 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.

Hint: The area was being utilized as a Uranium mining site.

Task: As a student of physics,

(a) Help the natives 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.

ITEM 7

At a national referral hospital, radioactive iodine, I-131 is used as the first treatment of thyroid cancer. For the first treatment to commence the radiation level from the machine should be equal to 250 counts per minute

The data as monitored and displayed on 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

Ater the treatment the patients are informed that the second treatment (Therapy) will be done using a machine that produces x rays radiations but this worried the patients that the radiations could be dangerous. The hospital counsellor told them not worry but they are not convinced.

Task: As a student of Physics;

(a) Explain how the radiations used in the therapy are produced.

(b) Explain to the patients the measures that the hospital staff puts into place to ensure safety of patients during treatment.

(c) Establish the time the patient has to wait before commencing the treatment.

ITEM 8

An electrician was contacted to construct an automatic switch for a home fan and he presented his construction model as illustrated below:

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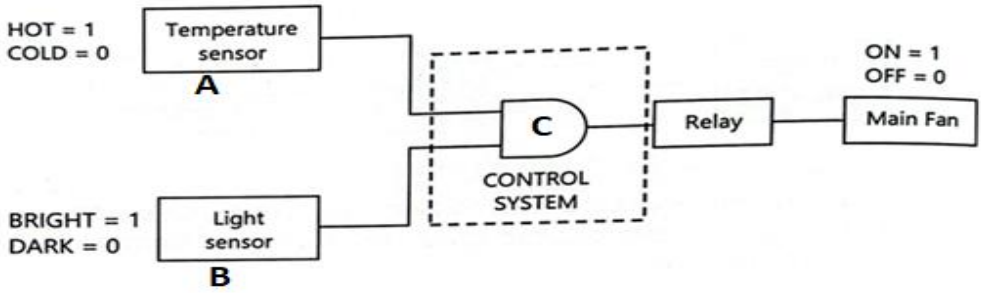

Fig. 2 shows a control system from the electrician

Her elder son with some knowledge of Logic gates who was at home by the time of construction of the control system called her mother who was in Switzerland using his mobile phone to inform her that the control system had been improperly installed, stressing that it should have the following combination of logic gates which was slightly different from what the electrician had used in the control system.

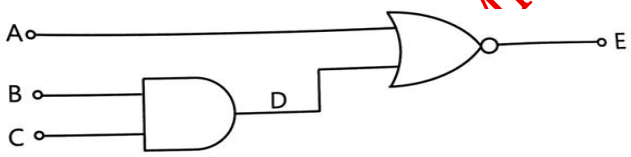

Fig. 3 shows a control system from the son

Task: As a student of physics;

(a) Under what circumstances would the home fan operate after installation by the electrician.

(b) Identify instruments in everyday life where such gates are applied.

(c) Construct a truth table for the logic circuit presented by the;

(i) The electrician

(ii) The son

ITEM 9

Students of physics were availed with data collected over a certain period of time all around the globe and they noticed the following.

- Some places having day time other places were having night time.
- Various places were having different weather seasons throughout the year
- that the earth is about 149,600,000km from the sun and it takes 365 days to complete one revolution

During the lesson, they were informed that the relative motion of the planets leads to occurrences of these events. At the end of the lesson, they were left with an assignment to list all the planets in the solar system in their order and explain how the relative motions lead to the occurrence of events above. However, your friend missed the lesson and had no idea on how to attempt the assignment

TASK: As a physics learner use your knowledge of physics to;

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a) Help your friend to attempt the assignment clearly explaining the causes of the trends in the data that was collected.
b) Explain to your friend to estimate the average speed of the earth stating any assumptions made.

ITEM 10

A group of tourists visited temporal Nasa station organized for public viewing of solar eclipse in different parts of North America that happened recently. They wondered how people at NASA use satellites to study weather patterns and such events are predicted to occur.

They were cautioned to use solar glasses to be able to view the eclipse safely since it shinning bright. At night, they were happy to see a number of stars in the sky that appeared with different colours and shone differently. Given the high temperatures of the sun during the day, one of the young tourists was curious to know how the sun produced such energy and why stars have different colours and appear to twinkle.

Task

Use your knowledge of Physics to

a) Explain how this particular type of eclipse occurs.
b) Explain what determines the colour and brightness of the star and why they appear to twinkle.
c) Explain the source of energy of the stars such as the sun and explain why solar glasses were necessary.
d) Explain how people around the world are able to view eclipse in real time.

ITEM 11

During bicycle competitions in a forested and mountainous areas, one of the riders lost his way out. Fortunately, he had a smartphone and called one of his friends but could not give the exact location to the friend. The friend told him to turn on the GPS on his phone. The GPS instantly gave him his exact location and the exit routes and this surprised him.

When they came back to the camp, during a movie night, they all observed rising and falling water levels on the TV. That same night, the moon was very bright and at the same time, so many stars were shinning in the sky which surprised them. One of them had no knowledge about earth and space physics was confused and could not understand those occurrences.

Hint: The GPS receiver is at a distance of 35786km from geostationary orbit and the signals travel at the speed of light.

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Task: As a learner of Physics, explain;

(a) How GPS was able to locate his position and how long the signals take to reach the receiver.
(b) How communication between him and his friend was possible.
(c) State other uses of satellites in our daily lives.
(d) How variation in water levels is brought about and their importance to mankind.
(e) Explain the origin of shining stars observed in the night sky?

SECTION B

PART I (MECHANICS & HEAT)

ITEM 12

Two hunters A and B supply meat to a certain butchery on daily basis. They use a uniform wooden pole of length 2m and weight 50N to carry their meat. On a particular day they had to supply 50kg of meat to a nearby butchery and it was tied at 50cm mark from one end of the pole. The hunters felt great tension at their shoulders as they carried it and they wondered why the pole didn't break despite the heavy load which was being carried using it for some time. When they reached home, the butcher had sent a complaint that they delayed the supply and they had to deliver the meat in the next 30minutes. However, they were hungry and one of then urged that 10 minutes are enough to move from home to the butchery, so they agreed to first prepared part of the meat using an electric air-frier rated 750W and eat. If the heat capacity of meat being cooked is 16.5kJK^{-1} and the meat will get ready if its temperature raises by 120^0C

Task: As a physics student help the hunters to:

(a) Know why the wooden pole did not break.

(b) Determine the forces that caused pain at their shoulders.

(c) Establish whether the hunters will able to deliver the meat in time if they consider eating first.

ITEM 13

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Two tourists from America visited Uganda and went for Mountain climbing. Before climbing they were briefed that they should be aware of nose bleeding if they climbed beyond 43000 cm height. The barometric reading at sea level is 76cmHg and at the top of the mountain is 72.12cmHg. When at the top they decided to make some tea and cook some food however they faced difficult getting the food cooked.

Given that 294kJ of energy was supplied to boil 1litre of water initially at 26^0c, the Specific heat capacity of water is $4200\,Jkg^{-1}K^{-1}$, Density of air is$1.2kgm^{-3}$ and Density of mercury $13600kgm^{-3}$.

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 implication of this on boiling.

(c) Design an instrument that could be used to measure the pressure of the atmosphere to be used by climber to avoid the eventualities as they approach the top of the mountain. (Available apparatus; Trough, one-meter-long glass tube, and mercury)

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ITEM 14

A certain driver set-off from his work place with a uniform speed of $20\,kmh^{-1}$ for 1.0 hours. As he approached the traffic light, he decelerated to $15kmh^{-1}$ for 0.5 hours after which he accelerated to $30kmh^{-1}$ for 1.0 hours. To his surprise, the car started to decelerate uniformly to rest in 0.5 hours due to lack of fuel and heavily loaded mini-bus by passed him with lots of luggage on top of its roof rack which greatly affects its stability. He attributed this mess of abrupt stopping to the petrol station attendant who might have cheated him yet he paid him money for full tank re-filling. However, when the mechanic came to inspect the car, it was found out that the tyres were hot and almost at the verge of bursting if the journey was to be continued.

Hint:

- Capacity of the car's fuel tank was 20 litres.
- Car consumed $\frac{1}{4}$ litres of fuel per km.

Task: As a learner of Physics;

(a) Prove whether the driver was cheated by the fuel attendant.

(b) Explain how the stability of the by-passing vehicle can be improved.

(c) Explain using Kinetic theory, why the car tyre would burst if the journey was continued.

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ITEM 15

A lorry of mass 3.5 tonnes collided head on with another stationary salon car of mass 1.5 tonnes which was parked by the roadside. Nearby traffic officers rushed to the scene & found out that; the lorry had worn out tyres and hot engine surface in one of the engine components. The engine was dissipating heat to the surrounding at a rate of 10 kW that would cause a temperature raise of $30^0\ C$ per 1.05 minutes. The driver was ignorant about the amount and a particular kind of liquid to be added in the engine component to cool it down. They also found out from the speed detecting camera that the lorry and the salon car moved at a speed of $20\ ms^{-1}$ and $15\ ms^{-1}$ respectively after the impact but they could not retrieve the initial speed of the lorry to determine if it was over speeding or not.

Hint:

- SHC of liquid = $4200\ Jkg^{-1}K^{-1}$
- Speed limit was $60\ kmh^{-1}$ along the road.

Task: As a learner of Physics;

(a) Explain to the driver the type of liquid that he needs to use to cool the engine

(b) Help the driver to determine the amount of liquid that he needs to put in the radiator so as to maintain good temperature conditions of the engine

(c) Help the traffic officers to determine if the loaded lorry was over speeding hence identify the type of collision between the lorry and the car.

PART II (ELECTROMAGNETISM & ELECTRICITY)

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ITEM 16

Various Physics projects were displayed on V.D and; Group I members, displayed & demonstrated a project of domestic house wiring (circuit) on a big soft board with different electrical components and colored wires. Group II members, displayed and demonstrated a project of making an electromagnetic device for carrying metal scrap in recycling plants using 1 pair of fresh dry cells connected in series in a cell holder, an iron rod and connecting wires of resistance 2Ω. The device malfunctioned after a short period of time due to short life span of cells. But parents did not have scientific knowledge about the learners' projects, and one parent tried to explain why the bulb dimed but his explanation was not clear.

Task; As a student of Physics help the parents to;

(a) Understand the color codes, main features of circuit displayed and their relevancy in the circuit. (Include a clearly well labelled diagram)
(b) Design the device and how its strength can be improved.
(c) How best can the cells be arranged so as to prolong their life span if, the current is greater than **0.70A** could ensure its efficiency.
Hint: **Emf of each cell = 1.50 V**, and **internal resistance = 0.1Ω**

ITEM 17

Your brother went to the salon to trim hair, and he noticed that; there was a new electric fan and, on its box, had markings ***(75W, 240V)*** when he looked up it was fixed in the ceiling of the salon and it had rotating plastic rods. He wondered what the figures meant and how the rods are able to rotate swiftly. On his way back home, dark clouds gathered, a thunderstorm suddenly broke out while children were playing under the trees. The thunder roared and an electric discharge flashed across the sky. Suddenly, it struck a tree near across the road, causing fire, panic and shock. Fortunately, no one was hurt, but everyone was frightened.

Task: As a student of Physics help your brother to;

(a) Identify the electromagnetic device that supports the "rods" and how it operates.
(b) Explain the of the labels on the electric fan box.

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(c) Assist the community to understand how such a phenomenon occurs and how their property can be protected from it.

(d) Suggest other safety measures (precautions) the people in the community can undertake to limit the effects of such an occurrence.

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ITEM 18

Nahya received gifts from her USA donor which included a radio with an input label of **3A**, **360W**. She was advised that the radio could not consume directly from her socket connected to the 240V mains in Uganda and required to use a **device** that would help **step down** the voltage, which she planned to make with consultations. Nahya contacted the technician and got a soft iron core that would hold a coil with a maximum of **80 turns**. Nahya planned to use the radio in for 45minutes per day for the two full weeks she would be in holidays as well as **three**, **7W** bulbs for 5 hours per day for the two weeks but does not know whether the electric energy she has will be enough since her submeter (yaka-meter) only reads $\mathbf{5.65}\ \boldsymbol{kWh}$**.**

Task: As a learner of physics;

(a) Use a labelled diagram, help Nahya understand the operation of the required device.

(b) Guide Nahya more on the possible distribution of the turns in both coils of the device.

(c) With clear mathematical computation, help Nahya know whether that prepaid electrical energy will be sufficient.

(d) As a learner of energy consumption and distribution, advise Nahya on the **precautions** and **good saving practices** of the energy in use above.

ITEM 19

During a physics lesson, a group of learners were given the following apparatus and required to use them to ascertain the best circuit that would give the highest current flow in regards to the arrangement of resistors and also use them to verify ohms law. connecting wires, a voltameter, an ammeter, a 9V battery and two resistors of 3Ω and 4Ω, a switch, a rheostat.

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When one of the learners connected to form a circuit, the ammeter deflected in opposite direction and also the nearby compass needle deflected when a bicycle spoke was connected in the circuit and placed near it. This confused them more since they couldn't get a scientific explanation. They continued trying in vain until lunch time when an electromagnetic device was sounded.

Task: As a student of physics; Help the group

(a) With reasons, design for them a working circuit and clearly explain to them how to use it to prove the required law.
(b) Appreciate the different ways they would arrange those resistors and which of them would give much current.
(c) Why the ammeter deflected in that direction.
(d) Know the cause for the deflection of the compass needle and any possible application for such phenomenon.
(e) Know the operation of the device that was sounded during lunch.

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PAPER 2 & 3

PRACTICAL ITEMS

ITEM 20

An investor owns a factory that manufactures gum boots. He buys rubber at sh 500 per kilogram. A girl collects 1000 rubber bungs whose masses are in the range 50 g – 100g inclusive as required by the investor. The girl would like to know how much she can earn from the sale of one rubber bung but has no weighing scale to measure its mass.

Task:

As a student of physics, carry out a scientific investigation to help the girl determine how much she can get from the sale of one rubber bung.

ITEM 21

A student had a problem of seeing near objects clearly. When he went to an optician he was told to buy spectacles to aid his vision. Unfortunately, the glasses fell down and the lens in the glass broke. he decided to visit the nearby eye clinic but did not know the focal length of the lens in his broken spectacles

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The broken spectacles had a lens whose focal length was in the range 9.0cm – 11.0cm. You have been provided with a lens similar to the one that got broken in the student's spectacles.

Task:

As a learner of physics, carry out a scientific investigation to determine whether the lens bought can be used to replace the broken one.

ITEM 22

A wholesaler dealing in dry cells checks their quality by considering their internal resistance to be 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 know whether the dry cells delivered are of good quality.

HINT: {***Include the following in your report: Aim, variables (Independent, dependent and controlled), hypothesis, Procedure, Errors anticipated, Precautions to mitigate the errors, Present data accurately (at least 5 sets), Analyse data (using graph) and advice/recommend***}.

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SECONDARY PHYSICS TEACHER'S ASSOCIATION(SEPTA) EXTENDS GREAT THANKS TO THE PHYSICS DEPARTMENT TEAM OF ST JOSEPH OF NAZARETH HIGH SCHOOL

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END

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