THE GRAND PHYSICS SEMINAR HELD AT VISION FOR AFRICA HIGH SCHOOL NAKIFUMA ON 13TH JULY 2024

UGANDA CERTIFICATE OF EDUCATION
535/1 PHYSICS PAPER 1
THEORY

SECTION A

THEME: LIGHT AND WAVES

TOPICS:	
LIGHT	**WAVES**
Nature of light; reflection of light at plane surfaces	General wave properties
Reflection of light at curved surfaces	Sound waves
Refraction, dispersion, and colour	
Lenses and optical instruments	

Item 1

One hot afternoon some learners walked along a tarmac road in the west ward direction to check on a new swimming pool. On the road, they saw a speeding car at a distance and its engine sounds kept on reducing as it moved further away. They also saw what looked like water near the car; but the water disappeared when they reached the spot where they had seen it and it reappeared to another spot ahead. Later on, the weather changed and there was a light drizzle though the sun was still bright. In the Eastern direction, they observed a semi-circular distribution of colours in the sky. They finally reached the swimming pool; however the pool-attendant warned them to be careful when they are to use the swimming pool because it may appear shallow when filled with water. The adventure ended in arguments because the learners had different views about the observations and experiences they had that day.

Task

Use your knowledge of physics to assist the learners to understand:

(a) why the sounds they heard from the car kept on reducing?

(b) the process that leads to what they observed on the tarmac road.

(c) the process that leads to what they observed in the sky.

(d) why swimming pool appears the way the attendant told them?

Item 2

During the music gala in a hall, one of the adjudicators observed the following;

- On entering the stage, the colour of dress of one presenter changed from a yellow dress with red dots to a red dress with black dots.
- The sound from the nearest loud speaker reached him after 0.05s.
- She kept on hearing voices of two people singing on stage, yet there was only one person on the stage.

Hint: *Speed of sound in air =320 ms^{-1}*

Task

Using the knowledge of Physics, help the adjudicator to understand;

(a) Why the colour of the dress changed.
(b) Why the sound was reaching her after 0.05s.
(c) The origin of the second voice and how it can be minimized.

Item 3

A tycoon is to construct a first-class hotel and as he consulted from the technical personnel, the following guidelines on facilities he wanted to set up were given;

- The swimming pool should have a label of its depths at different points to avoid relying on a deceptive look.
- The multipurpose hall must have a soft wall or it must use curtains along the walls.
- Each entrance should strictly have white lights as the inside of the hall may have other LED lights for decoration.
- The security personnel should have devices to check under the cars entering the hotel, as a way of ensuring hotel security.

The tycoon is not knowledgeable about the importance of such guidelines in his upcoming investment and is seeking for explanations.

Task

Using the knowledge of physics, help the business man understand;
(a) the cause of deceptive look.
(b) the reason behind multipurpose hall having a soft wall and curtains.
(c) why the entrance must have white lights and how decoration on individuals is attained from inside the hall.
(d) which kind of ***materials*** are needed in making the devices to be used while checking ***under*** the cars entering the hotel.

Item 4

In a town, there is a woman who uses loud horn speakers to broadcast various information to the community. She has received the following concerns from the members of her community;

- Listeners at different locations have noticed a difference in time in which the sound reaches them.
- People who are at far distances are unable to receive the information broadcast by the speakers.
- People are complaining about too much noise from the speakers, some of whom are not interested at all in what is being broadcast.

Because of those concerns, the town council leadership has advised the woman to set up a radio broadcasting station and the broadcasting authorities allocated her a radio frequency of 87.8 MHz. She is ready to take up the advice, only that she lacks enough knowledge to guide her more.

Use: *Speed of light in air = 3 x 10^8 ms^{-1}*

Task:

Using your knowledge of Physics, assist the woman to;

(a) differentiate between the type of waves produced by her current system and those to be produced in the system proposed by the town council leadership.

(b) understand why the new method of broadcasting will not cause a problem of noise pollution.

(c) understand why the new system of broadcasting is able to reach those who are far away and they get the broadcast almost instantly.

(d) determine wavelength of the waves used in broadcasting in the new system.

THEME: MODERN PHYSICS

TOPICS:	
Atomic models	
Nuclear processes	
Digital electronics	

Item 5

A government has constructed an underground pipe to transport its oil over long distances. When tested, the pipe is suspected to leak in a 100 m section and the leakage point is not easy to identify since the pipe is underground. An engineer has proposed mixing some radioactive substance of short half-life in the oil and using a detector to find the spot where the oil is leaking. The radioactive substance to be used should diminish activity to less than 10 s^{-1} within 1 hour. The engineer has identified one substance to be used and found out that its activity when mixed with the oil, reduced from 480 s^{-1} to 60 s^{-1} in 30 minutes. The engineer has not yet drawn conclusions about this choice of substance and may need your help.

Assit the engineer to:

(a) Determine:

(i) the half-life of the radioactive substance he is about to use.

(ii) the substance should now be mixed in the oil and start tracing the leakage.

(b) Explain:

(i) how the leakage is traced using this method.

(ii) why the substance to be used should have a short half-life.

Item 6

A home has a solar panel and a 12 V battery. The solar panel generates 52 V of d.c power but only 14 V in needed to charge the battery. The home owner wants to install a bulb that automatically comes on when night falls. He is in possession of the following electronic components; an AND gate; an OR gate, a NOT gate, a light dependent resistor L, which conducts when light falls on it, a 200 Ω resistor R and a 600 Ω resistor S. So far he has connected some of the components as shown in ***figure 1***. He is not sure if his system will function as required and he has failed to position the remaining the components.

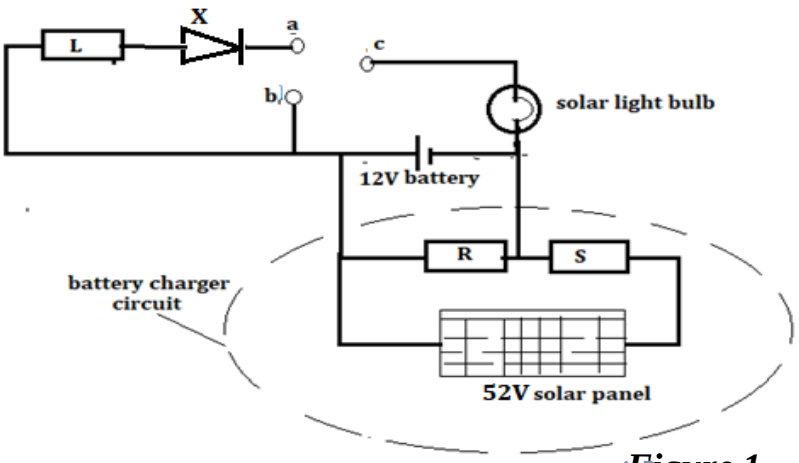


Figure 1

Task:

As a learner who has studied physics, help the home owner to:

(a) Make necessary calculations to find out whether the charger circuit will be able to efficiently charge the battery.

(b) Identify the type of gate, X; giving reasons for your response.

(c) (i) Identify the gate to be connected at **a**, **b** and **c** so that the light bulb is automatically switched on only when night falls.

(ii) Draw the circuit symbol for the gate chosen in (c) (i).

(iii)Draw the truth table for the gate chosen in (c)(i).

Item 7

During charity work in the hospital by Red Cross Society of one school, a certain liquid containing a radioactive material spilled on one student accidentally, having been placed on an open place by a medical intern. The hospital authorities immediately took the student for a mandatory self-isolation within the hospital premises. The parents accused the hospital of negligence and demanded to see their child in a weeks' time.

Hint:

- The liquid had an activity of 250 counts per second when tested immediately, with a half-life of 2 days.
- The back ground count rate in the laboratory was 50 counts per second.
- The student can be safe to re-join the public if the count rate falls below 10 counts per second.

Task:

Use your knowledge of physics to:-

(a) Determine how long the student will be self-isolated.

(b) Enlighten the parents on the dangers of having their child at home without medical monitoring.

(c) Explain to the medical intern how such materials should be handled.

Item 8

In a certain family, a child got an accident while playing with his friends and it was suspected to be broken leg. The family was referred by nearby health facility to go for X-ray radiography. The family already had some false information about how X-rays are produced and the related dangers to their child, therefor they were unwilling to go for it. The X-ray machine requires a voltage of about 4 kV to operate but the available main voltage supply is 10 kV.

Hint: *Available resistors are 300 Ω and 200 Ω*

Task

As physics learner,

(a) Help the family to:

(i) Clear the false information about the X-rays.

(ii) Understand how X-rays can be used to solve the problem of the family.

(b) Using the knowledge of digital electronics, help your friends understand how a 10 kV voltage would be used to operate the machine.

THEME: EARTH AND SPACE PHYSICS

TOPICS:	
The solar system	
Stars and galaxies	
Satellites and communication	

Item 9

As a man in Uganda was watching an educative TV show at 11:00 am, the program was interrupted to bring a live broadcast of some educative night time events in South Mexico. The live broadcast showed some children that who were viewing a dark sky on a cloudless, clear night. The dark sky had greyish areas and many bright twinkling spots of different extents of brightness and colours. Some of the bright spots appeared to be moving. The TV presenter reported that unlike night time, there was only one outstanding bright object in the sky during day time and that it is part of a continuously evolving universe. The man was unable to understand this TV production and wished to have a clear explanation.

Task:

As physics student, help the man to understand:

(a) (i) what the observed grey areas that the learners saw represent.
(ii) what the artificial bright spots represent and their significance in the universe.

(b) why there are outstanding bright objects that the TV presenter mentioned, and their significance in the universe.

(c) why there existed:
(i) different levels of brightness of the bright spots.
(ii) differences in colour of the bright spots.

Item 10

After research work, your group has presented the following article that was collected from a journal on nuclear science….

"Nuclear energy is the energy in the nucleus of any atom. An atom is a tiny unit that makes up matter; it consists of a small positively charged nucleus with negatively charged electrons rotating around. Nuclear energy can be used in generation of electricity but it must be released from an atom during the process of nuclear fission. A radioactive isotope of Uranium $^{92}_{235}U$ *is commonly in the production of nuclear energy. If the uranium sample of mass 64 kg decays to 4 kg in 96 days by emission of 2 alpha particles and 1 beta particle to form thorium (Th), then the large amounts of nuclear energy released can be trapped and used to power very big manufacturing industries and factories without directly affecting the environment. Also, the discoveries on radioactivity have led to significant advancements in sectors of agriculture, medicine, industries and archeology."*

At the end of your presentation, some classmates have not understand the ideas in it, and have requested you on behalf of the group to give them more details.

Task

As a learner of Physics assist them by:

(a) (i) explaining how the discoveries on radioactivity have played a great role in enhancing the different sectors.

(ii) explaining how harmful the discoveries can be, in the field of medicine.

(b) showing, using a well-balanced equation, how uranium reduced to thorium.

(c) determining the time taken by the uranium isotope to reduce to half its original size.

Item 11

In some southern part of South Africa, people were ordered to vacate their areas and relocate to other parts of the country in anticipation of the heavy rains in the coming months, that are likely to cause flooding and landslides. The Local authorities have been requested by the Ministry of Disaster Preparedness to sensitize the people about the issues. However, they are finding difficulties in explaining to the people:-

• Why rains will be experienced in their area while other parts of the continent are experiencing dry season.

• How it is possible to predict accurately weather patterns before they occur.

• Why there are two seasons threatening them with high rainfall in a period of just a year.

Task

As a student of physics, help the Local authorities to understand:-

(a) The variations in seasons as realized by the locals at the same time of the year.

(b) How the weather is always accurately predicted before it happens.

(c) Why the community is experiencing that challenge twice in the same year.

Item 12

In recent times Uganda joined a number of countries that have launched an artificial satellite. When the satellite is in orbit, the sun is the major source energy needed for operation of devices on the satellite. Some Ugandans think that the government is wasting resources in such activities and are planning to make a protest. You have been invited to make a presentation that can answer these Ugandans.

Task:

In your presentation:

(a) Explain

(i) why it is important for a country to have that type of technology.

(ii) why that object is called "artificial".

(b) (i) Inform them about other bodies that are kept in this type of motion.

(ii) Explain why such bodies have this kind of motion.

(b) (i) Explain how the major source of energy produces energy.

(ii) Explain the other roles of the major source of energy, on earth.

Item 13

An elder in a certain village was narrating to his family members his experience of a visit to London. He said that in London, day time was longer than night time with 16 hours of day and 8 hours of night, this was unique to family. He also added that stars were rare organisms that died at day time and resurrected at night. Furthermore, he stated that the shape of the moon kept changing over a month's cycle.

The family members, in comparison, said that some of the elder's experiences were equally observed in their village but unfortunately did not understand these occurrences.

Task

As a student of physics, help the elder and his family to understand;

a) how the unique observation in London came about.

b) the observation of stars at day time and night time.

c) why the shape of the moon keeps on changing over that period.

SECTION B

PART I

THEME: HEAT AND MECHANICS AND PROPERTIES OF MATTER

TOPICS:	
HEAT	**MECHANICS & PROPERTIES OF MATTER**
Temperature measurements	Measurements in Physics
Heat transfer	States of matter
Expansion of solids, liquids, and gases	Effects of forces
Heat quantities and Vapours	Work, energy, and power
	Turning effect of forces, centre of gravity & stability
	Pressure in solids and fluids
	Mechanical properties of Materials and Hooke's law
	Linear and non-linear motion

Item 14

A rider who has been using a simple bicycle has purchased a new and improved one. The total mass of the rider and this new improved bicycle is 80 kg. The rider uses this bicycle to go up a hill of height 5 m in 20 seconds and he is 75% efficient.

On the other hand, the simple bicycle has two toothed wheels are connected by a chain, with 48 teeth in the big toothed wheel and 16 teeth in the smaller toothed wheel. The rider is looking for more explanations to convince his brother that he is not just wasting money by buying the improved bicycle

Simple bicycle.

Improved bicycle.

Using your Physics knowledge, help the brother to:

(a) (i) determine the velocity ratio of the simple bicycle.

(ii) explain the advantages and disadvantages of having a high velocity ratio in the connected toothed wheels.

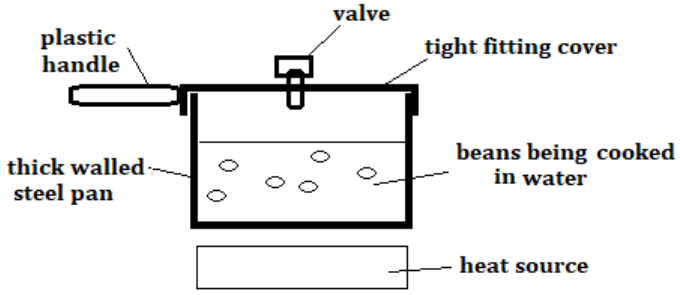
(b) determine the power used by rider to move up the hill using the improved bicycle.

(c) understand why the rider preferred to use the improved bicycle for riding up a hill.

(d) Explain why it is important for the rider to sweat.

Item 15

A S.4 child and her mum have gone to buy some cooking utensils. The mum explains to the shop attendant that she usually gets problems in cooking beans since they take long to get ready when being boiled in water, leading to wastage of energy and time. The attendant shows her an appliance claiming it cooks fast due to its features. The lady is not convinced about the appliance and wishes to get more information before buying it; so she asks the child to explain more.



Task:

Assuming that the lady is your parent or guardian, use knowledge of Physics to educate her on:

(a) why:

(i) the appliance makes the beans get ready faster.

(ii) the steel pan should have a plastic handle.
(ii) the steel pan should have a thick body.

(b) (i) why steel is an important property in this appliance.
(ii) why the bottom of the pan and its sides are made of different colours respectively.

(c) the different means by which heat from the heat source can reach the beans.

Item 16

A business woman intends to install a storage gravity water tank in his home which should supply pressure at 10 kPa. She also needs her tank to have a ladder with steps each of height 40 cm for climbing up to clean his tank. Due to extreme weather conditions the tank may burst as a result of the expansion and contraction of the pipes used. To avoid this, the business woman has been advised to buy a pipes made of a suitable material and get a person who will fit them well. Unfortunately, she does not have enough knowledge about such installation works and is looking for further assistance.

Hint:

Density of water = 1gcm^{-3}

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

Task

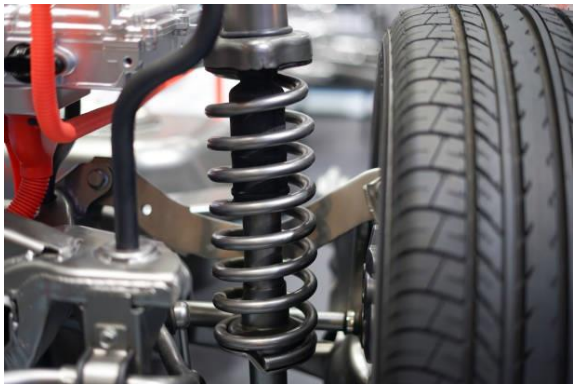
Using the knowledge of physics to help the business woman to;

(a) determine:
(i) the height the tank must be raised to.
(ii) the number of steps to be put in the ladder.

(b) understand:
(i) how the pipes would be connected to the tank.
(ii) how the suitable material of the pipes to be used would be determined.

Item 17

Your friend travelled in an old ramshackle vehicle for an appointment. The first 60 km they covered were on a rough road and the journey turned out to be bumpy and she felt like she was being carried in a wheel barrow. This made her recall Hooke's law which they learnt in Physics at school. After the bumpy section, the road was now smooth for the remaining 20 km where they moved at a speed of 80 kmhr^{-1}, which is the traffic speed limit for that road. For the entire journey she spent 1 hour on the road and unfortunately missed the appointment. She has been given a new appointment at the same time tomorrow. As she narrates this story to you, she is not sure if she will be able to make it for the appointment, and is seeking for you advice and help in this matter.



Task:
Help your friend to:

(a) differentiate between a wheelbarrow and the car, with reference to her experience.
(c) (i) Describe the important property of materials that is useful and applied in the vehicle for a better experience.
(ii) State the law that applies to materials as referred to in your friend's experience.
(d) determine the speed at which she moved on the bumpy section of the road.
(e) determine and advise her on how much earlier she should start the journey if she is to be on time for the new appointment, given that she is to use the same vehicle on the same road.

Item 18

A business lady operates a restaurant which serves food and drinks. In the morning as she was driving her car to his restaurant, it developed a problem. There was a lot of steam coming from the bonnet and the engine stopped working. The mechanic she invited told her that the engine had overheated because there was little water in the radiator. After filling the radiator with water the car started working. When she reached her restaurant, she prepared 0.02 kg ice cubes for customers who wish to add them to their drinks. She then steamed the matooke for lunch and proceeded to make her special drink that she serves out in plastic glasses that hold 0.5 kg of the drink.

Task:

Assist the business lady to;
(a) (i) understand the features that make her car radiator efficient for its purpose.
(b) (i) identify the various states of water that she used that day.
(ii) explain why each of the states of water works very well for the purpose it served that day.
(d) determine the specific heat capacity of the special drink, given that a customer needed four ice cubes to reduce the temperature from 30 ^{o}C to 10 ^{o}C.

Hint: Specific latent heat of fusion of ice is 336000 Jkg^{-1}
Specific heat capacity of water is 4200 $Jkg^{-1}K^{-1}$

Item 19

A class intends to undertake a physics project of making a thermometer to be used in a physics laboratory. At the planning stage, the following questions have come up;

- How to select the suitable liquid to be used.
- How to come up with the graduation on the thermometer.

They have approached you for some ideas to help them produce a working product.

Task:

As a physics learner help your friends to,
(a) understand;
(i) What they should consider when choosing a suitable liquid for this project.
(ii) How their thermometer should be graduated.

(b) determine the density of the liquid to be used in the absence of a measuring cylinder or any other apparatus for measuring volume.

Hint:

- the volume of the liquid required is $5cm^3$.
- knowledge of principles of moments to determine density.

Item 20

Your parents operate a diary business and buy five jerry cans daily. Before buying milk from any farmer, its purity is tested using a hydrometer. One evening the hydrometer accidentally fell down and stopped working yet the milk had to be tested. You advised them to keep the milk into a refrigerator which automatically switches off when the temperature of the milk has dropped from room temperature to a temperature of 10 ^{0}C. The parents were worried that their milk would get spoilt and hence make losses; they wanted you to explain and assure them if your advice would really work.

Hint;

- *Volume of each jerry can of milk is 20 litres*
- *Room temperature = 24 ^0C*
- *Specific heat capacity of milk = 3.14 $Jkg^{-1}K^{-1}$*
- *Density of pure milk = 1035 kgm^{-3}*
- Materials to use include; beam balance, measuring cylinder and beaker.

Task

Using the knowledge of physics, assist your parents to;

(a) determine the purity of the milk in absence of a hydrometer.

(b) understand how much heat energy is withdrawn by the refrigerator from the milk.

(c) understand how the features of the device you proposed, are able to save the milk from getting spoilt.

Item 21

In a certain home, it is the children's responsibility to draw water for cooking and also to boil it for drinking. They draw the water from an underground well using a rope and a bucket. The children have raised a complaint to their father that pulling water using a rope and a bucket is tiresome and are suggesting that a simple machine for drawing water be designed for them. Every day, they use an aluminium saucepan of mass 2 kg to boil 10 litres of water from a temperature of 24 ^{0}C to 90 ^{0}C. The father is planning to address his children's concern but is not certain of how to solve it, and is looking for guidance.

Task:

Using the knowledge of physics, help the father to;

(a) (i) design the simple machine that can be used and explain how it works.

(ii) understand how to improve on efficiency of the machine designed in (a)(i).

(b) understand how much heat energy is used daily by the family to boil drinking water.

Use;

Specific heat capacity of aluminum $= 900 Jkg^{-1}K^{-1}$
Specific heat capacity of water $= 4200 Jkg^{-1}K^{-1}$
Density of water $= 1000 kgm^{-3}$

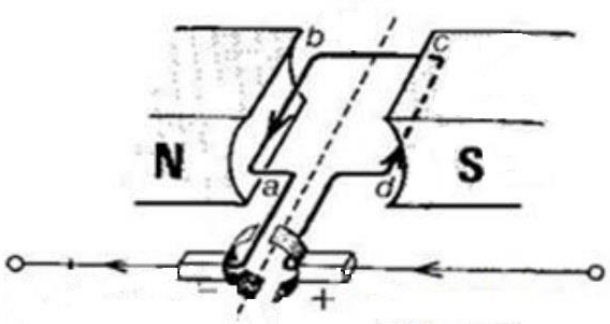
PART II

THEME: ELECTRICITY AND MAGNETISM

TOPICS:	
ELECTRICITY	**MAGNETISM**
Electrostatics	Magnets and magnetic fields
Introduction to current electricity	Electromagnetic effects
Voltage, resistance and Ohm's law	
Electric energy distribution and consumption	

Item 22

A S.4 boy has researched about a certain device that produces rotation when connected to a source of electricity and is found in appliances such as fans, cassette players and disc players. The boy has removed such a device from an old music cassette player at home and according to his research it can be converted into a dynamo to light his bicycle's headlamp. The boy is looking for assistance on how this can be done.



Task:

Help the boy to:

(a) describe the construction and working of the device to produce rotation.

(b) describe how the device is to be converted into a dynamo, and how it will work to light the head lamp.

(c) improve the efficiency of the device.

Item 23

Your neighbour bought an electric kettle and connected it the first time to a power socket to boil 2 kg of water. Immediately, the neighbour heard a small explosion in the kettle and it stopped working. The neighbour called you for help and on inspecting the kettle, it had the following features; a two pin plug connected to the kettle's cable. The cable had three wires in it, one with red insulation connected to the first pin, the second with blue insulation, connected to the second pin and the third

had green insulation but not connected to any pin, also, the heating element had blown. The label on the kettle read 2 kW, 110 V, 50Hz.

Assist your neighbour to:

(a) know the name given to each of the wires in the cable.
(b) (i) understand explain the meaning of quantities written on the label.
(ii) determine the resistance of the element of the kettle.
(c) (i) understand the cause of blowing of the kettle.
(ii) understand what could have been done to prevent blowing of the kettle.
(iii) know other precautions that should always be taken in proper use of the kettle.

Item 24

A community has started a project to generate electricity from a nearby water fall. They have installed a generator that produces 50,000 W of a.c. electricity at 500 V. They hope to transmit this electricity to the village that is 10 km away. They have erected the poles and connected the necessary wires all the way from the water fall to the village. The wires have a total resistance 4 Ω. The appliances the community hopes to use work on 240 V. An engineer has advised the leaders in the project not to connect this power to the users because it will cause problems. The leaders have disagreed with the engineer, saying that he is using this as a trick to get more money from him, else they need clear explanations.

Task:

Help the engineer to convince the leaders by;

(a) Explaining the problems that will arise if the electricity is used as it is.
(b) Determining the percentage power loss that is likely to occur along the way, when the power is used directly as it is.
(c) Explaining the working of the devices that must be installed in the transmission system to enable safe use of the electricity with minimum power loss.
(d) Giving the advantages that the community is to attain by generating a.c. instead of d.c.

Item 25

A certain home is failing to manage electricity bills and thinks the electricity board is cheating them. They recently bought 60 units of electricity which got used up in less than a week, even when they stopped using electricity for cooking food. They also complain that when the lights are switched on, the rooms in the house become too hot. You inspected their home and found out that they

had 6 filament bulbs of 100 W each that worked 5 hours a day and 3 security lamps of 200 W each that worked 10 hours a day. They were boiling water twice a day with a heating coil of power 2000 W and it was taking 15 minutes each time to boil water. They wish to get more information from you after your inspection.

Task:

Assist the members of the home to:

(a) Understand the meaning of the number of units they bought.

(b) Make necessary calculations to determine whether they were cheated, and give them any relevant advice.

(c) understand why the rooms get hot when their lights are switched on.

(d) come up with ways of reducing the electricity bill, even when they are still using it for same purposes.

Item 26

During a physics study tour to an electricity generation substation, learners were guided on the processes of electricity generation and consumption. From the information the substation engineer provided, learners made the following observations which were however not fully explained because of limited time;

- Electricity at the substation is transmitted at 13 kV in alternating current of 0.05 A.
- The voltage used for home consumption units is 240 V with a little higher direct current.
- Workers in the substation are all required to wear personal protective equipment (PPE).

Task

Using the knowledge of physics, help the learners to:

(a) understand why the power is transmitted at a value different from the one consumed.

(b) determine the exact current supplied to a given home, for consumption.

(c) how the voltage changes.

(d) understand why the substation workers use the PPE?

Item 27

A man constructed his house near a high-power line of 15 KV with 0.08 A. He wanted to connect the house to the power and use some electrical appliances. He consulted a local electrician who assured him that they can connect the power line direct to the house in order to reduce costs. The man was warned by his colleagues that he risks burning down his house if he continues with the electricians' plan.

Hint

The man wants to start up with the following appliances in the house:

Item	Number of items	Power rating	Time of use (hours)
Inside bulbs	4	60 W	8
Security bulbs	2	100 W	14
A television	1	120 W	20
A speaker	1	300 W	20
A fridge	1	600 W	4

Task

Using the knowledge of physics, help the man to:

(a) Understand;

(i) Why his house can easily burn down and explain what he can do to get power safely.

(ii) the recommended connection of the bulbs in the house, and why?

(b) Determine his weekly expenditure on electricity if the appliances are used daily, taking the unit cost of the electricity unit as Ug Shs. 550.

(c) Know the appropriate practices he needs to adapt which ensure his safety, basing on the location of his house.

Item

On a rainy day, a certain house was struck by lightning, instantly destroying the fuse in the meter box. The family members were all safe but were advised always to take precautions while it is raining. The house owner didn't understand why they needed to take precautions after all no harm came to them that day.

Hint;

Power supplied to the house through the metre box is 240 V and the fuse is made of a material of resistance 480 Ω.

Task

Using the knowledge of Physics;

(a) Explain to the house owner how he can safe-guard ***his house*** from such occurrences in the future.

(b) Suggest precautions the family members should always take to be safe when such a situation arises.

(c) Determine the rating of the fuse and the current above which may have caused it to burn.

Item 28

A land-lady was recently told that electricity from a power substation is transmitted at 12 kV using thick aluminium cables and is to be used in her house at 240 V. She got confused by how the electricity changes voltage from one value to another and said that the thick cables are a waste of money. Inside the house are two sets of appliances of resistance 20 Ω and 30 Ω but the land-lady is not sure of how they should be connected to ensure that they will work effectively.

Use your knowledge of physics to help the land-lady to understand;

a) the system through how the electricity changes from one value to another.
b) why such cables are used.
c) how the appliances should be connected to ensure that they work effectively with a high amount of current.