THE GRAND PHYSICS SEMINAR AT VISION FOR AFRICA HIGH SCHOOL NAKIFUMA ON Saturday 14TH JUNE 2025

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 color	
Lenses and optical instruments	

Item 1 - Mukono Parents' High School

The choir of a certain high school went to a studio to record an audio version of their school anthem. While in the studio, students made the following observations:

- The walls of the studio were covered by soft, thick woolen materials.
- The color of their uniforms changed as the different lights flashed in the studio. The uniform which was initially of blue skirts and white shirts with yellow collars, kept changing colors as green and red lights flashed on them.
- There was a section at the studio where two mirrors were inclined at an angle of 60^0 and when one student went there, she saw multiple images of herself.

They were later hosted at an FM radio station studio to premier their school anthem, but in that area, there are two FM radio stations known as Tower FM broadcasting at 100.2 MHz and KT FM broadcasting at 90.9 MHz.

All these experiences when narrated to the friends in the lower classes back at school looked mysterious.

Hint:
- The speed of electromagnetic waves in air = 3×10^8 ms^{-1}.
- The wavelength of the waves from the station they visited = 3.3 m

Task:
You were one of the choir team who went to the studio, with your knowledge of physics:

a) Explain to your friends in the lower classes why the walls of the studios are made the way you observed and what would go wrong if they are left bare and hard.
b) Explain how and why the colors of the students' uniforms kept on changing as the flash lights changed color.
c) Determine how many images your friend saw while in the studio.
d) Determine which FM radio station you went to.

Item 2

You are a researcher working on a project to develop a new medical imaging technique that uses laser light and optical fibers to detect abnormalities in tissues. You are using a convex lens to focus and concentrate the laser light onto a specific area on the tissue and then collecting the reflected light through an optical fiber.
As you're working on the project, you realize that the speed of sound in the tissue and the nature of the tissue is crucial in determining the accuracy of the imaging technique.

You also noticed the cashier using a specific type of an electromagnetic radiation to verify the authenticity of the bank notes. You were supposed to explain all the above details to your supervisor, who invited his friend, a non-physicist. The supervisors' friend needs clear explanations on your findings.

Hint: The lens used had a focal length of 20.5 cm

Task:
As a researcher with the knowledge of physics, provide clear explanations to the supervisors' friend on;

a) The distance where the lens can be placed from the tissue specimen for the best results.
b) How the optical fiber achieves the purpose intended in the project.
c) The nature of radiation used by the cashier.

Item 3

A group of learners were listening to a broadcast about a recent tsunami that hit Japan that resulted in death of a number of people and destruction of important power plants. From the broadcast the learners got that: a tsunami usually originates from an earthquakes that shakes the ground and water in two different ways.; the shaking results destruction that is experienced even in far off places from the epicenter; people in far off places can be warned through broadcasting once the epicentre becomes active, so that they can take precautions. Many mild earth quakes occur, and even in Uganda you may have experienced one. The learners were still puzzled about the science involved in the occurrence that was described.

Image: Tsunami

Task:

Help the learners to be able to:
(a) describe how the ground and water are shaken in two different ways and the respective waves that occur.
(b) explain why destruction may occur even in far off places from the epicentre.
(c) explain why people in far off places can get the warning by broadcast before disaster reaches them.

Item 4

A video hall has walls that are 105 m long and 30 m wide. The walls are made of highly polished concrete and are painted black on the inside. One speaker is placed at the back of the hall, while a loud horn-speaker is mounted outside on top of the hall to broadcast to the nearby community.
Unfortunately the hall has lost many customers. In S.4 vacation, you will be put in charge to improve its performance. The current in-charge has discovered the following;

- Viewers sitting at the back of the hall complain that the sound they hear is distorted. They claim to hear the sound after about 0.5s. They wonder how one inside-speaker can make two distorted sounds.
- Viewers say the speaker produces sound of very high frequency that has damaged their ears.
- Residents complain that sound from the loud-horn speakers inconveniences them a lot. During the night it is heard at further distance away while during the day, it is heard nearby.
- Viewers wonder why the hall's entrance has white lights, and not coloured lights.
- Some viewers don't know why guards at the entrance to the hall's car parking use certain curved mirrors check below their cars.

Hint: - *Use speed of sound in air = 330 ms^{-1}*
- *The* horn-speaker produces sound of wavelength 0.005Hz.

Task:

As a student of Physics;

(a) explain;
  i. why the people at the back row complained that the sound is distorted and how that effect can be reduced.
  ii. why there were differences in the effect of sound on the residents during day and during night, and how the effect can be reduced.
  iii. why the entrance must have white lights and not coloured lights.
  iv. the kind of curved mirrors are used by the guards to check below the customers' cars and how such mirrors are able to perform their role.

(b) determine if the sound from the speaker damages the ears of the viewers and what should be done to solve this problem.

THEME: MODERN PHYSICS

TOPICS
Atomic models
Nuclear processes
Digital electronics

Item 5 – Hope Christian High School

A patient who was suffering from liver cancer visited a radiographer for the routine consultation and treatment. According to his previous prescription, he was injected with Iridium-192 (^{192}Ir) radioisotope dose of mass 12 mg into his bloodstream this time around. The radiographer wrote a brief report on the medical form as shown below, before sending the patient for scanning.

Name: X

Date of visit: 2nd June 2025

Date of next visit: .....

To report on the next visit when the dosage has reduced to 0.75mg

However, he forgot to indicate the date of the next visit. The radiographer also told the patient to monitor the changes which may arise due to the dosage and report back to the hospital, if feeling abnormal, even before the due date. The patient then went for scanning photography. Unfortunately, he was told that the low voltage supply of the machine had mechanical issues and could not operate it. The patient failed to understand the effect of the low voltage supply of the machine on its operation, yet to him high voltage is always needed to operate machines.

Hint; Half-life of Iridium -192 (^{192}Ir) is 5 days,

Task:

As a student of physics,

a) Help the patient to determine the date for his next visit.
b) Explain to the patient the effect of the faulty part of the machine on its operation.
c) Sensitize the patient on the dangers of such dosages in treatment of the disease.
d)

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.

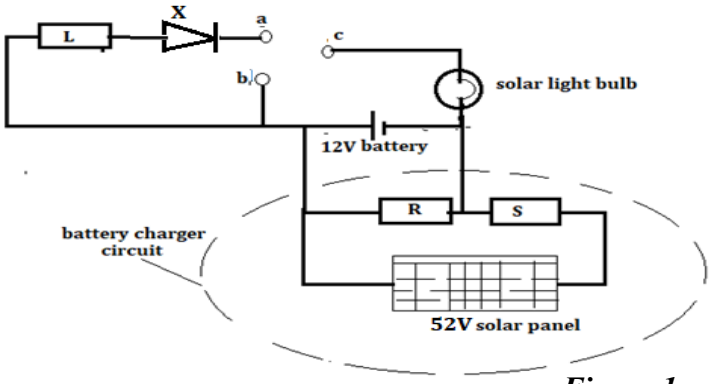


Figure 1

Task:

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

a) Make necessary calculations to determine 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

An underground water supply pipe in a local trading centre was suspected to be cracked. This was because the amount of water pumped does not correlate with the amount passing through a certain check point meter before distribution, this resulted to constant low pressure of water to the centre. The local authority had to address the challenge by locating the leaking point and repair it. They hired a technician, since the National water services delayed to respond, who introduced a radioactive isotope of 8g, containing the most penetrating radiation whose half-life was 6 hours, into the water supply so that the water that leaks from the crack is radioactive. This isotope was considered and chosen by the technician as opposed to the isotope of half-life 14 hours that was always used by the National water authorities. The Local authorities are challenged on when to tell the community the expected timing for water to be safe for use again and exactly why a different isotope was used as opposed to the one used by National water authorities, since they didn't get clear explanations from the technician.

Hint: Assume the safety desired levels of radiation is 6.25% for any human consumption.

Task:

As a student of physics, help the Local authorities;

(a) Identify the type of radiation that was emitted by the isotope in water for the leakage detection.
(b) Understand why the technician introduced that isotope as opposed to the one used by National water authorities.
(c) Sensitize the members of the communities about the risks associated with the kind of material introduced into the water.
(d) Understand when to tell the community members that the water is safe again for use.

Item 8

Uganda is planning to start producing nuclear energy and some sparsely populated areas in the country have been proposed for the reactor. There are two types of nuclear reactors, i.e., the fusion type and the fission type. The most common type of reactor is the fusion type which uses the uranium nuclide, $^{236}_{92}U$ as the fuel. Dangers arise from the radioactive products of nuclear reactions and precautions must be taken. People in the communities where the reactors are to be established have little knowledge about this form of energy production.

Task:

Help the community members to:

(a) understand the difference between the two ways of producing the energy and how energy results from the reactions.
(b) know the components of the nuclide mentioned and why this nuclide is suitable for the reactor.
(d) understand know the precautions that must be taken and why precautions must be taken.

Item 9

Residents in a community are concerned about liquid wastes that are released from one of the mining centers in their area. The L.C 1 chairman has invited a chemist to test a sample of the liquid waste to find out if it contains radioactive materials. The scientist has discovered that the background radiation in the area is 250 counts per hour; and more findings are as indicated in ***table 1.*** Unfortunately, the scientist is not able to give further information to the chairman because of his busy schedule.

Count rate (counts per hour)	800	520	345	225	145
Time (hours)	0	4	8	12	16

Table 1:

In the forthcoming village meeting, the L.C 1 chairman has to give detailed information to the residents about the current situation. However, the chairman lacks full knowledge about the scientist's findings, and is looking for a person to guide him on what to communicate to the people during the meeting.

Task:

As a student of Physics;

a) help the L.C 1 chairman to determine;
   i.) if the sample is radioactive or not.
   ii.) after what time it will be safe to dispose the liquid waste, if it is radioactive.

b) educate the L.C 1 chairman about;
   (i) what was meant by the statement "*The background radiation in the area is 250 counts per hour*"
   (ii) the sources of the background radiations in their area.
   (iii) why it is dangerous for the community members to be exposed to radioactive materials.
   (iv) how people dealing with such materials should handle them.

THEME: EARTH AND SPACE PHYSICS

The solar system
Stars and galaxies
Satellites and communication

Item 10

As a Ugandan man was viewing a program "*The Planetary Guide*" on an international TV station, the presenter highlighted the following;

- Uganda was experiencing a dry and wet season, while elsewhere it was winter and summer.
- The various artificial satellites launched in space were useful in a number of ways.
- The universe is so big, with billions of observable twinkling stars of different sizes and colours in the sky.
- Stars have life cycles such as white dwarfs, neutron stars and black holes.

The man enjoyed the programme, wondered about the presenter's observations and wished the program would take a longer time for him to get more explanations; unfortunately it lasted for a few minutes.

Task:

Using your knowledge of physics;

(a) help the man to understand;
   i.) what causes the differences in the occurrences that Uganda is experiencing in relation to other areas.
   ii.) the usefulness of the artificial objects that were launched in space.

(b) Write an explanation to the man to get more information about;
   i.) why the sun appears brighter when viewed from Venus than from the earth..
   ii.) why the stars are seen to have a certain observable appearance as indicated by the presenter.
   iii.)the effect of mass on the stars' life cycles.

(c) The man used his phone to download images of stars and realized that some were white, others red, blue or yellow**.** With scientific reasons, help him arrange the stars in order, starting with the coolest up to the hottest**.**

Item 11

You are a coastal engineer tasked with designing a seawall to protect a city from periodic high water level rise which is causing storms in the ocean. This has led to damage along the city coast line and ships when in water at the time of its occurrence. However, you are new to the area and un-aware of the exact location of the coastline always affected though the name was given to you. A colleague suggests using a specific technology to navigate the coast and survey the area but the engineer doesn't know how it works and how to use it.

Task:

As a colleague;

Help the engineer to understand;

a) the technology to use to navigate to the coastline.
b) the main cause of the storms which pause threats to the city coast line and ships.

Item 12

An area was always affected by poor network of the mobile phones. A group of community members started a drive to save money and buy new, better phones. They thought, their challenge comes from the type or nature of phones they have. However, a telecommunication company came to their rescue and erected a mast, the network in the place greatly improved. One elderly man in the community could not understand the magic in the network improvement and generally the connectivity in calls. What surprises the man more was the fact that network could be off but the time never becomes wrong. He also wondered that one day it was 6 pm in his phone and yet the Aljazeera Television was reporting a live news broadcast of images for the first phase of the moon just been seen, at that time, it was 11 pm local time at the broadcasters' area.

Task:

As a learner with clear understanding of the space physics, help the elderly man understand;

a) How connectivity is achieved.
b) Why the difference of 6 pm and 11 pm at the same time.
c) Why there are other growing phases that follow after what was just seen.

Item 13

Some people in the past used to assert that everything in the universe moves around the earth. Some learners have observed that both the sun and the moon appear to move around the earth from the east towards the west and tend to agree with this assertion. The learners also observed that during a period of about 28 days the moon gradually changes shape from a crescent to a full moon and some of them think that the daily change appearance of the moon is because the earth is round and it blocks different amounts of the surface of the moon from sun light.

Image: ***moon phases and lunar eclipse***

Task:

Help the learners to understand;

(a) the correct arrangement and motion of the heavenly bodies mentioned.
(b) how energy is produced from the central body in the system.
(c) the correct cause of appearance of the moon observed by the learners.
(d) what should be taking place if the learners' explanation about appearance of the moon were correct?

SECTION B

PART I

THEME: HEAT AND MECHANICS AND PROPERTIES OF MATTER

TOPICS:	
HEAT	MECHANICS AND 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 – St. Francis H/S Mukono Borgia

A gentleman who was digging a pit latrine got trapped down because he got stuck in the mud as some water started coming slowly from the underground and mixed with the soil he had dug. To get him out, a ladder could not work since the latrine was so deep. Similarly, pulling him directly could also not be easy because of the weight of the gentleman and the risk of another person being pulled downwards. He was then successfully pulled out using a simple machine with one wheel and a grooved rim.

When he was removed, a doctor was called to treat him since he had swollen body parts. On receiving this news, the doctor set off from rest and accelerated uniformly at a rate of 0.2 ms^{-2} for 2 minutes, he maintained this speed for 20 minutes. He then decelerated at a rate of 0.6 ms^{-2} coming to rest at the home of scene. The doctor spent 10 minutes while treating the patient and travelled back repeating the same motion in the opposite direction since he had another appointment at his home which was due one hour form the time he left.

Hint:

The doctor usually asks for a transport refund, apart from the treatment fee, at a rate of Shs. 500 per kilometer.

Task:
As a learner of physics,

a) State and describe the simple machine used to remove the gentleman for the pit latrine.
b) Determine whether the doctor was able to keep time for his next appointment?
c) Determine how much was refunded to the doctor for his transport.

Item 15
An aero-plane at the end of the runway is lifted up by a lift force, accelerating it uniformly from 12 ms^{-1} at the edge of the runway upwards for 5 minutes and attaining a velocity of 32 ms^{-1} just passed the cloud level. It maintained this velocity for 30 minutes while traveling horizontally. The pilot realized that the plane had a slight mechanical failure, this forced him to consider an emergency landing to a certain nearby airstrip where the plane had never ever landed. The pilot then decelerated uniformly immediately coming to rest after 5 minutes on the airstrips' parking yard, after contacting the authorities. The plane company had to compensate the travelers based on the distance covered away from the airport, as a policy of the transport regulator. The passengers had to be refunded their money so that they book another flight. The passengers also jerked forward when the plane brakes were suddenly applied to start the deceleration and the landing, this disorganized them and made some passengers raise an alarm of poor piloting.

Hint;
The regulators' policy considers a compensation of 1000 UGX per kilometer distance strayed off the airport. The aero plane is always not supposed to be pulled by an acceleration beyond 0.05ms^{-2} according to the manufacturers' descriptions so that it's safe in the flight.

Task;
As a physics learner, help the aero-plane company to:

a) determine the compensation fee for each passenger.
b) ascertain whether the acceleration after take-off caused the mechanical failure.
c) explain to some passengers what caused their disorganization during the sudden breaking.

Item 16
A single mother in her country home has hosted five grand-parents who are to stay for a night. She started the process of preparing warm water for their bathing. She had an electric kettle of capacity 5 litres. She switched on the electrical heater plugged in the kettle at its bottom after filling it with water and waited until water boiled at 100 ^{0}C, then the heater switched off automatically which left the visitors surprised as it was a first-time experience. She then mixed this hot water with 20 litres of cold water initially at 10 ^{0}C. The mothers' challenge is that she had to boil water again in the next morning for the grand-parents to take a shower again, wasting time and consuming more power.

Hint:
- Density of water = 1000 kgm^{-3}
- Specific heat capacity of water = 4200 $Jkg^{-1}K^{-1}$
- Bathing water used by the grand-parents should not exceed 30 ^{0}C.

Task:
a) Advise the mother if the temperature of the mixed water is not too high to cause challenges to the grand-parents.
b) Explain to the grand-parents about the component in the heater to behave surprisingly.
c) Suggest and describe the working of an equipment that the mother can use to keep this mixed water warm for the next morning, since all the visitors will bathe at the same time.

Item 17
The Regional Referral hospital wishes to transport vaccines to a given community. The effectiveness of this vaccine greatly depends on its temperature before being introduced in to the blood stream of the person being vaccinated. To maintain its effectiveness, the hospital decided to transport it using a refrigerated vehicle.

The distance between the hospital and the vaccination point is 84 km and the vehicle can move at an average speed of 75 kmh^{-1} in that road. During transportation, the temperature rise of the vaccine while in the vehicle is inevitable, it is evaluated several times, to rise at an average rate of 0.8 ^{0}C/minute.

Upon arrival on the vaccination centre, the health team put the vaccines in a plastic box fitted with ice, for some time, so as to lower the risen temperature of the vaccine to a normal temperature of the vaccine usage. A 0.5 kg mass of dry ice at 0 ^{0}C is fitted in the plastic box and 4 kg total weight of the vaccine with 3.5 kg total weight of the glass bottles is immediately transferred from the refrigerated vehicle into the dry ice.

Hint;
- At the time of use, all the ice had melted into water at 0 ^{0}C.
- The vaccine is effective for introduction into the person being vaccinated when in liquid form, at a temperature between 10 ^{0}C to 28 ^{0}C.
- The specific latent heat of fusion of ice = $3.36x10^5$ Jkg^{-1}.
- The specific heat capacity of the glass content of the bottle = 840 $Jkg^{-1}K^{-1}$.
- The specific heat capacity of the vaccine = 250 $Jkg^{-1}K^{-1}$.

Task:
As a learner of physics, determine whether the vaccine transported on that specific day was still effective by the time of use.

Item 18

A country is in the process of putting in place a programme to improve its capacity to develop and monitor its space activities including: air craft transport, weather, ozone layer protection; and communication satellites. Some trainees in the programme do not have a clear understanding of the nature of the atmosphere and important properties of its layers that will enable the activities to be done effectively. A group of trainees are to be taken to climb high up mountain Ruwenzori to a training camp. The trainees wondered why they were advised to carry pressure cookers for cooking and warned that some of them may experience symptoms of nose bleeding and breathlessness as they moved up the mountain.

Task:

(a) Describe to the trainees the different layers and their properties that are suitable for each of the mentioned activities to take place.

(b) Explain to the trainees why:

(i) nose bleeding may happen to some of them.

(ii) it was necessary to carry pressure cookers even when the foods they expected to cook do not usually need a pressure cooker.

Item 19

Jane owns a petrol engine car that she drives to go to work. One day car suddenly stopped and she called on her mechanic to help. The mechanic came told her that the engine had overheated. He opened the bonnet and using a towel that he had soaked in water opened the cap of the radiator cap with a lot of care. A lot of steam came out of the radiator and when the steam had stopped he filled the radiator with water and fixed the cap back. When Jane asked the mechanic why the engine had overheated the mechanic said the radiator had not been properly filled with water and advised her to always check on the level of water in the radiator before driving the car. However Jane did not properly understand the working of the radiator and the importance of water in running of the car.

Task:
Help Jane to understand:
(a) why the mechanic used a towel soaked in water for holding the cap of the radiator.
(b) features of the radiator that enable it perform its role efficiently.
(c) how overheating is controlled.
(d) why water is a good choice for the role it plays.

PART II

THEME: ELECTRICITY AND MAGNETISM

TOPIC	
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 20
You and your friends embark on a journey to go for mountain climbing and camping on a weekend. The mountain is located south of a thick dense forest cover, through which one can pass, the only route that takes you to the climbing foot of the mountain. At the start of the journey in the forest, you used a compass direction to pass through the forest, but, unfortunately along the journey, the compass breaks down. Your friends carried a radio of total internal resistance 9 Ω in order to listen to their favorite talk show, a bulb of 6 Ω to provide light and a battery of 12 V.
As ready explorers, your team also carried an insulated copper wire and pieces of connecting wires primarily for the battery connection, there was also a steel nail, a switch and a string, this were all for their comfort while exploring and camping.

The breakdown in the compass has caused challenges navigating through the thick forest, which had no direct access routes.

Hint: The fuse in the radio is rated 1 A.

Task:
As a learner of physics, help your friends to;
a) explore the alternative device you can invent and use to navigate through the forest.
b) determine the circuit connection that would help both the radio and the bulb to operate normally.

Item 21
A city required electricity to power its homes, businesses and industries. During a certain campaign rally, the incumbent city Mayor assured people that the city will have its own power plant and generate power to light the city in a months' time, since resources were available. On consultation with the electricity company, the city mayor was told that it involves many processes making it expensive and taking long during the connections. This puzzled the mayor.

In this city was a home owner who wishes to buy and use a 1000 W fridge for 3 hours a day, a 400 W flat iron for 45 minutes a day, a 200 W television set for 2 hours a day and a 60 W lamp for 5 hours. In his budget, he set a side Shs. 50,000 per month for electricity bills.

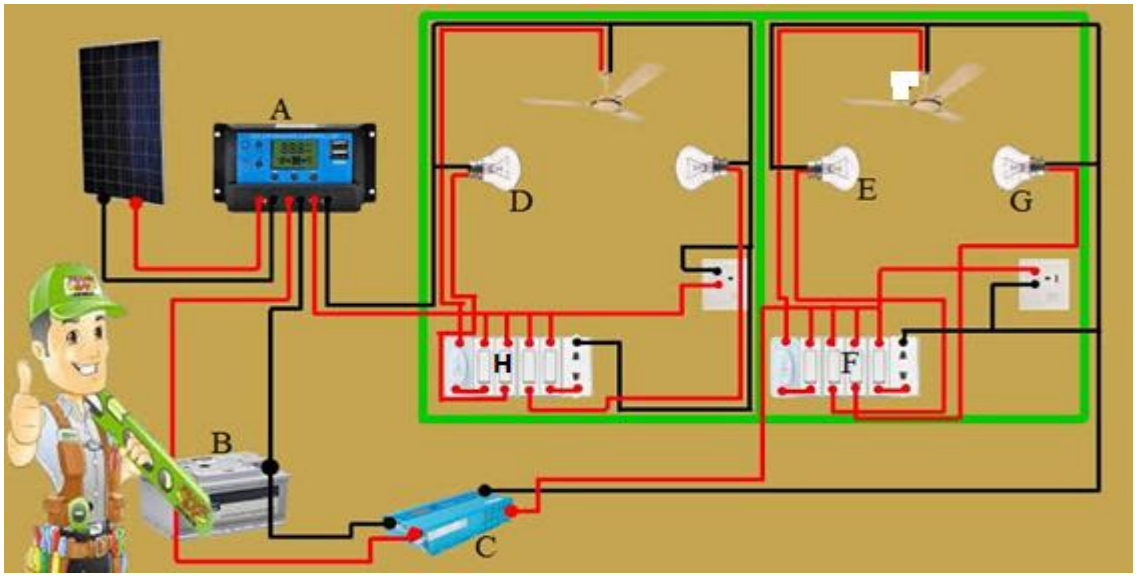
Hint; - Each unit of electricity costs Shs. 600
- An average of 30 days is taken for a month.

Task;
As a learner of physics;

a) Explain to the mayor the processes involved until the city is lit which makes the process time taking and expensive.
b) Help the home owner to either hold onto his budget or adjust when the city is finally light.

Item 22 - Fountain of Hope High School

A business-man completed the construction of his residential house and he was facing a challenge of electricity connection since the only electricity power line near is high voltage line. He was advised to install a solar system which would be relatively cheaper in a long run and as well reliable. The man therefore contacted the electrician who deals in solar installation, who gave him costing and the circuit diagram to be used is as shown below.



On reception of this plan, he wanted to do a secret price analysis and comparison with that of the Engineer, however he has limited knowledge of the components, their operation and the connections involved. He therefore consults you as a physics learner in a move to avoid paying consultation fee.

Task;
Help the owner to;

a) Identify the components A, B, C, E and H.
b) Understand the role of A and C in Solar installation.
c) Understand type of current used by bulb D and E.
d) Understand how the installation can be able to provide power at night in the absence of sunlight.
e) Understand the care and management of component B.

Item 23

A power transmission line carries electricity from a power plant to a residential area. The transmission lines are made of wires of some resistance and carries a current of 5 A. The voltage at the power plant is 2.2 kV, which is also being transmitted in the lines and the residential area requires 240 V.

The business man wants to tap that power as fast as possible for his residential home. He has been advised to avoid and desist from the temptation of tapping power direct from the high-power line. He has been advised to install a transformer and purchase some connecting wires whose resistance is less than that of the transmission line, if he is in a hurry. This kind of transformer is always 65% efficient.

Hint; - The transformer needed should be having 13750 turns in the primary coil.

- The fuse chosen for the main metre box will depend on the amount of current being delivered to the residential place.
- Specification of transformer is needed in terms of the number of turns for easy purchasing.

Task;

As a physics learner, guide the business man on the:

a) kind of the transformer to buy and its operation.
b) kind of fuse to use in his metre box.
c) specification of the transformer needed.

Item 24

A village community has started a project to generate electricity from a nearby water fall. They had to make a choice between two generators: generator A that produces 50,000W of d.c. electricity at 500V, or generator B that produces 50,000W of a.c. electricity at 500V. The engineer advised them to install generator B. They hope to transmit this electricity to the village that is 10km 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 4Ω. The appliances to community hope to use work on 240V. An engineer has advised the leaders in the project not to directly connect this power to the users because it will cause problems. The community leaders do not properly understand the engineer's choices and advice.

Image: transformer

Task:

(a) Explain to the community leaders:

(i) The importance of the engineer's choice of generator B.

(ii) Problems that will arise if the electricity is directly used as it is.

(b) Help the community leaders know the amount of power loss that is likely to occur along the way when the power is used directly as it is.

(c) Describe to the community leaders the working of devices that must be installed in the transmission system to enable safe use of the electricity with minimum power loss.

Item 25

While talking to members of a home in a community it was found out that they are experiencing difficulty in managing electricity bills. They think that the electricity board is cheating them. They recently bought 20 units of electricity and it was over before a week was completed, even when they had stopped using electricity for cooking food. In addition they complain that when the lights are switched on the rooms in the house become too hot. In one of the homes it was found that they had, 6 filament bulbs of 100W each that worked 5hours a day. They were boiling water twice a day in a source pan placed on a heating coil of power 2000W which was taking 15minnutes each time to boil water.

Image: ***Filament bulb, electric heater***

Task:

(a) Explain to the family members the meaning of the number of units bought.

(b) Use necessary calculations to give advice to the members on whether they were cheated.

(c) Explain to the members of the home why the rooms get hot when their lights are switched on.

(d) Explain to the family members, ways of reducing the electricity consumption even when they are still using it for same purposes.

Item 26

One evening, as a lady sorted rice for supper, the weather suddenly became windy. Some tiny metals on a nearby window all fell into the rice she was sorting and they all got mixed up into it. It started raining and there a strong bright flash in the clouds accompanied by heavy sound. The tree in her compound got struck down and electrical gadgets that were plugged into electric sockets got spoilt. Surprisingly her neighbour's house and electric gadgets were not affected at all by this situation.

She got puzzled by how her neighbour's property was able to be saved, and also needed to continue with preparing the rice, but without the metallic materials.

You are the neighbour's child and wish to educate the lady on this situation.

Task:

a) Explain to the lady:
   i.) the process that led to the strong bright flash and heavy sound that was experienced.
   ii.) the type of metal rod or system that made the neighbour's home safe from this disaster, and how it works.
   iii) other safety measures that should be taken by anyone inside or outside a house in order to avoid effects of that electrostatic discharge.

b) You have an iron nail of resistance 0.5Ω and a battery of 4 cells, each of e.m.f 1.5V.
   i.) Explain how you can construct an electromagnet to assist the lady continue preparing her meal and explain how an electromagnet operates.
   ii.) Explain what would happen if a battery of 2 cells of the same e.m.f was used instead of one of 4 cells.
   iii.) Identify other factors that could contribute to an increase in the number of metals being attracted.

END