A MUST HAVE

NEW LOWER SECONDARY

PHYSICS TOPICAL QUESTION BANK

Pass U.C.E

FIRST EDITION
2024

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NEW LOWER SECONDARY PHYSICS

TOPICAL QUESTION BANK

ORGANIZED BY

YIGA ASHRAF KASUMBA

(0777862462 / 0752162001 / 0704750287)

(S.1 TO S.4)

SCENARIO BASED ITEMS

(first edition © 2024)

Dedicated to:

St. Julian h/s gayaaza,

St. matia Mulumba sss kigoggwa,

Natete Muslim h/s,

mbogo mixed ss,

matugga h/s,

Buddo ss,

St mbagga's college Naddangila,

Namalere mixed secondary school,

Samaritan SS Kawempe

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WAVES AND LIGHT

Item 1

In a certain music concert that took place at night, a man played a guitar on a floating stage surrounded by disco lights flashing red, blue and green in the middle of the lake. The audience on the boats and shores were wearing yellow clothes with black spots on them. The audience was surprised about the new appearance of the colors of their clothes. The sound waves from the guitar travel through the air with a frequency of $\mathbf{440}\boldsymbol{Hz}$. The organizers also projected laser light, that travels through air with a frequency of $4.7\times\mathbf{10}^{\mathbf{8}}\boldsymbol{Hz}$ illuminating waves on the lake surface to aid visibility. The shores of the lake were $\mathbf{15}\boldsymbol{m}$ away from a tall storage building. Boys A and B standing in the same direction and in line with the playing music from the lake heard the sound at different intervals of time which attracted them to go and observe what was taking place at the lake. Boy A heard the sound after 3s and boy B heard the sound after 4s.

Hint:

($\textit{Speed of sound in air}=\mathbf{330}\boldsymbol{ms}\mathbf{-1}$, speed $\textit{of light in air}=\mathbf{3.0}\times\mathbf{10}^{\mathbf{8}}\boldsymbol{ms}\mathbf{-1}$)

Task:

As a physics student;

(a) Help the two boys to understand why they heard the sound at different intervals.

(b) Clearly explain why the color of the clothes of the audience kept on changing when colored lights flashed on them.

(c) Why was laser source of light preferred to provide laser light that enhanced visibility late in the late hours of the night.

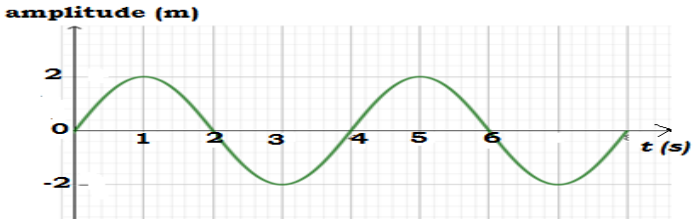
(d) Compare the wave length of the sound waves and laser light waves in air medium.

Item 2

A war erupted in a certain mountainous areas surrounded by small water bodies where soldiers only communicated by throwing a stone in water to alert their colleagues of danger ahead. Instead, this alerted their enemies. One of the soldiers had small sizable plane mirrors and torn paper box in his bag. Their leader sent spies to peep behind hills to see if the enemies were hiding there but many were captured and killed. They totally lacked knowledge on how to solve this problem. The enemy troops had a radio call that was used for communication and wave forms of wave length were produced on the receiver's computer clearly indicating the amplitude, period and time taken for the wave to reach the receiver at the headquarter. One afternoon, it threatened to rain and bright colors of different kind spread in the skies. This scared the soldiers even more.

Hint;

A graph obtained from the receiver's computer



Task:

As a physics student, help the soldiers to;

(a) Understand why the throwing of the stone in water always alerted their enemies

(b) Know the best way they could reduce the rate at which their spies were being killed and captured.

(c) Understand the strange appearance of the skies that sent them to hide outs.

(d) Determine frequency at which the waves reached the receiver at the home base of the army.

Item 3.

During a science project, learners are given two mirrors; a concave mirror of focal length 20cm and a convex mirror of focal length 20cm.

Task:

As a learner of physics;

a) help the students to determine which mirror forms a bigger image of a man of height 4cm standing 25 cm a way from each of the mirror.

b) write a brief report about the nature of image formed by each mirror advise which mirror is suitable for use as driving mirror

Item 4.

A brass band was invited to play during a celebration near a tall building, a distance slightly more than 17 m away. Two friends standing in the same direction and in line with the playing band, heard the sound from the band at different intervals of time which attracted them to go and attend the celebration.

On arrival, the sound they heard was unclear, confused and indistinct. Later in the night during the cerebration, coloured lights flashing red, blue and green made the colours of their clothes look different from the original colours which puzzled them.

The two friends heard sound after 4 s and 5 s, respectively and were originally wearing yellow clothes. Hint(Speed of sound in air = 330 ms^{-1})

Task:

As a physics student, help the two friends to understand why;

(a) they heard the sound at different intervals.

(b) the sound they heard was unclear, confused and indistinct.

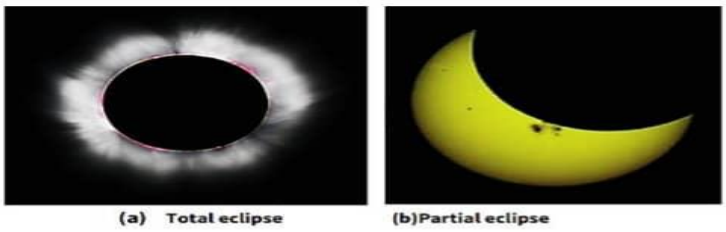
(c) the colour of their clothes kept changing when coloured lights flashed on them.

Item 5

Long time ago eclipses were considered as a message from the gods sine the people in that age dwelt so much in the spiritual realm than the scientific word. But with the development of science and technology, eclipses can now easily be explained scientifically instead of spiritually. Whenever eclipses occur many people gather out in open places to watch the beautiful view of the heavenly bodies as they align themselves in a beautiful display.

However, in most remote areas of Uganda some people still observe the eclipse directly using naked eyes not aware of the risk they are exposing their eyes to in the long run.

SUPPORT MATERIAL



(a) Total eclipse (b)Partial eclipse

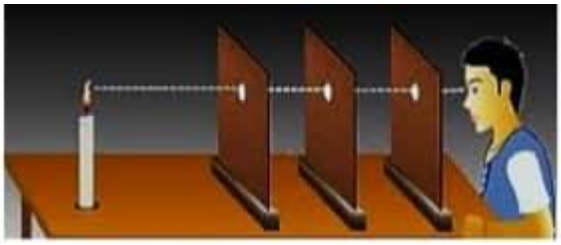
Task:

As a learner of physics;

a) Explain the difference between total and partial eclipse.

b) Using illustrations, explain the differences between solar eclipse and lunar eclipse.

c) In a certain experiment to investigate nature of light, the set up below was arranged.

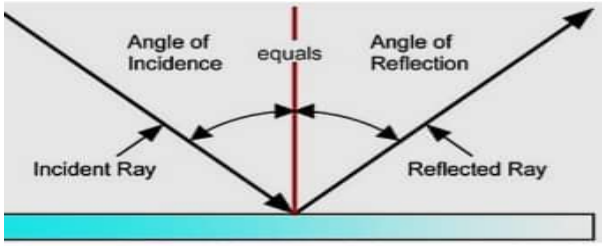


i) State the property of light being investigated and explain its implications in daily life.

ii) Explain what would happen when one of the cardboards is displaced slightly.

Item 6

We normally see the images of our faces when we look into the mirror. This is due to reflection of light.



Task:

As the learner of physics;

a) State the laws of reflection of light and use them to find the glancing angle if the angle of reflection is 350.

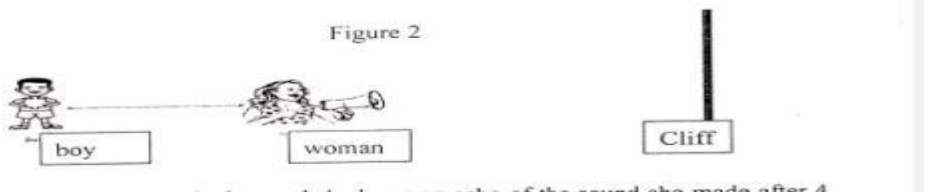
b) Describe the nature of the images formed by plane mirrors.

c) State the real-life applications of plane mirrors.

d) With the aid ray diagrams, describe the differences between images formed by plane mirrors and a pin hole camera.

Item 7

Two people stand in front of a cliff at an unknown distance between them as shown below.



The woman calls out the boy, she hears an echo of the sound she made after 4 seconds while the boy hears the same echo 3.5 seconds later.

Task:

As a learner of physics;

a) Help these people to determine the distance between them.

b) Write a report about the factors that increase the rate of movement of sound.

c) Explain why it would be easier for the sound to travel from the girl to the cliff at night than during the day

Item 8

While in your literature lesson, your teacher asks your friend to stand up and read for the class a book of Oliver Twist, however your friend always tells your literature teacher that she is unable to see the letters in the books and even when she sits near the board, she's unable to see but your teacher and other fellow literature students think she's bewitched. On the s.4 leavers party, a boy of height 120cm stands in front of a lens camera with a lens of focal length 40cm at a distance 160cm from camera.

Task

As a learner of physics,

By scale drawing find the; nature size and position of the image of the boy on the camera

explain to your fellow students and the literature teacher the cause of the problem and the would-be possible solution to the above problem

Item 9

A certain student was puzzled that the shallow end of the swimming pool at his school appeared to be about 1.5m deep when in the actual sense it was 2.0 m.

(i) Use a ray diagram to illustrate student's puzzle and explain why the swimming pool appeared shallower than it is actually is.

(ii) Determine the refractive index of the water in the swimming pool at school

b)A barber was given a curved mirror of focal length 30 cm so that he could use it as a shaving mirror in his salon.

i) Identify the type of curved mirror given to the barber and using a ray diagram

ii) explain how the selected curved mirror is used as a shaving mirror.

iii) State the properties of the image formed above?

iv) Which type of curved mirror is suitable to be used as a side mirror and why?

Item 10

During a science project, learners are given two devices; a pin hole camera of length 50cm and a concave mirror of focal length 50cm.

Tasks

As a learner of physics;

a)Help the students to determine which instrument forms a bigger image of a man of height 1.8m standing 2m away from each of the instruments.

b)Explain the difference in the properties of the images formed by the two instruments and identify the practical applications of the instruments.

Item 11

A barber was given a curved mirror of focal length 30 cm so that he could use it as a shaving mirror in his saloon.

a) Identify the type of curved mirror given to the barber

b) Use a ray diagram to illustrate the use of the selected curved mirror as a shaving mirror (05 scores)

c) What are the properties of the image formed above? (03 scores)

ITEM 12

Your uncle operates one of the largest supermarkets in Hoima city however he has been having some challenges especially theft of his goods in his supermarket.

What advice would you offer him using the knowledge of reflection of light to overcome such losses due to theft of his goods.

ITEM 13

Mr. Opolot a teacher of physics got challenges with his eyes and could not see properly, he was advised to seek medical assistance from ophthalmologist. He was given spectacles with converging lens of 20cm. while he was in class delivering strong thunder of wave length 2m roared which resulted into the breaking of his spectacles and was unable to deliver the lesson effectively that day. One of his students fixed a pencil of 10cm high at a distance of 60cm from him. Hint: Speed of sound in air is 330ms-1 *Task:*

As a student of physics, lead a guided discussion that helps the class to;

a) Determine the;

i Position

ii Height

iii Nature and magnification of the image that could be formed in his eyes.

b) Describe the power of his spectacles

c) Find the frequency of the thunder.

Item 14

One of your uncles wants to open a shop that deals with mirrors, and he has requested for your advice on how best he can choose the mirrors for his shop which he just plans to open. Most of the customers who buy mirrors need the following mirrors.

- ✓ Shaving mirrors and make up mirrors.
- ✓ Saloon mirrors
- ✓ Side mirrors (rear view mirrors)
- ✓ Washroom / bathroom mirrors
- ✓ Security mirrors in supermarkets and parks.

Write down an explanation of how best you can help your uncle identify and choose the mirrors wisely so that they can suit all his customer's needs.

Item 15

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 colors 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 16

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

- On entering the stage, the color 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 color 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 17

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 18

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.

Item 19

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 colors 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?

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

Task

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

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Task

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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 22

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;

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- 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.

EARTH AND SPACE PHYSICS

Item 1

On a certain day at around 1:30pm while in the dining hall, learners watched heavy fog-rains and floods being experienced in a certain outside country on an international T.V live channel. To worsen matters, the floods were happening at night and this risked many natives as many of them were ambushed while asleep. Learners wondered how it would be night and seriously raining in an area yet it was day and the Sun was highly shinning at that time in their school.

Task:

As a physics learner help the learners clear their queries about;

a) Occurrence of the floods in one area yet it was shining in their school at same time.

b) Why it was night in that outside country yet it was day-time in their area?

c) How T.V signals broadcast from where the floods were happening reached them.

Item 2

A child went out of the house at around 8:30pm and realized that security lights were off. The child saw glittering substances in the space and wondered why the clouds were so much glittering. While still wondering, the child heard a person tip-toe and rushed to the corridor with light switches to switch on. Unfortunately, the corridor was closed by parents who had mistakenly gone with the keys and was not yet back. The person knocked on the gate but the child was challenged whether the parent had come and had to open or the person knocking was a thief. Later the parent came, and when the child narrated, the parent said the glittering substances were artificial satellites in the international Space Station (ISS).

Task:

As a physics learner, using the knowledge of space physics and digital electronics, help the child and parent:

(a) Understand more types of those identified satellites and why they exist there without falling.

(b) Solve the problem of operation of security lights.

Item 3

In every year, there are various seasons which all people rely on to carry out different activities. At the beginning of a year here in Uganda, many people complain about too much sunshine wondering where the sun gets such too much energy from. Such people even wished the sun to die to have peace during the day and others prefer endless nights so that they don't have to deal with the sun. However, some people attributed the sun as the major source of energy on the earth.

Task:

As a physics student explain to the people;

(a) Where the sun sources its much energy from.

(b) Why some people attribute the sun as the major source of energy on the earth.

(c) About occurrence of various seasons and the likely stages that an average star like the sun may undergo to satisfy the wish of some people.

ITEM 4

As a physics student, you are tasked to design a home security light control circuit, the light should be activated by either manually pressing a switch or automatically by a light sensor. The sensor works as follows; when there is sunlight outside, it switches of the light but when there is darkness, it switches on the light. Draw a logic circuit diagram and a truth table for all the possible operations.

ITEM 5

A greenhouse farmer has two sensors in his green house; a temperature sensor and a humidity sensor. The plants in his green house can't give good yields if the temperatures are above 35℃ or if the humidity is high. He wants an alarm to be sounded if the plants are not having appropriate conditions for giving good yields. Using logic circuits, describe how this can be achieved.

Item 6.

In a certain country, a Television (TV) reporter was reporting live near the ocean about the high tides during night time. Viewers in another country were watching the live broadcast of the news bulletin during day time. The viewers wondered how it could be day and night at the same time, and how the event in one country could be watched live on TV in another country.

Task

Using your knowledge of physics, help the viewers to understand;

(a) the possibility of it being day in one place and night in another place.

(b) the occurrence of high ocean tides.

(c) how an event in one place can be broadcast live in another country.

Item 7

One of the most important components of our solar system is the sun. Another important component of our solar systems are the big masses called planets.

(a) Name all the planets found in our solar system.

(b) (i) Identify the planet that sustains life in our solar system.

(ii) How are the times and seasons of the year explained on the planet mentioned in (ii) above?

(c) Explain the statement "the sun has a life cycle".

Item 8

On November 7th 2022, Uganda launched its first satellite named PearlAfricaSat-I into space with the help of National Aeronautics and Space Administration (NASA). The purpose of the mission was to study weather patterns. Students of physics were availed with data collected over a certain of time and they noticed the following while some places were having day time. Other places were having night time. Various places were having different seasons.

Task:

As a learner of physics

a) **Explain why some places had daytime while it was night time at other places.**
b) **Explain why different places had weather patterns and how world- wide communication is made possible through satellites.**

Item 9

One of the most important components of our solar system is the sun. Mathias' father was called by his son who stays in Canada at exactly 8pm. While communicating using video chart he realized Matthias was still walking in sunlight in streets of Canada. This confused the father and asked why it was like that Uganda being night and Canada still in day light. Mathias laughed and told his dad not to even get surprised and added that there are other important components of our solar system with big masses called planets. The dad got confused the more.

As a sibling to Matthias and a learner of physics, help your dad to;

a) Know what is meant by the planet and identify all the planets found in the solar system.

b) Differentiate between the smallest and largest planet in the solar system

c) Identify the planet that sustains life in our solar system and greatest importance of the sun to the people.

d) Realize what causes the difference between a day and night.

Item 10

One of the most misunderstood branches of physics for many years has been space physics (Astronomy). Some of the examples of such misunderstandings include the following.

- The Catholic church at one time thought that other heavenly bodies, including the sun, orbited around the earth, rather than the earth. This was the problem that Catholic hierarchy had with Galileo. For example, the Church tried and arrested Galileo Galilei for supporting Sun-centered view of the universe.

- While watching the world cup which took place in Brazil in 2014 at 9pm East African time, the football fans watching the game in East Africa realized that it was still daytime in Brazil, some of them were puzzled by this?

- While it snows (winter) in most European countries in December around Christmas season, the people in East Africa have never seen any snow fall in East Africa and some of them wondered why it is this way?

How can you explain the above in case one of your classmates, siblings or friends is among those who need enlightenment about these astronomical events in order to promote deeper understanding of physics in the school and community at large?

Item 11

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 color of the bright spots.

Item 12

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

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.

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 13

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 14

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 15

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

Item 16

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 colors. 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:

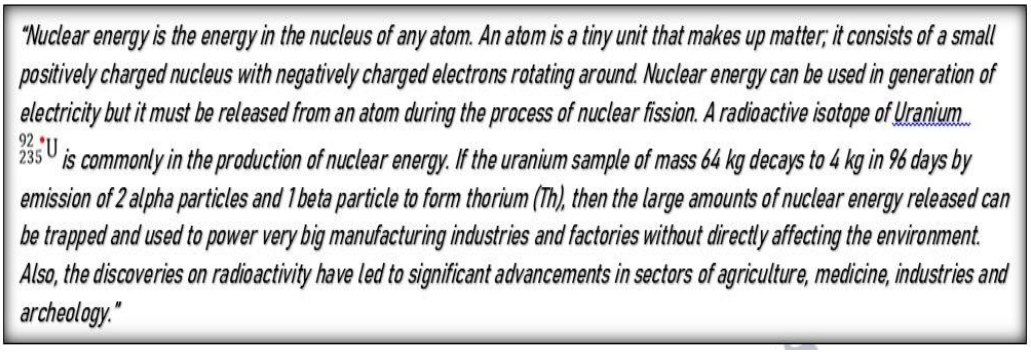
(a) (i) what the observed grey areas that the learners saw represent.
(ii) what the artificial bright spots represent and their significance in the universe.

(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 17

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



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 18

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: -

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- 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: -

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

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

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Task:
In your presentation:

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  (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 20

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

NUCLEAR PROCESSES, ATOMIC MODELS

Item 1

A group of students visited the nuclear power plant and they were blocked from entrance due to an accident that had occurred and several operators were exposed to radiation. Only emergency cars were allowed to enter to transport the operators to the hospital to undergo medical examination, including x-ray scans to assess any potential radiation related injuries. Students wondered how harmful radiations were. It became hard for them to understand even how the power plant could generate electricity after being told at the entrance that the plant was the only source of electricity in that area. If the plant' s radiation monitoring system detects a background radiation level of 30 counts per minute, and when the radioactive source is placed in front of the radiation detector, the reading on the detector is 550 counts per minute and the source has a half-life of 25 minutes.

Hint: The power plant will be safe for use if the detector reads 95 counts per minute.

Task

As a student of physics;

(a) Advise the Power plant team leader on how long they had to wait for the power plant to be safe for use.

(b) Help the students to understand;

(i) the relevant nuclear process at the power plant

(ii) Understand type of radiations emitted at the power plant and their properties

(c) How are the emitted radiations different from x-rays?

(d) Assist learners to appreciate that indeed the guide was right to stop them and explain how the operators managed to be there always.

Item 2

Time (days)	0	22	42	62	82	102	122	142	162
Count-rate	106	83	66	56	47	36	31	26	15

In a certain hospital, a patient has come in with suspected broken bone in their arm, and another patient is scheduled for a dental examination. Your x-ray machine produces electromagnetic waves with a frequency of $6\times1018Hz$. Your supervisor asks you to;

(i) Take an x-ray image of the patient's arm to confirm the bone fracture diagnosis

(ii) Take a dental x-ray to examine the patient's teeth and jaw alignment

HINT

Wavelength of x-rays	5×10^{-11}m	5×10^{-10}m	5×10^{-9}m
Image resolution	High	Medium	low

Task: As a learner of physics;

(a) Comment on the resolution of the image of patients arm and bone fracture.

(b) Explain how the frequency and wavelength relate to the penetrating power of the x-rays and how this affects your choice of settings for the arm and dental exams

(c) Suggest possible precautions taken while dealing with x-ray machines.

Item 3

A certain town experienced an atomic bomb blast, many people were killed in the incidence and others survived with severe injuries, the government advised those survived to re-locate to other places of the country because this village was not safe for them. The scientist carried out a scientific investigation using detectors of radiations and found out that the environment was still radioactive as shown in the table below.

The scientists recommended that the environment will be safe for use again when obtained half-life value is less than 60 days and they will need like 1 year (365 days) for the environment to be free from radioactive wastes and materials.

Task: As a student of physics, use your knowledge to:

a) Help the people to know the value of half-life and advise them accordingly.

b) Sensitize the people about the risk associated with radioactive materials and how they should be handled

c) Help the people to understand the value of number of neutrons of a nuclide Y formed when a radioactive substance X of mass number 208 and atomic number 104 decays by emitting 3 alpha particles, 4 beta particles and gamma rays to form a nuclide Y.

Item 4

In a certain town, people are concerned about the waste disposal from the factory into nearby lake which is their source of water for home use. They raised this issue to the chairperson Local Council 1 (LC1) who directed the management of the factory to stop disposing waste into the lake. A scientist was contacted to investigate the presence of radioactive material in the water. The scientist found out that the water was indeed radioactive as shown in table 1.

Time (days)	**0**	**5**	**10**	**15**	**20**	**25**	**30**
Activity/counts (min^{-1})	**1200**	**740**	**440**	**260**	**160**	**90**	**60**

Although the water from the lake remains radioactive for a long time, the scientist recommended that water will be safe for use again when the activity is less than 38 counts per minute.

Task:

As a student of physics;

a)Advise the chairperson LC1 about the time the community will wait for the water to be safe for use again.

b) Sensitize the members of the community about the risks associated with radioactive materials and how such materials should be handled.

ITEM 5

A senior two boy from a certain school was playing football with other boys, he is a very good striker and while trying to score using the head, he jumped up but unfortunately on landing, the right leg got a fracture. In trying to give him the first aid he felt a lot of pain and Headteacher invited the parents of the boy to come and pick him from the school for hospital in order to trace the broken bone. However the Headteacher promised the parents that the school shall meet all the medication charges and other related costs.

As a learner of physics help the parents to;

a) Differentiate and identify the medical device that the doctors shall use to trace the broken bone.

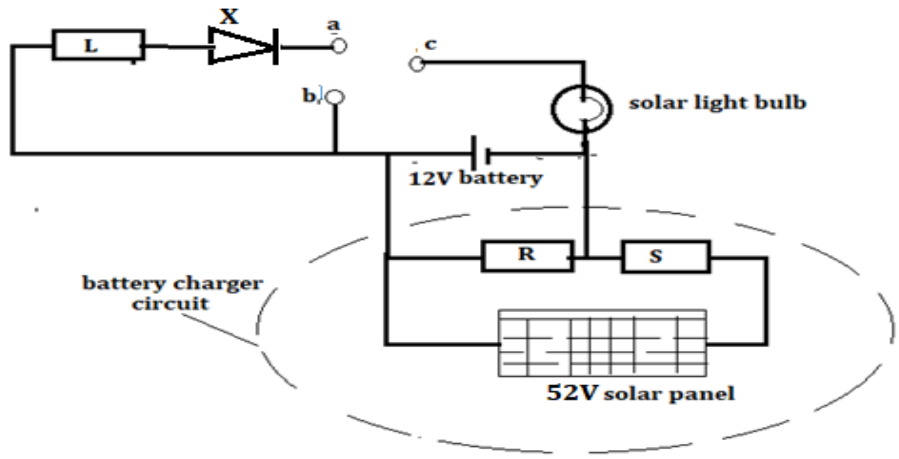
b) Describe the mode of operation of the medical device identified in (a) above.

c) Applications of the device both in industrial and medical other than tracing the broken bone.

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 ***figure1***.



He is not sure if his system will function as required and he has failed to position the remaining the components.

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.

Item 9

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 10

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 11

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 1

During holidays, a boy of mass 50 kg went to a play resort near the lake shores on a certain beach and sat on one side of a see-saw at a distance of 2.4 m from its pivot. It was very hot that day and the diurnal temperatures that were above 420C after afterwards he decided to enter the lake and swim to cool himself. He was wearing heavy black shorts and white vest. After swimming, he was left puzzled and wondering why his heavy black shorts dried quicker than the white vest and beach cottages (semi-houses) roofed with grass instead of iron sheets were cooler than those with iron sheets.

Hint: Specific heat capacity of the boy (human body) = 3.5 kJkg-1K-1

Task:

As a physics student;

(a) Help the guide at the play resort to determine if another boy of mass 40 kg will restore equilibrium in the see-saw if he sits at a distance of 3m from the pivot.

(b) Assist the boy to understand what has made him puzzled and keep wondering.

(c) Determine the quantity of heat lost by the boy if his temperature in the lake was 22^0C.

Item 2

A pump is used to fill a tank by drawing water from underground well to be used at school power house. In order to minimize on power consumption its use for limited time, the pump works at a constant rate of $2.4\ x10^2$W and it's able to raise 0.188 m³ of water every minute through a height of 6m. The cooks complain that it is slow at work. At the power house the cook is always surprised because water pumped in the morning is always above the normal temperature at 30℃ when measured using a thermometer which the cook checks before making morning tea. The pump is said to be efficient if the ratio of its work out put to work input is above 0.75 and the cook boils 9.5*l* of water for morning tea and 500g evaporated.

Support materials

Density of water is 1000kgm-3

Specific heat capacity of water = 4200Jkg-^{1}K-^{1}

Specific latent heat of vaporization of water 2.56×106Jkg–^{1}

Task.

(a) Obtain the rate at which the pump works in raising the water and comment on its efficiency.

(b) Explain to the cooks why water pumped in the morning has such temperature.

(c) How much heat is necessary to turn the lost volume of water into vapour.

Item 3

On a construction site a builder uses an electric lifter to transfer the mortar from the ground to a height of 17.0m on the building. When power went off and work has to continue, the builders got a rope, a pail of negligible mass with a handle that lift a maximum of 20kg of mortar. They want to design a simple machine with a help of a grooved rim which can enable them resume work. Given that the rope has a maximum thermal strength of 3.8kJ.

Hint;

Assume all the potential energy is converted to heat energy

Task.

a) **Help the builders to design the machine and guide the on how it works**
b) **. Advise whether the rope will withstand the heat generated or it will break.**
c) **Suggest the necessary factor to consider that enable the rope to success fully execute the work.**

Item 4

A steel and tube industries company limited was contacted by the school to make a number of new items to restock their kitchen. Among the items on the invoice are; saucepan, strainer, saucepan covers (lids), ladles, cups and plates for students. The school did not specify the type of materials these items should be made of and therefore, the procurement officer of the company their raw materials supplier and the following was supplied following the invoice.

- **Plain sheets of copper**
- **Plain sheets of aluminum**
- **Melamine resin powder**
- **Clay**
- **Wood**

For the production team to come up with the items requested by the school, they have to subject these raw materials to either heat or force however these materials behave differently under these two factors.

Support knowledge.

- **Heat capacity of copper is 400Jkg-1K-1**
- **Heat capacity of aluminum is 900 Jkg-1K-1**

Task

a) **As a physics learner, with reason(s) help the production team to select the raw material suitable for each item to be produced.**

b) Explain at particle level how these materials behave when subjected to either heat or when a force is applied.

Item 5

Workers at a construction site are meant to raise pieces of scrap of mass 6kg through a height of 15m. Their boss always complains that the workers do the work slowly, especially in the afternoon when the temperatures are high and in the morning when it is cold. In response, the workers claim their hands are burnt by the hot metals which slows them down. One of the workers suggested they use a pulley of velocity ratio 4 and efficiency of 80%. The string they used had a mass of 120g and a specific heat capacity of 2510$Jkg^{-1}K^{-1}$, and the work done to lift the load would be converted to heat energy in the string at the contact point of the pulley and the string would break if its temperature reaches 28℃.

Tasks

a) Explain why the metals are very cold in the morning and hot in the afternoon.
b) Draw a design of the required pulley and explain how it can be used to solve their problem
c) Determine the minimum force required to ensure an efficiency of 80% is achieved.
d) Determine if the string suggested above will be suitable for the purpose.
e) Suggest ways in which the efficiency of the pulley system can be improved.

Item 6

During holidays, a boy of mass 50kg went to a play resort near the lake shores on a certain beach and sat on one side of the see-saw at a distance of 2.4m from its pivot. It was very hot that day and the diurnal temperatures were above 42℃; afterwards he decided to enter the lake and swim to cool himself. He was wearing heavy black shorts and a white vest. After swimming, he was left puzzled and wondering why his heavy black shorts dried quicker than the white vest and the beach cottages roofed with grass were cooler than those roofed with iron sheets.

Hint: specific heat capacity of human body is $3.5kJkg^{-1}K^{-1}$.

As a physics student;

a) Help the guide at the play resort to determine if another boy of mass 40kg will restore equilibrium in the see-saw if he sits at a distance 3m from the pivot.
b) Assist the boy to understand what has made him puzzled.
c) Determine the quantity of heat lost by the boy if his temperature in the lake was 22℃

Item 7.

In certain town it's a must for drivers to be tested together with their vehicles for road worthiness. On certain day, a car started from rest and accelerated to 50m/s in ten seconds. The driver maintained that velocity for 20s and suddenly decelerated to rest in 2s making him to crash into the wind screen.

Task:

As a learner of physics,

a) **Draw a graph to show the relationship between velocity and time for the car.**
b) **State whether the driver's average velocity does not exceed the town's speed limit of 8m/s.**
c) **Find the rate at which the car's velocity reduces**
d) **Explain why the driver crashed into the wind screen and how this can be prevented**

Item 8

Zacharias is puzzled because his metallic doors are always very hard to close during day time when it is shining too much, and he says that the same doors are very easy to close in the evenings when the temperatures have lowered by considerable amounts.

Task:

As a Physics learner who understands better, the effect of temperature changes on matter:

a) **Explain the cause and applications of Zacharias' puzzle in our daily life**
b) **Basing on the kinetic theory, explain why liquids expand much more than solids for the same temperature change?**
c) **Explain the Biological importance of the anomalous expansion of water in preserving aquatic life in countries like Switzerland where temperatures go below 0o C, relating to the diagram shown below.**

Item 9

Some bottles of colorless liquids were being labelled when the technicians accidentally mixed them up and lost track of their contents. $\mathbf{15.0}\ \boldsymbol{ml}$ **sample withdrawn from one bottle weighed 22.3 g. The technicians knew that the liquid was either acetone, benzene, chloroform, or carbon tetrachloride. He however has challenges identifying the right chemical to label.**

Hint 1ml=1cm^3

LIQUID	Acetone	Benzene	Chloroform	Water	Carbot etrachl

					oride
DENSITY	**0.792**	**0.899**	**1.487**	**1.000**	**1.595**

a) **What was the identity of the liquid? (Clearly show each step of your work out) .**
b) **Using the table above Name those liquids which can float on water and explain why they float on water .**
c) **Using the table Name those liquids on which water floats on top and explain why water floats on those liquids named.**

Item 10

In your trading Centre, empty mineral water bottles are scattered everywhere, thus causing blockage of trenches. A business man came to your trading Centre to buy empty mineral water bottles and pays according to the mass of each bottle. The businessman only buys bottles whose mass exceeds 30g. Your brother wants to sell his mineral water bottle but wants to know its mass before selling to the businessman and has no access to any instrument measuring mass.

Task:

You are given a metre rule, a knife edge, a 100g mass and two pieces of thread. As a student of physics describe how you will assist your brother to determine the mass of the bottle so that he is able to sell it. In your investigation you find that when a mass of 100g is placed 15.0cm from the knife edge placed at the Centre of gravity of the metre rule, the bottle should be placed 37.5cm for the metre rule to balance. Assist your brother to find out whether the bottle can be sold to the businessman.

Item 11

A certain home owner intends to put up a metallic tank of height 4 m with a maximum volume of 5000 l fitted with an electrical heater which supplies 20,000 kJ of heat energy as shown in figure 1.

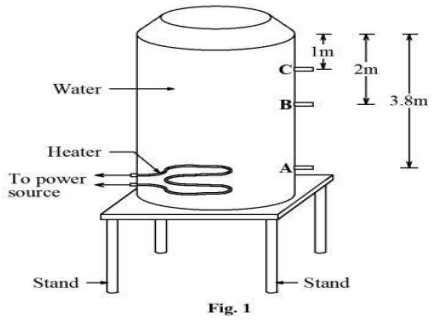


Fig. 1

The home owner found out that the heater was fitted at the lower part of the tank but he did not understand why it was done like that. Just before the hole for the outlet pipe was drilled at point

A, the home owner told the person with the drill that the correct position was either B or C. Task: As a learner of Physics;

(a) Explain to the home owner why;

(i) the electrical heater was fitted at the lower part of the tank and how eventually all the water gets hot.

(ii) the outlet pipe was drilled at point A.

c) If the initial temperature of the water in the tank is 20 o C, help the home owner to find out if the heater is working.
d) Advise the home owner on measures that can be taken to ensure that the tank stand can withstand the weight of the tank and water for a long time.

(Use: Density of water = 1000 kgm-3. Specific heat capacity of water = 4200 J kg-1 K-1. Acceleration due to gravity = 10 ms-2)

Item 12

A certain hotel has its bathrooms situated on the 3rd floor of a building. A customer of the hotel expects to bathe water at 32 o C. The hotel provides 10 litres of water at 20 o C to each customer. A boiler on ground floor heats water to 80 o C for the customers to use. The hotel management does not allow its workers to carry the hot water via the staircase.

Task:

Having studied physics;

a) help the hotel management to determine the quantity of hot water to be given to a customer for bathing.
b) advise the hotel management on how to keep the boiled water hot for a long period of time without keeping the boiler on.
c) explain to the management how the water from the boiler can reach the third floor safely.

(Use: Density of water = 1000 kgm-3. Specific heat capacity of water = 4200 J kg-1 K-1. Acceleration due to gravity = 10 ms-2)

Item 13

A jackfruit of mass 2500g is plucked off fruit the jackfruit tree from a height 4m above the ground and falls freely. The jackfruit accelerated to the ground and hit the ground.

Task.

As a learner of physics;

a) State and calculate the form of mechanical energy stored in the jackfruit before falling.

b) Determine the kinetic energy of the fruit as it hits the ground stating clearly the assumption and hence calculate the velocity with which it hits the ground.

c).Explain why the jackfruit comes to rest after hitting the ground and does not bounce back to the original height hence state the law shown by the behaviour of the fruit.

d) Determine the kinetic energy possessed by the fruit as it passes a point 1.5m above the ground.

Item 14

For man to earn a living, he has to do some work. A certain business man has to climb 20 stairs each of height 20cm to reach out his business store on the first floor of their business Arcade in Kampala city.

Stairs

Task:

As a physics scholar;

a) Help a lay man to understand the meaning of the term "work" and state its appropriate S.I units.

b) If the businessman has a mass of 73.5kg and is holding a bag of mass 1.5kg, determine the work done by the man when climbing the stairs and the power dissipated in 5minutes.

c) Explain why it is easier for the man to move down stairs than climbing them.

Item 15

At a certain construction site in a given town casual laborers were required to raise construction materials to the 3rd level which was 2400m from the ground, they requested for a crane consisting of a pulley system of velocity ratio 7. The operator raised a total load of 40,000N using an effort of 8,000N.

Task:

As a learner of physics;

a) **Draw a diagram to illustrate the pulley system contained in the crane.**
b) **Determine the efficiency of the pulley system.**

c) Explain why the efficiency of the machines is always less than 100% and state how it can be improved.
d) State the applications of pulleys in our daily life.

Item 16

A heap of weed of mass 3 tonnes is moving towards the turbines at the Jinja power station. A group of engineers needs to use a machine operating at 20 kW for five minutes, to remove the weed from the river as shown in Figure and place it at the bank, which is 15 m above the river.

Figure 1

a) Determine the efficiency of the machine and explain its value.

b) Explain how the machine is capable of floating in the water yet it is denser than water.

Item 17

The figure below shows a uniform metallic rod of length 4.0m pivoted at its centre that is used at a certain children's play resort.

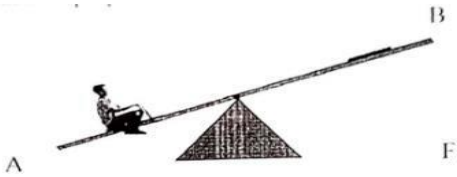


Figure 1

Task:

As a physics scholar;

a)Given that a boy of mass 48kg sits 1.5m from end A. Help the guide at play resort to determine if another boy of mass 40kg will restore equilibrium in the beam if he sits at a distance of 0.6m from the centre.

b)Identify two other instances in which the knowledge in this scenario would be applicable in real life.

c) With the boys off the rod, explain what would happen to the beam if the end B was heated by a considered hot flame.

ITEM 18

Mr. Onyango and Mr. Oketcho had an argument over the width of the path that separates their land. Mr. Onyango claimed that the path is 12 feet wide. However, Mr. Oketcho claimed it was 10 feet. When the chairman intervened, he measured the path with a foot rule and found out that it was 8 feet, after that the three were in disagreement.

Tasks

a) Why did Mr. Onyango and Mr. Oketcho fail to agree on the width of their path?

b) Why do you think the chairman got a different measurement?

c) As a physics learner, how would you solve the disagreement?

ITEM 19

On a hot day, a student dropped three ice cubes at -6℃ in a jug of water at room temperature. If the final temperature of the mixture after all the ice has melted was 16℃

Tasks

a) Sketch a temperature-time graph for the ice. (1 score)

b) Describe the key features of your graph in (i) above. (3 scores)

ITEM 20

Your elder sister has just received his S.6 results and she scored AAA in her combination PCM. He is soon going to apply for a course on Bachelors' degree level at Uganda's greastest University, Makerere. However, your sister is not sure of which career path he should apply for. He needs some one to guide her through the right career opportunity she can persue in future.

Tasks

a) Write down how you can help your sister in identifying all possible suitable physics careers she can Pursue at the Makerere University.

b) Identify the likely challenges and benefits in some of the careers available

ITEM 21

You are to drive **300 km** to an interview The interview is at **11:15 A.M**. You plan to drive at **100 km/h,** so you leave at **8:00 A.M**. to allow some extra time. You drive at that speed for the first **100 km**, but then construction work forces you to slow to **40 km/**h for **40 km**.

a) What would be the least speed needed for the rest of the trip to arrive in.
b) time for the interview?
c) And knowing how dangerous over rushing to beat the deadline can be to your life and other road users, explain how best you can overcome these dangers as you drive on your way to the interview?

ITEM 22

When a VHT ($Village\ Health\ Team$) member visited a patient in Kamwokya Hospital, he had to determine the temperature of the patient before giving the medication.

Tasks

a) As a medical doctor, help the VHT member to identify the points of reference that can help him to calibrate the instrument he has to use to determine the patient's body temperature.
b) The VHT member used mercury in glass thermometer.
c) As a physicist, identify the physical property used by this thermometer. .Why do you think the VHT member chose mercury instead of Alcohol as a thermometric liquid? (Give one reason)

ITEM 23

In your community, there is a village man moving around selling four different objects claiming they are made of Gold. Each object has a known mass. The objects are a tin cylinder, a container cube, a steel spanner and a slicing board. Mugisha wants to buy items for home use but he is not sure where what is buying is purely gold. Help Mugisha make a better choice.

ITEM 24

There is a parent project in your school to construct two rectangular pit latrines. one at the girls 'wing and another at the staff quarter' s wing . However, the Board of Governors and the school administration have failed to agree on the choice of materials to use in construction

Tasks

using the knowledge and skills learnt in ''mechanical properties of materials'' Suggest the choice of materials you would advice the school board to use in the construction of the latrines.

ITEM 25

A maize flour producer located in a certain trading centre in Eastern part of Uganda has heavily loaded his lorry truck with bags of quality maize flour. Before starting the journey that is estimated to be 1800Km and takes 3days to transport and supply maize flour to PEAS schools in the echoes cluster, the producer first checked his truck tyre pressure and temperature which was 600kPa and 15°C respectively in the morning. The producer started the journey early morning and had a stopover along a tarmac road on a hot sunny day and turned off the engine of the truck for some time. As the day progressed temperature in the tyre increased by three times the initial temperature and the nearby community had a blast of a bomb and they were all scared after a short time of parking by the producer.

Task

As a Physics student;

a) Help the producer to determine his average speed for the journey in ms−1.
b) Support the producer to know the final temperature in kelvins and pressure of the tyre.
c) Explain to the producer why the truck tyre had to burst.
d) What safety precautions should the producer have taken regarding tyre pressure and temperature before embarking on the long journey especially on a hot day?

Item 26

Jacob a student in a certain school in Fort Portal tourism city is a class counselor who is responsible for picking books from the library to classroom. The library is a temporary structure made up of tents painted black. Jacob normally runs to reach the library because of the big distance from the classroom, one day he ran from class via main hall up to a velocity of 5m/s in 10s to reach where the library is. However after picking books he got tired and rested in the library for 20 seconds.

While in the library he felt uncomfortable and returned back to class and reached in 10s. The following lesson he ran from class via science laboratory and reached the library with a velocity of 5m/s in 5s. He picked books and also rested for 20s then he came back to class in 5s. 4

Task

As a student of physics,

a) Advise Jacob the shortest route he should take so as to minimize wastage of

time and explain why?

b) Explain to class members what could be possible reasons why the counselor felt uncomfortable while in the library

c) Advise the school the kind of structure they should put up for the school library and explain why?

ITEM 29

Faisal constructed the latrine for his tenants but People from the neighborhood are complaining about the bad smell from the latrine.

Support

TASKS

a) **Why do you think people who are not inside or near the latrine are getting the smell?**
b) **People also reported that on cold days the situation is worse than on hot days. They are wondering why this is so. Give a reason why this is like that.**
c) **Which advice do you give to Mr. Faisal?**
d) **Give two applications of the above mechanism that makes the smell of the latrine to be in the neighborhood in rest life?**
e) **Its known that a stone can move more freely in air than in liquid. Using your knowledge of states of matter, explain why that happens.**

Item 30

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

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 31

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 32

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 33

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 34

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 35

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 36

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 ^{0}C*
- *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 37

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 $= 900Jkg^{-1}K^{-1}$

Specific heat capacity of water $= 4200Jkg^{-1}K^{-1}$

Density of water $= 1000kgm^{-3}$

ELECTRICITY AND MAGNETISM

Item 1

In a certain place, a house was connected to a 240V mains voltage supply and the owner wished to connect a TV set rated 120V, 75W, a flat iron rated 120V, 600W, an electric bell of resistance 5 ohms that would instantly produce sound to alert the house owner about the visitors at the gate

when a switch was pressed, and 4 bulbs rated 120V, 60W either in series or parallel connection for lighting purposes. The house owner also bought a Power King extension with a fuse rated 5A, where he plugged in his TV set and Flat iron. The T.V set is operated for 5 hours per day.

Task:

(a) Comment on the effectiveness of the fuse in the extension if it would support the above electrical appliances when plugged in the extension altogether.

(b) Assist the house owner to know in which way to connect his bulbs in the house and explain why?

(c) Explain how sound was produced when a switch was pressed.

(d) Determine the amount of money required to keep the T.V operating the whole day, if the electricity rate is Ugsh. 680 per kWh.

Item 2

In a certain school, students visited a hydroelectric power plant and received information that electricity at a dam is generated in form of alternating current (a.c) at 12kV but transmitted at 400kV using aluminum transmission cables yet in the physics laboratory electricity can be generated as direct current (d.c) using dilute sulphuric acid and two electrodes of copper and zinc where a filament is connected and after sometime its brightness fades. However, learners are confused about how voltage is increased and have questions how a.c is used to charge a mobile phone yet it is only d.c that can be used to charge mobile phones.

Task:

a) **Explain how voltage is changed from 12 kV to 400 kV**
b) **Explain how a.c from the dam is used to charge a mobile phone.**
c) **Determine the current in the transmission cables, if 10% of its energy lost in changing its voltage, if the current before the change is 20 A**
d) **Explain why the brightness of the bulb faded and how it can be restored.**

Item 3

A factory produces small metallic tanks for storing paint and uses a magnetic lifting device to move tanks around the factory and packing them in lorries for delivery. One construction company ordered for large size tanks. However, after manufacturing them, the magnetic lifting device failed to lift the tanks due to their increased weight. Even the packed tanks were found attracted to the other. The same day the factory engineer wasn't available which left the attendants puzzled on how to ensure delivery is made in time.

Support material: A strong electric battery, copper wires, iron rods, current controllers (variable resistors)

Tasks

As a physics student;

a) **Advise the attendants on how and which device they can design to effectively load them on lorries for timely delivery.**
b) **Explain how the strength of the device used for loading can be improved.**
c) **Explain why is that the tanks were found attracted to each other upon delivery**
d) **Advise the construction company on how they will be able to separate the tanks that are in contact.**

Item 4

The welders in a certain workshop are troubled with their tools being shocked by electricity from a generator of 240V. When they visited a technician, they were advised to wind a copper wire to 3000 turns around a soft iron ring on the receiving part so as to output 120V suitable for their work shop operations fixed in a box. However, the welders seem bothered of how this will be of help.

Task

As a learner of physics,

a) **Explain to the welders how the above design will produce power corresponding to their consumption.**
b) **Help the welder to determine the number of turns to be would on the output part of the device.**
c) **Comment on how efficient the device is if the ratio of current output to current input is 1.5 . Advise the welders on how to improve the efficiency of the device.**

Item 5

A certain household has a set of appliances as listed in the table below.

Appliance	**Power rating**	**Time of use**
4 bulbs	**20*W* each**	**13 hours every day**
Cooker	**2500*W***	**4 hours every day**
Flat iron	**1500*W***	**5 hours every week**
Electric fence of low resistance wire	**2200*W***	**10 hours every day**

While making the budget, the owner of the household was confused of how much money would be required every week to cater for the electricity bill. He was also confused on how the sockets for the appliances should be connected to ensure high current flow and why low resistance wire is

used instead of high resistance wires. The owner intends to spend sh.50000 on electricity every week and each unit of electricity costs shs.600.

Use the knowledge of physics to;

a) Determine if sh.50000 would be enough to cater for the electricity bill for the week.

b) Explain how the sockets of the appliances should be connected to ensure maximum current flows.

c) Explain why low-resistance wires are used for the electric fence.

d) Suggest measures on how to reduce the electricity bill.

Item 6

During a science project, learners are told that electricity at a sub-station is transmitted at 13kV with a current of 0.05A using thick aluminium wires for use inside a house at a voltage of 240V. The house has two television sets that operate on direct current but should be connected such that they receive maximum current and function properly. The learners, however, couldn't get an explanation of the issues mentioned.

Tasks

Use your knowledge of physics to;

a) Understand how the voltage is changed from 13kV to 240kV.

b) Why thick aluminum wires are used during power transmission.

c) Determine the current in the house if 20% of the electrical energy is lost during voltage change.

d) Account for the energy losses as the voltage changes and how these losses can be reduced.

e) Understand how the current used in the TV is changed from alternating current(AC) to direct current (DC)

f) How the television set should be connected to ensure they receive maximum current and function properly.

Item 7

Small pieces of metal which are unsafe to be eaten by chicken were found in feeds that had just been bought from a milling company by a poultry farmer. The small pieces of metal were later identified as iron. The farmer thought of disposing off the feeds but remembered that the pieces of metals could be sorted with a magnet which he did not have.

Hint:

A nail connecting wires of resistance 0.5Ω, two dry cells each of 1.5V were available to the farmer.

Task: As a student of physics;

a) **Help the farmer to remove the pieces of iron from the feeds.**
b) **Comment on the effectiveness of what you have designed, given that current of 4A is enough to create a strong magnet.**

Item 8

In a certain place, electricity is transmitted at 120V. A business person intends to connect 4 bulbs in a house rated 240V, 60w each and other domestic electrical appliances such that there is minimum power wastage. The business person has been advised to purchase a transformer of suitable specifications to achieve the objectives. The business person does not know what a transformer is, how and is bothered by the type of transformer that should be purchased.

Task: As a student of physics, help the business person to solve the problems he/she is faced with.

Item 9

In your neighborhood two tenants A and B, living in adjacent rooms but in the same house have a conflict whenever tenant A switches on her electric stove to start cooking, the bulbs in the room of the tenant B go dim. This has brought about brought about conflict between the two tenants. The conflict has been reported to the land lord who is finding it hard to solve the issue. The land lord has requested for your help to address the matter.

Task As a student of physics;

a) Write an explanation to the landlord on the root cause of this problem. *(8scores)*

b) Using diagrams, suggest a possible solution to the problem.

ITEM 10

One rainy day one of your community members was struck by lightning and his body was having third degree skin burns and deep wounds. Most community members claimed it was witchcraft, maybe they are right or there maybe another better explanation to this scenario using knowledge of states of matter.

Task Explain to the community members what state of matter lightening is giving three more examples of other substances that fall in the same state of matter as lightening

ITEM 11

During heavy rainstorms, most people seek for shelter under the nearby homestead whereas others may opt for the following risky measures.

❖ standing on people's **verandas** for fear mostly of getting wet.

❖Some people however may find themselves on the **BODABODA** and they just want to continue with their journey not knowing what risks involved:

❖ A few people tend to take **shelter under the tall trees**.

Some school children even dare to continue enjoying their **football games** in open soccer fields still not worried of the risks involved.

❖ Some people take shelter in very tall buildings which does not have a lightening

conductor.

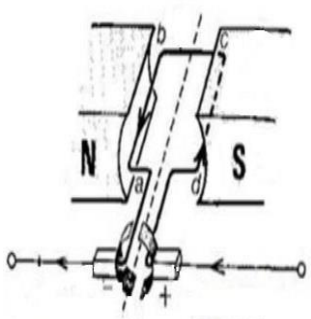



As a student of science in the science club of your school, you have been selected

to present to the community meeting during the termly **community awareness** week of your school. Write a clear well explained presentation on the possible reasons why the above the above-mentioned group of people are putting their lives in danger and in each case suggest the possible preventive measures that can be undertaken to address/minimise/overcome the dangers you have stated.

Item 12

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 13

Your neighbor bought an electric kettle and connected it the first time to a power socket to boil 2 kg of water. Immediately, the neighbor heard a small explosion in the kettle and it stopped working. The neighbor 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 neighbor 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 14

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 15

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 16

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 17

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 18

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 meter 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 19

A land-lady was recently told that electricity from a power substation is transmitted at 12 kV using thick aluminum 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.

END