535/1
PHYSICS
Paper 1
2024
2½ Hours

NTM MOCKS 2024
For the future

UGANDA CERTIFICATE OF EDUCATION

PHYSICS

Paper 1

Theory **2 Hours 30**
Minutes

INSTRUCTIONS TO CANDIDATES:

*This paper consists of **two** sections; **A** and **B**. It has **seven** examination items.*

*Section **A** has **three** compulsory items.*

*Section **B** has **two** parts; **I** and **II**. Answer **one** item from each part.*

*Answer **five** items in all*

Any additional item(s) answered will not be scored.

*All answers **must** be written in the answer sheets provided.*

Turn over

Item 1

The attendant of a swimming pool that is located between two tall buildings screamed loudly when the phone he was holding accidently fell in the swimming pool. The attendant was confused when he heard himself twice after screaming and wondered whether someone was repeating after him. On looking down into the water, the phone appeared nearer to the water surface. When he tried to pick it with his hand, he could not reach it.

Task.

As a student of physics, help the attendant understand why:

(a) He heard himself twice after screaming.

(b) He was unable to reach his phone with his hand yet the phone seemed to be near to the surface of the water in the pool.

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

The attendant heard himself first after **0.15 s** *and then again* **0.05 s** *later.*

Item 2

In some part of Uganda, people have been ordered to vacate their area and relocate to other parts of the country in anticipation of heavy rains in the coming months that are likely to cause flooding and landslides. The Local Council (LC) authorities have been requested to sensitize the people about this issue. However, the LC authorities are experiencing difficulties in explaining to the people:

(i) Why rains will be experienced in their area while other parts are experiencing dry seasons?

(ii) How is it possible that weather patterns can be accurately predicted before they occur?

Task:

As a student of physics, help the LC authorities understand what causes the different seasons and how weather forecast is accurately possible so that they can ably explain to the people.

Item 3

In a certain town, the amount of water reaching the people for use in homes has reduced and they are worried of water scarcity in the near future if this is not rectified. The authorities would like to rule out or confirm if there is any leakage in the underground water supply pipes that could have brought the pressure change at the taps in homes.

Table 1 and **Table 2** show the materials available for use in the process of checking for the leakage underground.

Table 1

A penetrative radioactive sample	*Activity /counts per minute*	*Half-life*	*Solubility in water*
P	*1000*	*22 hours*	*Very low*
Q	*800*	*36 days*	*low*
R	*600*	*15 hours*	*Very high*
S	*400*	*25 minutes*	*high*

Table 2.

Detector	*Counter*
Spark counter, Cloud chamber *Geiger Muller tube*	*Rate meter, Scaler*

Task.

As a student of physics, select with reason the:

(a) Appropriate materials from the tables and design the method that can help the people to find the location of the leakage.

(b) Advise the people about the time they will need to wait before using the water again.

Hint: Water will be safe for use again if the activity is below 38 counts per minute.

(c) Sensitize the people about the health hazards associated with the use of radioactive materials and how these health hazards can be minimized.

SECTION B

PART 1

*Attempt **one** item from this part.*

Item 4

The Head teacher of your school recently acquired a portable electric bell for use in office to quickly alert the secretary whenever he wants to make some inquires. Unfortunately, the bell did not work as expected. After opening it up, the headmaster discovered that it was missing a major electrical component. **Figure 1** shows the electric bell as found by the head teacher.

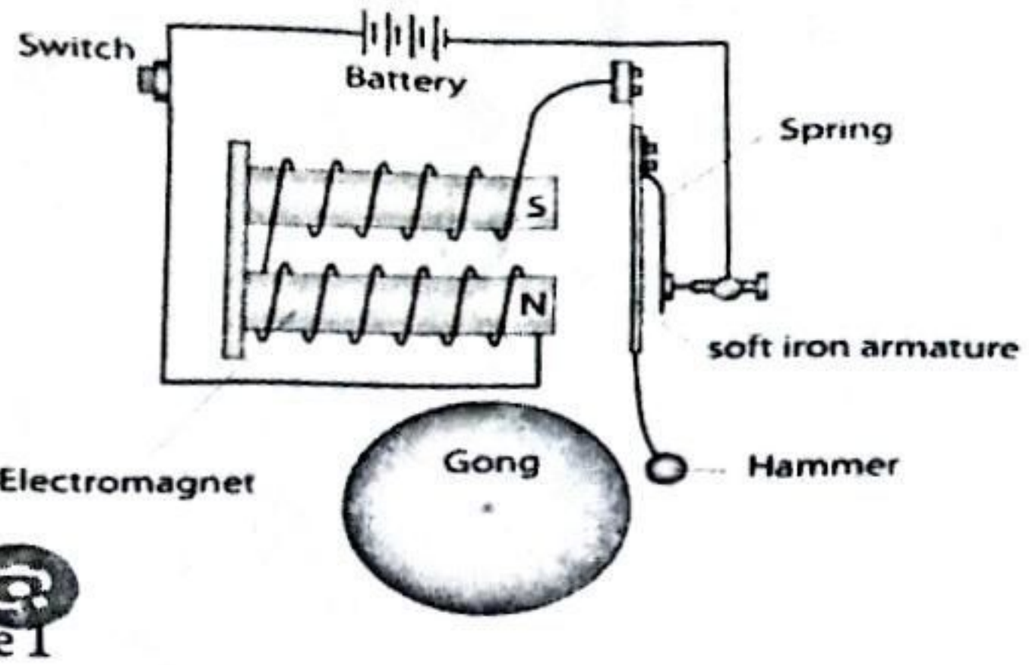

Figure 1

As a student of physics help the head teacher:

(a) to solve this problem through identifying the missing component and preparing an alternative one.

(b) understand how the electric bell will work.

(c) Comment on the effectiveness of this electric bell basing on what you have designed if a current of 0.5 A is appropriate for this type of electric bell.

Hint: You may use a long connecting wire of resistance 12 Ω and a 3-inch nail.

Each dry cell has an Emf of 1.5 V and negligible internal resistance.

Item 5

A student bought a small chargeable radio for use at school. However, the student discovered that whenever he turns it on when plugged in the electrical sockets, all metallic parts of the radio including its antenna are electrified and this is a dangerous occurrence since it may lead to electrocution. After opening the radio to check for the problem, it was discovered that there was no inbuilt transformer with in the radio.

Figure 2 shows the diagram indicated inside the radio where the transformer should have been.

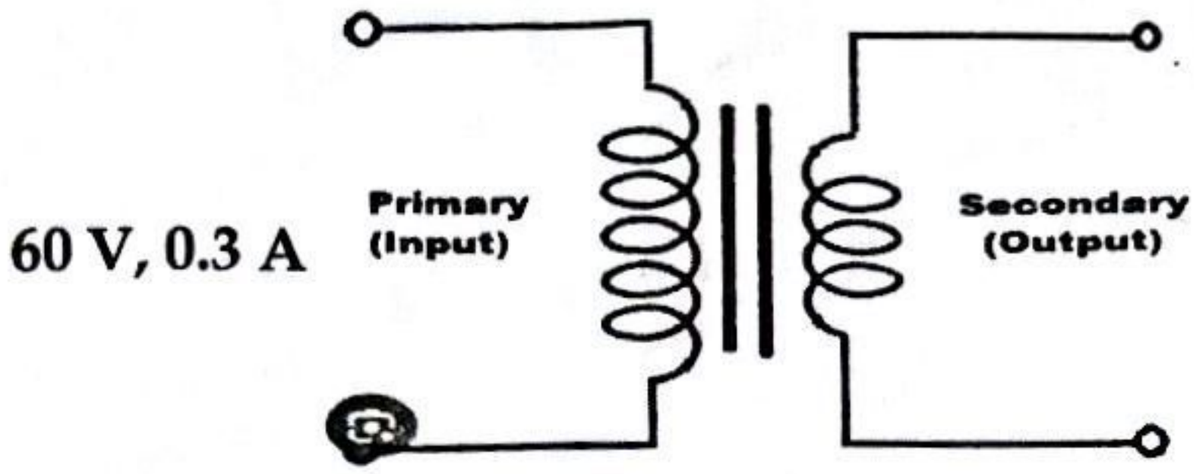

Figure 2

Task:

As a student of physics help the student to understand

(a) why there was electricity in the external parts of the radio.

(b) What should be done to rectify the problem

(c) Help with the design and specifications of a transformer that can help solve the problem and how a transformer works.

(d) A transformer will be reasonably effective if it is at least 75 % efficient. Comment on the effectiveness of the transformer model in figure 3.

PART II

*Attempt **one** item from this part.*

Item 6

The owner of a nursery school intends to put up a swing in the children play area. She has been advised that as the children swing, the maximum mechanical energy attained should not exceed **375 J** for any child as swinging from high heights can cause some health complications. The owner does not know mechanical energy and the maximum height through which the swing is displaced in order not to exceed the **375 J**. She wants to know the maximum speed with which a child moves during swinging.

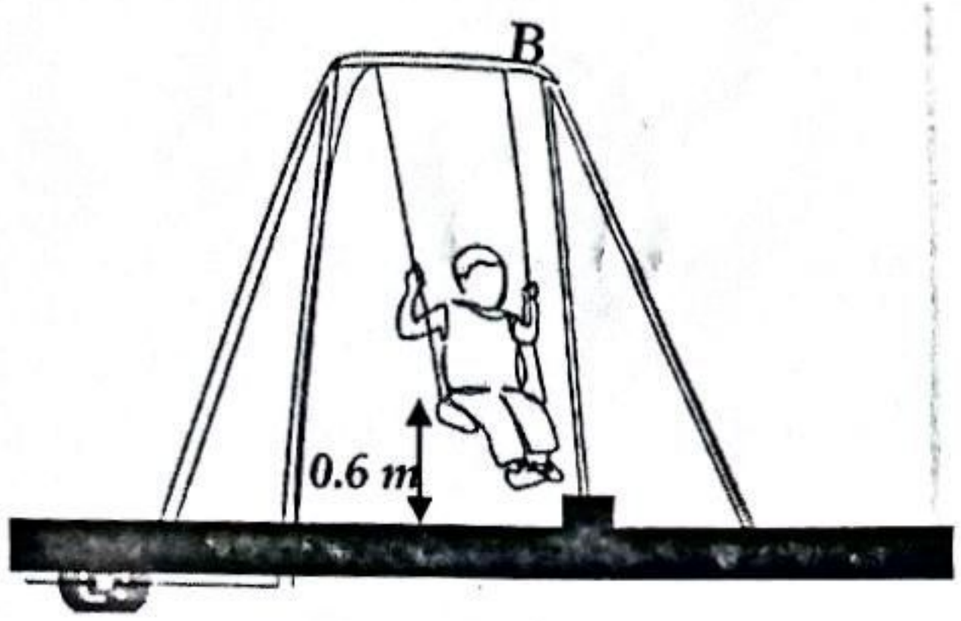

Figure 3

The owner has been made aware that heat will be produced at the contact points **A** and **B** during the swinging and if not regulated it may accumulate to harmful levels. In fact, if the temperature at these points exceeds 48^0 C, the rope may burn. Figure 3 shows the model of the swing.

HINT: All the mechanical energy transforms into heat at the contact points.

Average temperature at the contact points before swinging = 22^0 C

Heat capacity of the material of the rope = 20 J K^{-1}

Average mass of each child = 25 kg

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

Task

As a student of physics, help the owner:

(a) understand what mechanical energy is
(b) know the maximum height a child needs to be raised through from equilibrium position
(c) the maximum speed with which the child moves as he or she passes the equilibrium position.
(d) Why heat is generated at the contact points and how it can be minimized.
(e) In the above conditions advise the owner whether the material of the rope is appropriate for use.

Item 7

In a certain area, a farmer's goat fell in an underground water tank pit that was left uncovered. A worker in the farm has been tasked to remove the goat from the pit but the goat is too heavy to be removed by carrying it on the ladder. The worker has been provided with **two pulleys** and a **long strong string** among other materials to help in lifting the goat from the pit. The string will burn and break if the temperature at the contact points exceeds 59^0 C.

Hint: All the work done in lifting the goat from the pit transforms to heat energy at the contact points.

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

Heat capacity of the material of the string = 102 J K^{-1}

Mass of the goat = 65 kg and the initial temperature at the contact points is expected to 22 ^{0} C

The pit is 5.5 m deep.

TASK:

As a student of physics, Help the worker:

(a) with an appropriate design of a system that will help him to remove the goat from the pit.
(b) Why some heat will be generated and how it can be minimized.
(c) To determine whether the material of the string is appropriate for use.

END