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PHYSICS
Paper 1
July - August 2024
2½ hours

KAMPALA INTEGRATED SECONDARY SCHOOLS EXAMINATIONS BUREAU

KAMSSA

KAMSSA JOINT MOCK EXAMINATIONS

Uganda Certificate of Education

PHYSICS

Theory

Paper 1

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 booklets provided.*

SECTION A

Answer all the items from this section

ITEM 1

A student putting on a blue shirt and a yellow trouser stand between two vertical walls. He makes a loud sound while seeking for help. He hears the first echo after 2 seconds and the second echo after a further 3 seconds. Three members of the rescue team arrived to help. Each of them had a torch producing red, green and white light. The colors of his shirt and trouser changed when light was shone on him at a time. This brought confusion among these students.

Hint: speed of sound in air = $330ms^{-1}$.

Task

As a learner of physics, help these students to understand;

(a) The origin of the two echoes.

(b) The distance between the walls.

(c) Why the color of the student's clothes changed when colored lights flashed on them.

ITEM 2

An archeologist discovered a material in the field. He got the sample of it which was monitored using a Geiger muller tube and the following data was obtained.

Count rate (counts per minute)	800	500	350	200	80	25
Time (minutes)	0.0	1.0	1.8	3.0	5.0	7.5

He did not know if this material was radioactive until he got the above data. He had just handled the sample with bare hands thinking it was safe.

Task

As a physics student;

a) Help the archeologist to know the half-life of the material.

b) Help the archeologist to know the possible health hazards he is likely to face since he handled the sample with bare hands.

c) Advise the archeologist on how to handle such materials in future.

ITEM 3

In 2014, Brazil hosted FIFA world cup where different countries participated in the tournament. Some countries such as Uganda did not qualify for the tournament and hence had to watch the matches live on their TV screens. In one of the games, it was evident that it was day time in Brazil yet in Uganda it was night time which puzzled John as he was watching the game live on TV, during the same period of world cup tournament (12^{th} June to 13^{th} July of 2014) it was winter in Brazil which weather affected some of the participant nations in the tournament.

More support information

At John's home there was a satellite DSTV dish.

Task

Using physics knowledge;

a) Help John understand the cause of night in one country for which it can be daytime in another country.

b) Explain the cause of variations in seasons.
c) Explain how communication was possible in this situation.

SECTION B
PART I
Attempt one item from this part

ITEM 4

A young man is planning to build his first house in life. He has no experience in construction work. He approaches an engineer who recommends him to buy the following materials for the foundation of the house:

- Steel bars (Hollow type)
- Dump proof course
- Clay bricks
- Cement
- Gravel

After construction of the foundation, he has to hire a casual worker who uses a force of 80N to push 50kg of soil along a piece of timbre which is 15m long to fill the foundation with soil. The height of the foundation is 2m from ground. The young man complains that these materials are many and some of them should be removed.

Using the knowledge of physics.

a) Explain to the young man why
   (i) Damp proof course is important in this work.
   (ii) Hollow steel bars are necessary
b) Advise the man on how the foundation should be made stronger and stable.
c) Determine the efficiency of the system used to fill the foundation with soil.

ITEM 5

A person has hosted five visitors at his home who are to stay for a night. He has started the process of preparing warm water for bathing. He has an electric kettle of capacity 5 litres. He switches on the electrical heater plugged in the kettle at its bottom and waits until water boils at 100^0C.then the heater switches off automatically. He now mixes this hot water with 20litres of cold water initially at 10^0C.

Support

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

Task

As a physics learner;
(a) Advise the host if the temperature of the mixed water is not too high for water to burn the visitors given that the best bathing water should be at 15^0C.
(b) Suggest the number of liters to be used by each visitor if all of them are to use the same quantity of mixed water.
(c) Advise the person on how to keep this mixed water warm for a long time since all the visitors are to use the same bathroom one at a time. Explain your answer.

PART II
Attempt one item from this part

ITEM 6

A person wants to know how much money he should pay monthly after using the following appliances in his home. He has an electrical iron rated 240V, 1000W, a television set rated 240V, 50W, a fridge rated 240V, 100W and two computers each rated 240V, 50W. He switches on the appliances for two hours daily at once. He has to determine the size of the circuit breaker needed to keep these appliances safe.

Support: A unit of electricity costs Ugandan Shs.500

Task

As a physics student;

(a) Help the person to know his monthly bill

(b) Help the person to know the size of the circuit breaker needed and its importance

(c) Advise the best way of connecting the appliances for optimal use

ITEM 7

Small metal pieces are dangerous to be eaten by human beings. However, most of the ground nuts paste on market contain small pieces of these metals from old grinding machines made of iron. Each family is advised to have a mechanism of removing these metallic pieces.

Hint

You are provided with a nail, connecting wires of total resistance 1.6 Ω, 2 dry cells each of e.m.f 1.5V and internal resistance 0.2 Ω, a double cell holder and an insulated copper wire.

Task

As a physics student;

(a) Set up a mechanism for sorting the iron pieces from ground nuts.

(b) Comment on the effectiveness of the designed set up given that current of 2A is enough to create a strong magnet.

(c) Suggest how you can make this magnet stronger.

END

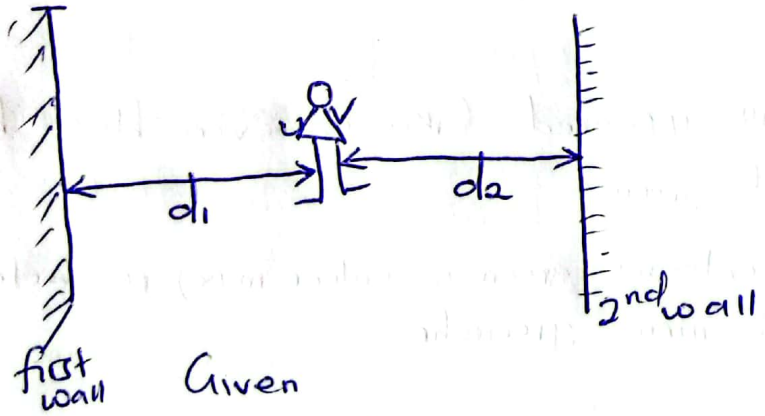
KAMSSA PHYSICS 1 MARKING GUIDE

PROPOSED SCORING GUIDE

ITEM 1

(a) Echo is reflected sound. It is produced when sound is bounced back off the reflecting surface such as a wall.
- When the student made loud sound, the sound was reflected off the two vertical walls creating the two echoes she heard.

(b) Distance between the walls



Given

$t_1 = 2s$, $t_2 = 3s$

speed of sound = 330 m/s

Sound (echo) travels total distance = $2d_1$ to wall and back to the student

for first wall, $D = SXT$

$$\frac{2d_1}{2} = \frac{330X2}{2}$$

$$d_1 = 330\ m$$

For second wall

$$2d_2 = 330X3$$

$$d_2 = \frac{330X3}{2}$$

$$d_2 = 495\ m$$

Distance between walls $= 330 + 495$

$= 825\ m$.

(c) The clothes of the student changed colour because of their ability to absorb and reflect light. Therefore the clothes changed colour due to their interaction with colour pigments in the flashed lights.

Under red light.

The blue shirt absorbed most of the red light and reflected very little thus appearing dark or black.

The yellow trouser (mix of red and green) ~~with~~ reflected the red light thus the trouser looked more redder or even orang

Under green light

The blue shirt ~~with~~ appeared darker or even black becau blue doesnot reflect green.

The yellow trouser (contains green in colour mix) reflected green and appeared more greenish

Under white light

White light contains all visible colours of the spectrum. Therefore, the blue shirt reflected blue light and absorbed o other colours.

The yellow trouser reflected yellow (red and green) ~~and absorbe~~. Ther the clothes appeared as their original colours.

ITEM 2

(a) Plot a graph of activity against time, then read the time that corresponds to 400 counts per minute as $T_{\frac{1}{2}}$.

(b) Possible health hazzards

- Radiation burns
- Skin Cancer
- Radiation sickness eg vomiting nausea, fatigue and fever
- Bone marrow
- DNA mutation (Damage)
- Leukemia
- sterility
- Immune system suippression
- Bone damage ~~et~~

(c) - Use of personal protective equipments.

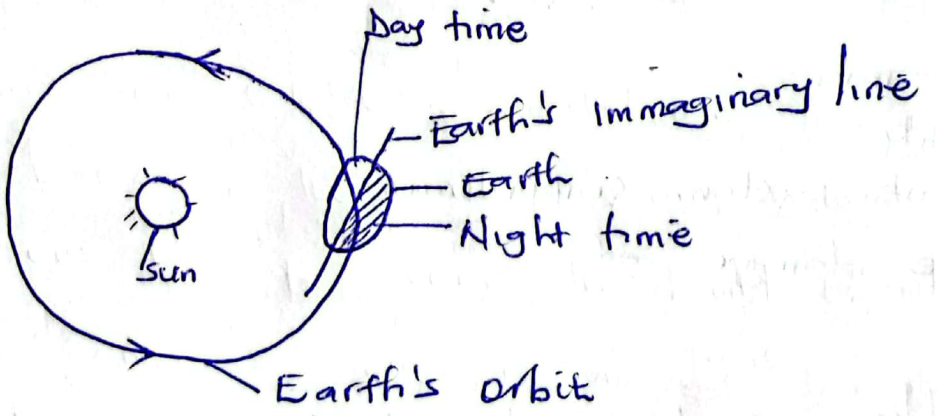
- Minimise time of exposure to radiations
- Maintain safe distance away from radiations
- Proper storage of radioactive materials.
- Avoid eating, drinking and smoking in areas with radiations
- Regular health monitoring
- Have enough training before handling radiations.
- Follow proper disposal of radioactive materials.

Item 3

b) Occurance of day and night simultaneously.

Day and night is caused by the Earth's rotation round its axis (spinning) as it rotates (orbits) the sun.

- The Earth takes 365 or 366 days to rotate round the sun but in so doing it also takes 24 hours to spin around its axis.
- As the earth orbits its axis, the part of it facing the sun receives direct sunlight for 12 hours hence day time.
- At the same time the opposite part of the earth facing away from the sun receives a shadow (darkness) for 12 hours hence night time.



(b) Varitations in season is as a result of the tilt as the earth rotates round the sun. The earth is tilted to about $23\frac{1}{2}^{0}$ on its axis relative to ~~the~~ its orbit round the sun. This tilt causes different parts of the Earth to receive varying amounts of sunlight throughout the year.

Item 3 (b) continued - - -

- Around 21st June in the Nothern Hemisphere, the North pole is tilted towards the sun while south pole is tilted away from the sun. This means that Northern Hemisphere receives more direct sunlight resulting into warmer temperatures and longer days than Southern hemisphere; therefore the Nothern hemisphere experiences Summer season.
- Around 21st december in Nothern hemisphere, the situation is reversed. The North pole is tilted away from the sun while south pole is tilted towards the sun.
- The Northern hemisphere experiences cooler temperatures and shorter days than southern hemisphere which receives more direct sunlight. Therefore, the Northern hemsphere experiences winter season and Summer season in Southern hemisphere.
- Around 21st March, and 23rd September, the Earth is positioned such that neither hemispheres is tilted towards or away from the sun.
- This results into equal length of days and nights worldwide leading to Vernal (spring) and autum equinoxes. During these times, the whole World experience a transition between warmer and cooler seasons.

(c) The Communication happened with the aid of a Communication satelite and broadcasting technology to transmit live event across the World as explained below

- During the World cup match, Cameras and Microphones at the stadium Captured the videos, audios and images of the match in real-time.
- The signals captured were then sent to the production Centre and prepared for broadcast.
- The processed broadcast signals were then sent to the Satelite uplink station in Brazil.
- The uplink station then sent (transmitted) the signals to the communication satelite orbiting the Earth. This satelite is positioned in a geostationary orbit (it stays in fixed position relative to earth's surface)
- The communication satelite in geostationary then retransmitted the signals back to the Earth covering a wide area including various regions around the World Uganda inclusive
- The signals sent to various regions were then received by John's DSTV satelite dish at his home in Uganda.
- The signals were then sent into John's DsTV decoder which converted the signals into a format that can be displayed on John's screen.
- This allowed John to watch the Match as it is live in Brazil.

ITEM 4

(i) Importance of Damp Proof Course (DPC)

The Damp Proof Course is a crucial element in construction especially for the foundation of a house.

- It serves as a barrier to prevent moisture from the ground from rising up through the walls of building by capillary action. This intern prevents problems such as weakening structure over time.
- It increases building's longevity (life span)
- Maintains Indoor air quality
- It prevents rotting of wooden components such as floorboards by preventing exposure to moisture
- Prevents paint and plaster damage

(ii) Necessity of Hollow steel bars

- They provide high strength for being lighter and more cost effective than solid bars.
- They allow better load distribution which reduces overall weight of the structure.
- They are more resistant to torsional forces making them Ideal for constructing foundations
- They are cost effective
- They are flexible (versatile) since they have many shapes
- They have higher moment of inertia compared to solid bars hence enabling them to be resistant to bulking

(b) Advise on strengthening the foundation.

- Use high quality materials such as cement, gravel and steel bars
- Proper mixing ie use a proper cement-water ratio, water-sand ratio and gravel.
- Reinforcement through use of steel bars especially dur construction of foundation
- Foundation depth should be enough to reach stable soil.

(c)

Work input = Force x distance

= 80 x 15

= 1200 J

Work output = potential energy needed to lift soil to height h = 2m

= mgh

= 50 x 9.81 x 2

= 981 J

Efficiency $\eta = \frac{\text{Work output}}{\text{Work input}} \times 100$

$= \frac{981}{1200} \times 100$

$= 81.75\%$

ITEM 5

(a) Given that $C_w = 4200\ J\,kg^{-1}K^{-1}$

$\rho_w = 1000\ kg\,m^{-3}$

Initial temperature of hot water $= 100^\circ C$

final temperature of mixture $= \theta_2$

Initial temperature of cold water $= 10^\circ C$

Volume of hot water $= 5$ litres

$= 5$ kg since $\rho = 1000\ kg\,m^{-3}$

Volume of cold water $= 20$ litres

$= 20$ kg

Amount of heat lost by hot water = Amount of heat gained by cold water

$$M_w C_w (100 - \theta_2) = M_w C_w (\theta_2 - 10)$$

$$5 \times 4200 (100 - \theta_2) = 20 \times 4200 (\theta_2 - 10)$$

$$2100,000 - 21000\theta_2 = 84000\theta_2 - 840000$$

$$-21000\theta_2 - 84000\theta_2 = -840000 - 2100000$$

$$\frac{-105000\theta_2}{-105000} = \frac{-2,940,000}{-105000}$$

$$\theta_2 = 28^\circ C$$

The water would not be safe for bathing since $28^\circ C > 15^\circ C$ which is the best basing water temperature.

(b) Total amount of water available = 20+5 = 25 litres
Available visitors = 5 visitors

Amount of water per visitor = $\frac{25}{5}$ = 5 litres of mixed water

(c) - Use of insulated container or thermal bath to reduce heat loss
- Cover the container to minimise heat loss through evaporation and convection
- Ensuring bathroom is warm so that the water cools down slowly.

ITEM 6

(a) Power Consumed = 1000W + 50w + 100w + 2x500 w
= 1250 W

Converting to Kilowatts = $\frac{1250}{1000}$ = 1.25Kw

~~Power~~ Consumed
Daily electricity consumption = 1.25 Kw x 2 hrs
= 2.5 Kwh

Monthly electricity Consumption = 2.5 x 30
= 75 Kwh

Monthly bill = 75, Kwh x 500
= 37500 shillings

(b) Given that all appliances use 240 V,

Total power consumed by appliances = 1250 kJ

Then

From $P = IV$

$$\frac{1250}{240} = \frac{I \times 240}{240}$$

$$I = 5.21 \text{ A}$$

The circuit breaker needed should not allow current of more than 5.21 A to pass through it. Therefore a circuit breaker of 5.21 A or below is recommended for use to keep appliances safe.

Importance of circuit breaker

- It protects appliances from overcurrent that could cause overheating and fire
- It automatically cuts off power supply if the current exceeds the safe limit.

(c) The best way of connecting appliances for optimal use;

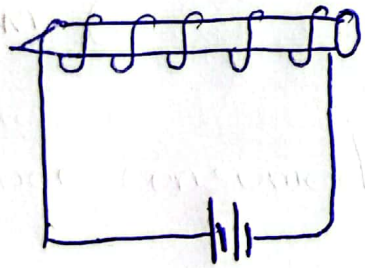
All appliances should be connected in parallel such that there is optimal consumption of power. Connecting them in parallel also allows the user to easily connect or disconnect other appliances without affecting the rest.

ITEM 7

(a) The Mechanism for sorting iron pieces from G.nuts requires a magnet therefore using electrical method, a magnet is formed as follows

Materials needed

Connecting wires of total resistance 1.6Ω
Dry cells of total emf 3V
Double cell holder
Insulated copper wire



- The dry cells are connected in series in a double cell holder
- The copper wire is wrapped around the nail tightly with very many turns to maximise the magnetic field.
- The free ends of the copper wire are connected to the terminals of the dry cell holder with 3V total emf
- Current flows through the circuit and creates a magnetic field around the nail thus forming an electromagnet.
- Using the electromagnet, iron pieces from ground nuts are removed since iron is easily attracted by the magnet formed. The electromagnet is moved on top of the G.nuts to remove the iron pieces

(b) Total resistance in the cell

$R = 0.2 + 0.2 + 1.6 \quad 0.4\ \Omega$

From

$V = IR$

$I = \frac{3}{0.4 + 1.6} = \frac{3}{2}$

$= 1.5\ A$

The current provided by the two cells is enough to create a strong magnetic field capable of picking up the iron pieces.

(c) Ways of making magnet stronger

- Increase number of turns
- Increase number of dry cells to create more current to flow.
- Use of a large nail which increases the surface area.
- Use copper wire with large diameter to reduce resistance of wire

END