535/1
PHYSICS
Paper 1
July/August 2024
$2^1/_2$ hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Certificate of Education

PHYSICS

Paper 1

Theory

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

This paper has **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 booklets/sheets provided.*

SECTION A

Answer **all** *the items in this section.*

Item 1

The manager of a certain store is faced with several challenges as highlighted below.

- Drinks from the fridge keep getting stolen. Initially, he could see the fridge directly but it was covered by a shelf. The manager could not afford to install cameras because of their cost.
- The manager could see near objects clearly but whenever he looked at an object that was far, it was unclear.
- Music played from a nearby bar was very loud. The sound was more disturbing at night than during the day. The owners of the bar claimed that their speakers produced sound waves of wavelength 1 cm which they thought was not harmful to anyone's ears.

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

  Use your knowledge of Physics to;

  (a) Identify which measures the manager of the store could take to be able to view the fridge.

  (b) Explain why the manager of the store could not see far objects clearly and what he could do to improve his vision.

  (c) Determine if the sound from the bar was harmful to the ears of those in the store, and explain why the sound was louder at night than during the day.

Item 2

Students were told to research on the construction of a nuclear power plant to provide a cheaper source of electricity. They discovered that a radioactive element, Uranium was used and it reacted as shown below;

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{139}_{56}Ba + {}^{95}_{b}Kr + 2{}^{1}_{0}n$$

The students however couldn't tell; if one of the products was an isotope of an element with an atomic number 36, which conditions are required for that reaction to successfully take place; other benefits of radioactivity, and how radioactive materials are handled.

Use your knowledge of Physics to;

(a) To determine if Krypton is an isotope of an element with an atomic number of 36.

(b) Identify which conditions are necessary for the reaction to take place successfully and precautions that should be taken when handling such materials.

(c) Identify other benefits of radioactive materials.

Item 3

A man who stays in an area with a view of the ocean requested his mother to pay him a visit to Canada. On her arrival at her son's home, it was noon, but her watch set to Ugandan time read 8:00 pm. On looking through the window, she also noticed very high waves in the ocean which was different from the photos that were always sent to her.

The mother called you to confirm if it was indeed night in Uganda while it was daytime in Canada.

Task

As a Physics student, explain to the mother;

(a) why it was night in Uganda and daytime in Canada?

(b) the cause of the high waves in the sea.

(c) how a person in Canada is able to make a phone call to Uganda.

SECTION B

PART I

*Answer **one** item from this part*

Item 4

A man set off for a destination 250 km away from his home at 4:00 am to be at his workplace at 8:00 am. The speed limit on that road is 80 kmh^{-1}. He set off on the journey without fastening his seatbelt and drove at an average of 60 kmh^{-1} for the first 2 hours. He saw a truck that had fallen covering the whole road and stepped on his brakes which brought the car to a sudden stop. This made him jerk forward almost crushing into his windscreen.

The man stopped for 45 minutes and resumed his journey, reaching his workplace on time. He got out of his car and discovered it was very cold so he decided to wear a black sweater which was against the choice of his workmates who said he looked smart in his white shirt.

Use your knowledge of Physics to;

(a) Determine if the driver exceeded the recommended speed limit.

(b) Explain what made the man jerk forward.

(c) Explain to the man's workmates why he chose a black sweater.

Item 5

During a dry season, a school resorted to drawing water from an underground well 8 m deep. Originally, they did it manually by lifting a metallic bucket of mass 4 kg and volume 20 liters. The school workers however complained that the bucket was very cold in the morning, very hot in the afternoon when the sun was up. It was also very tiring to keep pulling up the bucket manually. They suggested a pulley system of 4 wheels and an efficiency of 80 % be used to help them work quicker. None of them could however tell how the pulley works and how much effort would be required to raise the bucket.

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

Use your knowledge of physics to;

(a) Explain what makes the bucket very cold in the morning and hot when the sun is up?

(b) Show what the pulley system suggested above looks like and how it works.

(c) Determine if a force of 5 N will be enough to give the pulley system an efficiency of 80 %.

(d) Suggest ways in which the efficiency of the pulley system above can be improved.

Turn Over

PART II

Answer **one** item from this part.

Item 6

A certain landlord recently finished constructing a block of 2 houses and consulted an electrician to connect the houses to the electricity grid. The electrician informed him that the voltage of the electricity needed to be stepped down from 13 kV to 240 V before connecting the houses. The landlord thought the electrician wanted to cheat him so he decided to hire another person who was not qualified to do the job since he was cheaper. The houses were connected in a way that a breakdown in one house could affect all the houses. The tenants complained that the current was so low and some of their appliances could not work. The tenants have threatened to vacate the houses if he doesn't work on the problem. Given that the appliances in the houses are connected such that the effective resistances in the houses are 10 Ω and 12 Ω.

Use your knowledge of Physics to;

(a) Explain to the landlord why stepping down voltage is required and how it is done.

(b) Explain to the landlord the cause of the low current in the houses.

(c) Show with evidence the modifications that could be made to ensure more current flows in the houses.

Item 7

A household with various appliances **(a 3500 W cooker used for 4 hours daily, ten 60 W lights used for 10 hours daily, and a 2500 W water heater used for 30 minutes daily)** is connected to a 240 V mains supply. The owner struggles to estimate the monthly bill and is uncertain about why an electrician insisted on the heater being connected to a fuse. **Hint; The cost of one unit of electricity = Ush. 800**

Use your knowledge of physics to:

(a) Determine if 65,000/- will be enough for the monthly electricity bill.

(b) Recommend whether the appliances should be connected in parallel or in series for better functionality.

(c) Explain why the heater should be connected to a fuse and how it works.

END

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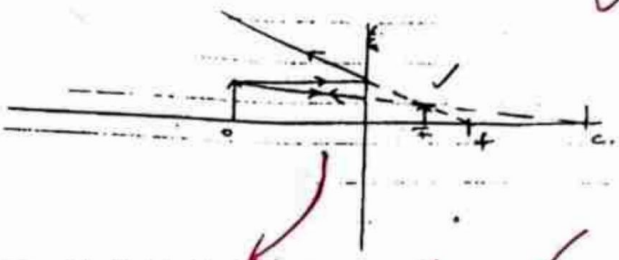
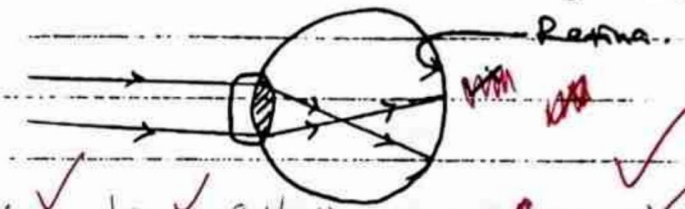
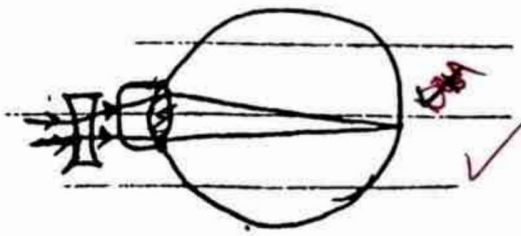
1a.	Installing a convex mirror in a corner where the mirror field of view could include the fridge  The convex mirror has a wide field of view, forms diminished images that are upright which makes it easy for the shop keeper to interprete.	
b.	The manager of the store had an eye defect called short sightedness  Image of objects that are far are formed before the retina. The eye defect can be cleared by wearing spectacles with a concave lens  The concave lens diverges the light rays making the image to form on the retina.	
(i)	$V = f\lambda$ $330 = f \times 0.01$ $f = \frac{330}{0.01} = 33{,}000\text{Hz}$ The sound was harmful to their ears since it was above the range of 20Hz – 20, 000Hz which is audible to humans.	
(ii)	The sound was louder at night because at night, the temperatures are low since air near the ground is cooler than that above. This leads to the sound being refracted towards the ground which makes it seem louder than during day. During day, the layers of air close to the ground are warmer than those above it. The sound is therefore refracted away from the ground making it faint.	

2.	$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{139}_{56}Ba + {}^{91}_{b}Kr + 2\,{}^{1}_{0}n.$ 92 + 0 = 56 + b b = 92 – 6 = 36 Yes, it is an isotope of an element with an atomic number 36, and it has the same atomic number.	04
b	Conditions necessary for nuclear fission ✓ Heavy unstable nucleus ✓ Low temperatures ✓ The presence of slow-moving neutrons. Precautions taken when handing radioactive materials ✓ Should be kept in lead bunkers. ✓ Should be handled with renovate controlled tongs. ✓ Avoid unnecessary exposure to radioactive materials. ✓ Wear an exposure meter. ✓ Wear a lead jacket. ✓ Maintain a safe distance from radioactive materials.	
c.	✓ Are used for treating diseases. ✓ Tracing leakages in pipes. ✓ Making weapons ✓ Sterilizing medical equipment ✓ In carbon – dating.	04
3.	The difference in time is due to rotation of the earth. A portion of the earth directly facing the sun will have sunlight hence day time while another portion facing away from the sun will have darkness hence night time.	04
b.	The high waves in the sea. (high tides) are caused by the moon's gravitational attraction on large masses of water on earth. The areas nearest and furthest away from the moon develop burges in the water hence the high tides.	03
	After an international number is dialed, a signal is sent to a telecommunications network which initiates the call. ✓ If the call is not in digital form, your voice is converted into digital signals. ✓ The digital signals are transmitted to an earth station equipped with large satellite dishes which uplinks the signal to a communication satellite in the geostationary orbit. ✓ The satellite receives the signal and amplifies it then uses its transponders to send the signal's to an earth station in the respondent's country. ✓ The earth station connects to the respondent's telecommunication network which connects to the recipient's phone.	08
4a.	1st part of the journey was at 60km/hrs From S = D/T D = S X T D = 60 X 2 = 120km	

Remaining part of the journey = 250km – 120km = 130km
After the 45 minutes delay
Remaining time = 8:00am – 6.45 a.m = 1hr 15min
= 1.25hrs

Speed if the driver arrives on time = $\frac{130km}{1.25}$
= 104km/hr

The driver exceeded the speed limit of 80km/hr

11

b. As the car was moving the man attained the same velocity as the car. When the brakes are applied on the car, it comes to a halt while the man jerks forward due to inertia.

03

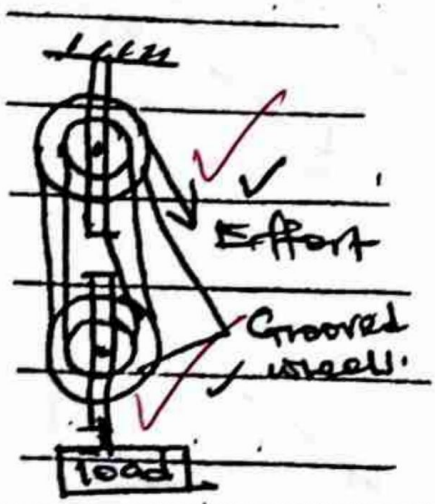
c. The sweater is made of a thick material which is a poor conductor of heat and helps regulate heat loss. The block colour is a good absorbor of heat which will help his body gain heat by radiation making him feel warm.

04

5a. In the morning, the bucket loses almost all its heat since it is a good conductor of heat.
In the afternoon, the sun is up and heat from it is radiated to the bucket making it hot.

04

b.



The lower block is connected to the load.
A light inextensible string is passed over the grooved wheels.

A downward force is applied on the string. This gives the lower block an upward motion.

05

c.

$\frac{MA}{VR} X100\%$

$0.8 = \frac{MA}{VR}$

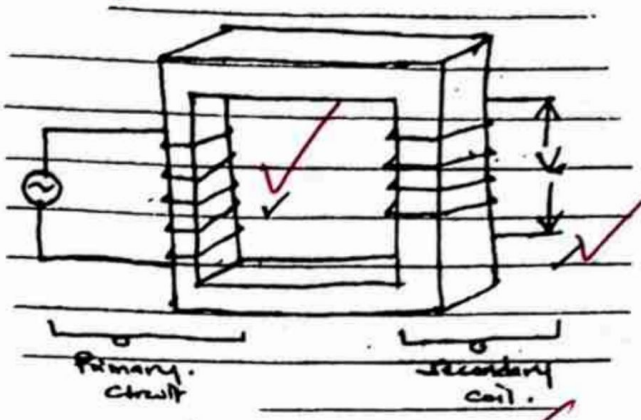
MA = 4 X 0.8
= 3.2

$MA = \frac{L}{E}$

$MA = \frac{(20+4)10}{3.2}$

= 75N

08

		An effort of 5N will not be enough	01
d.	✓ By oiling the moving parts at the machine. ✓ By reducing on the weight of the moving parts. ✓ ~~By increasing the number of wheels.~~	At least 3.	03
6.	The voltage of 13KV is too high since most house hold appliances use a less voltage.  ✓ When an alternating voltage moves through the primary coil, it induces a varying current which flows through the coil. ✓ The changing current induces a changing magnetic flux in the primary coil. ✓ The changing magnetic flux links up with the secondary coil with less turns which induces a lower voltage in the secondary coil.		
b.	The houses were connected in series which increased the resistance leading to low current in the houses. $R = 10 + 12 = 22\Omega$ $V = IR$ $240 = I \times 22$ $I = 10.91A$. If they had been connected in parallel $\frac{1}{R} = \frac{1}{10} + \frac{1}{22}, R = 6.875\Omega$ $V = IR$ $240 = I \times 6.875$ $I = 34.91A$ The houses therefore should be connected in parallel to ensure they receive more current, and the same emf and a fault in one would not affect the other.		

7a

Appliance	Daily Consumption	Monthly Consumption
Cooker	$\frac{3500}{1000}$ X 4 = 14kwh	14 X 30 = 420kwh
Lights	$\frac{60}{1000}$ X 10 = 0.6kwh	0.6 X 30 = 18kwh
Heater	2500 X 0.5 = 1.25kwh	1.25 X 30 = 37.5kwh

Total energy consumed at the end of the month = (420 + 18 + 37.5) Kwh

= 475.5kwh

Cost of electricity = 475.5 X 800 = 380, 400/=

∴ The 65,000/= would not be enough.

b. They should be connected in parallel to allow more current to flow, to have all the appliances work at the same EMF and ensure a fault in one would not affect the other

c Fuses are safety components which protect appliances and wiring by interrupting the flow of excessive current by melting.

How the fuse works.

A fuse consists of a metal wire or strip that melts when too much current flows through it. Under normal conditions, the current flows through the fuse without causing it to melt.
When the current exceeds the fuse's rated capacity, the wire heats up and melts which breaks the circuit preventing the excessive current from reaching the appliance thus preventing potential damage or fire.

END