

**UGANDA NATIONAL EXAMINATIONS BOARD**

**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 a total of **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 items answered will **not** be scored.*

*Answers to all items must be written in the answer booklet(s) provided.*

*Graph paper is provided.*

## SECTION A

Answer all the items in this section.

### Item 1.

In a classroom activity, senior three students of your school are presented with the learning aids shown in figures 1(a), 1(b) and 1(c).

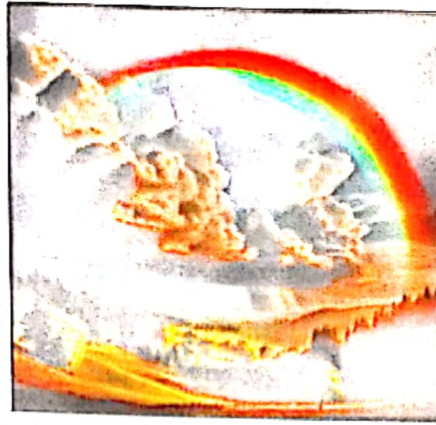


Fig. 1(a).

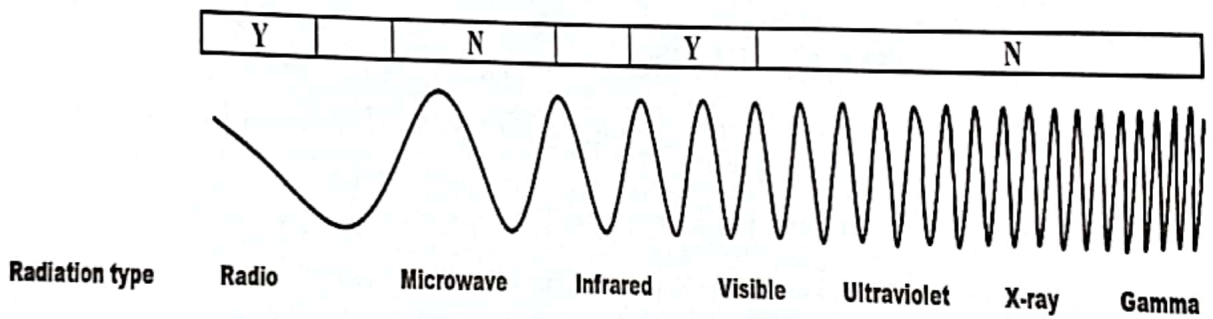


Fig. 1(b)

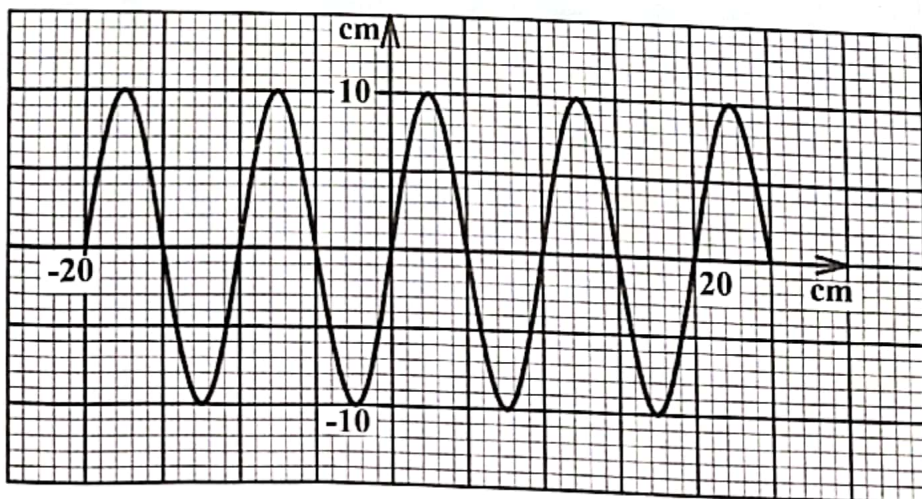


Fig. 1(c): A trace of a wave on a CRO, generated from a loud speaker

The students are required to;

- (a) (i) describe the formation of the phenomenon shown in figure 1(a) in a classroom setting.
- (ii) explain why the physical rainbow appears curved as shown in figure 1(a) and why it is in the position opposite to where the sun is.
- (b) (i) state the general name of the waves shown in figure 1(b).
- (ii) explain the effect of the two radiations at the extreme ends of figure 1(b) on a photographic plate.
- (iii) explain the usefulness of visible radiation.
- (iv) explain the pattern of the waves shown in figure 1(b).
- (c) use figure 1(c) to determine the;
  - (i) amplitude of the sound waves,
  - (ii) frequency of the sound waves.

The senior three students are unable to do the classroom activity due to lack of knowledge and have approached you for help.

**Task:**

Assist the senior three students do the classroom activity.

(*Hint: Velocity of sound in air is  $330 \text{ ms}^{-1}$ .*)

**Item 2.**

A patient has been taken by relatives to a hospital, complaining of severe pain in the neck. A doctor has admitted the patient in an isolated room and decided to examine the functioning of the thyroid gland. In the process of the examination, a radioactive isotope has been injected into the patient to be used to diagnose the thyroid disorder.

The activity of the radioactive isotope from the thyroid gland is detected and recorded as shown in table 1.

**Table 1**

Activity (counts per minute)	480	280	170	100	60	35
Time (hours)	0	10	20	30	40	50

Whenever the relatives of the patient want to check on him in the isolated room, the doctor tells them to wait for the right time (when the activity is equal to the background count rate of 40).

The doctor has also informed the relatives that if the right time for them to check on the patient comes, they must observe precautions in the isolated room.

The relatives have demanded to know the period they should wait before they can check on their patient but no one answers them. They have also been left wondering what the precautions are and why they should observe them.

You have heard the doctor talking to the relatives and they have contacted you to address their concerns.

**Task:**

- (a)
  - (i) Use the data in Table 1 to determine how long the relatives should wait before they are allowed to check on their patient.
  - (ii) Explain to the relatives why they need to wait for that time before they enter the isolated room.
- (b)
  - (i) State the precautions the relatives have to observe inside the isolated room.
  - (ii) Explain why the relatives should observe the precautions when inside the isolated room.

**Item 3.**

Some regions in Uganda are affected by the changes in seasons that sometimes may lead to famine. Accordingly, the people in Uganda have been demanding for solutions from the government to ensure that famine does not occur any more.

In November 2022, the government launched a satellite into the lower Earth orbit through the support of the International Space Station (ISS). A number of people criticised the move by the government to launch the satellite into space, claiming that the satellite will not solve the problem of famine in Uganda.

**Task:**

As a student of physics;

- (a) help the public to understand the occurrence of seasons.
- (b) make the people understand and appreciate the reason why the government of Uganda took the move.



## SECTION B

### Part I

Answer one item from this part.

#### Item 4

Your sister leaves home for work at 7:20 a.m. and as a must carries tea in a flask. One morning she needed to prepare the tea she carries but remembered that the only water she had in the house was 5 litres in a sauce pan of 0.2 kg in a deep freezer.

On removing the sauce pan from the deep freezer, she realised that all the water had turned into a block of ice. It was 7:00 a.m. and she was worried about leaving home late, but decided to heat the sauce pan containing the block of ice with her heater rated 4.22 kW, until all the ice turned into water and the water boiled ready for tea.

#### Hint:

<i>Specific heat capacity of the saucepan</i>	$= 900 \text{ J kg}^{-1}\text{K}^{-1}$
<i>Specific heat capacity of water</i>	$= 4,200 \text{ J kg}^{-1}\text{K}^{-1}$
<i>Specific latent heat of fusion of ice</i>	$= 336,000 \text{ J kg}^{-1}$
<i>Density of water</i>	$= 1000 \text{ kg m}^{-3}$
<i>Boiling point of water</i>	$= 100^\circ\text{C}$
<i>Temperature of ice in the sauce pan</i>	$= 0^\circ\text{C}$

#### Task:

- Determine how long it took your sister to boil the tea.
- Explain whether or not your sister was able to leave home for work at 7:20 a.m.

#### Item 5

Your father has hired a taxi to take the whole family to the village but is not sure of the total distance from your home to the village. The taxi driver has informed your father that he charges Shs2,500 per km moved and that your father should not worry about the distance since he installed a machine in his taxi that shows the motion of the taxi in form of a velocity time graph.

The taxi has set off from your home to the village and the velocity time graph for the whole journey is as shown in figure 2.

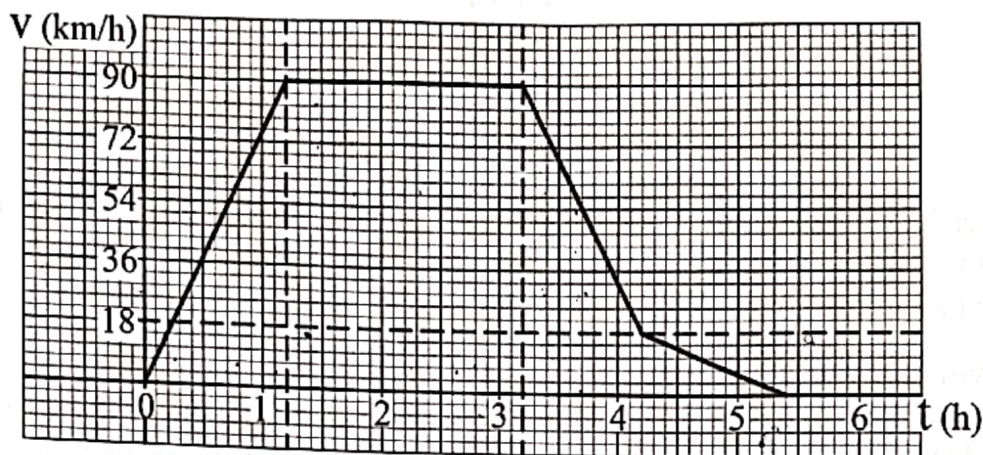


Fig. 2

On reaching the village, the taxi driver has requested for his payment. However, your father has refused to pay until he is helped to understand how the graph drawn by the machine is related to the distance travelled.

**Task:**

Help your father to;

- understand the motion of the taxi from your home to the village.
- determine the amount of money he has to pay to the taxi driver.

**Part II**

*Answer one item from this part.*

**Item 6.**

The school scouts planned to go for a camp where they would stay for seven days. The tent they were to use had no electrical wiring. The camp site was near a meter box from which they could access electric power which they would pay for. They intended to wire the tent so as to have electricity.

They planned to carry along with them components which they would use to make an electromagnetic device for alerting members of the different activities.

The scouts intended to use a bulb rated 240 V, 5 W for five hours every day and an electric kettle rated 240 V, 2 kW for 3 minutes a day. However, on the day of departure, the lead scout they were relying on to draw the wiring plan for the tent, design the electromagnetic device, as well as to determine the amount of money to pay for using the bulb and kettle, could not be accessed.

One of the scouts is your friend and has approached you for help.

**Task:**

Perform the duties of the lead scout.

(Hint: each unit of electric power costs Shs1000.)

**Item. 7**

Your friend, a carpenter, uses an electric drill to drive screws when making furniture. One day the drill he was using suddenly stopped working. He took the drill to a technician who informed him that the coil in the d.c. motor had got burnt and therefore the motor had to be repaired.

The technician assured your friend that he could repair the motor and make it even more efficient if your friend bought the required materials. However, your friend could not understand what the technician was saying and has therefore approached you for more information about the structure, mode of operation of the electric motor and how it can be made more efficient.

**Task:**

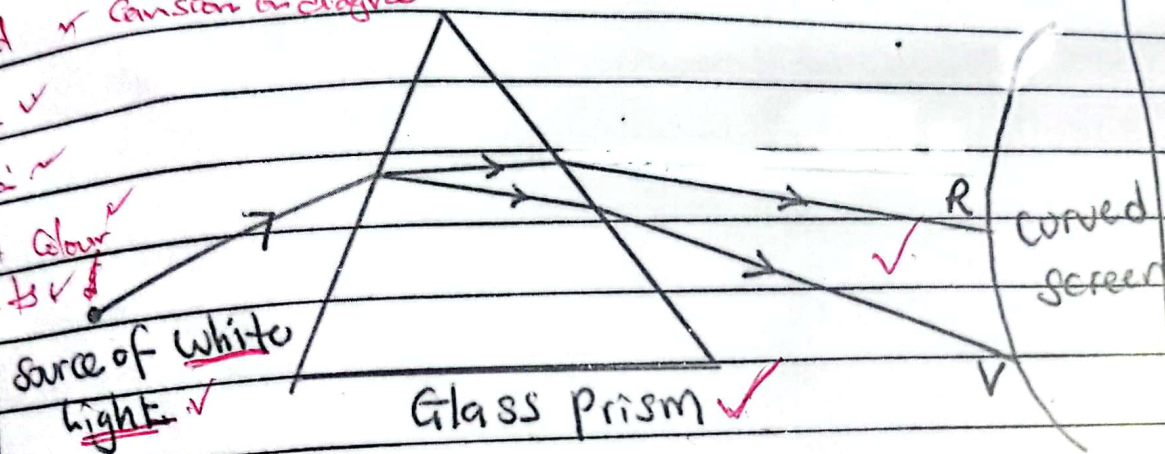
Provide the information needed by your friend.



## EXPECTED RESPONSES

- (a) (i) The phenomenon is a rainbow. ✓  $IR_1$  21 9-210-8  
 $mc_1$  7

white light ✓  
 dispersion ✓  
 different colour ✓  
 components ✓



When whitelight is incident onto the glass prism, refraction of light occurs. The light is then dispersed since white light consists of different colour components which travel at different speeds in the glass prism.

By the time they emerge out of the glass prism, they form a curved spectrum on the curved screen.

Note: Glass ruler, oil patch, soap bubble, water fall or any other material that causes dispersion may be used instead of a prism.



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Paper code: 535/1

Level: ☐ PLE ☒ UCE ☐ UACE

Year: 2024

R1

R1

R1

Physical shape

extends in angles of incidence

position of observer

curved shape of sky

Item

EXPECTED

RESPONSES

E.K.P

K.E

1

(a)(ii) The curved shape of the rainbow is due to the spherical shape of the raindrop. ✓

White light from the sun is dispersed and refracted by the raindrop into different

colours which emerge out at different angles to the normal ranging from  $40^\circ$

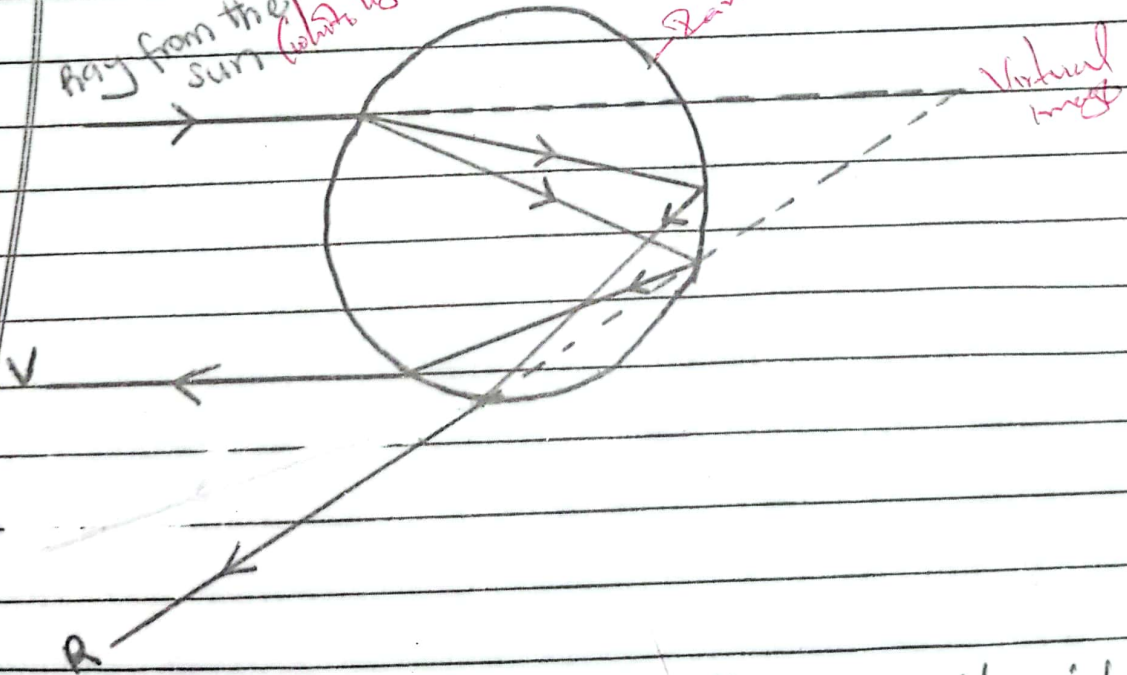
for violet to  $42^\circ$  for red to the observer.

The curved nature depends on the position of the observer on the earth's surface.

Ray from the sun (white light)

Raindrop

Virtual image



The rainbow appears on the opposite side because of total internal reflection. ✓

Since there is reflection, an image is formed on the opposite side ✓ to the source of light.

EXPECTED RESPONSES

E K P K W5 K W6

(b) (i) Electromagnetic waves  
(Electromagnetic spectrum)

(ii) The two radiations at the extreme

ends are radiowaves and gamma rays

Gamma rays darken photographic plates because they are highly penetrative due to their high frequencies / a lot of energy / short wavelengths.

Radio waves do not affect photographic plates because they carry low energy and are less penetrative, frequency since electromagnetic waves have the same speed.

(c) (i) Amplitude = 10cm or 0.1m

(ii) Wavelength,  $\lambda = 10\text{cm} = 0.1\text{m}$

From  $v = \lambda f$

$$330 = 0.1 \times f$$

$$f = \frac{330}{0.1}$$

$$f = 3300 \text{ Hz}$$



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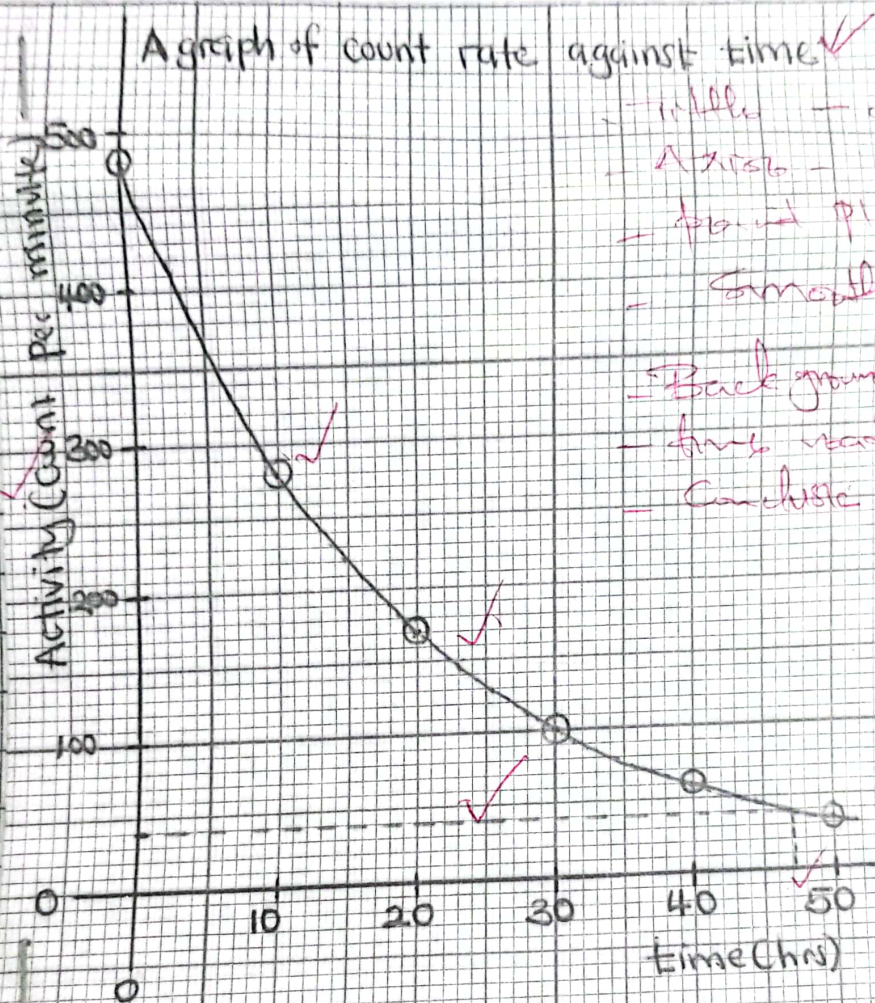
Year: 2024

Item 2

## Expected Responses

E	KP	KP	KP	KP
KP	K16	K17	K18	K19

(a.i)



- title - 01 ✓
- Axes - 01 ✓
- point plotted - 01 ✓
- smooth curve - 01 ✓
- Background ✓
- first read ✓
- Conclusion ✓

From the graph above, they should wait for 47 hours ✓ minimum 40 ✓

Alt:

$$\begin{array}{c|c|c|c} A & 60 & 40 & 35 \\ \hline t & 40 & x & 50 \end{array}$$

$$\frac{60-35}{40-50} = \frac{40-35}{x-50}$$

a(ii) - Before that time, the <sup>radiations from</sup> radioactive materials are <sup>highly</sup> dangerous and may cause harm to humans.

me - After that time, the materials will not cause any danger to their lives since the levels of radiation would have reduced below the background radiation.

b(i) Precautions

IR<sub>2</sub> - They should not eat or drink while inside the room.

(Any one) - Should put on personal protective equipment e.g. gloves, lead jackets, boots.

- Cover all the wounds with thick wool.

- Avoid direct contact with the patient.

- Reduce time of exposure while the room.

(ii) Dangers

- Cause cancer

- Sterility / infertility

IR<sub>2</sub> - Skin irritation / burn

- Genetic mutation

- Blindness

(Any one)



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Item 3	EXPECTED RESPONSES	E KP	KP W <sub>6</sub>	KP W <sub>2</sub>	KP W <sub>1</sub>
IP 3	(a) Seasons occur due to the tilt of the earth with respect to the orbit and the revolution around the sun that occurs throughout the year.				
	The part of the hemisphere of the earth close to the sun receives more sun light energy and experiences longer day time i.e. a dry season / summer.				
	The other parts of the hemisphere that face away receive less sun light and experience a shorter day time hence a wet season / winter.				
	During times when day time and night are equal, (when the sun overhead the equator), spring and autumn are experienced.				
Identify the satellite that is used to collect data from the ground station.	(b) The satellite launched was a weather satellite. It has instruments such as cameras, pyrometers, barometers etc for collecting data. After the data is collected, it is sent to a ground station in form of radiowaves where it is processed, analysed by meteorologists who make accurate predictions of the weather in the nearby future.				
3					

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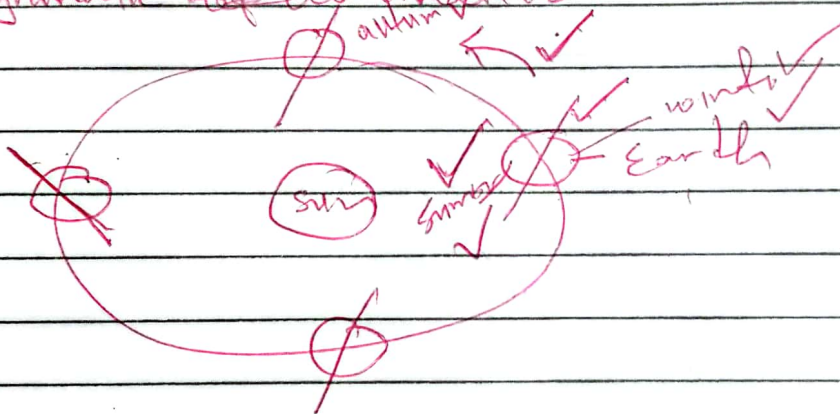
Level: ☐ PLE ☒ UCE ☐ UACE

Year: 2024

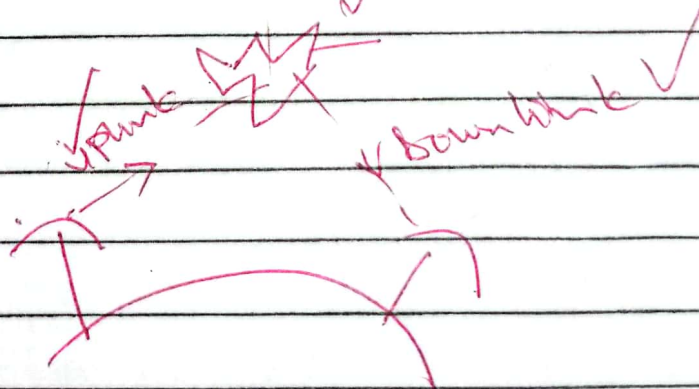
Item	EXPECTED RESPONSES	E KP	KP W6	KP W2
3	Other responses			
	- For surveillance Aug 1			
	- Communication			
MR	- Research			
	- Navigation			
	- Observation			
	- Making phone calls across continents			
	- Live Broadcast.			

Diagrammatic ~~not~~ alternative

3(b)



Diagrammatic alternative for 3(b)





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Item 4

EXPECTED RESPONSES

E  
KP

KP  
W6

KP  
W3

(a) Assuming no heat is lost to the surroundings. ✓

$$\text{Volume of water} = 5\text{L} = 5 \times 10^{-3} \text{m}^3$$

$$\text{Mass of water} = \rho V = 5 \times 10^{-3} \times 1000 = 5\text{kg} \quad \checkmark$$

Heat supplied = Heat gained by water by heater and saucepan. ✓

$$P \times t = M_i c_i + M_w c_w (100-0) + M_p c_p (100-0)$$

$$4.22 \times 1000 \times t = 5 \times 336000 + 5 \times 4200 \times (100-0)$$

$$+ 0.2 \times 900 \times (100-0) \quad \checkmark$$

$$4220t = 1680000 + 2100000 + 18000 \quad \checkmark$$

$$4220t = 3798000 \quad \checkmark$$

$$4220 \quad 4220$$

$$t = 900\text{s} \quad \checkmark$$

$$t = 15\text{min}$$

It took 15 minutes for the water to boil.

(b) 7:00

+ 15min ✓

7:15 a.m.

She was able to leave in time by 7:20 a.m.

because the tea was ready by 7:15 a.m. ✓

12. 0

PR  
MC<sub>g</sub>

Any 3 formally  
Substitute

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Item 5

Expected Responses

E	KP	KP	KP
KP	W3	W4	W5

(a) The taxi started from rest (home) and accelerated uniformly to a velocity of  $90 \text{ kmh}^{-1}$  in 1.2 hours. It maintained the constant velocity of  $90 \text{ kmh}^{-1}$  for 2 hours and decelerated uniformly to a velocity of  $18 \text{ kmh}^{-1}$  in 1 hour. It further decelerated uniformly to rest (village) in 1.2 hours.

(b) Total distance (s) = Area under the velocity time graph

$$s = \frac{1}{2}bh + \frac{1}{2}h(a+b) + \frac{1}{2}h(a+b)$$

$$= \frac{1}{2} \times 92 \times 1 + \frac{1}{2} \times 90(3.2+2) + \frac{1}{2} \times 18(2+1)$$

$$= 36 + 234 + 28.8$$

$$= 298.8 \text{ km}$$

$$\text{Total cost} = 298.8 \times 2500$$

$$= 747000 \text{ F}$$

The father has to pay shs. 747,000 to the taxi driver.





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Cost of electricity = Number of  $\times$  unit  $\checkmark$

Units                      COST

$$= \left[ \left( \frac{5}{1000} \times 5 \times 7 \right) + \left( \frac{2 \times 3}{60} \times 7 \right) \right] \times 1000 \checkmark$$

$$= (0.175 + 0.7) \times 1000$$

$$= 0.875 \times 1000$$

$$= \text{shs. } 875 \checkmark$$

They will pay shs. 875  $\checkmark$



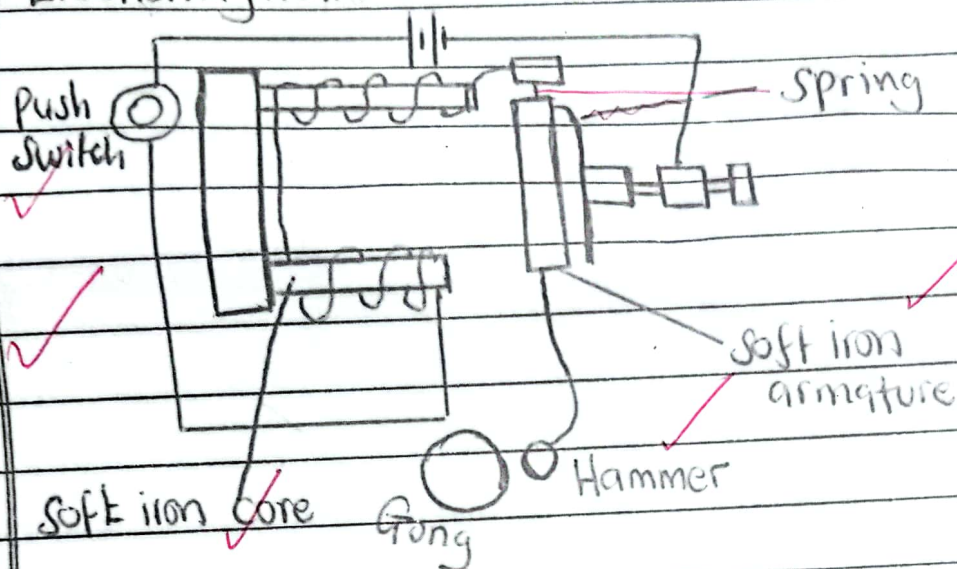
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Electromagnetic device is electric bell ✓



When the push switch is pressed current flows through the solenoid and the soft iron core gets magnetised. It attracts the soft iron armature which hits the gong.

As the armature moves, contact is broken, current stops flowing and the iron armature is no longer attracted.

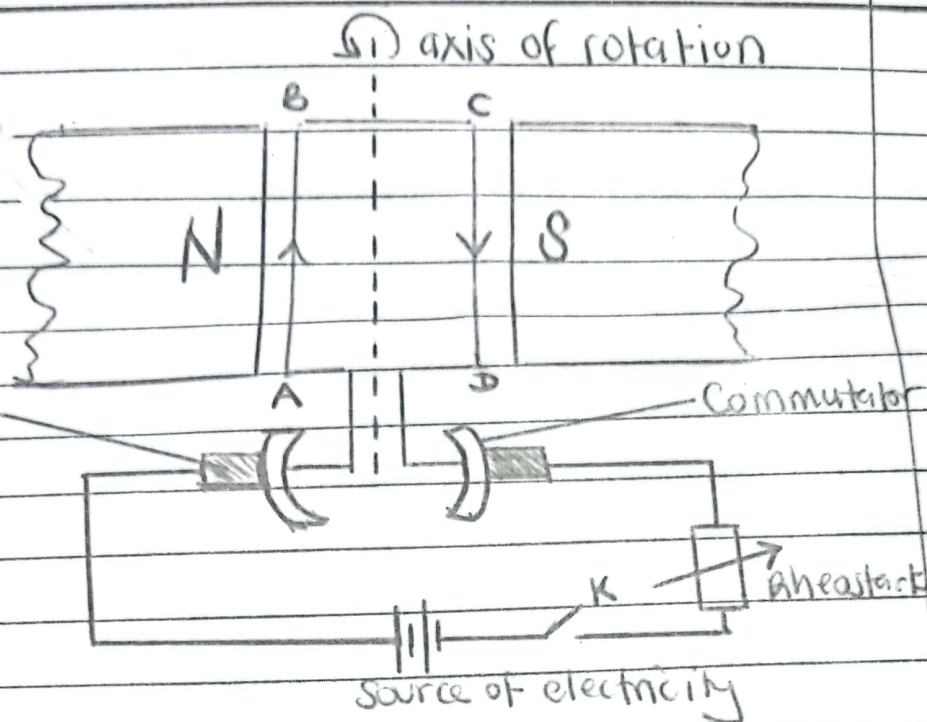
It is then pulled back by the spring and contact is re-made.

The process repeats itself and the bell rings continuously as long as the switch is pressed.

## EXPECTED RESPONSES

E.KP KP W6 KP W4 KP W0

7

function of  
2 motory. 1. 2. 3.  
Carbon  
brush-S  
CS

N, S - Poles of Permanent magnet

ABCD - Rectangular Coil.

When the switch K is closed, current flows in the coil in the direction ABCD. Side AB experiences an <sup>downward</sup> ~~upward~~ force in accordance with Fleming's left hand rule.

The forces are equal and opposite and form a couple. The coil rotates about the axis in the direction shown.

When the coil is in a vertical position, the commutators lose contact with the carbon brushes and no current flows through the coil.

However, the inertia drives the coil beyond



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7 the vertical position and the commutators and carbon brushes interchange contacts. ✓  
The direction of current in the coil is reversed but the direction of rotation of coil remains the same. ✓ The coil continues to rotate as long as the switch is closed.

Ways of making the motor more efficient.

- Using a stronger magnet. ✓
- Increasing the current. ✓
- Lubricating the contact between commutators and carbon brushes. ✓
- Using coils of very low resistance. ✓
- Winding the coil on a soft iron core. ✓
- Increasing the number of coils. ✓

What caused the coil to be burnt

- Over heating
- Over loading
- Contaminating terminals
- Excess current

### 535/1 Scoring Guidelines with Weighted scores

ITEM	ELEMENT OF CONSTRUCT	BASIS CODES	DESCRIPTOR	WEIGHTED SCORES
1.	Understands how waves are generated, propagated and their effects on matter in everyday life	IR1(1)	Explains physics concepts and theories, laws and principles in the generation/propagation/properties of waves, its effects on matter and their applications in everyday life.	5
		MC1	Interprets accurately and correctly uses numerical formulae with appropriate applications, assumptions and conclusions.	6
2.	Understands the structure of atoms, nuclear processes and their applications in everyday life	IR2(2)	Explains clearly physics concepts, theories, laws and principles, in the nuclear processes and their effects in everyday life	6
		IR2(1)	Explains physics concepts, laws and principles, in the nuclear processes and their effects in everyday life.	3
		MC2	Presents accurate and precise numerical formulae with appropriate applications, assumptions and conclusions.	5
3.	Understands galaxies, satellites, digital communication and their use in everyday life	IR3(2)	Explains clearly physics concepts , theories, laws and principles in identifying methods, distinguishes between processes in earth and space physics and their relevancy in everyday life.	6
		IR3(1)	Explains physics concepts theories, laws and principles in identifying some methods, distinguishes between processes	2



			in earth and space physics and their relevancy in everyday life.	
		MC3(1)	Presents accurate and precise numerical formulae with appropriate applications, assumptions and conclusions.	6
4	Understands the effect of force and heat on properties of matter in everyday life	IR4(2)	Explains clearly physics concepts theories, laws and principles in identifying complex methods and effects, distinguishes between similar effects of force and heat on properties of matter in everyday life.	6
		IR4(1)	Explains simple methods simple methods and effects of physics concepts, distinguishes between effects of force and heat on properties of matter in everyday life.	3
		MC4	Presents accurate and precise numerical formulae with appropriate applications, assumptions and conclusions.	6
5	Appreciates electricity and magnetism in everyday life	IR5(2)	Explains clearly physics concepts theories, laws and principles in identifying complex methods, effects, distinguishes between processes in electricity and magnetism and their applications in everyday life.	6
		IR5(1)	Explains physics concepts, laws and principles on simple methods, effects, distinguishes between processes in electricity and magnetism and their applications in everyday life.	4
		MC5(2)	Presents accurate and precise numerical formulae with appropriate applications, assumptions and conclusions.	6
		MC5(1)	Presents accurate and precise numerical formulae with appropriate applications, assumptions and conclusions.	6



## UCE 535/2 2024

### Item 1

Your school wishes to buy glass blocks of refractive indices between 1.4 and 1.6 inclusive, to be used during Physics practical lessons. The Director of Studies (DOS) has received samples of glass blocks from a supplier who claims that they are of the required range of refractive indices.

The DOS wants to confirm the supplier's claim but lacks the knowledge, yet both the teacher of Physics and Laboratory technician are absent.

You have been provided with the sample of the glass block that was delivered to the DOS.

### Task

Help the DOS to verify what the supplier says and advise the school on whether or not to buy the glass blocks.

### Item 2

You have visited your friend Sarah who repairs weighing scales and expressed interest in working with her at her workshop. A weighing scale has been brought to her workshop for repair. On examining the scale, she notices that the spring in the scale is faulty and needs replacement. The spring needed for the weighing scale should be of force constant between  $20 \text{ Nm}^{-1}$  and  $40 \text{ Nm}^{-1}$  inclusive.

As part of your interview, Sarah has provided you with a spring whose force constant is unknown and wants you to determine whether or not it can be used to repair the weighing scale.

### Task

Determine whether or not the spring provided to you can be used to repair the weighing scale.

my P1 (cm) 2/(cm) m(kg) 10(m/s)

1 2 3 25 50

20.02

0.154

m

5

1

**PHYSICS PRACTICAL 535/2 SCORING GUIDE 2024**

BASIC CODE	DESCRIPTOR	WEIGHT
A	Aim and purpose correctly stated Aim or purpose correctly stated No or wrong aim and purpose	6 2 0
VAR	Independent variables Dependent variables Controlled variables	Key points {4 – 6} = 5 {2 – 3} = 4 { 1 } = 2 { 0 } = 0
H	Statement with or without purpose correctly written No or wrong statement or purpose written	6 0
P	Half and above total key points One to less than half of total key points No key point	{6 – 13} = 3 {1 – 5} = 2 { 0 } = 0
EP	One error + one precaution related to the experiment Only an error or precaution or none written	3 0
PD	At least one set of values (dependent + independent variable) No set of values written	2 0
RDA	Values outside table (eg $P_o$ ) Accuracy of three experimental values Trend Unit (Any one) Calculated values (Any one)	At least 3 = 3 {1 – 2} = 2 { 0 } = 0
DAI	Title Drawing axes Labelling axis Uniform scale Plots (any one) Best straight line (through 3 points) Method of finding slope Reading coordinates accurately Substitution Arithmetic Answer Unit	{6 – 12} = 4 {3 – 5} = 3 {1 – 2} = 2 { 0 } = 0
CAD	Conclusion and advise related to hypothesis + aim + data Either conclusion or advise related to hypothesis + aim + data None written	6 5 0

A – Aim VAR – Variable

H – Hypothesis

P – Procedure

EP – Error and precaution

PD – Procedure + Diagram

RDA – Results and data analysis

DAI – Data analysis and evaluation

CAD – Conclusion and advise