



UGANDA NATIONAL EXAMINATIONS BOARD  
UGANDA ADVANCED CERTIFICATE OF EDUCATION  
NOVEMBER - DECEMBER, 2023

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SECTION A

Item 1

a) i) The phenomenon above is a rainbow.

Rainbows are formed when a water drop is incident

Rainbows are formed when white light from the sun is incident on the water drop in the atmosphere.

Light is then refracted and dispersed by the water drop forming spectrum.

The spectrum undergoes total internal reflection and it is seen in the opposite side to that of the sun.

ii) Rainbows appear curved because of the combination of light refraction through aspherical water droplets and the observer's position on the earth in that a person can only see the upper part of the circle.

The rainbow appears on the opposite side of the sun due to double refraction of the spectrum.

b) i) Electromagnetic waves

(i) They both darken the photographic plates.

(ii) They are used for lighting

- Communication

- Vision

- Treatment



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iv) The pattern is ~~increasing~~<sup>decreasing</sup> wavelength and increasing frequency.

c) i) amplitude = 10cm  
= 0.1m ✓

ii)  $V = f\lambda$  ✓

$$2\lambda = 20\text{cm}$$

$$\lambda = 10\text{cm}$$

$$\lambda = 0.1\text{m}$$

$$V = 330\text{m}^{-1}$$

$$330 = f \times 0.1$$

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

$$\begin{array}{l} m \\ (4-6) -02 \\ (1-3) -01 \end{array}$$

$$\begin{array}{l} w \\ (14-21) -03 \\ (7-13) -02 \\ (1-6) -01 \end{array}$$



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Item 2

a) ii) The patient will be discharged after ~~47~~ hours.

ii) Radiations ~~cause~~ skin burns

- Damage sight ✓
- Cause genetic mutations ✓
- Cause cancer ✓
- 

(12) 03 (5-10) 01  
(9-12) 02 (1-8) 01  
(6-8) 01  
(1-5) 01

b) i) - Wearing thin protective gears.

- Using long pair of tongs ✓
- Avoid unnecessary exposure ✓
- Putting on clothes made out of thick lead sheet.

iii) - To prevent skin burns ✓

- To prevent damage of sight ✓
- To prevent genetic mutation ✓
- Prevent cancer.

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(To be fastened together with other answers to paper)

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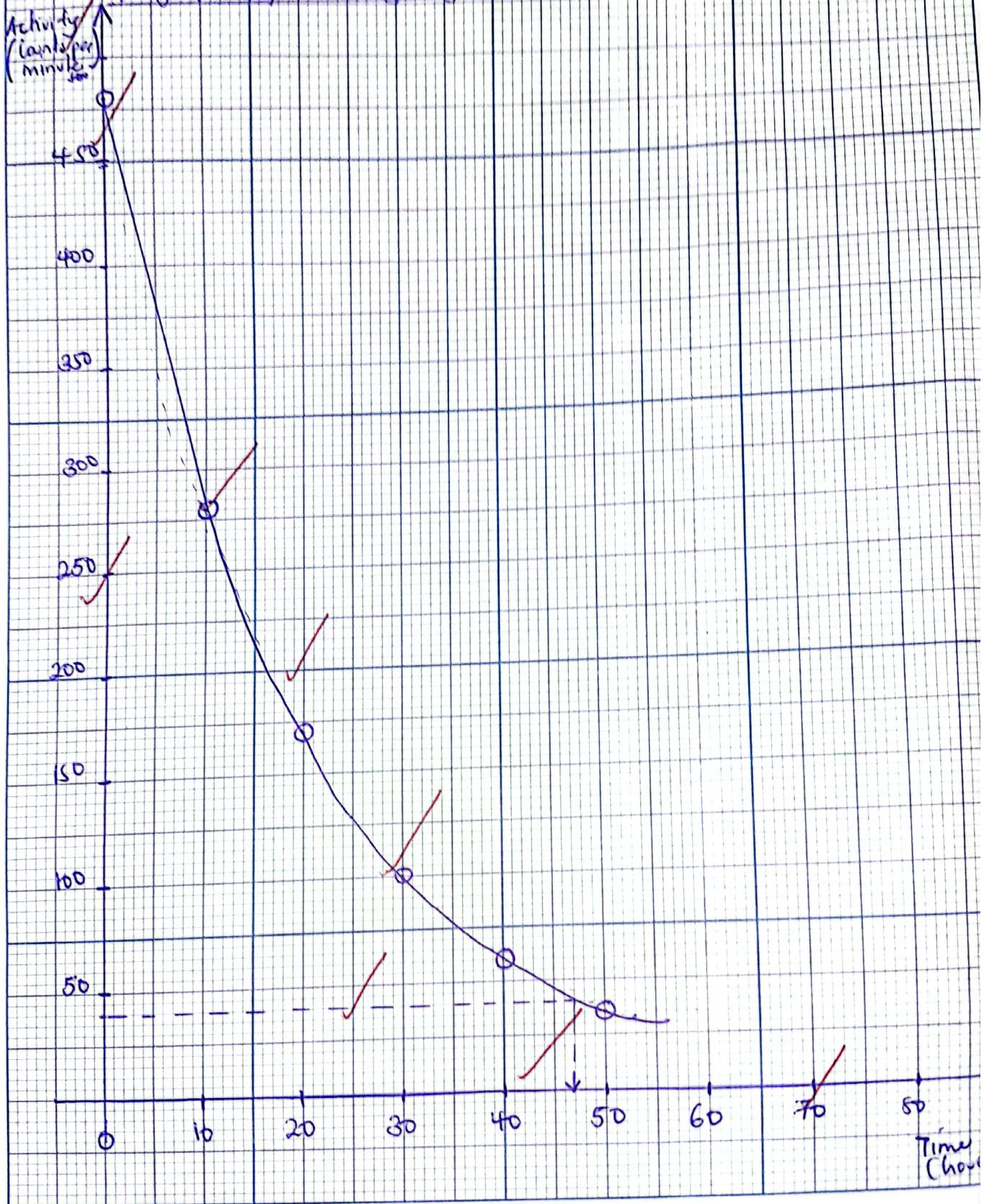
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A graph of activity against time.





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Item 3

a) Seasons are caused due to the earth's tilt as it revolves around the sun. This causes different regions to receive different amounts of solar energy which results into climatic and weather changes. When the northern hemisphere tilts towards the sun, it experiences summer while the southern hemisphere experiences winter and as the south hemisphere tilts towards the sun, it experiences summer while the northern hemisphere experiences summer.

18 -01

(1-8) -02

(9-16) -03

b) Communication:

This relays and amplifies radio telecommunication signals via a transponder and creates a communication channel between a transmitter and the receiver at different locations on the earth.

- ✓ Weather forecasting: Such as GOES and Landsat for monitoring the earth's atmosphere and climate.
- ✓ Navigation: e.g. GPS and GLONASS are used for providing location and timing information.
- ✓ Scientific research such as TERRIERS and hubble telescopes can be used for conducting research.



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Item 4 SECTION B

Part 1

Item 4

$$C_s = 900 \text{ J kg}^{-1} \text{ K}^{-1}$$

$$C_w = 4,200 \text{ J kg}^{-1} \text{ K}^{-1}$$

$$L_f = 336,000 \text{ J kg}^{-1}$$

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

$$\theta_1 = 100^\circ\text{C}$$

$$\theta_2 = 0^\circ\text{C}$$

$$1000 \text{ l} = 1 \text{ m}^3$$

$$5 \text{ l} = \frac{5}{1000} \text{ m}^3$$

$$m = \rho \times V$$

$$= \frac{5}{1000} \times 1000$$

$$= 5 \text{ kg}$$

$$m_s = 0.2 \text{ kg}$$

$$\rho = 4.22 \text{ kew}$$

$$= 4220 \text{ W}$$

Electrical energy supplied = heat used to melt ice + heat used to raise temp of ice + heat used for rise temp of the room

$$Pt = m_i L_f + m_i C_w (\theta_1 - \theta_2) + m_s C_s (\theta_1 - \theta_2)$$

$$4220 \times t = 5 \times 336000 + 5 \times 4200(100 - 0) + 0.2 \times 900(100 - 0)$$

$$4220t = 3798000$$

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

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

It took 15 minutes



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b.) New time

$$\begin{array}{r} 7:00 \text{ am} \\ + 15 \\ \hline 7:15 \text{ am.} \end{array}$$

$$\begin{array}{l} (1-3) - 01 \\ (4-6) - 02 \\ (7-9) - 03 \end{array}$$

She did not leave late for work.



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Items  $a = \frac{v-u}{t}$

$$a = \frac{90-0}{1.2}$$
$$= 75 \text{ kmh}^{-2}$$

$$a_2 = \frac{v-u}{t}$$
$$= \frac{98-90}{60}$$
$$= 72 \text{ kmh}^{-2}$$

$$a_3 = \frac{0-18}{1.2}$$
$$= -15 \text{ kmh}^{-2}$$

(1-5) - 01  
(b-10) - 02  
(11-15) - 03

A car started from rest and accelerated uniformly to  $90 \text{ kmh}^{-1}$  at a rate of  $75 \text{ kmh}^{-2}$  for 1 hour and 20 minutes. It then maintained the speed of  $90 \text{ kmh}^{-1}$  for 2 hours and decelerated to  $18 \text{ kmh}^{-1}$  at a rate of  $72 \text{ kmh}^{-2}$  for 1 hour and further decelerated to rest for 1.2 hours at a rate of  $15 \text{ kmh}^{-2}$ .

b) TDC = Area ✓

$$= \frac{1}{2}hb + Lxw + \frac{1}{2}h(a+b) + \frac{1}{2}bxh$$
$$= \frac{1}{2} \times 90 \times 1.2 + 90 \times 2 + \frac{1}{2}(18+90) + \frac{1}{2} \times 18 \times 1.2$$
$$= 298.8 \text{ cm}^2$$

$$1 \text{ km} = 2,500$$
$$298.8 = 2,500 \times 298.8$$
$$= 747,000 \text{ m}^2$$



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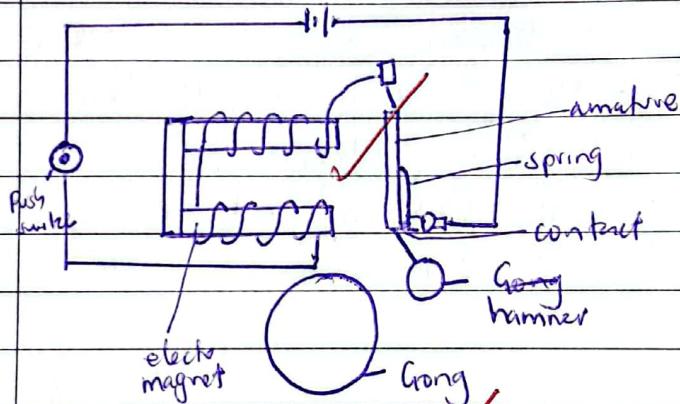
## Part 2

### Item 6

The wiring plan: The bulb and all appliances must be connected in parallel so that they operate on the same voltage and different current.

This helps switching each appliance differently without affecting the others and also there is low resistance thus saving energy.

### Electric bell:



- When the switch is pressed, the electric current flows through the circuit making the electromagnet to become magnetized thus attracting the soft iron armature causing the hammer to hit the gong.
- As the armature is attracted, the contact is lost thus cutting the flow of current hence the electromagnet becomes demagnetized.
- This makes the armature to return back thus making contact again and the process of hitting the gong is repeated until the switch is switched off.



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$$n = P(kW) \times \text{time}(hrs)$$

$$w/b P = 5kW$$

$$= \frac{5}{1000} = 0.005 \text{ kW}$$

$$t = 3 \text{ hrs} \times 7$$

$$= 21$$

$$= 0.005 \times 21$$

$$= 0.105 \text{ kWhrs}$$

$$\text{Kettle: } P = 2kW$$

$$t = \frac{3}{60} = 0.05 \text{ hours}$$

$$P = 2 \times 0.05 \times 7$$

$$= 0.7 \text{ kWhrs}$$

$$n = 0.7 + 0.105$$

$$= 0.875 \text{ kWhrs}$$

$$1 \text{ kWhrs} = 1000 \text{ J}$$

$$0.875 = 0.875 \times 1000$$

$$= \underline{\underline{0.875}}$$

$$(1-8)^{01}$$
  
$$(9-16)^{02}$$
  
$$(17-24)^{03}$$



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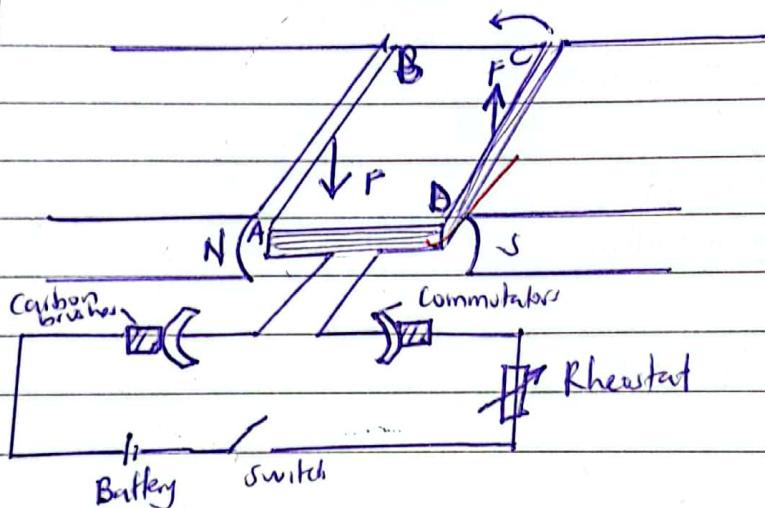
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Item 7

structure of a dc. motor

- It consists of a rectangular coil which can rotate in a magnetic field provided by the permanent magnets. The ends of the coil are connected to the commutators.
- Two carbon rods press against the commutators so that when the circuit is connected to the battery, the coil rotates.



Mode of operation:

- When the switch is closed, current flows through a rectangular coil ABCD.
- Side CD experiences an upward force while side AB experiences a downward force in accordance with Fleming's left hand rule.
- The two forces form a couple of forces which causes the coil to rotate in the anticlockwise direction.
- As the coil rotates and reaches the vertical position, the carbon brushes lose contact with the commutators and current is cut off but the coil continues to rotate due to the momentum gained.
- The two carbon brushes interchange contacts with the carbon brushes

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This reverses the direction of current in the coil and forces experienced at the sides of the coil.

This makes the coil to continue rotating as long as current is flowing.

### Energy losses

#### Energy loss

Friction between carbon brushes and commutators

heating effect due to resistance in the coil.

Bddy currents

how to minimise it.

- ✓ By lubricating.
- ✓ Using thick copper wires of low resistance.
- By winding the coil on laminated iron core.

(1-10) -01  
(11-20) -02  
(21-30) -03