535/2
PHYSICS THEORY
Paper 2
Aug. 2022
2 ½ hours

JINJA JOINT EXAMINATIONS BOARD

Uganda Certificate of Education

MOCK EXAMINATIONS 2022

PHYSICS

(Paper 2)

2 hours 15 minutes

INSTRUCTIONS TO CANDIDATES:

Answer any **five** *questions.*

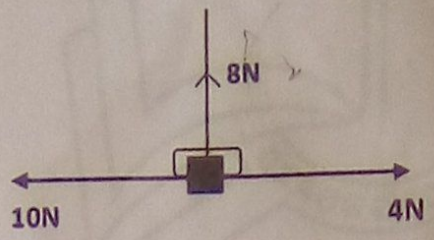
Any additional question(s) answered will **not** *be marked*

Mathematical tables and silent non-programmable calculators maybe used.

These values of physical quantities may be useful to you.

Acceleration due gravity, g	=	10 m s^{-2}
Specific heat capacity of water	=	4200 J kg^{-1} K^{-1}
Specific heat capacity of ice	=	2100 J kg^{-1} K^{-1}.
Specific latent heat of vaporization of water	=	2,260,000 J kg^{-1}
Specific latent heat of fusion of water	=	340,000 J kg^{-1}
Speed of sound in air	=	330 m s^{-1}
Density of water	=	1000 kg m^{-3}

1. (a) (i) Define the term vector quantity (1 mark)
   (ii) Give four examples of vector quantities (2 marks)
   (b) A body B, of mass 5kh is acted on by three forces as shown below



Determine the acceleration of the body (5 marks)

(c)(i) Define the term moment of a force (1 mark)

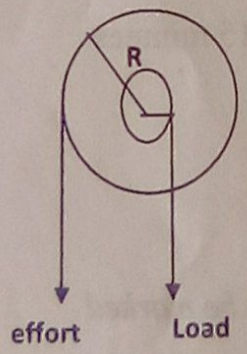
(ii) State the principle of moments (1 mark)

(iii) You are given a known mass, m, a knife edge X athread and a metre rule. Outline an experiment you would carry out to determine the mass, m, of metre rule. (3 marks)

(d) Two masses 20 kg and 60kg are suspended at the extrem ends of a uniform rod of mass 10kg and length 1m. Determine the point of suspension of the rod so as to have it balanced horizontally. (3 marks)

2. (a) The efficiency of a machine is 75%. Explain the meaning of the statement. (1 mark)\

(b)



The diagram shows a crosssection of a wheel amd axle machine. R = 0.8m, r = 0.25m. An effort of 15N raises aload of 36N calculate the;

(i) MA
(ii) VR and
(iii) Efficiency of the machine (6 marks)

(c) (i) Define the term momentum (1 mark)

(ii) State the principle of conservation of linear momentum. (1 mark)

(d) A bullet of mass 50g moving at 800ms^{-1} strikes a woolen block of mass 9.95kg ar rest. If the bullet remains embedded in the block after impact calculate;

(i) The velocity with ahich the block starts to move. (3 marks)
(ii) The distance moved by the block in one minute given that it is on a horizontal smooth surface. (1 mark)
(iii) The distance covered by the block before coming to rest if it were acted on by a frictional force of 5N. (3 marks)

3. (a) (i) What is an eclipse? (1 mark)

(ii) With the aid of a ray diagram explain the formation of the total eclipse of the moon. (4 marks)

(iii) Distinguish between regular and diffuse reflection. (2 marks)

(b) (i) Define principal focus of a concave mirror. (1 mark)

(ii) An object 4cm high is places 9cm in front of a concave mirror of focal length 15cm. Using a scale diagram determine the image distance, height of image and the magnification. (5 marks)

(c) Write down three uses of concave mirrors. (3 marks)

4. (a) Distinguish between heat and temperature. (1 mark)

(b) (i) Define the fixed points in reference to a thermometer. (2 marks)

(ii) With the aid of a diagram, explain how the lower fixed poit on a liquid in glass thermometer can be determined. (4 marks)

(iii) The fundamental interval of a liquid in glass is 12cm. If at a certain temperature the mercury thread is 3cm below the upper fixed point. Determine the temperature shown by the mercury thread. (2 marks)

(c) (i) Define the terms heat capacity and specific heat capacity. (2 marks)

(ii) 1.8kg of water is put in an ice making machine. If the water is at 40°c and the machine removes heat at a rate of 200J/S. How long will it take to convert it into ice at -15°c? (5 marks)

Take: Specific heat capacity of water as $4200JKg^{-1}K^{-1}$

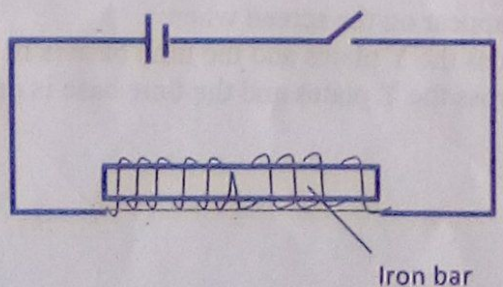
Specific latent heat of ice as $336000JKg^{-1}$

Specific heat capacity of ice as $2100JKg^{-1}K^{-1}$.

5. (a) (i) What is a magnet? (1 mark)

(ii) Describe with the aid of a diagram the single touch method of magnetizing metal bar, indicating the poles obtained. (5 marks)

(b)



A student connected the circuit in the lab as shown above. After witching on and off the switch several times, the student removed the iron bar from coil and tested for magnetism. It was found to have magnetic properties.

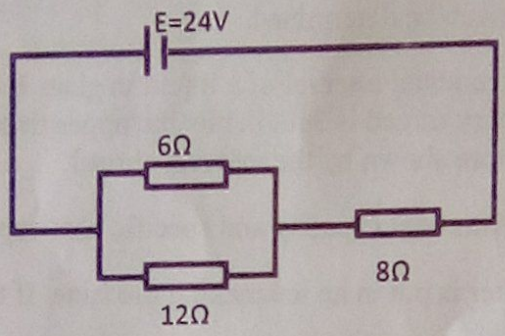
(i) Indicate the polarities acquired by the bar. (2marks)
(ii) Sketch the magnetic field pattern around the bar indicating neutral points if any. (2 marks)

(c) (i) State two defects of a simple cell. (2 marks)

(ii) How can the defects be minimized? (4 marks)

6. (a) (i) Define the terms emf and internal resistance of a cell. (2 marks)
(ii) State ohm's law (1 mark)
(iii) Describe an experiement to verity Ohm's law (5 marks)

(b)



A battery of emf 24V and negligible internal resistance is connected to resistors of 6Ω, 8Ω and 12Ω as shown. Calcualate

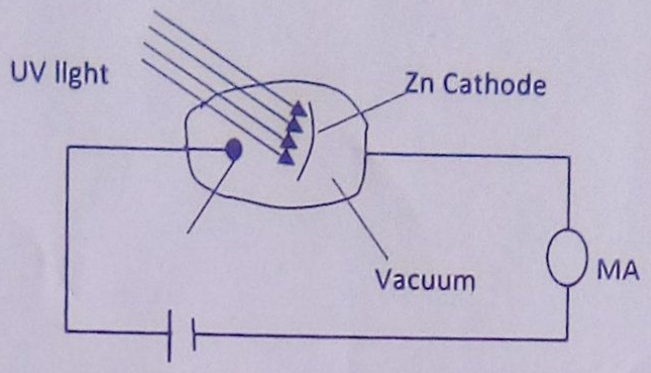
(i) The total resistance of the circuit. (2 marks)
(ii) The supply current (1 marks)
(iii) The power dissipated in the 6Ω resistor (3 marks)

(c) A house heating device has a powerrating of 2500 watts. It is used for 4 hours perday for 30 days. If the cost of a unit of power is 110/-, find the monthly bill. (2 marks)

7. (a) Draw a well labelled diagram of a cathode ray oscilloscope (CRO) and state the function of each part. (7 marks)
(b) State four uses of the CRO (2 marks)
(c) Sketch the traces that appear on the screen when:
(i) ac is connected across the Y plates and the time base is ff. (1 mark)
(ii) ac is connected across the Y plates and the time base is on. (1 mark)

(d) (i) what is photo electric effect. (1 mark)

(ii)



A zn cathode was enclosed in an evacuated tube as shown. When the cathode was irradiated with ultra violet radiation, the ammeter gave a reading. Explain why the ammeter gave. (3 marks)

(iii) A reading would happen in d(ii) above if a gas was introduced into the bulb. (1 mark)

8. (a) (i) What are X-rays? (1 mark)

(iii) Explain how the intensity and penetrating power of x-rays produced in an x-ray tube can be varied. (3 marks)

(iii) Write down 4 uses of x-rays. (2 marks)

(b) State and explain what would be observed when x-rays are passed above the cap of a positively charged gold leaf electroscope. (4 marks)

(c) (i) Define radio activity. (1 mark)

(ii) Write down 4 changers of radioisotopes. (2 marks)

(d) (i) ${}^{A}_{Z}X \rightarrow {}^{A}_{Z+1}Q + t$

X decays to Q according to the equation above. Identify t (1 mark)

(ii) 64g of X decays to 4g in 96 days calculate the mass of X that decays in 120 days.

(2 marks)

End

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MOCK EXAMINATIONS 2022

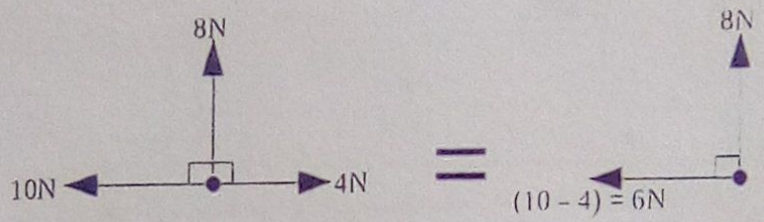
PHYSICS 535/2

MARKING GUIDE

1. (a) (i) A vector quantity is one with both magnitude and direction

(ii) Examples: force, momentum, velocity, acceleration

(b)



∴ Resultant force on the body is given by

$R^2 = 6^2 + 8^2 = 100$

Or R = 10N

From F = ma,

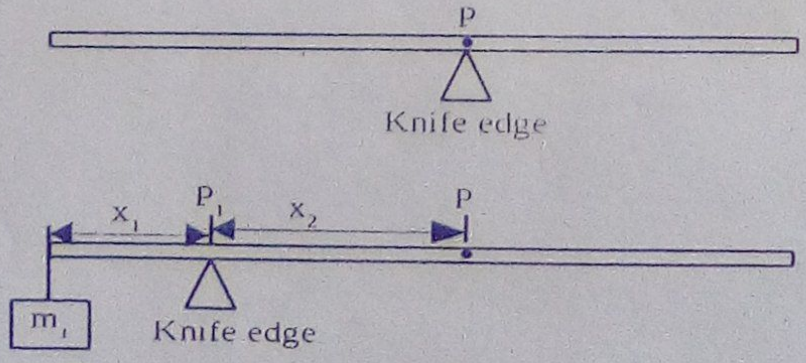
$$R = 5a = 10$$

$$a = 2ms^{-2}$$

(c) (i) Moment of force about a point is the product of force and its perpendicular distance from that point.

(ii) The principle of moments states that when a body is in equilibrium, the sum of clockwise moments about a given point balances the sum of anticlockwise moments about the same point.

(iii)



The metre rule is balanced on the knife edge.

The balance position P is noted.

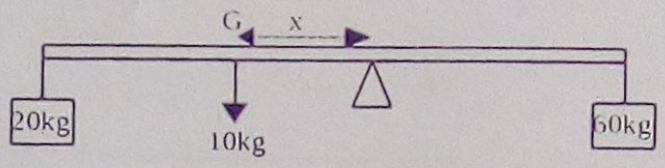
The known mass m_1 is suspended on the knife edge. The new balance point P_1 is noted.

The distances x_1 and x_2 are measured.

From $m_1 g x_1 = mgx_2$,

M can be calculated.

(d)



The weight of the rod acts through the centre of gravity, G = 50cm mark.

Let the pivot P be x cm from G

Then $20g \times (50 + x) + 10gx = 60g (50 - x)$

Or $20 (50 + x) + 10x = 60 (50 - x)$

$100 + 20x + 10x = 300 - 60x$

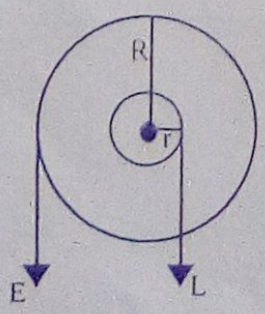
$90x = 200$

$x = \frac{200}{90} = 2.22\ cm$

Point of suspension is 2.22 cm from the centre on the same side as the 60 kg mass.

2. (a) Efficiency of a machine is 75% means only 75% of the input appears as power output. 25% is wasted against friction

(b)



L = 36N , E = 15N

(i) $MA = \frac{L}{E} = \frac{36}{15} = 2.4$

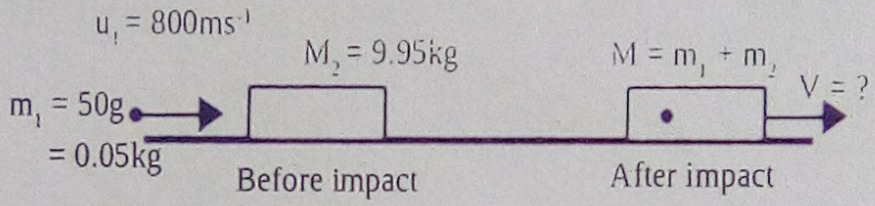
(ii) $VR = \frac{R}{r} = \frac{0.8}{25/100} = 3.2$

(iii) $Eff = \frac{MA}{VR} = \frac{2.4}{3.2} \times 100\% = 75\%$

(c) (i) Momentum is the product of mass and velocity .

(ii) The law of conservation of linear momentum states that if no external forces act on a system of colliding bodies, total momentum before collision is equal to total momentum after collision.

(d)



(i) From $m_1u_1 + m_2u_2 = (m_1 + m_2)V$

$0.005 \times 800 + 9.95 \times 0 = (9.95 + 0.005)V$

$40 = 10V$

$V = 4ms^{-1}$

(ii) Since surface is smooth, body moves with constant velocity of $4ms^{-1}$

$\therefore Distance = 4 \times 60 = 240m$

(iii) From F = ma,

$a = \frac{F}{m} = \frac{-5}{m_1 + m_2} = \frac{-5}{10} = -0.5ms^{-2}$

$[5N\ force\ is\ retarding\ force]$

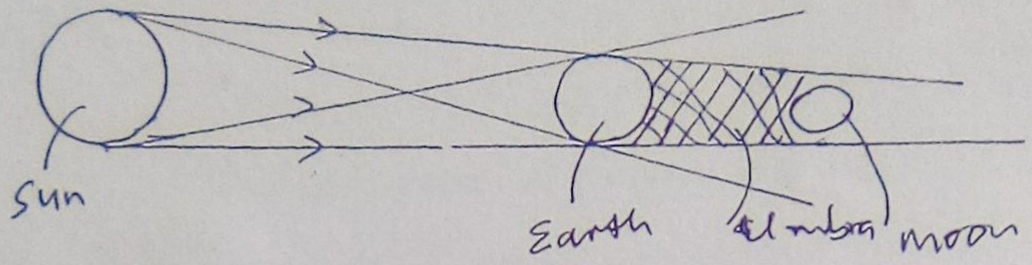
From $V^2 = u^2 + 2as$

$0^2 - 4^2 = -2 \times 0.5 \times s$

$s = 16m$

3. (a) (i) An eclipse is a shadow of the moon on the earth.

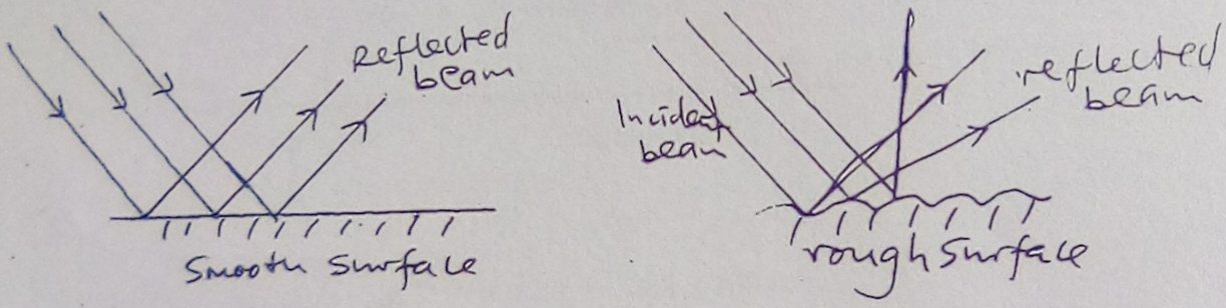
(ii)



Eclipse of the moon occurs when the earth casts its shadow on the moon.

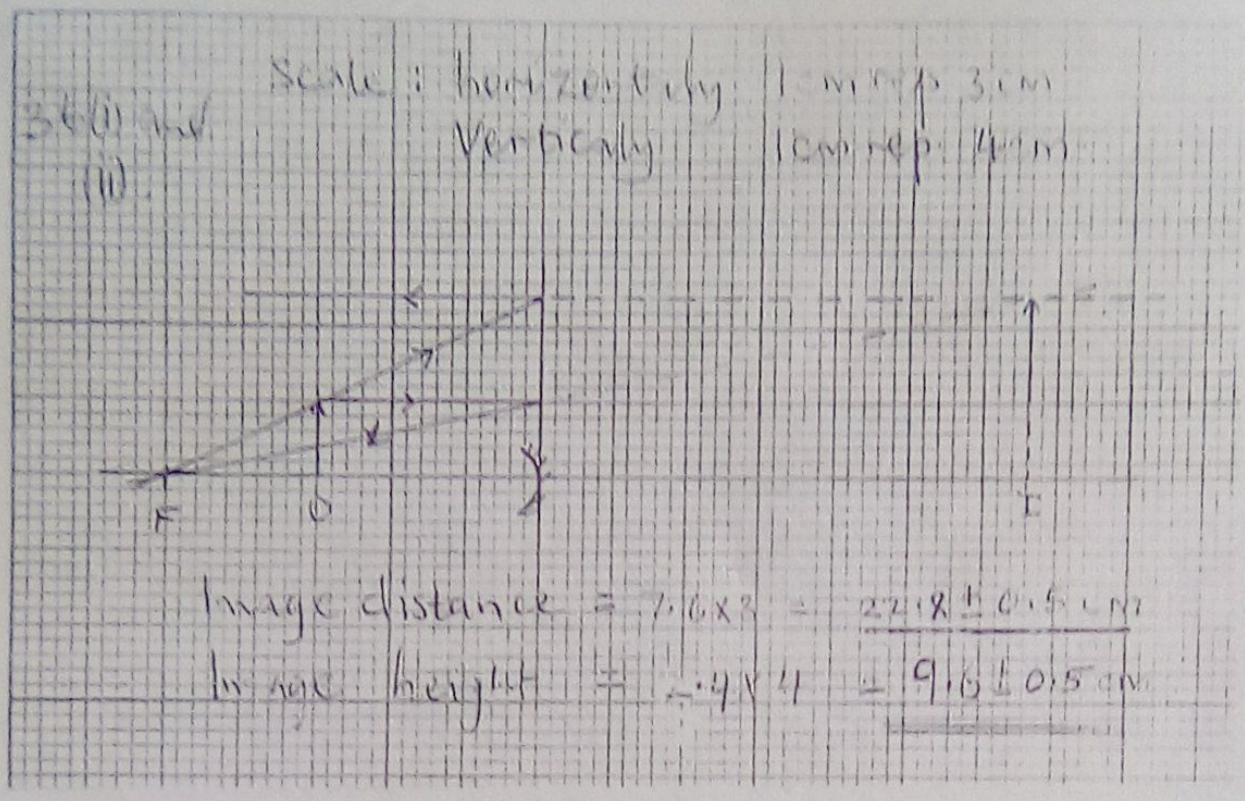
Total eclipse occurs when the entire moon is in the earth's umbra.

(iii)



Regular reflection is when an incident parallel beam is reflected parallel by a smooth surface. While diffuse reflection is when an incident parallel beam is reflected scattered in a different directions by a rough surface.

(b) (i) Principal focus of a concave mirror is a point on the principal axis through which all rays originally parallel and close to the principal focus pass after reflection by the mirror.



(c) Concave mirrors are used as

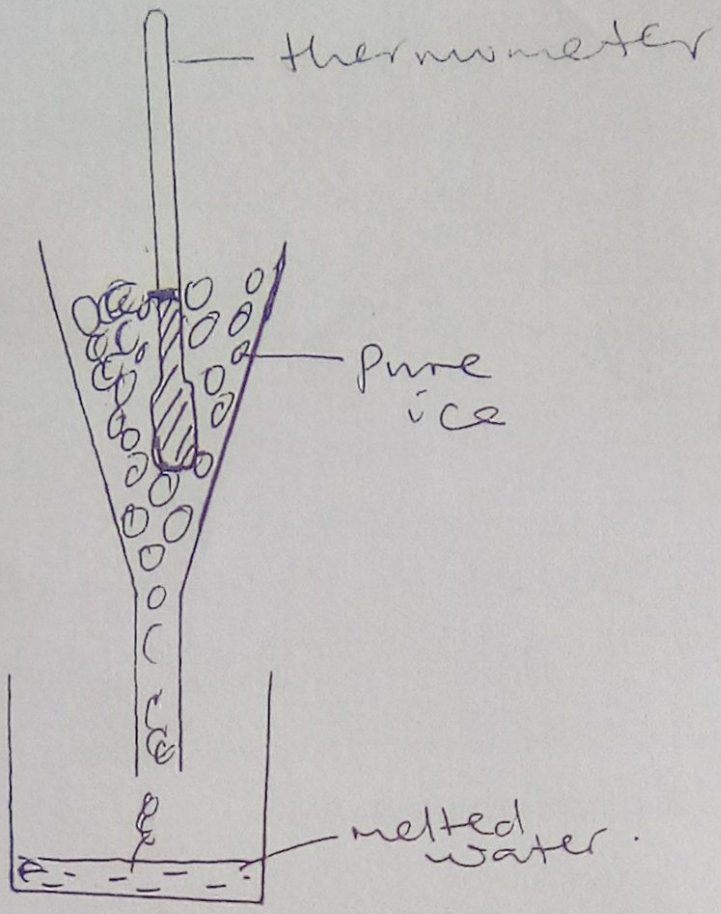
- Shaving mirrors
- In telescopes
- In projectors
- By dentists

4. (a) While heat is the form of energy which moves from one place to another due to a temperature difference, temperature is the degree of hotness or coldness.

(b) (i) The lower fixed point is the temperature of pure melting ice

The upper fixed point is the temperature of steam from water boiling at standard atmospheric pressure.

(ii)



The bulb of the thermometer is inserted into ice in a funnel.

After sometime, the liquid level is stable; this level is marked.

This is the lower fixed point $X_0 = 0^0C$ or 32^0F

(iii) $l_{100} - l_0 = 12$

$l_\theta - l_0 = 12 - 3 = 9$

From $\theta = \left(\frac{l_\theta - l_0}{l_{100} - l_0}\right) x\ 100^0C$

Temperature shown $= \frac{9}{12}\ 100^0C = 75^0C$

(c) (i) Heat capacity is the quantity of heat required to rise the temperature of a substance by 1^0C.

Specific heat capacity is the quantity of heat required to rise the temperature of 1kg mass of a substance by 1^0C.

(ii) Water at $40^0C \xrightarrow{mc\theta_1}$ *water at* $0^0C \xrightarrow{ml_f}$ *ice at* $0^0C \xrightarrow{mc_s\theta}$ *ice at* 15^0C

Heat removed $Q = mc_w\theta + ml_f + mc_s\theta_2$

$= 1.8\ x\ 4200\ x\ (40 - 0) + 1.8\ x\ 336000 + 1.8\ x\ 2100(0 - 15)$

$= 302400 + 604800 + 56700$

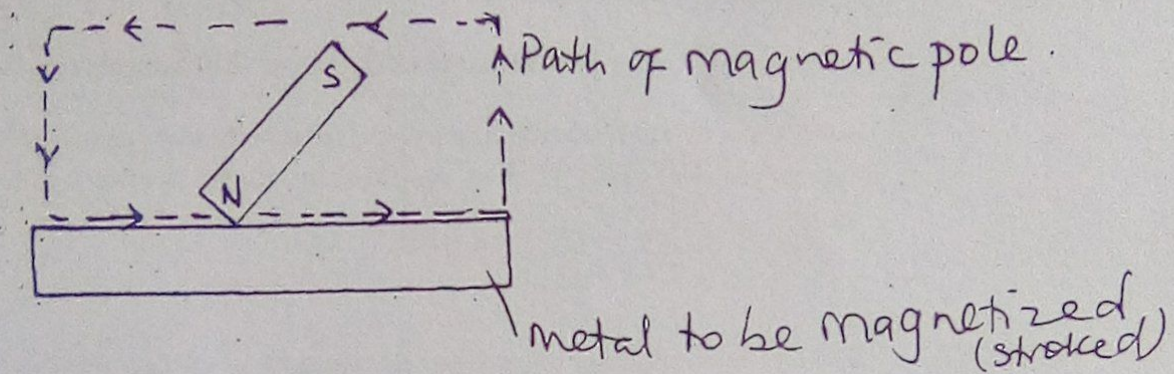
$= 963900\ J$

$$\text{Total time required} = \frac{\text{total energy}}{\text{power of machine}} = \frac{963900}{200}$$

$= 4819.5\ S$

5. (a) (i) A magnet is a piece of metal which attracts other magnetic materials.

(ii)

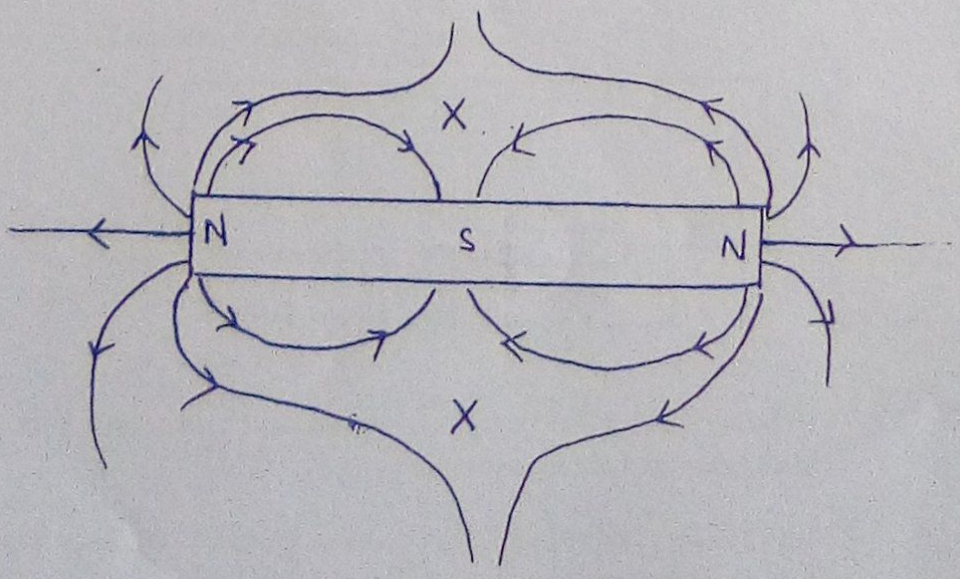


One pole of a bar magnet is moved (stroked) along the surface of the metal brand at the end it is lifted high off the bar. It is brought to the starting point to start a fresh cycle as shown by the path.

The process is repeated several times.

The end where the stroking starts acquires a pole similar to the one used for stroking where the stroking ends becomes an opposite pole.

(b) (i), (ii)



X, X Neutral points

(c) (i) – Local action

– Polarization

(ii) Local action is minimized by:

– Using pure zinc electrode

– Cleaning the impure zinc rod and rubbing its surface with mercury to form a zinc – mercury amalgam. The mercury dissolves the pure zinc covering the impurities.

Polarization is minimized by;

– Removing the copper rod and brushing its surface from time to time

– Adding a depolarizer (oxidizing agent) like potassium dichromate or manganese (IV) oxide. Each of these reacts with the hydrogen to form water.

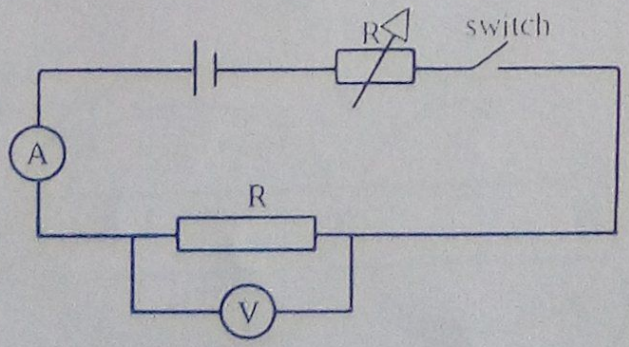
6. (a) (i) E.m.f is the work done in moving one coulomb of charge round a closed circuit including the source.

Accept open circuit pd across the terminals.

Internal resistance is the opposition to flow of charge through the source.

(ii) Ohm's law states that if the physical factors and temperature remain constant, current through a conductor is directly proportional to the p.d across its ends.

(iii)



A battery, voltmeter, ammeter, rheostat and a resistance R are connected in a circuit as shown.

The switch is closed and the rheostat adjusted for minimum value of V and I. these are then recorded. The rheostat is adjusted for other several values of V and I.

A graph of V against I is plotted. It is a straight line graph through the origin; hence $V \propto I$.

(b) (i) 6Ω *and* 12Ω are in parallel

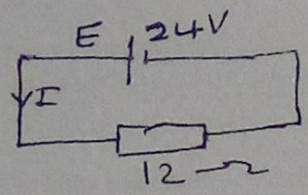
From $\frac{1}{R} = \frac{1}{6} + \frac{1}{12} = \frac{2+1}{12} = \frac{3}{12}$

Or $R = \frac{12}{3} = 4\Omega$

4Ω and 8Ω are in series

$\therefore Total\ resistance = 4 + 8 = 12\Omega$

(ii) Equivalent circuit is;



$\therefore suppply\ current\ I = \frac{24}{12} = 2A$

(iii) p.d across 6 Ω and 12 Ω resistors = IR = 2 x 4 = 8V

If I_1 is current through 6 Ω

Then $I_1 \times 6 = 8$

$I_1 = \frac{8}{6} = 1.33A$

From power $= I^2R = (1.33)^2 \times 6 = 10.61W$

(c) Power $= 2500W = \frac{2500}{1000} = 2.5\ kW$

Total time = 4 x 30 = 120 hors

Units used = no. of kilowatt hrs

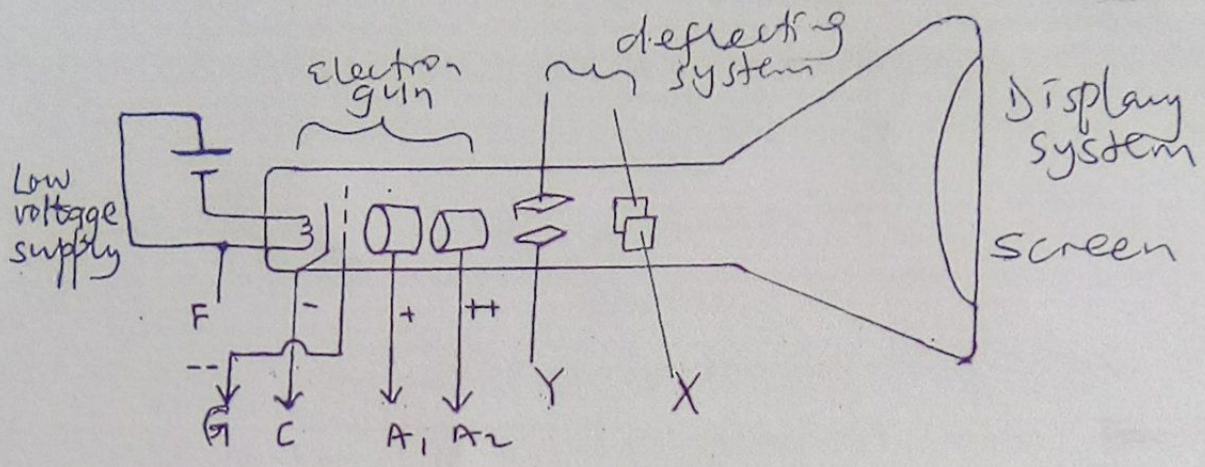
= 2.5 x 120 x 300

Cost = no. of units x cost per unit

= 300 x 100 = Shs 33,000

Monthly bill = Shs 33,000 per month.

7. (a)

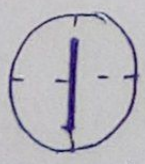


- Low voltage supply drives current through the filament F
- The filament heats the cathode which produces electrons by thermionic emission
- The grid G which is at a negative potential relative to the cathode controls the brightness of the screen as it controls the number of electrons reaching it.
- Anodes A_1 , A_2 which are at increasing positive potential relative to the cathode attracts and accelerates the electrons on the screen.
- Y – plates deflect the electrons vertically
- The X – plates deflects the electrons horizontally
- The screen is where the image (spot) is formed.

(b) Uses of CRO

- Can be used to remove both ac and dc voltages
- Can be used to display wave forms
- Measures frequency
- Measures wavelength
- Compares voltages
- Used in cardiographs to record heartbeats
- Can be used in radar systems to measure distance.

(c) (i) ac across Y – plates with time base off



(ii) a.c across X – plate with time base on

(d) (i) Photoelectric effect is the ejection of electrons from a metal surface when electromagnetic radiation of suitable frequency falls on them

(ii) When uv rays falls on the zinc surface, electrons are attracted by photo electric effect. These are attracted by the anode. Movement of the electrons completes the circuit and current flows in the external circuit and is registered by the ammeter.

(iii) The current gradually reduce to zero as the gas atoms interfere with the movement of the electrons.

8 (a) (i) x rays are electromagnetic waves of very high frequency produced when very fast moving electrons are stopped by matter.

(ii) – Varying the filament current varies the intensity of x – rays directly

– Varying the anode potential varies the penetrating power directly

(iii) x – rays are used in;

- Radiography
- Detection of cracks in metal plates and welded joints
- Radiotherapy
- Examination of the whole machines
- Study of crystals.

(b) There will be a gradual decrease in the divergence of the leaf and eventually the leaf collapses.

The x – rays ionizes the air above the cap creating positive and negative ions.

The negatively charged ions are attracted to the positively charged electroscope where they neutralize the charge on it hence the leaf divergence decreasing. When all charge is neutralized, the leaf collapses.

(c) (i) Radioactivity is the spontaneous disintegration of radioactive nuclei with subsequent release of one or more of the following;

$\propto$ – Partcles, β – particles or γ – rays

(ii) Radioisotopes can cause;

- Cancer
- Loss of eye sight
- Radioactive poisoning

- Skin burns
- Hereditary defects
- Sterility
- Death
- Leukemia

(d) (i) ${}^{A}_{Z}X \rightarrow {}^{A}_{Z+1}Q + t \equiv {}^{A}_{Z}X \rightarrow {}^{A}_{Z+1}Q + {}^{a}_{b}t$

a – mass number and b – atomic number of t

$$\therefore A = A + 1 \Rightarrow a = 0$$

$$Z = Z + 1 + b \Rightarrow b = -1$$

Hence ${}^{a}_{b}t = {}^{0}_{-1}t$ i.e

t is a β – particle

(ii) $64 \xrightarrow{1T_{1/2}} 32 \xrightarrow{2T_{1/2}} 16 \xrightarrow{3T_{1/2}} 8 \xrightarrow{4T_{1/2}} 4$

$4T_{1/2} = 96$

$$T_{1/2} = \frac{96}{4} = 24\ days$$

$\therefore 120\ days = \frac{120}{24} = 5\frac{T}{2}$

In 5th half-life mass reduces to $2g$.

$\therefore mass\ decayed = 64 - 2 = 62g$

- END -