## UACE PHYSICS SEMINAR SLATED FOR SATURDAY 28TH SEPTEMBER 2024 AT SEETA HIGH SCHOOL MUKONO (MBALALA CAMPUS)

***Physics paper one (P510/1)***

## SECTION A

**1.** (a) (i) Define **density** and **relative density**.

(ii) Outline any **two** factors that affect the volume per second of a liquid flowing through a given pipeline.

(b) (i) Explain the origin of viscosity in liquids and gases.

(ii) With the aid of a labelled diagram, describe an experiment to determine coefficient of viscosity of a liquid using Poiseuille's formula.

(c) In a blood transfusion, blood flows from a bottle at atmospheric pressure into a patient's vein in which the pressure is $20\ mmHg$ above the atmospheric pressure. The bottle is $95\ cm$ higher than the vein and the vein has a length of $3.0\ cm$ and internal diameter of $0.45\ mm$. Calculate the volume that flows into the vein in one minute.
(*Viscosity of blood is* $4.0X10^{-3}Nm^{-2}s$, *densities of blood and mercury are* $1005\ kgm^{-3}$ *and* $13600\ kgm^{-3}$ *respectively*)

(d) (i) State **Bernoulli's principle**.

(ii) Explain why an umbrella may be blown off when one holds it and moves over the wind.

[***LUBIRI HIGH***]

**2.** (a) State the **principle** of conservation of;

(i) linear momentum

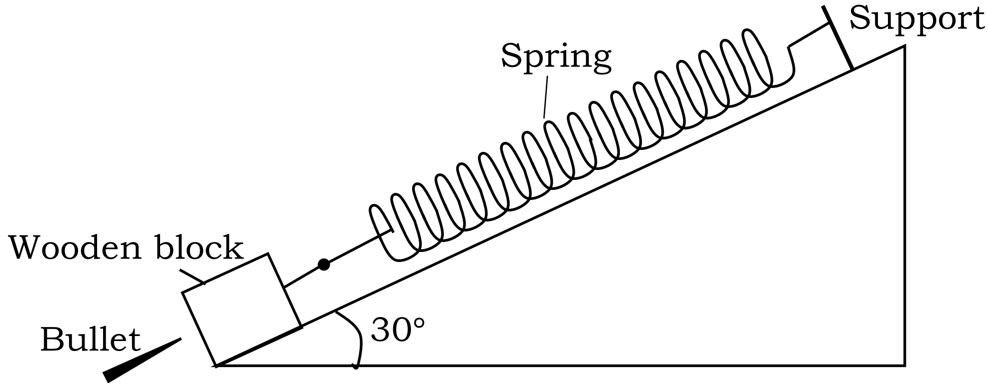
(ii) energy

(b) (i) Define **impulse** and state its units.

(ii) Sand is poured at a rate of $11.5\ gs^{-1}$ onto a pan of direct reading balance calibrated in newtons. The sand falls from a height of $37.5\ cm$ onto the pan and it does not rebound. Calculate the reading on the balance $18.0\ s$ after the sand first hits the pan.

(c) Distinguish between **elastic materials** and **plastic materials** using examples.

(d)




A wooden block of mass $880g$ resting at the bottom of a rough inclined plane making $30^0$ with the horizontal and coefficient of friction between the block and plane is 0.32. A bullet of mass $20g$ is fired at a close range and gets embedded into the block. The system moves up along the incline thereby compressing the spring of force constant $100Nm^{-1}$ through a distance of 60 $cm$.

(i) State the energy changes that take place.

(ii) Calculate the velocity at which the bullet strikes the block.

(iii) Explain briefly why the block will return to its initial position.

(e) (i) Define the terms **angular velocity**, **centripetal force** and **centrifugal force**.

(ii) Explain briefly the action of a centrifugal force.

[***SEETA HIGH SCHOOL GREEN CAMPUS***]

**3.** (a) (i) Define **Inertia**.

(ii) State the **work-energy theorem**.

(b) A simple pendulum of length $0.5m$ has a bob of mass $0.2kg$. It is displaced from its mean position P to position Q so that the string makes an angle of $60^0$ with the vertical. Calculate the;

(i) maximum potential energy of the bob.

(ii) loss in potential energy when the angle made by the string with the vertical turns to $30^0$.

(c) Define the following;

(i) **Gravitational constant**.

(ii) **Escape velocity**.

(d) (i) Explain briefly how world-wide television communication can be achieved using satellites.

(ii) Account for the moon not having an atmosphere.

(e) Describe an experiment to determine gravitational constant, ***G***, in a school laboratory.

**[*ST. BALIKUDDEMBE, KISOGA*] [MAKERERE COLLEGE SCHOOL]**

**4.** (a) (i) Define **surface tension** and **free surface energy**.

(ii) Explain why it is difficult to remove a dirt from a cloth without using soap.

(b) Two soap bubbles of radii $1.5mm$ and $2.5mm$ coalesce under isothermal conditions to form a common interface. Calculate the;

(i) radius of the common curvature.

(ii) excess pressure inside the interface.

(c) (i) Define **Young's modulus**, **work hardening** as used in properties of matter.

(ii) Derive an expression for the energy stored per unit volume of a stretched wire.

(d) With the aid of a labelled diagram, describe an experiment to investigate the relationship between tensile stress and tensile strain.

(e) A mass of $20g$ falls from a height of $200cm$ to the top of a spring of force constant $100Nm^{-1}$. Calculate the resulting compression in the spring if the mass;

(i) sticks on top of the spring.

(ii) bounces off the spring with a speed of $2.0ms^{-1}$.

[***JINJA COLLEGE***]

**5.** (a) Define;

(i) **Simple harmonic motion**.

(ii) **Period**.

(b) (i) Show that energy in simple harmonic motion is conserved.

(ii) Sketch a graph to show the variation of acceleration with displacement for a body executing simple harmonic motion.

(c) Describe an experiment to determine acceleration due to gravity using a spring of unknown force constant.

(d) (i) Define **angular displacement**.

(ii) Explain why the maximum speed of a car on a banked road is higher than that on an unbanked road.

(e) (i) Explain briefly the terms **stable** and **unstable** equilibrium of a body.

(ii) A horizontal rod AB is suspended at the end by strings. The rod is $0.8m$ long and a mass of $5kg$ is attached $0.6m$ away from A so that the body attains a horizontal equilibrium. Find the tension in each string.

[***ST. JOSEPH'S GIRLS' NSAMBYA***]

## SECTION B

**6.** (a) (i) Define **fixed points**, **fundamental interval**, **triple point of water** and **thermometric property**.

(ii) State **four** qualities of a good thermometric property.

(iii) Explain why it is wrong to use ice and steam points in modern thermometry.

(b) Describe the structure and action of a **digital** thermometer.

(c) (i) Define **latent heat** and **melting point**.

(ii) State and explain **one** application of specific latent heat of vaporization.

(d) $5kg$ of water were heated at constant pressure to produce steam at $100^0C$. If the density of steam is $0.58kgm^{-3}$. Calculate the;

(i) external work done.

(ii) internal energy, if the specific latent heat of vaporization of water is $2.259 \times 10^6 Jkg^{-1}$ and density of water is $1000kgm^{-3}$.

[***SEETA HIGH SCHOOL MAIN***]

**7.** (a) (i) Define **thermal conductivity**, **temperature gradient** and **heat current**.

(ii) Explain the mechanism in heat transfer in a cork.

(iii) Explain why metals are better conductors of heat than silk.

(b) (i) Define **specific heat capacity**.

(ii) Explain why water melon is always at lower temperature than the environment where it is placed.

(c) Describe an experiment to determine the specific heat capacity of a liquid using the method of cooling.

(d) A calorimeter containing first $50g$ and then later $110g$ of water is heated and suspended in the same constant temperature enclosure. It is found that the times taken to cool from $60^0C$ to $50^0C$ in the two cases are 17 $minutes$ and 35 $minutes$ respectively. Calculate the heat capacity of the calorimeter. [***BISHOP CYPRIAN KYABAKADDE***]

**8.** (a) (i) Distinguish between a **gas** and a **vapour**.

(ii) State and explain the conditions under which a real gas will behave as an ideal gas.

(b) Describe an experiment to determine the SVP of a liquid at $65^0C$.

(c) (i) State the **laws of black body radiation**.

(ii) Sketch a graph of intensity against wavelength and use it to explain why the center of a fire appears white.

(d) An electric fire element of length $30cm$, diameter $1.0cm$ emits 0.6 of the power it radiates at the same temperature. If it operates at a rate of $60W$, estimate its working temperature.

[***SEROMA CHRISTIAN SCHOOL***]

**9.** (a) (i) State **Newton's law** of cooling.

(ii) Explain briefly why small pieces of wood are used to light big logs.

(b) (i) Describe an experiment to determine the specific heat capacity of silver using the electrical method.

(ii) An electrical heater rated at $520W$ is used to raise the temperature of $2.5kg$ of a liquid from room temperature of $20^0C$ to $100^0C$ in $25\ minutes$ and the rate of heat loss at $100^0C$ is $16W$. Estimate the specific heat capacity of the liquid.

(c) Explain why metals feel cold to touch.

(d) A rectangular roof $12m\ X\ 10m$ has vertical walls $4m$ high for supporting a flat roof. The walls and roof are $25cm$ thick and are made of a material of thermal conductivity $0.25Wm^{-1}K^{-1}$. The doors and window cover an area of $16m^2$ and are made of glass of thickness $5mm$. The room is maintained at a constant temperature above its surroundings. If the percentage heat loss by conduction through the windows and doors is 94%, find the thermal conductivity of glass.
(*Neglect the heat loss through the floor*).

[***ST. JULIANA HS GAYAZA***]

## SECTION C

**10.** (a) Define the following terms; **Decay constant, Half-life, activity, Carbon-14 dating, Uranium dating**.

(b) (i) Define **radio-active equilibrium**.

(ii) Potassium $^{44}_{19}K$ has a half-life of 1200 $s$ and decays to form $^{44}_{20}Ca$, a stable isotope of calcium. Given a sample of 10$mg$ of potassium, calculate the activity of the sample after one hour and the number of atoms of calcium after one hour.

(c) Distinguish between **nuclear fission** and **nuclear fusion**.

(d) The deuterium-tritium fusion reaction is shown below.$^{2}_{1}H + ^{3}_{1}H \longrightarrow ^{4}_{2}He + ^{1}_{0}n$.

Taking the masses of $^{2}_{1}H = 2.0141U$, $^{3}_{1}H = 3.0161U$, $^{1}_{0}n = 1.0087U$ and $^{4}_{2}He = 4.0026U$ and $1U = 931MeV$, Boltzmann's constant $K_B = 1.38 \times 10^{-23}JK^{-1}$, calculate the;

(i) amount of energy released in the reaction.

(ii) temperature when the gas must be heated to initiate the reaction if the radii of deuterium and tritium are each $1.5 \times 10^{-15}m$.

[***KIIRA COLLEGE BUTIKI***]

**11.** (a) (i) Distinguish between **photoelectric effect** and **binding energy per nucleon**.

(ii) Define **quantum theory** of matter based on photoelectric effect.

(iii) State and explain **three** evidences of quantum theory of matter.

(b) Describe an experiment to provide the evidence for photoelectric effect.

(c) (i) State **Bragg's law** of X-ray diffraction.

(ii) Describe briefly Bragg's law of diffraction of a crystal.

(d) An alpha particle with initial kinetic energy of $1.6\,X\,10^{-13}J$ is directed towards the nuclear charge of $+50e$. Calculate the nearest distance of approach of the alpha particle to the nucleus.

[***NAALYA SS NAMUGONGO***]

**12.** (a) (i) Define an **electron volt, unified atomic mass unit, specific charge** and **stopping potential**.

(ii) With the aid of a labelled diagram, describe how a charge on an oil drop can be obtained using Millikan's experiment.

(b) An oil drop of radius $1.0 \times 10^{-3} cm$ falls freely in air, mid way between two vertical parallel metal plates which are $0.50 cm$ apart and its terminal velocity is $1.066 cms^{-1}$. When a potential difference of $3000V$ is applied between the plates, the path of the drop becomes a straight line inclined at an angle of $31.6^0$ to the vertical. Find the;

(i) horizontal velocity of the drop when the p.d on the plates is applied.

(ii) charge on the oil drop and density of air, given that $\eta = 1.82 \times 10^{-5} Pas$, density of oil drop $= 880 kgm^{-3}$.

(c) (i) Explain briefly the motion of electrons in a magnetic and electric field.

(ii) Describe briefly how specific charge of an electron can be got using the fine beam method.

(d) Sketch a graph of current-voltage for a discharge tube and explain its features.

[***IGANGA SS***]

**13.** (a) Define the following terms as applied to electronic devices.

(i) **Semi-conductor**.

(ii) **Intrinsic** and **Extrinsic**

(iii) **Thermionic emission**.

(b) (i) Explain briefly how a **P-N junction** is formed.

(ii) List **two** examples of impurities of elements used during the process of doping.

(c) With the time-base switched off, an alternating voltage with root mean-square value $2.82V$ is connected across the Y-plates of a CRO. If a vertical trace of length $40 cm$ is formed on the screen, find the voltage gain.

(e) Explain briefly the structure of a transistor.

**[*JINJA SS*]**

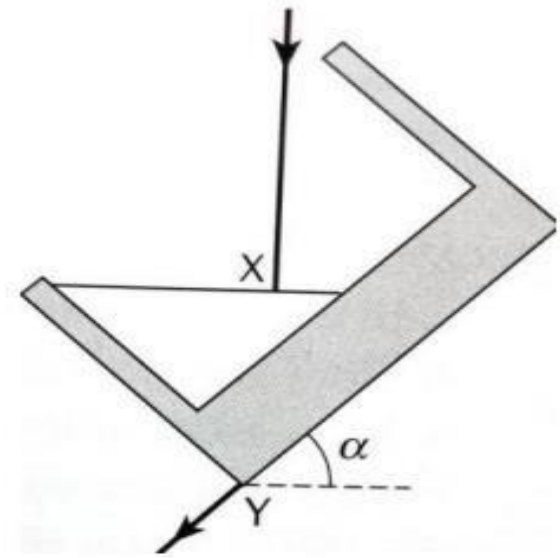
## ***Physics Paper two (P510/2)***

## SECTION A

**1.** (a) Define the term **refraction of light**.

(b) Describe an experiment to determine refractive index of water by critical reflection.

(c)




A glass container with thick bottom is half filled with water and a narrow beam of light is shone vertically down into the water. The glass is tilted until an angle $\alpha$ such that the light is refracted along the lower surface of the glass. If the refractive indices of water and glass are 1.33 and 1.5 respectively,

(i) Copy and complete the diagram to show the path of light from when it enters water at X to when it leaves glass at Y.

(ii) Calculate the critical angle at the glass-air interface.

(iii) Calculate the value of $\alpha$.

(d) Explain carefully why the apparent depth of the water tank changes with position of the observer.

(e) (i) What is meant by **limiting angle** of a prism.

(ii) Calculate the limiting angle of a prism of glass of material of refractive index 1.5.

[***BUKEDEA SS***]

**2.** (a) Define the terms **principal axis** and **focal plane** as applied to convex lenses.

(b) (i) A convex lens of **focal length** $f$ forms a real image I of real object O on a screen. If the distance between the object O and the screen is $d$, show that for the distance $d \leq 4f$, no image can be formed on the screen.

(ii) State another condition apart from that derived in (i) above for which a convex lens cannot form a real image on a screen.

(c) Describe an experiment to determine focal length of a concave lens using a concave mirror.

(d) An astronomical telescope consisting of an objective lens of focal length 60cm and an eye piece of focal length 3cm is focused on the moon so that the final image is formed at minimum distance of distinct vision (25cm) from the eye piece.

(i) Calculate the angular magnification.

(ii) Assuming that the diameter of the moon subtends an angle of 0.5° at the objective, find the actual size of the image.

[***UGANDA MARTYR'S SS NAMUGONGO***]

## SECTION B

**3.** (a) Distinguish between **longitudinal** and **transverse** wave motions.

(b) A progressive simple harmonic wave of frequency $250Hz$ and velocity $30ms^{-1}$ propagates in the positive $x$ direction in a time, t seconds, determine the;

(i) equation of propagation of the progressive wave if its amplitude is 0.03 m.

(ii) phase difference between two vibrating points on the progressive wave which are 10cm apart.

(c) Describe an experiment to determine the end correction of a resonance tube using a set of tuning forks.

(d) The absorption spectrum of a faint galaxy is measured and the wavelength of one of the lines identified as the calcium H line is found to be 478 nm. The same line has wavelength of 397nm when measured in the laboratory.

(i) is the galaxy moving towards or away from the earth.

(ii) explain your answer.

(iii) calculate the speed of the galaxy relative to the earth.

(e) Explain why sound is easily heard at night than during the day.

[***ELITE HIGH***]

**4.** (a) Define the term interference of light and state the conditions for interference pattern to be observed.

(b) (i) Describe an experiment to observe Newton's rings, and explain how they are formed.

(ii) In young's double slit experiment, the distance between the center of the interference pattern and the $10^{th}$ bright fringe on either side is 3.44cm and the distance between the slit and the screen is 2.00cm. if the wave length of the light used is $5.89\times10^{-7}$m, determine the slit separation.

(c) (i) What is meant by the terms; **diffraction** and **polarization** of light.

(ii) Two Polaroid sheets are placed close together in front of a lamp so that no light passes through them. Describe and explain what happens when one sheet is slowly rotated, the other remaining in the original position.

(iii) Calculate the polarizing angel for light travelling from water of refractive index 1.33, to glass, of refractive index 1.53.

(d) Mention any **two** uses of polarizing devices.

[]

**SECTION C**

**5.** (a) Define the term **magnetic field**.

(b) A stripe of metal foil 1.2cm wide and $1.5 \times 10^{-3} cm$ thick carries a current of 0.5A along its length, and the metal contains $5 \times 10^{22}$ free electrons per $cm^3$. If the stripe is placed normal to the magnetic field if flux density 0.5T, a p.d is developed across the foil.

(i) Explain why a p.d is developed across the stripe.

(ii) Calculate the mean drift velocity of the electrons.

(iii) Find the value of maximum p.d across the stripe.

(c) Describe an experiment to show the variation of magnetic flux density at the center of a circular coil with current through it.

(d) A rectangular coil of 50 turns and dimensions 5cm× 2cm hangs vertically inside a solenoid which carries a current of 4A and has 2000 turns per meter.

(i) Calculate the magnetic flux density of the solenoid.

(ii) If the plane of the rectangular coil was initially at $60^o$ to the axis of the solenoid, find the value of current that must be passed through the rectangular coil such that the initial torque on the coil is $3.0 \times 10^{-8} Nm$.

(e) Explain the orientation of a freely suspended bar magnet at a position in southern hemisphere.

[***SELONA SS MASAJJA***]

**6.** (a) State the **laws** of electromagnetic induction.

(b) A circular coil of 150 turns and cross-sectional area $0.3m^2$ is placed with its plane perpendicular to a horizontal magnetic field of flux density $1.2x10^{-2}T$. The coil is rotated about a vertical axis so that it turns through $70^0$ in 2s. Calculate the:

(i) initial flux linkage through the coil.

(ii) e.m.f induced in the coil.

(c) (i) Explain how back e.m.f is produced in a coil in an electric motor.

(ii) A metal air craft with a wing span of 40m flies with ground speed of $100kmh^{-1}$ in the direction due east at a constant altitude a region where the horizontal component of the earth's field is $1.6 \times 10^{-5}T$ *and* the angle of dip is 71.6°. find the potential difference that exists between the wing tips.

(d) With the aid of a diagram, describe how a simple a.c generator works.

(e) (i) Define **mutual induction**.

(ii) Explain three main structural designs for an alternating current transformer that improves its efficiency.

(iii) A lamp rated 30W, 0.5A is operated at full capacity using a transformer of efficiency 84%. If the current in the primary windings of the transformer is 2.38A, find the turn ratio and type of transformer used.

[***ST MARK NAMAGOMA***]

**7.** (a) Define the terms ***peak*** and ***root mean square (r.m.s)*** value of an alternating voltage.

(b) An inductor of inductance, L, is connected across a source of alternating voltage, $V = V_0 \sin \omega t$.

(i) Derive the relationship between the reactance and the frequency of the supply.

(ii) Sketch using the same axes the variation of current through the inductor and the voltage across it, with time.

(iii) Explain the phase difference in the graphs in d(ii) above.

(c) Describe with the aid of a diagram how a **thermal- couple meter** measures alternating current.

(d) A resistor of $500\Omega$ and a capacitor of capacitance C are connected in series with an ac supply of r.m.s value 15.0V and frequency 50Hz. If the p.d across the resistor has r.m.s value 10.0V, calculate the:

(i) p.d across the capacitor.

(ii) value of C.

[***BWEYOGERERE SS***]

## SECTION D

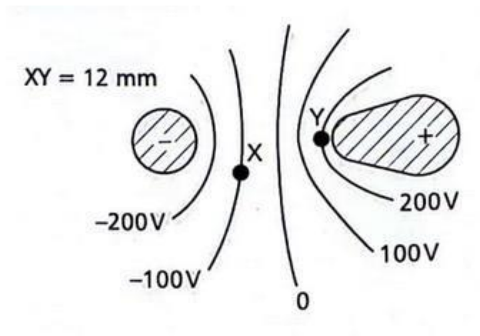
**8.** (a) Define the terms **electric field intensity** and **electric potential**.

(b) (i) A pin is placed on the cap of a positively charged gold leaf electroscope with its blunt end on the cap. Explain what is observed.

(ii) Describe an experiment to show that the surface of a pear-shaped conductor is an equipotential surface.

(iii) Derive an expression for electric field intensity perpendicular to a charged conductor of charge density $\delta$ in air.

(c) The figure shows equi-potentials of the electric field between two oppositely charged conductors.




Calculate the:

(i) potential energy of a $+2nC$ point charge at X.

(ii) work done to move the $+2nC$ charge from X to Y.

(d) With the aid of a diagram, describe how an electrophorus provides unlimited supply of electric charge.

[***SEETA HIGH SCHOOL MUKONO***]

**9.** (a) Define dielectric strength of a capacitor and state its units.

(b) Describe an experiment to determine dielectric constant of a material.

(c) A parallel air capacitor of area $25cm^2$ and with plate 1mm apart is charged to a potential of 100 V. The power supply is then disconnected and the plate moved a further 1 mm apart.

(i) Calculate the energy change due to the movement of the capacitor plates.

(ii) Account for the energy change in (i) above.

(d) (i) When capacitors are connected in series, the effective capacitance of the combination is less than the capacitance of either capacitor. Explain why?

(ii) Explain the effect of a dielectric on capacitance of a charged capacitor.

[***FOREST HILL COLLEGE***]

**10.** (a) What is meant by the terms **electromotive force** and **terminal p.d** of a cell.

(b) A voltmeter is connected in parallel with a variable resistance $R$, which is in series with an ammeter and a cell of emf $E$ and internal resistance $r$. The ammeter and voltmeter readings are noted for several values of $R$.

(i) Sketch a graph to show the variation of V with I, and use the graph to explain how $E$ and $r$ can be obtained.

(ii) If in this experiment the ammeter had a resistance of $10\Omega$ and the voltmeter a resistance of $100\Omega$, $R$=$2\Omega$ , $E$=2V and $r$=$2\Omega$, what would be the reading of the ammeter and the voltmeter?

(c) Explain the principle of a potentiometer.

(d) A meter bridge is balanced with a piece of aluminum wire of resistance $7.3\Omega$ in the left-hand gap, the sliding contact being 42.6cm from the left end of the bridge wire and the temperature 17℃. If the temperature of the aluminium wire is raised to 57℃, find the new balance length.
(Temperature coefficient of resistance of aluminum is $3.8\times10^{-3}$)

(e) Explain why the balance point of the meter bridge should be close to the middle of the bridge wire.

[***SEETA HIGH SCHOOL A-CAMPUS***]

## P510/3 (PHYSICS PRACTICAL)

1. Given $\boldsymbol{\alpha} = \mathbf{58^0}$ and $\boldsymbol{\beta} = \mathbf{98^0}$, find $\boldsymbol{\mu}$ from the expression $\boldsymbol{\mu} = \frac{\tan\frac{\beta}{2}}{\tan\frac{\alpha}{2}}$
2. Given $\boldsymbol{d} = \mathbf{0.0700}\boldsymbol{m}$, $\boldsymbol{h} = \mathbf{0.045}\boldsymbol{m}$, $\boldsymbol{\alpha} = \mathbf{0.35}\boldsymbol{N}$ and $\boldsymbol{W} = \mathbf{1.55}\boldsymbol{N}$**.** Find the density, $\beta$ of the liquid from the expression $\boldsymbol{\beta} = \frac{4(W-\alpha)}{\pi g h d^2}$,
**where** $\boldsymbol{\pi} = \mathbf{3.14}$ **and** $\mathbf{g} = \mathbf{9.81ms^{-2}}$
3. Given $\boldsymbol{\theta} = \mathbf{43^0}$, $\boldsymbol{\gamma} = \mathbf{38^0}$, find λ from the expression $\boldsymbol{\lambda} = \frac{\sin(\theta+\gamma)}{\sin\theta}$
4. Given $\mathbf{V_0} = \mathbf{0.95V}$, $\mathbf{I_0} = \mathbf{0.40A}$, $\mathbf{d} = \mathbf{0.34mm}$ **and** $\mathbf{y} =$ $\mathbf{30.0cm}$. Determine;

(i) the electrical resistivity**,** $\boldsymbol{\phi}$ from the expression**:** $\boldsymbol{\phi} = \frac{\pi d^2 S}{2}$

(ii) electrical resistance, **R** from the expression**:** $\mathbf{R} = \frac{V_o}{I_o} - \frac{4\phi y}{\pi d^2}$

**5.** Given $\mathbf{t = 5.20mm,\ b = 2.40cm},\ \mathbf{S = 0.680kgs^{-2}}$**,** and $\boldsymbol{l} = \mathbf{0.800m.}$ Determine the value of Young's modulus**, E** from the expression**:**

$\mathbf{E} = \frac{16\pi^2 l^3 S}{bt^3}$

**6.** Consider the table of results below.

| **L(cm)** | **1.5** | **3.0** | **4.5** | **6.0** | **7.9** | **9.0** |
|---|---|---|---|---|---|---|
| **i(°)** | **29** | **63** | **79** | **90** | **102** | **112** |

Copy and complete the table including values of $\frac{1}{L^2}$ and $\frac{1}{\sin^2 i}$

**7.** Consider the table below;

| **I(A)** | **0.66** | **0.54** | **0.50** | **0.44** | **0.40** | **0.36** |
|---|---|---|---|---|---|---|
| **V(V)** | **0.65** | **0.80** | **0.95** | **1.00** | **1.20** | **1.30** |
| **X(m)** | **0.200** | **0.300** | **0.400** | **0.500** | **0.600** | **0.700** |

(i) copy and complete the table including values of $\frac{V}{I}$, $\frac{I}{V}$, **VI,** $\frac{1}{I}$, $\frac{1}{V}$

(ii) Plot a suitable graph and use it to determine the **electrical resistivity**, $\boldsymbol{\rho}$ of the material of the wire, given that the mean diameter, **d** of the wire is **0.36mm**.

**8.** Consider the table below;

| **d(m)** | **0.900** | **0.800** | **0.700** | **0.600** | **0.500** | **0.400** |
|---|---|---|---|---|---|---|
| **X(m)** | **0.076** | **0.076** | **0.063** | **0.055** | **0.040** | **0.033** |

(i) Copy and complete the table including values of $\mathbf{\log_{10}} \boldsymbol{x}$ and $\mathbf{\log_{10}} \boldsymbol{d}$

(ii) Plot a graph of $\mathbf{\log_{10}} \boldsymbol{x}$ against $\mathbf{\log_{10}} \boldsymbol{d}$

(iii) Determine the slope, **K** of the graph.

**1. In this experiment, you will determine the moment of inertia, I , of the half metre rule provided by two methods.**

**METHOD I**

**a)** Measure and record the mass M of the half metre rule.

**b)** Clamp the metre rule such that the scale is facing you.

**c)** Tie the threads at points **P** and **Q,** equidistant from the point **C**, the **25.0cm** mark of the half metre rule such that the distance $\mathbf{d_2} =$ $\mathbf{0.150m}$.

**d)** Suspend the half metre rule from the clamped metre rule as shown in **figure 1,** making sure that the scale of the half metre rule faces upwards.

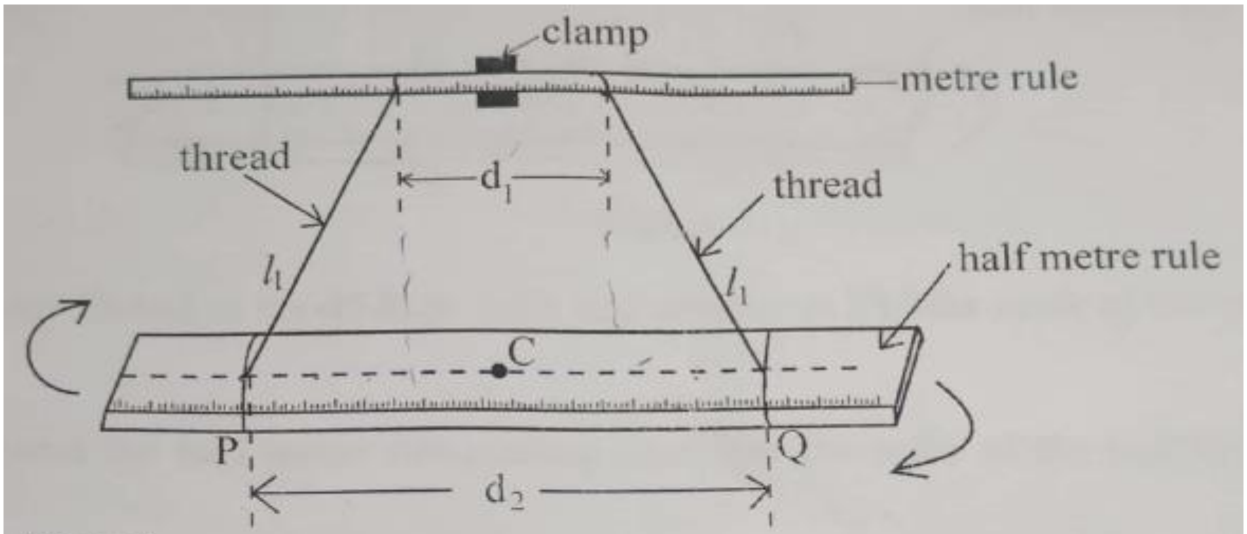



*Figure1*

**e)** Adjust the length $\boldsymbol{l_1}$ of the threads to **0.500m**

**f)** Adjust the separation of the threads on the clamped metre rule to $\mathbf{d_1} =$ $\mathbf{0.100m}$.

**g)** Turn the half metre rule through a small angle about a vertical axis through its centre **C** and release it to oscillate.

**h)** Measure and record the time, **t**, for 20 oscillations.

**i)** Determine the period **T**.

**j)** Calculate the value of $\mathbf{K_1}$ from the expression: $\mathbf{K_1} = \frac{\mathbf{T}}{\mathbf{4\pi}}\sqrt{\frac{\mathbf{gd_1d_2}}{\mathbf{l_1}}}$

**Where** $\boldsymbol{\pi = 3.14}$ **and** $\mathbf{g = 9.81ms^{-2}}$

**k)** Calculate the value of $I_1$ from the expression: $\mathbf{I_1 = M(K_1)^2}$

**METHOD II**

**a)** Set up the apparatus as shown in **figure 2.**

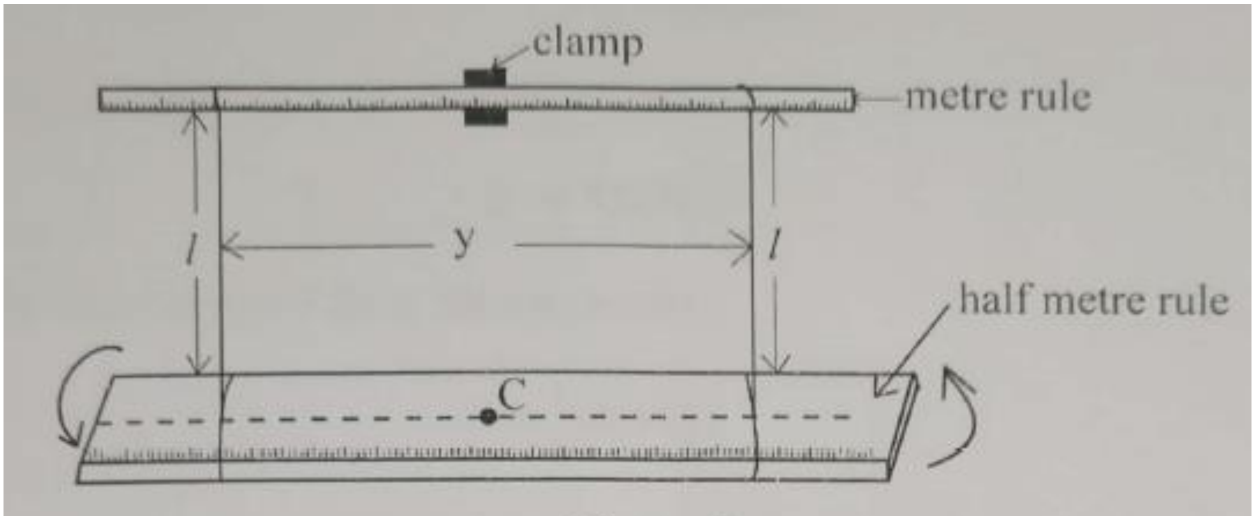



*Figure 2*

**b)** Tie one thread at the **45.0cm** mark and another at the **55.0cm** mark of the clamped metre rule.

**c)** Suspend the half metre rule, making sure that the scale of the half metre rule faces upwards

**d)** Adjust the distance **y** to $y = \mathbf{0.100m}$, ensuring that the threads are parallel and equidistant from the point **C**, the **25.0cm** mark of the half metre rule.

**e)** Adjust the length $l$ to **0.500m**.

**f)** Turn the half metre rule through a small angle about a vertical axis through its centre **C** and release it to oscillate.

**g)** Measure and record the time for 20 oscillations.

**h)** Determine the period **T**.

**i)** Repeat procedures (d) to (h) for values of $y = \mathbf{0.150,\ 0.200,\ 0.250,}$ $\mathbf{0.300\ and\ 0.350m}$

**j)** Tabulate your results including values of $\mathbf{T^2}$ and $\frac{1}{y^2}$ .

**k)** Plot a graph of $\mathbf{T^2}$ against $\frac{1}{y^2}$

**l)** Find the slope, **S** of the graph.

**m)** Calculate the value of $\mathbf{K_2}$ from the expression: $\mathbf{K_2} = \frac{1}{4\pi}\sqrt{\frac{Sg}{l}}$

$\mathbf{Where\ \pi = 3.14\ and\ \ g = 9.81ms^{-2}}$

**n)** Calculate the value of $\mathbf{I_2}$ from the expression: $\mathbf{I_2 = M(K_2)^2}$

**o)** Calculate the moment of inertia, **I** of the metre rule from the expression:

$$\mathbf{I} = \frac{1}{2}(\mathbf{I_1} + \mathbf{I_2})$$

2**. In this experiment, you will determine the constant μ of the material of**
**the glass block provided.**

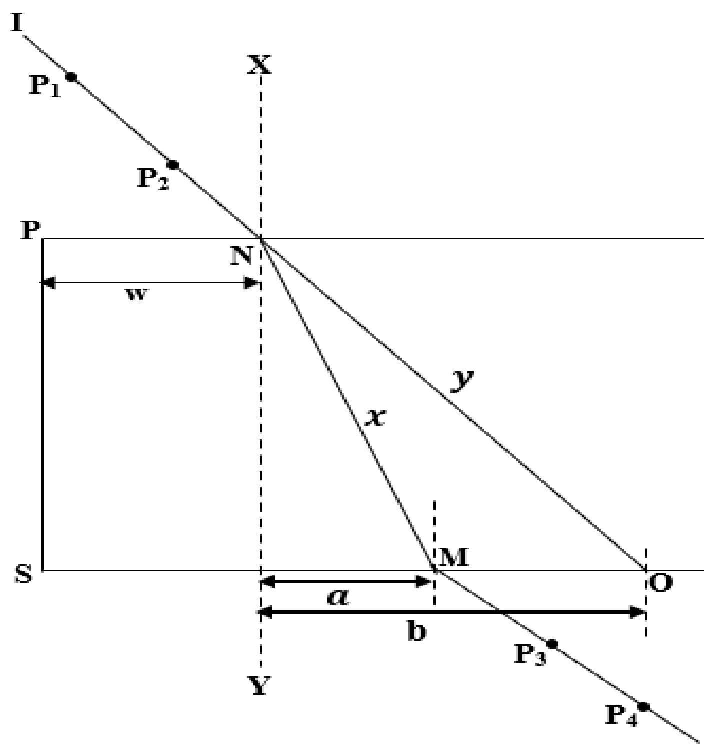



**Figure 3**

**a)** Place the glass block centrally on the plain sheet of paper with its broadest face upper most and trace its outline **PQRS**. Remove the glass block.

**b)** Construct a normal **XY** at **N** on **SR** such that $\mathbf{w = 1.5cm}$

**c)** Mark another point **O** on **PQ** such that $\mathbf{b = 5.0cm.}$

**d)** Join **O** and **N** and extend it to **I**.

**e)** Replace the glass block. Fix optical pins $\mathbf{P_1}$ and $\mathbf{P_2}$ vertically on the line **IN**.

**f)** Trace the path of light through the glass block using optical pins $\mathbf{P_3}$ and $\mathbf{P_4}$.

**g)** Remove the glass block and the optical pins.

**h)** Join $\mathbf{P_3}$ and $\mathbf{P_4}$ and extend it to **M**. Join **M** to **N** as shown in **figure 3**

**i)** Measure and record the distances $x, y$ and $a$

**j)** Calculate the value of $\mu$ from the expression: $\mu = \frac{ay}{bx}$

**METHOD II**

**a)** Fix a fresh plain sheet of paper on the soft board using drawing pins.

**b)** Place the glass block centrally on the sheet of paper with its broadest face upper most and trace its outline **WXYZ**.

**c)** Remove the glass block.

**d)** Construct a perpendicular **MN** at **B** where $\mathbf{WB} = \frac{1}{4}(\mathbf{WX})$.

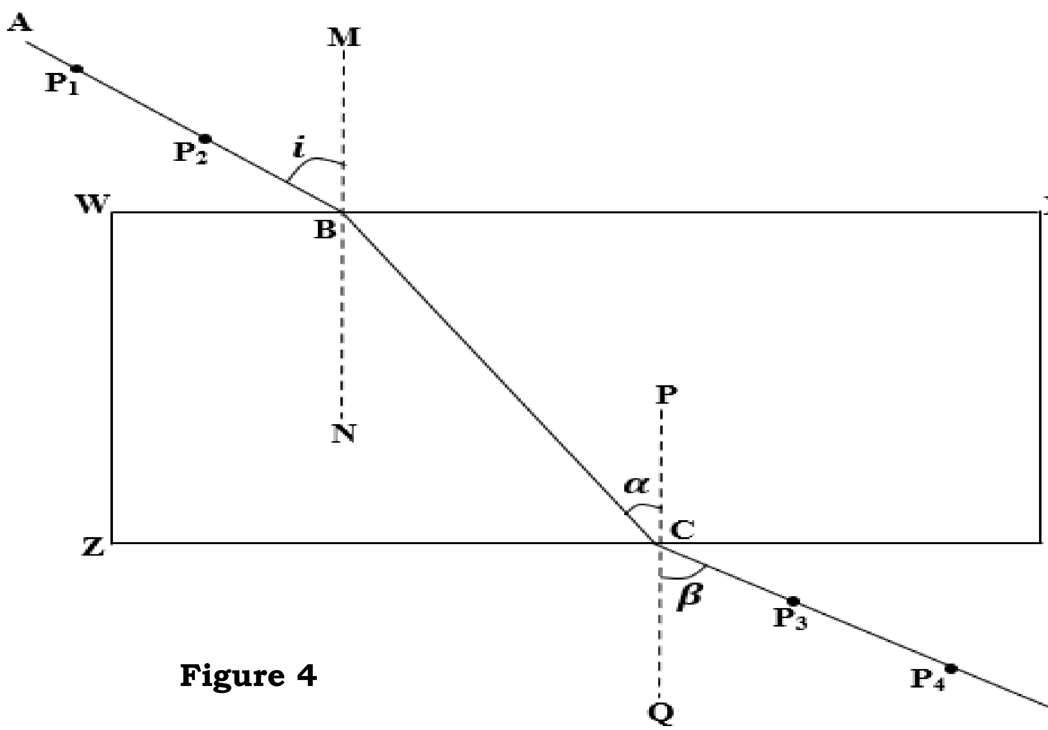



**Figure 4**

**e)** Draw a line **AB** such that angle $\mathbf{i} = \mathbf{20^0}$ as shown in **figure 4**

**f)** Fix two optical pins $\mathbf{P_1}$ and $\mathbf{P_2}$ vertically on the line **AB**.

**g)** While looking through the glass block from side **YZ**, fix optical pins $\mathbf{P_3}$ and $\mathbf{P_4}$ such that they appear in line with the images of $\mathbf{P_1}$ and $\mathbf{P_2}$.

**h)** Remove the glass block and the pins.

**i)** Draw a line through **$P_3$** and **$P_4$** to mete **YZ** at **C**.

**j)** Join **B** to **C**.

**k)** Draw a normal **PQ** at **C**.

**l)** Measure and record the angles $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$.

**m)** Repeat procedures **(d)** to **(k)** for values of $\mathbf{i} = \mathbf{30^0},\ \mathbf{40^0},\ \mathbf{50^0},\ \mathbf{60^0}$ and $\mathbf{70^0}$

**n)** Tabulate your results including values of values of $\boldsymbol{\cos^2\alpha},\ \boldsymbol{\theta = \frac{1}{2}(i + \beta)}$ and $\boldsymbol{\sin^2\theta}$

**o)** Plot a graph of $\cos^2\alpha$ against $\sin^2\theta$

**p)** Find the slope, K of the graph.

**q)** Calculate the value of $\mu$ from the expression : $\boldsymbol{\mu = \sqrt{-K}}$

**r)** Given that the value of $\boldsymbol{\mu}$ **is 0.667 (approximately)**, assess the accuracy of the two methods

3**. In this experiment, you will determine the constant, $\alpha$, of the wire labelled $W_1$**

**a)** Measure and record the diameter, **$d_2$** of the wire labelled **$W_2$.**

**b)** Connect the circuit as shown in **figure 5**

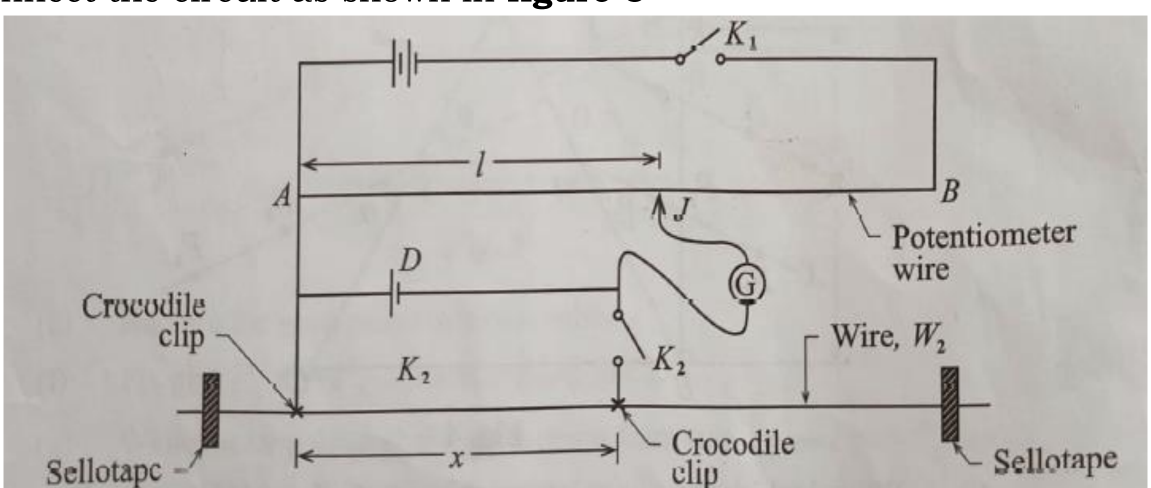



Fig. 5

**c)** Starting with a length $\boldsymbol{x = 0.200m}$ of the wire $\mathbf{W_2}$, close switches $\mathbf{K_1}$ and $\mathbf{K_2}$.

**d)** Move the sliding contact, **J**, along the potentiometer wire AB until a point is found where the centre zero galvanometer, G, shows no deflection.

**e)** Read and record the balance length, ***l***, in metres.

**f)** Open switches $\mathbf{K_1}$ and $\mathbf{K_2}$.

**g)** Repeat procedures **(c)** to **(f)** for values of $\boldsymbol{x = 0.300,\ 0.400,\ 0.500,\ 0.600}$ **and** $\boldsymbol{0.700m}$.

**h)** Tabulate your results including values of $\frac{1}{l}$ and $\frac{1}{x}$

**i)** Plot a graph of $\frac{1}{x}$ against $\frac{1}{l}$ for wire $\mathbf{W_2}$.

**j)** Find the slope, $\mathbf{S_2}$ of the graph.

**k)** Replace the labelled wire $\mathbf{W_2}$ with labelled wire $\mathbf{W_1}$.

**l)** Repeat procedures (c) to (g) with wire $\mathbf{W_1}$.

**m)** Tabulate your results including values of $\frac{1}{l}$ and $\frac{1}{x}$

**n)** Plot using the same axes in (i) a graph of $\frac{1}{x}$ against $\frac{1}{l}$ for wire $\mathbf{W_1}$.

**o)** Find the slope, $\mathbf{S_1}$ of the graph.

**p)** Find the constant , $\boldsymbol{\alpha}$ of the wire $\mathbf{W_1}$ from the expression $\boldsymbol{\alpha} = \mathbf{d_2}\sqrt{\frac{S_2}{S_1}}$

**q)** State any six sources of errors.

Qn 1.

**METHOD I**

(a) M = 46.0g [ $\mathbf{M = (30.0 - 75.0)g}$ ]

(h) t = 55.5s (SC) [ $\mathbf{t = (30.0 - 80.0)s}$ ]

(i) T = 2.78s

(j) $K_1 = \frac{T}{4\pi}\sqrt{\frac{gd_1d_2}{l_1}}$

**METHOD II**

**Let t = time for 20 oscillations.**

| $y(m)$ | $t(s)$ |
|---|---|
| **0.100** | **85.5** |
| **0.150** | **70.5** |
| **0.200** | **55.5** |
| **0.250** | **48.5** |
| **0.300** | **41.5** |
| **0.350** | **34.5** |

**Qn 2**

**(i)** $x = 7.1cm, \; y = 8.4cm, \quad a = 2.8cm$

**(j)** $\mu = \frac{ay}{bx}$

| $i(°)$ | $\alpha(°)$ | $\beta(°)$ |
|---|---|---|
| **20** | **13** | **19** |
| **30** | **20** | **30** |
| **40** | **25** | **40** |
| **50** | **31** | **50** |
| **60** | **36** | **60** |
| **70** | **39** | **70** |

**Qn 3**

| $d_1(mm)$ | $d_2(mm)$ | $d_3(mm)$ |
|---|---|---|
| **0.35** | **0.36** | **0.35** |

$d_2 = 0.35mm$

| **Wire $W_2$** | | | | **Wire $W_1$** | | | |
|---|---|---|---|---|---|---|---|
| $x(m)$ | $\frac{1}{x}(m^{-1})$ | $l(m)$ | $\frac{1}{l}(m^{-1})$ | $x(m)$ | $\frac{1}{x}(m^{-1})$ | $l(m)$ | $\frac{1}{l}(m^{-1})$ |
| 0.200 | | 0.350 | | 0.200 | | 0.320 | |
| 0.300 | | 0.390 | | 0.300 | | 0.370 | |
| 0.400 | | 0.435 | | 0.400 | | 0.415 | |
| 0.500 | | 0.480 | | 0.500 | | 0.465 | |
| 0.600 | | 0.521 | | 0.600 | | 0.511 | |
| 0.700 | | 0.562 | | 0.700 | | 0.560 | |

**END**