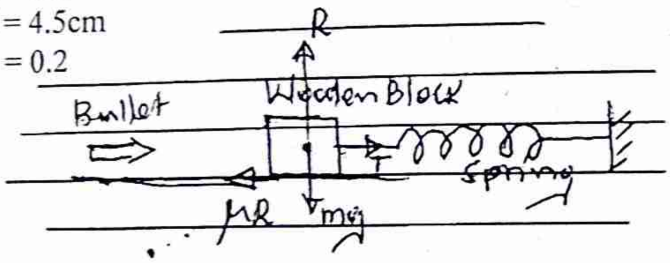
WAKISSHA JOINT MOCK EXAMINATIONS
MARKING GUIDE
Uganda Advanced Certificate of Education
UACE August 2024
PHYSICS P510/1

SECTION A

1. a) (i)	Is the way how physical quantities are related to the fundamental quantities of mass length and time.	01 mark
(ii)	$[L.H.S] = [P] = \frac{MLT^{-2}}{L^{-2}} X \frac{1}{L}$ $= ML^{-2}T^{-2}$ $[R.H.S.] = \frac{[\eta][v]}{[r]^4} = \frac{ML^{-1}T \ X \ L^3T^{-1}}{L^4}$ $= ML^{-2}T^{-2}$ Since [L.H.S.] = [R.H.S.], then the equation is dimensionally consistent.	03 marks
b) i)	- A body continues in its state of rest or uniform motion in a straight line unless acted upon by an external force. - The rate of change of momentum of a body is directly proportional to the applied force and takes place in the direction of the force. - For every action, there is an equal and opposite reaction.	03 marks
ii)	$s = ut + \frac{1}{2}at^2$ $95000 = u(1.2 \times 3600) + \frac{1}{2}a(1.2 \times 3600)^2$ ½ substitution $95000 = 4320u + 9331200a$ ------------------ 1 $175000 = u(2 \times 3600) + \frac{1}{2}a(2 \times 3600)^2$ $175000 = 7200u + 25920.000$ ---------------- 2 $u = 18.5185ms^{-1}$ $a = 1.6075 \times 10^{-3} ms^{-2}$	04 marks
c) i)	Is the time taken for a projectile to land at a point on the level through the point of a projection.	(01 mark)
ii)	Is the distance between the point of projection to the point where the projectile lands through the point of projection.	01 mark
i)	$u = 20 ms^{-1}$ $h = 50m$ $h = \frac{1}{2}gt^2$ $t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 50}{9.81}} = 3.193s$	02 marks
	$x = ut$ $= 20 \times 3.1939$ $= 63.86 m$	02 marks

iii)	$V_x = U$ $V_y = gt$ $= 9.81 \times 3.1938$ $= 31.33\ ms^{-1}$ $\left[\begin{array}{l} V_R\sqrt{31.33^2 x 20^2} \\ = 37.17 ms^{-1} \\ \theta = tan^{-1}\left(\frac{31.33}{25}\right) \\ = 51.4^0 \end{array}\right]$ Not required	03 marks
2a) (i)	When two or more bodies collide, the total linear momentum of the system is conserved provided there is no external force acting on the system	01 mark
ii)	- Fuel is introduced in a combustion chamber where combustion takes place and exhaust gases are expelled at a high velocity. - This causes a large backward momentum and an equal forward momentum is gained by the rocket. - Due to continuous combustion of the fuel, there is a large change in forward momentum which leads to the thrust, hence maintaining the motion of the rocket.	03 marks
b)	m = 40g M = 960g $K = 50Nm^{-1}$ X = 4.5cm $\mu = 0.2$  By conservation of momentum $Mu_b + M(0) = (m + M)V$ $U_b = \frac{(m+M)V}{m}$ Resultant force on the block and bullet $T - \mu R = ma$ $Kx - \mu mg = ma$ $50(0.045) - (0.2 \times 1.0 \times 9.8) = 1.0a$ $2.25 - 0.196 = a$ $a = 2.054ms^{-2}$ using $V^2 = u^2 + 2as$ u= 0 & s = x $V^2 = 2(2.054)(0.045)$ $= 0.18486$ $V = 0.43\ ms^{-1}$ Therefore $U_b = \left(\frac{0.04+0.960}{0.4}\right) \times 0.43$ $= 1.075\ ms^{-1}$	04

c) i) Friction force opposes relative motion between two surfaces in contact.

Explanation

- Surfaces have projection with small areas of contact.
- When in contact, the surface rest on each other's projection. Due to the actual area of contact being small, high pressure exists at the points of contact and a force which opposes motion is developed.

Friction force is independent of area of contact provided normal reaction is constant.

Explanation

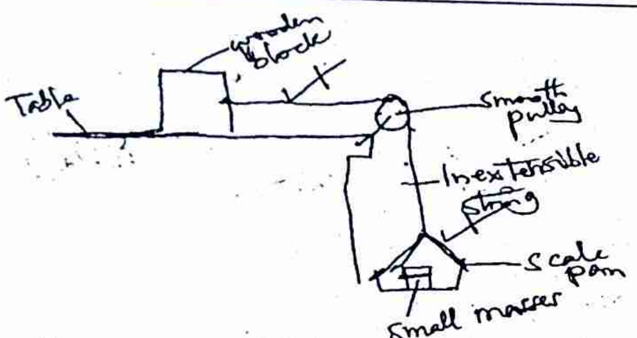
- When the object is turned over so that different surfaces are presented, the actual area of contact is approximately the same.

Friction force is directly proportional to normal reaction.

Explanation

- When the load increases, the pressure at the contacts increases. The area of contacts producing at the pressures stronger bonds and increases the interlock. A greater force is therefore required for motion to take place.

ii)

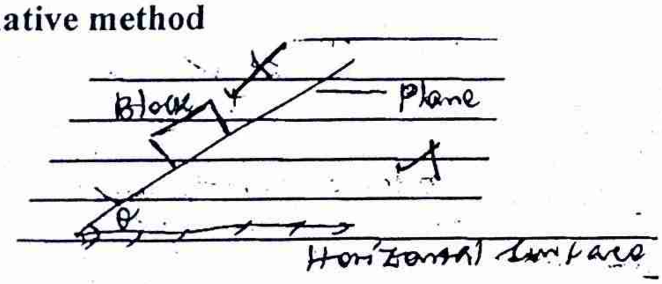


- **Small** masses are added **one at a time** to the scale pan until the wooden block **just** moves or slides.
- The masses of the wooden block and that of the scale pan and its contents are recorded as M and m respectively.
- The coefficient of static friction μ is then obtained from

$$\mu = \frac{m}{M}$$

03 marks

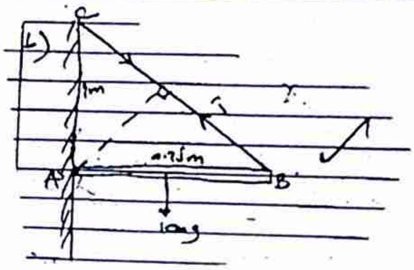
Alternative method



- A block is placed on a horizontal plane.
- The plane is gently tilted until the block just starts to slide downwards.
- The angle of tilt θ is then measured and recorded.
- The coefficient of static friction is obtained from $\mu = \tan\theta$

d)	• **More friction** is generated between the tyres and the road surface when a car moves on a hard rough surface. • This leads to heating of both the pressurized air in the tyres and the rubber material of the tyres and weakens the tyres. • The pressurized air expands and exerts more pressure on the walls of the already weakened walls of the tyres. • This may then lead to tyre burst. • When moves on a loud surface, the friction between the tyre and road surface.
3. a) i)	Ability of a material to change shape when a force is applied and to regain its original shape and size when the force is removed.
ii)	Ratio of tensile stress to the tensile strain.
iii)	The state in which a material stretches to and cannot regain its original shape and size when the stretching force is removed.

b)



i) $100 \times 9.81 \times 0.75 = T \times 0.75 \ldots\ldots\ldots \theta$

$T = 613.125N$

ii) $BC = \sqrt{1^2 x\ 0.75^2} = 1.25m$

$e = 1.25 - 1.23 = 0.02m$

$A = \frac{\pi d^2}{4} = \frac{\pi}{4} \times (0.8 \times 10^{-3})^2 = 5.027 \times 10^{-7} m^2$

$E = \frac{F/A}{e/l_o} = \frac{613.125 \, x \, 1.23}{0.02 \, x \, 5.027 \, x \, 0^{-7}}$

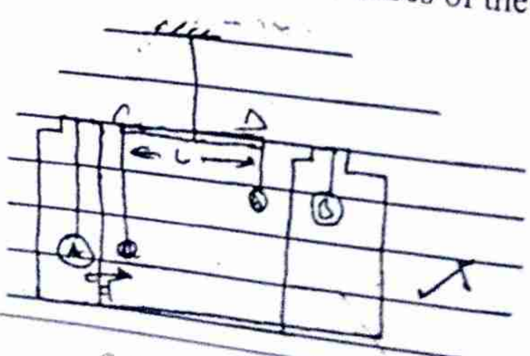
$= 7.5 \times 10^{10} Nm^{-2}$

c) i) All planets describe elliptical orbits about the sun as one focus

- The imaginary line joining the sun to a planet sweeps out equal areas in equal time intervals.

The squares of periods of resolution of a planet about the sun are in directly proportional to cubes of their mean distance apart.

ii)



Two identical gold sphere a and b of mass m are suspended from the ends of highly polished bar CD of length l.

Two large identical lead sphere near A and B of mass M are brought near a and b respectively, the distance between aA and bB & d, is measured and recorded.

The deflection θ of the bar CD is measured

Torque of couple on CD = $\frac{GmMl}{d^2}$

$$\frac{GmMl}{d^2} = K\theta$$

From which G is calculated.

l) On a flat track the centeprial force in due to the frictional force only, on a banked track centpital force is due to both component of the normal reaction acting horizontally and the horizontal components of the frictional force.

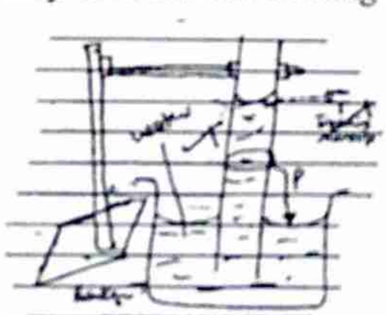
Thus the car travels faster on the banked track than on the flat track of the same radius.

20 Marks

4. a) i) Surface tension is the force acting at right angles to one side of an imaginary line of length 1m drawn in the surface of the liquid.

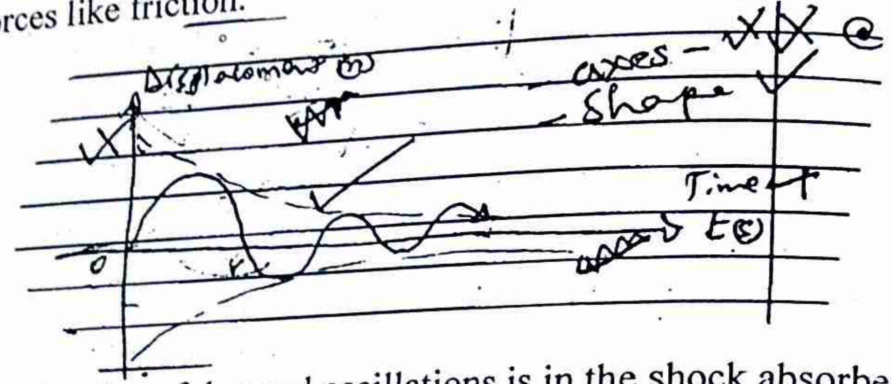
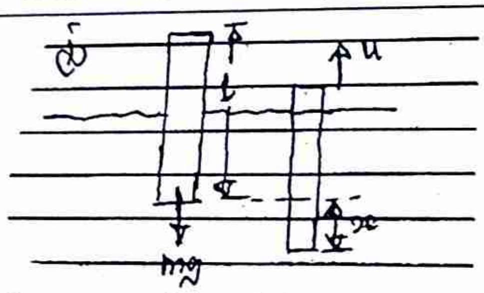
) Angle of contact- this is the angle made between the solid surface and the tangent to the liquid surface at the point of intersection with the solid surface as measured through the liquid.

b)
- A clean capillary tube is dipped in water as shown and a wire P which is bent is tied along the capillary tube with a rubber band.
- When the tube is dipped into water, the wire P is adjusted so that its top just touches the surface of the water.
- A travelling microscope is the focused on the water meniscus in the capillary tube and the reading noted, say, h.



- The beaker is then removed and the travelling microscope is focused on the tip of the wire P and the scale reading h_2 noted.
- The height of water rise, h is calculated from h = $[h_1 - h_2]$.
- The Capillary tube is removed and its diameter and radius r is determined by using a travelling microscope.
- The surface tension can be obtained from $\gamma = \frac{hr\rho g}{2\cos\theta}$ for clean glass of water $\theta = 0^0$

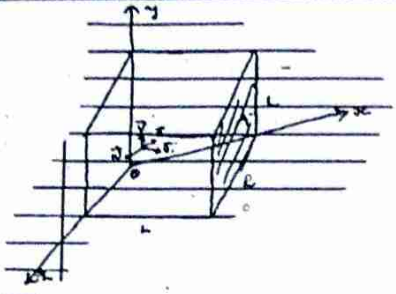
$$\gamma = \frac{hr\rho g}{2\cos\theta}$$

c)	$\theta = 0^0$ $r = \frac{d}{2} = \frac{0.05 \times 10^{-2}}{2}$ $h = \frac{2\cos\theta}{r\rho g}$ $= \frac{2 \times 7.0 \times 10^{-2} \times 2}{0.05 \times 10^{-2} \times 10^3 \times 9.81}$ $= 0.0571m$	03 m
d) i)	Damped oscillation are oscillations in which the amplitude of oscillation decreases with time due to presence of dissipative forces like friction.	
ii)		
iii)	One application of damped oscillations is in the shock absorbers of a vehicle. - The springs and fluids in the shock absorbs tame the oscillating or vibrating effect of the springs as they store and release energy after both compression and rebound and this ensure continuous contact between the tyres and the road surface.	02 mar
e (i)	 Up thrust = weight of the body $Ah\rho g = mg$ When the rod is depressed, the resultant upward force is $MO = mg - A(h + x)\rho g$ but $m = L\sigma A$ $AL\sigma a = A\rho gx$ $a = -\left(\frac{g\rho}{l\sigma}\right)x$ Hence the motion is s.h.m $W = \sqrt{\frac{g\rho}{l\sigma}}$	
(ii)	$T = \frac{2\Pi}{w} = 2\Pi\sqrt{\frac{l\sigma}{\rho g}}$ $L = 0.3m, \rho = 1000, g = 9.81\ \sigma = 800$ $T = 2\Pi\sqrt{\frac{030X800}{100X9.81}}$ T= 0.982	

SECTION B

a) i)	An ideal gas is a gas whose molecules make perfectly elastic collisions with each other and the walls of the vessel and also have negligible inter molecular forces.	01 mark
ii)	- Molecules of a gas are randomly moving about, continuously colliding with each other and the walls of the container. - Intermolecular collisions are perfectly elastic. - Thè duration of a collision is negligible compared to the time spent between collisions. - Intermolecular forces of attraction are negligible. - The volume occupied by molecules themselves is negligible.	Any two 01 mark

iii)



- The volume occupied by molecules themselves is negligible compared to the volume occupied by the gas.

Consider N molecules of a gas contained in a cube of side, L, each molecule having a mass, m. The molecules are considered to be in a state of continuous random motion. Consider one molecules having a velocity $\vec{c}$ at any instant where $\vec{c}$ has component $\vec{u}$, $\vec{v}$ and $\vec{w}$ in the ox , oy and oz respectively. Then;

$C^2 = |\vec{c}|^2 = |\vec{u}|^2 + |\vec{v}|^2 + |\vec{w}|^2$

Let $|\vec{u}| = u$, $|\vec{v}| = v$ and $|\vec{w}| = w$

$= c^2 = u^2 + v^2 + w^2$ ____________ (i)

Consider the speed u of a molecule perpendicular to the face A of the cube.

Change in momentum of the molecule = mu – (-mu)

= 2mu ________ (ii)

Let t be the time taken for the molecule to move from one face to another and back,

Then $t = \frac{2l}{u}$ ______________ (ii)

The rate of change of momentum, $F = {2mu}\big/{2l/u}$

$F = \frac{mu^2}{l}$ ____________(iii)

$P = {mu^2/l}\big/{l^2} = \frac{mu^2}{l^3}$ ____________ (iv)

For N molecules of the gas, the total pressure, P, exerted will be

$P_T = \frac{mu_1^2}{l^3} + \frac{mu_1^2}{l^3} + \ldots\ldots.. + \frac{mu_N^2}{l^3}$

$= \frac{m}{l^3}\{u_1^2 + u_2^2 + \ldots\ldots. + u_N^2\}$

Let $\vec{u}^2$ be the mean of the squares of the speeds in the ox – direction.

$\vec{u}^2 = \frac{u_1^2+u_1^2+\ldots+u_N^2}{N}$

$= u_1^2 + u_2^2 + u_3^2 + \ldots u_N^2 = N\vec{U}^2$

$= P = \frac{MN\bar{U}^2}{L^3}$ ______________ (v)

Since the molecules are moving randomly,

$u^2 = v^2 = w^2$

$= \overline{u^2} = \overline{v^2} = \overline{w^2}$

Now $\bar{c}^2 = \bar{u}^2 + \bar{v}^2 + \bar{w}^2$

$\bar{c}^2 = \bar{u}^2 + \bar{u}^2 + \bar{u}^2$

$= 3\bar{u}^2$

$\bar{u}^2 = 1/_3\, \bar{c}^2$

$\therefore P = \frac{mN}{l^3},\ 1/_3\, \bar{c}^2$

But density, $f = \frac{MN}{l^3}$

$\therefore P = 1/_3 f \bar{c}^2$

b) i) The molecules of the gas are in continuous random motion colliding with each other throughout the container.

ii) Increase in temperature increases the rate of collision of molecules with the walls of the container and the rate of collision is the measure of pressure.

c) $T_1 V_1^{v-1} = T_2 V_2^{v-1}$

$T_2 = \frac{473(2000)^{1.4-1}}{(4000)^{1.4-1}}$

$= 358.47k$

$P_2 = \frac{P_1 V_1}{V^8}$

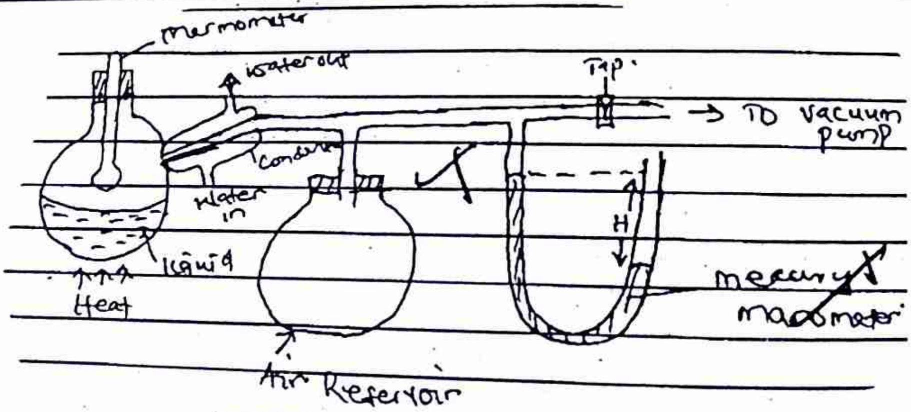
$= \frac{76 \times 2000^{1.4}}{(4000)^{1.4}}$

$= 28.8cmHg$

$P_3 = \frac{28.8 \times 4000}{3000} = 38.398cmHg$

d) i) Is the maximum constant pressure exerted by the vapour in dynamic equilibrium with its liquid.

ii)



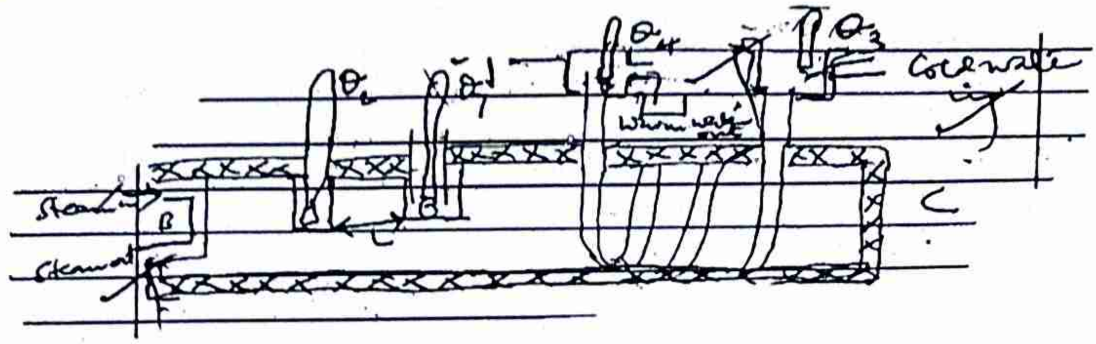
- The pressure above the water is set to any decreased value (below or above) atmosphere pressure using a vacuum pump.
- The tap is closed and the liquid is heated until it boils.
- The temperature θ of the vapour is determined using a thermometer and noted.
- The pressure, P of the vapour; P = H ± h where H is barometric height.
- The procedure is repeated for different pressure P and corresponding temperature θ is noted.
- A graph of P against θ is plotted and shows the variation.

a) i) Thermal conductivity is the rate of heat flow across opposite faces of a parallel sided slab when the temperature difference across the faces is one Kelvin.

Or K is the heat flow rate normal to one square metre area of a sample where faces are maintained at a temperature gradient of one Kelvin per metre.

ii) When one end of a solid is heated, molecules vibrate about their mean position and pass on their thermal energy as they collide with the neighboring molecules. This intermolecular vibrations continues until the whole solid is heated. 03

iii)



Any 4 parts correctly marked 02

- The apparatus is set up as shown in the figure above with the specimen metal rod AB long compared to it's diameter.
- Two holes are drilled and thermometers placed there at a measurable length, *l*.
- The holes are filled with mercury to ensure good thermal contact.
- A heater is placed at one and of the bar while the other end in cooled by circulating water.
- The whole apparatus is left running until the temperatures have become steady. The circulating water is collected over a measurable time interval and is recorded.

Let M = mass of water collected per second and θ_1 and θ_2 be the respective thermometer readings at C and D.

The diameter, d of the metal bar is obtained atleast three times at different positions of the bar and the cross section area in calculated from

$$A = \frac{\pi d^2}{4}$$

The rate of heat flow is given by.

$$Q/_t = MC_w (Q_4 - Q_3)$$

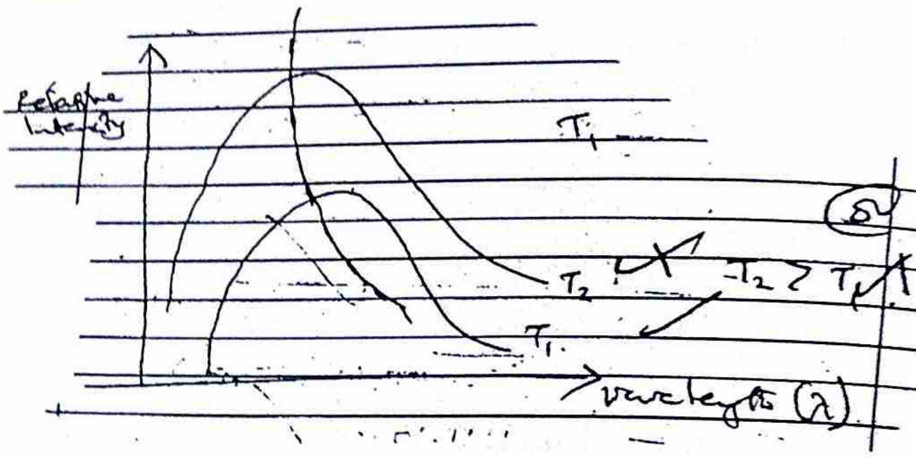
$$\frac{KA\,(\theta 2 - \theta 1)}{l} = MC_w (Q_4 - Q_3)$$

From which $k = \frac{MCw\,(Q4 - Q3)\,l}{A(\theta_2 - \theta_1)}$

Where θ_3 and θ_4 are the entrance and exit temperatures of water.

b) i)	Because its radiation depends on only temperature and their intensity increases with temperature.	02

ii)



Axes

Shap

Temp

Intensity increases with temperature but move rapidly for shorter wavelength.

For each radiation, intensity corresponds to a maximum value which reduces with temperature. — 02

c) At equilibrium

Power radiated by the filament = Power generated

$$2000 = \frac{80}{100}\,\delta\, AT^4$$

l

But $A = 2\Pi rl$

$= \Pi Dl$

$= \Pi \times 15 \times 10^{-3} \times 60 \times 10^{-2}$

$$2000 = \frac{80}{100} \times 5.07 \times 10^{-8} \times \Pi \times 15 \times 10^{-3} \times 60 \times 10^{-2}\ 7^4$$

$$T^4 = \frac{2000 \times 100}{80 \times 5.8 \times 10^{-8} \times \Pi \times 15 \times 10^{-3} \times 60 \times 10^{-2}}$$

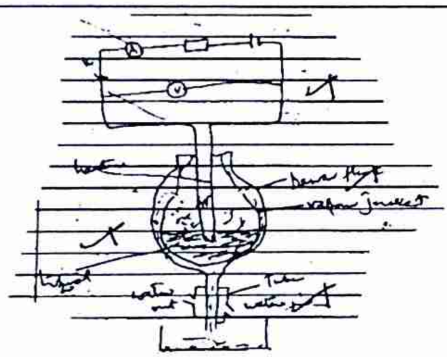
$$= \sqrt[4]{(1524{,}472{,}634{,}979{,}84)}$$

T= 1117.48K

$\lambda_{max}\, T$ = constant

$$\lambda_{max} = \frac{2.9 \times 10^{-3}}{T} = \frac{2.9X110^{-3}}{1117.48}$$

$= 2.6 \times 10^{-6}$m — 03

a) i)	Kelvin is $\frac{1}{273.16}$ of the thermodynamic scale of temperature	01
ii)	- should vary linearly and continuously with temperature - Should vary for a small change in temperature - Should correspond to a single value of temperature.	02 marks 02
b) i)	- The hot junction is placed at the triple point steam and unknown temperature - Determine the value E.m.f $E\theta$ at unknown temperature. - Determine the value E.m.f Erp at the triple point of water - The unknown temperature. $\theta = \frac{E_\theta}{E_{t.p}} \times 273.16K$	03 marks
ii)	$L_o = 2.0cm$ $L_{100} = 2.7cm$ $L_\theta = 8.4cm$ $\theta = \left(\frac{l_\theta - l_0}{l_{100} - l_0}\right) \times 100 + 273$ $= \left(\frac{8.4-2.0}{2.7-2.0}\right) \times 100 + 273k$ $= \left(\frac{6.4}{0.7} \times 100\right) + 273$ $= 1187.286k$	03
c) i)	During latent heat of vaporization, work is done against atmospheric pressure and in change of state yet during fusion, work is only done to weaken the intermolecular forces of a structure.	02 marks
ii)	 ½ - circuit 1 ½ - any 3 labelled - Switch k is closed and liquid is heated until it starts boiling. - A stop clock is started and the mass M_1 of the liquid collected in a time t is noted. - The ammeter reading I_1 and voltmeter reading V_1 are recorded. - At steady state I, V, t = $M_1 \times L_v + h$ ______ (i) Where h = heat loss to the surrounding - The rheostat is adjusted and a new ammeter reading I_2 and voltmeter reading V_2 are recorded. - New mass M_2 of the liquid collected in the same time is obtained. $I_2V_2t = M_2L_v + h$ ________ (ii) From (i) and (ii) $L_v = \frac{(I_1 V_2 - I_1 V_1)t}{(M_2 - M_1)}$	02 marks 04 marks

d)

M_s ($2.26 \times 10^6 + 4200($...
$\times 3.34 \times 10^5$

$$M_s = \frac{400+8400}{2.23 \times 10^6 + 4200 \times 90}$$

$$= \frac{8800}{2638000} = 0.028 \text{ ggkg}$$

Total mass $= 0.2 + 0.02899 = 0.22899$kg

X – rays are efms produced when streams of fasting moving electrons are suddenly ...

8. a) i)

X-rays	Cathode rays
- Carry no charge	Carry a negative charge
- Travel at the speed of light	Have a relatively low speed
- Have a higher penetrating power	Have a relatively low penetrating power
	Deflected by both electric and magnetic fields

Any ... marks

Cathrode rays are streams of fast moving electrons.

ii) The anode is a high melting point material so that it does not melt easily when struck by fast moving electrons. At the end of it are cooling fins that help to get rid rid of the heat gained by the a node (or there is circulating water) 03 ...

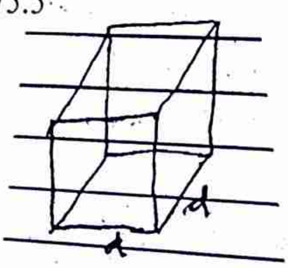
b) i) $2d\sin\theta = n\lambda$ where

d = inter planer spacing
θ = glancing angle
n = order of diffraction
λ = wave length

for constructive interference 01 ...

ii) The wavelength of the incident radiation must be of the same order as the inter-planer spacing 01 ...

iii) $\lambda = 1.10 \times 10^{-19}$ m, $n = 1$, $\theta = 19^0$
$R_{mm} = 75.5$..



Let d = inter planer spacing
Using $2d\sin\theta = n\lambda$

$$d = \frac{1 \times 1.10 \times 10}{2\sin 19^0}$$

$$= 1.69 \times 10 \text{ m}$$

Volume associated with one atom = dxdxd

$= d^3$

Volume associated with kol crystal, $V = 2d^3$

Now mass of one molecule, $m = \frac{M}{N_a}$

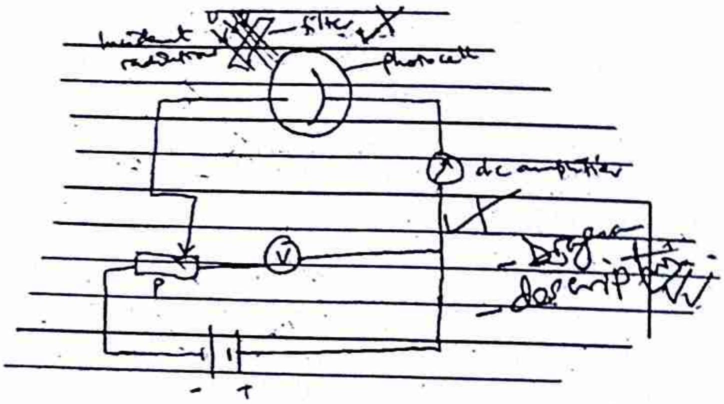
So density, $\rho = \frac{m}{v} = \frac{M}{N_a} \Big/ 2d^3$

$$f = \frac{75.5 \times 10}{6.02 \times 10^{23} \times 2 \times (1.69 \times 10^{-10})^3}$$

$= 1.299 \times 10^4 \text{ kg/m}^3$ — 04 marks

C i) Work fuction; Is the minimum energy required to eject an electron from a metal surface. — 01 mark

ii) Determination of plank's constant

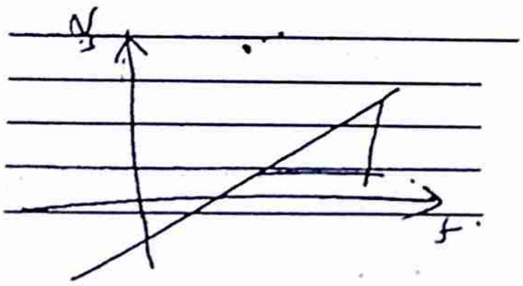


Any two labelled parts.

An incident beam of electromagnetic radiation is passed through a colour filter onto a photocell.

- The potential divide P is used to vary the p.d between the anode and cathode and the d.c amplifier is used for measuring small currents.
- The p.d. V is increased negatively until the current becomes zero and the stopping potential, V_s, is read and recorded from a voltmeter.
- A graph of V_1 against f is now ploted and its slope s is calculated.

04 marks



h = es

s = slope
e = electronic change
h = plank's constant

ii) $F = 6.0 \times 10^{14}$, $V_3 = 0.6$

From Eistan equation

$eVs = hf - Wo$

$f_1 h = Wo + oV4e$ 1

$f_2 h = Wo + 2.2e$ 2

$$\frac{f_1}{f_2} = \frac{W_{o+0.4e}}{W_{o+2.23}}$$

$W_o = 3.68 \times 10^{-19}$ J — 04 marks

$W_o = 6.64 \times 10^{-34} \times 6.0 \times 10^{14} - 0.6 \times 1.6 \times 10^{-19}$ — 20 marks

9. a) i) Radioactivity is the random spontaneous disintergration of an unstable radioactive nuclei accompanied with emission of any of α, β – particles or gamma tays

While,
Nuclear fission is the splitting of a heavy radioactive nuclide into light nuclei accompanied by release of energy.

ii) Binding Energy is the work done to take all the nucleons of an atom apart so that they are completely separated.

Or is the energy required to bring the constituent nucleons together to form a nucleus

b) i) Half life is the time taken for the number of atoms of a radioactive nuclide to reduce to half it's original value.

ii) Let N be the number of atoms present at a time t.

$-\frac{dN}{dt} \alpha N$ (dceecay law)

$-\frac{dN}{dt} = \lambda N$

$\int \frac{dN}{dt} = -\int \lambda at$

$1Nn = -\lambda t + c$

At $t = 0$, $N = No$

$InNo = C$

$InN = -\lambda t + InNo$

At $t = t_{1/2}$, (half life, $Nt = {}^{No}/_{2}$)

$In\left(\frac{No}{2}\right) = -\lambda\, t_{1/2} + InNo$

$In\left(\frac{{}^{No}/_{2}}{No}\right) = -\lambda\, t_{1/2}$

$-\lambda\, t_{1/2} = In2$

$t_{1/2} = \frac{In2}{\lambda}$ or $t_{1/2} = \frac{0.693}{\lambda}$

c) Mass defect $= 238.12492u - (234.11650 + 4.00387)u$

$= 0.00455u$

Energy $= 0.00455 \times 931 \times 10^{6} \times 1.6 \times 10^{-19}$

$= 6.778 \times 10^{-13} J$

Activity $A = \lambda N$.

$N = \frac{2}{238} \times 6.02 \times 10^{23}$ atom

$\lambda = \left(\frac{In2}{4500 \times 365 \times 24 \times 3600}\right)\left(\frac{2 \times 6.02 \times 10^{23}}{238}\right)$

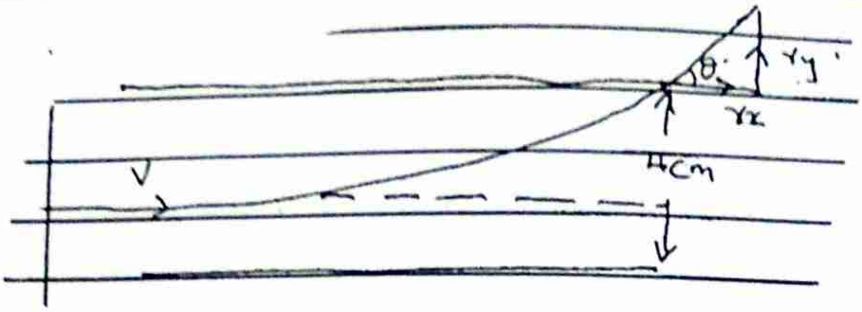
$= 2.47 \times 10^{10}$ Bq

$P = EA$

$= 6.778 \times 10^{-13} \times 2.471 \times 10^{10}$

$= 0.01674$ W

d i)



$\frac{1}{2} m_e v^2 = eV$

$V^2 = \frac{2eV}{m_e}$

$V = \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 1800}{9.11 \times 10^{7} ms^{-1}}}$

$= 2.51 \times 10^{7}\ ms^{-1}$

03 marks

ii) The electron beam describes a parabolic paths — 01 mark

iii) $V_x = 2.51 \times 10^{7}\ ms^{-1}$

$V_y = ayt = \left(\frac{E_e}{m_e}\right) \cdot \frac{L}{V}$

$V_y = \frac{v}{d}\frac{e}{m_e}\frac{l}{v}$

$V = \sqrt{(2.51 \times 10^{-7})^2 + (6.30 \times 10^{5})^2}$

$= 2.51 \times 10^{7}$ms in the direction 1.4^0

$= \frac{90}{4 \times 10^{-2}} \times \frac{1.6 \times 10^{-19}}{9.11 \times 10^{-31}} \times \frac{4 \times 10^{-2}}{2.51 \times 10^{7}}$

$= 6.30 \times 10^{5} ms^{-1}$

$\theta = \tan^{-1}\left(\frac{V_y}{V_z}\right)$

$= \tan^{-1}\left(\frac{6.30 \times 10^{5}}{2.51 \times 10^{7}}\right) = 1.4^0$

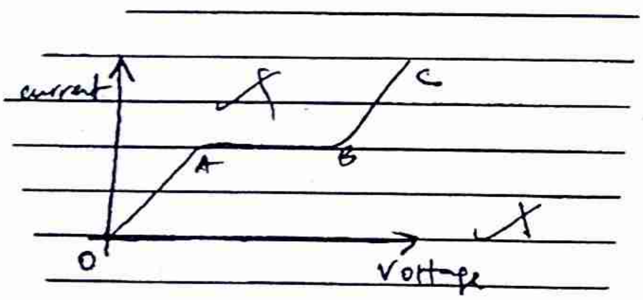
03 marks

20 marks

a) i) Positive rays are streams of positively charged particles that pass through a perforated cathode.

ii) Positive rays are produced when cathode rays in a discharge tube collide with gaseous atoms and strip off some electrons from the atoms. The positive ions formed are accelerated to the cathode and these streams of positive ions constitute positive rays

b)



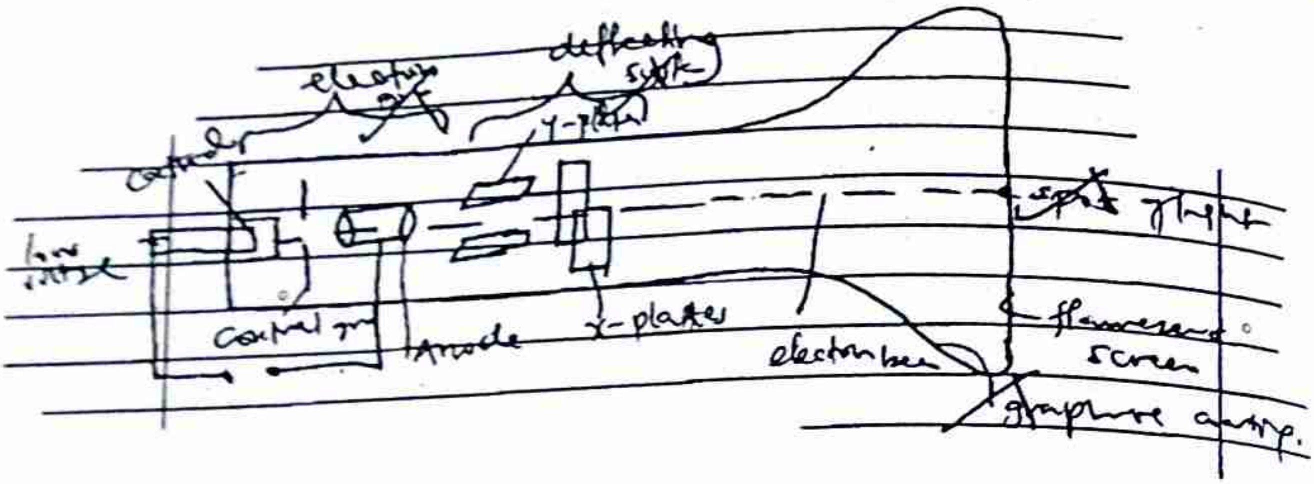
OA – as the applied voltage increases, the number of electrons reaching the anode increases, leading to increase in the current.

Along AB, the electron released all reach the anode at the same time so that the current through the tube appears constant.

Along BC, the number of electron due to ionizaton increases rapidly and not all the electrons reach at the anode at the same time, current increases gradually.

At breaking point a large number of electrons reaches the anode and current rises sharply.

c)



Electron gun

The heater heats the cathode to emit electrons by thermonic emmisson and are, accelerated by high p.d connected to the anode and cathode.

Deflecting system

y – plate deflect the beam vertically

x – plate deflect the beam horizontally flourscent screen

The spot of light is formed.

) i) A node resistance is the ratio of change in a node voltage to change anode current at a constant voltage gain.

) $Gm = 5mav^{-1}$ $\quad V_g = \frac{\mu R_l}{R_a + R_l} = \frac{5x\,10^{-3}\,x\,2x10^{4}\;\;x\,10.000}{(30{,}000)}$

$R_g = 2 \times 10^4 m$

$R_l = 10000\ N$ $\quad = \frac{100}{3} = 33.3V$

$\mu = gm \times Ra$

An co lab pa

4

20