ASSHU ANKOLE 2024 S.6 PHYSICS, (510/1) GUIDE
(Proposed marking guide).
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1 a) It is away a physical quantity is related to the three fundamental quantities of mass, length and time.

b) i) $P \propto r\, v\, \rho$

$P = K r^x v^y \rho^z$

$[P] = [K][r]^x[v]^y[\rho]^z$

$ML^{-1}T^{-2} = L^x . L^yT^{-y} . M^z L^{-3z}$

$ML^{-1}T^{-2} = L^{x+y-3z} M^z T^{-y}$

M: $1 = z$

T: $-y = -2$, $y = 2$

L: $x + y - 3z = -1$

$x = 0$.

$P = K r^0 v^2 \rho^1$

$P = K\rho v^2$

$\therefore P = \pi/_2\, \rho v^2$

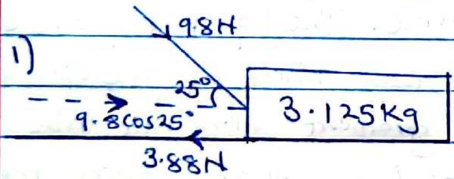
ii) $P_{max} = \frac{\pi}{2} \times 1.29 \times 15^2$

$= 455.92\,Nm^{-2}$.

c) The rate of change of momentum of a body is directly proportional to the force applied & It takes place in the direction of force

A newton is a force required to give a mass of 1kg an acceleration of $1ms^{-2}$.

i)



$9.8\cos25 - 3.88 = 3.125a$

$a = 1.60ms^{-2}$

ii) $S = ut + \frac{1}{2}at^2$

$= 0 + \frac{1}{2} \times 1.60 \times 6^2$

$= 28.8m$.

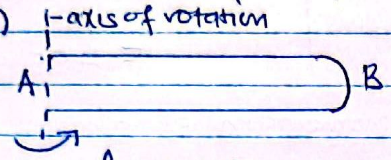
d) Soft cushion helps to increase the time of collision, reducing the force of impulse & momentum that is transfered to the head incase of an accident.

It also absorbs some K.E of the collision that it converts into deformation energy. This reduces the amount of energy transfered to the head, decreasing the severity of the accident.

2 a) Centripetal force is an inward force towards the center of the circle required to keep a body moving in a circular path.

b) The earth is elliptical with equatorial radius slightly greater than polar radius. At the equator, the body is less attracted towards the earth than at the poles, acceleration due to gravity is greater at poles than at the equator.

- The earth rotates about its polar axis. Weight of the body at equator has to provide centripetal force $m\omega^2 r$ where r is equatorial radius. hence g is is greater at poles than at the equator.

c)


A centrifuge seperates substances of different densities (eg milk $ fat) by whirling in a horizontal circle at a high speed.

The mixture is placed in a tube $ the tube is rotated in a horizontal circle. The liquid pressure at the closed end B is more than that at the open end A. This sets up a pressure gradient along the tube which creates a large centripetal force that causes matter of small density to move inwards while that of higher density to move away from the centre when rotation stops.

The tube is then placed in a vertical position $ the less dense substance comes to the top which is then seperated from the mixture.

d) i) The force of attraction btn 2 bodies in the Universe is directly proportional to the product of their masses $ inversely proportional to the square of the distance btn them.

ii) Planets describe elliptical orbits with the Sun at one focus.

- The imaginary line joining the sun $ a planet sweeps out equal areas in equal time intervals.
- The squares of the periods of revolution of a planet about the sun is directly proportional to the cube of the mean distance from the sun to the planet.

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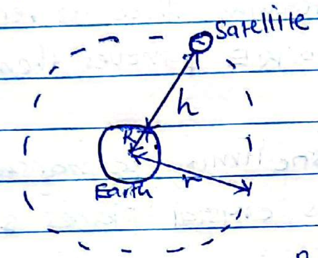
iii) $T^2 = \frac{4\pi^2 R^3}{GM_E}$ $\quad$ ~~make~~ * $R = h + r_e$

$$= \frac{4\pi^2 (200\times10^3 + 6.4\times10^6)^3}{(6.67\times10^{-11})(5.97\times10^{24})}$$

$$T^2 = 2.8503\times10^7$$

$$T = 5338.8s.$$

e) i) It is a path in space followed by a satellite which appears stationary when viewed from the earth's surface.



Attractive force = Centripetal force

$$m\omega^2 r = \frac{GM_e m}{r^2}$$

$$m\omega^2 (R+h) = \frac{GM_e m}{(R+h)^2}$$

But; $\omega = \frac{2\pi}{T}$, $M_e = \rho_e V_e = \rho V$
$= \rho \cdot \frac{4}{3}\pi R^3$.

$$\frac{4\pi^2}{T^2}(R+h) = \frac{G \rho_e V_e}{(R+h)^2}$$

$$\frac{4\pi^2}{T^2}(R+h)^3 = G\rho \tfrac{4}{3}\pi R^3$$

$$T^2 = \frac{3\pi (R+h)^3}{G\rho R^3}$$

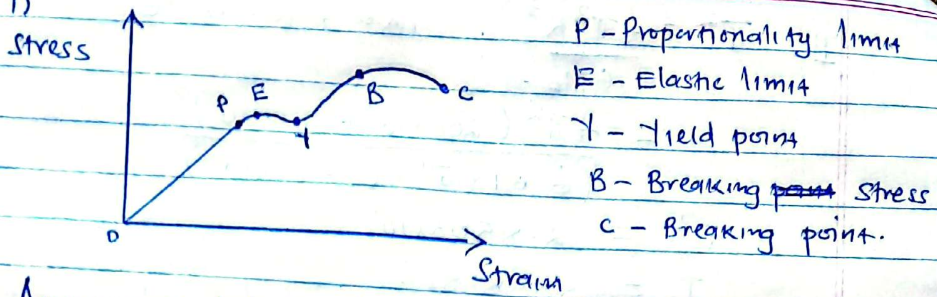
$$T = \sqrt{\frac{3\pi (R+h)^3}{G\rho R^3}}$$

3 a) i) It is the ratio of tensile stress to tensile strain of a material.

ii) Yield point is a point at which there is a marked increase in extension when the stress is increased beyond elastic limit.

Elastic limit is the maximum load which a material can experience & still regain its original size & shape once the load has been removed.

b) i)

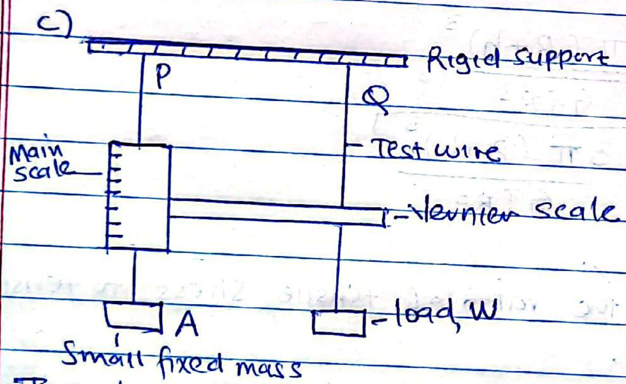


ii) Atoms are slightly displaced from eqbm positions when the load is applied. The energy used to stretch the wire becomes elastic P.E. When stretching force is removed, elastic P.E of atoms changes to K.E & moves them back to their eqbm posn.

When stretched beyond elastic limit, permanent displacement of atoms occurs as crystal planes slide over each other. Movement of dislocations takes place & on removing the stress, original shape & size is not recovered due to energy loss inform of heat.

At breaking point, the energy is used to break interatomic bonds.

c)



Two long thin identical steel wires P & Q are suspended besides eachother from the same rigid support B.

The wire P is kept taut & free of kinks by weight A attached to its end.

The original length l of testwire Q is measured & recorded.

The mean diameter d is determined & xsnal area $A = \frac{\pi d^2}{4}$ is found.

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- Known weight W is added to the free end of test wire & the corresponding extension e is read from vernier scale.
- The procedures are repeated for different weights;
- A graph of weight W against extension e is plotted & its slope S obtained.
- Youngs modulus is obtained from $E = \frac{SL}{A}$.

d) $E = \frac{FL}{Ae}$, $F = 2 \times 9.81 = 19.62N$.
$e = 1.2 \times 10^{-3}$ m
$L = 2.5m$.

$V = \frac{m}{\rho}$

$AL = \frac{m}{\rho}$

$A = \frac{m}{\rho L}$

$A = \frac{16 \times 10^{-3}}{7800 \times 2.5}$

$A = 8.205 \times 10^{-7} m^2$

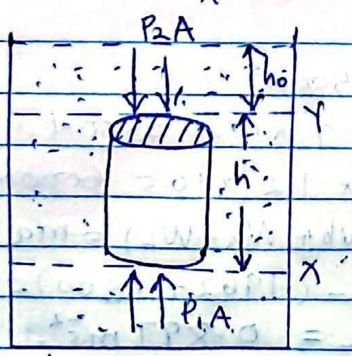
$E = \frac{19.62 \times 2.5}{8.205 \times 10^{-7} \times 1.2 \times 10^{-3}}$

$= 4.997 \times 10^{10}$

$E \approx 5.0 \times 10^{10} N m^{-2}$.

4 a) It states that when a body is wholly or partially immersed in a fluid, it experiences an upthrust equal to the weight of the fluid displaced.

Consider a cylindrical rod of Xsnal area A & height h immersed in a large quantity of a fluid of density ρ_f such that its top level is at level Y, ho meters below the fluid surface & its bottom is at level X as below.



Volume of displaced fluid = Vol of cylinder = Ah
Mass of fluid displaced = $Ah\rho_f$
Weight of fluid disp $= Ah\rho_f g$ —— (I)
Upthrust $= P_2A - P_1A$.
$= (h+h_o)\rho_f g A - h_o \rho_f A$
$U = A h \rho_f g$ —— (II)
Since (I) = (II) then U = W of fluid displaced, hence verifying Archimedes principle.

b) Upthrust is the apparent loss of weight of an object immersed in a fluid.

c) Measure & record the weight of the solid when completely immersed in water & record its weight, W_w. Solid is initially measured in air, its weight W_a is recorded.

$$R.D \text{ of solid} = \frac{W_{solid}}{W \text{ of an equal volume of water}}$$

$$R.D = \frac{W_a}{W_a - W_w}$$

But also $R.D = \frac{\rho_{solid}}{\rho_{water}}$

$$\rightarrow \frac{\rho_s}{\rho_w} = \frac{W_a}{W_a - W_w}$$

$$\rho_s = \left(\frac{W_a}{W_a - W_w}\right)\rho_w$$, density ρ_s of the solid can be determined.

d) (i) $U = W_b + W_h + W_L$ L - load, b - balloon, h - Hot air

$$V_a \rho_a g = M_b g + V_h \rho_h g + M_L g.$$

$$V_a \rho_a \cancel{g} = (M_b + M_h + M_L)\cancel{g}$$

$$500 \times 1.2 = (M_b + M_h + M_L)$$

$M_b + M_h + M_L = 600\,kg$ as the combined mass.

ii) At eqbm, $U = W_b + W_h + W_L$

$$V_a \rho_a g = M_b g + V_h \rho_h g + M_L g.$$

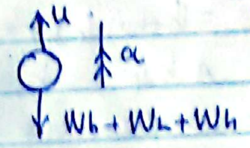
$$500 \times 1.2 \times 10 = (M_b + M_L)10 + 500 \times 0.8 \times 10$$

$$(M_b + M_L) = 200\,kg.$$

When $\rho_h = 0.7$, $V_h = 500\,m^3$

$$W_h = V_h \rho_h g = 500 \times 0.7 \times 10 = 3500\,N.$$

But $U = V_a \rho_a g = 500 \times 1.2 \times 10 = 6000\,N.$



$$U - (W_b + W_h + W_L) = ma$$

$$6000 - (1962 + 3500) = 600a$$

$$a = 0.897\,ms^{-2}.$$

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e) i) It states that for a non viscous incompressible fluid flowing steadily, the sum of the pressure plus the P.E per unit volume plus K.E per unit volume is constant at all points on a streamline.

ii) $A_1 V = A_2 V_2$

$$V_2 = \frac{A_1 V}{A_2} \quad \text{—— (i)}$$

$$P_1 + \tfrac{1}{2}\rho V^2 = P_2 + \tfrac{1}{2}\rho V_2^2 \quad \text{—— (ii)}$$

$$P_1 + \tfrac{1}{2}\rho V^2 = P_2 + \tfrac{1}{2}\rho\left(\frac{A_1 V}{A_2}\right)^2$$

$$P_1 - P_2 = \tfrac{1}{2}\rho V^2\left[\left(\frac{A_1}{A_2}\right)^2 - 1\right]$$

$$h_1\rho g - h_2\rho g = \tfrac{1}{2}\rho V^2[x^2 - 1]$$

$$(h_1 - h_2)\rho g = \tfrac{1}{2}\rho V^2[x^2 - 1]$$

$*\ h = h_1 - h_2,\ x = \frac{A_1}{A_2}$

$$\Rightarrow h\rho g = \tfrac{1}{2}\rho V^2(x^2 - 1)$$

$$V = \sqrt{\frac{2h\rho g}{(x^2 - 1)}}$$

5 a) i) It is a physical property which varies linearly & continuously with temperature.

ii) It should vary linearly with temp.
It shld vary continuously with temp.
It shld be measurable over a wide range of temp.
It shld be sensitive to temp changes.

iii) $R_\theta = R_0(1 + b\theta + \alpha\theta^2)$

At 100°c

$$R_{100} = R_0(1 + 3.8\times10^{-3}\times373 + -5.6\times10^{-7}\times373^2]$$

$$= 2.3395R_0$$

At 200°c, $R_{200} = R_0[1 + 3.8\times10^{-3}\times473 - 5.6\times10^{-7}\times473^2]$

$$= 2.67211176R_0.$$

At 0°c ; $R_{0°c} = R_0[1 + 3.8\times10^{-3}\times273 - 5.6\times10^{-7}\times273^2]$

$$= 1.99566R_0.$$

$$\theta = \frac{R_\theta - R_0}{R_{100} - R_0} \times 100^\circ C$$

$$= \frac{2.6711176 R_0 - 1.99566 R_0}{2.3395 R_0 - 1.99566 R_0} \times 100^\circ C$$

$$= \frac{0.67645176}{0.34384} \times 100^\circ C$$

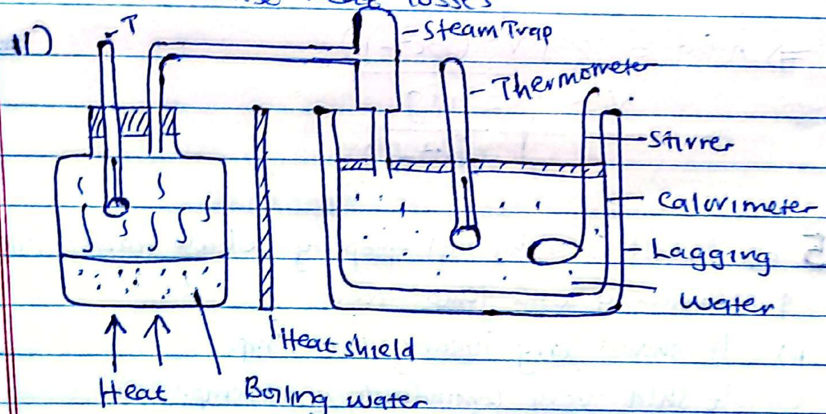
$$= 196.7^\circ C$$

iv) Because they have different thermometric properties which vary differently with temperature except at fixed points where they agree.

b) i) - Polishing calorimeter to minimise heat loss by radiation

- Calorimeter should be supported on an insulated stand.
- It shld be lagged to reduce heat loss by conduction.
- Liquid should be transfered as soon as possible to minimise heat losses

ii)



Mass m_1 of water & calorimeter is measured & recorded. Initial temp θ_1 of H_2O in calorimeter is noted. Steam from boiling H_2O is then passed into H_2O in the calorimeter thru a steam trap.

After a measurable temp rise, the final temp θ_2 of water in calorimeter is measured & recorded.

The new mass m_2 of H_2O in calorimeter is again measured & mass m_s of condensed steam is calculated from $m_s = m_2 - m_1$.

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Temperature θ_3 of steam is measured by thermometer T & recorded.

Mass m_c of empty calorimeter is obtained by weighing it.

Heat given by steam condensing + Heat given by condensed H_2O from θ_3 to θ_2

= Heat taken by Cal + Heat taken by H_2O.

$M_sL_v + M_s C_w(\theta_3-\theta_2) = (m_c C_c + m_w C_w)(\theta_3-\theta_2)$

where C_w = shc of H_2O, m_w = Mass of H_2O, $M_w = m_1 - m_c$

C_c = shc of Cal

Hence, L_v can be obtained by the above expression.

c) In fusion, heat is required to weaken the intermolecular bonds accompanied with a small increase in volume hence negligible work done against atm. pressure.

While in vaporization, heat is required to break intermolecular attractions & form a gas followed by a large increase in volume & more work ~~done~~ is done against atm. pressure in expanding the gas.

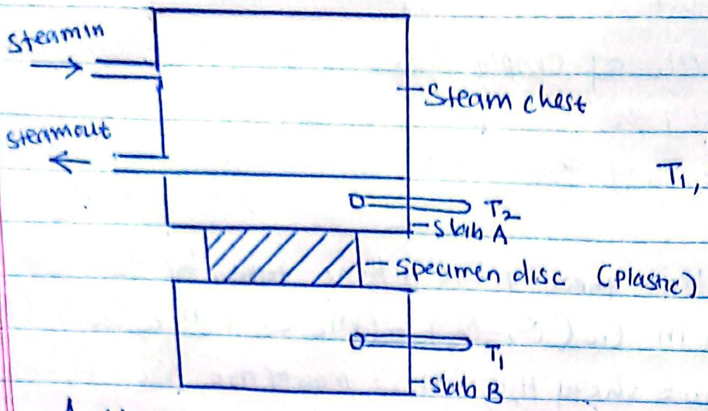
6. a) i)

✓ It is the rate of heat flow through a material per unit xsnal area per unit temperature gradient.

OR: The rate of heat flow at right angles to the opposite faces of $1m^3$ of material when temperature difference across the faces is 1K.

✓ Temperature gradient: Is the ratio of the difference in temperature btn the ends of the conductor to the length of the conductor.

11)



T_1, T_2 are Thermometers.

A plastic sample in form of a disc of small thickness, t and diameter, d is used.

The thin disc is sandwiched btn 2 metal slabs A and B each carrying a thermometer.

Steam is passed through steam chest until thermometers record steady temperatures θ_2 and θ_1 which are recorded.

$$\frac{Q}{t} = \frac{KA(\theta_2-\theta_1)}{t} \quad \text{——— (I)}$$

Sample is withdrawn \$ ~~block~~ slab B is heated directly when in contact with A until its temperature is about 10°c above θ_1.

Steam chest is removed \$ disc is placed on top of slab B.

Temperature of slab B is recorded at suitable time intervals.

A cooling curve is plotted \$ slope S of the graph at θ_1 is determined.

Mass m of slab B of specific heat capacity, c is determined.

$$Q/t = mcs \quad \text{——— (II)}$$

Thermal conductivity K of the disc is got from

$$mcs = \frac{KA(\theta_2-\theta_1)}{t}$$

$$\rightarrow mcs = \frac{K\pi d^2}{4}\,\frac{(\theta_2-\theta_1)}{t}$$

iii)

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$Q/t = mL_v = 10\times10^{-3}\times2200 = 22$

$Q/t = \frac{K_s A(150-\theta)}{0.5\times10^{-3}} = \frac{K_k A(\theta-100)}{2.5\times10^{-3}}$

$\frac{K_k A(\theta-100)}{2.5\times10^{-3}} = 22$

$66\times0.05(\theta-100) = 22\times2.5\times10^{-3}$

$\theta = 100.017°C$

$\frac{K_s A(150-\theta)}{0.5\times10^{-3}} = 22$

$K_s(66)(150-100.017) = 22\times0.5\times10^{-3}$

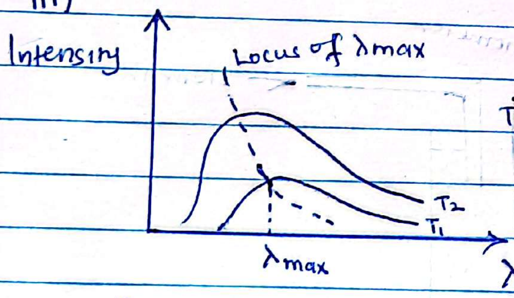
$K_s = 3.334\times10^{-6}\ Wm^{-1}K^{-1}$.

b) i) It states that the total power radiated per unit surface area of a black body is directly proportional to the fourth power of its absolute temperature.

OR: Total energy radiated by a black body per unit surface area per unit time is directly proportional to the 4th power of its absolute temp.

ii) Intensity of radiations is the energy radiated per meter square per second per unit wavelength interval.

iii)



c) $P_{net} = S\sigma(T_0^4 - T^4)$, $S = 4\pi r^2$.

$= 4\pi(30\times10^{-3})^2(5.67\times10^{-8}(240^4-200^4)) = 350.95\times10^{-2}W$

Also $P_{net} = mc\frac{\Delta\theta}{t}$

$mc\frac{\Delta\theta}{t} = 350.95\times10^{-2}$

$\frac{\Delta\theta}{t} = \frac{350.95\times10^{-2}}{mc}$ *Error: Supposed to be copper metal sphere.

Correction:

$$m = \rho V = 8960 \times \frac{4}{3}\pi (0.03)^3 = \frac{3.040}{3} kg$$

$$m = 1.013 \text{ kg}$$

$$\frac{\Delta\theta}{t} = \frac{3.5095}{mc}$$

$$\frac{\Delta\theta}{t} = \frac{3.5095}{1.013 \times 400} = 0.00866 \text{ K/s}.$$

7 a) i) It states that the volume of a fixed mass of a gas is directly proportional to absolute temperature at constant pressure.

ii) From $PV = nRT$, at constant Pressure

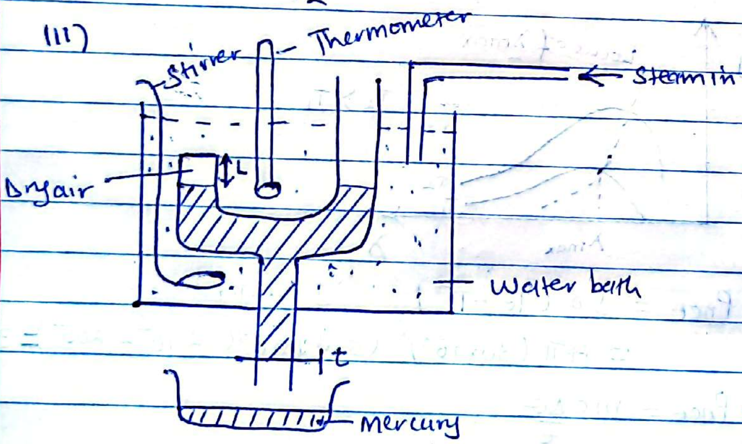
$$V_1 = \frac{nRT_1}{P} \; ; \; V_2 = \frac{nRT_2}{P}$$

$$\frac{V_1}{V_2} = \frac{nRT_1}{P} \times \frac{P}{nRT_2}$$

$$\frac{V_1}{V_2} = \frac{T_1}{T_2}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$ which is Charle's law.

iii)



Dry air is trapped in a closed limb of uniform Xsnal area A by mercury.
The tube is immersed in a water bath & is well stirred to ensure uniform temperature.

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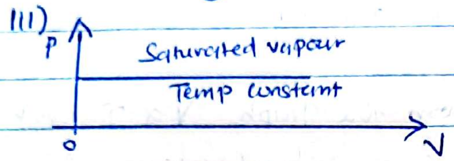
ii) When volume of saturated vapour is decreased at constant temp, the density of vapour increases & the rate of ~~cool~~ condensation increases.

As a result molecules return to the liquid than leave it.

The number of molecules in the vapour continue to fall until dynamic eqbm is again restored with S.V.P having the original value.

iii)



8 a) i)

Cathode rays	+ve rays
Light (less massive)	They are massive
-vely charged	+vely charged
Travel with same velocity	Have average of velocities
Produce x rays when they bombard matter	Do not produce x rays when they bombard matter.

ii)

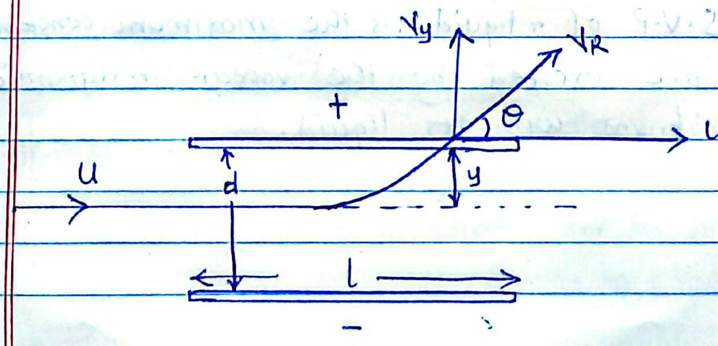
$$u = \sqrt{\frac{2eVa}{m}} = \sqrt{\frac{2 \times 1.6\times10^{-19} \times 3000}{9.11\times10^{-31}}} = 3.246\times10^{7}\,m/s.$$

$$V_y = \frac{Vel}{mdu} = \frac{1000\times1.6\times10^{-19}\times10\times10^{-2}}{9.11\times10^{-31}\times5\times10^{-2}\times3.246\times10^{7}}$$

$$V_y = 1.082\times10^{7}\,m/s$$

$$\theta = \tan^{-1}\left(\frac{V_y}{u}\right) = \tan^{-1}\left(\frac{1.082\times10^{7}}{3.246\times10^{7}}\right)$$

$$\theta = \tan^{-1}(1/3) = 18.43^\circ.$$



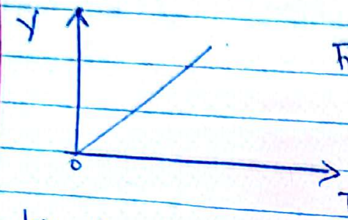
Mercury in the limbs is maintained at the Same level by opening the tap, t so that pressure of the gas is kept constant.

Temperature T of the gas is adjusted by passing steam through water bath & volume of the gas depends on length L of the tube.

Volume V of the gas is given by $V = A \cdot L$

The results are tabulated.

A graph of V against T is plotted.



From the graph, $V \propto T$ which verifies Charle's law.

b) i)

~~Molecular volu~~ - Volume of gas molecules is negligible compared to volume of the container for ideal gases while real gases have a finite volume that is significant at high P or low temp.

- In real gas the intermolecular forces of attraction are not negligible while ideal gas eqn assumes that intermolecular forces of attraction are negligible btn gas molecules.

ii) b accounts for the fact that molecules of a gas have a finite volume that is not negligible compared to the volume of the gas. It accounts for co-volume.

a/V^2, Pressure defect, accounts for intermolecular forces of attraction btn molecules which increase as volume decreases.

c) i) S.V.P of a liquid is the maximum constant pressure exerted by the vapour in dynamic equilibrium with its liquid.

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iii) When an electron moves horizontally into a uniform electric field, it describes a parabolic path.

The parabolic motion is brought by electric force experienced by electrons in the direction of the field.

The horizontal motion of electrons is not affected by the field.

b i) It measures voltage, frequencies, small time intervals, phase differences. etc

ii) $4V_0 = Y_g l$

$$V_0 = \frac{Y_g l}{4} = \frac{6 \times 4}{4} = 6V$$

$$V_{rms} = \frac{V_0}{\sqrt{2}} = \frac{6}{\sqrt{2}} = 4.24V.$$

$$f = 2/T = 2/0.01 = 200Hz.$$

c) i) It is when the anode potential is not sufficient to attract all electrons emitted from the cathode.

_The emitted electrons tend to collect in the form of electron cloud above the cathode.

ii) Saturation is when anode potential is increased to a value such that the number of electrons emitted is equal to the number of collected electrons.

9 a) i) A photon is a packet of energy carried by electromagnetic radiation.

ii) • For any given metal surface there is minimum frequency of radiation called threshold frequency below which no photo electrons are emitted.

• The K.E of photo electrons ranges from zero to maximum & the maximum K.E is proportional to the frequency of incident radiation.

• The number of photo electrons emitted per second is directly proportional to the intensity of incident radiation for a given frequency.

• There is no detectable time lag btn irradiation of a metal surface & emission of electrons by the surface.

III)

- Existence of threshold frequency; f_0
  It predicts no threshold freq contrary to what was experimentally observed
- Variation of K.E
  By wave theory an increase in intensity means more energy & hence greater value of K.E max of electrons. However K.E depends on frequency of radiation but not intensity.
- Instantaneous emission.
  Since there is continuous absorption & accumulation of energy by an electron, the theory predicts a time lag btn irradiation & emission of electrons, however the time lag is not experimentally observed.

b) i)

$$P_{in} = IV$$

But $I = ne$ & from $E = hf$, $E = eV$, $\Rightarrow V = \frac{hf}{e}$

$$\Rightarrow P_{in} = ne.\frac{hf}{e}$$

$$P_{in} = nhf$$ But $c = f\lambda$

$$n = \frac{P_{in}}{hf} \text{ --- (I)} \qquad f = c/\lambda \text{ --- (II)}$$

$$n = \frac{P_{in}}{hc/\lambda} = \frac{0.1}{6.6\times10^{-34}\times\frac{3\times10^{8}}{400\times10^{-9}}}$$

$$n = \underline{\underline{2.0\times10^{17}}} \text{ photons.}$$

ii) From $I = ne$

$$= 2.0\times10^{17}\times1.6\times10^{-19}$$

$$= 3.2\times10^{-2} A.$$

$$\Rightarrow I_{required} = \frac{13}{20}\times3.2\times10^{-2} A$$

$$= \underline{\underline{0.0208 A}}$$

iii) $K.E_{max} = \frac{hc}{\lambda} - W_0 = \frac{6.6\times10^{-34}\times3\times10^{8}}{400\times10^{-9}} - 3.52\times10^{-19}$

$$= \underline{\underline{1.43\times10^{-19} J}}$$

c) This is because the plate & the cap lost charges (electrons). So the magnitude of the -ve charge at the leaf & gold plate decreases thereby decreasing the divergence of the leaf gradually.

10 a) i) Nucleon number is the no of protons & neutrons in the nucleus of an atom.

ii) Radioisotope: Is an atom of the same element which has the same no of protons but different number of neutrons.

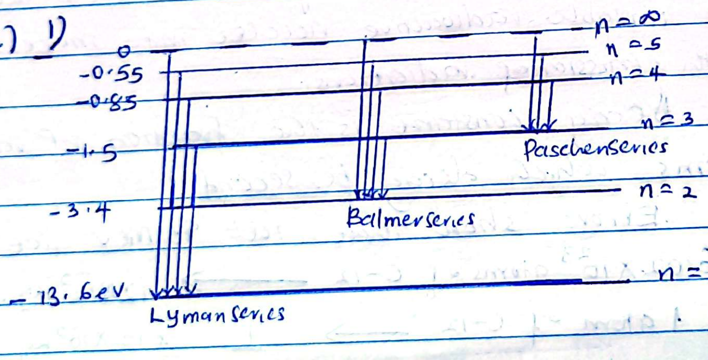
b) . In allowed circular orbits, the angular momentum is a multiple of $\frac{h}{2\pi}$, h is Plank's constant.

. When electrons are orbiting in these allowed orbits, they do not emit radiations.

. Electromagnetic radiation is emitted when the electron makes a transition b.tn the orbits

. In those orbits where the angular momentum is a multiple of $\frac{h}{2\pi}$, energy is constant.

c) i)



Lyman series corresponds to U.V part of the Spectrum

Balmer series corresponds to visible part of the spectrum

Paschen series corresponds to Infrared part of the spectrum.

ii) $-13.6\,eV + E = 0$

$E = 13.6\,eV$

$= 13.6 \times 1.6 \times 10^{-19}$

$= 2.176 \times 10^{-18} J.$

$E = \frac{1}{2} m v^2$

$v = \sqrt{\frac{2E}{m}} = \sqrt{\frac{2 \times 2.176 \times 10^{-18}}{9.11 \times 10^{-31}}} = 2.187 \times 10^{6} ms^{-1}.$

d i) Unified atomic mass unit:

It is the a twelveth of the mass of Carbon-12 atom.

B.E per nucleon: Is the ratio of energy needed to split a nucleus into its constituent nucleons to the mass no.

ii) $p = 26$, $n = 56 - 26 = 30$

Mass defect $= 26 \times 1.0078254 + 30 \times 1.0086654 -$ Mass of atom

$= 26 \times 1.0078254 + 30 \times 1.0086654 - 56u$

$= 0.46344$

$B.E = 0.4634 \times 931\,MeV = 431.4254\,MeV.$

B.E per nucleon $= \frac{431.4254\,MeV}{56}$

$= 7.7\,MeV.$

e) i) Radioactive decay is the spontaneous disintegration of unstable radioactive nuclei into more stable nuclei with emission of radiations.

Decay constant is the fraction of radioactive atoms which decay per second.

ii) Error: show that $1u = 931\,MeV$ not $934\,MeV$.

6.02×10^{23} atoms of C-12 $\longrightarrow 12 \times 10^{-3}$ kg.

1 atom of C-12 $\longrightarrow \frac{1}{6.02 \times 10^{23}} \times 12 \times 10^{-3}$ kg

$\Rightarrow$ 1 atom $= 1.99335548 2 \times 10^{-26}$ kg

$1u = \frac{1}{12} \times$ Mass of 1 atom $= \frac{1}{12} \times 1.993355482 \times 10^{-26}$ kg

$\Rightarrow 1u = 1.66 \times 10^{-27}$ kg.

$\Delta E = mc^2 = 1.66 \times 10^{-27} (3 \times 10^{8})^2 = 1.49 \times 10^{-10} J.$

But $1.602 \times 10^{-19} J \longrightarrow 1eV$

$1.49 \times 10^{-10} J \longrightarrow \frac{1.49 \times 10^{-10}}{1.602 \times 10^{-19}} eV = 931.97 \times 10^{6} eV$

$\Rightarrow 1u = 931.97 \times 10^{6} eV = \frac{931.97 \times 10^{6}}{10^{6}} MeV \simeq 931\,MeV.$

END.