Photo electric effect

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1) Light is having particle as well as wave nature the particle nature of the light can be proved by the phenomen like photo electric effect.

2) Light is having small energy packets will are called as photons and these photons travel with the same speed as that of light.

3) Each photon is having definite amount of energy and momentum

Energy of photon(E) $E = h\gamma = \frac{hc}{\lambda} = \frac{1240}{\phi}$ eV

where $hc = 1240$ (ev-nm)

h = Plank's constant $= 6.6 \times 10^{-34}$ J-sec

γ = frequency of light

$1ev = 1.6 \times 10^{-19}$ J

momentum of photon, $P = \frac{h}{\lambda} = \frac{E}{C}$

4) photons are not deflected by electric as well as magnetic field.

5) The rest mass of a photon is zero whereas mass of a moving photon is

$$m = \frac{h\gamma}{c^2}$$

Example → A source of light having power 200 watt is emitting 4×10^{20} photons/sec. Find out "λ" of the light.

Sol'n

$P = 200$ watt

$200 = 4 \times 10^{20} \times \frac{hc}{\lambda}$ $\left(\because E = \frac{hc}{\lambda}\right)$

$200 = 4 \times 10^{20} \times \frac{6.6 \times 10^{-34} \times 3 \times 10^{8}}{\lambda}$

$\lambda = 3.96 \times 10^{-7}$ m

☆ Photo electric effect →

When the light having photons of sufficient energy falls on the surface of a metal that then e^- can be ejected out.

This phenomenon is called as "photoelectric effect" and the ejected "e^-" are called as "photo electrons".

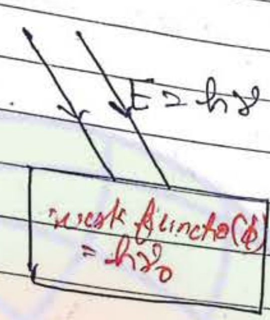
work function (ϕ) → $\frac{1242}{\lambda}$ ⇌ $\phi = h\nu_0 = \frac{hc}{\lambda_0}$ → threshold frequency

It is the min. amount of energy which the incident photons must have so the ejection of "e^-" can take place.

It depends upon the nature of the

Threshold frequency (ν_0) →

Note –
work function, threshold frequency minimum के लिए defined है



$$h\nu > \phi$$
$$h\nu > h\nu_0$$
$$\boxed{\nu > \nu_0}$$

It is the minm frequency which the incident light must have, so the ejection of e^- can take place. It also depends upon nature of given metal.

Threshold wavelength (λ_0)

$$\frac{hc}{\lambda} > \frac{hc}{\lambda_0}$$

$$\lambda_0 > \lambda$$

$$\boxed{\lambda < \lambda_0}$$

It is the maxm wavelength which the incident must have so that ejection of e^- can take place. It also depends on the nature of material.

$$K.E_{max} = h\nu - \phi = h\nu - h\nu_0 = \frac{hc}{\lambda} - \frac{hc}{\lambda_0}$$

$K.E_{min} = 0$

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Concept of kinetic energy →

i) If the energy of Incident photon is great than work function (ϕ) than the e^- will loose it's entire and it will start with the K.E. of $(h\gamma - \phi)$

ii) If it does not loose any part of their K.E in the collision than it will come out with max^m K.E of

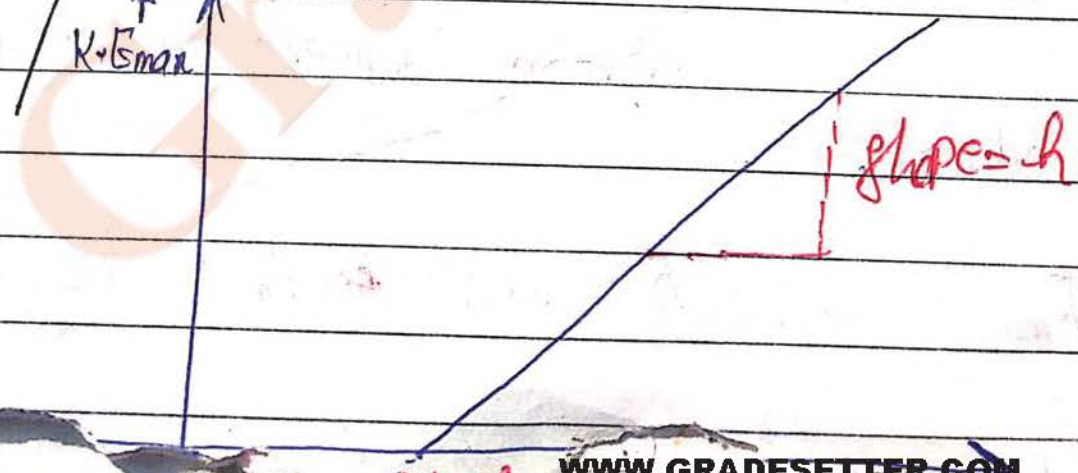
$$K.E_{max} = h\gamma - \phi = h\gamma - h\gamma_0 = \frac{hc}{\lambda} - \frac{hc}{\lambda_0}$$

iii) If the e^- looses it's entire energy in the collision that it's K.E will be minimum which is Zero.

iv) It is not necessary that if the energy of Incident photon is great than work function that photoelectric effect will definetly take place.

$$\boxed{0 \leq K.E \leq h\gamma - \phi}$$

v) $\frac{K.E_{max}}{\gamma} = \frac{h\gamma}{m} - \frac{h\gamma_0}{c}$



If the frequency of light is Increased than the K.E. of emmited photo electron's will Increase.

$\nu \uparrow$ K.E. $\uparrow$

ii) If Intensity of light is Increase than it means number of photons in the Incident beam is Incre so more number of photo electrons will be ejecte from metal surface.

$I \uparrow$ No. of photon's is

eg:) If the frequency of Incident light is doubled. than max. K.E of photo electrons be

a) doubled
b) more than double
c) less than double
d) can't say

$KE_{max} = h\nu - \phi$

5 10 5
15 = 20 5

} इन दोनों को देखें for NEET compet. so, b)

for board:-

$$KE_{max} = h\nu - \phi \quad -(1)$$

$K.E$ ... $h\nu - \phi$

$K.E'_{max} - 2K.E_{max} = \phi$

$\therefore K.E'_{max} > 2K.E_{max}$

b)

a) The light having wavelength 280 nm is falling on a metal surface having work function 2.5 e⁻ volt. Find out max. K.E. of Photoelectron.

Sol:

$K.E_{max} = h\gamma - \phi$

$= \frac{6.6 \times 10^{-34} \times 3 \times 10^{8}}{280 \times 10^{-9}} - 2.5 \times 1.6 \times 10^{-19}$

$= \frac{6.6 \times 280}{280}$

$-K.E_{max} = \frac{hc}{\lambda} - \phi$

$= \frac{1240}{280} - 2.5$

$= 1.9$ eV.

Note

(1) $K_{max} = \frac{1}{2} m V_{max}^2 = eV_0$ → Stopping Potential or Cutoff voltage

(2) $h\gamma = h\gamma_0 + K_{max}$

$h\gamma = h\gamma_0 + \frac{1}{2} m V_{max}$

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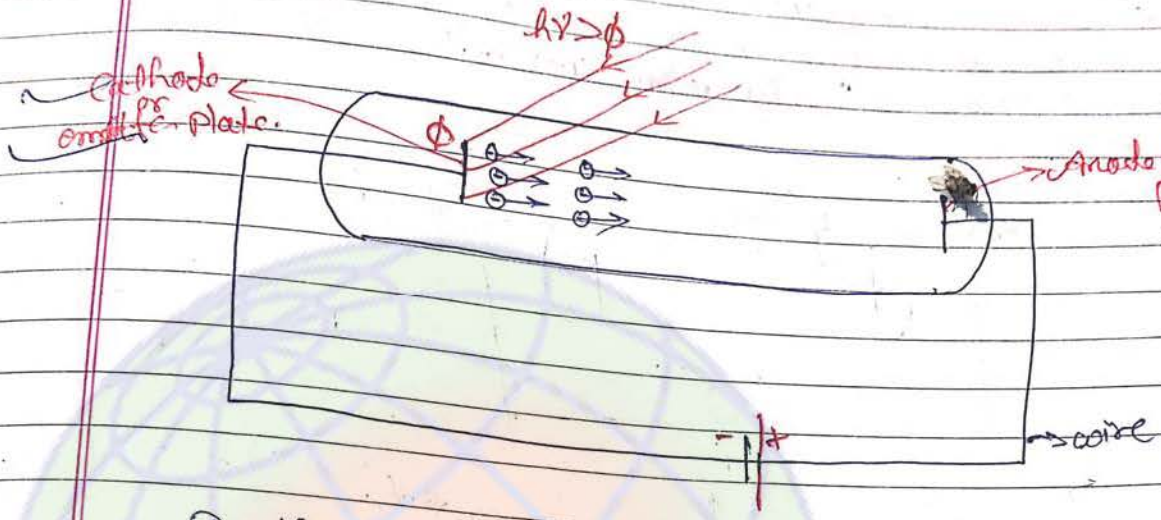
setup of photoelectric effect



In this experimental setup light having photon energy $h\nu$ ($h\nu \geq \phi$) falls on the surface of cathode plate so that e^- can be ejected out and these e^- reach the surface of anode plate.

If anode and cathode plate are connected with a wire as shown in figure then current starts to flow in the circuit which is called as photo current.

→ what happens if a battery is connected b/w cathode and anode plate.

a) If +ve terminal of battery is connected to anode plate

If the +ve potential across anode plate

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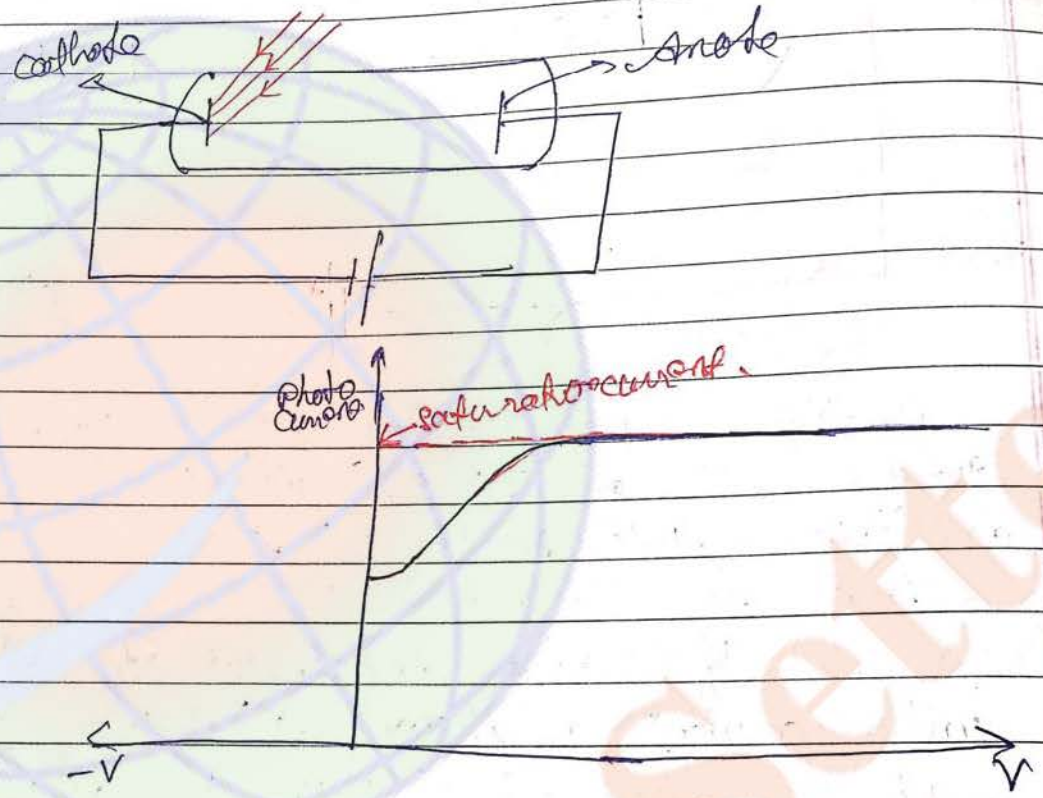
in the circuit will also Decreased after some time the current becomes maximum which is called as "Saturation current"



b) If -ve terminal of the battery is connected to anode plate.

In this case if the potential applied across anode becomes more -ve than less number of photoelectron's will reach the surface of [illegible] will dec the

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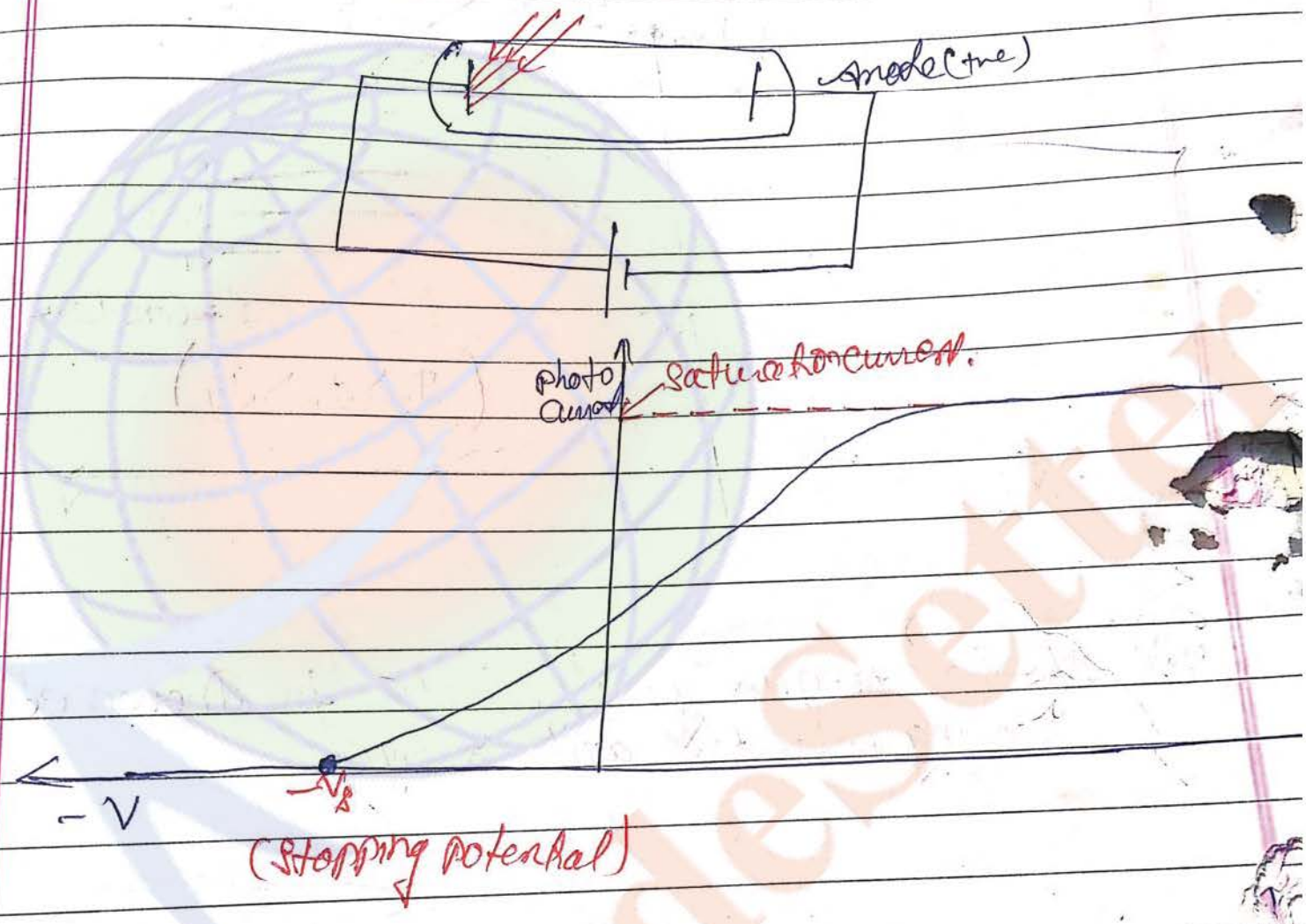
able to reach the surface of Anode Plate so photocurrent in the circuit become zero then the -ve potential is called as Stopping potential (V_s)



So,

Stopping potential (V_s) →

$$0 - K.E_{max} = -eV_s$$

$$V_s = \frac{K.E_{max}}{e} = \frac{h\gamma - h\gamma_0}{e} = \frac{hc}{e}\left(\frac{1}{\lambda} - \right.$$

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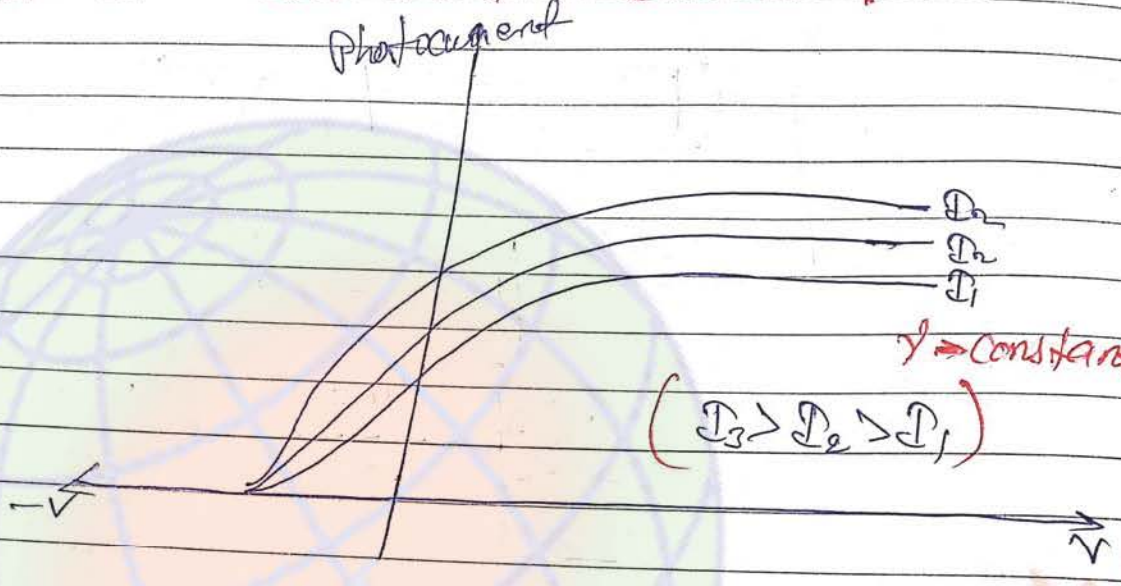
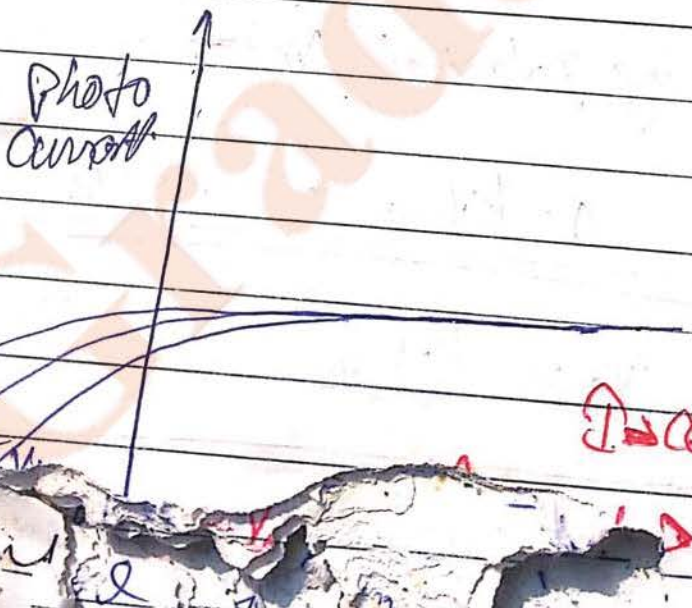
1) If the Intensity of light is Increased then more number of photoelectrons will be ejected from the cathode plate as a result the saturation current will also Increase.



2) If the frequency of light is Increased then stoping potential will Change...



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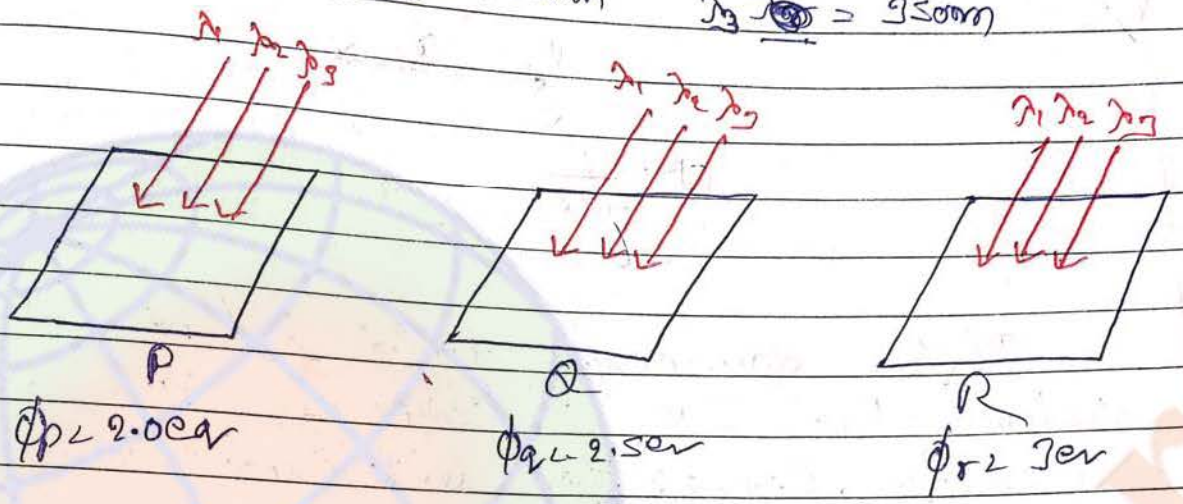
Ex 4
Q No 13

ϕ_P = 2.00 eV, ϕ_Q = 2.50 eV, ϕ_R = 3.00 eV

λ_1 = 550nm, λ_2 = 450nm, λ_3 = 350nm



ϕ_P = 2.0 eV, ϕ_Q = 2.5 eV, ϕ_R = 3 eV

λ_1 = 550nm

$E_{550} = \frac{1240}{550} = 2.25$ eV

λ_2 = 450nm

$E_{450} = \frac{1240}{450} = 2.75$ eV

λ_3 = 350

$E_{350} = \frac{1240}{350} = 3.54$ eV

P Q R

↓

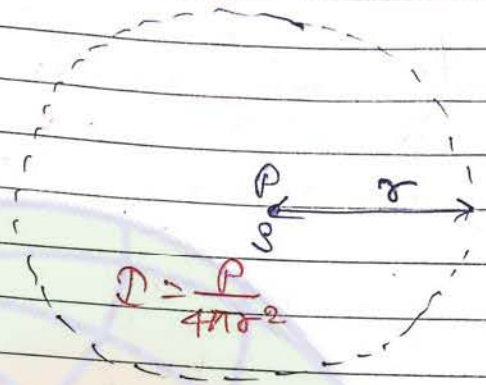
max e⁻ ejected

$V_s = \frac{1}{e}(h\gamma - \phi)$

Note ⇒

Gp 1 → 1 to 11, 21, 22, 23, 24
Gp 2 → 1 to 7, 15 to 18, 23, 24,
Gp 3 → 1 to 8, Page No. Date
Gp 4 → 4, 5, 7, 8, 13, 14

Note →



$I = \frac{P}{4\pi r^2}$

If the source of light is kept at a large distance then the Intensity of light will decrease hence the saturation current flowing in the circuit will also decrease.

$\therefore I = \frac{P}{4\pi r^2}$

$V_s = \frac{hc}{e}\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$

$\tan\theta = \frac{hc}{e}$

$\phi = \frac{hc}{\lambda_0}$

$\therefore \frac{1}{\lambda_0}$ value is

$\phi_1 : \phi_2 : \phi_3 = 1 : 2 : 4$

$\frac{1}{\lambda_{01}} = 0.004$

$\lambda_{01} = 1000\,nm$

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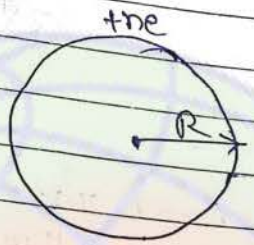
example → There is a metallic sphere of radius 'R' and threshold wavelength λ_0 to light having wavelength λ (less than λ_0) is incident on the sphere find out the total number of photoe- ejected from the sphere's.

Sol/M



$V_{(R)} = \frac{1}{4\pi\varepsilon_0}\frac{ne}{R}$

$$\frac{1}{4\pi\varepsilon_0}\frac{ne^2}{R} = hc\left[\frac{1}{\lambda} - \frac{1}{\lambda_0}\right]$$

$\because$ work done (Q) = ΔK.E

$$n = \frac{4\pi\varepsilon_0 R\,hc}{e^2}\left[\frac{1}{\lambda} - \frac{1}{\lambda_0}\right]$$

Additional →

Problem based on force exerted by light beam →

Q/ A light beam having power 100 watt is incident perpendicularly on a metallic surface where 70% of it's part is absorbed and rest 30% is reflected. Find out the force exerted by beam on the metal surface

Sol/M

(P=

Reflect → 2nd multi
Absorbt → No multi

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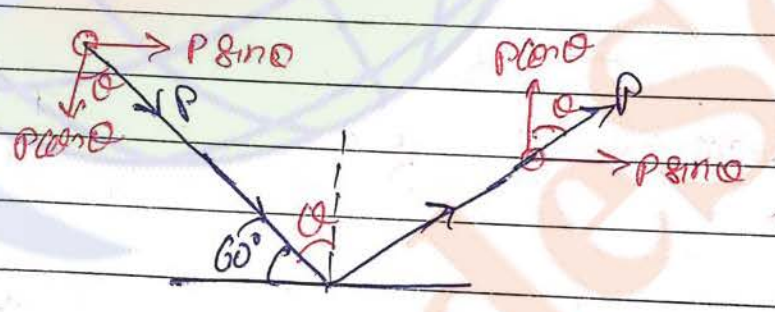
momentum = $\frac{100}{c}$

Net force exerted = $\left[\frac{100}{c} \times \frac{70}{100}\right] + \left[\frac{100}{c} \times \frac{30}{100}\right] \times 2$

$= \frac{130}{c}$ Ans.

Q2. A light beam having power 100 watt is incident on a perfectly reflecting surface (100% reflected) at an angle of 60° with the vertical. Find out the force exerted by the light beam.

Sol. energy transmitted per unit time = 100



momentum = $2 \times \frac{100}{c} \times \cos 60°$

$= \frac{100}{c}$

There is a hollow hemisphere of radius R' whose surface perfectly Reflecting. A light source having

H.W → Related Quota

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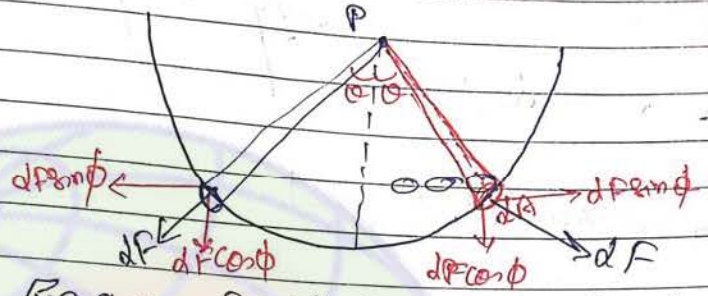


Energy Incident per unit time on the elem

$$\rightarrow \frac{P\,dA}{4\pi R^2}$$

momentum Inci

$$= \frac{P\,dA}{4\pi R^2 C}$$

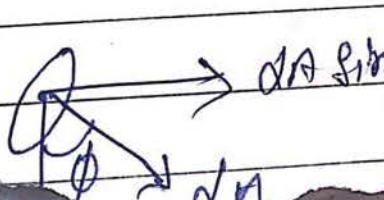
$$|d\vec{F}| = \frac{P\,dA}{2\pi R^2 C}$$

$$\text{Net force} = \int \frac{P}{2\pi R^2 C} dA\cos\phi$$

$$\Rightarrow \frac{P}{2\pi R^2 C}\int dA\cos\phi = \frac{P}{2\pi R^2 C}(\pi R^2)$$

$$= \frac{P}{2C}$$

Note →



1st Choice

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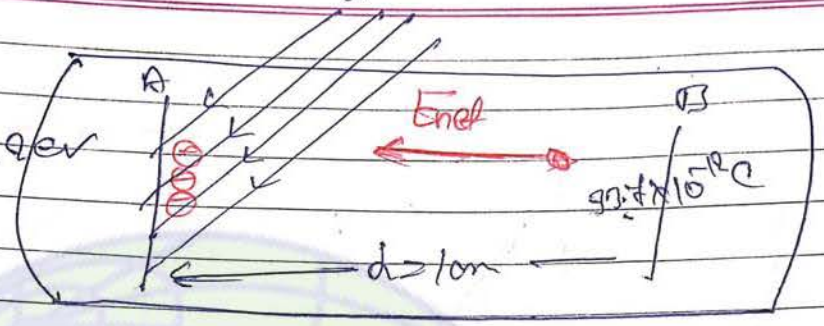
E = 5eV



10^{16} photo/ (m^2-sec)

Area of plate, $A = 5 \times 10^{-4}\ m^2$

photons Incident/sec = 5×10^{12}/sec

no. of e's emitted/sec = $\frac{5 \times 10^{12}}{10^6} = 5 \times 10^6$/sec.

a) 5×10^{-4}

b) $Q_A = 5 \times 10^{-4} \times 1.6 \times 10^{-19}$

$= 8 \times 10^{-12}$ C

$Q_B = 25.4 \times 10^{-12}$ C

$E_{net} = \frac{Q_B}{2A\epsilon_0} - \frac{Q_A}{2A\epsilon_0}$

c) K.E$_{max}$ = 5A eV

hc

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Note:—

⇒ In the process of photoelectric emission, all the emitted photoelectrons have diffe K.E

1st Choice ⊛ motion in one dimension

Real + motion

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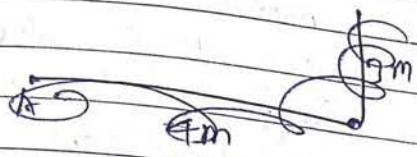
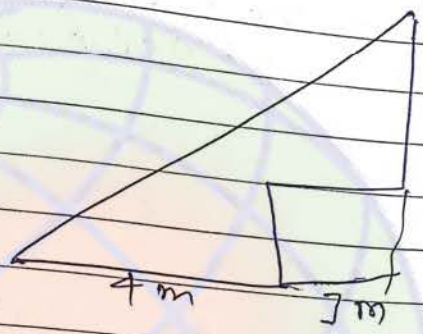
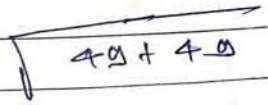
1) Distance and displacement →

eg#)





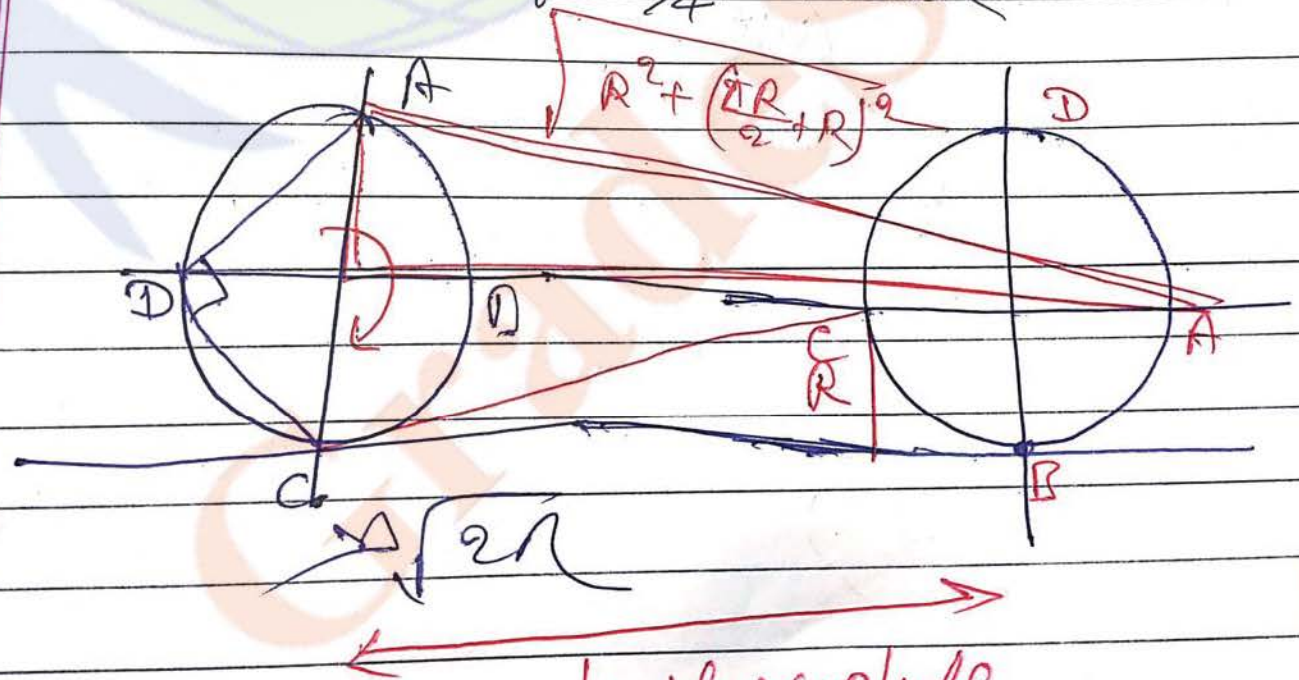


$\Rightarrow 2(4a)$

$\neq 4a\sqrt{2}$

eg2) A disk having Radius "R" is undergoing pure rolling on the ground surface find out the displacement of point of contact as well as the point after 1/4th revolute

Sol)



1st Choice

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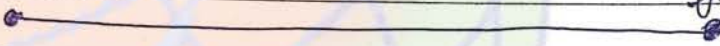
Eg:) A particle is at a separation of "s_0" from a fixed point & starts the motion towards the fixed point in such a way a that in each second it covers half of the remaining distance towards fixed point find out the separation b/w the particle and fixed point after time "t"

Sol/n



$s_0 \xrightarrow{1\text{sec}} \frac{s_0}{2} \xrightarrow{1\text{sec}} \frac{s_0}{4} \xrightarrow{1\text{sec}} \frac{s_0}{8}$

Separation left $= \frac{s_0}{(2)^t}$

1st Choice

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Average speed and Average velocity

Avg speed = $\frac{\text{Total distance}}{\text{total time taken}}$

Avg. velocity = $\frac{\text{total displacement}}{\text{total time taken}}$

eg:

A body covers half of the total distance with speed v_1 and remain half with two diff speed v_2 and v_3. but it move with these two speeds for the same duration of time. find A

s/n

Ans. speed =

v_1

speed = $\frac{\text{distance}}{t}$

$t = \frac{\text{dista}}{\text{speed}}$ $= \frac{v_1}{t}$, $\left(\frac{v_1+v_2}{t}\right)$

$= \left(\frac{v_1+v_2+v_3}{t}\right)$

Avg. speed = $\frac{dt}{v_1+v_2+v_3}$

Let

Total distance travelled $= s$

$\frac{s}{2} \rightarrow v_1$

$\frac{s}{2} \rightarrow v_2$ and v_3 $\quad \frac{s}{2} = v_2\left(\frac{t}{2}\right) + v_3\left(\frac{t}{2}\right)$

$$v_{av} = \frac{s}{\frac{s}{2} + \frac{s}{v_2+v_3}}$$

$$= \frac{2v_1(v_2+v_3)}{v_2+v_3+2v_1}$$

A body moves with speed "v_1" for half of the total time and with speed v_2 and v_3 for the remaining half time but it covers the same distance with these two speed. find out avg. speed

Let assume Suppose total time taken

$\frac{t}{2} = \frac{s}{v_1}$

$\frac{t}{2} = v_2$ and v_3 $= \frac{s}{\frac{s}{v_2} + \frac{s}{v_3}}$

$s = \frac{v_1 t}{2}$

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Suppose total time taken 't'

$\frac{t}{2} \rightarrow v_1 \rightarrow \frac{vt}{2}$

$\frac{t}{2} \rightarrow v_2$ and v_3 $\quad \frac{t}{2} = \frac{s}{2v_1} + \frac{s}{2v_3}$

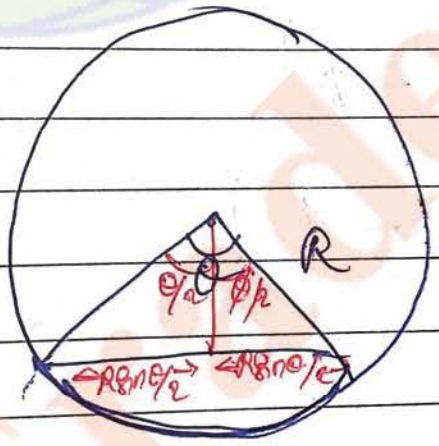
$t = s\left[\frac{1}{v_2} + \frac{1}{v_3}\right]$

$s = \frac{v_2 v_3 t}{v_2 + v_3}$

$$v_{av} = \frac{\frac{v_1 t}{2} + \frac{v_2 v_3 t}{v_2 + v_3}}{t}$$

eg 3.) A particle is moving along a circle with speed 'v' if its angular displacement then find out the magnitude of Avg. speed & Avg. vel. for this duration.

Sol:



RO

a) v_{av} speed $= \frac{R\theta}{Rt}$

b) $|\vec{v}_{av}| = \frac{2R\sin\theta/2}{t}$

Stoping potential off volodes

6)
$$\frac{h\nu_1 - \phi}{h\nu_2 - \phi} = \frac{1}{K}$$ $\phi = h\nu_0$

$\nu_0 = ?$

9) wavelength कोला →

8) 1) B, C

2) ϕ $\phi = 2$

$K.E_{max} = \frac{hc}{\lambda} - \phi$

$$v_1 = \sqrt{\frac{2}{m}\left(\frac{hc}{\lambda} - \phi\right)}$$

$$v_2 = \sqrt{\frac{2}{m}\left(\frac{4hc}{3\lambda} - \phi\right)}$$

3)
$$\frac{1}{2}mv_1^2 = (hf_1 - \phi)$$

$$\frac{1}{2}mv_2^2 = (hf_2 - \phi)$$

$$V_s = \frac{h\nu}{e} - \frac{\phi}{e}$$

mx

hc

y mx

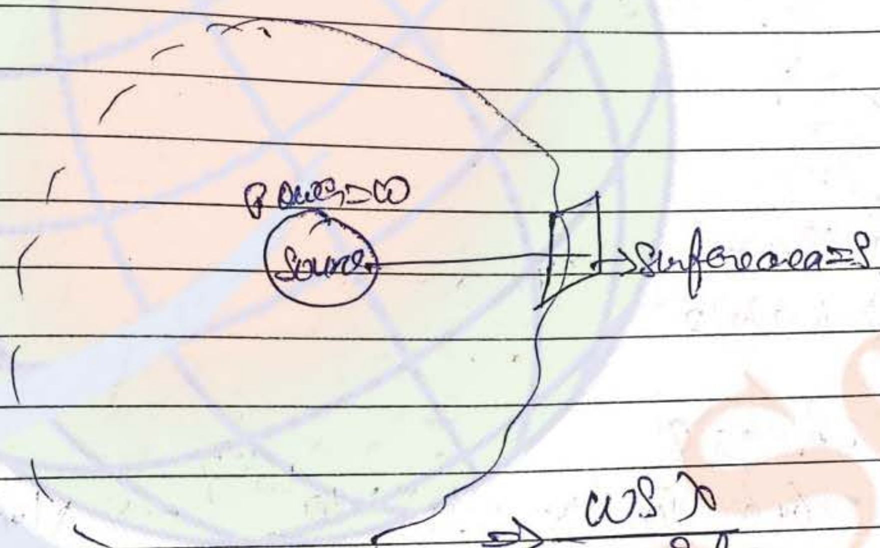
5) $K.E_{max} = eV_0$

6) $K.E_{max} = hc\left(\frac{1}{\lambda_0}\right) - \phi$

7) ($K.E = eV_0$) →

15) I का effect → stopping potential

16)



⇒ $\frac{wS\lambda}{4\pi a^2 hc}$

14) dis' का no effect on stopping pot

$I \propto \frac{1}{d^2}$

↓

saturation current

→ saturate.

17) A→ D... st

1st Choice

If → 32.2 mA/P

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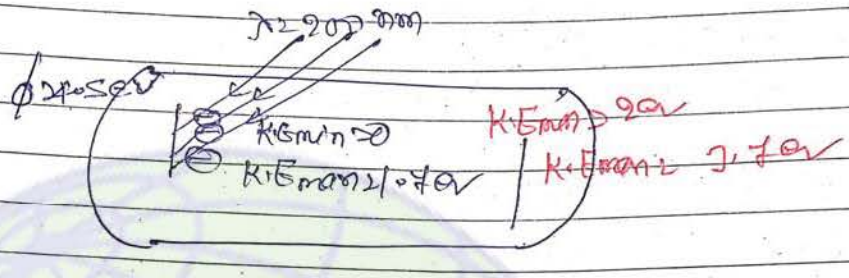
Q2)



$$\frac{1}{2}mv^2 = \frac{hc}{\lambda_{250}} - \phi$$

$$v = ?$$

$$\frac{3.2\times10^{8}\times620}{1240\times1.6\times10^{-19}} \times \frac{1}{100}$$

$$K.E_{max} = h\nu - \phi$$

$$= 6.6\times10^{-34} \times \left[\frac{1.2\times10^{15}}{2}\right] - 2\times1.6\times10^{-19}$$

~~$\frac{hc}{\lambda} - \phi = K.E_{max}$~~

$$K.E_{max} = \frac{1240}{262} - 3.74$$

$$= 1 \text{ eV}$$

Ans:

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Passage #11

$I_1 = 4.8\,mA$
$\lambda_1 = 3000\,A^\circ$
$P_1 = 1\,mW$
$n_1 = N$

$I_2 = ?$
$\lambda_2 = 1650\,A^\circ$
$P_2 = 5\,mW$
$n_2 = 2N$

$$\left[\frac{hc}{\lambda_2} - \frac{hc}{\lambda_0}\right] = 4\left[\frac{hc}{\lambda_1} - \frac{hc}{\lambda_0}\right]$$

$\lambda_0 = ?$

(165)

$$\frac{4.8}{I_2} \propto \frac{3000}{5 \times 1650}$$

$$I_2 = 13.2\,mA$$

(ii) No. of photons emitted/sec $= 4 \times 10^{15}$

No. of e^- ons emitted/sec $= \dfrac{13.2 \times 10^{-3}}{1.6 \times 10^{-19}}$

$= 8 \times 10^{16}$

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Inst. speed V/s Inst. velocity ⇒

The magnitude of Ins. vel. will be same as that of Inst. speed.

$$|\vec{V}_{inst}| = V_{inst} = \frac{ds}{dt}$$

s ⇒ Position of particle

The Inst. speed of the particle is changing with time s ∝ t^2
find out the displacement of the particle as well as distance travelled by the time interval of 6 sec.

$\frac{dv}{dt} \propto -2t$

s ? $V = \frac{ds}{dt}$

t = 6 sec.

$V = 4 - t^2 = 0$

$t = 2$ sec

Acceleration →

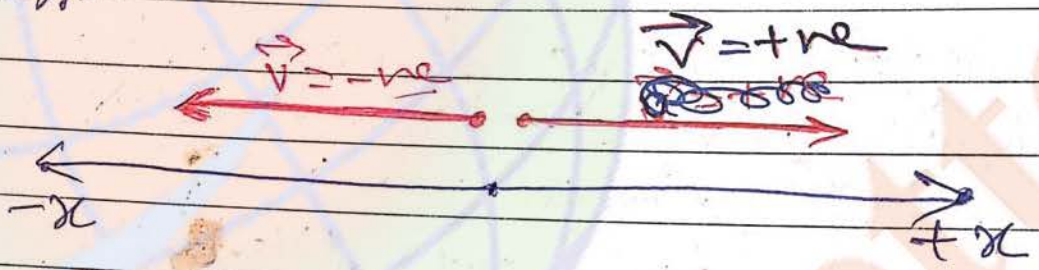
Rate of change of vel.

$$\vec{a} = \frac{d\vec{v}}{dt} = v\frac{dv}{dx}$$

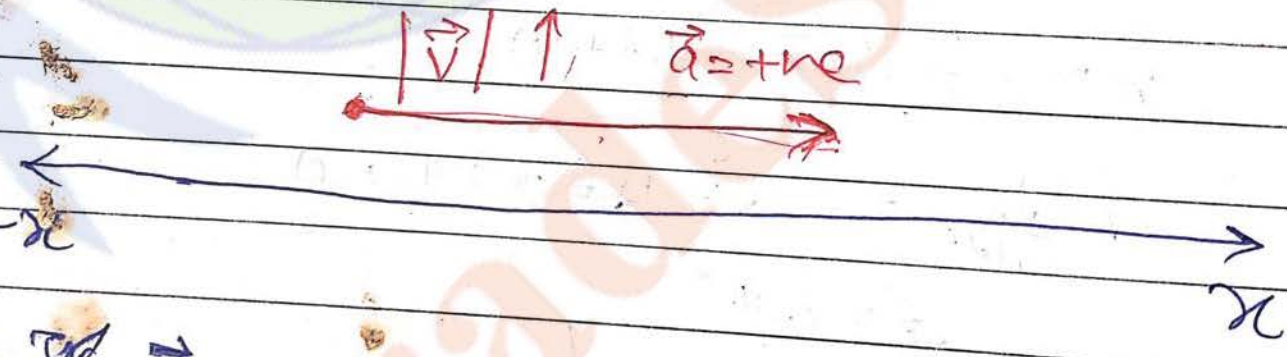
$$|\vec{a}_{av}| = \frac{\Delta \vec{v}}{\Delta t}$$

Sign of vel and Acc.ⁿ

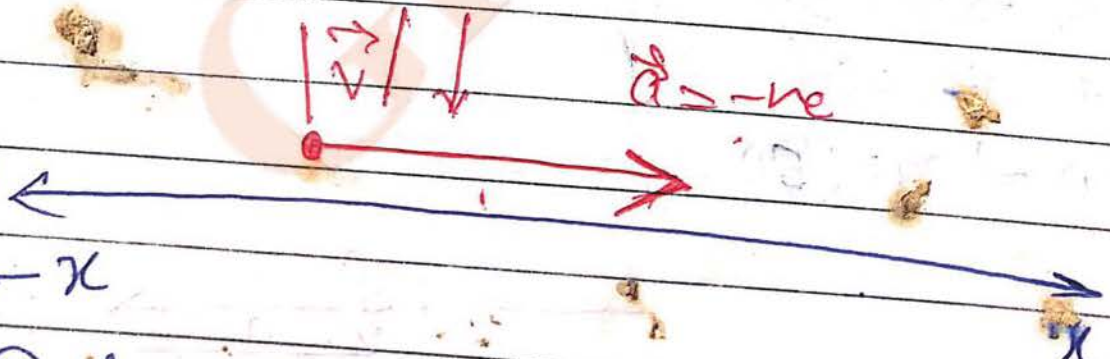
Case I →



Case II →



Case III →



Case IV th →

Example:

i) If $\frac{d|\vec{v}|}{dt}$ is zero than $\left|\frac{d\vec{v}}{dt}\right|$ must be zero

eg: circular motion → Polar

ii) If $\left|\frac{d\vec{v}}{dt}\right| = 0$ than $\frac{d|\vec{v}|}{dt}$ must be zero

→ (True)

1) Uniformly Accelerated motion →

$$\vec{a} = \text{Constant}$$

$$S_{nth} = u + \frac{a}{2}(2n-1)$$

→ Displacement in nth second

Eg. A body moves with Initial velocity east whereas its acc is 2 m/s² west

i) Find

ii)

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(ii) Displacement in 6th sec. only.
(iii) Displacement travelled in 6sec only.

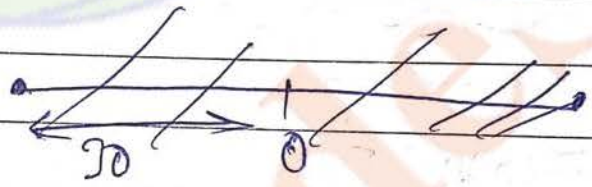
$u = 11 m/s$
$a = -2 m/s^2$
$t = 6 sec$

$s = ut + \frac{1}{2}at^2$

$s = 66 + \frac{1}{2} \times -2 \times 36$

$= 66 - 36$

$= 30$



(iii) $S_{nth} = u + \frac{-2}{2}(2n - 1)$

$= 11 - (2 \times 6 - 1)$

$= 11 - 11$

$= 0$

b)

$$v = u - a(t)$$
$$t = 5.5 \text{ sec}$$

$u = 11$ m/sec. → $a = -2$ m/s^2 → $t = 5.5$ sec, $v = 0$

$\frac{1}{2} \times 2 \times \left(\frac{1}{2}\right)^2 = \frac{1}{4}$ m

Total distance $= 30 + \left(\frac{1}{4} \times 2\right)$

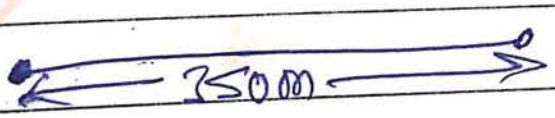
$= 30.5$ m

c) Disp. in 6th sec $= 0$

d) Distan in 6th sec $= \frac{1}{2}$ m

ex 2) A train having length 350 m starts from rest with uniform acc^n of 3×10^{-2} m/s^2. 30 sec the start its front headlight is switch after further 60 sec. tail signal light is switch off. Find out the disp. b/w two points on ground where these two events are take place.

Sol



$u = 0$

$v = u + a$

$v = 0$

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at t_1 =

$s = ut + \frac{1}{2}at^2$

$= 0 + \frac{1}{2} \times 3 \times 10^{-2} \times 900$

$s_1 = \frac{27}{2}$

At t_2 =

$s_2 = ut + \frac{1}{2}at^2$

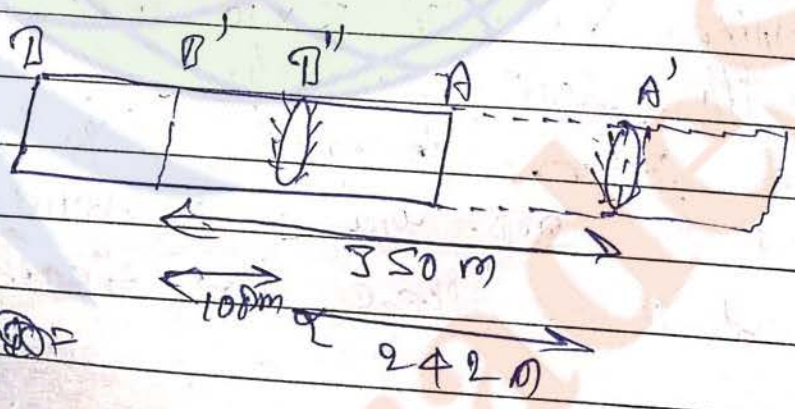
$= \frac{1}{2} \times 3 \times 10^{-2} \times 3600$

$= \frac{108}{2}$ 54

$= 54$

$\Rightarrow \frac{27}{2} - 54$

$\Rightarrow \frac{27 - 108}{2} =$



$s_1 = 135m$

$s_2 =$

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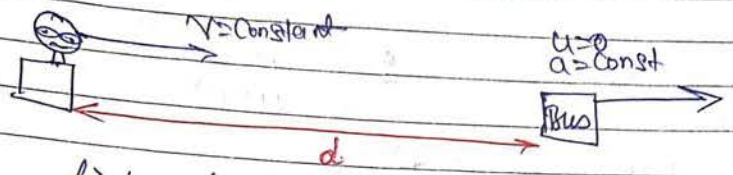

find out the min^m vel. of man ~~that he~~ value of constant vel. v the man should have so that he can catch the bus.

Sol^n

$$S_m - S_B = d$$

$$vt - \frac{1}{2}at^2 = d$$

$$\Rightarrow t^2 - \frac{2v}{a}t + \frac{2d}{a} = 0$$

$$t = \frac{\frac{2v}{a} \pm \sqrt{\frac{4v^2}{a^2} - \frac{8d}{a}}}{2}$$

$$\frac{4v^2}{a} \geq \frac{8d}{a}$$

$$\boxed{v \geq \sqrt{2ad}}$$

Relative

$$S_{mB} = d$$

$$u_{mB} = v$$

$$a_{mB} = -a$$

$$d = vt$$

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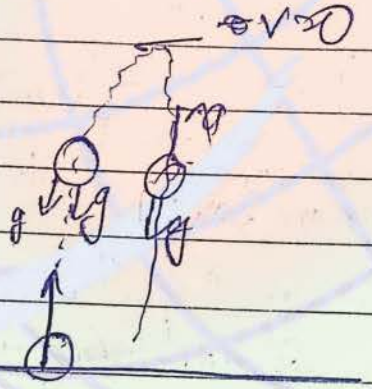
Vertical motion

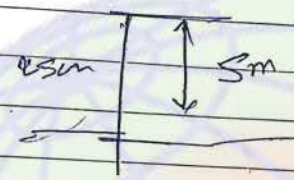
Q.1) A ball is thrown vertically upward which comes back also.
The air resistance provides the retardation of $2m/s^2$.
find out the ratio of time ascent to the time of descent.
(take $g=10$)

a) $2/3$ b) $3/2$ c) $\sqrt{\frac{2}{3}}$ d) $\sqrt{3/2}$



eg 2) A stone is released from the top of a tower when it is 5 m below the tower another stone is released from a point 25 m below the top of the tower both the stones reach the ground simultaneously find out the height of tower.

Sol/ⁿ



Q1) A lift starts from rest with an accⁿ of 1.2 in the upward direction after 2 sec a stone is released from the ceiling of lift if the sep. b/w the ceiling and floor of the lift is 2.7 m then find
a) time taken by the stone to collide with
b) displacement as well as distance travelled by stone in ground frame

Sol/ⁿ a) u = 0, a = 1.2 m/s², g = 9.8 m/s², t = 2 sec

$S = 2.7$ m
$t_1 = ?$
$S = +\frac{1}{2}(1.2) \times 4$
$= 2.4$

$-2.7 = -\frac{1}{2} \times (11) t^2$

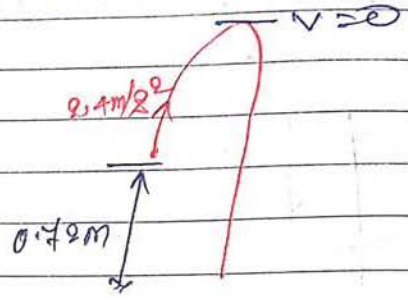
$t = 0.7$ sec

b) Displacement

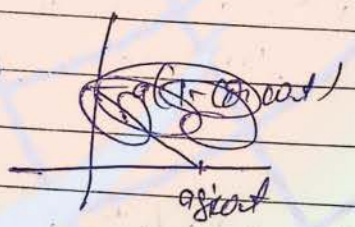
$$s = (2.4)(0.7) - \frac{1}{2}(4.9)(0.7)^2$$

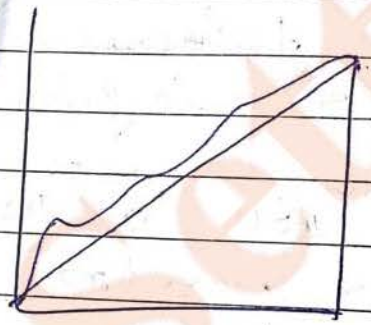
$$= 1.68 - .49 \times 4.9$$

$$= 0.792 \text{ m}$$



A particle is moving in xy plane whose x and y position are given by $x = a\sin\omega t$ and $y = a(1+\cos\omega t)$ find out distance travelled by the particle in the time interval of t.





$$\text{Distance} = \int \sqrt{v_x^2 + v_y^2}\, dt$$

$$v_x = a\omega\cos\omega t$$

$$v_y = a\omega\sin\omega t$$

$$v = a\omega$$

$$= 2\omega t$$

1st Choice

Problem based on Graph →

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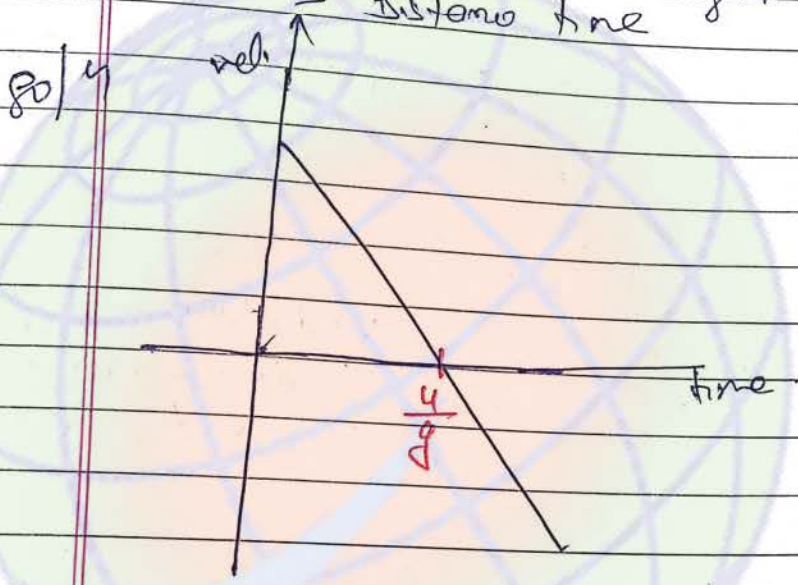
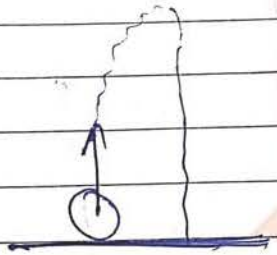
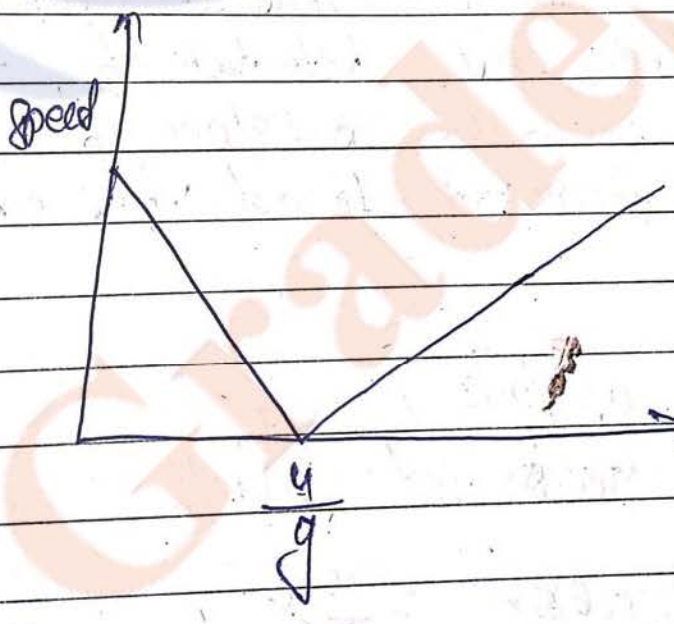
Q) A particle is ~~thrown~~ thrown vertically upward which comes back also. Draw
i) velocity time graph
ii) speed time graph
iii) Displacement time graph
iv) Distance time

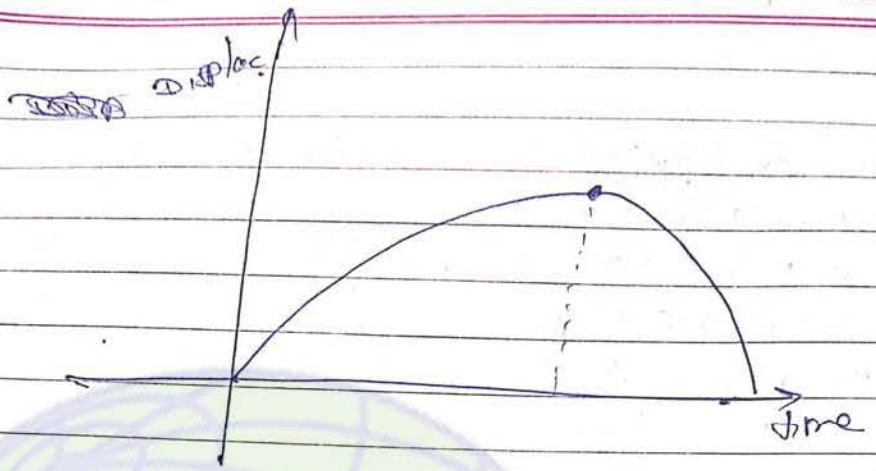




(∵ Acc^n is const.)

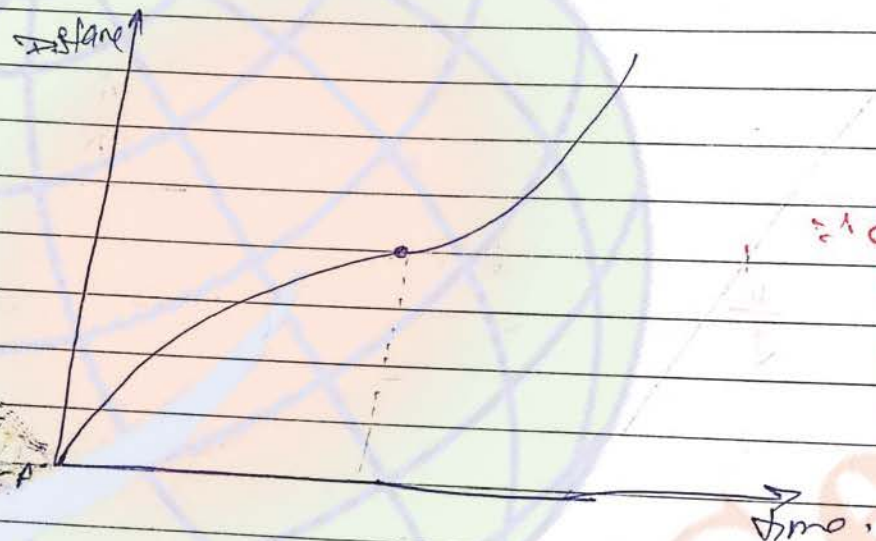
ii) (speed can't be -ve)





(c)

~~Velocity decrease~~



(d)

∴ distance always increase it can't be decrease

Q2) A body starts from rest and it can have the acc^n of $1 m/s^2$ and retardation of $4 m/s^2$ if body has to cover the distance of 200m from point A to B from rest to rest. find out the min time taken.

$u=0$, $a_1 = 1 m/s^2$

retardation $= 4 m/s^2$

$u=0$
$a = 1 m/s^2$
$s = 200$

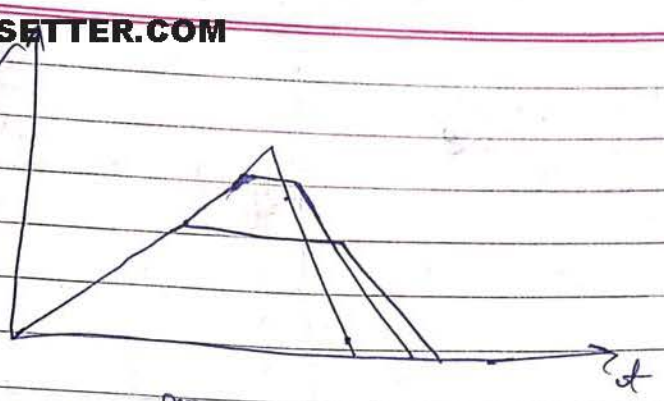
$s = ut + \frac{1}{2}at^2$

$200 = 0 + \frac{1}{2} \times 1 \times t^2$

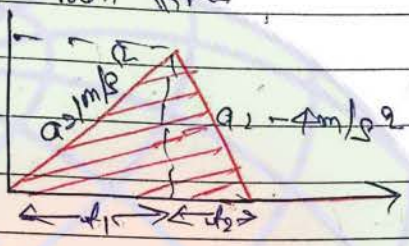
$t^2 = 400$

$t = 20$

Area $= \frac{1}{2} \times b \times h = \frac{1}{2} \times$



for min time



good idea

for min. time के लिए constant rest नहीं होना चाहिए।

$v_{max} = a_1 t_1$

$0 = v_{max} - 4t_2$

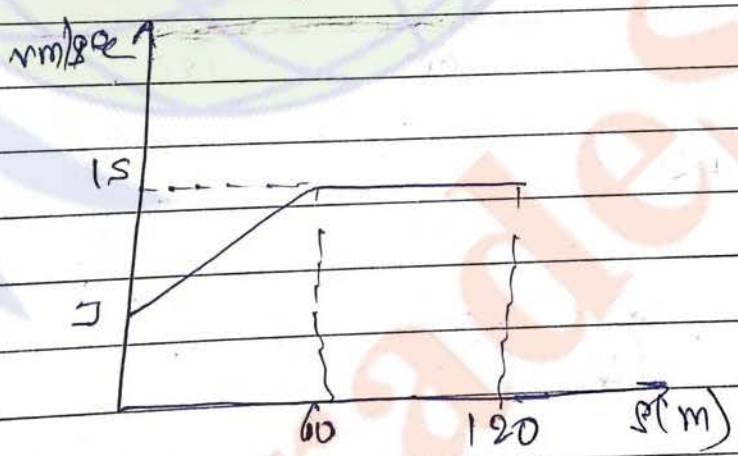
$t_1 = 4t_2$

$\frac{1}{2}\left[\frac{s+t}{t}\right][t_1] = 200$

$t_1 = \sqrt{320} = 8\sqrt{5}$

$t_2 = 2\sqrt{5}$

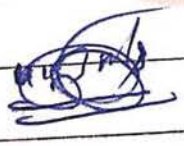
Q2)



i) Draw acc vs displacement graph corresponding to the graph shown.

ii) The total time taken in the journey is taken.

80/4



acc

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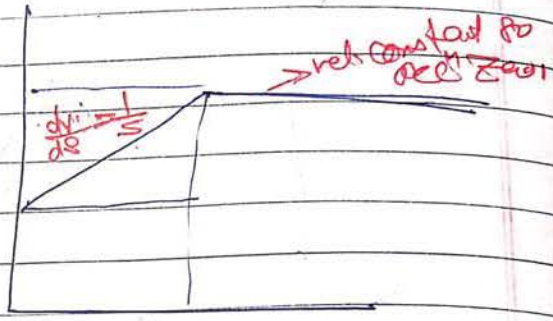
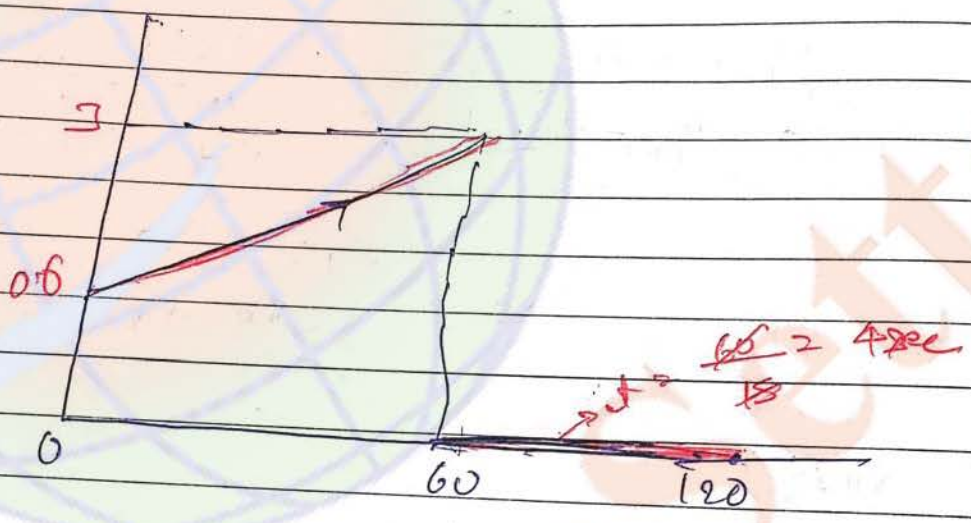
acc^n = $v \cdot \frac{dv}{ds}$



when
$v = 3\ m/sec$, $\therefore a = v \cdot \frac{dv}{ds} = 3\left(\frac{1}{s}\right) = 0.6\ m/s^2$

when:-
$v > 15\ m/sec$, $a = (15)\left(\frac{1}{s}\right) = 3\ m/sec$.



$\frac{ds}{dt} = \frac{s}{5} + 3$

$\int_0^{60} \frac{ds}{\frac{s}{5}+3} = \int_0^t dt$

$t = 5\left[\ln\left(\frac{s}{5}+3\right)\right]_0^{60}$

$= 8sec$

Total time $= 12\ sec$

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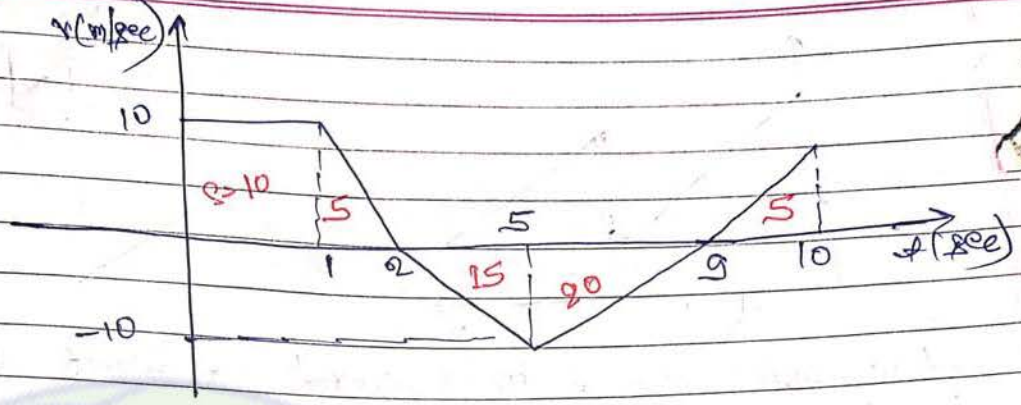
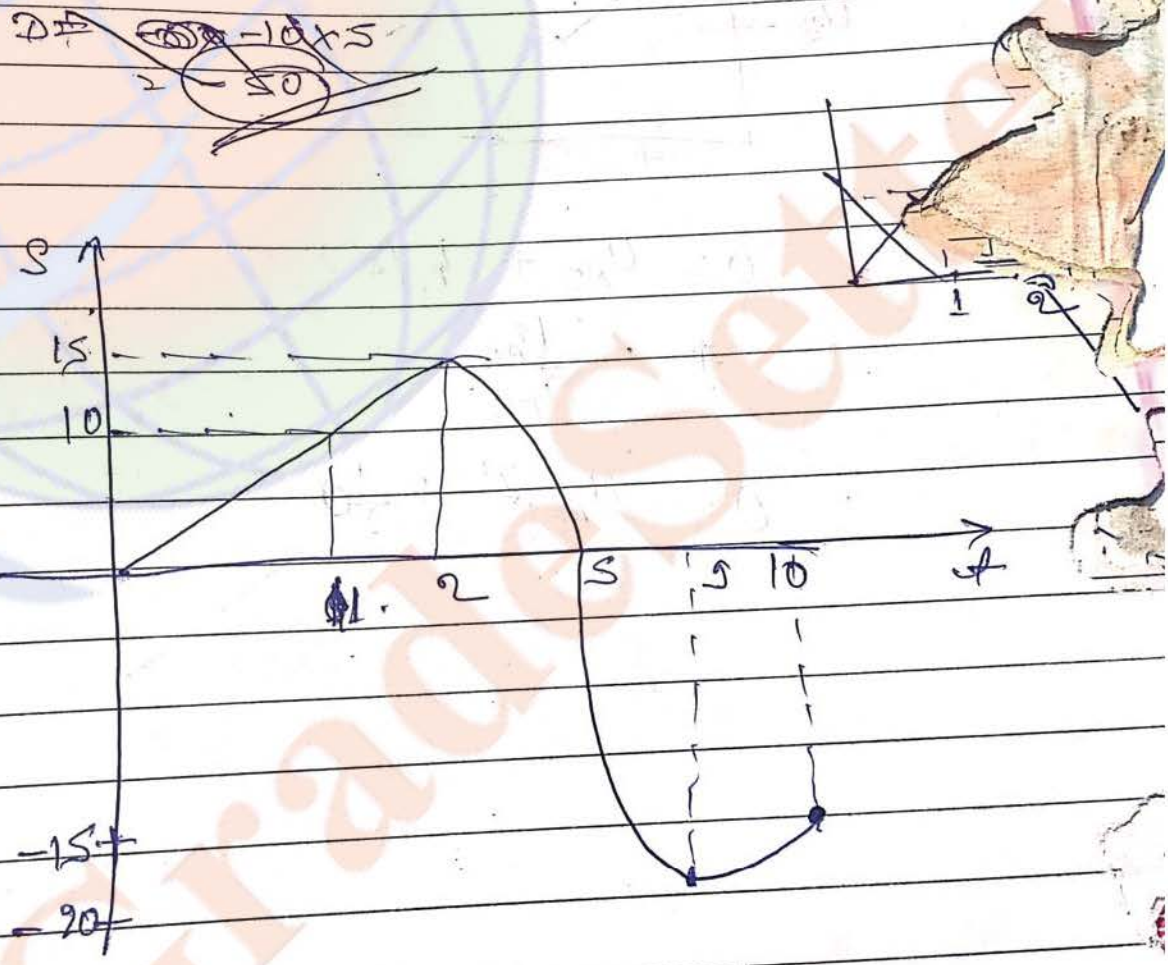
Q.



Draw the displacement-time graph for the given shown. Also calculate ~~distance~~ total displacement as well as distance travelled.

Sol/n



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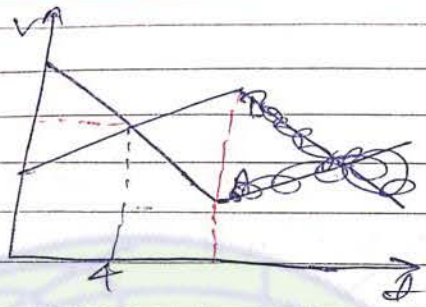
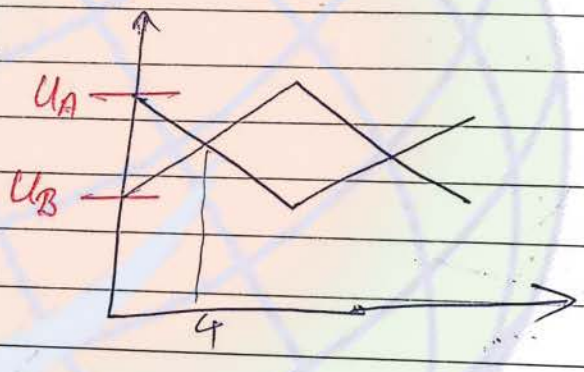


two bodies "A" and "B" starts from rest in the same direction as their v/t graph are shown.
after how much time they will meet the.



$$0 = u_{AB} + a_{AB}(t)$$

$$4 = \frac{u_{AB}}{a_{AB}}$$

$$0 = u_{AB}t' + \frac{1}{2}a$$

Read Procedure notes before writing

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Q1) The eq" of motion for a particle is given by $x = \alpha x^2 + \beta x$. where α and β are constant. "v" is instantaneous vel. find out the magn. vel. of the object

a) $2\alpha v^2$
b) $2\beta v^2$
c) $2\alpha v^3$
d) $2\beta v^3$

$$1 = 2\alpha x\left(\frac{dx}{dt}\right) + \beta\left(\frac{dx}{dt}\right)$$

$$v = \frac{1}{2\alpha x + \beta}$$

$$a = \frac{dv}{dt} = \frac{-2\alpha\left(\frac{dx}{dt}\right)}{(2\alpha x + \beta)^2}$$

$$= -2\alpha v^3$$

eg 2) A particle start from rest ($u = 0$), and acc" $= 2 + |2 - t|$. find out vel. at $t = 4$

$$v = u + at$$

$$v = (2 + |2 - t|)4$$

$$= 8 + 4|2 - t|$$

$$a = \frac{dv}{dt}$$

$$=$$

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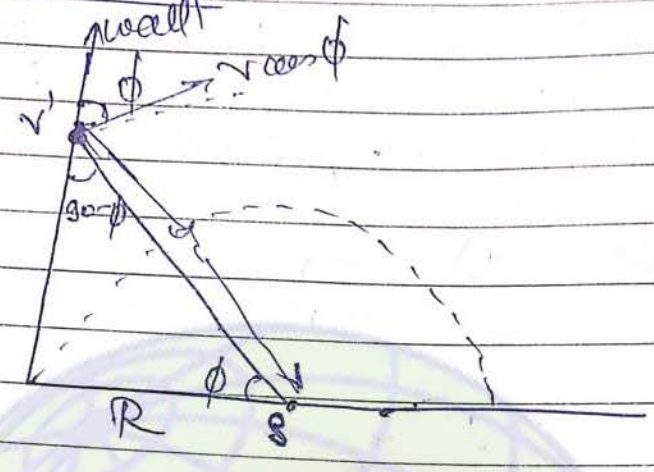
D.P.P. 2 (Q3)



$\cos\phi = \frac{R}{r}$

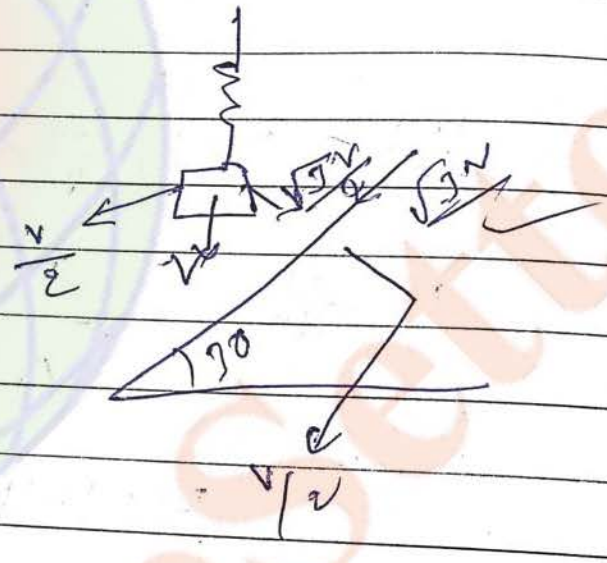
$r = R\sec\phi$

$\omega = \frac{v}{R} = \frac{v'\cos\phi}{R\sec\phi}$

$$v' = v\sec^2\phi$$

$\omega = \frac{2\pi}{T} = \sqrt{\frac{k}{m}}$

$v_{max} = \sqrt{\frac{k}{m}}A$



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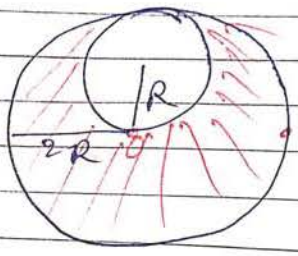
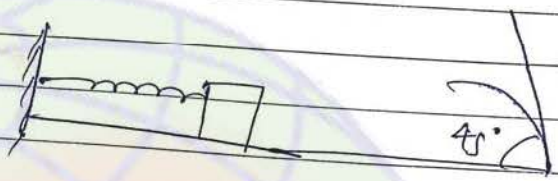
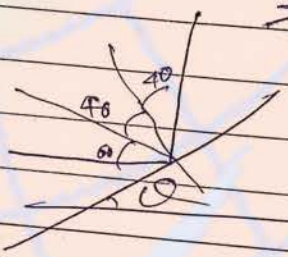
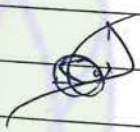
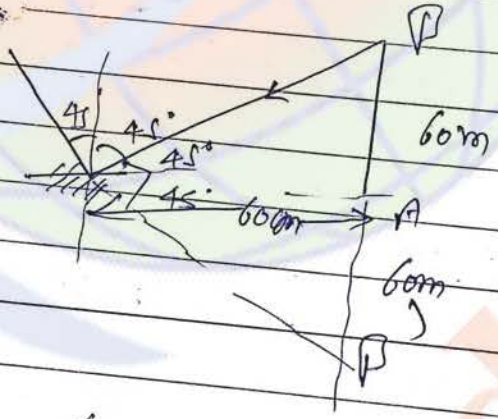


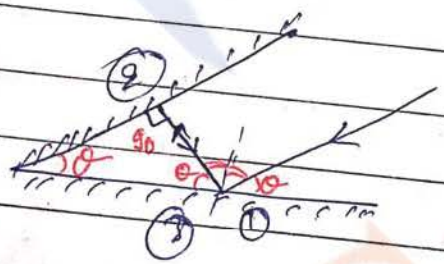


$\mu = 1 \ (\theta = 0)$





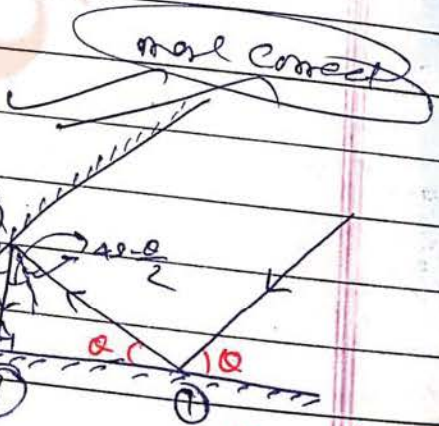




(No. of reflections = 1)

$90 + 2\theta = 180$

$\theta = 45$

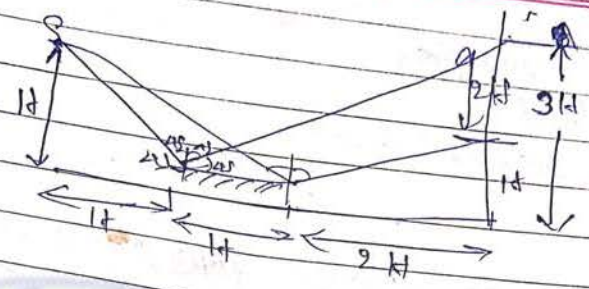


(No. of reflections = 2)

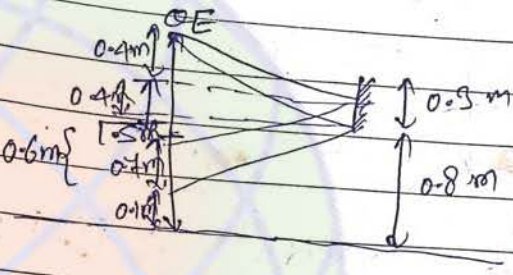
$90 + \theta + 45 + \frac{\theta}{2} = 180$

$\theta = 30°$

8.



9.



10.

$\vec{V_0} = 4\hat{j} + 4\hat{j} + 5\hat{k}$

$\vec{V_m} = 4\hat{j} + 5\hat{j} + 8\hat{k}$

$\vec{V_e} = 9\hat{j} + 4\hat{j} + 11\hat{k}$

Ray Z-axis — 20 s

240 (45)

$\vec{V_{em}} - \vec{V_{om}}$ (30 s)

$V_{em}(\delta) = -(5-8)$ 35

$= 11$

$u = -40$

$v = ?$ $\quad v = 40$

$f = 20$

$\frac{1}{20} = \frac{1}{v} + \frac{1}{-40}$

$\frac{1}{v} = \frac{1}{20} - \frac{1}{40} = \frac{1}{40}$

$= \frac{2-1}{40}$

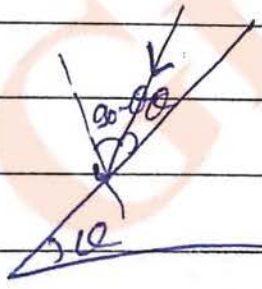
$= \frac{1}{40}$

$= \frac{2-0}{20}$

35

$\mu_1 \sin i = \mu_2 \sin r$

11.



$\mu_2 \sin r$

$\theta_{c1} = \sin^{-1}\left(\frac{1}{\mu_1}\right)$

$\theta_2 = \sin^{-1}\left(\frac{1}{\mu_2}\right)$

$(\theta_{c1} - \theta_2)$