YAKEEN NEET 2.0

2026

Laws of Motion

Physics | Lecture - 10

By- Manish Raj (MR Sir)

Todays Goal

Questions on Pseudo.

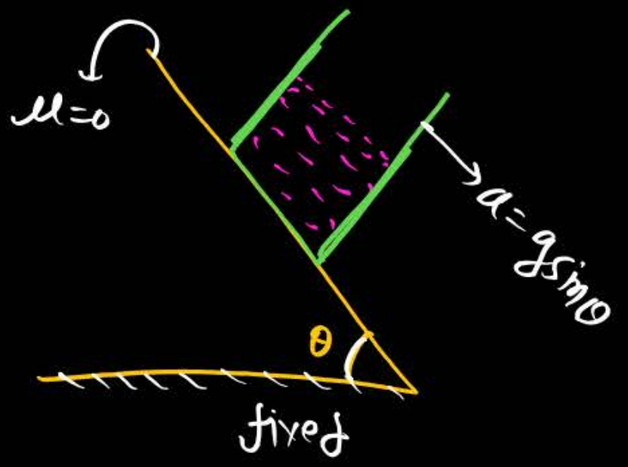
Questions on newtons 2nd Law
Gun Bullet / Rocket / Balloon Prop.

#

→ earth is a non-Inertial from.

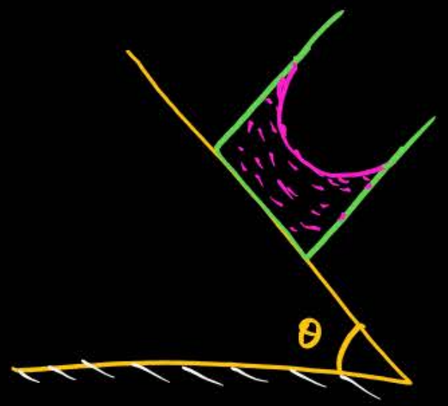
but we assume earth as a nearly Inertial from
becaus a_{earth} is negligable.

Beaker is half filled with water, it allow to slip down on smooth Inclined plane with angle Of Inclination θ.

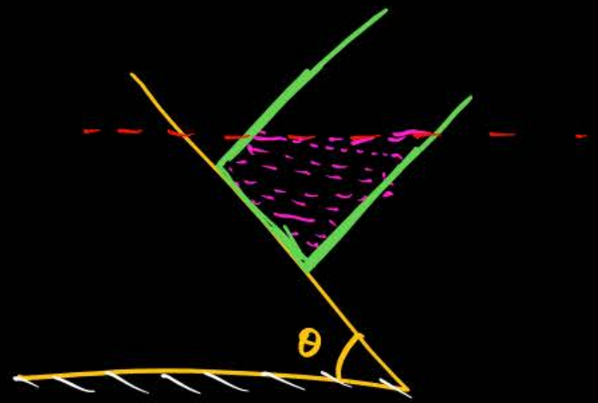


(A)

8% correct

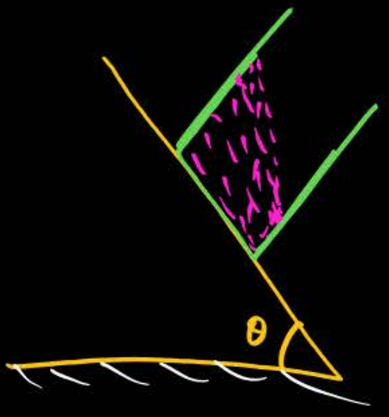


(B)

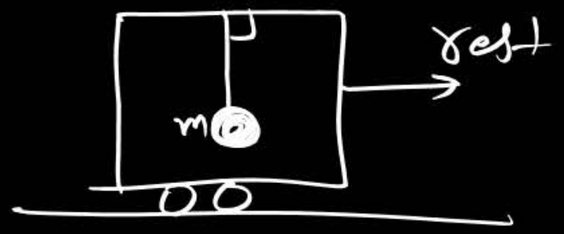


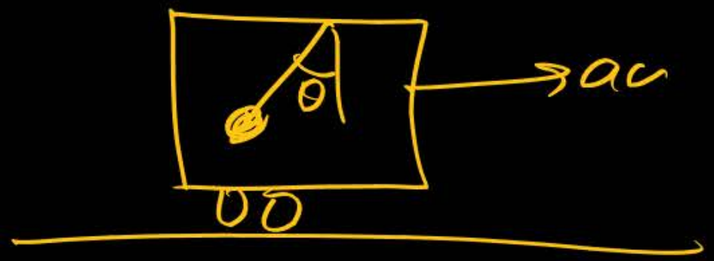
(C)

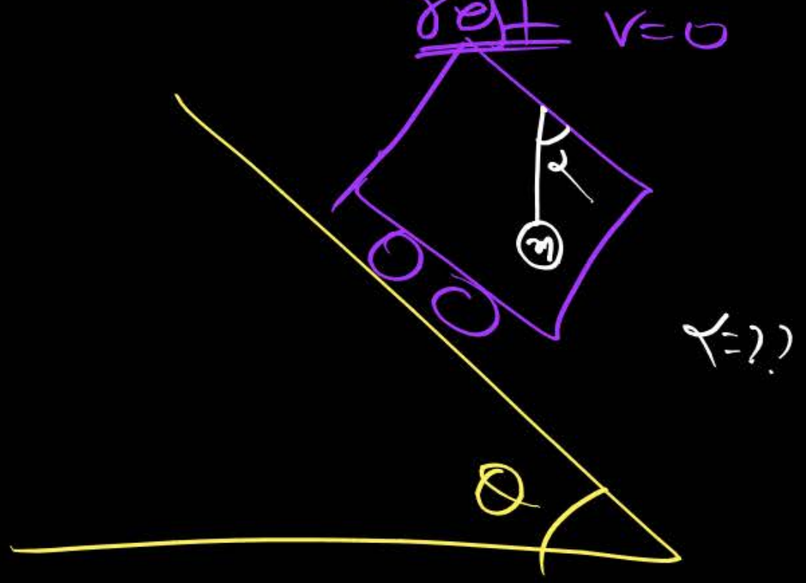
50%

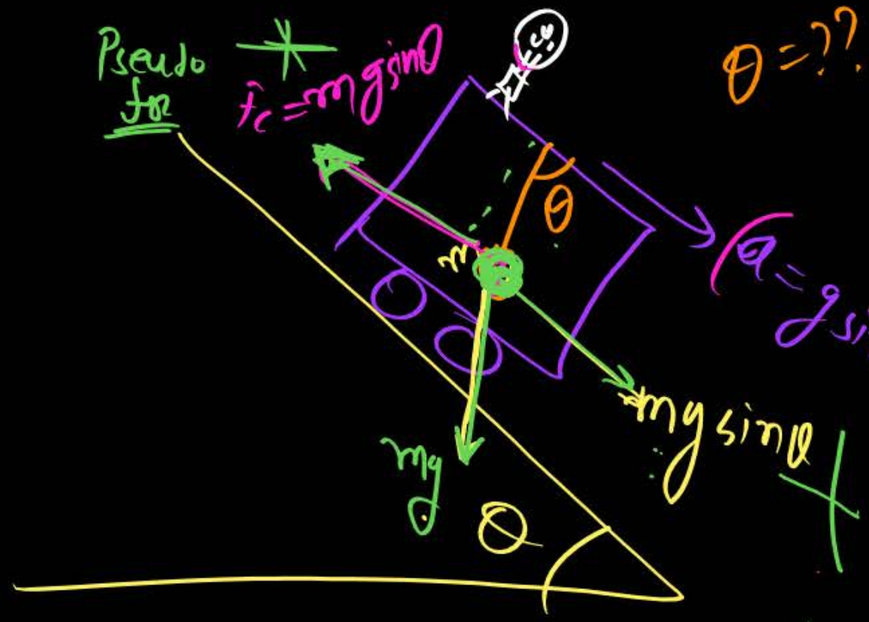


(D)









θ = ?? Think about it

$\theta = 90^\circ$

Question

H/w on equilibrium

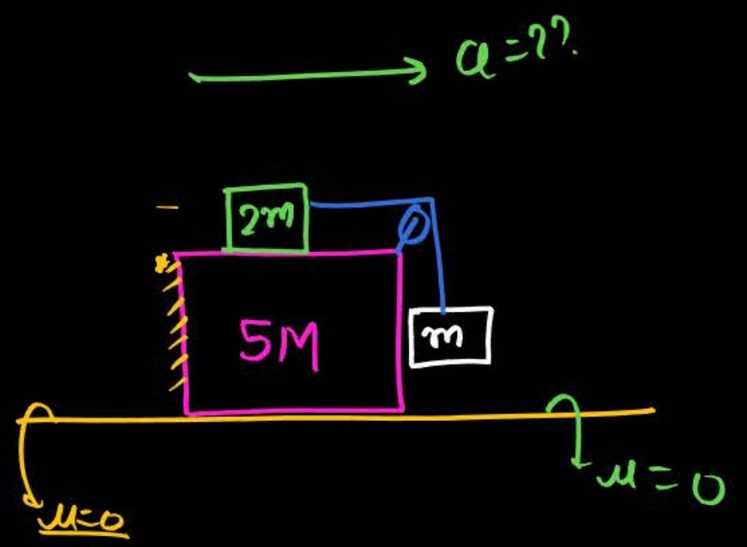
A weight Mg is suspended from the middle of a rope whose ends are at the same level. The rope is no longer horizontal. The minimum tension required to completely straighten the rope is

1. $Mg/2$
2. $Mg \cos 8$
3. $2\,Mg \cos 8$
4. Infinitely large

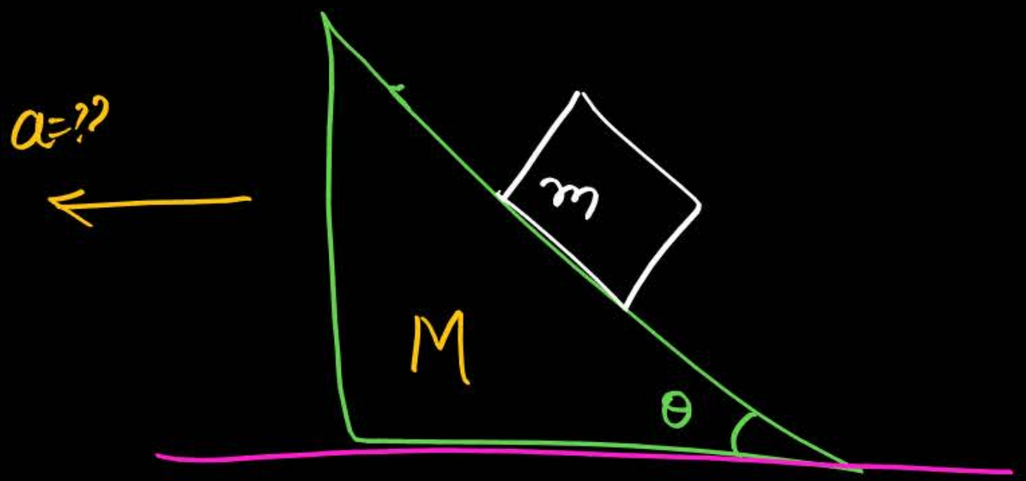
find accn of system so that Block A & B does Not Slid on wedge.

H/w

9 will discuss

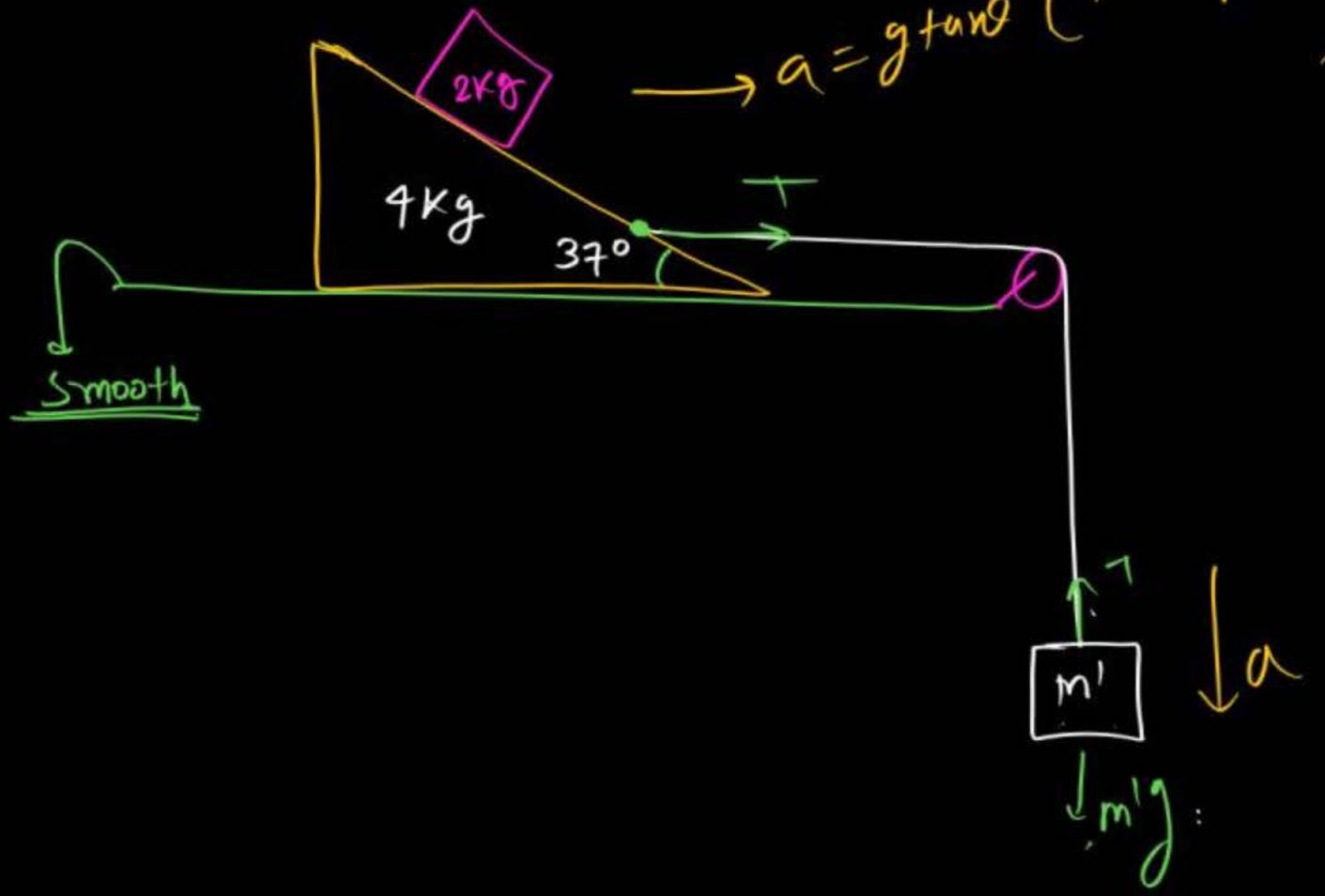


find acc^n of Inclied plane so that Block will free fall. & force applied on Inclied for this acceleration.



find value of m' so that Block of mass (2kg) does not slide on smooth Inclined Plane.

H.C. verma



$\longrightarrow a = g\tan\theta$ (Iss slide ki condn)

$$a = \frac{m'g}{(4+2+m')} = g\tan\theta$$

$$\frac{m'}{6+m'} = \tan 37^\circ = \frac{3}{4}$$

$$4m' = 18 + 3m'$$

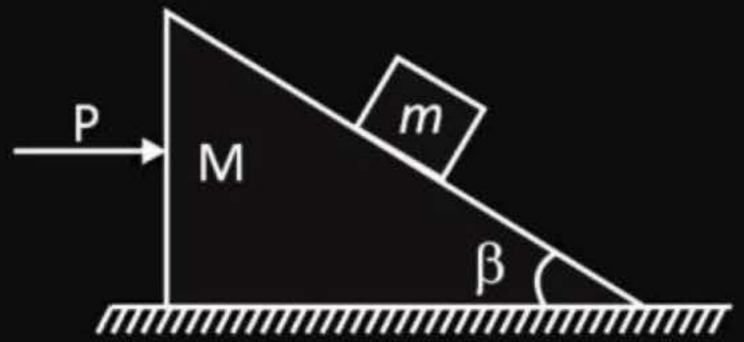
$$4m' - 3m' = 18$$

$$\boxed{m' = 18\,kg}$$

Question

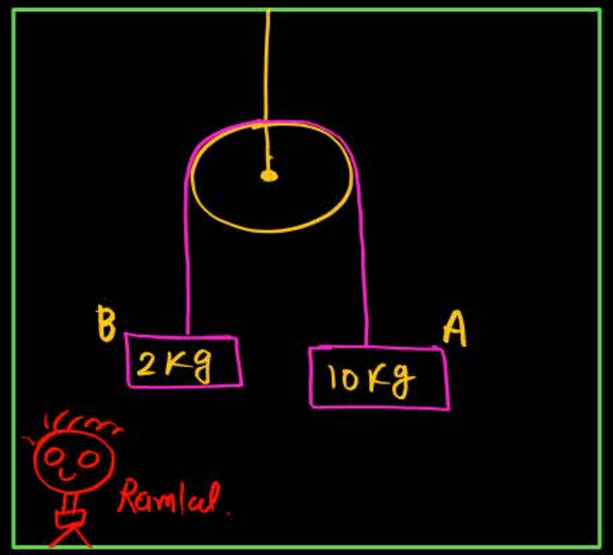
H/W

A block of mass m, is kept on a wedge of mass M, as shown in figure such that mass m remains stationary w.r.t. wedge. The magnitude of force P is



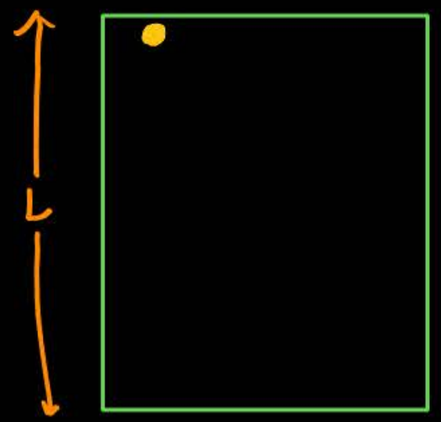
1. $g \tan \beta$
2. $mg \tan \beta$
3. $(m + M)g \tan \beta$
4. $mg \cot \beta$

find acc^{n} of Block A & B w.r.t Ramlal (lift) and w.r.t Ground.



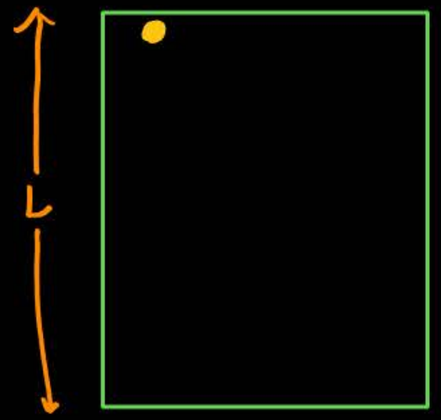
$a_{lift} = 4 m/s^2$

Ball is droped from top of lift as shown in fig. then find time when it will collide the base of lift.



$a_{lift} = 4 m/s^2$
$v_{lift} = 20 m/s$ at time of drop.

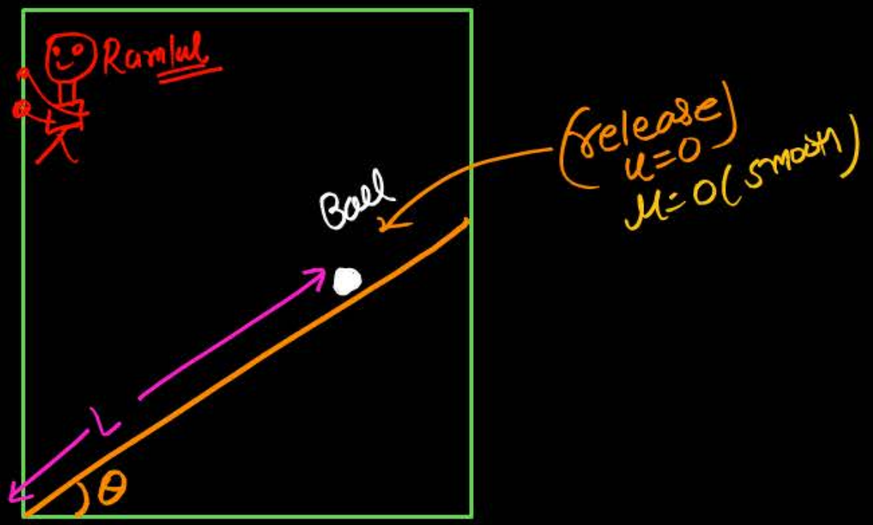
Ball is droped from top of lift as shown in fig. then find time when it will collide the base of lift.



$\downarrow a_{lift} = 5 m/s^2$

$\uparrow u_{lift} = 10 m/s$ at time of drop.

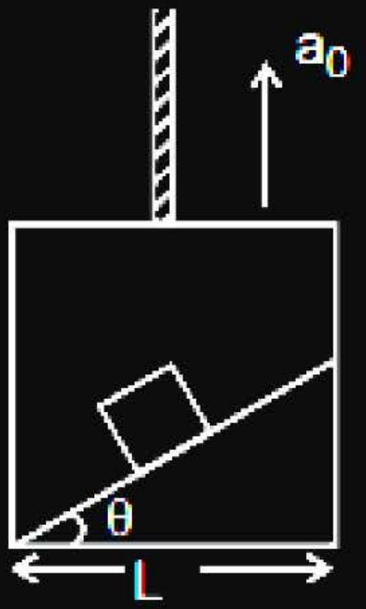
Time taken to reach the Base of lift :- (HCV)



(HCV)

Question

A particle slides down a smooth inclined plane of elevation θ, fixed in an elevator going up with an acceleration a_0 (see in figure). The base of the incline has a length L. Find the time taken by the particle to reach the bottom.



Newtons 2nd Law

Average

In time 't'

$$F_{Avg} = \frac{\Delta \vec{P}}{\Delta t}$$

$$\vec{F}_{Avg} = \frac{\vec{P}_f - \vec{P}_i}{\Delta t}$$

$$\vec{F}_{Avg} = \frac{\int \vec{F} \cdot dt}{\int dt}$$

at time 't'
Instantaneous.

$$\vec{F}_{net} = \frac{d\vec{P}}{dt}$$

$$\vec{F} \cdot dt = d\vec{P}$$

→ Slope of P/t graph is force.

$P = mv$ — (1)

Putting value of 'P'

$$\vec{F}_{inst} = \frac{d(mv)}{dt} = v\frac{dm}{dt} + m\frac{dv}{dt}$$

$$\vec{F} = \vec{v}\frac{dm}{dt} + m\frac{d\vec{v}}{dt}$$

Case-1
m = constn.

$$\vec{F} = m\frac{d\vec{v}}{dt} = m\vec{a}$$

Case-2
V = constn.

$$F = v\left(\frac{dm}{dt}\right)$$ *

→ In Balloon (Rocket)
→ Water flowing in pipe

Area of P/t = $\int F\,dt$

$\Delta P = \int F\,dt$ = change in momentum
= Area of F/t graph

P → F

$F = \frac{dP}{dt}$

Slope = $\frac{\Delta P}{\Delta t}$

* Slope of P/t graph is force

Question

A cricketer catches a ball of mass 150 g in 0.1 s moving with speed 20 m/s, then the experiences force of

(Avg.)

1. 300 N
2. 30 N
3. 3 N
4. 0.3 N

$$f_{Avg} = \frac{P_f - P_i}{\Delta t}$$

$$= \frac{0 - \frac{150}{1000} \times 20}{0.1}$$

$$= \frac{-\frac{30}{10}}{0.1} = \frac{-3}{1/10} = -30 \text{ Newton}$$

dir?

[~~Instantaneous~~ → (a) 60%
Avg → (b) 38%]

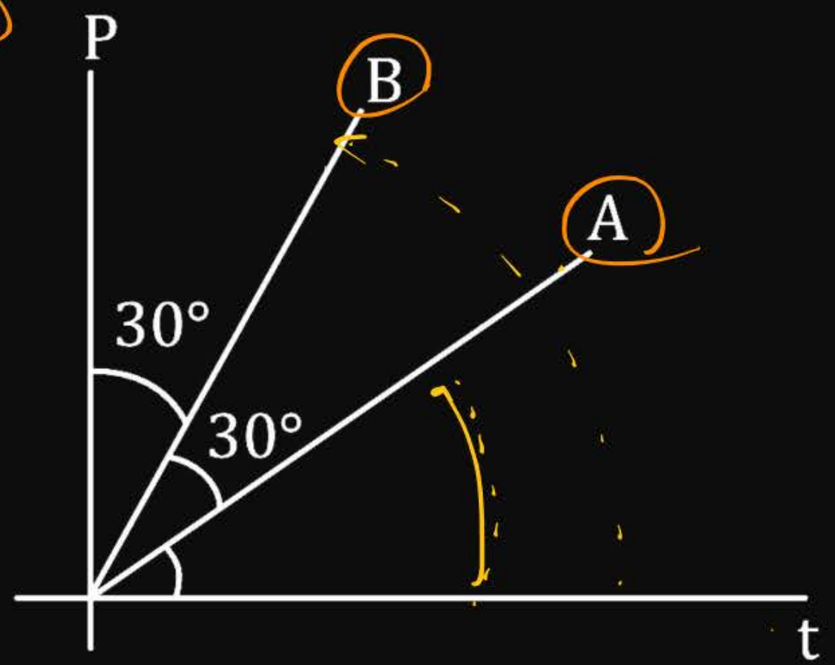
IMR Scam

Question

For two object P-t graph is given then find ratio of force acting on them.

$\frac{F_A}{F_B} = ??$

(Momentum)



$$\frac{F_A}{F_B} = \frac{\tan 30^\circ}{\tan 60^\circ}$$

$$= \frac{1}{\sqrt{3} \times \sqrt{3}} = \frac{1}{3} \text{ Ans}$$

Question

A force of 6 N acts on a body at rest and of mass 1 kg. During this time, the body attains a velocity of 30 m/s. The time for which the force acts on the body is

1. 7 second
2. 5 second
3. 10 second
4. 8 second

$F = \frac{p_f - p_i}{\Delta t}$

$F = \frac{mv_f - mv_i}{\Delta t}$ ($v_i = 0$)

$u = 0$, $F = 6\,N$, $1\,kg$, t, $v = 30\,m/s$

(1) $a = \frac{F}{m} = \frac{6}{1}$

$a = 6\,m/s^2$

$V = u + at$

$30 = 0 + 6t$

$5 = t$

2nd method

$F_{Avg} = \frac{M(v_f - v_i)}{\Delta t}$

$6 = \frac{1(30-0)}{t}$

$t = \frac{30}{6} = 5\,sec$

Impulse = change in momentum.

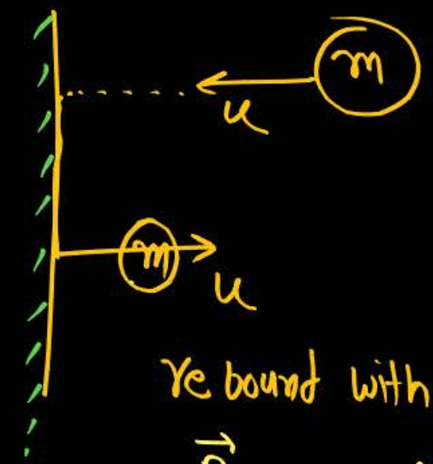
$\vec{J} = \Delta\vec{P} = \vec{P}_f - \vec{P}_i$

$\vec{J}$ = Area of F/t graph.

↳ vector (dirⁿ along change in momentum)

→ Impulsive force → large amount of force in very short interval of time.

MP*
Impulse ke liye
① $J = F \cdot \Delta t$ ② $J = \Delta P$
③ Area of F/t graph.



$J\left(\text{Impulse of Ball}\right) = 2mu\hat{i}$

Rebound with same speed

$\vec{P}_f = mu\hat{i} \quad \vec{P}_i = -mu\hat{i}$

$F = \frac{dP}{dt}$

$\int_{P_i}^{P_f} dP = \int_{t_1}^{t_2} F\,dt$

$\Delta P = \int_{t_1}^{t_2} F\,dt$

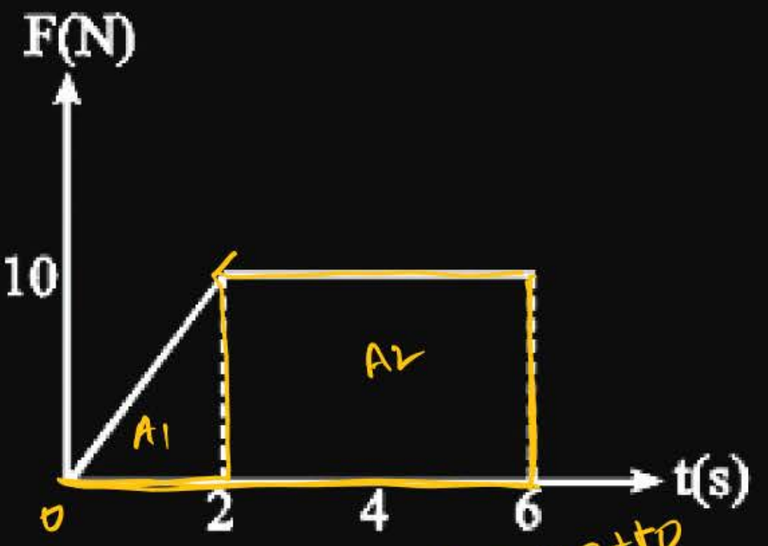
Const. force

$J = \int_{t_1}^{t_2} F \cdot dt = \vec{F} \cdot \Delta t$

Question

A body of mass 3 kg is acted on by a force which varies as shown in the graph below. The momentum acquired is given by:

1. Zero
2. 5 N-S
3. 30 N-S
4. 50 N-S

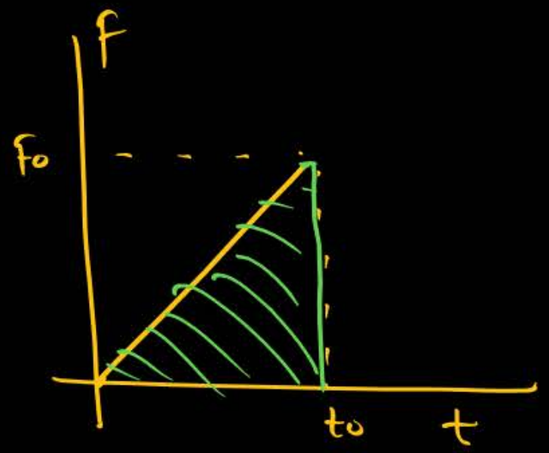


m = 3kg

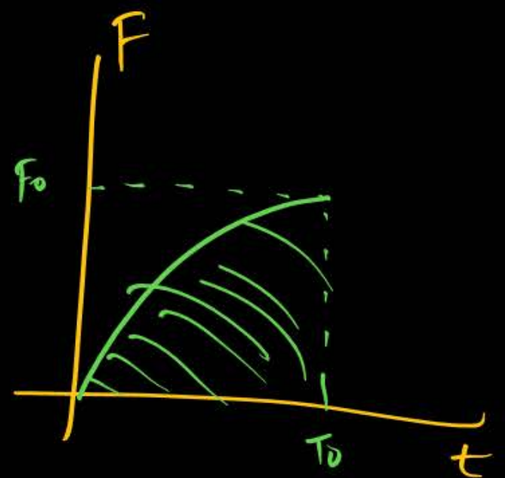
$(A) = \frac{2\times 10}{2} + 4\times 10 = 40+10 = 50$

$A = \frac{1}{2}\times 10(10) = 50$

Q) On which graph Impulse imparted to block is max^m.



(A)



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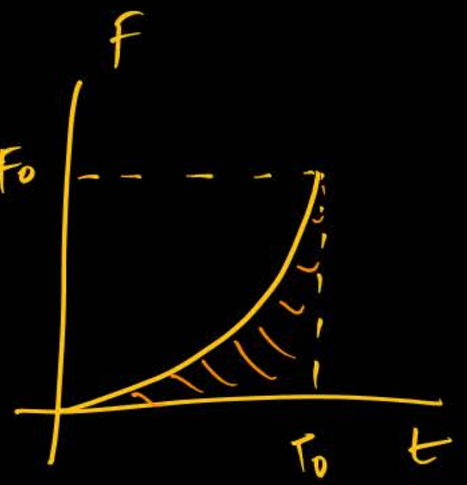

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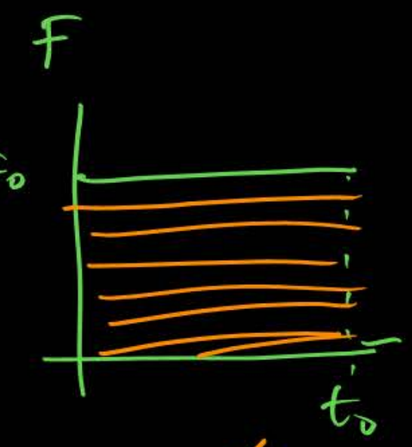


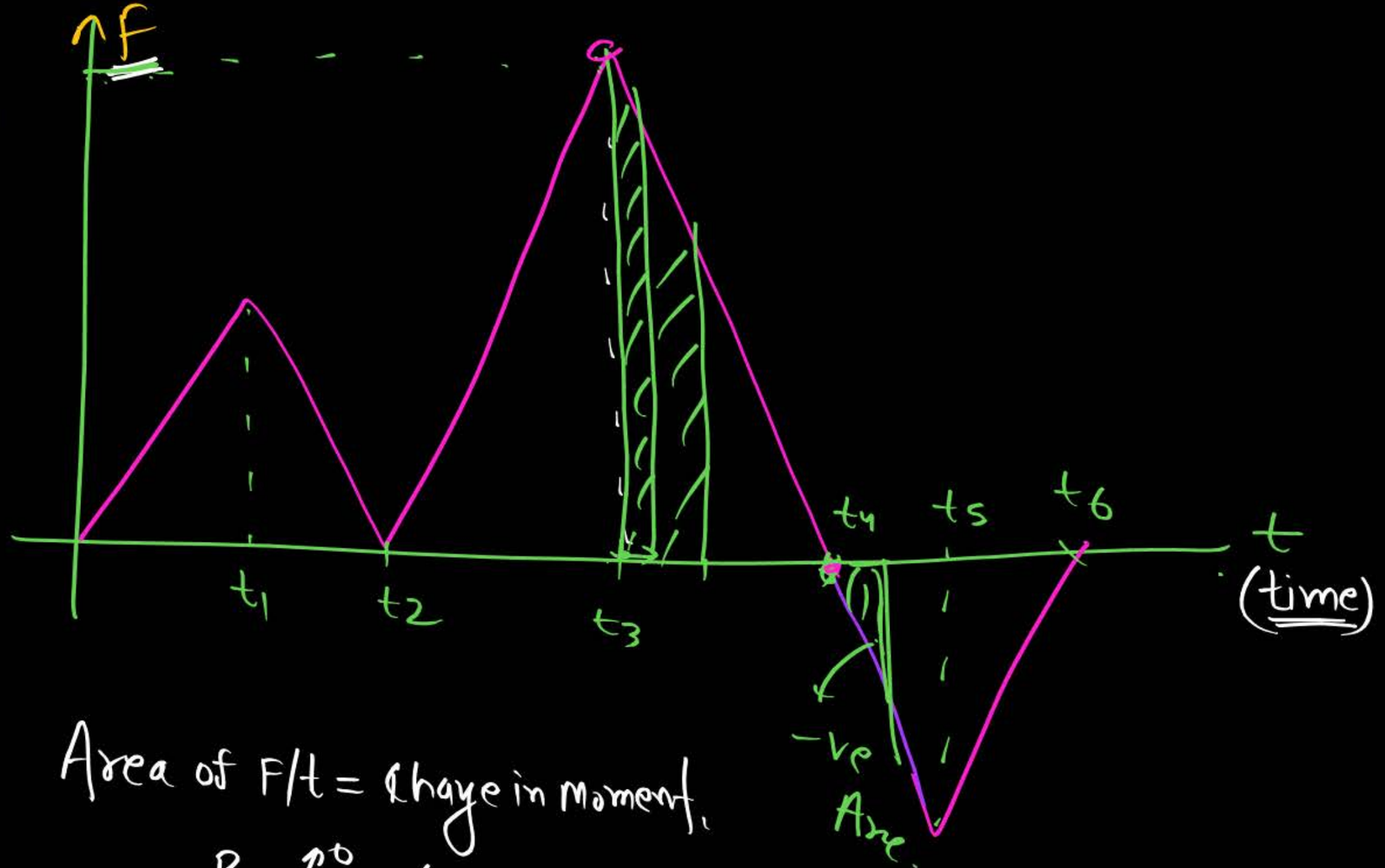
(D)

J = Impulse = change in Momentum = Area of F/t graph.

⑩ at which time Momentum is maximum :—
if $P_i = 0$

$F = P/t$

$\bar{F} = \frac{\Delta P}{\Delta t}$



(a) t_3 ✗

(b) t_4

(c) t_5

(d) t_6

Area of F/t = change in momentum.

$P_f - P_i = (\text{Area})$

$(P_f)_{max} = (\text{Area})_{max}$

force is max^m at t_3

#

(2) if intial velocity is 10m/s then find velocity at at $t_1 = 6sec$, $t_2 = 4sec$, $t_3 = 10sec$.

if $m = 2kg$.

Soln Area of $F/t = \Delta P$.

$m[\Delta v] = (Area)_{t=6sec}$

$= \frac{1}{2} \times (6+2) \times 10^{5}$

$2[v_f - v_i] = 40^{20}$

$v_f - 10 = 20$

at $t=6sec$ $\boxed{v_f = 30 m/s}$

for $t = 4sec$

$m(\Delta v) = (Area)_4$

$m(\Delta v) = \frac{1}{2}(4+2) \times 10^{5}$

$2[v_f - 10] = 30^{15}$

$\boxed{v_f = 25 m/s}$

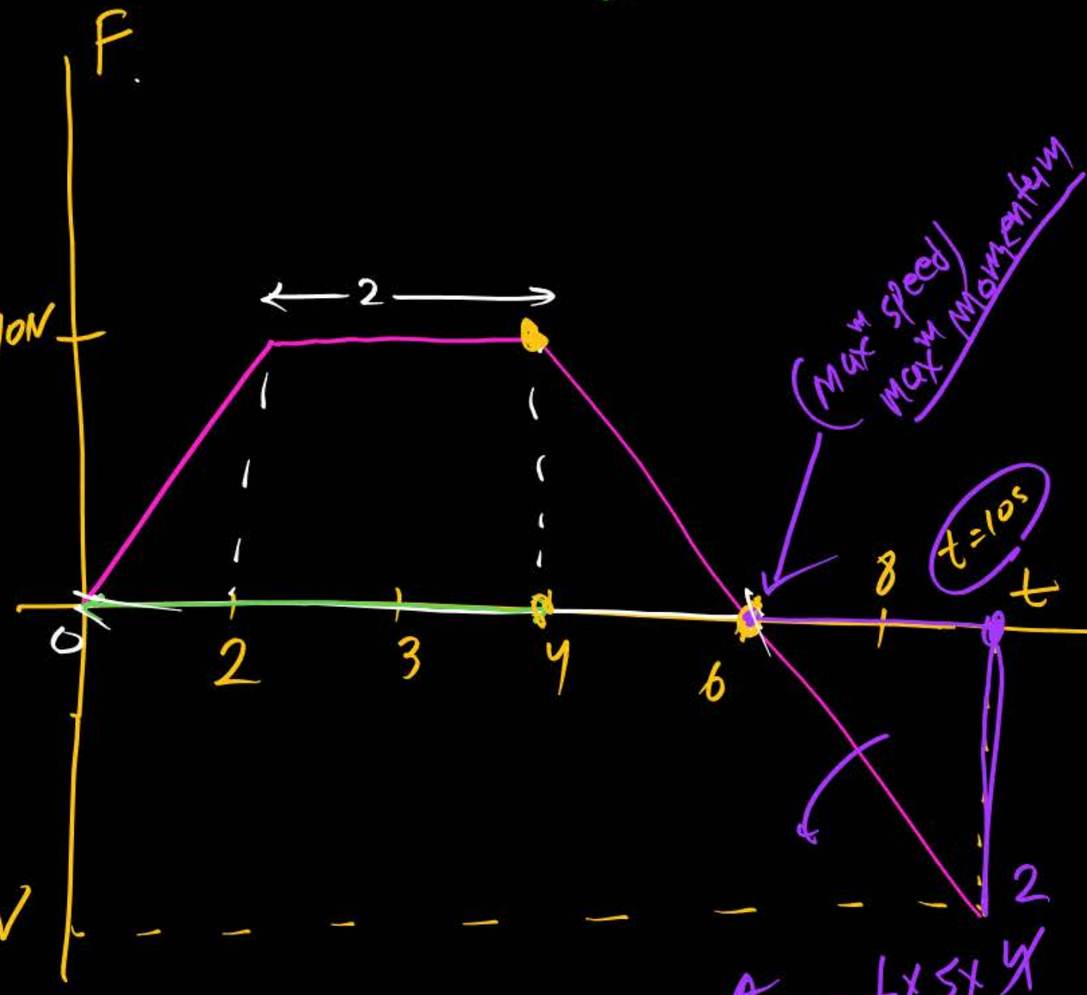
for $t = 10sec$

$m\Delta v = (Area)_{total}$

$2(v_f - v_i) = 40 - 10$

$2(v_f - 10) = 30^{15}$

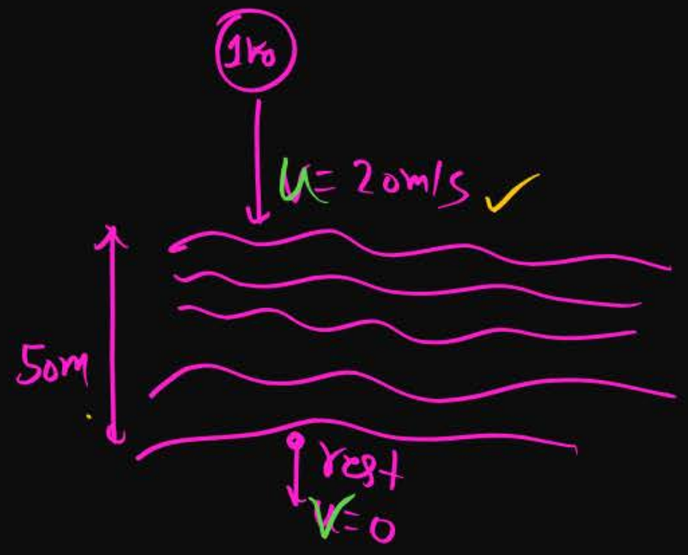
$\boxed{v_f = 25 m/s}$.



Question

A stone of mass 1 kg is thrown with a velocity of 20 m/s across the frozen surface of a lake and it comes to rest after travelling a distance of 50 m. What is the magnitude of the force opposing the motion of the stone?

$s = \frac{u^2}{2a}$ → find



$v^2 - u^2 = 2as$

$0 - (20)^2 = 2 \times a \times 50$

$a = -\frac{400}{100}$

$a = 4\ m/s^2$

$F = ma = 1(4)$ Newton

Question

The momentum p (in kg/m) of a particle is varying with time t (in s) as $p = 2 + 3t^2$. The force acting on the particle at $t = 3$ s will be

1. 18 N
2. 54 N
3. 9 N
4. 15 N

$p = 2 + 3t^2$

const.

$F = \frac{dp}{dt} = 0 + 3(2t) = 6t$

$F = 6 \times 3$

$= 18$ Newton

Q Momentum of object $P = t^2 + 2t - 5$ then find force acting on object in 2-sec.

$$F = \frac{dP}{dt}$$

MR Scam

$$F = 2t + 2$$

$$F = 2 \times 2 + 2$$

$$F = 4 + 2 = 6 \text{ Ns}$$

$$\vec{F}_{Av} = \frac{\vec{P}_f - \vec{P}_i}{\Delta t} = \frac{(\vec{P})_{t=2} - (P_i)_{t:0}}{2 - 0}$$

$$= \frac{3 - (-5)}{2}$$

$$= \frac{3+5}{2}$$

$$= \frac{8}{2} = 4 \text{ N}$$

Question

A force $\vec{F} = (2t\hat{i} + 3t^2\hat{j})N$ acts on an object moving in xy plane. Find magnitude of change in momentum of the object in time interval $t = 0$ to $t = 2$s.

$$\Delta p = p_f - p_i = \int F \cdot dt$$

$$\Delta p = \int_0^2 2t\,\hat{i}\,dt + \int_0^2 3t^2\,\hat{j}\,dt$$

$$= \left(\frac{2t^2}{2}\hat{i} + \frac{3t^3}{3}\hat{j}\right)_0^2$$

$$= 4 + 8 = 12$$

MR Scam

$$= (4-0)\hat{i} + (8-0)\hat{j}$$

$$\vec{\Delta p} = 4\hat{i} + 8\hat{j}$$

$$= \sqrt{16 + 64} = \sqrt{80}\ \text{N-sec}$$

(a) object gain velocity 20m/s after a application of 20N force on 5kg object then find Impulse imparted in this object.

Soln

$u = 20 m/s$

$F = 20 N$

$m = 5 kg$

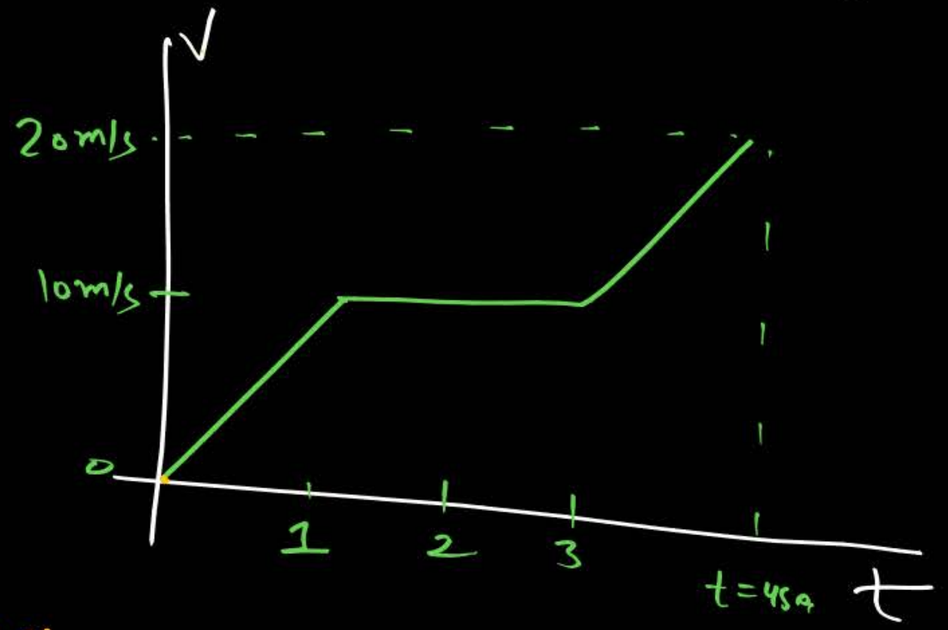
$J = \Delta P = F \cdot x dt$

$= m(v_f - v_i)$ ($v_i = 0$)

$J = 5 \times 20$

$J = 100\ N\text{-}s$

(10) Mass of object is 20kg then find Impulse Imparted in it in 4-sec. accordig to given graph.



Soln

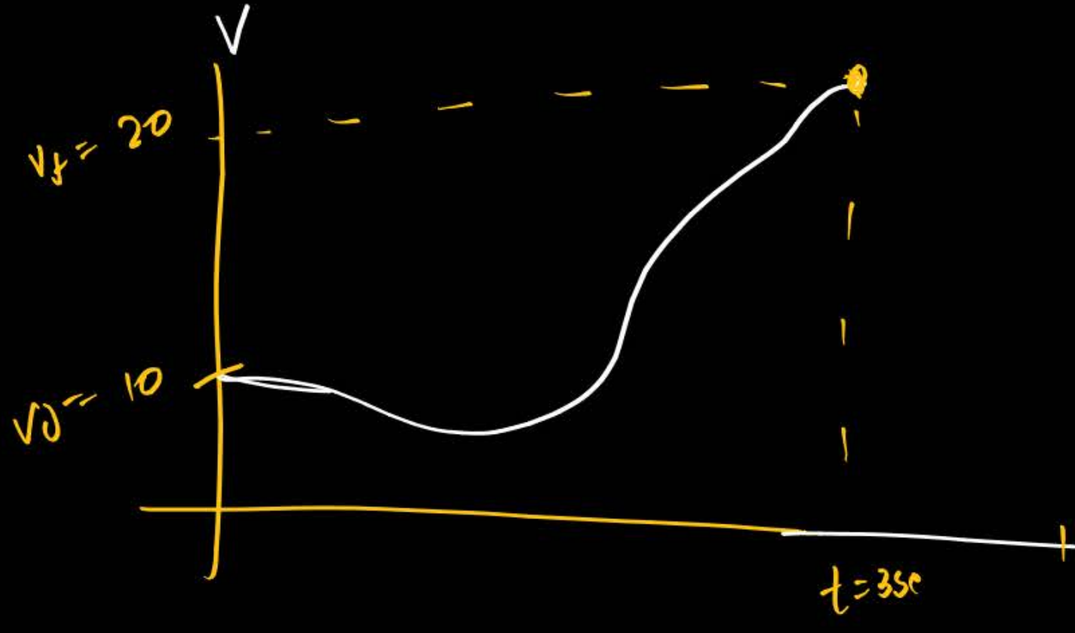
$J = \Delta P =$

$= m(\vec{V}_f - \vec{V}_i)$

$= 20[20-0]$

$= 400\ N\text{-sec.}$

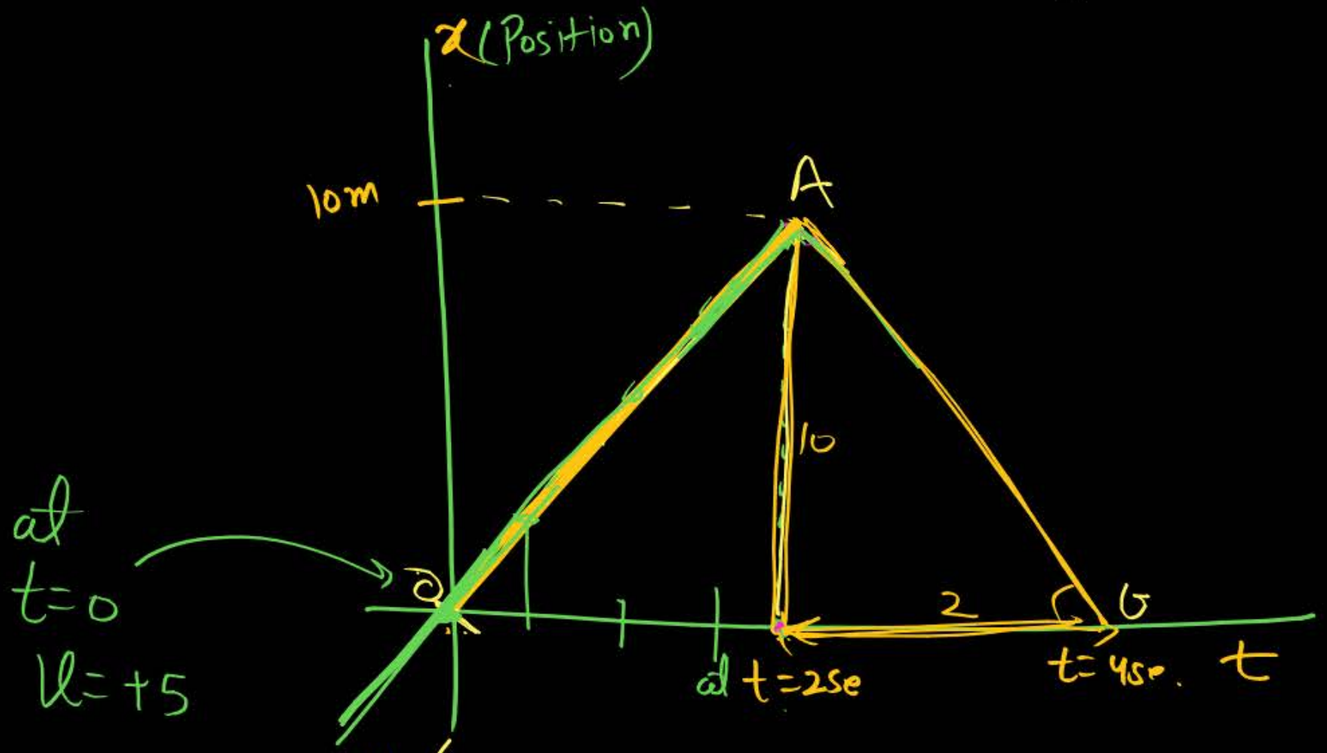
m = 5kg



$J_{in\ (3sec)} = 5(20-10)$

$= 5 \times 10 = 50$

(9) Mass of object is 20 kg then find Impulse Imparted in it at $t = 2\,sec$ {** according to given graph.



$\#\,(Slope)_{OA} = u = \frac{10}{2} = 5\,m/s$

$\#\,(Slop)_{AB} = -\frac{10}{2} = -5\,m/s$

$J = \vec{P}_f - \vec{P}_i$

$= m(v_f - v_i)$

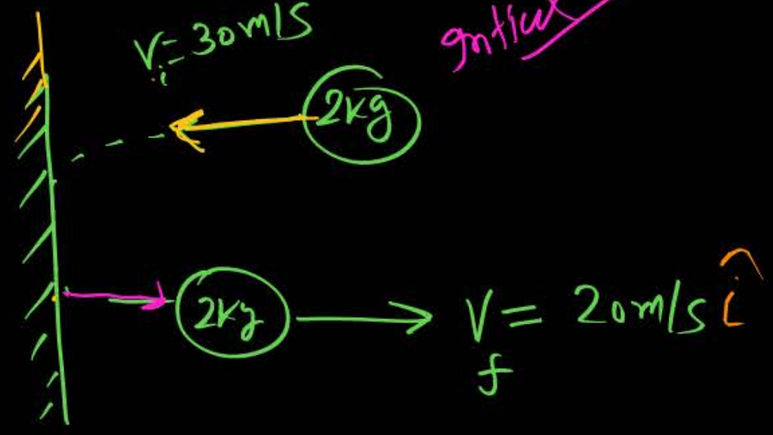
$= 20[-5-5]$

$= 20 \times (-10)$

$J = -200\,N\text{-}sec$

in $t=2$ to $t=2.0001$ se

(21)



initial

time of Contact $\Delta t = 0.4$ sec

Find $(force)_{Ay} = ??$

Soln

$$\vec{F}_{Ay} = \frac{P_f - P_i}{\Delta t}$$

$$= \frac{mv_f - mv_i}{\Delta t}$$

$$= m\left[\frac{\vec{v}_f - \vec{v}_i}{\Delta t}\right]$$

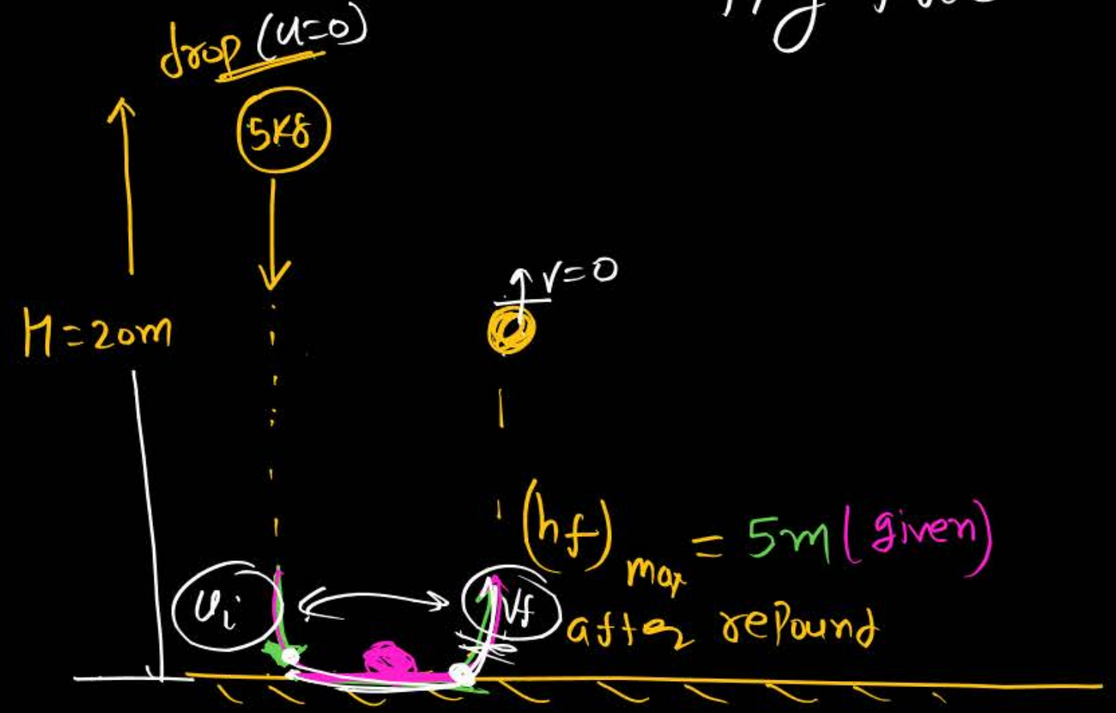
MR Scam

$$= 2\left[\frac{20 - 30}{0.4}\right] = \frac{2 \times -10}{\frac{4}{10}} = \frac{-20}{\frac{2}{5}} = -50$$

$$F_{Ay} = \frac{2\left[20\hat{i} - (-30)\hat{i}\right]}{0.4}$$

$$= \frac{2 \times 50}{\frac{4}{10}} = \frac{500}{2} = 250 \text{ Newton}$$

Avg force on ball due to ground is 200 N
then find time of contact.



$u_i = -\sqrt{2gH}$

$u_i = -\sqrt{2\times10\times20}$

$u_i = -20\,m/s\,\hat{j}$

$V_f = ?? =$

$H = \frac{u^2}{2g}$

$5m = \frac{u^2}{2\times10}$

$u_f = \sqrt{100}$

$u_f = +10\,m/s\,\hat{j}$

$$f_{Ay} = \frac{m[v_f - v_i]}{\Delta t}$$

$$200 = \frac{5[10-(-20)]}{\Delta t}$$

$$\Delta t = \frac{30\times5}{200} = \frac{3}{4}\,sec$$

Question

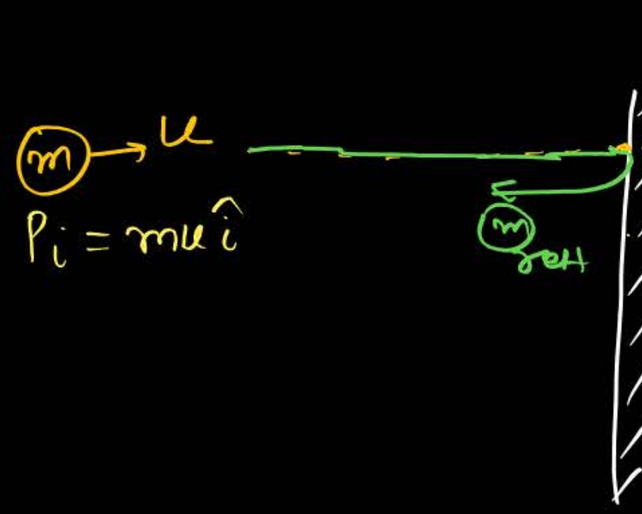
HW

Not in Syllabus

A ball of mass 50 g is dropped from a height of 20 m. A boy on the ground hits the ball vertically upwards with a bat with an average force of 200 N, so that it attains a vertical height of 45 m. The time for which the ball remains in contact with the bat is [Take $g = 10\ m/s^2$]

1. $1/20^{th}$ of a second
2. $1/40^{th}$ of a second
3. $1/80^{th}$ of a second
4. $1/120^{th}$ of a second

Q After collision with wall, ball stop then find force on ball due to wall.



t = time of contact.

$P_f = 0$ rest

$\vec{\Delta P} = P_f - P_i = -mu$

$\vec{F} = \frac{\Delta P}{\Delta t} = \frac{-mu}{t}\hat{i}$

$F = \frac{mu}{t}$ → दिवार पर दी जाने वाली बल का मान

force on wall due to ball.

t = for one ball

Q If n Ball is Projecty on wall per-sec then find total force on wall :—

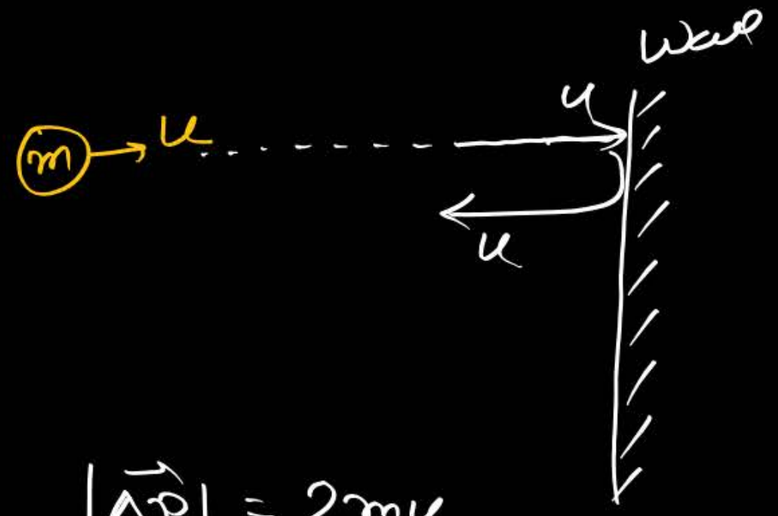
$F_{on\ wall} = n\frac{mu}{t}$

$f_{on\ wall} = nmu$

total n-Ball per sec collide ~~with~~

t = 1 sec में n Ball this किया है।

After collision with wall ball rebound with same speed. then find force on ball due to wall.



$$|\vec{\Delta P}| = 2mu$$

$$\vec{F_{Avg}} = \frac{\Delta P}{\Delta t} = \frac{2mu}{t}$$

n Ball Per Sec

$$F = 2nmu$$

Question

A disc of mass 1.0 kg kept floating horizontally in air by firing bullets of mass 0.05 kg each vertically at it, at the rate of 10 per second. If the bullets rebound with the same speed, the speed with which these are fired will be

1. 0.098 m/s
2. 0.98 m/s
3. 9.8 m/s
4. 98.0 m/s

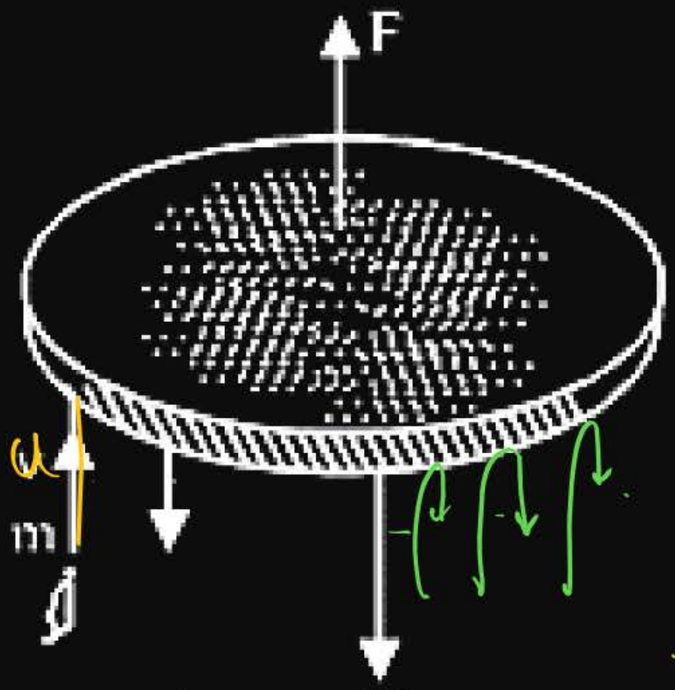
$F_{\text{on bullet}} = n\,2mu$

$F_{\text{on disc}} = 2nmu$

$(Mg)_{\text{disc}}$

$2nmu = mg$

$u = \frac{mg}{2mn} \Rightarrow \frac{1\times10}{2\times\frac{5}{100}} = 10$



ROCKET

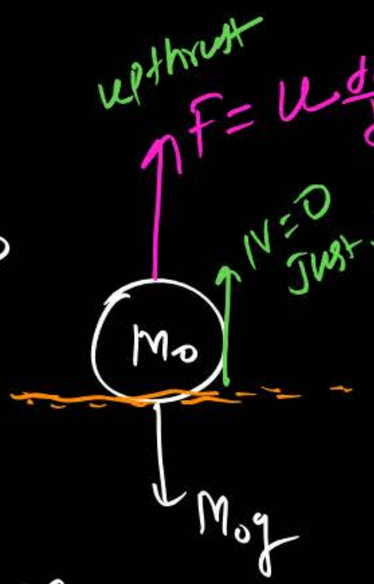
* M_0 = Initial mass of Rocket

$\frac{dM}{dt}$ = The rate at which gas is burning = α (ref)

* u = velocity of gas ejecting with respect to rocket

Mass of Rocket at time 't'

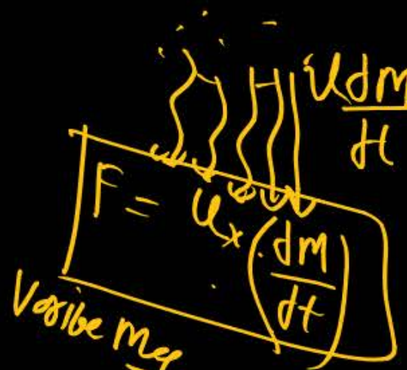
→ F.B.D



IV = 0
Just lift

$F_{on\ gas} = u\frac{dm}{dt}$

u = Velocity of ejecting gas w.r.t Rocket = muzzle velocity.



Condition to Just lift the Rocket

$$u\frac{dm}{dt} = M_0 g$$

acin at t = 0

$F_{net} = ma$

$$M_0 a_0 = u\frac{dm}{dt} - M_0 g$$

$$a_0 = \frac{u\frac{dm}{dt} - M_0 g}{M_0}$$

$$a_0 = \frac{u\frac{dm}{dt}}{M_0} - g$$

gravity free space

variable mass syst.

$$F = u\frac{dm}{dt}$$

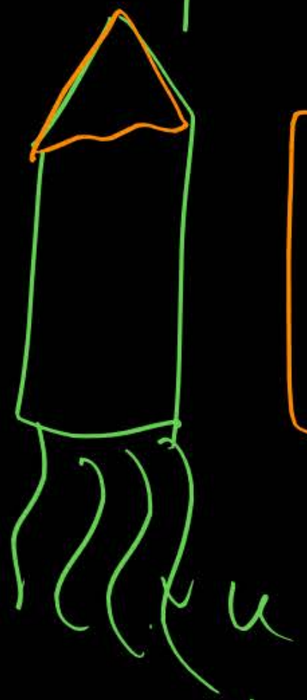
at $t=0$,

$$a_0 = \frac{u\frac{dm}{dt}}{m_0}$$

gf g consid gravity

$$a_0 = \frac{u\frac{dm}{dt}}{m_0} - g$$

gravity free space :→ a ftr acc^n aftr time t



$F = u\frac{dm}{dt}$

M_0 = intial mass

M_t (Remaing Mass) $= M_0 - t\frac{dm}{dt}$

$\frac{dm}{dt}$ = Mass burn by 1 sec.

Mass burn in time $t = t\frac{dm}{dt}$

$$a_t = \frac{\left(u\frac{dm}{dt}\right)}{M_t} = \frac{u\frac{dm}{dt}}{M_0 - t\left(\frac{dm}{dt}\right)}$$

gf g consider gravity

$$a_t = \frac{\left(u\frac{dm}{dt}\right)}{M_0 - \frac{dm}{dt}t} - g$$

Question

(1)

If the force on a rocket, that releases the exhaust gases with a velocity of 300 m/s is 210 N, then the rate of combustion of the fuel is :

1. 0.07 kg/s
2. 1.4 kg/s
3. 0.7 kg/s
4. 10.7 kg/s

Question

(2)

A 800 kg rocket is fired from earth so that exhaust speed is 1200 m/s. Then calculate mass of fuel burning per second, to provide initial thrust to overcome its weight.
(g = 10 m/s^2)

Question

(3)

A cracker rocket is ejecting gases at a rate of 0.05 kg/s with a velocity 400 m/s. The accelerating force on the rocket is:

1. 20 dyns
2. 20 N
3. 200 N
4. Zero

Question

(4)

A rocket of mass 5700 kg ejected mass at a constant rate of 15 kg/s with constant speed of 12 km/s. The acceleration of the rocket 1 minute after the blast is
(g = 10 m/s^2)

1. 34.9 m/s^2
2. 27.5 m/s^2
3. 3.50 m/s^2
4. 13.5 m/s^2

Question 5

If the force on a rocket, that releases the exhaust gases with a velocity of 300 m/s is 210 N, then the rate of combustion of the fuel is :

1. 0.07 kg/s
2. 1.4 kg/s
3. 0.7 kg/s
4. 10.7 kg/s

(6) A Ballon has 2 gram air, A small hole is made, air comes out with velocity 4 m/s & completly shrinks in 2.5 sec Then Avg. force on Ballon.

(7) A cart is moving with constant velocity 20m/s and Sand being droped in the cart at rate 50 Kg/min, then force required to move the cart with constant velocity

(8) A Satellite in force free space sweeps stationary interplanetary dust at rate $\frac{dm}{dt} = \alpha v$, v = velocity, m = mass then acceleration of Satellite.

HOME WORK

→ Rocket / Balloon / variable mein

ke question solve karna hai

Jo aage attach hai

THANK YOU

Rapid Test
(must do)