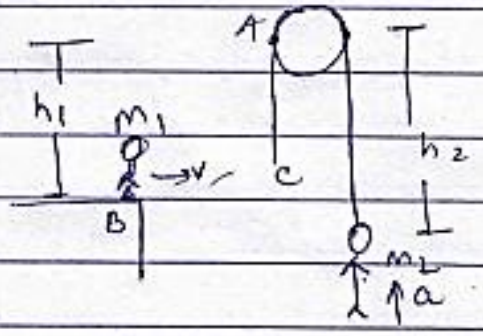
170727
170471
170424
150729
160468

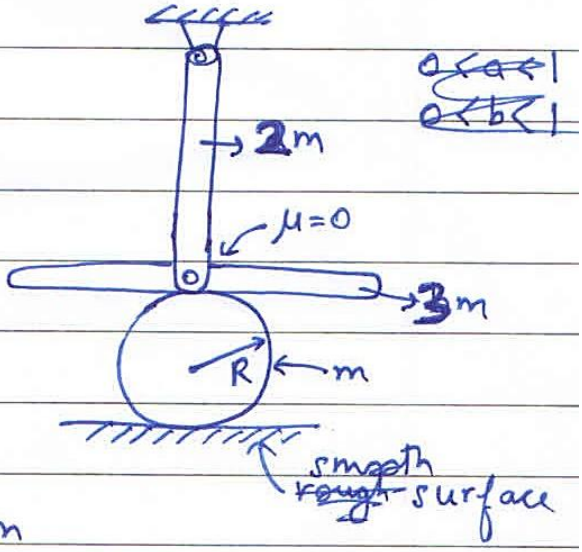
Q.



There are two monkeys and a rope-pulley system. One of the monkey jumps on and holds the rope with velocity v. At the same moment, the other monkey starts climbing up. Both the monkeys are climbing with same acceleration and one of them is having small oscillations about A. Radially ∈ Find tension. Consider the distance between B and C to be very less. Assume ideal pulley and rope.

{Find instantaneous tension in string after the monkey jumps}

Q) A rod is hinged to the ~~celing~~ ceiling, and is hinged further at the centre of another rod.
Both have equal lengths.



A disc of radius R and mass m is under the horizontal rod (not connected), and on a smooth surface.
There is pure rolling everywhere.

The disc is displaced slightly. Find the time period of oscillations.

PRABHAT KUMAR SINGH 170474
SUMIT KUMAR SUMAN 170731
PARIMAL MUKUL 170460
ANKIT KUMAR 170123
RAGHAV AGRAWAL 170519

Group

17 Vaibhav Pratap Singh - 160768
27 Pratiek Sharma - 160502
37 Mikhil ~~Sh~~ Panwar - 160451
47 Abhigyan Verma - 160013
57 Pragya Patel - 170477

Question

A rod of length l, mass m is tied at its end by two strings of length(L). as shown in fig 1. Now the ~~figure~~ system is given a small angular displacement θ about the z-axis as shown fig.2. Find the frequency of small oscillations. (ω).

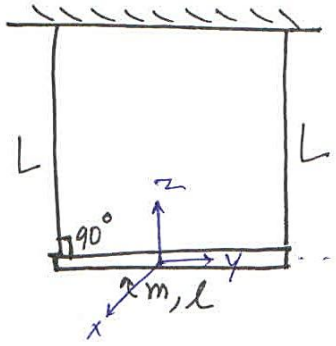


FIGURE 1

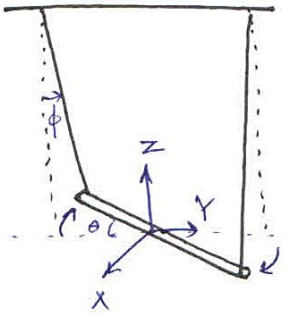


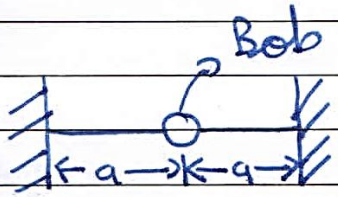
FIGURE 2

ESO 209-DYNAMICS

Page

QUIZ

1. 170252 DINESH
2. 170051 Adibya Sarkar
3. 170061 Aditya Tiwari
4. 170113 ANIMESH NAREDA
5. 170115 ANIRUDH

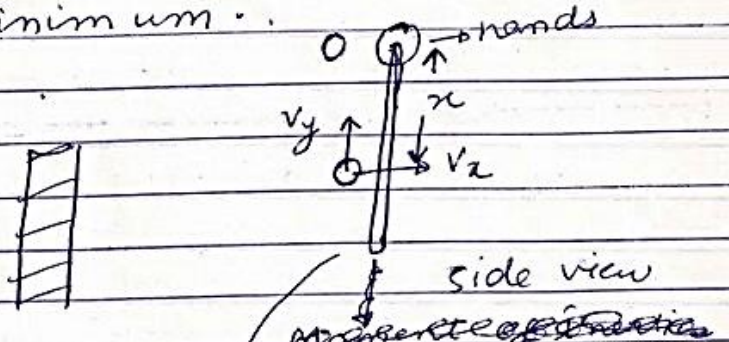


Q A small particle of mass M_{Bob} is attached to 2 highly tensioned wires as shown. Determine the natural frequency $\boxed{\omega_0}$ of the system for a small oscillation (vertical). The tension in both wire is give T and is constant.

Q. In a cricket match,
A bowler delivers a ball. ~~which follows~~
The batsman plays a straight drive.
Problem is to find the sweet spot of the bat so that the impulsive force on the hands of batsman is minimum.

Assumptions: The motion of bat before and after the shot is ~~co~~ assumed to be negligible. Surface of bat is assumed to be flat.
(Bat is a non uniform ~~ob~~ mass object of)

Given: i) V_x and V_y of the Ball before collision.
~~ii) Moment of Inertia of the bat is given.~~
ii) Coefficient of restitution e is given.
ii) ~~linear mass density $\mu(x)$ of bat is given.~~
To find: The distance from the hands of the point of contact of ball and the bat so that the reaction force (impulsive) at the hands is minimum.



(ii) Linear Mass density of bat = ~~μx~~

(iii) e (coefficient of Restitution is given).

Given:- i) V_x, V_y of ball.

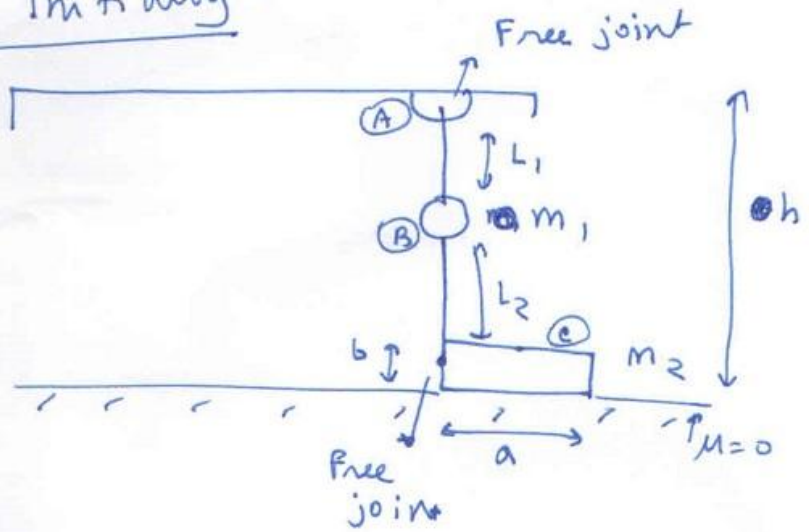
ii) Mass density (per unit length) = μx
(x is distance from hand)

(iii) e is given.

NITISH	KUMAR	170449
LICHA	TALO	160366
MAHIPAL	BERA	170369
SHEKHAR	SAINI	170661
SHUBHAM	RAJ	170688

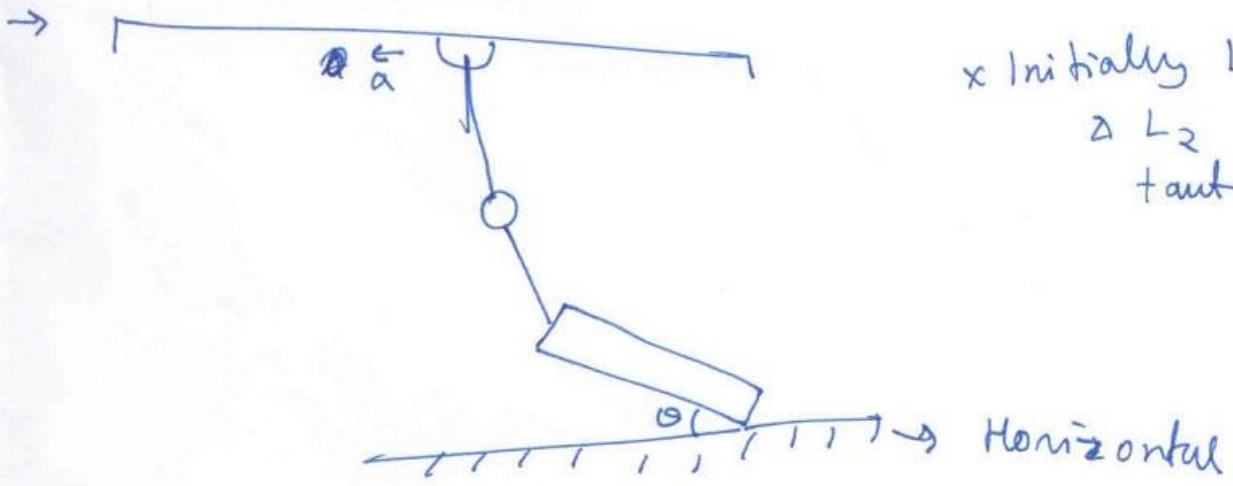
This is Nitish Kumar, ESO 209 student. Sir i would like to make slight change in the question submitted by our group.Instead of giving linear mass density of the bat, it's moment of inertia about the point from where it's held is given as Io. Also the position of centre of mass with respect to held point is given. The length of bat is L (given).

Initially:



170052 - Aditya
170013 - Abhay
170296 → Hemant
170097 - Amrendra
170389 - Arjav

(A) is accelerated to left with acceleration a

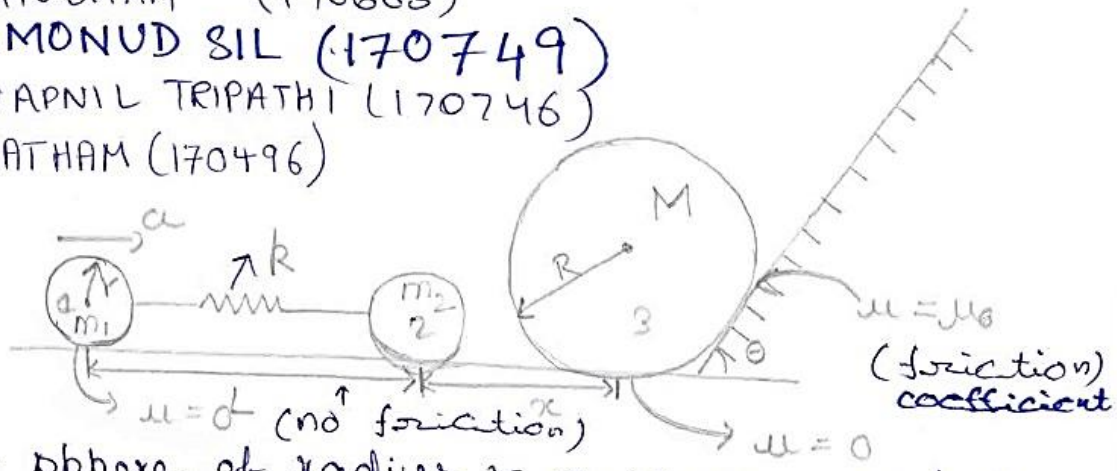


x Initially L_1, L_2 are taut

Find θ in steady state

ESO 209 A 03.11.18

① TRIPTESH BISWAS (170757)
② SHUBHAM (170685)
③ TAMONUD SIL (170749)
④ SWAPNIL TRIPATHI (170746)
⑤ PRATHAM (170496)



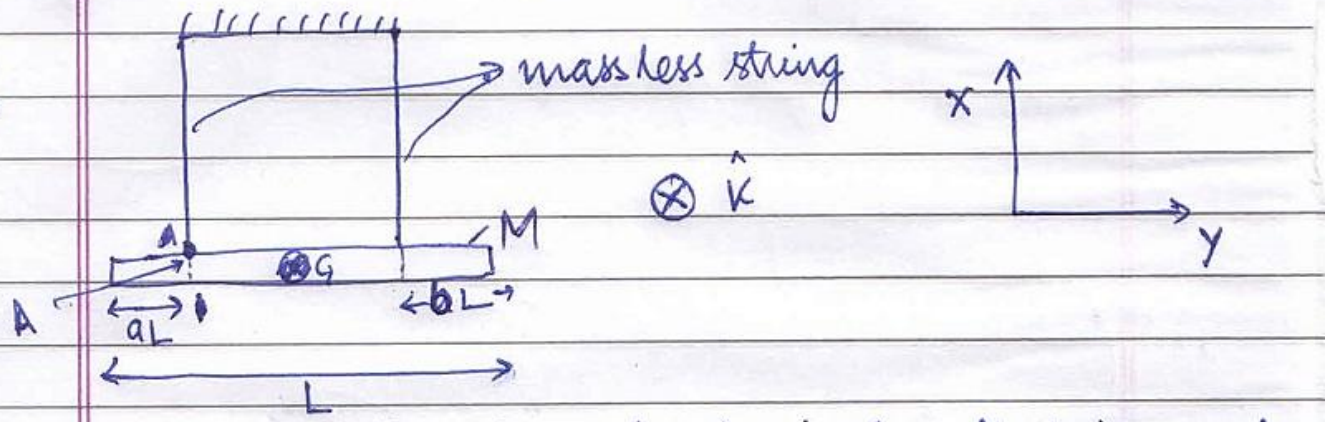
- Two sphere of radius r mass m_1 and m_2. One large sphere of radius R mass M.
- friction coefficient between the spheres and ground $\mu = 0$
- the mass m_1 is given an acceleration a towards right, ~~simultaneous~~ the mass m_2 approaches mass M and makes a contact.

a) Find the range of θ that the mass M climbs up the inclined plane without leaving contact (i.e the sphere may bounce off).

b) If the mass M climbs up find the distance travelled by it on the inclined plane.

1) 170805 VISHESH KAUSHIK
2) 170333 KARAN VAISH
3) 170362 LAVPREET SINGH
4) 170235 DEEPANSHU KATARE
5) 170081 AMAN GAUTAM

Q



Impulse is given inward at point A that is equal to $J\hat{k}$.

~~Will the system perform SHM, if yes then~~ find the angular frequency of small oscillation

Assume J to be small

And angular displacement is 'α'

(AMPLITUDE)

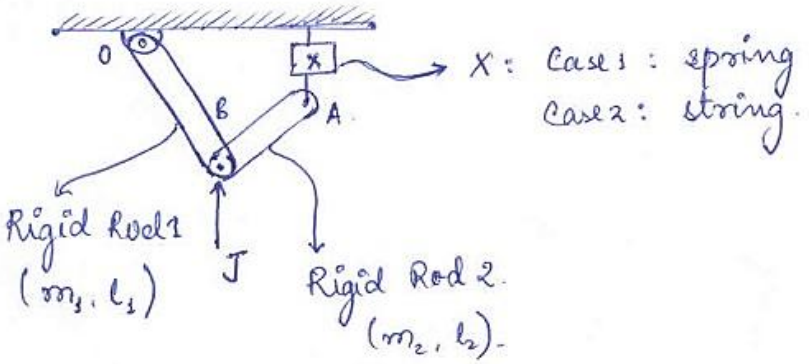
3rd Nov, 2015

QUIZ

ESO209

YASHRAJ SINGH - 170819
SUYASH SINGH - 170743
SHASHANK BUCHASIA - 170654
PRIYANSHU SAXENA - 170513
SATHVIK BHAGAVAN - 170638

QUESTION :



The above system contains 2 rigid rods, one of them hinged at O with the wall/cieling and the other hinged at the end of the first rod at B. The element X attached to the cieling at on one end and to the second rod at the other end. A vertical impulse(J) is applied at point "B".

(a) Supposing "X" to be a spring of spring constant (k) Calculate the velocity of point A.

(b) Supposing "X" to be a string, calculate the velocity of point A.

(c) Analyse the Answers for the two cases.

RISHU KATIYAR (170575)
VIJIT MALIK (170791)
SHASHANK KUMAR (170653)
AAIYUSH KAPURWAN (170002)
HEMRAJ MEENA (170299)

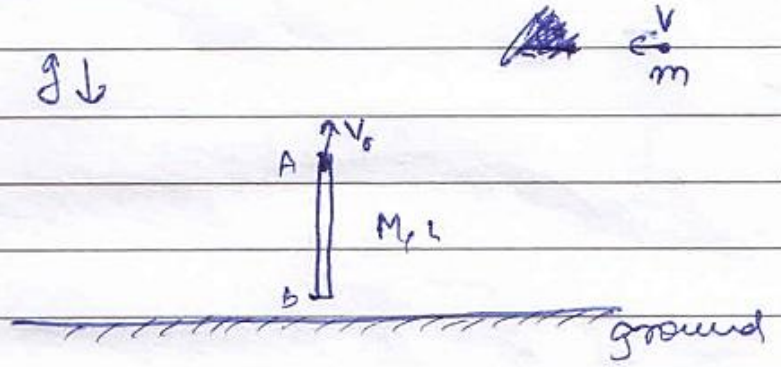


Fig (a)

Initially, a rod of length l, mass M is thrown vertically from the ground with an initial velocity V_0. When it reaches its max^m height, a bead of mass, m, with a velocity (horizontal) V strikes at the top of the rod and gets embedded.

a) What is the velocity (in terms of v_0) of the bead so that the (rod + bead) system strikes the ground horizontally without any complete rotation. (refer Fig (b))

b) Calculate the time taken, for the same (in part A)

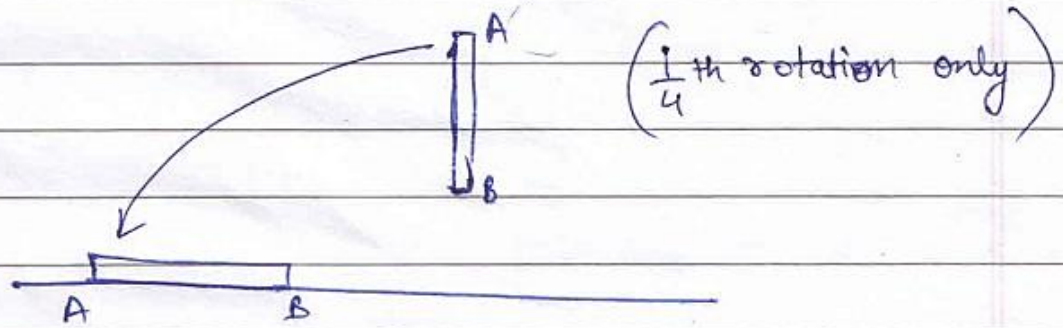
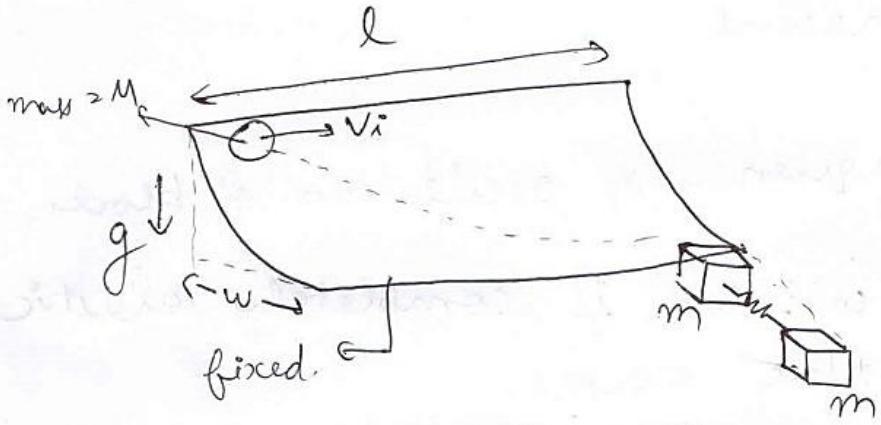
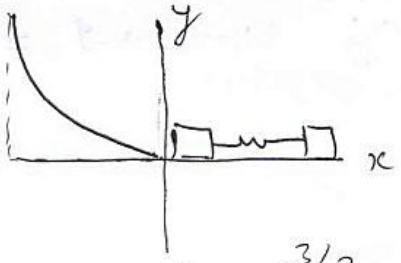


Fig (b)

Roll no.	Name
170019	ABHINAV
160812	VIVEK
170323	JAYANT
14074/14807074	AMAN
160016	ABHINA



Profile view:



Eq^n of curve $\Rightarrow y = (-x)^{3/2}$

The blocks are perfectly aligned with the wedge.

The ball starts from the position shown with only a horizontal component of the velocity initially.

The velocity is such that the ball always hits the block closer to the wedge.

Dimensions of wedge are as marked in figure.

(i) Friction absent.

(a) Find V_i.

(b) Find frequency of oscillation of blocks.

(ii) Friction present

(a) Find v_i

(b) Find frequency of oscillation of blocks.

The ~~collis~~ collision is completely elastic in both the cases.

Also, spring constant = k.

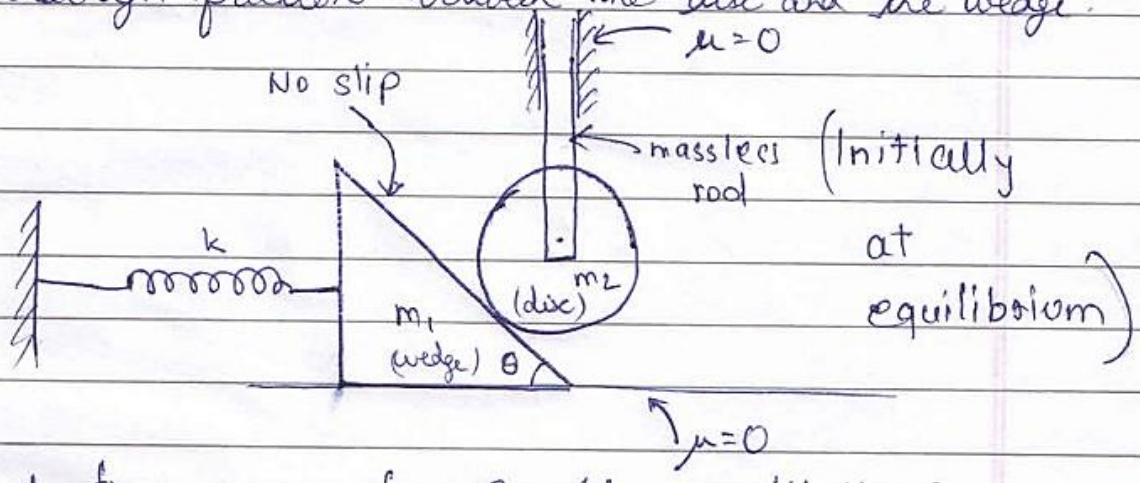
3/11/18

Date
Page

Surprise Quiz

Sameer Kumar Singh	170618
Himanshu Pandey	170301
Abhishek Mugal	170028
Kratik Jain	170345
Rohit Saini	170595

Q. See the setup given below. A spring of spring constant k is fixed to the ground and connected to a wedge of mass m_1. A disc of mass m_2 & radius R, is placed such that there is no slip between the wedge and the disc. The disc is constrained to move only in the vertical direction. Initially the setup is at rest and in equilibrium. Assume no friction b/w the ground and the wedge and enough friction between the disc and the wedge.

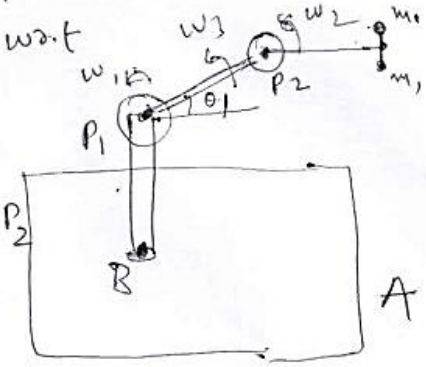


Find frequency for small oscillations.

Q. Pulley P_1 rotates anticlockwise = w_1

P_2 " " = w_3 w.r.t P_1

m_1 & m_2 " " w_2 w.r.t P_2



The system moves with velocity on plane A.

Find velocity of m_1 & m_2?

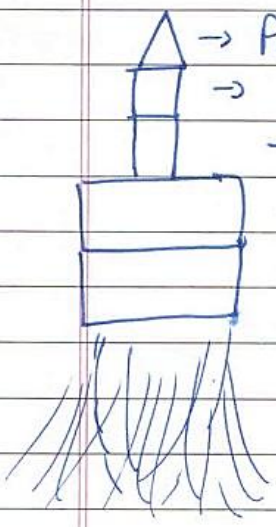
Roll No: 170001
170095
170561
170651
170399

Name	Roll
ANISH SAXENA	170118
INSHU NAMDEV	170308
BHAVESH SAXENA	170210
SUDHANSHU MISHRA	170726
PRATHAM SHUKLA	170497

Problem: A rocket, consisting of 5 different stages including the payload, S-1, S-2, P-1 and P-2. P-1 and P-2 are propellent masses while S-1 and S-2 are structural masses.

The rocket reaches the outer space only with the payload stage and the rest of the mass is rejected in space on the way in the stages as follows:

→ Gravity is to be considered.



→ Payload [$m/20$]
→ S-1 [$3m/20$]
→ P-1 [$4m/20$]
→ S-2 [$6m/20$]
→ P-2 [$6m/20$]

Fuel rejection rate is $m/500$ kg/s. and the relative speed of fuel rejection is u.

The sequence of seperation is: P-2 followed by S-2 then P-1 then S-1.

→ ~~Each~~ stage is ~~seperated~~ as soon as fuel is emptied.

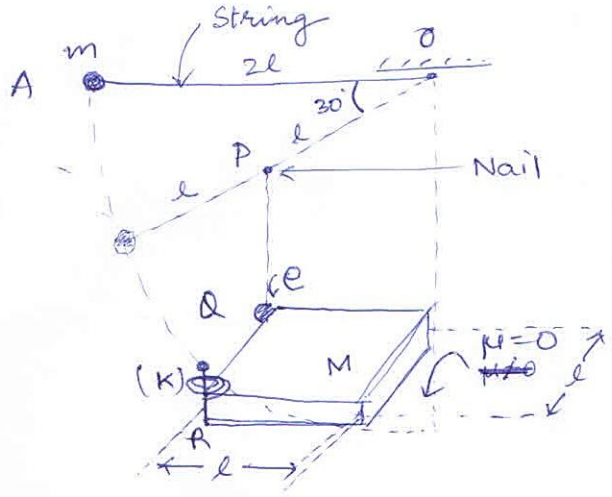
Q1. Find the final ~~velocity~~ speed of the payload given initial speed is $\hat{V_0}$ vertically upwards.

Q2. Subsequent structural masses (S-1 and S-2) are ejected after time to of ejections of P-1 and P-2 respectively.

complete

P.T.O

Q2. Plot the ~~vel~~ speed dependence as a function of time. $v(t=0) = v_0$.



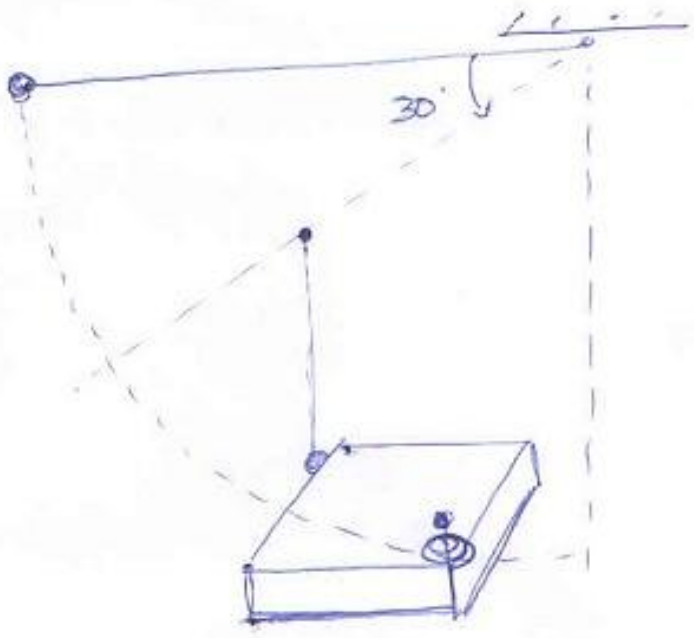
A ball of mass m, released from point A. The ball is attached to an inextensible string of length 2ℓ from point O. A nail is attached at point P, which obstructs the motion of the string.

The ball collides with the box of mass 'M'. at point Q. The box is hinged at point R and a spring is attached at R of torsional constant (K). The coefficient of restitution is 'e'.

Find the (a) time taken for the block to ~~stop~~ reach max^m angular displ.

(b) Maximum angular displacement of the box

ROLL NOS – 170307, 170257, 170506, 170325, 170317



Avani Srivashtava — 170178
Maitreyee srivastava — 170371
Pratigya Tomar — 170499
Priyakree Kachari — 170509
Manoj Kumar — 170372

(Ques)

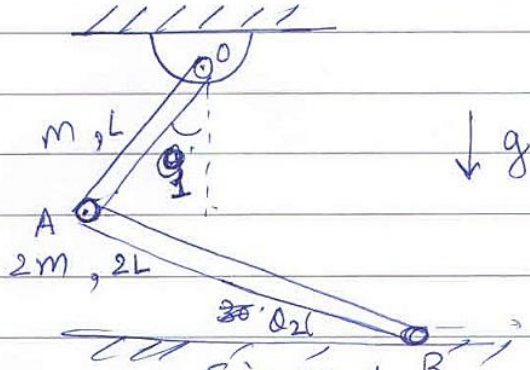


Figure 1

In the given figure an impulse of 2 NS at point B is given initially.

$\theta_1 = 60°$, $\theta_2 = 30°$, $L = 1m$, $m = 1kg$.

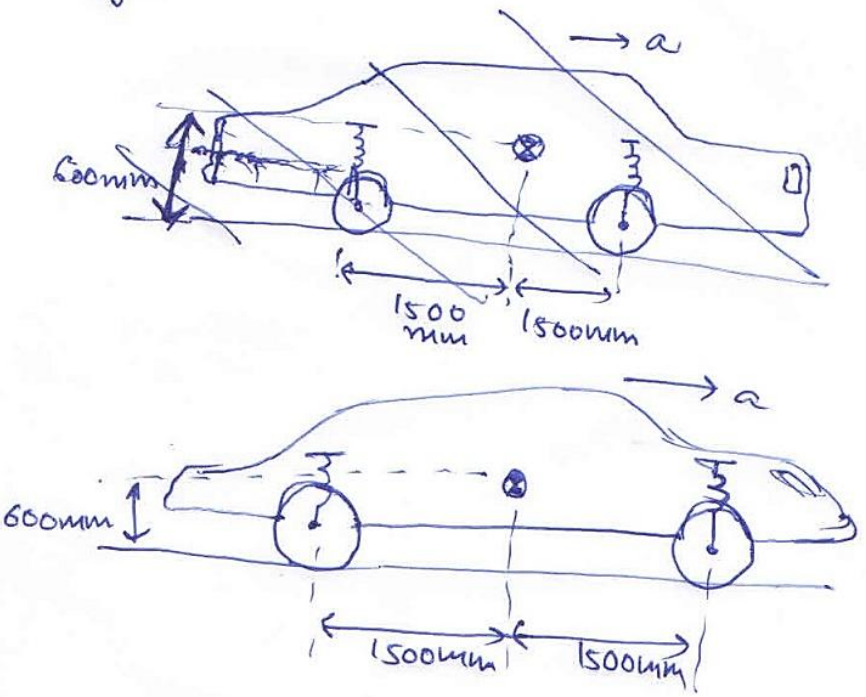
Point B slides frictionlessly on the ground.

At the instant when $\theta_1 = 0°$, find W_{OA}. (rod OA).

Joints are frictionless.

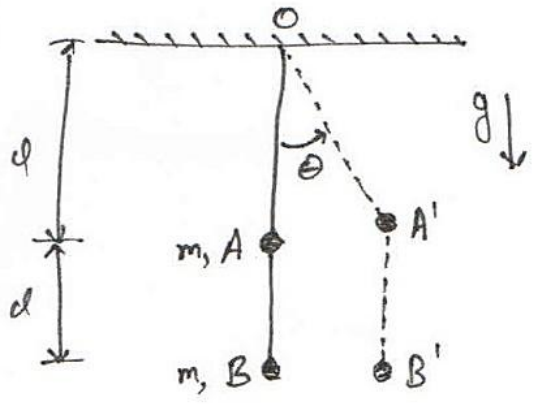
TEAM: ① PULKIT PANDEY — 170516
② AKASH KUMAR — 170069
③ NAVEEN BALAJI — 170420
④ VIPIN — 170800
⑤ ADITYA SINGH — 170056

Q. A 1 ton rear wheel drive accelerates forward at $a = g/3$. If the spring constant of both rear and front wheels are 40KN/m estimate the resulting momentary nose-up pitch angle θ. Neglect unsprung mass of tires and wheels. Consider vehicle rigid.



Roll No → (150753 Swagnit), (14287 Manmohan), (170173 Ashwin), (160063 Akash), (14088 AMIT)

Q



what will be frequency of (A & B) double-pendulum, when $\theta = 30°$ & mass A is released from A'?

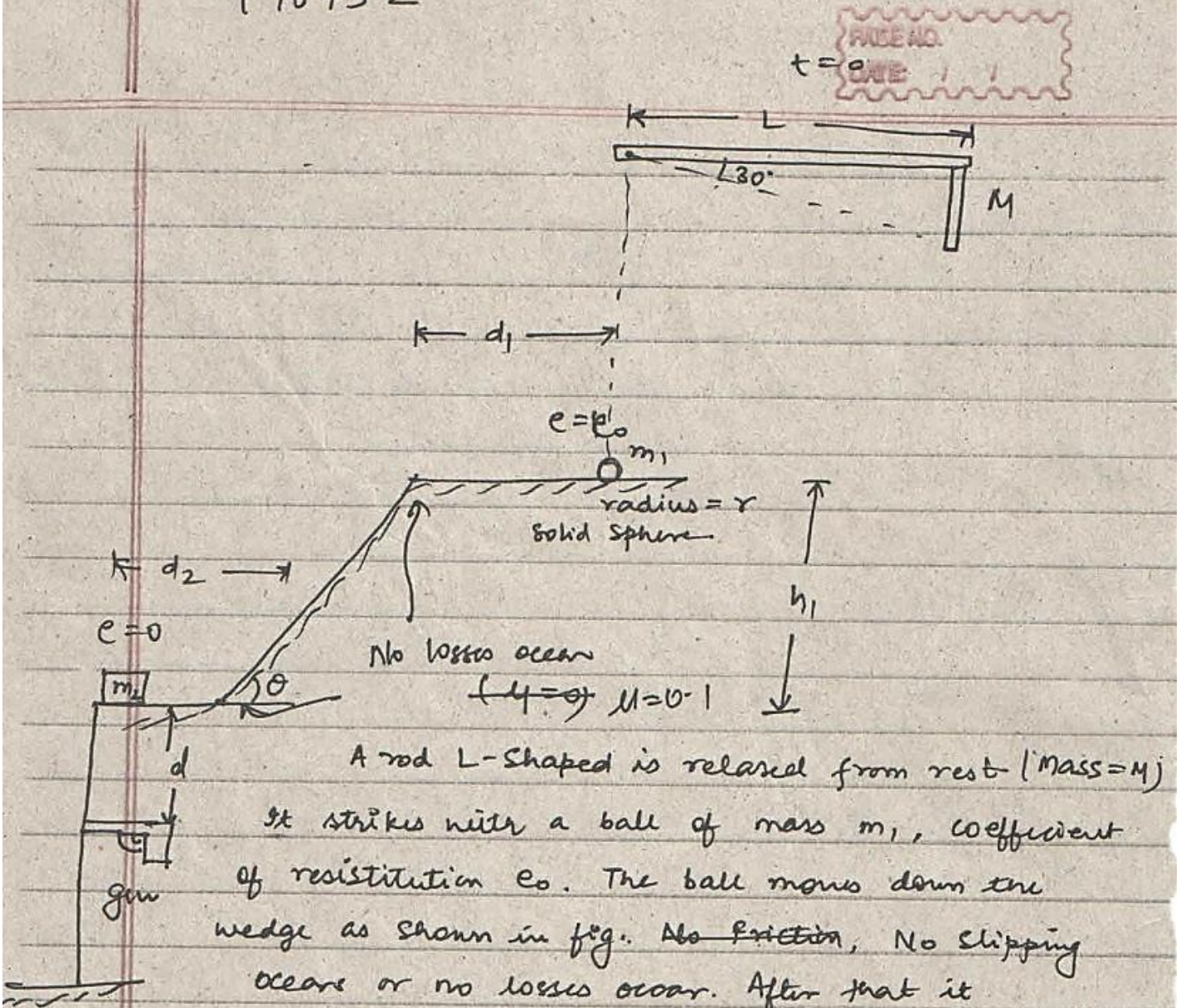
- mass A & B is attached with massless string
- $OA = AB = l$
- mass of A = mass of B = m

Roll no.

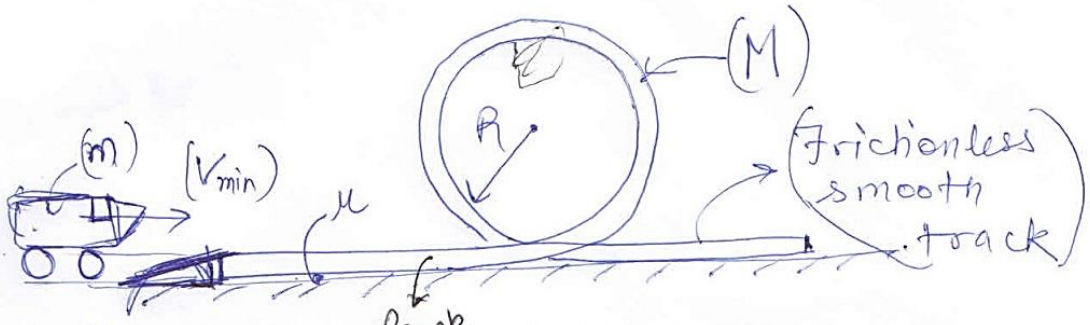
170732

170472

170452



A rod L-Shaped is relased from rest (mass=M) It strikes with a ball of mass m_1, coefficient of resistitution e_0. The ball moves down the wedge as shown in fig. ~~No Friction~~, No slipping ocean or no losses ocean. After that it strikes to mass m_2 with e=0. They both starts to free fall (Projectile motion). If rod is relased at t=0, Find to when (time) bullet should be fired (V_{bullet} = 200 m/s) Horizontally such that it strikes the combined mass system of m_1 and m_2.



Q) ~~⟹~~ In a hot-wheels loop toy.
Given a car of mass m. A ramp with a circular loop of radius R with mass M. The car is given an initial velocity V. The track is smooth. Coeff. of friction b/w the ramp and the ground is μ. (μ is sufficiently less). (which means M will also move)
~~(If for completion of loop.)~~
Find the minimum velocity for which the car completes the loop.

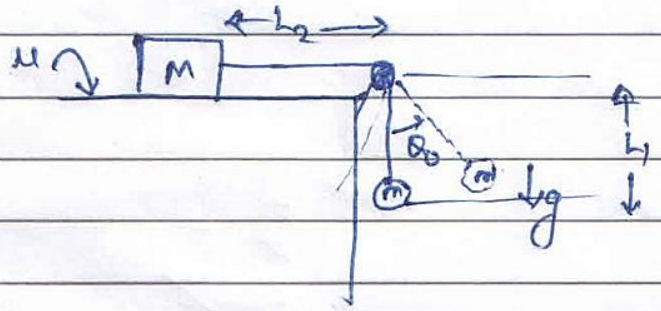
Group members

Abhilakh Choudhry	- 170016
Ardit Gupta	- 170145
Ayush Saini	- 170009
MANVENDRA SINGH	- 170381
RAMJASH JANGID	- 170552

Roll No: 170042
170122
170584

Date
Page

Q.11

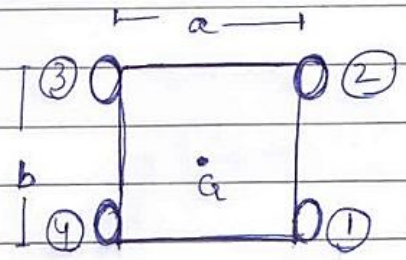


A block of mass M lies on a surface with coefficient of friction μ, an another mass m ~~is~~ ~~for~~ hangs from the pulley (massless) connected to M with a string. At ~~an~~ an instant, m is given angular displacement θ_0, and it starts undergoing oscillation.

With μ, L_1, L_2 given, find the maximum angular displacement θ_0 that can be provided so that ~~the~~ L_2 doesn't change.

Solve =>

Q



μ = coefficient of friction

Toy cart with with 4 wheels
wheel radius r Mass of cart excluding wheels = M
Mass of each wheel = m
~~Wheel ① and ② rotate move~~

(a) Wheel ① and ② move forward with ω
Wheel ③ and ④ move backward with ω
~~the~~ ~~with~~ how much time ~~angular~~ ~~velocity~~ will ~~the~~ it take for body to rotate 360° and about what point

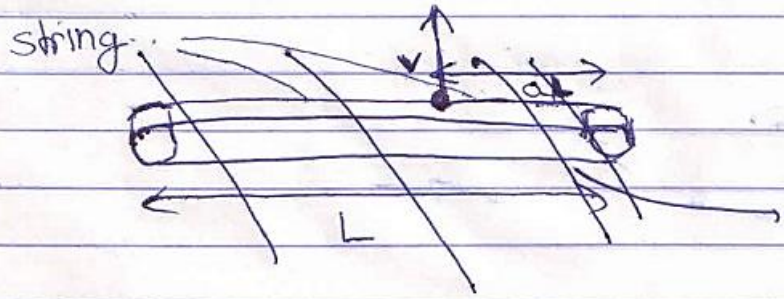
(b) wheel ① and ② move forward with 2ω
wheel ③ and ④ move backward with ω
~~if~~ ~~with~~ how much time ~~angular~~ ~~velocity~~ will ~~the~~ it take body to rotate 360° and about what point

~~Motion of ~~ ~~rotating~~

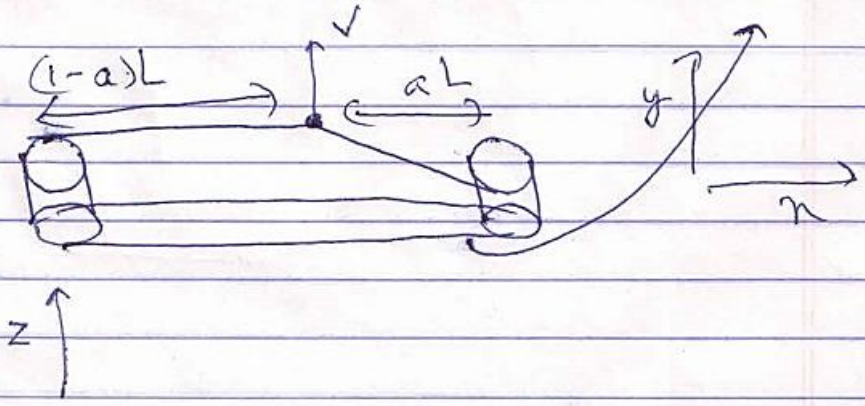
Roll Numbers
170711
170554
170596
170304
170340

MANJEET YADAV (170378
NITIK JAIN (170448)
PRATEEK YADAV (170495)
RATNESH ARGAL 170503
BALDIP 170203

(Q) A stone tied to 2 strings is thrown as shown. The strings unfold on 2 pulley without shifting as shown.
It is given that the tension is constant in the both strings (assume that its possible)T. Find the end coordinates of stone given the initial velocity is vertical and v.
The stone has mass m.
– Assume the pulleys to be very small as compared to the other distances in the problem.

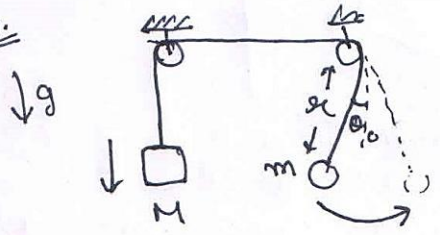


belt and chain mechanism such that pulleys rotate by some amount.



1)	ABHIJEET	170015
2)	MATARIA PENCE	170382
3)	RATNANGSHU DAS	170558
4)	AYUSH GUPTA	170191
5)	GARVIT GOPAL	160261

Q.



M is oscillating up and down

m is swinging, with initial release angle θ_0

Find the equation of motion of m.

170463	Parth Athale
170761	Tushar Goswamy
170141	Apurva Nandan
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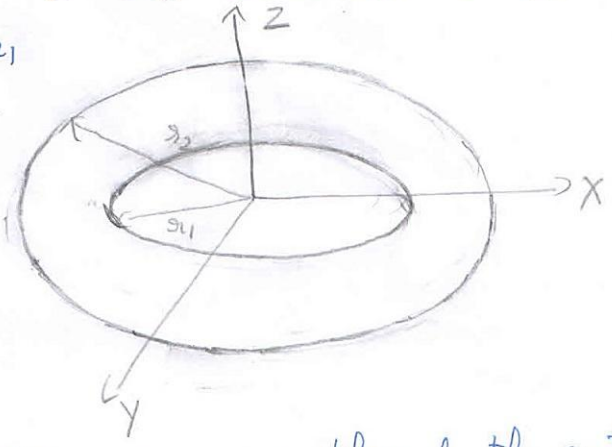
Q. Find the Moment of Inertia of a Torus (Donut) (Hollow) about the z axis as shown below:

Inner Radius = r_1
Outer Radius = r_2
Mass = m
Density = ρ



(Z-axis passes through the center & perpendicular to the diameter)

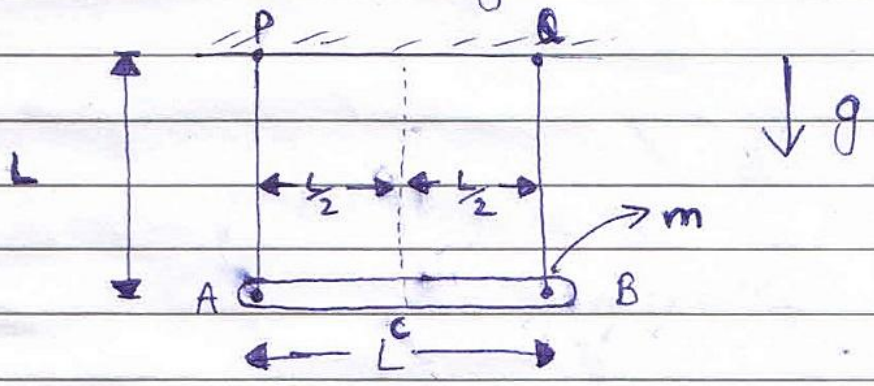
Ans:

$$I = \begin{bmatrix} \frac{m}{8}(5R^2+4\rho^2) & 0 & 0 \\ 0 & \frac{m}{8}(5R^2+4\rho^2) & 0 \\ 0 & 0 & \frac{m}{4}(3R^2+4\rho^2) \end{bmatrix}$$

where $R = r_2 - r_1$

Q The rod AB of mass m and length L hangs at rest as shown, suspended by inextensible massless string PA and QB. String QB is cut. At the instant immediately afterwards :

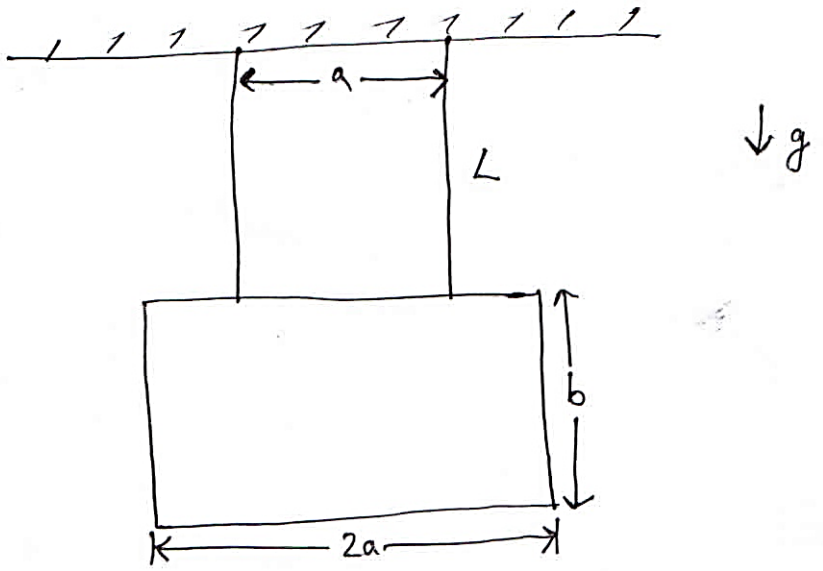
i) Find the Tension in string PA.



Extra

Roll no:- 170303, 170768, 170162, 150555, 150569

Q.



A thin uniform rectangular metal sheet of mass m, ~~and~~ length 2a and with b is hung by two strings of length L symmetrically as shown in the figure. For small oscillations find the frequency of metal sheet about the equilibrium.

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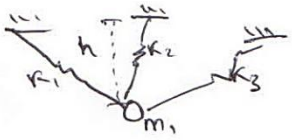
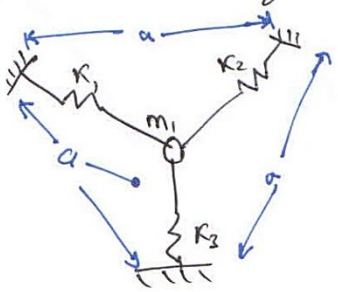
Ques:→ A ball of mass 'm' is attached to st three springs with spring constants K_1, K_2 & K_3. At $t=0$, the system is at equilibrium. Now ~~the~~ a mass 'm' falls from a height h above m_1 & strikes m_1 & sticks to it. a, Find the time period of oscillation of system of masses. (h = equilibrium height of m_1)



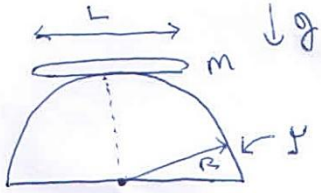
FRONT VIEW



TOP-VIEW

b, also determine the ratio of h & the amplitude of the oscillations of the combined mass.

⇒ Make suitable assumptions, if needed



Given a fixed hemispherical inverted bowl with coefficient of friction μ

A thin rod of mass m & length L is placed on the bowl such that top most pt of bowl coincides with center of rod.

Find frequency of small oscillations of rod?

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Vijay Lather (170788)
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Two ~~beads~~ of masses m & M (>>m) slids on a ~~frictionless~~ rod as shown in fig. Initially m is at rest and M moves with velocity V towards it. The distance between m and wall is L. All ~~questions~~ collisions are perfectly elastic. Find ~~Find the~~ How close can the heavier M get to ~~be to the wall when its velocity becomes zero~~ the wall.

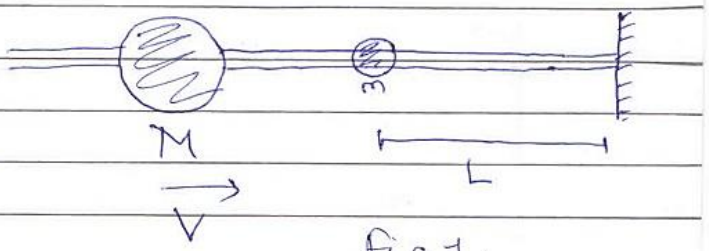

fig 1.

Que Two beads of masses m & M (>>m) slids on a frictionless rigid rod as shown in fig. 1. Initially m is at rest and M moves with V velocity towards m. The distances betw m and wall is L. All collisions are perfectly elastic. Find how close can the heavier M get to the wall.