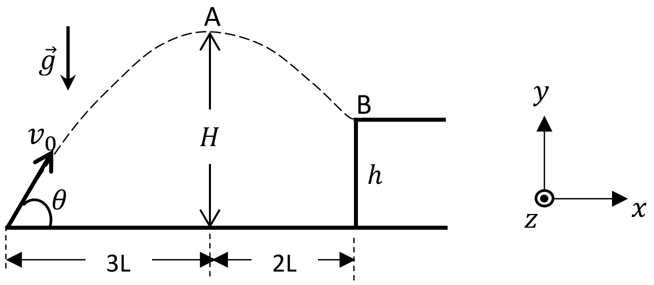
YTU Physics Department, 2016-2017 Fall Semester		Exam Date: 04 January 2017				Exam Time: 110 min.		
FIZ1001 Physics-1 FINAL EXAM		P1	P2	P3	P4	P5	TOTAL	
Name Surname								
Registration No								
Department								

Group No	Exam Hall	Signature of the Student
Lecturer's Name Surname		

The 9th article of Student Disciplinary Regulations of YÖK Law No.2547 states ***"Cheating or helping to cheat or attempt to cheat in exams"*** de facto perpetrators **takes one or two semesters suspension** penalty. Calculators are not allowed. Do not ask any questions about the problems. There will be no explanations. Use the allocated areas for your answers and write legible.

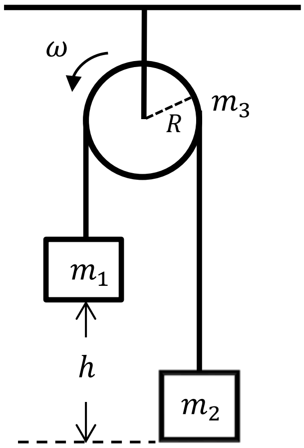
PROBLEM 1

a) An object is launched with an initial velocity of v_0 at an angle of θ above the horizontal as shown in Figure. The maximum height reached by this object is H (point A). If the object hits the wall of height h (point B) as shown in Figure, ***find*** $\boldsymbol{\frac{H}{h}}$ ***ratio***. (The solutions with the conservation of the energy will not be accepted).

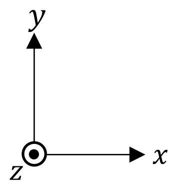


b) When the object with mass m is at point A, find the direction and magnitude of the angular momentum relative to point B in terms of given quantities.

PROBLEM 2



Two objects with masses $m_1 = 6M$ and $m_2 = 3M$ are connected by a cord passing over a pulley with mass $m_3 = 2M$ and radius R as shown in Figure. The cord has negligible mass and does not slip on the pulley. The pulley rotates on its axis without friction. Two objects starts from rest with h distance apart. (The moment of the inertia of the pulley is given by $I_p = \frac{1}{2}m_3R^2$).



a) Using the conservation of the energy, determine the speeds of the two objects as they pass each other.

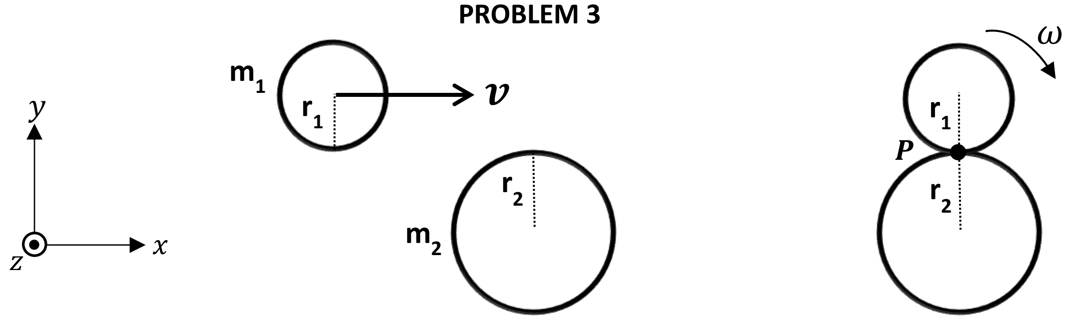
b) Write the angular momentum vector $\vec{L}$ of the system.

c) Write the net torque $\vec{\tau}$ acting on the system.

d) Find the linear acceleration of masses m_1 and m_2 using the concept of angular momentum and torque.

e) Find the tensions in the rope using the result of section **"d"**.

PROBLEM 3



A disk of mass $m_1 = m$ and radius $r_1 = r$ travelling at speed of v strikes another disk of mass $m_2 = 3m$ and radius $r_2 = \frac{5}{3}r$ which is initially at rest and lying on a flat and frictionless ice surface as shown in Figure. Assume that the collision is perfectly inelastic (disks stick together) such that their rims just touch, and they instantly stick together from point **P** and rotate with angular speed ω after the collision. Moment of inertia of a disk of mass m and radius r about its center of mass is $I = \frac{1}{2}mr^2$. (Express all your answers in terms of m, r and v, only). **After the collision;**

a) Find the position of the center of mass relative to the point P (choose point P as origin).

b) Find the moment of inertia of the system relative to the new center of mass.

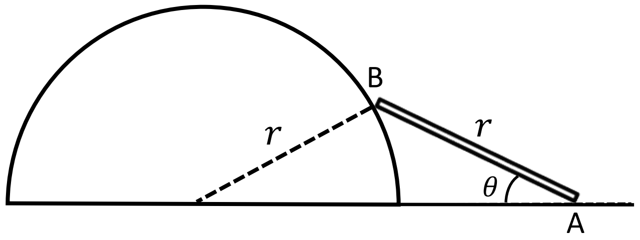
c) Find the velocity of the center of mass of the system.

d) Find the angular velocity of the system.

e) Find the kinetic energy of the system.

PROBLEM 4

A stationary semi-cylinder with radius r and a rod of length r and mass m is placed as shown in figure. While the one end of the rod is placed at point A in a plane with a coefficient of friction $\mu_s = \frac{\sqrt{3}}{3}$, the other end of the rod is at point B and in contact with the semi cylinder.

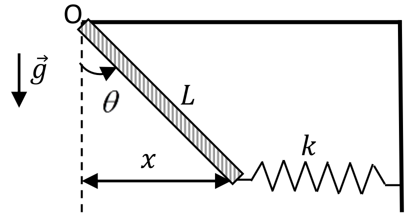


a) Draw free-body diagram of the rod on the figure given above and write the conditions of static equilibrium for the rod.

b) Determine the minimum value of the angle θ so that the rod will be in equilibrium.

PROBLEM 5

A homogeneous rod of mass M and length L is pivoted from the upper end as shown in figure. The rod's lower end is connected to a wall by a spring of force constant k. $x = 0$ and $\theta = 0$ is the equilibrium position of the rod-spring system. The rod is displaced by a small distance x (or small angle θ) from its horizontal equilibrium position and released. (For the rod: $I_{CM} = \frac{1}{12}ML^2$).



a) Write the equations of motion for the oscillatory motion.

b) Find the frequency of the oscillation for small oscillations (vibrations).