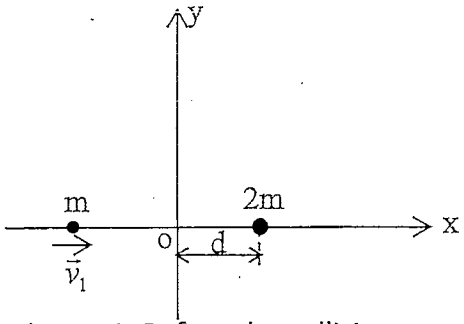
YTÜ Physics Department 2015-2016 Fall		Exam Date : 19.12.2015			Exam Time : 90 min.	
FIZ1001 Physics-1 Midterm Exam 2		P.1	P.2	P.2	P.4	TOTAL
Name Surname						
Registration No						
Department						
Group No	Exam Hall	Signature of the Student	The 9th article of Student Disciplinary Regulations of YÖK 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.				
Lecturer's Name Surname						

PROBLEM 1: A particle of mass ***m*** moving with a velocity of $\vec{v}_1 = v_1\hat{\imath}$ collides with a target particle of mass **2*m*** that is initially at rest at $x = d$ as shown in Figure-1 just before the collision. After the collision (Figure-2), the mass ***m*** moves with the velocity of $\vec{v}_1' = \frac{v_1}{2}\hat{\jmath}$ at an angle of $\theta = 90^0$ with respect to the original line of motion.



Figure–1: Before the collision

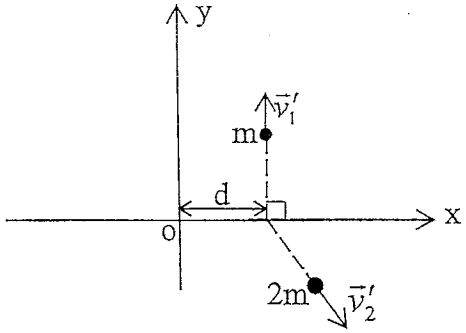


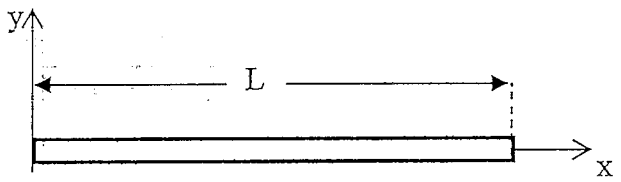
Figure –2: After the collision

a) Find the velocity $\vec{v}_2'$ of the mass **2*m*** after the collision.

b) Calculate the velocity of the center of mass of the particles after the collision.

c) Define the type of the collision and **explain the reason.**

PROBLE 2: Consider a non-uniform rod of mass M and length L placed along the x-axis with one end at the origin, as shown in the figure. Linear mass density of the rod varies with x according to the expression $\lambda = Ax^2$ (A is a positive constant).



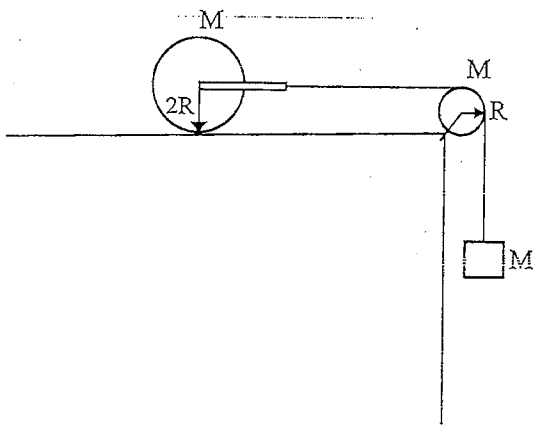
a) Find the total mass M of the rod in terms of **A and L.**

b) Find the position of the center of mass of the rod.

c) Calculate the moment of inertia of the rod about y-axis in terms of **M and L.**

d) Calculate the moment of inertia about an axis perpendicular to the rod and passing through its center of mass in terms of **M and L** ***by using parallel axis theorem***.

PROBLEM 3: A uniform, solid cylinder with mass M and radius 2R rests on a horizontal tabletop. A string is attached by a yoke to a frictionless axle through the center of the cylinder so that the cylinder can rotate about the axle. The string runs over a disk-shaped pulley with mass M and Radius R that is mounted on a frictionless axle through its center. A block of mass is suspended from the free end of the string (the figure). The string doesn't slip over the pulley surface, and the cylinder rolls without slipping on the tabletop. (For solid cylinder and pulley with mass M and radius R rotating around the axis through its center is; $I = \frac{1}{2}MR^2$).



a) Draw free-body diagram and write the equation of motion for each mass.

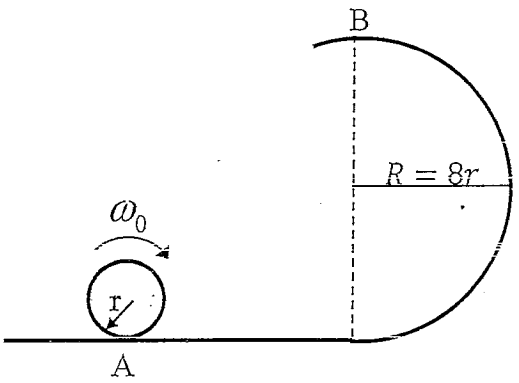
For mass M:

For cylinder:

For pulley:

b) Find the **magnitude of the acceleration of the block** after the system is released from rest.

PROBLEM 4 : i) A solid sphere of mass *M* and radius *r* rolls without slipping along the horizontal track (point A) with the angular speed ω_0 as shown in figure. What is the value of ω_0 so that the sphere completes the loop of radius $R = 8r$ (passing through point B)? ($\boldsymbol{Moment\ of\ Ineartia\ of\ solid\ sphere;\ I = \frac{2}{5}Mr^2}$)



ii) A particle of mass $m = 1kg$ has the velocity of $\vec{v} = 2\hat{\imath} - \hat{k}$ and the position vector of $\vec{r} = \hat{\imath} - 4\hat{\jmath} + 2\hat{k}$ relative to the origin. Find the **angular momentum vector** and **its magnitude** relative to the origin.