YTÜ Physics Department 2015-2016 Fall			Exam Date :			Exam Time : 110 min.	
FIZ1001 Physics-1 Final Exam			P.1	P.2	P.3	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 $m = 1$ kg starts its motion from the origin at $t = 0\ s$ then it moves on x-y plane with an instantaneous position vector given by $\vec{r} = (t^2 + t)\hat{\imath} + 3t\hat{\jmath}$.

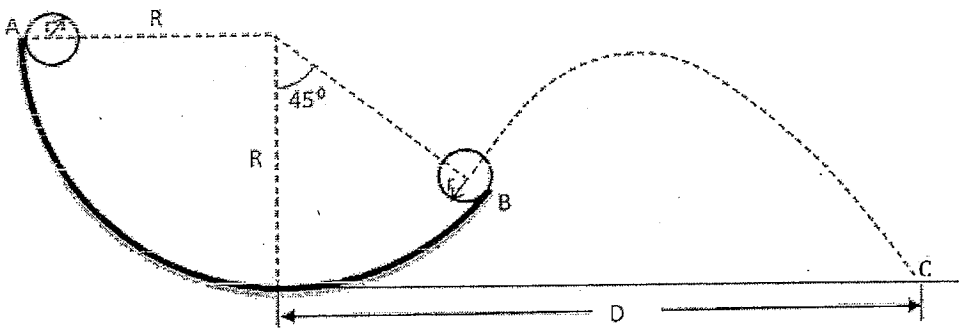
a) Calculate the linear momentum and angular momentum relative to the origin at $t = 1$ s.

b) Calculate the force and torque acting on the particle at $t = 1$ s.

c) Calculate the rate of change of angular momentum at $t = 1$ s.

d) Verify the work and kinetic energy theorem for this particle between the time interval of $t = 1$ s and $t = 2\ s$.

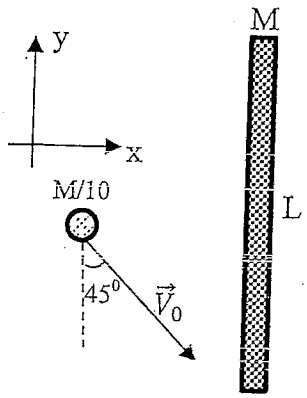
PROBLEM 2: A solid sphere of radius $r = 1m$ rolls without slipping on a circular track of radius $R = 11m$. Sphere starts rolling from rest at the height of R (point A). As shown in the figure, it leaves the circular track from the point B. Moment of inertia of solid sphere is $I = \frac{2}{5}mr^2$. $\left(g = 10\frac{m}{s^2}\ and\ cos45^0 = sin45^0 = 0{,}7\right)$.



a) Calculate the velocity of the sphere at point B.

b) Calculate the horizontal landing distance D $(take\ \sqrt{129} \cong 11)$.

PROBLEM 3: A uniform stick pf mass M and length L is initially lying at rest on a frictionless horizontal surface. A particle of mass $M/10$ is initialy sliding with speed V_0 at an angle of 45^0 with respect to the stick . The particle hits the end of the stick. After collision the speed of particle is reduced to zero, so only the stick is moving. **All of your answers below should be expressed in terms of M, L and V_0 only.** Moment of inertia of the stick around the axis through center of mass is $I_{CM} = \frac{1}{12}ML^2$

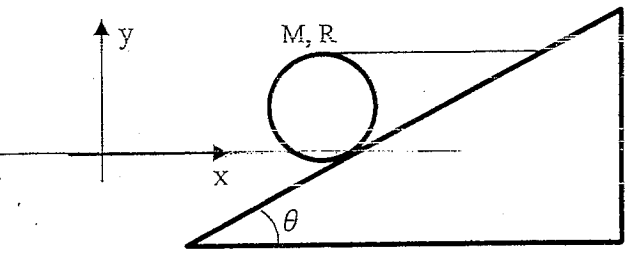


a) Find the velocity of the center of mass of the stick after the collision in terms of unit vectors.

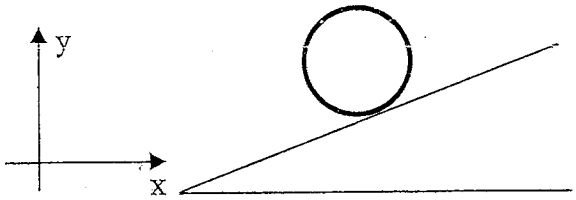
b) Find the angular speed of the stick relative to the axis through the center of mass of the stick.

c) Find the energy lost during the collision.

PROBLEM 4: (a) A ball of mass M rests on a rough incline with an horizontal angle of θ as shown in the figüre. In addition, there is a horizontal rope attached to the ball's top surface, which is pulling directly to the right



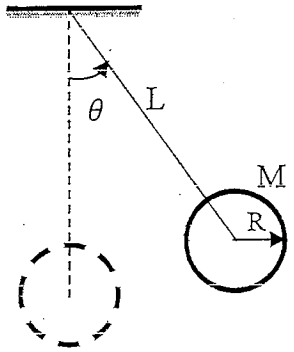
i) Draw the free body diagram of the ball according to the given axes and write the Newton's equations for rotational and translational motions which satisfy the static equilibrium conditions.



ii) Obtain the force of tension on the rope in terms of M and g for $\theta = 45^0$.

PROBLEM 4:(b) A physical pendulum has a shape of a disk of radius R and mass of M. The disk is attached from its center of mass to the one end of a weightless stick of length L. The pendulum swings about its equilibrium position on the plane of the disc. Moment of inertia of the disk around the axis through its center of mass is $I_{KM} = \frac{1}{2}MR^2$ dir.

i) Draw free body diagram of disc and write the equations of motion of the dick.



ii) Find the period and frequency of the pendulum fort the oscillations with small amplitudes.