YTU Physics Department, 2016-2017 Fall Semester		Exam Date: 05 November 2016				Exam Time: 100 min.		
FIZ1001 Physics-1 Midterm-I		P1	P2	P3	P4	P5	P6	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 (12p)

The velocity of a particle moving in the xy-plane is given by the velocity vector $\vec{v} = 2t\hat{\imath} - 3t^2\hat{\jmath}$ (m/s).
The particle is at the origin at $t = 0$.

a) Find the position of the particle $(\vec{r})$ as a function of time.

b) Find the total acceleration $(\vec{a})$ of the particle.

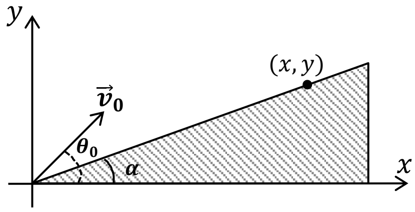
c) Find the magnitude of the tangential acceleration (a_t) at $t = 1s$.

d) Find the power transferred to the mass m=1kg at t=1s.

PROBLEM 2 (13p)

A projectile is fired uphill with a speed of $v_0 = 10$ (m/s) and a horizontal angle of θ_o, over an incline which slopes at an angle of α to the horizontal as shown.

$Cos\theta_0 = 0.7$
$Sin\theta_0 = 0.7$
$Cos\alpha = 0.8$
$Sin\alpha = 0.6$
$g = 10\ m/s^2$



a) Write components of the position as a function of time $x(t)$ and $y(t)$.

b) Express y as a function of x only $(y = f(x))$ for the projectile.

c) Find the position (x, y) where the projectile hits the incline.

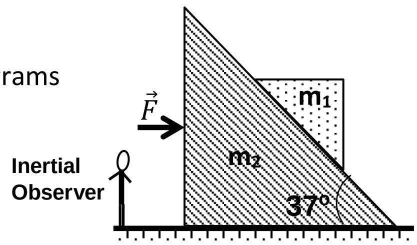
d) Determine the time taken by the projectile to hit the incline.

PROBLEM 3 (25p)

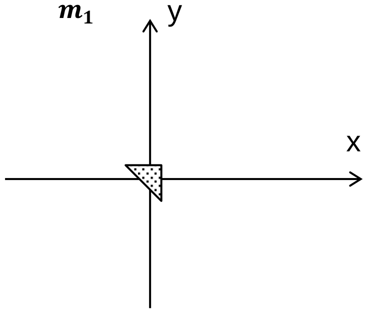
In the system of triangle shaped blocks illustrated in the figures, a constant external force $\vec{F}$ is applied in such a way that m_1 stays stationary relative to m_2. The whole system is frictionless.
Here, $m_1 = 2.4$ kg, $m_2 = 4.0$ kg, $cos37^o = 0.8$, $sin37^o = 0.6$ and $g = 10\ \frac{\text{m}}{\text{s}^2}$.

a) For an inertial observer standing still on the ground:

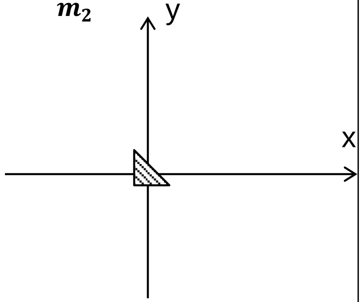
a-1) Draw free body diagrams



m_1



m_2



a-2) Write the equation of motions for:

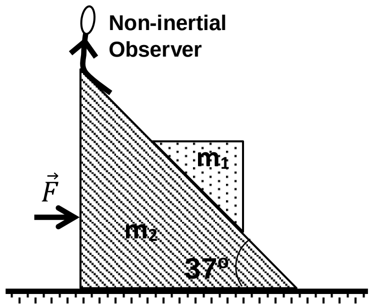
$\underline{m_1}$:

$\underline{m_2}$:

a-3) Find the accelerations of the masses.

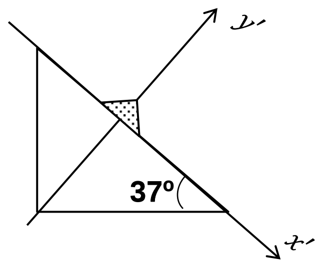
a-4) Find the force F.

b) Now, $\vec{F}$ is reduced in such a way that m_2 has an acceleration of $A = 5\, m/s^2$ relative to the ground (inertial observer), and m_1 has an acceleration of a_1' relative to non-inertial observer (observer on m_2).



b-1) Draw free body diagram of m_1 according to non-inertial observer.

m_1

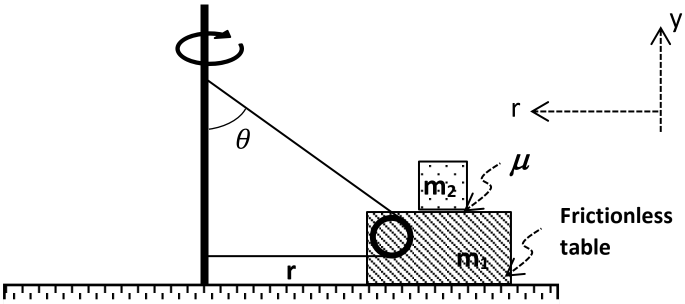


b-2) Write the equation of motion for m_1 according to non-inertial observer.

b-3) Find the acceleration a_1'.

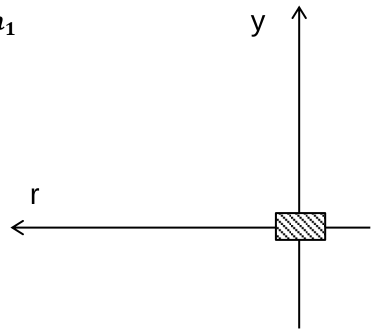
PROBLEM 4 (25p)

A block of mass m_1 is attached to a vertical rod by a single string which passes around a pulley and attached to the block as shown in figure. The block m_1 rotates on a frictionless table. Another block of mass m_2 is placed onto rough surface of mass m_1. The coefficient of static friction between the two masses is μ. The entire system rotates on a frictionless table so that the blocks are moving in a horizontal circle of r with a constant speed v. The block of mass m_2 stays stationary relative to block of mass m_1. Assume that the pulley and the string are weightless and frictionless and the blocks are point objects.

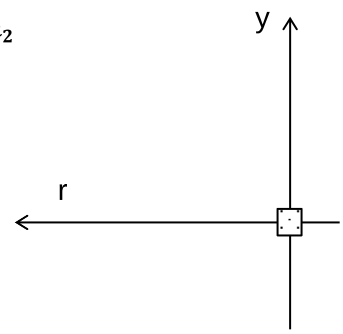


a-1) Draw the free body diagrams for m_1 and m_2.

$\boldsymbol{m_1}$



$\boldsymbol{m_2}$



a-2) Write the equation of motions for:

$\underline{\boldsymbol{m_1}}$:

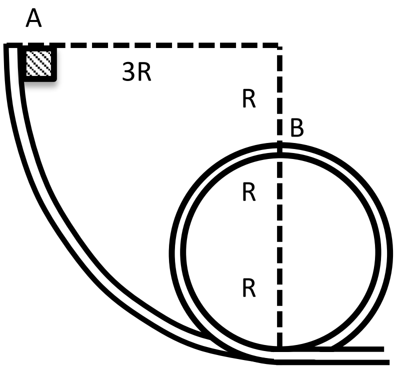
$\underline{\boldsymbol{m_2}}$:

b) Find the maximum value of the speed that the mass m_2 can stay stationary relative to m_1 while entire system rotates, in terms of μ, g and r.

c) Find the tension on the string while the system rotates at the maximum speed obtained in **b,** in terms of μ, θ, m_1, m_2 and g.

PROBLEM 5 (13p)

A small block of mass m starts from rest at point A and slides along a rough loop-the-loop rail as shown in the figure. Assume that a constant kinetic friction force f_k is acting on the block during its travel on the rail.



a) What is the work done between A and B by

a-1) Conservative forces

a-2) Normal force

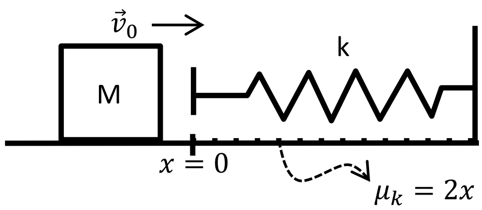
a-3) Force of friction

b) Write equation of the conservation of energy for the block between A and B.

c) What should be the magnitude of the force of friction, so that the magnitude of normal force $\vec{N}$ acting on the block is equal to its weight $m\vec{g}$ at point B.

PROBLEM 6 (12p)

A block of mass M slides along a horizontal table with speed $\vec{v}_0$. At $x = 0$, it hits a spring with spring constant k and begins to experience a friction force. The coefficient of friction is variable and is given by $\mu_k = 2x$. The block first comes momentarily to rest at $x = L$.



a) Find the work done by the forces acting on the block between $x = 0$ and $x = L$.

a-1) Gravitational force

a-2) Spring force

a-3) Normal force

a-4) Force of friction

b) If the loss of mechanical energy, between $x = 0$ and $x = L$, due to the friction is half of the energy of the block at $x = 0$, what is the spring constant in terms of M, v_0 and L.