YTU Physics Department, 2016-2017 Fall Semester			Exam Date: 10 December 2016				Exam Time: 100 min.		
FIZ1001 Physics-1 Midterm-II			P1	P2	P3	P4	P5	P6	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 (25p)

A particle with mass $m_1 = 2\ kg$ and velocity $\vec{v}_1 = 10\hat{\imath}\ (m/s)$ makes a head-on (central) collision with another particle with mass $m_2 = 4\ kg$ and velocity $\vec{v}_2 = -2\hat{\imath}\ (m/s)$.

(i) If the collision is perfectly inelastic;

a) Find the final velocities of the particles.**(5p)**

b) If the collision between the particles has lasted $10^{-3}s$, find the average force exerted by m_2 on m_1.**(5p)**

c) Find the energy loss or gain during the collision. **(5p)**

(ii) If the collision is elastic, find the final velocities of the particles after the collision ($\vec{v}_1'$ ve $\vec{v}_2'$). **(10p)**

PROBLEM 2 (13p)

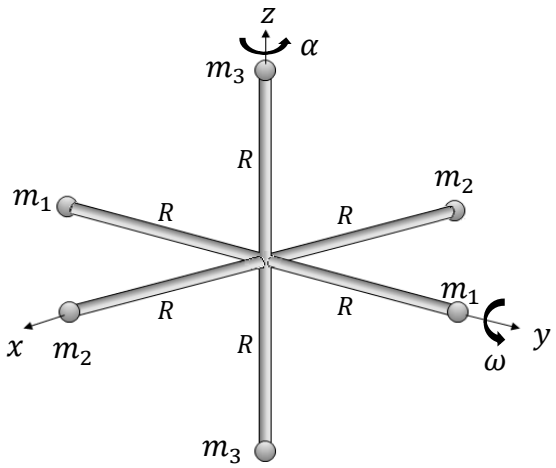
A disk of mass M and radius R starts from rest and rotates with constant angular acceleration about a fixed axis. $(I_{disk} = \frac{1}{2}MR^2)$

a) Find the time "t", when the tangential acceleration (a_t) of a point on the disk at a distance of r from the rotation axis equal to radial acceleration (a_r). Express your answer in terms of the angular acceleration (α). **(5p)**

b) Find the angular displacement (θ) at that time. **(3p)**

c) Find the work done on the disk in that time interval in terms of M, R and α. **(5p)**

PROBLEM 3 (12p)



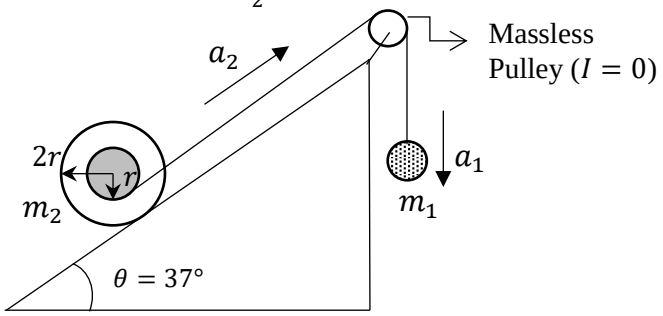
Three identical rods, each of length $2R$ and mass $3M$ are placed perpendicular to each other as shown in figure. Particles with masses $m_1 = \frac{M}{2}$, $m_2 = M$ and $m_3 = 2M$ are attached to the ends of the rods. **(For a rod of length l and mass m, the moment of inertia is $I_{CM} = \frac{1}{12}ml^2$).**

a) If the system rotates about the y-axis with constant angular velocity (ω), find the angular momentum of this system $(\vec{L})$ in terms of M, R and ω. **(6p)**

b) If the system rotates about the z-axis with constant angular acceleration (α), find the torque $(\vec{\tau})$ in terms of M, R and α. **(6p)**

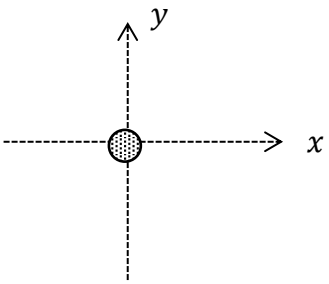
PROBLEM 4 (25p)

A cylinder (yo-yo) of mass m_2 is attached to another mass m_1 by a string of negligible mass passing over a weightless pulley. While m_1 is moving vertically downward the yo-yo is rolling up an incline with horizontal angle θ. There is no friction between the yo-yo and the incline. In here, $m_1 = 10\ kg$, $m_2 = 5\ kg$, $r = 0{,}5\ m$, $g = 10\ \ m/s^2$, $sin37 = 0.6$, $cos37 = 0.8$ and the moment of inertia of the yo-yo of mass M and radius R about the perpendicular axis through its center of mass is $I = \frac{1}{2}MR^2$.

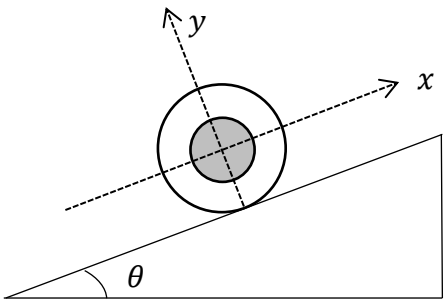


a) Draw free-body diagram for each object and write the equations of motion. **(13p)**

$\boldsymbol{m_1}$:



$\boldsymbol{m_2}$:



b) Express angular acceleration α in terms of a_1, a_2 and r. **(4p)**

c) Find the magnitude of the acceleration a_1. **(8p)**

PROBLEM 5 (13p)

Two persons with masses m_1 and m_2 stand at the ends of a plank with mass M and length L, as shown in Figure-1. The plank is placed on an ice surface. At the same time, person with mass m_1 moves towards right for $2\,m$ and person with mass m_2 moves towards left for $5\,m$ (Figure-2). In this case, find the displacement of the left end of the plank. Take the position of the m_1 in the initial situation as the origin. (In each figure, the system is stationary).

$(m_1 = 40\,kg,\ m_2 = 50\,kg,\ M = 10\,kg,\ L = 10\,m)$.

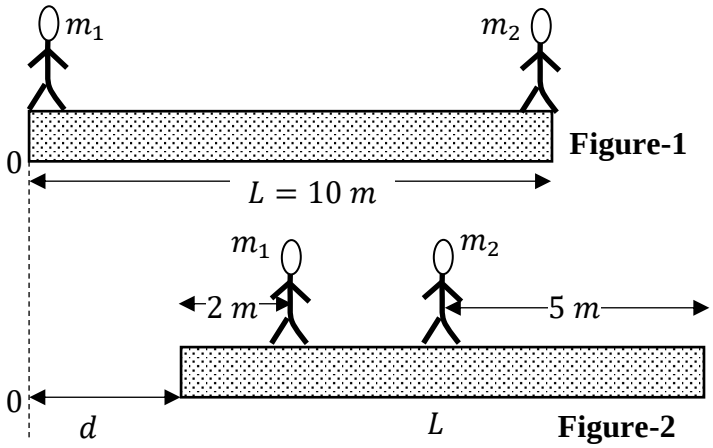
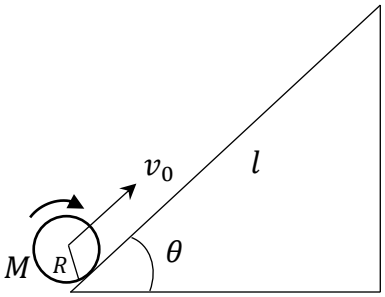


Figure-1

Figure-2

PROBLEM 6 (12p)



A sphere of mass M and radius R is rolled up a plane of angle θ. If the initial velocity of the sphere is v_0, what is the distance l it travels up the plane before it begins to roll back down ($I = \frac{2}{5}MR^2$).