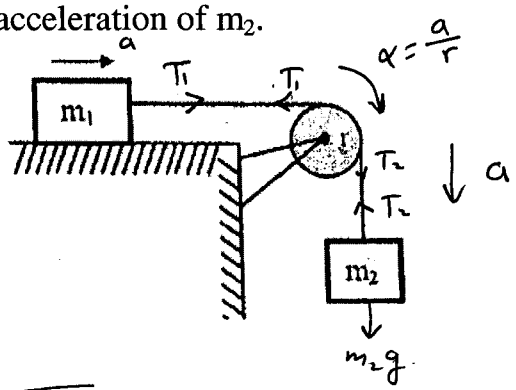
Name: (Key) **Quiz # 7 Ch. 10** ID # Sec #

1- A mass m_1= 5 kg which slides on a frictionless surface is connected by a light cord to a mass m_2 = 4 kg. The pulley (radius = 0.2 m) rotates about a frictionless axle and has rotational inertia of 0.088 kgm^2. Calculate the acceleration of m_2.



for m_2

$T_2 - m_2 g = -m_2 a$

$T_2 = m_2(g-a)$

for m_1

$T_1 = m_1 a$

for the Pulley

$\tau_{net} = I\alpha$

$T_1 r - T_2 r = -I\frac{a}{r}$

$r(T_1 - T_2) = -I\frac{a}{r}$

$m_1 a - m_2(g-a) = -I\frac{a}{r^2}$

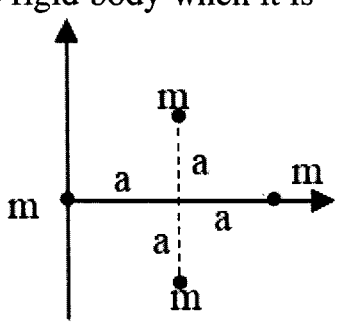
$m_1 a - m_2 g + m_2 a = -\frac{I}{r^2} a$

$a(m_1 + m_2) + \frac{I}{r^2} a = m_2 g$

$a = \frac{m_2 g}{(m_1 + m_2 + \frac{I}{r^2})} = \frac{4(9.8)}{(5+4+\frac{0.088}{(0.2)^2})}$

$a = 3.5 \ m/s^2$

2- Four identical particles, each with mass m, are arranged in the xy plane as shown in figure. They are connected by light (mass-less) rods to form a rigid body. If m=2.0 kg and a = 3.0 m, calculate the kinetic energy of the rigid body when it is rotating about the x-axis with angular speed of 4 rad/s.



$K = \frac{1}{2} I_x \omega^2$

$= \frac{1}{2}(2(3)^2 + 2(3)^2)\omega^2$

$= \frac{1}{2}(18+18)(4)^2$

$= \frac{1}{2}(36)(16) = \boxed{288 \ J}$

$I_x = \sum_i m_i r_i^2$

$= ma^2 + ma^2 + 0 + 0$

$= 2ma^2$

$= 36 \ kgm^2$

3- A wheel has a moment of inertia 12 kgm^2 about its axis of rotation. As it turns through 5 rev, its angular velocity increases from 5.0 rad/s to 6.0 rad/s. Find the value the net torque about the axis of rotation (consider the torque to be constant).

$I = 12 \ kgm^2$

$\Delta\theta = 5 \ rev. = 10\pi \ rad$

$\omega_i = 5 \ rad/s$

$\omega_f = 6 \ rad/s$

$\tau_{net} = I\alpha$

$\alpha = ?$

$\omega_f^2 - \omega_i^2 = 2\alpha\Delta\theta$

$36 - 25 = 2\alpha(10\pi)$

$\alpha = \frac{11}{2(10\pi)} = 0.175 \ rad/s^2$

$\tau_{net} = I\alpha = (12)(0.175) = 2.1 \ N.m$