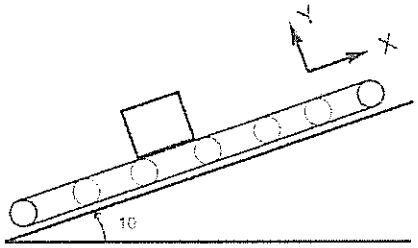
Midterm Test
MIE 100- Winter 2009
Thursday 6:15-7:45 pm, March 5 2009
Aids allowed: non-programmable calculator and aid sheet

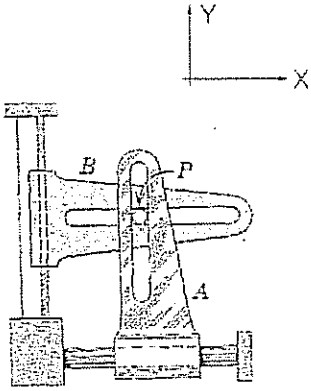
1-Box A is at rest on a conveyor belt that is initially at rest. As the belt is started in the upward direction, slipping occurs between the belt and the box. The coefficients of kinetic and static friction between the belt and the box are: $\mu_k = 0.3$ $\mu_s = 0.4$

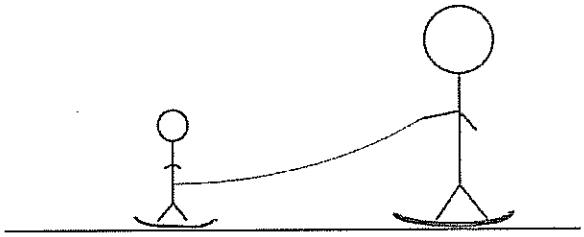
a) Draw a free body diagram of the box as it is slipping. [10 Marks]
b) Determine the acceleration of the box as it is slipping; use the co-ordinate system shown. [10 Marks]



2-The pin P is constrained to move in the slotted guides which move at right angles to each other. At the instant presented, A has a velocity to the right of 0.4 m/s which is decreasing at the rate of 2.5 m/s^2. At the same instant, B is moving down with a velocity of 0.3 m/s which is decreasing at the rate of 1.5 m/s^2.

a) Find the acceleration of pin P, use the rectangular co-ordinate system given. [10 Marks]
b) Find the angle between the X-axis and the direction of travel at the instant shown. [10 Marks]
c) Find the tangential component of the acceleration of pin P. [10 Marks]
d) Determine the radius of curvature of the path of P. [10 Marks]



3-A mother and her child are skiing together with the mother holding a rope attached to the child's waist (see figure below). They are both travelling to the left at the same speed of 5 km/h on a flat portion of a trail. Suddenly, the mother pulls the rope for 3 seconds and decreases the child's speed to 2.5 km/h. The mass of mother and child are M_{Mother}=60 kg and M_{child}=25 kg, respectively. If friction between the skis and snow is negligible, then determine:

a) The mother's speed at the end of the 3 s interval. [10 Marks]
b) The average value of the tension in the rope during the 3 s interval. [10 Marks]
c) The work done by the mother (via the rope) on the child during the 3 s interval. [10 Marks]
d) The total distance traveled by the child during the 3 s interval. [10 Marks]