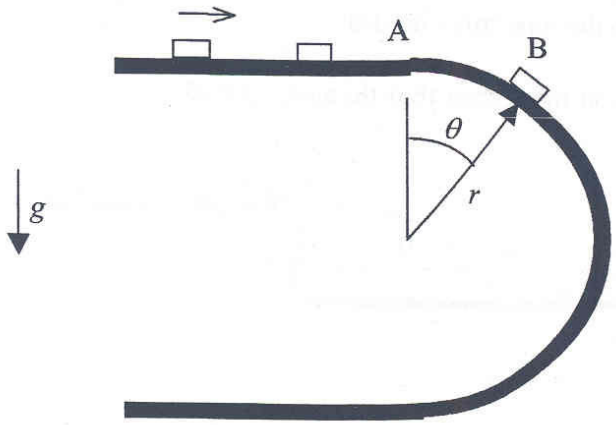
**ME104 Section 2 – Engineering Mechanics II (Dynamics)**

**Midterm I**

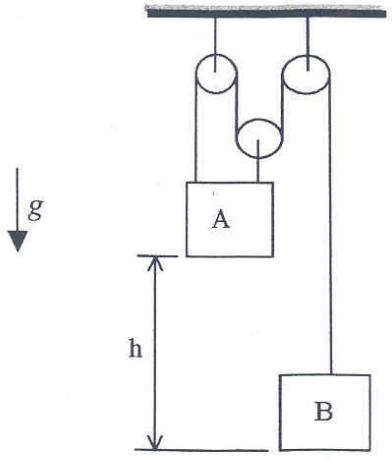
1. (30 points) A conveyer belt moving at constant speed $v$ carries boxes toward a vertical semicircular section of radius $r$. The coefficient of friction between the boxes and the belt is $\mu$.

   Derive an equation that will allow you to determine the angle $\theta$ at which boxes begin to slip with respect to the belt.




2. (40 points) The pulley system shown in the figure below is released from rest at time $t = 0$. For the case where $m_A = 100\text{kg}$, $m_B = 20\text{kg}$ and $h = 2\text{m}$,

   a. (25) Determine the accelerations of the two masses;
   b. (15) Determine the time after release at which the masses are at the same height.

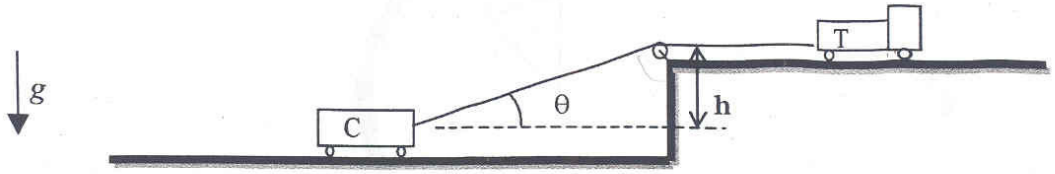


3. (30 points) A cart ($C$)is being pulled along the ground by truck $T$ above the cart with the aid of an inextensible rope. The truck has constant speed $v_T$. It can be shown (note that you do not have to do this!) that the rate of change of the angle $\theta$ may be written as

$$\dot{\theta} = \frac{v_T \sin^2 \theta}{h \cos \theta}$$

Let the mass of the cart be $m_C$ = 100kg, the speed of the truck be $v_T$ = 10 m/s and the height of the "step" be $h$ = 5m. Assume that there is no friction between the wheels of the cart and the ground, and that the pulley around which the rope turns is ideal.

Determine the tension in the rope at the instant that the angle $\theta = 45°$.




$h = r \sin\theta$

$r = \frac{h}{\sin\theta}$