系所組別：機械工程學系乙、戊組
考試科目：動力學
考試日期：0223，節次：2

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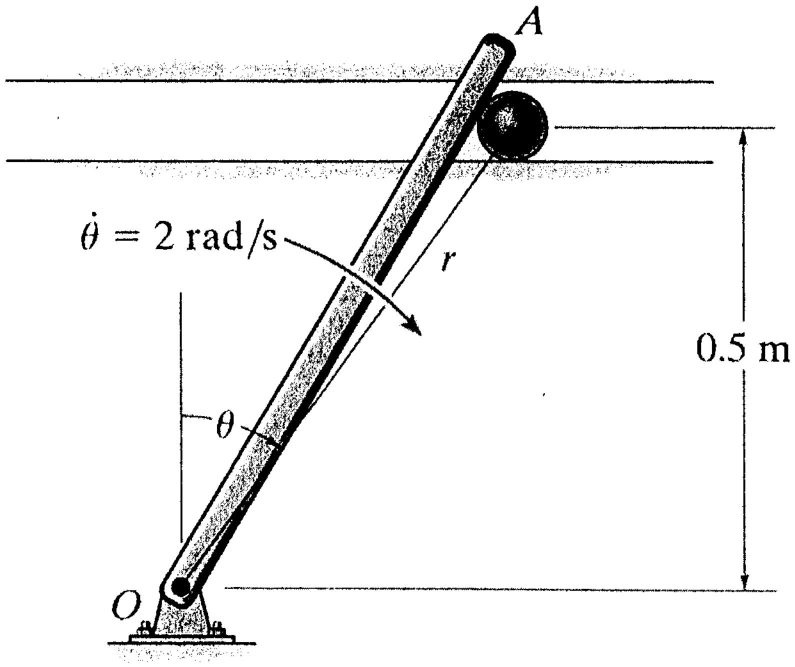
P1. (a) Consider a particle moves in one-dimension. If its acceleration-displacement relation is known and can be plotted as a graph, please tel1 us how to calculate the velocity of the particle. **(5%)**

(b) Please derive the principle of angular impulse and momentum for a particle. Please explain the angular momentum would remain constant under what kind of conditions. **(10%)**

(c) Please derive the principle of work and energy. Please explain the conservation of energy will apply under what kind of conditions. **(10%)**

P2. The particle has a mass of 1 kg and is confined to move along the smooth horizontal slot due to the rotation of the arm *OA*. Determine the force of the rod on the particle and the normal force of the slot on the particle when $\theta = 30°$. The rod is rotating with a constant angular velocity $\dot{\theta} = 2$ rad/s. Assume the particle contacts only one side of the slot at any instant. **(25%)**



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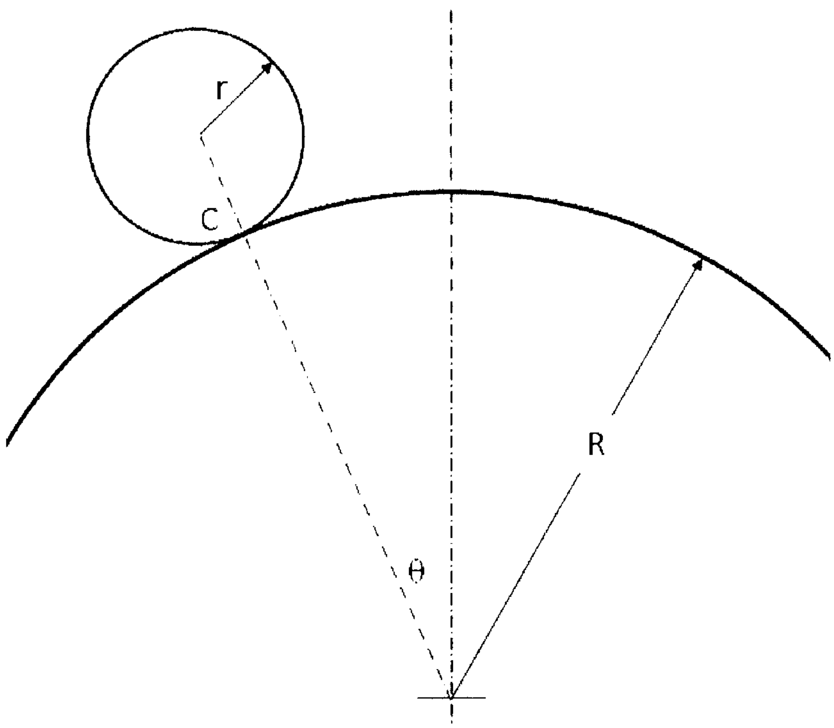
P3. The disk of mass **m** and radius **r** is released from rest with θ close to zero and rolls without slipping on the circular guide of radius **R**. (a) **(5%)** Derive expression for the angular velocity of the disk (b) **(10%)** Derive expression for the acceleration of contact point **C** (c) **(10%)** Derive the normal force **N** between the disk and the guide in terms of θ and its time derivatives.



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P4. Within the 87th and 91st floor of Taipei 101 there is a tuned mass damper for reducing vibration of the skyscraper due to typhoon and earthquakes. A picture of the damper and a mechanical model of the building and the tuned mass damper are shown below. The first flexural mode of vibration of the building can be modeled as a mass of M and a spring with stiffness K. The tuned mass damper can be modeled as a simple pendulum with length r and mass m. The wind force is $F_0.\cos(\Omega t)$. Assume that the angular displacement of the pendulum is very small. (a) **(15%)** Derive the equations of motion for the horizontal displacement, x_1, of the building and the tune mass damper, x_2. (b) **(10%)** Show that by proper design of the tuned mass damper the vibration of the building can be reduced.