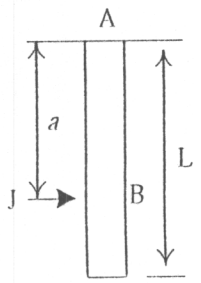
1. A long thin uniform bar of mass M and length L is hung from a fixed (assumed frictionless) axis at A as shown in the figure below. The moment of inertia about A is $ML^2/3$.



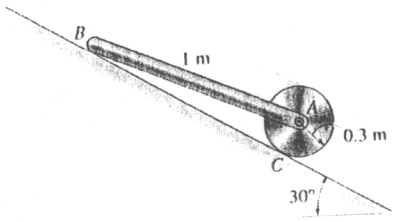
(a) Please explain what is the principle of impulse and momentum? (5 points)

(b) An instantaneous horizontal impulse J is delivered at B, a distance a below A. What is the initial angular velocity of the bar? (7 points)

(c) In general, as a result of J, there will be an impulse J' on the bar from the axis at A. What is J'? (7 points)

(d) Where should the impulse J be delivered in order that J' be zero? (6 points)

2. The assembly consists of a 10-Kg disk and an 8-Kg bar which is pin connected to the disk. The system is released from the rest. The coefficients of static and kinetic friction between the disk and the inclined plane are μ_s =0.6 and μ_k=0.4, respectively. Neglect friction at B.



(a) Without performing any detailed mathematical manipulation, please tell us how to solve this problem. (8 points)

(b) Determine the angular acceleration of the disk. (8 points)

(c) How long it required traveling a 10-meter distance. (4 points)

(d) If the friction at B cannot be neglected, how can you solve this problem? (please do not involve any mathematical detail.) (5 points)

(背面仍有題目,請繼續作答)

3.

(3.1) If $\vec{F}$ is a conservative force, show that $\nabla \times \vec{F} = 0$, where $\nabla = \frac{\partial}{\partial x}\vec{i} + \frac{\partial}{\partial y}\vec{j} + \frac{\partial}{\partial z}\vec{k}$, $\vec{i}, \vec{j}$ and $\vec{k}$ are the unit vectors along x, y and z axes, respectively. (12%)

(3.2) Derive the mathematical equation of principle of work and energy for a system of particles. Discuss the term of work done by internal forces of the system for problems of deformable body and rigid body. (13%)

4. The small block at A has a mass M_A and is mounted on the uniform bent rod having mass M_R. If the rotor at B causes a harmonic movement $\delta_B = d_0 \cos \omega t$, determine:

(3.1) equation of motion of the system. (15%)

(3.2) natural frequency of the system. (5%)

(3.3) condition of resonance. (5%)