1. (15%)

(a) Please give the direction of the relative velocity of the contact points of two rigid bodies, and explain the reasons. (Either in Chinese or in English is acceptable.)

(b) Please translate the following sentences into Chinese. "From the above derivation it should be evident that the principle of work and energy cannot be used for the analysis of this problem since it is not possible to know how the internal forces of deformation and restitution vary or move during the collision. By knowing the particle's velocities before and after collision, however, the energy loss during collision can be calculated on the basis of the difference in the particle's kinetic energy."

(c) Please state what the conditions are that a force is a conservative force, and also give two examples of it. (Either in Chinese or in English is acceptable.)

2. (15%) As shown in Fig. 1, there are revolute joints A, and D between rod AB and the frame, and rod CD and the frame, respectively; the collar at C is pin-connected to CD and slides over AB. At the instant $\theta = 60^\circ$ rod AB has an angular velocity $\omega_{AB} = 3$ rad/sec and an acceleration $\alpha_{AB} = 5$ rad/sec^2. Please determine the angular velocity, ω_{CD}, and angular acceleration, α_{CD}, of rod CD at the instant.

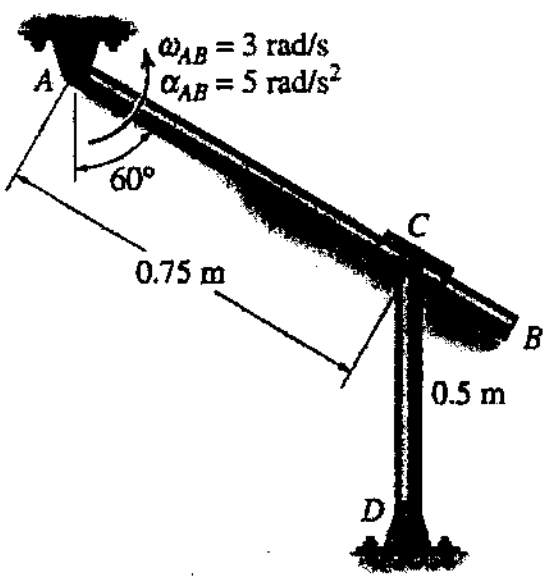

Fig. 1

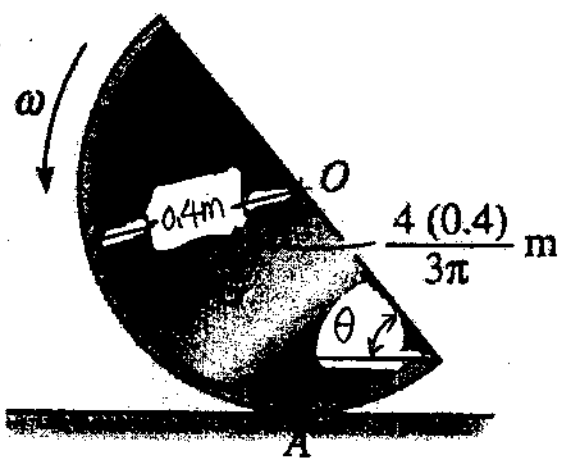

Fig. 2

3. (20%) As shown in Fig. 2, the semicircular disk has a mass of 10 Kg is rotating at $\omega = 4$ rad/sec at the instant $\theta = 60^\circ$, please determine the normal and frictional forces it exerts on the ground at this instant. Assume the disk does not slip as it rolls.

(背面仍有題目,請繼續作答)

4. (10%) (English Technical Writing) Please explain **impulse**, **momentum**, and **the principle of impulse and momentum** in English. You have to write one paragraph, which contains no more than 6 sentences, without using any equation. Please use complete sentences and be cautious about grammar.

5. (20%) The system shown in Figure 3 consists of a 20-lb disk A, a 4-lb slender rod BC, and a 1-lb smooth collar C. If the disk rolls without slipping, determine the velocity of the collar at the instant $\theta = 30°$. The system is released from rest when $\theta = 45°$. (Mass moment of inertia about mass center: $\frac{1}{12}ml^2$ (for the slender rod) and $\frac{1}{2}mr^2$ (for the disk).)

6. (20%) Figure 4 shows a spatial four-bar linkage. Crank CB rotates about the horizontal axis with a constant angular velocity $\omega_1 = 3$ rad/s at the position shown. The coupler link AB has a ball-and-socket fitting on each end and connects crank DA with CB. For the instant shown in the figure, determine the angular velocity ω_2 and the angular acceleration α_2 of crank DA.

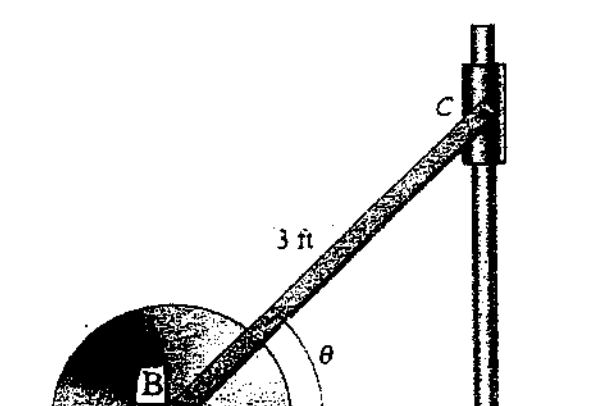

Figure 3

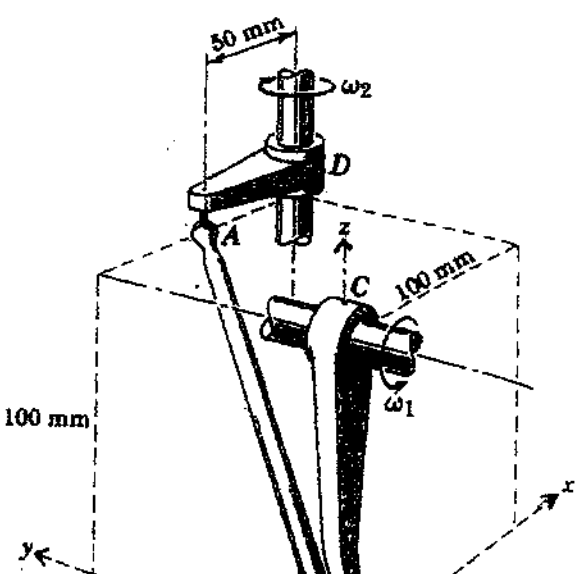

Figure 4