題號： 227　　國立臺灣大學 109 學年度碩士班招生考試試題

科目： 動力學(A)

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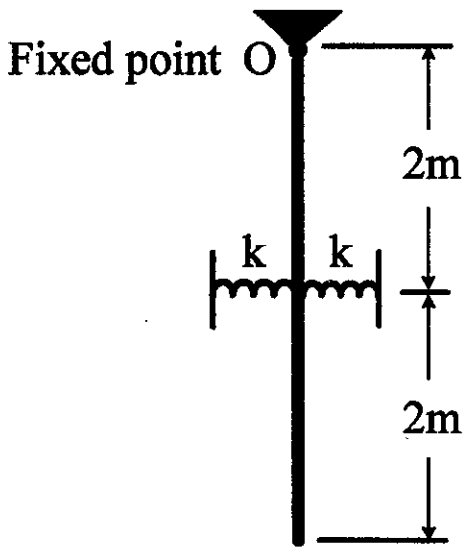
1. If the lower end of a 6-kg slender rod is displaced a small angle θ and released from the rest. Each spring has a stiffness of k=200N/m and is un-stretched when the rod is hanging vertically. Please determine

(a) (10%) The total energy equation with respect to the parameter θ

(b) (5%) The equation of motion with respect to the parameter θ (assuming $\theta \approx 0$)

(c) (5%) The natural frequency of system vibration



2. Two 0.1 kg-massed are connected to a linear spring on a frictionless table. The center of mass of the 2-particle system is stationary. At the instant shown, the velocity is $\vec{V}_1 = \vec{V}_2 = 0.1\vec{e}_r + 2.5\vec{e}_\theta$ m/s and r = 0.5m. The spring constant, K =10 N/m, and the spring applies no force when the masses are at the origin, $F = 2Kr$. *Note: You do not need to consider the gravity on this system.*

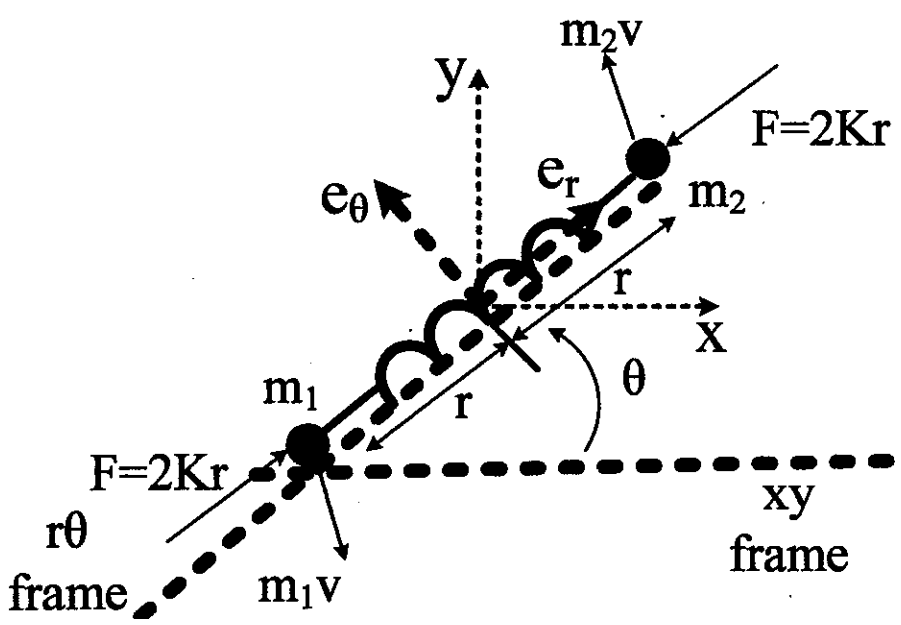
(a) (5%) How many degrees of freedom are in the system?

(b) (5%) Write the total kinetic energy of this two masses system.

(c) (5%) Express the work done by the spring.

(d) (5%) Derive the equations of motion **represented by the position θ** of the two masses system.

(e) (10%) Plot the path (x, y-coordinate) for one period of oscillation of particle m_1.



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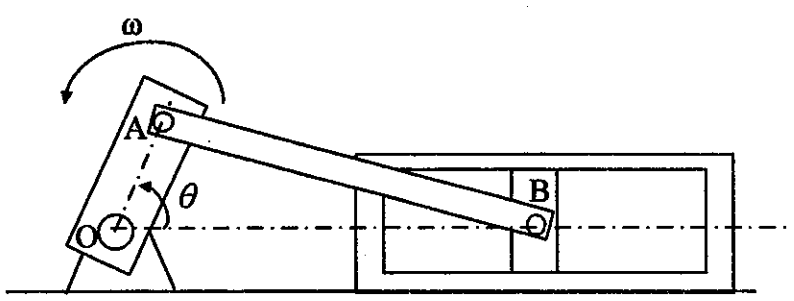
3. A slender rod *AB* of a mass 0.5 kg and length 100 mm is connected to the piston. The piston and piston pin have a combined mass of 1.5 kg. The bar *OA* is running at a constant speed (ω) of 1500 revolutions per minute in the counterclockwise direction. The bar *OA* has a length of 30 mm. Neglect the weights and force exerted by the gas in the cylinder. For the angle θ=90°, determine

(a) (5%) Velocity of piston pin *B*, angular velocity of the slender rod *AB*.

(b) (5%) Angular acceleration of the slender rod *AB*.

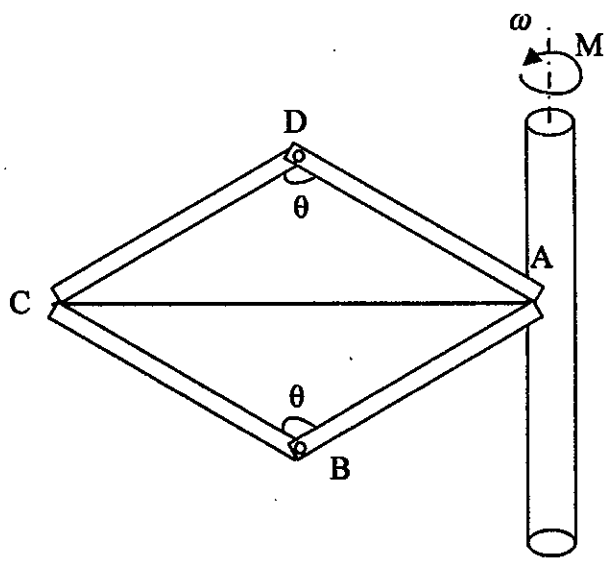
(c) (15%) Force on the piston pin *B*.



4. The shaft is subject to a torque *M* (Newton meter). Slender rods *AB*, *BC*, *CD*, and *DA* are in a plane which is perpendicular to the shaft. Slender rods *AB*, *BC*, *CD*, and *DA* each have a mass *m* (kg) and length ℓ (meter). The angle between slender rods *AB* and *BC*, and angle between rod *AD* and *DC* have the same value θ (rad). Two cases are discussed.

(a) (13%) During rotation, the angular velocity ω (rad/sec) and applied torque *M* (Newton meter) of the assembly maintain constant at ω_0 (rad/sec) and M_0 (Newton meter) respectively. θ (rad) changes from θ_1 to θ_2. Determine the time interval in terms of m, ℓ, ω_0, M_0, θ_1, θ_2.

(b) (12%) During rotation, θ maintains at $\pi/3$, and applied torque $M=10t$ (Newton meter), where t is in seconds. The assembly starts from rest. Slender rods *AB*, *BC*, *CD*, and *DA* each have mass m=6 kg and length ℓ=2m . Determine the angular velocity when t is 5 seconds.



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