編號： 193　系所：航空太空工程學系丙組　　科目：工程力學

本試題是否可以使用計算機：☑可使用，☐不可使用　（請命題老師勾選）

Problem 1. As shown in Fig. p1(a), a weightless rod is subject to a constant distributed load ω (force per unit length) over the length a and two concentrated loads P_1 and P_2 located at points with the distances b and L, respectively, from the left end of the rod. If the force system is to be equivalent to the one shown in Fig. p1(b), determine the force P and the moment M_c (about the point with the distance c from the left end of the rod) in terms of ω, P_1, P_2, a_0, a, b, L, and c. Also, if the orginal force system is to be equivalent to the one shown in Fig. p1(c), determine the force Q and the distance x in terms of ω, P_1, P_2, a_0, a, b, and L. (25%)

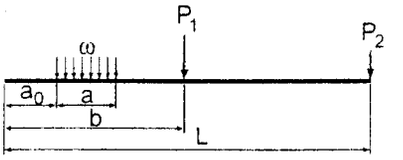

Figure p1(a)

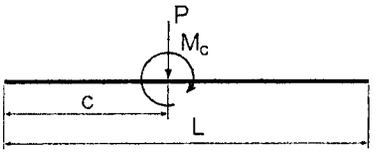

Figure p1(b)

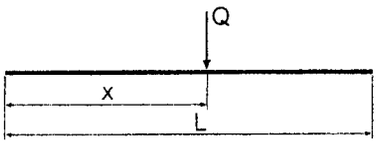

Figure p1(c)

Problem 2. In Fig. p2, a ball-spring system embedded in a frame lies in a fixed horizontal plane and Oxy is an inertial coordinate system. The ball can slide in the frame and the contact between the ball and the frame is frictionless. Let the mass of the ball be m and the original length and the elastic constant of the two identical springs be l and k (force per unit length), respectively. For the position and the attitude of the frame shown, let

$$r_A = a_0 + a_1 t + a_2 t^2$$
$$\theta = \theta_0 + \theta_1 t + \theta_2 t^2$$
$$\psi = \psi_0 + \psi_1 t + \psi_2 t^2$$

where a_i, θ_i, ψ_i, $(i = 0, 1, 2)$, are all constant and t is the time. Determine d, the displacement of the ball from its neutral position, in terms of all the parameters given above and the time. (25%)

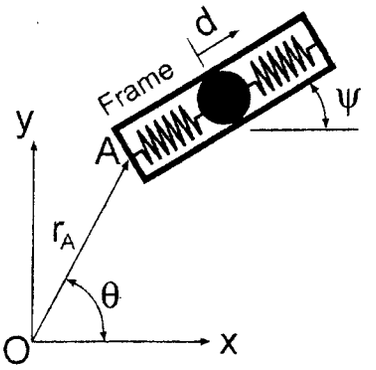

Figure p2

(背面仍有題目，請繼續作答)

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Problem 3. A uniform thin rod of mass m is resting stilly on a smooth horizontal plane as shown in Fig. P3. The length of the rod is L. A horizontal force F which is perpendicular to the rod is then applied at end A of the rod. Find the internal force and moment at point B which is located at a distance of d from end A? (20%)

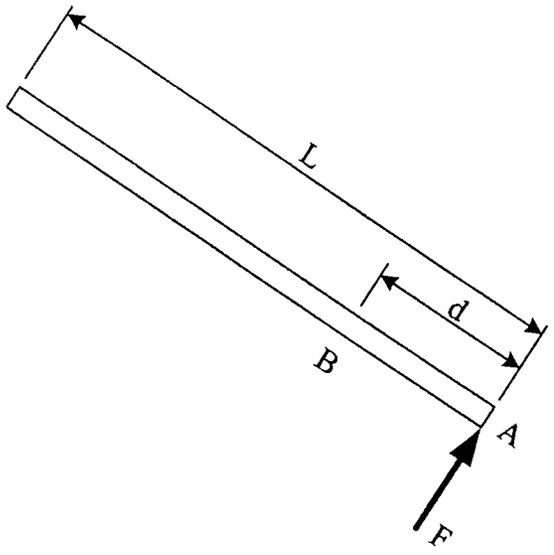

Fig. P3

Problem 4. A uniform disc of mass m is resting stilly on a plate. The plate has a mass of M and is also resting stilly on a smooth horizontal plane. The coefficients of static and kinetic friction between the disc and the plate are f_s and f_k, respectively. A horizontal force F is then applied on the plate as shown in Fig. P4.

(a) Find the maximum value of force F so that the disc is not going to slip on the plate. (15%)

(b) Suppose m = 0.5Kg, M = 1Kg, $f_s = 0.3$, $f_k = 0.1$, r = 0.1 m and F =15N. Find (i) the acceleration of the plate, (ii) the acceleration at the center of the disc and (iii) the angular acceleration of the disc. (5%)

(c) Ditto (b) with F = 10N. (10%)

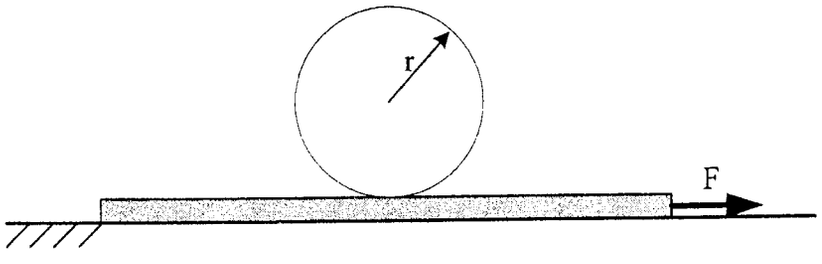

Fig. P4