1. Explain the following items, either in Chinese or in English.
   (a) D'Alembert principle. [7%]
   (b) Euler equations of motion. [8%]

2. Each of the three plates has a mass of 10 kg. If the coefficients of static and kinetic friction at each surface of contact are $\mu_s = 0.3$ and $\mu_k = 0.2$, respectively. When the three horizontal forces are applied,
   (a) show that plate B will not slip. [5%]
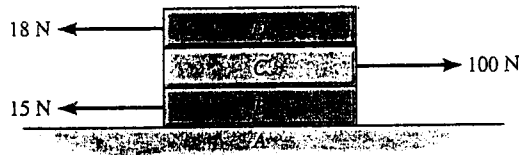   (b) determine the acceleration of plate C. [10%]

Fig. A2

3. The 40-kg flywheel (disk) is mounted 20mm off its true center at G. If the shaft is rotating at a constant speed $\omega = 8\,rad/s$, determine
   (a) the maximum reactions exerted on the journal bearing at A and B. [10%]
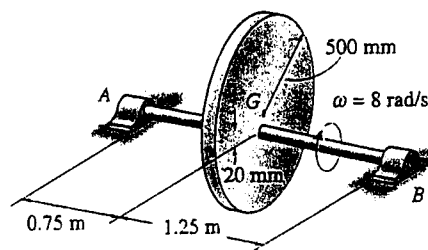   (b) the minimum reactions exerted on the journal bearing at A and B. [10%]


Fig. A3

（背面仍有題目，請繼續作答）

4. Please give answers for the following problems, either in Chinese or in English.　But a higher score will be given for correct answers in English.

   (a) Under what condition(s), the acting forces between two moving rigid bodies with point-contact will pass their centers of curvature of the contact points. [4 %]

   (b) Under what condition(s), the mechanical efficiency of a mechanical system with some mechanical elements in motion is equal to one. [8 %]

5. For the planar three-bar linkage as shown in Fig. B1, CG_3 is the mass center of link 3, F_p is the external force acting on link 3; between links 1 and 3 there is a pin-in-slot joint.　If the gravity forces and inertial forces should be considered but frictions are to be neglected, please define the symbols needed, and (a) give the free-body diagram of link 3, (b) give the equilibrium equations of link 3. [13 %]

Fig. B1

Fig. B2

$k = 10$ lb/ft

Fig. B3
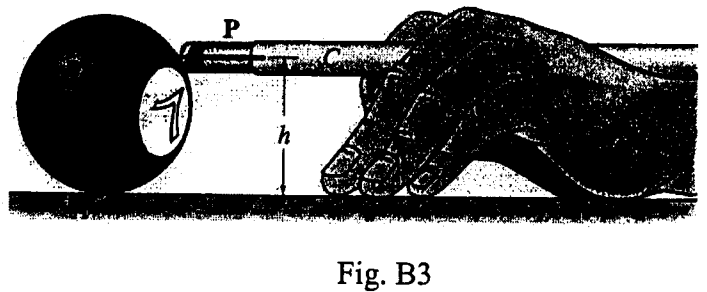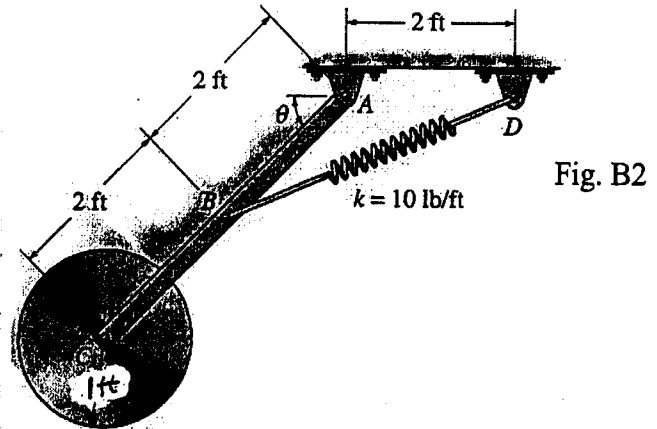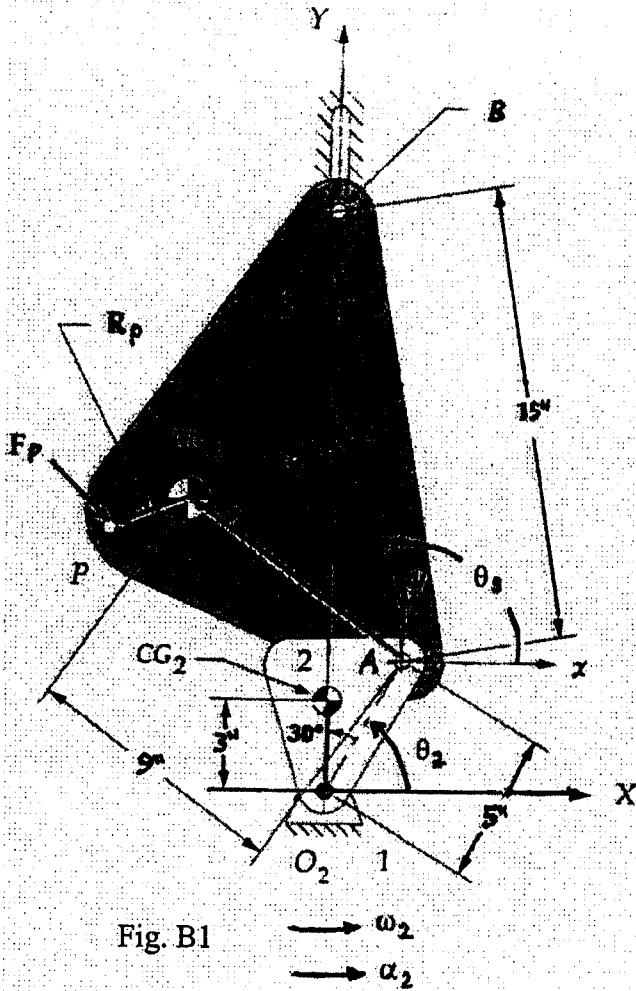
6. As shown in Fig. B2, the assembly consists of a 5 lb slender rod AC to which in pin-connected a 12 lb disk and spring BD.　If the rod is brought into the horizontal position $\theta = 0°$, and the disk is given a counterclockwise rotation of 3 rad/sec when the rod is released from rest, please determine the angular velocity of the rod at the instant $\theta = 90°$.　The spring has an unstretched length of 1 ft. [13%]

7. Please determine the height h at which a billiard ball of mass m and radius r must be struck so that no friction force develops between it and the table at A, as shown in Fig. B3.　Assume that the cue C only exerts a horizontal force **P** on the ball. [12 %]