

(A) 工程力學

- 1
 - (a) What vertical motion must the top of a yo-yo (see Fig. 1.a) string be given to make its center stay fixed in space? What will be the force in string? (10%)
 - (b) The table in Fig. 1.b turns at constant speed. Write the equation of motion for the point mass with $l \neq 0$. (10%)
- 2 A particle P of mass m is constrained to slide without friction down a tube attached to a constantly spinning cone c as shown in Fig. 2. A constant gravitational field (down e_3) is assumed. In terms of the coordinates and the constants given in Fig. 2, derive
 - (a) a single scalar differential equation describing the motion of the particle P. (10%)
 - (b) the constrained force(s) acting on the particle P. (10%)
- 3 As shown in Fig. 3, a disk of radius r and thickness l spins at the constant rate Ω about the bearing A-A. Simultaneously, the horizontal shaft B-B rotates at the constant rate ω . When the support fork is at the vertical position, determine the force(s) and the moment(s) which the support fork exerts on the disk. (15%)
- 4 The system hangs initial at rest (Fig. 4). Suddenly, the upper end of the spring is given the motion $x = x_0 \cos \omega_f t$. Find the resulting motion of the mass. Note that b in the figure stands for the viscous friction between the mass and the sliding wall. (15%)

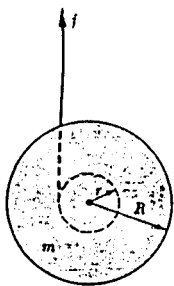


Figure 1.a

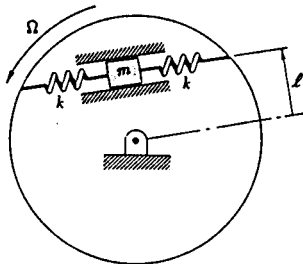


Figure 1.b

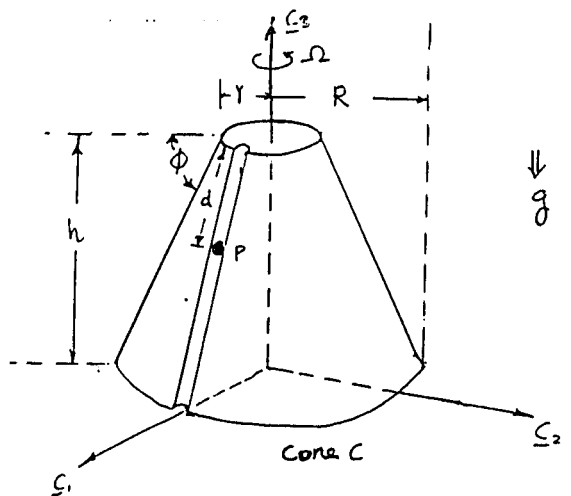


Figure 2

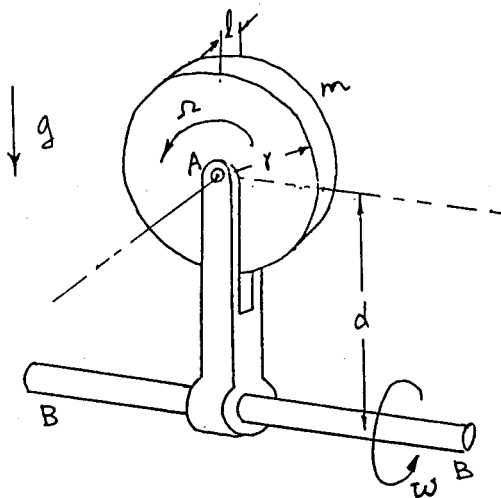


Figure 3

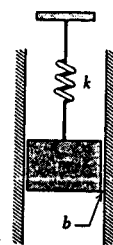


Figure 4

(B) 飛行力學.

1. An airplane having wing area 16 m^2 and aspect ratio 6 is flying in the cruise speed of 50 m/sec at the sea level (the air density 1.226 kg/m^3). At an angle of attack of -1° , the measured lift and drag are 0 and 15 kg , respectively. At an angle of attack of 2° , the lift and drag are measured as 410 kg and 19 kg , respectively. Calculate the parasite drag coefficient and the Oswald's Span efficiency of the airplane. Also determine the required thrust during the flight. (20%)
2. It is essential to consider the longitudinal and the lateral/directional stability when designing an airplane. Please discuss the criteria of static stability with physical explanations for both cases. (10%)