國立臺灣大學 105 學年度碩士班招生考試試題

The solutions and answers may be in either Chinese or English.

1. Describe and explain the followings:
   (a) Degree-of-freedom of a mechanical system (5%)
   (b) Dynamic equilibrium and its relationship with d'Alembert's principle (10%)

2. As shown in Fig. 1, a rigid and slender shaft carries two offset particles, each of mass *m*, and rotates about the z-axis with the constant angular rate ω as indicated. Determine the x- and y-components of the bearing reactions at A and B due to the dynamic imbalance of the shaft for the position shown. (15%)

3. An electric motor with an attached disk is running at a constant speed of 60 rev/min in the direction shown in Fig. 2. Its housing and mounting base are initially at rest. The entire assembly is next set in rotation about the vertical Z-axis at the constant rate N = 40 rev/min with a fixed angle γ of 60°.
   (a) Find the angular velocity and angular acceleration of the disk (use unit vector **i**, **j**, **k** to express the vectors, **i**, **j**, and **k**, are corresponding to the *x*-*y*-*z* axes of the motor) (10%),
   (b) Determine the velocity and acceleration of point A at the top of the disk for the instant shown (10%).

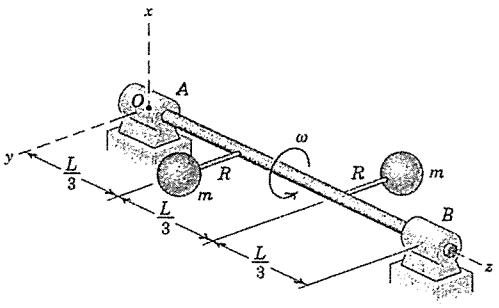


Fig. 1

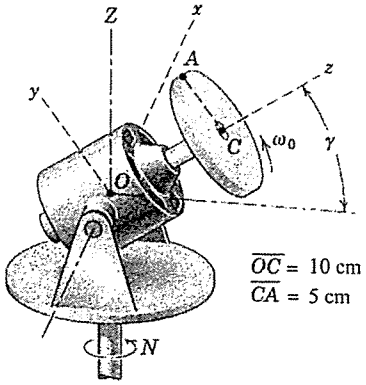
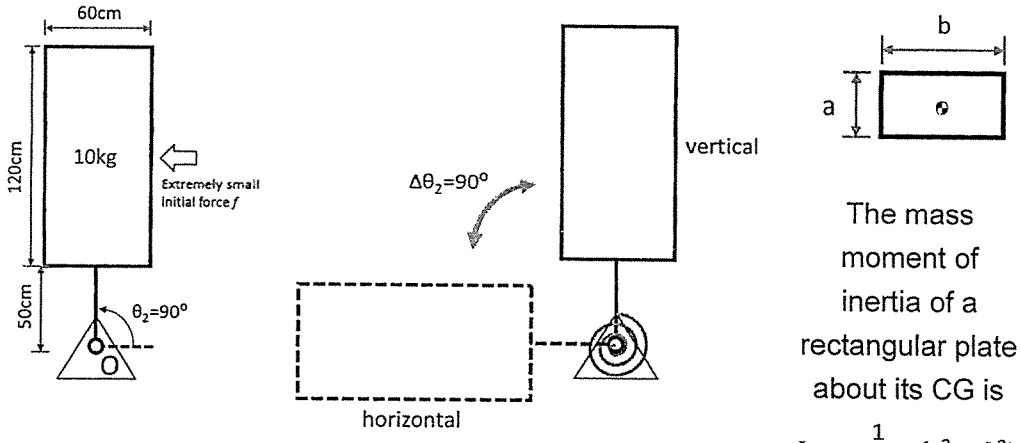


Fig. 2

見背面

4. A rectangle plate is connected with a weightless rod as shown in Fig. 3(a), and hinged to the ground at point O. Initially, the link is hanged vertically and an extremely small force *f* is applied on the link to initiate the rotation. Ignore the work done by the initial force *f*. (Gravitational acceleration g=9.81m/s^2)
   (a) Find the maximum angular velocity ω_2 of the link and its related angular acceleration α_2 and displacement θ_2. (10%)
   (b) As shown in Fig. 3(b), a torsional spring is installed between the base and the link. Determine the stiffness of the spring which can make the link oscillating between the vertical and horizontal states as shown in Fig. 3(b). (unit of the torsional spring stiffness is N·m) (10%)



The mass moment of inertia of a rectangular plate about its CG is

$$I_{GG} = \frac{1}{12}m(a^2 + b^2)$$

Fig. 3

接次頁

5. Shown in Fig. 4 is a planetary gear system, where the gear teeth are not drawn in the figure. Each of the three identical planet gears A, B, and C has a mass of 0.8 Kg, a radius r=50 mm, and a radius of gyration of 30 mm about its center. The carrier E has a mass of 1.2 kg and a radius of gyration about O of 60 mm. The ring gear D has a radius R=150 mm and is fixed. Now a torque M=5 N·m is applied to the shaft of the carrier at O as shown.

(a) Draw the free-body diagram and show the forces on each free body, i.e. carrier and one planet A. (5%)

(b) Write the force and moment balance equations on the carrier and planet A. (10%)

(c) What is the relation of angular acceleration between the carrier and the planet? (5%)

(d) Solve the force and moment equations and determine the initial angular acceleration of the carrier. (10%)

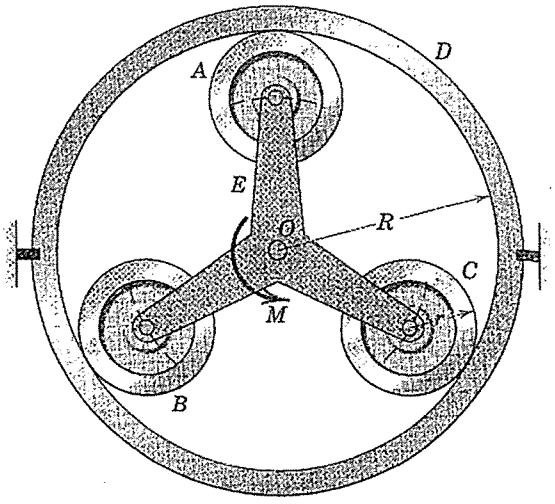


Fig. 4

試題隨卷繳回