編號： 158 國立成功大學 107 學年度碩士班招生考試試題

系　　所：生物醫學工程學系

考試科目：工程力學　　考試日期：0205，節次：1

※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Explain the following terms: (20%)
   (a) Mathematical form of "center of mass" and "center of gravity". (5%)
   (b) D'Alembert's principle. (5%)
   (c) Radius of gyration. (5%)
   (d) Conservation of angular momentum. (5%)

2. A block shown in Figure 1 of mass M traveling down the rough incline, and the coefficient of kinetic friction is μ. Determine the location **C** of the effective normal force N. The effective normal force is located at the centroid of the nonuniform pressure distribution which the incline exerts on the bottom surface of the block. (10%)

Figure 1

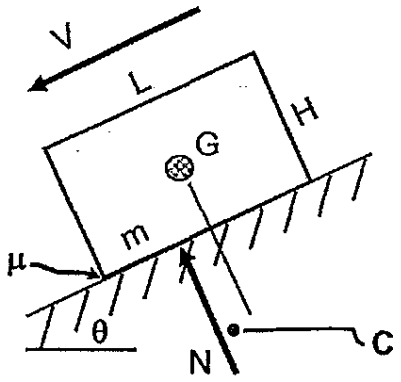
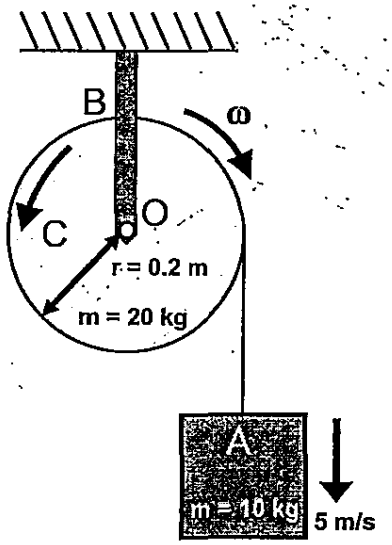


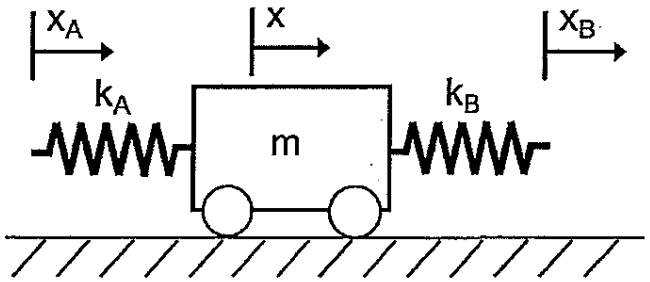
Figure 2



3. The 10-kg block A is suspended by the cable that is securely wrapped around the pulley B, as shown in Figure 2. At certain instant, block A drops at speed of 5 m/s, which applies a couple C to the pulley causing block A to stop after dropped for 3 m. Please determine the amount of couple C applied. (10%)

4. In Figure 3, a slider block m is connected with two springs of spring constant k_A and k_B, respectively. Assume each spring is displaced from each of its endpoint with $x_A = X_A\cos\omega t$ and $x_B = X_B\cos\omega t$. Please (1) derive the differential equation of motion for the slider block m; (2) solve the steady-state vibration of the slider block. (20%)

Figure 3



5. A cylinder bar ABD of radius R = 100 mm and mass M = 100 kg is supported by a thrust bearing D so that ABD can freely rotate along its central axis, as shown in Figure 4. Bar sleeve C with negligible mass is controlled by internal mechanism that allows C sliding along BD, so that the connecting rod BP and CP, BQ and CQ can vary between an angle θ from 0° to 180°. Four connecting rods are equal length and weight of uniformed slender rod, with length l = 1000 mm, mass m = 10 kg, and the thickness can be ignored. Assume when ABD is located at $\theta = 180°$, the entire system can be considered as a uniformed cylinder. At the beginning of $\theta = 0°$, the system is rotating at 1 rad/s around the ABD center axis. Please (1) prove the mass moments of inertia I_{zz} of rod ABD is equal to $0.5mR^2$; (2) determine the speed of the system when the internal mechanism causes C to slide to $\theta = 180°$. (20%)

Figure 4

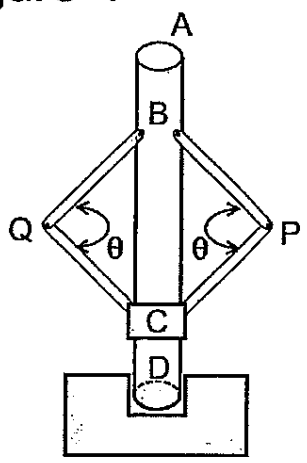
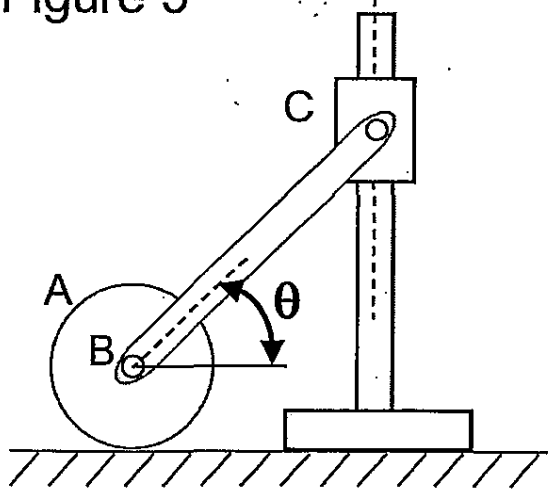


Figure 5



6. In Figure 5, the disk A is 20 kg and with radius of 50 cm rotates without slipping. The center of the disk is connected to a bar BC that has a mass of 10 kg and length 150 cm. The other side of the bar BC is connected to a collar C sliding along a fixed vertical shaft. Assume at $\theta = 45°$, the collar C is sliding downward with velocity $V_C = 120$ cm/s. Please determine the velocity V_C of the collar C when $\theta = 30°$. (20%)