編號： 81　　國立成功大學 107 學年度碩士班招生考試試題

系　　所：機械工程學系

考試科目：動力學　　考試日期：0205，節次：2

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

1. A block moves outward along the slot in the platform with a speed of $\dot{r} = 2t$ m/s, where t is in seconds, as shown in Figure 1. The platform rotates at a constant rate of 6 rad/s. If the block starts from rest at the center, determine the magnitudes of its velocity and acceleration when $t = 1$ s. (20%)

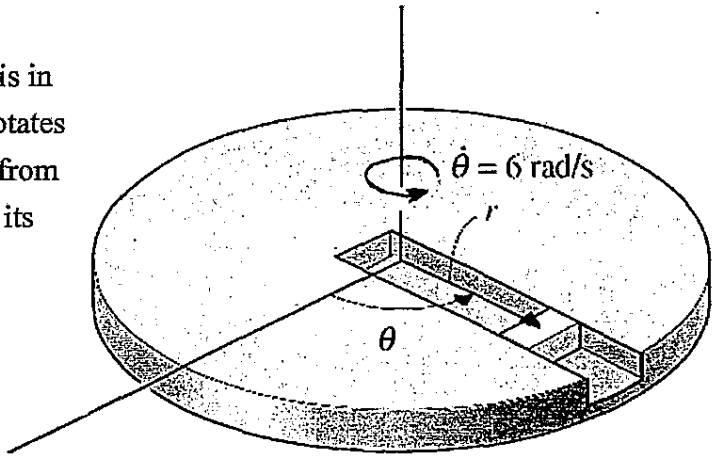

Figure 1

2. Consider a mechanism shown in Figure 2. Knowing that at the instant shown bar AB has an angular velocity of 10 rad/s clockwise and it is speeding up at a rate of 2 rad/s^2, determine the angular velocities and accelerations of bar BD and bar DE, respectively. (20%)

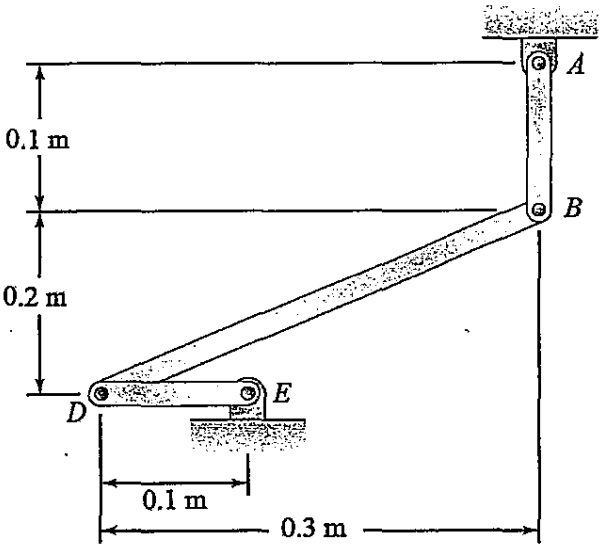

Figure 2

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3. Two uniform slender rods *AO* and *BC*, each of mass *m* and length *L*, are welded together to form a T-shaped assembly as shown in Figure 3. Two identical springs and two identical dampers are attached at points *D* and *E* on the rod *BC*. The springs are unstretched when $\theta = 0$. The assembly is pivoted at point *O*. (20%)
   (a) If *A* is given an initial small horizontal displacement u_0 and release from rest, derive the equation of the motion and the initial conditions of the vibration system in terms of θ.
   (b) Write the natural frequency of the vibration system in terms of *k*, *m*, L_1 and *L*. Discuss how L_1 affects the natural frequency.
   (c) Determine the displacement of point *A* at the time $t = 1$ s after the release for $k = 9600$ N/m, $c = 500$ N-s/m, $L = 500$ mm, $L_1 = 100$ mm, $m = 5$ kg and $u_0 = 1$ mm. Is the system under damped, critically damped or overdamped vibration?

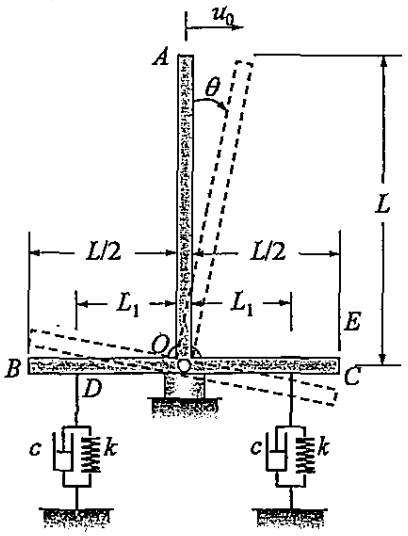

Figure 3

4. A bullet with a mass of $m_1 = 20$ g is fired with a horizontal velocity of $v_1 = 300$ m/s and hit a uniform slender beam *OA* at point *B*, as shown in Figure 4. The beam has a mass of $m_2 = 3$ kg and a length of $L = 2$ m. After the impact, the bullet is embedded in the beam. The beam is suspended from a collar with a mass of $m_3 = 3$ kg, which can slide along a horizontal rod without friction. Determine the maximum angle of rotation of the beam during its subsequent motion. Assume that the mass of the bullet can be neglected when the bullet is embedded in the beam. (20%)

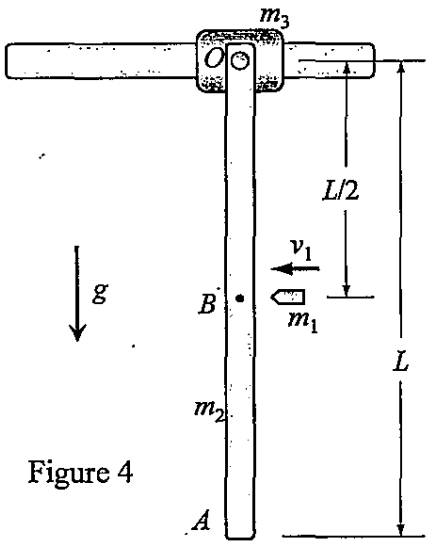

Figure 4

5. The three identical small balls are connected by the hinged links of negligible mass and equal length, as shown in Figure 5. They are released from rest in the position shown and slide down along the quarter-circular guide in the vertical plane. When the upper sphere reaches the bottom position, the spheres have a horizontal velocity of 0.4 m/s. Calculate the energy loss due to friction and the total impulses I_x and I_y on the system of three spheres during this interval. The masses of the spheres are $m_1 = m_2 = m_3 = 0.5$ kg. The radius of the quarter-circular guide is $R = 0.2$ m. (20%)

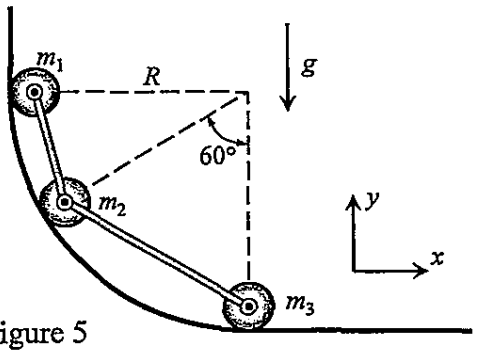

Figure 5