國立成功大學 108 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：0223，節次：2

※ 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. The rotation of rod OA about O, as shown in Fig. 1, is defined by the relation $\theta = t^3 - t$, where θ and t are expressed in radians and seconds, respectively. Collar B slides along the rod so that its distance from O is $r = t^3 - 2t$, where r and t are expressed in inches and seconds, respectively. When $t^3 = 1$ s, determine (a) the velocity of the collar, (b) the acceleration of the collar, (c) the radius of curvature of the path of the collar. (20%)

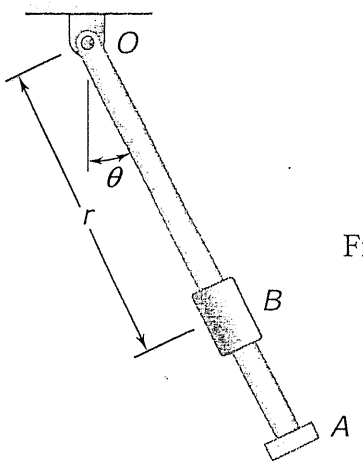

Fig. 1

2. Pegs A and B are restricted to move in the elliptical slots due to the motion of the slotted link, as shown in Fig. 2. If the link moves with a constant speed of 2 m/s, determine the magnitude of the velocity and acceleration of peg A when $x = 1$ m. (20%)

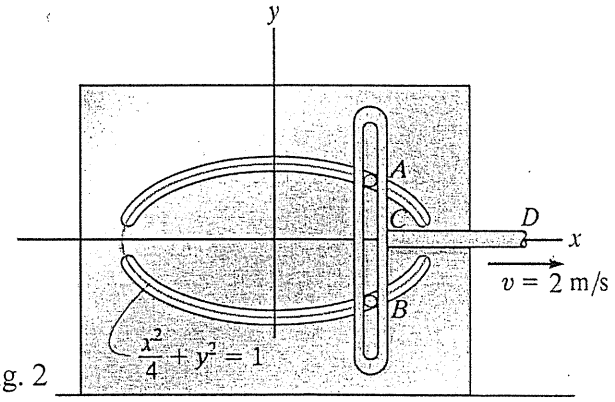

Fig. 2

3. Three steel spheres of equal mass and equal diameter are suspended from the ceiling by cords of equal length L that are spaced at a distance slightly greater than the diameter of the spheres. Initially, sphere A is pulled back by an angle θ and release from rest. As sphere A swings down, it hits sphere B, which then hits sphere C, as shown in Fig. 3. At its final status, sphere C reaches its highest position C'. Denoting the coefficient of restitution between the spheres by e, determine (a) the velocities of A and B immediately after the first collision; (b) the velocities of B and C immediately after the second collision; (c) the maximum swing angle θ' of sphere C after the second collision. The length of the cord is $L = 0.15$ m and the coefficient of the restitution is $e = 0.8$. (20%)

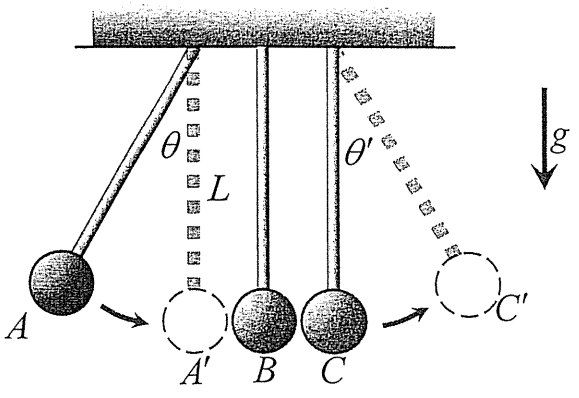

Fig. 3

4. End A of a uniform rod AB is attached to a 0.2 kg collar that can slide without friction on a vertical rod. The collar is connected by a spring k = 10 N/m End B of the rod is attached to a uniform rod BC. If the rod is released from rest in the position shown in Fig. 4, determine the velocity of the collar when it passes though the point D. The two rods AB and BC have identical mass m = 0.5 kg and identical length L = 50 cm. At the initial position, the angle is $\theta = 45°$ and the spring is un-stretched. (20%)

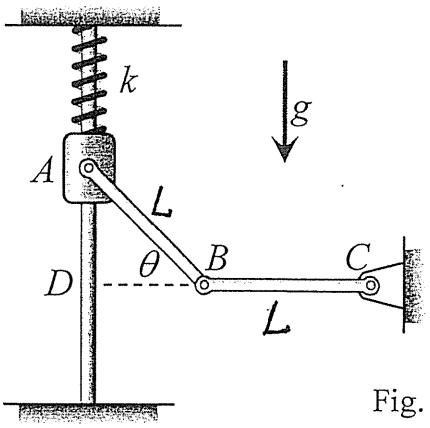

Fig. 4

5. A square plate of side length L = 0.12 m can rotate without friction about a pivot at its center O. The plate is connected by eight springs of equal spring constant k and eight dampers of equal damping constant c at its four corners, as shown in Fig. 5. If the plate is rotated by a small angle θ and then released from rest, (a) derive the equation of the motion of the plate; (b) determine the natural frequency of the vibration motion; and (c) discuss the effects of damping constants c on the transient vibration of the plate. The mass of the plate is m = 1.5 kg and the spring constant of the spring is k = 1000 N/m. All the springs are un-stretched when θ = 0. (20%)

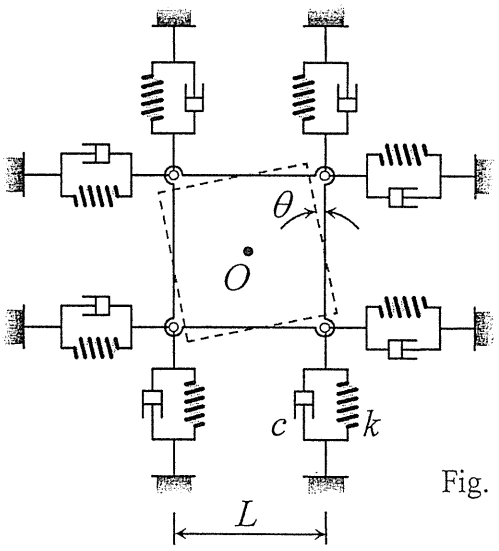

Fig. 5