國立成功大學

111學年度碩士班招生考試試題

編　號： 71

系　所： 機械工程學系

科　目： 動力學

日　期： 0219

節　次： 第 2 節

備　註： 可使用計算機

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※ 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. (20%) The roller at A is moving upward with a velocity of $\mathbf{v_a = 3\ ft/s}$ and has an acceleration of $\mathbf{a_a = 4\ ft/s^2}$ when $\mathbf{s_a = 4\ ft}$. Determine the velocity and acceleration of block B at this instant shown in Figure 1.

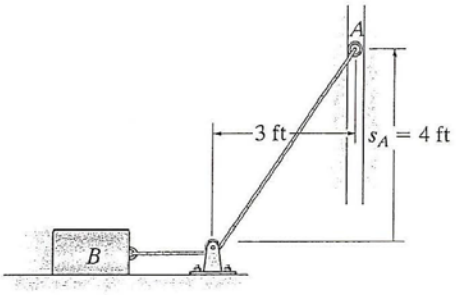

Figure 1

2. (20%) If the slotted arm **AB** rotates about the pin A with a constant angular velocity of $\omega_{AB} = \mathbf{10\ rad/s}$, please determine the angular velocity of link **CD** at the instant shown in Figure 2.

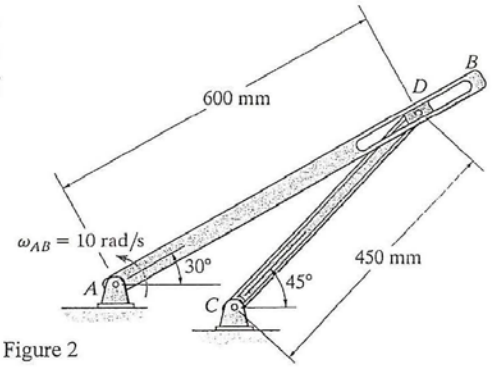

Figure 2

3. (20%) The uniform rods AB and BC with weights of 2 kg and 4 kg, respectively. The small wheel at C with negligible weight can freely slide along a 30° inline. If the mechanism is release from rest at the position shown in Figure 3, determine the velocity of pin B after the rod AB has rotated through 90°.

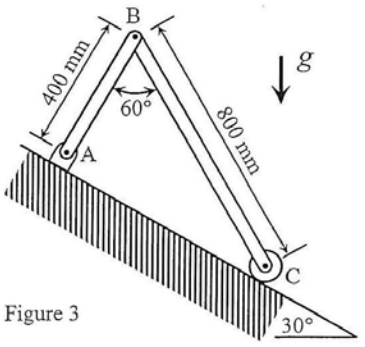

Figure 3

4. (20%) The slender uniform bar AB has mass M and is pivoted at A. The spring k and the damper c is connected to the bar's center C. The small object with mass m, initially at a position h vertically measured from pivot A, is release from rest and then collides at B, as shown in Figure 4. Before the collision, the bar is under equilibrium and an initial angle $\theta = \theta_0$ is observed. The roller D is used so that the line jointed by C and D is always in the vertical direction. After the collision, the object m is adhered on the bar, and the vibration motion of the bar is triggered. The parameters are given as follows: L = 200 mm, h = 50 mm, M = 1.5 kg, m = 0.1 kg, k = 300 N/m and c = 15 N-s/m.

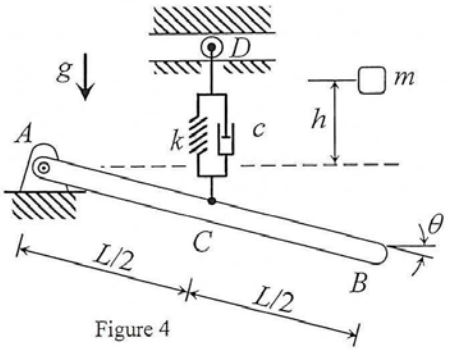

Figure 4

(a) Determine the angular velocity of the bar immediately after the collision. To solve this, you may use the angular momentum conservation principle. Please also explain why this principle can be used during the collision while the bar is subjected to external forces such as gravity force, spring force and damping force.

(b) Write the equation of the motion for the vibration motion in terms of θ and determine the natural frequency after the collision.

(c) Is this vibration underdamped, critically damped or overdamped? Give theoretical calculations to support your answer.

5. (20%) One end of a massless cable is connected to a small B with a mass of 0.3 kg, while the other end passes through a small hole C in a smooth table, as shown in Figure 5. A force F is applied to the cable so that it is pulled downward through the hole with a constant speed v_c = 750 mm/s. At its initial position, the ball is at the radial position r_1 = 500 mm from the hole and the circumferential component of the ball's velocity is v_1 = 600 mm/s. Determine (a) the speed of the ball at the instant that the radial position is r_2 = 300 mm from the hole; and (b) the work done by the force F during the motion from r_1 to r_2.

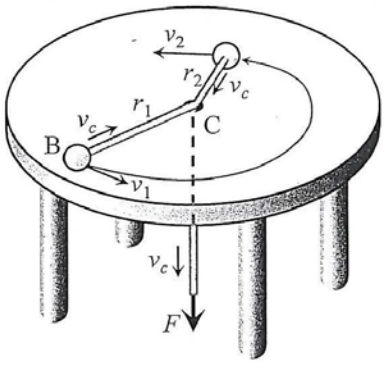

Figure 5