編號： 153

# 國立成功大學 109 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：0210，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. Explain the following terms: (18%)
   1) D'Alembert principal. (6%)
   2) Coefficient of kinetic friction. (6%)
   3) Equation of angular momentum. (6%)

2. As shown in Figure 1, slider Q with a mass of 2 kg slides along the semicircular rail DQE. The spring DQ is fixed to points D and Q by bolts, respectively. The spring constant k of the DQ is 300 N / m, and its unstressed length is the same as the rail radius R of 300 mm. It is assumed that the friction and spring mass can be ignored. After being pushed to the position of $\theta$ = 70°, it is released from rest. Try: (12%)
   (1) Tangent acceleration of Q, ($a_t$) (6%);
   (2) The reaction force of the rail to the slider. (6%)

Figure 1

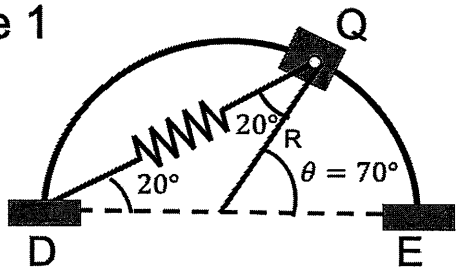
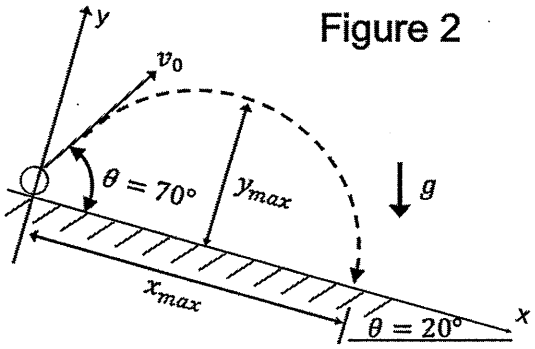
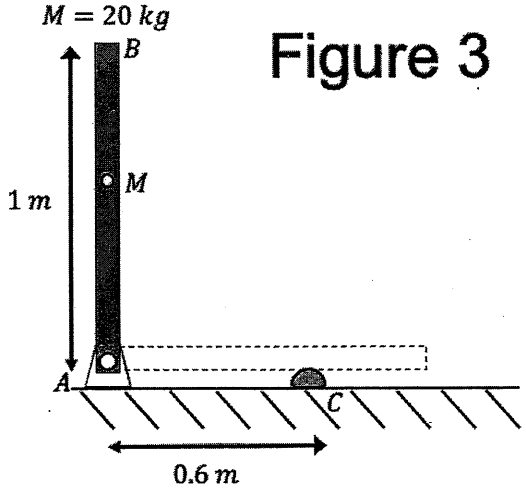



Figure 2




3. As shown in Figure 2, a small ball is projected on the 20° inclined plane. The initial velocity of the projectile is $V_0$ = 8 m/s, and the projection direction is 70° from the inclined plane. The coordinate axis direction x-y is shown in the figure. (18%) Try to determine the
   (1) landing time; (6%)
   (2) position of $X_{max}$ of the ball; (6%)
   (3) determine the speed of the ball $V_{max}$ when landing. (6%)

Figure 3




4. A slender homogeneous rod with a pin at point A drops from its original stationary vertical position, as shown in Figure 3. When it reaches the horizontal state, it hits a protrusion C on the ground and bounces upward. If the recovery coefficient of this collision is 0.7, find: (18%)
   (1) the angular velocity ω of the rod after the collision; (6%)
   (2) the maximum rotation angle $\theta_{max}$ after the rod rebounds; (6%)
   (3) if the collision lasts for 0.01 s, try to find the average impulse $F_{avg}$. (6%)

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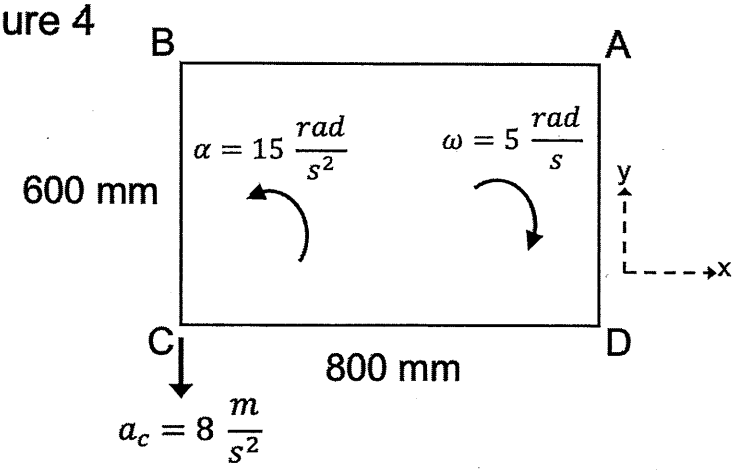
5. For the instant represented in Figure 4, corner C of the rectangular plate has an acceleration of 8 m/s$^2$ in the negative y-direction, and the plate has a clock wise angular velocity of 5 rad/s which is decreasing by 15 rad/s$^2$ each second. Determine the magnitude of the acceleration of A at this instant. Solve by (18%)
   (1) scalar-geometric; (9%)
   (2) by vector-algebraic methods. (9%)

Figure 4




6. The pendulum in the Figure 5 consists of a slender rod and a small ball with a mass of 5 kg, and a spring supports it horizontally and laterally at any time. It is assumed that the mass of the rod and the size of the ball are negligible. When the rod is vertical, the spring is at a free length. Try to find the natural frequency of this pendulum at small amplitudes. (16%)

Figure 5