國立成功大學
111學年度碩士班招生考試試題

編　號：153

系　所：生物醫學工程學系

科　目：工程力學

日　期：0219

節　次：第 2 節

備　註：可使用計算機

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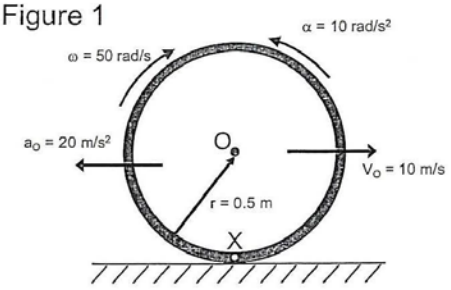
※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Explain the following terms: (20%)
   (a) The mathematical form of "center of mass" and "center of gravity." (4%)
   (b) D'Alembert's principle. (4%)
   (c) Beating phenomenon. (4%)
   (d) Conservative force. (4%)
   (e) Conservation of angular momentum. (4%)

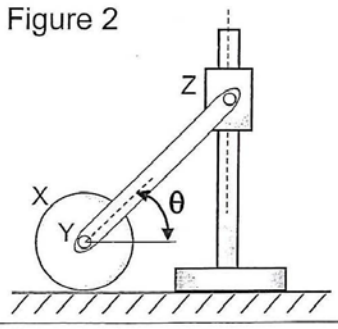
2. The hoop shown in Figure 1 is rotating on a rough surface and has an angular velocity ω = 50 rad/s and an angular deceleration α = 10 rad/s^2. The center of the hoop travels at a velocity of V_O = 10 m/s and a deceleration a_O = 20 m/s^2. Determine the acceleration of point X at this instant. (20%)

Figure 1



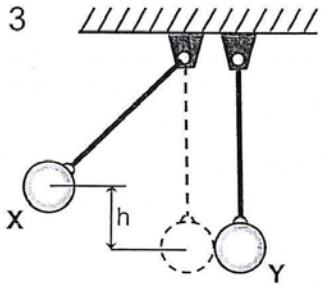
3. In Figure 2, the disk X is 50 kg and with the radius of 0.3 m rotates without slipping. The center of the disk is connected to a bar YZ with a mass of 5 kg and a length of 1.2 m. The other side of the bar YZ is connected to a collar Z sliding along a fixed vertical shaft. Assume at θ= 45°; the collar Z is sliding downward with velocity V_Z = 150 cm/s. Please determine the velocity V_Z of the collar Z when θ= 10°. (20%)

Figure 2



4. In Figure 3, two small balls X and Y with the same mass of 0.5 kg are hung up with equal-length and light-weight ropes. Released from still at the position with the height h = 0.5 m shown in the figure, the ball X starts to swing downward. (20%)
   (a) Immediately before the impact, what is the speed of the ball X? (6%)
   (b) Assuming that the collision is a center collision, what equation should be used to find the speed of each ball after the collision? (6%)
   (c) Assuming that the collision is plastic, what is the maximum ascent height of the two balls after the collision? (8%)

Figure 3



5. The tennis ball has a mass of 0.2 kg and enters the racket, as shown in Figure 4, with an initial velocity of $\vec{V}_{in} = 5\vec{\imath} + 2\vec{\jmath} - 10\vec{k}$. The player swings the racket to hit the ball that leaves the racket at the final speed $\vec{V}_{out} = 8\vec{\imath} + 3\vec{\jmath} + 20\vec{k}$. (20%)
   (a) What is the impulse $\vec{I}$ exerted by the racket on the tennis ball during the stroke? (10%)
   (b) Suppose the time of hitting the ball is 0.01 second. What is the average force F borne by the tennis ball? (10%)

Figure 4