編號： 130

# 國立成功大學 107 學年度碩士班招生考試試題

系　　所：系統及船舶機電工程學系

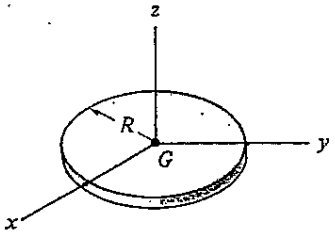
考試科目：動力學

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。

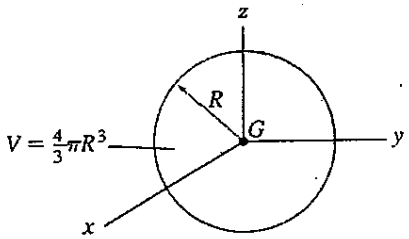
1. Show that the mass moment of inertia respect to the z axis of a thin circular disk is, $I_{zz}=\frac{mR^2}{2}$ , Fig. 1a, and for a sphere is $I_{zz}=\frac{2}{5}mR^2$, Fig.1b, where the m represents the mass of the thin disk or the sphere. Hint: density is ρ, and m=ρV (20%)




Thin circular disk

$I_{xx}=I_{yy}=\frac{1}{4}mR^2 \qquad I_{zz}=\frac{1}{2}mR^2$

Fig. 1a




Sphere

$I_{xx}=I_{yy}=I_{zz}=\frac{2}{5}mR^2$

Fig. 1b

2. The ball of mass *m* and radius *r* is cast onto the horizontal surface such that it rolls without slipping. Determine the minimum speed $v_G$ of its mass center G so that it rolls completely around the loop of radius $R+r$ without leaving the track. See Fig. 2. (20%)

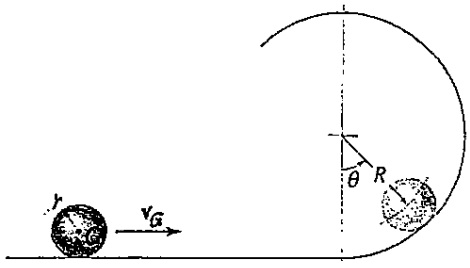



Fig. 2

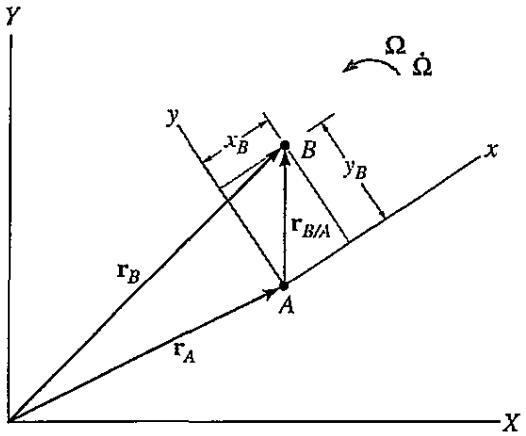



Fig.3

3. As shown in Fig. 3, the base point A represents the origin of the *x*, and *y* coordinate system, which is assumed to be both translating and rotating at angular velocity Ω and angular acceleration Ω̇ with respect to the X and Y system. ***Derive*** the formulas representing the **absolute velocity and acceleration of B** in terms of the absolute velocity $\mathbf{V_A}$ and the acceleration $\mathbf{a_A}$ of A, relative position vector, relative velocity and relative acceleration of B to A, $\mathbf{r_{B/A}}$, $\mathbf{V_{B/A}}$ and $\mathbf{a_{B/A}}$, respectively. (20%)

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4. Consider a system that gains mass. (a) Derive the equation of motion for the system shown by Fig. 4a. Notice that $v > v_i$ . (b) A chain of length *l*, Fig. 4b, has a mass *m*. Determine the magnitude of force **F** required to raise the chain with a constant speed $v_c$ starting from rest when y=0. (20%)

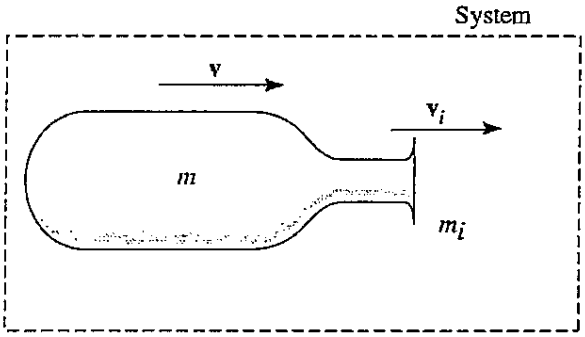


Fig. 4a

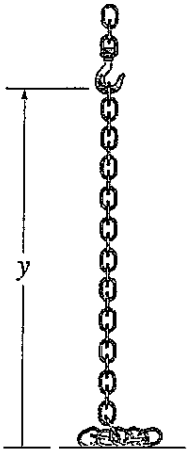


Fig. 4b

5. If the link AB is rotating at $\omega_{AB} = 3\ rad/s$, determine angular velocities of links BC and CD at the instant shown. See Fig. 5. (20%)

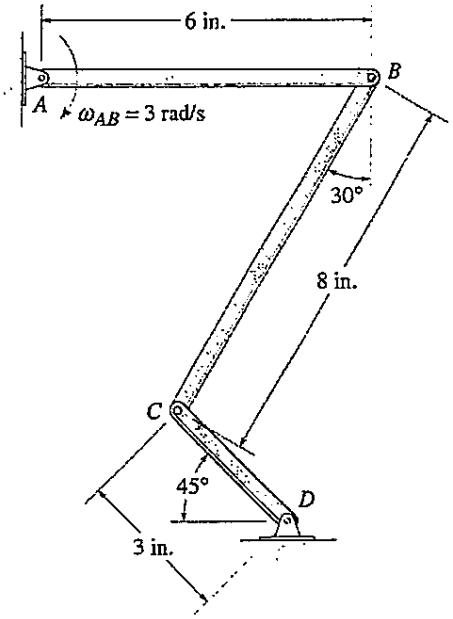


Fig. 5