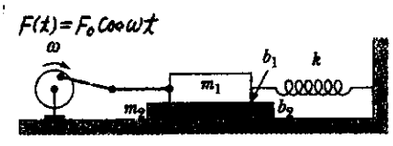
編號：E 47　系所：物理學系　　科目：古典力學

本試題是否可以使用計算機：□可使用 ，☑不可使用 （請命題老師勾選）

（每題25分，共100分）

1. Fig. 1 illustrates a mass m_1 driven by a sinusoidal force whose frequency is ω. The mass m_1 is attached to a rigid support by a spring of force constant k and slides on a second mass m_2. The frictional force between m_1 and m_2 is represented by the damping parameter b_1, and the frictional force between m_2 and the support is represented by b_2. (a) Find the coupled eqs. for x_1 & x_2; (b) By taking $F(t) = \mathrm{Re}\left[F_0 e^{i\omega t}\right]$, $x_1(t) = \mathrm{Re}\left[A_1 e^{i\omega t}\right]$, $x_2(t) = \mathrm{Re}\left[A_2 e^{i\omega t}\right]$ with F_0, A_1 & A_2 complex, find the solutions of x_1 & x_2.
2. As in fig. 2, a particle of mass m can slide freely along a wire AB whose perpendicular distance to the origin is h. The line OC rotates about the origin at a constant angular velocity $\dot{\theta} = \omega$. The position of the particle can be described in terms of the angle $\theta(t) = \omega t$ and the distance $q(t)$ to the point C. If the particle is subject to a gravitational force (i.e. $U = mgy$), find the eq. of motion for $q(t)$.
3. As in fig. 3, hard spheres of radius R_1 moving rightward are scattered by a hard sphere of radius R_2 at rest. Assume smooth surfaces and $m_1 << m_2$. (a) Show that the differential cross section is given by $\sigma(\psi) = \dfrac{-b}{\sin\psi}\dfrac{db}{d\psi}$, where b is the impact parameter and ψ the scattering angle; (b) Find $b(\psi)$ and then $\sigma(\psi)$.
4. As in fig. 4, calculate the inertia tensor of a homogeneous cube of density ρ, sides of length b, with the center of mass at the origin and three adjacent edges along the coordinate axes.



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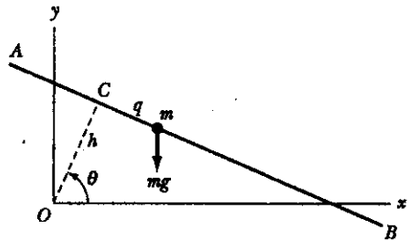

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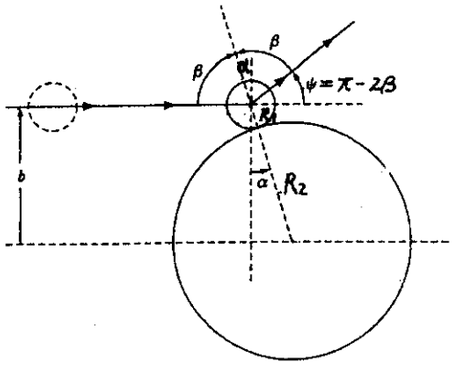

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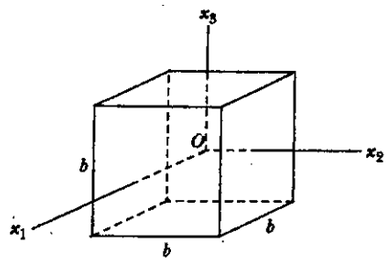

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