系所組別：航空太空工程學系丙組

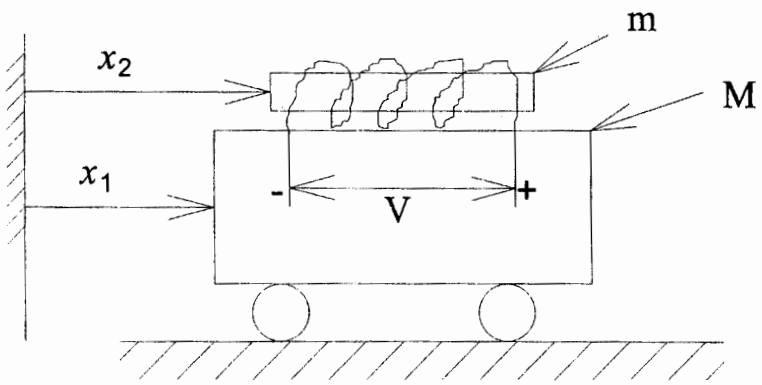
考試科目：動力學 考試日期：0223，節次：2

※ 考生請注意：本試題不可使用計算機

1. A particle of mass m is projected vertically upward at z=0, with an initial velocity v_0. Assuming for an upward velocity $v \geq 0$, there is a square-law drag force bv^2, where b is constant. Express v as a function of the vertical displacement and find the maximum height of the particle. (20%)

2. Particles $m_1=2m$ and $m_2=m$ can slide without friction on parallel fixed horizontal wires separated by a distance h. A spring of stiffness k and unstressed length h connects the two particles. If m_1 has an initial velocity v_0, m_2 is initially motionless, and the spring is initially unstressed, find: (a) the maximum velocity v_2 of m_2; (b) the maximum stretch δ of the spring. (30%)

3. Consider the system shown below, where mass m is a magnetic bar and is sliding in a solenoid that is mounted on a cart of mass M. Let x_1 and x_2 be the absolute positions of M and m, respectively. A force F is applied to m in the positive x_2 direction if a positive voltage V is applied to the solenoid, and $F=\mu V$, where μ is a constant. For simplicity, let $\mu=1$. Suppose friction is negligible.



   a. Derive the governing equation of the system. (4%)
   b. At this moment both M and m are still at the position $(x_1, x_2) = (0,0)$. You are asked to design V(t) to move both masses to the position $(x_1, x_2) = (1,1)$ in 10 seconds. Please design V(t), or, explain why you cannot do it? (8%)

(背面仍有題目,請繼續作答)

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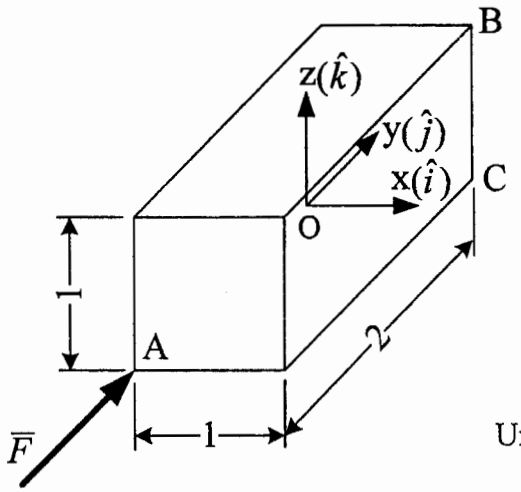
4. A 12kg uniform rectangular block with mass center O is shown below. At this moment, point O has a velocity $\bar{V} = 2\hat{\imath} + 3\hat{\jmath}\ \mathrm{m/s}$, and the block is rotating with an angular velocity $\bar{\omega} = 1\hat{\imath} + 1\hat{\jmath} + 1\hat{k}\ \mathrm{rad/s}$.
   a. Find the inertia matrix of the block with respect to the frame (x, y, z). (3%)
   b. Find the moment of inertia about the axis $\overline{AB}$. (7%)
   c. Find the angular momentum of the block. (3%)
   d. A force $\bar{F} = 1\hat{\jmath}\ \mathrm{N}$ is applied at corner A. Find the acceleration at corner C. (15%)
   e. At this moment, what is the power delivered to the block by the force $\bar{F}$? (10%)



Unit : m