1. The winch （絞盤）W is drawing in cable at a constant rate of 2 m/s as shown in Fig. 1. Determine the velocity of the counterweight C relative to elevator E.

2. Consider a particle of mass m subject to a central force potential $U = U(r)$. Show that
   (i) The mechanical energy $E = mv^2/2 + U(r)$ is conserved, where v is the magnitude of the velocity of the particle.
   (ii) The motion is planar, and
   (iii) The rate of change of the area swept by its radius vector is constant.

3. (25%) A sphere of mass m and radius r is projected along a rough horizontal surface with a forward linear initial velocity v_0 and a counterclockwise angular velocity ω_0. If the final velocity of the sphere is to be zero, express (a) the required ω_0 in terms of v_0 and r, (b) the time required for the sphere to come to rest in terms of v_0 and the coefficient of friction μ_k.

4. A pendulum with mass of $m = 0.2$ kg and length of 1.0 m has an angular velocity of 3.0 rad/s when $\theta = 75°$. Suddenly, the motion of the pendulum is interrupted by a small peg located 0.6 m directly under the support as shown in Fig. 2. Determine the velocity of the mass and the corresponding tension in the cord
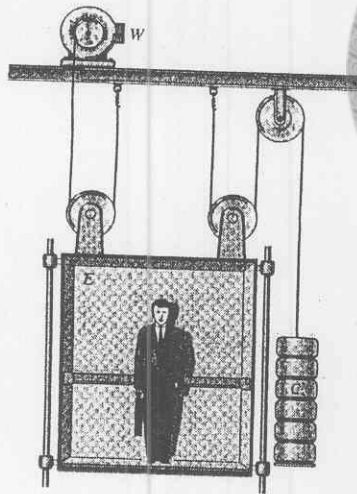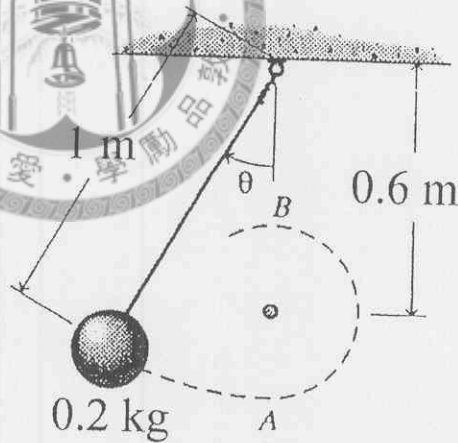   (a). At position A.　　(b). At position B.

Fig. 1

Fig. 2.

試題隨卷繳回