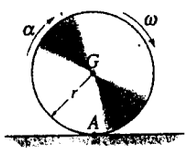
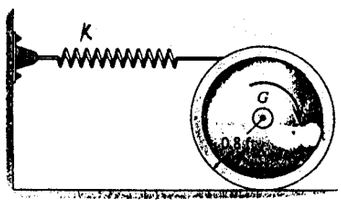
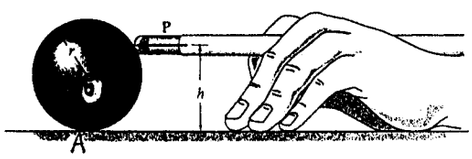
B1. At a given instant, the cylinder has an angular velocity ω and angular acceleration α. Derive the velocity and acceleration of its center if it rolls without slipping. (10%)



B2. The wheel weighs 40 lb, and has a radius of gyration R = 0.6 ft about its mass center G. It is subjected to a clockwise couple moment 150 lb-ft and rolls from rest without slipping. The spring has a stiffness k and is initially unstretched when the couple moment is applied. Determine the smallest stiffness k so that the angular velocity of the wheel will not exceed 6.5 rad/s after its center moves 0.5 ft. (25%)



B3. The ball of mass m must be struck by the horizontal force P. Determine the height h so that no frictional force develops between it and the table at A. ($I_O = 2mr^2/5$) (15%)



(背面仍有題目,請繼續作答)

A1. (a) What is the "conservative force"?(5%)
(b) If **F** is a conservative force, show that $\nabla \times F = 0$, where $\nabla = (\partial/\partial x)i + (\partial/\partial y)j + (\partial/\partial z)k$, and **i**, **j**, and **k** are unit vectors along x, y, and z axes, respectively.(10%)

A2. The crate has a mass of 1000 kg and rests on a surface, as shown in Fig.2, for which the coefficients of static and kinetic friction are $\mu_s = 0.4$ and $\mu_k = 0.3$, respectively. If the motor M supplies a cable force of $\mathbf{F} = (60t^2 + 100)$N, where t is in second, determine the power that must be supplied to the motor when t=10 sec. The motor has an efficiency $\varepsilon = 0.8$. (20%)

A3. The 200-kg roller-coaster car starts from rest on the track, as shown in Fig.3, having the shape of a cylindrical helix. If the helix descends 4 m for every one revolution, determine the time required for the car to attain a speed of 20 m/s. Neglect friction and the size of the car.(15%)

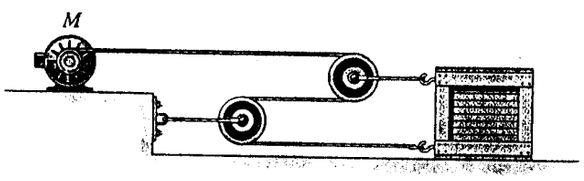


Fig.2

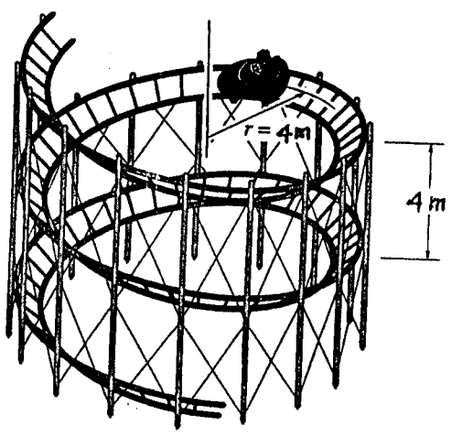


Fig.3