1. Arm AB rotates clockwise at the constant rate of 40 rad/s as it pushes the slider along guide CD, which is described by $y = x^2/200$ (x and y are in millimeters). Determine the velocity and acceleration of the collar when it is at the position $x = 200$ mm.

(20%)

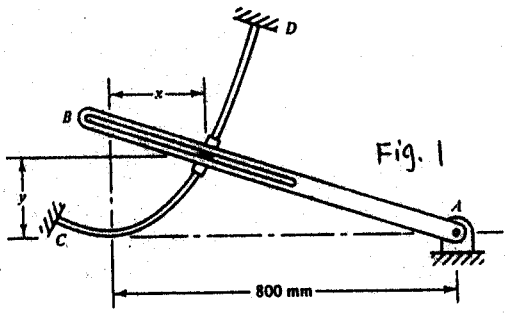

Fig. 1

2. The slender, 200-kg beam is suspended by a cable at its end as shown. If a man pushes on its other end with a horizontal force of 30 N, determine the initial acceleration of its mass center G, the beam's angular acceleration, the tension in the cable AB, and the initial acceleration of the end A. (20%)

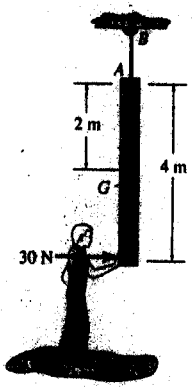

Fig. 2

3. The ball B, shown in Fig. 3, has a weight of 0.8 lb and is attached to a cord which passes through a hole at A in a smooth table. When the ball is $r_1 = 1.75$ ft from the hole, it is rotating around in a circle such that its speed is $v_1 = 4$ ft/s. If by applying a force F the cord is pulled downward through the hole with a constant speed $v_c = 6$ ft/s, determine *(a)* the speed of the ball at the instant it is $r_2 = 0.6$ ft from the hole, and *(b)* the amount of work done by the force F in shortening the radial distance r. Neglect the size of the ball.

(20%)

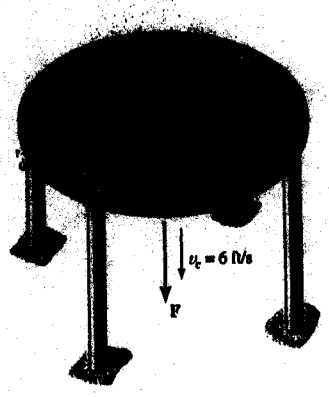

Fig. 3

4. A sphere of radius r and mass m is placed on a horizontal surface with no linear velocity but with a clockwise angular velocity ω_0. Denoting by μ_k the coefficient of kinetic friction between the sphere and the floor, determine *(a)* the time t_1 at which the sphere will start rolling without sliding, *(b)* the linear and angular velocities of the sphere at time t_1.

(20%)

Fig. 4

5. A 10-kg block is suspended from a cord wrapped around a 5-kg disk, as shown in Fig. 5. If the spring has a stiffness $k = 200$ N/m, determine the natural period of vibration for the system.

(20%)

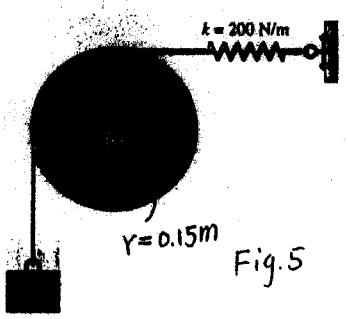

Fig. 5