1. The set up shown in Fig. 1 is held steady by the force f_1. If f_1 =10 lb, what does the scale read ? (25%)

2. A particle of mass m moves in a smooth horizontal slot in a disc which rotates about a vertical axis, through O, with a constant angular velocity ω, as shown in Fig.2. At time t = 0 the particle is at y = 0 and has velocity $y = v_0$ relative to the slot. Derive expressions for the displacement of the particle, y, and N, the horizontal reaction between the slot and the particle, as functions of time. (20%)

3. A uniform bar of length L and mass m is at rest on a smooth horizontal surface. A particle, also of mass m, moving with speed v_0 along the surface strikes the rod at the end, as shown in Fig. 3. If the particle sticks to the bar calculate the angular velocity of the bar and particle after the impact. I_G for the bar is $ML^2/12$. (15%)

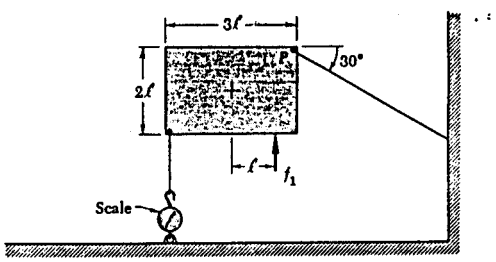

Fig. 1

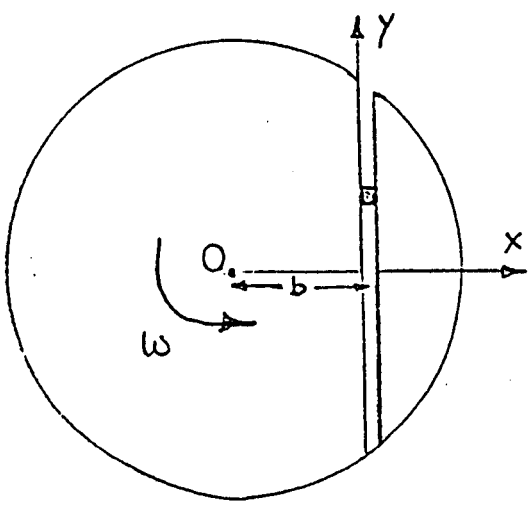

Fig. 2

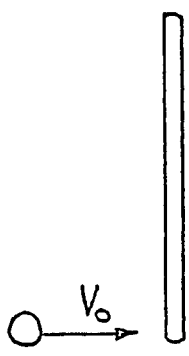

Fig. 3

4. A uniform rod AB of length L and mass m is freely pinned at A to a vertical axle DE which rotates with a constant angular velocity ω, as shown in Fig.4. The rod is kept at a constant angle β to the horizontal by means of a horizontal wire BC. Determine the tension in the wire. The pin at A has a horizontal axis. The centre of the axle DE is fixed in an inertial framework. (15%)

5. The rectangular block, which is solid and homogeneous, is supported at its corners by small rollers resting on horizontal surfaces, as shown in Fig. 5. If the supporting surface at B is suddenly removed, determine the expression for the initial acceleration of corner A. (25%)

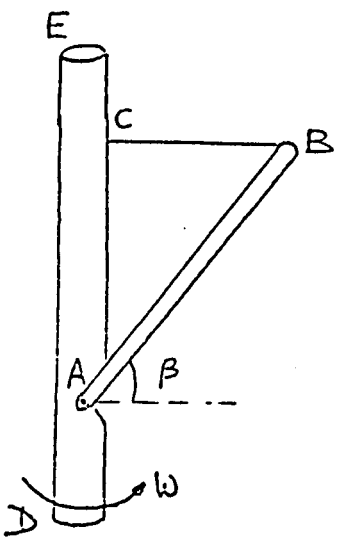

Fig. 4

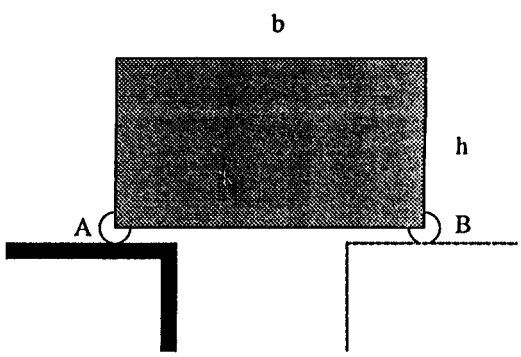

Fig. 5