

1. Briefly describe the following terms. (15%)
 - (a) Rigid Body
 - (b) Coriolis acceleration
 - (c) Center of percussion
 - (d) Principal axis of inertia
 - (e) Euler's equation
 - (f) Inertial system
 - (g) Perigee and Apogee
 - (h) Natural Frequency

2. A heavy elevator is descending vertically at a uniform speed V_0 m/sec. A light ball is bouncing vertically up and down the floor of the elevator. It is found that the time between each bounce is a constant equal to T seconds. Deduce the coefficient of restitution between the ball and the floor. (20%)

3. A constant force F is applied in the vertical direction to the symmetrical linkage shown in Figure 3. If the link begins in the rest position at an angle θ_0 to the horizontal, determine the angular velocity of link AB when it is horizontal.

Each link has mass m_0 , length L and centroidal mass moment of inertia $\bar{I}_L = \frac{1}{2}m_0L^2$. The wheel may be considered as a solid circular disk of mass m , radius r , and centroidal moment of inertia $\bar{I}_w = \frac{1}{2}mr^2$, which rolls without slip. (15%)

4. A triangle represented by ABC is initially in the position shown in Figure 4.1. After a rotation about certain axis passing through the center, O , the final position is indicated in Figure 4.2. Find
 - (a) the location of the rotation axis; (10%)
 - (b) the magnitude of the rotation angle. (10%)

5. A force F is suddenly applied normally to the uniform plate shown in Figure 5. Where should the force be applied if the reaction at the ball and socket support, i.e., point O , is zero. (There is no gravitational force and $I_{X'} = \frac{mL^2}{12}$, $I_{Y'} = \frac{mL^2}{3}$.) (20%)

6. A circular disc (lamina) of radius R has a mass center G a distance b from the geometric center. Initially the disc is held at rest in contact with a smooth vertical wall and a smooth horizontal floor. It is released from rest in the positions shown in Figure 6. Is the initial angular acceleration the same in both cases? Justify your answer carefully. (Note that the disc is initially touching the vertical wall and may or may not remain in contact.) (10%)

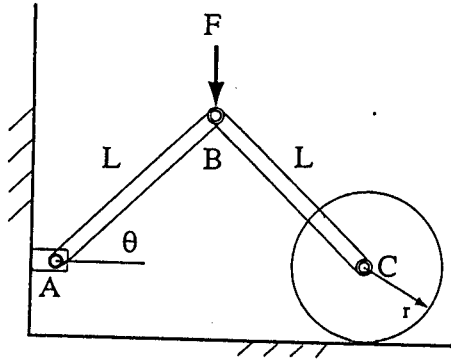


Figure 3

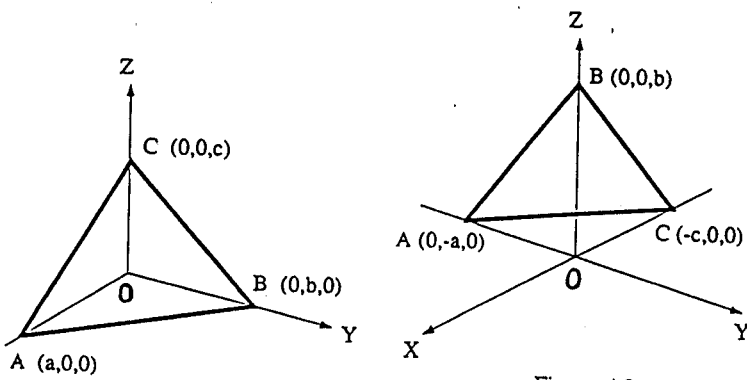


Figure 4.1

Figure 4.2

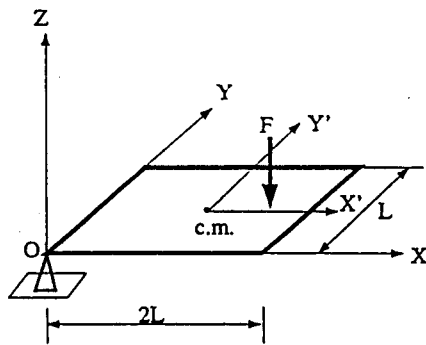
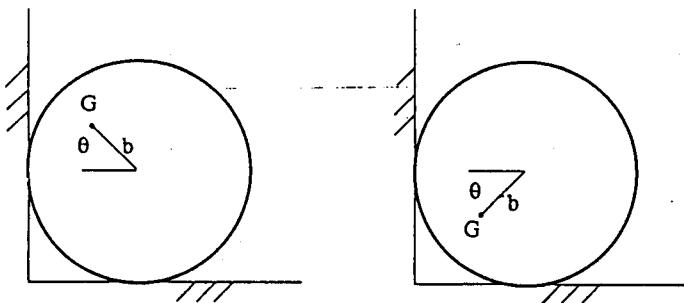


Figure 5



The angle θ is the same in both cases.

Figure 6