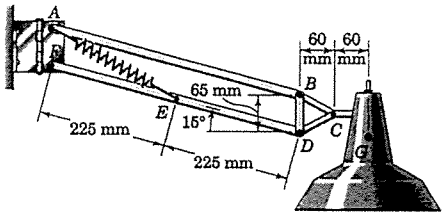
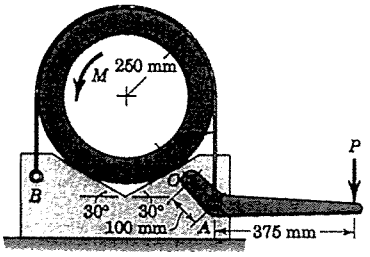
[Note: refer to the figures on bottom for the corresponding problems]

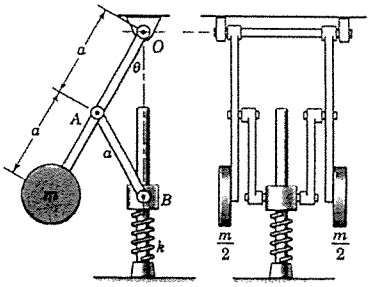
1. The designers of lamp mechanisms, shown in the figure, usually rely on joint friction to aid in maintaining static equilibrium. Here assume that sufficient friction exists at point C to prevent rotation, but ignore friction at all other joints. If the mass of the lamp fixture is 0.6 kg with mass center at G, determine the spring force F_s necessary for equilibrium in the position shown. (20 points)
2. Find the couple M required for the design of the band brake shown to turn the pipe in the V-block against the action of the flexible band. A force $P = 100$ N is applied to the lever, which is pivoted about O. The coefficient of friction between the band and the pipe is 0.3, and that between the pipe and the block is 0.4. The weights of the parts are negligible. (15 points)
3. In the mechanism shown the spring of stiffness k is uncompressed when $\theta = 60°$. Also the masses of the parts are small compared with the sum m of the masses of the two cylinders. The mechanism is constructed so that the arms may swing past the vertical, as seen in the right-hand side view. **Please use the principle of virtual work** to determine the values θ for equilibrium and investigate the stability of the mechanism in each position. Neglect friction. (15 points)
4. A small block having a mass of 0.1 kg is given a horizontal velocity of $v_1 = 0.4$ m/s when $r_1 = 500$ mm. It slides along the smooth conical surface. Determine the distance h it must descend for it to reach a speed of $v_2 = 2$ m/s. Also, what is the angle of descent θ, that is, the angle measured from the horizontal to the tangent of the path? (15 points)
5. Determine the vertical and horizontal components of reaction at the pin support A and the angular acceleration of the 12-kg rod at the instant shown, when the rod has an angular velocity of $\omega = 5$ rad/s. (15 points)
6. The 25-kg square plate is pinned at corner A and attached to a spring having a stiffness of $k = 300$ N/m. If the plate is released from rest when $\theta = 0°$, determine its angular velocity when $\theta = 90°$. The spring is unstretched when $\theta = 0°$. (20 points)



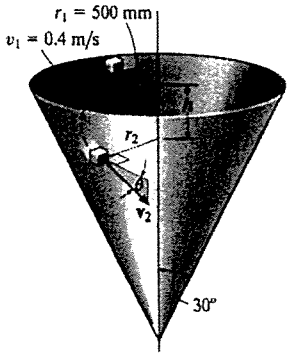
Problem 1



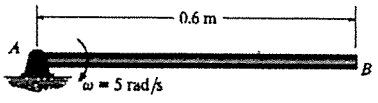
Problem 2



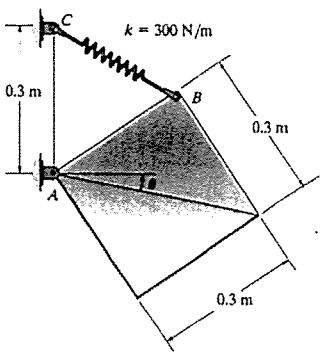
Problem 3



Problem 4



Problem 5



Problem 6

試題隨卷繳回