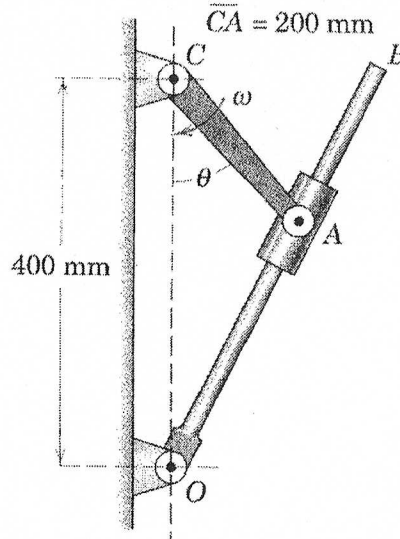
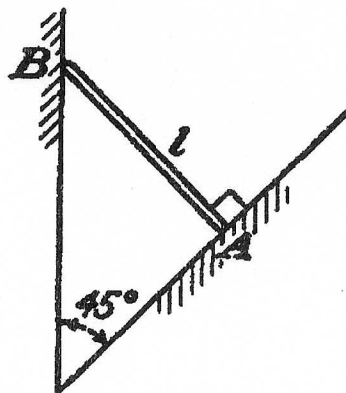


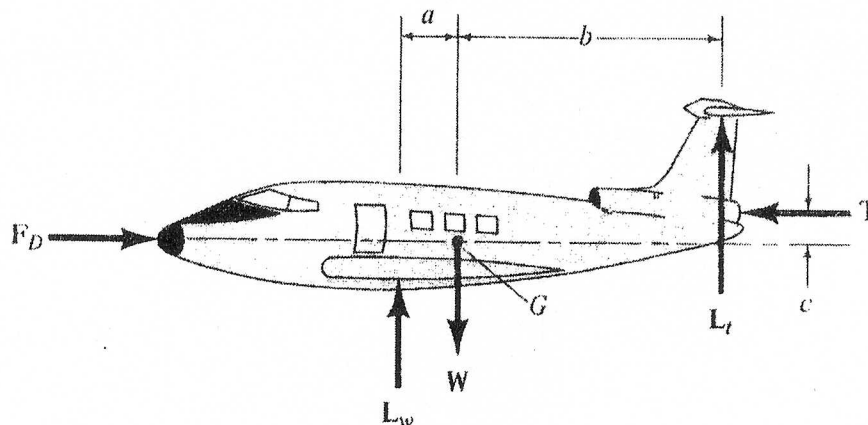
1. Link  $OB$  slides through the pivoted collar at  $A$ . If  $OC = 400$  mm,  $CA = 200$  mm, and link  $CA$  rotates clockwise with a constant angular velocity of 5 rad/sec, calculate the angular velocity and acceleration of link  $OB$  when  $\angle OCA = 90^\circ$ . (20%)



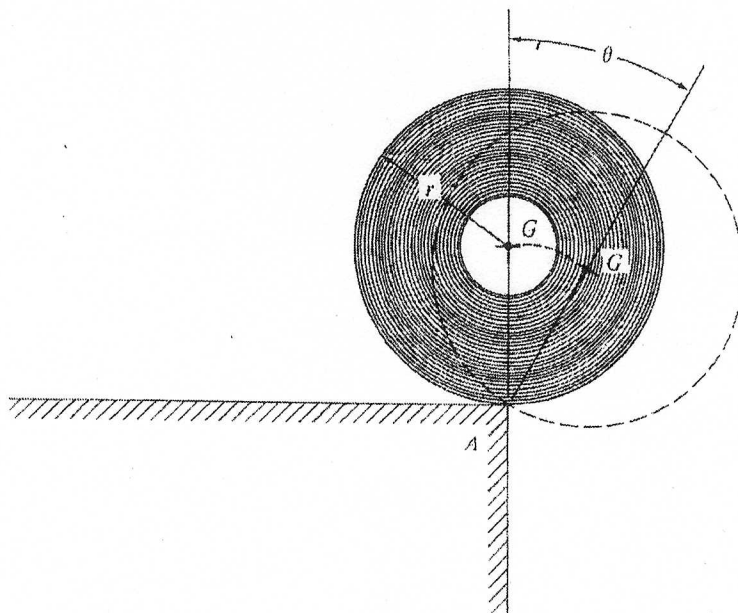
2. A uniform ladder of length  $l$  rests at  $A$  on a 45-deg incline and at  $B$  against a vertical wall. The ladder itself is also at 45 deg so that it is perpendicular to the incline at  $A$ . Assuming no friction at  $B$ , what coefficient of friction at  $A$  is necessary to prevent slipping? (15%)



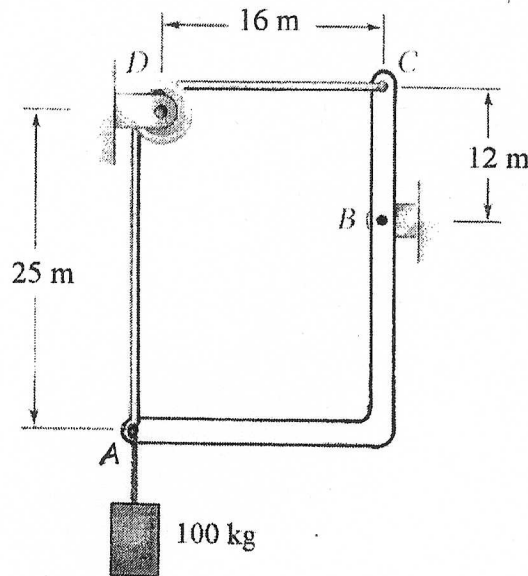
3. The forces acting on the jet aircraft, which is flying level at constant velocity, must be in equilibrium. If the aircraft has a mass of  $m = 10,000$  kg, and the jet provides a thrust which has a magnitude of  $T = 5$  kN, determine the lift provided by both wings  $L_w$ , and tail  $L_t$ , and the air resistance of drag  $F_D$ . The weight  $W$  of the aircraft acts through the center of gravity  $G$  as shown. Set  $a = 1$  m,  $b = 7$  m, and  $c = 0.8$  m. (15%)



4. A large roll of paper having a mass of  $m = 20$  kg and radius  $r = 150$  mm is resting over the edge of a table, such that the end of the paper on the roll is attached to the table's surface. If the roll is disturbed slightly from its equilibrium position, using the conservation-of-energy theorem, determine the angle  $\theta$  at which it begins to leap off the table edge  $A$  as it falls. The centroidal radius of gyration of the roll is 75 mm. (20%)



5. Member  $ABC$  is supported by a pin and bracket at  $B$  and by an inextensible cord attached at  $A$  and  $C$  and passing over a frictionless pulley at  $D$ . A  $100\text{ kg}$  mass is hanged at  $A$ . The tension may be assumed to be the same in portion  $AD$  and  $CD$  of the cord. If  $AD = 25\text{ m}$ ,  $CD = 16\text{ m}$ ,  $BC = 12\text{ m}$  and neglecting the size of the pulley, determine the tension in the cord and the reaction at  $B$ . (15%)



6. A homogeneous disk of radius  $r$  and mass  $m$  is mounted on an axle  $OG$  of length  $R$  and negligible mass. The axle is pivoted at the fixed point  $O$ , and the disk is constrained to roll on a horizontal floor. Knowing that the disk rotates counterclockwise at the rate  $\omega_1$  about the axle  $OG$ , determine (a) the angular velocity of the disk, (b) its angular momentum about  $O$ , (c) its kinetic energy. (15%)

