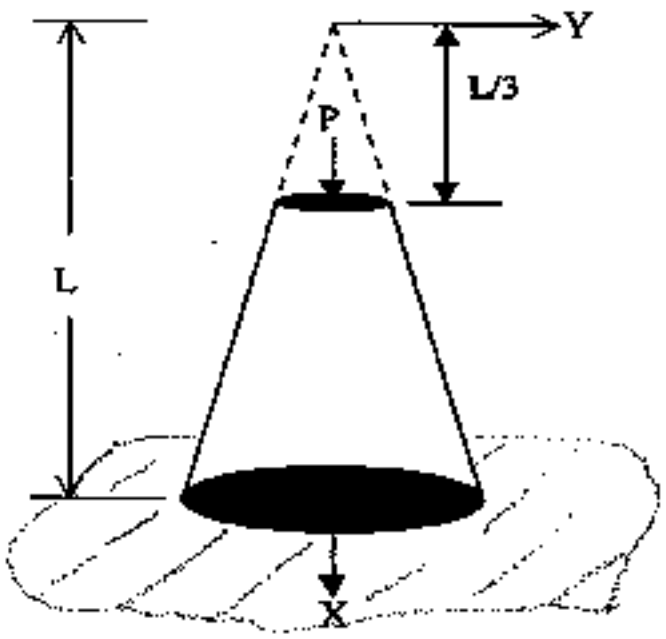
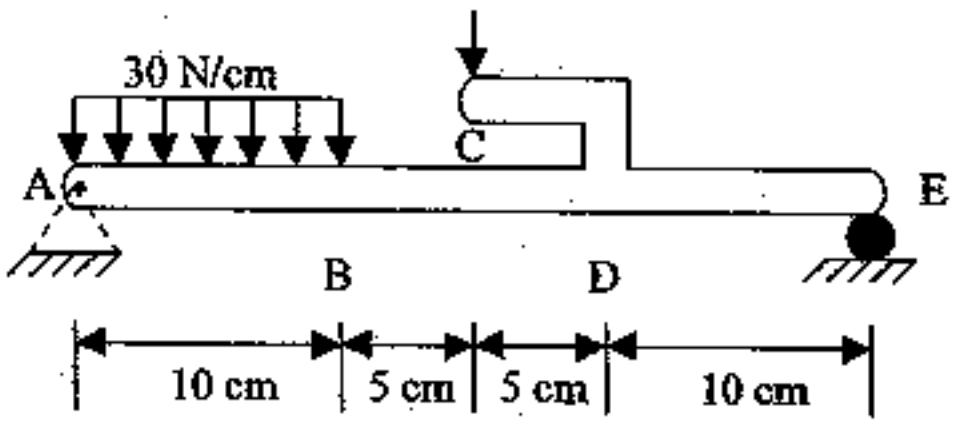
1. Answer or explain the following problems: (20%)
   (a) Plot the stress-strain diagram for a typical structural steel (mild steel) in tension and point out the yield point, proportional limit, point of ultimate stress, and fracture point in the diagram.
   (b) Shear flow in beams
   (c) Improperly constrained structure
   (d) Principal moments of inertia of areas

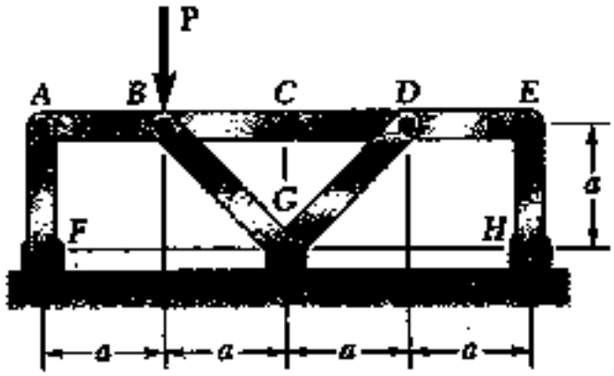
2. Determine the change in length of the homogeneous tapered bar, as shown in the figure, due to it own weight and the load P applied at the centroid of the upper surface. Express the results in terms of P, L, b, and the modulus E and the specific weight γ of the material. The taper of the bar is slight enough for the assumption of a uniform axial stress distribution over a cross section to be valid. (20%)



3. Plot the shear and bending moment diagrams for the mechanical link AE. The distributed load of 30 N/cm extends from A to B , and the 200 N load is applied at C. (20%)



4. Members ABC and CDE are pin-connected at C and supported by four links. For the loading shown, determine the force in each link. (20%)



5. Bar AB is attached to collars which may slide on the inclined rods shown. A force $\boldsymbol{P}$ is applied at point D located at a distance a from end A. Knowing that the coefficient of static friction μ_s between each collar and the rod upon which it slides is 0.3 and neglecting the weights of the bar and of the collars, determine the smallest value of the ratio a/L for which equilibrium is maintained. (20%)