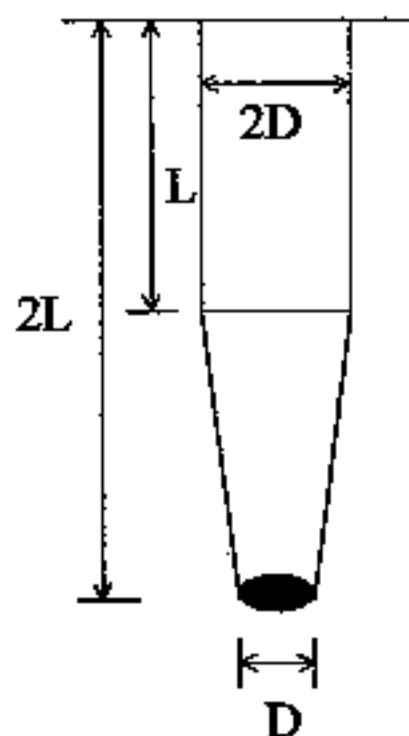


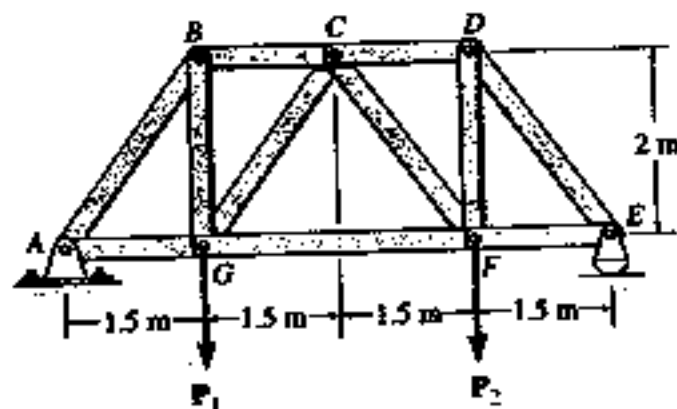
1. Explain the following terms: (20%)

- (a) Modulus of toughness
- (b) Pure torsion of a circular bar
- (c) Neutral surface of a beam
- (d) Effective length of a column

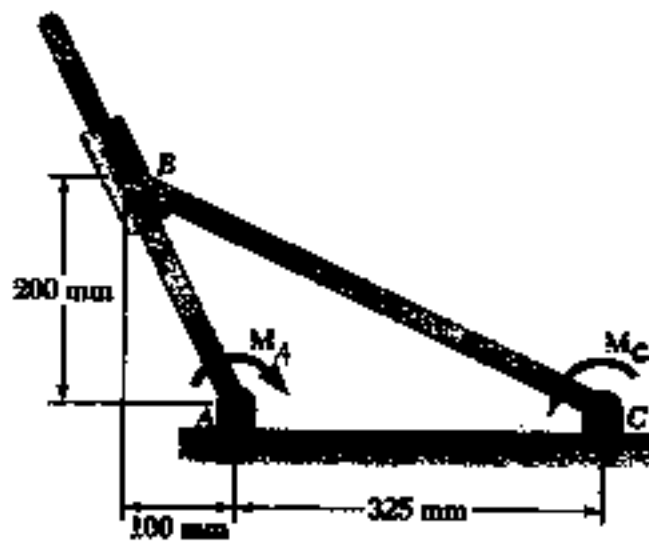
2. As shown in the figure, the bar is composed of two segments, the upper segment is a prismatic bar with the diameter of $2D$ and length of L , the lower segment is a tapered bar with the length of L and diameter of D at the end. Assuming γ and E are the weight density and modulus of elasticity of the bar, respectively. Determine the strain energy of the bar if the only load of the bar is the weight of the bar itself. (20%)



3. Determine the force in members GF and CG , and DE of the truss and state if the members are in tension or compression. If $P_1 = 30$ kN and $P_2 = 60$ kN. (20%)



4. Two rods of negligible weight are connected by a collar at B . A couple M_A of magnitude 15 N-m is applied to rod AB . Knowing that the coefficient of static friction $\mu_s = 0.3$ between the collar and rod AB , determine the range of couple M_C for which equilibrium will be maintained. (20%)



5. Two equal wheel loads P , distance $L/4$ apart, move slowly across a simple beam AB of span length L and flexural rigidity EI . Determine the maximum value of the deflection δ_C at the midpoint of the beam. (20%)

