1. A simply-supported beam (see Fig. 1) having a width w of 0.25 m, a thickness $2b$ of 0.5 m, and a length L of 10 m is made of a material with a specific weight ρg of 75 kN/m^3.
(a) Please draw the shear and moment diagrams of the beam due to weight.(10%)
(b) Please derive the maximum shear and bending stresses of the beam. (10%)

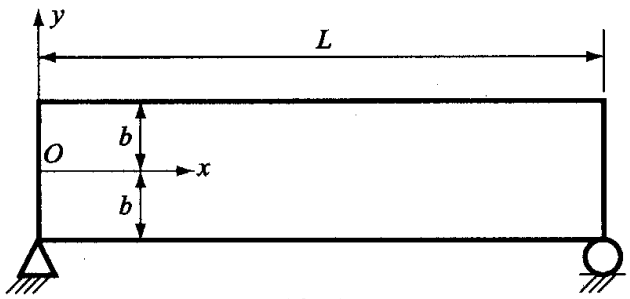

Fig. 1

2. A beam is constructed from three boards bolted together as shown in Fig.2. Determine the shear force developed in each bolt if the bolts are spaced $s = 300$ mm apart and the applied shear is $V = 30$ kN. (20%)

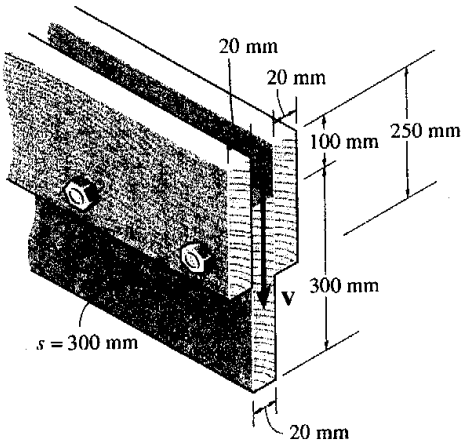

Fig. 2

3. An element in plane stress at the surface of a machine is subjected to stresses σ_x=120 N/mm^2, σ_y=45 N/mm^2, and τ_{xy}=30 N/mm^2 in Fig. 3. Using Mohr's circle, determine (a) the stresses acting on an element inclined at an angle θ=45°, (b) the principal stresses, and (c) the maximum shear stresses. (Consider only the in-plane stresses.) (20%)

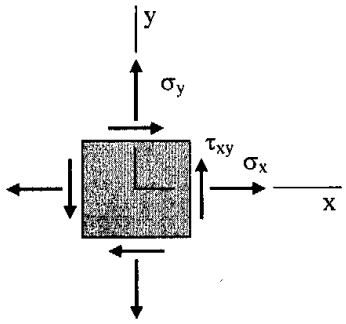

Fig. 3

4. The simple beam ABCD with an overhang supports two concentrated loads P and Q (see Fig. 4). For what ratio P/Q will the deflection at point D be zero? (The flexural rigidity EI is constant throughout the beam.)(20%)

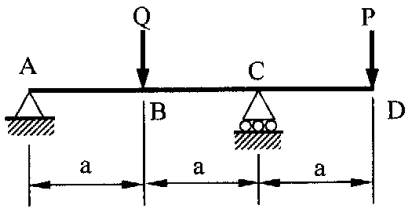

Fig. 4

5. Find the forces in the member as shown in Fig. 5 by using ONLY **Method of Virtual Work**. Take E= 30 x 10^6 psi and A= 724.1 in.^{2} for each member. (20%)

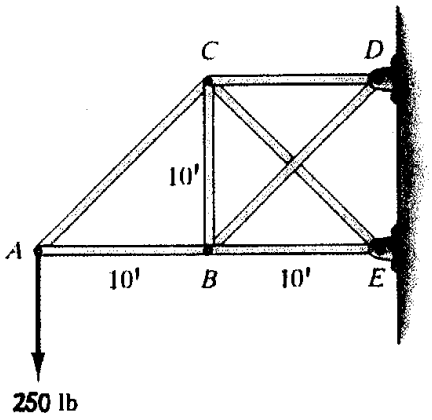

Fig. 5