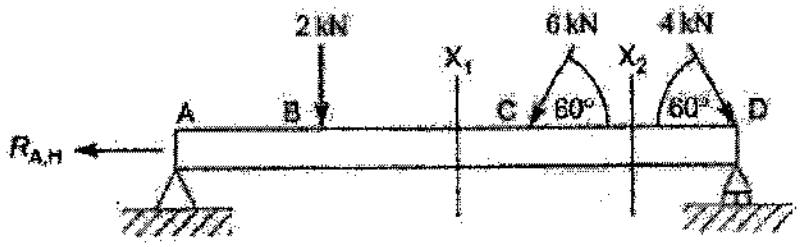
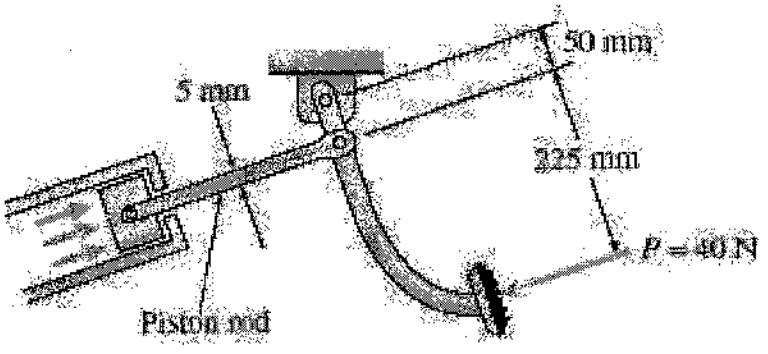
1- The figure shows a beam ABCD supporting three concentrated loads, two of which are inclined to the longitudinal axis of the beam. Construct the normal force diagram for the beam and determine the maximum value. [Mark:10]



2- A short, deep cantilever beam is 500 mm long by 200 mm deep and is 2 mm thick. It carries a vertically downward load of 10 kN at its free end. Assuming that the shear stress is uniformly distributed over the cross section of the beam, calculate the deflection due to shear at the free end. Take G=25 000 N/mm^2. [Mark:10]

3- A cube of material is subjected to the following direct stress system: σ_x=+120 N/mm^2, σ_y=+80 N/mm^2 and σ_z=-100 N/mm^2. If Young's modulus, E, is 200 000 N/mm^2 and Poisson's ratio, ν, is 0.3 calculate the direct strain in the x, y and z directions and hence the volumetric strain in the cube. [Mark:10]

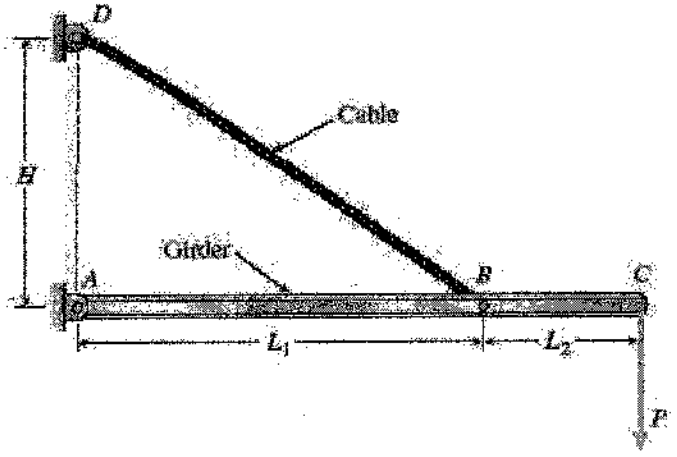
4- Calculate the compressive stress in the circular piston rod (see figure) when a force P= 40 N is applied to the brake pedal. Assume that the line of action of the force P is parallel to the piston rod, which has diameter 5 mm. Also, the other dimensions shown in the figure (50 mm and 225 mm) are measured perpendicular to the line of action of the force P. [Mark:10]



5- A loading crane consisting of a steel girder ABC supported by a cable BD is subjected to a load P (see figure). The cable has an effective cross-sectional area A = 0.471 in^2. The dimensions of the crane are H = 9 ft, L_1 = 12 ft, and L_2 =4 ft. [Mark:10]

(a) If the load P = 9000 lb, what is the average tensile stress in the cable?

(b) If the cable stretches by 0.382 in., what is the average strain?



6- If σ_x = 84 MPa, σ_y = - 30 MPa, τ_{xy} = - 32 MPa, determine the principal stresses and maximum shear stress and their directions. [Mark:10]

7- If σ_x = 100 MPa, σ_y = 34 MPa, τ_{xy} = 28 MPa, determine the stresses on the face of $\theta = 40°$. Use Mohr's Circle for Plane Stress to determine σ_1, σ_2 and τ_{max}. [Mark:10 + 5 Bonus]

Assume any missing data

Good luck