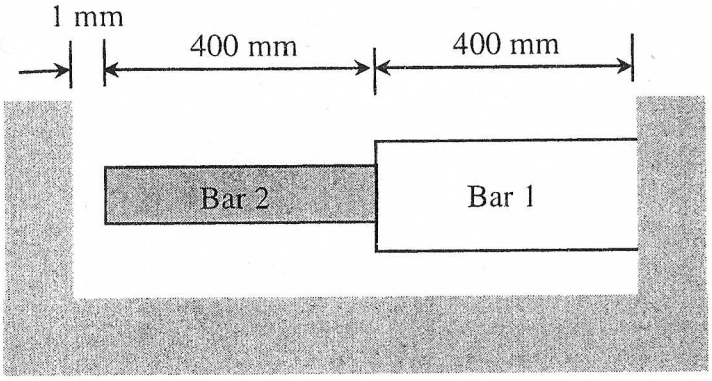
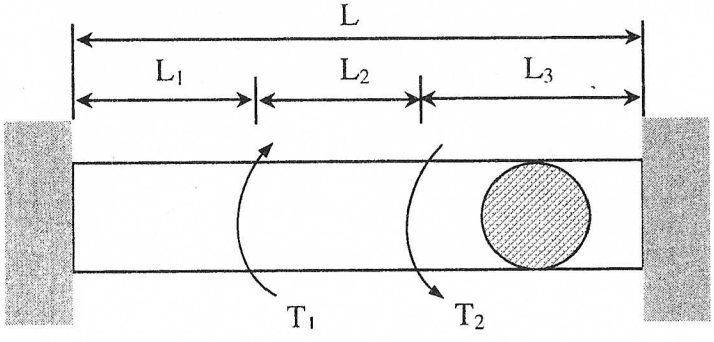
1. Determine (a) the compressive force in the bars shown after a temperature rise of 100℃, and (b) the corresponding change in length of bar 1. (15 points)

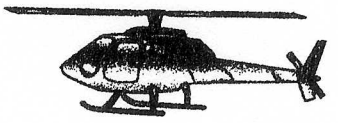


Bar 2	Bar 1
$A = 400\ mm^2$	$A = 800\ mm^2$
$E = 100\ GPa$	$E = 200\ GPa$
$\alpha = 30\times10^{-6}/℃$	$\alpha = 20\times10^{-6}/℃$

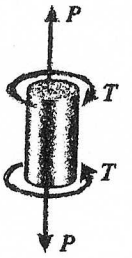
2. Determine the reactive torques at the fixed ends of the circular shaft loaded by the couples shown in figure. The cross section of the bar is constant along the length. Assume elastic action. (15 points)



3. The rotor shaft of a helicopter drives the rotor blades that provide the lifting force to support the helicopter in the air (Fig. 3a). As a consequence, the shaft is subjected to a combination of torsion and axial loading (Fig. 3b). For a 50mm diameter shaft transmitting a torque $T = 2.4$ kN.m and a tensile force $P = 125$ kN, determine the maximum tensile stress, maximum compressive stress, and the maximum shear stress in the shaft. (15 points)



(a)



(b)

Fig. 3

4. A tapered cantilever beam AB of solid circular cross section supports a load P at the free end (Fig. 4). The diameter d_B at the large end is the twice the diameter d_A at the small end ($d_B / d_A = 2$). Determine the bending stress σ_B at the fixed support and the maximum bending stress $\sigma_{max.}$ (20 points)

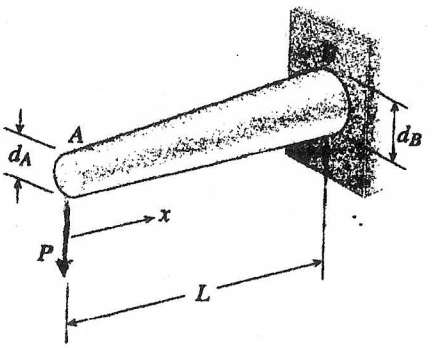
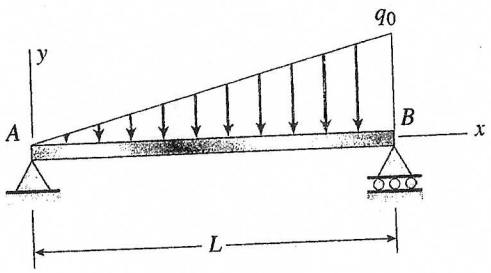


Fig. 4

5. A uniform beam AB supports a triangularly distributed load of maximum intensity q_0 . Determine (a) the equation of the deflection curve of the beam y(x), (b) the deflection slope at the support A. The flexuous rigidity EI is given.(20 points)



6. A fixed-end beam AB supports a uniform load of intensity q acting over part of the span, as shown. Determine the reactions of this beam at both ends A and B. (15 points)