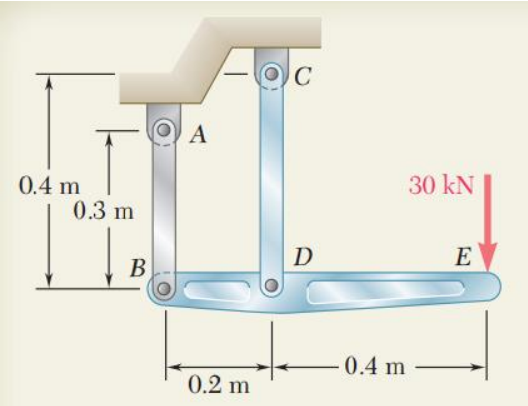
SOM Question Sheet -2

Q1. The rigid bar BDE is supported by two links AB and CD. Link AB is made of Aluminium (E= 70 GPa) and has a cross sectional area of 500mm^2; link CD is made of steel (E= 200 GPa) and has a cross sectional area of 600mm^2. For the 30 kN force shown, find the deflection

(a) of B,
(b) of D,
(c) of E

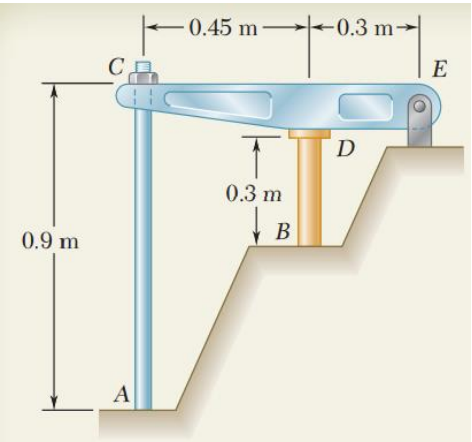


Answer: (a) 0.514 mm upwards, (b) 0.300 mm downwards, (c) 1.928 mm downwards

Q2. The rigid bar CDE is attached to a pin support at E and rests on the 30 mm diameter brass cylinder BD. A 22 mm diameter steel rod AC passes through a hole in the bar and is secured by a nut which is snugly fitted when the temperature of the entire assembly is 20°C. The temperature of the brass cylinder is then raised to 50°C while the steel rod remains at 20°C. Assuming that no stresses were present before the temperature change, determine the stress in the cylinder.

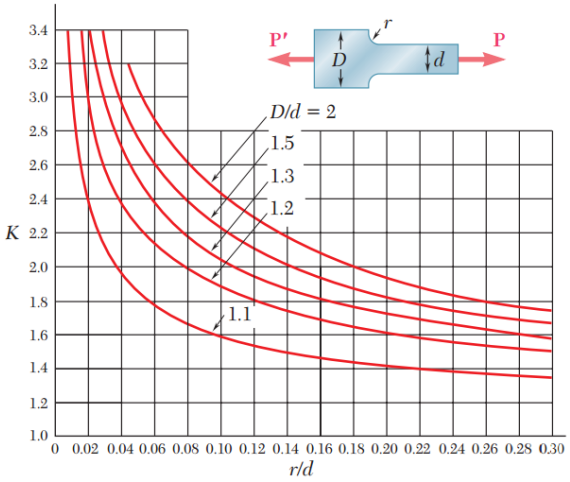
Rod AC (steel): E = 200 GPa, $\alpha = 11.7 \times 10^{-6}/\,^{o}C$

Rod BD (brass): E = 105 GPa, $\alpha = 20.9 \times 10^{-6}/\,^{o}C$



Answer: 44.8 MPa

Q3. Determine the largest axial load P that can be safely supported by a flat steel bar consisting of two portions, both 10mm thick and, respectively, 40 and 60 mm wide, connected by fillets of radius r = 8 mm. Assume an allowable normal stress of 165 MPa. Use the curve given below.



Answer: 36.3 kN

Q4. At a point in a material the two-dimensional stress system is defined by

$$\sigma_x = 60\ MPa.tensile$$

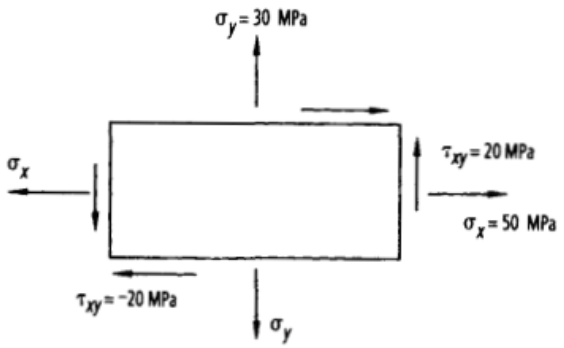
$$\sigma_y = 45MPa, compressive$$

$$\tau_{xy} = 37.5\ MPa$$

Evaluate the values and directions of the principal stresses. What is the value of the greatest shear stress?

Answer: 71.9 MPa, - 56.9 MPa and 64.4 MPa

Q5. At a point of a material the stresses forming a two-dimensional system are shown in Figure below. Using Mohr's circle of stress, determine the magnitudes and directions of the principal stresses. Determine also the value of the maximum shearing stress.



Answer: 22.36 MPa at 45^{o} to the plane of principal stresses.