College of Engineering & Technology

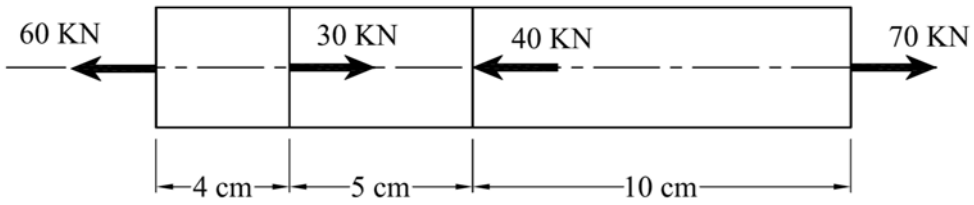
Department: Mechanical Engineering
Lecturer: Dr. Rola Afify
Course Code: ME276

Question one

A circular bar of length 30 cm and diameter 4 cm has a modulus of elasticity 210 GPa is subjected to a pull of axial load of 70 kN. Calculate tensile stress and strain.

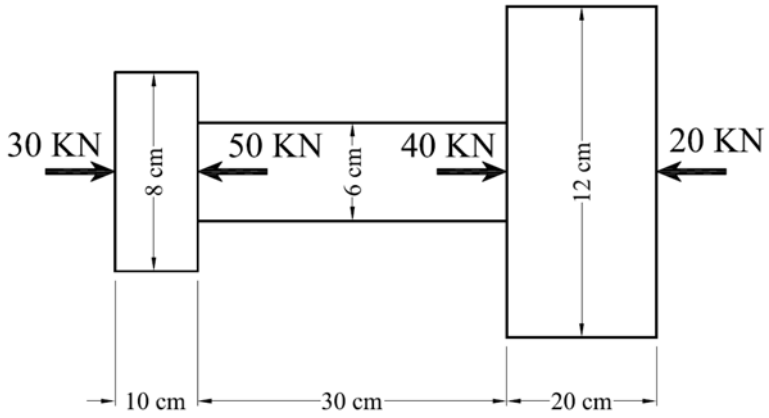
Question two (9 marks)

A circular steel rod of length 19 cm and diameter 3 cm loaded as shown in the figure. Calculate the extension in the 10 cm length part, if the modulus of elasticity 210 GPa. Draw the Normal Force Diagram (N.F.D).



Question three

A circular steel rod of length 60 cm loaded as shown in the figure. If the modulus of elasticity of the rod material 200 GPa; calculate the extension in the 8 cm diameter part. Draw the Normal Force Diagram (N.F.D).



Question four

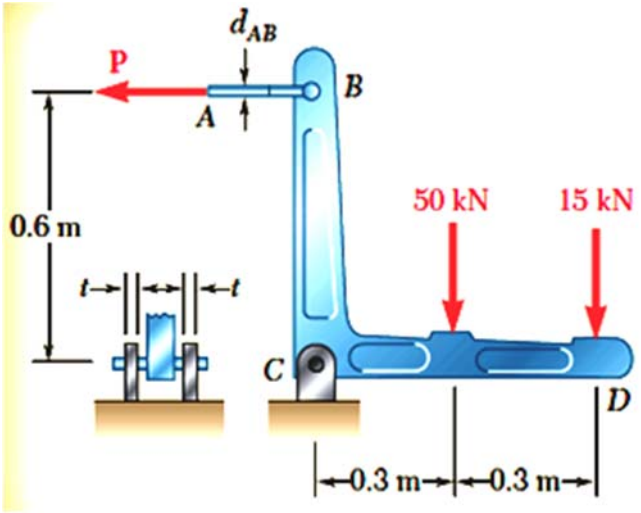
Calculate the force needed to shear a sheet of metal 6 mm thick and 0.7 m wide given that the ultimate shear stress is 50 MPa.

Question five

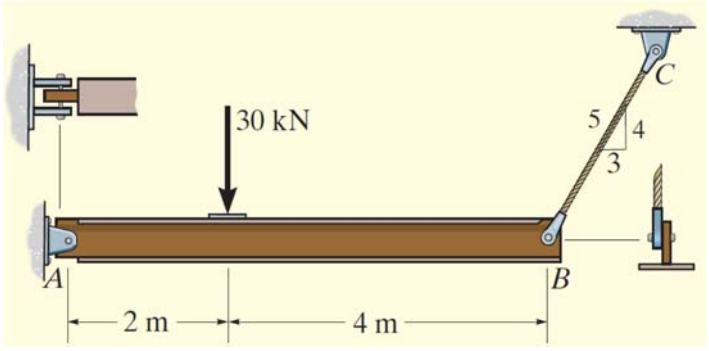
Two forces are applied to the bracket BCD as shown in the figure.

(a) Knowing that the control rod AB is to be made of a steel having an ultimate normal stress of 600 MPa, determine the diameter of the rod for which the factor of safety with respect to failure will be 3.3.

b) The pin at C is to be made of a steel having an ultimate shearing stress of 350 MPa. Determine the diameter of the pin C for which the factor of safety with respect to shear will also be 3.3.



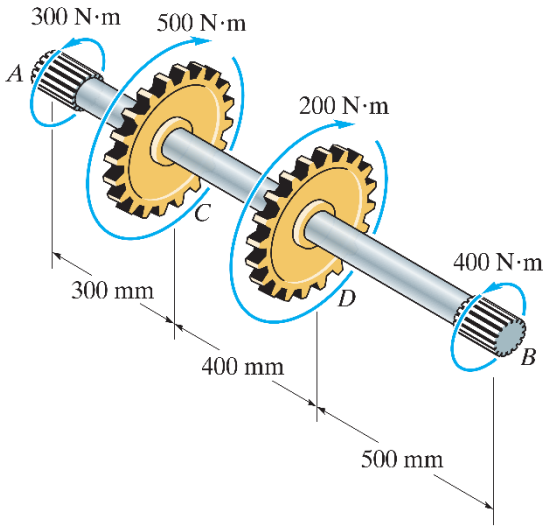
Question six

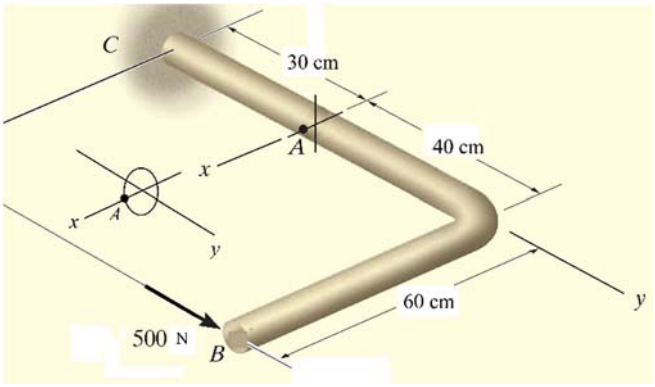


The two members, shown in the figure, are pinned together at *B*. If the pins have an allowable shear stress of τ_{allow} = 90 MPa, and allowable tensile stress of rod *CB* is (σ_t)allow = 115 MPa. Determine to nearest mm the smallest diameter of pins *A* and *B*.

Question seven

The splined ends and gears attached to the solid steel shaft shown in Fig.1 are subjected to the torques shown. Determine the angle of twist of end *B* with respect to end *A*, maximum shear stress in the shaft and draw the torque diagram. The shaft has a diameter of 40 mm and modulus of Rigidity 80 GPa.



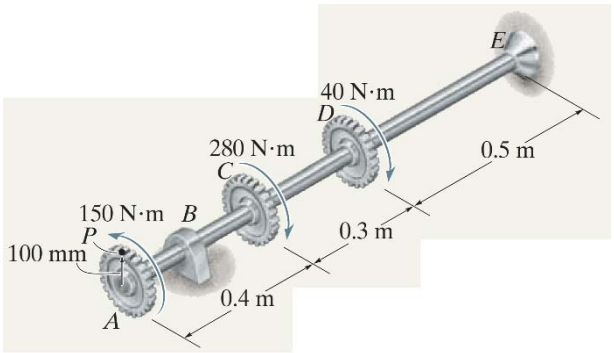


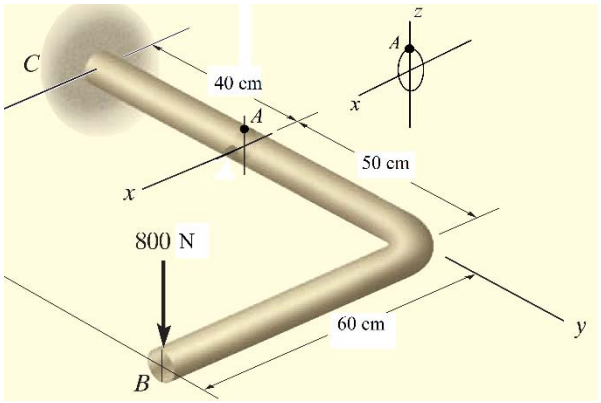
Question eight

The solid rod shown in Fig. 2 has a diameter of 2 cm. If it is subjected to the force of 500 N, determine the state of stress and the principal stresses at point *A*.

Question nine

The gears attached to the fixed-end steel shaft are subjected to the torques shown in Figure If the modulus of Rigidity is 80 GPa and the shaft has a diameter of 14 mm, determine the displacement of the tooth *P* on gear *A*, maximum shear stress in the shaft and draw the torque diagram. The shaft turns freely within the bearing at *B*.





Question ten

The solid rod shown in Fig. 2 has a diameter of 2 cm. If it is subjected to the force of 800 N, determine the state of stress and the principal stresses at point *A*.