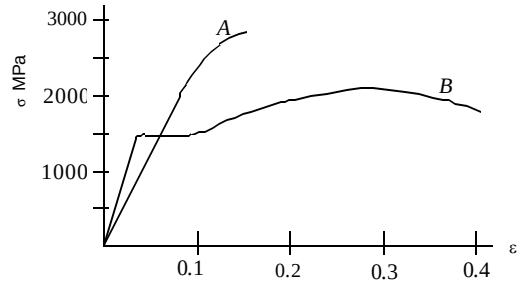
ME111
Mid-Term Exam
October 25, 1999
80 Minutes, Open Notes and Textbook (Only)

Problem 1 (25 Points)



Problems (a) - (f), refer to figure above.

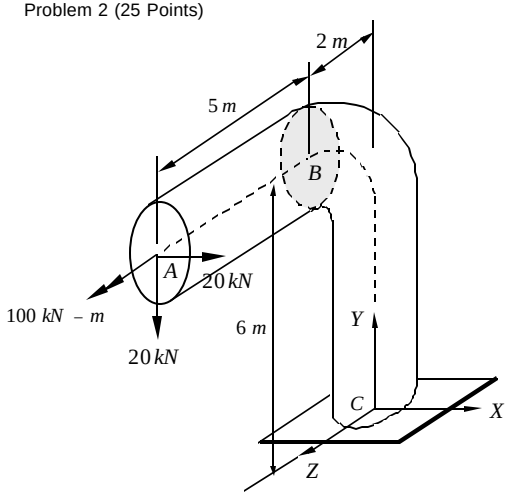
(a) Characterize material A and B as ductile or brittle.
(b) Which is the stiffest material?
(c) Which has the highest ultimate strength?
(d) If material A has a specified 2% offset strain, determine its approximate yield strength using the above figure.
(e) Which material has the largest modulus of resilience?
(f) Which material has the largest modulus of toughness?

(g) If a metal has the following experimentally determined properties:

$E = 72\,GPa, \quad S_u = 200\,MPa, \quad U_R = 0.24\,MPa, \quad U_T = 231\,MPa$

Estimate the yield strength, Brinell hardness, and strain at fracture. Is the material brittle or ductile? Why?

Problem 2 (25 Points)

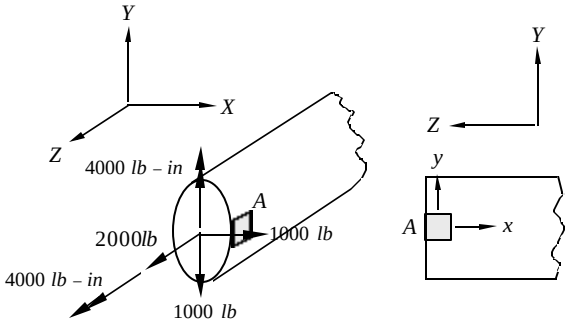


A circular bar is bent into a bracket and supported by the plate at C as shown. The bracket is subject to forces and a torque at A.

(a) Determine all support reactions at C and show them acting in a drawing

(b) Cut the bracket at B and consider AB as a free body. Determine the internal forces acting on the cut at B and show them acting in a drawing.

Problem 3 (25 Points)



A circular bar of diameter $D = 4\,in$ is subject to the internal resultants shown. Determine the "x-y" state of plane stress at point A and show the stress components in a drawing of the "stress element."

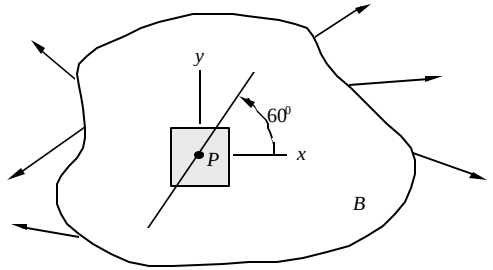
For your convenience, note that:

$$A = \frac{\pi D^2}{4} = 4\pi$$

$$I_x = I_y = \frac{\pi D^4}{64} = 4\pi$$

$$J_z = \frac{\pi D^4}{32} = 8\pi$$

Problem 4 (25 Points)



The state of plane stress in a body B at point P is given as:

$$\sigma_x = 200, \quad \sigma_y = 100, \quad \tau_{xy} = -50$$

(a) Determine the normal stress across the line AB at the point P (use any approach you wish).

(b) **Using Mohr's circle**, determine the principal stresses and maximum shear stresses and show them acting on a properly oriented element.