

ROSE-HULMAN INSTITUTE OF TECHNOLOGY
Department of Mechanical Engineering

EM121

Statics and Mechanics of Materials I

Exam 1

Spring 2008-2009

Name: _____

CM: _____

Problem 1 (25 pts) _____

Problem 2 (35 pts) _____

Problem 3 (40 pts) _____

Total _____

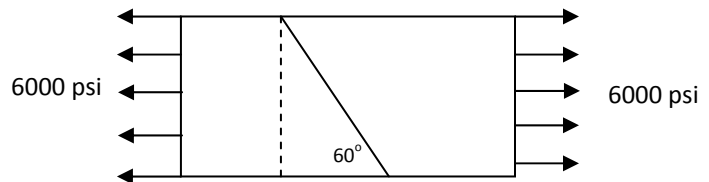
Be sure to show all work to receive full credit.

Problem 1 – 25 points

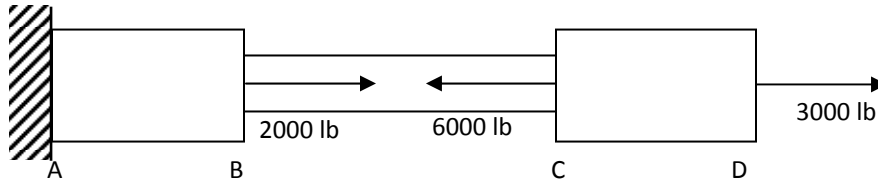
- a. (5 pts) A force, \vec{F} , of magnitude $F = 1000$ lb acts along a line going from point A: $(-2,3,-5)$ to point B: $(5,6,5)$. Write this force in component form. Give units.

- b. (5 pts) Suppose we have a bar in tension, as shown in the view below. The normal stress on the inclined plane is approximately (choose one)

- 4500 psi (tension)
- 1500 psi (tension)
- 1500 psi (compression)
- 2600 psi (tension)
- The answer cannot be found from the data given.
- None of the above (give value)_____



- c. (10 pts) Calculate the stress in Section BC of the compound bar shown below. The cross-sectional area of BC is 0.25 in^2 . Be sure to draw a free body diagram and indicate tension or compression for the stress.



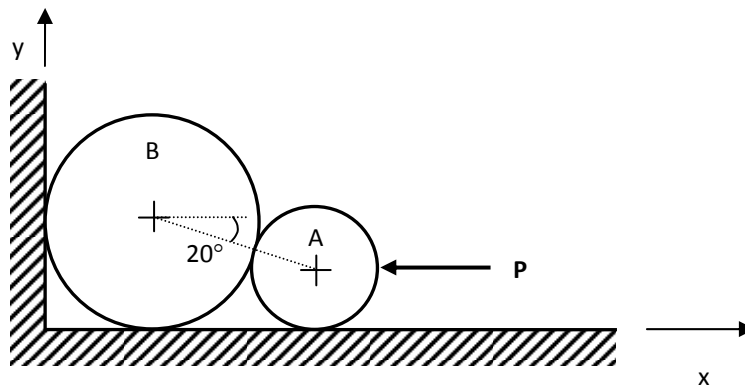
- d. (5 pts) Now we have a different bar, with a length of 5 inches and a cross-sectional area of 0.2 in^2 . The modulus of elasticity of the material in the bar is $10 \times 10^6 \text{ lb/in}^2$. If the bar experiences a load of 1000 lbs, how much longer does it get?

Problem 2 – 35 points

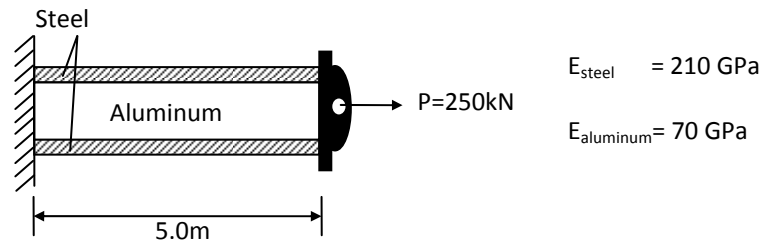
A horizontal force of known magnitude P acts on the small pipe A, which is in contact with large pipe B as shown in the figure. The pipes are of known equal weight W and all surfaces (including the floor and the wall) are smooth.

We wish to determine all of the forces acting on the pipes.

Set up the equations as completely as possible, but do not solve the equations. Clearly identify your equations and unknowns.



Problem 3 – 40 points



The above diagram shows an aluminum block sandwiched between two structural steel plates. The sandwich structure is firmly embedded in the ground at one end and attached to a rigid plate at the other end. The initial length of the sandwich structure is 5.0m. The cross-sectional area of one steel plate is 0.005m^2 and the cross-sectional area of the aluminum block is 4 times that of one steel plate. A load $P=250\text{kN}$ is applied to the rigid plate as shown in the above diagram. ($E_{\text{steel}} = 210\text{ GPa}$, $E_{\text{aluminum}} = 70\text{ GPa}$)

a. Circle T (true) or F (false)

T F The stress in each steel plate is the same as the stress in the aluminum block

T F The strain in each of the steel plates is the same as that in the aluminum block

b. Find the forces in the steel and in the aluminum.

