

Name: _____

Lab: Tu, W, Th, F

ENES 220 – Mechanics of Materials

Spring 2000

March 1, 2000

MIDTERM EXAM #1

Grading:

Problem 1: _____ / 20

Problem 2: _____ / 40

Problem 3: _____ / 40

Total: _____ / 100

Policies:

1. Write your name and circle your lab day on all sheets.
2. Use only the paper provided. Ask for additional sheets, if required.
3. Place only one problem on each sheet (front and back).
4. Draw a box around answers for numerical problems.
5. Include free body diagrams (FBDs) for all equilibrium problems.
6. Closed book; closed notes.
7. Show all work used to arrive at your answer in an organized, top-down fashion.

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Complete the following five statements. Note that you are allowed to ONLY use terms from the list below; other terms WILL NOT be accepted.

- (a) _____ materials exhibit substantial plastic deformation before failure
- (b) _____ can be used to calculate the lateral strain from the linear (axial) strain
- (c) When a material is compressed in the axial direction, it will _____ in the transverse direction
- (d) In the elastic region, the _____ relates τ to γ
- (e) For statically indeterminate problems, the number of equilibrium equations is _____ the number of unknown loads (forces or torques)

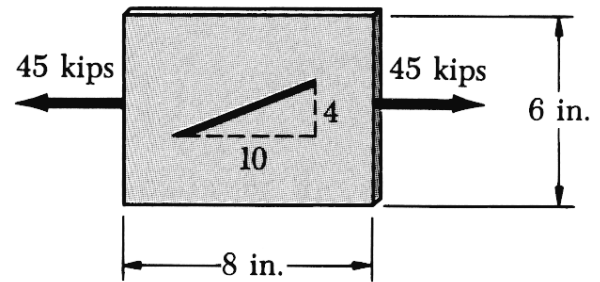
List of possible terms:

| | | | |
|----------|-----------------|-----------------|-------------------------|
| brittle | yield stress | fracture stress | ultimate tensile stress |
| ductile | bearing stress | endurance limit | shear stress |
| expand | Poisson's ratio | Young's modulus | Old's modulus |
| contract | bulk modulus | elastic modulus | shear modulus |
| equal to | greater than | less than | remain the same |

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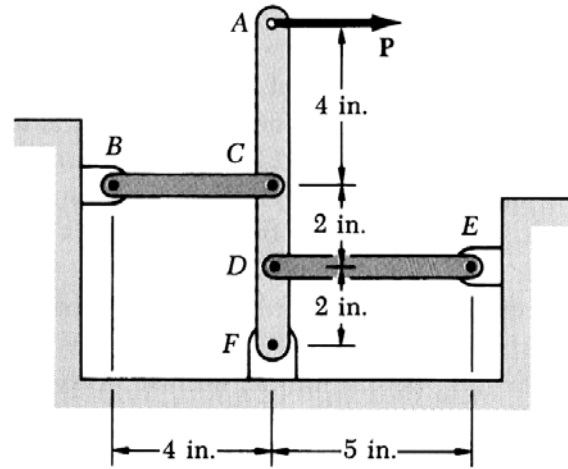
A line of slope 4:10 was scribed on a 0.25 in thick steel plate ($E = 29 \times 10^6$ psi, $G = 11.2 \times 10^6$ psi, $\nu = 0.3$). Determine the slope of the line when the plate is subjected to a 45 kip axial load.



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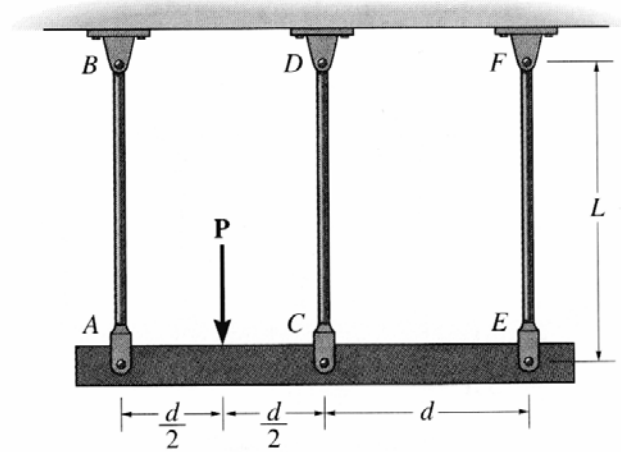
Links BC and DE are both made of steel ($E = 29 \times 10^6$ psi) and are 0.5 in wide and 0.25 in thick. Member AF is assumed to be rigid. Let $P = 800$ lb. Write all equations necessary to find the forces in members BC and DE. DO NOT SOLVE.



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The three suspender bars AB, CD, and EF are made of the same material and have equal cross-sectional areas A . Beam ACE is assumed to be rigid, and is subjected to the force P as shown. Write all equations necessary to find the forces in members AB, CD, and EF. DO NOT SOLVE.



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A hollow cylindrical steel shaft ($G = 75 \text{ GPa}$) is fixed at its base and subjected to a torque T at the free end. The shaft has an outer radius of 45 mm and an inner radius of 30 mm . Determine the maximum value of the torque if the angle of twist is limited to 3° and if the shear stress is limited to 85 MPa .

