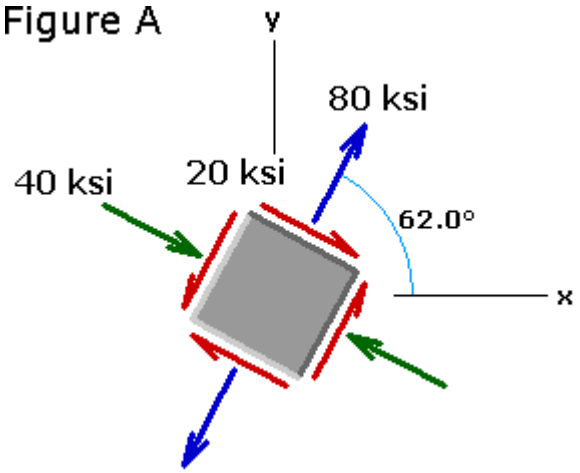
1. At a point in a structure subjected to plane stress, the normal and shear stresses on two perpendicular planes are as shown in Figure A.
   - Compute the normal and shear stresses acting on horizontal and vertical planes at the point.
   - Show these results on the stress element in Figure B.

Figure A



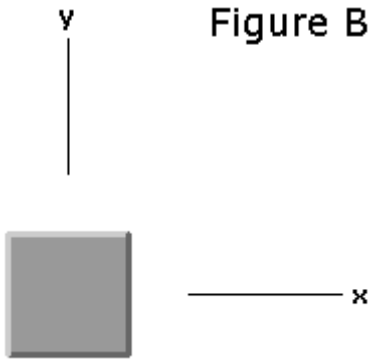


Figure B

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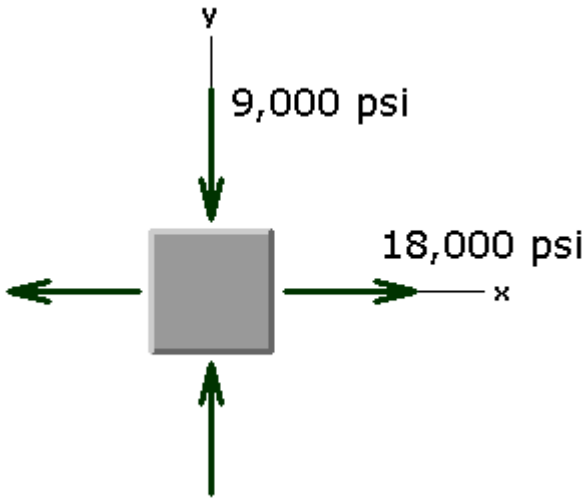
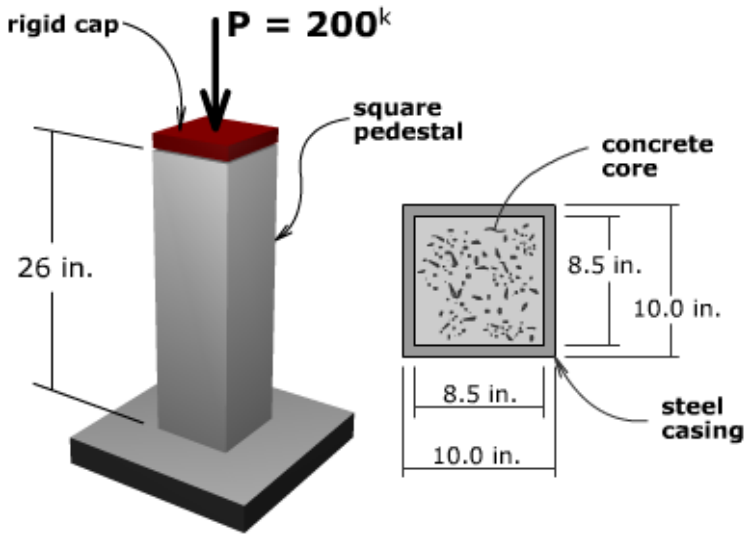
Include proper units
Box-in your answers

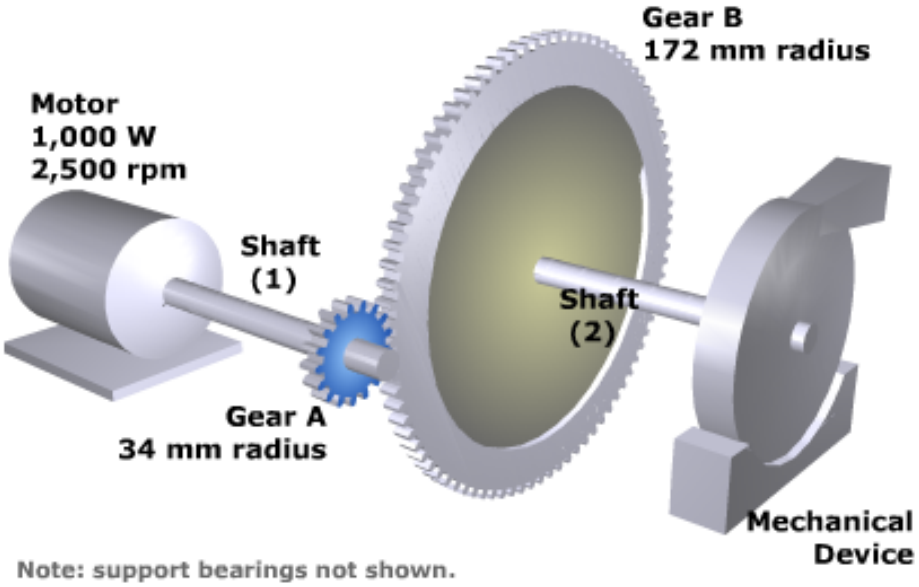
2. A steel plate is subjected to plane stress as shown in the figure. The corresponding strains in the plate are $\varepsilon_x = +700 \times 10^{-6}$ in/in and $\varepsilon_y = -500 \times 10^{-6}$ in/in.
   - Determine Poisson's ratio and the modulus of elasticity E for the steel.



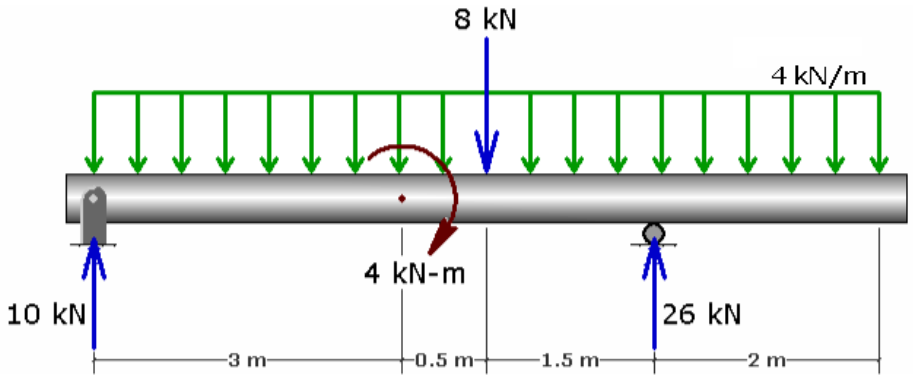
3. A square pedestal 26 inches tall consists of a steel casing filled with concrete. The moduli of elasticity for the steel and concrete are 30,000 ksi and 4,000 ksi, respectively. Assume that the stresses in the steel and concrete are uniformly distributed over their respective areas. A load of P = 200 kips is applied through a rigid cap as shown.
   - What is the stress in the concrete and in the steel?
   - What is the change in length of the casing?



4. An electric motor is capable of providing a maximum power of 1,000 watts at a rotational speed of 2,500 rpm. The motor drives Shaft (1) that is connected to Gear A. Gear A is connected to Gear B. Gear B is connected to Shaft (2) that drives a small mechanical device. Gear A has a radius of 34 mm, and Gear B has a radius of 172 mm. Both Shafts (1) and (2) are to be solid shafts with an allowable torsional shear stress of 50 MPa.
   - Compute the minimum required diameters for Shafts (1) and (2).



5. The beam shown is to be designed using a solid circular cross-sectional shape. The allowable bending stress is 100 MPa and the allowable horizontal shearing stress is 45 MPa.
   - Determine the smallest diameter circular cross section that can be used for the beam shown.



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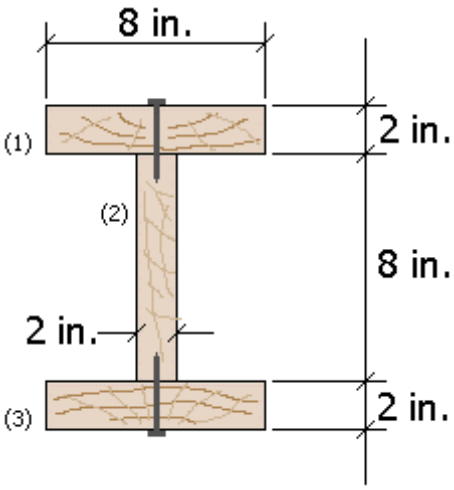
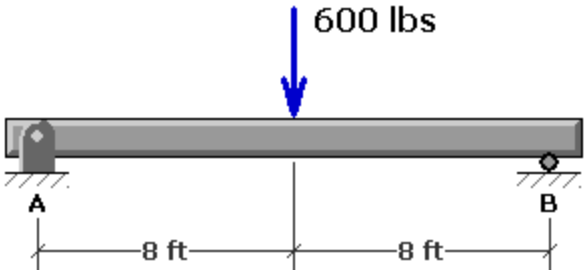
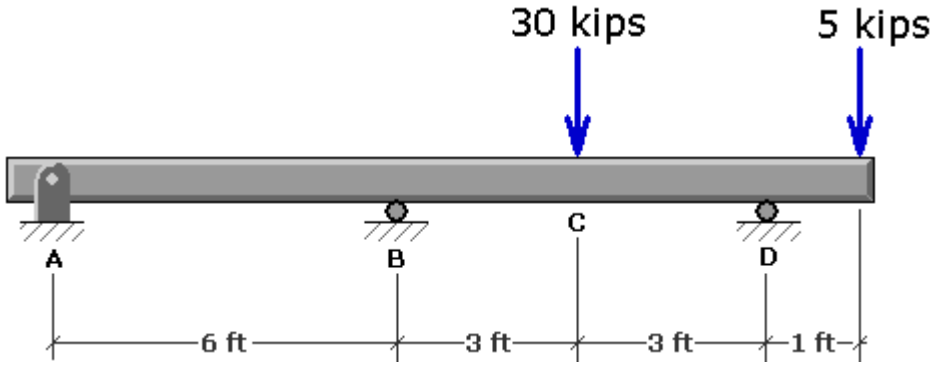
Box-in your answers

6. A timber beam is fabricated from three 2 in. by 8 in. pieces of lumber to form the cross section shown. The flanges of the beam are fastened to the web with nails that can safely transmit a shear force of 200 lbs each. The timber beam is simply supported and carries a 600 lb concentrated load at midspan.
   - Determine the spacing required for the nails.



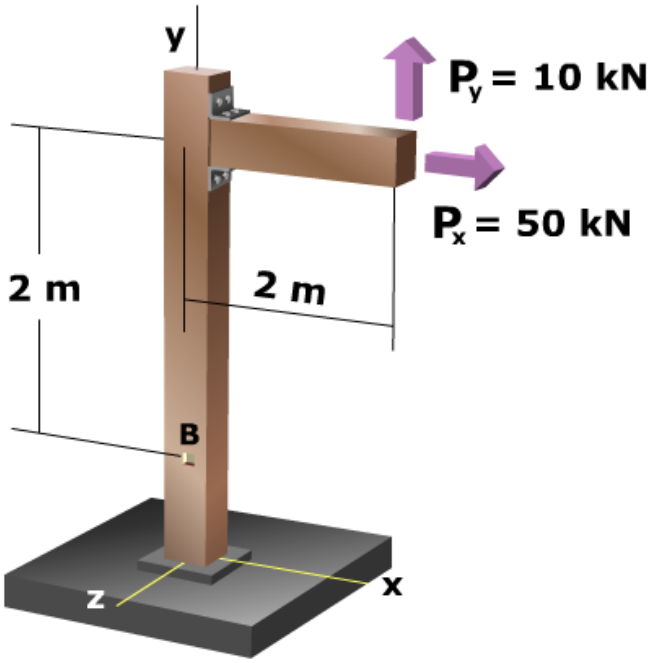


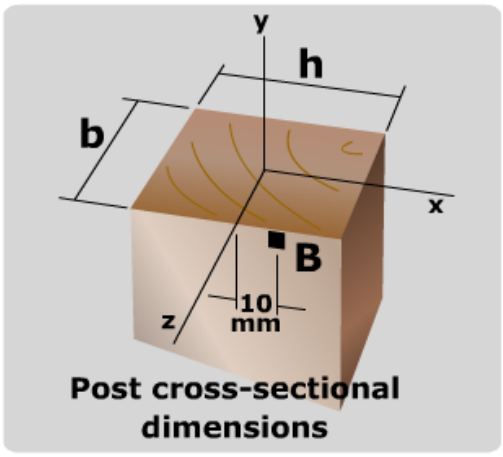
7. Determine the support reaction at B for the simply supported beam with the loading shown. Assume EI = 720 x 10^6 lb-in^2 for all portions of the beam.

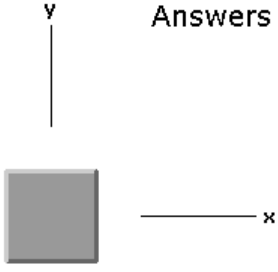


Student _____

8. A post-and-beam structure supports two concentrated loads: 50 kN in the positive x direction, and 10 kN in the positive y direction. The wood post has dimensions h = 250 mm and b = 100 mm. Point B is located on the front face (i.e., the +z face) of the post, 10 mm away from the centerline of the post in the positive x direction (see sketch).
   - Compute the stresses σ_x, σ_y, and τ_{xy} at point B for the given loadings.
   - **Show these stresses properly oriented on a stress element.**







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