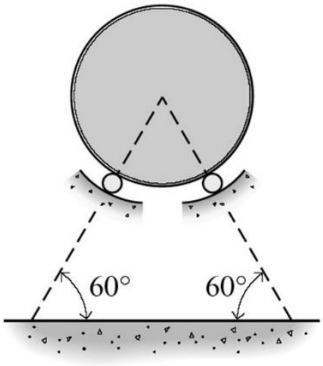
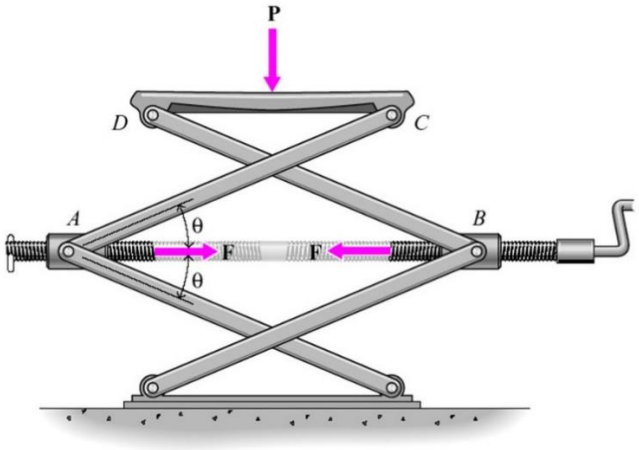
Midterm Examination

Mechanics of Materials for Energy Resources Engineering April 15th, 2021

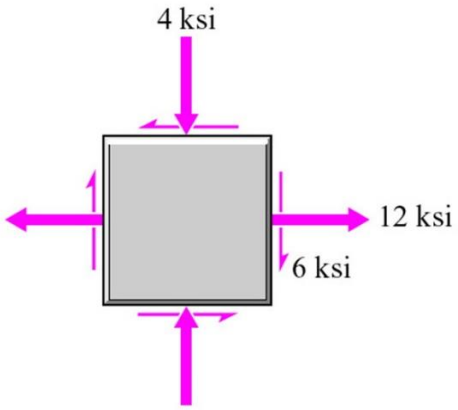
1. An 800-lb homogeneous cylinder is supported by two rollers as shown below. Determine the forces exerted by the rollers on the cylinder. All surfaces are smooth (frictionless) [10]



2. A scissors jack for an automobile is shown below. The screw threads exert a force F on the blocks at joints A and B. Determine the force P exerted on the automobile if F = 800 N and θ = 15°. Repeat for θ = 30° and θ = 45° [20]

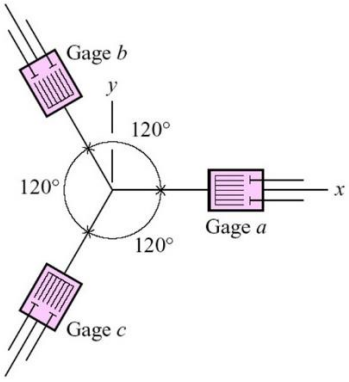


3. Normal and shear stresses on horizontal and vertical planes at a point in a structural member are shown below.
   a. Determine the principal stresses, the maximum in-plane shearing stress, and the maximum shearing stress. [15]
   b. Locate the planes on which these stresses act and show the stresses on a sketch. [5]



Midterm Examination

4. At a point on the free surface of a steel (ν=0.30) machine part, the strain rosette shown below was used to obtain the following normal strain data: ε_a = -555μm/m, ε_b = +925μm/m, and ε_c = +740μm/m. Determine
   a. The strain components ε_x , ε_y, and γ_{xy} at the point [15]
   b. Three kinds of principal strains and the maximum shearing strain at the point. A sketch is not required. [10]



5. A 1 x 2-in. rectangular bar of steel [E=30,000 ksi and α = 6.6(10^{-6})/°F] has a length of 4 ft. The bar is subjected to an axial load P = 3000 lb and a temperature increase of ΔT°F. Determine the temperature increase ΔT if the elongation of the bar is 0.05 in. [10]

6. A structural steel (E = 29,000 ksi and γ = 0.284 lb/in^3) bar of rectangular cross section consists of uniform and tapered sections as shown below. The width of the tapered section varies linearly from 2 in. at the bottom to 5 in. at the top. The bar has a constant thickness of 1/2 in. Determine the elongation of the bar resulting from application of the 30-kip load P and the weight of the bar. [15]