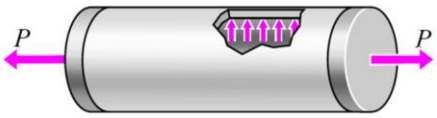
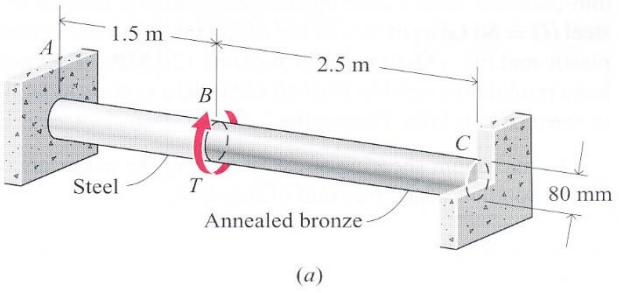
Final Examination

Mechanics of Materials for Energy Resources Engineering June 10th, 2021

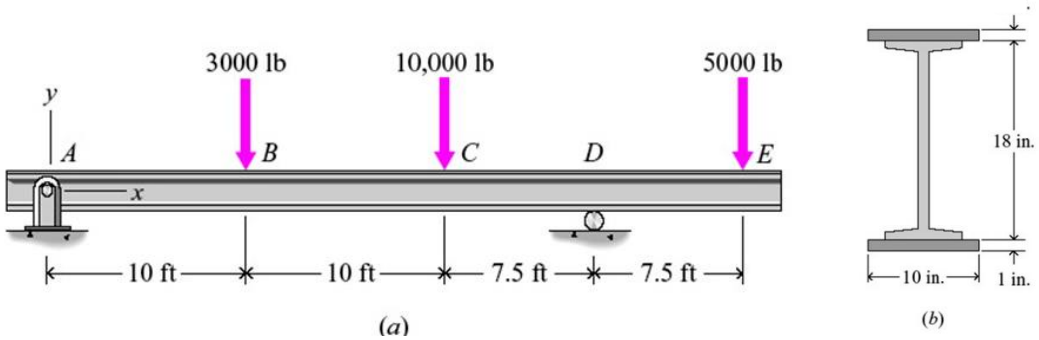
1. A thin-walled pressure vessel, similar to the one shown below has an inside diameter of 4 ft and a wall thickness of 0.25 in. The internal pressure is 100 psi and the axial tensile load is 5000 lb. Determine the maximum shear stress at points on the outside and inside surfaces of the vessel. [12]



2. Two 80-mm diameter steel (G = 80 GPa) and bronze (G = 45 GPa) shafts are rigidly connected and supported as in (a) below. The shearing stress-strain diagram for the steel is shown in (b). The bronze has a proportional limit in shear of 84 MPa. Determine the torque required to produce a maximum shearing stress of 60 MPa in the bronze. [20]



3. A beam is loaded and supported as shown below. Two 10 x 1-in. steel plates are welded to the flanges of an *S18x70* whose cross section has a sencond moment of area (I) of 926 in.^{4} Determine the maximum tensile and compressive flexural stresses in the beam. [18]



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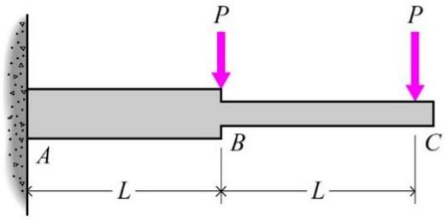
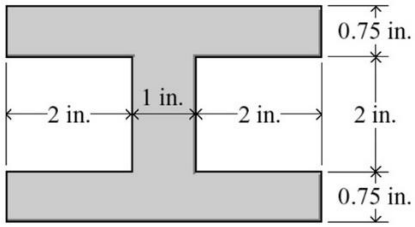
4. The cantilever beam *ABC* shown below has a second moment of area of $2I$ in the interval *AB* and a second moment of area I in the interval *BC*. Determine
   a. The deflection at section B. [10]
   b. The deflection at section C. [10]



5. Determine the maximum allowable compressive (Euler buckling) load for a 10-ft-long aluminum (E = 10,000 ksi) column having the cross section shown below if a factor of safety of 2.25 is specified. [10]



6. The simply supported 6061-T6 aluminum alloy (E = 70 GPa) beam *A* shown below is 75 mm wide x 25 mm deep. The center support is a helical spring with a modulus of 18 kN/m. The spring is initially unstressed and in contact with the beam. The 22-kg block drops 50 mm onto the top of the beam. Determine
   a. The impact factor. [6]
   b. The static deflection. [6]
   c. The maximum flexural stress in the beam when the block drops onto the beam. [8]