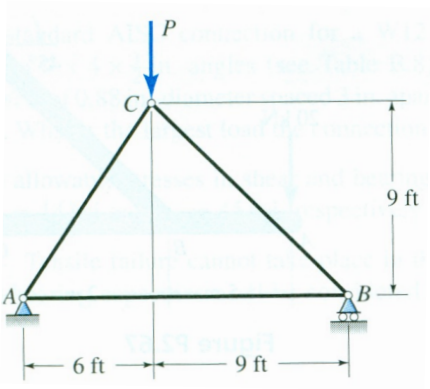
Exam 1, October 18, 2014
90 minutes

Name:_____

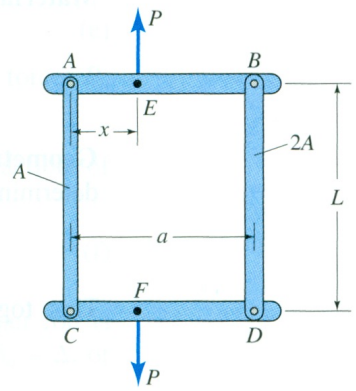
There are 2 pages, 4 problems. All are worth 25 points.
Exam is closed book, closed notes. No electronic devices except non-programmable calculators are allowed. Students using smartphones, PDA's, etc., for ANY reason will receive a Dean's warning.
Time yourself….and Good Luck

1. A pin-connected truss is subjected to a vertical force P=10 kips, applied at joint C as shown in the figure. What is the required cross-sectional area of each member? The materials strengths are 20 ksi in tension and 14 ksi in compression. Use a factor of safety F.S.=2 in design. (25 pts)

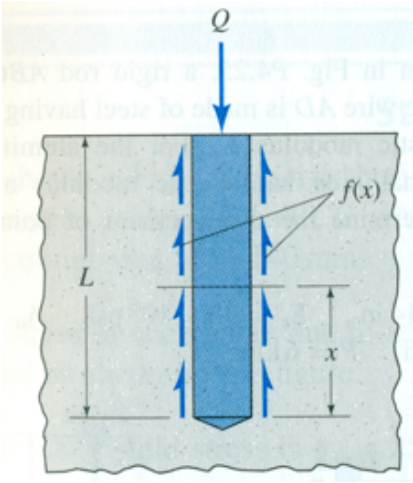


2. Two horizontal rigid members AB and CD are connected by bars as shown in the figure. The bars have length L, modulus of elasticity E, and cross-sectional area A and 2A. Before the forces are applied, the distance between points E and F is equal to the length of the bars, L. Show that the change in distance; i.e., displacement, between the two points, E and F, at which the forces P are acting is given by:

$$\delta = \frac{PL}{AE}\left[1 - 2\left(\frac{x}{a}\right) + \frac{3}{2}\left(\frac{x}{a}\right)^2\right]$$ (25 pts)



3. A foundation pile of axial stiffness E and cross-sectional area A, which has been driven to a depth L in the ground, supports a vertical load Q, as depicted in the Figure. Assume that this load is resisted by a frictional force whose intensity varies parabolically, $f(x)=kx^2$. Here k, a constant, is to be found from the equilibrium of vertical forces. Determine the total shortening "Δ" of the pile in terms of Q, L, A and E as needed. (25 pts)



4. A steel rod and brass rod, each restrained at both ends, are fastened at their free end by a pin of diameter d, as shown in the figure. Compute the shear stress on the pin if the temperature drops by ΔT. (25 pts)

Given: $d = \frac{7}{8}$ in., $a = 3$ ft, $b = 4$ ft, $\Delta T = 40°C$,
$A_s = 1$ in.^{2}, $A_b = 1.5$ in.^{2}, $E_s = 29 \times 10^6$ psi, $E_b = 15 \times 10^6$ psi,
$\alpha_s = 6.5 \times 10^{-6}/°F$, $\alpha_b = 11.3 \times 10^{-6}/°F$