MEEG 4103 Quiz 6.1b.081 (Closed book, closed notes)

1. ② Define *(a)* 1 newton (N), *(b)* 1 pound (lb) in terms of pound-mass (lbm) and the *value* of the standard gravitational acceleration in SI.

2. ③ Using the chain-link conversion technique and the exact relations 1 lbm = 0.453 592 37 kg, 1 ft = 0.3048 m, as well as the definitions of 1 lb and 1 N, convert a stress of $\sigma = 100\ \text{MPa}$ into kpsi to *five* significant digits of precision.

3. ⑤ In computing the size factor k_b for a nonrotating round bar in bending with diameter d, show that the effective dimension d_e is given by $d_e = 0.370\,d$.

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1. *(a)* $1\ \text{N} = 1\ \text{kg}\cdot\text{m/s}^2$. ① *(b)* $1\ \text{lb} = (1\ \text{lbm}) \times (9.80665\ \text{m/s}^2)$ ①

2.

$$\sigma = 100\ \text{MPa} = 10^8\ \text{Pa} \cdot \frac{1\ \text{N/m}^2}{1\ \text{Pa}} \cdot \frac{1\ \text{kg}\cdot\text{m/s}^2}{1\ \text{N}} \cdot \frac{1\ \text{lbm}}{0.45359237\ \text{kg}} \cdot \frac{1\ \text{lb}}{1\ \text{lbm}\cdot 9.80665\ \text{m/s}^2} \cdot \frac{(0.3048)^2\ \text{m}^2}{1^2\ \text{ft}^2} \cdot \frac{1^2\ \text{ft}^2}{(12)^2\ \text{in}^2} \cdot \frac{1\ \text{psi}}{1\ \text{lb/in}^2} \cdot \frac{1\ \text{kpsi}}{10^3\ \text{psi}} = 14.50377\ \text{kpsi}$$ ②

$$\sigma = 14.504\ \text{kpsi}$$ ①

3. ② Sketch of

Cross-sectional area of material stressed at and above 95% of the maximum stress in the *nonrotating* round bar	=	Cross-sectional area of material stressed at and above 95% of the maximum stress in the *rotating* round bar

$$\left[\pi\left(\frac{d}{2}\right)^2 \cdot \frac{2\theta}{360^\circ} - 0.95\left(\frac{d}{2}\right)^2 \sin\theta\right](2) = \frac{\pi}{4}\left[d_e^2 - (0.95\,d_e)^2\right]$$ ②

where $\theta = \cos^{-1} 0.95 = 18.19487^\circ$ $\therefore\ d_e = 0.3696\,d$ $d_e = 0.370\,d$ ①