

**12.8.**  $\tau_e > \tau_a = \tau_b > \tau_c = \tau_d > \tau_f$ . The torque  $\tau = rF|\sin\theta|$ . We must calculate each torque:

$$\tau_a = \left(\frac{L}{2}\right)F \qquad \tau_d = \frac{L}{2}F \sin 45^\circ = \frac{\sqrt{2}}{4}LF$$

$$\tau_b = \left(\frac{L}{4}\right)F \qquad \tau_e = L(2F)$$

$$\tau_c = \left(\frac{L}{2}\right)F \sin 45^\circ = \frac{\sqrt{2}}{4}LF \qquad \tau_f = LF \sin 0^\circ = 0$$