37. (a) The shear stress is given by F/A, where F is the magnitude of the force applied parallel to one face of the aluminum rod and A is the cross-sectional area of the rod. In this case F is the weight of the object hung on the end: $F = mg$, where m is the mass of the object. If r is the radius of the rod then $A = \pi r^2$. Thus, the shear stress is

$$\frac{F}{A} = \frac{mg}{\pi r^2} = \frac{(1200\,\text{kg})(9.8\,\text{m/s}^2)}{\pi(0.024\,\text{m})^2} = 6.5 \times 10^6\ \text{N/m}^2\ .$$

(b) The shear modulus G is given by

$$G = \frac{F/A}{\Delta x/L}$$

where L is the protrusion of the rod and Δx is its vertical deflection at its end. Thus,

$$\Delta x = \frac{(F/A)L}{G} = \frac{(6.5 \times 10^6\,\text{N/m}^2)(0.053\,\text{m})}{3.0 \times 10^{10}\,\text{N/m}^2} = 1.1 \times 10^{-5}\ \text{m}\ .$$