39. (a) Let F_A and F_B be the forces exerted by the wires on the log and let m be the mass of the log. Since the log is in equilibrium $F_A + F_B - mg = 0$. Information given about the stretching of the wires allows us to find a relationship between F_A and F_B. If wire A originally had a length L_A and stretches by ΔL_A, then $\Delta L_A = F_A L_A / AE$, where A is the cross-sectional area of the wire and E is Young's modulus for steel ($200 \times 10^9\,\mathrm{N/m^2}$). Similarly, $\Delta L_B = F_B L_B / AE$. If ℓ is the amount by which B was originally longer than A then, since they have the same length after the log is attached, $\Delta L_A = \Delta L_B + \ell$. This means

$$\frac{F_A L_A}{AE} = \frac{F_B L_B}{AE} + \ell \,.$$

We solve for F_B:

$$F_B = \frac{F_A L_A}{L_B} - \frac{AE\ell}{L_B} \,.$$

We substitute into $F_A + F_B - mg = 0$ and obtain

$$F_A = \frac{mgL_B + AE\ell}{L_A + L_B} \,.$$

The cross-sectional area of a wire is $A = \pi r^2 = \pi(1.20 \times 10^{-3}\,\mathrm{m})^2 = 4.52 \times 10^{-6}\,\mathrm{m}^2$. Both L_A and L_B may be taken to be $2.50\,\mathrm{m}$ without loss of significance. Thus

$$\begin{aligned} F_A &= \frac{(103\,\mathrm{kg})(9.8\,\mathrm{m/s^2})(2.50\,\mathrm{m}) + (4.52 \times 10^{-6}\,\mathrm{m^2})(200 \times 10^9\,\mathrm{N/m^2})(2.0 \times 10^{-3}\,\mathrm{m})}{2.50\,\mathrm{m} + 2.50\,\mathrm{m}} \\ &= 866\ \mathrm{N} \,. \end{aligned}$$

(b) From the condition $F_A + F_B - mg = 0$, we obtain

$$F_B = mg - F_A = (103\,\mathrm{kg})(9.8\,\mathrm{m/s^2}) - 866\,\mathrm{N} = 143\ \mathrm{N} \,.$$

(c) The net torque must also vanish. We place the origin on the surface of the log at a point directly above the center of mass. The force of gravity does not exert a torque about this point. Then, the torque equation becomes $F_A d_A - F_B d_B = 0$, which leads to

$$\frac{d_A}{d_B} = \frac{F_B}{F_A} = \frac{143\,\mathrm{N}}{866\,\mathrm{N}} = 0.165 \,.$$