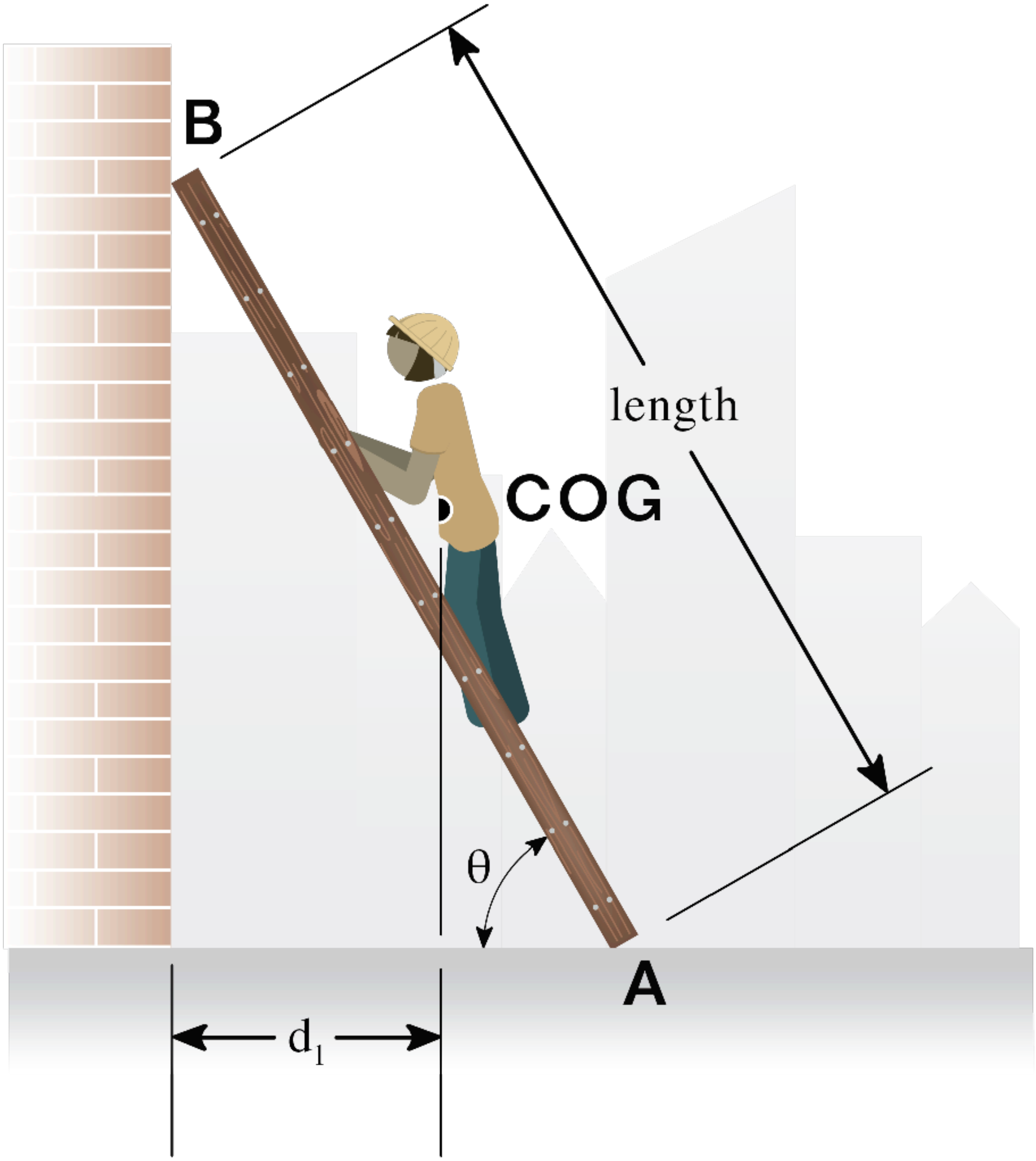
21-S-8.2-RP-02



Kate is climbing a ladder to clean the wall since she cannot reach the top on her own. She stops climbing just as the ladder is on the verge of slipping. If Kate is $4\ \mathrm{ft}$ and $11\ \mathrm{in}$ tall and weighs $W_K\ \mathrm{lbs}$, and the ladder has a uniform weight of W_L lbs, find the coefficient of friction between the ladder and the surface at A such that the ladder experiences impending slipping. Assume that there is no friction between the ladder and the wall at B.

Find the normal reactions at A and B.

Assume $L = length$

$$\Sigma M_A = 0 \rightarrow (L\cos(\theta) - d_1) \cdot W_K + \frac{L\cos(\theta)}{2} \cdot W_L - L\sin(\theta) \cdot N_B = 0$$

$$\Rightarrow N_B = \frac{(L\cos(\theta) - d_1) \cdot W_K + \frac{L\cos(\theta)}{2} \cdot W_L}{L\sin(\theta)}$$

$$+ \uparrow \Sigma F_y = 0 \rightarrow N_A - W_K - W_L = 0$$
$$\Rightarrow N_A = W_K + W_L$$

Find the magnitude of the friction force applied on the ladder at A and the corresponding static coefficient of friction between the ladder and the floor.

$$+ \rightarrow \Sigma F_x = 0 \rightarrow N_B - F_A = 0$$
$$\Rightarrow F_A = N_B$$

Assuming impending slipping, $F_A = \mu_s N_A$

$$\Rightarrow \mu_s = \frac{F_A}{N_A}$$