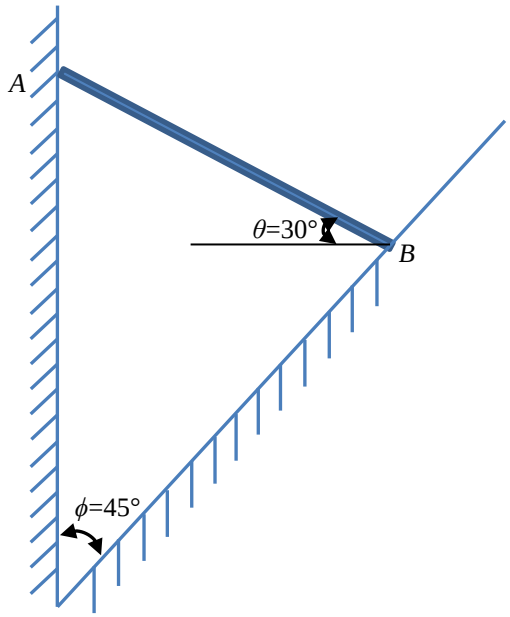
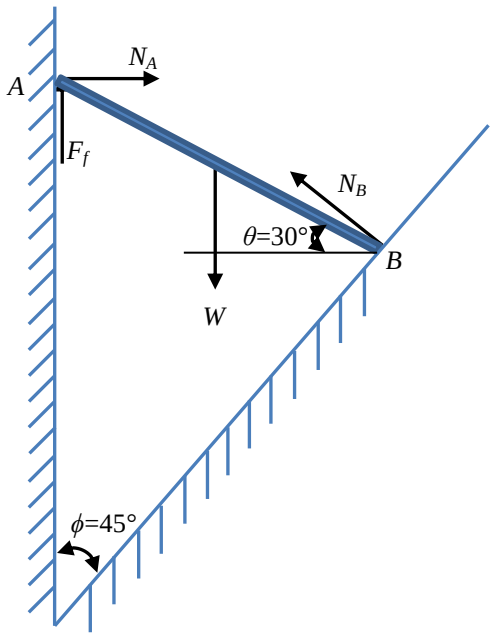
25. A uniform rod is placed along the vertical surface at A and on the smooth surface at B. If the rod has a weight of $W \sim N(25, 0.1^2)$ lb and the coefficient of friction at A is $\mu_s = 0.3$, determine the distributions of normal forces at A and B.



Solution



According the force equilibrium, we have

$$\sum F_y = 0; \quad N_A = N_B \cos\phi$$

$$\sum F_x = 0; \quad W = \mu_s N_A + N_B \sin\phi$$

Solve the above equations, we can obtain

$$N_A = \frac{W\cos\phi}{\sin\phi + \mu_s \cos\phi}$$

$$N_B = \frac{W}{\sin\phi + \mu_s \cos\phi}$$

Thus, we can have

$$\mu_{N_A} = \frac{\mu_W \cos\phi}{\sin\phi + \mu_s \cos\phi} = 19.23\,\text{lb}$$

$$\sigma_{N_A} = \frac{\sigma_W \cos\phi}{\sin\phi + \mu_s \cos\phi} = 0.0769$$

$$\mu_{N_B} = \frac{\mu_W}{\sin\phi + \mu_s \cos\phi} = 27.2\,\text{lb}$$

$$\sigma_{N_B} = \frac{\sigma_W}{\sin\phi + \mu_s \cos\phi} = 0.109$$

Finally, we have

$N_A \sim N(19.23, 0.0769^2)\,\text{lb}$ and $N_B \sim N(27.2, 0.109^2)\,\text{lb}$. **Ans**.