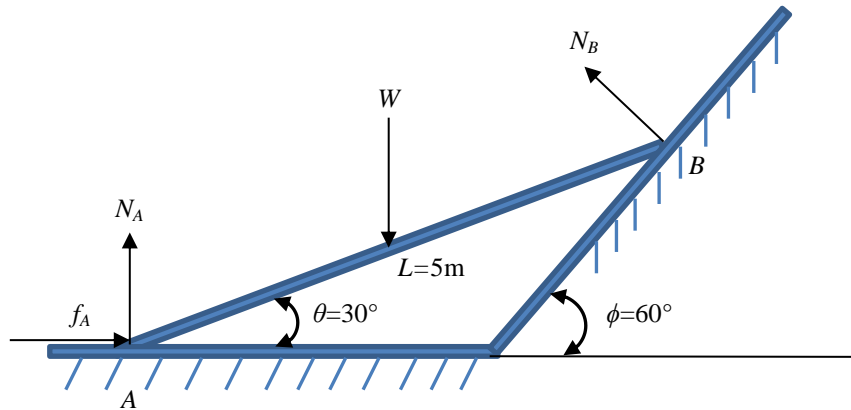20. Plate *AB* has a random weight $W \sim N(5, 0.01^2)$ lb due to manufacturing imprecision. Determine the distribution of normal forces at *A* and *B* if the inclined wall is smooth and the static coefficient of friction between the plate and horizontal wall is $\mu_s = 0.3$.

Solution

$$\sum F_x = 0; \quad f_A = N_B \sin \phi$$

$$f_A = \mu_s N_A$$

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

Solve the equation above, we can obtain

$$\mu_{N_B} = \frac{\mu_W}{\cos \phi + \sin \phi / \mu_s} = 1.476 \text{ lb}$$

$$\sigma_{N_B} = \frac{\sigma_W}{\cos \phi + \sin \phi / \mu_s} = 0.003$$

$$\mu_{N_A} = \mu_{N_B} \frac{\sin \phi}{\mu_s} = 4.262 \text{ lb}$$

$$\sigma_{N_A} = \sigma_{N_B} \frac{\sin \phi}{\mu_s} = 0.0085$$

Finally, we have $N_A \sim N(4.262, 0.0085^2)$ lb and $N_B \sim N(1.476, 0.003^2)$ lb.   **Ans.**