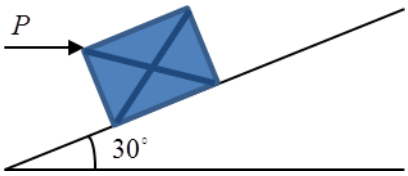
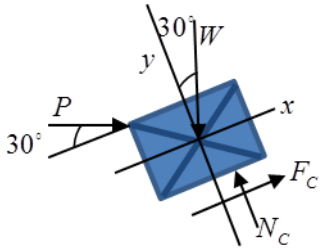
2. A horizontal force P, which follows a normal distribution $P \sim N(100, 5^2)$ lb, acts on a crate whose mass also follows a normal distribution $W \sim N(320, 10^2)$ lb. Determine the distribution of the frictional force. *P* and *W* are distributed independently.



Solution



Assume no slipping

$$\Sigma F_x = 0;\ P\cos 30^\circ - W\sin 30^\circ + F_C = 0$$

$$\mu_{F_C} = \mu_W \sin 30^\circ - \mu_P \cos 30^\circ = 73.4 \text{ lb}$$

$$\sigma_{F_C} = \sqrt{(\sigma_P \cos 30^\circ)^2 + (\sigma_W \sin 30^\circ)^2} = 6.6 \text{ lb}$$

Thus, the distribution of the frictional force is $F_C \sim N(73.4, 6.6^2)$ lb **Ans.**