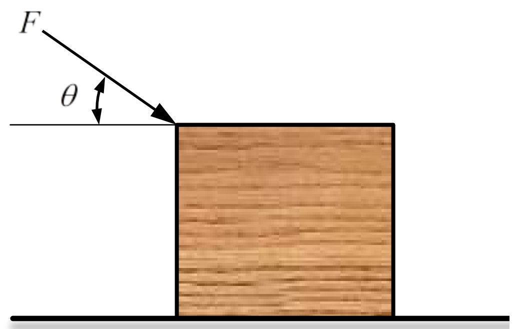
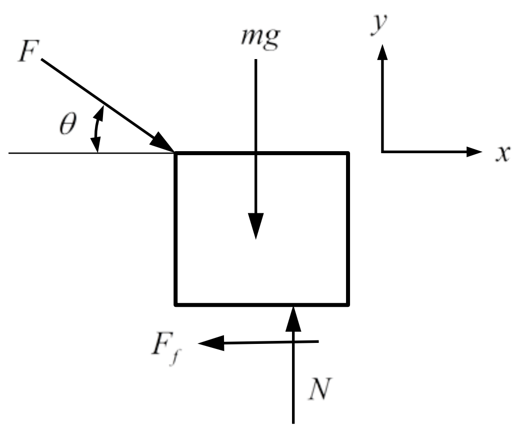
2-30. The 20-kg block is subjected to the force $F = 200\ \text{N}$ with the angle $\theta = 30^\circ$. If the coefficient of kinetic friction between the floor and the block is normally distributed $\mu_k \sim N(0.3, 0.03^2)$, determine the power supplied by F when $t = 2\ \text{s}$. The block is at rest initially.





$$(+\uparrow)\ \Sigma F_y = ma_y : N - F\sin\theta - mg = 0$$

$$N = F\sin\theta + mg$$

$$(+\rightarrow)\ \Sigma F_x = ma_x : F\cos\theta - \mu_k N = ma_x$$

$$F\cos\theta - \mu_k (F\sin\theta + mg) = ma$$

$$a = \frac{F\cos\theta}{m} - \frac{\mu_k (F\sin\theta + mg)}{m}$$

At $t = 2\ \text{s}$,

$$v = v_0 + at = \frac{F\cos\theta t}{m} - \frac{\mu_k (F\sin\theta + mg)t}{m}$$

$$P = (F\cos\theta)v = \frac{(F\cos\theta)^2 t}{m} - \frac{\mu_k (F\sin\theta + mg)F\cos\theta t}{m}$$

$$\mu_P = \frac{(F\cos\theta)^2 t}{m} - \frac{\mu_{\mu_k} (F\sin\theta + mg)F\cos\theta t}{m} = 1460.90\text{ W}$$

$$\sigma_P = \sqrt{\left(-\frac{\sigma_{\mu_k}(F\sin\theta + mg)F\cos\theta t}{m}\right)^2} = 153.91\text{ W}$$

Therefore, $P \sim N(1460.90, 153.91^2)$ W. **Ans.**