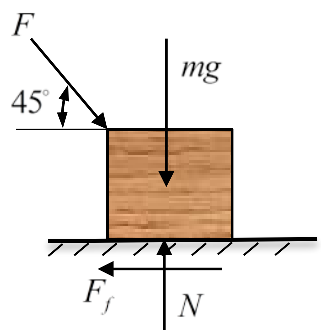
2-26. The 80-kg block is subjected to a normally distributed force $F \sim N(600, 60^2)$ N with an initial velocity $v_0 \sim N(2, 0.2^2)$ m/s. The coefficient of kinetic friction between the block and the floor is $\mu_k = 0.3$, determine the velocity of the block when $t = 5$ s. F and v_0 are independent.



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

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

$$(+\rightarrow)\ \Sigma F_x = ma_x;\ F\cos\theta - F_f = ma_x$$

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

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

The velocity of the block when $t = 5$ s

$$\begin{aligned} v &= v_0 + at \\ &= v_0 + \frac{(\cos\theta - \mu_k\sin\theta)Ft}{m} - \mu_k gt \end{aligned}$$

$$\begin{aligned} \mu_v &= \mu_{v_0} + \frac{(\cos\theta - \mu_k\sin\theta)\mu_F t}{m} - \mu_k gt \\ &= 2 + \frac{(\cos 45^\circ - 0.3\sin 45^\circ)(600)(5)}{80} - 0.3(9.81)(5) \\ &= 5.85 \text{ m/s} \end{aligned}$$

$$\begin{aligned} \sigma_v &= \sqrt{\left(\sigma_{v_0}\right)^2 + \left(\frac{(\cos\theta - \mu_k\sin\theta)\sigma_F t}{m}\right)^2} \\ &= \sqrt{(0.2)^2 + \left(\frac{(\cos 45^\circ - 0.3\sin 45^\circ)(60)(5)}{80}\right)^2} \\ &= 1.87 \text{ m/s} \end{aligned}$$

Therefore, $v \sim N(5.85, 1.87^2)$ m/s .