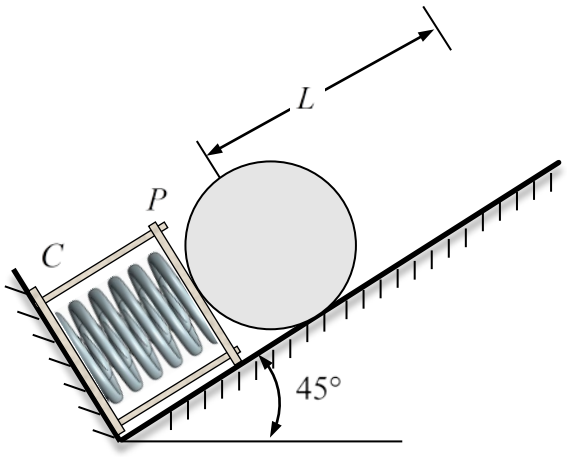
2-10. The $m = 5\,\text{kg}$ ball is shot from a spring device. If the ball is shot to the maximum distance of $L \sim N(1, 0.1^2)\,\text{m}$ up the smooth plane after the spring is pushed back $s = 0.3\,\text{m}$ and the ball is released from rest. The four cords *C* and plate *P* keep the spring compressed $s_0 = 0.1\,\text{m}$ when no load is on the plate. Determine the distribution of stiffness *k*.



Solution

$$\Sigma T_1 + \Sigma V_1 = \Sigma T_2 + \Sigma V_2$$

$$0 + \frac{1}{2}k(s + s_0)^2 = \frac{1}{2}ks_0{}^2 + mgL\sin 45°$$

$$\Rightarrow k = \frac{2mg\sin 45°}{s^2 + 2s_0 s}L$$

Thus

$$\mu_k = \frac{2mg\sin 45°}{s^2 + 2s_0 s}\mu_L = 462.45\ \text{N/m}$$ **Ans.**

$$\sigma_k = \frac{2mg\sin 45°}{s^2 + 2s_0 s}\sigma_L = 46.25\ \text{N/m}$$ **Ans.**

Therefore, the stiffness $k \sim N(462.45, 46.25^2)\,\text{N/m}$.