

Problem

11) A spring with elastic constant of $k = 90 \text{ N/m}$ is attached to a 40 kg block through a massless hook that is capable of supporting a maximum force of 500 N before breaking. We stretch the spring 5 m from its relaxed position and we let it go. (Assume that the surface is frictionless, see figure below).

Find the angular frequency of the block's oscillations

$$\omega = \sqrt{\frac{k}{m}} = \sqrt{\frac{90 \text{ N/m}}{40 \text{ kg}}} = \frac{3}{2} \text{ rad/s} = 1.5 \text{ rad/s}$$

Find the period of the block's oscillations

$$T = \frac{2\pi}{\omega} = 4.19 \text{ s}$$

Find the maximum force that the spring exerts on the hook. Does the hook break?

$$\begin{aligned} F_{\text{MAX}} &= m a_{\text{MAX}} = m A \omega^2 \\ &= (40 \text{ kg})(5 \text{ m})(1.5 \text{ rad/s})^2 \\ &= 450 \text{ N} \rightarrow \text{J! DOES NOT} \\ &\quad \text{break} \end{aligned}$$