21-R-WE-SS-34

A mouse trap uses a torsional spring (k= 100 N/rad) to store energy. The spring is wound such that it is at its natural length when the jaw of the trap sits on the wooden base. The jaw has a mass of 0.3kg, a length of 10cm and a moment of inertia of 2 g·m^2 about the pivot.
What is the velocity with which the tip of the jaw strike the wood when it is triggered if 100 J of energy is used against friction in the hinge?

Solution

This is just a simple conservation of energy problem.

$$
\begin{aligned}
E_{\text{spring 1}} + E_{\text{kinetic 1}} &= E_{\text{spring 2}} + E_{\text{kinetic 2}} + W_{\text{friction}} \\
\frac{1}{2}k\left(\Delta\theta\right)^2 + 0 &= 0 + \frac{1}{2}I\omega^2 + 100 \\
\frac{1}{2}\cdot 100 \cdot \pi^2 &= \frac{1}{2}\cdot\frac{2}{1000}\omega^2 + 100 \\
\Rightarrow \omega &= 627.3 \quad [\text{ rad/s }]
\end{aligned}
$$

$$
\begin{aligned}
v_A &= \omega \times r \\
&= 62 \quad [\text{ m/s }]
\end{aligned}
$$