University Physics 1A

Alvin Lin

October 4th, 2017

Work-Energy Theorem

$$\frac{1}{2}mv^2 = \text{kinetic energy in joules}$$

Constant Force with a Varying Direction of Motion

An iceboat is tethered by a rope to a post so that it can move around an arc of a circle of radius $R = 100.0m$. The wind exerts a constant force $F = 150N$ on the boat. What is the work done by the wind on the boat as it rotates through $90.0°$?

$$\begin{aligned}
W &= \int \vec{F} \cdot \ \mathrm{d}\vec{s} \\
&= \int F \ \mathrm{d}s \cos(\theta) \\
&= F \int \cos(\theta) \ \mathrm{d}s \\
&= F \int \cos(\theta) r \ \mathrm{d}\theta \\
&= Fr \int_0^{90} \cos(\theta) \ \mathrm{d}\theta \\
&= (150N)(100)(\sin(90) - \sin(0)) \\
&= 15000J
\end{aligned}$$

If the boat starts from rest, what is its speed at the end of this motion (again, friction is negligible)?

$$W = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$
$$15000J = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$
$$v_f = \sqrt{\frac{30000J}{m}}$$

The mass of the iceboat is the same as the problems from the Activities Manual (250kg).

$$v_f \approx 11\frac{m}{s}$$

You can find all my notes at `http://omgimanerd.tech/notes`. If you have any questions, comments, or concerns, please contact me at alvin@omgimanerd.tech