University Physics 1A

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September 29th, 2017

Work

$$\text{work} = \overrightarrow{force} \times \overrightarrow{displacement}$$
$$W = \vec{F} \cdot \overrightarrow{\Delta x}$$

There are two ways to define the dot product.

$$\begin{aligned}
\vec{A} \cdot \vec{B} &= |A||B| \cos(\theta) \\
\vec{A} &= A_x \hat{i} + A_y \hat{j} \\
\vec{B} &= B_x \hat{i} + B - y \hat{j} \\
\vec{A} \cdot \vec{B} &= (A_x \hat{i} + A_y \hat{j}) \cdot (B_x \hat{i} + B_y \hat{j}) \\
&= A_x B_x \hat{i} \cdot \hat{i} + A_y B_x \hat{j} \cdot \hat{i} + A_x B_y \hat{i} \cdot \hat{j} + A_y B_y \hat{j} \cdot \hat{j} \\
\vec{A} \cdot \vec{B} &= A_x B_x + 0 + 0 + A_y B_y
\end{aligned}$$

The calculation for work assumes a constant force and a straight line displacement. A curved path can be broken up into infinitely many straight segments. The total work is therefore the sum of the work in each segment.

$$W = \sum \vec{F} \cdot \overrightarrow{\Delta x}$$

This can be generalized to:

$$W = \int \vec{F} \cdot \mathrm{d}\vec{x}$$

where $\mathrm{d}\vec{x}$ is an infinitesimal displacement tangent to the path. This is the work done by force $\vec{F}$ on an object moving along the path. Work is expressed in the units of newton meters, or joules.

Power

Power is the rate at which work is done, or the rate of change of work.

$$\begin{aligned} P &= \frac{\text{work done}}{\text{time}} \\ &= \frac{\mathrm{d}W}{\mathrm{d}t} \\ \frac{J}{s} &= Watt = W \\ 1\ horsepower &= 746W \end{aligned}$$

Reminders and Homework

Complete the homework on TheExpertTA and WebAssign.
Remember to bring the Activities Manual.

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