

# University Physics 1A

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## Work

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

There are two ways to define the dot product.

$$\vec{A} \cdot \vec{B} = |A||B| \cos(\theta)$$
$$\vec{A} = A_x \hat{i} + A_y \hat{j}$$
$$\vec{B} = B_x \hat{i} + B_y \hat{j}$$
$$\vec{A} \cdot \vec{B} = (A_x \hat{i} + A_y \hat{j}) \cdot (B_x \hat{i} + B_y \hat{j})$$
$$= A_x B_x \hat{i} \cdot \hat{i} + A_y B_x \hat{j} \cdot \hat{i} + A_x B_y \hat{i} \cdot \hat{j} + A_y B_y \hat{j} \cdot \hat{j}$$
$$\vec{A} \cdot \vec{B} = A_x B_x + 0 + 0 + A_y B_y$$

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.

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

This can be generalized to:

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

where  $d\vec{x}$  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.

$$P = \frac{\text{work done}}{\text{time}}$$
$$= \frac{dW}{dt}$$

$$\frac{J}{s} = \text{Watt} = W$$

$$1 \text{ horsepower} = 746W$$

## 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](mailto:alvin@omgimanerd.tech)