

Energy

- A fluid-like quantity that is capable of producing change
- measured in Joules (J)
- Is never created or destroyed
 - It is simply transferred from one storage mechanism to another

Work (W)

- Energy transfer
- measured in Joules (J)

* Energy is typically transferred via a force

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

\vec{F} = force acting on a particle (N)

\vec{x} = displacement of the particle (m)

Recall that a dot product can be written in three different ways

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

$$W = F_x x_x + F_y x_y + F_z x_z$$

$$W = F \cos \theta$$

↑ angle between \vec{F} and \vec{x}

* This form of work is useful when the force is constant.

$$W = \int_a^b F(x) dx$$

* This form of work is useful for variable forces that do work in 1 dimension

$$W = \int_a^b \vec{F} \cdot d\vec{x}$$

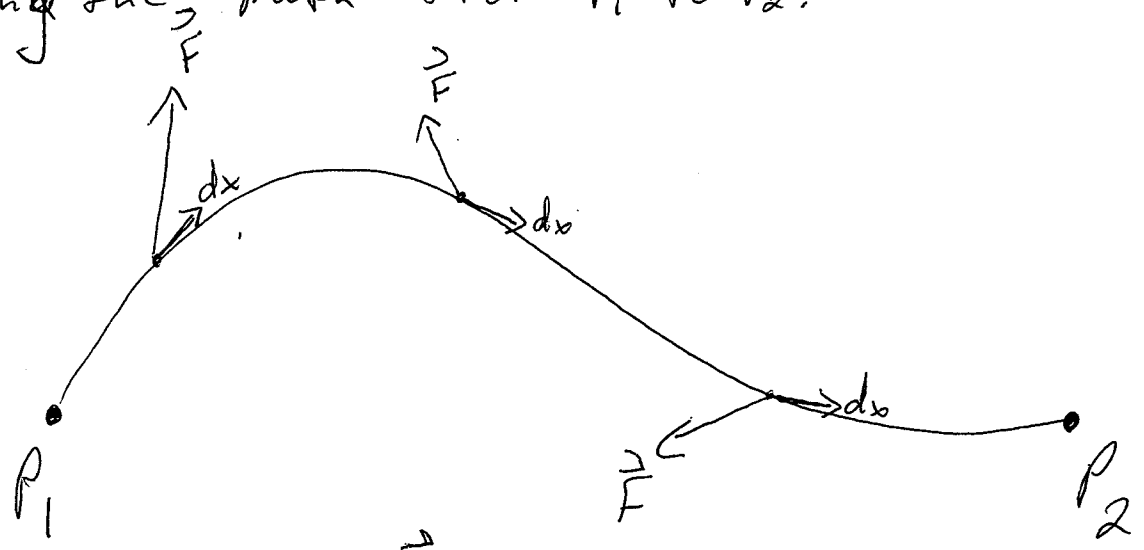
* This form of work is useful for variable forces that do work in multiple dimensions

\vec{F} and \vec{dx} are vectors that can have components in any number of dimensions.

$$W = \int_{a_x}^{b_x} F_x dx_x + \int_{a_y}^{b_y} F_y dx_y + \int_{a_z}^{b_z} F_z dx_z$$

* Since the integral is a linear operator and the dot product can be rewritten as a sum of products, work in 3D can be rewritten in this form

In the following example the Force \vec{F} varies by position along the path from P_1 to P_2 .



Note: \vec{dx} is tangent to the path at all points along the path.