

So let's talk about energy!

1 | Types of Energy

- Potential Energy $PE_{grav} = mgh$ (which is work (force times distance) for moving stuff up $\vec{F} \cdot \vec{h}$)
- Kinetic Energy $KE_{translational} = \frac{1}{2}mv^2 + KE_{rotational} = \frac{1}{2}I\omega^2$

Where...

- I : moment of inertia
- ω : rotational velocity

2 | Work

$W = \vec{F} \cdot \vec{d}$, where \vec{F} force and \vec{d} change of distance that the force manifest.

$$\Rightarrow W = |\vec{F}| \cos \theta \times |\vec{d}|$$

$$\text{which, } \Rightarrow W = |\vec{d}| \cos \theta \times |\vec{F}|$$

so, essentially, work is either displacement times parallel as part of force, or visa versa.

Why?

2.1 | The Dot Product, a review

2.1.1 | What is it

The Dot product is a measure of the "parallelity" of \vec{F} with \vec{D} .

\Rightarrow Dot product: the component of the first vector parallel to the second vector multiplied to the magnitude of d.

$$\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}| \cos \theta$$

2.1.2 | Calculating it

Given two vectors

- $\vec{V}_1 = \langle a_x, a_y, a_z \rangle$
- $\vec{V}_2 = \langle b_x, b_y, b_z \rangle$

The dot product is...

$$\vec{V}_1 \cdot \vec{V}_2 = a_x b_x + a_y b_y + a_z b_z$$

3 | Potential Energy

Potential energy exists because of a force field. There is an object "propping" it up pending release of energy.

3.1 | Where did $\Delta PE = W = mg\Delta h$ come from?

So, define $PE = -W_{AB}$. Which is "potential energy of A to B." Gravity will do a certain amount of work from one point to another, it will do the opposite the other way.

$$\Delta PE_g = -W_{AB} = -\vec{F} \cdot \vec{d}$$

$$\Delta PE_g = -((-mg) \cdot \Delta h) \text{ The negative again! } \$ \text{ is}$$