Chapter 5: Power, Work, and Energy

Topics

- The concepts of power, work, and energy
- And their precise definitions
- Work-energy theorem
- Conservative forces and energy conservation

5.1 The Concepts of Work and Power

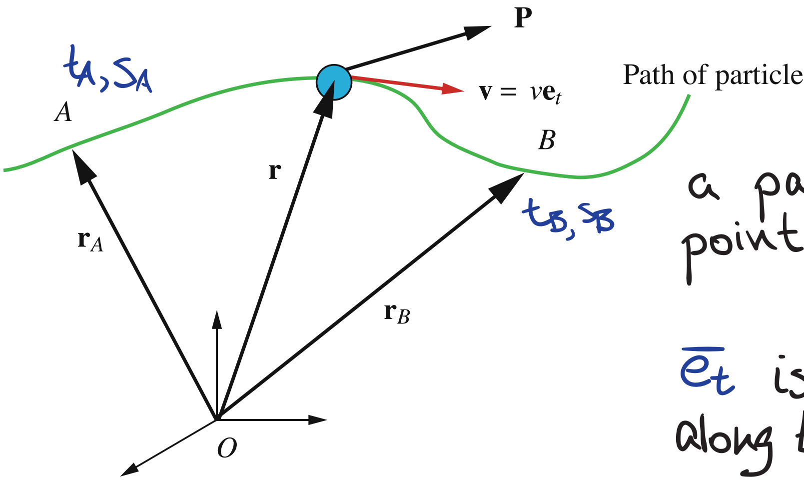
We will rigorously define work and power momentarily, but we can gain some intuition in the simple case of a constant force acting on a particle in the direction of its motion—

5.2 The Power of a Force

Consider a force $\bar{P}$ acting on a particle of mass m.

Def.: $\boxed{}$

where $\bar{v} = \dot{\bar{r}}$ is, as usual, the absolute velocity.



Consider the work done by a force $\bar{P}$ on a particle from point A to point B.

$\bar{e}_t$ is the unit tangent vector along the particle's path.

The work has several equivalent expressions:

Let's write down $\bar{P}$ and $d\bar{r}$ in different bases:

$\bar{P} =$	$d\bar{r} =$
$=$	$=$
$=$	$=$

From (*),

5.3 The Work-Energy theorem

Definition: The Kinetic energy of a particle is defined to be

The work-Energy theorem relates the time rate-of-change of the Kinetic energy and the resultant force $\bar{F}$ acting on a particle:

5.4 Conservative Forces

Let $U = U(\bar{r})$ be the potential energy function. A force $\bar{P}$ is defined to be conservative if

Let's show this:

Therefore, if $\overline{r_A} = \overline{r_B}$ (closed path), $W_{AB} = 0$ (remember: $\overline{P}$ was a conservative force!).

If $\overline{P}$ is conservative, then its mechanical power is:

Examples of non-conservative forces:

Next time we'll look at examples of conservative forces, especially: