

# Energy

Patrick Chen

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Potential energy ( $U$ ) is the form of internal energy associated with reversible changes in the configuration state of an object or system. In reversible changes in the configuration state, the kinetic energy is converted into potential energy, then back into kinetic energy. Total mechanical energy is defined as the sum of kinetic energy and all the potential energies in a system.

$$E = K + U$$

From this definition, the gravitational potential energy can be calculated if we assume there are no other potential energies in the system.

$$\begin{aligned}v_f^2 &= v_i^2 + 2a\Delta d \\v_f^2 - v_i^2 &= 2a\Delta d\end{aligned}$$

$$\begin{aligned}\Delta K &= K_f - K_i \\&= \frac{1}{2}m(v_f^2 - v_i^2) \\&= \frac{1}{2}m(2a\Delta d) \\&= \frac{1}{2}m(2(-g)\Delta y) \\&= -mg\Delta y \\ \Delta K + \Delta U &= 0 \\ -\Delta K &= \Delta U \\ mg\Delta y &= \Delta U\end{aligned}$$

Kinetic energy that is converted in an interaction (collision) that does not reappear is dissipated energy. Coherent deformation is reversible and incoherent deformations is non-reversible. Incoherent interactions are dissipative.

- coherent: mechanical
- incoherent: thermal, source

Source energy is an incoherent energy that is used to produce other forms of energy.

## Efficiency

The efficiency of a interaction is the ratio of useful energy output and total energy input. It is often represented as a percentage.

$$\text{Efficiency} = \frac{\text{Useful energy out}}{\text{Total energy in}} \cdot 100\%$$