

# Free energy [tln3]

## Mechanical system:

Consider a mechanical system in the form of a massive particle moving in a potential (e.g. harmonic oscillator, simple pendulum).

- Energy can be stored in a mechanical system when some agent does work on it.
- If the work involves exclusively *conservative* forces, then all energy added can be retrieved as work performed by the system.
- If the work done also involves *dissipative* forces, then only part of the energy added is retrievable as work performed by the system.
- The energy stored in and retrievable from the system is called *mechanical energy* (kinetic energy plus potential energy).

## Thermodynamic system:

Consider a thermodynamic system in contact with a work source and (optionally) also with a heat reservoir and/or a particle reservoir.

- Energy can be stored in a thermodynamic system when some agent does work on it.
- If the work is done *reversibly*, then all the energy added can be retrieved as work performed by the system.
- If the work is done *irreversibly*, then only part of the energy added is retrievable as work performed by the system.
- The energy stored and retrievable as work is called *free energy*.
- The free energy stored in or retrieved from a thermodynamic system is expressed by some *thermodynamic potential*.
- The form of thermodynamic potential depends on the constraints imposed on the system during storage and retrieval of free energy.