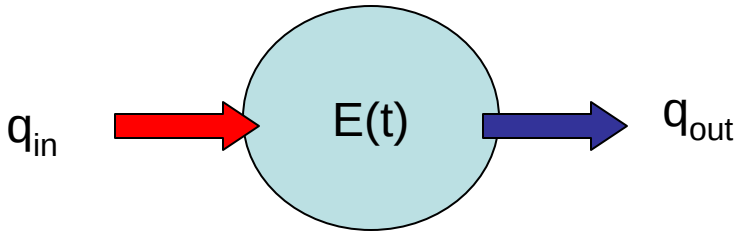
Energy Conservation

Thermal energy exchanges take place at the boundaries of an object where all three modes of heat transfer (conduction, convection, radiation) can emerge due to the presence of temperature differences. A simplified version of the energy conservation equation can be written as

$$\frac{dE}{dt} = q_{in} - q_{out}$$

We have neglected mechanical work done, possible energy exchange due to the mass exchanges at the boundaries, and possible energy generation within the system. These other terms will be added later for a more complete thermodynamic analysis.

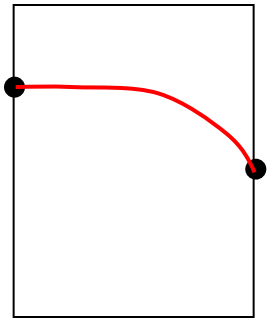


Example, Thermal Energy Conservation/Conduction

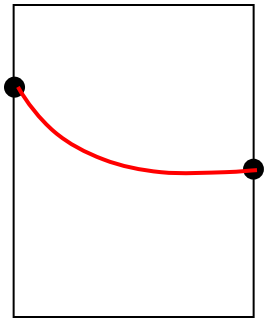
The temperature distribution inside the solid block shows that the block is (a) losing energy; (b) gaining energy; (c) neither losing nor gaining energy at **the very next instant**. (Assume no internal heat generation). Why?

The key consideration here is the energy exchange with its surrounding:
(a) the temperature profile at the right surface indicates heat transfer to the right while no energy exchange at the left surface
(b) Just the opposite, heat is flowing in from the left but nothing happens at the right surface
(c) Both surfaces show little energy exchange

(a) Losing energy



(b) Gaining energy



(c) Stay the same