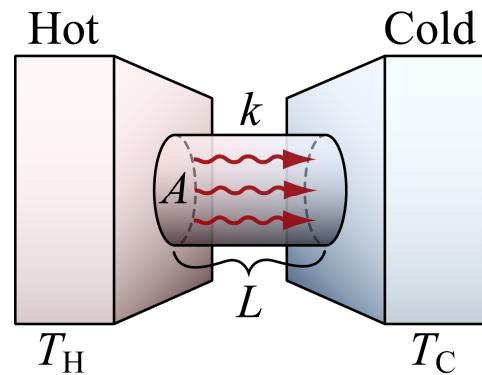


First law of thermodynamics (for AP Physics 2)

Heat conduction

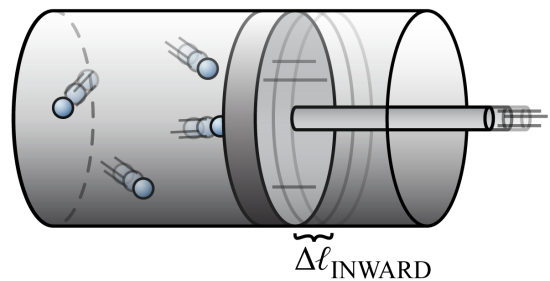
$$\Delta Q = \frac{kA}{L} \Delta T \Delta t$$



Work

$$\begin{aligned} \Delta W_{\text{OUTSIDE ON SYS}} &= F_{\text{INWARD,AVG}} \Delta \ell_{\text{INWARD}} \\ &= P_{\text{AVG}} A \Delta \ell_{\text{INWARD}} \end{aligned}$$

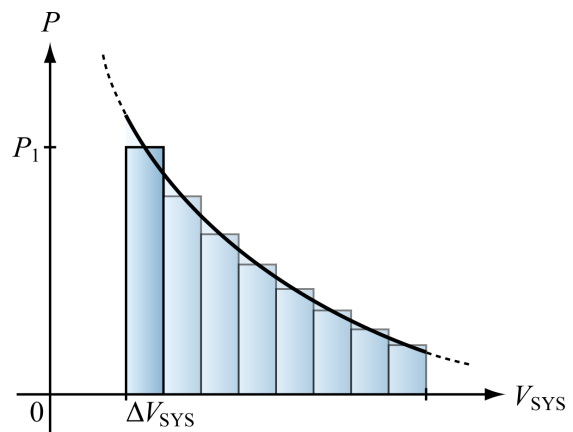
$$\Delta W_{\text{OUTSIDE ON SYS}} = P_{\text{AVG}} (-\Delta V_{\text{SYS}})$$



$$\Delta W_{\text{BY SYS}} = P_{\text{AVG}} \Delta V_{\text{SYS}}$$

Signed area

$$\Delta W_{\text{BY SYS}} = \text{under graph of } P \text{ vs. } V_{\text{SYS}}$$



First law of thermodynamics

$$\Delta U_{\text{SYS}} = \Delta Q_{\text{OUTSIDE INTO SYS}} + \Delta W_{\text{OUTSIDE ON SYS}}$$

Types of thermodynamic processes

- isovolumetric** – at constant volume
- isothermal** – at constant temperature
- isobaric** – at constant pressure
- adiabatic** – without transfer of heat