

Warm-Up:

The First Law

The first law of thermodynamics states that energy is conserved. In other words, the amount of energy in a system can change, but any energy lost during a chemical reaction must be gained by its surroundings. Although a fire may give off heat, the energy does not just disappear—it is spread throughout its surroundings until it is so spread out that it can no longer be measured by the human senses.

Daily

What is the change in internal energy of a system in a reaction in which 300 joules are absorbed by the system from its surroundings and 120 joules of that energy are used to do work on the surroundings?

$$300 \text{ J in} \rightarrow \boxed{} \xrightarrow{\text{out}} 120 \text{ J} = 180 \text{ J absorbed}$$

- First Law Thermodynamics: Law of Conservation of energy
↳ heat may be transferred

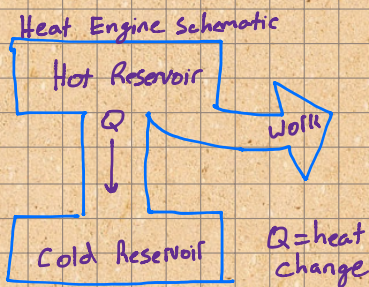
• Adiabatic Process: if you compress/expand a system temp inside will increase/decrease accordingly [heat is not exchanged w/ surroundings]

↳ Internal Combustion Engine: as the piston compresses gas it is ignited and then expands → heat mostly stays internal

- Heat Engine: changes internal energy into mechanical work

↳ Functions:

- 1) Heat absorbed from a higher temp reservoir
- 2) Convert energy into mechanical work
- 3) Expe/exhaust left over energy into low temp reservoir



★ Not all energy can be converted into useful work, some is lost to the surroundings → we can calculate this efficiency

→ Carnot Efficiency: $\frac{T_{\text{hot}} - T_{\text{cold}}}{T_{\text{hot}}}$ ★ Kelvin Scale

Ex: If hot and cold reservoirs are the same temp [400K]
What is the efficiency?

$$\frac{400 - 400}{400} = 0\%$$

Ex 2: Hot = 300 K
Cold = 25 K $\frac{300 \text{ K} - 25 \text{ K}}{300 \text{ K}} = 0.916 = 91.6\%$

• Refrigerators: heat engines in reverse → extract heat from cold and exhaust it to the surroundings

↳ Cannot cool a room by opening the fridge

• 2nd Law of Thermodynamics: entropy is always increasing

↳ Entropy: measure of disorder

↳ order leads to disorder

↳ Useful energy is converted to non-useful energy [heat]