All Work, No Heat!

Brief review of elementary classical Mechanics Notions

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Newton 1st & 2nd

- 1st Law of inertia: Momentum of an *isolated* object is unchanged
- 2nd : $\mathbf{F} = \boldsymbol{ma}$
- "Inertial mass" is the proportionality constant between force & acceleration; "Inertial mass" is measured somehow; Force is what that satisfies $\mathbf{F} = \boldsymbol{ma}$; "Circular logic"
- Source of force field; e.g. Gravitation; $\boldsymbol{F} = \frac{-\boldsymbol{Gm_1m_2}}{\boldsymbol{r^2}}$; $\boldsymbol{m_1}$ and $\boldsymbol{m_2}$ are Gravitational masses
- Principle of equivalence: Inertial and Gravitational masses are equivalent
- Force field (like electrical & magnetic) need not involve masses

Work

- Intuitive notion of physiological work-performed against resisting force
- $\boldsymbol{W = F * d}$
- Can the work done in this purely mechanical system be recovered?
- Already lifted mass, in principle, can be lowered to lift another mass

Potential & Kinetic Energy in simple mechanical system

- Cricket ball in Bumrah's hand has potential energy...
- At a particular position, ball has the potential to gain kinetic energy when accelerated/applied force
- Potential energy=Stored energy capacity of a mechanical system (e.g. system=object in a force field)
- Kinetic energy=Capacity to do work, present in the object in the form of motion of the object; Cricket ball with kinetic energy can move against a resisting gravitational force
- Work mediates transformation of Kinetic energy to Potential energy
- Conservation of energy & Work-Energy theorem

Potential Energy interconversion to Kinetic Energy

- Hydroelectric energy/power
- Solar energy did the lifting of water, gave water (in the form of cloud) its potential energy
- Potential energy released is transformed to kinetic energy of rain, which is seldom used for work
- However, water falling from high altitude can be used for doing work
- Typically, hydroelectric power plants can covert ~85% of potential energy from stored water into electrical energy
- Energy density is less; Energy release per unit mass or volume is less

What is a simple mechanical system?

- No “friction”; No heat; No temperature
- Mechanical quantities vs. thermodynamical quantities
- How do we extend notions of work, work-energy theorem, conservation and conversion of energy as seen in simple mechanical systems to thermodynamical systems?
- ESO-Thermodynamics!