

14.5 Mechanical Energy and Conservation of Mech. Energy

Def (Total chg in mech. energy of system) $\Delta E_m = \Delta K_{s,1} + \Delta U_{s,1}$

- closed system, only conservative internal forces: $\Delta E_m = 0$
- completely reversible processes: closed system, processes take place, only conservative forces act

14.7 Chg of Mech. En. for closed system w/ Internal Non-conserv. Forces

- suppose internal forces are both conservative and non-conservative

$$W = W_c + W_{nc}$$

↗ path-indep.
↘ path dep.

$$W_c = -\Delta U \Rightarrow W = -\Delta U + W_{nc} = \Delta K$$

$$\Rightarrow W_{nc} = \Delta K + \Delta U = \Delta E_{mech}$$

$\Delta E_{sys} = \Delta E_m - W_{nc} = 0$ energy conserved but some mech en. transferred to non-recoverable energy W_{nc}
ie there is an irreversible process happening

14.7.1 Chg of Mech. En. for a Non-closed System

- system now in contact w/ surroundings

$$\Rightarrow \Delta E_{sys} = -\Delta E_{surroundings}$$

- chg in energy of the system can be due to external work done on the sys.

$$W_{ext} = \int_A^B \vec{F}_{ext} \cdot d\vec{r}$$

$$W_{ext} > 0 \Rightarrow \Delta E_{surround.} < 0$$

- chg in energy can also be due to thermal energy flowing in/out

This flow is denoted Q .

Convention: $Q > 0 \Rightarrow$ en. flows into sys, $\Delta E_{sur.} < 0$

$$\Rightarrow W_{ext} + Q = \Delta E_{sys} \quad (\text{First Law of Thermodynamics})$$