

Introduction to the First Law of Thermodynamics Introduction to Work

First Law of Thermodynamics

$$\Delta E_{sys} = Q_{into sys} - W_{by sys}$$
$$= Q_{into sys} + W_{on sys}$$

$$\frac{dE_{CV}}{dt} = \dot{Q}_{into\ CV} - \dot{W}_{by\ CV} + \sum_{into\ CV} \dot{m}e - \sum_{out\ of\ CV} \dot{m}e$$
$$= \dot{Q}_{into\ CV} + \dot{W}_{on\ CV} + \sum_{into\ CV} \dot{m}e - \sum_{out\ of\ CV} \dot{m}e$$

Types of Energy

 $\Delta E_{sys} = \Delta U_{sys} + \Delta (KE)_{sys} + \Delta (PE)_{sys}$

 $\Delta e_{sys} = \Delta u_{sys} + \Delta (ke)_{sys} + \Delta (pe)_{sys}$



Work required to accelerate an object



$$\therefore W_{\text{on system},1\to2} = \frac{1}{2} m \left(V_2^2 - V_1^2 \right)$$

Work required to lift an object in a gravity field



 $\mathbf{F} = \begin{bmatrix} 1 & \mathbf{F} & \mathbf{F} \\ V_1 & V_2 & W_{\text{on system}, l \to 2} = \int_{1}^{2} \mathbf{F}_{\text{on system}} \cdot d\mathbf{s}$ $x \quad \text{object with} \\ \maxs, m & = \int_{V_1}^{V_2} \left(\underbrace{m \frac{dV}{dt}}_{\text{Newton's 2nd law}} \hat{\mathbf{e}}_x \right) \cdot \left(\underbrace{Vdt}_{x \to d} \hat{\mathbf{e}}_x \right)$ $= m \int_{V_1}^{V_2} V \, dV$

: $W_{\text{on system},1\to2} = \frac{1}{2} m \left(V_2^2 - V_1^2 \right)$