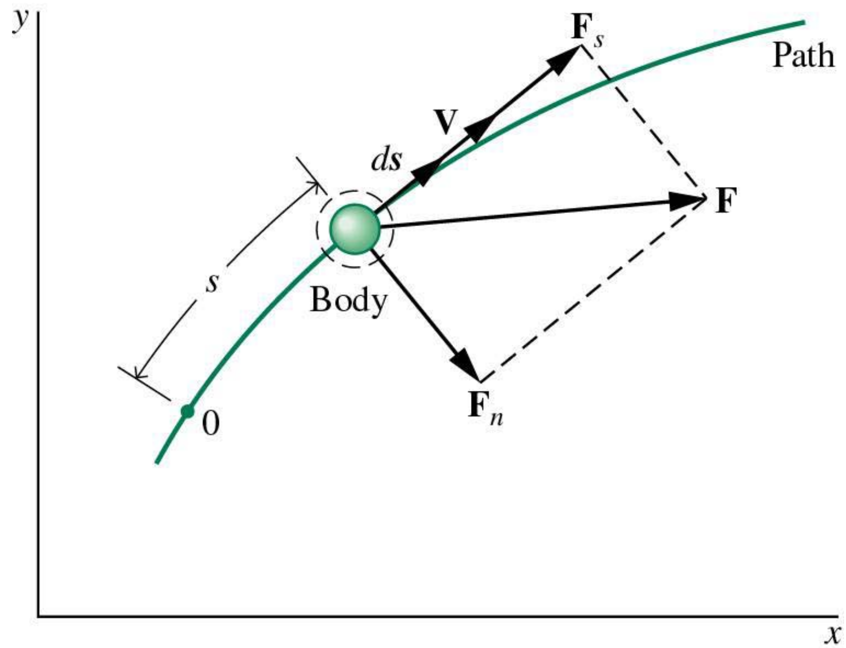
We will cover the following concepts,

- ***Work, Kinetic and Potential Energy***
- ***Conservation of Energy***
- ***Power***
- ***Work Sign Convention and Notation***
- ***Expansion or Compression Work***

A body moves from point s_1 with velocity V_1 to point s_2 with velocity V_2.



Newton's 2nd law: F = m.a then

$$F_s = m\frac{dV}{dt}$$

$$= m\frac{dV}{ds}\frac{ds}{dt} = m\frac{dV}{ds}V$$

Integrated from *s_1 point s_2*

$$\int_{V_1}^{V_2} mVdV = \int_{s_1}^{s_2} F_s ds$$

Evaluating

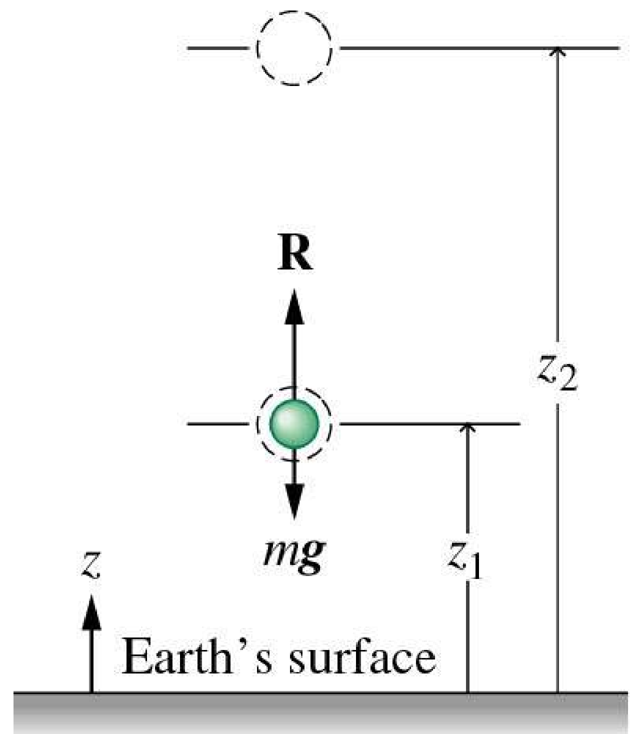
$$\underbrace{\frac{1}{2}m(V_2^{\,2} - V_1^{\,2})}_{Kinetic\ Energy} = \underbrace{\int_{s_1}^{s_2} F_s ds}_{Work}$$

$$\Delta KE = KE_2 - KE_1 = \Delta W$$

A body moves from point z_1 with velocity V_1 to point z_2 with velocity V_2.

Energy Balance:

$$\frac{1}{2}mV_2^2 + mgz_2 = \frac{1}{2}mV_1^2 + mgz_1 + \int_{z_1}^{z_2} R\,dz$$



$$\Delta PE = PE_2 - PE_1 = mg(z_2 - z_1)$$

The rate of energy transfer by work is called power.

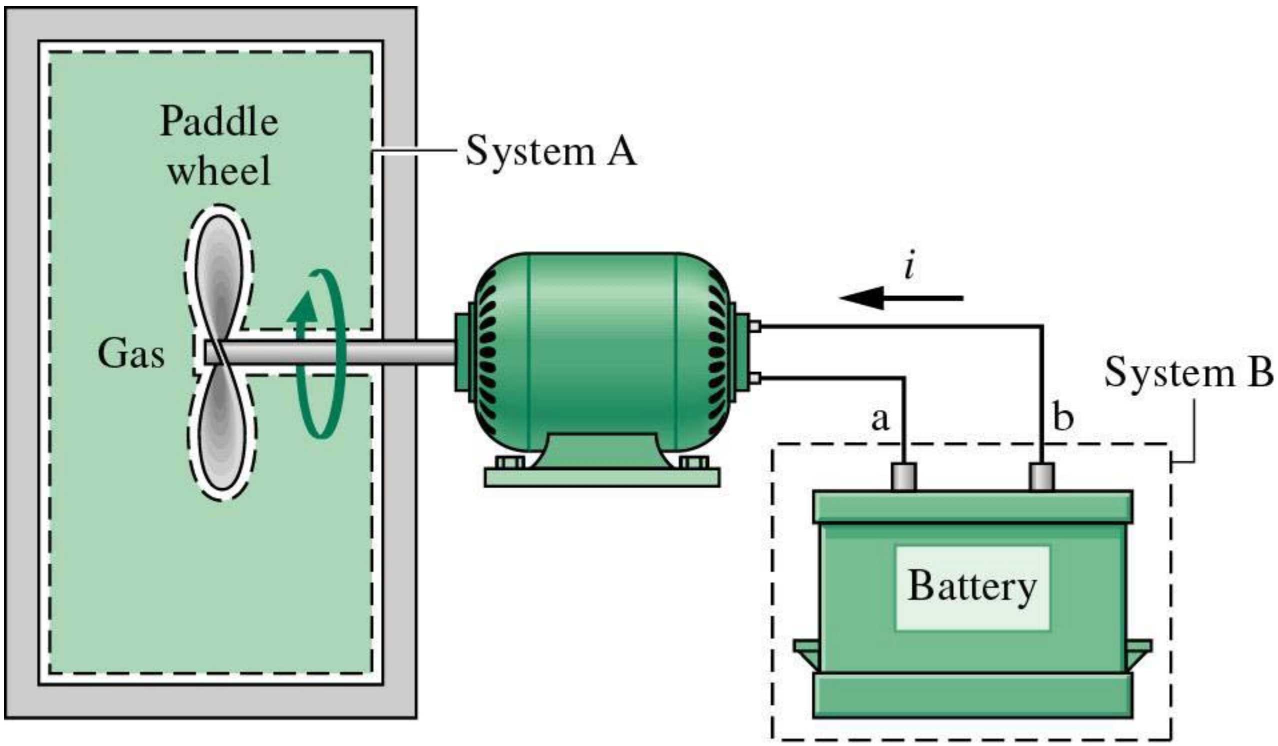
$$\dot{W} = \frac{Work}{Time} = \frac{dW}{dt} = F.V$$

$$W = \int_{t_1}^{t_2} \dot{W} dt = \int_{t_1}^{t_2} F.V dt = \int_{s_1}^{s_2} F.\frac{ds}{dt} dt$$

$$W = \int_{s_1}^{s_2} F.ds$$

$$W > 0: \text{ work done } \textit{by} \text{ the system}$$

$$W < 0: \text{ work done } \textit{on} \text{ the system}$$



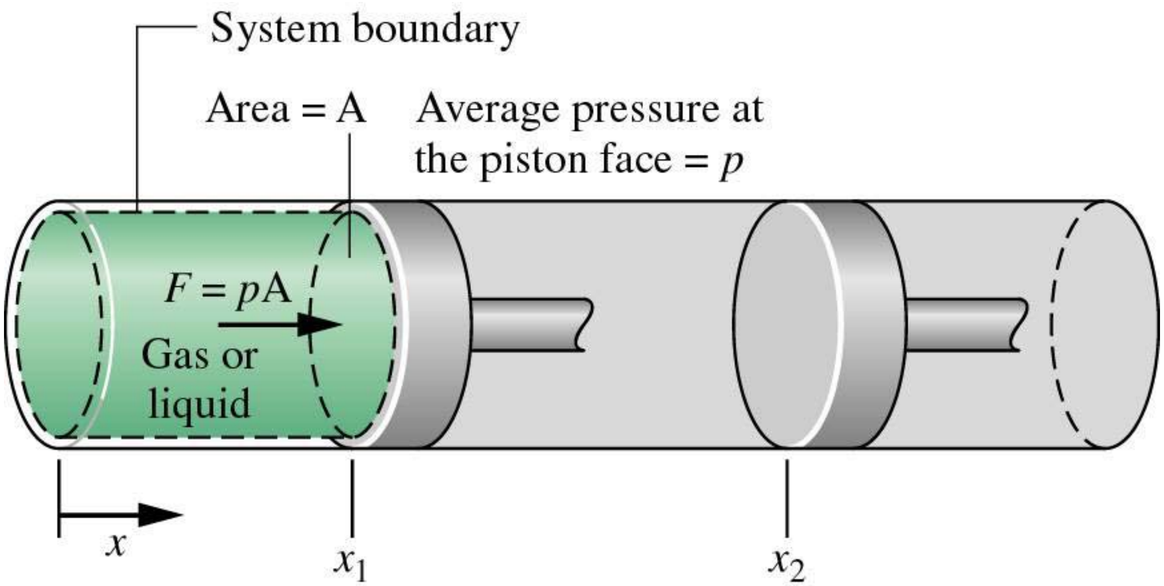
Work is *not* a property of the system or the surroundings so we *can not* say the amount of work at state 1 is W_1. It can only be defined for a process, meaning the work done on/by the system from state 1 to state 2.

$$W = \int_1^2 \delta W$$

δW is called inexact.

How about this integral? Is velocity exact or inexact?

$$\int_{\cancel{V}_1}^{\cancel{V}_2} d\cancel{V} = \cancel{V}_2 - \cancel{V}_1$$



$$\delta W = pAdx$$
$$= pd\forall$$

$$W = \int_{\forall_1}^{\forall_2} pd\forall$$