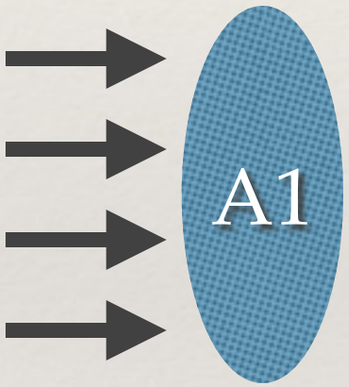
Bernoulli's Equation

Fluids



A fluid moves through a surface of area A_1

And passes on to move through surface A2

$$E_1 = \text{kinetic energy} + \text{potential energy} = \frac{1}{2}\Delta m_1 \bullet v_1^2 + \Delta m_1 \bullet g \bullet y_1$$

$$E_2 - E_1 = \frac{1}{2}\Delta m \bullet v_2^2 + \Delta m \bullet g \bullet y_2 - \frac{1}{2}\Delta m \bullet v_1^2 + \Delta m \bullet g \bullet y_2$$

This is all well and good, but why would E1 and E2 change.
They would only change if there was a change in energy in the system, i.e. if work is done on the system

W_{on} = [force]X[distance] = [pressure X area]X[velocity X time interval]

Work Done

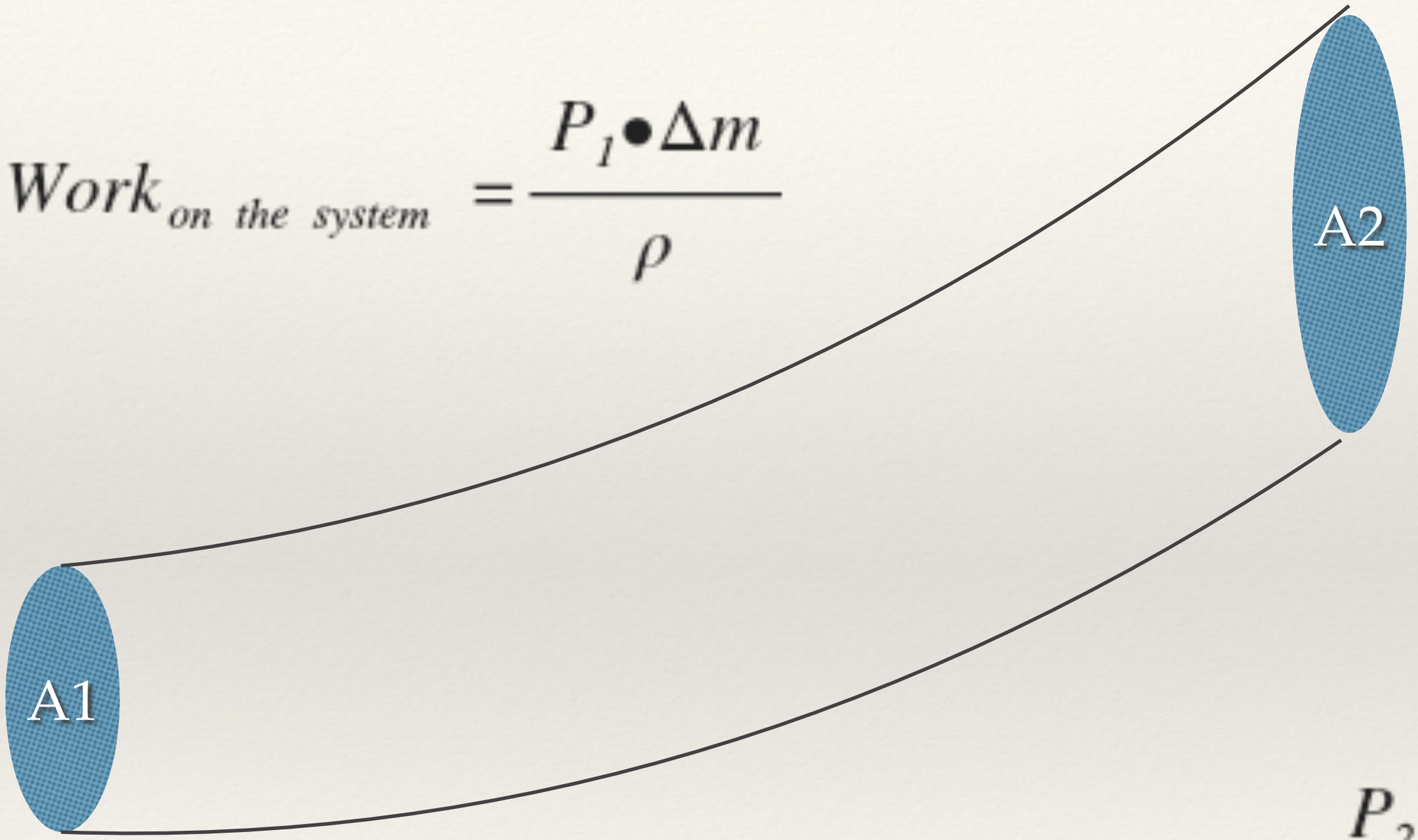
$$Won = [force] x [distance] = [pressure \ x \ area] \ x \ [velocity \ x \ time interval]$$

$$Won = (P_1 \bullet A_1) \bullet (v_1 \bullet \Delta t)$$

$$= P_1 \bullet (\rho \bullet A_1 \bullet v_1 \bullet \Delta t) / \rho$$

This term is just a mass

$$Work_{\text{on the system}} = \frac{P_1 \bullet \Delta m}{\rho}$$



$$Work_{\text{by the system}} = \frac{P_2 \bullet \Delta m}{\rho}$$

$$W_{on} - W_{out} = \frac{p_1 \bullet \Delta m}{\rho} - \frac{p_2 \bullet \Delta m}{\rho}$$

Net work done in the system

Returning to

$$E_2 - E_1 = \frac{1}{2}\Delta m \bullet v_2^2 + \Delta m \bullet g \bullet y_2 - \frac{1}{2}\Delta m \bullet v_1^2 + \Delta m \bullet g \bullet y_2$$

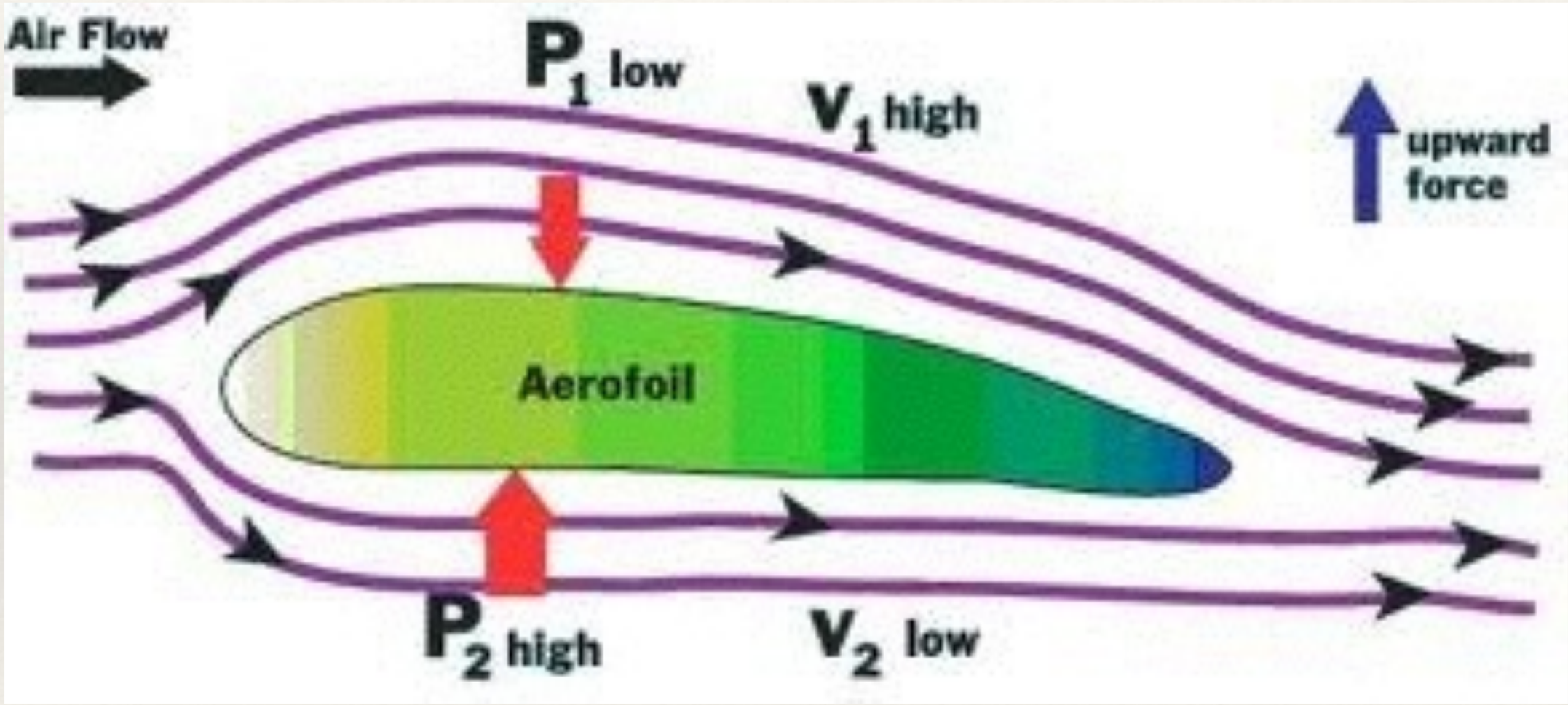
Becomes

$$E_2 - E_1 = \Delta m \bullet \left[\frac{1}{2}(v_2^2 - v_1^2) + g(y_2 - y_1) \right]$$

$$\frac{(P_1-P_2)\bullet\Delta m}{\rho}=\Delta m\bullet\left[\frac{1}{2}(v_2^2-v_1^2)+g(y_2-y_1)\right]$$

$$P_1-P_2=\rho\bullet\left[\frac{1}{2}(v_2^2-v_1^2)+g(y_2-y_1)\right]$$

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$$


Air Flow
P_1 low
V_1 high
upward force
Aerofoil
P_2 high
V_2 low