

Application of Closed System Energy Balance

- Carefully read the problem statement
- Evaluate which terms in the energy balance are zero
- Write simplified equation
- Plug in known values and solve for desired unknown

Example 1

A gas cylinder contains N_2 at 200 atm and 80°C. As a result of cooling at night, the pressure in the cylinder drops to 190 atm and the temperature to 30°C.

Which of the terms in the energy equation are zero?

(ΔE_k , ΔE_p , W)

For the non-zero terms, are their values positive or negative?

$Q = \text{negative}$

$\Delta U = \text{negative}$

Example 2

Water is pumped from one reservoir to another 300 ft away. The water level in the second reservoir is 40 ft above the water level of the first reservoir. How much work per mass of water was performed?

What is the system? (liquid water only)

Which terms are zero? Why?

What is the simplified form of the energy balance?

How was the work performed?

What is the answer in Btu/lb_m?

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How was the work performed? Pump

What is the answer in Btu/lb_m? $g\Delta h \rightarrow 0.33 \text{ Btu/lb}_m$

$$\frac{W}{m} = \frac{\left(\frac{32.2 \text{ ft}}{\text{s}^2}\right)(260 \text{ ft})}{\left(\frac{32.2 \text{ lb}_m \text{ ft}}{\text{lb}_f \text{ s}^2}\right)} \left(\frac{9.486 \times 10^{-4} \text{ Btu}}{0.7376 \text{ ft} \cdot \text{lb}_f}\right)$$