

Some examples

You eat a 1000 Calorie dessert and don't want to gain weight so you run up several flights of stairs - how far do you have to climb.

$$\text{Want } \Delta U = 0 = Q - W$$

↑  
from  
dessert

↑  
climbing up  
stairs

$$Q = 1000 \text{ kcal} \cdot 4186 \text{ J/kcal} = 4.186 \times 10^6 \text{ J}$$

Thus

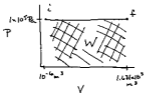
$$W = mgh = 4.186 \text{ J} \times 10^6$$

$$h = \frac{4.186 \text{ J} \times 10^6}{mg} = \frac{4.186 \times 10^6 \text{ J}}{100 \text{ kg} \cdot 9.8 \text{ m/s}^2}$$

$$h = 4270 \text{ m} - \text{climb Mt. Whitney!}$$

WATER  $\rightarrow$  STEAM

1 gram = 1 ml = 1 cm<sup>3</sup> of water becomes 1671 cm<sup>3</sup> of steam when it boils at 1 atm



$$\begin{aligned}W &= \int P dV \\&= P \Delta V \text{ const pressure} \\&= 1 \times 10^5 \text{ Pa} \cdot 1.670 \times 10^{-3} \text{ m}^3 \\&= 167 \text{ J} \\&\quad \text{Work is positive}\end{aligned}$$

Heat is the heat of vaporization

$$\begin{aligned}Q &= m L_v = 1 \times 10^{-3} \text{ kg} \times 2.49 \times 10^3 \text{ J/kg} \\&= 1 \times 10^{-3} \text{ kg} \times 249 \times 10^3 \text{ J/kg} \\&= 2490 \text{ J}\end{aligned}$$

Heat is positive

$$\begin{aligned}\Delta u &= Q - W \\&= 2490 \text{ J} - 167 \text{ J} \\&= 2323 \text{ J}\end{aligned}$$