Homework 1

Answer Sheet

1) $Q = m \cdot c \cdot \Delta T$

a) $10 \times 10^6 J = 65 \times 10^3 g \times 4.18 J/gK \times \Delta T$

$\Delta T = 36.8\ K = 36.8°C$

b) Through evaporation of water by perspiration
Through dissipation of heat from skin by radiant energy.

2) a) $\Delta U = q + w$

$\Delta U = +400J - 100J$

$\Delta U = 300J$

b) Since internal energy is a state function the change in internal energy from $B \rightarrow A$ will be the same with $A \rightarrow B$ with an opposite sign.

$\Delta U_{B \rightarrow A} = -300J$

c) Again since internal energy is a state function the change in internal energy from $A \rightarrow B$ from a diff. path will be the same.

$300J = q + 400J$

$q = -100J$

3) $P_i \cdot V$ (constant) $= n R T_i$

$$\frac{P_i}{T_i} = \frac{nR}{V} = \frac{P_f}{T_f}$$

($\frac{nR}{V}$: constant)

$$\frac{100\ atm}{300\ K} = \frac{P_f}{400\ K}$$

$$P_f = 133.33\ atm$$

$$\Delta U = q + w$$

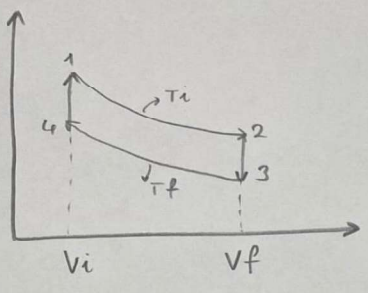
Since the process occurs under constant volume there is no expansion work $w = 0$

$$\Delta u = q = n \cdot C_{v,m} \Delta T$$

$$\Delta U = q = 1\ mol \times 1/2\ 8.314\ J/mol.K \times 100\ K$$

$$\Delta U = q = 415,7\ J$$

4)



a) Isothermal expansion (reversible) : ($V_i \rightarrow V_f$ at T_i)

$$w_{1\rightarrow 2} = -nRT_i \ln \frac{V_f}{V_i}$$

Isochoric process : (at V_f)

$$w_{2\rightarrow 3} = -p_{ex} \underbrace{\Delta V}_{\rightarrow 0}$$

$$w_{2\rightarrow 3} = 0$$

Isothermal compression : ($V_f \rightarrow V_i$ at T_f)

$$w_{3\rightarrow 4} = -nRT_f \ln \frac{V_i}{V_f}$$

Isochoric process : (at V_i)

$$w_{4\rightarrow 1} = -p_{ex} \underbrace{\Delta V}_{\rightarrow 0}$$

$$w_{4\rightarrow 1} = 0$$

b) $w_{1\rightarrow 2} < 0$ → work done by the system on the surroundings.

$w_{2\rightarrow 3} = 0$

$w_{3\rightarrow 4} > 0$ → work done on the system by the surroundings

$w_{4\rightarrow 1} = 0$

c) $2 \rightarrow 3$ heat is given off from the system to the surroundings

$4 \rightarrow 1$ heat is absorbed from the surr. by the sys