

Gas Process Worksheet

1) $V = 1 \text{ m}^3$ $n = 1 \text{ mole}$

a) $\frac{m_A}{m_B} = \frac{40 \text{ amu}}{2 \text{ amu}} = 20$

b) $P = NkT$, so $T_A = T_B$

$$\frac{T_A}{T_B} = 1$$

c) $C_v = \frac{f}{2} k$, so $\frac{C_{vA}}{C_{vB}} = \frac{3}{5}$ $C_{vB} > C_{vA}$

2) $KE = \frac{3}{2} NkT$

a) Per molecule $KE = \frac{3}{2} kT = \frac{1}{2} m v^2$

$$v = \left(\frac{3kT}{m} \right)^{\frac{1}{2}} = \left(\frac{3RT}{M_{AMU}} \right)^{\frac{1}{2}}$$

$$v_{Ar} = \left(\frac{3 \cdot 8.31 \frac{\text{J}}{\text{mole} \cdot \text{K}} \cdot 273 \text{K}}{40 \frac{\text{g}}{\text{mole}} \cdot 0.04 \text{kg}} \right)^{\frac{1}{2}} = 412 \text{ m/s}$$

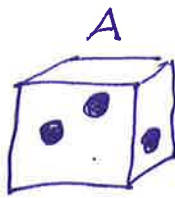
$$v \propto \left(\frac{1}{m} \right)^{\frac{1}{2}}$$

$$v_{H_2} = \left(\frac{m_{Ar}}{m_{H_2}} \right)^{\frac{1}{2}} v_{Ar} = (20)^{\frac{1}{2}} 412 \text{ m/s} = 1840 \text{ m/s}$$

~~b) + c)~~ $\Delta E \equiv \Delta U = Q - W = C_v n \Delta T$ $C_v = \frac{f}{2} R \equiv \frac{f}{2} k$ $\rightarrow 0$ because container is rigid.

Ar $Q = \frac{f}{2} n R \Delta T = \frac{3}{2} (1 \text{ mole}) 8.3 \frac{\text{J}}{\text{mole} \cdot \text{K}} 100 \text{ K} \approx 1.25 \text{ kJ}$

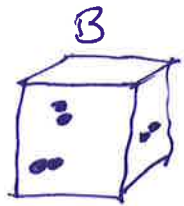
H_2 $Q = Q_{Ar} \left(\frac{5}{3} \right) \approx \underline{\underline{2.07 \text{ kJ}}}$



Ar

$f = 3$

$m = 40$



H₂

$f = 5$

@ room Temp.
 $m = 2$

2d) If we let the volume increase as we increase the temperature then the heat we add will increase the temperature, ~~the~~ $\Delta U \equiv \Delta E$, and it will do the work of expansion: $\int P dV$. Thus, $C_p > C_v$.

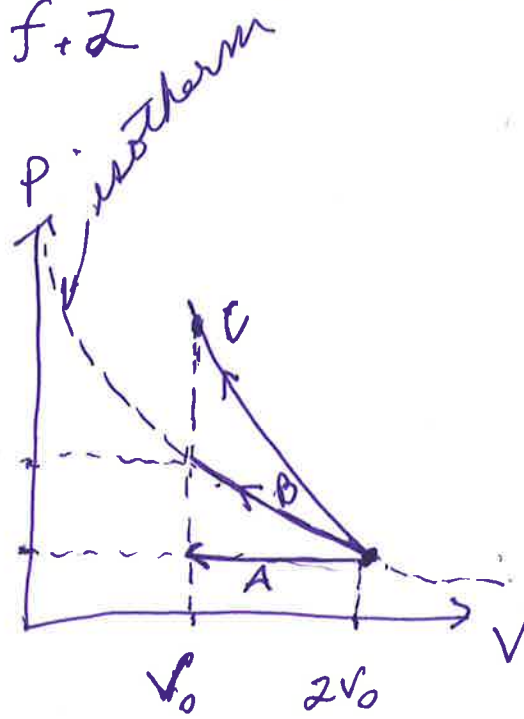
We saw in P 's derivation that allowing the gas to expand under constant pressure while heating it ~~the~~ increases the specific heat by R or $k \dots$ or $f \Rightarrow f+2$
 Ar $C_p = \frac{5}{2} R$ $H_2 C_p = \frac{7}{2} R$

3) see drawing

4) $\Delta U \equiv \Delta E$ is explicitly a function of temperature $2P_0$

thus: $\Delta U_A < 0, \Delta U_B = 0, \Delta U_C > 0$ P_0

because $T_A \downarrow$ T_B stays const
 $T_C \uparrow$



6)

5) $Q = \Delta U + W_{out}$
 $Q_C = 0$ (adiabatic)
 $Q_B =$ area under curve B
 because $\Delta U = \Delta T = 0$

for all of these processes
 $W_{out} < 0$ because we are putting work in and $|W_C| > |W_B| > |W_A|$
 $W = \int P dV$ ~~but~~

Q_A is more negative than Q_B because you are lowering temperature and absorbing work in