Chem Eng 3401

4.d | $T = \frac{T^* \varepsilon}{k_B} = \frac{(2)(1.736 \times 10^{-21} J) \cdot K}{(1.38 \times 10^{-23} J)} = \boxed{251.59 K}$

weight Argon $= 6.633 \times 10^{-26} kg$

$t = t^* \sigma = t^* \sigma \cdot \left(\frac{m}{\varepsilon}\right)^{1/2} = (0.005)(3.35 \times 10^{-10} m)\sqrt{\frac{6.633 \times 10^{-26} kg}{1.736 \times 10^{-21} J}}$

$= 1.035 \times 10^{-14} s$

type of matter explored further down

4.f | $C_v^* \approx ~~190.94~~ \; 191.68$

$C_v = C_v^* \frac{\varepsilon}{m \frac{\varepsilon}{k_B}} = \frac{k_B}{m} C_v^* \quad \frac{1.38 \times 10^{-23} \frac{J}{K}}{6.63 \times 10^{-23} g} \times 191.68 \approx \cancel{39.75} \frac{J}{gK}$

$\boxed{39.03 \frac{J}{gK}}$

b/c our density is so high, there will be discrepancies outside of ideal gas behavior, explaining the approximate 100 fold difference

4.e cont | our $T \approx 252 K$, $dt \approx 10^{-14} s$

density $\rho = (N_{part})(m)(\text{density}) = (125)(6.63 \times 10^{-26} kg)(1.33 \times 10^{27} \frac{1}{m^3}) =$

$1.10 \times 10^{4} \frac{kg}{m^3} = 1.10 \times 10^{4} \frac{g}{L}$

Much higher density @ STP, must be dealing with liquid state

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4g | $C_V^* \approx 98.903$. Because C_V^* is an extensive property this is expected,

$$\frac{C_V^*(N=125)}{C_V^*(N=64)} = \frac{191.68}{98.903} = 1.938 \approx \frac{125}{64} = 1.953$$

4j | $\langle(\delta U)^2\rangle = k_B T^2 C_V$

$$\varepsilon^2 \langle \delta U^{*})^2 \rangle = k_B \left(\frac{\varepsilon^2}{k_B^2} T^{*2} \right) (k_B C_V^*)$$

$$= \varepsilon^2 T^{*2} C_V^*$$

$$\boxed{\langle (\delta U^*)^2 \rangle = T^{*2} C_V^*}$$

4.f | adding the thermostat we enter the Canonical ensemble, with ~~Both~~ total energy ~~is~~ no longer constant & fluctuating. the potential energy exhibits similar content