Phase transitions

During a phase transition:

$$E_{int} = KE_{int} + PE_{int} \longrightarrow \Delta E_{int} = \Delta PE_{int}$$

During melting and evaporation, the PE_{int} increases:

$$\Delta E_{melt} = \lambda \cdot m \qquad \Delta E_{evap} = r \cdot m$$

During freezing and condensation, the PE_{int} decreases:

$$\Delta E_{freeze} = -\lambda \cdot m \qquad \Delta E_{condens} = -r \cdot m$$

Where λ is the latent heat of melting, and r is the latent heat of evaporation (both are different for different substances).

Homework 20

Problem 1.
Can you explain qualitatively why the internal potential energy increases during melting and decreases during freezing? How does internal potential energy change during sublimation and desublimation?
Hint: you can think about work and the change in potential energy.

Problem 2.
Do the water molecules change when the water evaporates? How does the character of their motion change after evaporation?

Problem 3.
$1\ kg$ of water is mixed with some amount of ice in a thermally insulated glass. The initial temperature of the water is $10℃$, and the initial temperature of the ice is $0℃$. After coming to thermal equilibrium, all of the ice melts, and the resulting water has a temperature of precisely $0℃$. How much ice (in kilograms) was initially in the glass? The specific heat of water is $4200\ J/(kg \cdot K)$, and the latent heat of melting of ice is $334\ kJ/kg$.

Problem 4* (bonus problem). On the next page!

Homework 20

Problem 4* (bonus problem).

One kilogram of ice is placed into an electric kettle with power $P = 1500\ W$ (which means it produces $1500\ J$ of energy every second). The initial temperature of ice is $0°\mathrm{C}$. How much time is needed to evaporate all the water, starting with ice?

The latent heat of melting of ice is $334\ kJ/kg$.
The latent heat of evaporation of water is $2260\ kJ/kg.$
The specific heat of water is $4200\ J/(kg \cdot K)$