

Which has a lower Enthalpy?

- A. liquid iron
- B. solid iron ←
- C. they are exactly the same
- D. it depends on the temperature

Which has a higher Entropy?

- A. liquid iron ←
- B. solid iron
- C. they are exactly the same
- D. it depends on the temperature

Which has a lower Gibb's Free Energy?

- A. liquid iron
- B. solid iron
- C. they are exactly the same
- D. it depends on the temperature ←

Equilibria

Balance between stability of
lower Enthalpy (energy)
& higher Entropy

Physical Equilibria

Phase transitions (no "chemistry")

State with the lowest free energy is most stable

$$G = H - TS$$

therefore at high temperature
the state with highest S will be the most stable

Vapor pressure

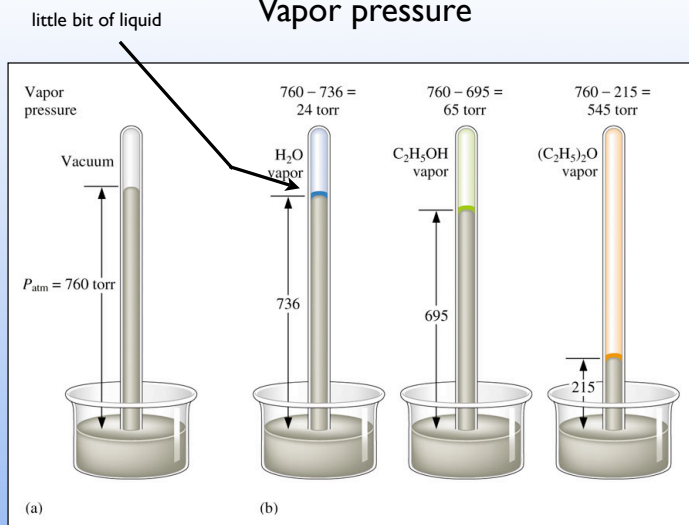


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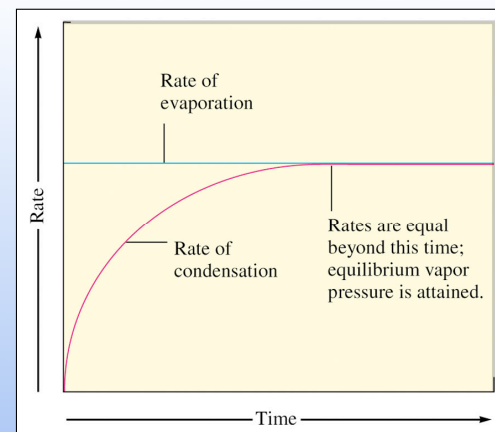


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Look at movie

Comparing different liquids

what matters is the free energy of the vapor compared to the liquid

For almost all substances the difference in **ENTROPY** between the vapor and the liquid is the same!

$$\Delta S_{\text{vap}} = 85 \text{ J K mol}^{-1}$$

Therefore the diversity in liquids properties is dominated by the **ENTHALPY** of vaporization

Enthalpies of Vaporization

Water	40.65 kJ mol ⁻¹
Ammonia	23.35 kJ mol ⁻¹
Diethyl Ether	27.4 kJ mol ⁻¹
Methane	8.19 kJ mol ⁻¹
Methanol	37.8 kJ mol ⁻¹
Ethanol	38.5 kJ mol ⁻¹
Propanol	47.5 kJ mol ⁻¹
Butanol	51.6 kJ mol ⁻¹

Why does butanol (C_4H_9OH) have a lower vapor pressure than methanol (CH_3OH)?

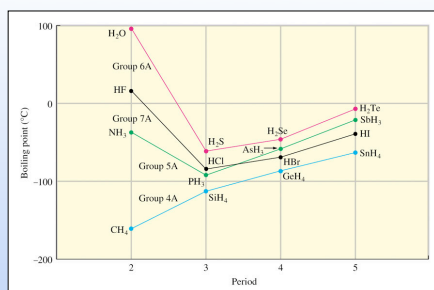
- A. it has a higher entropy
- B. it has stronger inter molecular forces
- C. it has a lower molecular weight
- D. it has a higher density

Intermolecular forces lead to the enthalpy difference between the liquid and the vapor

The larger the IMF the larger the ΔH_{vap}

The larger the ΔH_{vap} the smaller the vapor pressure

The the smaller the vapor pressure the higher the boiling point



Why is the boiling point of H_2Te higher than H_2Se ?

- A. H_2Te has a larger dipole
- B. H_2Se has more dispersion forces
- C. H_2Te has more dispersion forces
- D. Both A & C

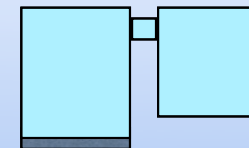
Before we get to boiling let's look at how different properties affect vapor pressure



first all liquid



then comes to equilibrium with liquid + vapor with a pressure that is the vapor pressure



then add more volume

At equilibrium there is less liquid, but the same Pressure!