QUIZ: high VP = low IMF

critical point = all states have same free energy b/c they are all at equilibrium

Unit 5 Day 3 Activity - "Thinking About Solutions"

SOLUTIONS

Solution = Solvent + Solute

Solubility = how much you can dissolve

Dissolution = process of dissolving

① Salt dissolved in H_2O : w/ stirring, salt dissolved in room temp water
Sugar dissolved in H_2O : w/ stirring, sugar dissolved in room temp. water

② sugar = molecular solid (descrete entity w/ molecular forces) ; salt = ionic solid (ionic bonds w/ Na^+ & Cl^-)

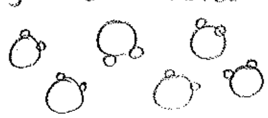
* 4 DIF TYPES OF SOLID:
1. metallic solid
2. molecular solid
3. covalent solid
4. ionic solid

③ Intermolecular Forces holding:

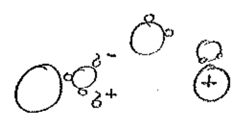
$C_{12}H_{22}O_{11}$: van der waals, dipole-dipole, hydrogen

NaCl : van der waals, dipole-dipole, ionic

④ sugar (molecular solid)



NaCl



⑤ Endothermic Process b/c w/ the addition of ammonium nitrate, solution went from 19.1°C to 14.5°C ; energy comes from surroundings

⑦ $\Delta H_{solution}$ terms?

1. → break solute (costs energy - Lattice Energy)
$+\Delta H_{latice}$

2. form new solvent-solute interactions give off energy (solvation energy)
$\Delta H_{solution} = \Delta H_{lattice} + \Delta H_{solvation}$

Unit 5 Day 3 Continued

- entropy of a system usually increases when solute is added to solvent
- spontaneous dissolution of the endothermic solution is entropically driven

What is the sign for the change in Free Energy for the dissolution process in which polystyrene peanuts were placed in water?
↳ POSITIVE (non-spontaneous)

		ΔG	ΔS	ΔH	
water A	BIO-FOAM	+	+	+	
acetone B		−	+ (big +)	~0	very small positive
water C	ECO-FOAM	−	+ (big +)	~0	very small positive
acetone D		+	+ (doesn't mean it happens)	+	

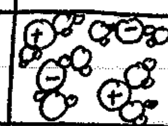
like dissolves like
ΔH is near Ø b/c IMFs are same

Thinking Like a Chemist About Dissolution

- Mathematical Relationship between VP and T:

$$\ln\left(\frac{P_2}{P_1}\right) = \frac{\Delta H_{vap}}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

*be careful of units!

	$C_{12}H_{22}O_{11}$ (sugar)	NaCl (salt)	
Type of solid	Molecular	Ionic	
IMF	hydrogen bonding, dipole-dipole, dispersion	Ionic	
Microscopic View			→ during Dissolution Process
Endothermic/ Exothermic?	Endothermic - energy absorbed to break bonds	→ Same	
Entropy	Increases	Increases	→ during the dissolution process

- Solution = Solvent + Solute
- Solubility = how much you dissolve
- Dissolution = process of dissolving

- How do we think about this in terms of energy?
  1. Break solute
     - costs energy (lattice energy)
  2. Form new
     - Solute - solvent interactions
     - Gives off energy (solvation energy)

$\Delta H_{solution} = \Delta H_{lattice\ energy} + \Delta H_{solvation}$

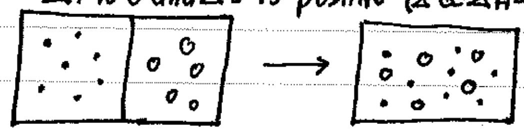
* Usually $\Delta H_{lattice\ energy} > \Delta H_{solvation}$

→ $\Delta H_{solution}$ usually endothermic

* entropy decreases in gas phase

* dissolution processes are not spontaneous

- mixture of gases is spontaneous because ΔH is 0 and ΔS is positive ($\Delta G = \Delta H - T\Delta S$)



- How can you explain the spontaneous dissolution of the endothermic solution?
  → It must be entropically given ($\Delta G = \Delta H - T\Delta S$)

- Polystyrene peanuts in acetone dissolved (did not dissolve in water)
  - Acetone: $\Delta G = -$, $\Delta S = +$, $\Delta H = \sim 0$ (very small positive)
  - Water: $\Delta G = +$, $\Delta S = +$, $\Delta H = +$
  - ↳ describing the process, does not mean it happens!

- Bio-degradable peanuts in water dissolved (did not dissolve in acetone)
  - Water: $\Delta G = -$, $\Delta S = +$, $\Delta H = \sim 0$ (very small positive)
  - Acetone: $\Delta G = +$, $\Delta S = +$, $\Delta H = +$
  - ↳ Explanation: $\Delta G = \Delta H - T\Delta S$

    $(+) = ? - (+)$

    ↙ must be positive