Chemistry 11 (5) - Unit 9 Notes

Note Title 6/10/2008

Tues Jun 10 08

Unit 9 - Solutions

Types of Solutions

Solution - A homogeneous mixture

Gaseous Solutions - eg. Air (N_2 & O_2)

Liquid Solutions eg. salt water, carbonated water

Solid Solutions - Alloys eg. brass, steel

Solute - The component present in the smaller amount.

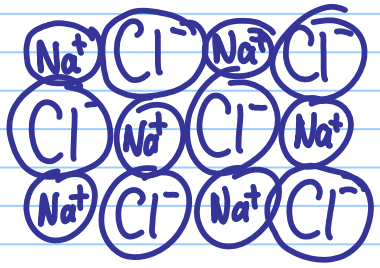
Solvent - The component present in the larger amount.

Types of Solutes

ionic solutes

eg) NaCl

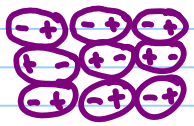
metal, non-metal



Polar-Covalent solutes

- molecules with a $\delta+$ end and $\delta-$ end

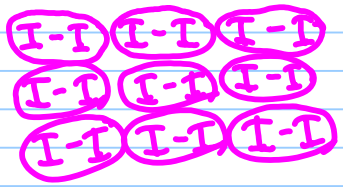
eg) sucrose (sugar)



non-polar covalent solutes

- no charges

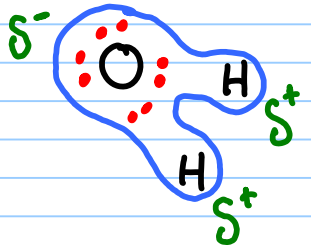
eg.



Types of Solvents

- **Polar Covalent Solvents**

eg) H_2O



- **Non-Polar Covalent Solvent**

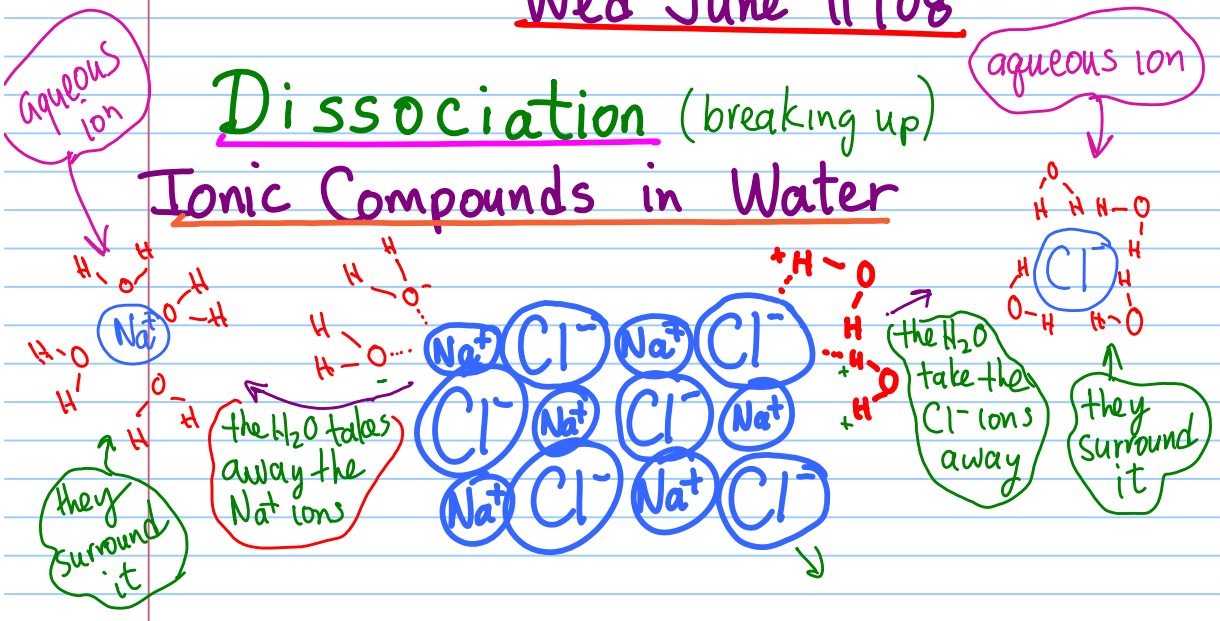
-no charges

eg) Paint thinner (non-polar solvent)

Wed June 11 | 08

Dissociation (breaking up)

Ionic Compounds in Water



Why doesn't paint thinner dissolve salt? - the PT molecules have no charges to attract the ions. (non-polar)

Material	Best Solvent
ionic solids (NaCl)	polar covalent (water)
polar-covalent solids (sugar)	polar covalent (water)
non-polar covalent (iodine, grease)	non-polar covalent (paint thinner) gasoline diesel fuel

Thurs Jun 12 08

DISSOCIATION EQUATIONS

Look 'em up
Don't make 'em up!

eg) $NaCl_{(s)} \rightarrow Na^+_{(aq)} + Cl^-_{(aq)}$

$CaCl_{2\,(s)} \rightarrow Ca^{2+}_{(aq)} + 2Cl^-_{(aq)}$

$Fe(NO_3)_{3\,(s)} \rightarrow Fe^{3+}_{(aq)} + 3NO_3^-{}_{(aq)}$

a PAI

part of the PAI. Stays down

$Al_2(SO_4)_{3\,(s)} \rightarrow 2Al^{3+}_{(aq)} + 3\,SO_4^{2-}{}_{(aq)}$

$Ni_2(CO_3)_{3\,(s)} \rightarrow 2\,Ni^{3+}_{(aq)} + 3\,CO_3^{2-}{}_{(aq)}$

total pos. charge = +6 ← total neg. charge = -6

Individual Ion Concentration

eg) a) Find $[Al^{3+}]$ in 0.50 M $AlCl_3$

$$AlCl_{3(s)} \rightarrow Al^{3+}_{(aq)} + 3Cl^-_{(aq)}$$

$$[Al^{3+}] = 0.50\ M\ AlCl_3 \times \frac{1\ M\ Al^{3+}}{1\ M\ AlCl_3} = \underline{0.50\ M}$$

b) Find $[Cl^-]$

$$[Cl^-] = 0.50\ M\ AlCl_3 \times \frac{3\ M\ Cl^-}{1\ M\ AlCl_3} = \underline{1.5\ M}$$

(short-cut)

Find $[Cr^{3+}]$ and $[SO_4^{2-}]$ in a 0.40 M solution of $Cr_2(SO_4)_3$

$$0.40\ M \xrightarrow{2/1} 0.80\ M$$

$$Cr_2(SO_4)_{3(s)} \rightarrow 2Cr^{3+}_{(aq)} + 3SO_4^{2-}_{(aq)}$$

$$0.40\ M \xrightarrow{\times\ 3/1} 1.2\ M$$

$$Cr_2(SO_4)_{3(s)} \rightarrow 2Cr^{3+}_{(aq)} + \underline{3}SO_4^{2-}_{(aq)}$$

$[Cr^{3+}] = 0.80\ M \quad [SO_4^{2-}] = 1.2\ M$

Recall:

Becca dissolves 60.0 g of Na_2CO_3 into enough water to make 300.0 mL of solution. Find $[Na^+]$ and $[Na_2CO_3]$ in the solution

Plan: g → mol → M $[Na_2CO_3]$ dissociate → $[Na^+]$, $[CO_3^{2-}]$

$$60.0\,g\,Na_2CO_3 \times \frac{1\,mol}{106.0\,g} = 0.566\,mol$$

$2(23.0)+12.0+3(16.0) = 106.0\,g/mol$

mol/M/L

$$M = \frac{mol}{L} = \frac{0.566\,mol}{0.300\,L} = 1.887\,M$$

$[Na_2CO_3]$

1.887 M —2/1→ 3.77 M; 1.887 M —1/1→ 1.887 M

$$Na_2CO_{3(s)} \rightarrow 2Na^+_{(aq)} + CO_3^{2-}{}_{(aq)}$$

$[Na^+] = 3.77\,M$

$[CO_3^{2-}] = 1.89\,M$

Question: What mass of $AlBr_3$ must be dissolved in 500.0 mL of solution to give a $[Br^-]$ of 4.50 M

Plan: $[Br^-] \rightarrow [AlBr_3]_M \rightarrow$ mol $AlBr_3 \rightarrow$ g $AlBr_3$

Dissociation:

1.50 M ←1/3— 4.50 M

$$AlBr_{3(s)} \rightarrow Al^{3+}_{(aq)} + 3Br^-_{(aq)}$$

$[AlBr_3] = 1.50\,M$

$mol = M \times L$

$= 1.50\,M \times 0.500\,L = 0.750\,mol$

mass $0.75\,mol\,AlBr_3 \times \frac{266.7\,g}{1\,mol} = 200.0\,g$

Dilutions of Solutions

$$FC \times FV = IC \times IV$$

or $$FC = IC \times \frac{IV}{FV}$$

eg) Sean adds 150.0 mL of water to 50.0 mL of 0.60 M $MgCl_2$. Find the final $[Cl^-]$. Always: dilute then dissociate

$$FC = IC \times \frac{IV}{FV} = 0.60\,M \times \frac{50.0\,mL}{200.0\,mL}$$

$$= 0.15\,M$$

$[MgCl_2]$

$$0.15\,M \xrightarrow{2/1} 0.30\,M$$

$$MgCl_{2(s)} \rightarrow Mg^{2+}_{(aq)} + 2Cl^-_{(aq)}$$

Ans. $[Cl^-] = 0.30\,M$

Fri June 13/08

Mixtures

① With no common ions.
② With common ions.

- Each solution "sees" the other one as if it was water. (dilution first → then dissoc.)

eg) Serena mixes 200.0 mL of 0.20 M (IC) NaCl with 300.0 mL of 0.15 M $AlBr_3$. Find the final conc. of all 4 ions.

① Find the final conc. of NaCl

$$FC = \frac{IC \times IV}{FV} = 0.20\,M \times \frac{200.0\,mL}{500.0\,mL} = 0.080\,M$$

(500.0 mL: 200.0 + 300.0)

② $NaCl_{(s)} \rightarrow Na^+_{(aq)} + Cl^-_{(aq)}$

0.080 M —(1/1)→ 0.080 M; 0.080 M

③ Find final $[AlBr_3]$

$$\text{final } [AlBr_3] = 0.15\,M \times \frac{300.0\,mL}{500.0\,mL} = 0.090\,M$$

$AlBr_{3(s)} \rightarrow Al^{3+}_{(aq)} + 3Br^-_{(aq)}$

0.090 M —(1/1)→ 0.090 M; 0.090 M —(3/1)→ 0.27 M

Ans: $[Na^+] = 0.080\,M$ $[Cl^-] = 0.080\,M$

$[Al^{3+}] = 0.090\,M$ $[Br^-] = 0.27\,M$

Mixtures With Common Ions

30.0 mL of 0.60 M Na_2SO_4 is mixed with 45.0 mL of 0.30 M Na_3PO_4. Find the final conc. of all 3 ions.

$$\text{final } [Na_2SO_4] = 0.60\,M \times \frac{30.0\,mL}{75.0\,mL} = 0.24\,M$$

$Na_2SO_{4(s)} \rightarrow 2Na^+_{(aq)} + SO_4^{2-}{}_{(aq)}$

0.24 M —(2/1)→ 0.48 M; 0.24 M —(1/1)→ 0.24 M

final $[Na_3PO_4] = 0.30M \times \frac{45.0\,mL}{75.0\,mL} = 0.18M$

1/1

0.18M —3/1→ 0.54 M → 0.18 M

$Na_3PO_{4(s)} \longrightarrow 3Na^+_{(aq)} + PO_4^{3-}{}_{(aq)}$

Answers

final $[SO_4^{2-}] = 0.24\,M$

$[PO_4^{3-}] = 0.18\,M$

$[Na^+] = 0.48M + 0.54\,M = 1.02\,M$

from the Na_2SO_4 | from the Na_3PO_4

ation Reactions