

ex: convert 5.42M $\text{NaHCO}_3(aq)$
 w/ a $d = 1.19 \text{ g/mL}$ to molar conc!

MON↑

WED↓

2/14/15

$$\frac{5.42 \text{ mol NaHCO}_3}{1 \text{ L of sol}^n} \xrightarrow{\text{molar conc.}} \frac{\text{? mol NaHCO}_3}{\text{? kg H}_2\text{O}}$$

molar conc. →

concs are intensive props
 let's take 1-L of solⁿ

⇒ 5.42 mol NaHCO_3

Solⁿ: $\text{H}_2\text{O} + \text{NaHCO}_3$

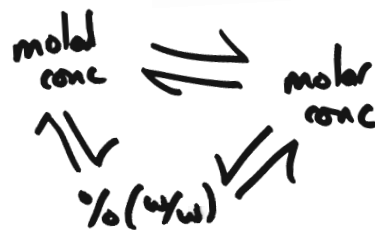
$\text{H}_2\text{O} + \text{NaHCO}_3$

$$1 \text{ L} \xrightarrow{d} \#g \rightarrow \frac{1000 \text{ mL}}{1 \text{ mL}} \cdot 1.19 \frac{g}{\text{mL}} = 1190 \text{ g}$$

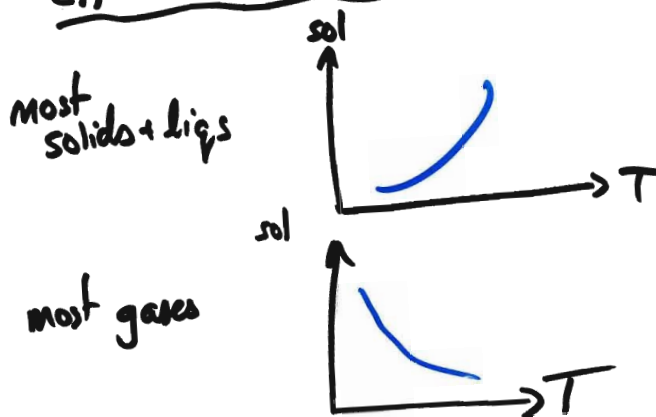
$$\frac{5.42 \text{ mol NaHCO}_3}{1 \text{ mol NaHCO}_3} \cdot \frac{84.01 \text{ g NaHCO}_3}{1 \text{ mol NaHCO}_3} = 455 \text{ g NaHCO}_3$$

$$\begin{aligned} \text{mass H}_2\text{O} &= \text{mass sol}^n - \text{mass NaHCO}_3 = 1190 \text{ g} - 455 \text{ g} \\ &= 735 \text{ g H}_2\text{O} = 0.735 \text{ kg H}_2\text{O} \end{aligned}$$

$$\text{molar conc} = \frac{5.42 \text{ mol}}{0.735 \text{ kg}} = 7.37 \text{ m}$$



Effect of T on solubility



Henry noticed that sol. of gas in liquid depended upon P of gas above liq.



$$[A] \propto P_A$$

if $P_A \uparrow$, $[A] \uparrow$ depends on:

- ① Temp
- ② gas
- ③ solvent

Henry's law: $C = KP$

conc \uparrow Henry's law constant \downarrow pressure \downarrow

ex: Sol. of $N_2(g)$ in water is $8.2 \times 10^{-4} M$ when $P_{N_2} = 1.2 \text{ atm}$.

What's sol of N_2 if $P_{N_2} = 35 \text{ atm}$?

$$C = KP, \quad K = \frac{C}{P} = \frac{8.2 \times 10^{-4} M}{1.2 \text{ atm}} = 6.83 \times 10^{-4} M/\text{atm}$$

$$C = KP = 6.83 \times 10^{-4} \frac{M}{\text{atm}} \times 35 \text{ atm} = 0.024 M$$

Most gases obey Henry's law, unless they react w/ solvent.

ex: O_2 in blood \uparrow Hemoglobin (Hb)



ex: CO_2 in water $\ddot{\sim}$ Henry's law



ex: NH_3 in water



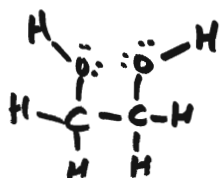
Colligative Properties

physical properties that depend upon solute conc, not ID.

examples: b.p. elevation
fp depression.
osmotic pressure.

1 kg H₂O(l) @ 1 atm fp = 0 °C bp = 100 °C

1 kg H₂O(l) + 1 mol
CH₂(OH)CH₂(OH) fp = -1.86 °C, bp = 100.52 °C



$\Delta T_f = 1.86^\circ\text{C}$ $\Delta T_b = 0.52^\circ\text{C}$
freezing point DEPRESSION boiling point ELEVATION

Both ΔT_f and ΔT_b } \propto molal conc (m)

$$\Delta T_f = K_f \cdot m$$

$$\Delta T_b \text{ (}^\circ\text{C)} = K_b \cdot m \text{ (} \frac{\text{mol}}{\text{kg}} \text{ or } m \text{)}$$

K_f = freezing-point depression constant
(for a particular solvent)

K_b = boiling-pt. elevation const

ex: H₂O(l) $K_f = 1.86^\circ\text{C}/m$
 $K_b = 0.52^\circ\text{C}/m$

ex: Benzene(l) $K_f = 5.12^\circ\text{C}/m$
 C₆H₆(l) $K_b = 2.53^\circ\text{C}/m$