

Announcements

To join clicker to class today
(Clickers with LCD display
join automatically):

- Turn on the Clicker (the red LED comes on).
- Push “Join” button followed by “20” followed by the “Send” button (switches to flashing green LED if successful).

Review

- % yield = $100\% \times (\text{amount collected} / \text{amount expected})$.
- Limiting reagents: what's used up first in a reaction.
- What's in the water? Units are mass of solute per mass of solution.

What's Dissolved in the Water?

(a small selection)

Solute	Lake Water (ppm)	Drinking Water (ppm)	Deionized Water (ppm)
Ca ²⁺ (makes water hard)	~160 mg/kg	~160 mg/kg	~0 mg/kg
Na ⁺	~10 mg/kg	~10 mg/kg	~0 mg/kg
Ni ²⁺	~4 mg/kg	~4 mg/kg	~0 mg/kg
O ₂	~9 mg/kg	~9 mg/kg	~9 mg/kg
SO ₄ ²⁻	~25 mg/kg	~31 mg/kg	~0 mg/kg
F ⁻ (for teeth)	~0 mg/kg	~1 mg/kg	~0 mg/kg
CHCl ₃ (disinfection by product)	~0 mg/kg	~0.002 mg/kg (~ 2 μg/kg)	~0 mg/kg

ppm, ppb, ppt units

- ppm = parts per million
 - $= (10^6 \text{ ppm})(\text{mass solute}) / (\text{mass of sol'n})$
 - Equivalent to $(\text{mg solute}) / (\text{kg sol'n})$
- ppb = parts per billion
 - $= (10^9 \text{ ppb})(\text{mass of solute}) / (\text{mass of sol'n})$
- ppt = parts per trillion
 - $= (10^{12} \text{ ppt})(\text{mass of solute}) / (\text{mass of sol'n})$

Molarity

- Molarity (M) = (moles of solute)/(L sol'n)
- Ex: What is the molarity of the solution made from 35. g of NaCl to make 170 mL of solution.
 - $MM(\text{NaCl}) = 22.990 + 35.453 = 58.443$ g/mole

How we use Molarity

- Ex: Suppose we want to react 1.0×10^{-5} moles of CaCO_3 (~2 mg) in the following reaction:
 - $\text{H}_2\text{SO}_4(\text{aq}) + \text{CaCO}_3(\text{s}) \longrightarrow \text{CaSO}_4(\text{aq}) + \text{H}_2\text{O} + \text{CO}_2(\text{g})$
 - Converts CaCO_3 into CaSO_4 , which is slightly water soluble.
 - How acid rain damages buildings and why limestone would not have lasted near surface of early Earth.
 - Have a 4.5×10^{-5} M solution
 - How many mL of solution do we need?

Converting between mg/kg and M

- Molarity of CHCl_3 (residual from disinfection) in drinking water?
 - $2 \mu\text{g}/\text{kg}$
 - $\text{MM}(\text{CHCl}_3) = 119.38 \text{ g}/\text{mol}$
 - $D(\text{H}_2\text{O}@ 25 \text{ }^\circ\text{C}) = 0.996 \text{ g}/\text{mL}$

$\text{mg CHCl}_3/\text{kg sol'n} \rightarrow \text{mol CHCl}_3/\text{kg sol'n} \rightarrow \text{mol CHCl}_3/\text{g sol'n}$

$\rightarrow \text{mol CHCl}_3/\text{mL sol'n} \rightarrow \text{mol CHCl}_3/\text{L sol'n}$

Concentration Unit Conversions

- What is the ppb of Cl^- in a 0.050 M CaCl_2 solution?
 - Solution density = 0.995 g/mL
 - $\text{MM}(\text{Ca}^+) = 40.08 \text{ g/mol}$
 - $\text{MM}(\text{Cl}^-) = 35.45 \text{ g/mol}$