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).

- Exam scores posted on web.
- Please check them and let me know if you find an error.
- More information on the exam was included in the e-mail sent out yesterday and is duplicated in the announcements posted on the class web site.

- If you would like to discuss your study strategies, you are welcome to come see me.
- You will need to bring your notes, worked out problems and any other study material you have used.

Review

- Moles & molar mass.
- Stoichiometry.

mass of A -{÷MM(A)}-> moles of A -{mole ratio}-> moles B -{xMM(B)}-> mass B

- % composition.
- empirical vs. molecular formulas.
- Combustion analysis.

Percent Yield

- All the calculations we have done so far assume that all the reactants are converted to products. Often not true:
  - Sometimes have a limiting reagent.
  - Most reactions go both backwards and forwards so do not reach completion.
  - There are often competing RXNs that take the reactants to compounds other than the desired products. (Want: A—>B, but get some A—>D)
  - Poor experimental technique (losing half the sample down the drain or collecting bits of filter paper with your product).
- The amount you are off by is quantified in the

$$\%\ yield = \frac{amount\ collected}{amount\ \exp ected} \cdot 100\%$$

Example % yield

- Consider elements in Earth's crust. Compounds of Na make up about 2.5% of crust.
- A common reaction of group 1 alkali metals (where "M" represents any alkali metal) is
  - $2M + 2H_2O \rightarrow 2MOH$ (metal hydroxide) + H_2
  - Specific case: $2Na + 2H_2O \rightarrow 2NaOH + H_2$
- Start with 23.0 g Na and an unlimited supply of H_2O, what is the % yield if we got 35.0 g of NaOH?
  - M(Na) =22.990 g Na /mol Na
  - M(NaOH)=39.997 g NaOH/mol NaOH

Other possible questions with same info.

$CaCO_3$ --> $CaO + CO_2$

- How many g of CaO do I get when 80.00 g of CO_2 are produced? Answer: 101.9 g CaO
  - MM(CaO) =56.077 g/mol
  - MM(CO_2) = 44.010 g/mol
  - MM($CaCO_3$) = 100.087 g/mol
- Concrete is made by slaking CaO with water to make $Ca(OH)_2$.How much $Ca(OH)_2$ will I get when the CaO is slaked? Answer: 134.6 g $Ca(OH)_2$
  - MM($Ca(OH)_2$) = 74.0926 g/mol

Example Limiting Reagent Calculation

- RXN: $3Na_2CO_3(aq) + 2H_3PO_4(aq) \longrightarrow 2Na_3PO_4(aq) + 3CO_2(g) + 3H_2O(l)$
- Have 5.00 g of each reagent. Assuming 100% yield how much CO_2 do we get?
  - $\mathcal{M}(Na_2CO_3)$= 105.988 g/mol Na_2CO_3
  - $\mathcal{M}(H_3PO_4)$=97.994 g/mol H_3PO_4
  - $\mathcal{M}(CO_2)$=44.010 g/mol CO_2

Stoichiometry and Solutions

- What's in the water: solutions and suspensions.
- Solution concentration (molarity, M)
- Solute types: electrolytes and non-electrolytes
- Colligative properties (Osmosis/Osmotic pressure, freezing point depression, boiling point elevation).
- molality, *m* (another concentration unit)
- Acid-Base reactions (weathering, net-ionic and molecular equations)
- Precipitation Reactions (weathering, solubility trends, saturated, unsaturated, supersaturated)

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