

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 \div MM(A) \rightarrow moles of A \times mole ratio \rightarrow moles B \times MM(B) \rightarrow mass B

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

Percent Yield

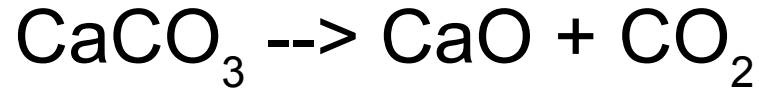
- All the calculations we have done so far assume that all the reactants are converted to products. Often not true:
 - Sometimes have a limiting reagent.
 - Most reactions go both backwards and forwards so do not reach completion.
 - There are often competing RXNs that take the reactants to compounds 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

$$\% \text{ yield} = \frac{\text{amount collected}}{\text{amount expected}} \cdot 100\%$$

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.



• How many g of CaO do I get when 80.00 g of CO₂ are produced? Answer: 101.9 g CaO

– MM(CaO) = 56.077 g/mol

– MM(CO₂) = 44.010 g/mol

– MM(CaCO₃) = 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: $3\text{Na}_2\text{CO}_3(\text{aq}) + 2\text{H}_3\text{PO}_4(\text{aq}) \longrightarrow 2\text{Na}_3\text{PO}_4(\text{aq}) + 3\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{l})$
- Have 5.00 g of each reagent.
Assuming 100% yield how much CO_2 do we get?
 - $\mathcal{M}(\text{Na}_2\text{CO}_3) = 105.988 \text{ g/mol Na}_2\text{CO}_3$
 - $\mathcal{M}(\text{H}_3\text{PO}_4) = 97.994 \text{ g/mol H}_3\text{PO}_4$
 - $\mathcal{M}(\text{CO}_2) = 44.010 \text{ g/mol CO}_2$

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