Lecture 37: Reactions 4

Read:  BLB 4.6 & 10.5
HW:   BLB 4:81a,b,83,87; 10:28,55,57; 18:26,61
      Sup Rxns 12–18

Know:
• solution stoichimetry
• reactions in the gas phase

Check out the grad-u-lator on the Chem110 website

Review chemical nomenclature (e.g., BST #5, Lecture 8 ...); & memorize those strong acids & bases (BLB Table 4.2)

Bonus deadline for BST #10: Net ionic equations, Thurs, April 16; FINAL SKILL CHECK TEST DEADLINE: MONDAY, APRIL 27

Missed Exam 1, 2 or 3 due to illness? Make-up Exam: Monday, April 20 @ 6:30, 105 Wartik. Covers material from Exams 1–3, multiple choice. You must sign up by downloading & completing the request form & giving it to me: deadline to sign up is TODAY. (info under “Exam Schedule” on Chem110 website)

Need help?? Get help!! TAs in CRC (211 Whitmore) and SI—hours on Chem 110 website; my office hours (Mon 12:30-2 & Tues 10:30-12 in 324 Chem Bldg [or 326 Chem])

Final Exam: MONDAY, May 4, 12:20 pm
**Example:**

How many liters of $\text{N}_2$ at 735 mm Hg and 26°C are produced from 126 g NaN$_3$ (sodium azide)?

\[
\text{NaN}_3 (s) \longrightarrow \text{Na} (s) + \text{N}_2 (g)
\]

\[
\begin{align*}
\text{NaN}_3 & : \text{65 g/mol} \\
\text{Na} & : \text{23 g/mol} \\
\text{N}_2 & : \text{28 g/mol} \\
126 \text{ g} & \quad V = ??? \\
\text{P} & = 735 \text{ mmHg} \\
\text{T} & = 26°C
\end{align*}
\]
Example:
48.6 g Mg reacts with 11.2 L O_2 at STP. A What is the expected yield (theoretical yield) of MgO (in grams) B Which reactant is the limiting reagent, and which is in excess? C How much of the excess reagent remains after the reaction goes to completion? D What is being oxidized? What is being reduced?
*previous example con’t.*

When you react Mg with O\(_2\) in lab, you get 32.2 g.  **What is your percent yield?**
**Example:**
The arsenic in a 1.22 g sample of a pesticide was converted to AsO$_4^{3-}$ by suitable chemical treatment. It was then titrated using Ag$^+$ to form Ag$_3$AsO$_4$ as a precipitate. **A** What is the oxidation state of As in AsO$_4^{3-}$? **B** If it took 25.0 mL of 0.102 M Ag$^+$ to reach the equivalence point in this titration, what is the mass percentage of arsenic in the pesticide?

\[
\begin{align*}
\text{Ag}^+ \text{(aq)} + \text{AsO}_4^{3-} \text{(aq)} & \rightarrow \text{Ag}_3\text{AsO}_4 \text{(s)} \\
107.9 \text{ g/mol} & \quad 138.9 \text{ g/mol} & \quad 462.6 \text{ g/mol} \\
25.00 \text{ mL} & \quad ??? \quad ??? \\
0.102 \text{ M} & \quad ??? \quad ??? \text{ mass\% of As in 1.22 g pesticide}
\end{align*}
\]
Example:
In an explosion, a compound that is a solid or a liquid decomposes very rapidly, producing large volumes of gas. The force of the explosion results from the rapid expansion of the hot gases. For example, TNT (trinitrotoluene) explodes according to the reaction shown below.

A Balance this chemical equation. B How many moles of gas are produced in the explosion of 1.0 kg of TNT? C What volume will these gases occupy if they expand to a total pressure of 1.0 atm at 298 K? D At 1.0 atm total pressure, what would be the partial pressure of each gas?

\[
\text{C}_7\text{H}_5(\text{NO}_2)_3(\text{s}) \rightarrow \text{CO(g)} + \text{C(s)} + \text{H}_2(\text{g}) + \text{N}_2(\text{g})
\]

\[
\begin{array}{c|c|c|c|c}
\text{Compound} & \text{Number} & \text{Mass} & \text{Molecular Weight} & \text{Density} \\
\hline
\text{C}_7\text{H}_5(\text{NO}_2)_3 & 1 & \text{1.0 kg} & 227 \text{ g/mol} & 28 \text{ g/mol} \\
\text{CO} & 1 & \text{28 g/mol} & 28 \text{ g/mol} & \text{ } \\
\text{C} & 1 & \text{12 g/mol} & 12 \text{ g/mol} & \text{ } \\
\text{H}_2 & 1 & \text{2 g/mol} & 2 \text{ g/mol} & \text{ } \\
\text{N}_2 & 1 & \text{28 g/mol} & 28 \text{ g/mol} & \text{ }
\end{array}
\]
Does $\sum X_i = 1.000$? Does $P_{\text{tot}} = \sum P_i$? Always check your answers to see whether they make sense!!
Example:
What spectator ions are present when HClO₄(aq) reacts with Ca(OH)₂(aq)?

H⁺
HCl⁺
O²⁻
ClO₄⁻
Ca²⁺
OH⁻
Before next class:

Read: BLB 5.3–5.5
HW: BLB 5:4,6,17,29,37,39,41,53,55

Know:
• energy
• enthalpy
• enthalpy of reactions
• calorimetry

Answers:
p. 2: 73.8 L
p. 3: (a) 40.3 MgO; (b) O₂ is LR; (c) 24.3 g excess Mg; (d) Mg oxidized, O reduced
p. 4: 79.9%
p. 5: (a) +5; (b) 5.23%
p. 6: (b) 44.1 mol; (c) 1078 L; (d) P_{CO} = 0.60 \text{ atm}, P_{H_2} = 0.25 \text{ atm}, P_{N_2} = 0.15 \text{ atm}
p. 8: Ca^{2+}, ClO_4^-