

Sample exam 2: Chapters 3 and 4

*Closed book; open homework, handouts, lab book, notes and calculators; no collaboration, including using other people's materials. You have **fifty minutes** to complete the quiz; there are 50 points possible.*

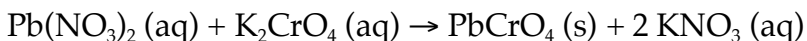
1. Quick ones:

a. How many **moles** of cyanide (CN^-) ions result when 1 mole of iron (III) cyanide dissolves?

b. What is the **weight percent carbon** (%C) in CaCO_3 ?

c. A 4.00 L volume of 12.00 M hydrochloric acid is diluted with distilled water to a total volume of 10.00 L. How many **moles** of HCl (aq) are contained in that volume?

d. Write the **net ionic equation** of:

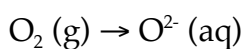


e. In the reaction $\text{C}_5\text{H}_{12} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$, which chemical is undergoing **oxidation** (i.e., is being oxidized)?

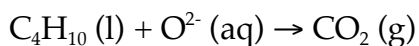
2. For the precipitation reaction between aqueous sodium carbonate and aqueous calcium chloride, a student writes: "The class mean and standard deviation for the maximum amount of precipitate was 0.833 ± 0.184 g; the theoretical maximum yield for the precipitate was 0.862 g. The class mean was low due to the systematic error of allowing precipitate to escape into the filtrate and not refiltering the filtrate." Assume that the student's calculations are fine; explain if the source of error mentioned is **consistent** with the results.

3. Fuel cells combust hydrocarbons as an oxidation-reduction reaction, using the experimental apparatus shown above.

a. **Balance** this half-reaction:



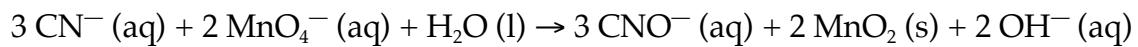
b. **Balance** this half-reaction:



c. When the two half-reactions (parts a and b) are combined, **how many moles of electrons are transferred** for each mole of butane (C_4H_{10}) combusted? Note that the answer will *not* be zero, even though the “loose” electrons cancel when the half-reactions are added. Remember that, even though *algebraically* the electrons cancel on both sides, *physically*, they are still moving electrical charge around.

4. One can purchase 4.000 L bottles of stock 12.00 M hydrochloric acid from chemical companies. In the course of your lab tech career, you break one bottle. Fortunately, the acid is contained in one pool. **How many** 454 g (1 pound) **boxes** of sodium bicarbonate (NaHCO_3) would you need to completely neutralize the spill? Hint: assume that 1 mole of NaHCO_3 (s) neutralizes 1 mole of HCl (aq). The answer is why this sort of accident should be avoided!

5. In class, we balanced the equation:



How much **precipitate** (in grams) will result if 20.00 mL of 1.25 M $\text{Fe}(\text{CN})_3$ and 20.00 mL of 1.50 M KMnO_4 react in a basic solution (i.e., use the stoichiometry above)?

(extra credit — 3 points) Would the reaction solution in question 5 become more conductive, less conductive, or remain the same conductivity as the reaction progresses to completion? **Justify** your answer.

6. A **hydrocarbon** (a compound containing only carbon and hydrogen) is 81.7% by mass carbon. What is the **empirical formula** of the hydrocarbon?