

CHEM 100 Exam 4 Review

You should feel comfortable with the following topics:

Ch. 7:

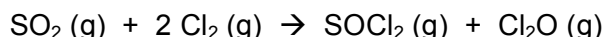
- Fully balance a chemical equation.
- Classify a reaction as a single displacement or a double displacement reaction.
- Classify a reaction as a precipitation, acid/base, or redox reaction.
- Use the solubility rules to determine whether a compound is soluble or insoluble in water.
- Predict the products of a reaction based on given starting materials.
- Write a net ionic equation from a balanced molecular equation.
- Write a gas-producing reaction. (H_2 and CO_2 forming reactions).

Ch. 8:

- $\text{g} \rightarrow \text{mol} \rightarrow \text{mol} \rightarrow \text{g}$ calculations.
 - From a mass of starting material, determine the amount of product made.
 - From a mass of starting material, know how much of the other starting material is needed.
- Limiting Reagent problems – given the mass of two starting materials, identify the limiting reagent and determine the maximum amount of product that can be formed.
- Determining percent yield.

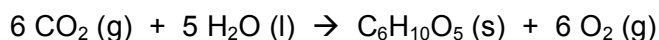
Review Problems – for a more complete review, redo homework and in-class problems as well!

1. **Predicting Reactions.** Predict the products of the reaction described below. Please give the complete molecular equation and net ionic equation to each reaction. Identify the reaction as a double displacement or single displacement reaction. Also classify each reaction as Precipitation, Acid-Base or Redox.
 - a) The reaction of calcium metal and aqueous hydrobromic acid.
 - b) The reaction between lead (II) phosphate and sodium sulfate.
 - d) The reaction between magnesium and perchloric acid.
 - e) The reaction between lead (II) acetate and sodium chloride.
 - f) The reaction between potassium carbonate and hydrobromic acid.
2. Chlorine gas reacts with sulfur dioxide to produce thionyl chloride (SOCl_2), a common reagent in organic synthesis, and dichlorine monoxide, according to the following balanced reaction:



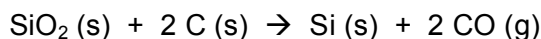
If you start with 150.0 g of each starting material, how many grams of thionyl chloride can be produced?

3. CO_2 is removed from the atmosphere by trees and converted into cellulose. The basic reaction for this is:



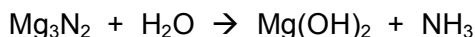
You decide to start a business making cellulose for paper from CO_2 , reducing greenhouse gases, and saving trees in the process. You run a test reaction with 1.00×10^3 g of CO_2 . What is the maximum amount of cellulose, in grams, that will be produced by this reaction?

4. Silicon metal can be produced by heating sand (SiO_2) with graphite in an electric arc furnace, according to the following reaction.



If you begin with 55.0 g of SiO_2 , what is the maximum amount of elemental silicon that can be formed? *MWs: $\text{SiO}_2 = 60.084 \text{ g/mol}$; $\text{Si} = 28.0855 \text{ g/mol}$.*

5. Ammonia can be made in the reaction of magnesium nitride and water, as in the following unbalanced reaction.



- Balance the reaction.
 - If we start with 58.1 g of Mg_3N_2 how much ammonia gets produced, in g?
 - How many grams of water are needed to react with the Mg_3N_2 ?
 - If only 10.68 g of ammonia is produced, what is the percent yield of the reaction?
6. Write balanced molecular equations for the following reactants. Be sure to list all phase labels. Classify the reaction as a double displacement or single displacement reaction. Also classify each reaction as a precipitation, acid-base, or redox reaction.
- The reaction between lead (II) acetate and sodium iodide.

Molecular:			
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This reaction is a: Precipitation Acid-Base Redox
(circle all that apply) Double Displacement Single displacement Combination

- The reaction between lithium carbonate and hydrochloric acid.

Molecular:			
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This reaction is a: Precipitation Acid-Base Redox
(circle all that apply) Double Displacement Single displacement Combination

- The reaction of zinc and sulfuric acid.

Molecular:			
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This reaction is a: Precipitation Acid-Base Redox
(circle all that apply) Double Displacement Single displacement Combination

7. Give the net ionic equation for the following balanced molecular equations. Be sure to include all charges and phase labels.
- $\text{CaCO}_3 (\text{s}) + 2 \text{HCl} (\text{aq}) \rightarrow \text{CaCl}_2 (\text{aq}) + \text{H}_2\text{O} (\text{l}) + \text{CO}_2 (\text{g})$
 - $2 \text{Na} (\text{s}) + \text{H}_2\text{SO}_4 (\text{aq}) \rightarrow \text{Na}_2\text{SO}_4 (\text{aq}) + \text{H}_2 (\text{g})$
 - $2 \text{K}_3\text{PO}_4 (\text{aq}) + 3 \text{Ca}(\text{NO}_3)_2 (\text{aq}) \rightarrow \text{Ca}_3(\text{PO}_4)_2 (\text{s}) + 6 \text{KNO}_3 (\text{aq})$

8. All the following equations are balanced **EXCEPT**

- a. $(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \rightarrow \text{N}_2\text{O} + \text{Cr}_2\text{O}_3 + 4\text{H}_2\text{O}$.
- b. $2\text{NH}_4\text{SCN} + \text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O} \rightarrow 2\text{NH}_3 + 10\text{H}_2\text{O} + \text{Ba}(\text{SCN})_2$.
- c. $\text{C}_{12}\text{H}_{22}\text{O}_{11} \rightarrow 12\text{C} + 11\text{H}_2\text{O}$.
- d. $\text{NH}_4\text{NO}_3 \rightarrow \text{N}_2\text{O} + 2\text{H}_2\text{O}$.
- e. $2\text{Mg} + \text{CO}_2 \rightarrow 2\text{MgO} + \text{C}$.

9. All the following reactions can be described as displacement reactions **EXCEPT**

- a. $\text{Zn}(\text{s}) + \text{FeCl}_2(\text{aq}) \rightarrow \text{ZnCl}_2(\text{aq}) + \text{Fe}(\text{s})$.
- b. $\text{CuSO}_4(\text{aq}) + \text{Fe}(\text{s}) \rightarrow \text{Cu}(\text{s}) + \text{FeSO}_4(\text{aq})$.
- c. $2\text{Na}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{NaOH}(\text{aq}) + \text{H}_2(\text{g})$.
- d. $\text{C}_6\text{H}_6(\text{l}) + \text{Cl}_2(\text{g}) \rightarrow \text{C}_6\text{H}_5\text{Cl}(\text{l}) + \text{HCl}(\text{g})$.

10. All the following are strong electrolytes (soluble) in aqueous solution **EXCEPT**

- a. Na_3PO_4 .
- b. $\text{NH}_4\text{H}_2\text{PO}_4$.
- c. NH_3 .
- d. Na_2HPO_4 .
- e. NaH_2PO_4 .

11. Which of the following ionic compounds is **INSOLUBLE** in water?

- a. $(\text{NH}_4)_2\text{CO}_3$
- b. AgBr
- c. CuSO_4
- d. KI
- e. LiNO_3

12. A precipitate is expected when an aqueous solution of potassium iodide is added to an aqueous solution of

- a. sodium sulfate.
- b. iron(II) chloride.
- c. calcium perchlorate.
- d. barium hydroxide.
- e. lead nitrate.

13. What products result from the addition of aqueous solutions of $\text{Cu}(\text{NO}_3)_2$ and $(\text{NH}_4)_2\text{S}$?

- a. $\text{CuS}(\text{aq})$ and $\text{NH}_4\text{NO}_3(\text{s})$
- b. $\text{CuS}(\text{s})$ and $\text{NH}_4\text{NO}_3(\text{s})$
- c. $\text{CuS}(\text{s})$ and $\text{NH}_4\text{NO}_3(\text{aq})$
- d. $\text{Cu}_2\text{S}(\text{s})$ and $\text{NH}_4\text{NO}_3(\text{aq})$
- e. $\text{CuS}(\text{s})$, $\text{NH}_3(\text{g})$, and $\text{H}_2\text{S}(\text{g})$

14. All the following equations are double-displacement reactions **EXCEPT**

- a. $\text{Na}_2\text{CO}_3(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{Na}_2\text{SO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$.
- b. $2\text{NaOH}(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{Na}_2\text{SO}_4(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$.
- c. $2\text{NaOH}(\text{aq}) + (\text{NH}_4)_2\text{SO}_4(\text{aq}) \rightarrow \text{Na}_2\text{SO}_4(\text{aq}) + 2\text{NH}_3(\text{g}) + \text{H}_2\text{O}(\text{l})$.
- d. $\text{Na}_2\text{CO}_3(\text{aq}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{Na}_2\text{SO}_4(\text{aq}) + \text{CuCO}_3(\text{s})$.
- e. $\text{Cl}_2(\text{g}) + \text{Na}_2\text{SO}_3(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Na}_2\text{SO}_4(\text{aq}) + 2\text{HCl}(\text{aq})$.

15. Which of the following reactions could be classified both as a precipitation reaction and an acid base reaction?
- a. $\text{Cu} + 2\text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + \text{SO}_2 + 2\text{H}_2\text{O}$
 - b. $\text{Ba}(\text{OH})_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{H}_2\text{O}$
 - c. $2\text{Li} + 2\text{H}_2\text{O} \rightarrow 2\text{LiOH} + \text{H}_2$
 - d. $\text{CaCO}_3 + 2\text{HNO}_3 \rightarrow \text{Ca}(\text{NO}_3)_2 + \text{CO}_2 + \text{H}_2\text{O}$
 - e. $\text{POBr}_3 + 3\text{H}_2\text{O} \rightarrow \text{H}_3\text{PO}_4 + 3\text{HBr}$
16. The net ionic equation for the reaction of the weak acid phosphoric acid with a dilute solution of calcium hydroxide to form a precipitate is
- a. $6\text{H}^+(\text{aq}) + 2\text{PO}_4^{3-}(\text{aq}) + 3\text{Ca}^{2+}(\text{aq}) + 6\text{OH}^-(\text{aq}) \rightarrow \text{Ca}_3(\text{PO}_4)_2(\text{s}) + 6\text{H}_2\text{O}(\text{l})$.
 - b. $2\text{H}^+(\text{aq}) + 4\text{H}_2\text{PO}_4^-(\text{aq}) + 3\text{Ca}^{2+}(\text{aq}) + 6\text{OH}^-(\text{aq}) \rightarrow \text{Ca}_3(\text{PO}_4)_2(\text{s}) + 6\text{H}_2\text{O}(\text{l})$.
 - c. $2\text{H}_3\text{PO}_4(\text{aq}) + 3\text{Ca}(\text{OH})_2(\text{aq}) \rightarrow \text{Ca}_3(\text{PO}_4)_2(\text{s}) + 6\text{H}_2\text{O}(\text{l})$.
 - d. $2\text{H}_3\text{PO}_4(\text{aq}) + 3\text{Ca}^{2+}(\text{aq}) + 6\text{OH}^-(\text{aq}) \rightarrow 3\text{Ca}^{2+}(\text{aq}) + 2\text{PO}_4^{3-}(\text{aq}) + 6\text{H}_2\text{O}(\text{l})$.
 - e. $2\text{H}_3\text{PO}_4(\text{aq}) + 3\text{Ca}^{2+}(\text{aq}) + 6\text{OH}^-(\text{aq}) \rightarrow \text{Ca}_3(\text{PO}_4)_2(\text{s}) + 6\text{H}_2\text{O}(\text{l})$.
17. The net ionic equation for the reaction of nitric acid with lithium hydroxide is
- a. $\text{HNO}_3(\text{aq}) + \text{LiOH}(\text{aq}) \rightarrow \text{LiNO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l})$.
 - b. $\text{HNO}_3(\text{aq}) + \text{LiOH}(\text{aq}) \rightarrow \text{Li}^+(\text{aq}) + \text{NO}_3^-(\text{aq}) + \text{H}_2\text{O}(\text{l})$.
 - c. $\text{HNO}_2(\text{aq}) + \text{Li}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{Li}^+(\text{aq}) + \text{NO}_2^-(\text{aq}) + \text{H}_2\text{O}(\text{l})$.
 - d. $\text{H}^+(\text{aq}) + \text{NO}_2^-(\text{aq}) + \text{Li}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{Li}^+(\text{aq}) + \text{NO}_2^-(\text{aq}) + \text{H}_2\text{O}(\text{l})$.
 - e. $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$.