

CH 221 Problem Set #4

Complete problem set on separate pieces of paper showing all work, circling final answers, etc.

Covering: Chapter Four and Chapter Guide Four

Important Tables and/or Constants: Solubility Table (in the "Net Ionics" lab or here: <https://mhchem.org/sol>)- Use the Net Ionics solubility table when answering questions about solubility in CH 221)

- Balance the following equations:
 - $\text{Cr(s)} + \text{Cl}_2\text{(g)} \rightarrow \text{CrCl}_3\text{(s)}$
 - $\text{SiO}_2\text{(s)} + \text{C(s)} \rightarrow \text{Si(s)} + \text{CO(g)}$
 - $\text{Fe(s)} + \text{H}_2\text{O(g)} \rightarrow \text{Fe}_3\text{O}_4\text{(s)} + \text{H}_2\text{(g)}$
- Balance the following equations and name each reactant and product:
 - $\text{SF}_4\text{(g)} + \text{H}_2\text{O(l)} \rightarrow \text{SO}_2\text{(g)} + \text{HF(l)}$
 - $\text{NH}_3\text{(aq)} + \text{O}_2\text{(aq)} \rightarrow \text{NO(g)} + \text{H}_2\text{O(l)}$
 - $\text{BF}_3\text{(g)} + \text{H}_2\text{O(l)} \rightarrow \text{HF(aq)} + \text{H}_3\text{BO}_3\text{(aq)}$
- What mass of HCl, in grams, is required to react with 0.750 g of Al(OH)_3 ? What mass of water, in grams, is produced? What mass of AlCl_3 , in grams, is produced? The equation:
$$\text{Al(OH)}_3\text{(s)} + 3 \text{HCl(aq)} \rightarrow \text{AlCl}_3\text{(aq)} + 3 \text{H}_2\text{O(l)}$$
- Hexane (C_6H_{14}) burns in air (O_2) to give CO_2 and H_2O . Write a balanced equation for this reaction. If 215 g of C_6H_{14} is mixed with 215 g of O_2 , what masses of CO_2 and H_2O are produced in the reaction? What mass of excess reactant remains at the end of the reaction?
- Consider the reaction: $2 \text{CH}_3\text{SH} + \text{CO} \rightarrow \text{CH}_3\text{COSCH}_3 + \text{H}_2\text{S}$. If you begin with 10.0 g of CH_3SH and excess CO ,
 - What is the theoretical yield of $\text{CH}_3\text{COSCH}_3$?
 - If 8.65 g of $\text{CH}_3\text{COSCH}_3$ is isolated, what is the percent yield?
- A metal M reacts with O_2 according to the equation below. If 0.356 g of the metal M reacts with an excess of oxygen to make 0.452 of the metal oxide MO_2 , use this information to find the identity of the metal M.
$$\text{M(s)} + \text{O}_2\text{(g)} \rightarrow \text{MO}_2\text{(s)}$$
- Saccharin, an artificial sweetener, has the formula $\text{C}_7\text{H}_5\text{NO}_3\text{S}$. Suppose you have a sample of a saccharin-containing sweetener with a mass of 0.2140 g. After decomposition to free sulfur and converting it to the SO_4^{2-} ion, the sulfate ion is trapped as the water-insoluble BaSO_4 . The quantity of BaSO_4 obtained is 0.2070 g. What is the mass percent of saccharin in the sample of sweetener?
- To find the formula of a compound composed of iron and carbon monoxide, $\text{Fe}_x(\text{CO})_y$, the compound is burned in pure oxygen to give Fe_2O_3 and CO_2 . If you burn 1.959 g of $\text{Fe}_x(\text{CO})_y$ and obtain 0.799 g of Fe_2O_3 and 2.200 g of CO_2 , what is the empirical formula of $\text{Fe}_x(\text{CO})_y$?
- Mesitylene is a liquid hydrocarbon with formula C_xH_y . Burning 0.115 g of the compound in oxygen gives 0.379 g of CO_2 and 0.1035 g of H_2O . What is the empirical formula of mesitylene?
- Benzoquinone, a chemical used in the dye industry and in photography, is an organic compound containing only C, H and O. What is the empirical formula of the compound if 0.105 g of the compound gives 0.257 g of CO_2 and 0.0350 g of H_2O when burned completely in oxygen? What is the molecular formula if the molar mass of the compound = 108 g/mol?

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Note: For questions #11 - 13, use the **solubility table** found in the “**Net Ionic Reactions**” Lab, available in the Chemistry 221 Companion or on the website (<http://mhchem.org/221/classroom/lab.htm>)

11. Decide whether each of the following is water-soluble. If soluble, tell what ions are produced. Describe them as strong electrolyte, weak electrolyte or non-electrolyte when placed in water.
- NiCl₂
 - Cr(NO₃)₃
 - ethanol
 - ammonia
 - BaSO₄
12. Predict the products of each precipitation reaction. Balance the completed equation, and then write the net ionic equation.
- Pb(NO₃)₂(aq) + KBr(aq) →
 - Ca(NO₃)₂(aq) + KF(aq) →
13. Balance the following equations, and then write the net ionic equation. Identify the spectator ions, if any.
- Mg(OH)₂(s) + HCl(aq) → MgCl₂(aq) + H₂O(l)
 - HNO₃(aq) + CaCO₃(s) → Ca(NO₃)₂(aq) + H₂O(l) + CO₂(g)