

Chemistry 101 – Exam I
3 March 2010

Name _____

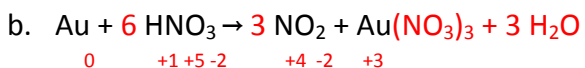
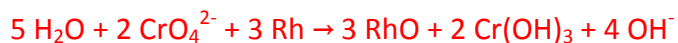
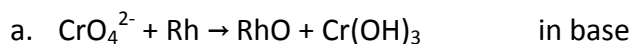
Show all work for credit. Answers without supporting work will receive zero (0) credit. Give all numerical answers with the correct units and the correct number of significant figures.

1. 4 points – What is my cell phone policy as stated on the syllabus for this course?

Quoted from the syllabus:

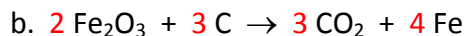
I expect all cell phones to be in the OFF position during this class. Any person whose cell phone rings during class will have their grade lowered by one grade point.

2. 18 points – Balance the following oxidation reduction reactions:



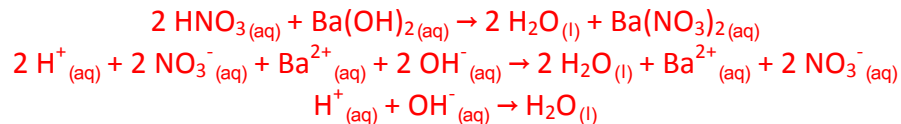
write a complete chemical equation for this one

3. 3 points – Balance the following equations by mass:



4. 15 points – Nitric acid reacts with Barium Hydroxide in a neutralization reaction.

a. Write the balanced chemical, ionic and net ionic equation for the complete neutralization.



b. It requires 14.60 mL of 0.09834 M barium hydroxide solution to react completely with 20.00 mL of the nitric acid solution. What is the molar concentration of the sulfuric acid?

$$? \frac{\text{mol HNO}_3}{\text{L HNO}_3} = \frac{14.60 \text{ mL Ba(OH)}_2}{20.00 \text{ mL HNO}_3} \times \frac{0.09834 \text{ mol Ba(OH)}_2}{1 \text{ L Ba(OH)}_2} \times \frac{2 \text{ mol HNO}_3}{1 \text{ mol Ba(OH)}_2} = 0.1436 \text{ M HNO}_3$$

5. 15 points – Complete the following table:

<i>Name of Compound</i>	<i>Chemical Formula</i>
Potassium Acetate	$\text{KC}_2\text{H}_3\text{O}_2$
Copper(I) Phosphate	$\text{Cu}_3(\text{PO}_4)_2$
Phosphorus Trichloride	PCl_3
Gallium Sulfite	$\text{Ga}_2(\text{SO}_3)_3$
Arsine	AsH_3
Boric acid	H_3BO_3
Sulfuric acid	$\text{H}_2\text{SO}_{4(\text{aq})}$
Sodium Oxide	Na_2O
Rhenium(III) Bicarbonate	$\text{Re}(\text{HCO}_3)_3$
Iron(II) Dichromate	FeCr_2O_7

6. 10 points – A sphere with a radius of 5.00 in is constructed from an alloy that is 25.34% by mass Aluminum, 44.67% by mass Chromium, and the rest is Molybdenum. If the alloy has a density of 7.43 g mL^{-1} , how many atoms of Chromium are present in the sphere? The volume of a sphere is $\frac{4}{3}\pi r^3$ and $1 \text{ in} = 2.540 \text{ cm}$.

$$\begin{aligned} ? \text{ at Cr} &= \frac{4}{3}\pi(5.00 \text{ in})^3 \times \left(\frac{2.540 \text{ cm}}{1 \text{ in}}\right)^3 \times \frac{1 \text{ mL}}{1 \text{ cm}^3} \times \frac{7.43 \text{ g sphere}}{1 \text{ mL}} \times \frac{44.67 \text{ g Cr}}{100.00 \text{ g sphere}} \times \frac{1 \text{ mol Cr}}{51.996 \text{ g Cr}} \times \frac{6.022 \times 10^{23} \text{ at Cr}}{1 \text{ mol Cr}} \\ &= 3.30 \times 10^{26} \text{ at Cr} \end{aligned}$$

7. 15 points – Vanillin is a component of many baked goods. It is a molecule that is 63.15% C, 5.30% H, and the rest is oxygen. Calculate the empirical formula of vanillin.

$$63.15 \text{ g C} \times \frac{1 \text{ mol C}}{12.0107 \text{ g C}} = 5.2578 \text{ mol C} / 1.9719 = 2.666 \times 3 = 8$$

$$5.30 \text{ g H} \times \frac{1 \text{ mol H}}{1.00794 \text{ g H}} = 5.2582 \text{ mol H} / 1.9719 = 2.666 \times 3 = 8$$

$$(100.00 - 63.15 - 5.30) \text{ g O} \times \frac{1 \text{ mol O}}{15.9994 \text{ g O}} = 1.9719 \text{ mol O} / 1.9719 = 1.0000 \times 3 = 3$$

The empirical formula of vanillin is $\text{C}_8\text{H}_8\text{O}_3$.

8. 20 points – Textbook problem 3.103. Thiophene is a liquid compound of the elements C, H, and S. A sample of thiophene weighing 7.96 mg was burned in oxygen, giving 16.65 mg CO₂. Another sample was subjected to a series of reactions that transformed all of the sulfur in the compound to barium sulfate. If 4.31 mg of thiophene gave 11.96 mg of barium sulfate, what is the empirical formula of thiophene? Its molecular mass is 84 amu. What is its molecular formula? (Hint: we did this one in class.)

$$\%C = \frac{16.65 \text{ mg CO}_2}{7.96 \text{ mg sample}} \times \frac{1 \text{ mol CO}_2}{44.0095 \text{ g CO}_2} \times \frac{1 \text{ mol C}}{1 \text{ mol CO}_2} \times \frac{12.0107 \text{ g C}}{1 \text{ mol C}} \times 100 = 57.09\%C$$

$$\%S = \frac{11.96 \text{ mg BaSO}_4}{4.31 \text{ mg sample}} \times \frac{1 \text{ mol BaSO}_4}{233.390 \text{ g BaSO}_4} \times \frac{1 \text{ mol S}}{1 \text{ mol BaSO}_4} \times \frac{32.065 \text{ g S}}{1 \text{ mol S}} \times 100 = 38.12\%S$$

$$\%H = 100.00 - \%C - \%S = 4.79\%$$

$$57.09 \text{ g C} \times \frac{1 \text{ mol C}}{12.0107 \text{ g C}} = 4.75326 \text{ mol C} / 1.1888 = 3.9984 = 4$$

$$38.12 \text{ g S} \times \frac{1 \text{ mol S}}{32.065 \text{ g S}} = 1.1888 \text{ mol S} / 1.1888 = 1$$

$$4.79 \text{ g H} \times \frac{1 \text{ mol H}}{1.00794 \text{ g H}} = 4.75227 \text{ mol H} / 1.1888 = 3.9975 = 4$$

The empirical formula is C₄H₄S. The empirical mass is 84.1396 amu. Because this is the same as the molecular mass the molecular formula is the same as the empirical formula: C₄H₄S.