

Chem 103 Summer 2022
Professor Goldsmith

_____ Name

EXAM 1 – June 15, 2022

#1 (/20) _____

#2 (/15) _____

#3 (/15) _____

#4 (/15) _____

#5 (/20) _____

#6 (/15) _____

Bonus (/3) _____

Total (/100) _____

1. (20 points)

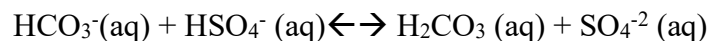
a) If you want a sample of $\text{Al}_2(\text{SO}_4)_3$ that contains 3.86×10^{25} atoms of O, how many grams of $\text{Al}_2(\text{SO}_4)_3$ do you need?

b) How many potassium ions are there in 785 mL of a 0.47M potassium phosphate solution?

c) Balance this equation: $(\text{NH}_4)_2\text{MoS}_4 + \text{H}_2 \rightarrow \text{MoS}_2 + \text{NH}_3 + \text{H}_2\text{S}$

d) Balance this equation: $\text{Na}_2\text{B}_4\text{O}_7 + \text{HCl} + \text{H}_2\text{O} \rightarrow \text{NaCl} + \text{H}_3\text{BO}_3$

e) In the following reaction which species are acting as acids and which are acting as bases?
How do you know?



2. (15 points) 50.0 g of an unknown molecule (that may contain C, H and O) is burned (i.e. reacts with molecular oxygen), producing 126.3 g of CO_2 and 22.1 g of H_2O .

a) How many moles of C atoms were in the original unknown?

b) How many moles of H atoms were in the original unknown?

c) If the molecular weight of this unknown is 122.1 g/mole, what is its formula?

d) Write the balanced equation for the combustion of this compound (i.e. the reaction that occurred when it was burned)

3. (15 points) It is a hot day and you are getting ready to get into your tiny backyard swimming pool. The pool has 22.0 gallons of water in it (it is really one of those plastic kiddie pools) and the pool thermometer reads 28.3 °C. All of a sudden a red hot chunk of rock falls from the sky and lands in the pool; you were almost hit by a meteorite!! After recovering from your surprise, you reach into the pool to remove it and notice that the water is a lot warmer – the thermometer now reads 35.1 °C. You inspect the meteorite, which had equilibrated to the temperature of the water and note that it appears to be made of pure iron. You then weigh it and find that its mass is 3885 grams. When you look up the specific heat capacity of iron you find it to be 0.444 J/g•K. What was the temperature of the meteorite just before it hit your pool?

4. (15 points)

a) Write the total ionic equation for the reaction of aqueous potassium chromate (K_2CrO_4) with aqueous iron chloride (FeCl_3). Hint: a precipitate forms.

b) Write the net ionic equation for the process in a)

c) If you combine 575 mL of a 0.37M potassium chromate solution with 450 mL of a 0.28M iron (III) chloride solution, how many grams of precipitate will be formed?

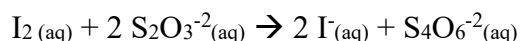
5. (20 points) C_2H_2 is acetylene and is very combustible (it is used in welding torches).

a) Write the balanced equation for the combustion of acetylene in the presence of oxygen gas. Assume that the products are liquid water and gaseous carbon dioxide

b) The $\Delta_f H^\circ$ of liquid water is -285.8 kJ/mol . The $\Delta_f H^\circ$ of gaseous carbon dioxide is -393.5 kJ/mol . If you combust 100 grams of acetylene with excess oxygen, enough heat is given off to melt a cube of ice 10.0 inches on a side originally at 0.0°C (the density of ice is 0.917 g/cm^3)
What is the $\Delta_f H^\circ$ of acetylene?

6. (15 points) You come across an unmarked bottle on the shelf in the chemistry stockroom. By a process of elimination you narrow down the identity of the chemical to three possibilities: $\text{Li}_2\text{S}_2\text{O}_3$, $\text{Na}_2\text{S}_2\text{O}_3$ or $\text{K}_2\text{S}_2\text{O}_3$. You take 2.50 grams of the unknown, dissolve it in water to make 50 mL of solution and titrate it with a 0.055 M solution of iodine (I_2). The iodine solution is brown, but when it reacts with thiosulfate ($\text{S}_2\text{O}_3^{2-}$) ions it becomes colorless. After the addition of 143.6 mL of the iodine solution, the brown color persists, meaning that the endpoint of the titration has been reached.

a) The chemistry that occurs can be described by the equation below. For each atom, assign the oxidation number and indicate what, if anything, is being oxidized/reduced. Remember that the oxidation number is just book-keeping and isn't actually the number of electrons.



b) What is the chemical formula of the unknown material? You can't just guess, you need to prove that your answer is correct.

Bonus (3 points) Write a haiku (5/7/5 syllables) describing your first 2 weeks of the post-bacc program

LAST NAME _____

FIRST NAME _____