

**City College, Chemistry Department
Chemistry 10301, sections T, T2, T3 Prof. T. Lazaridis
Second Midterm exam, Nov. 6, 2007**

Name (last name first): _____

I.D. Number last 4: _____

Workshop leader: _____

**Note: There are 7 questions in this exam (check both sides of the sheet).
Fill in your answer in the blank space provided immediately following each
question. 1/2 point will be subtracted every time you report a numerical result with
an incorrect number of significant figures. The last sheet of this exam contains
information that may or may not be needed to answer these questions.**

**1. (20) a. (5) How many ml of stock solution are needed to make 320 ml of
1.5 M HNO₃ solution from 16 M HNO₃ stock solution?**

$$\mathbf{VdMd = VcMc \Rightarrow Vc = VdMd/Mc = 320 \text{ ml} \times 1.5 \text{ M} / 16 \text{ M} = 30 \text{ ml}}$$

**b. (5) The solubility of DDT has been estimated as 5.0×10^{-5} g/100 g of
water. Express this solubility in parts per million.**

$$\mathbf{5.0 \times 10^{-5} \text{ g} / 100 \text{ g} \times 10^6 \text{ ppm} = 0.5 \text{ ppm}}$$

**c. (5) An average pair of human lungs contains about 3.5 L of air after
inhalation and about 3.0 L after exhalation. If the temperature is 37 °C and
the pressure is 1.0 atm, how many moles of gas will be present in the lungs
(a) after inhalation and (b) after exhalation? [assume ideal gas]**

$$\mathbf{n = PV/RT = 1 \text{ atm} \times 3.5 \text{ L} / 0.082 \text{ (atm L/mol K)} (37+273) \text{ K} = 0.14 \text{ mol}}$$

(after inhalation)

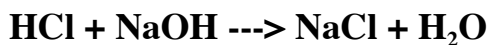
$$\mathbf{n = PV/RT = 1 \text{ atm} \times 3.0 \text{ L} / 0.082 \text{ (atm L/mol K)} (37+273) \text{ K} = 0.12 \text{ mol}}$$

(after exhalation)

**d. (5) Give the oxidation numbers of each element in the compound
KCrO₃Cl.**

O: -2 Cl: -1 K: +1 Cr: +6

2. (10) When an HCl solution was titrated against 0.09850 M NaOH, it was found that 45.00 ml of the acid reacted with 40.10 ml of the base. What is the molarity of the HCl solution?



$$40.10 \times 10^{-3} \text{ L of base} \times 0.09850 \text{ mol/L} = 3.950 \times 10^{-3} \text{ mol of NaOH}$$

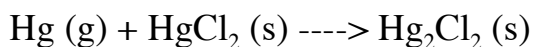
This reacted with 3.950×10^{-3} mol of HCl.

$$\text{molarity: } 3.950 \times 10^{-3} \text{ mol} / 45.00 \times 10^{-3} \text{ L} = 0.08777 \text{ M}$$

3. (15) Using your datasheet, find the standard enthalpy of the following reactions and indicate whether they are exothermic or endothermic:



$$\Delta H^\circ = \{4X(+33.2) + 2X(-157.3)\} - \{2X(-302.9)\} = +424.0 \text{ kJ/mol (endothermic)}$$

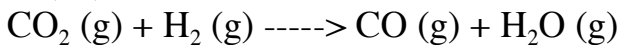


$$\Delta H^\circ = \{-265.2\} - \{+61.3 - 224.3\} = -102.2 \text{ kJ/mol (exothermic)}$$

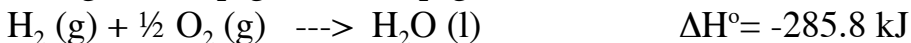
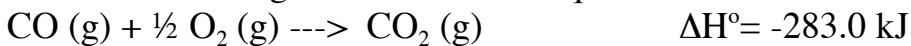


$$\Delta H^\circ = \{2X(-436.7)\} - \{2X(-397.7)\} = -78.0 \text{ kJ/mol (exothermic)}$$

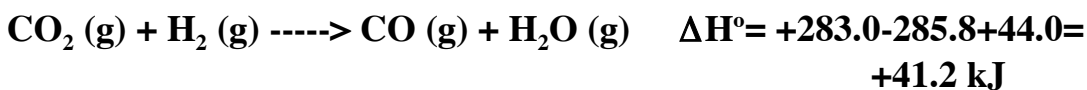
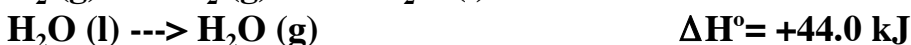
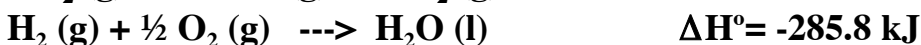
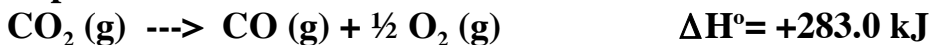
4. (15) Use Hess's law to calculate the standard enthalpy of the reaction



from the following thermochemical equations



Flip the first and third and add to the second:



5. (10) A 13.0 g sample of iron at 95 °C is dropped into 80.0 g of water at 15.0 °C. Using your data sheet, calculate the final temperature of the iron and water mixture. Assume that no heat is lost to the surroundings.

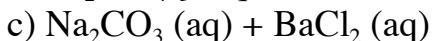
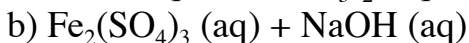
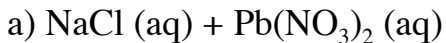
Specific heat of iron = 0.449 J/g °C and of water 4.180 J/g °C

Iron temperature drops from 95 °C to X and that of water rises from 15.0 °C to X. The heat that iron loses is equal to the heat that water gains:

$$13.0 \text{ g} \times 0.449 \text{ J/g } ^\circ\text{C} \times (95 - X) ^\circ\text{C} = 80.0 \text{ g} \times 4.180 \text{ J/g } ^\circ\text{C} \times (X - 15.0) \Rightarrow$$

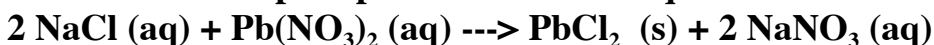
$$X = 16.4 ^\circ\text{C}$$

6. (18) Use the solubility rules to predict whether or not a precipitation reaction will occur when the following aqueous solutions are mixed. Write the molecular and the net ionic equation for each reaction that does occur.

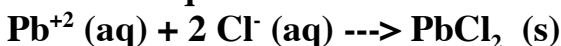


a) Chlorides are soluble but Pb is an exception =>

Pb^{+2} and Cl^- will precipitate. Molecular equation:

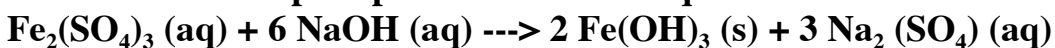


Net ionic equation:

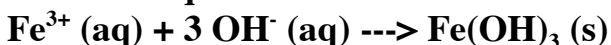


b) Hydroxides are insoluble. Na is an exception but Fe is not =>

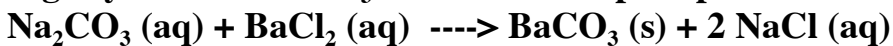
Fe^{3+} and OH^- will precipitate. Molecular equation:



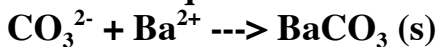
Net ionic equation:



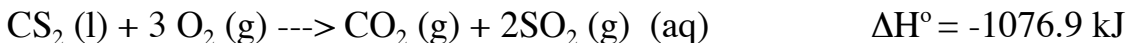
c) Carbonates are insoluble. Na is an exception but BaCO_2 is only slightly soluble => CO_3^{2-} and Ba^{2+} will precipitate. Molecular equation:



Net ionic equation:



7. (12) The thermochemical eq. for the combustion of carbon disulfide is:



How many kJ of heat are released when 25.0 g of CS_2 is burned?

Molar mass of $\text{CS}_2 = 12.01 + 2 \times 32.06 = 76.13 \text{ g/mol}$

$25.0 \text{ g} / 76.13 \text{ (g/mol)} = 0.328 \text{ mol} \quad \times 1076.9 \text{ kJ/mol} = 353 \text{ kJ}$