

CHEMISTRY 1210 – SPRING 2017

EXAM 2

March 23rd 2017

Name:

Student #:

_____ / 37

Time allowed: 1h50

Only approved calculators are permitted

Cell phones and other electronics must be turned off

“What is ‘HIJKLMNO’? – H₂O”

Good Luck – Bonne chance – Suerte

$$T_k = T_c + 273.15$$

$$K_w = 1.0 \times 10^{-14} \text{ (at } 25^\circ\text{C)}$$

Assume all acid-base questions are at 25°C unless specified

1) **(2 pts)** Which of the above salts would have the highest molar solubility?



2) **(2 pts)** Calculate the molar solubility of the compound AgCl ($K_{sp} = 1.8 \times 10^{-10}$) in a solution containing 0.010 M CaCl₂.

3) **(2 pts)** Will a precipitate of magnesium fluoride form when 300. mL of 1.1×10^{-3} M MgCl₂ are added to 500. mL of 1.2×10^{-3} M NaF? ($K_{sp}(\text{MgF}_2) = 6.9 \times 10^{-9}$) (Assume NaCl is highly soluble and does not precipitate)

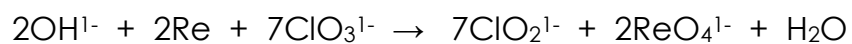
4) **(2 pts)** The solubility of tin(II) iodide (SnI_2) is 4.77 g/L. What is K_{sp} for this compound

5) **(3 pts)** A solution contains 0.10 M Ba^{2+} and 0.10 M Sr^{2+} . A solution of CrO_4^{2-} is slowly added to increase the concentration of CrO_4^{2-} in solution. Considering that $K_{sp} \text{BaCrO}_4 = 1.2 \times 10^{-10}$ and $K_{sp} \text{SrCrO}_4 = 3.5 \times 10^{-5}$.

a) Which of ion (Ba^{2+} or Sr^{2+}) will precipitate first

b) What range of concentrations will precipitate one cation but not the other?

6) **(3 pts)** Given the following balanced redox reaction:

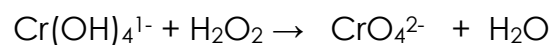


a) What is the oxidizing agent? _____

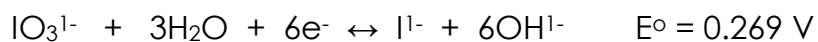
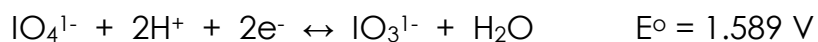
b) What element(s) is/are undergoing oxidation? _____

c) How many electrons are involved in the reduction process? _____

7) **(2 pts)** Balance the following oxidation reduction reaction occurring in basic solution.



8) (7 pts) Use the following reduction potentials to answer this question:



a) The strongest reducing agent is: (1 pt) _____

b) Write the shorthand cell notation for the *spontaneous* electrochemical cell formed by coupling a Cu/Cu²⁺ half cell with an IO₃¹⁻ half cell in basic solution.

c) Consider an electrochemical cell prepared by connecting a 1.0 L Copper half-cell containing a copper electrode and 0.10 M Cu²⁺ and a 1.0 L Zinc half-cell containing a zinc electrode in a 0.50 M Zn²⁺ solution

i) Determine the initial cell potential of this electrochemical cell

ii) Determine which electrode would be heavier and by what mass (what is the mass increase) after the cell operates for 121 seconds at 5.0 A.

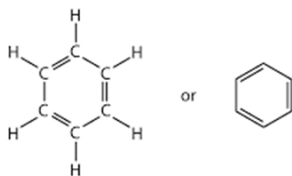
9) **(1 pts)** An experiment in a coffee cup calorimeter results in $q_{\text{rxn}} = 2.345 \text{ kJ}$. Is the reaction exothermic or endothermic and will the calorimeter temperature increase or decrease?

Endo or Exo

Calorimeter T: increase or decrease

10) **(2 pts)** High purity benzoic acid (MW: 122.122) has $\Delta H = -3227 \text{ kJ/mol}$ for its combustion reaction. A 1.221 g sample burns in a calorimeter (heat capacity = $1365 \text{ J/}^\circ\text{C}$) that also contains 1201 g of water (heat capacity = $4.184 \text{ J/g }^\circ\text{C}$). What is the temperature change following complete combustion of the benzoic acid sample?

11) **(2 pts)** Determine the change in enthalpy (ΔH) resulting from the combustion of 1.00 mol of benzene (C_6H_6)? Consider the unbalanced reaction: $\text{C}_6\text{H}_6 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$



Bond energies in kJ/mol: C-H: 415; C=C: 615; C-C: 345; O=O: 495; C=O: 750; O-H: 460

12) **(3 pts)** One way to quickly cool your tea after steeping the tea leaves in hot water is to add an ice cube. Determine the final temperature of a 251 mL tea that was initially at 85.0 °C when a 25 g ice cube at -10.0 °C is added to the tea.

(For the tea, assume heat capacity is the same as water $c=4.184 \text{ J/g}^\circ\text{C}$ and density of water 1.000 g/mL)

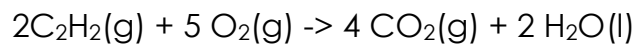
(assume this takes place in a perfect insulator, $c = 0 \text{ J/}^\circ\text{C}$, no calorimeter!)

($\Delta H_{\text{fus}}(\text{ice}) = 6100 \text{ J/mol}$, $c_{\text{ice}} = 2.04 \text{ J/g}^\circ\text{C}$, melting temperature of ice is 0°C, boiling point of water is 100°C)

(Hint: this is a multi-step process)

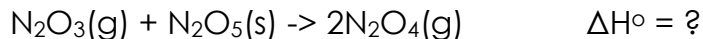
13) **(2 pts)** A calorimeter is calibrated by adding a fixed amount of heat to it and measuring its temperature change. When 20.3 kJ of heat are added to a 25.5 °C calorimeter, its temperature rises to 30.4 °C. The same calorimeter is used to analyze a combustion reaction. Determine the change in temperature for the calorimeter when 10.5 g of diesel is burned inside the calorimeter. ($\Delta H_{\text{comb}}(\text{diesel}) = -44.8 \text{ kJ/g}$)

14) (2 pts) Acetylene, C_2H_2 , is used as a fuel in welding because it produces a very hot flame.



Determine the standard enthalpy change for the combustion reaction considering the following: $\Delta H^\circ_f = -227.0, -393.5, -285.8$ kJ/mol for $C_2H_2(g)$, $CO_2(g)$ and $H_2O(l)$, respectively.

15) (2 pts) The chemistry of nitrogen oxides is very versatile. Determine the standard enthalpy for the following reaction:



Given the list of reactions below:

