⌛ : 120 min

Chem. 205
Final Examination

June 9, 1999
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Family Name: _____ First Name: _____

I.D. #: _____ Major: _____

Section (day): _____

Instructor: _____

Score:

I. _____ / 26

II. _____ / 24

III. _____ / 20

IV. _____ / 18

V. _____ / 12

Grade: _____ / 100

☺ GOOD LUCK

I. A(16%) **Fill in the blanks:**

During a titration, a student had to fill a buret twice because he needed 55.41ml. The uncertainty in a buret reading is ±0.02ml, therefore, the absolute uncertainty on the measured volume is _____ and the relative uncertainty is _____.

100ml of 0.100M Fe^{2+} were titrated with 0.0200M MnO_4^- in acidic medium to produce Fe^{3-} and Mn^{2+}. The normalities of Fe^{2+} and MnO_4^- solutions are respectively _____ and _____. The volume of MnO_4 needed to react completely with Fe^{2+} is _____.

The solubility of $Mg(OH)_2$ (M.wt.58.3) is 0.0085 gram per liter of water; therefore, the solubility product of this salt is _____.

A silver chloride precipitate weighing 0.3221 g was obtained from 0.4926g of a soluble salt mixture. The percentage of the chloride in the sample is _____.

A solution is saturated with respect to a compound of the general formula AB_2C_3:

$$AB_2C_{3(s)} \rightleftharpoons A^+ + 2B^+ + 3C^-$$

If this solution is found to contain ion C^- at a concentration of 0.0030M, then the solubility product of the compound AB_2C_3 is _____.

B(10%) Answer the following short questions:

Zinc hydroxide is an amphoteric hydroxide. Write balanced ionic equations to show its reaction with:

a- Hydrochloric acid

b- Sodium hydroxide

Calculate the pH of 250.0ml of an aqueous solution containing 0.616g of the strong acid trifluoromethane sulfonic acid CF_3SO_3H (M.wt.150.1)

How could you use the differences in the action of NH_4OH on silver chloride and mercurous chloride to separate silver from mercury ? Write the equations of the reactions.

II. A(16%) **Circle the letter preceding the best answer:**

What is true about lead chromate $PbCrO_4$ (Ksp = 1.8×10^{-14}) in a 0.10M $Pb(NO_3)_2$ solution:

a- Its solubility is higher than in pure water.
b- Its solubility may remain constant if the temperature is constant.
c- According to LeChatelier's principle, the favored direction of the equilibrium will be towards precipitation.
d- All of the above are true statements.
e- None of the above statements is true.

To prepare a desired dilute concentration of a given 0.716M solution (A), 20.0ml of (A) were measured in a graduated cylinder and the volume was made up to 100ml with water. Then 3.0ml of the resulting solution were taken and placed in a test tube to which 5.0ml of water were then added. What is the desired concentration of the final solution in the tube:

a- 0.086 M
b- 0.054 M
c- 0.18 M
d- 0.29 M
e- 0.43 M

The range of molar concentrations that can be used to produce transmittance readings between 20.0 and 60.0% of 1.50cm cells and 550 M^{-1} cm^{-1} molar absorptivity of the species used, is:

a- 0.699 – 0.222
b- $5.77 \times 10^{-3} - 1.83 \times 10^{-3}$
c- $6.05 \times 10^{-4} - 1.91 \times 10^{-3}$
d- $2.69 \times 10^{-4} - 8.47 \times 10^{-4}$
e- can not be determined unless we draw a calibration curve.

A compound (Mwt = 280.0g) observed 65.0% of the radiation at a concentration of 15.00×10^{-3} g/l. Calculate the molar absorptivity at this wavelength (Hint: absorbed 65.00% i.e. transmitted 35.00%):

a- 4255 M^{-1} cm^{-1}
b- 1702 x 10 M^{-1} cm^{-1}
c- 1746 M^{-1} cm^{-1}
d- 2227 M^{-1} cm^{-1}
e- 2128 M^{-1} cm^{-1}

B(8%) 20.00ml of a strong momoprotic acid (HA) were titrated with a standard 0.8650 M NaOH solution. After the addition of 8.00ml of the base, the H_3O^+ concentration remaining was equal to 5.200×10^{-1} M.

- Name a suitable indicator for this titration.

- Draw a qualitative, but clearly labeled, titration curve.

- Write the equation of the reaction.

- Calculate the pH of the solution after the addition of 8.00ml of the base.

- Calculate the accurate concentration of the acid.

III. (20%) Choose a reagent that would allow you to distinguish between the given solutions of cations. Write the involved chemical reactions and give the colors of precipitates where applicable.

Hg_2^{2+} and Hg^{2+}

Fe^{3+} and Cu^{2+}

Al^{3+} and Bi^{3+}

Ca^{2+} and K^{+}

Hg^{2+} and Mg^{2+}

Ni^{2+} and Ag^{+}

NH_4^{+} and Na^{+}

IV. (18%) A mixture of calcium, magnesium, bismuth, copper and silver ions when treated with concentrated H_2SO_4 yielded a precipitate (A) and a decantate (B) containing the remaining cations. Then, 6M HCl was added to (B) and yielded a precipitate (C) and a decantate (D). This decantate was treated with thioacetamide and hot water. The result was a mixture of two solids (E,F) and a solution containing one cation (G).
Give the chemical formulas of the ion (s) or precipitate (s) which are present in:

(A)

(B)

(C)

(D)

(E,F)

(G)

Write the equations of the reactions involved in

- The precipitation of (A), (E) and (F)
- The indentification of (G)

V. (12%) Draw a flow sheet that describes the separation and identification of the following ions when present in a mixture:

Al^{3+}, Pb^{2+}, Na^{+}, Fe^{3+}