

Name: _____

Introduction to Analytical Chemistry
Chem. 210 Sections 001 and 002
Exam III

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Spring 2005

Answer all the questions. **DO NOT** write on this examination paper, use the blank sheets at the end of the exam for your answers. Credit will **NOT** be given for numerical questions unless all relevant calculations are shown. Please give answers to numerical questions to **3** significant figures unless otherwise asked.

1. a) Lead (II) iodide is a sparingly soluble material. Calculate the equilibrium concentration of Lead (II) ions and iodide ions at equilibrium in an aqueous solution.

10 points

b) A solution is prepared such that it is 0.01M in iron (II) sulfate and 0.015M in sodium sulfate. Calculate the ionic strength of the solution.

10 points

c) Calculate the K^{1sp} (concentration based solubility product) of silver carbonate in a 0.01M solution of magnesium nitrate.

10 points

2. a) Arrange the following acids in order of increasing acidic strength.

Nitric acid
Formic acid
Chloroacetic acid
Hypochlorous acid

5 points

b) In the following reaction indicate which species is acting as a:

- i) Brønsted Lowry Acid
- ii) Brønsted Lowry Base
- iii) Conjugate Acid
- iv) Conjugate Base



5 points

c) At 50°C K_w for water is 5.47×10^{-14} . Calculate the pH of a neutral solution at 50°C.

5 points

d) Calculate the pH and pOH of a 10M solution of perchloric acid.

5 points

e) Calculate the pH and pOH of a 1.0×10^{-9} M solution of nitric acid.

10 points

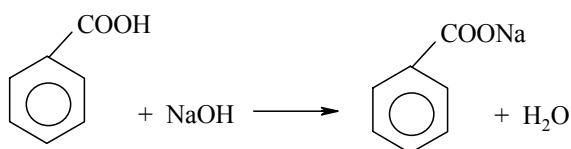
3. a) 25.00 mLs of hydrochloric acid is titrated with 30.15mLs of 0.1076M potassium hydroxide. Calculate the molarity of the hydrochloric acid.

5 points

b) 25.00mLs of 0.1250M nitric acid is titrated with 0.0750M sodium hydroxide. Calculate the pH and pOH of the solution after the addition of 12.00mLs of sodium hydroxide.

10 points

c) 0.1034g of benzoic acid are titrated to an end point with 35.71mLs of sodium hydroxide. Calculate the molarity of the sodium hydroxide.



5 points

4. a) What are the requirements needed for a material to be a primary standard?

10 points

b) Define or explain the following:

- i) Equivalence point
- ii) Differentiating solvent
- iii) Standard solution
- iv) Activity
- v) p factor

10 points

ANSWERS

1. a) $[Pb^{2+}] = 1.21 \times 10^{-3} M$
 $[I^-] = 2.42 \times 10^{-3} M$

b) $\mu = 0.0850$

c) $\mu = 0.0300$

$K_{sp}^1 = 2.75 \times 10^{-11}$

2. a) Nitric Acid – Strong Acid

Formic Acid $K_a = 1.77 \times 10^{-4}$

Chloroacetic Acid $K_a = 1.36 \times 10^{-3}$

Hydrochlorous Acid $K_a = 3.0 \times 10^{-8}$

Hydrochlous Acid, Formic Acid, Chloroacetic Acid, Nitric Acid
Increasing acidic strength \rightarrow

b) i) H_2O

ii) $(CH_3)_3 NH$

iii) $(CH_3)_3 NH^+$

iv) OH^-

c) $pH = 6.63$ is a neutral solution at $50^\circ C$.

d) $pH = -1.00$
 $pOH = 15.0$

e) $pH = 6.99$
 $pOH = 7.01$

3. a) $0.130 M$

b) $pH = 1.22$
 $pOH = 12.8$

c) $0.0237 M$

4. a)

- i) Must be at least 99.9% pure
- ii) Must be available at a reasonable cost
- iii) Must be able to write a balanced chemical reaction
- iv) Must be stable in air
- v) Must have a reasonably high molecular weight

b)

- i) This is the point in a titration where an exact stoichiometric amount of titrant has been added to the analyte to react completely with the analyte.
- ii) This is a solvent in which the relative acid and base strengths of acids and bases can be determined.
- iii) This is a solution whose molarity is very well known.
- iv) This is a measure of the 'effective' or thermodynamic concentrations of an ion in solution.