

UNIVERSITY OF JORDAN
HEM. 0303211
Four Exam II

DEPARTMENT OF CHEMISTRY
ANALYTICAL CHEMISTRY
Second Semester

December 14, 2015

STUDENT'S NAME:
Instructor's Name:
Lecture times:
Seat No.:
Registration no.: 0127870

Answer Sheet

1	a	<u>b</u>	c	d	E
2	a	<u>b</u>	c	d	E
3	a	b	<u>c</u>	d	E
4	<u>a</u>	b	c	d	E
5	<u>a</u>	b	c	d	E
6	a	<u>b</u>	c	d	E
7	a	<u>b</u>	c	d	E
8	a	<u>b</u>	c	d	E
	a	b	c	d	<u>E</u>

10	a	b	c	d	<u>e</u>
11	a	b	c	d	<u>e</u>
12	<u>a</u>	b	c	d	e
13	a	b	<u>c</u>	d	e
14	a	b	c	d	<u>e</u>
15	a	b	c	<u>d</u>	e
16	a	b	<u>c</u>	d	e
17	a	b	c	<u>d</u>	e
18	a	<u>b</u>	c	d	E

1. Calculate the pH in a solution that is 0.050 M NaOH

- a) 13.11
- b) 12.70
- c) 11.36
- d) 10.63
- e) 11.59

2. Calculate the pH for a 0.40 M NaNO_2 solution. For HNO_2 , $K_a = 4.5 \times 10^{-4}$

- a) 10.25
- b) 8.47
- c) 5.52
- d) 6.24
- e) 9.74

3. Calculate the solubility of SrSO_4 ($K_{sp} = 3.2 \times 10^{-7}$) in a solution that contains 0.100 M $\text{Sr}(\text{NO}_3)_2$

- a) 1.0×10^{-7}
- b) 6.4×10^{-7}
- c) 3.2×10^{-6}
- d) 1.2×10^{-8}
- e) 8.0×10^{-7}

4. One of the following pairs of substances can be used as a buffer

- a) $\text{NH}_3/\text{NH}_4^+$
- b) $\text{HCl}/\text{CH}_3\text{COOH}$
- c) HCl/NH_3
- d) $\text{NH}_3/\text{H}_2\text{SO}_4$
- e) None of the above

5. In an aqueous solution of acetic acid, CH_3COOH , the solution contains CH_3COOH and CH_3COO^- . The ratio of $[\text{CH}_3\text{COO}^-]/[\text{CH}_3\text{COOH}]$

- a) Increases with pH of the solution up to pH 7 but decreases with increasing pH between pH 7 and pH 14.
- b) Increases with pH of the solution
- c) Decreases with pH of the solution
- d) Independent of the pH of the solution
- e) None of the above

Calculate the pH for a solution that contains 0.0200 M NaOCl and 0.0200 M HOCl . K_a for $\text{HOCl} = 3.0 \times 10^{-8}$

- a) 5.66
- b) 7.52
- c) 8.91
- d) 9.91
- e) 10.91

$$\text{pH} = \text{p}K_a + \log \frac{[\text{A}^-]}{[\text{HA}]}$$

$$= 7.52$$

7. Calculate the value of the ionic strength in a 0.10 M NaCl + 0.10 M MgSO_4 solution.

- a) 0.1
- b) 0.5
- c) 0.4
- d) 0.3
- e) 0.2

$$I = \frac{1}{2} \left((0.1)^2 + (0.1)^2 \right) = \frac{1}{2} (0.1 + 0.1) = 0.1$$

8. The activity coefficient of one of the following species is equal to 1.00 regardless of the ionic species

- a) $\text{Fe}(\text{CN})_6^{4-}$
- b) CH_3COOH
- c) Cl^-
- d) SO_4^{2-}
- e) Br^-

9. Calculate the activity of Ag^+ in a 0.100 M AgNO_3 solution. The activity coefficient of Ag^+ at the ionic strength of the solution is 0.95.

- a) 0.0095
- b) 0.100
- c) 0.950
- d) 0.0100
- e) 0.095

$$a = \gamma \cdot c = 0.95 \cdot 0.1 = 0.095$$

10. Given the ACTIVITY COEFFICIENTS for ions at 25 °C

ION	Activity coefficient at Indicated Ionic Strength				
	0.001	0.005	0.01	0.05	0.1
Ag^+	0.965	0.925	0.897	0.8	0.75
CN^-	0.965	0.926	0.900	0.81	0.76

Use activities to calculate the solubility of AgSCN in 0.0333 M solution of $\text{Mg}(\text{ClO}_4)_2$. For AgSCN , the thermodynamic $K_{sp} = 1.1 \times 10^{-12}$.

- a) 1.1×10^{-12} M
- b) 4.6×10^{-5} M
- c) 2.5×10^{-7} M
- d) 6.9×10^{-6} M
- e) 1.4×10^{-6} M

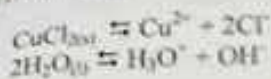
$$K_{sp} = [\text{Ag}^+][\text{SCN}^-] = 1.1 \times 10^{-12}$$

$$1.1 \times 10^{-12} = (s)(s) = s^2$$

$$s = \sqrt{1.1 \times 10^{-12}} = 1.05 \times 10^{-6}$$

$$I = \frac{1}{2} (2^2(0.0333)^2 + 1^2(0.0333)^2) = 0.00833$$

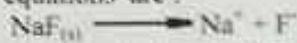
11. In an aqueous solution saturated with CuCl_2 , the relevant equilibria are



The charge balance equation is

- a) Indeterminate
- b) $[\text{H}_3\text{O}^+] + [\text{Cu}^{2+}] = [\text{Cl}^-] + [\text{OH}^-]$
- c) $[\text{Cu}^{2+}] = 2[\text{Cl}^-]$
- d) $[\text{H}_3\text{O}^+] + [\text{Cu}^{2+}] = 2[\text{Cl}^-] + [\text{OH}^-]$
- e) $[\text{H}_3\text{O}^+] - 2[\text{Cu}^{2+}] = [\text{Cl}^-] + [\text{OH}^-]$

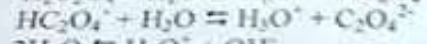
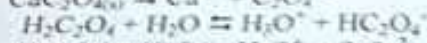
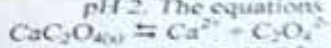
12. In an acidic aqueous solution saturated with $\text{NaF}_{(s)}$, the relevant equations are:



One of the following mass-balance equations is correct:

- a) $[\text{Na}^+] = [\text{F}^-] + [\text{HF}]$
- b) $[\text{H}_3\text{O}^+] = [\text{F}^-]$
- c) $[\text{H}_3\text{O}^+] = [\text{F}^-] + [\text{HF}]$
- d) $[\text{F}^-] = [\text{Na}^+]$
- e) $[\text{Na}^+] = [\text{F}^-] - [\text{HF}]$

13. Use the systematic approach for solving multiequilibrium problems to calculate the solubility of Calcium oxalate, CaC_2O_4 , in a solution that has been buffered at pH 2. The equations for the relevant equilibria are given below



- a) 8.8×10^{-6}
- b) 7.0×10^{-5}
- c) 6.2×10^{-4}
- d) 4.9×10^{-3}
- e) 1.8×10^{-2}

$$K_{sp} = 1.7 \times 10^{-9}$$

$$K_1 = 5.60 \times 10^{-2}$$

$$K_2 = 5.42 \times 10^{-5}$$

$$K_w = 1.0 \times 10^{-14}$$

$$\text{Step 1: } [\text{H}_3\text{O}^+] = 10^{-2} \text{ M}$$

$$K_1 = \frac{[\text{H}_3\text{O}^+][\text{HC}_2\text{O}_4^-]}{[\text{H}_2\text{C}_2\text{O}_4]} = 5.60 \times 10^{-2}$$

$$K_2 = \frac{[\text{H}_3\text{O}^+][\text{C}_2\text{O}_4^{2-}]}{[\text{HC}_2\text{O}_4^-]} = 5.42 \times 10^{-5}$$

$$K_w = 1.0 \times 10^{-14} = [\text{H}_3\text{O}^+][\text{OH}^-]$$

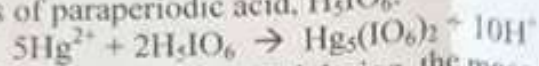
4. Precipitation from a homogeneous solution means:

- a) Addition of the precipitating reagent by automatic syringe instead of a burette or pipette.
- b) Generation of the precipitating reagent in the solution by a slow chemical reaction
- c) Addition of the precipitating reagent with vigorous stirring to the analyte solution
- d) Addition of the precipitating reagent very slowly to the analyte solution.
- e) Addition of the precipitating reagent homogeneously mixed with some other inert substances

15. The choice of the maximum temperature for drying and ignition of a precipitate in gravimetric analysis is based on:

- a) The temperature necessary to remove hydrate water
- b) The temperature necessary to convert the precipitate to the pure element
- c) The temperature necessary to remove moisture
- d) The temperature necessary to reach the constant weighing form
- e) None of the above

16. The mercury in a 0.7152 g sample was precipitated with an excess of paraperiodic acid, H_5IO_6 :



After filtration, washing and drying, the mass of the precipitate, $\text{Hg}_5(\text{IO}_6)_2$ (molar mass = 1448.8 g/mole) was 0.3408 g. Calculate the percentage of Hg_2Cl_2 (molar mass = 472.1 g/mole) in the sample.

$m_{\text{Hg}} = 0.7152$

$\text{Hg}_5(\text{IO}_6)_2$
 Hg_2Cl_2

- a) 47.22%
- b) 38.82%
- c) 56.34%
- d) 8.96%
- e) 25.67%

17. An aqueous solution contains NaNO_3 and KSCN . The thiocyanate ion can be precipitated as AgSCN by addition of AgNO_3 . After an excess of the AgNO_3 has been added, the major ion that makes up the counter-ion layer is

- a) SCN^-
- b) H^+
- c) Ag^+
- d) NO_3^-
- e) K^+

18. One of the following would increase the particle size of a crystalline precipitate:

$\frac{A-Q}{S}$

- a) Fast addition of the reactants
- b) Addition of the reagent at high temperature
- c) Increasing the concentration of the reagent.
- d) Increasing the concentration of the analyte
- e) None of the above

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