Dr. Zellmer | Chemistry 1220 | All Sections
Time: 7 PM Sun. | Spring Semester 2023 | March 26, 2023
40 min | Quiz VIII

Name _____ Rec. TA/time _____

Show **ALL** your work or **EXPLAIN** to receive full credit. R = 0.08206 L•atm/mol•K = 8.314 J/mol•K

1. A 25.0 mL of 0.020 M HCl is titrated with 0.010 M NaOH. What is the pH of the solution when 25.0 mL of NaOH has been added?

2. A 25.00 mL sample of 0.100 M HCl is titrated with 0.100 M NaOH. What is the **pH** of the solution at the points where 24.9 and 25.1 mL of NaOH have been added.

NOT on quiz, just for practice.

3. You have a solution of KOH of unknown concentration. A 15.00 mL sample of the KOH solution was titrated with 0.1050 M HNO_3. It took 21.35 mL of HNO_3 to reach the equivalence point. What was the concentration of the original KOH solution?

4. A 1.40 g sample of Vitamin C is dissolved in 100.0 mL of water and titrated with 0.250 M NaOH to the methyl orange equivalence point. The volume of the base used is 34.1 mL. What is the **molecular weight** of Vitamin C assuming one dissociable proton per molecule?

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5. (12 pts) Answer the following questions for the titration of 40.0 mL of 0.100 M HCN with 0.0400 M NaOH. (HCN: $K_a = 4.9 \times 10^{-10}$) (**Show all work or explain**, including ICE tables, assumptions & check for % error when necessary.)

a) (2 pts) How many mL of NaOH are required to reach the **equivalence point**?

b) (2 pts) What is the pH when 50.0 mL of NaOH has been added to the HCN solution?

c) (4 pts) What is the **pH** at the **equivalence point**?

d) (4 pts) What is the **pH** at the point where 25.0 mL of NaOH has been added?

6. (8 pts) 15.0 mL of 0.100 M CH_3NH_2 is titrated with 0.035 M HCl. ($K_b = 4.4 \times 10^{-4}$)
Show work or explain!

a) (2 pts) How many mL of HCl are required to reach the **equivalence point**?

b) (2 pts) Sketch the titration curve and clearly mark the **pH** at the **equivalence point**. (less than 7, equal to 7 or greater than 7).

c) (4 pts) What is the **pH** at the **equivalence point**?

7. Which of the following equations is the "Bruce" equation as named during lecture?

a) $M_aV_a = M_bV_b$
b) $M_1V_1 = M_2V_2$
c) $M_1V_2 = M_2V_1$
d) $M_aV_b = M_bV_a$

8. (3 pts) You have a saturated solution of $Mg_3(PO_4)_2$. It follows that

a) $[Mg^{2+}] < [PO_4^{3-}]$
b) $[Mg^{2+}] = (K_{sp})^{1/5}$
c) $[Mg^{2+}] = 3/2\ (K_{sp})^{1/5}$
d) $[Mg^{2+}] = 3\ (K_{sp}/108)^{1/5}$
e) $[Mg^{2+}] = 2/3\ [PO_4^{3-}]$

9. (3 pts) Which compound is more soluble in water, $Mn(OH)_2$ ($K_{sp} = 1.6 \times 10^{-13}$) or $SrCO_3$ ($K_{sp} = 9.3 \times 10^{-10}$)? **Show all work and explain!**

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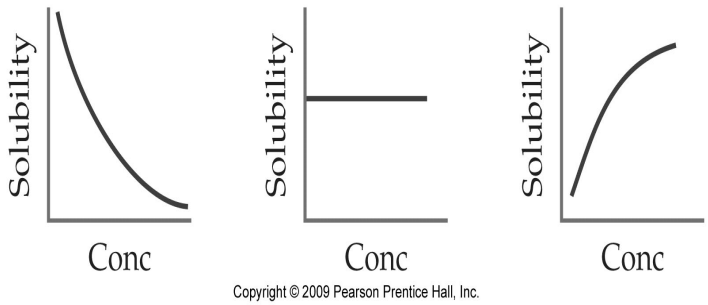
10. (3 pts) Which of the following salts will be substantially more soluble in acidic solution than in pure water?

1) $Ca_3(PO_4)_2$ 2) AgCl 3) CuBr 4) $BaSO_4$ 5) PbF_2

11. (3 pts) Solutions of strontium carbonate, $SrCO_3$, were prepared. The graphs below represent the effects on the solubility of strontium carbonate in the presence of various additives: hydrochloric acid, strontium nitrate and potassium chloride (conc. of additive on x-axis). Match the additives to the graphs to account for the solubility behavior: K_{sp} for $SrCO_3$ is 9.3×10^{-10}.



a) hydrochloric acid	strontium nitrate	potassium chloride
b) potassium chloride	hydrochloric acid	strontium nitrate
c) hydrochloric acid	potassium chloride	strontium nitrate
d) strontium nitrate	hydrochloric acid	potassium chloride
e) strontium nitrate	potassium chloride	hydrochloric acid

12. (15 pts) For CaF_2, $K_{sp} = 3.9 \times 10^{-11}$ and for HF, $K_a = 6.8 \times 10^{-4}$. (Show ICE or stoichiometry tables, state any assumptions made and check the percent error.)

a) (3 pts) Calculate the molar solubility of CaF_2 in pure water.

b) (5 pts) Calculate the molar solubility of CaF_2 in the presence of 0.010 M NaF.

c) (7 pts) Calculate the molar solubility of CaF_2 in the presence of 2.0 M HCl.

13. (6 pts) Calculate the concentration of free Cd^{2+} ions in a solution made by adding 0.010 moles of $Cd(NO_3)_2$ to 1.0 L of a 2.0 M NaBr solution. $K_f = 5 \times 10^3$ for $CdBr_4^{2-}$
(Show ICE or stoichiometry tables, state any assumptions made and check the percent error.)

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14. (6 pts) Calculate the molar solubility of $Al(OH)_3$ in 3.0 M NaOH. **Show ALL work & explain!**
$K_{sp}\,(Al(OH)_3) = 4.6 \times 10^{-33}$ $K_f\,(Al(OH)_4^-) = 1.1 \times 10^{33}$

15. (5 pts) The K_f for the complex ion $Ag(S_2O_3)_2^{3-}$ is 2.9×10^{13}. The K_{sp} for AgI is 8.5×10^{-17}. What is the molar solubility of AgI in a solution that is made by adding $Na_2S_2O_3$ to make the solution 2.0 M in $Na_2S_2O_3$?
(Show ICE or stoichiometry tables, state any assumptions made and check the percent error.)

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USEFUL INFORMATION

R = 0.08206 L-atm/mol-K = 8.3145 J/mol-K

	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIIIB			IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1.008 **H** 1																	4.003 **He** 2
2	6.941 **Li** 3	9.012 **Be** 4											10.811 **B** 5	12.011 **C** 6	14.007 **N** 7	15.999 **O** 8	18.998 **F** 9	20.179 **Ne** 10
3	22.990 **Na** 11	24.305 **Mg** 12											26.98 **Al** 13	28.09 **Si** 14	30.974 **P** 15	32.06 **S** 16	35.453 **Cl** 17	39.948 **Ar** 18
4	39.098 **K** 19	40.08 **Ca** 20	44.96 **Sc** 21	47.88 **Ti** 22	50.94 **V** 23	52.00 **Cr** 24	54.94 **Mn** 25	55.85 **Fe** 26	58.93 **Co** 27	58.69 **Ni** 28	63.546 **Cu** 29	65.38 **Zn** 30	69.72 **Ga** 31	72.59 **Ge** 32	74.92 **As** 33	78.96 **Se** 34	79.904 **Br** 35	83.80 **Kr** 36
5	85.47 **Rb** 37	87.62 **Sr** 38	88.91 **Y** 39	91.22 **Zr** 40	92.91 **Nb** 41	95.94 **Mo** 42	98 **Tc** 43	101.07 **Ru** 44	102.91 **Rh** 45	106.42 **Pd** 46	107.87 **Ag** 47	112.41 **Cd** 48	114.82 **In** 49	118.69 **Sn** 50	121.75 **Sb** 51	127.60 **Te** 52	126.90 **I** 53	131.39 **Xe** 54
6	132.91 **Cs** 55	137.33 **Ba** 56	138.91 **La** 57	178.39 **Hf** 72	180.95 **Ta** 73	183.85 **W** 74	186.21 **Re** 75	190.23 **Os** 76	192.22 **Ir** 77	195.08 **Pt** 78	196.97 **Au** 79	200.59 **Hg** 80	204.38 **Tl** 81	207.2 **Pb** 82	208.98 **Bi** 83	209 **Po** 84	210 **At** 85	222 **Rn** 86
7	223 **Fr** 87	226.03 **Ra** 88	227.03 **Ac** 89	261 **Rf** 104	262 **Ha** 105	263 **Sg** 106	262 **Ns** 107	265 **Hs** 108	266 **Mt** 109	269 110	272 111	277 112						

Lanthanide Series	140.12 **Ce** 58	140.91 **Pr** 59	144.24 **Nd** 60	145 **Pm** 61	150.36 **Sm** 62	151.96 **Eu** 63	157.25 **Gd** 64	158.93 **Tb** 65	162.50 **Dy** 66	164.93 **Ho** 67	167.26 **Er** 68	168.93 **Tm** 69	173.04 **Yb** 70	173.04 **Lu** 71
Actinide Series	232.04 **Th** 90	231.04 **Pa** 91	238.03 **U** 92	237.05 **Np** 93	**Pu** 94	**Am** 95	**Cm** 96	**Bk** 97	**Cf** 98	**Es** 99	**Fm** 100	**Md** 101	**No** 102	**Lr** 103

A PERIODIC CHART OF THE ELEMENTS
(Based on ^{12}C)