

INFORMATION, SCRAP, AND COVER PAGE

This page contains information which may or may not be needed. This page can also be used for scrap paper or for cover paper. THIS PAGE WILL NOT BE COLLECTED. TEAR THIS PAGE OFF THE EXAM. DO NOT TURN IN THIS PAGE.

$$R = 0.08206 \text{ atm}\cdot\text{L}/(\text{mol}\cdot\text{K}) = 8.314 \text{ J}/(\text{mol}\cdot\text{K}) \text{ or J/K}$$

$$T(\text{K}) = T(^{\circ}\text{C}) + 273$$

Free energy $\Delta G^{\circ} = -RT \ln K$

Free Energies of Formation (in kJ or kJ/mol)

$$\text{F}^{-}(\text{aq}) -278.79$$

$$\text{Mg}^{2+}(\text{aq}) -454.8$$

$$\text{MgF}_2(\text{s}) -1,071.1$$

Quadratic Equation
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Henderson-Hasselbalch
$$\text{pH} = \text{p}K_a + \log \frac{\text{base}}{\text{acid}}$$

K_a Values	$\text{CH}_3\text{CO}_2\text{H}$	1.8×10^{-5}	
	CO_2	(1) 4.5×10^{-7}	(2) 4.7×10^{-11}
	HClO_2	1.1×10^{-2}	
	SO_2	(1) 1.4×10^{-2}	(2) 6.7×10^{-8}
	H_2SO_4	(2) 1.0×10^{-2}	

K_b Values	NH_3	1.8×10^{-5}
	HONH_2	9.1×10^{-9}
	CH_3NH_2	4.4×10^{-4}

K_{sp} Value	PbSO_4	2.5×10^{-8}
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PRINT NAME _____

SIGN NAME _____

CIRCLE your recitation section in the list below.

A: M 9:00 HM 210

B: M 10:00 DA 208B

C: T 11:00 NS 317

D: W 8:00 LF 130

E: W 12:00 SK 209

F: Th 4:00 HM 108

SCORED GRADE: _____

All answers should be with the correct significant figures.

The Periodic Table and the Information Page will not be collected. They can be used as scratch paper or as cover paper. Do not turn them in.

Be certain your answers are clear. If an answer is not clear, it can be considered wrong.

Problems marked with ** in the margin are derived from the assigned homework. These total 36 points.

Place your name in the space provided at the top of each question page. This helps to identify the pages if they are accidentally separated during grading and processing.

Work promptly. Use your time effectively.

last name: _____

****KEEP YOUR WORK AND ANSWERS COVERED.****

1. (30 pts) Indicate whether each statement is true (T) or false (F). Be certain T or F is clearly indicated.

- _____ Barium hydroxide is a strong base.
- _____ Autoionization of water is opposed by entropy.
- _____ A solution of pH 6 is more acidic than a solution of pOH 10.
- _____ Hydrogen iodide can deprotonate water.
- _____ Water is the conjugate acid of hydroxide.
- _____ For a solution of a monoprotic weak acid, dilution results in a smaller percent dissociation.
- _____ $\text{Fe}^{3+}(\text{aq})$ is a weaker acid than $\text{Fe}^{2+}(\text{aq})$.
- _____ Sodium bicarbonate and sodium carbonate are suitable for use in a buffer at pH 6.00.
- _____ Calcium carbonate has stronger ion pairing than potassium nitrate.
- _____ Silver oxalate will be more soluble at pH 9 than at pH 5.

2. (7 pts) 0.0228 mol of hydroxylamine, HONH_2 , is dissolved to make 250. mL of solution. Circle the pH of the solution.

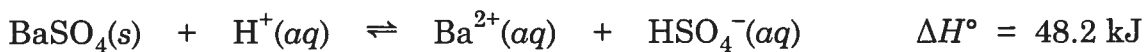
8.72	8.95	9.11	9.46	9.63	9.87
10.21	10.43	10.76	10.90	11.28	11.59

Circle the percent dissociation of the base.

0.0098	0.014%	0.032%	0.047%	0.081%	0.18%
0.30%	0.63%	0.87%	2.1%	3.4%	4.3%

last name: _____

- ** 3. (9 pts) Consider the following system at equilibrium.



Will the following actions favor a shift to the right side (R), to the left side (L), or have no such effect (N)?

Decrease temperature. _____

Increase the amount of water solvent. _____

Add more $\text{BaSO}_4(s)$. _____

4. (6 pts) Circle the pH for a solution which is prepared by dissolving 0.00632 mol ammonium bromide in a solution volume of 750. mL.

3.16	3.42	3.70	3.92	4.07	4.12
4.56	4.70	5.06	5.33	5.54	5.66

- ** 5. (6 pts) An excess of $\text{PbSO}_4(s)$ is added to a solution of 0.000343 M K_2SO_4 . Circle the concentration (in M) of $\text{Pb}^{2+}(aq)$ at equilibrium.

5.6×10^{-6}	6.0×10^{-6}	7.3×10^{-6}	7.6×10^{-6}	8.8×10^{-6}	9.1×10^{-6}
1.6×10^{-5}	2.0×10^{-5}	4.3×10^{-5}	4.6×10^{-5}	6.2×10^{-5}	7.3×10^{-5}

6. (8 pts) Indicate whether separate solutions of each of the following are acidic (A), basic (B) or neutral (N).

$\text{Fe}(\text{NO}_3)_3$ _____ Cs_2SO_4 _____ NaHSO_3 _____ pyridinium bromide _____

- ** 7. (6 pts) Pure hydrogen chloride is a gas. Circle the volume (in L) of $\text{HCl}(g)$ at 541 Torr and 25 °C that is needed to prepare 14.0 L of aqueous solution with pH = 3.70.

0.043	0.046	0.051	0.055	0.060	0.068
0.073	0.079	0.084	0.088	0.091	0.096

last name: _____

8. (2 pts) Give the formula of one monoprotic, strong oxyacid. _____
(2 pts) Give the formula of the conjugate base of hydrogen phosphate. _____
(2 pts) Of CH_3CO_2^- , ClO_2^- and SO_3^{2-} , which ion is the weakest base? _____
(2 pts) What is the charge of the metal ion in PtCl_4^{2-} ? _____

- ** 9. (5 pts) Using free energies of formation, calculate ΔG° for the solubility product equation for magnesium fluoride and use this value to calculate K_{sp} at 25 °C. Circle this value of K_{sp} below.

4.3×10^{-8} 6.8×10^{-8} 1.9×10^{-9} 7.6×10^{-9} 8.8×10^{-10} 9.1×10^{-10}
 1.6×10^{-11} 5.1×10^{-11} 4.3×10^{-12} 4.6×10^{-12} 6.2×10^{-13} 7.3×10^{-13}

- ** 10. (4 pts) Write the balanced equation for complex formation for $\text{Cd}(\text{OH})_4^{2-}$. (Phases are not needed.)

- ** 11. (6 pts) Give the value of the indicated K for each of the following.

K_{b} of SO_4^{2-} _____ K_{a} of CH_3NH_3^+ _____

12. (5 pts) A solution is prepared from 0.0237 g acetic acid and 0.0213 g sodium acetate in a total volume of 100. mL. Circle the pH.

4.02 4.11 4.28 4.36 4.40 4.56
4.92 5.08 5.12 5.20 5.37 5.46