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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.

F A basic solution has pOH > 7.

T Hydrogen oxalate ion is amphoteric.

F Bicarbonate ion is the conjugate base of carbonate ion.

F Hypochlorous acid is polyprotic.

T HPO_4^{2-} has a higher pK_a than $H_2PO_4^-$.

F 0.010 M KOH has a lower pH than 0.01 M NH_3.

T The basicity of ammonia arises from a lone pair in an sp^3 hybrid orbital which can pull H^+ from an acid, at least to some extent.

F At standard conditions, dissociation of a weak acid is exergonic.

T Nitrite ion is basic.

F Lead(II) chloride has a significant base dissociation effect.

2. (6 pts) A solution contains 0.010 M Ag^+ and you want to recover the majority of the Ag^+ ion from this. The silver ion can be precipitated using Cl^- to form AgCl. Circle the concentration (in M) of Cl^- which must be present at equilibrium in order to have $[Ag^+] = 1.2\ \mu M$.

1.9×10^{-6}	3.5×10^{-6}	5.3×10^{-6}	7.1×10^{-6}	8.6×10^{-6}	2.1×10^{-5}
4.8×10^{-5}	6.4×10^{-5}	7.5×10^{-5}	9.0×10^{-5}	**1.5×10^{-4}**	3.7×10^{-4}

** 3. (6 pts) A solution contains 0.256 g perchloric acid in 800. mL of solution. Circle the pH.

1.06	1.32	1.60	2.31	**2.50**	2.78
3.26	3.40	3.61	4.12	4.38	4.53

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** 4. (8 pts) 0.0126 mol triethylamine, $(C_2H_5)_3N$, was dissolved into water to produce 300.0 mL of solution. Circle the concentration (in M) of $(C_2H_5)_3NH^+$ at equilibrium.

0.0032	0.0035	0.0038	0.0041	(0.0044)	0.0047
0.0050	0.0053	0.0056	0.0059	0.0062	0.0065

Circle the percent dissociation. Above answer must be correct for credit here.

2.7%	3.6%	4.8%	5.0%	6.3%	7.6%
8.3%	9.0%	(10.%)	12%	13%	14%

5. (5 pts) Consider the metal complex formed by a cobalt(II) cation, four ammonia ligands, and two fluoride ligands.

What is the charge of the complex? 0

What is the shape of the complex? octahedral

** 6. (6 pts) Of the following acids, CIRCLE the one which is the strongest. UNDERLINE the one which is the weakest.

HIO	$HBrO_3$	$HBrO_2$	($HClO_3$)	$HClO_2$	HClO

7. (5 pts) 0.00200 mol of the weak base imidazole, $C_3H_4N_2$, is dissolved in 250. mL solution. The pH at equilibrium is measured to be 9.45. Circle the value of K_b.

3.2×10^{-9}	8.7×10^{-9}	4.9×10^{-8}	(9.8×10^{-8})	2.4×10^{-7}	7.1×10^{-7}
3.6×10^{-6}	8.3×10^{-6}	2.3×10^{-5}	6.4×10^{-5}	3.5×10^{-4}	7.9×10^{-4}

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** 8. (3 pts) Give the formula of the conjugate base of ammonium ion. NH_3

(3 pts) Give the formula of the product of the deprotonation of hydrofluoric acid. F^-

** 9. (8 pts) A buffer solution is prepared from 0.0608 mol CH_3CO_2H and 0.0163 mol $NaCH_3CO_2$ in 1.00 L total volume. Circle the initial pH.

3.82	3.98	(4.17)	4.36	4.52	4.66
4.81	5.02	5.13	5.31	5.53	5.60

Circle the pH after adding 1.6 mmol HNO_3. (Above answer must be correct for credit here.)

3.81	3.88	3.92	(4.11)	4.40	4.53
4.63	4.76	4.96	5.21	5.30	5.55

10. (8 pts) Indicate whether separate solutions of each of the following are acidic (A), basic (B) or neutral (N).

K_2HAsO_4 B piperidinium chloride A $Bi(ClO_4)_3$ A $Ba(CN)_2$ B

** 11. (6 pts) Derive the equation for solubility with complex formation for copper(I) chloride using cyanide as the ligand, to form the complex $Cu(CN)_4^{3-}$. Put only the final answer on the line below; only that will be graded. Phases are not needed.

$$CuCl + 4CN^- \rightleftharpoons Cu(CN)_4^{3-} + Cl^-$$

12. (6 pts) Circle the solubility (in M) of $Fe(OH)_2$ in a solution of KOH which is initially at pH 9.84.

4.9×10^{-9}	8.3×10^{-9}	(1.0×10^{-8})	3.1×10^{-8}	4.6×10^{-8}	7.3×10^{-8}
9.8×10^{-8}	1.4×10^{-7}	3.5×10^{-7}	4.1×10^{-7}	6.5×10^{-7}	7.8×10^{-7}