Updated July 6/06 **CHAPTER 5 ANSWERS**

NUMERICAL ANSWERS TO ASSIGNED TUTORIAL PROBLEM SETS FOR CHEM205
FROM KOTZ & TREICHEL'S CHEMISTRY & CHEMICAL REACTIVITY, **6th Ed.**

NOTE: none of the answers from Ch.5 have been verified

Ch.	Q#	Answer	Units	SFs	Comments
5	2				strong electrolytes: hydrochloric acid, nitric acid
5	2				weak electrolyte: acetic acid
5	2				strong electrolytes: sodium hydroxide, potassium hydroxide
5	2				weak electrolytes: ammonia, calcium hydroxide
5	8a				soluble: Ni^{2+} and Cl^- ions
5	8b				soluble: Cr^{2+} and NO_3^- ions
5	8c				soluble: Pb^{2+} and NO_3^- ions
5	8d				insoluble
5	10				$Ni(NO_3)_2(aq) + Na_2CO_3(aq) \text{-->} NiCO_3(s) + 2NaNO_3(aq)$
5	10				$Ni^{2+}(aq) + CO_3^{2-}(aq) \text{-->} NiCO_3(s)$
5	12a				$Pb(NO_3)_2(aq) + 2KBr(aq) \text{-->} PbBr_2(s) + 2KNO_3(aq)$
5	12b				$Ca(NO_3)_2(aq) + 2KF(aq) \text{-->} CaF_2(s) + 2KNO_3(aq)$
5	12c				$Ca(NO_3)_2(aq) + Na_2C_2O_4(aq) \text{-->} CaC_2O_4(aq) + 2NaNO_3(aq)$
5	16				$H_3PO_4(aq) \text{-->} H^+(aq) + H_2PO_4^-(aq)$
5	16				$H_2PO_4^-(aq) \text{-->} H^+(aq) + HPO_4^{2-}(aq)$
5	16				$HPO_4^{2-}(aq) \text{-->} H^+(aq) + PO_4^{2-}(aq)$
5	20a				$H_3PO_4(aq) + 3KOH(aq) \text{-->} K_3PO_4(aq) + 3H_2O(l)$
5	20a				phosphoric acid, potassium hydroxide, potassium phosphate, water
5	20b				$H_2C_2O_4(aq) + Ca(OH)_2(s) \text{-->} CaC_2O_4(s) + 2H_2O(l)$
5	20b				oxalic acid, calcium hydroxide, calcium oxalate, water
5	24a				$Zn(s) + 2HCl(aq) \text{-->} H_2(g) + ZnCl_2(aq)$
5	24a				$Zn(s) + 2H^+(aq) \text{-->} H_2(g) + Zn^{2+}(aq)$
5	24b				$Mg(OH)_2(s) + 2HCl(aq) \text{-->} MgCl_2(aq) + 2H_2O(l)$
5	24b				$Mg(OH)_2(s) + 2H^+(aq) \text{-->} Mg^{2+}(aq) + 2H_2O(l)$
5	24c				$2HNO_3(aq) + CaCO_3(s) \text{-->} Ca(NO_3)_2(aq) + H_2O(l) + CO_2(g)$
5	24c				$2H^+(aq) + CaCO_3(s) \text{-->} Ca^{2+}(aq) + H_2O(l) + CO_2(g)$
5	26a				$2NaOH(aq) + FeCl_2(aq) \text{-->} Fe(OH)_2(s) + 2NaCl(aq)$
5	26a				$2OH^-(aq) + Fe^{2+}(aq) \text{-->} Fe(OH)_2(s)$
5	26b				$BaCl_2(aq) + Na_2CO_3(aq) \text{-->} BaCO_3(s) + 2NaCl(aq)$
5	26b				$Ba^{2+}(aq) + CO_3^{2-}(aq) \text{-->} BaCO_3(s)$
5	28				Hint only: carbonate minerals react with acid to release CO_2…
5	30a				coefficients: 1,1,1,2; precipitation
5	30b				coefficients: 1,2,1,2; precipitation
5	30c				coefficients: 1,2,1,1,1; gas-forming
5	36a				P is +5 (V); F is -1 (-I)
5	36b				H is +1 (+I); As is +5 (+V); O is -2 (-II)
5	36c				U is +4 (+IV); O is -2 (-II)
5	36d				N is +5 (+V); O is -2 (-II)
5	36e				P is +5 (V); O is -2 (-II); Cl is -1 (-I)
5	36f				Xe is +6 (+VI); O is -2 (-II)

Ch.	Q#	Answer	Units	SFs	Comments
5	38a				precipitation
5	38b				redox: Ca from 0 to +2; O from 0 to -2
5	38c				redox: Fe from +2 to +3; O from 0 to -2
5	40a				$Cr_2O_7^{2-}$ is reduced (oxidizing agent); Sn^{2+} is oxidized (reducing agent)
5	40b				FeS is oxidized (reducing agent); NO_3^- is reduced (oxidizing agent)
5	42	0.0159	M	3	$K_2Cr_2O_7$ Thus, $[K^+]$=0.0318M; $[Cr_2O_7^{2-}]$=0.0159M
5	48a				0.12M Ba^{2+}; 0.24M Cl^-
5	48b				0.0125M Cu^{2+}; 0.0125M SO_4^{2-}
5	48c				1.000M K^+; 0.500M $Cr_2O_7^{2-}$
5	50	3.4	g	2	$H_2C_2O_4$
5	54a	0.150	M	3	$K_2Cr_2O_7$
5	54b	0.500	M	3	$K_2Cr_2O_7$ correct method
5	56	$3x10^{-11}$	M	1	H+ conc.; solution is acidic (pH < 7)
5	60a	9.17		2	(recall SF rule for logs...) pH > 7 therefore basic
5	60b	5.66		2	pH < 7 therefore acidic
5	60c	$5.6x10^{-6}$	M	2	pH < 7 therefore acidic
5	60d	1.60		2	pH < 7 therefore acidic
5	64	2.34	g	3	N_2H_4
5	66	10.2	g	3	mass $KAl(OH)_4$ because Al is limiting reagent (thus none remains)
5	70	42.5	mL	3	volume HCl(aq) required to reach equivalence point
5	74	0.0149	mol	3	NaOH required
5	74	0.00498	mol	3	if citric acid, this #mol leads to MM = 192 g/mol (correct for citric acid)
5	74	0.00746	mol	3	if tartaric acid, leads to MM=128 g/mol (incorrect, so not tartaric acid…)
5	78				many possibilities. *E.g.,* a = $NaCH_3CO_2$; b = NiS; c=NaOH, d = $PbCl_2$
5	84				Hint: oxidizing agents accept electrons in order to convert an atom with a reactive high oxidation state to a less reactive lower oxidation state… & reducing agents donate electrons in order to convert an atom with a reactive low oxidation state to a less reactive higher oxidation state.
5	88				only need 0.125 mol KCl for 250 mL solution of 0.500 M concentration… So: take ¼ of the KCl, add it to empty vol. flask, add some water (<<250 mL), swirl flask to dissolve KCl, then add water until bottom of meniscus sits at 250mL-calibration line on flask's neck. Cap flask, and mix thoroughly by carefully inverting flask several times.
5	92a				$(NH_4)_2S(aq) + Hg(NO_3)_2(aq)$ --> $HgS(s) + 2NH_4NO_3(aq)$
5	92b				ammonium sulfide, mercury(II) nitrate, mercury(II) sulfide, ammonium nitrate
5	92c				precipitation
5	96	0.219	g	3	mass of citric acid in soft drink
5	100a				coeff.s 1,2,2,1,1; gas-forming & acid-base rxn; net: leave out K^+ & ClO_4^-
5	100b				coeff.s 1,1,1,2; precipitation rxn; net: leave out Cl^-, NH_4^+ ions
5	100c				coeff.s 1,1,1,2; precipitation rxn; net: leavout NO_3^-, Na^+ ions
5	104				
5	106	0.00110	M	3	Na_2CO_3 conc. in diluted solution
5	110				Using stoichiometry, must have had 0.00932 mol $C_2O_4^{2-}$; use mol $C_2O_4^{2-}$ to determine which formula is correct. If $K[Fe(C_2O_4)_2(H_2O)_2$, then would have had 1.43g compound initially present; if $K_3[Fe(C_2O_4)_3]$, then would have had 1.36g compound….

Ch.	Q#	Answer	Units	SFs	Comments
5	112a				$(NH_4)_2PtCl_4(aq) + 2NH_3(aq) \rightarrow Pt(NH_3)_2Cl_2(aq) + 2NH_4Cl(aq)$
5	112b				Using stoichiometry…need 15.54 g $(NH_4)PtCl_4$; 0.667 L NH_3 solution.
5	112c				0.0176 mol C_5H_5N reacted in titration with HCl (= excess pyridine, unused by reaction with cisplatin). Using density, 0.0186 mol pyridine originally added. Difference = 0.0010 mol C_5H_5N (= amount reacted with cisplatin). Started with 5.00×10^{-4} mol cisplatin. Thus, reaction occurred in 2:1 ratio of pyridine to cisplatin, to yield $Pt(NH_3)_2Cl_2(C_5H_5N)_2$.
5	118				pptn rxn: $FeCl_3(aq) + 3NaOH(aq) \rightarrow Fe(OH)_3(s) + 3NaCl(aq)$
5	118a				Using stoichiometry: $FeCl_3$ is limiting $\rightarrow$ 0.625 g $Fe(OH)_3$ (s) expected.
5	118b				NaOH in excess; 0.0176mol reacted, so 0.0017mol remains in solution. After mixing, total volume ~0.0675L, so conc. = 0.025 M NaOH after rxn.
5	122				one possibility: $BaCO_3(s) + 2HCl(aq) \rightarrow BaCl_2(aq) + H_2O(l) + CO_2(g)$