Problem Set 2a Precipitation Titrations and Gravimetric Analysis

1] What is pAg when 25.00-mL of 1.00e-2 M $AgNO_3$ is added to 25.00-mL of 1.00e-2M NaCl? K_{sp} (AgCl) = 1.8e-10 [1]

2] A solution of 0.100 M XNO_3 is used to titrate a 100.00 mL solution of 0.100 M KCl. The K_{sp} of XCl is 1.8e-11

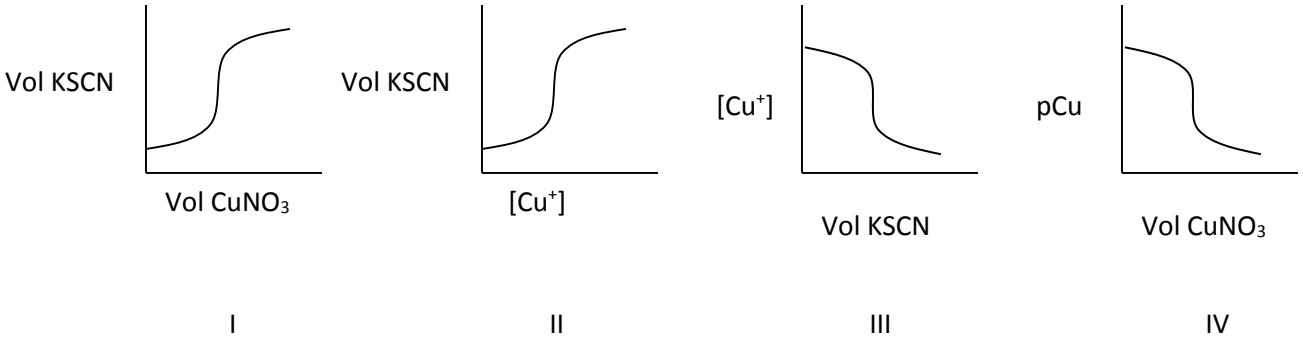
a) What is pX if 50.00 mL of the titrant is added to the KCl solution?

b) What is pX if 100.00 mL of the titrant is added?

c) What is pX if 150.00 mL of the titrant is added? [2]

3] A 0.9961 g silver ore sample was treated with HNO_3 and then with excess NaCl(aq). A precipitate was dried and weighed 0.0711 g. What is percent silver in the ore? AW: Ag 107.9, H 1.008, O 16.00, N 14.01, Cl 35.45 [3]

4] Which diagram best describes the curve for the titration of 50.0-mL of 0.100 M KSCN with 0.0500 M $CuNO_3$? The K_{sp} of CuSCN is 4.8e-15 [4]



5] A mixture of AgCl (MW 143.35, K_{sp}=1.8e-10) and AgBr (MW 187.9, K_{sp}=5.0e-13) weighs 2.000 g. This mixture is reduced to silver metal (AW 107.9), which weighs 1.300 g. Calculate the mass of AgCl in the original sample. [5]

6] What is the concentration Cl^- required to remove 99% of Ag^+ in a solution of 0.100 F $AgNO_3$? [6]

Answers

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[1] Rxn: $Ag^+ + Cl^- = AgCl(s)$ & mol Ag^+ added = mol Cl^- added

So $AgCl(s) = Ag^+ + Cl^-$

$+x \quad +x$

$Ksp = x^2 = 1.8e\text{-}10$ $x = 1.3e\text{-}5$ M pAg = 4.89

[2] Titration Rxn: $X^+ + Cl^- \rightleftarrows XCl(s)$

a) Moles of excess Cl^- = 0.10000 L * 0.100 M KCl – 0.05000 L * 0.100 M XNO_3 = 5.00e-3 mol Cl^-

$[Cl^-]$ = 5.00e-3 mol Cl^- / 0.1500 L = 3.33e-2

$XCl(s)$	$\rightleftarrows$	X^+	+	Cl^-
--		x		x+3.33e-2

$x(3.33e\text{-}2) \cong 1.8e\text{-}11$
$x = 5.4e\text{-}10$ M
pX = 9.27

b) This is the equivalence point.

$XCl(s)$	$\rightleftarrows$	X^+	+	Cl^-
--		x		x

$x^2 = 1.8e\text{-}11$ $x = 4.24e\text{-}6$ pX = 5.37

c) We are past the equivalence point.

(150.00 – 100.00) mL * 0.100 M Ag^+ (250.00 mL) = 0.0200 M X^+ or pX = 1.699

[3] 0.0711 g AgCl (mol AgCl / 143.32 g) (mol Ag / mol AgCl) (107.868 g / mol Ag) (100 / 0.9961g) = 5.37 %

[4] IV

[5] x g AgCl + y g AgBr = 2.000 g

x g AgCl*(mol AgCl/143.35 g)*(mol Ag/mol AgCl)*(107.9 g/mol) = 0.7527x g Ag

y g AgCl*(mol AgBr/187.9 g)*(mol Ag/mol AgBr)*(107.9 g/mol) = 0.5742y g Ag

0.7527x g Ag + 0.5742y g Ag = 1.300 g

y = 2.000 – x sub into above

0.7527x + 0.5742(2.000 – x) = 1.300 g

mass Ag = 0.849 g

[6] $[Ag^+]$ = (1-0.99) 0.100 F = 1.00e-3 M $K_{sp} = [Ag^+][Cl^-]$ = 1.8e-10 = 1.00e-3 M*$[Cl^-]$ ➔ $[Cl^-]$ = 1.80e-7 M