بسم الله الرحمن الرحيم

Analatical-qusoor questions-second exam

لجنة الصيدلة

راية للخير وفارس لن يترجل

1) write the charge and mass balance for asolution made by dissolving $MgBr_2$ to give

Mg^{+2} , Br^- , $MgBr^+$, $MgOH^+$

2) write the mass and charge Balance for:

$$Ag_2S \rightleftharpoons 2Ag^+ + S^{-2}$$

$$S^{-2} + H_2O \rightleftharpoons HS^- + OH^-$$

$$HS^- + H_2O \rightleftharpoons H_2S + OH^-$$

3) 50.00 ml solution containing NaBr (halide) was treated with excess $AgNO_3$ to precipitate 0.214 g of AgBr (m.wt 187.8)

what was the Molarity of NaBr in the solution. (0.02279 M)

$$NaBr + AgNO_3 \rightarrow AgBr$$

$$\text{Number of moles (AgBr)} = \frac{0.214\ g}{187.8} = 1.1395 \times 10^{-3}\ \text{moles} = NaBr$$

$$\text{Molarity (NaBr)} = \frac{\text{number of moles}}{\text{Volume (L)}} = \frac{1.1395 \times 10^{-3}}{50 \times 10^{-3}}$$

$$= 0.02279\ M$$

*4) 6.0 g mixture of $FeCl_3$ (f.wt = 126.85) and $AlCl_3$ (m.wt = 133.7) was analyzed gravimitically giving 2.64 g ppt of respective oxides Fe_2O_3 (159.7) and Al_2O_3 (102), calculate the percentage of Al (27 g/mol) and Fe (m.wt = 55.85) in original mixture

1) charge Balance:

$$MgBr_2 \longrightarrow Mg^{+2} + 2Br^-$$

+ تنسوا هذه المعادلة: $H_2O \rightleftharpoons H^+ + OH^-$

$$[H^+] + 2[Mg^{+2}] + [MgBr^+] + [MgOH^+] = [OH^-] + [Br^-]$$

mass Balance.

$$2[Mg^{+2}] = [Br^-]$$

$$2\left[[Mg^{+2}] + [MgBr^+] + [MgOH^+]\right] = [Br^-] + [MgBr^+]$$

2) charge Balance:

$$2[S^{-2}] + [OH^-] + [HS^-] = [Ag^+] + [H^+]$$

mass balance:

$$[Ag^+] = 2[S^{-2}]$$

$$[Ag^+] = 2\left[[S^{-2}] + [HS^-] + [H_2S]\right]$$

3) $AgNO_3 + NaBr \rightarrow \underline{\underline{AgBr_{(s)}}} + NaNO_3$

الراسب

0.214 g

# of mol of AgBr = $\frac{\text{mass}}{\text{m.wt}} = \frac{0.214}{187.8} = 1.14 * 10^{-3}$ mol

mol Br^- ($NaBr$) = mol AgBr.

$= 1.14 \times 10^{-3}$ mol

Molarity for NaBr = $\frac{\text{mol}}{\text{Volume (L)}}$

$= \frac{1.14 * 10^{-3}}{50 * 10^{-3}} = \underline{\underline{0.0228\ M}}$

4) $FeCl_3 = x$, $AlCl_3 = y$

$x + y = 6.0$ gram → #1 equation.

* mol $FeCl_3 = \frac{x}{126.85}$ = mol Fe^{+3}

* mol $AlCl_3 = \frac{y}{133.7}$ = mol Al^{+3}

$1 \rightarrow 2$

$? \rightarrow \frac{x}{126.85}$

* mol Fe_2O_3 = $\frac{2}{}$ mol Fe^{+3} = $3.94 * 10^{-3}\, x$

* mass Fe_2O_3 = $3.94 * 10^{-3} x * 159.7$ = $0.6295\, x$ gram

* mol Al_2O_3 = 2 mol Al^{+3} = $3.74 * 10^{-3}\, y$

* mass Al_2O_3 = $3.74 * 10^{-3} y * 102$ = $0.3815\, y$ gram

$Fe_2O_3 + Al_2O_3 = 2.64$.

$0.6295x + 0.3815y = 2.64$ gram → # 2 equation

عن طريقة الحل بالتعويض

$X = 6 - Y$

نعوّض قيمة x في "equation 2"

$$0.6295(6-Y) + 0.3815Y = 2.64$$

$$3.777 - 0.6295Y + 0.3815Y = 2.64$$

$$-0.248Y = -1.137$$

$$\boxed{Y = 4.585} \longrightarrow \boxed{X = 6 - 4.585 = 1.415}$$

So, mass Fe^{+3} = mol * m.wt.

$$= \frac{1.415}{126.85} * 55.85 = 0.623 \text{ gram}$$

$$\%Fe = \frac{0.623}{6} * 100\% = \boxed{10.4\%}$$

So, mass Al^{+3} = mol * m.wt

$$= \frac{4.585}{133.7} * 27 = 0.925 \text{ gram}$$

% Al = 0.925 / ... [illegible]

part 1

*) when acoagulated precipitate is dispersed during washing step, this process is known as:

a) digestion. b) reprecipitation.

c) peptization. d) filtration.

*) which of the following statement is incorrect:

a) supersaturation tends to decrease the particle size of ppt.

b) Coprecipitation is precipitation of impurities along with the desired product.

c) adsorption of ions by the precipitate is called peptization.

d) HNO_3 and NH4cl are volatile electrolytes.

*) the false statement in the following is:

a) Homogeneous ppt is better than normal ppt in gravimetry.

b) adsorption coprecipitation and post precipitation are example of ppt impurities.

c) digestion of ppt in hot solution promotes particle growth.

d) supersaturation in gravimetry improves crystal growth formation.
less super saturated

part 3

*) the volhard titration with Ag^+ ion is characterized by:

a) adsorption of colored indicator on the ppt at the end point.

b) formation of white AgSCN precipitate at the end point.

c) an accumulation of all ions as precipitate at the end point.

d) formation of soluble $feSCN^{+2}$ red color complex at end point.

part 1

*) which of the following is correct?

a) charge balance equation may contain charged and uncharged species.

b) mass balance equation may contain charged and uncharged species.

c) the sharpness of the end point in precipitation titration can be improved by using more dilute solutions of analyte and titrant.

part 1

* an occlusion is: occlusions

a) adsorped impurity b) colloid.

c) an impurity that is trapped by the growing crystal.

d) an impurity that takes the place of another atom in the crystal lattice. inclusions

*) which of the following factor usually increase↑ solubility:

a) presence of common ion.

b) presence of diverse ions.

c) decreasing atmospheric pressure.

d) using distilled water.

*) what is the wrong statement in the following:

a) gravimetry means precipitation of an analyte selectively as an insoluble weighed matter of known formula.

b) precipitating agent in gravimetry should be added slowly and in excess.

c) optimal conditions for precipitation requires dilute solution at high temperature.

d) solubility and solubility product are not related.

*) Relative supersaturation ratio increases if:

a) reagents added slowly with stiring.

b) employing dilute solution.

c) solubility of forming precipitate decrease.

d) precipitation from homogeneous solution is employed.

*) ignition is employed in gravimetric method to:

a) dry precipitate

b) Remove volatile molecules.

c) convert analyte to more stable form.

d) minimize occlusion.

*) peptization means:

a) Breakage of precipitate to colloidal solution.

b) trap of foreign ions in crystal of ppt.

c) some type of inclusion.

d) after peptization, filtration of ppt is easier.

"precipitation titration" volume Ag^+ at end point;

Q.2) Consider the titration **of 25.0 ml of 0.1 M I^- with 0.05 Ag^+ :** mol I^- = mol Ag^+

analyte titrant $\frac{25}{1000} * 0.1 = 0.05 * V$

a) Calculate **[Ag^+] after adding 10.0 ml Ag^+, given that $K_{sp\ (AgI)} = 8.3 \times 10^{-17}$**

b) What is the **volume of Ag^+** required to reach **equivalence point?** * Volume (Ag^+) = 50 ml

c) What **pAg** after adding ~~45~~ 55 ml Ag^+ **?**

Answer:

a) 10.0 ml means before end point (equivalent point)

I^- is "analyte" الي بضل عليها شغل

mols I^- added = $25 * 10^{-3} * 0.1 = 2.5 * 10^{-3}$ mol.

mols Ag^+ added = $0.05 * 10 * 10^{-3} = 5 * 10^{-4}$ mol

mols I^- reacted with mols Ag^+ = $5 * 10^{-4}$ mol

mols I^- unreacted = $(2.5 * 10^{-3}) - (5 * 10^{-4})$ $= 2 * 10^{-3}$ mol

$[Ag^+] = \frac{2 * 10^{-3} \text{ mol}}{(25+10) * 10^{-3}} = 0.057 \text{ M}$

b) is answered at the begening (volume Ag^+ = 50 ml)

c) 55 ml of Ag^+ → after equivalent point - (Ag^+ زيد بضل 5 ml عليها)

mols Ag^+ = $(5 * 10^{-3} * 0.05) = 2.5 * 10^{-4}$

$[Ag^+] = \frac{2.5 * 10^{-4}}{(55+25) * 10^{-3}} = 3.125 * 10^{-3}$ M

*Volhard titration : the mechanism that used in it is back titration.

Example: Suppose 50.0 ml of 0.1M Ag^+ is added to 25 ml sample containing Cl^-, excess Ag^+ required 30 ml SCN^- (0.1M) to reach end point.
what is the $[Cl^-]$ in the solution?

Answer:

$Ag^+_{excess} + Cl^- \longrightarrow AgCl + Ag^+_{excess}$ (باقي)

Ag^+ (باقي) $+ SCN^- \longrightarrow AgSCN$

mol Ag^+ added $= 50.0 * 10^{-3} * 0.1 = 0.005$ mol

mol SCN^- reacted $= 30 * 10^{-3} * 0.1 = 0.003$ mol

mol Ag^+ remaining $= 0.005 - 0.003 = 0.002$ mol

equal 0.002 mol Cl^-

$[Cl^-] = \frac{0.002}{25 * 10^{-3}} = 0.08$ M of Cl^-

*) 40.0 ml solution of NaI (f.wt = 150 g/mol) was treated with 50.0 ml of 0.2 M $AgNO_3$, after precipitation the supernatant was titrated in the presence of Fe^{+3} with 36.0 ml of 0.14 M KSCN, How many grams of I^- (A.wt = 127 g/mol) was in the original solution?

Answer = 0.63

$$NaI + AgNO_3 \rightarrow NaNO_3 + AgI$$

150 g/mol 0.2 M
40 ml 50 mL

$$AgI \rightarrow Ag^+ + I^-$$

$$Ag^+ \text{ (excess)} \rightarrow KSCN \rightarrow AgSCN$$

36 ml
0.14

Number of moles KSCN $= 36 \times 0.14 \times 10^{-3} = 5.04 \times 10^{-3}$ mol = moles of Ag^+ excess

Number of moles ($AgNO_3$) $= 0.2 \times 50 \times 10^{-3} = 0.01$ mol

moles of Ag^+ excess $= 0.01 - (5.04 \times 10^{-3}) = 4.96 \times 10^{-3}$ mol = moles of I^-

$I^- = 4.96 \times 10^{-3} \times 127 = 0.62992$ g

*) A solution of volume 25.00 ml containing 0.0155 M $Na_2C_2O_4$ was titrated with 0.0257 M $La(ClO_4)_3$ to precipitate lanthianium oxalate: $2La^{+3} + 3C_2O_4^{-2} \longrightarrow La_2(C_2O_4)_{3(s)}$

what volume of $La(ClO_4)_3$ is required to reach equivalent point?

Answer = **10.05 ml**

$$2La^{+3} + 3C_2O_4^{-2} \longrightarrow La_2(C_2O_4)_{3(s)}$$

0.0257 M 25 ml 0.0155 M

Number of moles $C_2O_4^{-2}$ $= 25 * 10^{-3} * 0.0155 = 3.875 \times 10^{-4}$ mol

$2 \longrightarrow 3$

$? \longrightarrow 3.875 \times 10^{-4}$

Number of moles $(La^{+3}) = 2.583 \times 10^{-4}$ mol.

Volume $= \frac{\text{N. moles}}{\text{Molarity}} = \frac{2.583 \times 10^{-4}}{0.0257} = 0.0100518\ L$

*1) of the following pairs, the Conjugate acid/base pair is:

a) H_3PO_4/HPO_4^{-2}.
b) H_2PO_4/HPO_4^{-2}.
c) H_3PO_4/OH^-.
d) $H_2C_2O_4/C_2O_4^{-2}$.

*2) what is the pH of solution Containing $5.0*10^{-8}$ mol NaOH per litre (Consider H^+ coming from water)

Answer:

$$NaOH \rightleftharpoons Na^+ + OH^-$$
$$5*10^{-8} \qquad 5*10^{-8}$$

$$H_2O \rightleftharpoons H^+ + OH^-$$
$$x \qquad (x + 5.0*10^{-8})$$

$$\rightarrow 10^{-14} = (x)(x + 5*10^{-8})$$

$$x^2 + 5*10^{-8}x - 10^{-14} = 2ero$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \rightarrow x = \frac{-5*10^{-8} \pm \sqrt{5*10^{-8} - 4*1*(1*10^{-14})}}{2*1}$$

$$x = 7.81*10^{-8} \longrightarrow \text{equal } (OH^-) \text{ from water} \longrightarrow$$

بشكل كلي $(OH^-) = (5*10^{-8}) + (7.81*10^{-8})$

$OH^- = 12.81*10^{-8}$

$pOH = -\log(12.81*10^{-8}) = 6.89$

$pH = 14 - 6.89 = \boxed{7.11}$

*3) what is the pH of 0.20 M CH_3COOH solution?

weak acid

$(Ka\ of\ CH_3COOH) = 1.80*10^{-5}$

$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

$0.2 - x \qquad x \qquad x$

ignore x

$0.2 >> 100*10^{-5}$.

$Ka = \frac{x^2}{0.2-x} \longrightarrow 1.8*10^{-5} = \frac{x^2}{0.2}$

$x = \sqrt{1.8*10^{-5}*0.2}$.

$1.897*10^{-3}$.

$pH = -\log(1.897*10^{-3})$

$= \boxed{2.72}$

*4) the pH for 10^{-8} M KOH is:

note that 10^{-8} is less than 10^{-6}

so, only take the (OH^-) that comes from water

$\boxed{pH = 7}$

أو أي رقم يكون أقرب شي

= 7 جاية

*5) the false statement of the following is?

a) the pH for 0.3 M $HClO_4$ is higher than that for 0.1 M HCOOH.

b) solution of pH = 2 and pOH = 12 have similar acidity

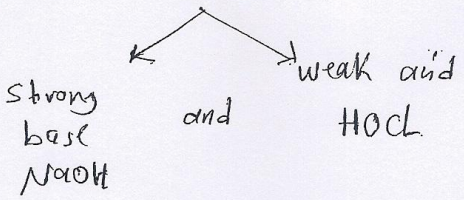
c) weak base provide weak Conjugate acid.

d) adding base to water cannot lower the pH.

water to base lower pH

*6) what is the pH of a solution containing 0.0100 M NaOCl? ($K_a = 3.00 * 10^{-8}$ for HOCl)

→ NaOCl → salt that comes from



so, the solution is Basic.

$$[OH^-] = \sqrt{K_b * C} = \sqrt{\frac{10^{-14}}{3*10^{-8}} * 0.01}$$

$$(OH^-) = 5.77 * 10^{-5}$$

$$pOH = -\log(5.77 * 10^{-5}) = 4.24$$

$$pH = 14 - 4.24$$

$$= 9.76$$

*7) the percentage dissociation of 0.1 M HA ($K_a = 10^{-4}$) is: ← weak

Ans: α or α → same as percentage dissociation

$$\alpha = \frac{[A^-]}{[HA]} * 100\%$$

$$\alpha = \frac{3.1*10^{-3}}{0.1} * 100\% = 3.16\%$$

$HA \rightleftharpoons H^+ + A^-$

$0.1-x \quad x \quad x$

$H^+ = \sqrt{Ka * C}$

$= \sqrt{0.1 * 10^{-4}} = 3.1*10^{-3} = A^-$

*8) 100.0 ml of 0.2 M HCl solution was added to 300.0 ml of 0.5 M HF solution ($K_a = 1.2*10^{-4}$)

what is the pH of final solution? بدي لحسبها 10^{-5} →

Ans # of mol of HCl = $0.2 * 0.1 = 0.02$ → new Concentration = $\frac{0.02}{(100+300)*10^{-3}}$ ← $= 0.05$

So $H^+ = 0.05$

# of mol of HF = $0.3 * 0.5 = 0.15$ → new Concentration = $\frac{0.15}{0.4} = 1.25$ ~~0.375~~

so $H^+ = \sqrt{1.2*10^{-4} * 0.375} = 0.0122$

so, total $H^+ = 0.05 + 0.0122 = 0.0622$

$pH = 1.21$

*9) to 100.0 ml of acetic /acetate buffer solution that is 1.0 M CH_3COOH and 0.50 M CH_3COO^-, 100 ml of the same buffer that is 0.50 M CH_3COOH and 0.5 M CH_3COO^- was added, what is the pH of the resulting buffer solution ($K_a(CH_3COOH) = 1.8 \times 10^{-5}$)

Answer:

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

0.1 M 0.50

then adding 0.5M 0.5M.

so, the total concentration for CH_3COOH = 1.5 M.

and for CH_3COO^- = 1M

$$pH = pKa + \log\left(\frac{CH_3COO^-}{CH_3COOH}\right)$$

$$pH = 4.57$$