

Øving 7 - Erlend Sørli

- 1) a) Vi titrerer en sterk base med en sterk syre, da vil $\text{pH} = 7$ ved ekvivalenspunktet, omslaget er plutselig. Forestår buffer med omslag i området 7: Fenolrødt

b) NH_3 er en svak base, titreret med en sterk syre vil all NH_3 ha protonisert til NH_4^+ ved start, da er $[\text{NH}_4^+]_0 = 0,2 \cdot 0,1 \text{ mol/l} = \frac{1}{15} \text{ M}$
Dilsert volum: 200 mL 0,3 L

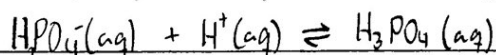
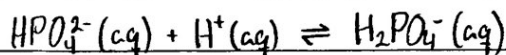
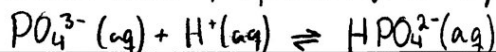
Ved MVL og PB:

$$10^{-9,24} = \frac{x^2}{\frac{1}{15} - x} \Rightarrow x = [\text{H}^+] = 6,20 \cdot 10^{-6} \Rightarrow \text{pH} = 5,2$$

Siden pH i ekvivalenspunktet, ønsker vi en indikator med omslag rundt $\text{pH} = 5,2$, men helst litt lavere ettersom vi har en buffer midlertidig.

Indikator: Bromkresolgrønn

- 2) Hvis Ag_3PO_4 løses fullstendig: $\text{Ag}_3\text{PO}_4(\text{cg}) \rightleftharpoons 3\text{Ag}^+(\text{aq}) + \text{PO}_4^{3-}(\text{aq})$
 PO_4^{3-} er korr. base i en flerprotsisk syre, som foreligger slik:

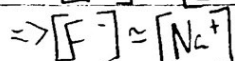
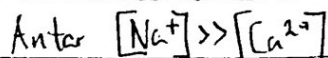
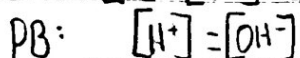
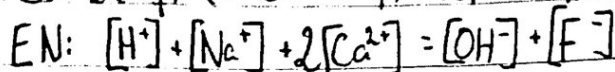
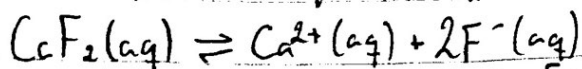
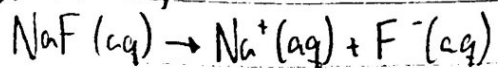


Vi ser at ved økende $[\text{H}^+]$ vil $[\text{PO}_4^{3-}]$ gå ned, og mer forventer at ved synkende pH løses mer av saltet

- 3) $1 \text{ ppm} = 10^{-6}$, $K_{\text{sp}}(\text{CaF}_2) = 3,2 \cdot 10^{-11} = [\text{Ca}^{2+}][\text{F}^-]^2 = x \cdot (2x)^2 = 4x^3$
 $\text{CaF}_2(\text{s}) \rightleftharpoons \text{Ca}^{2+}(\text{aq}) + 2\text{F}^-(\text{aq}) \Rightarrow x = \sqrt[3]{3,2 \cdot 10^{-11}/4} = 2 \cdot 10^{-4}$
 $\text{Ca}^{2+} \quad 2x \quad \text{F}^-: 2[\text{Ca}^{2+}] = 2 \cdot 2 \cdot 10^{-4} = 4 \cdot 10^{-4} \text{ mol/L}$
 $m(\text{F}^-) = (4 \cdot 10^{-4} \cdot 19) \text{ g/L} = 7,6 \cdot 10^{-3} \text{ g/L}$

tetthet vann: $1 \text{ g/cm}^3 = 1000 \text{ g/dm}^3 = 1000 \text{ g/L}$, $1 \text{ ppm} = 1000 \text{ g/L} \cdot 10^{-6} = 10^{-3} \text{ g/L}$
 $\Rightarrow 7,6 \cdot 10^{-3} > 10^{-3} \Rightarrow \text{det er nok (7,6 ppm} > 1 \text{ ppm)}$

4 a) $K_{sp}(\text{CaF}_2) = 3,2 \cdot 10^{-11} \text{ mol/L}$



$$K_{sp}(\text{CaF}_2) = 3,2 \cdot 10^{-11} \text{ mol/L} = [\text{Ca}^{2+}][\text{F}^-]^2 \approx [\text{Ca}^{2+}][\text{Na}^+]^2$$

$$\Rightarrow [\text{Ca}^{2+}] \approx \frac{K_{sp}}{[\text{Na}^+]^2} = \frac{K_{sp}}{(0,02)^2} = 8 \cdot 10^{-8} \text{ mol/L}$$

$$\text{Fra likevekten: } [\text{CaF}_2]_{\text{l\o st}} = [\text{Ca}^{2+}] = 8 \cdot 10^{-8} \text{ mol/L}$$

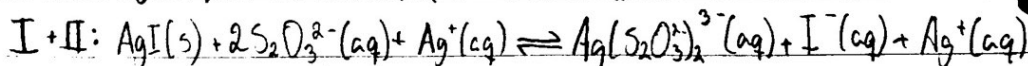
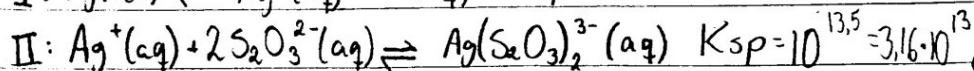
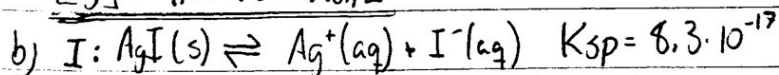
Spjkk av antakelse: $8 \cdot 10^{-8} \ll 0,02 \Rightarrow$ den stemmer

Vi får at: løseligheten av CaF_2 i $0,020 \text{ M NaF}$ er $8 \cdot 10^{-8} \text{ mol/L}$

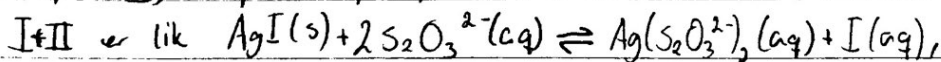
5 a) $\text{AgI (s)} \xrightleftharpoons{(\text{aq})} \text{Ag}^+(\text{aq}) + \text{I}^-(\text{aq}) \quad K_{sp} = 8,3 \cdot 10^{-17}$

$$K_{sp} = [\text{Ag}^+][\text{I}^-] = [\text{Ag}^+]^2 \Rightarrow [\text{Ag}^+] = \sqrt{K_{sp}} = 9,11 \cdot 10^{-9}$$

$$[\text{Ag}^+] = 9,11 \cdot 10^{-9} \text{ mol/L}$$



$$K_{sp}(\text{I} + \text{II}) = K_{sp}(\text{I}) \cdot K_{sp}(\text{II}) = 2,62 \cdot 10^{-3}$$

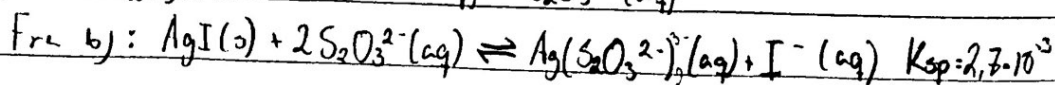
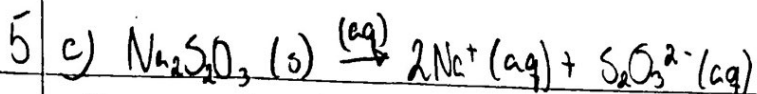


med innetak av Ag^+ på hver side av likevektstegnet, men siden

K_{sp} regnes ut ifra aktiviteten til produkter/aktiviteten til reaktanter,

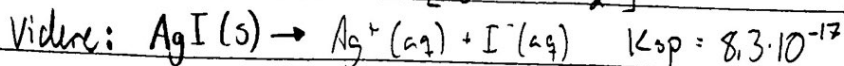
kan vi se bort ifra Ag^+ siden $\frac{a_{\text{Ag}^+}}{a_{\text{Ag}^+}} = 1$, og den ikke påvirker K_{sp} ,

dermed er K_{sp} for rx: $2,62 \cdot 10^{-3} \text{ mol/L}$



$$K_{\text{sp}} = \frac{[\text{Ag}(\text{S}_2\text{O}_3)_2^{3-}][\text{I}^-]}{[\text{S}_2\text{O}_3^{2-}]^2} = \frac{x^2}{(0,02 - 2x)^2} = 2,7 \cdot 10^{-3}$$

$$\Rightarrow x = 9,41 \cdot 10^{-4}, [\text{Ag}(\text{S}_2\text{O}_3)_2^{3-}] = 9,41 \cdot 10^{-4} = [\text{I}^-]$$



$$\Rightarrow K_{\text{sp}} = [\text{Ag}^+][\text{I}^-] \Rightarrow [\text{Ag}^+] = \frac{K_{\text{sp}}}{[\text{I}^-]} = \frac{8,3 \cdot 10^{-17}}{9,41 \cdot 10^{-4}} = 8,8 \cdot 10^{-14} \text{ mol/L}$$

Vi får: $[\text{Ag}(\text{S}_2\text{O}_3)_2^{3-}] = 9,41 \cdot 10^{-4} \text{ mol/L}$ och $[\text{Ag}^+] = 8,8 \cdot 10^{-14} \text{ mol/L}$