2006V

$(Ca^{2+}) = 0,02 \Rightarrow (CaX^{2})_{ekv} = 0,01 M$

$(EDTA) = 0,02$

$pH = 11 \Rightarrow (H^{+}) = 1 \cdot 10^{-11}$

(Ca^{2+}) er $1 \cdot 10^{-6} m$ ved ekv.

$T = \left((X^{4-}) + (HX^{3-}) - Ca^{2+}\right) v$

Vi må beregne (X^{4-}) og (HX^{3-}):

(HX^{3-}) finner vi fra K_1 over

$$\frac{(X^{4-})(H^{+})}{(HX^{3-})} = 5,5 \cdot 10^{-11}$$

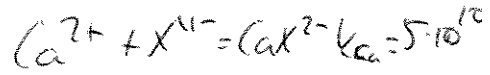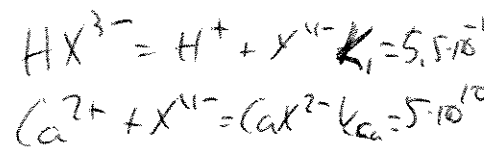$$\frac{(X^{4-}) \cdot 1 \cdot 10^{-11}}{(HX^{3-})} = 5,5 \cdot 10^{-11}$$

$$(HX^{3-}) = 0,18(X^{4-})$$

(X^{4-}) finner vi fra K_{Ca}:

$$\frac{(CaX^{2-})}{(Ca^{2+})(X^{4-})} = 5 \cdot 10^{10}$$

$$\frac{0,01}{1 \cdot 10^{-6} \cdot (X^{4-})} = 5,5 \cdot 10^{10}$$

gir $(X^{4-}) = 2 \cdot 10^{-7}$

$HX^{3-} = H^{+} + X^{4-} \quad K_1 = 5,5 \cdot 10^{-11}$

$Ca^{2+} + X^{4-} = CaX^{2-} \quad K_{Ca} = 5 \cdot 10^{10}$

$$T = \left((2 \cdot 10^{-7} + (0,18 \cdot 2 \cdot 10^{-7}) \div 1 \cdot 10^{-6}\right) v$$
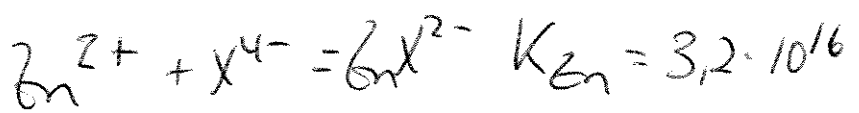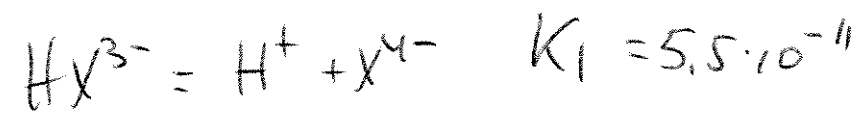
$$= 7,64 \cdot 10^{-7}$$

Relativ feil To%:

$$T_\% = \frac{7,64 \cdot 10^{-7} \cdot 100\%}{0,02 \cdot \frac{1}{2}}$$

$$= 0,0076\%$$

2006 H

$(Zn^{2+}) = 0,02$

$(EDTA) = 0,05$

$pH = 10 \Rightarrow (H^+) = 1 \cdot 10^{-10}$

$HX^{3-} = H^+ + X^{4-} \quad K_1 = 5,5 \cdot 10^{-11}$

$Zn^{2+} + X^{4-} = ZnX^{2-} \quad K_{Zn} = 3,2 \cdot 10^{16}$

(Zn^{2+}) ved ekv. pkt

$$T = \left((X^{4-}) + (HX^{3-}) - (Zn^{2+}) \right) / v$$

Vi setter $T = 0$ og får at

$$(Zn^{2+}) = (X^{4-}) + (HX^{3-})$$

Vi bruker K_1 for å beregne (HX^{3-}):

$$\frac{1 \cdot 10^{-10} (X^{4-})}{(HX^{3-})} = 5,5 \cdot 10^{-11}$$

$$(HX^{3-}) = \frac{1 \cdot 10^{-10}}{5,5 \cdot 10^{-11}} (X^{4-}) = 1,82 (X^{4-})$$

Setter inn i uttrykket for (Zn^{2+}) over og får at

$$(Zn^{2+}) = (X^{4-}) + 1,82(X^{4-}) = 2,82(X^{4-})$$

eller at $(X^{4-}) = \dfrac{(Zn^{2+})}{2,82}$

Setter inn dette i K_{Zn} og får:

$$\frac{(ZnX^{2-})}{(Zn^{2+})(X^{4-})} = 3,2 \cdot 10^{16}$$

$$\frac{0,0143}{\dfrac{(Zn^{2+}) \cdot (Zn^{2+})}{2,82}} = 3,2 \cdot 10^{16}$$

$0,0143^2$

Hvis vi har 10 mL løsr. forbrukes
4 mL EDTA side EDTA er
2,5x sterkere (10÷4 = 14~y)

$$\Rightarrow (Zn^{2+}) = \sqrt{\frac{0,0143 \cdot 2,82}{3,2 \cdot 10^{16}}} = 1,12 \cdot 10^{-9} \text{ M}$$

(Teor. on Zn^{2+})

Teoretisk feil hvis $(Zn^{2+}) = 1 \cdot 10^{-8} M$ ved ekv. pkt:

$$T = \left((X^{4-}) + (HX^{3-}) - (Zn^{2+})\right) v$$

Vi må beregne (X^{4-}) og (HX^{3-})

Ved pH $= 10$ har vi funnet at $(HX^{3-}) = 2{,}82(X^{4-})$

Vi har også at $(ZnX^{2-}) = 0{,}0143 M$.

$\underline{(X^{4-})}$:

$$\frac{0{,}0143}{1 \cdot 10^{-8} \cdot (X^{4-})} = 3{,}2 \cdot 10^{16}$$

$$(X^{4-}) = \underline{4{,}47 \cdot 10^{-11}}$$

$\underline{HX^{3-}}$: Setter inn i K_4 for å finne (HX^{3-})

$$\frac{1 \cdot 10^{-10} \cdot 4{,}47 \cdot 10^{-11}}{(HX^{3-})} = 5{,}5 \cdot 10^{-11}$$

$$(HX^{3-}) = \underline{8{,}13 \cdot 10^{-11}}$$

Setter inn i T og får:

$$T = \left((4{,}47 \cdot 10^{-11} + 8{,}13 \cdot 10^{-11}) - 1 \cdot 10^{-8}\right) v$$

$$\approx \div 1 \cdot 10^{-8} v$$

$$T\% = \frac{\div 1{,}0 \cdot 10^{-8} \cdot 100\% \cdot 14}{0{,}02 \cdot 10} = \underline{-7{,}0 \cdot 10^{-5} \%}$$