

Øving 3 - Ertend Sørlve

Oppgave 1

$$K = \frac{a_{\text{CO}_2(g)} \cdot a_{\text{H}_2\text{O}(l)} \cdot a_{\text{Na}_2\text{CO}_3(s)}}{(a_{\text{NaHCO}_3(s)})^2} = \frac{P_{\text{CO}_2(g)} \cdot P_{\text{H}_2\text{O}} \cdot 1}{1^2} \cdot \frac{1}{P^{\circ 2}}$$

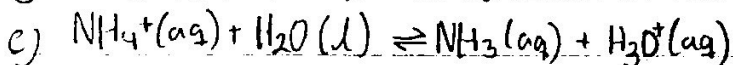
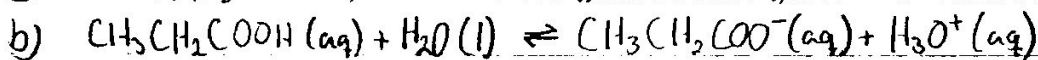
Vi vet at $n_{\text{CO}_2} = n_{\text{H}_2\text{O}} \Rightarrow P_{\text{CO}_2} = P_{\text{H}_2\text{O}}$

Vi får:

$$K = (P_{\text{CO}_2})^2 \cdot \frac{1}{P^{\circ 2}} = 0,231 \Rightarrow P_{\text{CO}_2} = \sqrt{0,231} \cdot P^{\circ} = 0,481 \text{ atm}$$

$P_{\text{CO}_2} = 0,481 \text{ atm}$. Vi kan fange CO_2 i sett ved å tilsette produktene i en lukket beholder, varme opp, og så kjøle ned.

Oppgave 2



Oppgave 3

a) HBr er en sterk syre

b) HCl er en sterk syre

c) HCN er en svak syre $\text{HCN}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{CN}^-(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$

$$\text{MVL: } K = \frac{[\text{CN}^-][\text{H}_3\text{O}^+]}{[\text{HCN}]}$$

d) H_3PO_4 er en svak syre: $\text{H}_3\text{PO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_2\text{PO}_4^-(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$

$$\text{MVL: } K = \frac{[\text{H}_3\text{O}^+][\text{H}_2\text{PO}_4^-]}{[\text{H}_3\text{PO}_4]}$$

Oppgave 4

I) svak syre

II) sterk syre

III) svak base

IV) sterk base

V) svak base

VI) svak syre

VII) svak syre

VIII) sterk base

IX) sterk syre

Oppgave 5

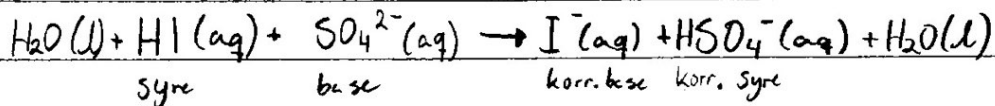
Siden OCl^- og NH_3 med vann gir netto syrer, og NO_3^- er korr. base til sterk syre, er $\text{NO}_3^- < \text{H}_2\text{O} < \text{OCl}^-, \text{NH}_3$

Base	$K_a^{(1)}$	$K_b^{(2)}$	(1) K_a for korr. syrer
NH_3	$5,75 \cdot 10^{-10}$	$1,74 \cdot 10^{-5}$ 1.	(2) K_b for basene
OCl^-	$2,95 \cdot 10^{-8}$	$3,39 \cdot 10^{-7}$ 2.	

Rangert etter basestyrke, er $\text{NO}_3^- < \text{H}_2\text{O} < \text{OCl}^- < \text{NH}_3$

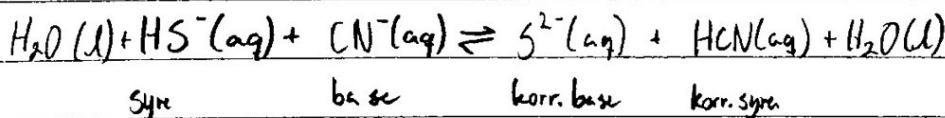
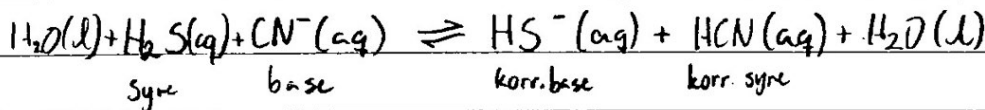
Oppgave 6

a) SO_4^{2-} er korr. base til HSO_4^- , HSO_4^- kan fungere som base og bli H_2SO_4 , som er en sterk syre. I dette eksemplet vil ikke dette skje siden H_2SO_4 er en sterkere syre enn HI . $K_b(\text{SO}_4^{2-}) > K_b(\text{H}_2\text{O})$

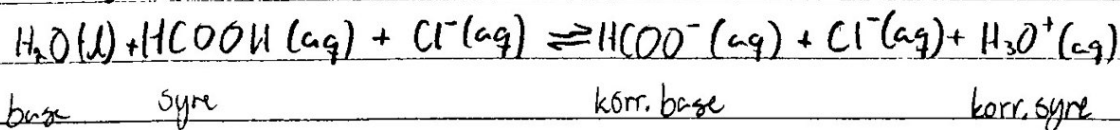


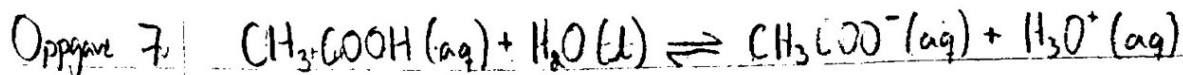
b) H_2S er en toprotisk svak syre, $\text{H}_2\text{S} \rightleftharpoons \text{HS}^- \rightleftharpoons \text{S}^{2-}$, S^{2-}

* $K_b(\text{CN}^-) < K_b(\text{H}_2\text{O})$ er svak base, men ligger på grensen til å være en sterk base, men CN^- er en svakere base, vi får to likevekter i løsningen*

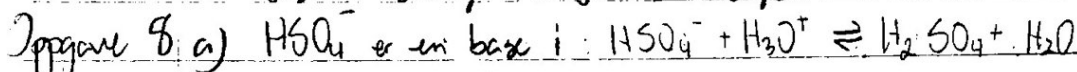


c) Cl^- er korr. base til HCl , som er en sterk syre, det vil innstilles en likevekt, men produktene vil så og si nesten ikke eksistere: $K_b(\text{Cl}^-) < K_b(\text{H}_2\text{O})$

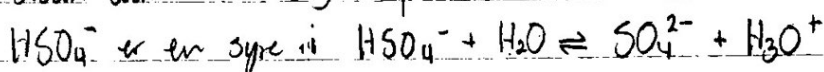




- a) i rx er det H_2O og CH_3COO^- som fungerer som baser, og konkurrerer om protonet.
- b) CH_3COO^- er den sterkeste basen siden vann er både syre og base (amfoter). CH_3COO^- kan kun fungere som base.
- c) CH_3COO^- er korresponderende base til svak syre, og vil i vann innstille en likevekt, da eksisterer fortsatt CH_3COO^- i løsningen. En sterk base protolyserer fullstendig slik at det $\approx$ ikke finnes noe opprinnelig base i løsningen. CH_3COO^- er derfor ikke en sterk base, dermed er den svak.

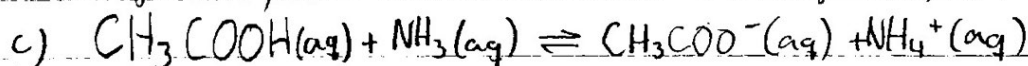


siden den tar til seg et proton



siden den gir fra seg et proton

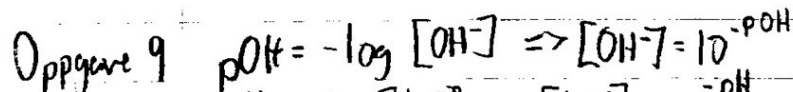
- b) 1. Syre: HNO_3 , korr. base: NO_3^- (base: H_2O , korr. syre: H_3O^+)
 2. Syre: H_3O^+ , korr. base: H_2O (base: HS , korr. syre: H_2S)
 3. Syre: HF , korr. base: F^- (base: OH^- , korr. syre: H_2O)



syre
base
base
syre

$$K_a(\text{CH}_3\text{COOH}) < K_a(\text{NH}_4^+)$$

$$K_b(\text{CH}_3\text{COO}^-) > K_b(\text{NH}_3)$$



$\text{pH} = -\log [\text{H}_3\text{O}^+] \Rightarrow [\text{H}_3\text{O}^+] = 10^{-\text{pH}}$, $\text{pOH} = 14 - \text{pH} \Rightarrow \text{pH} = 14 - \text{pOH}$

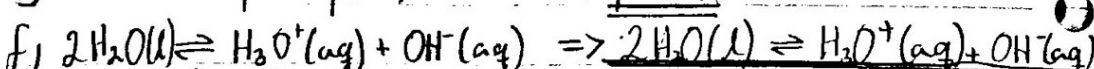
a) $[\text{H}^+] = 10^{-1,5} = 3,16 \cdot 10^{-2} \Rightarrow [\text{H}^+] = 3,16 \cdot 10^{-2} \text{ mol/L}$

b) $\text{pH} = -\log 0,01 = 2 \Rightarrow \underline{\text{pH} = 2}$

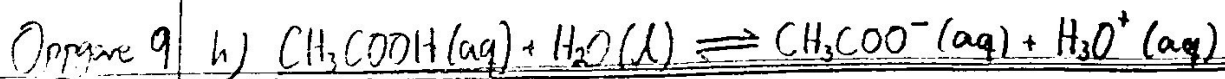
c) $\text{pOH} = -\log 0,01 = 2 \Rightarrow \underline{\text{pOH} = 2}$

d) $\text{pH} = 14 - 2 = 12 \Rightarrow \underline{\text{pH} = 12}$

e) Påvirker ikke pH $\Rightarrow \underline{\text{pH} = 7}$



g) $\text{pH} = 14 - (-\log 3 \cdot 10^{-2}) = 12,5 \Rightarrow \underline{\text{pH} = 12,5, [\text{H}^+] = 3,33 \cdot 10^{-13}}$
 $[\text{H}^+] = 10^{-12,5} = 3,33 \cdot 10^{-13}$



i) $K = \frac{[\text{CH}_3\text{COO}^-][\text{H}_3\text{O}^+]}{[\text{CH}_3\text{COOH}]}$

j) $K = K_a(\text{CH}_3\text{COOH}) \cdot \frac{1}{c} = 10^{-4,76} = 1,74 \cdot 10^{-5}$
 $K = 1,74 \cdot 10^{-5}$

k) $K_a = 10^{-\text{p}K_a} = 10^{-3}, K_a = 10^{-4}$
 $K_a = 10^{-3}, K_a = 10^{-4}$

l) Fra i og j, ser vi at dersom $[\text{CH}_3\text{COOH}] = [\text{CH}_3\text{COO}^-] \Rightarrow K_a = [\text{H}_3\text{O}^+]$
 Vi får at $\text{pH} = -\log K_a = -\log 1,74 \cdot 10^{-5} = 4,74$. Så lenge konsentrasjonene er like, vil dette gjelde, dermed:

$\text{pH} = 4,74$ i begge tilfeller

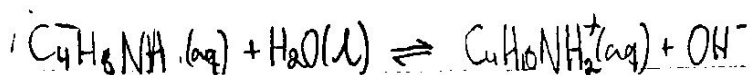
m) $K_a = \frac{[\text{CH}_3\text{COO}^-][\text{H}_3\text{O}^+]}{[\text{CH}_3\text{COOH}]} = \frac{x \cdot x}{0,1 - x} = 1,74 \cdot 10^{-5}$
 $x^2 = 1,74 \cdot 10^{-6} - 1,74 \cdot 10^{-5} x$
 $x^2 + 1,74 \cdot 10^{-5} x - 1,74 \cdot 10^{-6} = 0$
 $x = \frac{-1,74 \cdot 10^{-5} \pm \sqrt{(1,74 \cdot 10^{-5})^2 + 4 \cdot 1,74 \cdot 10^{-6}}}{2}$
 $x = 1,31 \cdot 10^{-3} = [\text{H}_3\text{O}^+]$

$\Rightarrow \text{pH} = -\log(1,31 \cdot 10^{-3}) = 2,88 \approx 2,9$

$\text{pH} = 2,9$

n) Ingen av dem; K_w og K_a påvirkes av temperaturen.

Oppgave 10



$$K_b = \frac{[C_4H_9NH_3^+][OH^-]}{[C_4H_9NH_2]}$$

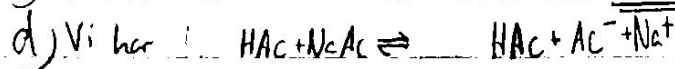
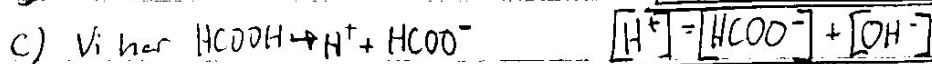
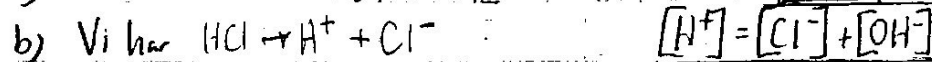
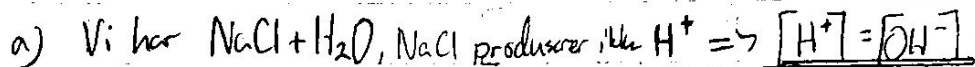
$$[OH^-] = 10^{-pOH} = 10^{-(14-pH)} = 6.61 \cdot 10^{-4} \text{ mol/L}$$

$$x = \text{endring} = [OH^-] = [C_4H_9NH_3^+] = 6.61 \cdot 10^{-4} \text{ mol/L}$$

$$K_b = \frac{x^2}{10^{-3} - x} = \frac{(6.61 \cdot 10^{-4})^2}{(10^{-3} - 6.61 \cdot 10^{-4})} \text{ mol/L} = 1.29 \cdot 10^{-3} \text{ mol/L}$$

$$\underline{K_b = 1.29 \cdot 10^{-3} \text{ mol/L}}$$

Oppgave 11



Det er ikke mulig å sette opp PB



$HSO_4^- \rightleftharpoons H^+ + SO_4^{2-}$, denne har også lyseret i to ganger, så $[H^+] = 2[SO_4^{2-}]$

