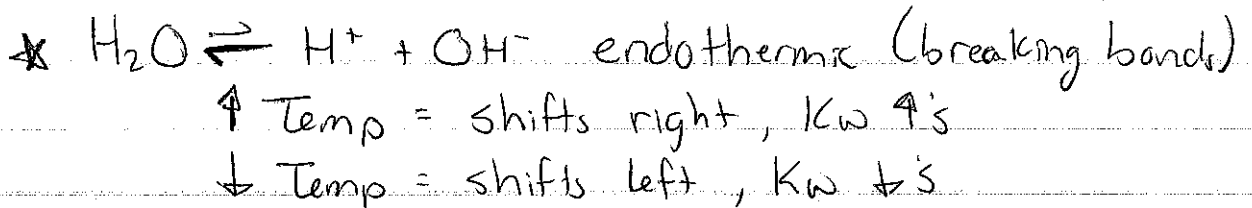


18.2 Calculations w/ A+B

Ionization of H_2O

K_w is temp dependent (since eqm constant)



change K_w , change $[H^+] + [OH^-] \therefore$ change pH
table pg 367

* even though pH changes, H_2O is still neutral b/c
 $[H^+] + [OH^-]$ are always equal

pH + pOH scales are interrelated

* $pOH = -\log[OH^-]$ vs. $pH = -\log[H^+]$
 $[OH^-] = 10^{-pOH}$ $[H^+] = 10^{-pH}$

- inverse relationships * ↑ $[H^+]$ ↓ $[OH^-]$
- scales inverse * ↑ $[H^+]$ ↓ pH v/v OH

* if $K_w (1.00 \times 10^{-14}) = [H^+][OH^-]$ at 298 K
then, $pH + pOH = pK_w (14.00)$

(graphs 368/369)

ex: lemon juice $\text{pH} = 2.90$ @ 298K

$$[\text{H}^+] = 10^{-\text{pH}} = 10^{-2.90} = \boxed{1.26 \times 10^{-3} \text{ mol dm}^{-3}}$$

$$\text{pH} + \text{pOH} = 14 \quad \text{pOH} = 14 - \text{pH} = 14 - 2.90 = \boxed{11.10}$$

$$[\text{OH}^-] = 10^{-\text{pOH}} = 10^{-11.10} = \boxed{7.94 \times 10^{-12} \text{ mol dm}^{-3}}$$

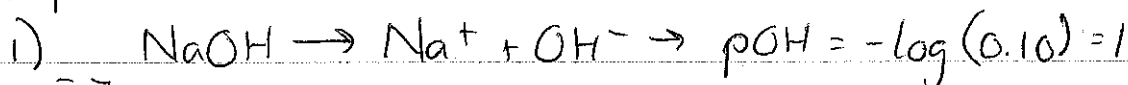
or

$$K_w = [\text{H}^+][\text{OH}^-] = 1.00 \times 10^{-14} = (1.26 \times 10^{-3})(\text{OH}^-)$$

Strong A/B \rightarrow pH/pOH deduced from [I]

b/c assume full dissociation $[\text{I}] = [\text{egm}]$

Calc pH:

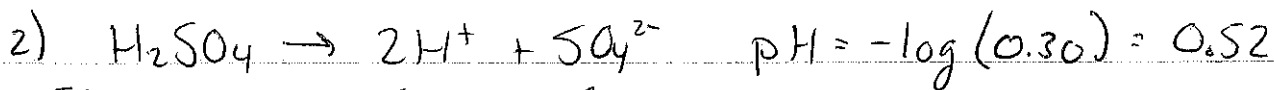


[I] 0.10 0 0

[egm] 0.10

$$\text{pOH} + \text{pH} = 14$$

$$\boxed{\text{pH} = 13}$$

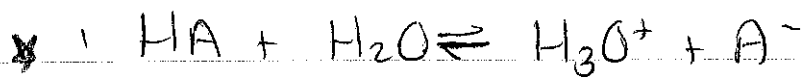


[I] 0.15 0 0

[egm] $2(0.15) = 0.30$

Weak A/B \rightarrow do not fully dissociate \therefore reach eqm

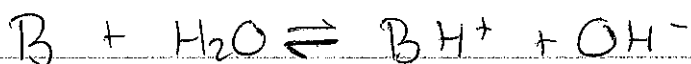
Need to write eqm expression to determine $[\text{H}^+]/[\text{OH}^-]$



$\rightarrow 2 \quad K_a = \frac{[\text{H}_3\text{O}^+][\text{A}^-]}{[\text{HA}]}$ - modified ³ eqm constant \rightarrow acid dissociation constant (measure of dissociation aka strength)

\downarrow
 Fixed value for particular acid at specified temp. 4^* does not depend on [acid]

$\uparrow K_a$, stronger acid, b/c more dissociation \therefore more product made



$K_b = \frac{[\text{BH}^+][\text{OH}^-]}{[\text{B}]}$ - base dissociation constant

$\uparrow K_b$, \uparrow base strength b/c more dissociation

K_a & K_b allow:

- 1) compare strengths of weak A/B
- 2) calc [ion] at eqm
- 3) pH & pOH calc

ICE calculations

- 1) given [I] \rightarrow before dissociation
- 2) pH/pOH \rightarrow $[\text{H}^+]/[\text{OH}^-]$ at eqm
- 3) [eqm] go into expression
- 4) small K_a/K_b - use approximations

2/24 examples pg 373-374

due to small #'s $K_a + K_b \rightarrow pK_a + pK_b$

$$\star \quad pK_a = -\log K_a \quad \text{vs} \quad pK_b = -\log K_b$$

$$K_a = 10^{-pK_a} \quad K_b = 10^{-pK_b}$$

- pK_a/pK_b usually positive & no units
- inverse relationship

Strong acid
 $K_a \uparrow \uparrow$ $\downarrow \downarrow K_a \uparrow$
 Weak acid

- change of 1 $pK_a/pK_b = 10$ -fold change K_a/K_b
- $pK_a/pK_b \in$ specified temp \rightarrow table 21
 (need to convert to K_a/K_b for calcs)

$$\star \quad K_a \times K_b = [H^+][OH^-] = K_w$$

$\therefore pK_a + pK_b = pK_w (14) \rightarrow$ holds for any conjugate A/B pair

$\uparrow K_a, \downarrow K_b$ (for conj. base)

\therefore stronger acids have weaker conj. bases

$$K_a \times K_b = \frac{[H^+][A^-]}{[HA]} \times \frac{[HA][OH^-]}{[A^-]} \quad \text{for conj. A/B}$$