3/20/2019

Last time...

	$A_{(aq)} \rightleftharpoons 2B_{(aq)}$		
I	1.0	0	$[A]_0 = 1.0M$
C	$-x$	$+2x$	$[B]_0 = 0.0M$
E	$(1.0-x)$	$(2x)$	$K_c = 3.3\times10^{-5}$ (small!)
			$[A]_{eq}$? $[B]_{eq}$?

$$K_c = 3.3\times10^{-5} = \frac{[B]^2}{[A]_{eq}} = \frac{(2x)^2}{(1.0-x)}$$ Quadratic?

... because $K_c \ll 1$, we know that x will be small

then we can assume $(1.0-x) \approx 1.0$

then: $$3.3\times10^{-5} \approx \frac{(2x)^2}{1.0} \approx 4x^2$$

$$x = \sqrt{\frac{3.3\times10^{-5}}{4}} = 2.87\times10^{-3}$$

$[A]_{eq} = 1.0 - x = 1.0 - 0.00287 = 1.0\ M$

1dp 4dp 1dp

$[B]_{eq} = 2x = 2\times2.87\times10^{-3} = 5.74\times10^{-3}\ M$

2sf. 2sf.

Rule of thumb: 5% rule

- check that we less than 5% dissociation

$$\left(\frac{x}{\text{init conc}} \times 100 < 5\% \ \checkmark\right)$$

$$\frac{2.87\times10^{-3}}{1.0} \times 100 = 0.287\% \ \checkmark$$

Le Châtelier's Principle

"When we stress a dynamic eqm, it shifts to remove the stress"

Homeostasis: too hot? Sweat (cools us down)

STRESS ~ RELIEF

too cold? Shiver (warms us up)

etc.

Stresses: conc, pressure, temp } raise/lower

Relief: counteract stress

ex: $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

- add $NO_2(g)$ (Stress) Relief: $[NO_2]\downarrow$ Shift to LHS

- add $N_2O_4(g)$ (Stress) Relief: $[N_2O_4]\downarrow$, Shift to RHS

ex: $Ca_3(PO_4)_2(s) \rightleftharpoons 3Ca^{2+}(aq) + 2PO_4^{3-}(aq)$

calcium phosphate

if we lower Ca^{2+} conc, ... need in increase Ca^{2+} conc, ... shift to RHS.

(stress) (relief)

(osteoporosis)

Pressure changes: Boyle's law: $p \propto 1/V$

$V\downarrow, P\uparrow$ // $V\uparrow, p\downarrow$

ex. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

Stress: decreasing V ($P\uparrow$)
Relief: need to decrease p ($p\downarrow$)
⇒ shift to RHS, fewer molecules of gas, lowering of pressure!

// more molecules
- more they hit walls
- more pressure!

Temp. changes

$\Delta H < 0$ (-ve), exothermic, heat is lost by rxn: $A \rightleftharpoons B + \text{heat}$
$\Delta H > 0$, (+ve), endothermic, heat is gained by rxn: $\text{heat} + A \rightleftharpoons B$

If we raise T, we must have added heat } stresses
" lower T, " —— " removed heat }

ex: $57.2\text{kJ} + N_2O_4(g) \rightleftharpoons 2NO_2(g)$; $\Delta H^\circ = +57.2\text{kJ}$
endothermic

increase T (stress) → adding heat / relief is to remove heat → So, we must shift to RHS

So, we make more NO_2 @ eqm! less N_2O_4!

Affects K_c (or K_p) ... in this case, $K\uparrow$ as $T\uparrow$
- other stresses (conc, pressure) do not change K

exothermic rxns
as $T\uparrow$, $K\downarrow$

Ch 16 Acids + Bases

Acids: taste sour
turn litmus RED

Bases: taste bitter
turn litmus BLUE
feel slippery

Definitions

1880s **Arrhenius**: Acids: form H^+ ions in aq. sol^n
Bases: form OH^- " —————— "

ex: Hydrochloric acid: $HCl(aq) \longrightarrow H^+(aq) + Cl^-(aq)$

Sodium hydroxide: $NaOH(aq) \longrightarrow Na^+(aq) + OH^-(aq)$