Chapter 4 Notes

09-28-18

Acids & Bases

Strong acids = strong electrolytes (100% dissociated into ions)

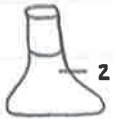
$HI(aq) + H_2O(\ell) \longrightarrow H_3O^+(aq) + I^-(aq)$

Strong bases = soluble hydroxides (LiOH, NaOH, KOH, ect.)

$LiOH(aq) \longrightarrow Li^+(aq) + OH^-(aq)$ ↳ strong electrolytes

Li^+ OH^-

Group II hydroxides are sparingly soluble



2.1×10^{-3} M $Ca(OH)_2$

$Ca(OH)_2(s,aq) \rightarrow Ca^{2+}(aq) + 2OH^-(aq)$

1 mol $Ca(OH)_2$ ⇝ 1 mol Ca^{2+} $\quad [Ca^{2+}] = 2.1 \times 10^{-3}$ M

1 mol $Ca(OH)_2$ ⇝ 2 mol OH^- $\quad [OH^-] = 4.2 \times 10^{-3}$ M

Acid-Base Reactions

What volume of 0.141M KOH(aq) is required to react (neutralize, titrate) with 25.00 mL of 0.0972 M HI?

$HI(aq) + KOH(aq) \xrightarrow{\sim 100\%} H_2O(\ell) + KI(aq)$

0.0972 mol/L 0.141 mol/L

25.00 mL V = ?

Go moles ∀ $n = mV$

$$n = \frac{0.0972\ \text{mol}}{1\ \text{L}} \left| \frac{0.02500\ \text{L}}{} \right. = 0.00243\ \text{mol HI}$$

$$n_{KOH\ Needed} = \frac{0.00243\ \text{mol HI}}{1\ \text{mol HI}} \left| \frac{1\ \text{mol KOH}}{} \right. = 0.00243\ \text{mol KOH}$$

$n = mV$

$$\hookrightarrow V = \frac{n}{m} = \frac{0.00243\ \text{mol KOH}}{0.141\ \text{mol KOH}} \left| \frac{\text{L soln}}{} \right. = \boxed{0.0172\ \text{L KOH}}$$

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Assigning Oxidation Numbers

* Simple ions have the same oxidation number as their ion charge.

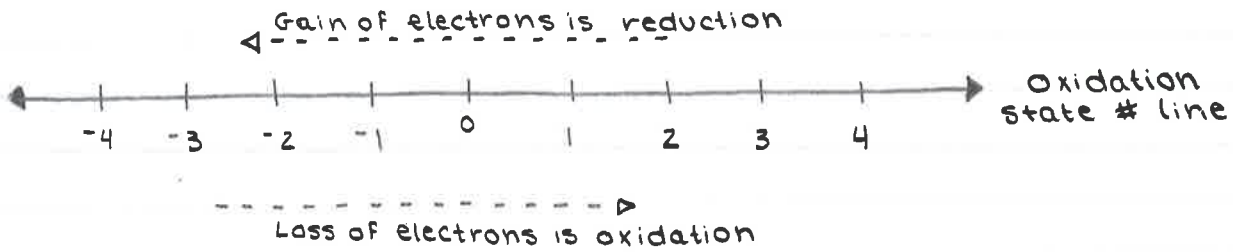
	Na^+	Ca^{2+}	Cl^-	S^{2-}	Al^{3+}
Ox #:	+1	+2	-1	-2	+3

* Neutral atoms and molecular elements have an ox. # of zero

	Al	Cu	Fe	Cl_2	O_2	N_2
Ox #:	0	0	0	0	0	0

Demo: $3Cu^{2+}(aq) + 2Al(s) \longrightarrow 3Cu(s) + 2Al^{3+}(aq)$

Ox #: 2 0 0 3



$3Cu^{2+}(aq) + 6e^- \longrightarrow 3Cu(s)$

$2Al(s) \longrightarrow 6e^- + 2Al^{3+}(aq)$

$Cu^{2+}(aq)$ was reduced, Al was the reducing reagent

$Al(s)$ was oxidized, $Cu^{2+}(aq)$ was the oxidizing reagent

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Assigning Oxidation Numbers

* "In polyatomic ions and neutral compounds," oxygens are usually -2
* " hydrogens are usually +1
* Σ (the sum) of oxidation numbers must equal the charge of the ionic or zero if neutral

$KMnO_4(aq)$

K^+ MnO_4^- ---▸ (oxygen's ox # = -2 → $-2 \times 4 = -8$ → charge of $MnO_4^- = -1$

Ox #: +1 +7 -2

$(-1 = -8 + x) \rightarrow x = 7$

(charge MnO_4^- = -1; Ox #: O_4 = -8; Ox # Mn = +7)

NH_4NO_3

NH_4^+ NO_3^-

-3 +1 +5 -2

Is this an oxidation reaction?

$KMnO_4(aq) + K_2SO_3(aq) \longrightarrow K^+(aq) + Mn^{2+}(aq) + SO_4^{2-}(aq)$

Ox #: +1 | +7 -2 | +1 | +4 -2 | +1 | +2 | +6 -2

2e⁻ oxidation

5 e⁻ reduction

① The manganese in $KMnO_4$ was reduced
② The sulfur in K_2SO_4 was oxidized
③ $KMnO_4$ was the oxidizing reagent
④ K_2SO_4 was the reducing reagent

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Oxidation-Reduction Demo: Combustion of methane?

$$CH_4(g) + O_2(g) \longrightarrow CO_2(g) + H_2O(\ell)$$

Ox #: -4 $+1$ 0 $+4$ -2 $+1$ -2

$8e^-$ oxidation

The carbon in CH_4 was oxidized.