

## UNIT 5 – THE ESSENTIAL EQUATIONS

### 5.2 Periodicity

1.  $4\text{Na(s)} + \text{O}_2\text{(g)} \rightarrow \text{Na}_2\text{O(s)}$
2.  $2\text{Mg(s)} + \text{O}_2\text{(g)} \rightarrow \text{MgO(s)}$
3.  $4\text{Al(s)} + 3\text{O}_2\text{(g)} \rightarrow 2\text{Al}_2\text{O}_3\text{(s)}$
4.  $\text{Si(s)} + \text{O}_2\text{(g)} \rightarrow \text{SiO}_2\text{(s)}$
5.  $\text{P}_4\text{(s)} + 5\text{O}_2\text{(g)} \rightarrow \text{P}_4\text{O}_{10}\text{(s)}$
6.  $\text{S(s)} + \text{O}_2\text{(g)} \rightarrow \text{SO}_2\text{(g)}$
7.  $\text{Na}_2\text{O(s)} + \text{H}_2\text{O(l)} \rightarrow 2\text{NaOH(aq)}$
8.  $\text{Na}_2\text{O(s)} + 2\text{H}^+\text{(aq)} \rightarrow 2\text{Na}^+\text{(aq)} + \text{H}_2\text{O(l)}$
9.  $\text{MgO(s)} + \text{H}_2\text{O(l)} \rightleftharpoons \text{Mg(OH)}_2\text{(s)} \rightleftharpoons \text{Mg(OH)}_2\text{(aq)}$
10.  $\text{MgO(s)} + 2\text{H}^+\text{(aq)} \rightarrow \text{Mg}^{2+}\text{(aq)} + \text{H}_2\text{O(l)}$
11.  $\text{Al}_2\text{O}_3\text{(s)} + 6\text{H}^+\text{(aq)} \rightarrow 2\text{Al}^{3+}\text{(aq)} + 3\text{H}_2\text{O(l)}$
12.  $\text{Al}_2\text{O}_3\text{(s)} + 3\text{H}_2\text{O(l)} + 6\text{OH}^-\text{(aq)} \rightarrow 2\text{Al(OH)}_6^{3-}\text{(aq)}$
13.  $\text{Al}_2\text{O}_3\text{(s)} + 3\text{H}_2\text{O(l)} + 2\text{OH}^-\text{(aq)} \rightarrow 2\text{Al(OH)}_4^-\text{(aq)}$
14.  $\text{SiO}_2\text{(s)} + 2\text{OH}^-\text{(aq)} \rightarrow \text{SiO}_3^{2-}\text{(aq)} + \text{H}_2\text{O(l)}$
15.  $\text{P}_4\text{O}_{10}\text{(s)} + 6\text{H}_2\text{O(l)} \rightarrow 4\text{H}_3\text{PO}_4\text{(aq)}$
16.  $\text{P}_4\text{O}_{10}\text{(s)} + 12\text{OH}^-\text{(aq)} \rightarrow 4\text{PO}_4^{3-}\text{(aq)} + 6\text{H}_2\text{O(l)}$
17.  $\text{SO}_2\text{(g)} + \text{H}_2\text{O(l)} \rightleftharpoons \text{H}_2\text{SO}_3\text{(aq)}$
18.  $\text{SO}_3\text{(g)} + \text{H}_2\text{O(l)} \rightarrow \text{H}_2\text{SO}_4\text{(aq)}$
19.  $\text{SO}_2\text{(g)} + 2\text{OH}^-\text{(aq)} \rightarrow \text{SO}_3^{2-}\text{(aq)} + \text{H}_2\text{O(l)}$
20.  $\text{SO}_3\text{(g)} + 2\text{OH}^-\text{(aq)} \rightarrow \text{SO}_4^{2-}\text{(aq)} + \text{H}_2\text{O(l)}$

### 5.3 Redox Equilibria

21.  $\text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + 2\text{e}^-$
22.  $\text{O}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) + 4\text{e}^- \rightarrow 4\text{OH}^-(\text{aq})$

#### **5.4 Transition Metals**

23.  $\text{AgCl}(\text{s}) + 2\text{NH}_3(\text{dilute}) \rightarrow [\text{Ag}(\text{NH}_3)_2]^+(\text{aq}) + \text{Cl}^-(\text{aq})$
24.  $\text{AgBr}(\text{s}) + 2\text{NH}_3(\text{conc}) \rightarrow [\text{Ag}(\text{NH}_3)_2]^+(\text{aq}) + \text{Br}^-(\text{aq})$
25.  $\text{AgBr}(\text{s}) + 2\text{S}_2\text{O}_3^{2-}(\text{aq}) \rightarrow [\text{Ag}(\text{S}_2\text{O}_3)_2]^{3-}(\text{aq}) + \text{Br}^-(\text{aq})$
26.  $\text{S}_2\text{O}_8^{2-}(\text{aq}) + 2\text{I}^-(\text{aq}) \rightarrow 2\text{SO}_4^{2-}(\text{aq}) + \text{I}_2(\text{aq})$
27.  $\text{S}_2\text{O}_8^{2-}(\text{aq}) + 2\text{Fe}^{2+}(\text{aq}) \rightarrow 2\text{SO}_4^{2-}(\text{aq}) + 2\text{Fe}^{3+}(\text{aq})$
28.  $2\text{Fe}^{3+}(\text{aq}) + 2\text{I}^-(\text{aq}) \rightarrow 2\text{Fe}^{2+}(\text{aq}) + \text{I}_2(\text{aq})$
29.  $2\text{MnO}_4^-(\text{aq}) + 5\text{C}_2\text{O}_4^{2-}(\text{aq}) + 16\text{H}^+(\text{aq}) \rightarrow 2\text{Mn}^{2+}(\text{aq}) + 10\text{CO}_2(\text{g}) + 8\text{H}_2\text{O}(\text{l})$
30.  $\text{MnO}_4^-(\text{aq}) + 8\text{H}^-(\text{aq}) + 5\text{Fe}^{2+}(\text{aq}) \rightarrow \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l}) + 5\text{Fe}^{3+}(\text{aq})$
31.  $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 14\text{H}^+(\text{aq}) + 6\text{Fe}^{2+}(\text{aq}) \rightarrow 2\text{Cr}^{3+}(\text{aq}) + 7\text{H}_2\text{O}(\text{l}) + 6\text{Fe}^{3+}(\text{aq})$
32.  $2\text{CrO}_4^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
33.  $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow 2\text{CrO}_4^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
34.  $[\text{Cr}(\text{OH})_6]^{3-}(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightleftharpoons \text{CrO}_4^{2-}(\text{aq}) + 4\text{H}_2\text{O}(\text{l}) + 3\text{e}^-$
35.  $\text{Co}(\text{NH}_3)_6^{2+}(\text{aq}) \rightleftharpoons \text{Co}(\text{NH}_3)_6^{3+}(\text{aq}) + \text{e}^-$
36.  $\text{Co}(\text{OH})_2(\text{s}) + \text{OH}^-(\text{aq}) \rightleftharpoons \text{Co}(\text{OH})_3(\text{s}) + \text{e}^-$

#### **5.5 Reactions of Inorganic Compounds in Solution**

37.  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons [\text{Fe}(\text{H}_2\text{O})_5(\text{OH})]^+(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$
38.  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons [\text{Fe}(\text{H}_2\text{O})_5(\text{OH})]^{2+}(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$
39.  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightleftharpoons [\text{Fe}(\text{H}_2\text{O})_4(\text{OH})_2](\text{s}) + 2\text{H}_2\text{O}(\text{l})$
40.  $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}(\text{aq}) + 3\text{OH}^-(\text{aq}) \rightleftharpoons [\text{Cr}(\text{H}_2\text{O})_3(\text{OH})_3](\text{s}) + 3\text{H}_2\text{O}(\text{l})$
41.  $[\text{Cr}(\text{H}_2\text{O})_3(\text{OH})_3](\text{s}) + 3\text{OH}^-(\text{aq}) \rightleftharpoons [\text{Cr}(\text{OH})_6]^{3-}(\text{aq}) + 3\text{H}_2\text{O}(\text{l})$

42.  $[\text{Cr}(\text{H}_2\text{O})_3(\text{OH})_3](\text{s}) + 3\text{H}_3\text{O}^+(\text{aq}) \rightleftharpoons [\text{Cr}(\text{H}_2\text{O})_6]^{3+}(\text{aq}) + 3\text{H}_2\text{O}(\text{l})$
43.  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}(\text{aq}) + 2\text{NH}_3(\text{aq}) \rightleftharpoons [\text{Cu}(\text{H}_2\text{O})_4(\text{OH})_2](\text{s}) + 2\text{NH}_4^+(\text{aq})$
44.  $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}(\text{aq}) + 3\text{NH}_3(\text{aq}) \rightleftharpoons [\text{Cr}(\text{H}_2\text{O})_3(\text{OH})_3](\text{s}) + 3\text{NH}_4^+(\text{aq})$
45.  $2[\text{Fe}(\text{H}_2\text{O})_6]^{3+}(\text{aq}) + 3\text{CO}_3^{2-}(\text{aq}) \rightarrow 2[\text{Fe}(\text{H}_2\text{O})_3(\text{OH})_3](\text{s}) + 3\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{l})$
46.  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{FeCO}_3(\text{s}) + 6\text{H}_2\text{O}(\text{l})$
47.  $[\text{Co}(\text{H}_2\text{O})_4(\text{OH})_2](\text{s}) + 6\text{NH}_3(\text{aq}) \rightleftharpoons [\text{Co}(\text{NH}_3)_6]^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l}) + 2\text{OH}^-(\text{aq})$
48.  $[\text{Cu}(\text{H}_2\text{O})_4(\text{OH})_2](\text{s}) + 4\text{NH}_3(\text{aq}) \rightleftharpoons [\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}(\text{aq}) + 2\text{H}_2\text{O}(\text{l}) + 2\text{OH}^-(\text{aq})$
49.  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}(\text{aq}) + 4\text{Cl}^-(\text{aq}) \rightleftharpoons [\text{CuCl}_4]^{2-}(\text{aq}) + 6\text{H}_2\text{O}(\text{l})$