SCH 3UI - Common Reactions That You **Must** Know

### Activity Series

These elements are ranked most reactive to least reactive. A more reactive element will often react to displace a less reactive element in a reaction.

K, Na, Ca, Mg, Al, Zn, Fe, Sn, Pb, H, Cu, Hg, Ag, Pt, Au

### Common Reactions

1. A metal and oxygen gas will combine to make a metal oxide.
   
   \[ 4 \text{Fe} + 3 \text{O}_2 \rightarrow 2 \text{Fe}_2\text{O}_3 \]  
   \[ 4 \text{Na} + \text{O}_2 \rightarrow 2 \text{Na}_2\text{O} \]

   i) use the periodic table to predict the most likely valence of a transition metal.
   
   ii) metals are always elemental, \( \text{O}_2 \) is always diatomic.

2. Non-metallic elements combine with oxygen to make non-metallic oxides.
   
   \[ \text{S} + \text{O}_2 \rightarrow \text{SO}_2 \]
   \[ \text{C} + \text{O}_2 \rightarrow \text{CO}_2 \]

   
   \[ \text{K}_2\text{O} + \text{H}_2\text{O} \rightarrow 2 \text{KOH} \]
   \[ \text{Fe}_2\text{O}_3 + \text{H}_2\text{O} \rightarrow 2 \text{Fe(OH)}_3 \]

4. Non-metallic oxides and water combine to form acids.
   
   \[ \text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_3 \]
   \[ \text{NO}_2 + \text{H}_2\text{O} \rightarrow \text{HNO}_3 + \text{HNO} \]

5. Peroxides decompose to metallic oxides and oxygen gas
   
   \[ 2 \text{Na}_2\text{O}_2 \rightarrow 2 \text{Na}_2\text{O} + \text{O}_2 \]
   \[ 2 \text{H}_2\text{O}_2 \rightarrow 2 \text{H}_2\text{O} + \text{O}_2 \]

6. Chlorates and perchlorates decompose on heating to give oxygen and a salt.
   
   \[ 2 \text{KClO}_3 \rightarrow \text{heat} \rightarrow 2 \text{KCl} + 3 \text{O}_2 \]
   \[ \text{KClO}_4 \rightarrow \text{heat} \rightarrow \text{KCl} + 2 \text{O}_2 \]
7. A metal and a compound may react in a single displacement reaction if the metal is more reactive than the metal in the compound. See the activity series above for more information.

eg. \(2 \text{Al}(s) + 6 \text{HCl} \rightarrow 2 \text{AlCl}_3 + 3 \text{H}_2(g)\)

eg. \(\text{Cu}(s) + 2 \text{AgNO}_3 \rightarrow 2 \text{Ag}(s) + \text{Cu(NO}_3)_2\)

eg. \(\text{Ag}(s) + \text{Cu(NO}_3)_2 \rightarrow \text{No reaction}\)

8. A metal in acid will produce a metallic salt and hydrogen gas. A salt is a positive metal ion and a negative ion ending in "ide", "ate" or "ite".

eg. \(2 \text{Na} + 2 \text{HCl} \rightarrow 2 \text{NaCl} + \text{H}_2(g)\)

\(\text{Na} \) displaces \(\text{H}\) from the molecules because \(\text{Na}\) is more reactive.

eg. \(\text{Pb} + \text{H}_2\text{SO}_4 \rightarrow \text{PbSO}_4 + \text{H}_2(g)\)

--- Θ <∞Φ - Copper and nitric acid do not perform this reaction.

\(\text{Cu} + \text{HNO}_3 \rightarrow \text{Cu(NO}_3)_2 + \text{H}_2\text{O} + \text{NO}_2(g)\)


eg. \(2 \text{Na} + 2 \text{H}_2\text{O} \rightarrow 2 \text{NaOH} + \text{H}_2(g)\)

10. An acid and a base will neutralize each other to create water and a salt.

eg. \(\text{HCl} + \text{NaOH} \rightarrow \text{H}_2\text{O} + \text{NaCl}\)

eg. \(2 \text{H}_3\text{PO}_4 + 3 \text{Mg(OH)}_2 \rightarrow 6 \text{H}_2\text{O} + \text{Mg}_3(\text{PO}_4)_2\)

11. Some aqueous ions will react to form a gaseous product

eg. \(\text{CO}_3^{2-}(aq) + \text{acid} \rightarrow \text{H}_2\text{CO}_3(aq) \rightarrow \text{CO}_2(g) + \text{HOH}\)  \(\text{(CaCO}_3(aq) + 2\text{HCl(aq)} \rightarrow \text{CaCl}_2 + \text{CO}_2(g) + \text{HOH)}\)

eg. \(\text{SO}_3^{2-}(aq) + \text{acid} \rightarrow \text{H}_2\text{SO}_4(aq) \rightarrow \text{SO}_2(g) + \text{HOH}\)  \(\text{(Na}_2\text{SO}_3(aq) + 2\text{HCl(aq)} \rightarrow \text{2NaCl} + \text{SO}_2(g) + \text{HOH)}\)

eg. \(\text{NH}_4^+(aq) + \text{base} \rightarrow \text{NH}_4\text{OH}(aq) \rightarrow \text{NH}_3(g) + \text{HOH}\)  \(\text{(NH}_4\text{Cl(aq) + KOH(aq)} \rightarrow \text{KCl(aq) + NH}_3(g) + \text{HOH)}\)

eg. \(\text{S}^{2-}(aq) + \text{acid} \rightarrow \text{H}_2\text{S(g)}\)  \(\text{(FeS(s) + 2HCl(aq)} \rightarrow \text{FeCl}_2(aq) + \text{H}_2\text{S(g))}\)

eg. \(\text{CN}^{3-}(aq) + \text{acid} \rightarrow \text{HCN(g)}\)  \(\text{(KCN(aq) + HCl(aq)} \rightarrow \text{KCl(aq) + HCN(g))}\)