****

**How to become a formulation hero**

**Basics – you will need to know these…and a couple more!**

**Write the symbols and oxidation numbers for these elements** (*hint: these only have one ox. number*)**:**

1. Lithium, sodium and potassium (*Group 1 elements*)
2. Beryllium, magnesium and calcium (*Group 2 elements*)
3. Boron and aluminium (*Group 3 elements*)
4. Oxygen
5. Zinc
6. Silver

**For these elements** (*hint: these have more than one*)**:**

1. Carbon
2. Nitrogen
3. Sulfur
4. Chlorine, bromine, iodine and astatine
5. Iron, cobalt and nickel
6. Palladium and platinum
7. Copper and mercury
8. Gold

**Formulate the ions and include the charges on each:**

1. *Example – Ox****ide*** *🡪 O2-*

*(Any ion that ends in “****ide****” only contains 1 type of element)*

1. Perox**ide** (*the only time that oxygen does not have a oxidation number of -2)*
2. Hydr**ide**
3. Chlor**ide**, iod**ide** and brom**ide**

(*Any ion that ends with “ite” or “ate” always contain oxygen)*

1. **Hypo**chlor**ite**, **hypo**iod**ite**, **hypo**brom**ite**
2. Chlor**ite**, iod**ite**, brom**ite**
3. Chlor**ate**, iod**ate**, brom**ate**
4. **Per**chlor**ate**, **per**iod**ate**, **per**brom**ate**
5. Sulfide
6. Sulfite
7. Sulfate
8. Nitride
9. Nitrite
10. Nitrate
11. Carbonate
12. Silicate
13. Borate
14. Phosphate
15. Arsenate
16. Chromate and **di**chromate
17. Manganate and **per**manganate

**Hint for formulation**

When we are formulating chemical compounds we must follow 1 simple rule. When we add the oxidation numbers (of the element) and the charges on the ions, we must ensure that they equal 0.

**Example 1:**

*Lithium sulfate – Lithium is in group 1 so will have an oxidation state of +1. The sulfate ion has a charge of 2- (SO42-). So, to formulate this compound I will need 2 lithium atoms and 1 sulfate ion…*

***+1 +1 -2 = 0***

***Li2SO4***

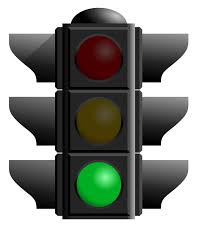
**Example 2:**

*Gold(III) silicate – In this case gold has an oxidation state of +3 (remember it can also have +1). The silicate ion has a charge of 4- (SiO44-). So, to formulate this compound I will need 4 gold atoms and 3 silicate ions…*

***+3 +3 +3 +3 -4 -4 -4 = 0***

***Au4(SiO4)3***

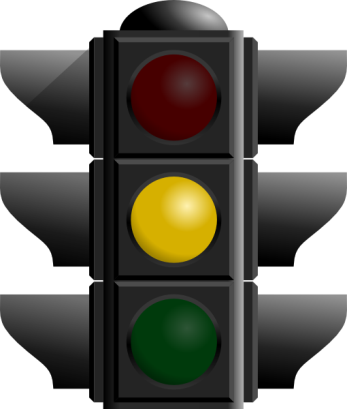
**Easy formulation**

1. ****Lithium hydride
2. Magnesium hydride
3. Aluminium hydride
4. Calcium oxide
5. Iron(II) sulfide
6. Zinc carbonate
7. Gold(I) bromide
8. Gold(III) fluoride
9. Cobalt(III) hydroxide
10. Cobalt(II) nitride
11. Fe2O3
12. Pt(OH)2
13. Pt(OH)4
14. NiO
15. NiBr3
16. CuS
17. Cu2O
18. CuO2
19. HgCl
20. HgCl2

**Some common names that you just have to remember:**

* NH3 ammonia
* CH4 methane
* BH3 borane
* B2H6 **di**borane (*because it is formed by 2 boranes*)
* H2O water

**Medium difficulty formulation (*combining more complicated metals and ions*)**

1. Titanium(II) hypochlorite
2. Titanium(IV) chlorite
3. Zinc bromate
4. Silver perbromate
5. Calcium chromate
6. Calcium dichromate
7. Lithium nitride
8. Potassium nitrite
9. Sodium nitrate
10. Aluminium sulfite
11. Cobalt(II) arsenate
12. Lead(IV) cyanide
13. Lead(II) cyanate
14. Potassium manganate
15. Potassium permanganate
16. Be(IO3)2
17. Li2O2
18. Ni(NO3)3
19. Rb2SO3
20. Au(ClO)3
21. Pb(IO4)4
22. CrMnO4
23. Zn3(PO4)2
24. HgCN
25. Hg(CN)2
26. SnSiO4
27. FeBr3
28. Mn(OH)2
29. Ag2CO3
30. Ti(NO2)2

**Naming acids**

Acids cause the most problems in formulation because they follow a slightly different logic. Any compound whose formula begins with hydrogen is called an acid. Therefore its name must end with “acid”.

**Example 1** – if we followed the normal rules for naming chemicals then **HCl** would be called **hydrogen chloride**. However, because the formula begins with an **H** we must call it ………… acid. In this case, **hydrochloric acid**.

**Example 2** - if we followed the normal rules for naming chemicals then **H2SO4** would be called **hydrogen sulfate**. However, because the formula begins with an **H** we must call it ………… acid. In this case, **sulfuric acid**.

**Basic rules for naming acids:**

* If a compound contains only hydrogen and 1 other element 🡪 **hydro**………**ic** **acid**

e.g. HBr 🡪 **hydro**brom**ic acid** H2S 🡪 **Hydro**sulfur**ic acid**

* For the group 7 acids that also contain oxygen we must convert their names as shown below:

**Formula Expected name Actual name**

HClO Hydrogen **hypo**chlor**ite** **Hypo**brom**ous** acid

HClO2 Hydrogen chlor**ite** Brom**ous** acid

HClO3 Hydrogen chlor**ate** Chlor**ic** acid

HClO4 Hydrogen **per**chlor**ate** **Per**chlor**ic** acid

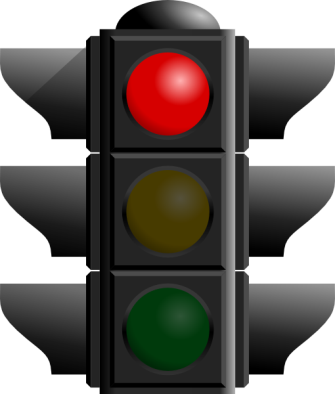
* For other common acids (with S, N or P) where there are 2 possibilities we use the endings “ous” and “ic” depending on whether the lowest or highest ox. number is being used:

**Lowest ox. number Highest ox. number**

Sulfur**ous** acid H2SO3 (S+4) Sulfur**ic** acid H2SO4 (S+6)

Nitr**ous** acid HNO2 (N+3) Nitr**ic** acid HNO3 (N+5)

Phosphor**ous** acid H3PO3 (P+3) Phosphor**ic** acid H3PO4 (P+5)

**Difficult formulation**

1. Hypobromous acid
2. Iodic acid
3. Hydroiodic acid
4. Phosphoric acid
5. Phosphorous acid
6. Nitric acid
7. Hydrochloric acid
8. Hydroselenic acid
9. Periodic acid
10. Chlorous acid
11. HNO3
12. H2O (trick question)
13. H2S
14. HBrO3
15. HI
16. HClO4
17. HClO3
18. H2SO4
19. HIO2
20. H3PO3

**If you can do these then you are a formulation hero.**

**Congratulations!**

