OXIDATION STATES

- When using oxidation states, we effectively imagine everything to be an ion – the oxidation state is the charge it would have if it was an ion.

- **RULES** for assigning oxidation states:

a) In elements, the oxidation state is always zero
e.g. Cl_2 (Cl 0)

b) On simple ions, the oxidation state is the charge on the ion
e.g. Cu^{2+} (Cu +2); Cl^- (Cl –1); Al_2O_3 (Al +3, O -2)

c) The total of all the oxidation states must always equal the overall charge on the species.

d) Some common ones: H is nearly always +1; oxygen –2; Group 1 +1; Group 2 +2
e.g. CH_4 (C -4, H +1); CO_2 (C +4, O -2); H_2O (H +1, O -2); Na_2O (Na +1, O –2); MgO (Mg +2, O –2)

e) In molecules and more complex ions, the more electronegative element is assumed to be the negative ion

1) Calculate the oxidation state of the stated element in each of the following species:

species	Fe	$FeCl_3$	$FeCl_2$	K_2FeO_4	$[Fe(H_2O)_6]^{2+}$
oxidation state	Fe ……..	Fe ……..	Fe ……..	Fe ……..	Fe ……..

species	Cl_2	ClO_3^-	ClO^-	Cl_2O_7	Cl_2O_3
oxidation state	Cl ……..	Cl ……..	Cl ……..	Cl ……..	Cl ……..

2) Calculate the oxidation state of each element in the following:

species	SO_2	S_8	SO_3	H_2S	NH_3
oxidation state	S ……. O …….	S ……..	S ……. O …….	H ……. S …….	N ……. H …….

species	NO_2	NO_3^-	N_2	KCl	SO_4^{2-}
oxidation state	N ……. O …….	N ……. O …….	N ……..	K ……. Cl …….	S ……. O …….

species	Na_2CO_3	Cr_2O_3	CrO_3	MnO_4^{2-}	MnO_4^-
oxidation state	Na…. C …. O ….	Cr ……. O …….	Cr ……. O …….	Mn ……. O …….	Mn ……. O …….

species	Cu_2O	CuO	$KCuCl_2$	NaH	H_2O_2
oxidation state	Cu ……. O …….	Cu ……. O …….	K…. Cu …. Cl ….	Na ……. H …….	H ……. O …….

- Range of oxidation states – this is limited by the position of an element in the Periodic Table as the diagram below shows.
  - For example, N is in group 5 and could lose up to 5 electrons (oxidation state +5) or gain 3 electrons (oxidation state -3) before another shell of electrons is affected.
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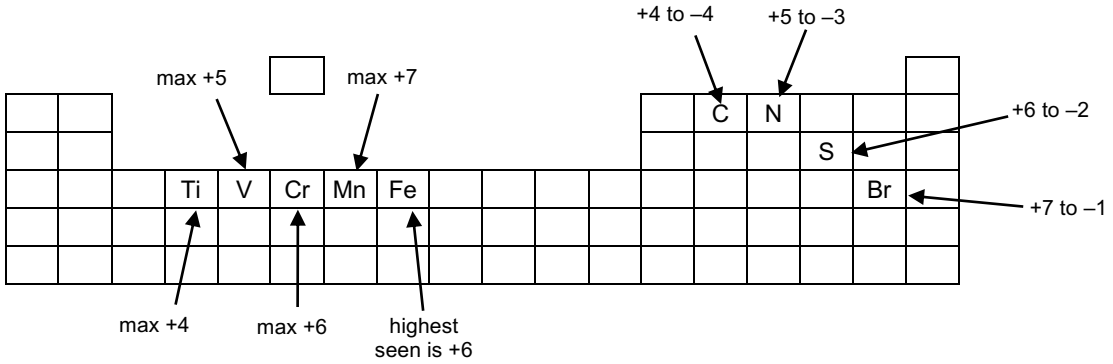
  - With the transition metals, they usually have positive oxidation states as they are metals, losing electrons until they reach a Group 0 noble gas electron configuration, but not usually being higher than +7 in practice



3) Give the likely range of oxidation state for each of the following elements.

a) phosphorus ……

b) silicon ……

c) iodine ……

d) gallium ……

4) State whether each of these oxidation states is likely to occur in stable compounds.

a) Sc +3 …….

b) Ni +2 …….

c) K +2 …….

d) W +6 …….

e) Se –3 …….

f) Mo +7 …….

g) Sb +5 …….