CHEMISTRY OF INDIVIDUAL OXIDES

1) SODIUM OXIDE (Na_2O)

Na_2O is a simple strong basic oxide. It is basic because it contains the oxide ion, O^{-2}, which is a very strong base with a high tendency to combine with hydrogen ions.

Reaction With Water:

Sodium oxide reacts exothermically with cold water to produce sodium hydroxide solution. Depending on its concentration, this will have a pH around 14.

$$Na_2O + H_2O \rightarrow 2NaOH$$

Reaction With Acids:

As a strong base, sodium oxide also reacts with acids. e.g, it would react with dilute hydrochloric acid to produce sodium chloride solution.

$$Na_2O + 2HCl \longrightarrow 2NaCl + H_2O$$

2) MAGNESIUM OXIDE (MgO)

Magnesium Oxide is again a simple basic oxide, bc it also contains oxide ions. However, it isn't as strongly basic as sodium oxide because the oxide ions aren't so free. In the Na_2O case, the solid is held together by attraction b.w 1+ and 2- ions. In the MgO case, the attractions are b.w 2+ and 2- ions. It takes more energy to break these.

Reaction With Water:

If we shake some white MgO powder with water, nothing seems to happen (it doesn't look as if it reacts). However if we test the pH of this liquid, we find that it is somewhere around pH 9 (showing that it is slightly alkaline). There must have been some slight rctn with water to produce hydroxide ions in solution. Some $Mg(OH)_2$ is formed in the reaction, but this is almost insoluble and so not many hydroxide ions actually get into solution.

$$MgO + H_2O \longrightarrow Mg(OH)_2$$

Reaction With Acids:

MgO reacts with acids. It reacts with warm dilute HCl to give magnesium chloride solu

$$MgO + 2HCl \longrightarrow MgCl_2 + H_2O$$

3) ALUMINIUM OXIDE (Al_2O_3)

As it is amphoteric oxide, it has reactions as both base and an acid.

No

Reaction With Water:

~~Aluminium oxide will react with hot dilute HCl acid to give aluminium chlorid~~

Aluminium oxide doesn't react in a simple way with water and doesn't dissolve in it. Although, it still contains oxide ions, they are held too strongly in the solid lattice to react with water

Reaction With Acids:

Aluminium oxide will react with hot dilute HCl acid to give aluminium chloride solution.

$$Al_2O_3 + 6HCl \longrightarrow 2AlCl_3 + 3H_2O$$

Reaction With Bases:

Aluminium Oxide has also got an acidic side to its nature, and it shows this by reacting with bases such as sodium hydroxide solution

Various aluminates are formed, compounds where the aluminium is found in the negative ion. This is possible bcz aluminium has the ability to form covalent bonds with oxygen.

With hot, concentrated sodium hydroxide solution, aluminium oxide reacts to give a colourless solution of sodium tetrahydroxoaluminitate.

$$Al_2O_3 + 2NaOH + 3H_2O \longrightarrow 2Na[Al(OH)_4]$$

4) SILICON DI OXIDE (SiO_2)

react at 800°C
$SiO_2 + H_2O \xrightarrow{300^\circ} Si(OH)_4$

SiO_2 doesnot react with water, but it reacts with concentrated alkalies forming silicates (SiO_3^{2-})

$$SiO_2 + 2NaOH \longrightarrow Na_2SiO_3 + H_2O$$

Sodium silicate

5) PHOSPHORUS (V) OXIDE (P_4O_{10})

Reaction With Water:

Phosphorus (V) oxide reacts violently with water to give a solution containing a mixture of acids, the nature of which depends on the conditions. We usually just consider one of these, phosphoric (V) acid, H_3PO_4 (phosphoric acid or orthophosphoric acid)

$$P_4O_{10} + 6H_2O \longrightarrow 4H_3PO_4$$

REACTION WITH BASE:

As it is acidic so it reacts with NaOH as follows:

$$NaOH + H_3PO_4 \rightarrow NaH_2PO_4 + H_2O$$
$$2NaOH + H_3PO_4 \rightarrow Na_2HPO_4 + 2H_2O$$
$$3NaOH + H_3PO_4 \rightarrow Na_3PO_4 + 3H_2O$$

Again, if were to react phosphorus (V) oxid directly with sodium hydroxide solution rather than making the acid first, we would end up with the same possible salts

$$12NaOH + P_4O_{10} \rightarrow 4Na_3PO_4 + 6H_2O$$

6) SULPHUR OXIDES (SO_x)

(i) SULPHUR DIOXIDE (SO_2)

REACTION WITH WATER:

Sulphur dioxide is fairly soluble in water, reacting with it to give a solution of sulphurous acid, H_2SO_3

$$SO_2 + H_2O \rightarrow H_2SO_3$$

REACTION WITH BASE:

As it is acidic so it reacts with NaOH and CaO as follows:

$SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$

$Na_2SO_3 + H_2O + SO_2 \rightarrow 2NaHSO_3$

$CaO + SO_2 \rightarrow CaSO_3$

$SO_2 + NaOH \rightarrow NaHSO_3$ + H_2O

(ii) SULPHUR TRI OXIDE (SO_3)

REACTION WITH WATER:

SO_3 reacts violently with water to produce a fog of concentrated sulphuric acid droplets

$SO_3 + H_2O \rightarrow H_2SO_4$

REACTION WITH BASE

$CaO + SO_3 \rightarrow CaSO_4$

$SO_3 + NaOH \rightarrow NaHSO_4$

(7) CHLORINE OXIDES (Cl_2O_x)

(i) CHLORINE (I) OXIDE (Cl_2O)

REACTION WITH WATER:

Cl_2O is far less acidic than Cl_2O_7. It reacts with water to some extent to give chloric (I) oxide, HOCl - also known as hypochlorous acid

$Cl_2O + H_2O \rightleftharpoons 2HOCl$

REACTION WITH BASE

Cl_2O reacts with NaOH to give a solution of Sodium chlorate (I) (sodium hypochlorite)

$$2NaOH + Cl_2O \longrightarrow 2NaOCl + H_2O$$

(ii) CHLORINE (VII) OXIDE (Cl_2O_7)

Chlorine (VII) oxide is the highest oxide of chlorine - the chlorine is in maximum oxidation state of +7.

REACTION WITH WATER

Chlorine (VII) oxide reacts with water to give the very strong acid, chloric (VII) acid - also known as perchloric acid. The pH of typical solutions will, like, sulphuric acid, be around zero.

$$Cl_2O_7 + H_2O \longrightarrow 2HClO_4$$

REACTION WITH BASE:

$$2NaOH + Cl_2O_7 \rightarrow 2NaClO_4 + H_2O$$