

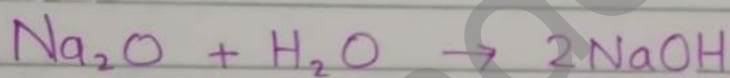
# CHEMISTRY OF INDIVIDUAL OXIDES

## 1) SODIUM OXIDE ( $\text{Na}_2\text{O}$ )

$\text{Na}_2\text{O}$  is a simple strong basic oxide. It is basic because it contains the oxide ion,  $\text{O}^{2-}$ , which is a very strong base with a high tendency to combine with hydrogen ions.

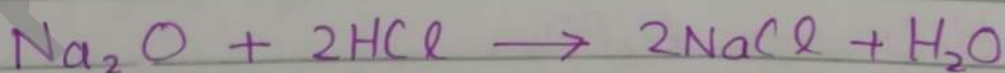
### Reaction With Water:

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



### 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.

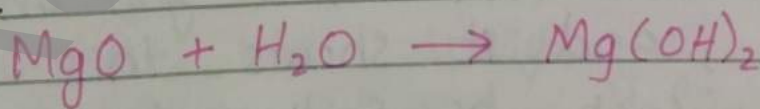


## 2) MAGNESIUM OXIDE (MgO)

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  $\text{Na}_2\text{O}$  case, the solid is held together by attraction b/w  $1^+$  and  $2^-$  ions. In the  $\text{MgO}$  case, the attractions are b/w  $2^+$  and  $2^-$  ions. It takes more energy to break these.

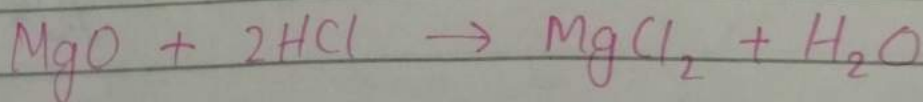
### Reaction With Water:

If we shake some white  $\text{MgO}$  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 rxn with water to produce hydroxide ions in solution. Some  $\text{Mg}(\text{OH})_2$  is formed in the reaction, but this is almost insoluble and so not many hydroxide ions actually get into solution.



### Reaction With Acids:

$\text{MgO}$  reacts with acids. It reacts with warm dilute  $\text{HCl}$  to give magnesium chloride solution.





### 3) ALUMINIUM OXIDE ( $\text{Al}_2\text{O}_3$ )

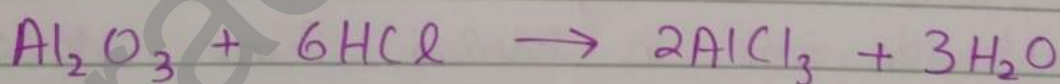
As it is amphoteric oxide, it has reactions as both base and an acid.

<sup>No</sup> Reaction With Water:

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

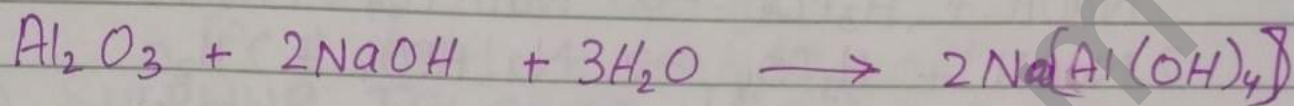
Aluminium oxide will react with hot dilute HCl acid to give aluminium chloride solution.



Reaction With Bases:

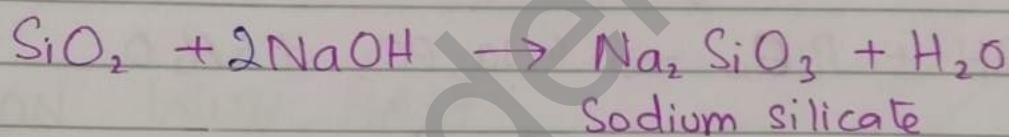
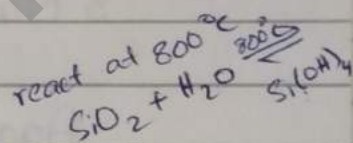
Aluminium Oxide has also got an acidic side to its nature, and it shows this by reacting with bases such as sodium hydroxide solution. Various aluminates are formed, compounds where the aluminium is found in the negative ion. This is possible bcz aluminium has the ability to form covalent bonds with oxygen.

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



#### 4) SILICON DIOXIDE ( $\text{SiO}_2$ )

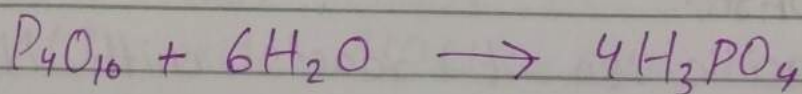
$\text{SiO}_2$  does not react with water, but it reacts with concentrated alkalis forming silicates ( $\text{SiO}_3^{2-}$ )



#### 5) PHOSPHORUS (V) OXIDE ( $\text{P}_4\text{O}_{10}$ )

Reaction With Water:

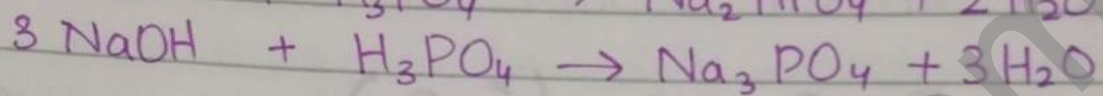
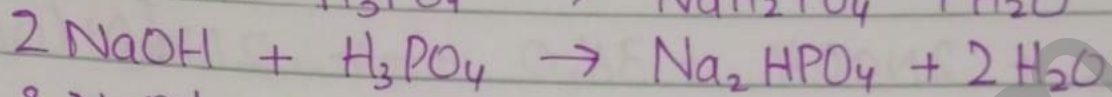
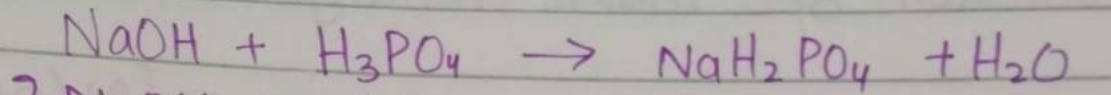
Phosphorus (V) oxide reacts violently with water to give a solution containing a mixture of acids, the nature of which depends on the conditions. We usually just consider one of these, phosphoric (V) acid,  $\text{H}_3\text{PO}_4$  (phosphoric acid or orthophosphoric acid)



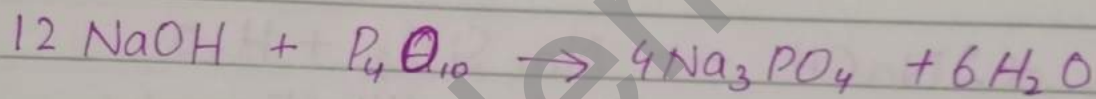


## REACTION WITH BASE:

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



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

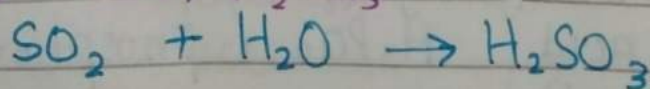


## 6) SULPHUR OXIDES ( $\text{SO}_x$ )

### (i) SULPHUR DIOXIDE ( $\text{SO}_2$ )

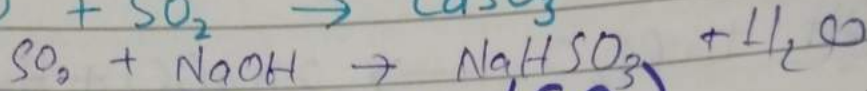
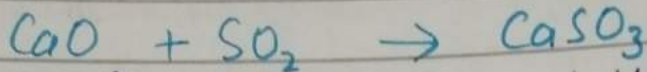
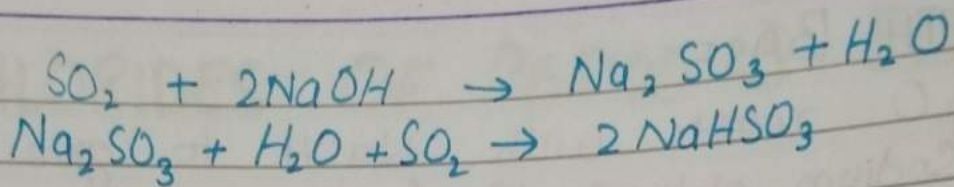
#### REACTION WITH WATER:

Sulphur dioxide is fairly soluble in water, reacting with it to give a solution of sulphurous acid,  $\text{H}_2\text{SO}_3$



#### REACTION WITH BASE:

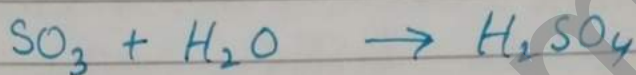
As it is acidic so it reacts with NaOH and CaO as follows:



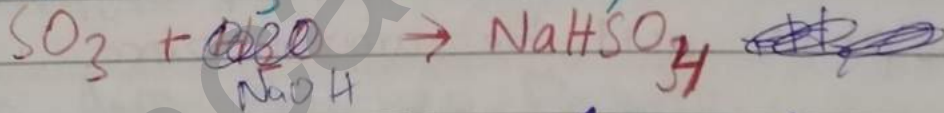
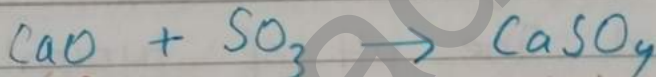
## (ii) SULPHUR TRI OXIDE ( $\text{SO}_3$ )

### REACTION WITH WATER:

$\text{SO}_3$  reacts violently with water to produce a fog of concentrated sulphuric acid droplets



### REACTION WITH BASE

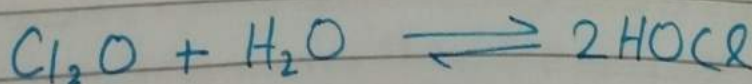


## (7) CHLORINE OXIDES ( $\text{Cl}_2\text{O}_x$ )

### (i) CHLORINE (I) OXIDE ( $\text{Cl}_2\text{O}$ )

#### REACTION WITH WATER:

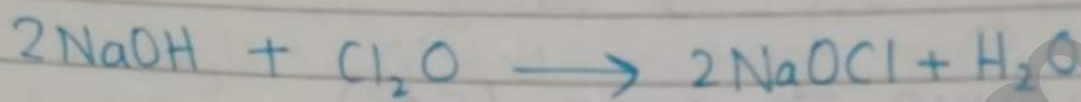
$\text{Cl}_2\text{O}$  is far less acidic than  $\text{Cl}_2\text{O}_7$ . It reacts with water to some extent to give chloric (I) oxide,  $\text{HOCl}$  - also known as hypochlorous acid





## REACTION WITH BASE

$\text{Cl}_2\text{O}$  reacts with  $\text{NaOH}$  to give a solution of sodium chlorate (I) (sodium hypochlorite)

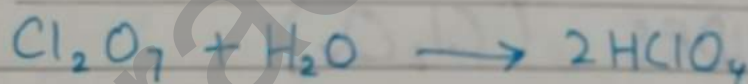


## (ii) CHLORINE (VII) OXIDE ( $\text{Cl}_2\text{O}_7$ )

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.



## REACTION WITH BASE:

