

# Sulphurdioxide (SO<sub>2</sub>)

**Presented by: Sirjana Basaula**

# Physical properties of SO<sub>2</sub>

- it is colourless gas with pungent and suffocating odour of burning sulphur
- it is heavier than air and very soluble in water, solution is called sulphurous acid(H<sub>2</sub>SO<sub>3</sub>)
- it can be liquified at -10<sup>0</sup>C and solidified at -76<sup>0</sup>C

## Chemical Properties of sulphur dioxide (SO<sub>2</sub>)

### 1. Weak acidic nature of SO<sub>2</sub> :

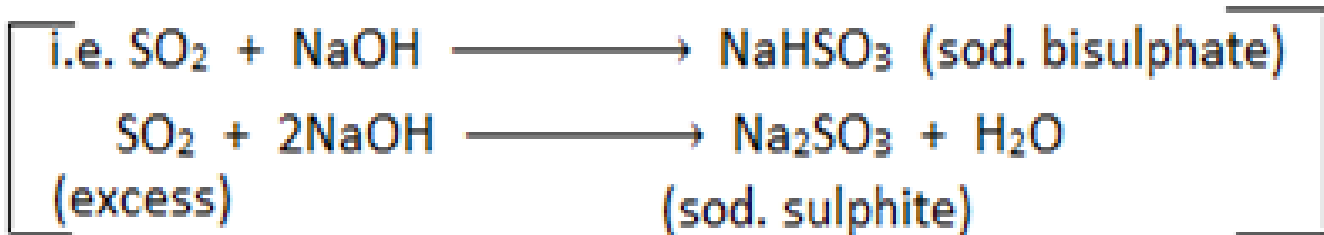
It dissolves in water to give sulphurous acid, a weak diprotic (dibasic) acid.



Sulphurous acid ionizes in two steps:

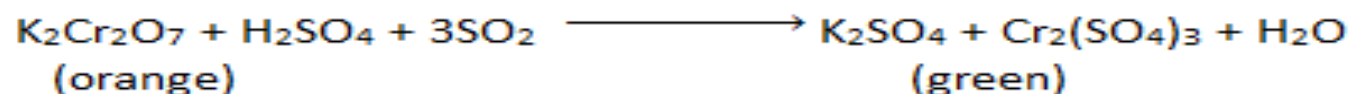


It produces two series of salts if reacted with base.Eg.

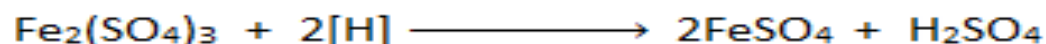
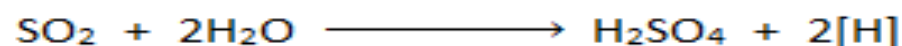
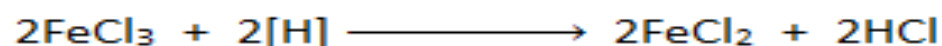




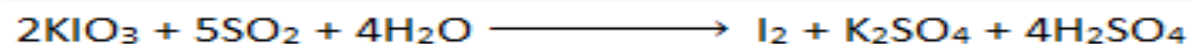
- It reduces acidified  $K_2Cr_2O_7$  solution and orange color of  $K_2Cr_2O_7$  changes to light green.



- It reduces ferric salt to ferrous salt and colour changes from yellow to light green.

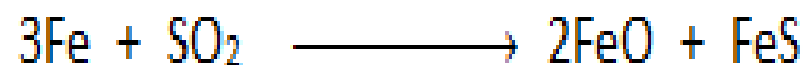
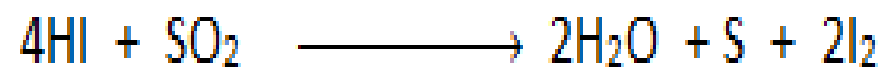
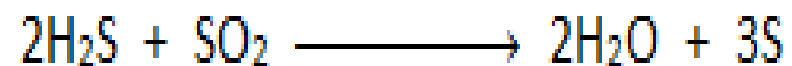


- It reduces potassium iodate( $KIO_3$ ) solution to iodine.



### 3. SO<sub>2</sub> as an oxidizing agent :

SO<sub>2</sub> oxidizes powerful reducing agents like H<sub>2</sub>S, HI, Mg, Fe, etc and itself get reduced to sulphur or sulphide.



## 4. SO<sub>2</sub> as bleaching agent

SO<sub>2</sub> can act as a bleaching agent in presence of moisture. It can bleach coloured wool, silk, flower, hair, etc. The bleaching action of sulphur dioxide is due to the formation of nascent hydrogen in presence of moisture, which reduces colouring substance to colourless reduced product.



In some cases, bleaching action of SO<sub>2</sub> is due to formation of colourless addition product.

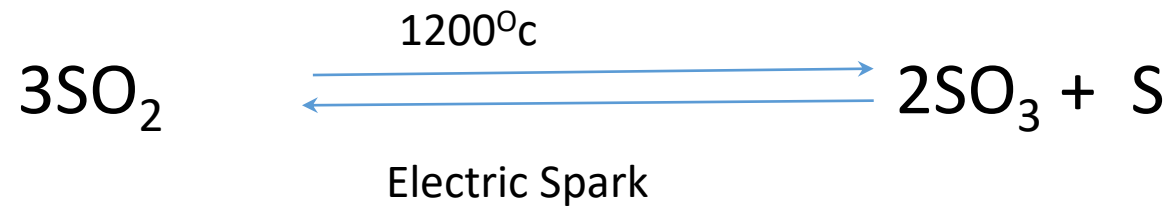


→ The bleaching action of SO<sub>2</sub> is temporary. The bleached colourless compound will regain its original colour slowly on standing in air due to oxidation by air.

5. Combustibility: neither combustible nor a supporter of combustion, strongly burning magnesium and potassium however continues to burn in it



6. Thermal dissociation: it dissociates at 1200°C into sulphur trioxide and sulphur



# Sulphuric Acid( $\text{H}_2\text{SO}_4$ )

Physical properties:

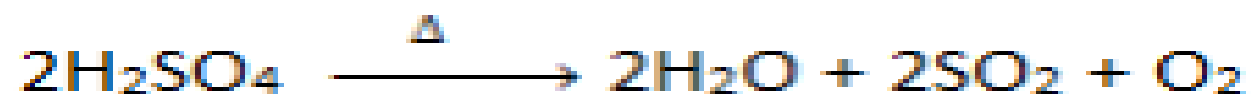
- it is colourless liquid with density of 1.84 at  $15^\circ\text{C}$
- it boils at  $338^\circ\text{C}$
- it fumes strongly in moist air and is highly corrosive
- it dissolves in water with evolution of larger quantity of heat, it is safe to add the acid in water when diluting
- pure anhydrous  $\text{H}_2\text{SO}_4$  is bad conductor of electricity
- aqueous solution of  $\text{H}_2\text{SO}_4$  is good conductor of electricity
- sulphuric acid is a dense oily liquid known as **oil of vitriol**

## Chemical properties of $\text{H}_2\text{SO}_4$ :

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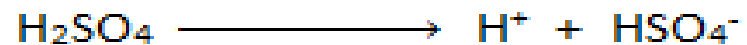
### 1. Decomposition of $\text{H}_2\text{SO}_4$ :

On heating  $\text{H}_2\text{SO}_4$  decomposes into  $\text{SO}_2$ ,  $\text{H}_2\text{O}$  and  $\text{O}_2$ .

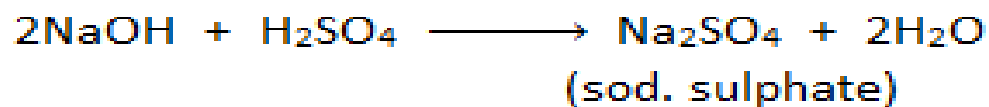
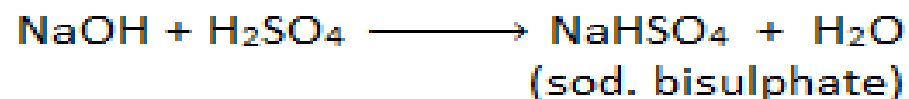


## 2. Acidic nature of H<sub>2</sub>SO<sub>4</sub>:

H<sub>2</sub>SO<sub>4</sub> is a strong dibasic (diprotic) acid and ionizes in two steps.



It gives two series of salts like bisulphate and sulphate when reacted with base. Eg.

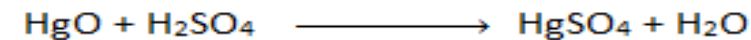


### 3. $\text{H}_2\text{SO}_4$ as an oxidizing agent :

i. **Action with metals** : More electropositive metals ( i.e. metals lying above hydrogen in electrochemical series) like Zn, Fe, Mg, Al, etc. react with dil  $\text{H}_2\text{SO}_4$  to produce hydrogen gas. Here  $\text{H}_2\text{SO}_4$  reduces to  $\text{H}_2$  and metals oxidize to metal sulphates.

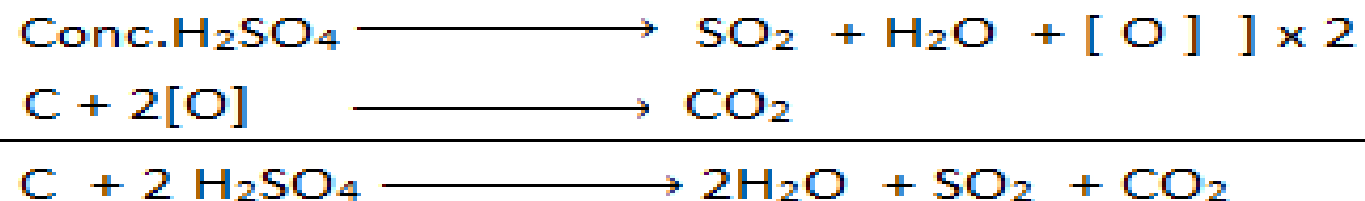


Conc.  $\text{H}_2\text{SO}_4$  oxidizes Zn, Cu, Ag, Hg, etc. to respective metal sulphates and  $\text{H}_2\text{SO}_4$  gets reduced to  $\text{SO}_2$ .

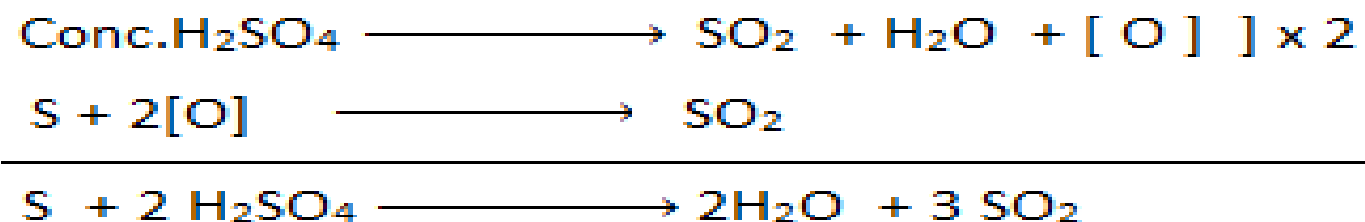


## ii. Action with non metals :

- Carbon is oxidized to carbondioxide.



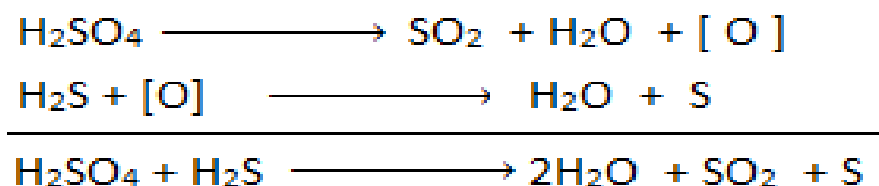
- Sulphur is oxidized to sulphurdioxide.



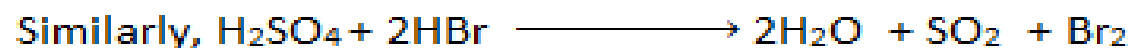
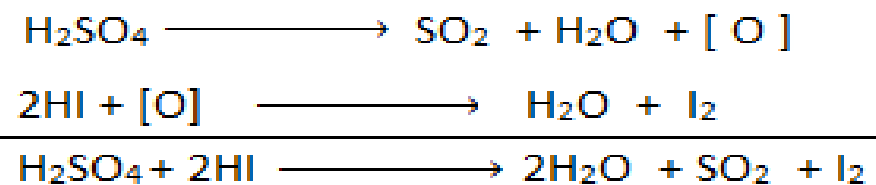
- Phosphorus is oxidized to phosphoric acid.

### iii. Action with some other reducing agents :

- $\text{H}_2\text{SO}_4$  oxidizes  $\text{H}_2\text{S}$  to  $\text{S}$  and itself reduces to  $\text{SO}_2$ .



- $\text{HBr}$  and  $\text{HI}$  are oxidized to  $\text{Br}_2$  and  $\text{I}_2$  respectively.

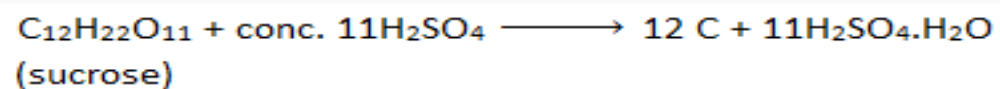


*{Note :  $\text{HCl}$  can not be oxidized to  $\text{Cl}_2$  because of strong bond.}*

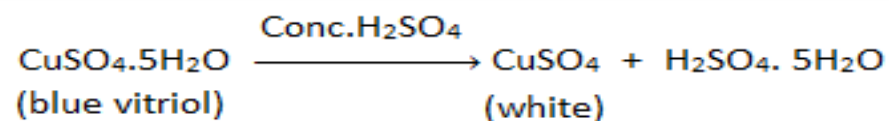
#### 4. Sulphuric acid as dehydrating agent :

H<sub>2</sub>SO<sub>4</sub> is a good dehydrating agent. It absorbs water molecules from sugar, cellulose, copper sulphate crystals, etc.

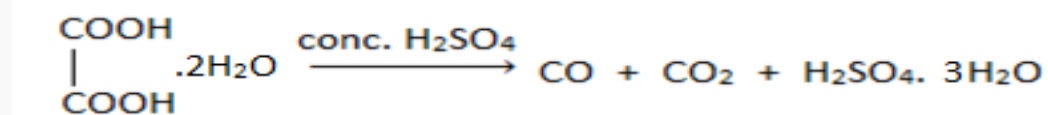
- **With sugar (charring action)** : When conc. H<sub>2</sub>SO<sub>4</sub> is treated with sugar, wood, paper, etc. it absorbs water and a black mass of carbon is formed. This process is called charring.



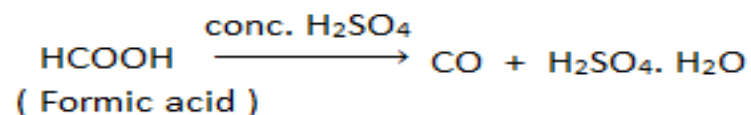
- **With copper sulphate crystals** : It removes water of crystallization from hydrated salts.



- **With oxalic acid crystals and formic acid:**



(Oxalic acid)



## Uses of sulphuric acid :

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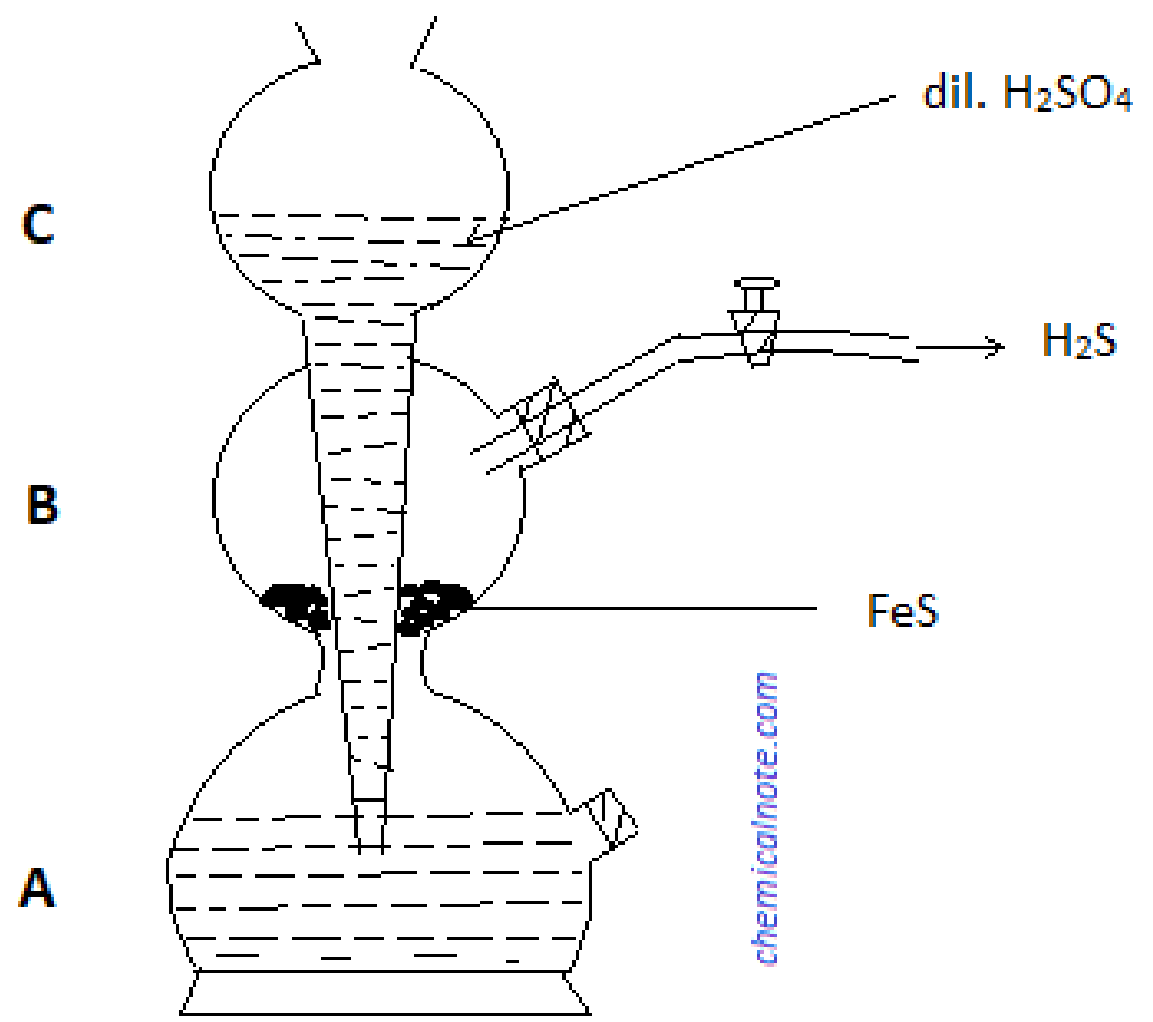
- It is used for the manufacture of fertilizers.
- It is used in manufacture of HCl,  $\text{HNO}_3$ ,  $\text{H}_3\text{PO}_4$ , etc.
- It is used as an oxidizing agent.
- It is used as a drying and dehydrating agent.

# Hydrogen Sulphide(H<sub>2</sub>S)

## Preparation of hydrogen sulphide in Kipp's apparatus:

To prepare hydrogen sulphide gas in a Kipp's apparatus, iron sulfide (FeS) is placed in the middle bulb of the apparatus, then dilute sulfuric acid is added to the top bulb; when the tap is opened, the acid flows down and reacts with the iron sulfide, generating hydrogen sulfide gas which can be collected through the tap.

- **Chemical reaction:**  $\text{FeS (solid)} + \text{H}_2\text{SO}_4 \text{ (liquid)} \rightarrow \text{FeSO}_4 \text{ (aqueous)} + \text{H}_2\text{S (gas)}$ .
- **Kipp's apparatus function:** This apparatus allows for controlled gas production by isolating the reaction when the tap is closed, preventing the acid from continuously reacting with the iron sulfide.



**Fig.Kipp's apparatus**

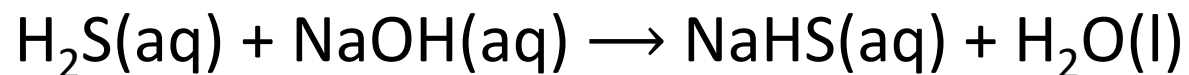
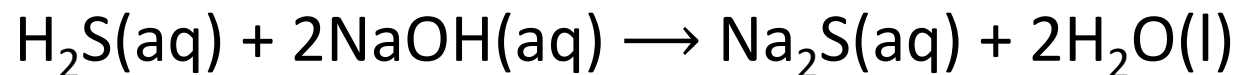
*chemicalnote.com*

# Chemical Properties

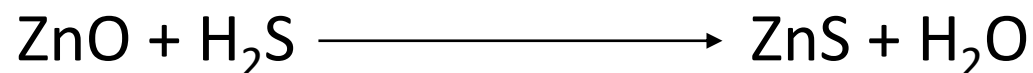
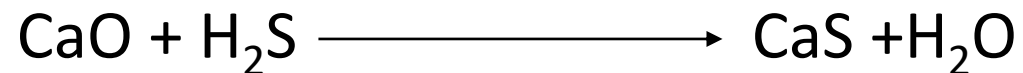
## 1. Acidic nature (as a weak acid)

- Dibasic acid

Reaction with sodium hydroxide:



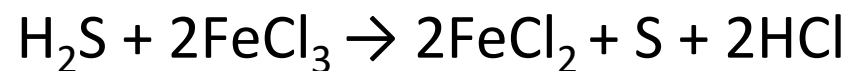
- Being weaker acid than carbonic acid, does not decompose carbonates.
- Combines with metal oxides to form their sulphides.



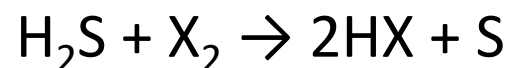
## 2. Reducing properties:

Hydrogen sulfide (H<sub>2</sub>S) exhibits strong reducing properties and can react with various substances, including ferric salts, halogens, hydrogen peroxide, sulfur dioxide, and nitric acid.

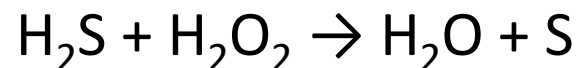
### 1. Reducing Properties with Ferric Salts (Fe<sup>3+</sup>):



### 2. Reducing Properties with Halogens:



### 3. Reducing Properties with Hydrogen Peroxide (H<sub>2</sub>O<sub>2</sub>):



### 4. Reducing Properties with Sulfur Dioxide (SO<sub>2</sub>):

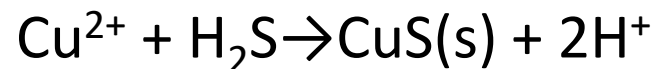


### 3. Analytical reagent:

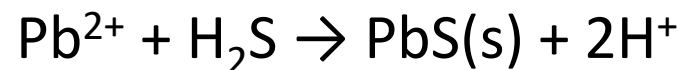
H<sub>2</sub>S is used to detect metal ions in solution by reacting with them to form **insoluble metal sulfides**. The formation of these sulfides can be used to identify metals based on their solubility or color.



Iron (III) forms iron(III) sulfide (Fe<sub>2</sub>S<sub>3</sub>), a black precipitates.



Copper (II) forms copper(II) sulfide (CuS), which is a black precipitate.



Lead (II) forms lead(II) sulfide (PbS), a black precipitate.

# Uses

- $\text{H}_2\text{S}$  gas is used as an important analytical reagent in qualitative analysis.
- Used as a reducing agent.
- Used in the preparation of haloacids like  $\text{HBr}$ ,  $\text{HI}$ , etc.
- Used in the preparation of metallic sulphides, some of which are in turn used as pigments.