

GROUP-16 ELEMENTS (CHALCOGENS)

Group 16 Elements: O,S,Se,Te,Po

General electronic configuration: ns^2np^4

ATOMIC & PHYSICAL PROPERTIES

- Ionisation enthalpy decreases from oxygen to polonium.
- Oxygen atom has less negative electron gain enthalpy than S because of the compact nature of the oxygen atom. However from the S onwards the value again becomes less negative upto polonium.
- Electronegativity gradually decreases from oxygen to polonium, metallic character increases from oxygen to polonium.
- Oxygen & S are non-metals, selenium and tellurium are metalloids. Po is a radioactive metal.
- Oxygen is a diatomic gas while S, Se & Te are octa atomic solid S_8, Se_8 & Te_8 molecules which has puckered 'ring' structure.

CHEMICAL PROPERTIES

- Common oxidation state:- -2,+2,+4 & +6.
- Due to inert pair effect, the stability of +6 decreases down the group and stability of +4 increases.

Oxygen exhibits +1 state in O_2F_2 , +2 in OF_2 .

Anomalous behavior of oxygen-due to its small size, high electronegativity and absence of d-orbitals.

TREND IN PROPERTIES

Acidic character- $H_2O < H_2S < H_2Se < H_2Te$

Thermal stability- $H_2O > H_2S > H_2Se > H_2Te$

Reducing character- $H_2S < H_2Se < H_2Te$

Boiling point- $H_2S < H_2Se < H_2Te < H_2O$

Reducing property of dioxides- $SO_2 > SeO_2 > TeO_2$

Stability of halides- $F > Cl > Br > I$

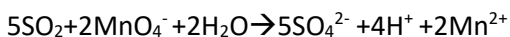
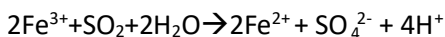
HALIDES OF SULPHUR

DI HALIDES: sp^3 hybridisation but angular structure, SCl_2

TETRA HALIDES: sp^3 hybridisation-see-saw geometry, SF_4

HEXA HALIDES: sp^3d^2 , octahedral SF_6

DIOXYGEN



SO₂ molecule is angular.

OXIDES

A binary compound of oxygen with another element is called oxide. Oxides can be classified on the basis of nature

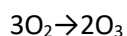
- **Acidic Oxides:**-Non metallic oxides. Aqueous solutions are acids. Neutralize bases to form salts.Ex:SO₂,CO₂,N₂O₅ etc.
- **Basic Oxides:**metallicoxides.Aqueous solutions are alkalis. Neutralize acids to form salts.Ex:Na₂O,K₂O,etc.
- **Amphoteric oxides:**-some metallic oxides exhibit a dual behavior. Neutralize bothacids& bases to form salts.
Ex:-Al₂O₃,SbO₂,SnO,etc.....

Neutral non metal oxide → CO, N₂O, NO

OZONE

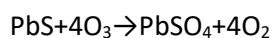
PREPARATION

Prepared by subjecting cold, dry oxygen to silent electric discharge.



PROPERTIES

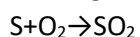
Due to the ease with which it liberates atoms of nascent oxygen, it acts as a powerful oxidizing agent. For eg:- it oxidisesleadsulphide to lead sulphate and iodide ions to iodine.



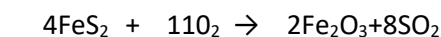
SULPHUR DIOXIDE

PREPARATION

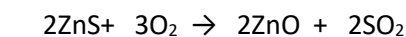
Burning of S in air



Roasting of sulphide minerals



(Iron pyrites)



(Zinc blende)

PROPERTIES

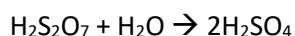
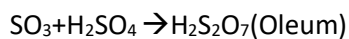
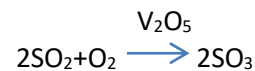
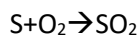
- Highly soluble in water to form solution of sulphurous acid
 $SO_2 + H_2O \rightarrow H_2SO_3$
- SO₂ reacts with Cl₂ to form sulphuryl chloride
 $SO_2 + Cl_2 \rightarrow SO_2Cl_2$
- It reacts with oxygen to form SO₃ in presence of V₂O₅ catalyst
 $2SO_2 + O_2 \rightarrow 2SO_3$

- Moist SO₂ behaves as a reducing agent. It converts Fe(III) ions to Fe(II) ions & decolourises acidified potassium permanganate (VII) solution (It is the test for the gas).

SULPHURIC ACID

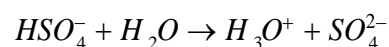
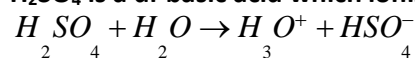
PREPARATION

It is manufactured by contact process which involves following reactions.

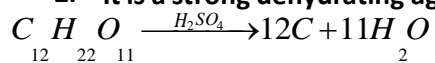


PROPERTIES

- H₂SO₄ is a di-basic acid which ionizes as -



- It is a strong dehydrating agent .eg:-charring action of sugar



It is a moderately strong oxidizing agent.

