

illustrate by symbols any chemical changes taking place: (a) Hydrogen, (b) nitrogen monoxide, (c) chlorine, (d) sulphur dioxide, (e) sodic carbonate, (f) "quick" lime, (g) magnesian sulphate, (h) ferric chloride.

4. (a) Hydrogen is usually obtained by displacing the gas from sulphuric acid by means of zinc, thus: $\text{H}_2\text{SO}_4 + \text{Zn} = \text{ZnSO}_4 + \text{H}_2$.

(b) Nitrogen monoxide is obtained by heating ammonium nitrate: $-\text{NH}_4\text{NO}_3 = \text{N}_2\text{O} + 2\text{H}_2\text{O}$.

(c) Chlorine is obtained by heating together a mixture of sodium chloride, manganese dioxide and sulphuric acid: $-\text{MnO}_2 + 2\text{NaCl} + 3\text{H}_2\text{SO}_4 = \text{MnSO}_4 + 2\text{HNaSO}_4 + 2\text{H}_2\text{O} + \text{Cl}_2$; or by heating together hydrochloric acid and manganese dioxide: $-\text{MnO}_2 + 4\text{HCl} = \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$.

(d) Sulphur dioxide is given off when sulphuric acid is heated with copper: $-2\text{H}_2\text{SO}_4 + \text{Cu} = \text{CuSO}_4 + 2\text{H}_2\text{O} + \text{SO}_2$.

(e) Sodic carbonate is obtained by heating sodic sulphate along with excess of chalk and powdered coal in a reverberatory furnace. There are two stages in the process, in the first of which the sulphate is converted into sulphide: $-\text{Na}_2\text{SO}_4 + 4\text{C} = \text{Na}_2\text{S} + 4\text{CO}$. In the second stage the sulphide is converted into carbonate: $-\text{Na}_2\text{S} + \text{CaCO}_3 = \text{Na}_2\text{CO}_3 + \text{CaS}$. The carbonate is separated out of the resulting mixture by treating with water. If the solution be evaporated, and the residue be calcined and again dissolved, the crystallized carbonate will be obtained on slowly cooling the solution.

(f) Quicklime is obtained by heating limestone (calcium carbonate) in a proper kiln: $-\text{CaCO}_3 = \text{CaO} + \text{CO}_2$.

(g) Magnesian sulphate is prepared by treating dolomite (magnesian calcic carbonate) with sulphuric acid; thus (omitting the calcic carbonate): $-\text{MgCO}_3 + \text{H}_2\text{SO}_4 = \text{MgSO}_4 + \text{H}_2\text{O} + \text{CO}_2$. The crystals have the formula $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$.

(h) Ferric chloride is obtained by treating iron sesquioxide with hydrochloric acid: $-\text{Fe}_2\text{O}_3 + 6\text{HCl} = \text{Fe}_2\text{Cl}_6 + 3\text{H}_2\text{O}$; or by passing chlorine over red-hot iron, when direct combination takes place.

5. Describe and explain any phenomena observable, when—

(a) Copper is put into strong nitric acid;

(b) Water is mixed with strong commercial sulphuric acid;

(c) The breath is passed for some time through lime-water, and then carbon dioxide is passed through it in excess.

(d) A few drops of sulphuric acid is added to a solution of sodic thiosulphate.

(e) Ferrous sulphate is strongly heated in the air.

(f) A drop of a solution of potassic permanganate is added to water containing organic matter.

5. (a) Dense brown fumes are produced if the nitric oxide which is formed is admitted to contact with the air; this is due to the combination of NO with oxygen. The liquid, also, becomes green, owing to the formation of copper nitrate.

(b) Great heat is developed and a shrinkage in volume is observed, both phenomena being due to the chemical combination of the acid and the water.

(c) First, the lime-water becomes turbid owing to the production of calcium carbonate, the CO_2 exhaled from the lungs combining with the CaO in the water. Secondly, the water becomes clear again, owing to the solution of the CaCO_3 in the carbonic acid.

(d) Sodic sulphate and thiosulphuric acid are formed, the latter immediately decomposing into sulphurous acid and sulphur.

(e) White acid fumes are given off, which condense in oily drops. The sulphate is converted into ferric oxide, sulphur trioxide and sulphur dioxide.

(f) The permanganate gives up a portion of its oxygen to the organic matter and loses its characteristic colour.

6. What is the chemical difference in the bleaching effected by chlorine and that by sulphur dioxide?

Dry chlorine will not bleach. Why?

6. The bleaching effected by chlorine is due to the oxidation of the colouring matter; that effected by sulphur dioxide is a deoxidizing or reducing process. In the former case