H Cl 1.2474 times heavier than water. Hence it will be seen, that as compared with the standard water, $H_2 S O_4$ is the heaviest, H N O_3 the next, and H Cl the lightest; and this is the order in which they will arrange themselves, $H_2 S O_4$ being at the bottom.

VI. (*a*). "Describe the manufacture of Hydric Sulphate ($H_2 S O_4$). (*b*). What impurities may it contain? (*c*). Account for their presence."

(*a*). Take a large glass bottle, and place in the bottom a thin layer of water. Arrange four tubes entering it near the bottom, and a waste pipe at the top. Through the first tube pass steam into the bottle. Through the second pass in Sulphuric Dioxide (made by burning sulphur). Heat a flask containing Copper turnings and Nitric Acid, to make Oxide of Nitrogen ($N_2 O_3$), which takes up an atom of Oxygen from the air, and becomes $N_2 O_3$ and allow this to enter by the third tube. The fourth tube is employed to admit, from time to time, a current of air. The action that takes place is this: when the $S O_2$ and $N_2 O_3$ come in contact, the latter readily gives up one-third of its O to the $S O_2$ to form $S O_3$; and this, uniting with the steam ($H_2 O$) forms $H_2 S O_4$ which is absorbed by the water in the bottom of the vessel. Now, the moment the $N_2 O_3$ gives up part of its O to the $S O_2$, the $N_2 O_2$ which is left unites with the O of the air, which is being admitted from time to time, to form $N_2 O_3$, which immediately hands over one-third of its O to the $S O_2$ to again form $S O_3$ and so the same operation is repeated *ad infinitum*, the ($N_2 O_2$) being merely the carrier of O from the air to the $S O_2$. The solution of $H_2 S O_4$ at the bottom of the vessel will be found to be very weak, but may be concentrated by evaporation.

(*b*). The impurities of commercial $H_2 S O_4$ are Lead, Arsenic and Nitric Acid.

(*c*). The Lead comes from the leaden chambers in which the $H_2 S O_4$ is made.

The Arsenic, as an impurity of sulphur, passes over with the $S O_2$ and mingles with the $H_2 S O_4$.

The Nitric Acid is owing to the presence of its constituents in the chamber where the $H_2 S O_4$ is made.

VII. "Give equations for the manufacture of (*a*) Hydric Sulphide, (*b*) Sulphuric Anhydride, (*c*) Carbonic Oxide, (*d*) Chlorine, (*e*) and explain its bleaching power."

(*a*). $Fe S + H_2 S O_4 = H_2 S + Fe S O_4$

(*b*). $S O_2 + O$ (in presence of heated and finely divided Platinum) $= S O_3$.

(*c*). $\begin{cases} 1.\ C O_2 + C = 2\ C O. \\ 2.\ 4\ C O_2 + 3\ Fe = 4\ C O + Fe_3 O_4 \end{cases}$

(*d*). $Mn O_2 + 4\ H Cl = 2\ H_2 O + Mn Cl_2 + Cl_2$

(*e*). The bleaching of Chlorine depends on its strong affinity for Hydrogen. If we put a piece of *dry* litmus paper into a jar of dry Chlorine no action will take place; but, if we moisten the litmus paper, the Chlorine will immediately bleach it. The reason of this is that the Chlorine unites with the Hydrogen of the water and liberates in the fibres of the material the Oxygen, which, being in a nascent state, and hence possessed of intense combining power, unites with the vegetable coloring matter to form other compounds which are colorless.

VIII. "What volume of O is required to completely burn 10 litres of $H_2 S$, and how much of each product would be formed?"

5 litres of O are required to unite with the H, giving 10 litres of $H_2 O$; 10 litres of O are required to unite with the S, giving 10 litres of $S O_2$; in one equation—10 litres of $H_2 S$ + 15 litres of O = 10 litres of $H_2 O$ + 10 litres of $S O_2$

IX. "How much commercial $H_2 S O_4$ containing 80 per cent. of pure acid could be obtained by roasting 300 kilogr. of Pyrites ($Fe S_2$) in the air, when only 80 per cent. is given off?"

For every 5 $Fe S_2$ used we get 4 S_2 to enter