TDC Part I Paper I, Group B

Inorganic Chemistry

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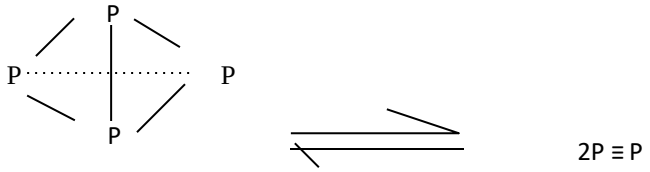
TOPIC:- Group 15, Allotropy

Allotropy

Phosphorous has many allotropes, the most common being while phosphorous existing as discrete tetrahedral P_4 molecules in the gaseous, liquid and solid states. It is soft, waxy and highly reactive and glows in moist air emitting a greenish – yellow light. This phenomenon is called phosphorescence and is the origin of the name of the element. It is stored under water. At very high temperature P_4 molecules dissociates to P_2:



$2P \equiv P$

Condensation of the vapours gives brown phosphorous, which probably contains P2 molecules. If white phosphorous is heated in absence of air, red phosphorous is obtained. It exists in a variety of polymeric modifications. The most thermodynamically stable form is black phosphorous obtained by heating white phosphorous at high pressure. It is inert having a layer structure examples of these structures are shown in fig 19.

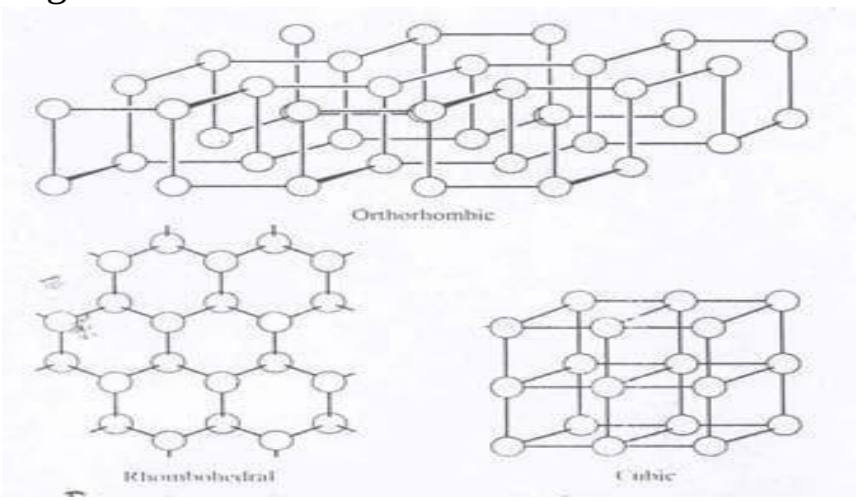


Fig.19: Allotropes of Phosphorus

Arsenic, antimony and bismuth exist in several allotropic modifications. Arsenic vapour contains tetrahedral As_4 molecules. In the solid state it exists in a yellow form comprising of As_4 molecules and a stable grey (α) form having a rhombohedral structure. Antimony exists in α form and another form having hexagonal close packed structure. Bismuth exists in α – form and a form having body- centred cubic structure.

Bismuth is the heaviest element to have a stable, non-radioactive nucleus. All other heavier elements are radioactive. The liquid form of bismuth expands on solidification.