

## COMMON REACTIONS

## With Oxygen to Form Oxides



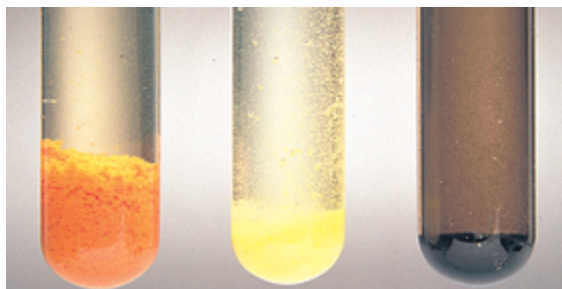
As, Sb, and Bi follow this reaction pattern, but as monatomic elements. N reacts to form NO and NO<sub>2</sub>. It also reacts as N<sub>2</sub> to form N<sub>2</sub>O<sub>3</sub> and N<sub>2</sub>O<sub>5</sub>.

## With Metals to Form Binary Compounds

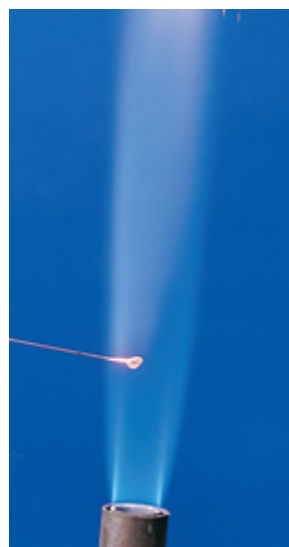


## ANALYTICAL TEST

There are no simple analytical tests for the presence of nitrogen or phosphorus compounds in a sample. Antimony produces a pale green color in a flame test, and arsenic produces a light blue color. Arsenic, antimony, and bismuth are recognized in qualitative analyses by their characteristic sulfide colors.



Formation of sulfides is the confirmatory qualitative analysis test for the presence of bismuth, antimony, and arsenic.



Arsenic flame test



Antimony flame test

## PROPERTIES OF THE GROUP 15 ELEMENTS

	N	P*	As	Sb	Bi
Melting point (°C)	-209.86	44.1	817 (28 atm)	630.5	271.3
Boiling point (°C)	-195.8	280	613 (sublimes)	1750	1560 ± 5
Density (g/cm <sup>3</sup> )	1.25 × 10 <sup>-3</sup>	1.82	5.727	6.684	9.80
Ionization energy (kJ/mol)	1402	1012	947	834	703
Atomic radius (pm)	75	110	120	140	150
Ionic radius (pm)	146 (N <sup>3-</sup> )	212 (P <sup>3-</sup> )	—	76 (Sb <sup>3+</sup> )	103 (Bi <sup>3+</sup> )
Common oxidation number in compounds	-3, +3, +5	-3, +3, +5	+3, +5	+3, +5	+3
Crystal structure†	cubic (as a solid)	cubic	rhombohedral	hcp	rhombohedral
Hardness (Mohs' scale)	none (gas)	—	3.5	3.0	2.25

\* Data given apply to white phosphorus.

† Crystal structures are for the most common allotropes.