Revised August 2006

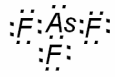
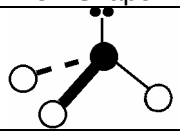
AP WORKED ANSWERS

1996, 9

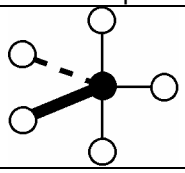
Points 2, 2, 2, 2

(a) Hydrogen fluoride molecules have intermolecular hydrogen bonds which are very strong compared to the dipole-dipole intermolecular bonds in Hydrogen chloride. The HF molecules are attracted to one another more strongly, and as a result have a much higher boiling point keeping them in the liquid state.

(b) AsF_3 has 5 + (3 x 7) = 26 valence electrons.

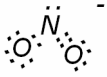
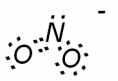
Lewis structure	3D Shape
	
3 BP, 1 LP	Trigonal Pyramid

AsF_5 has 5 + (5 x 7) = 40 valence electrons.

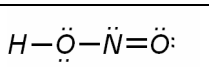
Lewis structure	3D Shape
	
5 BP, 0 LP	Trigonal Bipyramid

In AsF_3 the dipoles caused by differences in electronegativity and the lone pair, DO NOT cancel and therefore the molecule is polar. In AsF_5 the dipoles caused by differences in electronegativity DO cancel and therefore the molecule is non-polar.

(c) The N-O bonds in NO_2^- are intermediate in length between single and double due to the two possible resonance structures of the ion. Two structures are possible since the formal charges on the atoms within these ions are equally favorable, suggesting they both exist.

Lewis structures for NO_2^-	
	

The N-O bonds in HNO_2 are one single and one double bond making them different lengths. This is supported by there being only one Lewis structure with the most favorable formal charge possible. Unlike NO_2^-, interchanging the single and double N-O bonds in this structure does NOT lead to an equally favorable formal charge.

Lewis structure for HNO_2


(d) Sulfur has empty 3d orbitals available in its valence shell allowing the expansion of the octet via hybridization. Oxygen has no empty 2d orbitals in its valance shell and therefore cannot expand its octet and cannot accommodate more than four electron pairs.