3.28 (a) The formal charge on the central chlorine atom is +3; all four oxygen atoms have formal charges of −1.

(b) The formal charge of the central sulfur in the Lewis diagram for sulfur dioxide is +1; the left-hand oxygen has a formal charge of −1, and the right-hand oxygen has a formal charge of 0.

(c) The formal charge on the central bromine in this representation of the bonding in the bromite ion is +1. The two oxygens both have formal charges of −1.

(d) The formal charge on the central nitrogen in this Lewis diagram for nitrate ion is +1. The left-hand oxygen has a formal charge of 0, and the other two oxygen atoms have formal charges of −1.

3.30 In the Cl–Cl–O structure, the central Cl atom has formal charge +1 and the O atom has formal charge −1. In the Cl–O–Cl structure, each atom has formal charge zero. The second structure is favored because it shows less separation of formal charge.

3.32 (a) The "Z" represents a Group V element, such as N.

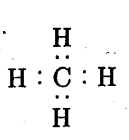
(b) The unknown main group element is a Group VII element, such as Cl.

(c) The unknown main group element is a Group VI element, such as S.

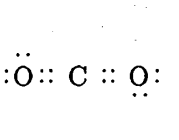
(d) The "Z" is a Group V element, such as N.

3.34 The Lewis dot structures are

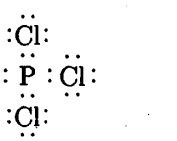
(a)



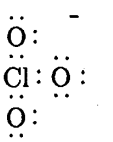
(b)



(c)



(d)



3.54 (a) Phosphorus trifluoride has a central P with *SN* 4. The molecule is trigonal pyramidal, like NH_3 (text Figure 3.6(c)).

(b) Sulfuryl chloride has a central S with *SN* 4. The molecule is close to tetrahedral, but somewhat distorted because of the different steric requirements of the O's and Cl's.

(c) The PF_6^- anion has a central P with *SN* 6. The anion is octahedral.

(d) The ClO_2^- anion has a central Cl with *SN* 4. The anion is bent.

(e) Germanium hydride has a central Ge with *SN* 4. It is tetrahedral.

3.58 There are many possible answers for each part. Examples: (a) ClO_4^- (b) CO_2 (c) SbF_6^- (d) ClO_3^-

3.62 (a) Using VSEPR concepts, the $GaCl_4^-$ ion has a central Ga with steric number 4; it would be tetrahedral. The $SbCl_4^-$ ion has a central Sb with *SN* 5. It would have a seesaw geometry (text Figure 3.14(b)) since one of the five electron pairs is a lone pair.

(b) The $SbCl_2^+$ ion, in which the central Sb has *SN* 3, is a bent molecular ion, and the $GaCl_2^+$ ion, in which the central Ga has *SN* 2, is linear. It follows that the formulation $(SbCl_2^+)(GaCl_4^-)$ is more likely correct.

3.64 (a) The observation of a nonzero dipole moment for O_3 rules out a symmetrical linear geometry for the molecule. The molecule of ozone could be linear if the two O-to-O bonds were of different lengths, or if the molecule were bent.

(b) VSEPR assigns a steric number of 3 to the central O and predicts that the molecule of ozone is bent.

3.66 $\overset{-3}{N}\overset{+1}{H_4}\overset{+5}{N}\overset{-2}{O_3}$ $\quad$ $\overset{+2}{Ca}\overset{+2}{Mg}\overset{+4}{Si}\overset{-2}{O_4}$ $\quad$ $\overset{+2}{Fe}(\overset{+2}{C}\overset{-3}{N})_6^{4-}$ $\quad$ $\overset{-3}{B_2}\overset{+1}{H_6}$

$\overset{+2}{Ba}\overset{-1}{H_2}$ $\quad$ $\overset{+2}{Pb}\overset{-1}{Cl_2}$ $\quad$ $\overset{+2}{Cu_2}\overset{-2}{O}(\overset{+6}{S}\overset{-2}{O_4})$ $\quad$ $(\overset{+\frac{5}{2}}{S_4}\overset{-2}{O_6})^{2-}$

The choices for C and N in $Fe(CN)_6^{4-}$ were somewhat arbitrary; other choices are possible.

3.70 (a) magnesium silicate

(b) iron(II) hydroxide; iron (III) hydroxide

(c) diarsenic pentaoxide or arsenic(V) oxide

(d) ammonium hydrogen phosphate

(e) selenium hexafluoride

(f) mercury(I) sulfate