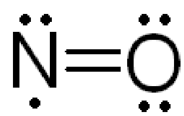
Solution Set 2

9.35 Elements of the third period and beyond have valence electrons in shells of principal quantum number $n = 3$ and greater. These shells have more subshells than just the s and p subshells. The octet rule is based on the idea that an atom is attempting to completely fill its outmost s and p subshells alone, which can only hold eight electrons total. The presence of additional subshells in an outermost shells can lead to violations of this simple rule.

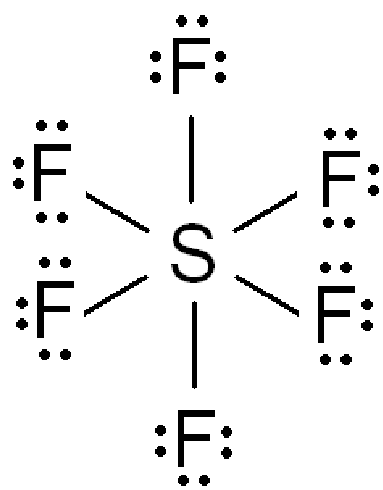
9.36 The following are examples of Lewis structures for molecules that do not obey the octet rule:

Beryllium dichloride (BeH_2)

Nitric oxide (NO)



Sulfur hexafluoride (SF_6)

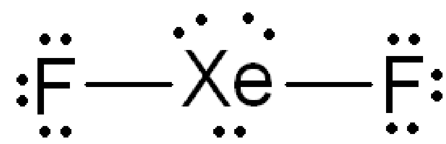


9.37 If fluorine formed seven covalent bonds with other atoms, it would effectively have a fourteen electrons, an expanded octet. Fluorine is a period 2 element, however, and its outermost shell ($n = 2$) only has an s subhshell and a p subshell. This shell can only hold eight electrons total. Period 2 elements do not violate the octet rule.

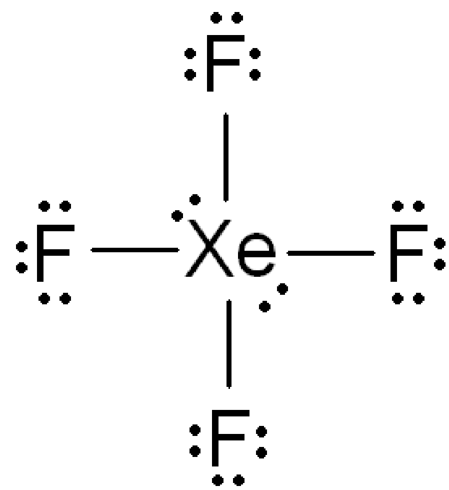
9.38 A *coordinate covalent bond* is a covalent bond in which one atom donate both electrons to the bond (usually a lone pair is donated by one atom to complete an incomplete octet in the other atom). In the normal covalent bond, each atom donates one electron to the bond.

9.41 The Lewis structure of the following compounds are

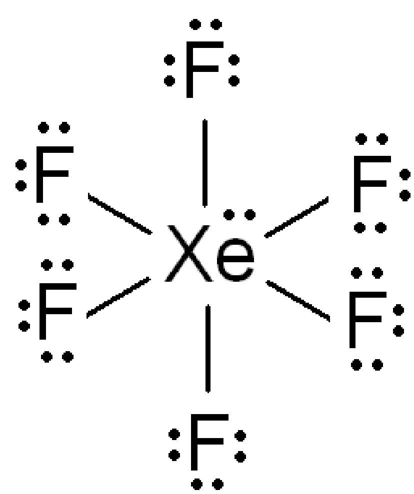
(a) XeF_2



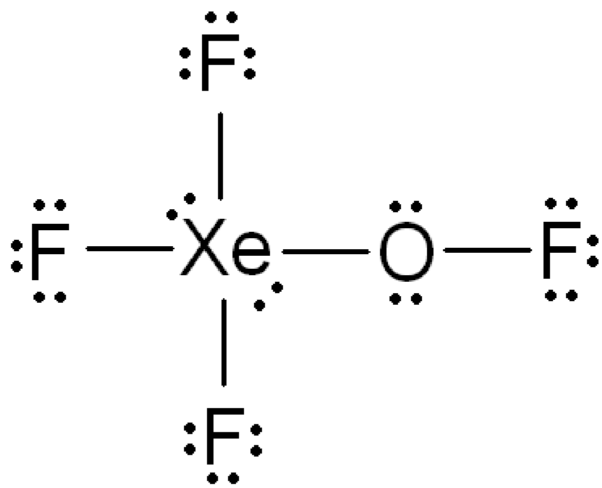
(b) XeF_4



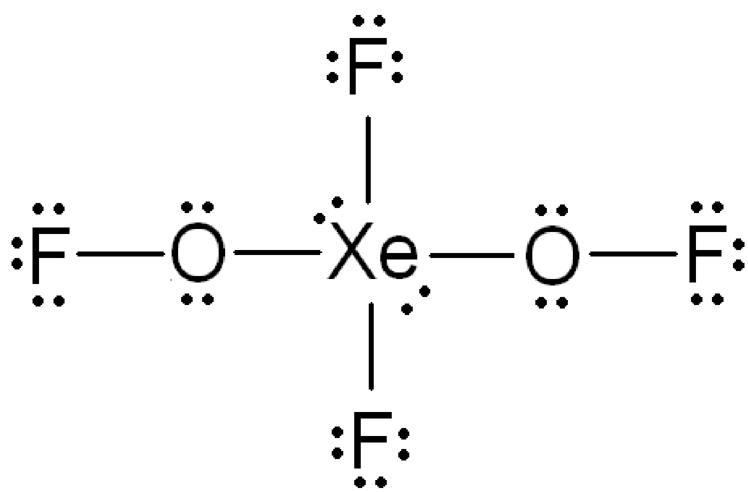
(c) XeF_6



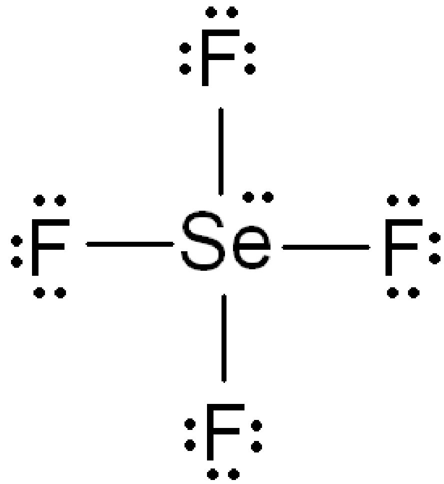
(d) $XeOF_4$



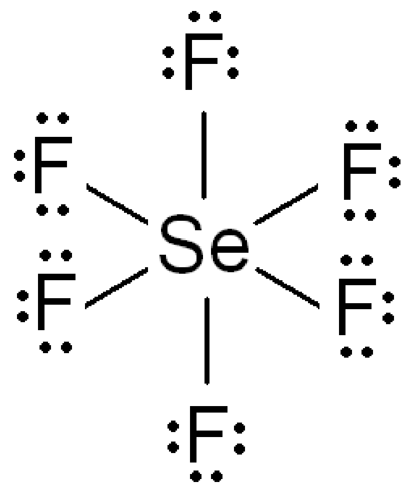
(e) XeO_2F_2



9.43 The Lewis structure for SeF_4 is



The Lewis structure for SeF_6 is



The Se atom for both molecules have an expanded octet.

9.47 In each of these three chemical reactions, we are breaking a nitrogen-hydrogen bond. The average bond energy of this type of bond would therefore be the average of the three bond energies given.

$$\overline{BE} = \frac{435 \text{ kJ} + 381 \text{ kJ} + 360 \text{ kJ}}{3} = 392 \text{ kJ}$$

9.49 By definition, the bond energy of F_2 is the enthalpy change of the chemical reaction $F_2(g) \rightarrow 2F(g)$. On the other hand, the standard enthalpy of formation for $F(g)$ refers to the chemical reaction $\frac{1}{2}F_2(g) \rightarrow F(g)$, i.e. we start with whatever stoichiometric coefficients are necessary on the most stable form of the constituent element(s) to form *one* mole of the product, fluorine atoms in this case. Since the latter equation is half the former equation, the standard enthalpy of formation for F atoms is exactly half the bond energy of F_2: $\Delta H_f^0 = 78.45$ kJ.