

A triple covalent bond, or simply a *triple bond*, is a covalent bond in which three pairs of electrons are shared between two atoms. For example, elemental nitrogen,  $\text{N}_2$ , like hydrogen and the halogens, normally exists as diatomic molecules. In this case, however, each nitrogen atom, which has five valence electrons, acquires three electrons to complete an octet by sharing three pairs of electrons with its partner. This is illustrated in the Lewis structure and the formula structure for  $\text{N}_2$ , as shown below.



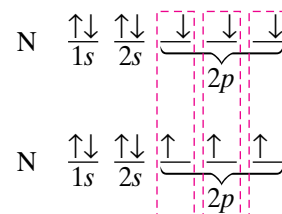
**Figure 11** represents nitrogen's triple bond through orbital notation. Like the single bonds in hydrogen and halogen molecules, the triple bond in nitrogen molecules is nonpolar.

Carbon forms a number of compounds containing triple bonds. For example, the compound ethyne,  $\text{C}_2\text{H}_2$ , contains a carbon-carbon triple bond.



*Double and triple bonds are referred to as **multiple bonds**, or multiple covalent bonds. Double bonds in general have greater bond energies and are shorter than single bonds. Triple bonds are even stronger and shorter. Table 2 compares average bond lengths and bond energies for some single, double, and triple bonds.*

In writing Lewis structures for molecules that contain carbon, nitrogen, or oxygen, one must remember that multiple bonds between pairs of these atoms are possible. (A hydrogen atom, on the other hand, has only one electron and therefore always forms a single covalent bond.) The need for a multiple bond becomes obvious if there are not enough valence electrons to complete octets by adding unshared pairs. Sample Problem D on the next page shows how to deal with this situation.



Nitrogen molecule

**FIGURE 11** In a molecule of nitrogen,  $\text{N}_2$ , each nitrogen atom is surrounded by six shared electrons plus one unshared pair of electrons. Thus, each nitrogen atom follows the octet rule in forming a triple covalent bond.

**TABLE 2** Bond Lengths and Bond Energies for Single and Multiple Covalent Bonds

Bond	Average bond length (pm)	Average bond energy (kJ/mol)	Bond	Average bond length (pm)	Average bond energy (kJ/mol)
C—C	154	346	C—O	143	358
C=C	134	612	C=O	120	732
C≡C	120	835	C≡O	113	1072
C—N	147	305	N—N	145	163
C=N	132	615	N=N	125	418
C≡N	116	887	N≡N	110	945