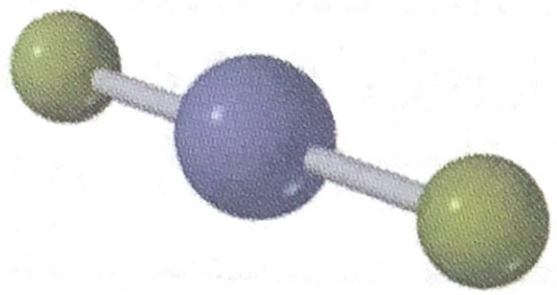
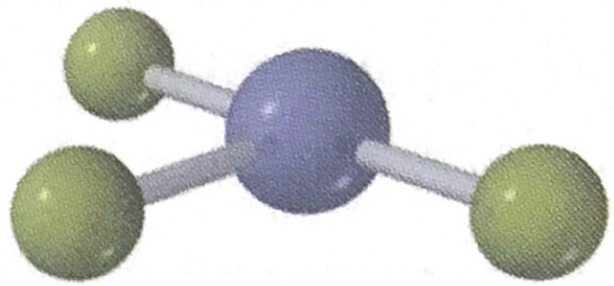
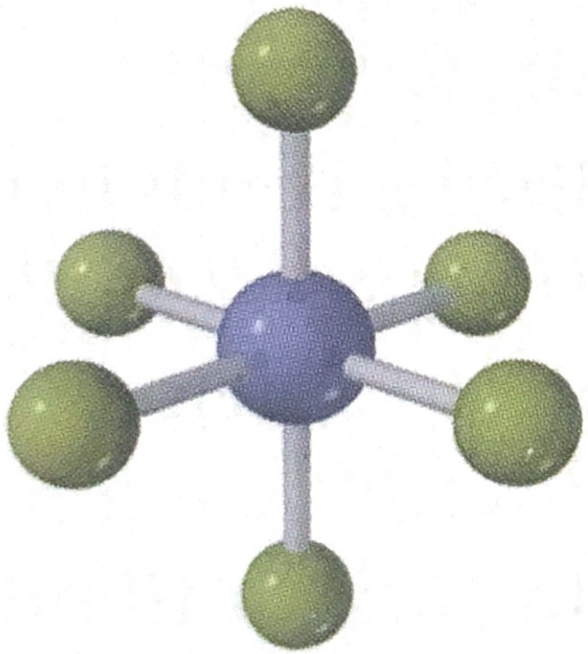
9.3 For each molecule (a)–(f), indicate how many different electron-domain geometries are consistent with the molecular geometry shown. [Section 9.2]



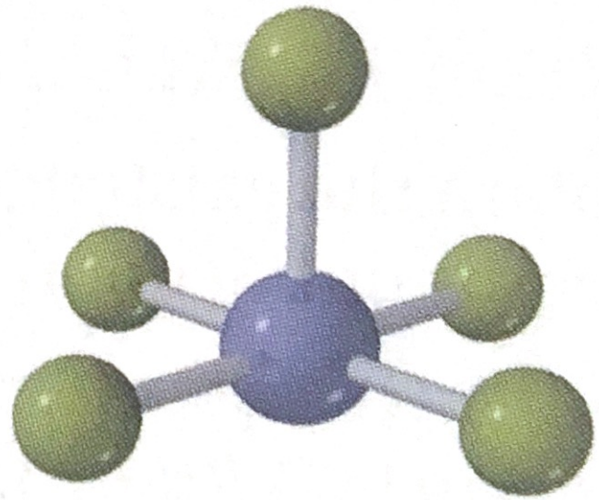
(a)



(b)

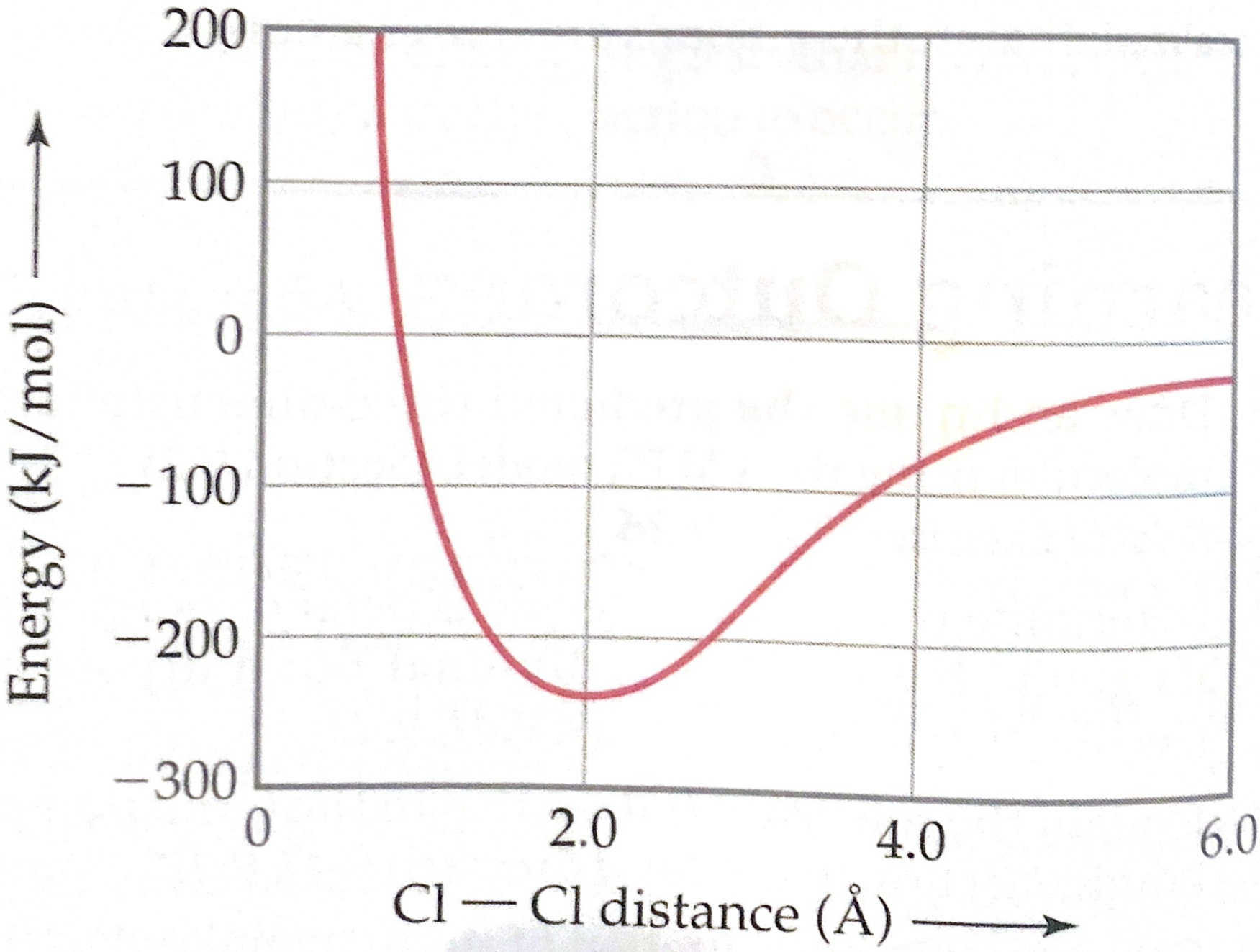


(c)

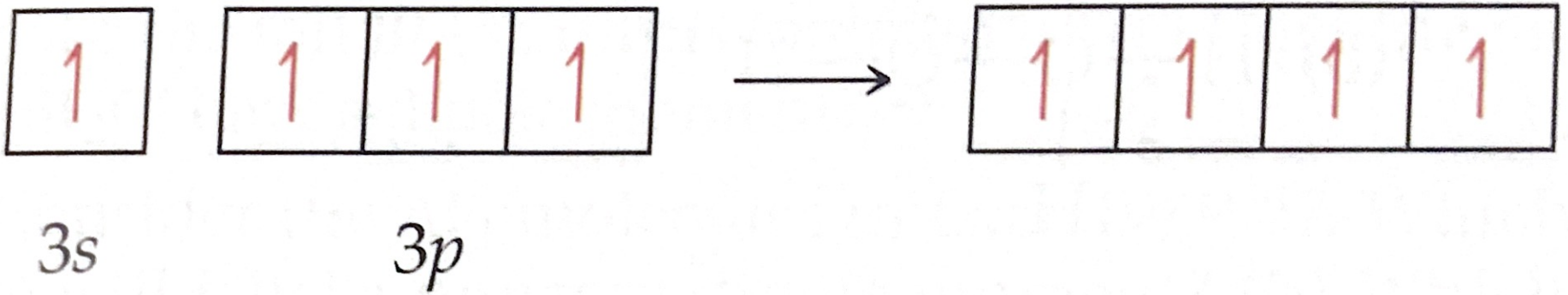


(d)

9.5 The following plot shows the potential energy of two Cl atoms as a function of the distance between them. (**a**) If the two atoms are very far away from each other, what is their potential energy of interaction? (**b**) We know that the Cl_2 molecule exists. What is the approximate bond length and bond strength for the Cl-Cl bond in Cl_2 from this graph? (**c**) If the Cl_2 molecule is compressed under higher and higher pressure, does the Cl–Cl bond become stronger or weaker?



9.6 The orbital diagram that follows presents the final step in the formation of hybrid orbitals by a silicon atom. (**a**) Which of the following best describes what took place before the step pictured in the diagram: (i) Two 3*p* electrons became unpaired, (ii) An electron was promoted from the 2*p* orbital to the 3*s* orbital, or (iii) An electron was promoted from the 3*s* orbital to the 3*p* orbital? (**b**) What type of hybrid orbital is produced in this hybridization? [Section 9.5]



9.9 The molecule shown below is called *furan*. It is represented in typical shorthand way for organic molecules, with hydrogen atoms not shown, and each of the 4 vertices representing a carbon atom.

(**a**) What is the molecular formula for furan? (**b**) How many valence electrons are there in the molecule? (**c**) What is the hybridization at each of the carbon atoms? (**d**) How many electrons are in the π system of the molecule? (**e**) The C—C—C bond angles in furan are much smaller than those in benzene. The likely reason is which of the following: (i) The hybridization of the carbon atoms in furan is different from that in benzene, (ii) Furan does not have another resonance structure equivalent to the one above, or (iii) The atoms in a five-membered ring are forced to adopt smaller angles than in a six-membered ring. [Section 9.5]

9.15 How does a trigonal pyramid differ from a tetrahedron so far as molecular geometry is concerned?

9.17 (**a**) An AB_6 molecule has no lone pairs of electrons on the A atom. What is its molecular geometry? (**b**) An AB_4 molecule has two lone pairs of electrons on the A atom (in addition to the four B atoms). What is the electron-domain geometry around the A atom? (**c**) For the AB_4 molecule in part (b), predict the molecular geometry.

9.19 *In which of these molecules or ions does the presence of nonbonding electron pairs produce an effect on molecular shape?* (**a**) SiH_4, (**b**) PF_3, (**c**) HBr, (**d**) HCN, (**e**) SO_2.

9.39 (**a**) Is the molecule BF_3 polar or nonpolar? (**b**) If you react BF_3 to make the ion BF_3^{2-}, is this ion planar? (**c**) Does the molecule BF_2Cl have a dipole moment?

9.43 Dichloroethylene ($C_2H_2Cl_2$) has three forms (isomers), each of which is a different substance. (**a**) Draw Lewis structures of the three isomers, all of which have a carbon–carbon double bond. (**b**) Which of these isomers has a zero dipole moment? (**c**) How many isomeric forms can chloroethylene, C_2H_3Cl, have? Would they be expected to have dipole moments?

Orbital Overlap; Hybrid Orbitals (Sections 9.4 and 9.5)

9.45 For each statement, indicate whether it is true or false. (**a**) In order to make a covalent bond, the orbitals on each atom in the bond must overlap. (**b**) A *p* orbital on one atom cannot make a bond to an *s* orbital on another atom. (**c**) Lone pairs of electrons on an atom in a molecule influence the shape of a molecule. (**d**) The 1*s* orbital has a nodal plane. (**e**) The 2*p* orbital has a nodal plane.

9.47 For each statement, indicate whether it is true or false. (**a**) The greater the orbital overlap in a bond, the weaker the bond. (**b**) The greater the orbital overlap in a bond, the shorter the bond. (**c**) To create a hybrid orbital, you could use the *s* orbital on one atom with a *p* orbital on another atom. (**d**) Nonbonding electron pairs cannot occupy a hybrid orbital.

9.49 Consider the molecule BF_3. (**a**) What is the electron configuration of an isolated B atom? (**b**) What is the electron configuration of an isolated F atom? (**c**) What hybrid orbitals should be constructed on the B atom to make the B–F bonds in BF_3? (**d**) What valence orbitals, if any, remain unhybridized on the B atom in BF_3?