Analysis

(d) According to the evidence collected, solid 1 is network covalent, 2 is ionic, 3 is metallic, and 4 is molecular.

Evaluation

(e) Most of the evidence was sufficient to classify the majority of the solids. The classification of the network covalent solid fits with the properties of network covalent solids but was done mainly by elimination once the others were classified. This classification is very uncertain and it is possible that solid 1 may be a low-solubility ionic solid. The classification of solids 2, 3, and 4 seems relatively certain.

Other properties such as hardness and melting points would help to make the classification more certain.

CHAPTER 4 SUMMARY

(Page 280)

Force or bond	Central particle	Surrounding particles
covalent	electron pair	nuclei
covalent network	electron pair	nuclei
dipole–dipole	charge site	opposite charge sites
hydrogen	proton	electron pairs
ionic	ion	oppositely charged ions
London	nuclei	nearby valence electrons
metallic	nuclei	mobile valence electrons (electron sea)

Substance	Hardness	Melting point	Electrical conductivity		
			Solid	Liquid	Solution
molecular	low	low	negligible	negligible	negligible
ionic	medium to high	high	negligible	high	high
covalent network	high	very high	negligible	negligible	n/a
metallic	medium	medium to high	high	high	n/a

CHAPTER 4 SELF-QUIZ

(Page 281)

1. False: The shape of molecules of the rocket fuel hydrazine, $N_2H_{4(l)}$, is predicted by VSEPR theory to be pyramidal around each nitrogen.
2. True
3. False: A central atom with two bonded atoms and two unshared electron pairs has a V-shaped arrangement of its electron pairs.
4. False: Ionic substances are ionic solids, with ionic bonding.
5. False: Hydrogen bonding is possible whenever the molecule contains hydrogen atoms bonded to N, O, or F atoms.
6. False: A molecule with a pyramidal shape and polar bonds will be polar.
7. True
8. True
9. False: The end of a soap molecule that attracts and dissolves oily dirt must be nonpolar.
10. True
11. (b)
12. (b)

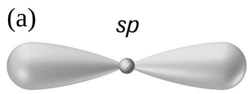
13. (d)
14. (a)
15. (c)
16. (c)
17. (c)
18. (a)
19. (b)
20. (d)

CHAPTER 4 REVIEW

(Page 282)

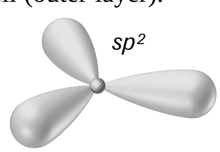
Understanding Concepts

1. (a) ·Ca· (2) (b) :C̈l· (1) (c) ·P̈· (3) (d) ·Si· (4) (e) :S̈· (2)
2. For a covalent bond to form between two approaching atoms, both atoms must have a valence orbital occupied by a single electron (or one atom must have a vacant valence orbital and the other must have a lone pair of electrons) and the orbitals must be able to overlap in space.
3. (a) three lone pairs
   (b) one lone pair
   (c) two lone pairs
   (d) no lone pairs
   (e) one lone pair
4. (a) :F̈· (b) ·P̈· (c) K· (d) :S̈e· (e) ·Sr·
5. The electron configuration that gives an atom maximum stability is one with eight electrons in the shell with the highest principal quantum number (the “valence” shell).
6. (a) $1s^2\ 2s^2\ 2p^6$
   (b) A carbide-12 ion has 6 protons and 6 neutrons in the nucleus, with 2 electrons in the first shell (inner layer), and 8 more electrons in the second shell (outer layer).
7. (a)



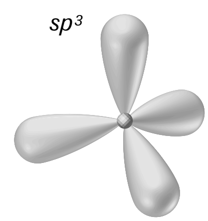
linear

(b)



trigonal planar

(c)



tetrahedral

8. (a) sp^3
   (b) sp^2
   (c) sp
   (d) sp^3
9. A sigma bond involves overlap of orbitals directly, or end to end, between the atomic nuclei.
   A pi bond involves side-by-side overlap of the two lobes of *p* orbitals above and below a line between the atomic nuclei.
10. (a) 2 sigma bonds
    (b) 3 sigma bonds and 2 pi bonds
    (c) 5 sigma bonds and 1 pi bond
    (d) 7 sigma bonds
11. The B atom has sp^2 hybridization initially, and the N atom has sp^3 hybridization (with an unshared pair of elecrons in the fourth hybrid orbital). After reaction, both central atoms must be sp^3 hybridized (they are each bonded to four other atoms). This occurs because the N supplies both electrons for the B-N sigma bond.