Hybridization

2-1

Longest to shortest bond length: b > a > c
Strongest to weakest bond: c > a > b

2-2
Sigma bonds: 7
Pi bonds: 0

2-3
Sigma bonds: 5
Pi bonds: 1

2-4
Sigma bonds: 3
Pi bonds: 2

Hybridization, Electron Geometry, and Molecular Shape

2-6 Correct answer is (b) sp³, tetrahedral.

2-7
a) Tetrahedral
b) Trigonal bipyramidal
c) Tetrahedral
d) Trigonal planar

Boron has trigonal planar geometry. The hydrogen atoms are at a 120° angle from each other to be as far apart as possible.

**Bond Rotation**

2-11 This molecule can rotate freely around the middle bond as there are no major steric hindrance interactions.

2-12 This molecule cannot rotate freely around the middle bond as the large bromine substituents attached at the ortho positions of the benzene rings experience significant steric hindrance with each other.

2-13 No; the pi-bond prevents free rotation about the C=C bond.

**Polarity of Bonds and Molecules**

2-14

a) 2

b) No dipole moment
c) 1

2-16 True

Intermolecular Forces (IMFs)

2-17

a) Cannot H-bond
b) Can H-bond
c) Can H-bond
d) Can H-bond
e) Cannot H-bond
f) Cannot H-bond

2-18

(a)

(b)

(c)
a) London Dispersion Forces
b) Dipole-Dipole Interactions
c) Ionic Forces
d) Hydrogen bonding

**IMFs and Solubility**

2-20

a) Not miscible
b) Miscible
c) Not miscible
d) Soluble
e) Not soluble
f) Soluble

2-21 Caffeine will dissolve in dichloromethane (DCM) significantly more than in hexanes as DCM is a more polar solvent and caffeine is a polar molecule (like dissolves like).

**Hydrocarbons and an Introduction to Isomerism**

2-22

a) Alkene
b) Alkane
c) Alkyne
d) Alkane
e) Alkene
f) Alkene
It does not have cis/trans configuration, as the triple bond in the compound \((\text{CH}_3)_2\text{CHC≡CCH}_3\) holds the four carbons in a straight line due to the \(sp\) hybridization of the middle two carbons (which have a linear geometric configuration).

Organic Compounds with Oxygen

2-26

a) Ether

b) Ketone

c) Carboxylic acid

d) Alcohol and Amine

e) Amide

f) Ether and Alkene

2-27

a) Alcohol and Amine (We will learn that the most correct classification for hydroxyl groups bonded to benzene rings is phenol)

b) Alcohol, Ether, Ketone, Amine and Alkene

c) Ester, Ether, Amine and Alkene
2-28

a) Aldehyde and carboxylic acid
b) Alcohol, Ketone, Amine
c) Alcohol, Ketone, Carboxylic acid

2-29

Organic Compounds with Nitrogen

2-30 Compound B has a slight dipole moment due to the cis configuration of the amine groups. Since it has a dipole moment, it experiences dipole-dipole interactions in addition to hydrogen bonding, thus increasing its boiling point.

2-31