6.3 Review Questions (p. 322)

1. (a) The energy associated with the bonded atoms must be less than when the atoms are apart.

(b) This tells us that the attractive forces existing between the bonded atoms exceed the repulsive forces.

2. An ionic crystal lattice is the three-dimensional symmetrical arrangement of cations and anions in a solid ionic crystal. The vast number of interionic forces present in such a crystal must be overcome to melt an ionic compound and this explains the high melting points of such compounds.

3. A crystal lattice shows us that no neutral independent molecules exist in ionic compounds. The formulas that we write simply represent the smallest whole number ratios of cations to anions that exist in ionic compounds.

4. (a) The attractive forces associated with Ionic bonds are the electrostatic forces between positively charged cations and negatively charged anions.

(b) The attractive forces associated with covalent bonds are the electrostatic forces between negatively charged electrons and adjacent positively charged nuclei.

5. (a) Similarities between ionic and covalent bonds include:

- Both involve valence electron clouds.
- Both involve electrostatic attractions between oppositely charged species.
- The formation of both bonds begins with the valence electrons of two atoms experiencing the attractive force of adjacent positive nuclei.
- Ionic and covalent bonds can both be strong

(b) Differences between ionic and covalent bonds include:

- Ionic bonds involve the transfer of valence electrons forming ions whereas covalent bonds involve the sharing of valence electrons with no ion formation.
- Ionic bonds form only between metals and non-metals whereas covalent bonds usually (but not always) form between two non-metals.
- Ionic bonding does not result in molecule formation whereas covalent bonding usually does.
- The attractive forces associated with covalent bonds are the electrostatic forces between negatively charged electrons and adjacent positively charged nuclei.
- The attractive forces associated with Ionic bonds are the electrostatic forces between positively charged cations and negatively charged anions.

6.

Elements	Compound Formula	ΔEN Value	Nature of Bonds Present
(a) rubidium and oxygen	**Rb_2O**	**2.7**	**ionic**
(b) strontium and bromine	**$SrBr_2$**	**1.8**	**ionic**
(c) carbon and sulphur	**CS_2**	**0**	**covalent**
(d) silicon and chlorine	**$SiCl_4$**	**1.2**	**polar covalent**

7. ΔEN for MgS = 1.3
ΔEN for H_2O = 1.4
We see that the bonds in water actually possess slightly more ionic character than those in magnesium sulphide even though the former compound contains two non-metals and the latter compound contains a metal and a non-metal.

8. The formula for glucose and other molecular compounds does not represent a ratio as do ionic formulas. Rather, they represent the actual number of atoms of each element existing in an individual molecule of the compound.

9. The melting of molecular covalent compounds does not involve the breaking of covalent chemical bonds within the molecules, but rather overcoming the relatively weak attractive forces between those molecules in the solid phase.

10. Diamond is a type of covalent substance is known as a network covalent solid. Rather than consisting of individual molecules as molecular covalent compounds do, these substances are held together by covalent bonds that extend throughout the entire sample. This means that the "molecule" is literally as big as the sample itself. To melt such a substance, all of the covalent bonds within this giant molecule must be broken and this accounts for the very high melting point.

11. The bond in HCl is a polar covalent bond (ΔEN = 0.9) whereas the bond in N_2 must be pure covalent (ΔEN = 0). This means that electron density in the HCl molecule is concentrated on the chlorine side of the molecule making that end of the molecule somewhat negative and the hydrogen end of the molecule somewhat positive. We might expect therefore, that HCl molecules would attract each other more strongly than N_2 molecules where the electron density is evenly distributed throughout the molecule. (The melting point of HCl is –114.2°C and the melting point of N_2 is – 210°C.)