***Chemistry***

**11: Solutions and Colloids**

**11.1: The Dissolution Process**

1. How do solutions differ from compounds? From other mixtures?

Solution

A solution can vary in composition, while a compound cannot vary in composition. Solutions are homogeneous at the molecular level, while other mixtures are heterogeneous.

3. When KNO3 is dissolved in water, the resulting solution is significantly colder than the water was originally.

(a) Is the dissolution of KNO3 an endothermic or an exothermic process?

(b) What conclusions can you draw about the intermolecular attractions involved in the process?

(c) Is the resulting solution an ideal solution?

Solution

(a) The process is endothermic as the solution is consuming heat. (b) Attraction between the K+ and  ions is stronger than between the ions and water molecules (the ion-ion interactions have a lower, more negative energy). Therefore, the dissolution process increases the energy of the molecular interactions, and it consumes the thermal energy of the solution to make up for the difference. (c) No, an ideal solution is formed with no appreciable heat release or consumption.

5. Indicate the most important types of intermolecular attractions in each of the following solutions:

(a) The solution in Figure 11.2

(b) NO(*g*) in CO(*l*)

(c) Cl2(*g*) in Br2(*l*)

(d) HCl(*g*) in benzene C6H6(*l*)

(e) Methanol CH3OH(*l*) in H2O(*l*)

Solution

(a) ion-dipole forces; (b) dipole-dipole forces; (c) dispersion forces; (d) dispersion forces; (e) hydrogen bonding

7. Heat is released when some solutions form; heat is absorbed when other solutions form. Provide a molecular explanation for the difference between these two types of spontaneous processes.

Solution

Heat is released when the total intermolecular forces (IMFs) between the solute and solvent molecules are stronger than the total IMFs in the pure solute and in the pure solvent: Breaking weaker IMFs and forming stronger IMFs releases heat. Heat is absorbed when the total IMFs in the solution are weaker than the total of those in the pure solute and in the pure solvent: Breaking stronger IMFs and forming weaker IMFs absorbs heat.

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