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16 SOLUTIONS

Reviewing Content

42. The solvent is the substance in which the solute is dissolved.
43. Random collisions of the solvent molecules with the solute particles provide enough force to overcome gravity.
44. **Solubility** is the amount of a substance that dissolves in a given quantity of solvent at specified conditions of temperature and pressure to produce a saturated solution. **Saturated solution** is a solution containing the maximum amount of solute for a given amount of solvent at a constant temperature and pressure. **Unsaturated solution** is a solution that contains less solute than a saturated solution at a given temperature and pressure. **Miscible** describes liquids that dissolve in each other. **Immiscible** describes liquids that are insoluble in each other.
45. Particles of solute crystallize.
46. No; if there were undissolved solute, the excess solute would come out of a supersaturated solution.
47. $1.13 \times 10^3 \text{ g AgNO}_3$
48. Solubility increases with pressure.
49. a. $1.6 \times 10^3 \text{ g/L}$
b. $1.7 \times 10^3 \text{ g/L}$
50. Dilute and concentrated are relative terms and are not quantitative. Molarity provides the exact number of moles of solute per liter of solution.
51. Molarity is the number of moles of solute dissolved in one liter of solution.
a. 1.5M KI
b. $3.3 \times 10^{-3} \text{ M MgCl}_2$
52. $2.80 \times 10^3 \text{ mL}$
53. a. $3.6 \times 10^3 \text{ mol NaCl}$, 29 g NaCl
b. 1.0 mol KNO_3 , $1.6 \times 10^3 \text{ g KNO}_3$
c. $2.5 \times 10^3 \text{ mol CaCl}_2$, 2.8 g CaCl_2
54. a. $2.5 \times 10^3 \text{ g NaCl}$
b. 2.0 g MgCl_2
55. a. 10% (v/v) ethanol
b. 85% (v/v) (energy) alcohol

56. Colligative properties are properties of a solution that depend only on the number of solute particles. Boiling point elevation, freezing point depression, and vapor-pressure lowering. Boiling points are elevated because shells of solvent form around solute particles, reducing the amount of solvent molecules that have sufficient energy to escape the solution; boiling increases. Solutes disrupt the ordering of the solvent structure, so more kinetic energy must be withdrawn from a solution for it to solidify. This lowers the freezing point of the solution.
57. a. sea water
b. 1.50M KNO₃
c. 0.100M MgCl₂
58. The effective molarity of the Ca(NO₃)₂ solution is 1M. The effective molarity of the NaNO₃ solution is 2M.
59. When vapor pressure is lowered relative to pure solvent, more energy must be applied to reach the boiling point; thus the boiling point is increased relative to pure solvent.
60. The salt lowers the freezing point of the ice-water cooling mixture.
61. 150 solutions: 1 mol of solute in 1 L of solution; 1M solution; 1 mol of solute in 1000 g of solvent.
62. Add 27 g of H₂O to 57.8 g of CH₃OH.
a. 100.26°C
b. 101.26°C
63. a. -4.6°C
b. -2.2°C
64. a. -1.1°C
b. -0.13°C
c. -1.3°C

Understanding Concepts

65. a. The freezing point depression is twice as great for solute B; solute B must provide twice as many particles in solution.

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