***Chemistry***

**3: Composition of Substances and Solutions**

**3.3: Molarity**

45. What information do we need to calculate the molarity of a sulfuric acid solution?

Solution

We need to know the number of moles of sulfuric acid dissolved in the solution and the volume of the solution.

47. Determine the molarity for each of the following solutions:

(a) 0.444 mol of CoCl2 in 0.654 L of solution

(b) 98.0 g of phosphoric acid, H3PO4, in 1.00 L of solution

(c) 0.2074 g of calcium hydroxide, Ca(OH)2, in 40.00 mL of solution

(d) 10.5 kg of Na2SO4•10H2O in 18.60 L of solution

(e) 7.0 × 10–3 mol of I2 in 100.0 mL of solution

(f) 1.8 × 104 mg of HCl in 0.075 L of solution

Solution

(a) ;

(b) First convert mass in grams to moles, and then substitute the proper terms into the definition.

Molar mass of H3PO4 = 97.995 g/mol



;

(c) Molar mass [Ca(OH)2] = 79.09 g/mol



;

(d) Molar mass (Na2SO4•10H2O) = 322.20 g/mol



;

(e) 

;

(f) Molar mass (HCl) = 36.46 g/mol





49. Consider this question: What is the mass of the solute in 0.500 L of 0.30 *M* glucose, C6H12O6, used for intravenous injection?

(a) Outline the steps necessary to answer the question.

(b) Answer the question.

Solution

(a) determine the number of moles of glucose in 0.500 L of solution; determine the molar mass of glucose; determine the mass of glucose from the number of moles and its molar mass; (b) 0.500 L contains 0.30 *M* × 0.500 L = 1.5 × 10–1 mol. Molar mass (glucose): 6 × 12.0011 g + 12 × 1.00794 g + 6 × 15.9994 g = 180.158 g, 1.5 × 10–1 ~~mol~~ × 180.158 g/~~mol~~ = 27 g.

51. Calculate the number of moles and the mass of the solute in each of the following solutions:

(a) 2.00 L of 18.5 *M* H2SO4, concentrated sulfuric acid

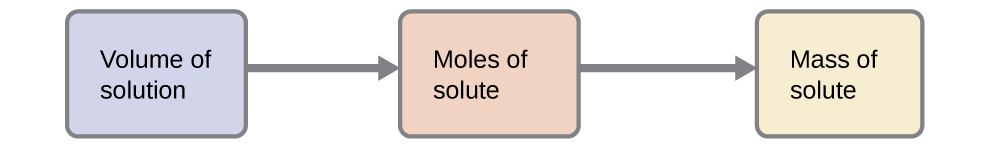
(b) 100.0 mL of 3.8 × 10–5 *M* NaCN, the minimum lethal concentration of sodium cyanide in blood serum

(c) 5.50 L of 13.3 *M* H2CO, the formaldehydeused to “fix” tissue samples

(d) 325 mL of 1.8 × 10–6*M* FeSO4, the minimum concentration of iron sulfate detectable by taste in drinking water

Solution

The molarity must be converted to moles of solute, which is then converted to grams of solute:





(a) ;

(b) ;

(c);

(d) 

53. Consider this question: What is the molarity of KMnO4 in a solution of 0.0908 g of KMnO4 in 0.500 L of solution?

(a) Outline the steps necessary to answer the question.

(b) Answer the question.

Solution

(a) determine the molar mass of KMnO4; determine the number of moles of KMnO4 in the solution; from the number of moles and the volume of solution, determine the molarity; (b) Molar mass of KMnO4 = 158.0264 g/mol



55. Calculate the molarity of each of the following solutions:

(a) 0.195 g of cholesterol, C27H46O, in 0.100 L of serum, the average concentration of cholesterol in human serum

(b) 4.25 g of NH3 in 0.500 L of solution, the concentration of NH3 in household ammonia

(c) 1.49 kg of isopropyl alcohol, C3H7OH, in 2.50 L of solution, the concentration of isopropyl alcohol in rubbing alcohol

(d) 0.029 g of I2 in 0.100 L of solution, the solubility of I2 in water at 20 °C

Solution

(a) ;

(b) ;

(c);

(d) 

57. There is about 1.0 g of calcium, as Ca2+, in 1.0 L of milk. What is the molarity of Ca2+ in milk?

Solution



59. If 0.1718 L of a 0.3556-*M* C3H7OH solution is diluted to a concentration of 0.1222 *M*, what is the volume of the resulting solution?

Solution



61. What volume of a 0.33-*M* C12H22O11 solution can be diluted to prepare 25 mL of a solution with a concentration of 0.025 *M*?

Solution



63. What is the molarity of the diluted solution when each of the following solutions is diluted to the given final volume?

(a) 1.00 L of a 0.250-*M* solution of Fe(NO3)3is diluted to a final volume of 2.00 L

(b) 0.5000 L of a 0.1222-*M* solution of C3H7OH is diluted to a final volume of 1.250 L

(c) 2.35 L of a 0.350-*M* solution of H3PO4 is diluted to a final volume of 4.00 L

(d) 22.50 mL of a 0.025-*M* solution of C12H22O11 is diluted to 100.0 mL

Solution

(a) ;

(b) ;

(c) ;

(d) 

65. A 2.00-L bottle of a solution of concentrated HCl was purchased for the general chemistry laboratory. The solution contained 868.8 g of HCl. What is the molarity of the solution?

Solution

Determine the number of moles in 434.4 g of HCl: 1.00794 + 35.4527 = 36.4606 g/mol



This HCl is present in 1.00 L, so the molarity is 11.9 *M*.

67. What volume of a 0.20-*M* K2SO4 solution contains 57 g of K2SO4?

Solution



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