3.1: Formula Mass and the Mole Concept

What is the total mass (amu) of carbon in each of the following molecules?

1. (a) CH₄
2. (b) CHCl₃
3. (c) C₁₂H₁₀O₆
4. (d) CH₃CH₂CH₂CH₂CH₃

(a) 12.01 amu; (b) 12.01 amu; (c) 144.12 amu; (d) 60.05 amu

What is the total mass of hydrogen in each of the molecules?

1. (a) CH₄
2. (b) CHCl₃
3. (c) C₁₂H₁₀O₆
4. (d) CH₃CH₂CH₂CH₂CH₃

Calculate the molecular or formula mass of each of the following:

(a) P₄
(b) H₂O
(c) Ca(NO₃)₂
(d) CH₃CO₂H (acetic acid)
(e) C₁₂H₂₂O₁₁ (sucrose, cane sugar).

(a) 123.896 amu; (b) 18.015 amu; (c) 164.086 amu; (d) 60.052 amu; (e) 342.297 amu

Determine the molecular mass of the following compounds:
Determine the molecular mass of the following compounds:

(a)
\[ \text{Cl} \quad \text{C} = \text{O} \quad \text{Cl} \]

(b)
\[ \text{H} \quad \text{C} = \text{C} \quad \text{C} \quad \text{H} \]

(c)
\[ \text{Br} \quad \text{C} = \text{C} \quad \text{Br} \]

(d)
\[ \text{O} \quad \text{S} \quad \text{O} \quad \text{H} \quad \text{O} \quad \text{H} \]

Determine the molecular mass of the following compounds:

(a)
\[ \text{H} \quad \text{C} = \text{C} \quad \text{H} \quad \text{H} \quad \text{CH}_2\text{CH}_3 \]

(b)
Which molecule has a molecular mass of 28.05 amu?

(a)  

(b)
Write a sentence that describes how to determine the number of moles of a compound in a known mass of the compound if we know its molecular formula.

Use the molecular formula to find the molar mass; to obtain the number of moles, divide the mass of compound by the molar mass of the compound expressed in grams.

Compare 1 mole of H₂, 1 mole of O₂, and 1 mole of F₂.

1. (a) Which has the largest number of molecules? Explain why.
2. (b) Which has the greatest mass? Explain why.

Which contains the greatest mass of oxygen: 0.75 mol of ethanol (C₂H₅OH), 0.60 mol of formic acid (HCO₂H), or 1.0 mol of water (H₂O)? Explain why.

Formic acid. Its formula has twice as many oxygen atoms as the other two compounds (one each). Therefore, 0.60 mol of formic acid would be equivalent to 1.20 mol of a compound containing a single oxygen atom.

Which contains the greatest number of moles of oxygen atoms: 1 mol of ethanol (C₂H₅OH), 1 mol of formic acid (HCO₂H), or 1 mol of water (H₂O)? Explain why.

How are the molecular mass and the molar mass of a compound similar and how are they different?

The two masses have the same numerical value, but the units are different: The molecular mass is the mass of 1 molecule while the molar mass is the mass of 6.022 \times 10^{23} molecules.

Calculate the molar mass of each of the following compounds:

1. (a) hydrogen fluoride, HF
2. (b) ammonia, NH₃
3. (c) nitric acid, HNO₃
4. (d) silver sulfate, Ag₂SO₄
5. (e) boric acid, B(OH)₃

Calculate the molar mass of each of the following:

1. (a) S₈
2. (b) C₅H₁₂
3. (c) Sc₂(SO₄)₃
4. (d) CH₃COCH₃ (acetone)
5. (e) C₆H₁₂O₆ (glucose)

(a) 256.528 g mol⁻¹; (b) 72.150 g mol⁻¹; (c) 378.103 g mol⁻¹; (d) 58.080 g mol⁻¹; (e) 180.158 g mol⁻¹

Calculate the empirical or molecular formula mass and the molar mass of each of the following minerals:

1. (a) limestone, CaCO₃
2. (b) halite, NaCl
3. (c) beryl, Be₃Al₂Si₆O₁₈
4. (d) malachite, Cu₂(OH)₂CO₃
5. (e) turquoise, CuAl₆(PO₄)₄(OH)₈(H₂O)₄

Calculate the molar mass of each of the following:

1. (a) the anesthetic halothane, C₂HBrClF₃
2. (b) the herbicide paraquat, C₁₂H₁₄N₂Cl₂
3. (c) caffeine, C₈H₁₀N₄O₂
4. (d) urea, CO(NH₂)₂
5. (e) a typical soap, C₁₇H₃₅CO₂Na

(a) 197.382 g mol⁻¹; (b) 257.163 g mol⁻¹; (c) 194.193 g mol⁻¹; (d) 60.056 g mol⁻¹; (e) 306.464 g mol⁻¹

Determine the number of moles of compound and the number of moles of each type of atom in each of the following:

1. (a) 25.0 g of propylene, C₃H₆
2. (b) 3.06 × 10⁻³ g of the amino acid glycine, C₂H₅NO₂
3. (c) 25 lb of the herbicide Trefflan, C₁₃H₁₆N₂O₄F (1 lb = 454 g)
4. (d) 0.125 kg of the insecticide Paris Green, Cu₄(AsO₃)₂(CH₃CO₂)₂
5. (e) 325 mg of aspirin, C₆H₄(CO₂H)(CO₂CH₃)

Determine the mass of each of the following:

1. (a) 0.0146 mol KOH
2. (b) 10.2 mol ethane, C₂H₆
3. (c) 1.6 × 10⁻³ mol Na₂SO₄
4. (d) 6.854 × 10³ mol glucose, C₆H₁₂O₆
5. (e) 2.86 mol Co(NH₃)₆Cl₃

1. (a) 0.819 g;
2. (b) 307 g;
3. (c) 0.23 g;
4. (d) 1.235 × 10⁶ g (1235 kg);
5. (e) 765 g

Determine the number of moles of the compound and determine the number of moles of each type of atom in each of the following:

1. (a) 2.12 g of potassium bromide, KBr
2. (b) 0.1488 g of phosphoric acid, H₃PO₄
3. (c) 23 kg of calcium carbonate, CaCO₃
4. (d) 78.452 g of aluminum sulfate, Al₂(SO₄)₃
5. (e) 0.1250 mg of caffeine, C₈H₁₀N₄O₂

Determine the mass of each of the following:

1. (a) 2.345 mol LiCl
2. (b) 0.0872 mol acetylene, C₂H₂
3. (c) 3.3 × 10⁻² mol Na₂CO₃
4. (d) 1.23 × 10³ mol fructose, C₆H₁₂O₆
5. (e) 0.5758 mol FeSO₄(H₂O)₇

1. (a) 99.41 g;
2. (b) 2.27 g;
3. (c) 3.5 g;
4. (d) 222 kg;
5. (e) 160.1 g

The approximate minimum daily dietary requirement of the amino acid leucine, C₆H₁₃NO₂, is 1.1 g. What is this requirement in moles?

Determine the mass in grams of each of the following:

1. (a) 0.600 mol of oxygen atoms
2. (b) 0.600 mol of oxygen molecules, O₂
3. (c) 0.600 mol of ozone molecules, O₃
1. (a) 9.60 g; (b) 19.2 g; (c) 28.8 g

A 55-kg woman has $7.5 \times 10^{-3}$ mol of hemoglobin (molar mass = 64,456 g/mol) in her blood. How many hemoglobin molecules is this? What is this quantity in grams?

Determine the number of atoms and the mass of zirconium, silicon, and oxygen found in 0.3384 mol of zircon, ZrSiO$_4$, a semiprecious stone.

- Zirconium: $2.038 \times 10^{23}$ atoms; 30.87 g
- Silicon: $2.038 \times 10^{23}$ atoms; 9.504 g
- Oxygen: $8.151 \times 10^{23}$ atoms; 21.66 g

Determine which of the following contains the greatest mass of hydrogen: 1 mol of CH$_4$, 0.6 mol of C$_6$H$_6$, or 0.4 mol of C$_3$H$_8$.

Determine which of the following contains the greatest mass of aluminum: 122 g of AlPO$_4$, 266 g of Al$_2$Cl$_6$, or 225 g of Al$_2$S$_3$.

- AlPO$_4$: 1.000 mol
- Al$_2$Cl$_6$: 1.994 mol
- Al$_2$S$_3$: 3.00 mol

Diamond is one form of elemental carbon. An engagement ring contains a diamond weighing 1.25 carats (1 carat = 200 mg). How many atoms are present in the diamond?

The Cullinan diamond was the largest natural diamond ever found (January 25, 1905). It weighed 3104 carats (1 carat = 200 mg). How many carbon atoms were present in the stone?

- 3.113 $\times 10^{25}$ C atoms

One 55-gram serving of a particular cereal supplies 270 mg of sodium, 11% of the recommended daily allowance. How many moles and atoms of sodium are in the recommended daily allowance?

A certain nut crunch cereal contains 11.0 grams of sugar (sucrose, C$_{12}$H$_{22}$O$_{11}$) per serving size of 60.0 grams. How many servings of this cereal must be eaten to consume 0.0278 moles of sugar?

- 0.865 servings, or about 1 serving.

A tube of toothpaste contains 0.76 g of sodium monofluorophosphate (Na$_2$PO$_3$F) in 100 mL.

- a. What mass of fluorine atoms in mg was present?
- b. How many fluorine atoms were present?

Which of the following represents the least number of molecules?

- a. 20.0 g of H$_2$O (18.02 g/mol)
b. 77.0 g of CH₄ (16.06 g/mol)  
c. 68.0 g of CaH₂ (42.09 g/mol)  
d. 100.0 g of N₂O (44.02 g/mol)  
e. 84.0 g of HF (20.01 g/mol)

20.0 g H₂O represents the least number of molecules since it has the least number of moles.

### 3.2: Determining Empirical and Molecular Formulas

What information do we need to determine the molecular formula of a compound from the empirical formula?

Calculate the following to four significant figures:

a. (a) the percent composition of ammonia, NH₃  
b. (b) the percent composition of photographic "hypo," Na₂S₂O₃  
c. (c) the percent of calcium ion in Ca₃(PO₄)₂

(a) % N = 82.24%  
% H = 17.76%;

(b) % Na = 29.08%  
% S = 40.56%  
% O = 30.36%;

(c) % Ca²⁺ = 38.76%

Determine the following to four significant figures:

a. the percent composition of hydrazoic acid, HN₃  
b. the percent composition of TNT, C₆H₂(CH₃)(NO₂)₃  
c. the percent of SO₄²⁻ in Al₂(SO₄)₃

Determine the percent ammonia, NH₃, in Co(NH₃)₆Cl₃, to three significant figures.

% NH₃ = 38.2%

Determine the percent water in CuSO₄·5H₂O to three significant figures.

Determine the empirical formulas for compounds with the following percent compositions:

(a) 15.8% carbon and 84.2% sulfur
(b) 40.0% carbon, 6.7% hydrogen, and 53.3% oxygen

(a) CS₂

(b) CH₂O

Determine the empirical formulas for compounds with the following percent compositions:

(a) 43.6% phosphorus and 56.4% oxygen

(b) 28.7% K, 1.5% H, 22.8% P, and 47.0% O

A compound of carbon and hydrogen contains 92.3% C and has a molar mass of 78.1 g/mol. What is its molecular formula?

C₆H₆

Dichloroethane, a compound that is often used for dry cleaning, contains carbon, hydrogen, and chlorine. It has a molar mass of 99 g/mol. Analysis of a sample shows that it contains 24.3% carbon and 4.1% hydrogen. What is its molecular formula?

Determine the empirical and molecular formula for chrysotile asbestos. Chrysotile has the following percent composition: 28.03% Mg, 21.60% Si, 1.16% H, and 49.21% O. The molar mass for chrysotile is 520.8 g/mol.

Mg₃Si₂H₃O₈ (empirical formula), Mg₆Si₄H₆O₁₆ (molecular formula)

Polymers are large molecules composed of simple units repeated many times. Thus, they often have relatively simple empirical formulas. Calculate the empirical formulas of the following polymers:

a. Lucite (Plexiglas); 59.9% C, 8.06% H, 32.0% O
b. Saran; 24.8% C, 2.0% H, 73.1% Cl
c. polyethylene; 86% C, 14% H
d. polystyrene; 92.3% C, 7.7% H
e. Orlon; 67.9% C, 5.70% H, 26.4% N

A major textile dye manufacturer developed a new yellow dye. The dye has a percent composition of 75.95% C, 17.72% N, and 6.33% H by mass with a molar mass of about 240 g/mol. Determine the molecular formula of the dye.

C₁₅H₁₅N₃

3.3: Molarity
Questions

Explain what changes and what stays the same when 1.00 L of a solution of NaCl is diluted to 1.80 L.

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

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

What does it mean when we say that a 200-mL sample and a 400-mL sample of a solution of salt have the same molarity? In what ways are the two samples identical? In what ways are these two samples different?

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

a. (a) 0.679 M;
b. (b) 1.00 M;
c. (c) 0.06998 M;
d. (d) 1.75 M;
e. (e) 0.070 M;
f. (f) 6.6 M

Determine the molarity of each of the following solutions:

a. 1.457 mol KCl in 1.500 L of solution
b. 0.515 g of H₂SO₄ in 1.00 L of solution
c. 20.54 g of Al(NO₃)₃ in 1575 mL of solution
d. 2.76 kg of CuSO₄·5H₂O in 1.45 L of solution
e. 0.005653 mol of Br₂ in 10.00 mL of solution
f. 0.000889 g of glycine, C₂H₅NO₂, in 1.05 mL of solution

Answers:

a.) 0.9713 M

b.) 5.25x10⁻³ M

c.) 6.122x10⁻² M
Consider this question: What is the mass of the solute in 0.500 L of 0.30 M glucose, \( \text{C}_6\text{H}_{12}\text{O}_6 \), used for intravenous injection?

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

(b) Answer the question.

(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) 27 g

Consider this question: What is the mass of solute in 200.0 L of a 1.556-M solution of KBr?

1. (a) Outline the steps necessary to answer the question.
2. (b) Answer the question.

Answer:

(a)

1. Calculate to moles of KBr by multiplying the Molarity by the amount of solution (200.0 L)
2. Find the Molar Mass of KBr and convert moles of solute to grams

(b)

\[ \frac{1.556 \text{ moles}\text{KBr}}{1 \text{cancel(L)}} \times 200.0 \text{cancel(L)} = 311.2 \text{moles}\text{KBr} \]
\[ 311.2 \text{cancel(moles)} \times \frac{119.0 \text{g}\text{KBr}}{1 \text{cancel(mole)} \text{KBr}} = 37,030 \text{g} \]

37,030 g; 37.03 kg

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

1. (a) 2.00 L of 18.5 \( M \) \( \text{H}_2\text{SO}_4 \), concentrated sulfuric acid
2. (b) 100.0 mL of 3.8 \times 10^{-5} \( M \) \( \text{NaCN} \), the minimum lethal concentration of sodium cyanide in blood serum
3. (c) 5.50 L of 13.3 \( M \) \( \text{H}_2\text{CO} \), the formaldehyde used to "fix" tissue samples
4. (d) 325 mL of 1.8 \times 10^{-6} \( M \) \( \text{FeSO}_4 \), the minimum concentration of iron sulfate detectable by taste in drinking water

(a) 37.0 mol \( \text{H}_2\text{SO}_4 \);

\[ 3.63 \times 10^3 \text{ g } \text{H}_2\text{SO}_4; \]
(b) $3.8 \times 10^{-6}$ mol NaCN;
1.9 $\times 10^{-4}$ g NaCN;
(c) 73.2 mol H$_2$CO;
2.20 kg H$_2$CO;
(d) $5.9 \times 10^{-7}$ mol FeSO$_4$;
$8.9 \times 10^{-5}$ g FeSO$_4$

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

a. 325 mL of $8.23 \times 10^{-5}$ M KI, a source of iodine in the diet
b. 75.0 mL of $2.2 \times 10^{-5}$ M H$_2$SO$_4$, a sample of acid rain
c. 0.2500 L of 0.1135 M K$_2$CrO$_4$, an analytical reagent used in iron assays
d. 10.5 L of 3.716 M (NH$_4$)$_2$SO$_4$, a liquid fertilizer

Answers:

a. 2.67x10$^{-5}$ moles KI; 4.44x10$^{-3}$ g KI
b. 1.7x10$^{-6}$ moles H$_2$SO$_4$ ; 1.6x10$^{-4}$ g H$_2$SO$_4$
c. 2.838x10$^{-2}$ moles K$_2$CrO$_4$ ; 5.510g K$_2$CrO$_4$
d. 39.0 moles (NH$_4$)$_2$SO$_4$ ; 5,160 g (NH$_4$)$_2$SO$_4$

Consider this question: What is the molarity of KMnO$_4$ in a solution of 0.0908 g of KMnO$_4$ in 0.500 L of solution?

1. (a) Outline the steps necessary to answer the question.
2. (b) Answer the question.

(a) Determine the molar mass of KMnO$_4$; determine the number of moles of KMnO$_4$ in the solution; from the number of moles and the volume of solution, determine the molarity; (b) $1.15 \times 10^{-3}$ M

Consider this question: What is the molarity of HCl if 35.23 mL of a solution of HCl contain 0.3366 g of HCl?

1. (a) Outline the steps necessary to answer the question.
2. (b) Answer the question.

Answer:

(a)
1. Convert g of HCl to moles of HCl and convert mL of solution to L of solution
2. Divide moles of HCl by L of solution

\( (b) \)

\( \frac{0.3366 \cancel{g} \ce{HCl}}{36.46 \cancel{g} \ce{HCl}} \times 9.232 \times 10^{-3} \text{moles}\ce{HCl} \)

\( \frac{35.23 \text{mL}}{0.03523 \text{L}} = 0.2621 \text{M}\ce{HCl} \)

Calculate the molarity of each of the following solutions:

(a) 0.195 g of cholesterol, \( \text{C}_{27}\text{H}_{46}\text{O} \), in 0.100 L of serum, the average concentration of cholesterol in human serum
(b) 4.25 g of \( \text{NH}_3 \) in 0.500 L of solution, the concentration of \( \text{NH}_3 \) in household ammonia
(c) 1.49 kg of isopropyl alcohol, \( \text{C}_3\text{H}_7\text{OH} \), in 2.50 L of solution, the concentration of isopropyl alcohol in rubbing alcohol
(d) 0.029 g of \( \text{I}_2 \) in 0.100 L of solution, the solubility of \( \text{I}_2 \) in water at 20 °C

(a) \( 5.04 \times 10^{-3} \text{ M} \); 
(b) \( 0.499 \text{ M} \); 
(c) \( 9.92 \text{ M} \); 
(d) \( 1.1 \times 10^{-3} \text{ M} \)

Calculate the molarity of each of the following solutions:

a. 293 g HCl in 666 mL of solution, a concentrated HCl solution
b. 2.026 g FeCl\(_3\) in 0.1250 L of a solution used as an unknown in general chemistry laboratories
c. 0.001 mg Cd\(^{2+}\) in 0.100 L, the maximum permissible concentration of cadmium in drinking water
d. 0.0079 g C\(_7\)H\(_5\)SNO\(_3\) in one ounce (29.6 mL), the concentration of saccharin in a diet soft drink.

There is about 1.0 g of calcium, as Ca\(^{2+}\), in 1.0 L of milk. What is the molarity of Ca\(^{2+}\) in milk?

\( 0.025 \text{ M} \)

What volume of a 1.00-\( \text{M} \) Fe(NO\(_3\))\(_3\) solution can be diluted to prepare 1.00 L of a solution with a concentration of 0.250 \( \text{M} \)?

If 0.1718 L of a 0.3556-\( \text{M} \) C\(_3\)H\(_7\)OH solution is diluted to a concentration of 0.1222 \( \text{M} \), what is the volume of the resulting
solution?

0.5000 L

If 4.12 L of a 0.850 \( M \) \( \text{H}_3\text{PO}_4 \) solution is be diluted to a volume of 10.00 L, what is the concentration the resulting solution?

What volume of a 0.33-\( M \) \( \text{C}_{12}\text{H}_{22}\text{O}_{11} \) solution can be diluted to prepare 25 mL of a solution with a concentration of 0.025 \( M \)?

1.9 mL

What is the concentration of the \( \text{NaCl} \) solution that results when 0.150 L of a 0.556-\( M \) solution is allowed to evaporate until the volume is reduced to 0.105 L?

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

a. (a) 1.00 L of a 0.250-\( M \) solution of \( \text{Fe(NO}_3\text{)}_3 \) is diluted to a final volume of 2.00 L
b. (b) 0.5000 L of a 0.1222-\( M \) solution of \( \text{C}_3\text{H}_7\text{OH} \) is diluted to a final volume of 1.250 L
c. (c) 2.35 L of a 0.350-\( M \) solution of \( \text{H}_3\text{PO}_4 \) is diluted to a final volume of 4.00 L
d. (d) 22.50 mL of a 0.025-\( M \) solution of \( \text{C}_{12}\text{H}_{22}\text{O}_{11} \) is diluted to 100.0 mL

1. (a) 0.125 \( M \);
2. (b) 0.04888 \( M \);
3. (c) 0.206 \( M \);
4. (e) 0.0056 \( M \)

What is the final concentration of the solution produced when 225.5 mL of a 0.09988-\( M \) solution of \( \text{Na}_2\text{CO}_3 \) is allowed to evaporate until the solution volume is reduced to 45.00 mL?

A 2.00-L bottle of a solution of concentrated \( \text{HCl} \) was purchased for the general chemistry laboratory. The solution contained 868.8 g of \( \text{HCl} \). What is the molarity of the solution?

11.9 \( M \)

An experiment in a general chemistry laboratory calls for a 2.00-\( M \) solution of \( \text{HCl} \). How many mL of 11.9 \( M \) \( \text{HCl} \) would be required to make 250 mL of 2.00 \( M \) \( \text{HCl} \)?

What volume of a 0.20-\( M \) \( \text{K}_2\text{SO}_4 \) solution contains 57 g of \( \text{K}_2\text{SO}_4 \)?

1.6 L

The US Environmental Protection Agency (EPA) places limits on the quantities of toxic substances that may be discharged into the sewer system. Limits have been established for a variety of substances, including hexavalent chromium, which is limited to 0.50 mg/L. If an industry is discharging hexavalent chromium as potassium dichromate (\( \text{K}_2\text{Cr}_2\text{O}_7 \)), what is the maximum permissible molarity of that substance?
3.4: Other Units for Solution Concentrations

Questions

1. Consider this question: What mass of a concentrated solution of nitric acid (68.0% HNO₃ by mass) is needed to prepare 400.0 g of a 10.0% solution of HNO₃ by mass?
   a. Outline the steps necessary to answer the question.
   b. Answer the question.
2. What mass of a 4.00% NaOH solution by mass contains 15.0 g of NaOH?
3. What mass of solid NaOH (97.0% NaOH by mass) is required to prepare 1.00 L of a 10.0% solution of NaOH by mass? The density of the 10.0% solution is 1.109 g/mL.
4. What mass of HCl is contained in 45.0 mL of an aqueous HCl solution that has a density of 1.19 g cm⁻³ and contains 37.21% HCl by mass?
5. The hardness of water (hardness count) is usually expressed in parts per million (by mass) of \( \text{CaCO}_3 \), which is equivalent to milligrams of \( \text{CaCO}_3 \) per liter of water. What is the molar concentration of Ca\(^{2+}\) ions in a water sample with a hardness count of 175 mg CaCO₃/L?
6. The level of mercury in a stream was suspected to be above the minimum considered safe (1 part per billion by weight). An analysis indicated that the concentration was 0.68 parts per billion. Assume a density of 1.0 g/mL and calculate the molarity of mercury in the stream.
7. In Canada and the United Kingdom, devices that measure blood glucose levels provide a reading in millimoles per liter. If a measurement of 5.3 mM is observed, what is the concentration of glucose (C\(_6\)H\(_{12}\)O\(_6\)) in mg/dL?
8. A throat spray is 1.40% by mass phenol, \( \text{C}_6\text{H}_5\text{OH} \), in water. If the solution has a density of 0.9956 g/mL, calculate the molarity of the solution.
9. Copper(I) iodide (CuI) is often added to table salt as a dietary source of iodine. How many moles of CuI are contained in 1.00 lb (454 g) of table salt containing 0.0100% CuI by mass?
10. A cough syrup contains 5.0% ethyl alcohol, C\(_2\)H\(_5\)OH, by mass. If the density of the solution is 0.9928 g/mL, determine the molarity of the alcohol in the cough syrup.
11. D5W is a solution used as an intravenous fluid. It is a 5.0% by mass solution of dextrose (\( \text{C}_6\text{H}_{12}\text{O}_6 \)) in water. If the density of D5W is 1.029 g/mL, calculate the molarity of dextrose in the solution.
12. Find the molarity of a 40.0% by mass aqueous solution of sulfuric acid, \( \text{H}_2\text{SO}_4 \), for which the density is 1.3057 g/mL.

Solutions

1. (a) The dilution equation can be used, appropriately modified to accommodate mass-based concentration units: \( \% \text{mass}_1 \times \text{mass}_1 = \% \text{mass}_2 \times \text{mass}_2 \) This equation can be rearranged to isolate \( \% \text{mass}_1 \) and the given quantities substituted into this equation.
   (b) 58.8 g

3. \( \text{mass}(114 \ \text{g}) \)
5. \( 1.75 \times 10^{-3} \ \text{M} \)
7 \(\text{mg/dL}\)
9 \(2.38 \times 10^{-4}\) mol
11 \(0.29\) mol