# *Quantitative Chemical Analysis 10th edition Harris Test Bank*

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Name:_____ Class:_____ Date:_____

**Chapter 00: The Analytical Process**

1. _____ chemical analysis is the measurement of how much of a chemical substance is present. _____ chemical analysis is the determination of what is present in a sample.
   a. Quantitative; Qualitative
   b. Stoichiometric; Qualitative
   c. Qualitative; Quantitative
   d. Stoichiometric; Identification
   e. Quantitative; Identification

*ANSWER:* a

2. Which of the following analyses is NOT quantitative?
   a. A home pregnancy test.
   b. A chocolate bar contains 33% fat.
   c. The density of water is determined to be 1.0 g/mL at 4ºC.
   d. A tap water sample was found to contain 13 200 ppb $Pb^{2+}$.
   e. A driver had 0.12% alcohol in his bloodstream.

*ANSWER:* a

3. *Chemical Abstract* is the most comprehensive source for locating articles published in chemistry journals. _____ is software that accesses *Chemical Abstract*.
   a. Google Scholar
   b. SciFinder
   c. Web of Science
   d. Wikipedia
   e. Microsoft Office

*ANSWER:* b

4. Sampling is the process in which
   a. general questions are translated into specific questions to be answered through chemical measurements.
   b. the chemical literature is searched to find appropriate procedures or, if necessary, devise new procedures to make the required measurements.
   c. a representative material is selected to analyze.
   d. a representative sample is converted into a form suitable for analysis.
   e. the concentration of analyte is measured in several identical portions.

*ANSWER:* c

5. A sample with a uniform chemical composition is a _____ sample.
   a. homologous
   b. homogeneous
   c. uniform
   d. consistent

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e. heterogeneous

*ANSWER:* b

6. A(n) _____ sample is a sample in which the chemical composition differs from place to place.
   a. variable
   b. homogeneous
   c. random
   d. inconsistent
   e. heterogeneous

*ANSWER:* e

7. When extracting a sample with a liquid, the liquid is _____ from the sample.
   a. transferred
   b. drained
   c. decanted
   d. effused
   e. dispensed

*ANSWER:* c

8. A(n) _____ is used to grind solids into smaller particles.
   a. orbital shaker
   b. vortexer
   c. mixer
   d. mortar and pestle
   e. centrifuge

*ANSWER:* d

9. _____ is the substance being measured during a chemical analysis.
   a. Bulk
   b. Lot
   c. Sample
   d. Analyte
   e. Aliquot

*ANSWER:* d

10. The liquid above the packed solid following a centrifugation is the _____.
   a. solvonatant
   b. analyte
   c. serum
   d. decanted
   e. supernatant

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**Chapter 00: The Analytical Process**

*ANSWER:* e

11. A(n) _____ is a suspension of a solid in a liquid.
    a. slurry
    b. colloid
    c. gel
    d. supernatant
    e. allotrope

*ANSWER:* a

12. _____ is the series of procedures applied to a sample prior to analysis.
    a. Preanalysis clean up
    b. Sample preparation
    c. Filler elimination
    d. Matrix removal
    e. Lot cleaning

*ANSWER:* b

13. An aliquot is
    a. a portion of a larger whole, especially a sample taken for chemical analysis or other treatment.
    b. the substance being measured.
    c. a suspension of a solid in a liquid.
    d. the decanted liquid following a centrifugation.
    e. the liquid above the packed solid following a centrifugation.

*ANSWER:* a

14. For separations performed using a chromatography column, the plot of detector response versus time is a(n) _____, and the area under the peak is _____ to the quantity of compound passing through the detector.
    a. column plot; proportional
    b. column plot; inversely proportional
    c. chromatogram; proportional
    d. chromatogram; inversely proportional
    e. absorbance spectrum; proportional

*ANSWER:* c

15. A(n) _____ is a plot of detector response as a function of analyte concentration. The curve is constructed using _____ containing known concentrations of the analyte of interest.
    a. analyte curve; response solutions
    b. response curve; standard solutions
    c. analyte curve; analyte solutions

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d. calibration curve; standard solutions

e. response curve; response solutions

*ANSWER:* d

16. _____ is the process of procuring a representative sample to analyze.

a. Inspection

b. Examination

c. Representation

d. Sampling

e. Partaking

*ANSWER:* d

17. Solid-phase extraction is a sample preparation technique. Which statement(s) is/are NOT true for an aqueous solid-phase extraction?

I. Solid-phase extraction separates analyte from the sample matrix using a chromatography stationary phase.
II. An aliquot of the aqueous sample is applied to the solid-phase extraction tube. It is washed with additional sample and then a water wash.
III. The analyte sticks to the column, and the water wash removes all species that do not adhere to the column.
IV. An organic solvent is used to wash the analyte from the column.
V. The organic phase containing the analyte is evaporated to dryness, and the solid is dissolved in water, ready for analysis.

a. III

b. I

c. II and III

d. IV

e. II

*ANSWER:* e

18. Which is NOT a general step in the analytical process?

a. sample preparation

b. selecting an analytical procedure

c. making policy

d. reporting and interpretation

e. analysis

*ANSWER:* c

19. The purpose of replicate measurements is to assess the _____ in the analysis and to guard against _____ in the analysis of a single aliquot.

a. error; uncertainty

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b. variability; gross error
c. uncertainty; precision
d. error; accuracy
e. accuracy; error

*ANSWER:* b

20. _____ are repeated measurements to assess variability in an analysis and to guard against gross error in the analysis of a single aliquot.
a. Replicate measurements
b. Aliquots
c. Sampling
d. Analysis
e. Error measurements

*ANSWER:* a

21. Which statement is NOT true?
a. For a random heterogeneous material, differences in composition are random and on a fine scale.
b. A representative random sample is collected from randomly selected portions of the sample for a given number of times.
c. Segregated heterogeneous material has large regions with obviously different compositions.
d. A representative composite sample is collected from a segregated material by taking portions from each region, where the number of collected portions are proportional to the area of the region.
e. All are true statements.

*ANSWER:* e

22. _____ occurs when a species other than analyte increases or decreases the analytical signal and makes it appear that the concentration is greater or less than the real concentration.
a. Interference
b. Masking
c. Aliquots
d. Disruption
e. Intervention

*ANSWER:* a

23. _____ is the transformation of an interfering species into a form that is not detected.
a. Interference
b. Masking
c. Obscurance
d. Cloaking
e. Camouflaging

*ANSWER:* b

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24. $Ca^{2+}$ in lake water can be measured with a reagent called EDTA. However, the presence of $Al^{3+}$ will provide a false signal because it reacts with EDTA as well. The method of adding excess $F^-$ to minimize the effects of $Al^{3+}$ on the $Ca^{2+}$ determination is called

a. interference.
b. masking.
c. obscurance.
d. cloaking.
e. camouflaging.

*ANSWER:* b

25. Chemists use the term _____ to refer any chemical of interest.

a. analyte
b. species
c. replicate
d. aliquot
e. bulk

*ANSWER:* b

26. A calibration curve for the determination of aspirin is constructed from known concentration aspirin solutions (mg/mL) and the HPLC peak areas for each standard. If the equation of the best-fit line is $y = 12.565x - 0.71$, what is the concentration for an unknown that has a peak area of 83.5?

*ANSWER:* 6.70 mg/mL; Substitute $y = 83.5$ into $y = 12.565x - 0.71$ and solve for $x$.

27. The allicin concentration in a garlic extract sample was determined using HPLC. A calibration curve prepared using allicin standards of known concentration (M) has an equation of the best-fit line of $y = 24\ 376x + 8.4$. What is the molar concentration of allicin in the garlic extract sample if it has a signal of 88.9?

*ANSWER:* 0.003 30 M; Substitute $y = 88.9$ into $y = 24\ 376x + 8.4$ and solve for $x$.

28. The spectrophotometric analysis of a series of permanganate standards (mM) at 525 nm gave a calibration equation of $y = 2.492\ 5x + 0.091$. If an unknown sample has an absorbance reading of 0.654, what is the millimolar concentration of permanganate in the unknown solution?

*ANSWER:* 0.226 mM; Substitute $y = 0.654$ into $y = 2.492\ 5x + 0.091$ and solve for $x$.

29. The fluorescence quantum yield measurement results of quinine sulfate in 0.1 M $H_2SO_4$ solution showed that there was a linear relationship between the integrated photoluminescence intensity and absorbance of quinine sulfate. The relationship is described by the equation $y = 1.28 \times 10^8 x - 780\ 102$, where $y$ is the integrated photoluminescence intensity and $x$ is the absorbance of quinine sulfate. If the sample has an absorbance of 0.045, what is its photoluminescence intensity?

*ANSWER:* $4.98 \times 10^6$; Substitute $x = 0.045$ into $y = 1.28 \times 10^8 x - 780\ 102$ and solve for $y$.

30. Inorganic anions can be analyzed by capillary electrophoresis with conductivity detection. A calibration curve for nitrate was constructed by plotting the signal (μV) as a function of nitration concentration (μM),

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resulting in an equation of $y = 498x + 3.28$. If a sample contains 62.5 μM nitrate ions, what would be the signal of nitrate in the sample?

*ANSWER:* $3.11 \times 10^4$ μV or 31.1 mV; Substitute $x = 62.5$ into $y = 498x + 3.28$ and solve for $y$.

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## Chapter 01: Chemical Measurements

1. Which constant is NOT used to define the fundamental SI units?
   a. Avogadro's number
   b. speed of light in vacuum
   c. elementary charge
   d. Planck's constant
   e. π

*ANSWER:* e

2. Which of the following is NOT a fundamental SI unit of a quantity?
   a. second (s)
   b. meter (m)
   c. gram (g)
   d. ampere (A)
   e. mole (mol)

*ANSWER:* c

3. A satellite in low Earth orbit with a circular orbit has an orbital speed of 7.3 km/s relative to the Earth's surface. Calculate the satellite's speed in miles per hour. (1 mi = 1.609 km)
   a. $1.6 \times 10^{4}$ mi/h
   b. $1.3 \times 10^{-3}$ mi/h
   c. $4.2 \times 10^{4}$ mi/h
   d. $3.3 \times 10^{-3}$ mi/h
   e. $3.1 \times 10^{2}$ mi/h

*ANSWER:* a

4. The planet Mars orbits 2.279 $10^{11}$ m from the Sun. Express the distance using the appropriate prefix.
   a. 227.9 Gm
   b. 227.9 mM
   c. 2.279 km
   d. 22.79 nm
   e. None of these is correct.

*ANSWER:* a

5. The calorie content of a candy bar is 230. Calories per serving (1 bar). Calculate the specific energy (kJ/g) of the candy bar. (1 candy bar = 52.7 g, 1 Calorie = 1 000 calories, 1 calorie = 4.184 J)
   a. $2.90 \times 10^{3}$ kJ/g
   b. 18.3 kJ/g
   c. $1.83 \times 10^{-2}$ kJ/g
   d. $5.07 \times 10^{4}$ kJ/g

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e. $9.59 \times 10^{-1}$ kJ/g

*ANSWER:* b

6. The gas mileage for a new car model destined for sale in Europe must be determined for regulatory and promotional purposes. If the car uses 10.5 gallons to travel 250. miles, what is the gas mileage in km/L? (1 mi = 1.609 km, 1 gal = 3.785 L)

a. 174 km/L
b. 3.25 km/L
c. 67.3 km/L
d. 14.9 km/L
e. 10.1 km/L

*ANSWER:* e

7. Calculate the mass of $NaCH_3CO_2$ contained in 500.0 mL of a 0.150 0 M $NaCH_3CO_2$ solution. ($NaCH_3CO_2$ = 82.034 3 g/mol)

a. 914.3 µg
b. 283.4 g
c. 24.61 µg
d. 6.153 g
e. 24.61 g

*ANSWER:* d

8. Which statements are TRUE regarding the expression of the concentration of a 54.9-ppm Fe solution in terms of molarity?

I. The molar mass of iron is needed to calculate the moles of iron in solution.
II. The density of iron is needed to calculate the mass of iron in solution.
III. The solution density is needed to calculate the solution volume.
IV. The type of glassware used to prepare the solution must be known.

a. I, III, and IV
b. I and II
c. I and III
d. II and III
e. None of these statements is true.

*ANSWER:* c

9. Calculate the molarity of a 30.0 wt% hydrogen peroxide ($H_2O_2$, FM 34.014 7) solution. The density of 30 wt% hydrogen peroxide is 1.135 g/cm$^3$.

a. 7.77 M
b. 0.0100 M
c. 0.100 M

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d. 10.0 M

e. 8.82 M

*ANSWER:* d

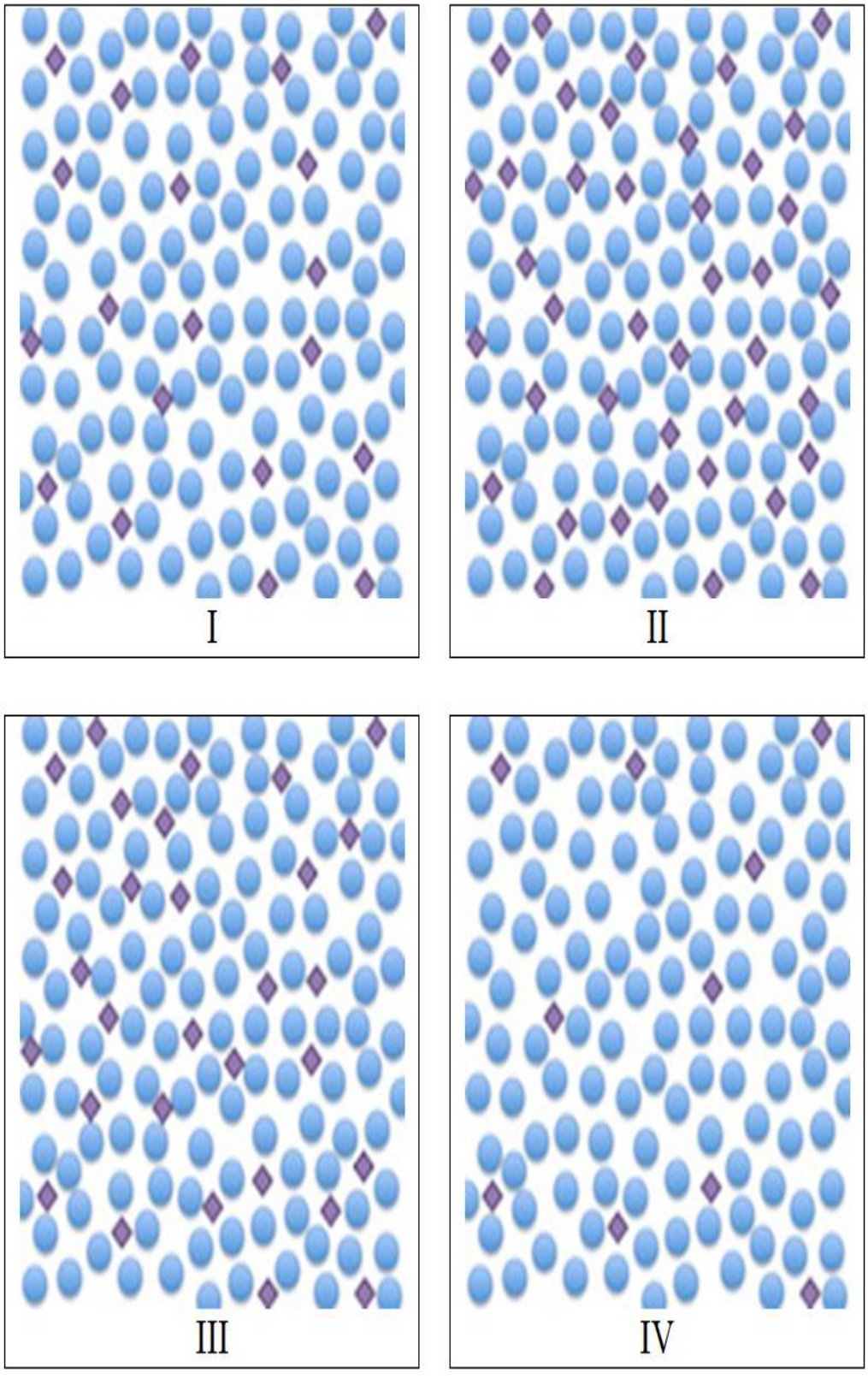
10. Arrange the molecular views of four different solutions in order of increasing concentration. Diamond shapes represent solute particles, and circle shapes represent solvent particles.

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**Chapter 01: Chemical Measurements**




a. I < II < III < IV
b. II < III < I < IV

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c. IV < II < III < I
d. IV < I < III < II
e. III < IV < II < I

*ANSWER:* d

11. Calculate the molarity of a 2.0-ppm $Mg^{2+}$ solution.
a. $8.2 \times 10^{-5}$ M
b. $8.2 \times 10^{-2}$ M
c. $1.2 \times 10^{-2}$ M
d. $1.2 \times 10^{-5}$ M
e. $4.9 \times 10^{-2}$ M

*ANSWER:* a

12. Calculate the mass of $Na_2CO_3$ (FM 105.988 8) needed to prepare a 15.00 mM solution with a volume of 500.0 mL.
a. 1.258 g
b. 3.180 g
c. 0.794 9 g
d. 7.076 g
e. 0.014 1 g

*ANSWER:* c

13. What volume of 12.1 M HCl must be diluted to prepare a 0.250 0 M HCl solution with a volume of 2.000 L?
a. 41.3 mL
b. 96.8 mL
c. 10.3 mL
d. 24.2 mL
e. 6.05 mL

*ANSWER:* a

14. What volume of a 36.0 wt% HCl (FM 36.458) solution must be diluted to prepare 1.000 L of a 0.100 0 M HCl solution? The density of 36.0 wt% HCl is 1.18 g/mL.
a. 11.7 mL
b. 8.58 mL
c. 1.20 mL
d. 10.1 mL
e. 64.6 mL

*ANSWER:* b

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**Chapter 01: Chemical Measurements**

15. How many grams of $CaCO_3$ (FM 100.086) are needed to prepare 150.0 mL of an 80.0-ppm $Ca^{2+}$ solution?

a. 0.012 0 g
b. 0.030 0 g
c. 1.875 g
d. 0.533 g
e. 29.9 g

*ANSWER:* b

16. A student needs to prepare 500.0 mL of a solution containing 0.999 g of solid copper(II) sulfate. Which of the statements regarding the proper procedure to prepare this solution are FALSE?

I. The 0.999 g of solid copper(II) sulfate is added to a 500.0-mL volumetric flask containing 500.0 mL of distilled water.
II. The 0.999 g of solid copper(II) sulfate is added to a 500.0-mL volumetric flask containing approximately 400 mL of distilled water before dilution to 500.0 mL.
III. The 0.999 g of solid copper(II) sulfate is placed in an empty 500.0-mL volumetric flask, diluted to 500.0 mL with distilled water, and allowed to dissolve.

a. I and II
b. II and III
c. I and III
d. I, II, and III
e. None of the statements is false.

*ANSWER:* c

17. The sulfur content of an ore is determined gravimetrically by reacting the ore with concentrated nitric acid and potassium chlorate, which converts all of the sulfur to sulfate. The excess nitrate and chlorate is removed by reaction with concentrated hydrochloric acid, and the sulfate is precipitated using $Ba^{2+}$.

$$Ba^{2+}(aq) + \boxed{\phantom{00}}(aq) \rightarrow BaSO_4(s)$$

Analysis of 10.183 0 g of a sulfur-containing ore yielded 13.022 1 g of $BaSO_4$ (FM 233.43). What is the percent by mass sulfur in the ore?

a. 32.18%
b. 52.63%
c. 10.74%
d. 17.56%
e. The answer cannot be calculated with available data.

*ANSWER:* d

18. When solutions of $Pb^{2+}$ and $\boxed{\phantom{00}}$ are mixed, the precipitate $PbCrO_4$ is produced. What volume of 0.175 0 M $CrO_4^{2-}$ removes all $Pb^{2+}$ from 50.00 mL of a 0.340 0 M $Pb^{2+}$ solution?

a. 97.14 mL

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b. 25.74 mL
c. 48.57 mL
d. 194.3 mL
e. 75.00 mL

*ANSWER:* a

19. A mixture of 50.00 g propane ($C_3H_8$, FM 44.10) and 100.00 g oxygen ($O_2$, FM 31.998) is combusted to form carbon dioxide and water. _____ is the limiting reactant, and _____ of _____is in excess.

$$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2\ (g) + 4H_2O\ (g)$$

a. Propane; 22.44 g; oxygen
b. Oxygen; 63.71 g; propane
c. Oxygen; 22.42 g; propane
d. Propane; 27.44 g; oxygen
e. None of these answers is correct.

*ANSWER:* c

20. Which of the following statement(s) is/are TRUE regarding the properties of the limiting reagent in a chemical reaction?

I. The limiting reagent in a chemical reaction is the one that is consumed first.
II. Once the limiting reagent in a chemical reaction is gone, the reaction ceases.
III. The limiting reagent in a chemical reaction is the one that has the least mass.

a. I
b. II
c. III
d. I and II
e. I, II, and III

*ANSWER:* d

21. On average, one gallon of kerosene contains 135 000 BTU of heat energy per gallon combusted. Convert the energy content of kerosene to SI units. (1 BTU = 1 055 J, 1 gal = 3.785 L)

*ANSWER:* $3.76 \times 10^7$ J/L or 37.6 MJ/L

22. Tidal volume is the amount of air breathed in with each normal breath. The average tidal volume is 0.50 L, and the average breathing rate is 12 breaths/min. Calculate the total volume (in $m^3$) of air a person breathes in one hour.

*ANSWER:* 0.36 $m^3$/h

23. An NaCl (FM 58.44) solution has a concentration of 33.5 wt% and a density of 1.049 2 g/mL. What is the molarity of the solution?

*ANSWER:* 6.01 M

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**Chapter 01: Chemical Measurements**

24. Find the molarity and molality of a 44.0 wt% $H_2SO_4$ (FM 98.079) solution with a density of 1.338 g/mL.
*ANSWER:* 6.00 M; 6.80 *m*

25. The maximum contaminant level for arsenic is 0.010 ppm for drinking water per EPA regulation. The arsenic concentration for the drinking water of a municipality was measured to be 4.92 x $10^{-6}$ M arsenic. What is the arsenic concentration of the water sample in ppm? Does the water sample meet EPA guidelines? Assume the drinking water sample has a density of 1.000 0 g/mL.
*ANSWER:* 0.369 ppm; exceeds EPA regulation

26. What volume of a 50.0 wt% NaOH (FM 40.00) solution is needed to prepare a 0.350 0 M NaOH solution with a volume of 500. mL? The density of 50 wt% NaOH solution is 1.515 g/mL at 25°C.
*ANSWER:* 9.24 mL

27. What volume of a 25.0 mM $Li^+$ solution is needed to prepare 100.0 mL of a 10.0 ppm $Li^+$ solution?
*ANSWER:* 5.76 mL

28. The recommended daily allowance of calcium for men between the ages of 19 and 50 is 1000 mg Ca. Three multivitamin tablets are analyzed for calcium gravimetrically with the precipitation of $Ca^{2+}$ by the oxalate ion, $C_2O_4^{2-}$. If the mass dry calcium oxalate (FM 128.097) obtained is 2.013 6 g, how many tablets must a man take in a given day to meet the recommended daily allowance?

$$Ca^{2+}(aq) + C_2O_4^{2-}(aq) \rightarrow CaC_2O_4(s)$$

*ANSWER:* 0.210 00 g Ca per tablet; 5 vitamin tablets

29. Lead(II) carbonate precipitates when aqueous lead(II) is mixed with aqueous carbonate.

$$Pb^{2+}(aq) + CO_3^{2-}(aq) \rightarrow PbCO_3(s)$$

If 5.000 g $Pb(NO_3)_2$ (FM 331.2) and 2.500 g $Na_2CO_3$ (FM 105.988 8) are mixed in water, which ion is the limiting reactant? What mass of $PbCO_3$ (FM 267.21) is precipitated?
*ANSWER:* $Pb^{2+}$ is the limiting reactant and 4.035 g $PbCO_3$ is precipitated.

30. A 15.3-g sample of an organic compound is completely combusted in air, producing 21.0 g $CO_2$ and 8.61 g $H_2O$. What is the weight percent of C in the organic compound?
*ANSWER:* 37.5%

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