1. How many protons, neutrons and electrons are present in (a) an atom of nitrogen-15 and (b) an atom of iron-56?

2. The mass of an iron atom is 9.29×10^{-26} kg. How many iron atoms are present in an iron magnet of mass 25.0 g?

3. What is the likely charge of the monoatomic atoms of (a) Nitrogen and (b) Calcium

4. Write the formula of the binary ionic compound formed by magnesium and phosphorus.

5. Nanotechnology researchers have developed a hydrogen storage device capable of storing large quantities of hydrogen. This research is vitally important for finding ways to transport hydrogen safely and economically. Supposed you have developed a hydrogen storage of devide that can store 1.29×10^{24} hydrogen atoms. What is the chemical amount of hydrogen (in moles) of hydrogen that can be stored?

6. Fluorine gas is so reactive that it reacts explosively with almost every other element. If you are working with fluorine and making quantitative observations, it is very important to know which materials you have. Calculate (a) the amount of F_2 and (b) the number of F atoms in 22.5 g of F_2. The molar mass of fluorine molecules is 38.00 $g.mol^{-1}$ or, more specifically 38.00 g. $(mol\ F_2)^{-1}$.

7. Chlorine, which is used to sanitize water supplies and swimming pools, has two naturally occurring isotopes: chlorine-35 and chlorine-37. The mass of an atom of chlorine-35 is 5.807×10^{-23}g, and that of an atom of chlorine-37 is 6.139×10^{-23}g. In a typical natural sample of chlorine, 75.77% of the sample is chlorine-35 and the rest is chlorine-37. What is the molar mass of a typical sample of chlorine?

8. Potassium permanganate, $KMnO_4$, is very reactive and is used by film studios to stain new materials to make them look old. Suppose you are a film studio technician and are examining how different concentrations of the compound have different effects. You need about 0.10 mol $KMnO_4$ to prepare a solution. What mass (in grams) of the compound do you need?

9. Suppose you are working on the design of a photovoltaic cell that you hope will be able the use the sunlight to split water into its elements in an economical manner. As a preliminary step, you need to know what mass of hydrogen can be produced from a given mass of water. What is the mass percentage of hydrogen in water?

10. In some cases, you might want to test a compound to see if it is the expected product. A first step is to determine its empirical formula. Suppose you sent a sample of an unknown compound that you suspect to be vitamin C, which has the molecular formula **$C_6H_8O_6$**, to a laboratory for combustion analysis. The laboratory reports a composition of 40.9% carbon, 4.58% hydrogen, and 54.5% oxygen. Might it be vitamin C?

11. You are continuing your investigation of the compound from the previous question. Mass spectrometry analysis shows that the molar mass of the sample is 176.12 g x mol^{-1}. Given its empirical formula of $C_3H_4O_3$, what is the molecular formula of the compound? Can you be confident that it is indeed vitamin C?

12. Suppose that you dissolved 10.0 g of cane sugar in enough water to make 200.0 mL of solution. You want to report its concentration. Cane sugar is sucrose ($C_{12}H_{22}O_{11}$, molar mass 342 g x mol^{-1}). What is the molar concentration of sucrose in the resulting solution?

13. Very dilute solutions of copper(II) sulfate, $CuSO_4$, are used to control algal growth in fish tanks. Suppose that you are investigating the optimum concentration of copper(II) sulfate that will control the algae but not harm the fish. You are asked to prepare 250.0 mL of a solution that is approximately 0.0380 M $CuSO_4$ (aq) from solid copper(II) sulfate pentahydrate, $CuSO_4 \cdot 5H_2O$. What mass of solid do you need?

14. Many reagents in chemistry stockrooms are prepared as aqueous solutions. Suppose you want to measure out 0.760 mmol CH_3COOH, acetic acid (an acid found in vinegar and used a lot in the lab), and you have available 0.0560 M CH_3COOH (aq). What volume of solution should you use?

15. Sodium hydroxide solution is used in the recycling of newspapers; it causes the paper fibers to swell, allowing the ink to be removed. Suppose you are working in a laboratory of a newsprint company and are investigating how cellulose fibers are affected by sodium hydroxide solutions with different concentrations. You need to prepare 250.0 mL of 1.25 x 10^{-3} M of NaOH(aq) and will use a 0.0270 M NaOH(aq) stock solution. How much stock solution do you need?

Quick answers

1. (a) 7,8,7 (b) 26, 30, 26
2. 2.69 x 10^{23}
3. N^{3-} and Ca^{2+}
4. Mg_3P_2
5. $2.14\ mol\ H$
6. (a) $\mathbf{0.592\ mol\ F_2}$ **(b)** $\mathbf{7.13\ x\ 10^{23}}$
7. $\mathbf{35.45\ g\ x\ mol^{-1}}$
8. $15.8\ g$

9. 11.19%
10. The empirical formula is $C_3H_4O_3$. This could be vitamin C.
11. The molecular formula is actually $C_6H_8O_6$, which is indeed the molecular formula of vitamin C.
12. 0.146 $mol\ x\ L^{-1}$
13. 2.37 g of copper(II) sulfate pentahydrate
14. 13.6 ml of acetic acid
15. 11.6 mL