Practice Problems – Percent Composition, Empirical and Molecular Formulas

1. Find the percent composition of each of the elements in acetic acid, the compound that gives vinegar its tart taste.

2. Find the percent composition of each of the elements in sulfuric acid, H_2SO_4.

3. Find the percent composition of a compound that contains 1.94g of carbon, 0.48g of hydrogen, and 2.58g of sulfur in a 5.00g sample of the compound.

4. A sample of an unknown compound with a mass of 0.147g has the following composition: 50.51% fluorine and 49.49% iron. When this compound is decomposed into its elements, what mass of each element would be recovered?

5. Find the percent composition of a compound that contains 2.63g of carbon, 0.370g of hydrogen, and 0.580g of oxygen in a 3.58g sample of the compound.

6. A sample of an unknown compound with a mass of 2.76g has the following composition: 66.07% carbon, 4.06% nitrogen, and 23.16% oxygen. What is the mass of each element in the sample?

7. Find the percent composition of a compound that contains 2.7369g of chlorine, 0.4116g of oxygen, and 0.7971g of phosphorus in a 3.9460g sample of the compound.

8. Find the percent composition of a compound that contains 1.51g of chromium, 1.13g of potassium, and 1.62g of oxygen in a 4.26g sample of the compound.

9. A sample of a compound that has a mass of 0.432g is analyzed. The sample is found to be made only of fluorine and oxygen. Given that the sample contains 0.128g of oxygen, calculate the percent composition of both elements in the compound.

10. What is the percent composition of a carbon-oxygen compound, given that a 95.2g sample of the compound contains 40.8g of carbon and 54.4g of oxygen?

11. What is the percent composition of a sulfur-chlorine compound, given that a 30.9g sample of the compound contains 9.63g of sulfur and 21.3g of chlorine?

12. All of the following sources are used as fertilizers that contribute nitrogen to the soil: $(NH_2)_2CO$ (urea), NH_4NO_3 (ammonium nitrate), $HNC(NH_2)_2$ (guanidine), NH_3 (ammonia). Which of them is the richest source of nitrogen on a mass percentage basis

13. Determine the empirical formula of a compound containing 2.644g of gold and 0.476g of chlorine.

14. Determine the empirical formula of a compound containing 0.928g of gallium and 0.412g of phosphorus.

15. Determine the empirical formula of a compound containing 1.732g of carbon, 0.289g of hydrogen, and 0.459g of oxygen.

16. Find the empirical formula of a compound, given that the compound is found to contain 47.9% zinc and 52.1% chlorine by mass.

17. Find the empirical formula of a compound, given that a 48.5g sample of the compound is found to contain 1.75g of carbon and 46.75g of bromine.

18. Determine the empirical formula of a compound containing 20.23% aluminum and 79.77% chlorine.

19. Determine the empirical formula of a compound containing 24.74% potassium, 34.76% manganese, and 40.50% oxygen.

20. Determine the empirical formula of a compound containing 4.288g of carbon and 5.712g of oxygen.

21. Determine the empirical formula of a compound containing 2.16g of aluminum, 3.85g of sulfur, and 7.68g of oxygen.

22. Determine the empirical formula of a compound containing 3.611g of calcium and 6.389g of chlorine.

23. Determine the empirical formula of a compound containing 67.6% mercury, 10.8% sulfur, and 21.6% oxygen.

24. 1,6-diaminohexane is used to make nylon. What is the empirical formula of this compound if it is composed of 62.1% carbon, 13.8% hydrogen, and 24.1% nitrogen?

25. Allicin is the compound that gives garlic its characteristic smell. Analysis of this compound gives the following composition by mass: 44.4% carbon, 6.21% hydrogen, 39.5% sulfur, and 9.86% oxygen. What is the empirical formula for allicin?

26. Peroxyacylnitrate (PAN) is one of the components of smog. Its constituent elements are C, H, N, and O. Determine the empirical formula for PAN given that the partial percent composition is 19.8% C, 2.50% H, and 11.6% N.

27. Find the molecular formula of a compound that contains 42.56g of palladium and 0.80g of hydrogen. The molar mass of the compound is 216.8 g/mol.

28. Find the molecular formula of a compound that contains 30 45% nitrogen and 69.55% oxygen. The molar mass of the compound is 92.02 g/mol.

29. Find the molecular formula of a compound, given that a 212.1g sample of the compound contains 42.4g of hydrogen and 169.7g of carbon. The molar mass of the compound is 30.0 g/mol.

30. A compound is known to have a molar mass of 391.5 g/mol. Find the molecular formula of a compound, given the results of an analysis of a 310.8g sample that revealed the sample only contain boron and iodine. The analysis showed that the amount of iodine in the sample was 302.2g.

31. Find the molecular formula of a compound that contains 56.36g of oxygen and 43.64g of phosphorus. The molar mass of the compound is 283.9 g/mol.

32. The compound methyl butanoate smells like apples. Given its percent composition as 58.8% carbon, 9.8% hydrogen, and 31.4% oxygen and a molar mass of 102 g/mol, what is the molecular formula for methyl butanoate?

33. The antibacterial drug Cipro® has a molar mass of 331 g/mol. It was determined that the percent composition is 61.63% carbon, 5.44% hydrogen, 5.74% fluorine, 12.69% nitrogen, and 14.50% oxygen. Find the molecular formula for Cipro®.

34. Monosodium glutamate, MSG, a common ingredient in Asian cuisine that enhances food flavor, has the following mass composition: 35.51% C, 4.77% H, 37.85% O, 8.29% N, and 13.60% Na. If the molar mass of the compound is 169 g/mol, what is the molecular formula?

35. Tooth enamel is largely hydroxyapatite, which has a mass composition of 41.41% O, 18.50% P, 0.20% H, and 39.89% Ca. If the molar mass of hydroxyapatite is 1004 g/mol, what is the molecular formula?

36. The molar mass of caffeine is 194.19g. Is the molecular formula of caffeine $C_4H_5N_2O$ or $C_8H_{10}N_2O_4$?

37. Octane, a compound of carbon and hydrogen, has a molar mass of 114.26g. If one mole of the compound contains 18.17g of hydrogen, what is the molecular formula of octane?

38. Hydrated sodium tetraborate, commonly called borax has the general formula $Na_2B_4O_7.xH_2O$. Chemical analysis indicates that this hydrate is 52.8% sodium tetraborate and 47.2% water. Determine the formula and name the hydrate.