

1. To determine the amount of iron in a dietary supplement, a random sample of 15 tablets weighing a total of 20.505 g was ground into a fine powder. A 3.116-g sample was dissolved and treated to precipitate the iron as $\text{Fe}(\text{OH})_3$. The precipitate was collected, rinsed, and ignited to a constant weight as Fe_2O_3 , yielding 0.355 g. Report the iron content of the dietary supplement as g $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ per tablet.
2. A 1.4639-g sample of limestone was analyzed for Fe, Ca, and Mg. The iron was determined as Fe_2O_3 yielding 0.0357 g. Calcium was isolated as CaSO_4 , yielding a precipitate of 1.4058 g, and Mg was isolated as 0.0672 g of $\text{Mg}_2\text{As}_2\text{O}_7$. Report the amount of Fe, Ca, and Mg in the limestone sample as %w/w Fe_2O_3 , %w/w CaO , and %w/w MgO .
3. A 516.7-mg sample containing a mixture of K_2SO_4 and $(\text{NH}_4)_2\text{SO}_4$ was dissolved in water and treated with BaCl_2 , precipitating the SO_4^{2-} as BaSO_4 . The resulting precipitate was isolated by filtration, rinsed free of impurities, and dried to a constant weight, yielding 863.5 mg of BaSO_4 . What is the %w/w K_2SO_4 in the sample?
4. A 38.63-mg sample of potassium ozonide, KO_3 , was heated to 70 °C for 1 h, undergoing a weight loss of 7.10 mg. A 29.6-mg sample of impure KO_3 experiences a 4.86-mg weight loss when treated under similar condition. What is the %w/w KO_3 in the sample?
5. The water content of an 875.4-mg sample of cheese was determined with a moisture analyzer. What is the %w/w H_2O in the cheese if the final mass was found to be 545.8 mg?
6. The iron in an organometallic compound was determined by treating a 0.4873-g sample with HNO_3 and heating to volatilize the organic material. After ignition, the residue of Fe_2O_3 weighed 0.2091 g.

- a. What is the %w/w Fe in this compound?
- b. The carbon and hydrogen in a second sample of the compound were determined by a combustion analysis. When a 0.5123-g sample was carried through the analysis, 1.2119 g of CO₂ and 0.2482 g of H₂O were collected. What are the %w/w C and %w/w H in this compound and what is the compound's empirical formula?
7. In the presence of water vapor the surface of zirconia, ZrO₂, chemically adsorbs H₂O, forming surface hydroxyls, ZrOH (additional water is physically adsorbed as H₂O). When heated above 200 °C, the surface hydroxyls convert to H₂O(g), releasing one molecule of water for every two surface hydroxyls. Below 200 °C only physically adsorbed water is lost. Nawrocki, et al. used thermogravimetry to determine the density of surface hydroxyls on a sample of zirconia that was heated to 700 °C and cooled in a desiccator containing humid N₂.¹ Heating the sample from 200 °C to 900 °C released 0.006 g of H₂O for every gram of dehydroxylated ZrO₂. Given that the zirconia had a surface area of 33 m²/g and that one molecule of H₂O forms two surface hydroxyls, calculate the density of surface hydroxyls in mmol/m².
8. The concentration of airborne particulates in an industrial workplace was determined by pulling the air through a single-stage air sampler equipped with a glass-fiber filter. The air was sampled for 20 min at a rate of 75 m³/h. At the end of the sampling period, the filter's mass was found to have increased by 345.2 mg. What is the concentration of particulates in the air sample in mg/m³ and mg/L?
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