8.

You need to dissolve $CaCl_2$ in water to make a mixture that is 30.5% calcium chloride by mass. If the total mass of the mixture is 234.9 g, what masses of $CaCl_2$ and water should be used?

Map

Mass of $CaCl_2$

Number

71.6 g $CaCl_2$

Mass of water

Number

163.3 g H_2O

Explanation

View Previous View Next Exit

The concentration of the $CaCl_2$ in this solution is 30.5% by mass, which means that there are 30.5 grams of $CaCl_2$ for every 100 grams of solution. Write this as a conversion factor.

$$\frac{30.5\ \text{g}\ \text{CaCl}_2}{100\ \text{g}\ \text{solution}}$$

Now use the conversion factor to cancel out units of "g solution".

$$234.9\ \text{g}\ \text{solution} \times \left(\frac{30.5\ \text{g}\ \text{CaCl}_2}{100\ \text{g}\ \text{solution}} \right) = 71.6\ \text{g}\ \text{CaCl}_2$$

To calculate the mass of water needed to make this solution, simply subtract the mass of the $CaCl_2$ from the total mass of the solution.

$$\text{Mass}\left(\text{H}_2\text{O}\right) = \text{Mass}\left(\text{total}\right) - \text{Mass}\left(\text{CaCl}_2\right)$$

$$= 234.9\ \text{g} - 71.6\ \text{g}$$

$$= 163.3\ \text{g}$$

Finally apply these totals to the molarity formula, being sure to include a conversion factor for volume.

$$M = \frac{n}{V} = \frac{0.340 \text{ mol}}{746 \text{ mL} \times \dfrac{1 \text{ L}}{1000 \text{ mL}}} = 0.455 \text{ M}$$

15.

To aid in the prevention of tooth decay, it is recommended that drinking water contain 1.20 ppm fluoride (F^-).

(a) How many grams of F^- must be added to a cylindrical water reservoir having a diameter of 4.15×10^2 m and a depth of 85.16 m?

Number: 13800000 g F^-

(b) How many grams of sodium fluoride, NaF, contain this much fluoride?

Number: 30600000 g NaF

(a) Using the definition of parts per million (ppm), the ratio of the F^- mass to the water mass must satisfy the equation

$$1.20 \text{ ppm} = \frac{F^- \text{ mass}}{H_2O \text{ mass}} \times 10^6$$

The mass of water in the reservoir is calculated from the volume of water in the reservoir. The volume of water in the reservoir is

$$V = \pi \left(2.08 \times 10^2 \text{ m}\right)^2 \left(85.16 \text{ m}\right) = 11500000 \text{ m}^3$$

Using the density of water (1.00 g/mL), the mass of water in the reservoir is calculated to be

$$\left(11500000 \text{ m}^3\right)\left(\frac{\text{L}}{10^{-3} \text{ m}^3}\right)\left(\frac{10^3 \text{ mL}}{\text{L}}\right)\left(\frac{1.00 \text{ g}}{\text{mL}}\right) = 1.15 \times 10^{13} \text{ g}$$