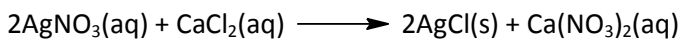


## Parts per Million and Normality Problems

- 1) A certain solution has a  $[\text{CaCl}_2] = 1.0 \times 10^{-5} \text{ M}$ . What is the  $[\text{Cl}^{-1}]$  concentration in the solution if the density of the solution is 0.99 g/mL? Give your answer in ppm (m/m). **[0.72]**
- 2) A certain solution has an  $[\text{NO}_3^{-1}] = 2.4 \text{ ppb (m/m)}$  and a density of 0.99 g/mL. All the nitrate ions in the solution originated from an  $\text{Al}(\text{NO}_3)_3$  contamination. What concentration of  $\text{Al}(\text{NO}_3)_3$  would give rise to the  $\text{NO}_3^{-1}$  contamination in the solution? Give your answer in moles/L. **[1.3 x 10<sup>-8</sup>]**
- 3) It took 21.62 mL of  $1.00 \times 10^{-5} \text{ M AgNO}_3$  solution to titrate a 25.00 mL aliquot of  $\text{CaCl}_2$ :



What was the concentration of  $\text{CaCl}_2$  in the original solution? Give your answer in ppm (m/m) and assume that the original solution had a density of 0.99 g/mL. **[0.48]**

- 4) Water hardness is measured in ppm (m/v), where the mass is of the solute in grams and the volume is of the solution in mL. This particular metric has the advantage that you don't have to weigh out large quantities of water (it's far more convenient to measure its volume), but the disadvantage that the resulting number is temperature-dependent.
  - a) A solution has a hardness of 20.0 ppm (m/v)  $\text{CaCO}_3$  at 4°C (where the density of the solution is 1.00 g/mL). What will be its hardness at 25°C, where the density of the solution will be 0.997 g/mL? **[19.9]**
  - b) Based on your answer to (a), how serious is the problem of temperature-dependence when quoting water hardness levels? **[Not very – the uncertainty created is probably within measurement error.]**
- 5) What is the concentration (in moles/L) of a 0.90 N solution of  $\text{H}_3\text{PO}_4$ ? **[0.30]**
- 6) What is the normality of the solution that results when 10.0 mL of 1.00 M  $\text{H}_2\text{SO}_4$  is diluted to 250.0 mL? **[0.080]**
- 7) What is the equivalent mass of  $\text{Ba}(\text{OH})_2$ ? **[85.67 grams]**
- 8) A metal hydroxide has the formula  $\text{M}(\text{OH})_3$  and has an equivalent mass of 35.62 grams.
  - a) What is the metal, M? **[Fe]**
  - b) How many grams of the metal hydroxide would be necessary to neutralize a 4.0-litre spill of 6.0 N acid? **[855]**
  - c) If the metal hydroxide came in 250-gram bottles, how many bottles would you need for the neutralization? **[4]**
- 9) What is the normality of an acid if a 20.0 mL aliquot required 26.18 mL of 0.0100 N  $\text{Ca}(\text{OH})_2$  for complete reaction? **[0.0131]**