Moles and Solutions **Answers**

Use a calculator and a periodic table to answer the following questions.

1. Calculate the concentration, in mol dm^{-3}, of the following solutions. Give each answer to an appropriate number of significant figures.

   a. A solution formed by dissolving 0.5 moles of sodium chloride in 1 dm^3 of water.

   concentration = $\frac{0.5}{1}$ = 0.5 mol dm^{-3}

   concentration = **0.5** mol dm^{-3}

   b. A solution formed by dissolving 0.125 moles of potassium manganate(VII) ($KMnO_4$) in 100 cm^3 of water.

   volume = $\frac{100\ cm^3}{1000}$ = 0.1 dm^3

   concentration = $\frac{0.125}{0.1}$ = 1.25 mol dm^{-3}

   concentration = **1.25** mol dm^{-3}

   c. A solution formed by dissolving 20.0 g of sodium hydroxide (NaOH) in 250 cm^3 of water.

   M_r of NaOH = (23.0 × 1) + (16.0 × 1) + (1.0 × 1) = 40.0

   moles of NaOH = $\frac{20.0}{40.0}$ = 0.5

   volume = $\frac{250\ cm^3}{1000}$ = 0.25 dm^3

   concentration = $\frac{0.5}{0.25}$ = 2 mol dm^{-3}

   2 to 3 s.f. = 2.00

   concentration = **2.00** mol dm^{-3}

   d. A solution formed by dissolving 26.9 g of copper(II) chloride ($CuCl_2$) in 300 cm^3 of water.

   M_r of $CuCl_2$ = (63.5 × 1) + (35.5 × 2) = 134.5

   moles of $CuCl_2$ = $\frac{26.9}{134.5}$ = 0.2

   volume = $\frac{300\ cm^3}{1000}$ = 0.3 dm^3

   concentration = $\frac{0.2}{0.3}$ = 0.66666... mol dm^{-3}

   0.66666... to 3 s.f. = 0.667

   concentration = **0.667** mol dm^{-3}

2. Calculate the number of moles of solute in each of the following solutions. Give each answer to an appropriate number of significant figures.

   a. 1 dm^3 of 0.5 mol dm^{-3} iron(II) sulfate ($FeSO_4$) solution.

   moles = 1 × 0.5 = 0.5

   number of moles = **0.5** mol

   b. 100 cm^3 of 1.5 mol dm^{-3} potassium chloride (KCl) solution.

   volume = $\frac{100\ cm^3}{1000} = 0.1\ dm^3$

   moles = 0.1 × 1.5 = 0.15

   number of moles = **0.15** mol

   c. 250 cm^3 of 73 g dm^{-3} hydrochloric acid (HCl) solution

   M_r of HCl = (1.0 × 1) + (35.5 × 1) = 36.5

   moles of HCl in 73 g = $\frac{73}{36.5} = 2$

   73 g dm^{-3} = 2 mol dm^{-3}

   volume = $\frac{250\ cm^3}{1000} = 0.25\ dm^3$

   moles = 0.25 × 2 = 0.5

   0.5 to 2 s.f. = 0.50

   number of moles = **0.50** mol

   d. 40 cm^3 of a solution that is prepared by dissolving 21 g of sodium fluoride (NaF) in 500 cm^3 of water.

   M_r of NaF = (23.0 × 1) + (19.0 × 1) = 42.0

   moles of NaF in 21 g = $\frac{21}{42.0}$ = 0.5 moles

   volume of prepared solution = $\frac{500\ cm^3}{1000} = 0.5\ dm^3$

   concentration of prepared solution = $\frac{0.5}{0.5} = 1$ mol dm^{-3}

   volume = $\frac{40\ cm^3}{1000} = 0.04\ dm^3$

   moles of NaF in 40 cm^3 of solution = 0.04 × 1 = 0.04

   0.04 to 2 s.f. = 0.040

   number of moles = **0.040** mol

3. A student is preparing a 0.500 mol dm^{-3} solution of potassium nitrate (KNO_3). Calculate the mass, in grams, of potassium nitrate the student should dissolve in 100 cm^3 of water.

   Give your answer to an appropriate number of significant figures.

   volume of water = $\frac{100\ cm^3}{1000} = 0.1\ dm^3$

   moles of KNO_3 in prepared solution = 0.1 × 0.500 = 0.05

   M_r of KNO_3= (39.1 × 1) + (14.0 × 1) + (16.0 × 3) = 101.1

   mass = 0.05 × 101.1 = 5.055

   5.055 to 3 s.f. = 5.06

   mass = **5.06** g

4. A student is preparing a 0.125 mol dm^{-3} solution of lithium hydroxide (LiOH). Calculate the volume of water, in cm^3, which is needed to dissolve 2.39 g of lithium hydroxide to prepare this solution.

   M_r of LiOH = (6.9 × 1) + (16.0 × 1) + (1.0 × 1) = 23.9

   moles of LiOH = $\frac{2.39}{23.9} = 0.1$ moles

   volume = $\frac{\text{number of moles}}{\text{concentration}} = \frac{0.1}{0.125} = 0.8\ dm^3$

   0.8 dm^3 × 1000 = 800 cm^3

   volume = **800** cm^3

5. A student completely dissolved 49.05 g of an unidentified white solid in 500 cm^3 of water. The student then carried out a titration and determined that a 25.0 cm^3 sample of the solution contained 0.0250 moles of the solid.

   Calculate the relative molecular mass (M_r) of the solid.

   volume of sample used in titration = $\frac{25.0\ cm^3}{1000} = 0.025\ dm^3$

   concentration = $\frac{0.0250}{0.025} = 1\ mol\ dm^{-3}$

   volume of original solution = $\frac{500\ cm^3}{1000} = 0.5\ dm^3$

   moles in original solution = 0.5 × 1 = 0.5

   M_r = $\frac{\text{mass of substance}}{\text{number of moles}} = \frac{49.05}{0.5} = 98.1$

   relative molecular mass = **98.1**