

Molarity and Solution Stoichiometry

Answer key with worked solutions

A. Understanding

1. Molarity.

Moles of solute per litre of **solution**; unit mol/L (M).

2. Volume of water vs volume of solution.

Dissolving the solid changes the total volume, so the solution is not exactly 250.0 mL. Dissolve the solid in less water, then add water **up to** a final volume of 250.0 mL (for example in a volumetric flask).

B. Calculating molarity and amounts

3. 10.0 g NaOH in 500.0 mL.

$n = 10.0 \div 40.00 = 0.250$ mol. Molarity = $0.250 \div 0.5000$ L = **0.500 M**

4. KCl for 250.0 mL of 0.150 M.

$n = 0.150 \times 0.2500 = 0.03750$ mol. $M(\text{KCl}) = 74.55$ g/mol, so mass = $0.03750 \times 74.55 =$ **2.80 g**

5. Moles in 35.0 mL of 0.200 M.

$n = 0.200 \times 0.0350 =$ **0.00700 mol**

C. Dilution

6. Volume of 12.0 M HCl needed.

$$V_1 = \frac{M_2 V_2}{M_1} = \frac{0.600 \times 500.0}{12.0} = \mathbf{25.0 \text{ mL}}$$

7. New concentration.

$$M_2 = \frac{2.00 \times 50.0}{400.0} = \mathbf{0.250 \text{ M}}$$

D. Titrations

8. Concentration of HCl.

$$n(\text{NaOH}) = 0.120 \times 0.02250 = 0.002700 \text{ mol} = n(\text{HCl}) \text{ (1 : 1). } [\text{HCl}] = 0.002700 \div 0.02500 = \mathbf{0.108 \text{ M}}$$

9. Concentration of H_2SO_4 .

$$n(\text{NaOH}) = 0.200 \times 0.01875 = 0.003750 \text{ mol. } n(\text{H}_2\text{SO}_4) = 0.003750 \div 2 = 0.001875 \text{ mol. } [\text{H}_2\text{SO}_4] = 0.001875 \div 0.01500 = \mathbf{0.125 \text{ M}}$$