Activity 4C: Standard solutions

Ans p. 20

1. Name the particles present and calculate the amount, in mol, of each present in the following aqueous solutions. (**Note**: All solutions contain water molecules. Do not include these in the answers.)

a. 5 mL of 0.1 mol L^{-1} sodium chloride solution.

b. 10 mL of 0.2 mol L^{-1} sodium carbonate solution.

c. 35 mL of 0.25 mol L^{-1} iron(III) chloride solution.

d. 30 mL of 0.01 mol L^{-1} calcium hydroxide solution.

e. 20 mL of 0.25 mol L^{-1} sulfuric acid.

2. A student has been asked to prepare 250 mL of standard 0.200 mol L^{-1} sodium carbonate solution.

An empty beaker was weighed (116.48 g) and *anhydrous* sodium carbonate, Na_2CO_3, was added until the combined mass of beaker and sodium carbonate was 122.05 g. The solid was transferred to a 250 mL volumetric flask. The sodium carbonate was dissolved in deionsed water and the volume made up to the mark.

[M (Na_2CO_3) = 106.0 g mol^{-1}]

a. **i.** Find the mass of sodium carbonate that was weighed out.

ii. Calculate the amount of sodium carbonate in this mass.

b. Calculate the concentration of the standard solution in mol L^{-1}.

c. If a 20.00 mL sample of this solution is used, what amount (mol) of carbonate ions would be present in the sample?

3. 5.30 g of sodium carbonate, Na_2CO_3, is dissolved in water to make 250.0 mL of solution.

[M(Na_2CO_3) = 106.0 g mol^{-1}]

a. Find the amount of Na_2CO_3 in 5.30 g of the solid.

b. Find the concentration in mol L^{-1} of the sodium carbonate solution.

c. What amount of CO_3^{2-} is present in 20.0 mL of this solution?

4. 0.160 g of anhydrous sodium hydroxide is dissolved in enough distilled water to form 50.0 mL of solution.

a. Find the concentration of this solution. [M(NaOH) = 40.0 g mol^{-1}]

b. What amount of $OH^-(aq)$ is present in 75.00 mL of this solution?

c. Explain why this solution would not make a good primary standard.

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Activity 4C: Standard solutions (page 19)

1. a. NaCl: sodium ions, 0.0005 mol; chloride ions, 0.0005 mol

b. Na_2CO_3: sodium ions, 0.004 mol; carbonate ions, 0.002 mol

c. $FeCl_3$: iron(III) ions, 0.0088 mol; chloride ions 0.026 mol

d. $Ca(OH)_2$: calcium ions, 0.0003 mol; hydroxide ions, 0.0006 mol

e. H_2SO_4: hydrogen ions, 0.01 mol; sulfate ions, 0.005 mol

2. a. i. 122.05 – 116.48 g = 5.57 g **ii.** $n = \frac{m}{M} = \frac{5.57\text{ g}}{106\text{ g mol}^{-1}} = 0.0525\text{ mol}$

b. $c = \frac{n}{V} = \frac{0.0525\text{ mol}}{0.250\text{ L}} = 0.210\text{ mol L}^{-1}$

c. $n = cV = 0.210\text{ mol L}^{-1} \times 0.02000\text{ L} = 0.00420\text{ mol}$

3. a. $n = \frac{m}{M} = \frac{5.30\text{ g}}{106\text{ g mol}^{-1}} = 0.0500\text{ mol}$

b. $c = \frac{n}{V} = \frac{0.0500\text{ mol}}{0.250\text{ L}} = 0.200\text{ mol L}^{-1}$

c. $n = cV = 0.200\text{ mol L}^{-1} \times 0.02000\text{ L}$
$= 0.004\text{ mol}$

4. a. $n = \frac{m}{M} = \frac{0.160\text{ g}}{40.0\text{ g mol}^{-1}} = 0.00400\text{ mol}$

$c = \frac{n}{V} = \frac{0.00400\text{ mol}}{0.0500\text{ L}} = 0.0800\text{ mol L}^{-1}$

b. $n = cV = 0.0800\text{ mol L}^{-1} \times 0.07500\text{ L}$
$= 0.00600\text{ mol}$

c. The NaOH does not have a constant composition. It can absorb water from the air, so its mass can change between the time it is weighed and the time when the solution is made up.

RESOURCES

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