

Net ionic equations, titration and redox

AP Chemistry · Lab answers

Model answers use the sample data. Your masses will differ a little, but the shape of the graph and the position of the break at about 33 mL should agree. Show conversions from volume to moles and give masses to two or three significant figures.

Level: AP Chemistry · **Curriculum:** AP Chem Unit 4

Question 1 Equations

$\text{Na}_2\text{CO}_3(\text{aq}) + \text{CaCl}_2(\text{aq}) \rightarrow \text{CaCO}_3(\text{s}) + 2\text{NaCl}(\text{aq})$. Net ionic: **$\text{Ca}^{2+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{CaCO}_3(\text{s})$** .

Question 2 Amounts

$n(\text{Ca}^{2+}) = 0.0250 \times 0.400 = \mathbf{0.0100 \text{ mol}}$. $n(\text{CO}_3^{2-}) = 0.0100 \text{ L} \times 0.300 = \mathbf{0.00300 \text{ mol}}$ and $0.0400 \times 0.300 = \mathbf{0.0120 \text{ mol}}$.

Question 3 Limiting reagent

10.0 mL: $0.00300 \text{ mol CO}_3^{2-} < 0.0100 \text{ mol Ca}^{2+}$, so **Na_2CO_3 is limiting**. 40.0 mL: $0.0120 \text{ mol CO}_3^{2-} > 0.0100 \text{ mol Ca}^{2+}$, so **CaCl_2 is limiting**.

Question 4 Theoretical mass

20.0 mL: $n = 0.00600 \text{ mol}$, $m = \mathbf{0.601 \text{ g}}$. 50.0 mL: Ca^{2+} limiting, $n = 0.0100 \text{ mol}$, $m = \mathbf{1.00 \text{ g}}$.

Question 5 Percent yield

20.0 mL: $0.58 / 0.601 \times 100 = \mathbf{96.6 \text{ percent}}$. All five are 96 to 97 percent, so the loss is consistent, probably precipitate left on the beaker or paper.

Question 6 Graph

Mass rises in a straight line from the origin and then levels at 0.97 g. The lines meet where $n(\text{CO}_3^{2-}) = 0.0100 \text{ mol}$: $V = 0.0100 / 0.300 = \mathbf{33.3 \text{ mL}}$.

Question 7 Explain the plateau

All the Ca^{2+} has precipitated; extra CO_3^{2-} stays dissolved, so **the mass is fixed by the amount of Ca^{2+}** .

Question 8 Improve the method

Precipitate lost during transfer: rinse the beaker into the funnel. Moisture left in the precipitate: dry to constant mass. **Both would otherwise change the measured mass.**