Finding a Particle Deficit in a Solution

Base your answers on the information provided and your knowledge of chemistry. Use the 2025 Chemistry Reference Tables as needed.

A classroom model relates freezing-point decrease to the amount of independently moving dissolved particles. Every test uses the same mass of water. In this range, 0.010 mol of such particles lowers the freezing temperature by 0.10 °C. A formula unit of calcium chloride can separate into one calcium ion and two chloride ions.

Solution	**Amount of solute added (mol)**	**Measured freezing-point decrease (°C)**
Sugar reference	0.010	0.10
Calcium chloride	0.010	0.24

1 What freezing-point decrease would the model predict if all the calcium chloride dissolved and every ion moved independently?

(1) 0.10 °C

(2) 0.20 °C

(3) 0.24 °C

(4) 0.30 °C

2 Calculate the effective amount of independently moving particles indicated by 0.24 °C. [1]

Answer and work

A separate test confirms that all 0.010 mol of calcium chloride dissolved. The class proposes a model where some calcium ions and chloride ions move as pairs. Each pair counts as one independently moving particle instead of two. The model forms no larger groups.

3 Calculate how many moles of these pairs would account for the measured decrease. Explain why each pair changes the effective count. [1]

Answer and work

4 Explain why the independent dissolution test matters when interpreting the particle deficit. [1]

Answer and work