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Unknown A Data (I didn't have any, so pretend it is here)

Average molar mass of unknown A = 89.5 g/mol +/- 0.6 g/mol

Calculation – Helps to show a sample

Calculation – Helps to show another sample

Using a Q-test, the data from Bench 2 was excluded as it was outside the 95% confidence interval.

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Conclusion: The freezing point depression for solutions of NaCl, CaCl₂ and ethylene glycol was measured to determine the van t'Hoff factors for each solute. Ethylene glycol is a molecular compound and should have had $i=1$ but our data showed a measured van t'Hoff factor of 0.7. Similarly for the two ionic compounds, NaCl and CaCl₂, which should have had $i=2$ and $i=3$, respectively, the actual measured values were lower. NaCl had a measured van t'Hoff factor of 0.8 while CaCl₂ had an $i=1.9$.

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The discrepancy in the van t'Hoff factors is most likely due to the small change in freezing point. The digital thermometer was only capable of measuring temperatures with 0.1 C precision and the freezing point depressions were almost all less than 1 C. As a result, there was only one significant figure in the measured depressions which leads to errors of as much as 40% for the smallest depressions (0.5 C).

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In addition, the mixing of the cooling ice with the solvent water leads to two possible sources of error. The amount of actual solvent water might not be accurately measured due to continuous melting of the ice as well as wetting of the ice surface. While this error is probably small compared to the temperature measurement, it cannot be ignored. More significantly, it is possible that the solute precipitated onto the surface of the ice which would have reduced the effective concentration of the solutions. This reduced concentration would have appeared as a reduced van t'Hoff factor which is what was observed.

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Further experimentation should be performed using an indirect freezing method where the ice was not mixing directly with the solution. The temperature limitation can be overcome by either investing in a thermometer with 0.01 C precision or increasing the molality of the solutions so that the depression is more than 3 C.

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The molar mass of unknown A was determined to be 89.5 g/mol with a standard deviation of 0.6 g/mol. While there is no way to verify the accuracy of this value since the compound's identity is unknown, the precision in the result provides some confidence that the number is accurate.
