

Question 1

1. A student performs a calorimetry experiment with KCl.

Part A

Consider the K^+ ion in KCl.

- i. **Write** the complete ground-state electron configuration for the potassium ion, K^+ .
- ii. Which has the larger radius, the K^+ ion or the K atom? **Explain** your reasoning using principles of atomic structure.

The following information applies to parts B, C, D, and E.

A student performs an experiment to determine the enthalpy of solution, ΔH_{soln} , of KCl. The student places water in a calorimeter, measures the initial temperature, adds $\text{KCl}(s)$, and stirs until the KCl dissolves completely. The temperature is continuously monitored during the experiment. Data from the experiment are given in the following table.

Mass of water	97.5 g
Mass of $\text{KCl}(s)$	6.80 g
Initial temperature of water	24.5°C
Final temperature of solution	21.1°C

Part B

Describe how the student can use the temperature readings during the experiment to determine when the dissolution is complete.

Part C

Use the data in the table to do the following.

- i. **Calculate** the magnitude of the thermal energy, q , in joules, transferred during the dissolution. Show the work that leads to your answer. (Assume that the solution has a specific heat capacity of $3.95 \text{ J}/(\text{g}\cdot^\circ\text{C})$.)
- ii. **Calculate** the value of the molar enthalpy of solution, ΔH_{soln} , in kJ/mol , for KCl given that 0.0912 mol of KCl dissolved. Show the work that leads to your answer. Include the sign with your answer.

Part D

The calorimeter is not perfectly insulated. Would this cause the magnitude of ΔH_{soln} calculated in part C (ii) to be greater than, less than, or equal to the accepted value? **Justify** your answer.

Part E

The student performs a second experiment using the same mass of water but 6.80 g of $\text{RbCl}(s)$ instead of 6.80 g of $\text{KCl}(s)$. The magnitude of the molar enthalpy of solution, ΔH_{soln} , of RbCl is approximately equal to that of KCl.

Is the magnitude of ΔT in the RbCl experiment greater than, less than, or equal to that in the KCl experiment? **Justify** your answer. (Assume that the specific heat capacities of the solutions are equal.)

Part F

RbCl has a K_{sp} of 57 at 20°C .

- i. **Write** the net ionic equation for the dissolution of RbCl in pure water.
- ii. **Calculate** the molar solubility of RbCl in a saturated solution at 20°C . Show the work that leads to your answer.
- iii. A second saturated solution is prepared by dissolving $\text{RbCl}(s)$ in $1.0 \text{ M KCl}(aq)$ at 20°C instead of in pure water. Will the molar solubility of RbCl in $1.0 \text{ M KCl}(aq)$ be greater than, less than, or equal to the molar solubility calculated in part F (ii)? **Justify** your answer.