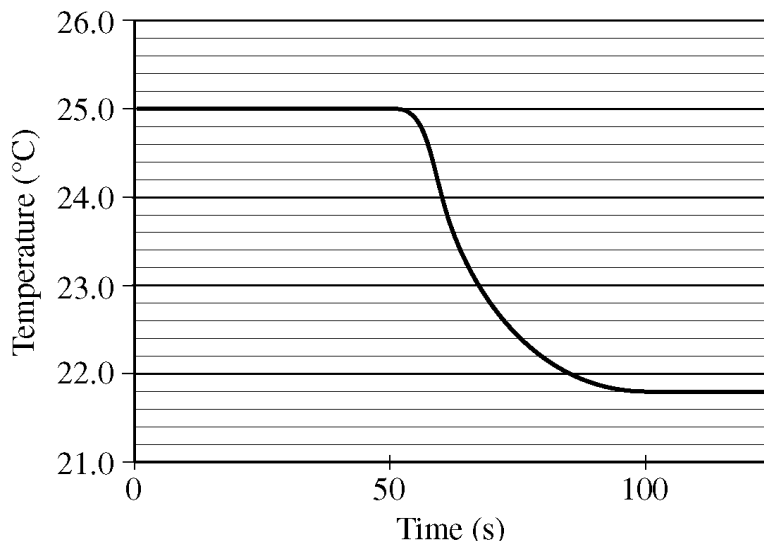


Modified from the 2010 AP Exam

1) A student performs an experiment to determine the molar enthalpy of solution of urea, H_2NCONH_2 . The student places 91.95 g of water at 25°C into a coffee-cup calorimeter and immerses a thermometer in the water.

After 50 s, the student adds 5.13 g of solid urea, also at 25°C , to the water and measures the temperature of the solution as the urea dissolves. A plot of the temperature data is shown in the graph below.



- (a) Determine the change in temperature of the solution that results from the dissolution of the urea.
- (b) According to the data, is the dissolution of urea in water an endothermic process or an exothermic process? Justify your answer.
- (c) Assume that the specific heat capacity of the calorimeter is negligible and that the specific heat capacity of the solution of urea and water is $4.2 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$ throughout the experiment.
- (i) Calculate the heat change of the urea in joules.
- (ii) Calculate the molar enthalpy of solution, $\Delta H_{\text{soln}}^\circ$ of urea in kJ mol^{-1} .
- (f) The student performs another trial of the experiment but this time adds urea that has been taken directly from a refrigerator at 5°C . What effect, if any, would using the cold urea instead of urea at 25°C have on the experimentally obtained value of $\Delta H_{\text{soln}}^\circ$? Justify your answer.