Calorimetry worksheet 2

1) Methanol, CH_3OH, undergoes combustion according to the equation
   $2CH_3OH(l) + 3O_2(g) => 2CO_2(g) + 4H_2O(g)$
   In an experiment to determine its suitability as a fuel, a sample of methanol underwent complete oxidation in a bomb calorimeter.
   The calorimeter was first calibrated by passing a current through an electric heater placed in the water surrounding the reaction vessel. A potential of 6.25 volts was applied for 2.80 minutes. The measured current was 1.46 amperes and the temperature of the water and reaction vessel increased by 0.653 °C.
   a) Determine the calibration constant, in $kJ\ °C^{-1}$, for the calorimeter and its contents.
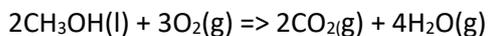
   b) A student then used this calorimeter to determine the molar heat of combustion of methanol. 0.894 g of methanol was placed in the reaction vessel and excess oxygen was added. An electric ignition heater provided the energy required to initiate the combustion reaction. On this occasion, the temperature of the water increased by 8.45 °C.
   Use this experimental data to determine the value of ΔH for the combustion of methanol given by the following equation. $2CH_3OH(l) + 3O_2(g) => 2CO_2(g) + 4H_2O(g)$ Include appropriate units in your answer.

   c) The value of ΔH, calculated using the enthalpy of combustion provided in the data book, is different from the value of ΔH calculated from the experimental data provided in part b). Provide a reason for this difference.

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   d) Why is it necessary for the calorimeter to be calibrated when we can use the specific heat of water (given as $4.18\ J\ g^{-1}\ K^{-1}$ in the data book) to measure energy output?

2) A calorimeter is used to produce the temperature vs time graph shown in diagram 1 when 22.7 grams of NH_4Cl dissolves in 100g of water according to the equation below.

$NH_4Cl(s) \rightarrow NH_4^+(aq) + Cl^-(aq)$ $\Delta H = +14.8kJ/mol$

Find the calibration factor of the calorimeter.

Diagram 1