Calorimeter Class Work $q=mc\Delta T$

In the following 5 questions, if there is a bomb calorimeter being used, assume that all heat is absorbed by the water, i.e. that the heat absorbed by the 'bomb' itself is insignificant.

1. When 1.37 g of barium reacts with oxygen, there is a release of 5.57×10^3 J of energy. How much heat would be produced during the formation of 1.00 mol of barium oxide. (Answer 558 kJ is produced)

2. The heat produced by burning 1.00 g of hydrazine (N_2H_4) is collected in 3.95 kg of water in a calorimeter. If the temperature rise is 1.2 K, calculate the molar heat of combustion of hydrazine. (Answer -6.3×10^2 kJ/mol)

3. Octane, (C_8H_{18}), is one component of gasoline. The heat produced by burning 1.00 g of octane is collected in 2.00 kg of water in a calorimeter. The temperature rise was 24.4 K. Calculate the molar heat of combustion of octane. (Answer -2.33×10^4 kJ/mol)

4. A particular calorimeter contains 3.54 kg of water. When 8.36 g of calcium are made to react with excess chlorine gas in this calorimeter, the observed temperature rise is 11.2 K. Calculate the molar heat of formation of calcium chloride. (Answer $- 7.94 \times 10^2$ kJ/mol)

5. A bomb calorimeter contains 1.68 kg of water surrounding the bomb. Chlorine gas was pumped into the bomb until the pressure was 1.21×10^3 kPa at 27.0°C. Then an excess of hydrogen gas was pumped into the calorimeter and the mixture was ignited. The observed temperature rise was 28.5 K. If all of the heat was collected in the water and the volume of the bomb was 2.24 L. Calculate the molar heat of formation of hydrogen chloride gas. (Answer -92.1 kJ/mol)

6. 3.00 g of potassium hydroxide (KOH) pellets are put into a Styrofoam calorimeter (i.e. a used Styrofoam coffee cup) containing 250 mL of water. The initial temperature of the water is 22.3°C. The mixture is then stirred until all of the KOH is dissolved. The final temperature of the solution is measured and recorded as 29. 7 °C. Calculate the heat of solution for potassium hydroxide ($\Delta H_{sol'n}$) . The specific heat capacity of the solution may be assumed to be the same as that of water since this is a dilute solution (3 g in 250 mL is roughly a 1 % solution). Assume no heat loss from the calorimeter. Ignore the mass of solute when calculating q. ($\Delta H_{sol'n}$ = -144 kJ/mol)

7. 12.72 g of ammonium chloride is dissolved in 100 mL of water in an insulated calorimeter so that the temperature changes from 24.7°C to 7. 2°C. Calculate the heat of solution of ammonium chloride assuming that the specific heat capacity of the solution is the same as that of water. Ignore the mass of solute when calculating q. ($\Delta H_{sol'n}$= 30.7kJ/mol)

8. A sample of sucrose ($C_{12}H_{22}O_{11}$) with a mass of 1.32 g is burned in a bomb calorimeter. The overall heat capacity (C x m) of the calorimeter has been previously determined to be 9.43 kJ °C^{-1}. The

temperature of the calorimeter changed from 25.00°C to 27.31 °C. Calculate the heat of combustion of sucrose. ($\Delta H_{comb.}$= -5.64 x 10^3kJ/mol)

9. A sample of carbon with a mass of 4.00 g is burned in a 500 g "bomb " calorimeter made of nickel metal [C_{Ni} = 0.444 kJ/(kg.°C)]. The bomb calorimeter is immersed in an insulated container containing 1.50 kg of water. The temperature is measured before and after and found to increase from 22.75°C to 42.98°C. Calculate the molar heat of combustion of carbon. (ΔH= -394 kJ/mol)