Thermochemical Equations Quiz

On a clean sheet of paper, answer the following questions. Show all work and calculations for full credit.

1. In a coffee cup calorimeter, 50.0 mL of 1.0 M NaOH and 50.0 mL of 1.0 M HCl are mixed. Both solutions were originally at 23.5°C. After the reaction, the final temperature is 29.9 °C. Assuming that all the solutions have a density of 1.0 g/mL, and a specific heat capacity of 4.184 J/g°C, calculate the enthalpy change for the neutralization of HCl by NaOH. Assume no heat is lost to the surroundings or the calorimeter.
2. Based on your answer to #1, is the reaction endothermic or exothermic? Explain using two pieces of your data.
3. Methyl alcohol (CH3OH) is completely combusted. Water vapor is one of its products. Write the balanced thermochemical equation for this reaction showing the enthalpy of the reaction ( ΔHrxn = -1277 kJ/mol) as either a reactant or a product.
4. Calculate the enthalpy change for the following reaction if only 25.00 g of calcium carbonate were used.

$$CaCO\_{3} \left(s\right)+  176 kJ  \rightarrow   CaO \left(s\right)+  CO\_{2} (g)$$

1. Sketch an energy diagram for the reaction in #4. Estimate the enthalpy of the reactants and the enthalpy of the products when drawing.
2. 50.0 mL HCl + 50.0 mL NaOH = 100. mL reaction mixture.

100 mL reaction mixture is aqueous, therefore 100 mL solution = 100 g solution

m = 100 g C = 4.184 J/g°C ΔT = 29.9 °C – 23.5 °C = 6.4 °C

q = mCΔT

 = (100 g)(4.184 J/g°C)(6.4 °C)

q = 2680 J

Since ΔHrxn = -q

ΔHrxn = -2680 J

1. The reaction is exothermic because the temperature of the system increased due to thermal energy from the reaction being transferred to the aqueous system. Also, the value for the enthalpy of the reaction is negative indicating an exothermic reaction.

3. $2CH\_{3}OH \left(l\right)+ 3O\_{2}\left(g\right) \rightarrow 2CO\_{2}\left(g\right)+4H\_{2}O \left(g\right)+1277 kJ$

4.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 25.00 g CaCO3 | 1 mole CaCO3 | 176 kJ |  | = 43.97 kJ |
|  | 100.0692 g CaCO3 | 1 mole CaCO3 |  |  |

5.

 

CaO (s) + CO2(g)

CaCO3(s)

176 kJ