

Chapters 6 and 18: Thermodynamics

1. A 50.0 mL sample of 0.100 M AgNO₃ and a 50.0 mL sample of 0.100 M HCl are mixed in a coffee cup calorimeter, forming AgCl(s). The initial temperature of the solutions is 24.30°C, and the final temperature is 25.10°C. Assume that the mixture's total mass is 100.0 g and that its specific heat capacity is the same as that of pure water. Assume that no heat is lost to the surroundings. Determine DH for the reaction in kJ/mol, and explain the sign (positive or negative) for the reaction.
2. Calculate DH for the reaction $P_4O_{10}(s) + 6PCl_5(g) \rightarrow 10Cl_3PO(g)$ given the information below:
 $P_4(s) + 6Cl_2(g) \rightarrow 4PCl_3(g)$ $DH = -1225.6$ kJ
 $P_4(s) + 5O_2(g) \rightarrow P_4O_{10}(s)$ $DH = -2967.3$ kJ
 $PCl_3(g) + Cl_2(g) \rightarrow PCl_5(g)$ $DH = -84.2$ kJ
 $PCl_3(g) + \frac{1}{2} O_2(g) \rightarrow Cl_3PO(g)$ $DH = -285.7$ kJ
3. For the following chemical reactions, predict the sign of ΔS for the system. Note that this should not require any detailed calculations.
 - A) $Fe(s) + 2HCl(g) \rightarrow FeCl_2(s) + H_2(g)$
 - B) $3NO_2(g) + H_2O(\ell) \rightarrow 2HNO_3(\ell) + NO(g)$
 - C) $2K(s) + Cl_2(g) \rightarrow 2KCl(s)$
 - D) $Cl_2(g) + 2NO(g) \rightarrow 2ClNO(g)$
 - E) $SiCl_4(g) \rightarrow Si(s) + 2Cl_2(g)$
4. Write a thermochemical reaction to represent the combustion of Fe(s) with oxygen gas to produce iron(III) oxide if DH for the reaction is -1652 kJ/mol. How much heat is released when 10.0 g Fe and 3.00 g O₂ react? You may assume that the percentage yield for the reaction is 100%.
5. A 95.0 g sample of H₂O at 22°C is added to a 55.0°C sample of water. If the final temperature of the resulting water sample is 37°C, then what mass of hot water was added?