

Chapter 10
Thermochemistry: Energy Changes in Chemical Reactions
Learning Objectives

8.12.2022

To satisfy the minimum requirements for this course, you should be able to:

1. **Demonstrate an understanding of thermochemistry** and be able to:
 - explain the relationships among the following: system, surroundings, and universe; exothermic process and endothermic process; internal energy (E) and enthalpy (H); ΔE , ΔH , q, and w
 - state the first law of thermodynamics in words and perform calculations using the first law for a closed system ($\Delta E = q + w$)
 - distinguish between state functions and path functions and identify examples of each
 - explain the sign conventions for heat (q) and work (w)
 - identify whether a process as exothermic or endothermic, given the sign of ΔH
 - calculate the quantity of heat involved in a reaction given the quantity of reactants and the enthalpy change for the reaction
 - calculate the amount of reactant needed to generate a given amount of heat
 - explain how “standard state” is defined for solids, liquids, gases, and solutes in solution.
2. **Demonstrate an understanding of the concept of calorimetry**, and be able to:
 - Define the meaning of heat capacity (C_P), specific heat (c_P) and molar heat capacity ($c_{P,n}$) of a substance. Give the units for each.
 - perform calculations using the equations:
 - a. $q = m c_P \Delta T$
 - b. $q = C_P \Delta T$
 - c. $q = n c_{P,n} \Delta T$
 - d. $q = n \Delta H$ for a chemical reaction or phase transition
 - use constant pressure calorimetry data to calculate the standard reaction enthalpy or to calculate the specific heat of a substance
 - calculate the energy transfer necessary to heat or cool a sample through a temperature range that includes phase change(s), given the appropriate thermodynamic data (heating curve calculation)
3. **Calculate the standard enthalpy change (ΔH_{rxn}°) for a chemical reaction** using:
 - standard enthalpies of formation (ΔH_f° found in Appendix 4, Table A4.3, p. APP-18-24) of reactants and products (direct method)
 - Hess's law (indirect method)
4. **Use bond energies to estimate ΔH for a chemical reaction** (selected Bond Energies are given in Table 4.6, p. 173 and a more complete listing is given in Table A4.1, p. APP-17)
5. **Naval Application: Fuels and Lubricants** (see handout and Section 10.9 - Fuels Applications)
 - understand the term fuel value (or energy content) and compare fuel values for fuels
 - describe how the percent oxygen in a fuel affects its fuel value, and explain how adding ethanol to gasoline affects its fuel value
 - define the terms flashpoint, flammability, and volatility
 - describe the relative flammability of the military fuels: JP-4, JP-5, and JP-8
 - describe several uses of lubricating oils

Note - Section 10.8 (Energy Changes When Substances Dissolve) is not assigned.