

5: Thermochemistry

OVERVIEW OF THE CHAPTER

5.1, 5.2 **Thermodynamics: The First Law and Internal Energy Changes**

Review: Dimensional Analysis (1.6)

Learning Goals: You should be able to:

1. Give examples of different forms of energy.
2. List the important units in which energy is expressed and convert from one to another.
3. Define the first law of thermodynamics both verbally and by means of an equation.
4. Describe how the change in internal energy of a system is related to the exchanges of heat and work between the system and its surroundings.
5. Define the term *state function* and describe its importance in thermochemistry.

5.3, 5.4 **Enthalpy: Enthalpies of Reaction**

Review: Meaning of chemical equations (3.1); stoichiometric calculations (3.6).

Learning Goals: You should be able to:

1. Define enthalpy, and relate the enthalpy change in a process occurring at constant pressure to the heat added to or lost by the system during the process.
2. Sketch an energy diagram such as that shown in Figure 5.12 of the text, given the enthalpy changes in the processes involved, and associate the sign of ΔH with whether the process is exothermic or endothermic.
3. Calculate the quantity of heat involved in a reaction at constant pressure given the quantity of reactants and the enthalpy change for the reaction on a mole basis.

5.5, 5.8 **Calorimetry: Fuel Values**

Learning Goals: You should be able to:

1. Define the terms heat capacity and specific heat.
2. Calculate any one of the following quantities given the other three: heat, quantity of material, temperature change, and specific heat.
3. Calculate the heat capacity of a calorimeter, given the temperature change and quantity of heat involved; also calculate the heat evolved or absorbed in a process from a knowledge of the heat capacity of the system and its temperature change.
4. Define the term fuel value; calculate the fuel value of a substance given its heat of combustion or estimate the fuel value of a material given its composition.
5. List the major sources of energy on which humankind must depend, and discuss the likely availability of these for the foreseeable future.

5.6

Hess's Law

Learning Goals: You should be able to:

1. State Hess's law, and apply it to calculate the enthalpy change in a process, given the enthalpy changes in other processes that could be combined to yield the reaction of interest.

5.7

Enthalpies of Formation: Calculating Heats of Reactions

Learning Goals: You should be able to:

1. Define and illustrate what is meant by the term standard state, and identify the standard states for the elements carbon, hydrogen, and oxygen.
2. Define the term standard heat of formation, and identify the type of chemical reaction with which it is associated.
3. Calculate the enthalpy change in a reaction occurring at constant pressure, given the standard enthalpies of formation of each reactant and product.