Chapter 5

Enthalpy

1. Which one of the following conditions would always result in an increase in the internal energy of a system _____?

A) The system loses heat and does work on the surroundings.
B) The system gains heat and does work on the surroundings.
C) The system loses heat and has work done on it by the surroundings.
D) The system gains heat and has work done on it by the surroundings.
E) None of the above is correct.

2. Which one of the following statements is true _____?

A) Enthalpy is an intensive property.
B) The enthalpy change for a reaction is independent of the state of the reactants and products.
C) Enthalpy is a state function.
D) H is the value of q measured under conditions of constant volume.
E) The enthalpy change of a reaction is the reciprocal of the ΔH of the reverse reaction.

3. The reaction

$$4Al\,(s) + 3O_2\,(g) \rightarrow 2\,Al_2O_3\,(s) \qquad \Delta H^\circ = -3351\ kJ$$

is _____, and therefore heat is _____ by the reaction.

A) endothermic, released
B) endothermic, absorbed
C) exothermic, released
D) exothermic, absorbed
E) thermoneutral, neither released nor absorbed

4. Under what condition(s) is the enthalpy change of a process equal to the amount of heat transferred into or out of the system _____?

(a) temperature is constant
(b) pressure is constant
(c) volume is constant

A) a only
B) b only
C) c only
D) a and b
E) b and c

5. The British thermal unit (Btu) is commonly used in engineering applications. A Btu is defined as the amount of heat required to raise the temperature of 1 lb of water by 1 °F. There are _____ joules in one Btu. 1 lb = 453.59 g; °C = (5/9)(°F - 32°); specific heat of $H_2O(l)$ = 4.184 J/g-K.

A) 3415
B) 60.29
C) 1054
D) 5.120×10^{-3}
E) Additional information is needed to complete the calculation.

6. A 22.44 g sample of iron absorbs 180.8 J of heat, upon which the temperature of the sample increases from 21.1 °C to 39.0 °C. What is the specific heat of iron _____?

A) 0.140
B) 0.450
C) 0.820
D) 0.840
E) 0.900

180.8/(22.44*17.9)

7. Of the following, ΔH_f° is not zero for _____.

A) O_2 (g)
B) C (s, graphite)
C) N_2 (g)
D) F_2 (s)
E) Cl_2 (g)

8. Consider the following two reactions:

$A \rightarrow 2B \qquad \Delta H^\circ_{rxn} = 456.7$ kJ/mol

$A \rightarrow C \qquad \Delta H^\circ_{rxn} = -22.1$ kJ/mol

Determine the enthalpy change for the process: _____

$2B \rightarrow C$

A) -478.8 kJ/mol
B) -434.6 kJ/mol
C) 434.6 kJ/mol
D) 478.8 kJ/mol
E) More information is needed to solve the problem.

9. For which one of the following reactions is the value of $\Delta H°_{rxn}$ equal to $\Delta H_f°$ for the product _____?

A) $2\ C\ (s,\ graphite) + 2\ H_2\ (g) \rightarrow C_2H_4\ (g)$
B) $N_2\ (g) + O_2\ (g) \rightarrow 2\ NO\ (g)$
C) $2\ H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (l)$
D) $2\ H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (g)$
E) $H_2O\ (l) + 1/2\ O_2\ (g) \rightarrow H_2O_2\ (l)$

- **Enthalpies of formation (ΔH_f):** the enthalpy change associated with the process of the formation of a compound from its constituent elements.
- **Standard state:** 1atm, 298 K (25℃)
- **Standard enthalpy change of a reaction (ΔH^0):** the enthalpy change when all reactants and products are in their standard states.
- **Standard enthalpy of formation of a compound (ΔH_f^0):** the enthalpy change for the reaction that forms one mole of the compound from its element with all substance in their standard states.

  Note: the standard enthalpy of formation of the most stable form of any element is zero.