**Method 2:**

**Standard Enthalpies of Formation**

* ΔH0f is the quantity of energy that is absorbed or released when one mol of a compound is formed directly from its elements in their standard states
* the enthalpy of formation of an element in its standard state is zero

Writing Formation Equations

1. write one mol of product in the given state
2. write the reactant elements in their standard states
3. balance your equation

Example:

Write the formation equation for liquid ethanol, C2H5OH

2C(s) + 3H2(g) + 1/2O2(g) 🡪 C2H5OH(l)

The value of the standard enthalpies of formation can be found in Appendix C6 on page 799-800.

Using Standard Enthalpies of Formation

The enthalpy change for a reaction is equal to the total enthalpy of formation of the products minus the total enthalpy of formation of the reactants.

ΔH = ∑nΔH0f(products) - ∑nΔH0f(reactants)

Note: there are different enthalpy values for different states.

Example:

What is the molar enthalpy of combustion of methane fuel?

CH4(g) + 2O2(g) 🡪 CO2(g) + 2H2O(l)

ΔH0f CH4(g) = -74.4 kJ/mol

ΔH0f O2(g) = 0 kJ/mol

ΔH0f CO2(g) = -393.5 kJ/mol

ΔH0f H2O(l) = -285.5 kJ/mol

ΔH = ∑nΔH0f(products) - ∑nΔH0f(reactants)

= [(1 x -393.5) + (2 x -285.5)] – [(1 x -74.4) + (2 x 0)]

= [-965.1 kJ] – [-74.4 kJ]

= -890.7 kJ

Multistep Calculations

Example:

What mass of octane is completely burned to cause the heating of 20.0 kg of aqueous ethylene glycol automotive coolant from 100C to 700C? The specific heat capacity of aqueous ethylene glycol is 3.5 J/(g0C). Assume water is produced as a gas and that all the heat flows into the coolant.

C8H18(g) + 25/2 O2(g) 🡪 8 CO2(g) + 9H2O(g)

Calculate the molar enthalpy of combustion

ΔH = [(8 x -393.5) + (9 x -241.8)] – [(1 x -250.1) + (25/2 x 0)]

= -5074.1 kJ/mol

ΔH octane = Q coolant

nΔHcomb = mcΔT

n octane = (mcΔT)/ΔHcomb

= (20.0 x 3.5 x 60)/5074.1

= 0.83 mol

m octane = 0.83 mol x 114.26 g/mol

= 94.58 g