Homework - Worksheet

② $2C_8H_{18(\ell)} + 25O_{2(g)} \rightarrow 16CO_{2(g)} + 18H_2O_{(g)}$

$\Delta H_c = -10148.2\,kJ$

Step 1: Hr (general)

$\Delta H_r = nH_r$ ..... $\Sigma nH_{fp} - \Sigma nH_{fr}$

$H_r = \frac{\Delta H_r}{n} = \frac{-10148.2\,kJ}{2\,mol} = -5074.1\,kJ/mol$

Step 2: n (specific)

$1000\,g\,C_8H_{18} \times \frac{1\,mol\,C_8H_{18}}{114.26\,g\,C_8H_{18}} = 8.752\,mol\,C_8H_{18}$

Step 3: ΔHr (specific)

$\Delta H_r = nH_r$

$\Delta H_r = (8.752\,mol)(-5074.1\,\frac{kJ}{mol})$

$\Delta H_r = -44\,408\,kJ$

$= \boxed{-44.4\,MJ}$

Multi-Step Energy Calculations can be used when energy produced in one chemical reaction is used to heat another substance. These calculations are very similar to calorimetry calculations.

total enthalpy change = quantity of heat

$$\Delta H_r = -q$$

Sample Problem

What mass of octane is completely burned during the heating of 20.L of aqueous ethylene glycol automobile coolant from -10.°C to 70.°C? The volumetric heat capacity of aqueous ethylene glycol is 3.7 kJ/L°C.

Ex. $2C_8H_{18(l)} + 25O_{2(g)} \longrightarrow 18H_2O_{(g)} + 16CO_{2(g)}$

Step1: Hr (general)

$\Delta H_r = \Sigma n H_{fp} - \Sigma n H_{fr}$

$\Delta H_r = [(18\,mol)(-241.8\,\frac{kJ}{mol}) + (16\,mol)(-393.5\,\frac{kJ}{mol})] - [(2\,mol)(-250.1\,\frac{kJ}{mol}) + (25\,mol)(0\,\frac{kJ}{mol})]$

$\Delta H_r = -10148.2\,kJ$

$H_r = \frac{\Delta H_r}{n} = \frac{-10148.2\,kJ}{2\,mol} = -5074.1\,\frac{kJ}{mol}$

Step2: n (specific)

$\Delta H_r = -q$

$nH_r = -vC\Delta T$

$n(-5074.1\,\frac{kJ}{mol}) = -(20.L)(3.7\,\frac{kJ}{L\cdot°C})(80.°C)$

$n = 1.1667\,mol$

Step3: m (specific)

$1.1667\,mol\,C_8H_{18} \times \frac{114.26\,g\,C_8H_{18}}{1\,mol\,C_8H_{18}} = 130\,g\,C_8H_{18}$

Worksheet #3-5