Hess's Law Report Sheet (an example)

Reaction of interest: $XCO_{2(g)} + XH_2O_{(g)} \rightarrow C_xH_{2x(g)} + \frac{3x}{2} O_{2(g)}$

Pathway reactions:

Eq. 1: $C_xH_{2x(g)} + H_{2(g)} \rightarrow C_xH_{2x+2(s)}$ $\Delta H_{rxn} = -A$ kJ/mol

Eq. 2: $H_2O_{(g)} \rightarrow \frac{1}{2} O_{2(g)} + H_{2(g)}$ $\Delta H_{rxn} = +B$ kJ/mol

Eq. 3: $C_xH_{2x+2(s)} + \frac{3x+1}{2} O_{2(g)} \rightarrow XCO_{2(g)} + \frac{2x+2}{2} H_2O_{(g)}$ $\Delta H_{rxn} = -C$ kJ/mol

Strategy:

(1) Identify the reactants and products

a. Reactants: $XCO_{2(g)} + XH_2O_{(g)}$

b. Products: $C_xH_{x(g)} + \frac{3x}{2} O_{2(g)}$

(2) Arrange pathway reactions such that the reactants and products are properly aligned

Eq. 1: $C_xH_{2x(g)}^{*} + H_{2(g)} \rightarrow C_xH_{2x+2(s)}$ $\Delta H_{rxn} = -A$ kJ/mol

$C_xH_{2x+2(s)} \rightarrow C_xH_{2x(g)} + H_{2(g)}$ $\Delta H_{rxn} = +A$ kJ/mol

Eq. 2: $H_2O_{(g)} \rightarrow \frac{1}{2} O_{2(g)} + H_{2(g)}$ $\Delta H_{rxn} = +B$ kJ/mol

$\frac{1}{2} O_{2(g)} + H_{2(g)} \rightarrow H_2O_{(g)}^{*}$ $\Delta H_{rxn} = -B$ kJ/mol

Eq. 3: $C_xH_{2x+2(s)} + \frac{3x+1}{2} O_{2(g)} \rightarrow XCO_{2(g)} + \frac{2x+2}{2} H_2O_{(g)}$ $\Delta H_{rxn} = -C$ kJ/mol

$XCO_{2(g)} + \frac{2x+2}{2} H_2O_{(g)} \rightarrow C_xH_{2x+2(s)} + \frac{3x+1}{2} O_{2(g)}$

(3) Adjust coefficients to match reaction of interest confidents.

Done, coefficients match

(4) Adjust any other pathway reaction that does not have the main product or reactant confidents such that they cancel.

Checked through and the hydrogens cancel.

(5) Check that the compounds cancel that are not in the pathway of interest.

Summing up both sides of the equations:

$XCO_{2(g)} + \frac{2x+2}{2} H_2O_{(g)} + \frac{1}{2} O_{2(g)} + H_{2(g)} + C_xH_{2x+2(s)}$

$\rightarrow C_xH_{2x(g)} + H_{2(g)} + H_2O_{(g)}^{*} + C_xH_{2x+2(s)} + \frac{3x+1}{2} O_{2(g)}$

Expanding the algebra: cancelling the black and the red on the reactant side and the green on the product side.

$XCO_{2(g)} + XH_2O_{(g)} + \boxed{\cancel{H_2O_{(g)}}} + \boxed{\cancel{\frac{1}{2} O_{2(g)}}} + \boxed{\cancel{H_{2(g)}}} + \boxed{\cancel{C_xH_{2x+2(s)}}}$

$\rightarrow C_xH_{2x(g)} + \boxed{\cancel{H_{2(g)}}} + \boxed{\cancel{H_2O_{(g)}^{*}}} + \boxed{\cancel{C_xH_{2x+2(s)}}} + \frac{3x}{2} O_{2(g)} + \boxed{\cancel{\frac{1}{2} O_{2(g)}}}$

What remains is reaction of interest: $\Delta H_{rxn} = +A$ kJ/mol + $-B$ kJ/mol + (+ C kJ/mol)