Hess's Law

↳ the enthalpy change associated with a reaction carried out in multiple steps is equal to the sum of the enthalpy changes for each individual step.

Steps! (flip, multiply coefficients, or divide coefficients)

1. Manipulate elemental equations to resemble the equation of interest (overall reaction)
   ↳ Whatever you do to the equations, you do to the enthalpy values.
2. Combine the "new" reaction
3. Cancel out any compounds that are the same on both sides of the reaction
4. Combine the new ΔH values

$2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$ ΔH=?

Elemental Equations:

1. $2C_{(s)} + O_{2(g)} \rightarrow 2CO_{(g)}$ ΔH= -221.0kJ

x2 $2C_{(s)} + 2O_{2(g)} \rightarrow 2CO_{2(g)}$ ΔH= -393.5kJ x2

$2CO_{(g)} \rightarrow 2C_{(s)} + O_{2(g)}$ ΔH= 221.kJ

$2C_{(s)} + 2O_{2(g)} \rightarrow 2CO_{2(g)}$ ΔH = -787 kJ

$2CO_{(g)} + 2C_{(s)} + 2O_{2(g)} \rightarrow 2C_{(s)} + 2O_{2(g)} + 2CO_{2(g)}$

$2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$

ΔH= -566 kJ/mol

exothermic

Ex 2 overall $2N_{2(g)} + 5O_{2(g)} \rightarrow 2N_2O_{5(g)}$ ΔH= ?

elemental

$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}$ ΔH = -285.8 kJ

$N_2O_{5(g)} + H_2O_{(l)} \rightarrow 2HNO_{3(l)}$ ΔH = -76.6kJ

x2 $2N_{2(g)} + 5O_{2(g)} + 2H_{2(g)} \rightarrow 4HNO_{3(l)}$ ΔH= -348.2kJ x2

-696.4

endothermic $4HNO_{3(l)} \rightarrow 2N_2O_{5(g)} + 2H_2O_{(l)}$ ΔH=153.2kJ

$2H_2O_{(l)} \rightarrow 2H_{2(g)} + O_{2(g)}$ ΔH= 571.6kJ

$2N_{2(g)} + 5O_{2(g)} \rightarrow 2N_2O_{5(g)}$ ΔH= 28.4kJ