Hess’ Law

Heats of Summation solutions

1. Reverse equation #2 ΔH becomes – 90.37 kJ ΔHrxn = 33.8 – 90.37

ΔHrxn = – 56.57 kJ

1. Rev eq #1 and multiply by two

2 KCl (s) + 2 H2O (l) 🡪 2 KOH (s) + 2 HCl (g) ΔHrxn = + 207.2 kJ

H2SO4 (l) + 2 KOH (s) 🡪 K2SO4 (s) + 2H2O (l) ΔHrxn = -342.4 kJ

ΔH = – 135.2 kJ

1. Rev #1 multiply by ½ Rev #2 multiply by ½; Multiply #3 by ½ Rev 4 and multiply by ½

HCl(g) + NaNO2(s) 🡪 HNO2 (l) + NaCl(s) ΔH° = ?

 HCl (g) + ½ Na2O (s) 🡪 NaCl (s)+ ½ H2O (l) ΔH° = – 253.7 kJ

 NaNO2(s) 🡪 ½ NO (g) + ½ NO2(g) + ½ Na2O(s) ΔH° = +213.57 kJ

 ½ NO (g) + ½ NO2(g) 🡪 ½ N2O (g) + ½ O2 (g) ΔH° = – 21.34 kJ

 ½ N2O (g) + ½ O2 (g) + ½ H2O (l) 🡪 HNO2 (l) Δ H° = – 17.17 kJ

ΔH =– 78.64 kJ

1. Leave #1; rev #2 multiply by 2; rev #3

C2H2(g) 🡪 2 C(s) + H2 (g) ΔH = ?

 C2H2 (g) + 5/2 O2 (g) 🡪 2 CO2(g) + H2O(l) ΔH = -1299.5 kJ

 2CO2(g) 🡪 2C(s) + 2O2(g) ΔH = 787 kJ

 H2O (g) 🡪 H2(g) + ½ O2(g) ΔH = + 285.8 kJ

 ΔH = – 226.7 kJ

1. Rev #1 multiply by ½ ; rev #2; multiply #3 by 2

N2 (g) + 5/2 O2 (g) 🡪 N2O5(g) ΔH = ?

 H2O (l)🡪 H2(g) + ½ O2(g) ΔH = + 285.8 kJ

 2 HNO3 (l) 🡪 N2O5 (g) + H2O(l) ΔH = +73.7 kJ

 N2 (g) + 3 O2 (g) + ½ H2 (g) 🡪 2 HNO3 (l) ΔH = – 348.2 kJ

1. Just add the Equations together as is. ΔH = – 592.7 kJ
2. Looking for N2( g) + 5/2 O2 (g) 🡪 N2O5 (g) H = ?

Rev #1 multiply by ½ ; rev #2; multiply #3 by 2;

H2O(l) 🡪 H2(g) + ½ O2(g) ΔH = + 285.8 kJ

2HNO3(l) 🡪 N2O5(g) + H2O(l) ΔH = +73.7kJ

N2(g) + 3 O2(g) + H2(g) 🡪 2 HNO3(l) ΔH = – 348.2 kJ

 ΔH = 11.3 kJ

1. Multiply #1 by ½ ; rev #2 multiply by ½ ΔH = – 128 kJ
2. Leave #1 and 2 alone; Rev #3. ΔH = – 235.7 kJ
3. Rev #1 x ½ ; rev #2 x ½ ; multiply #3 by ½ ; rev 4 x ½

ΔH = – 78.6 kJ

1. Multiply #1 and #2 by 2; rev #3 ΔH = – 2381.7 kJ
2. Leave #1; Rev #2 multiply by ½ ; multiply #3 by ½ ΔH = 155.7 kJ