**AP Chem**

**Hess’ Law Practice**

(1)  Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:   
PCl5(g)  →  PCl3(g)  +  Cl2(g)

P4(s)  +  6Cl2(g)  →  4PCl3(g)            ΔH = -2439 kJ   
4PCl5(g)  →  P4(s)  +  10Cl2(g)         ΔH = 3438 kJ   
answer = 249.8 kJ 

(2)  Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:   
2CO2(g)  +  H2O(g)  →  C2H2(g) +  5/2O2(g)

C2H2(g) + 2H2(g)  →  C2H6(g)                              ΔH  =-94.5 kJ   
H2O(g)  →  H2(g) + 1/2O2 (g)                               ΔH  =71.2 kJ   
C2H6(g) +  7/2O2(g)  →  2CO2(g)  +  3H2O(g)     ΔH  =-283 kJ   
answer = 235 kJ 

(3)  Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:   
N2H4(l)  +  H2(g)  →  2NH3(g)

N2H4(l)  +  CH4O(l)  →  CH2O(g)  +  N2(g)  +  3H2 (g)         ΔH = -37 kJ   
N2(g)  +  3H2(g)  →  2NH3(g)                                                ΔH = -46 kJ   
CH4O(l)  →  CH2O(g) +  H2(g)                                              ΔH = -65 kJ   
answer = -18 kJ 

(4)  Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:   
H2SO4(l)  →  SO3(g)  +  H2O(g)

H2S(g)  +  2O2(g)  →  H2SO4(l)                                  ΔH = -235.5 kJ   
H2S(g)  +  2O2(g)  →  SO3(g)  +  H2O(l)                    ΔH = -207 kJ   
H2O(l)  →  H2O(g)                                                      ΔH = 44 kJ   
answer = 72 kJ 

(5)  Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:   
2C2H4O(l) + 2H2O(l)  →  2C2H6O(l) +  O2(g)

C2H6O(l)  +  3O2(g)  →  2CO2(g)  +  3H2O(l)            ΔH = -685.5 kJ   
C2H4O(l)  +  5/2O2(g)  →  2CO2(g)  +  2H2O(l)         ΔH = -583.5 kJ   
answer = 204.0 kJ

(6)  Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:   
N2(g) +  2O2(g)  →  2NO2(g)

N2(g)  +  3H2(g)  →  2NH3(g)                                  ΔH = -115 kJ   
2NH3(g)  +  4H2O(l)  →  2NO2(g)  +  7H2(g)          ΔH = -142.5 kJ   
H2O(l)  →  H2(g)  +  1/2O2(g)                                 ΔH = -43.7 kJ   
answer = -83 kJ

(7)  Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:   
CO2(g)  →  C(s) +  O2(g)

H2O(l)  →  H2(g)  +  1/2O2(g)                                    ΔH = 643 kJ   
C2H6(g)  →  2C(s) +  3H2(g)                                     ΔH = 190.6 kJ   
2CO2(g) +  3H2O(l)  →  C2H6(g) + 7/2O2(g)            ΔH = 3511.1 kJ   
answer = 886 kJ

(8)  Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:   
N2H4(l)  +  CH4O(l)  →  CH2O(g)  +  N2(g)  +  3H2 (g)

2NH3(g)  →  N2H4(l)  +  H2(g)                 ΔH = 22.5 kJ   
2NH3(g)  →  N2(g)  +  3H2(g)                 ΔH = 57.5 kJ   
CH2O(g) +  H2(g)  →  CH4O(l)               ΔH = 81.2 kJ   
answer = -46.2 kJ

(9)  Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:   
1/2H2(g)  +  1/2Cl2(g)  →  HCl(g)

COCl2(g)  +  H2O(l)  →  CH2Cl2(l)  +  O2(g)                               ΔH = 47.5 kJ   
2HCl(g)  +  1/2O2(g)  →  H2 O(l)  +  Cl2(g)                                 ΔH = 105 kJ   
CH2Cl2(l) +  H2(g)  +  3/2O2(g)  →  COCl2(g)  +  2H2O(l)         ΔH = -402.5 kJ   
answer = -230 kJ

(10)  Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:   
C2H2(g) +  5/2O2(g)  →  2CO2(g)  +  H2O(g)

C2H6(g)  →  C2H2(g) + 2H2(g)                              ΔH = 283.5 kJ   
H2(g) + 1/2O2(g)  →  H2O(g)                                ΔH = -213.7 kJ   
2CO2(g)  +  3H2O(g)  →  C2H6(g) +  7/2O2(g)      ΔH = 849 kJ   
answer = -705 kJ

(11)  Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:   
HCl(g) + NaNO2(s) → HNO2(l) + NaCl(s)

2NaCl(s) + H2O(l) →  2HCl(g) + Na2O(s)                 ΔH = 507 kJ   
NO(g) + NO2(g) + Na2O(s) → 2NaNO2(s)             ΔH = -427 kJ   
NO(g) + NO2(g) → N2O(g) + O2(g)                         ΔH = -43 kJ   
2HNO2(l) → N2O(g) + O2(g) + H2O(l)                    ΔH = 34 kJ   
Answer = -78 kJ

(12)  Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:   
Zn(s) +  1/8S8(s)  +  2O2(g)  →  ZnSO4(s)

Zn(s) + 1/8S8(s)   →   ZnS(s)                                   ΔH = -183.92 kJ   
2ZnS(s) + 3O2(g)   →   2ZnO(s) + 2SO2(g)            ΔH = -927.54 kJ   
2SO2(g) + O2(g)   →   2SO3(g)                              ΔH = -196.04 kJ   
ZnO(s) + SO3(g)   →   ZnSO4 (s)                           ΔH = -230.32 kJ   
Answer = -976.03 kJ 

These problems involve using heat of formation values that are found in the appendix of your textbook.

(13)  What is the enthalpy of the following reactions?

(a)   SiF4(g)    →    Si(s)    +    2F2(g)    (answer:  +1615.0 kJ)

(b)   SiF4(g)    →    Si(g)    +    2F2(g)    (answer:  +2065.0 kJ)

(c)   SO3(g)    +    H2O(g)    →    H2SO4(aq)    (answer: -271.8 kJ)

(d)   3K2O2(s)    +    3H2O(l)    →    6KOH(aq)    +    O3(g)    (answer: -412 kJ) (not -411.7 kJ)

(e)   Fe3O4(s)   +   8HCl(g)  →   2FeCl3(s)   +   FeCl2(s)  +  4H2O(g)  (answer: -252 kJ) (not -251.6 kJ)