### *AP Chemistry*

### *Hess' Law Problems*

### 1. Calculate the value of Ho in kJ for the following reaction using the listed thermochemical equations:

### P4O10(g) + 6 PCl5(g) rx 10 Cl3PO(g)

1/4 P4(s) + 3/2 Cl2(g) rx PCl3(g) ****Ho = -306.4 kJ  
 P4(s) + 5 O2(g) rx P4O10(g) ****Ho  = -2967.3 kJ  
 PCl3(g) + Cl2(g) rx PCl5(g) ****Ho = -84.2 kJ  
 PCl3(g) + 1/2 O2(g) rx Cl3PO(g) ****Ho = -285.7 kJ

### 2. Given the following equations and Ho values, determine the heat of reaction (kJ) at 298 K for the reaction:

### 2 SO2(g) + 2 P(s) + 5 Cl2(g) rx 2 SOCl2(l) + 2 POCl3(l)

SOCl2(l) + H2O(l) rx SO2(g) + 2 HCl(g) ****Ho  = +10.3 kJ  
 PCl3(l) + 1/2 O2(g) rx POCl3(l) ****Ho = -325.7 kJ  
 P(s) + 3/2 Cl2(g) rx PCl3(l) ****Ho = -306.7 kJ  
 4 HCl(g) + O2(g) rx 2 Cl2(g) + 2 H2O(l) ****Ho = -202.6 kJ

### 3. Calculate the heat of combustion (kJ) of propane, C3H8 using the listed standard enthalpy of reaction data:

### C3H8(g) + 5 O2(g) rx3 CO2(g) + 4 H2O(g)

3 C(s) + 4 H2(g) rx C3H8(g) ****Ho = -103.8 kJ  
 C(s) + O2(g) rx CO2(g) ****Ho = -393.5 kJ  
H2(g) + 1/2 O2(g) rx H2O(g) ****Ho = -241.8 kJ

### 4. Given the following equations and Ho values given below, determine the heat of reaction at 298 K for the reaction:

### 2 N2(g) + 5 O2(g) rx2 N2O5(g)

2 H2(g) + O2(g) rx 2 H2O(l) deltaHo = -571.6 kJ  
 N2O5(g) + H2O(l) rx 2 HNO3(l) deltaHo = -73.7 kJ  
N2(g) + 3 O2(g) + H2(g) rx 2 HNO3(l) deltaHo = -348.2 kJ

Key

1. -610.1 kJ

2. -10982.8 kJ

3. -2043.9 kJ

4. +22.6 kJ