Dougherty Valley HS AP Chemistry
Thermochemistry – Hess's Law

WORKSHEET #1

Name: **Date:** **Period:** **Seat #:**

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1. Calculate the standard enthalpy change, ΔH_o, for the formation of 1 mol of strontium carbonate (the material that gives the red color in fireworks) from its elements. (–1220 KJ)

Sr (s) C(graphite) $\frac{3}{2}$O (g) → SrCO (s)

(1) Sr (s) + $\frac{1}{2}O_2$ (g) → SrO (s) $\Delta H° = -592$ kJ

(2) SrO (s) + CO_2 (g) → SrCO (s) $\Delta H° = -234$ kJ

(3) C(graphite) O_2 (g) → CO (g) $\Delta H° = -394$ kJ

2. The combination of coke and steam produces a mixture called coal gas, which can be used as a fuel or as a starting material for other reactions. If we assume coke can be represented by graphite, the equation for the production of coal gas is (+15.3 kJ)

2 C (s) + 2 H_2O (g) → CH_4 (g) + CO_2 (g)

(1) C(s) + H_2O (g) → CO (g) + H_2 (g) $\Delta H° = 131.3$ kJ

(2) CO (g) + H_2O (g) → CO_2 (g) + H_2 (g) $\Delta H° = -41.2$ kJ

(3) CH_4 (g) + H_2O (g) → 3 H_2 (g) + CO (g) $\Delta H° = 206.1$ kJ

3. One reaction involved in the conversion of iron ore to the metal is (– 11 kJ)

FeO (s) + CO (g) → Fe (s) + CO (g)

(1) 3 Fe_2O_3 (s) + CO (g) → 2 Fe_3O_4 (s) + CO_2 (g) $\Delta H° = -47$ kJ

(2) Fe_2O_3 (s) + 3 CO (g) → 2 Fe (s) + 3 CO_2 (g) $\Delta H° = -25$ kJ

(3) Fe_3O_4 (s) + CO (g) → 3 FeO (s) + CO_2 (g) $\Delta H° = 19$ kJ

[4] Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:

PCl_5 (g) → PCl_3 (g) + Cl_2 (g)

P_4 (s) + 6Cl_2 (g) → 4PCl_3 (g) $\Delta H = -2439$ kJ

4PCl_5 (g) → P_4 (s) + 10Cl_2 (g) $\Delta H = 3438$ kJ

Answer = 249.8 kJ

[5] Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:

2CO_2 (g) + H_2O(g) → C_2H_2 (g) + $\frac{5}{2}O_2$ (g)

C_2H_2 (g) + 2H_2 (g) → C_2H_6 (g) $\Delta H = -94.5$ kJ

H_2O(g) → H_2 (g) + $\frac{1}{2}$O2 (g) $\Delta H = 71.2$ kJ

C_2H_6 (g) + O_2 (g) → 2CO_2 (g) + 3H_2O(g) $\Delta H = -283$ kJ

Answer = 235 kJ

[6] Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:

N_2H_4 (*l*) + H_2 (g) → 2NH_3 (g)

N_2H_4 (*l*) + CH_4O (*l*) → CH_2O (g) + N_2 (g) + 3H_2 (g)	ΔH = –37 kJ
N_2 (g) + 3H_2 (g) → 2NH_3 (g)	ΔH = –46 kJ
CH_4O(l) → CH_2O(g) + H_2 (g)	ΔH = –65 kJ

Answer = –18 kJ

[7] Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:

H_2SO_4 (*l*) → SO_3 (g) + H_2O(g)

H_2S(g) + 2O_2 (g) → H_2SO_4 (*l*)	ΔH = –235.5 kJ
H_2S(g) + 2O_2 (g) → SO_3 (g) + H_2O(*l*)	ΔH = –207 kJ
H_2O(*l*) → H_2O(g)	ΔH = 44 kJ

Answer = 72 kJ

[8] Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:

2C_2H_4O(*l*) + 2H_2O(*l*) → 2C_2H_6O(*l*) + O_2 (g)

C_2H_6O(*l*) + 3O_2 (g) → 2CO_2 (g) + 3H_2O(*l*)	ΔH = –685.5 kJ
C_2H_4O(*l*) + O_2 (g) → 2CO_2 (g) + 2H_2O(*l*)	ΔH = –583.5 kJ

Answer = 204.0 kJ