Hess's Law Extra WS Name: _____

(1) Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:

$$2\ CO_2(g) + H_2O(g) \rightarrow C_2H_2(g) + {}^5/_2\ O_2(g)$$

$C_2H_2(g) + 2H_2(g) \rightarrow C_2H_6(g)$	ΔH = –94.5 kJ
$H_2O(g) \rightarrow H_2(g) + ½\ O_2(g)$	ΔH =71.2 kJ
$C_2H_6(g) + {}^7/_2\ O_2(g) \rightarrow 2\ CO_2(g) + 3\ H_2O(g)$	ΔH = –283 kJ

(2) Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:

$$H_2SO_4(l) \rightarrow SO_3(g) + H_2O(g)$$

$H_2S(g) + 2\ O_2(g) \rightarrow H_2SO_4(l)$	ΔH = –235.5 kJ
$H_2S(g) + 2\ O_2(g) \rightarrow SO_3(g) + H_2O(l)$	ΔH = –207 kJ
$H_2O(l) \rightarrow H_2O(g)$	ΔH = 44 kJ

(3) Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:

$$N_2(g) + 2\ O_2(g) \rightarrow 2\ NO_2(g)$$

$N_2(g) + 3H_2(g) \rightarrow 2\ NH_3(g)$	ΔH = –115 kJ
$2\ NH_3(g) + 4\ H_2O(l) \rightarrow 2\ NO_2(g) + 7\ H_2(g)$	ΔH = –142.5 kJ
$H_2O(l) \rightarrow H_2(g) + ½\ O_2(g)$	ΔH = –43.7 kJ

(4) Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:

$$CO_2(g) \rightarrow C(s) + O_2(g)$$

$H_2O(l) \rightarrow H_2(g) + ½\ O_2(g)$	ΔH = 643 kJ
$C_2H_6(g) \rightarrow 2\ C(s) + 3\ H_2(g)$	ΔH = 190.6 kJ
$2\ CO_2(g) + 3\ H_2O(l) \rightarrow C_2H_6(g) + {}^7/_2\ O_2(g)$	ΔH = 3511.1 kJ

(5) Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:

$$N_2H_4(l) + CH_4O(l) \rightarrow CH_2O(g) + N_2(g) + 3H_2(g)$$

$2\ NH_3(g) \rightarrow N_2H_4(l) + H_2(g)$	ΔH = 22.5 kJ
$2\ NH_3(g) \rightarrow N_2(g) + 3\ H_2(g)$	ΔH = 57.5 kJ
$CH_2O(g) + H_2(g) \rightarrow CH_4O(l)$	ΔH = 81.2 kJ

(6) Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:

$\frac{1}{2}\ H_2(g) + \frac{1}{2}\ Cl_2(g) \rightarrow HCl(g)$

$COCl_2(g) + H_2O(l) \rightarrow CH_2Cl_2(l) + O_2(g)$ ΔH = 47.5 kJ

$2\ HCl(g) + \frac{1}{2}\ O_2(g) \rightarrow H_2O(l) + Cl_2(g)$ ΔH = 105 kJ

$CH_2Cl_2(l) + H_2(g) + \frac{3}{2}\ O_2(g) \rightarrow COCl_2(g) + 2\ H_2O(l)$ ΔH = –402.5 kJ

(7) Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:

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

$C_2H_6(g) \rightarrow C_2H_2(g) + 2\ H_2(g)$ ΔH = 283.5 kJ

$H_2(g) + \frac{1}{2}\ O_2(g) \rightarrow H_2O(g)$ ΔH = –213.7 kJ

$2\ CO_2(g) + 3\ H_2O(g) \rightarrow C_2H_6(g) + \frac{7}{2}\ O_2(g)$ ΔH = 849 kJ

(8) Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:

$HCl(g) + NaNO_2(s) \rightarrow HNO_2(l) + NaCl(s)$

$2\ NaCl(s) + H_2O(l) \rightarrow 2\ HCl(g) + Na_2O(s)$ ΔH = 507 kJ

$NO(g) + NO_2(g) + Na_2O(s) \rightarrow 2\ NaNO_2(s)$ ΔH = –427 kJ

$NO(g) + NO_2(g) \rightarrow N_2O(g) + O_2(g)$ ΔH = –43 kJ

$2\ HNO_2(l) \rightarrow N_2O(g) + O_2(g) + H_2O(l)$ ΔH = 34 kJ

(9) Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:

$Zn(s) + \frac{1}{8}\ S_8(s) + 2O_2(g) \rightarrow ZnSO_4(s)$

$Zn(s) + \frac{1}{8}\ S_8(s) \rightarrow ZnS(s)$ ΔH = –183.92 kJ

$2\ ZnS(s) + 3\ O_2(g) \rightarrow 2ZnO(s) + 2\ SO_2(g)$ ΔH = –927.54 kJ

$2\ SO_2(g) + O_2(g) \rightarrow 2\ SO_3(g)$ ΔH = –196.04 kJ

$ZnO(s) + SO_3(g) \rightarrow ZnSO_4(s)$ ΔH = –230.32 kJ

Answers: (1) 235 kJ; (2) 73 kJ; (3) –83 kJ; (4) 886 kJ; (5) –46.2 kJ; (6) –230 kJ; (7) –705 kJ; (8) –79 kJ; (9) –976.03 kJ