Hess's Law #2

Solve the following problems on a separate sheet of paper.

1) Use Hess' Law to calculate the heat of reaction for the formation of strontium carbonate, the material that gives the red color in fireworks:

$Sr(s) + C(s) + {}^{3}/_{2}\,O_2(g) \leftrightarrows SrCO_3(s)$

Using the following thermochemical equations:

$Sr(s) + {}^{1}/_{2}\,O_2(g) \leftrightarrows SrO(s)$	$\Delta H^\circ = -592$ kJ
$SrO(s) + CO_2(g) \leftrightarrows SrCO_3(s)$	$\Delta H^\circ = -234$ kJ
$C(s) + O_2(g) \leftrightarrows CO_2(g)$	$\Delta H^\circ = -394$ kJ

2) Use the following equations to calculate the enthalpy change for the following:

$2C(s) + H_2(g) \leftrightarrows C_2H_2(g)$	$\Delta H^\circ =$
$C_2H_2(g) + {}^{5}/_{2}\,O_2(g) \leftrightarrows 2CO_2(g) + H_2O(l)$	$\Delta H^\circ = -1229.6$ kJ/mole
$C(s) + O_2(g) \leftrightarrows CO_2(g)$	$\Delta H^\circ = -393.5$ kJ/mole
$H_2(g) + \frac{1}{2}O_2(g) \leftrightarrows H_2O(l)$	$\Delta H^\circ = -285.9$ kJ/mole

3) Use the following equations to calculate the enthalpy change for the following:

$CH_4(g) + 2O_2(g) \leftrightarrows CO_2(g) + 2H_2O(l)$	$\Delta H^\circ = ?$
$2H_2(g) + C(s) \leftrightarrows CH_4(g)$	$\Delta H^\circ = 74.81$KJ
$2H_2(g) + O_2(g) \leftrightarrows 2H_2O(l)$	$\Delta H^\circ = -285.85$
$C(s) + O_2(g) \leftrightarrows CO_2(g)$	$\Delta H^\circ = -393.52$ kJ

4) Use the following equations to calculate the enthalpy change for the following:

$C_2H_2(g) + 2H_2(g) \leftrightarrows C_2H_6(g)$	$\Delta H^\circ = ?$
$2C_2H_2(g) + 5O_2(g) \leftrightarrows 4CO_2(g) + 2H_2O(l)$	$\Delta H^\circ = -2600$ kJ
$2C_2H_6(g) + 7O_2(g) \leftrightarrows 4CO_2(g) + 6H_2O(l)$	$\Delta H^\circ = -3120$ kJ
$H_2(g) + \frac{1}{2}\,O_2(g) \leftrightarrows H_2O(l)$	$\Delta H^\circ = -286$ kJ

5) Find ΔH° for making chloroform ($CHCl_3$) from methane

$$CH_4(g) + 3Cl_2(g) \leftrightarrows CHCl_3(l) + 3HCl(g)$$

using the following equations:

${}^{1}/_{2}\,H_2(g) + {}^{1}/_{2}\,Cl_2(g) \leftrightarrows HCl(g)$	$\Delta H^\circ = -92.31$ kJ
$C(s) + 2H_2(g) \leftrightarrows CH_4(g)$	$\Delta H^\circ = -74.81$ kJ
$C(s) + {}^{1}/_{2}\,H_2(g) + {}^{3}/_{2}\,Cl_2(g) \leftrightarrows CHCl_3(l)$	$\Delta H^\circ = -134.47$ kJ

6) Given the following data:

$Fe_2O_3(s) + 3CO(g) \leftrightarrows 2Fe(s) + 3CO_2(g)$ $\Delta H° = -28$ kJ
$3Fe_2O_3(s) + CO(g) \leftrightarrows 2Fe_3O_4(s) + CO_2(g)$ $\Delta H° = -59$ kJ
$Fe_3O_4(s) + CO(g) \leftrightarrows 3FeO(s) + CO_2(g)$ $\Delta H° = +38$ kJ

Calculate $\Delta H°$ for the reaction

$$FeO(s) + CO(g) \leftrightarrows Fe(s) + CO_2(g)$$

7) Use the following equations to calculate the enthalpy change for the following:

$2NH_3(g) + 3N_2O(g) \leftrightarrows 4N_2(g) + 3H_2O(l)$ $\Delta H° =$

$2NH_3(g) + {}^3/_2\,O_2(g) \leftrightarrows N_2(g) + 3H_2O(l)$ $\Delta H° = -765.5$ kJ/mole
$3N_2O(g) + 3H_2(g) \leftrightarrows 3N_2(g) + 3H_2O(l)$ $\Delta H° = -1102.2$ kJ/mole
$3H_2O(l) \leftrightarrows 3H_2(g) + {}^3/_2\,O_2(g)$ $\Delta H° = 857.7$ kJ/mole

8) Use Hess' Law to calculate the heat of reaction for:

$ClF(g) + F_2(g) \leftrightarrows ClF_3(l)$

From:
$2ClF(g) + O_2(g) \leftrightarrows Cl_2O(g) + OF_2(g)$ $\Delta H° = 167.5$ kJ
$2F_2(g) + O_2(g) \leftrightarrows 2OF_2(g)$ $\Delta H° = -43.5$ kJ
$2ClF_3(l) + 2O_2(g) \leftrightarrows Cl_2O(g) + 3OF_2(g)$ $\Delta H° = 394.1$ kJ

9) Calculate the $\Delta H°$ for this reaction:

$$C_6H_4(OH)_2(aq) + H_2O_2(aq) \leftrightarrows C_6H_4O_2(aq) + 2H_2O(l)$$

from the following data:

$C_6H_4(OH)_2(aq) \leftrightarrows C_6H_4O_2(aq) + H_2(g)$ $\Delta H° = +177.4$ kJ
$H_2(g) + O_2(g) \leftrightarrows H_2O_2(aq)$ $\Delta H° = -191.2$ kJ
$H_2O(g) \leftrightarrows H_2O(l)$ $\Delta H° = -43.8$ kJ
$H_2(g) + ½\,O_2(g) \leftrightarrows H_2O(g)$ $\Delta H° = -241.8$ kJ

10) Calculate $\Delta H°$ for the reaction

$$N_2H_4(l) + O_2(g) \leftrightarrows N_2(g) + 2H_2O(l)$$

Given the following data

$2NH_3(g) + 3N_2O(g) \leftrightarrows 4N_2(g) + 3H_2O(l)$ $\Delta H° = -1010$ kJ
$N_2O(g) + 3H_2(g) \leftrightarrows N_2H_4(l) + H_2O(l)$ $\Delta H° = -317$ kJ
$2NH_3(g) + {}^1/_2\,O_2(g) \leftrightarrows N_2H_4(l) + H_2O(l)$ $\Delta H° = -143$ kJ
$H_2(g) + {}^1/_2\,O_2(g) \leftrightarrows H_2O(l)$ $\Delta H° = -286$ kJ