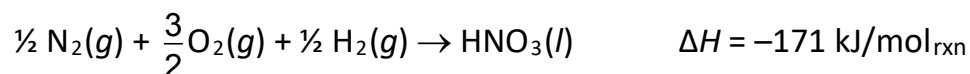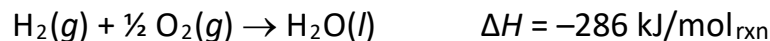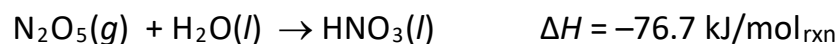Find the enthalpy change for the following reaction: $2 N_2(g) + 5 O_2(g) \rightarrow 2 N_2O_5(g)$

Use the following thermochemical equations:

$$N_2O_5(g) + H_2O(l) \rightarrow HNO_3(l) \qquad \Delta H = -76.7 \text{ kJ/mol}_{rxn}$$

$$H_2(g) + \tfrac{1}{2} O_2(g) \rightarrow H_2O(l) \qquad \Delta H = -286 \text{ kJ/mol}_{rxn}$$

$$\tfrac{1}{2} N_2(g) + \tfrac{3}{2} O_2(g) + \tfrac{1}{2} H_2(g) \rightarrow HNO_3(l) \qquad \Delta H = -171 \text{ kJ/mol}_{rxn}$$

Let's Practice!
1. Given the following information, find the heat of formation for methane: $C(s) + 2 H_2(g) \rightarrow CH_4(g)$

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l) \qquad \Delta H°_{comb} = +891 \text{ kJ mol}^{-1}$$

$$C(s) + O_2(g) \rightarrow CO_2(g) \qquad \Delta H°_f = -394 \text{ kJ mol}^{-1}$$

$$2\ H_2(g) + O_2(g) \rightarrow 2H_2O(l) \qquad \Delta H°_f = -286 \text{ kJ mol}^{-1} \times 2$$
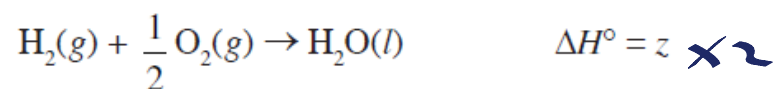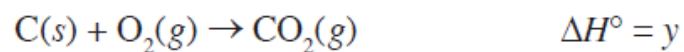
$$\Delta H_{rxn} = -75 \text{ kJ}$$

2. Calculate the heat of formation for sulfur dioxide, SO_2, from its elements sulfur and oxygen. Use the balanced chemical equation and the following information.

$$S(s) + \tfrac{3}{2} O_2(g) \rightarrow SO_3(g) \qquad \Delta H = -395.2 \text{ kJ/mol}_{rxn}$$

$$2\ SO_2(g) + O_2(g) \rightarrow 2\ SO_3(g) \qquad \Delta H = \frac{+198.2 \text{ kJ/mol}_{rxn}}{2}$$

$$S + O_2 \longrightarrow SO_2$$

$$\Delta H_{rxn} = -296.1 \text{ kJ}$$

$$C(s) + 2H_2(g) \rightarrow CH_4(g) \qquad \Delta H^\circ = x \;\; -\!\!\times$$
$$C(s) + O_2(g) \rightarrow CO_2(g) \qquad \Delta H^\circ = y$$
$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l) \qquad \Delta H^\circ = z \;\;\times 2$$

3. Based on the information given above, what is ΔH° for the following reaction?

$$CH_4(g) + 2\,O_2(g) \rightarrow CO_2(g) + 2\,H_2O(l)$$
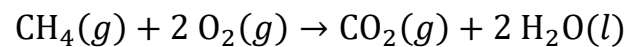
a. x + y + z

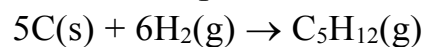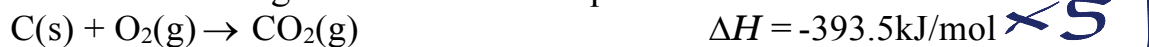b. x + y − z

c. y + z − 2x

d. y + 2z − x

4. Find the enthalpy change for the formation of pentane, C_5H_{12}, by the reaction of carbon with hydrogen.

$$5C(s) + 6H_2(g) \rightarrow C_5H_{12}(g)$$

Use the following thermochemical equations:

$C(s) + O_2(g) \rightarrow CO_2(g)$ $\qquad\qquad \Delta H = \text{-393.5kJ/mol} \times 5$

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$ $\qquad \Delta H = \text{-285.8kJ/mol} \times 6$

$C_5H_{12}(g) + 8O_2(g) \rightarrow 5CO_2(g) + 6H_2O(l)$ $\qquad \Delta H = \text{-3535.6kJ/mol}$

$$-146.7\,kJ = \Delta H$$