

## Answer on Question#59766 – Chemistry | General Chemistry

Calculating the standard enthalpy of combustion/formation

### Solution:

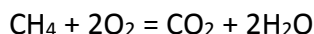
1) Hess' Law:

$$\Delta H^{\circ}_{\text{rxn}} = \sum \Delta H^{\circ}_{\text{f, products}} - \sum \Delta H^{\circ}_{\text{f, reactants}}$$

2) Substitute values into equation. Since oxygen is an element in its standard state, its enthalpy of formation is zero.

1) For CH<sub>4</sub> –

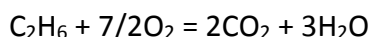
The balanced equation for the combustion of methane is:



$$\Delta H^{\circ}_{\text{comb}} = [1\text{mole}(\text{CO}_2) * (-394) + 2\text{moles}(\text{H}_2\text{O}) * (-286)] - [1\text{mole}(\text{CH}_4) * (\Delta H^{\circ}_{\text{f}}) + 2\text{moles}(\text{O}_2) * 0] = -890$$

$$\Delta H^{\circ}_{\text{f}}(\text{CH}_4) = -76 \text{ kJ/mol}$$

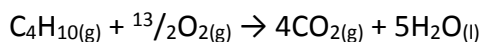
2) For C<sub>2</sub>H<sub>4</sub>(g) -



$$\Delta H^{\circ}_{\text{comb}} = [2 * (-394) + 2 * (-286)] - [( \Delta H^{\circ}_{\text{f}} ) + (3) * 0] = -1409 \text{ kJ/mol}$$

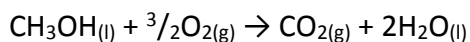
$$\Delta H^{\circ}_{\text{f}}(\text{C}_2\text{H}_4) = -237 \text{ kJ/mol}$$

3) For C<sub>4</sub>H<sub>10</sub>(g) -



$$\Delta H^{\circ}_{\text{comb}} = [4 * (-394) + 5 * (-286)] - [(-125) + \frac{13}{2} * 0] = -2881 \text{ kJ/mol}$$

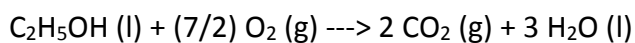
4) For CH<sub>3</sub>OH(l) -



$$\Delta H^{\circ}_{\text{comb}} = [ (-394) + 2 * (-286) ] - [(\Delta H^{\circ}_{\text{f}}) + \frac{3}{2} * 0] = -715 \text{ kJ/mol}$$

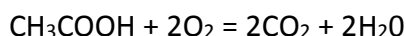
$$\Delta H^{\circ}_{\text{f}} = -251 \text{ kJ/mol}$$

5) For C<sub>2</sub>H<sub>5</sub>OH(l)



$$\Delta H^{\circ}_{\text{comb}} = [ 2 * (-394) + 3 * (-286) ] - [ (-278) + \frac{7}{2} * 0 ] = -1368 \text{ kJ/mol}$$

6) For CH<sub>3</sub>COOH



$$\Delta H^{\circ}_{\text{comb}} = [2 * (-394) + 2 * (-286)] - [(\Delta H^{\circ}_{\text{f}}) + 2 * 0] = -876 \text{ kJ/mol}$$

$$\Delta H^{\circ}_{\text{f}} = -484 \text{ kJ/mol}$$

7) For CH<sub>3</sub>COOC<sub>2</sub>H<sub>5</sub>(l)



$$\Delta H^{\circ}_{\text{comb}} = [ 4 * (-394) + 4 * (-286) ] - [ (-481) + (5) * 0 ] = -2239 \text{ kJ/mol}$$

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