Question #83146

scientist measures the standard enthalpy change for the following reaction to be -816.9 kJ:

CH4(g) + 2 O2(g)CO2(g) + 2 H2O(g)

Based on this value and the standard enthalpies of formation for the other substances, the standard enthalpy of formation of H2O(g) is kJ/mol.

Solution:

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O \qquad (1)$$

According to the chemical equation (1) and Hess's law [1], the standard enthalpy of formation of H_2O is equal to:

$$\Delta H_f^0(H_2O) = \frac{\Delta H_{reaction}^0 - \Delta H_f^0(CO_2) + \Delta H_f^0(CH_4)}{2}$$

$$\Delta H_f^0(H_2O) = \frac{-816.9 - (-393.509) + (-74.9)}{2} = -249.1455 \approx -249.15\ kJ/mol$$

Answer:

The standard enthalpy of formation of H_2O is equal to -249.15 (based on the standard enthalpy change for the following reaction (measured) and the standard enthalpies of formation for the other substances (CH_4, CO_2) [2]).

References:

[1] https://en.wikipedia.org/wiki/Hess%27s_law

[2] https://en.wikipedia.org/wiki/Standard_enthalpy_of_formation