Assignment:

The enthalpy of combustion of methane, graphite and dihydrogen at 298 K are, –890.3 kJ mol⁻¹, –393.5 kJ mol⁻¹, and –285.8 kJ mol⁻¹ respectively. Calculate the enthalpy of formation of CH₄(g).

SOLUTION

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O; \quad \Delta H_1 = -890kJ \quad mol^{-1}...(i)$$

$$C+O_2\longrightarrow CO_2;\quad \Delta H_2=-393.5kJ\quad mol^{-1}\ldots(ii)$$

$$2H_2 + O_2 \longrightarrow 2H_2O; \quad \Delta H_3 = 2 \times (-285.8) \, kJ \quad mol^{-1}...(iii)$$

Required reaction

$$ightarrow C + 2H_2 \longrightarrow CH_{4(g)}; \quad \Delta H_f = ?$$

From equation (ii)-(i)+(iii)

$$\Delta H_f = (-393.5) + 890.3 + 2(-285.8) = -74kJ \quad mol^{-1}$$