Internal energy of combustion

What is the molar internal energy of combustion for propane, C_3H_8 assuming that water is in the vapor phase (T = 373 K)?

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Solution: Write down the balanced equation

$$C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O\ (g)$$

Calculate the change in number of moles of gas, Δn_{gas}.

$\Delta n_{gas} = \Sigma\ n_{products} - \Sigma\ n_{reactants}$

$\Delta n_{gas} = 3 + 4 - 1 - 5 = 1$

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Use the relationship between enthalpy and internal energy:

$$\Delta H = \Delta U + P\Delta V$$
$$\Delta H = \Delta U + \Delta nRT$$

Thus,

$$\Delta U = \Delta H - \Delta nRT$$

If we wish to write these are molar quantities we can write:

$$\Delta U_m = \Delta H_m - \Delta \nu RT$$

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Hence in this case

$$\Delta U = -2220\ kJ/mol - (1)\left(8.31 \frac{J}{molK}\right)(373\ K)$$

$$\Delta U = -2223\ \mathrm{kJ/mol}$$