Answer on Question #55502 - Chemistry - General chemistry

Question:

Write the balanced incomplete combustion reaction for ethane (C_2H_6), producing CO and water vapour. Make sure to include phases. Also, make sure that the stoichiometric coefficients are whole numbers and are not fractions.

a) What is the enthalpy of the reaction ($\Delta H°rxn$), in kJ, for the process in part (d)?
b) Calculate the total heat (q), in kJ, produced by 260.0 g of ethane when 9.00% by mass of it burns incompletely and the remainder burns completely.

Solution

The balanced incomplete combustion reaction for ethane

$2C_2H_6(g) + 5O_2 (g) = 4CO (g) + 6H_2O(g)$
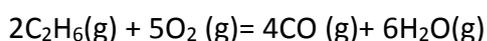
a) $\Delta H°rxn = 4\Delta H°(CO) + 6\Delta H°(H_2O) - 2\Delta H°(C_2H_6) - 5\Delta H°(O_2)$

$$\Delta H°rxn = 4\Delta H°(CO) + 6\Delta H°(H_2O) - 2\Delta H°(C_2H_6) - 5\Delta H°(O_2)$$

$$\Delta H°rxn = 4 \times (-110.5) + 6 \times (-241.8) - 2 \times (-84) - 5 \times (0) = \mathbf{-1724.8\ kJ}$$

b) Burns incompletely 260×0.09 = 23.4 g of ethane, it corresponds to the amount of

$M(C_2H_6)$ = 30.1 g/mol, n = 23.4/30.1 = 0.777 mol

2 mol of ethane make 1724.8 kJ of heat
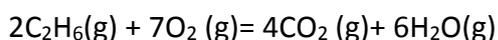
0.777 mol of ethane make x kJ of heat

X = 0.777×1724.8/2 = 670.1 kJ

Burns completely 250-23.4 = 226.6 g of ethane, it corresponds to the amount of

$M(C_2H_6)$ = 30.1 g/mol, n = 226.6/30.1 = 7.53 mol

For total combustion of ethane:

$2C_2H_6(g) + 7O_2 (g) = 4CO_2 (g) + 6H_2O(g)$

$$\Delta H°rxn = 4 \times (-393.5) + 6 \times (-241.8) - 2 \times (-32) - 7 \times (0) = -2960.8\ kJ$$

2 mol of ethane make 2960.8 kJ of heat

7.53 mol of ethane make x kJ of heat

x = 7.53×2960.8/2 = 11147.4 kJ

The total heat is the sum of complete and incomplete burning heat

Q=670.1 + 11147.4 = **11817.5 kJ**

Answer: -1724.8 kJ; 11817.5 kJ