

The moles for octane will be multiplied by 9 because 1 mole of octane produces 9 moles of water vapor.

Convert to grams

$$mass = n \times M$$

$$mass = (6.166 \times 9) \times 18$$

$$mass = 999 \text{ g}$$

$$mass = 0.999 \text{ kg}$$

\therefore There is 0.999 kg of H_2O released per litre of petrol

$$\begin{aligned} \therefore \text{The total amount of gas released per litre of petrol} &= \\ &= 2.17 + 0.999 \\ &= 3.169 \text{ kg} \end{aligned}$$

Change in enthalpy:

$$\begin{aligned} \Delta H &= \text{energy required to break bonds} - \text{energy released when new bonds form} \\ &= H(\text{reactants}) - H(\text{products}) \end{aligned}$$

Reactants

1 mole of C_8H_{18} and $12\frac{1}{2}$ moles of O_2 contain:

$$4 \text{ moles of C-C bonds} = 4 \times 347 = 1388 \text{ kJ/mol}$$

$$18 \text{ moles of C-H bonds} = 18 \times 413 = 7434 \text{ kJ/mol}$$

$$12\frac{1}{2} \text{ moles of O=O bonds} = 12.5 \times 495 = 6187.5 \text{ kJ/mol}$$

$$\begin{aligned} \text{Energy required to break bonds} &= 1388 + 7434 + 6187.5 \\ &= 15009.5 \text{ kJ/mol} \end{aligned}$$

Products

8 moles of CO_2 and 9 moles of H_2O

$$16 \text{ moles of C=O bonds} = 16 \times 745 = 11920 \text{ kJ/mol}$$

$$18 \text{ moles of H-O bonds} = 18 \times 464 = 8352 \text{ kJ/mol}$$

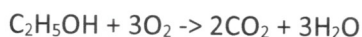
$$\begin{aligned} \text{Energy released when new bonds form} &= 11920 + 8352 \\ &= 20272 \text{ kJ/mol} \end{aligned}$$

$$\Delta H = \text{energy required to break bonds} - \text{energy released when new bonds form}$$

$$\Delta H = 15009.5 - 20272$$

$$\Delta H = -5262.5 \frac{\text{kJ}}{\text{mol}} \text{ (exothermic)}$$

Combustion of ethanol



Moles of ethanol used