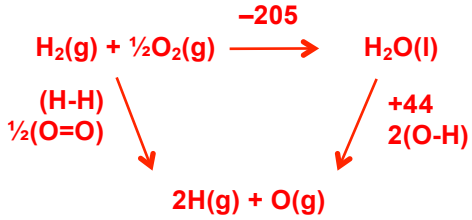
1 Hydrogen reacts with oxygen as shown: $H_2(g) + ½O_2(g) \rightarrow H_2O(l)$ $\Delta H = -205$ kJ mol^{-1}

Calculate the bond enthalpy for the O=O bond using this and the following data.

Bond enthalpies: H-H = 463, O-H = 436 kJ mol^{-1}
Enthalpy of vaporisation of water = +44 kJ mol^{-1}



–205 + 44 + 2(O-H) = (H-H) + ½(O=O)

½(O=O) = –205 + 44 + 2(O-H) – (H-H)

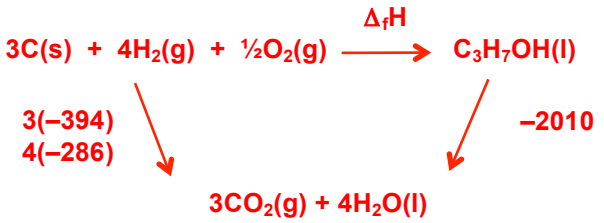
½(O=O) = –205 + 44 + 2(436) – (463)

½(O=O) = +248

(O=O) = +496 kJ mol^{-1}

2 Calculate the enthalpy of formation of propan-1-ol, $C_3H_7OH(l)$, given the following data.

Δ_cH $C_3H_7OH(l) = -2010$ kJ mol^{-1} Δ_cH $C(s) = -394$ kJ mol^{-1} Δ_cH $H_2(g) = -286$ kJ mol^{-1}



Δ_fH – 2010 + = 3(–394) + 4(–286)

Δ_fH = 3(–394) + 4(–286) + 2010

Δ_fH = –316 kJ mol^{-1}

3 Calculate the enthalpy of formation of ammonium chloride give the following information.

$2NH_4Cl(s) + Ca(OH)_2(s) \rightarrow 2NH_3(g) + CaCl_2(s) + 2H_2O(g)$ $\Delta H = +246$ kJ mol^{-1}

Δ_fH / kJ mol^{-1} $Ca(OH)_2(s) = -987$ $NH_3(g) = -46$ $CaCl_2 = -795$ $H_2O(g) = -242$

ΔH = [Sum Δ_fH products] – [Sum Δ_fH reactants]

+246 = [2(–46) –795 + 2(–242)] – [2(Δ_fH) – 987]

+246 = –1371 – [2(Δ_fH) – 987]

2(Δ_fH) = –1371 + 987 – 246 = –630

Δ_fH = –315

4 1.08 g of methanol, $CH_3OH(l)$, was burned in a spirit burner and used to heat 100.0 g of water in a copper calorimeter. The temperature of the water rose by 38°C. Calculate the enthalpy of combustion of methanol determined by this experiment. The specific heat capacity of the solution is 4.18 J K^{-1} g^{-1}.

$$q = mc\Delta T = 100 \times 4.18 \times 38 = 15884 \text{ J} = 15.884 \text{ kJ}$$

$$moles = \frac{1.08}{32.0} = 0.03375$$

$$\Delta H = -\frac{q}{mol} = -\frac{15.884}{0.03375} = -470 \text{ kJ mol}^{-1}$$