Marks 5

- Glucose is a common food source. The net reaction for its metabolism in humans is:

$$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$$

Calculate $\Delta H°$ for this reaction given the following heats of formation.

$\Delta H°_f$ ($C_6H_{12}O_6(s)$) = –1274 kJ mol^{-1}, $\Delta H°_f$ ($CO_2(g)$) = –393 kJ mol^{-1} and
$\Delta H°_f$ ($H_2O(l)$) = –285 kJ mol^{-1}

Using $\Delta_{rxn}H^0 = \sum m\Delta_f H^0(\text{products}) - \sum n\Delta_f H^0(\text{reactants}):$

$$\Delta_{rxn}H° = [6\times\Delta_f H°(CO_2(g)) + 6\times\Delta_f H°(H_2O(l))] - [\Delta_f H°(C_6H_{12}O_6(g))]$$

$$= [(6\times-393) + (6\times-285)] - [(-1274)] = -2794\,\text{kJ mol}^{-1}$$

(Note that $\Delta_f H°(O_2(g)) = 0$ as it is an element in its standard state).

Answer: **-2794 kJ mol^{-1}**

If the combustion of glucose is carried out in air, water is produced as a vapour. Calculate the $\Delta H°$ for the combustion of glucose in air given that

$$H_2O(l) \rightarrow H_2O(g) \qquad \Delta H° = +44 \text{ kJ mol}^{-1}$$

As vaporising liquid water requires energy (+44 kJ mol^{-1}), the combustion enthalpy is reduced. Six moles of H_2O are produced in the combustion so the enthalpy of combustion is reduced to:

-2794 + (6 × +44) = -2530 kJ mol^{-1}

Answer: **-2530 kJ mol^{-1}**

Will ΔS be different for the two oxidation reactions? If so, how will it differ and why?

As gaseous molecules have higher entropy than liquid phase molecules, oxidation to produce $H_2O(g)$ will lead to a higher value for ΔS than oxidation to produce $H_2O(l)$.