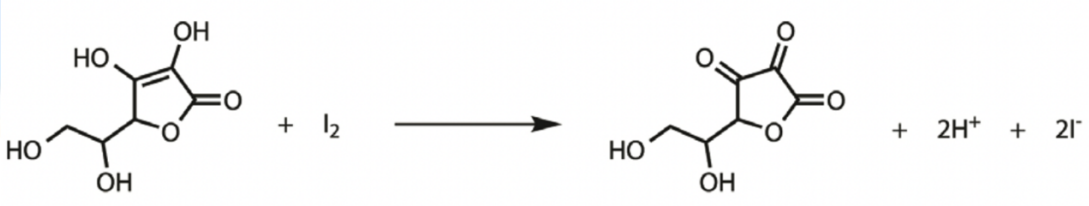
SL HL Paper 3 Section A Data Response (5)

The Royal Society of Chemistry has introduced a global experiment for school students to determine the amount of vitamin C in various fruits.

Students first determine how many drops of a given iodine solution are required to react with a known amount of vitamin C by calibrating the iodine solution with a known amount of vitamin C using starch as an indicator.
All the Vitamin C content is then extracted from a selected fruit and the number of drops of the standardised iodine solution required to react with the vitamin C is determined. The amount of vitamin C in mg g^{-1} in the selected fruit is then calculated.
The relevant equation for the reaction in aqueous solution is:



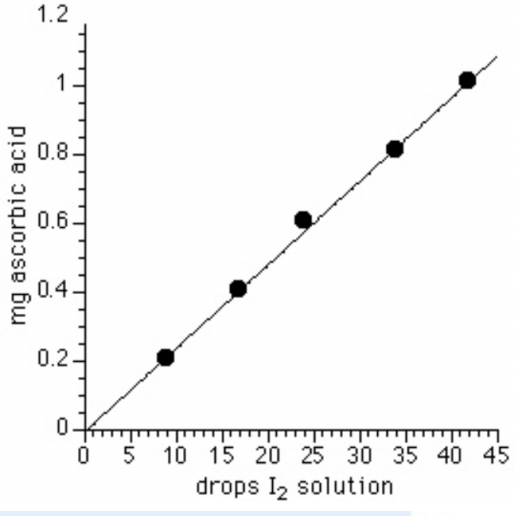
ascorbic acid (vitamin c) dehydroascorbic acid

The molar mass of vitamin C = 176.12 g mol^{-1}

(a) (i) Deduce the two half-equations for the oxidation of vitamin C and the reduction of iodine in aqueous solution. ***[2]***

(ii) Explain why vitamin C is soluble in water. ***[1]***

(b) A student in a particular school obtained the following calibration curve:



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She found that the vitamin C extracted from 3.04 g of a fresh red pepper required 82 drops of the iodine solution to react completely.

(i) Deduce the concentration of vitamin C in mg g^{-1} of the fresh red pepper. ***[2]***

(ii) It was determined that 103 drops of the iodine solution had a total volume of 1.00 cm^3. Calculate the concentration of the iodine solution in mol dm^{-3}. ***[2]***

(c) Iodine can be formed by the reaction between iodide and iodate ions in acidic solution:

$I^-(aq) + IO_3^-(aq) + 6H^+(aq) \rightarrow 3I_2(aq) + 3H_2O(l)$

This redox reaction is known as a disproportionation reaction as iodine is simultaneously oxidised (from -1 to zero) and reduced (from +5 to zero).

Iodine is insoluble in water but it does dissolve in a solution of potassium iodide as it forms the complex triiodide ion, I_3^-.

$I_2(aq) + I^-(aq) \rightarrow I_3^-(aq)$

Discuss whether this reaction between iodine and iodide ions can also be considered to be a disproportionation reaction. ***[2]***

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