

2) The concentration of vitamin C in a filtered sample of grapefruit juice was determined by titrating the juice with  $9.367 \times 10^{-4}$  M iodine,  $I_2$ , solution using starch solution as an indicator. The molar mass of vitamin C is  $176.0 \text{ g mol}^{-1}$ . The reaction can be represented by the following equation.



The following method was used:

1. Weigh a clean 250 mL conical flask.
2. Use a 10 mL measuring cylinder to measure 5 mL of grapefruit juice into the conical flask and reweigh it.
3. Add 20 mL of deionised water to the conical flask.
4. Add a drop of starch solution to the conical flask.
5. Titrate the diluted grapefruit juice against the  $I_2$  solution
  - a) What impact would each of the following have on the calculation of the concentration of vitamin C in grapefruit juice?
    - A. 10 mL of deionised water was added to the conical flask.

*No impact*

B. The concentration of the  $I_2$  solution was actually  $8.972 \times 10^{-4}$  M.

*Overestimation of the concentration*

C. The initial volume of the  $I_2$  solution in the burette was 1.50 mL, but it was read as 2.50 mL.

*Underestimation*

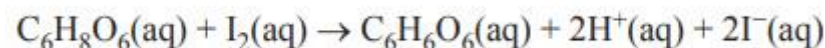
D. The balance was faulty and the measured mass of grapefruit juice was lower than the actual mass.

*An overestimation*

E. The burette was washed with distilled water but not dried before use.

*An overestimation*

b) If the measured mass of grapefruit juice was 4.85 g and the titre was 21.50 mL, what was the measured percentage mass/mass (% m/m) concentration of vitamin C in the grapefruit juice, to the right number of significant figures?



*Step 1 Calculate the mol of  $I_2$  delivered in the titre.*

*=>  $n = C \times V = 9.367 \times 10^{-4} \text{ M} \times 0.02150 = 2.014 \times 10^{-5} \text{ mol}$ .*

*Step 2 Mol of vit<sub>c</sub> =  $2.014 \times 10^{-5} \text{ mol}$*

*Step 3 Mass of Vit<sub>c</sub> =  $2.014 \times 10^{-5} \text{ mol} \times 176.0 \text{ g mol}^{-1} = 3.544 \times 10^{-3} \text{ g}$ .*

*Step 4 Calculate %m/m =  $(3.544 \times 10^{-3} \text{ g} / 4.85 \text{ g}) \times 100 = 0.0731\% \text{ m/m}$*

c) Give one assumption made in this titration.

*The only substance that  $I_2$  can react with in the grapefruit juice is Vit<sub>c</sub>*

d) What difference would it make if the 5 mL of grapefruit juice was delivered with a 5 mL pipette as opposed to a 10 mL measuring cylinder.

*None as it's the mass of the sample not the volume that the %m/m is calculated on.*