

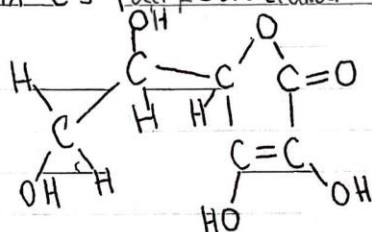
## Candidate 3 evidence

Title: Mass of Vitamin C in table.

Aim: To investigate the mass of vitamin C in different brands of vitamin tablets.

Underlying Chemistry:

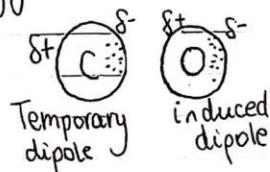
Vitamin C also known as ascorbic acid is a water-soluble nutrient and it can dissolve in water due to its multiple hydroxyl groups present. Vitamin C's full structural formula is:



There are three different intermolecular forces of attraction present in Vitamin C which are London dispersion forces, permanent dipole-permanent dipole attraction and hydrogen bonding.

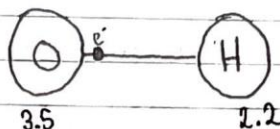
London Dispersion forces are the weakest intermolecular force of attraction and is when a temporary dipole of which the electrons are distributed unevenly within the atom then causes an induced dipole in another atom.

The London dispersion forces between Carbon and Oxygen are as follows:

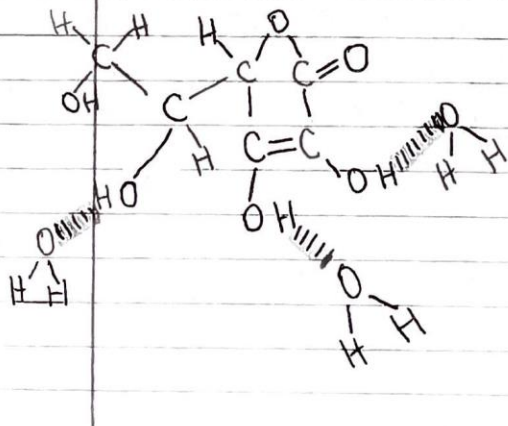


→ happens as electrons repel electrons.

Permanent dipole - permanent dipole attraction is due to a difference in electronegativity between atoms. It is when one atom has a stronger attraction for electrons than another atom that shares the electrons. Vitamin C is a polar molecule as it has a difference in more than 0.3 electronegativity between Oxygen and Hydrogen. The permanent dipole - permanent dipole attraction within oxygen & Hydrogen are as follows:



Vitamin C can dissolve in water due to its multiple hydroxyl (OH) groups as it can bond to water by Hydrogen bonding. Hydrogen bonding is the strongest intermolecular force of attraction between molecules bonded Hydrogen - Nitrogen, Oxygen or Fluorine. The large difference in electronegativity shows that it has a strong attraction and so the mp/bp is fairly high due to the strong Hydrogen bonds required to break. The Hydrogen bonding between Oxygen and Hydrogen are as follows

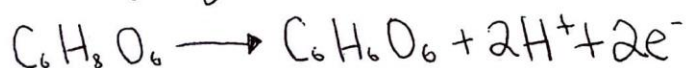


As Vitamin C is polar, it should be cooked in non-polar substances for example oil as it can be maintained in food this way. This is because polar does not dissolve non-polar as only "like" dissolves "like". This forms an immiscible layer where the polar and nonpolar substances cannot mix

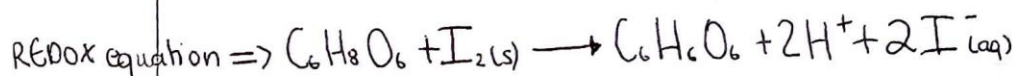
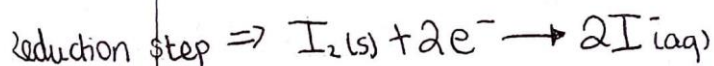
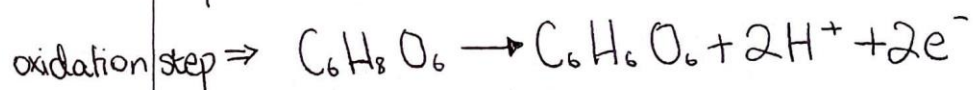
An antioxidant is a molecule that inhibits oxidation in another substance by oxidising instead of the substance. It is a reducing agent and donates electrons to oxidising agents.

In food, vitamin C is an antioxidant and is added to stop them from oxidising and therefore spoiling. In the body, vitamin C is required as some oxidation reactions are harmful and this vitamin oxidises instead so that the body can be healthy and free of diseases.

Vitamin C undergoing oxidation:



Oxidation reactions require reduction reactions to accept these electrons and the two half reactions forming the full redox equation in my experiment is as follows:



### Experimental Method:

I titrated Iodine and vitamin C solution using starch as an indicator. I wore gloves as Iodine stains skin.

### My Results:

#### Vitamin Store

	Titration 1	Titration 2	Titration 3
Initial Reading (cm <sup>3</sup> )	0.6	0.0	21.4
Final Reading (cm <sup>3</sup> )	23.8	21.4	42.6
Volume of Iodine Solution used (cm <sup>3</sup> )	23.2	21.4	21.2

Average of concordant results: 21.3 cm<sup>3</sup>

Mass of Vitamin C in Vitamin Store tablet:

Iodine

Vitamin C

$$\text{vol} = \frac{21.3}{1000}$$

$$\text{moles} = 0.0005325$$

$$\text{conc} = 0.025 \text{ mol l}^{-1}$$

$$\text{gfm} = 176$$

$$\text{moles} = 0.0005325$$

1:1

mass = 0.09372g in 50cm<sup>3</sup>  
from a 500cm<sup>3</sup> standard  
solution

$$\text{mass in } 500\text{cm}^3 = 0.9372\text{g}$$

$$\text{mass of vitamin C} = 937.2\text{mg}$$

Tesco			
	Titration 1	Titration 2	Titration 3
Initial Reading (cm <sup>3</sup> )	2.0	5.0	11.2
Final Reading (cm <sup>3</sup> )	25.4	27.9	34.5
Volume Iodine Solution added (cm <sup>3</sup> )	23.4	22.9	23.3

Average of concordant results: 23.35 cm<sup>3</sup>

Mass of Vitamin C in Tesco tablet:

Iodine

$$\text{vol} = \frac{23.35}{1000}$$

$$\text{conc} = 0.025 \text{ mol l}^{-1}$$

$$\text{moles} = 0.00058375$$

1:1

Vitamin C

$$\text{moles} = 0.00058375$$

$$\text{gfm} = 176$$

$$\text{mass} = 0.10274 \text{ g}$$

$$\begin{aligned} \text{mass in } 500 \text{ cm}^3 &= 1.0274 \text{ g} \\ &= \underline{\underline{1027.4 \text{ mg}}} \end{aligned}$$

Haliborange			
	Titration 1	Titration 2	Titration 3
Initial Reading (cm <sup>3</sup> )	0.9	6.6	5.4
Final Reading (cm <sup>3</sup> )	23.7	22.0	28.0
Volume of Iodine Solution added (cm <sup>3</sup> )	22.8	15.4	22.6

Average of concordant results = 22.7 cm<sup>3</sup>

Mass of vitamin C in Haliborange tablet:

Iodine

Vitamin C

$$\text{vol} = \frac{22.7}{1000}$$

$$\text{moles} = 0.0005675$$

1:1

$$\text{gfm} = 176$$

$$\text{conc} = 0.025 \text{ mol l}^{-1}$$

$$\text{moles} = 0.0005675$$

$$\text{mass in } 50 \text{ cm}^3 = 0.09988 \text{ g}$$

$$\begin{aligned} \text{mass in } 500 \text{ cm}^3 &= 0.9988 \text{ g} \\ &= \underline{\underline{998.8 \text{ mg}}} \end{aligned}$$

Secondary Sources from Website information:

(1)



**Vitamin Store** High Strength  
Vitamin C Orange Flavour 20  
Effervescent Tablets

**£1.00**  
05p per 1 unit

Ingredients      Product Information      Nutrition      Reviews

**Nutrition**

Typical values	per Tablet	%RDA*
Vitamin C	1000 mg	1250

\*RDA means Recommended Daily Allowance

(2)

**Tesco**

**Name and address**

Tesco Stores Ltd,  
Welwyn Garden City AL7 1GA,  
U.K.

**Net Contents**

20 Tablets

**Nutrition**

Typical Values	One Tablet	%RDA*
Energy	0kJ / 0cal	0%
Fat	0g	0%
Saturates	0g	0%
Carbohydrate	0g	0%
Sugars	0g	0%
Fibre	0g	-
Protein	0g	0%
Salt	0g	0%
Vitamin C	1000.0mg (1250%NRV)	-
Zinc	15.0mg (150%NRV)	-

\*Reference Intake of an average adult (8400 kJ / 2000 kcal)

## Haliborange:

### Product Description

Haliborange Effervescent Vitamin C 1000mg 20 Tablets with Sugar and Sweeteners.

Haliborange Vitamin C Effervescent Tablets are free from artificial preservatives and colours. They are also suitable for vegetarians and vegans.

Vitamin C:

- Contributes to the normal function of the immune system
- Contributes to normal function of the nervous system
- Contributes to normal energy-yielding metabolism

For generations Haliborange has been a delicious way of adding to the body's supply of Vitamin C effectively and easily. Bursting with the flavour of sunshine orange, Haliborange effervescent Vitamin C drink is a delicious way of providing the body with a daily contribution towards the normal function of the immune system.

Vitamin C:

- Contributes to the normal function of the immune system
- Contributes to normal function of the nervous system
- Contributes to normal energy-yielding metabolism
- Orange Flavour

They are also suitable for vegetarians and vegans

Vitamin C - contributes to the normal function of the immune system, nervous system and normal energy-yielding metabolism

(3)

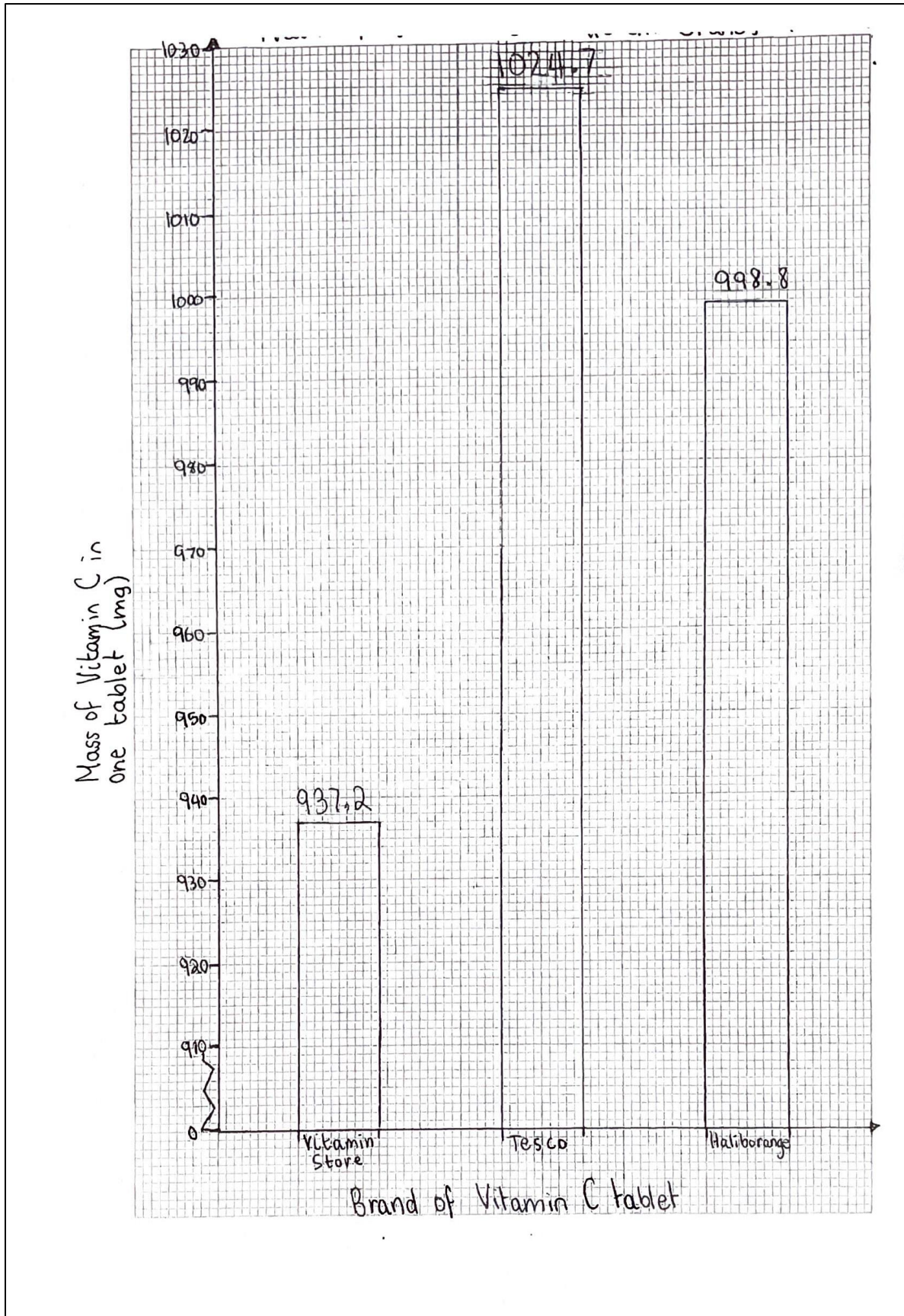
## Graphical Presentation: Inserted

Analysis: My results that I obtained from my experiment are as follows: Vitamin Store had a mass of 937.2 mg per tablet, Tesco had a mass of 1024.7mg of vitamin C per tablet and Haliborange had a mass of 998.8mg per tablet. My secondary data shows that each tablet brand had 1000mg of vitamin C showing my results were not as accurate. Vitamin Store's mass was the furthest away mass being 62.8mg off the actual mass of 1000mg. The closest reading to my secondary source was Haliborange being only 1.2mg off the actual mass of 1000mg. Tesco was in the middle and was 24.7mg over the actual reading of 1000mg.

Conclusion: In conclusion my results that I obtained from my results were as follows:

The mass of vitamin C (mg) in one Vitamin C tablet was; Vitamin Store → 937.2mg, Tesco → 1024.7mg, Haliborange → 998.8mg. These results varied from the actual mass of 1000mg per tablet.





### Evaluation:

When I was testing Vitamin Store tablet, I left my vitamin C solution overnight and therefore it oxidised and gave me inaccurate results. To improve my accuracy, I would have made a fresh vitamin C solution so that the oxygen in the air was not affecting my final results. Hence the lowest and furthest apart mass of Vitamin C that I obtained from my results.

I used starch as an indicator and the colour change was from pale orange/yellow to blue/black. These colours fluctuated back and forth so was difficult to see a clear end point. If I repeated my experiment, to improve my reliability I would use a white tile and continuously stir the mixture so that I could see when the mixture permanently changed so I was not titrating too much iodine giving me unreliable results.

I was also unsure of how intense I should make the starch solution colour turn to as the blue/black solution started very faint and was difficult to tell when I should stop titrating. Next time, to improve my reliability, I would use a colour detector sensor so that I knew what the colour intensity should be and stop titrating at a certain colour for all three of the vitamin C tablet brands and each repeat.

The website information from my secondary data was reliable as it had to get tested many times before it got put onto a published website therefore it was a good source to compare to.

### References:

- (1) <https://groceries.iceland.co.uk/vitamin-store-high-strength-vitamin-c-orange-flavour-20-effervescent-tablets/p/66519>

Date accessed: February 2018

- (2) <https://www.tesco.com/groceries/en-GB/products/253495567>

Date accessed: February 2018

- (3) <https://www.tesco.com/groceries/en-GB/products/253707468>

Date accessed: February 2018