
Vitamin C
تفريغ التجربة الآخيرة (٩) لاب عقاقير

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Experiment (9)
Quantitative and Qualitative Analysis of Ascorbic Acid

Ascorbic acid (well-known as vitamin C) is a naturally occurring weak acid, with antioxidant properties and an important component of a healthy diet. is It is needed by the body to help wounds heal, to enhance the absorption of iron from plant foods, and to support the immune system.

It is essential in collagen synthesis and works as an antioxidant to protect your cells against free radicals, which may play a role in heart disease, cancer, and other diseases. The history of Vitamin C revolves around the history of the human disease scurvy. Its symptoms include exhaustion, massive hemorrhaging of flesh and gums, general weakness, and diarrhea.

الأهمية الثانية لـ VitamineC في كيف؟ كـ antioxidant

to protect your cells against free radicals

* damage of بتعمل free radicals عن طريق عملية وهي إلى بتسرع عملية aging . فوجود ascorbic acid بتعطيها neutrolization of free radicals

مقارنة اكثر

free radicals → هي الجذور الحرة او الجزيئات الحرة قابلة انها الوجود منفردة وهي غير مستقرة قادرة على التفاعل مع أي الكترون لتستقر.

مقارنة اكثر

وهوان ترتبط مع مواد بالجسم وتسبب امراض او تجاعيد (تسرع ظهور التجاعيد) و VitamineC بتعطيها هاد الالكترون إلي بتحتاجه فبنطفأ عملية aging وظهور التجاعيد . وفي فيتامينات موجودة بالصيدليات اسمها (anti oxidants) وهي انها

الفائدة الخامسة

* ممكن انه اي Fe supplement لازم يكون فيه امتصاصه بالامعاء كيف؟ بحول non absorbable form → Absorbable form

ferrous → ferric لحتى يصير امتصاص بالامعاء

* VitC لتسرع

* ممكن تجي free radicals من chemicals مثل pollution و UV radiation وأكثر مصدر إلها مباشرة الشمس لهيك VitC موجود كثير في واقيات الشمس

* في ريسة مكتوب باول صفحة بجنب التعريف فيها نقاط أهمية VitC من الناحية التجميلية (الدكتورة شرحتلي).

الفائدة السادسة

* مهم للمناعة بالشتاء ، دوره اساسي supporting innate & adaptive immunity system

by → stimulation of neutrophile & site of infection

improve of phagocytosis and oxidant generation

and in microbial Killing.

e radicals,

, and other

ds heal, to

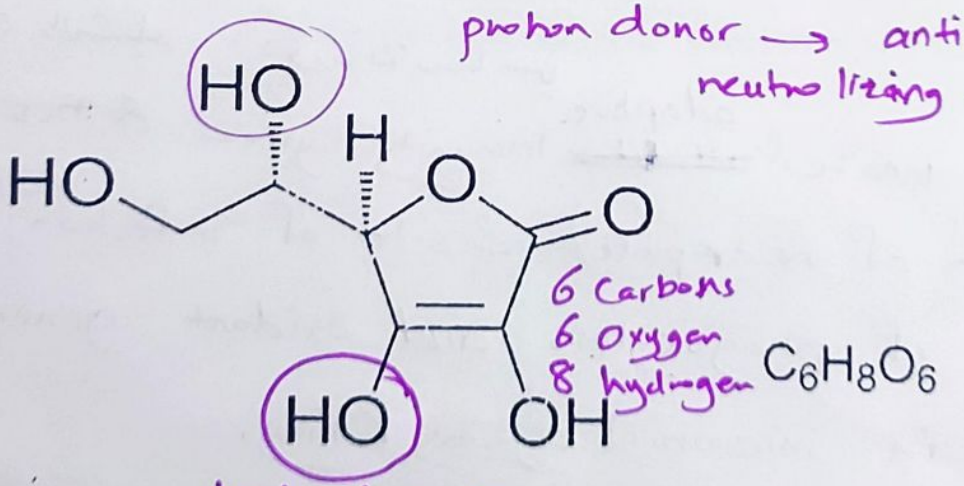
ods, and to

الدكتورة قرأت الكلام تحت الصور و حكت انها من أهميه ال vitamins C من الناحية التجميليه

cancer, and other diseases. The history of Vitamin C revolves around the history of the human disease scurvy. Its symptoms include exhaustion, massive hemorrhaging of flesh and gums, general weakness, and diarrhea. & Resultant death was common.

- Vitamin C is a six-carbon chain, closely related chemically to glucose. In 1934, Rechstein worked out a simple, inexpensive, four-step process for synthesizing ascorbic acid from glucose. This method has been used for commercial synthesis of Vitamin C.

Ascorbic Acid (Structure and Formula)



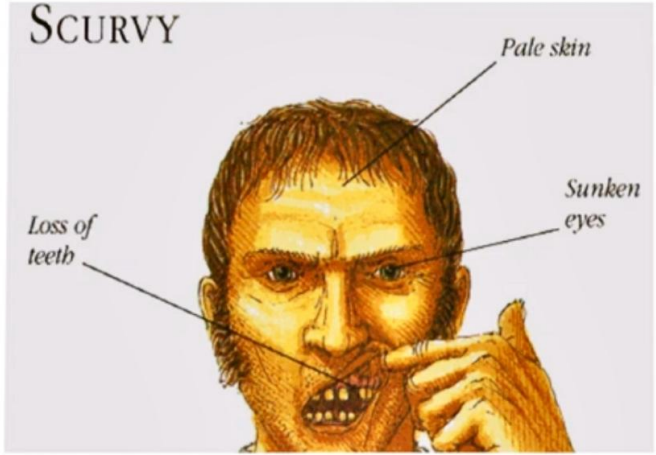
proton donor → antioxidant by neutralizing the free radicals in body

that give it a water soluble criteria

any excess of Vit C will not cause any problem because its easily excreted

The history of Vitamin C revolves around the history of the human disease scurvy. Its symptoms include exhaustion, massive hemorrhaging and swollen of flesh and gums, loss of teeth, general weakness, diarrhea, development of red or blue spots on the skin, usually on your shins have skin that bruises easily. Resultant death was common if left untreated .

الي تحته خط مو موجود بملف السلايدات عاليتمز بس هاي السلايده شرحت عليها الدكتورة و ذكرت النقطه هاي



Vitamin C can be found in various products ranging from supplements to skincare products.

برضه سلايد مو موجوده بملف السلايدات الي نزلوه

* Vit C has several dosage Form.
اله أكثر من شكل ممكن

1) gum
2) lotions المستحضرات التجميلية
3) Serum
4) additive to Sunscreen] for fine lines/wrinkles
5) Cream
6) drop

* Vit C should be obtained from outer source
لا ينتجه الجسم

* مرض Scurvy : ظهر كثيرًا للبحارة لما يقدروا ياخذوا الفاكهة لما ما بياكلوا Vit C. فواكه وخضرات إلي هي أصلًا مصدر رئيسي لل Vit C.

* أعراض ① symptoms & hemorrhage swelling of flesh & gums.
لثة تتنفخ وتنزف والأسنان بتتهتز وتقع.

② loss of teeth

③ بقع حمراء وزرقاء على Shins مقدمة الرجل

④ pale skin

❖ Properties of Ascorbic acid:

powerful reducing agent
Free radicals بعطي الكترونات

- ✓ Naturally occurring organic compound (weak acid). → mildly acidic solution. Solution ما تنقل
- ✓ White to yellow crystals or powder.
- ✓ Water-soluble vitamin (mildly acidic solution).

excess ← ايش بطلع من Kidneys في Urine

- ✓ In the solution → rapidly oxidized (destroyed) upon exposure to heat, light, metals, and oxygen. (unstable)

بسبب (OH) بتروبا بالماء.

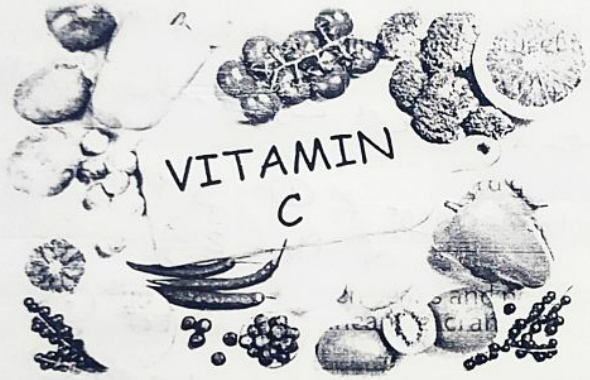
(Cu) Cuppor mainly

- ✓ In the dry state → reasonably stable to air (Not to UV light).

لازم احفظه بمكان مغلق ومعتم وممكن يتحول لـ ascorbate

❖ Vitamin C occurs naturally primarily in fresh fruits and vegetables.

Vitamin-C (mg/100g)	Foods
100 – 350	Chili peppers, sweet peppers, parsley, and turnip greens
25 – 100	Citrus juices (oranges, lemons, etc.), tomato juice, mustard greens, spinach, brussels sprouts
10 – 25	Green beans and peas, sweet corn, asparagus, pineapple, cranberries, cucumbers, lettuce
< 10	Eggs, milk, carrots, beets, cooked meat



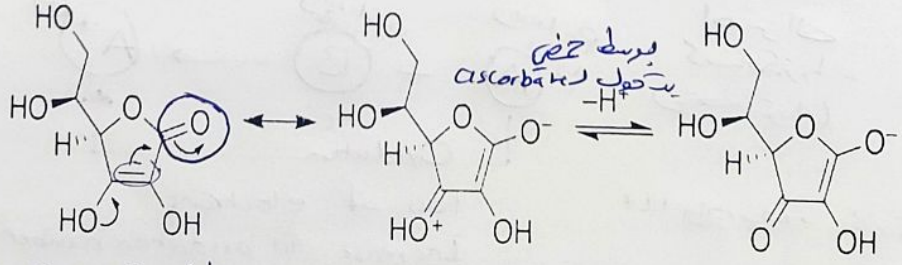
* ممكن حصله بالحلول على ascorbate أو على ascorbic acid داخل محلول
Stabilization of negative charge بسبب
becouse of resonance system

* Stabilization بتخلي البروتون الموجودة بـ ascorbic acid من أقوى الـ acids / البروتونات التي تفقد اسهل من اي مركب آخر يحتوي على (OH).
* OH فيه أقوى من اي مركب آخر فله OH (أقوى حمضية).

❖ Acidity:

In ascorbic acid structure, you can see the conjugated system, composed of the electrons in the double bond, hydroxyl group lone pair, and carbonyl group. Because of resonance stabilization of the conjugate base (ascorbate), the hydroxyl group in ascorbic acid is much more acidic than typical hydroxyl groups.

(stable)
dehydroascorbic acid



يفرط جزيء ascorbate يتحول لـ

غني جدًا بالالكترونات
↓
reducing agent ← يفقد الكترونات

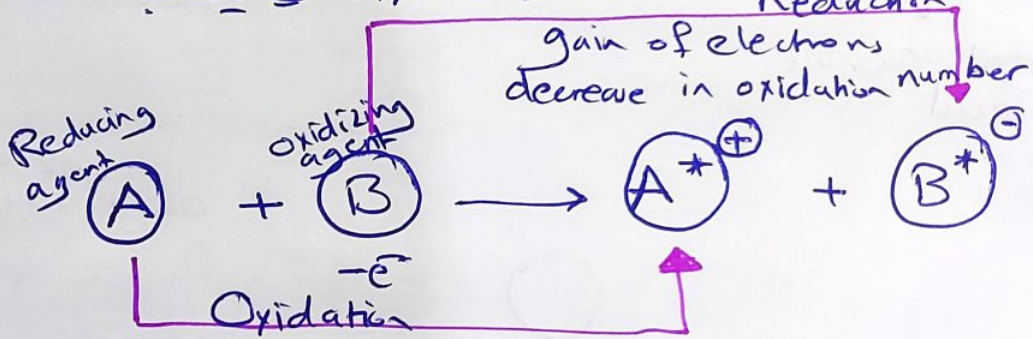
ascorbate (stable)

Redox titration: always occur in pairs of electrons.

Oxidation
تأكسد.
فقد الكترونات
[redacted]
شحنة تزداد

Reduction
اختزال.
كسب الكترونات
[redacted]
شحنة تقل

لا واحد يفقد لازم التاني يكسب



*لا واحد يفقد لازم التاني يكسب

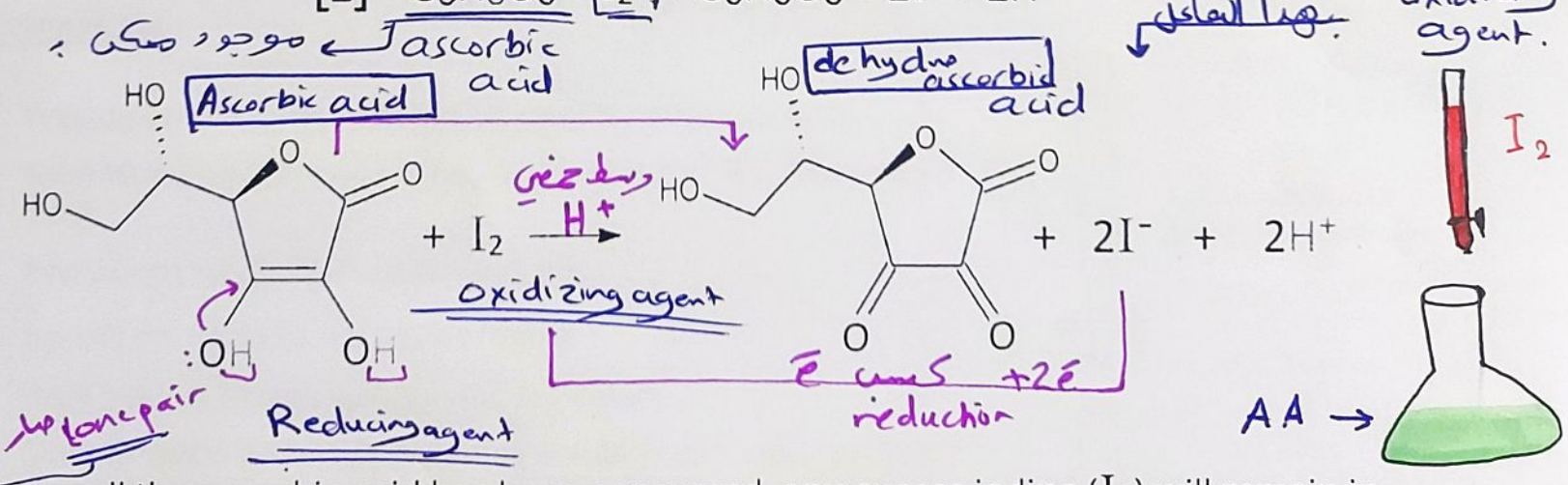
Quantitative Determination of Ascorbic Acid:

A suitable method for the determination of vitamin C (ascorbic acid, $C_6H_8O_6$) is a titration with potassium iodate (KIO_3). In this reaction (redox titration), potassium iodate is used as a titrant and when added to an ascorbic acid solution that contains strong acid and potassium iodide (KI), the potassium iodate reacts with potassium iodide, liberating molecular iodine (I_2) as shown in the reaction below:

[1] $KIO_3 + 5KI + 6H^+ \rightarrow 3I_2 + 6K^+ + 3H_2O$

During the titration, if the solution contains ascorbic acid, the I_2 produced in equation 1 is used up in a rapid reaction with ascorbic acid (equation 2), during which dehydroascorbic acid ($C_6H_6O_6$) and iodide ion (I^-) are formed:

[2] $C_6H_8O_6 + I_2 \rightarrow C_6H_6O_6 + 2I^- + 2H^+$

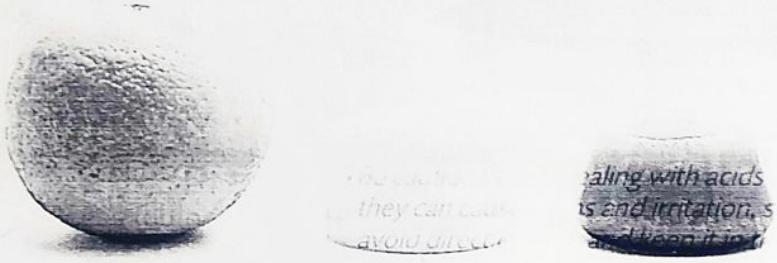


Once all the ascorbic acid has been consumed, any excess iodine (I_2) will remain in solution. This excess iodine reacts with starch, to form an intensely blue colored complex, indicating that the endpoint is reached.

Practical Work

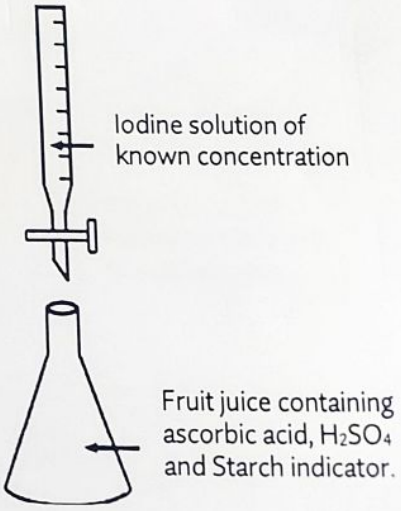
Materials & Chemicals Needed:	*Glassware Needed:*
- Citric Fruit (Orange or Limon). - Starch indicator solution: (1%). - H_2SO_4 (1M). - Iodine Solution (0.05M). - Vitamin C tablet. - Bendict's reagent - $NaHCO_3$ - $AgNO_3$	- Burette and stand - 100 mL volumetric flask - 20 mL pipette - 250 mL Erlenmeyer flask - Dropper. - Graduated cylinders (10ml) & (100). - Test tubes - Spatula
	Notes: · *Be cautious while dealing with acids they can cause burns and irritation, so avoid direct contact and keep it in the fumehood.*

Part 1: Determination of Ascorbic Acid Amount (mg%) in Fruit Juice:



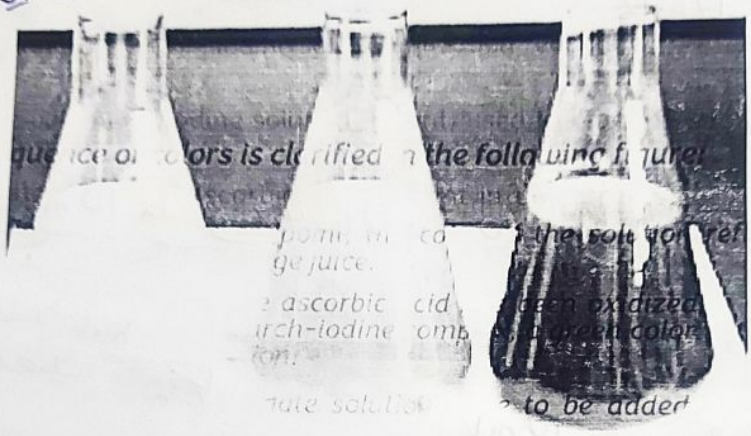
Procedure:

1. Freshly juice a citric fruit (an orange) to obtain its juice.
2. Take 10 mL of the fruit Juice, place in a 250 mL Erlenmeyer Flask.
3. Add 80 mL of distilled water and stir.
4. Add 10 mL of 1M H_2SO_4 (Fume hood).
5. Add 5 mL of starch solution (as indicator).
6. Start titration with 0.05M Iodine solution until you reach the end point.
7. Record the volume of iodine solution (titrant) used to reach the end point.
8. Calculate the (%mg) of ascorbic acid present in your fruit sample.



➢ *The sequence of colors is clarified in the following figure:*

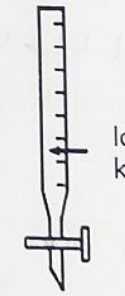
- ***Left flask:*** *before the endpoint, the color of the solution reflects the bright orange color of fresh orange juice.*
- ***Centre flask:*** *Once all the ascorbic acid has been oxidized, a slight excess of added iodate forms a starch-iodine complex, a green color in this case. This is the endpoint of the titration.*
- ***Right flask:*** *If further iodate solution were to be added after the endpoint (missed the endpoint).*



Part 2: Determination of Ascorbic acid Amount (%yield) in tablet solution

Procedure:

1. Dissolve a single vitamin C tablet in 200 mL of distilled water (in a volumetric flask if possible).
2. Take 20 mL of tablet solution and add 70 mL of distilled water in 250ml Erlenmeyer flask.
3. Add 10 mL of 1M H_2SO_4 and add 5 mL of starch (indicator).
4. Start titration with 0.05M Iodine solution until you reach the end point.
5. Record the volume of iodine solution (titrant) used to reach the end point.
6. Calculate the (%assay) of ascorbic acid present in vitamin C tablet solution.



Iodine solution of known concentration

Vitamin C tablet solution, H_2SO_4 and Starch indicator.

❖ Part 1: Determination of Ascorbic Acid Amount (mg%) in Fruit Juice:

- **Notes:**
  - At the beginning, clean all glassware needed and label them clearly using permanent marker.
  - Burettes are very delicate and expensive, make sure that you clean them while they are clamped to a stand.
  - Rinse with distilled water, then rinse with the titrant solution.
  - Do not pour any liquid inside the burette without using a liquid funnel and wearing safety goggles.

Ascorbic acid amount (mg %) in friut juice.

Ex: the volume of (0.05 M) Iodine solution obtained was 3 mL.

only at end point { # of mol of AA = # of mol of I_2 } حسب hint

weight of AA / Wwt AA = { M_{I_2} * V_{I_2} } من السؤال معروفين لانهم معطية ما دام القانون.

(arrow from M_{I_2} * V_{I_2}:) حطناهم ان End point

?? / 176.12 = 0.05 * 3 * 10^{-3} (arrow from 10^{-3}:) تحويل من mL → L

weight of AA = 0.0264 g

g → mg ← هيك بدهم

0.0264 g * 10^{+3} = 26.4 mg in 10 mL of fruit Juice.

(arrow from "in 10 mL of fruit Juice":) هيك حسب procedure

mg % → X mg in 100 mL solution (note beside this line:) حسب hint وهيك تعريفها

26.4 mg → 10 mL

?? → 100 mL → 264 mg %.

وبالمثال إلي بعد (in 200mL?) هيك مكتوب ← هاي بنضرب جبناها من procedure حين طالب لما عملنا التجربة.

➢ *The sequence of colors is clarified in the following figure:*

- ***Left flask:*** *before endpoint, iodine formed from added iodate reacts with ascorbic acid leaving the solution colorless.*
- ***Centre flask:*** *At the titration endpoint all the ascorbic acid has reacted, and the slight excess of added iodate reacts to give a pale blue color due to starch indicator. This is the endpoint of the titration.*
- ***Right flask:*** *If addition of iodate is continued after the endpoint, further starch-iodine complex is formed, giving the solution a stronger blue-black color. (Missed the endpoint).*

(نقوم بتحديد ال endpoint)

(Hint) **Calculations:**

- The stoichiometric ratio of the reaction between ascorbic acid and iodine is 1:1.
- Please refresh your memory with calculations of: # of moles (mass / M.W), amount (mg%) and amount(%Assay) before attending the laboratory session.

actual amount / theoretical amount *100 %.

M * V (molarity)

weight of analyte per 100 mL of solution

Part 3: Qualitative Determination of Ascorbic Acid:

Many chemical tests are performed to detect the presence of ascorbic acid.

بعد الصابات بدي اطلع كم ملغ بـ 100 مل

I. $AgNO_3$ test:

A.A "reducing agent" + $AgNO_3$ $\xrightarrow{HNO_3}$ Ag ppt. (Grey ppt.) + $AgNO_3$ + dehydroascorbic acid

oxidizing agent

testtube تفاعل بقاع راسب رمادي

II. $NaHCO_3$ test: acid base reaction تفاعل Not redox.

A.A "acid" + $NaHCO_3$ "base" ⟶ CO_2 + H_2O + sodium ascorbate (Bubbling)

III. Benedict's test:

الاختلاف بالوان ماخذة

A.A + Benedict's reagent (Cu^{+2}-citrate) $\xrightarrow{heat}$ Cu_2O" brick red to brown ppt." + dehydroascorbic acid

Ascorbic Acid Amount (mg%) in Fruit Juice

Ex: the volume of (0.05M) Iodine solution obtained was 3 ml

Mol = weight / MWT

# of mol of AA = # of mol of I_2

Weight of AA / MWT AA = M_{I_2} x V_{I_2} → E.P

?? / 176.12 = 0.05 x 3 x 10^{-3}

Weight of AA = 0.0264 g

0.0264 g x 10^{+3} = 26.4 mg in 10 ml of fruit juice

❖ Molecular weight for Ascorbic Acid= 176.12g/mol

mg% → X mg in 100ml solution

26.4mg → 10 ml

?? → 100 ml → 264 mg%

Ascorbic Acid Amount (%Assay) in tablet solution

Ex: the volume of (0.05M) Iodine solution obtained was 11.2 ml

Mol = weight / MWT

❖ Molecular weight for Ascorbic Acid= 176.12g/mol

# of mol of AA = # of mol of I_2

Weight of AA / MWT AA = M_{I_2} x V_{I_2}

?? / 176.12 = 0.05 x 11.2 x 10^{-3}

Weight of AA = 0.0986 g → 20 ml of tablet solution (200ml?)

0.0986 g AA → 20 ml

?? g AA → 200ml → 0.986 g → Act. amount

❖ % Assay

$$\% \text{ Assay} = \frac{\text{Actual Amount}}{\text{Theoretical Amount}} \times 100\%$$

One tablet contains 1 g of AA → Theo. Amount

0.986 g → Act. Amount

$$\% \text{ Assay} = \frac{0.986}{1g} \times 100\%$$

$$= 98.6\% \checkmark$$