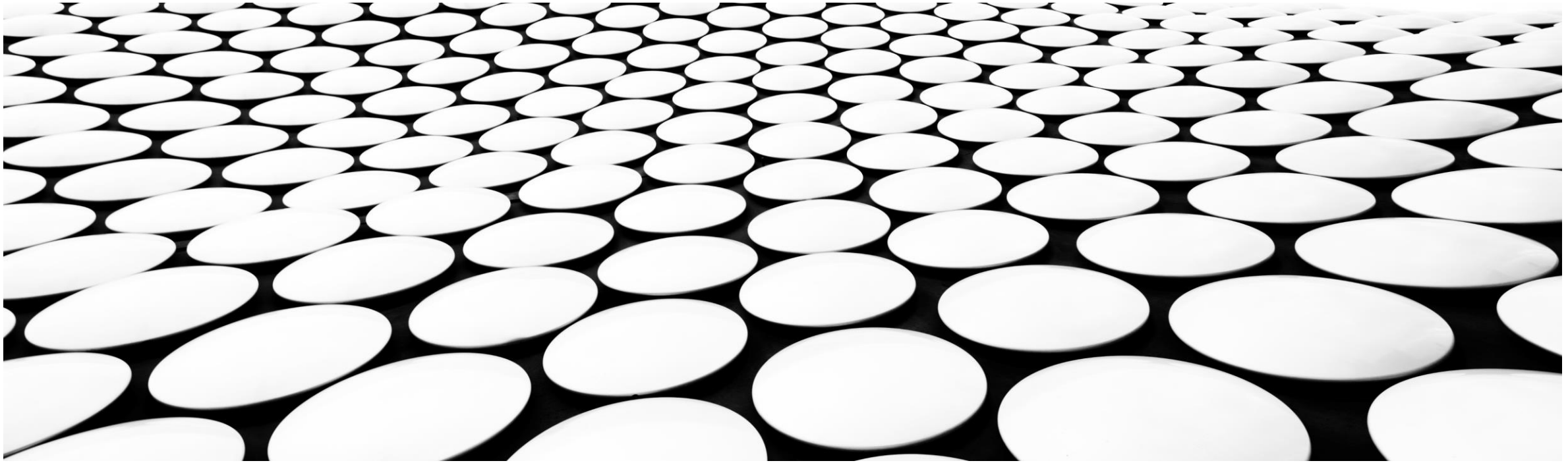
Practical

advance pharmaceutical analysis

pH meter

It’s applications

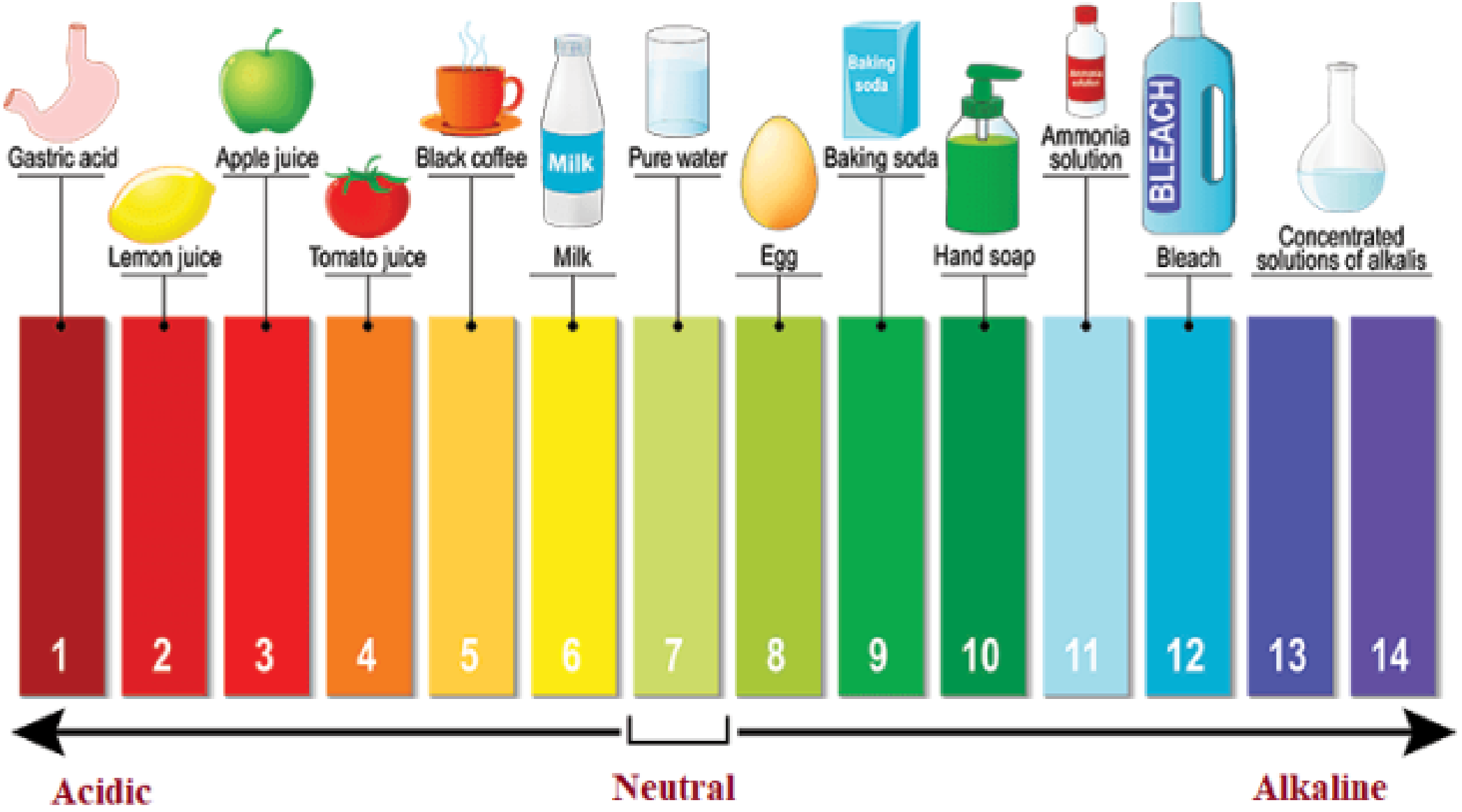


- A **pH meter** is a scientific instrument that measures the hydrogen ion activity in water based solutions, indicating its acidity or alkalinity expressed as

$$pH = -\log [H^+]$$

- The pH meter measures the difference in electrical potential between a pH electrode (Glass electrode) and a reference electrode, and so the pH meter is sometimes referred to as a "potentiometric pH meter". The difference in electrical potential relates to the acidity or pH of the solution.

- The pH meter is used in many applications ranging from laboratory experimentation to quality .
- The rate and outcome of chemical reactions taking place in water often depends on the acidity of the water, and it is therefore useful to know the acidity of the water, typically measured by means of a pH meter.
- Knowledge of pH is useful or critical in many situations, including chemical laboratory analyses. pH meters are used for soil measurements in agriculture, water quality for municipal water supplies, swimming pools, environmental remediation; manufacturing, healthcare and clinical applications such as blood chemistry; and many other applications.
- Advances in the instrumentation and in detection have expanded the number of applications in which pH measurements can be conducted. The devices have been miniaturized, enabling direct measurement of pH inside of living cells.
- Major end-users are food science, pharmaceuticals & biotechnology, environmental research & pollution center, and others.


Gastric acid
Lemon juice
Apple juice
Tomato juice
Black coffee
Milk
Pure water
Egg
Baking soda
Hand soap
Ammonia solution
Bleach
Concentrated solutions of alkalis
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Acidic
Neutral
Alkaline

Applications of pH Meter

Most products require a specific pH for activity or stability, especially in the food and beverage industry, cosmetic industry and pharmaceutical sector.

1. pH Meter is very crucial in Agriculture industry for soil evaluation. Major crops require alkaline environment and hence pH Meter becomes necessary.
2. It is also used in Food industry especially for dairy products like cheese, curds, yogurts, etc.
3. It becomes mandatory for chemical and pharmaceutical industries.
4. It becomes a significant factor in the production of detergents.
5. pH level monitoring is essential in water treatment plants and RO water purifiers.

Advantages of pH Meter

1. pH Meter is inexpensive and robust.
2. Pocket size pH Meters are user friendly.
3. Readings are accurate and precise.

Disadvantages of pH Meter

1. Temperature impacts the output readings.
2. pH Meter using glass electrodes must be clean as deposition on the electrodes affects the readings.

Errors in pH meter

1. Standards.
2. Junction potential
3. Junction potential drift.
4. Sodium error.
5. Acid error.
6. Equilibration time.
7. Hydration of glass.
8. Temperature.
9. Cleaning.

Calibration of pH meter

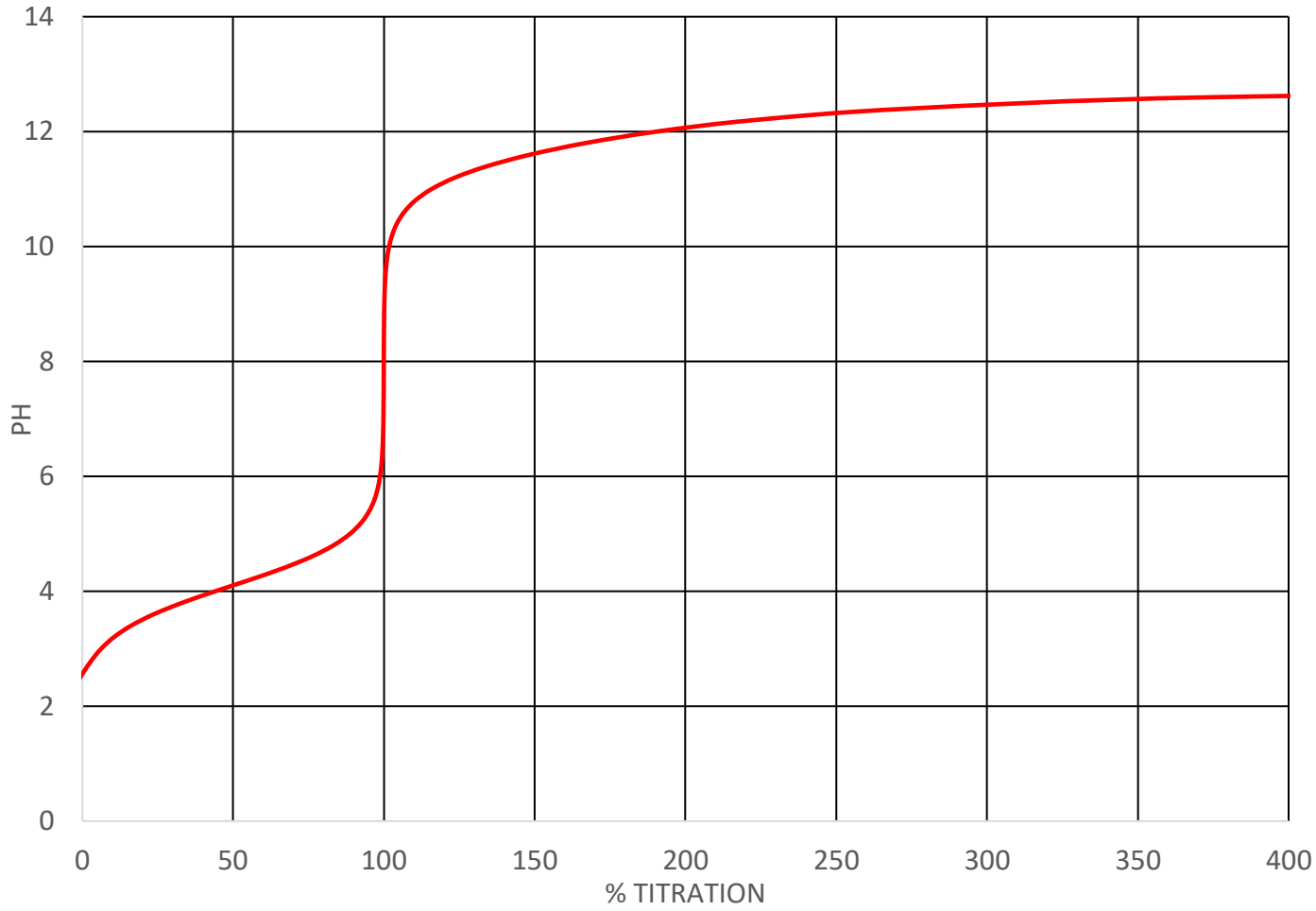
Titration of the ascorbic acid (vitamin C) in tablets By pH meter

Vitamin C, also known as ascorbic acid and L-ascorbic acid, is an essential nutrient involved in the repair of tissues and the enzymatic production of certain neurotransmitters. It is required for the functioning of several enzymes and immune functions. It is also an important antioxidant. It is found in food and used as a dietary supplement. Vitamin C is mainly used to treat scurvy.

- **Procedure (pH-metric titration)**

1. Place a tablet of Vitamin C in a beaker, add about 50 mL of warm distilled water, and crush the tablet with a glass stirring rod. Cool down the solution.
2. Dilute the sample in your volumetric flask to the total volume of (100 -150 mL) with distilled water.
3. Place the beaker on magnetic stirrer insert the magnet in it, as well as pH-electrode. Ask the assistant to control the correctness of the installation and some advices.
4. Measure volume of NaOH and note pH; Repeat for each adding small portions of NaOH (the titrant base), noting also the actual volume of titrant added (total). Finish titration when pH exceeds 9-10.

Procedure



Titration curve of 0.1 M ascorbic acid using 0.1 M NaOH as titrant

Processing the results

Using a computer data-sheet, plot the titration curve obtained and determine as exactly as possible the volume of titrant corresponding to the inflection point.

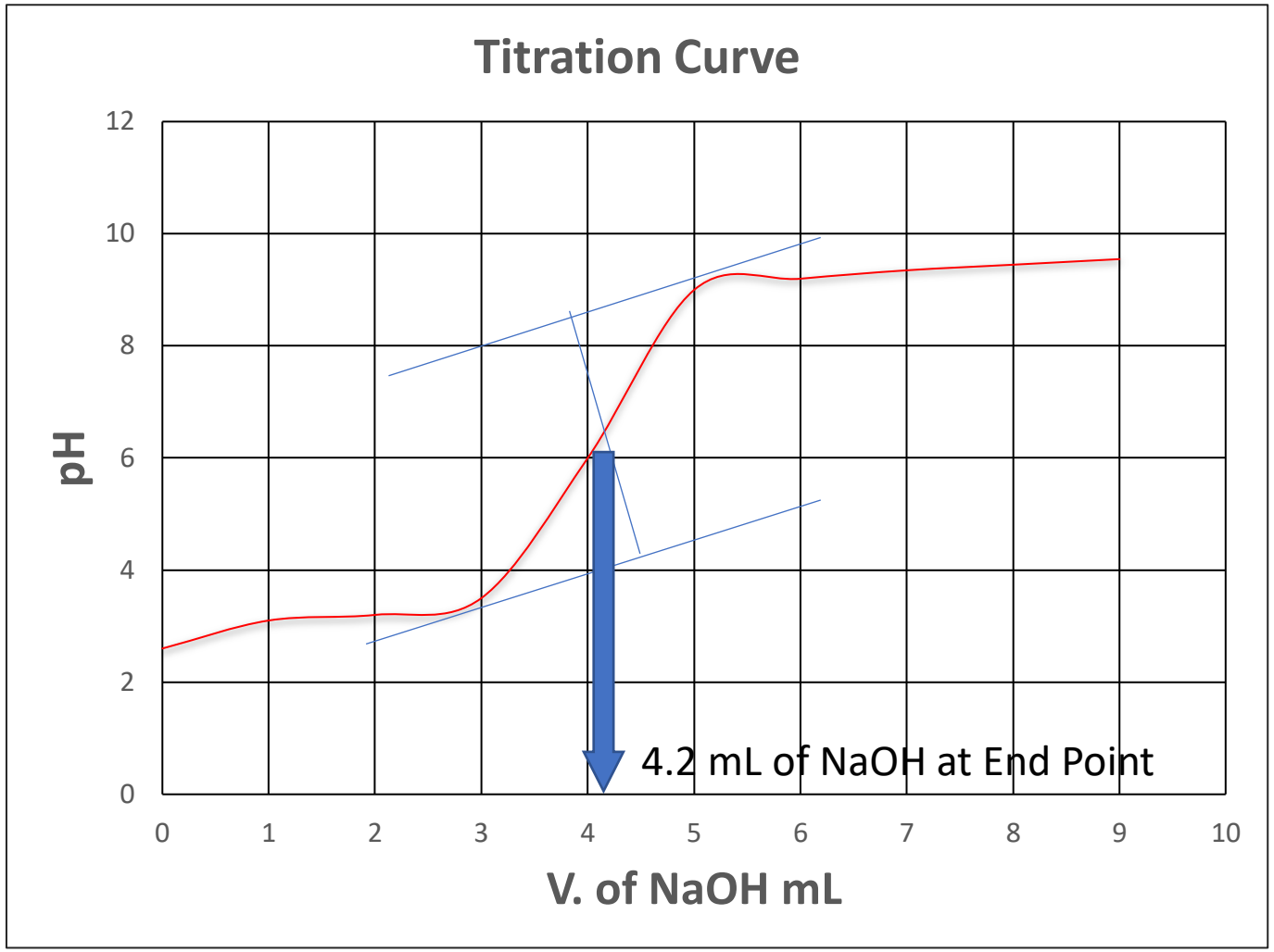
For more aspiring students :-

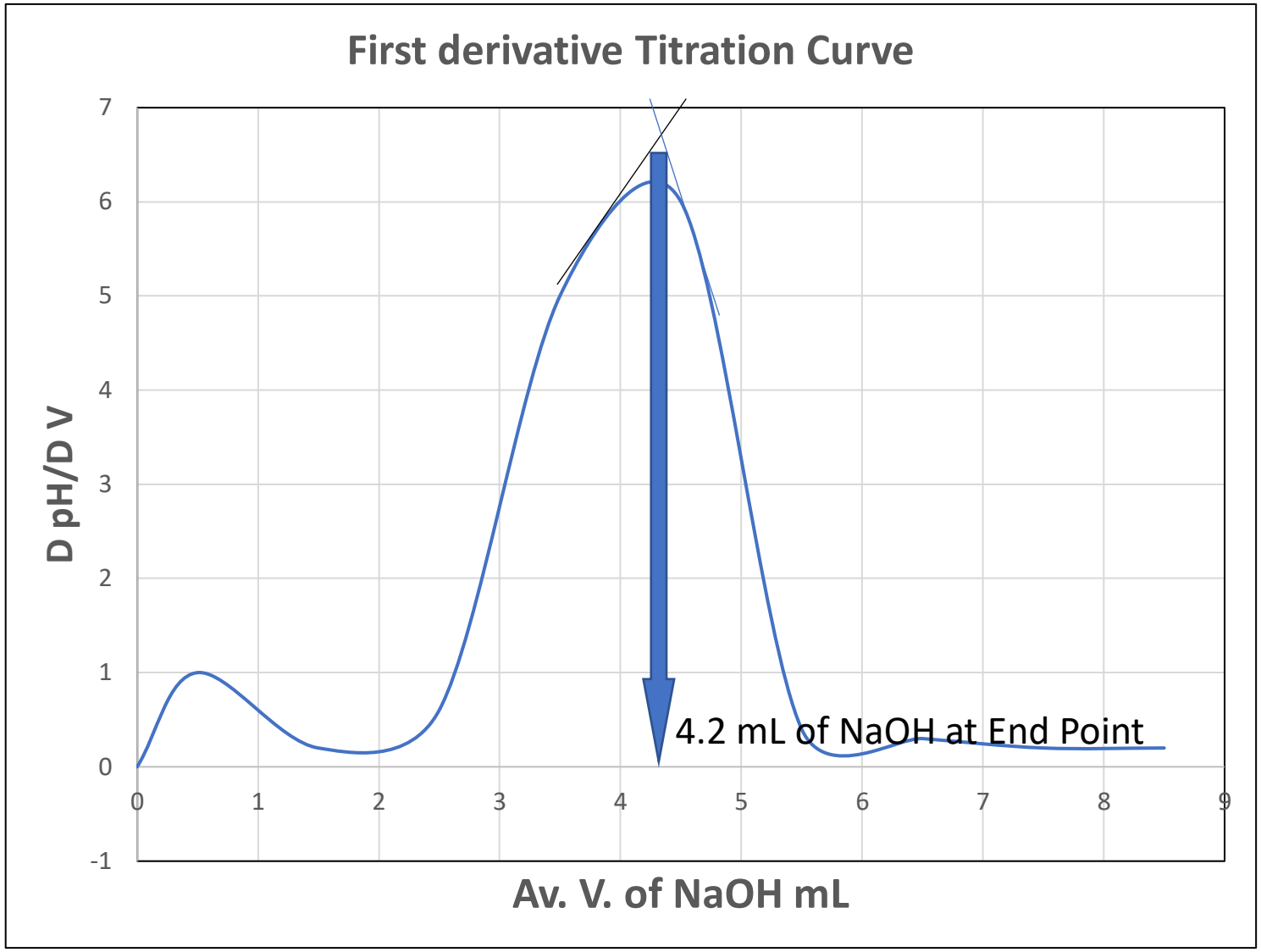
The preciseness of determination of the inflection point can be very improved if calculating the first and second derivatives of the titration curve.

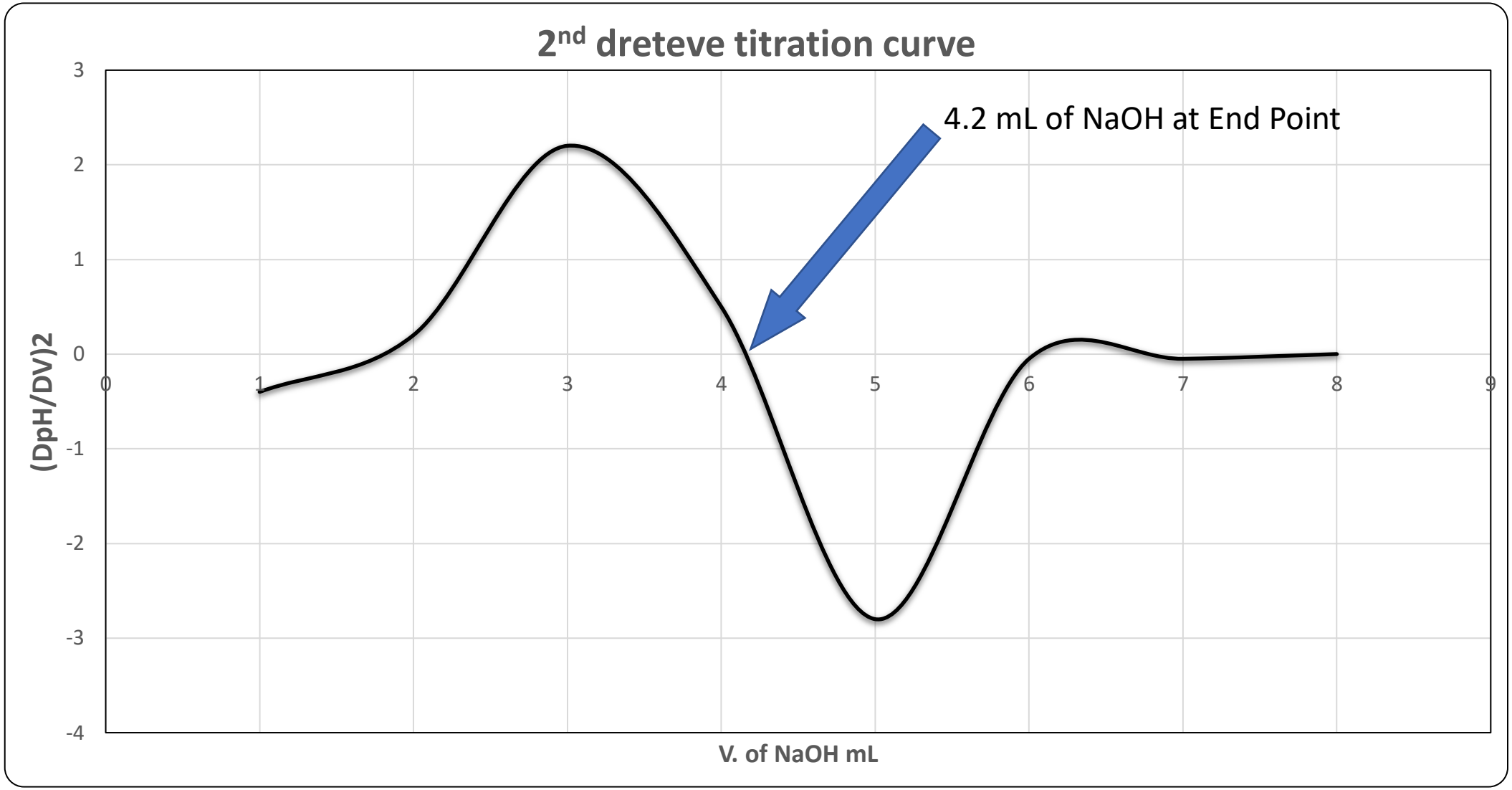
Record all the numbers obtained, as well as the calculations made.

Note your observation concerning the comparison of your result with the factory value.

(DpH/Dv)2	VAA	DpH/DV	VA	pH	V. of NaOH
0	0	0	0		0
-0.4	1	0.5	0.5	2.6	0
0.2	2	0.1	1.5	3.1	1
2.2	3	0.3	2.5	3.2	2
0.5	4	2.5	3.5	3.5	3
-2.8	5	3	4.5	6	4
-0.05	6	0.2	5.5	9	5
-0.05	7	0.15	6.5	9.2	6
0.0	8	0.1	7.5	9.35	7
		0.1	8.5	9.45	8
				9.55	9


Titration Curve
12
10
8
6
4
2
0
pH
0
1
2
3
4
5
6
7
8
9
10
V. of NaOH mL
4.2 mL of NaOH at End Point


First derivative Titration Curve
D pH/D V
7
6
5
4
3
2
1
0
-1
0
1
2
3
4
5
6
7
8
9
4.2 mL of NaOH at End Point
Av. V. of NaOH mL


2nd dreteve titration curve
4.2 mL of NaOH at End Point
(DpH/DV)2
V. of NaOH mL
3
2
1
0
-1
-2
-3
-4
0
1
2
3
4
5
6
7
8
9

Calculation:

1. Calculate mass of ascorbic acid and mass % in tablets ?

Mass (mg)= (N X V_{mL}) of NaOH X Eq. Mass of Ascorbic acid

2. Calculate K_{a1} of acid ?

pK_a = pH at mid titration (50% Titration), Why? Explain

At buffer solution pH = pKa + log ([Salt]/[Acid])

Thank you for listening