SOMAIYA VIDYAVIHAR UNIVERSITY

Somaiya Vidyavihar University, Mumbai.

Somaiya TRUST

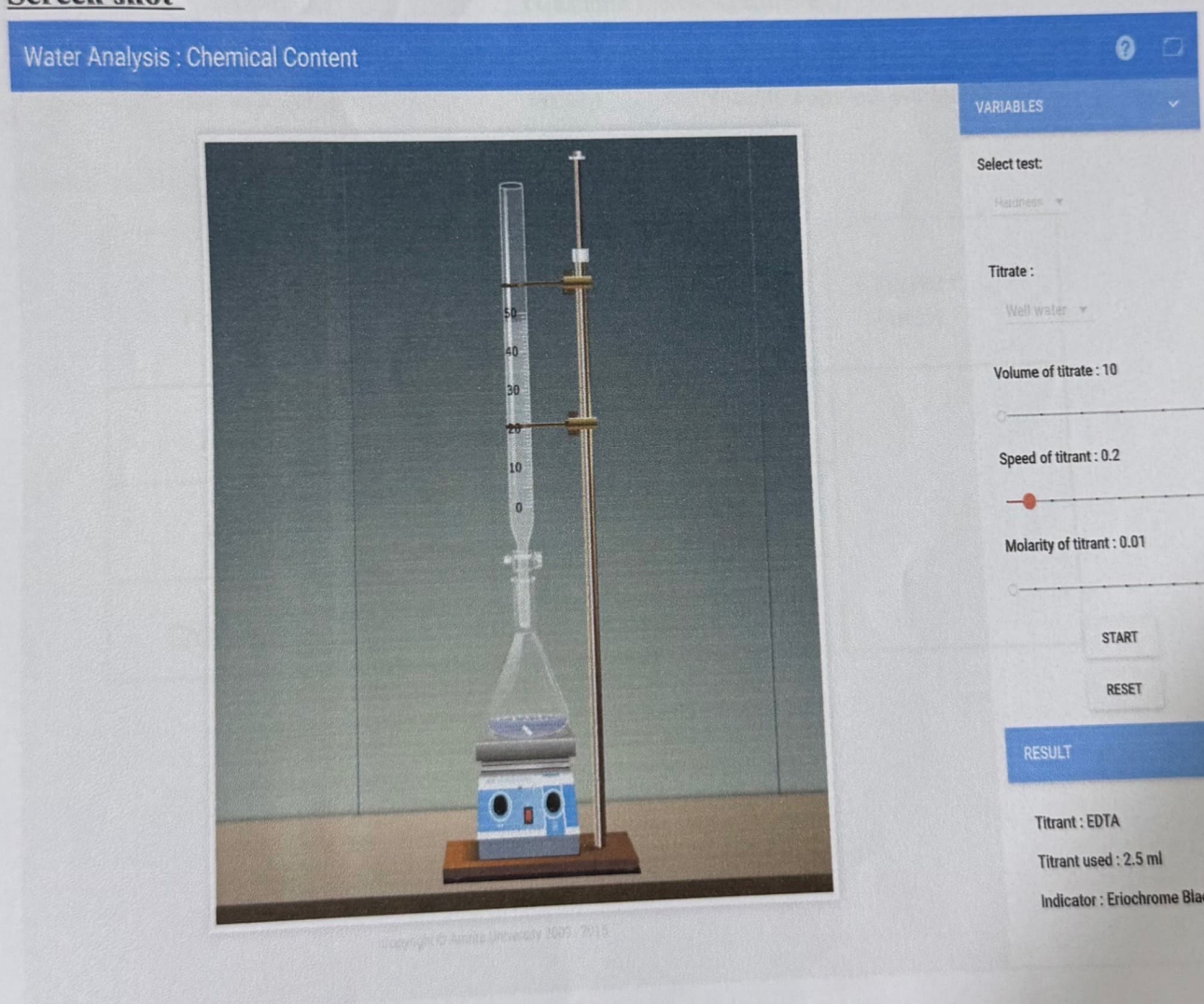
Faculty of Engineering and Technology

Applied Chemistry Laboratory
Subject: Engineering Chemistry

Observation:

PART 1 - WELL WATER

Screen shot-



Burette	: **0.01 M** EDTA solution
Conical flask	: **10 mL** of sample + Indicator
Indicator	: EBT
End point	: Wine red to Blue

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Reaction:

$(Ca^{+2} + Mg^{+2})$ + EBT + Buffer (9- 10) → (Ca-EBT + Mg-EBT) complex

(Hard water) (Indicator) (Unstable **wine-red** complex)

[Ca-EBT + Mg-EBT]complex + EDTA → EBT + [Ca-EDTA + Mg-EDTA] complex

(Unstable **wine-red** complex) (**Blue**) (Stable colorless complex)

Pilot Reading : **2(mL) to 3(mL)**

Reading	I (mL)	II (mL)	Constant (mL)
Initial	0.00	0.00	2.5
Final	2.5	2.5	
Difference	2.5	2.5	

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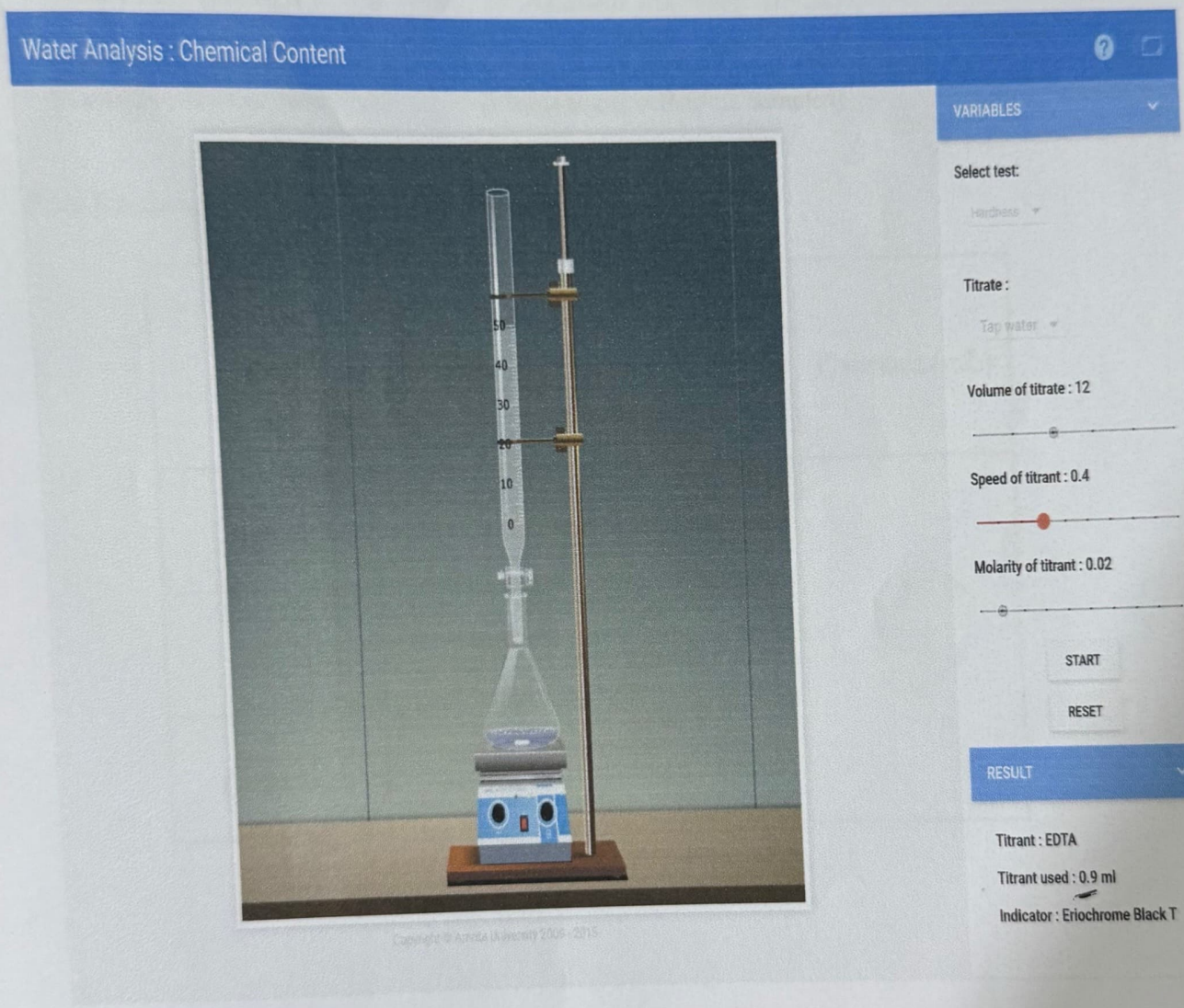
PART 2 - TAP WATER

Screen shot-



Burette	: **0.02 M** EDTA solution
Conical flask	: **12 mL** of sample + Indicator
Indicator	: EBT
End point	: Wine red to Blue

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Reaction:

(Ca^{+2} + Mg^{+2}) + EBT + Buffer (pH 9-10) à (Ca-EBT + Mg-EBT) complex
(Hard water) (Indicator) (Unstable **wine-red** complex)

[Ca-EBT + Mg-EBT] complex + EDTA à EBT + [Ca-EDTA + Mg-EDTA] complex
(Unstable **wine-red** complex) (**Blue**) (Stable colourless complex)

Pilot Reading : **0.5 (mL) to 2 (mL)**

Reading	I (mL)	II (mL)	Constant (mL)
Initial	0.00	0.00	1.9
Final	1.9	1.9	
Difference	1.9	1.9	

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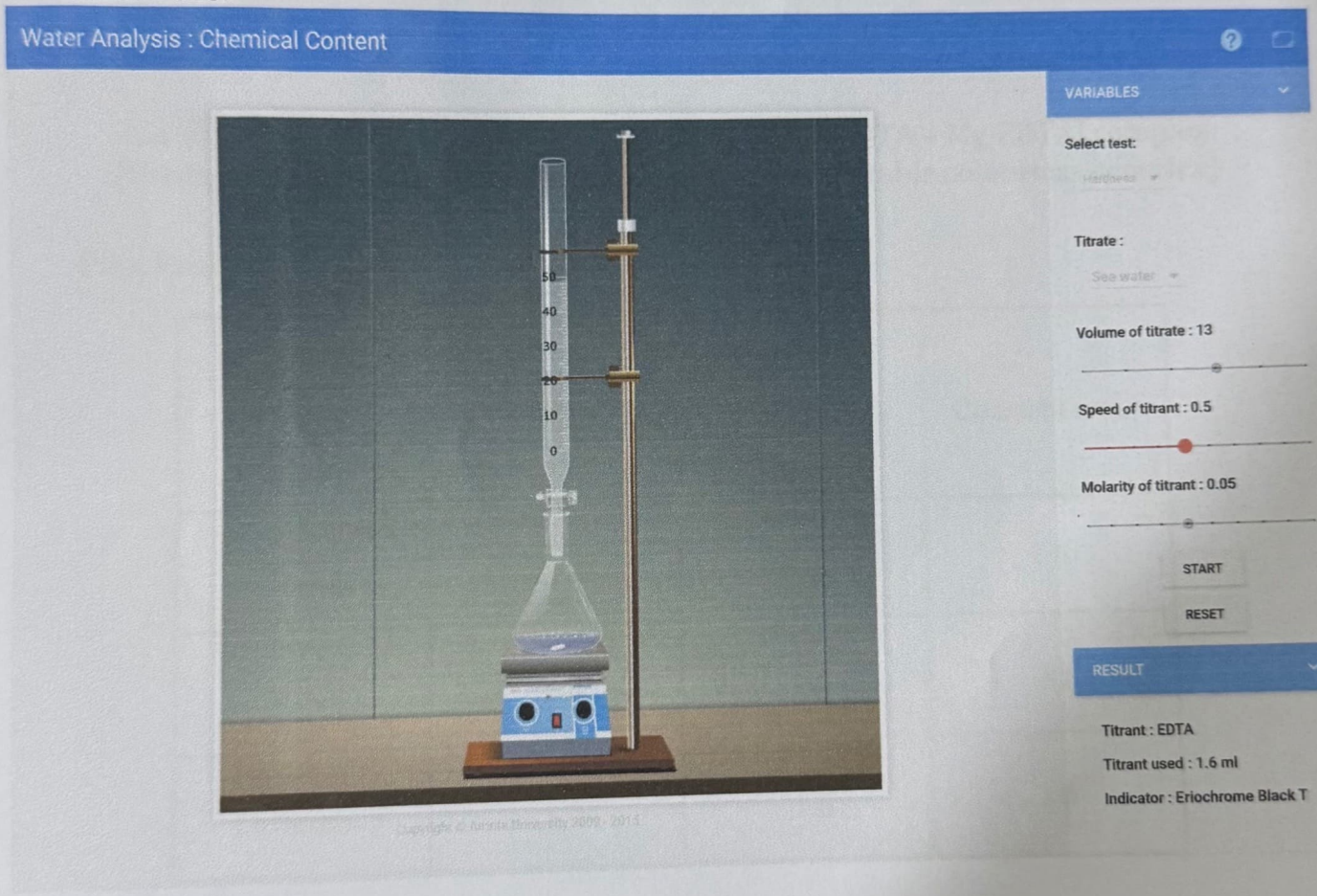
PART 3 - SEA WATER

Screen shot-



Burette	: **0.05M** EDTA solution
Conical flask	: **13mL** of sample + Indicator
Indicator	: EBT
End point	: Wine red to Blue

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Reaction:

$(Ca_{+2} + Mg_{+2})$ + EBT + Buffer (pH 9-10) → (Ca-EBT + Mg-EBT) complex
(Hard water) (Indicator) (Unstable **wine-red** complex)

[Ca-EBT + Mg-EBT] complex + EDTA → EBT + [Ca-EDTA + Mg-EDTA] complex
(Unstable **wine-red** complex) (**Blue**) (Stable colourless complex)

Pilot Reading : **1 (mL) to 2 (mL)**

Reading	I (mL)	II (mL)	Constant (mL)
Initial	0.00	0.00	1.6
Final	1.6	1.6	1.6
Difference	1.6	1.6	1.6

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Calculation:

Formula:

Total Hardness (ppm)= $\frac{\text{Vol.of EDTA (ml)} \times 0.1 \times M_{EDTA} \times 10^6}{\text{Vol. of Sample (ml)}}$

Part-1: Well water

Total Hardness (ppm) = $\frac{2.5}{10} \times \frac{0.1 \times 0.01 \times 10^6}{10}$

= 250 ppm

Part-2: Tap water

Total Hardness (ppm) = $0.9 \times \frac{0.02 \times 0.1 \times 10^6}{12}$

= 150 ppm

Part-3: Sea water

Total Hardness (ppm) = $1.6 \times \frac{0.1 \times 0.05 \times 10^6}{13}$

= 615.38 ppm

Result: The hardness of Sea water is the highest = 615.38 ppm.

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Assignments:

1. Convert the total hardness of water samples in ppm and meq/L from the following:
   A. 20.23$_o$Cl; B. 31.8$_o$Fr

2. A sample of water has hardness 208ppm $CaCO_3$ eq. Find the hardness in terms of mg/L, $_o$Fr, $_o$Cl, meq/L.

3. How many grams of $FeSO_4$ dissolved per litre gives 210.5ppm of hardness?

4. Three samples were analysed for their salt content:
   (i) Sample A contains 168mg of magnesium carbonate per litre
   (ii) Sample B contains 820mg of calcium nitrate and 2mg of silica per litre
   (iii) Sample C contains 20g potassium nitrate and 2g calcium carbonate per 500ml

   Determine the hardness in ppm and grains per gallon.

5. Classify the following into temporary, permanent and non-hardness causing impurities: $Ca(HCO_3)_2$, $MgSO_4$, $CaCl_2$, CO_2, HCl, $Mg(HCO_3)_2$, $CaSO_4$, NaCl. How many grams of $CaCl_2$ dissolved per litre gives 150ppm of hardness?

6. Classify the following into carbonate and non-carbonate impurities and calculate all types of hardness-
   $Mg(HCO_3)_2$ = 7.1mg/L, $Ca(HCO_3)_2$= 8.1mg/L, $MgCO_3$= 4.2mg/L, $CaCO_3$=10mg/L, $MgSO_4$= 24mg/L.

7. 0.28g $CaCO_3$ was dissolved in HCl and made upto 1L with distilled water. 100ml of this solution required 28ml EDTA solution. 100ml of hard water sample required 33ml of EDTA solution. After boiling, cooling and filtering, 100ml of the solution required 10ml of EDTA. Calculate hardness.