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Chemistry 205 Report

Spectrophotometric Determination of Iron in Vitamin Tablets

Name: **Date:** 28 - 02 - 2013

Partner:

Purpose: ① To learn the principles of spectrophotometry and the use of a spectrophotometer
② To determine the wavelength of maximum absorbance of an iron complex
③ To determine, spectrophotometrically, the concentration of iron in an unknown solution and in a vitamin tablet

Data and calculation:

Molarity of Fe stock = 6.1611×10^{-4} M
Molarity of Fe 1 solution =

Table 1. Absorption values of the 10 mL Iron Solution at Different Wavelengths

λ (nm)	A	% T
400	0,230	58,5
425	0,362	42,9
450	0,481	33,8
475	0,529	26,4
480	0,599	25,2
485	0,618	21,0
490	0,596	25,3
495	0,590	25,7
500	0,618	24,0
505	0,618	24,1
510	0,629	23,5
515	0,598	25,2
520	0,582	26,2
525	0,519	30,2
550	0,139	72,6
575	0,010	97,8
600	0	100

Plot Absorbance versus wavelength and attach the graph to the report.

λ_{max} = 510 nm

Table 2. Concentration of Fe Standard Solutions

Fe standard solution	Volume of Fe stock solution	Total Volume (mL)	Molarity (moles / L)
1	10,0 mL	100,0 mL	$6,1611 \times 10^{-5}$
2	8,0 mL	100,0 mL	$4,9289 \times 10^{-5}$
3	6,0 mL	100,0 mL	$3,6967 \times 10^{-5}$
4	4,0 mL	100,0 mL	$2,4644 \times 10^{-5}$
5	2,0 mL	100,0 mL	$1,2322 \times 10^{-5}$

Table 3. Preparation of the Vitamin Tablet Solution

Mass of the tablet before crushing	0,4093g ± 0,0001
Mass of 100 mL beaker	50,8911g ± 0,0001
Mass of 100 mL beaker + crushed vitamin tablet	51,2912g ± 0,0001
Mass of the crushed vitamin tablet	0,4001g

Table 4. Absorbance and Transmittance Values versus Fe Concentrations of the Iron Solutions at λ_{max}

Fe standard solution	Molarity	% T	Absorbance
1	$6,1611 \times 10^{-5}$	23,5	0,629
2	$4,9289 \times 10^{-5}$	35,0	0,456
3	$3,6967 \times 10^{-5}$	45,3	0,344
4	$2,4644 \times 10^{-5}$	61,8	0,209
5	$1,2322 \times 10^{-5}$	81,5	0,089
Unknown (# 3)	$3,98 \times 10^{-5}$	36,5	0,438
Vitamin Tablet (diluted)	$1,66 \times 10^{-5}$	65,6	0,183

(linear regression slope is 10769)

- Plot Absorbance versus concentration for the Fe standard solutions and attach graph to the report. Find the slope. slope $= \varepsilon \cdot b = \frac{A}{c} = \frac{0,629 - 0,089}{(6,1611 \times 10^{-5} - 1,2322 \times 10^{-5})} = 11000$

- Find the following and show the calculation of each:

Molarity of the iron unknown = $C = \frac{A}{\varepsilon b} = \frac{0,438}{11000} = 3,98 \times 10^{-5} M$

But in the original? (-1)

% error = 28%. (-4)

Molarity of iron in the diluted vitamin tablet solution = $C = \frac{A}{\varepsilon b} = \frac{0,183}{11000} = 1,66 \times 10^{-5}$ M

Molarity of iron in the original vitamin tablet solution =

$M_1V_1 = M_2V_2 \Rightarrow M_1 = \frac{M_2V_2}{V_1} = \frac{1,66 \times 10^{-5} \times 100}{2ml} = 8,3 \times 10^{-4}$ M

$1,66 \times 10^{-4}$ M

% mass of iron in tablet =

$M = \frac{m}{V} \Rightarrow m = M \times V = 1,66 \times 10^{-4} \times 250 \times 10^{-3} = 4,15 \times 10^{-5}$ mol

$2,079 \times 10^{-4}$ mol

$m = \frac{m}{M} \Rightarrow m = m \times M = 4,15 \times 10^{-5} \times 56 = 0,0023$ g

0,0116 g

% mass $= \frac{0,002}{0,4001} \times 100 = 0,499$ %

Questions

1. What color would you expect for light transmitted through a solution with an absorption maximum at 550 nm?

   we expect violet color

2. What fraction of ultraviolet radiation is transmitted through a sunscreen that has a maximum absorbance of 0.35 near 300nm?
   Is this sunscreen more or less effective than a sunscreen with 37% transmittance at the same wavelength?

$A = -\log T \Rightarrow 0,35 = -\log T$

$T = 0,45$

less effective as more radiation is being transmitted.

3. A 15.0 mg sample of a compound with a molecular weight of 384.63 was dissolved in a 5-mL volumetric flask. A 1.00 mL aliquot was withdrawn, placed in a 10-ml volumetric flask, and diluted to the mark.
   a. Find the concentration (M) of the sample in the 5-mL flask.

$M = \frac{m}{V}$ and $n = \frac{m}{M} \Rightarrow M = \frac{m}{M \times V} = \frac{15 \times 10^{-3}}{384,63 \times 5 \times 10^{-3}} = 7,8 \times 10^{-3}$ M

   b. Find the concentration (M) of the sample in the 10-mL flask.

$M_1V_1 = M_2V_2 \Rightarrow 7,8 \times 10^{-3} \times 1,00 = M_2 \times 10 \Rightarrow M_2 = 7,8 \times 10^{-4}$ M

   c. The 10-mL sample was placed in a 0.500-cm cuvet and gave an absorbance 0f 0.634 at 495 nm. Find the molar absorbtivity at 495 nm.

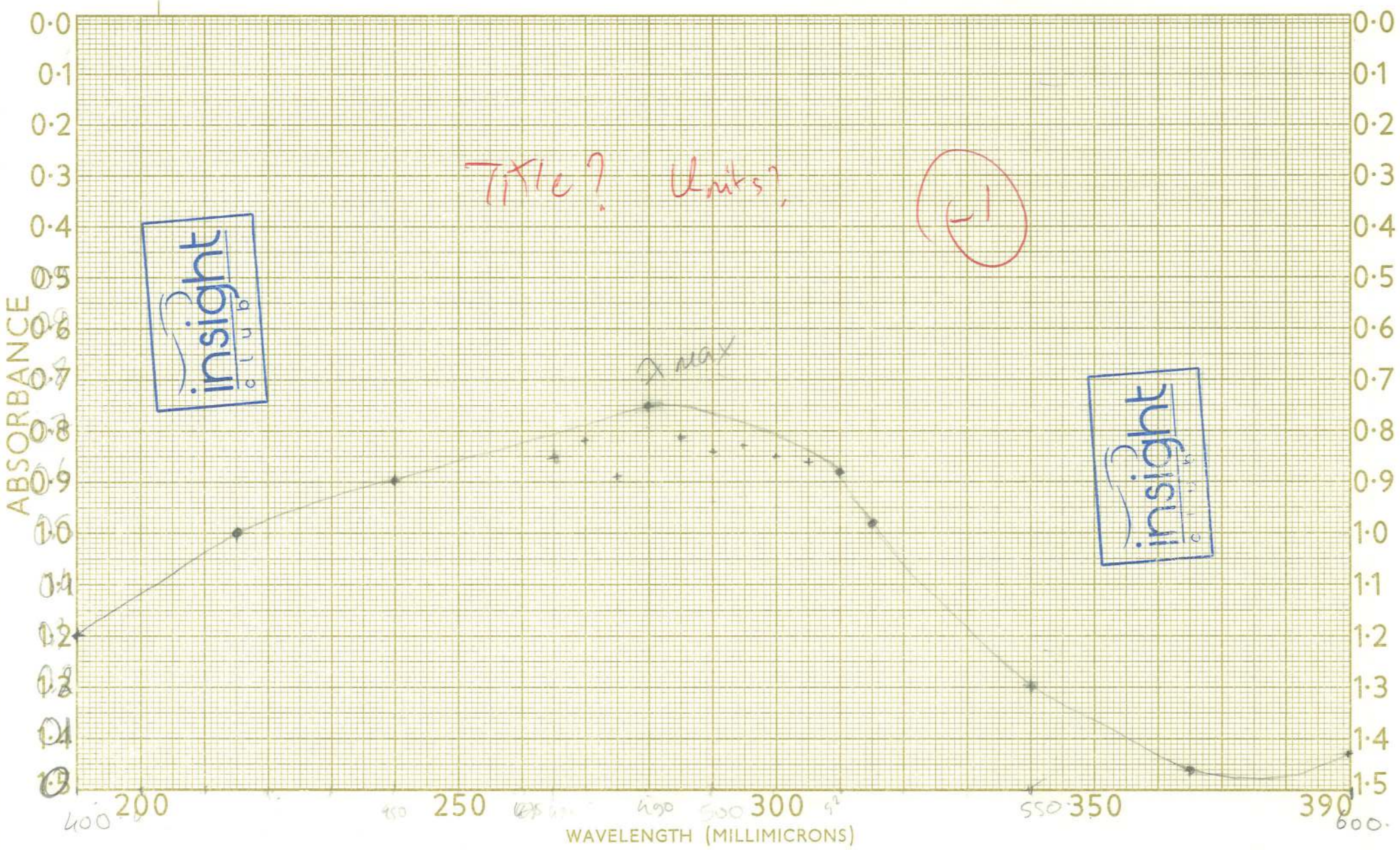
$b = 0,500$ cm

$A = 0,634$

$\lambda = 495$

$A = \varepsilon bc$

$\Rightarrow \varepsilon = \frac{A}{bc} = \frac{0,634}{0,5 \times 7,8 \times 10^{-4}} = 1,63 \times 10^{3}$ M.cm^{-1}



SAMPLE Rena Hamadeh, Samia Joueidi	CURVE NO.	SCAN SPEED	OPERATOR
	CONC.	SLIT	DATE
ORIGIN	CELL PATH	REMARKS	
SOLVENT	REFERENCE		

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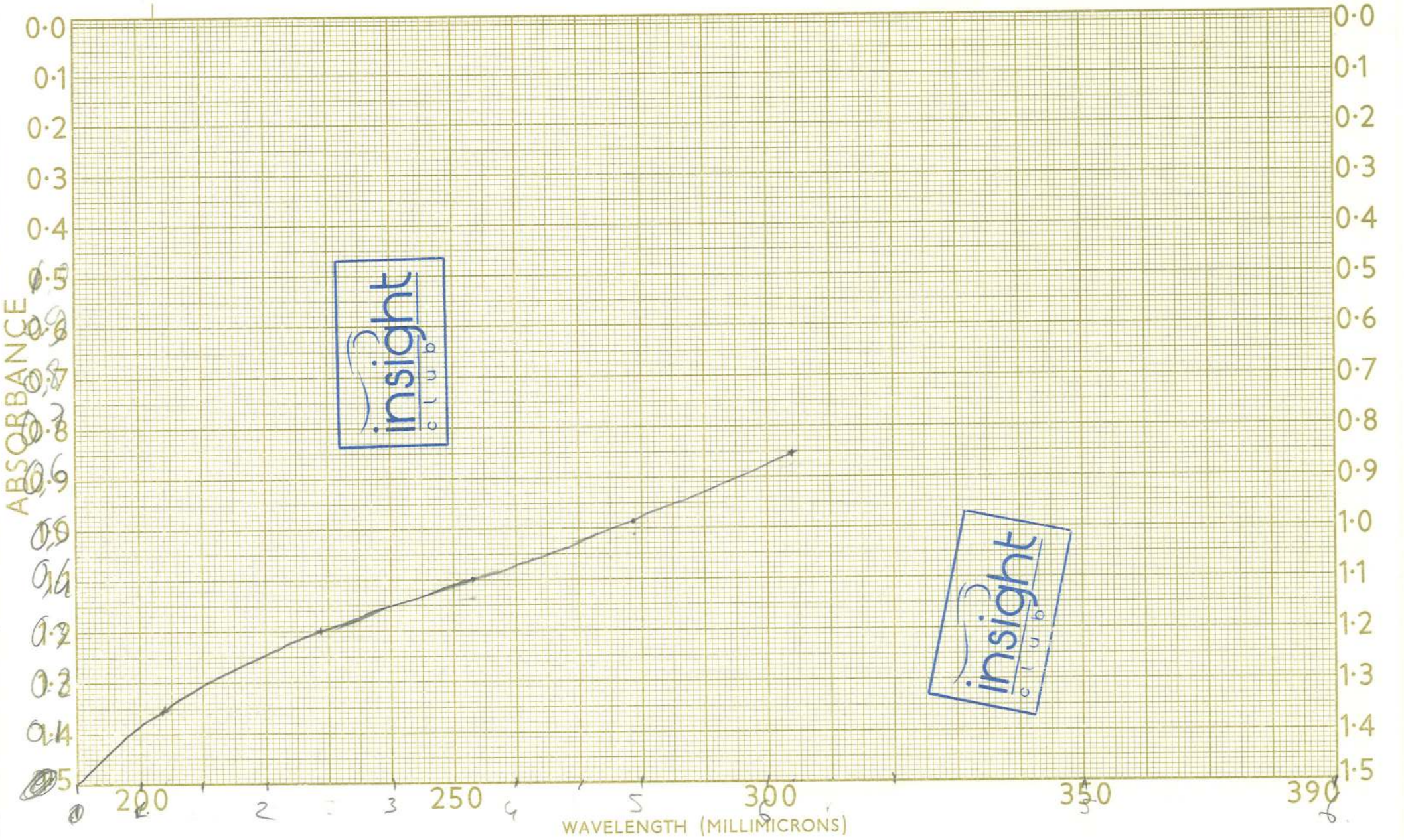

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