

Exp. No. 10	Experiment/Subject Solvatochromatic Dyes	Date 11/13/2023	Course & Section No. 213 203
Name Emma M. B. H.	Lab Partner	Locker/Desk No. 30	

Solvatochromatic Dyes

Reference: "An Experiment in Thinking of Scientifically", D. J.

Sardella Chem Ed. 69:333 (1992)

3 Purpose: Use Greney's spectrometer to determine the wavelength

of maximum absorption of the solutions.

4 Material: Spectrophotometer,

5 Procedure: Warm the instrument for 20 minutes.

Use the wavelength T and \downarrow button to adjust to the wavelength

to the experiment. Use the cuvette that $\frac{1}{2}$ full with your "blank" solution

into the instrument. Press the "0 ABS/100% T" Button

it is calibrated.

Press the "A/T/C" Button to select the proper data output for the experiment.

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Taking an Absorbance reading

- ① Obtain 5 cuvettes, each containing merocyanine dissolved in one of solvent.
- ② Observe the color of each solution and determine the relative polarity of each solvent.
- ③ Use the UV-Vis spectrophotometer to determine wavelength of Max absorb of each solution: 400 nm to 700 nm.
- ④ Set to 400 nm, Zero the spectrometer using.
- ⑤ Measure the absorbance of each merocyanine.
- ⑥ Increase the wavelength by 25 nm and repeat absorb reading.
- ⑦ Continue increase the length by 25 nm and take the reading until it reach 700 nm.

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Table observed color and polarity

Solvent	Observed Color	Color absorbed	Relative Polarity
Methanol CH_3OH	Yellow	Purple	
1-propanol $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	dark pink	light green	
2-propanol $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$	light red	green orange yellow	
Acetone CH_3COCH_3	purple	purple	
Acetone CH_3COCH_3	little yellow	purple	
Water	little yellow	purple	

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Methanol
CH3OH

1-propanol
CH3CH2CH2OH

2-propanol
CH3CHOHCH3

Acetone
CH3COCH3

Acetone
CH3COCH3

350 2.366 1.372
400 2.126 3.102

425 0.626 1.714

Purple

450 0.168 0.386

0.836 1.941 0.107 0.089

475 0.088 0.207

1.040 2.766 0.220 0.093

500 0.031 0.190

1.789 3.240 0.553 0.199

525 -0.001 0.105

2.323 3.250 1.289 0.434

550 -0.005 0.037

1.903 2.761 2.188 0.9343

575 -0.004 0.002

0.862 1.032 2.199 1.397

600 -0.003 -0.002

0.178 0.178 1.076 1.278

625 -0.003

0.012 0.015 0.132 0.243

650 -0.007

0.002 0.004 0.005 0.011

675

0.039 -0.004 -0.007

700

0.004 -0.002 -0.006

375 0.005 2.875

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Table 3

Solvent	λ_{max}	ϵ_r (kJ/mol)	Relative solvent polarity (1-5)
Methanol CH_3OH	375 400	299.26	2
1 propanol	525	228.01	3
$CH_3CH_2CH_2OH$	525	228.01	4
2 propanol	525		
$CH_3CHOHCH_3$	575	208.18	6
Acetonitrile CH_3CN	575	208.18	5
Acetone CH_3COCH_3	575		
Water	375 575	319.24	1

375 2895

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Observation

the propanol 1 and 2 are only solution that does give negative number when it's near 700 wavelength.

most of solution have negative number when it's near to 700 wavelength.

~~solution~~ solution that absorbed purple & doesn't reflect any wavelength below 700

$$\frac{(6.02 \times 10^{23})(6.26 \times 10^{-34})(300 \times 10^8)}{400 \times 10^{-9}} = 29926$$

1000

$$\frac{(6.02 \times 10^{23})(6.26 \times 10^{-34})(300 \times 10^8)}{525 \times 10^{-9}} = 22801$$

1000

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$$6.023 \times 10^{23}$$

$$(6.023 \times 10^{-34}) / (3.00 \times 10^8)$$

$$= 2.008 \times 10^{-16}$$

$$575 \times 10^{-9}$$

$$1.000$$

$$6.023 \times 10^{23}$$

$$(6.023 \times 10^{-34}) / (3.00 \times 10^8)$$

$$= 2.008 \times 10^{-16}$$

$$375 \times 10^{-9}$$

$$1.000$$

Wavelength, nm	Absorbance(wave length) for the solution with the following solvent					
	Methanol CH ₂ OH	1-Propanol CH ₃ CH ₂ CH ₂ OH	2-Propanol CH ₃ CH(OH)CH ₃	Acetonitrile, CH ₃ CN	Acetone, CH ₃ COCH ₃	Water H ₂ O
350.000	1.372					2.366
375.000	2.875					3.005
400.000	3.106					2.126
425.000	1.714			0.183		0.626
450.000	0.386	0.826	1.941	0.107	0.084	0.168
475.000	0.207	1.040	2.760	0.221	0.093	0.088
500.000	0.190	1.790	3.240	0.553	0.199	0.031
525.000	0.105	2.325	3.250	1.293	0.434	-0.001
550.000	0.037	1.903	2.751	2.188	0.943	-0.005
575.000	0.003	0.862	1.032	2.199	1.397	-0.004
600.000	-0.002	0.171	0.178	1.076	1.278	-0.003
625.000	-0.003	0.012	0.015	0.132	0.243	
650.000	-0.007	0.002	0.004	0.005	0.011	
675.000		0.039		-0.004	-0.007	
700.000		0.004		-0.002	-0.006	

Result: Water has the highest relative polarity because of the low amount of energy and wavelength took to reach the max Absorbance. Some of the solvents took the same amount of wavelength to reach the max absorbance. Acetonitrile and Acetone took the higher amount of wavelength to reach the max absorbance.

Discussion: There is a difference between the visual analysis of the relative energies and energy ranking from actual measurement of the energies using the Genesys 20 because visual analysis was a predictor or finding the amount of light that can be absorbed. hypochromic shift was occurring during the experiment. The types of categories in this experiment are the solvents that took higher wavelengths to turn into negative, such as the 1-Propanol and Acetonitrile, Acetone, and solvents that require shorter wavelengths like methanol and water. Most of the polarity was miscible in the table at Solvent Polarity Table, so it could not be compared. The solvent will bathochromic shift because it took higher amount of wavelength to get higher Absorbance. It will be less than the first solvent because of the higher amount required.

Conclusion: The purpose is to determine the wavelength of maximum absorption of solution and it can be achieved through the experiment several types of dyed solvent and recording their absorption of solution and try to calculate their polarity's. The results were little like anticipated outcomes because there may be small error occurring during the experiment such as the exposure of light to solvent may have resulted in different outcome. In future, it may be helpful to experiment with low lighting so that light does not affect the solvent.