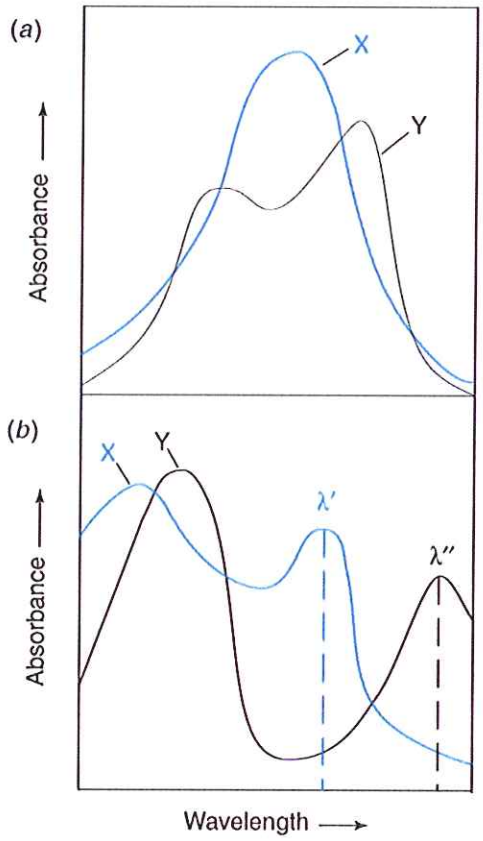
25pts

Chemistry 1A Laboratory Quiz
Spectroscopy & Ideal Gas Law

Name Key



Questions 1-3 refer to the spectral profiles presented to the left

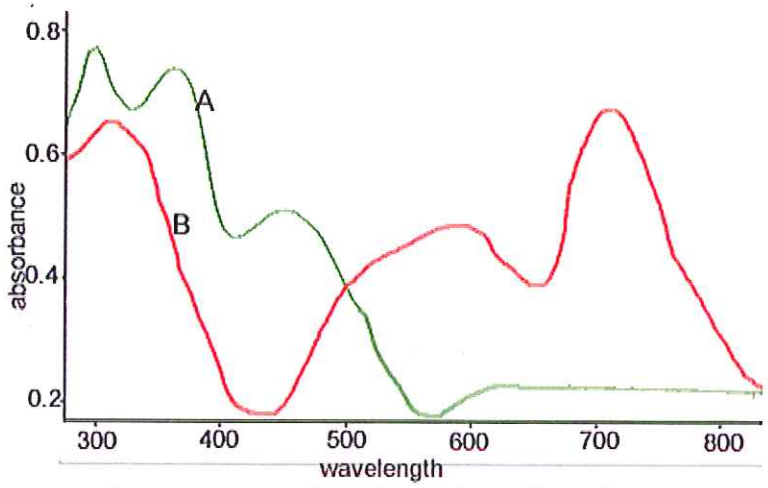
(2) 1) True/False – both spectra (a) and (b) have regions of spectral interference T

(3) 2) For spectra (a) how many λ_{max} are present?
2 (X & Y) one for X one for Y

(3) 3) What do the peaks and valleys in the spectral profile tell you about the solution being analyzed?

Peaks → compound Absorbance @ particular λ
Valley → no compound absorbance @ a particular λ

4) UV-visible spectroscopy was used to measure the spectra of two solutions,, one solution containing compound A and the other compound B. The analyst recorded the absorbance of each solution over a range of wavelengths on the same axes. The resultant absorbance spectrum is shown below.



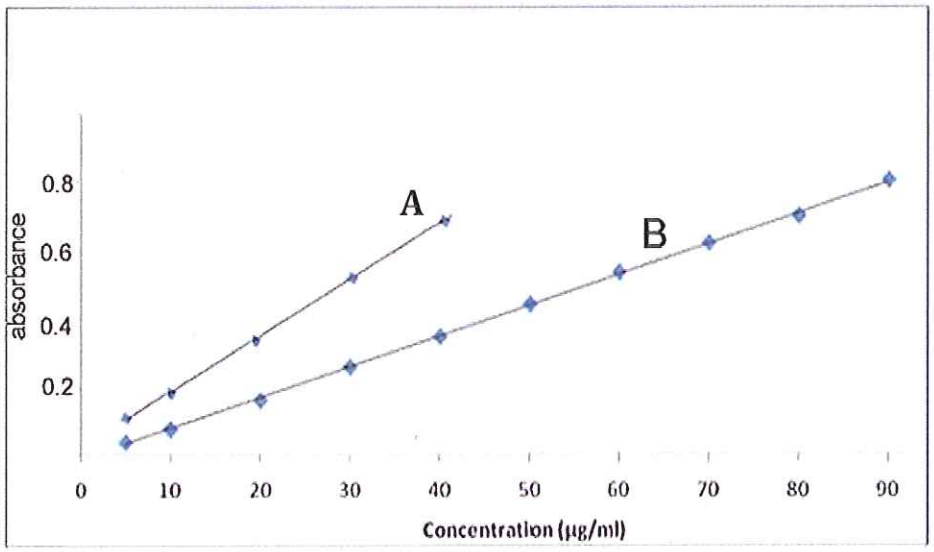
a) If equal volumes of solution A and solution B were mixed, which wavelength should be used to measure the absorbance of Solution A in this mixture and which wavelength should be used to measure solution B? Justify your answer

(2) Soln A $\lambda_{max} \leq 430$

Soln B $\lambda_{max} \geq 570$

These regions have minimal overlap (i.e. interference)

b) A chemist used the appropriate wavelengths for each solution and constructed two calibration curves on the same set of axes, shown below.



The chemist found that, when it was measured at the appropriate wavelength, Solution B had an absorbance of 0.375. If Solution B contained an organic substance with molecular formula $C_{23}H_{40}O_6N_3$, determine its concentration in mg/L. (C = 12.01 g/mol; H = 1.01 g/mol; O = 16.00 g/mol; N = 14.01 g/mol)

(3) Soln B: Ab = 0.375 → [Soln B] = 40 µg/ml

$1\,\mu g = 10^{-3}\,mg$

$1\,ml = 10^{-3}\,L$

$$\frac{40\,\mu g}{ml} \times \frac{10^{-3}\,mg}{1\,\mu g} \times \frac{1\,ml}{10^{-3}\,L} = 4.0 \times 10^{1}\,\frac{mg}{L}$$

c) Calculate the molarity of the compound in solution B

(3) $$\frac{0.04\,g\ Soln\,B}{L} \times \frac{1\,mol}{454\,g} = 8.8 \times 10^{-5}\,M$$

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d) A sample of contaminated water containing the same compound as found in solution A was analysed and found to have an absorbance of 0.80. Can the calibration curves above be used to analyse the sample of contaminated water for its concentration of the compound found in solution A? If your answer is **yes**, justify your answer or if your answer is **no** offer a way that it can be used.

No. Soln A cal curve only extends to Ab = 0.7. In order to accurately quantitate the Ab value must fall w/in the cal curve. It would be possible to quantitate the contaminated sample, but one must analyze a std soln of A @ 0.9 Ab.

5) A sample of nitrogen gas is collected over water at 20°C and a pressure of 1.00 atm. The volume of the collected gas is 250.0 L. What is the mass of N_2 collected? (At 20°C, the vapor pressure of water is 17.5 torr)

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$17.5\ \text{torr} \times \frac{1\ \text{atm}}{760\ \text{torr}} = 0.023\ \text{atm}$

$1.00\ \text{atm} - 0.023\ \text{atm} = 0.977\ \text{atm}$

$PV = nRT$

$$n = \frac{(0.977\ \text{atm})(250.0\ \text{L})}{\left(0.082\ \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}\right)(293.15\ \text{K})}$$

$= 10.141\ \text{mol}\ N_2 \times \frac{28.02\ \text{g}}{1\ \text{mol}\ N_2}$

$= 284.48\ \text{g}\ N_2$

$284.5\ \text{g}\ N_2$