

Physical Sciences

Time: 6 ½ Minutes
Questions 1–5

Worked out solutions can be found at:
<http://www.premed411.com/PS.html>

Passage I (Questions 1-5)

Chemical groups which have characteristic absorption bands are called *chromophores*. Table 1 lists the spectral characteristics of some common organic chromophores.

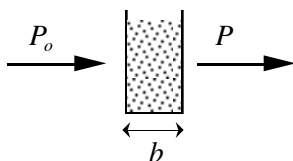
Chromophore	Example	Absorption maxima (Å)	Molar absorptivity (M ⁻¹ cm ⁻¹)
C=C	H ₂ C=CH ₂	1825	250
		1744	16,000
		1704	16,500
		1620	10,000
C≡C	HC≡CC ₂ H ₅	1720	2500
Benzene		2550	200
		2000	6300
		1800	100,000
C-OH	CH ₃ OH	1500	1900
		1830	200

Table 1 Spectral Characteristics of Organic Chromophores

Beer's law describes the decrease in radiant power of monochromatic radiation as it passes through a solution, which contains a chromophore.

$$\log P_o/P = \epsilon bc = A$$

P_o is the radiant power of light before entering the solution, and P is the radiant power afterwards. The path length of the light (b) is measured in centimeters. The concentration (c) of the solution is measured in moles per liter.



ϵ is a constant called the molar absorptivity. The logarithm of the ratio of the incident power to the transmitted power is given by A , the *absorbance* of the solution.

An ArF laser, having a wavelength of 193 nm, was used to determine the molar absorptivity of a 1.0×10^{-4} M solution of ammonium succinamate. When radiation from this laser, passed through 10 mm of solution, the ratio of the incident power to transmitted power was found to be 10.

- Which of the following would NOT result in an increase in the absorbance?
 - an increase in the incident power.
 - an increase in the path length.
 - an increase in the concentration.
 - an increase in the molar absorptivity .
- What is the molar absorptivity of the solution mentioned in the passage?
 - $10^3 \text{ M}^{-1} \text{ cm}^{-1}$
 - $10^4 \text{ M}^{-1} \text{ cm}^{-1}$
 - $10^5 \text{ M}^{-1} \text{ cm}^{-1}$
 - $10^6 \text{ M}^{-1} \text{ cm}^{-1}$
- The term $\log P_o/P$ can best be characterized as:
 - the absorbance.
 - the difference, in watts, between the incident power and the transmitted power.
 - the solution's energy absorption efficiency.
 - The power absorption ratio.
- Which of the following would NOT interfere with the results obtained when conducting experimental measurements of the molar absorbtivity?
 - reflection by the walls of the container.
 - absorption by the walls of the container.
 - absorption by molecules in the solution.
 - scattering by molecules in the solution.
- Which chromophore has an absorption maxima that would produce an absorbance equal to one, at a concentration of 1×10^{-5} M, and path length of 1.0 cm?
 - C=C
 - C≡C
 - Benzene
 - C-OH