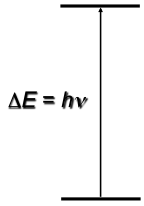
Visible Spectroscopy
Beer's Law

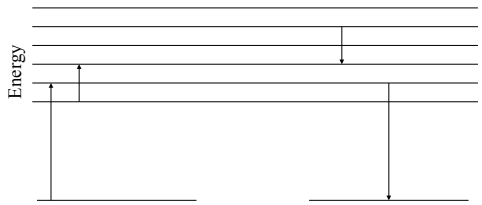
Transitions between energy states



Gaps between electron energy levels correspond to wavelengths; between 200 and 800 nm (Ultraviolet-Visible)

Absorption and Emission of Light

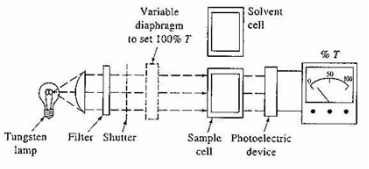
(Dropping from an excited state to ground state or lower state)



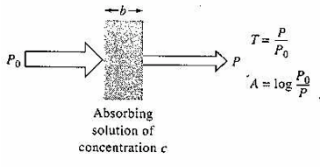
Absorption Emission

(Excitation from ground state or from an excited state to a higher state)

Spectrophotometer

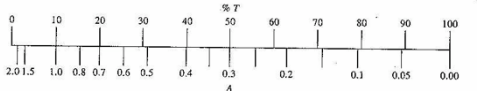


Attenuation of Light



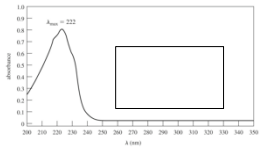
Transmittance vs. Absorbance

Transmittance scale is linear
Absorbance scale is exponential



The Spectrum

- The spectrometer measures the intensity of a reference beam (P_r=I_r) and the intensity of a beam through a sample (P=I_s).
- Absorbance is the log of the ratio $\frac{I_r}{I_s}$
- Graph is absorbance vs. wavelength.



Beer's Law

- Graph is absorbance vs. concentration.
- Beer's Law:
  A = ε*cl;* A =*abc*
  ε (*a*) is the molar absorptivity, *c* is the sample concentration in moles per liter, and *l (b)* is the length of the light path in centimeters.
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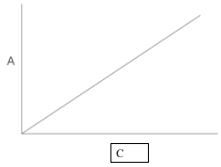
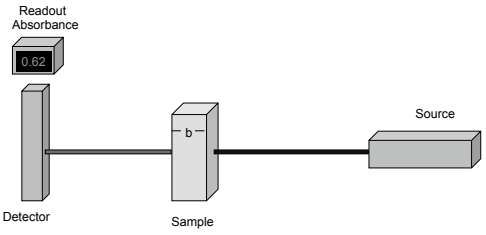


Beer's Law A = εbc

Path Length Dependence, b

Beer's Law A = εbc

Path Length Dependence, b

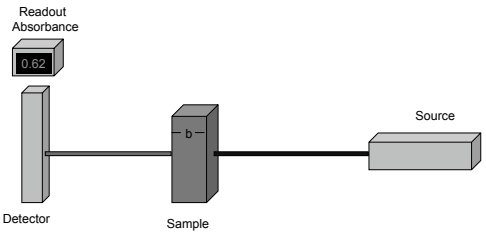


Beer's Law A = εbc

Concentration Dependence, c

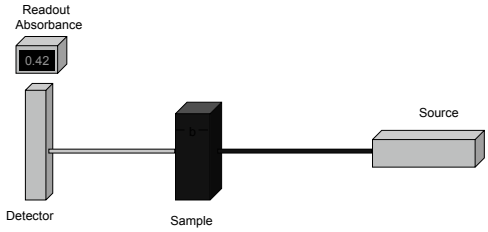
Beer's Law A = εbc

Concentration Dependence, c



Beer's Law A = εbc

Concentration Dependence, c

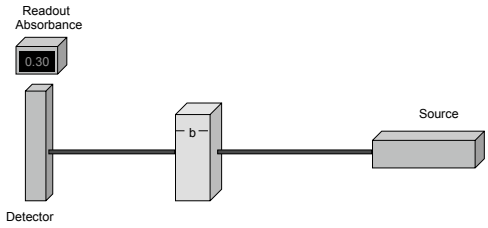


Beer's Law A = εbc

Wavelength Dependence, ε

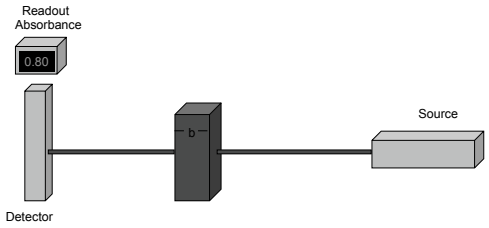
Beer's Law A = εbc

Wavelength Dependence, ε



Beer's Law A = εbc

Wavelength Dependence, ε



Prelab Calculation

What is the manganese concentration in a sample that has an absorbance of 0.658, a path length of 1.50cm and a molar absorptivity, ε = 5.85 x 10^3 L/mol · cm.

$A = \varepsilon\, b\, c$

A. 3.85 x 10^3M MnO_4^-
B. 1.12 x 10^{-4}M MnO_4^-
C. 7.50 x 10^{-5}M MnO_4^-
D. 1.69 x 10^{-4}M MnO_4^-

Prelab Calculation

What is the manganese concentration in a sample that has an absorbance of 0.658, a path length of 1.50cm and a molar absorptivity, ε = 5.85 x 10^3 L/mol · cm.

$A = \varepsilon\, b\, c$

C. 7.50 x 10^{-5}M MnO_4^-