COMSATS Institute of Information Technology, Abbottabad

Course title and code	Analytical Techniques
Assignment number	01
Assignment title	**10 Numericals of Beer–Lambert law**
Submitted by	Zohaib HUSSAIN
Registration number	Sp13-bty-001
Submitted To	Dr. Murtazaa SAYED.
Date of submission	Sunday, March 13, 2016

1. A solution of Tryptophan has an absorbance at 280 nm of 0.54 in a 0.5 cm length cuvette. Given the absorbance coefficient of trp is 6.4×10^3 $LMol^{-1}cm^{-1}$. What is the concentration of solution?

Solution:

As $\varepsilon = A / l\, c$

$l = 0.5$ cm

$A = 0.54$

$\varepsilon = 6.4 \times 10^3$ $LMol^{-1}cm^{-1}$

C=?

So $c = A/\varepsilon\, l$

$= 0.54 / 6.4 \times 10^3 \times 0.5$

Answer = 0.000168 M

2. A solution of thickness 2 cm transmits 40% incident light. Calculate the concentration of the solution, given that ε = 6000 dm3 /mol/cm.

Solution:

$A = 2 - \log 10\ \%T = 2 - \log 10\ 40 = 2 - 1.6020 = 0.398$

$A = \varepsilon\, l\, c$

$l = 2$cm

$\varepsilon = 6000$ dm3/mol/cm

$A = 0.398$

c=?

So $c = A/\varepsilon\, l = 0.398/ 6000 \times 2$

Answer = 3.316 X 10^{-5} mol / dm3

3. A solution shows a transmittance of 20%, when taken in a cell of 2.5 cm thickness. Calculate its concentration, if the molar absorption coefficient is 12000 dm3/mol/cm.

Solution:

$A = 2 - \log_{10} \%T = 2 - \log_{10} 20 = 2 - 1.301 = 0.698$

$A = \varepsilon l c$

$l = 2.5$ cm

$\varepsilon = 12000$ dm3/mol/cm

$A = 0.698$

$c = ?$

So $c = A / \varepsilon l$

$= 0.698 / 12000 \times 2.5$

Answer = 2.33×10^{-5} mol / dm3

4. Calculate the molar absorptivity of a 1×10^{-4} M solution, which has an absorbance of 0.20, when the path length is 2.5 cm.

Solution:

$A = \varepsilon l c$

$l = 2.5$ cm

$A = 0.20$

$C = 1 \times 10^{-4}$ M

$\varepsilon = ?$

So $\varepsilon = A / l c$

$= 0.20/ 2.5 \times 1 \times 10^{-4}$

Answer = 800 dm3/mol/cm.

5. The concentration of yeast t-RNA in an aqueous solution is 10 M. The absorbance is found to be 0.209 when this Solution is placed in a 1.00 cm cuvette and 258 nm radiations are passed through it.

a) **Calculate the specific absorptivity, including units, of yeast t-RNA.**
b) **What will be the absorbance if the solution is 5 M?**
c) **What will be the absorbance if the path length of the original solution is increased to 5.00 cm?**

Solution

5a

l = 1.00 cm

c = 10.00 M

A=0.209

So $\varepsilon = A / l\ c$

$= 0.209 / 1.00$ cm X 10 M

Answer = 0.0209 dm3/mol/cm.

5b

ε = 0.0209 dm3/mol/cm.

l = 1.00 cm

c = 5.00 M

A=?

So $A = \varepsilon\ l\ c$

A = 0.0209 dm3/mol/cm. X 1.00 cm X 5M

Answer = 0.1045

5c

ε = 0.0209 dm3/mol/cm.

l = 5.00 cm

c = 10.00 M

A=?

So A = ε l c

A = 0.0209 dm3/mol/cm X 5.00 cm X 10.00 M

Answer = 1.045

6. Calculate the molar absorptivity of a 0.5 x 10^{-3} M solution, which has an absorbance of 0.17, when the path length is 1.3 cm.

Solution:

A = ε l c

l= 1.3 cm

A= 0.17

C= 0.5 x 10^{-3} M

ε =?

So ε = A / l c

= 0.17/ 1.3 × 0.5 x 10^{-3}

Answer = 261.53 dm3/mol/cm.

7. A CaCO3 solution shows a transmittance of 90%, when taken in a cell of 1.9 cm thickness. Calculate its concentration, if the molar absorption coefficient is 9000 dm3/mol/cm.

Solution:

$A = 2 - \log_{10} \%T = 2 - \log_{10} 90 = 2 - 1.954 = 0.045$

$A = \varepsilon l c$

$l = 1.9$ cm

$\varepsilon = 9000$ dm3/mol/cm

$A = 0.045$

$c = ?$

So $c = A / \varepsilon l$

$= 0.045 / 9000 \times 1.9$

Answer = 2.631×10^{-6} mol / dm3

8. Extinction coefficient of NADH at 340 nm is 6440 L/mol/cm. whereas NAD does not absorb at 340nm. What absorbance will be observed when light at 340nm passes through a 1cm cuvette containing 10uM NADH and 10 uM NAD.

Solution:

$\varepsilon = 6440$ L/mol/cm.

$l = 1.00$ cm

$c = 10.0$ uM $= 10 \times 10^{-6}$ M

$A = ?$

So $A = \varepsilon l c$

A $= 6440$ L/mol/cm X 1.00 cm X 10 X 10^{-6} M

Answer = 0.0644

Note: this absorbance is only for NADH because NAD do not absorb at 340nm.

9. A 1.00×10^{-4} M solution of an analyte is placed in a sample cell with a path length of 1.00 cm. When measured at a wavelength of 350 nm, the solution's absorbance is 0.139. What is the analyte's molar absorptivity at this wavelength?

l = 1.00 cm

c = 1.00×10^{-4} M

A=0.139

ε =?

So ε = A / l c

= 0.139/ $1.0 \times 1.00 \times 10^{-4}$

Answer = 1390 $cm^{-1} M^{-1}$

10. The absorbance of a Cu sulphate solution containing 0.500 mg Cu/mL was reported as 0.3500 at 440 nm.

a) **Calculate the specific absorptivity, including units, of Cu sulphate on the assumption that a 1.00 cm cuvette was used.**
b) **What will be the absorbance if the solution is diluted to twice its original volume**

Solution

a) l = 1.00 cm

c = 0.500 mg/ml

A= 0.3500

ε =?

So $\varepsilon = A / l\ c$

$= 0.3500 / 1.0 \times 0.500$

Answer = 0.7 $cm^{-1}(mg/mL)^{-1}$

b) c= 0.250 mg/ml

$\varepsilon = 0.7\ cm^{-1}(mg/mL)^{-1}$

l = 1.00 cm

A=?

So $A = \varepsilon\ l\ c$

A = $0.7\ cm^{-1}(mg/mL)^{-1}$ X 1.00 cm X 0.250 mg/ml

Answer = 0.175