## *ORGANIC TUTORIAL-1*

*Dated 25/8/2014*

*Problems and Solutions*

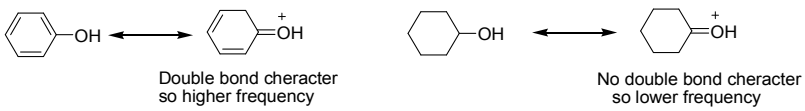
1. *Which is higher in energy per photon, electromagnetic radiation of with wave number 3000 $cm^{-1}$ or with wave length 2$\mu$m (Write the question in the board and allow the students to solve the problem first, leave the questions for some time for late comers)*

   *Answer: 1 $\mu m = 10^{-4}$ cm, so 2 $\mu m = 2 \times 10^{-4}$ =2/10000 cm = 1/5000cm = 5000 $cm^{-1}$ 5000 $cm^{-1}$ is higher in energy than 3000$cm^{-1}$*

2. *Light of what wavelength has a wave number200 $cm^{-1}$. (Write the question in the board and allow the students to solve the problem first)*
   *Answer: -$\tilde{u}$ (it should be written/read as nuebar)*
   *$\tilde{u}$ ($cm^{-1}$)=1 / $\lambda$(cm)*
   *or 200 ($cm^{-1}$) =$10^4$ / $\lambda(\mu m)$ because 1 $\mu m = 10^{-4}$ cm*
   *or $\lambda(\mu m) = 10^4/200 = 50\mu m$*

3. *Assuming the force constant are the same, which will occur at a higher frequency. (a)a C-O or a C-Cl stretch? (b)a C-O stretch or a C-C stretch?*
   *Students may be allowed to calculate using Hooks law $\tilde{u} = 1/2\pi c[f(m_1+m_2)/m_1m_2]^{1/2}$*
   *Alternatively answer can be arrived at directly*
   (a) *C-O because vibrations of lighter atoms occur at higher frequencies.*
   (b) *C-C, (same explanations as above)*

4. *Which will occur at a higher frequency?*
   (a) *The C-O stretch of phenol or C-O stretch of cyclohexanol?*




5. *Problems based on Beer-Lambert's law:*

   *(i) A solution of thickness 2 cm transmit 40% incident light. Calculate the concentration of the solution,*

   *given that $\varepsilon$ = 6000 $dm^3$/mol/cm.*

   *Answer : 3.316 x $10^{-5}$ mol/$dm^3$*

6. *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 $dm^3$/mol/cm.*

   *Answer : 2.33 x 10-5 mol/$dm^3$*

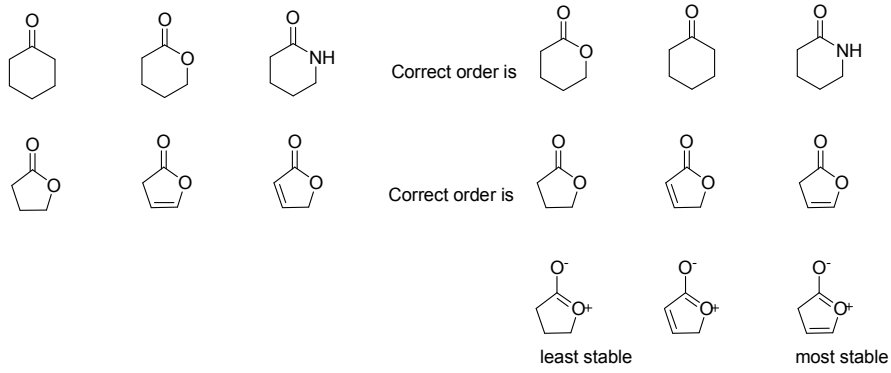
7. *Calculate the molar absorptivity of a 1 x$10^{-4}$M solution, which has an absorbance of 0.20, when the path length is 2.5 cm.*

   *Answer: 800 dm3/mol/cm*

**Problems based on Beer – Lambert's law:**

1. A solution of thickness 2 cm transmits 40% incident light. Calculate the concentration of the solution, given that ε = 6000 $dm^3$/mol/cm.
   **Answer:** 3.316 X $10^{-5}$ mol / $dm^3$.
2. Calculate the optical density, if 10% of incident light is transmitted.
   **Answer:** 1.0
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 $dm^3$/mol/cm.
   **Answer:** 2.33 X $10^{-5}$ mol / $dm^3$.
4. Calculate the molar absorptivity of a 1 x $10^{-4}$ M solution, which has an absorbance of 0.20, when the path length is 2.5 cm.
   **Answer:** 800 $dm^3$/mol/cm.
5. Calculate the absorbance of a solution when the transmittance is 33%.
   **Answer:** 0.4814

5. *List the following compounds in order of decreasing frequency of the C=O absorption band.*




*Explanation: The C=O absorption band of an esters occurs at the higher frequency because the ester has the most double bond character since the predominant effect of the ester oxygen atom is inductive electron withdrawal. The C=O absorption band of an amide occurs at the lowest frequency because an amide has the least double bond character since the predominant effect of an amidic nitrogen atom is electron donation by resonance.*

*For the part II, it can be explained by the relative stability of the resonance contributors.*