

TENTAMENEN VIBRATIONAL SPECTROSCOPY

Datum: Mon., 16 Jan. 2012
Tijd: 14.00-17.00 uur
Zaal: Havinga-Zaal
Docent: Dr Jörg Matysik

*Voorzie het 1e blad van naam, adres, jaar van aankomst en nummer collegekaart.
Schrijf op de andere losse bladen alleen de naam. Bij het tentamen is het gebruik van de syllabus toegestaan. Vragen 1 t/m 12. Waardering is aangegeven.*

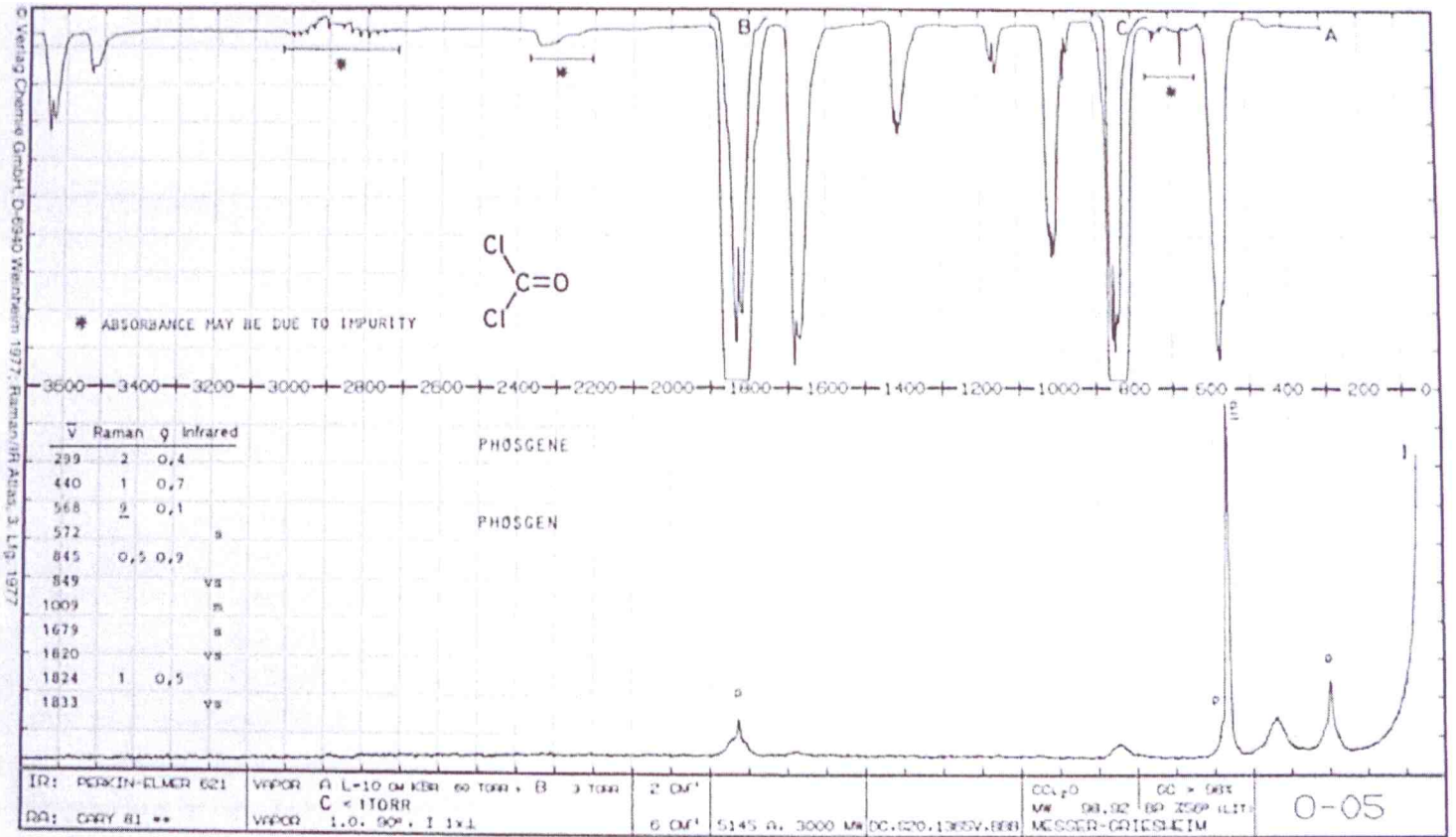
*On page 1, write your name, adress, year of enrolment and the number of the college card.
At the following pages not your name. It is allowed to use the syllabus during the examination. There are questions 1 to 12. The rating is given.*

PART I

1. What frequency (in Hz) has radiation of a wavelength of 30 μm ? What is the spectral region? [0.5 points]
2. Explain the meaning of the term 'slit function' for a monochromator? [0.5 points]
3. Under which conditions, vibrational signals may show a Gauss shape? [0.5 points]
4. What are the limits of the harmonic oscillator model? [0.5 points]
5. How many normal modes has a) a 5-atomic non-linear molecule, b) a 4-atomic linear molecule? [0.5 points]
6. What is the origin of the Christiansen effect? How the problem can be solved? [0.5 points]
7. How CARRS overcomes fluorescence? [1 point]
8. Compare the capacities of Raman and IR spectroscopies for the investigation of aqueous samples. [0.5 points]
9. What are the advantages of a FT-Raman system over a dispersive Raman spectrometer [0.5 points]

PART II

10. What is the symmetry group of a P_4O_6 -molecule (4 P-atoms at the corners of a tetrahedron, 6 O-atoms along the edges of the tetrahedron)? [0.5 points]



11. What is the symmetry group of a phosgene molecule/
 How many vibrations do you expect?
 How many stretching & deformation modes do you expect?
 Which modes are IR and Raman active?
 Which vibration of a phosgene molecule would you expect?
 Can you assign some signals in the spectrum? [2.5 points]

12. NO_2^+ is a linear molecule ($O=N=O$, $M_N = 14$ g/mol, $M_O = 16$ g/mol).
 What is the symmetry group?
 How many vibrations do you expect?
 How many stretching & deformation modes do you expect?
 Which modes are IR and Raman active?
 Which band shape would you expect for the signals of the molecule in the gas state?
 What force constants do you estimate for those vibrations?
 At which frequencies do you expect these stretching vibrations? [2.5 points]