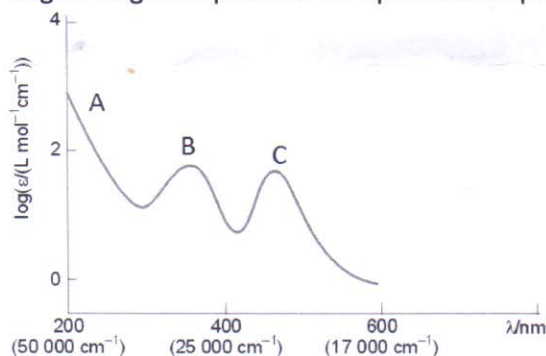


Exam 2016-2017 (ii)

This exam consists out of 4 problems and 2 pages. **Write your name and student number on every page containing answers.** It is not allowed to use your notes, books, mobile phone, etc. The use of a molecular model kit is allowed. Read the questions carefully before you answer them. Answer the question precisely and clearly indicate how you got to the answer. When a justification is asked, it counts as least as many points as the answer itself. The number of points (total = 90) is indicative and may be re-evaluated.

- 1) The typical yellow light that comes from a sodium lamp is due to emission of light from a 2P state to 2S state in sodium. In absence of a magnetic field two sharp peaks can be observed in the emission spectrum. Explain this. How many signals do you expect to find for this 2P to 2S emission of in case sodium is placed in a magnetic field. - 20 points
- 2) Consider an octahedral d^2 complex.
 - a. Give all term symbols belonging to octahedral d^2 complex and indicate which of these term(s) is/are the ground state. - 5 points
 - b. In the Figure below is given the absorption spectrum. Which three d-d transitions are most important to explain this spectrum? - 5 points
 - c. Assume that Δ (the energy difference between the t_{2g} and e_g orbitals) is relatively large. Assign the peaks in the spectrum. Explain your answer. - 10 points



- 3) Give the irreducible representations of the C-H stretching modes of the compounds below. Determine how the H atoms move during the C-H stretching modes. Give your answer in the form of normalized linear combinations. - 30 points
 - a. Methane (T_d)
 - b. Ethene (D_{2h})
 - c. 1,3,5-trichlorobenzene (D_{3h})
- 4) Give the irreducible representations belonging to the IR active bending modes of chloroform (CHCl_3 , C_{3v}). - 20 points