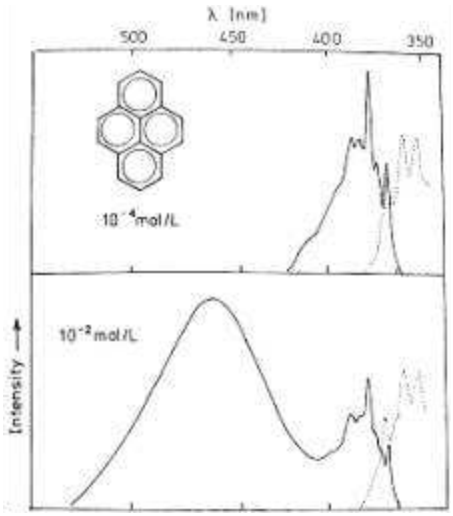
Molecular Photonics

Exercise **3**

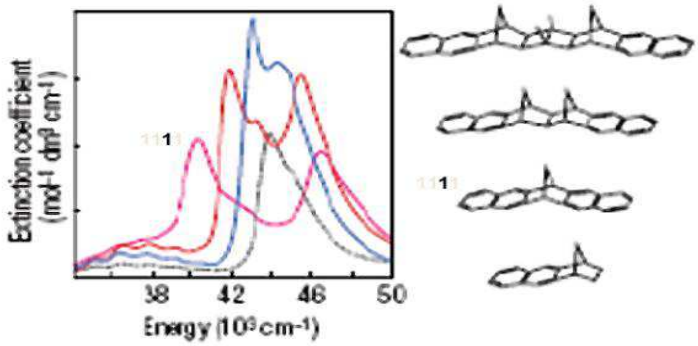
1. What is an excimer?
   a. Draw a MO scheme that represent excimer formation.
   b. Draw schematically the potential energy curves that represent excimer formation and the differences between monomer and excimer fluorescence. Explain the expected differences in the shape and wavelength.

2. In the two UV-vis/Fluorescnces spectra of pyrene below there are major differences.
   a. Suggest an explanation (notice the concentrations).
   b. What changes can one expect in the fluorescence spectra at higher concentrations? Suggest what will happen to the fluorescence spectrum of pyrene in crystal form.

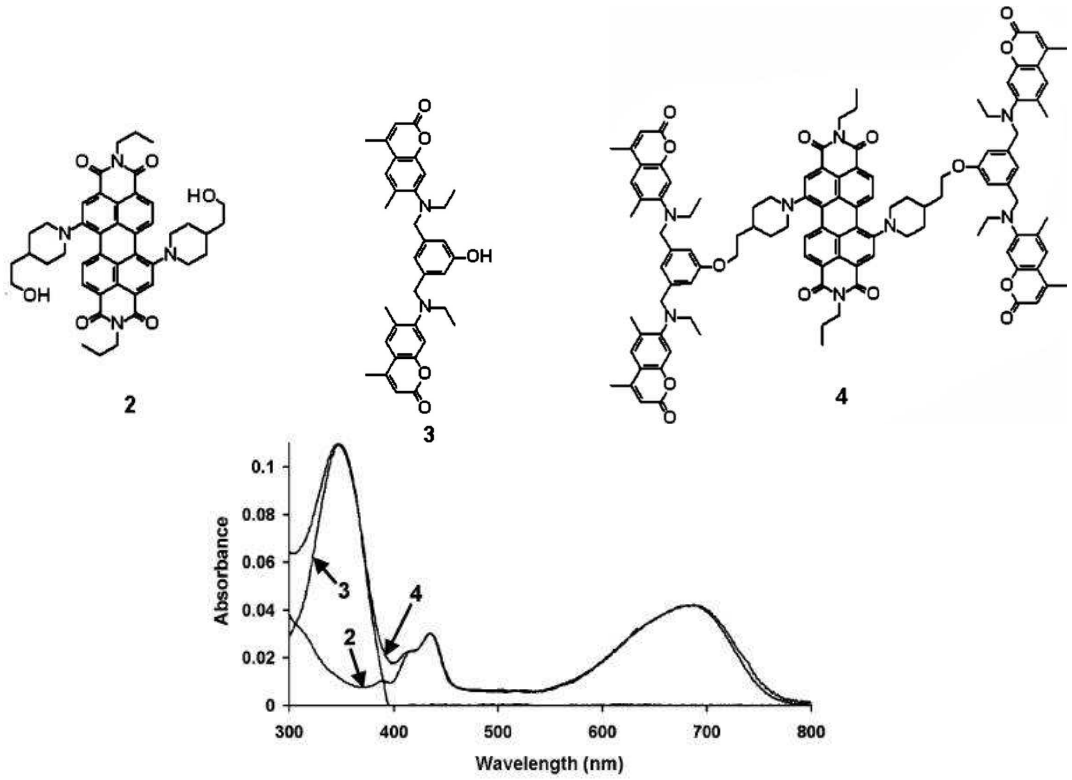


   c. Suggest one biochemical application for pyrene excimers.

3. Draw the four situations of exciton energy level splitting using Kasha's theory. (Kasha et al. *Pure Appl. Chem*. **1965**, *11*, 371-392.)
   a. Explain shortly the reason for the energy stabilization and allowedness of each level.
   b. Explain using the answer to question **3a** the spectrum below what can be said regarding the relative position in space of the naphthalenic moieties of dimer **1**. (monomer's trace is in black),



4. What are the three mechanisms for energy transfer between two molecules?
   a. Draw schemes and explain each mechanism.
   b. Which one is the most common?
   c. In what specific case the answer for question **4b** is not the dominating mechanism? Explain.
5. By what means one can detect energy transfer between molecules?
   a. Give an example for a system like this. Draw schematically the molecular system and the spectra of the different components.
6. Compound **2** is a perylene diimide derivative. Compound **3** is a coumarine derivative. Compound **4** is the combination of both. The figure below shows the UV-vis spectra of all the three compounds. The spectrum of **4** is the sum of the spectra of **2** and **3**. (Fréchet et al. *J. Am. Chem. Soc*. **2002**, *124*, 11848-11849)
   a. Describe shortly what will be observed in the emission spectra when compound **4** will be excited at 380 nm and 750 nm.



   b. Draw a schematic energy level diagram that describes the photophysical processes that occur in this system.
   c. What is the energy transfer efficiency that was found for the system by Fréchet and coworkers? What will happen to it if the distance between **2** and **3** will increase? Suggest a general way to check that. What dependency on the distance will be found?

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