

Coordination Chemistry and Reactivity of f Elements

TD3

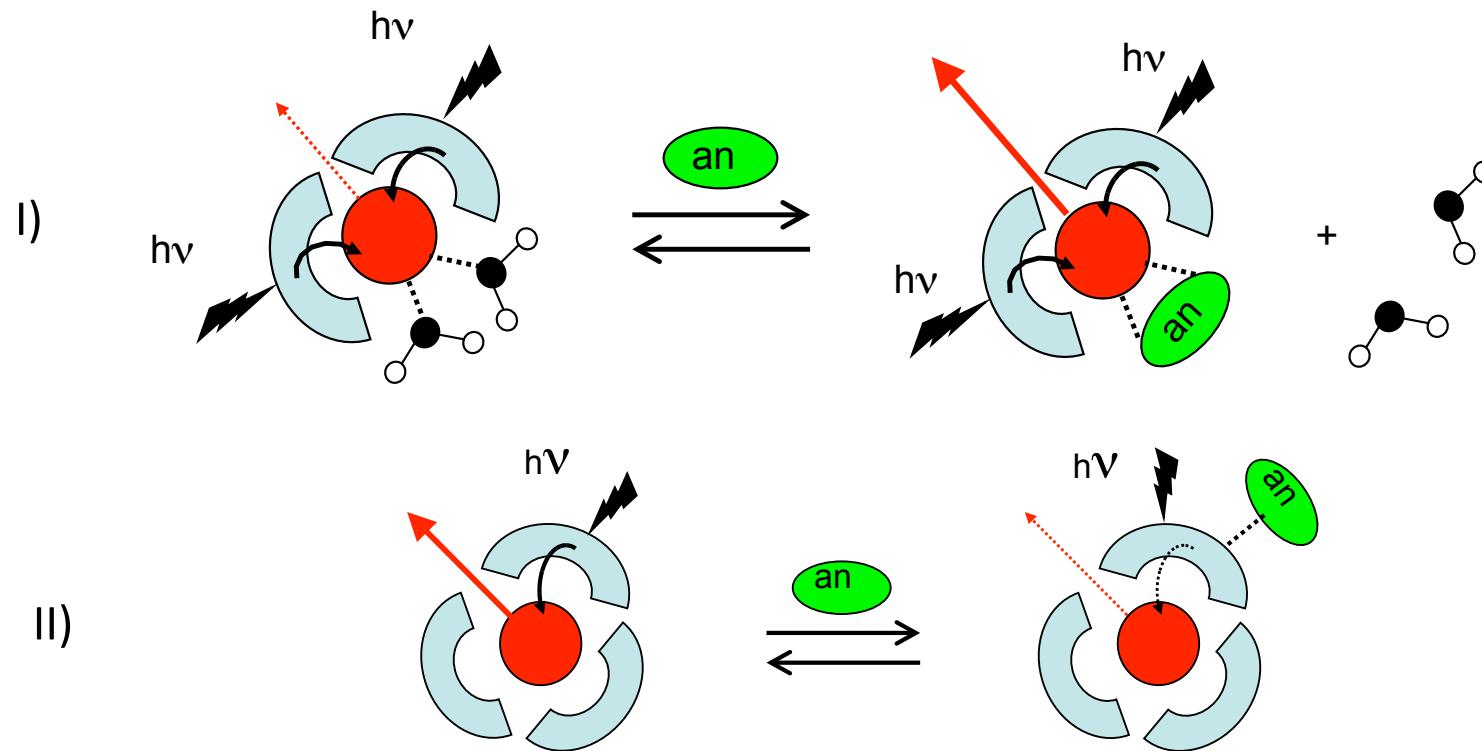
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Question 1

1) What properties of the Ln(III) render them attractive for application as luminescent chemical sensors?

2) Explain the two different modes of sensing shown below and give potential applications.

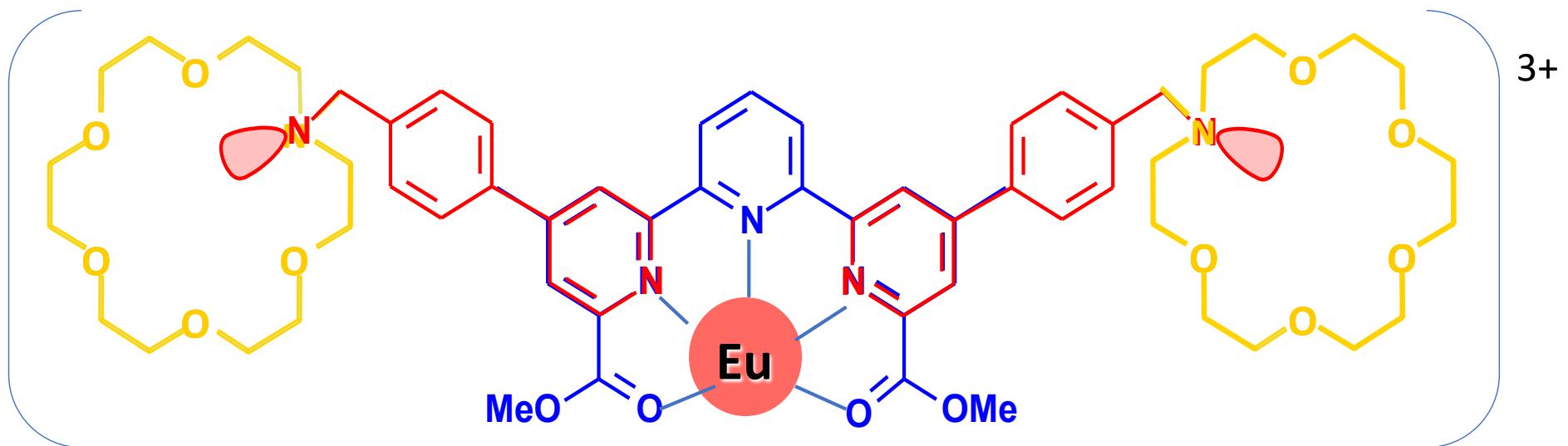


Question 2

1) Indicate the key design principles for the development of biological tags based on lanthanides.

Question 3

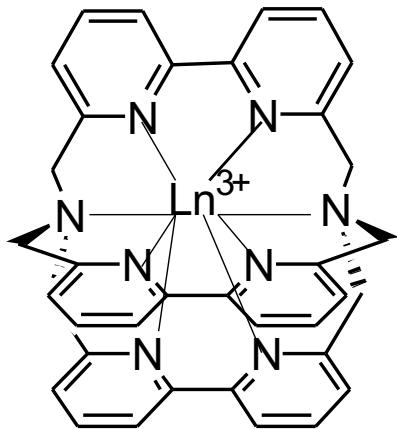
1) The europium complex below becomes luminescent in the presence of potassium. Explain the mode of action.



Question 4

A) Explain the concept of FRET (**Foster Resonance Energy Transfer**) also known sometimes in an abuse way as Fluorescence Resonance Energy Transfer

B) The bpy.bpy.bpy cryptate was originally used in the commercial DELFIA Kit. What are the disadvantages of this system and how could it be improved?



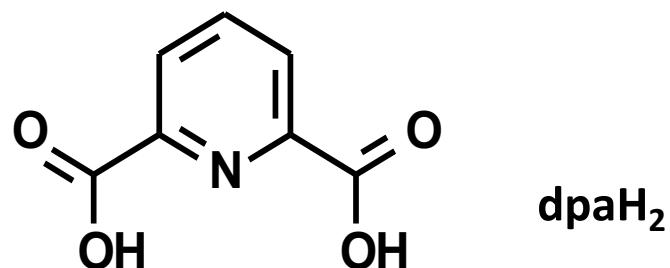
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Question 5

A) Draw the structure of the complex $[\text{Eu}(\text{dpa})_3]\text{K}_3$ and the scheme of formation of the complex from the ligand in water. In the solid state the luminescence lifetime of the complex is 1.67 ms

In the concentration range $1-1.7 \times 10^{-4}$ M, for the complex $[\text{Eu}(\text{dpa})_3]^{3-}$ a lifetime $\tau_{\text{obs}}(\text{H}_2\text{O}) = 1.56 \pm 0.02$ ms was measured in water and a lifetime of $\tau_{\text{obs}}(\text{D}_2\text{O}) = 3.0 \pm 0.1$ ms, was measured in D_2O . Explain why. Explain also why the value of lifetime is lower in water than in the solid state.

Calculate the value of the number of coordinated water molecules for the complex in water and indicate how the value can be explained.



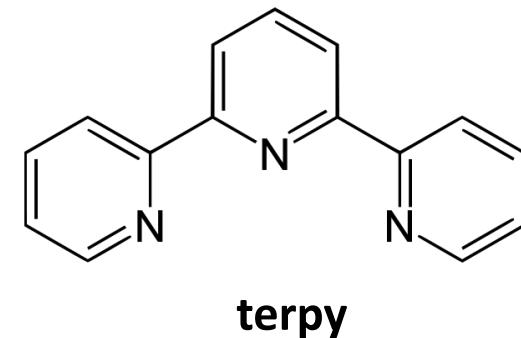
Question 6

A) Complete the following equations and indicate what is the geometry of the final complex.

B) Indicate which of the formed complexes is the most luminescent and why.



C) Indicate the colour of luminescence



Question 7

- A)** Give advantages and disadvantages of MRI an fluorescence imaging
- B)** Which Ln is the best for application of fluorescence imaging in vivo and why?
- C)** Indicate what kind of fluorophore are needed and give an example.
- D)** What are the different requirements for the application of lanthanide complexes for in vivo Imaging?

Question 8

Suggest a possible design for building an oxygen sensor indicating the element of design required . Indicate why such sensor is needed.

Question 9

- A)** What are « non classical » lanthanides(II)?
- B)** Indicate examples of ligands that have allowed the isolation complexes of these elements
- C)** Indicate how the complex is prepared and why and draw the structure $[\text{NdI}_2(\text{THF})_5]$