1. Fox and coworkers (Science 1990, 247, 1069-1071) reported the kinetics of electron transfer in a series of Ir dimers of the following type:

![Ir dimer structure](image)

Results from a study of the driving force dependence of the electron-transfer rates are given on the following page.

Semiclassical electron-transfer theory predicts that intramolecular rates can be described by the following equation:

$$k_{ET} = \frac{4\pi^3}{h^2\lambda RT} H_{AB}^2 \exp\left\{-\frac{(\Delta G^0 + \lambda)^2}{4\lambda RT}\right\}$$

On the basis of the electron transfer rate data, what is the value of $H_{AB}$ for this series of complexes? Predict the positions, extinction coefficients, and widths of the Ir–(R–py)$^+$ charge transfer absorption bands for the four Ir compounds used in this study.
3. The reaction between Ru(bpy)$_3^+$ and Ru(bpy)$_3^{3+}$ produces light with a spectrum that closely matches that of MLCT-excited Ru(bpy)$_3^{2+}$ (*Ru(bpy)$_3^{2+}$).

The relevant reduction potentials for Ru(bpy)$_3^{2+}$ are:

\[ E(Ru(bpy)_3^{3+}/Ru(bpy)_3^{2+}) = 1.25 \text{ V vs. NHE} \]

\[ E(Ru(bpy)_3^{2+}/Ru(bpy)_3^{+}) = -1.25 \text{ V vs. NHE} \]

The energy difference between the minimum of the ground-state potential energy surface and that of *Ru(bpy)$_3^{2+}$ is approximately 2.1 eV.

Explain why the Ru(bpy)$_3^+$ + Ru(bpy)$_3^{3+}$ reaction is chemiluminescent.