Problem 1: pH-dependence of enzyme activity

We consider an enzymatic reaction where the substrate can be in two protonation states

$$S^- + H^+ \leftrightharpoons HS$$

and the enzyme reacts only with the deprotonated form

$$S^- + E \leftrightharpoons ES^- \rightarrow E + P$$

Calculate the reaction rate as a function of the proton concentration c_{H+}

Problem 2: Transition from double helix to single strand

Consider the reaction scheme

$$2M \underset{k_{-1}}{\overset{k_1}{\leftrightharpoons}} D$$

where M denotes the single-stranded form and D the double helical form. Calculate the half period τ as a function of the total concentration $c_T = 2c_D + c_M$