1 Carbon monoxide poisoning

In carbon monoxide poisoning the CO replaces the O_2 adsorbed on hemoglobin (Hb) molecules in the blood. To show the effect, consider a model for which each adsorption site on a heme may be vacant or may be occupied either with energy ε_A by one molecule O_2 or with energy ε_B by one molecule CO. Let N fixed heme sites be in equilibrium with O_2 and CO in the gas phases at concentrations such that the activities are $\lambda(O_2) = 1 \times 10^{-5}$ and $\lambda(CO) = 1 \times 10^{-7}$, all at body temperature 37°C. Neglect any spin multiplicity factors.

(a) First consider the system in the absence of CO. Evaluate ε_A such that 90 percent of the Hb sites are occupied by O_2. Express the answer in eV per O_2.

(b) Now admit the CO under the specified conditions. Fine ε_B such that only 10% of the Hb sites are occupied by O_2.