

# 1 Carbon monoxide poisoning

In carbon monoxide poisoning the CO replaces the  $\text{O}_2$  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  $\varepsilon_A$  by one molecule  $\text{O}_2$  or with energy  $\varepsilon_B$  by one molecule CO. Let  $N$  fixed heme sites be in equilibrium with  $\text{O}_2$  and CO in the gas phases at concentrations such that the activities are  $\lambda(\text{O}_2) = 1 \times 10^{-5}$  and  $\lambda(\text{CO}) = 1 \times 10^{-7}$ , all at body temperature  $37^\circ\text{C}$ . Neglect any spin multiplicity factors.

- (a) First consider the system in the absence of CO. Evaluate  $\varepsilon_A$  such that 90 percent of the Hb sites are occupied by  $\text{O}_2$ . Express the answer in eV per  $\text{O}_2$ .
- (b) Now admit the CO under the specified conditions. Find  $\varepsilon_B$  such that only 10% of the Hb sites are occupied by  $\text{O}_2$ .