Consider an alpha particle trapped in a well $V_0 = 80$ MeV deep. The $\alpha$ energy is $E_\alpha = 60$ MeV. Let $\kappa a = 32.2$. Draw an energy diagram of the well and barrier, labeling the energies and barrier thickness. Find the alpha particle tunneling rate $R$ and mean lifetime $\tau$. Assume the alpha particle trial escape frequency is $f = 10^{21}$/s.

\[ T = \exp\{-2\kappa a\} = \exp\{-68.4\} = 2 \times 10^{-30} \]

\[ R = f T = 1 \times 10^{21} \times 2 \times 10^{-30} = 2 \times 10^{-9} \text{ s}^{-1} \]

\[ \tau = \frac{1}{R} = 5 \times 10^8 \text{ s} = 15.9 \text{ yrs} \]