Exercise (Coupling)
Write the Hamilton function for a midplane symmetric accelerator with tunes $\nu_x$ and $\nu_y$ that has the following perturbations from midplane symmetry. What resonances can occur? Which of these resonances can lead to very large oscillation amplitudes and therefore have to be avoided?
(a) Weak skew quadrupole perturbations with strength $k_{1s}(s) = \frac{q_p}{p} \partial_x B_x(s)$.
(b) Weak skew sextupoles perturbations with strength $k_{2s}(s) = \frac{q_p}{p^2} \partial_x^2 B_x(s)$.

Exercise (Amplitude dependent tune shift)
Write the Hamilton function for a midplane symmetric accelerator with tunes $\nu_x$ and $\nu_y$ that has small midplane symmetric oktopoles with strength $k_3$.
(a) Derive the horizontal and vertical amplitude dependent tune shifts as functions of $J_x$ and $J_y$.
(b) Show that $\partial J_x \nu_y = \partial J_y \nu_x$ for your result from (a).

Exercise (Review)
Go through the steps of finding the resonance frequencies of a rectangular pillbox cavity.