Problems A2-2: Static and Dynamic Imperfections

1) A linac that transports a beam with very small vertical and large horizontal emittance suffers from quadrupole vibrations. All quadrupoles have the same jitter amplitude. Unfortunately due to budget limitations only some quadrupoles can be stabilised. How should the quadrupoles be selected for stabilisation? You can assume thin quadrupoles.

2) A badly designed linac shows slow systematic drifts due to temperature changes after it has been switched on. After $100\ \mathrm{s}$ these drifts result in an emittance growth of $\Delta\epsilon_{100} = 100\ \mathrm{nm}$.
a) What is the expected average emittance growth after $\Delta\epsilon_{200}$ $200\ \mathrm{s}$?
b) What is the emittance growth if the beam orbit is measured every second and 10% of the value is corrected?

3) A transport line consists of a FODO lattice with quadrupole spacing L_0 and focal strength f_0. The line is rebuilt changing the quadrupole spacing to $L = 2L_0$ and the focal strength to $f = 2f_0$.
How does the quadrupole jitter tolerance σ_q change?