14.2)

from 6.5: $m = -\frac{IV}{gv}$

Static phase

$mg = I \pi r^2 \frac{\partial B_z}{\partial z}$

dynamic phase

$V = -\pi r^2 v \frac{\partial B_z}{\partial z}$

AC Josephson effect:

$V = n \frac{h}{2e} f$

where
n = some positive integer
h = plancks
f = frequency

Quantum Hall:

$R_H = \frac{h}{ie^2}$

using ohms we can swap

$m = -\frac{IV}{gv} \Rightarrow -\frac{V^2}{R} = mgv$

$\frac{n^2 h^{\not 2} f^2}{4\not e^2} \cdot \frac{i \not e^2}{\not h} = mgv \qquad \frac{n^2 h f^2 i}{4} = mgv$

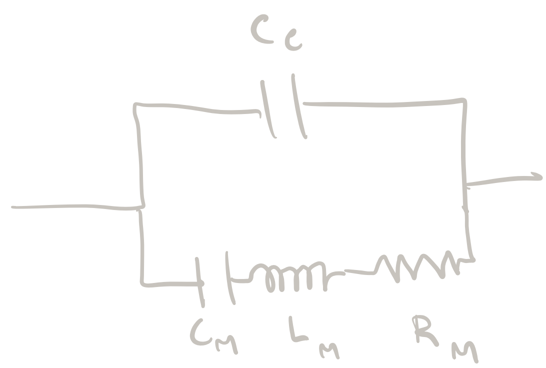
14.4) for a quartz resonator

$C_e = 5\ pF$

$C_M = 20\ fF$ mechanical capacitance

$L_M = 3\ mH$ mechanical inductance (from inertia of crystal mass)

$R_M = 6\ \Omega$




mechanical C + L are less likely to couple / drift thermally

impedances

$Z_C = \frac{1}{i\omega C}$ $Z_L = i\omega L$ $Z_R = R$

$$\frac{1}{Z} = \frac{1}{Z_{C_e}} + \frac{1}{Z_{C_M} + Z_{L_M} + Z_{R_M}}$$

$$\therefore\ Z = \left( i\omega C_e + \frac{1}{\frac{1}{i\omega C_M} + i\omega L_M + R_M} \right)^{-1}$$

See google colab for rest