

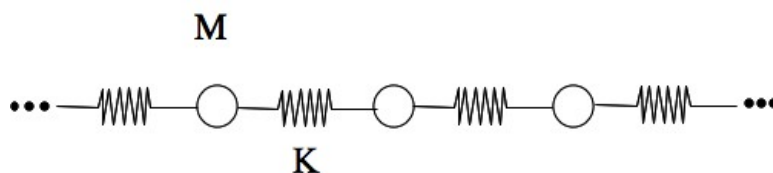
Acoustics Exercise 4. To be returned on Friday 17.4.2009

- (1) Calculate, for a spherical outwards propagating wave

$$p(r) = A \frac{\exp[i(kr - \omega t)]}{r}$$

its volume velocity, impedance $Z = p/v$, rms - intensity and rms-energy density.

- (2) Let a sphere, with radius a vibrate uniformly in perpendicular to its surface with velocity $v_r(t)$. What is the resulting sound field?
- (3) Let us consider an one-dimensional, infinite crystal $\{x_n\}$, in which atoms of mass M are attached consequently with spring constant K defined forces. At equilibrium, the atoms are a distance a apart.



Solve the resulting set of equations:

$$M \frac{d^2 x_n(t)}{dt^2} = K(x_{n+1} - x_n) - K(x_n - x_{n-1})$$

with a trial function

$$x_n(t) = A \exp[i(kan - \omega t)]$$

Derive the dispersion relation of the crystal

$$\omega^2 = \frac{4K \sin^2(ka/2)}{M}$$

- (4) In the previous problem, what is the maximum frequency of an harmonic solution? What is the propagation speed of a signal(sound)?