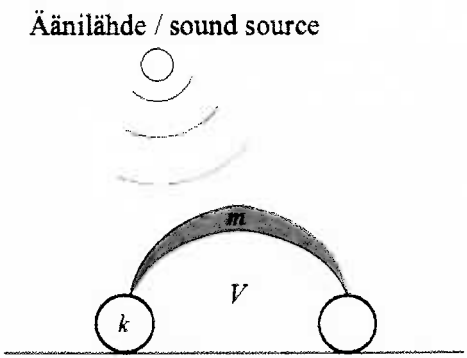
Problem 1:
Explain briefly (1-3 sentences), what the following concepts mean:
(a) eigenmode
(b) transmission loss
(c) local reaction
(d) critical angle
(e) relaxation time

Problem 2:
A hearing protector, as represented in the figure, with mass m and the padding spring constant k, has been seamed on a large stiff plate. The internal volume of the hearing protector is V. Draw up an approximate analogous electric circuit of the system, supposing that the motion occurs only in one dimension. Mark clearly the type of the electrical components and give their values using m, k, and v. What electrical value corresponds to the sound pressure inside the dome? Remember to include the sound source in your circuit.



Problem 3:
Show that those eigenmodes of a rectangular membrane for which m = n have eigenfrequencies which are integer multiples of the fundamental frequency. What are the constraints for membrane dimensions, if the eigenfrequency of some mode (m,n), where $m \neq n$, is to be an integer multiple of the fundamental? What should the dimensions of a rectangular membrane be, if the eigenfrequency of mode (3,1) is to be twice the fundamental?

Problem 4:
A cylindrical pipe with length $0.3m$ and cross-sectional radius of $0.02m$ is open at one end and closed at the other end. When excited (e.g. by slapping at the end), the pipe emits a nearly harmonic tone. Determine the pitch of this tone. What can you say about the spectrum of the tone? What is the impedance value inside the tube looking towards the open end at the frequency of the fourth partial?

Problem 5:
Ten identical equal-phase monopoles are located on a line so that the distance between adjacent monopoles is half of the wavelength. What is the angle of maximum sound radiation (measured from the line connecting the sources) and the width of the main lobe? *Hint: the width of the main lobe is the angle between the two closest zero-radiation directions around the direction of maximum radiation.*