Homework 1: Helmholtz resonator and system impedance

It is given a Helmholtz resonator.
The internal volume of the resonator consists in a parallelepipedon, with sizes 25 cm (H) 25 cm (W) 18 cm (L). The neck of the resonator is cylindrical, with length 6 cm, and radius 2.5 cm.

a) Derive the resonance frequency of the resonator neglecting the virtual elongation of the neck.
b) Derive the resonance frequency of the resonator including the virtual elongation of the neck.
c) Let us consider that there is also a resistance in the system. Find the resistance value for which the system is critically damped, considering that all the other quantities are kept fixed.
d) Let us now consider that the resistance is R = 5*10^(-4) kg/s. Derive the impedance of the system for the case when the virtual elongation is kept into account. Plot the impedance in Matlab.
e) Compute the Q factor and time decay factor for the above system.
f) Plot the Q factor and resonance frequency of the system as a function of the resistance R, for a range of R between 0 kg/s and 0.5 kg/s.

Please provide the report as a PDF file by Oct. 6, 2022 and upload it using the WeBeep platform in the “Assignment H1” delivery folder. One file for each student must be uploaded. If more than one student participated to the assignment, write on the cover page of the assignment the name, surname and ID of all the participating students.