

ELECTROACOUSTIC ANALOGIES – Exercises

Exercise 3

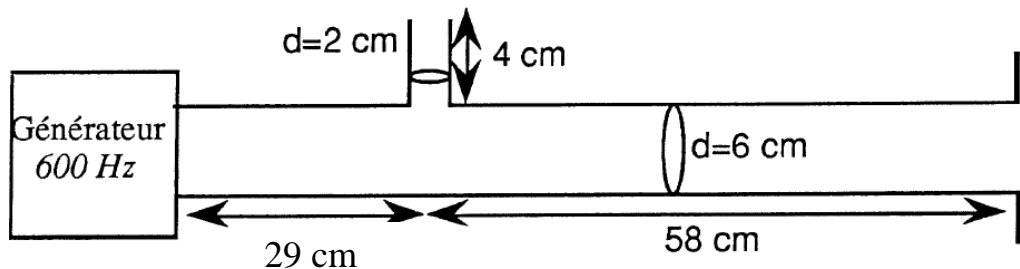
Two identical empty spheres are connected with a tube having a length “l” and a cross-section “S”.

The volume of both spheres is equal to the volume of the tube.

Give the analytical expression of the resonance frequencies.

Exercise 4

The following acoustic system is fed with the plane waves generated by a sound source at 600 Hz. The source is supposed to impose a pressure of 1 Pa at the entrance of the system.



Questions:

- a) Compute the input acoustic impedance as seen by the sound ‘generator’ at the entrance of the system.

The impedance of the air load at the output of each tube can be assimilated to the radiation impedance of infinite rigid baffles.

- b) What is the acoustic intensity at the input of the main tube (expressed in dB) ?

$$C = 344\text{ m/s and } \rho_0 = 1.18\text{ kg/m}^3$$

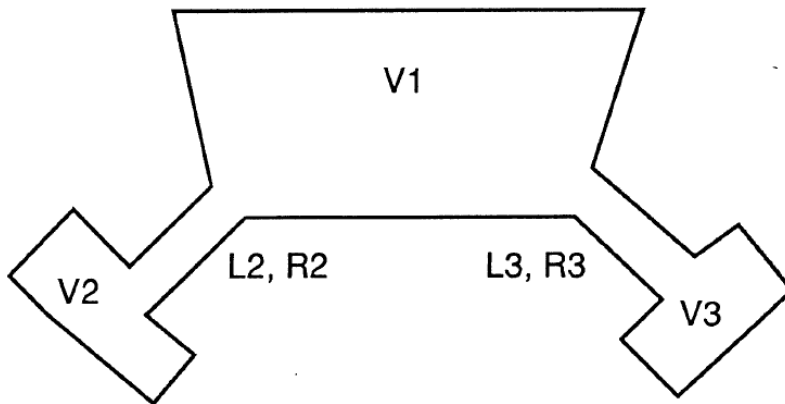
Solutions:

a) $Z_{in} = 7030 + j 37900\text{ (Pa} \cdot \text{s/m}^3\text{)}$

b) $I_{in} = 8.35 \cdot 10^{-4}\text{ W/m}^2\text{ (89.2 dB)}$

Exercise 5

Give the analog electrical circuit of the following acoustic system (the *artificial ear*):



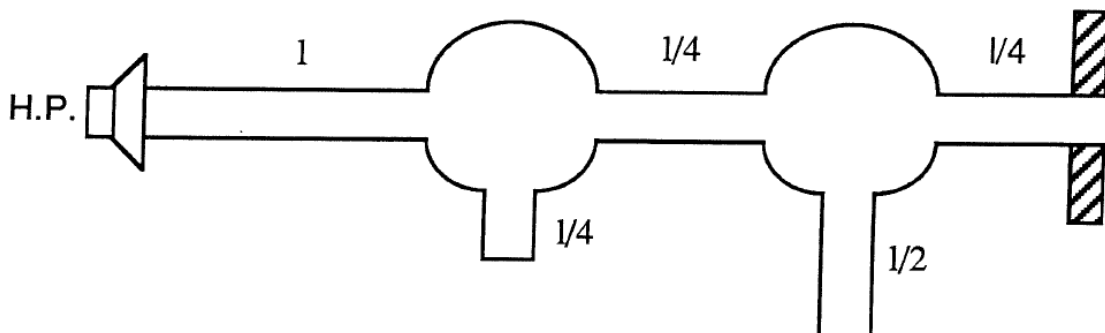
Exercise 6

The following acoustic system is composed of several tubes having the same diameter 5cm. Their length is a fraction of the same length “ $l = 2.15\text{m}$ ” ($1, 1/2$ or $1/4$). The two spheres are identical and have the same diameter of 10cm. The output of the system radiates in an infinite rigid baffle.

$C = 344 \text{ m/s}$.

Questions:

- Give the analog electrical circuit
- Compute the input acoustic impedance as seen by the loudspeaker (sound ‘generator’) at the entrance of the system. The emitted signal is a pure tone at 80 Hz.



Solution :

$$Z_{in} = -j 538000 \text{ (Pa} \cdot \text{s/m}^3\text{)} \quad \text{(capacitive)}$$