Design of a recorder flute

Goal
Design a recorder flute dimensioning the bore, the last two finger holes, the flue channel and the instrument mouth.

First component: resonator
The resonator is shaped as a cone whose conical semiangle is 0.75°. The instrument is aimed at being a treble recorder, with a length of 0.45m. For the sake of simplicity we consider that only two finger holes are present.

Question 1
Find the diameter of the cone at the resonator head and foot so that the note produced when all the finger holes are closed is F4 (349.23 Hz).

Question 2
Find the position of the last finger hole (i.e. the one closest to the resonator foot) in order to produce the note G4 (392 Hz) when it is open.

Question 3
Find the position of the second last finger hole in order to produce the note A4 (440 Hz) when the two finger holes are open.

Second component: flue channel and mouth
The instrument is aimed at producing a spectrum whose centroid is at 2.0 kHz when the pressure difference between the player mouth and the flue channel entrance is 62 Pa.

Question 4
Find the flue channel thickness that complies with the above specifications. For this pair of thickness and jet velocity, compute the Reynolds number Re and assess the jet regime that is undergoing at the flue channel exit and in the instrument mouth (laminar, turbulent, etc).

Question 5
Consider that the flue channel length is 20 mm. Find the thickness of the boundary layer at the flue channel exit for the specifications defined above (Question 4).

Question 6 (difficult question for extra points, and some degrees of freedom are purposely left to the student)
Dimension the instrument mouth length W so that the jet receptivity at the labium is able to produce a sound pressure level at the resonator foot is 90 dB.

Important information
Deadline: send the report by January 09, 2021.
Difficulty coefficient: 3.0 (question 1 to 5). Question 6 will add some extra points to the grade achievable with questions 1 to 5.