

ear canal

$$L = 1.80 - 2.60 \text{ cm}$$

What is the range of fundamental resonant frequencies?

For a temperature of  $T = 37.0^\circ\text{C}$ , ~~The velocity of the~~  
the velocity of the wave is

$$v = 331 \frac{\text{m}}{\text{s}} \sqrt{\frac{T_k}{273k}} = 331 \frac{\text{m}}{\text{s}} \sqrt{\frac{273+37}{273}} = 353 \frac{\text{m}}{\text{s}}$$

ear canal is an open-closed pipe

for the fundamental resonance

$$\lambda = \frac{4L}{n} = 4L$$



$$\lambda_1 = 4(1.80 \times 10^{-2} \text{ m}) = 7.2 \times 10^{-2} \text{ m}$$

$$\lambda_2 = 4(2.60 \times 10^{-2} \text{ m}) = 1.04 \times 10^{-1} \text{ m}$$

frequency is then from  $v = \lambda \cdot f$ 

$$f = \frac{v}{\lambda}$$

$$\text{so } f_1 = \frac{v}{\lambda_1} = \frac{353 \text{ m/s}}{7.2 \times 10^{-2} \text{ m}} = 4903 \text{ Hz} = \underline{\underline{4900 \text{ Hz}}}$$

$$f_2 = \frac{v}{\lambda_2} = \frac{353 \text{ m/s}}{1.04 \times 10^{-1} \text{ m}} = 3394 \text{ Hz} = \underline{\underline{3390 \text{ Hz}}}$$

The frequency range is then

$$\boxed{3390 - 4900 \text{ Hz}}$$