PROBLEM 34: ORGANIZE AND PLAN

We are given frequency and the speed of waves in the two mediums. We use the fundamental relationship to derive the wavelength as follows $\lambda = v/f$.

SOLVE Plugging in values:
Part (a): Wavelength in air is $\lambda = \frac{343 \text{ m/s}}{4.8 \times 10^6 \text{ Hz}} = 71 \ \mu\text{m}.$

Part (b): Wavelength in muscle is $\lambda = \frac{1580 \text{ m/s}}{4.8 \times 10^6 \text{ Hz}} = 330 \ \mu\text{m}.$

Part (c): The resolution is approximately $330 \ \mu\text{m} = 0.33 \text{ mm}.$ The dimensions of typical muscle cells are approximately $3 \ \mu\text{m}.$ Therefore the image will resolve details of hundreds cells but no better.

REFLECT Wave phenomena are widespread in many technologies. Ultrasound itself has saved countless lives !