# Physics 101: The Science of Sound
# MiniTest 4a, 12/1/06

Name _____

For questions with numerical answers, draw a box around your final answer.

Except as noted, correct answers get full credit. Incorrect answers get partial credit based on the work shown.

If any problem relies on a previous answer, scoring on that problem will be based on YOUR previous answer, whether or not it is correct.

Scoring:

Raw Total: _____/100 pts

Adjusted Score: _____%

# Potentially useful equations

$g = 9.81\ \text{m/s}^2$

$\pi = 3.1415$

$\Delta x = A\cos(\phi)$

$\Delta x = A\cos\left(\frac{360^\circ}{T}t + \phi_0\right)$

$v_{\text{avg,pp}} = 4\frac{A}{T}$

$v_{\max} = \frac{\pi}{2}v_{\text{avg,pp}}$

$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

$PE = \frac{1}{2}k(\Delta x)^2$

$KE = \frac{1}{2}mv^2$

$E = \frac{1}{2}kA^2$

whole tone ratio = 1.12246

semitone ratio = 1.05946

$L_I = (10\ \text{dB})\log\left(\frac{I}{I_0}\right)$

$I = I_0\,10^{(L_I/10\ \text{dB})}$

$\Delta L_I = L_{I1} - L_{I2} = (10\ \text{dB})\log\left(\frac{I_1}{I_2}\right)$

$\frac{I_1}{I_2} = 10^{(\Delta L_I/10\ \text{dB})}$

$A = \pi r^2$

$A = 4\pi r^2$

$g[\text{dB}] = (10\ \text{dB})\log\left(\frac{W_{\text{out}}}{W_{\text{in}}}\right) = (10\ \text{dB})\log(g)$

$v = \sqrt{\frac{F_T}{\mu}}$

$I = \frac{\Delta p^2}{400\ \text{kg/m}^2\text{s}}$

1) [15 pts] When a certain microphone collects $3.0\times10^{-7}$W of sound power, the microphone sends a $8.00\times10^{-9}$W electrical signal to a recording device. Which of the following would be an accurate description of the microphone's gain? (Circle one)

(A) $-2.92\times10^{-7}$W (B) 37.5 (C) -15.7dB (D) 0.0267dB (E) 15.7dB (F) 54.7dB

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2a) [10 pts] To the right are elements of someone speaking the vowel sound "ah." Specifically, there's a spectrum of the sound at the beginning of the vocal tract, and the response curve of the vocal tract. In the output spectrum, give the SIL for the following partials:

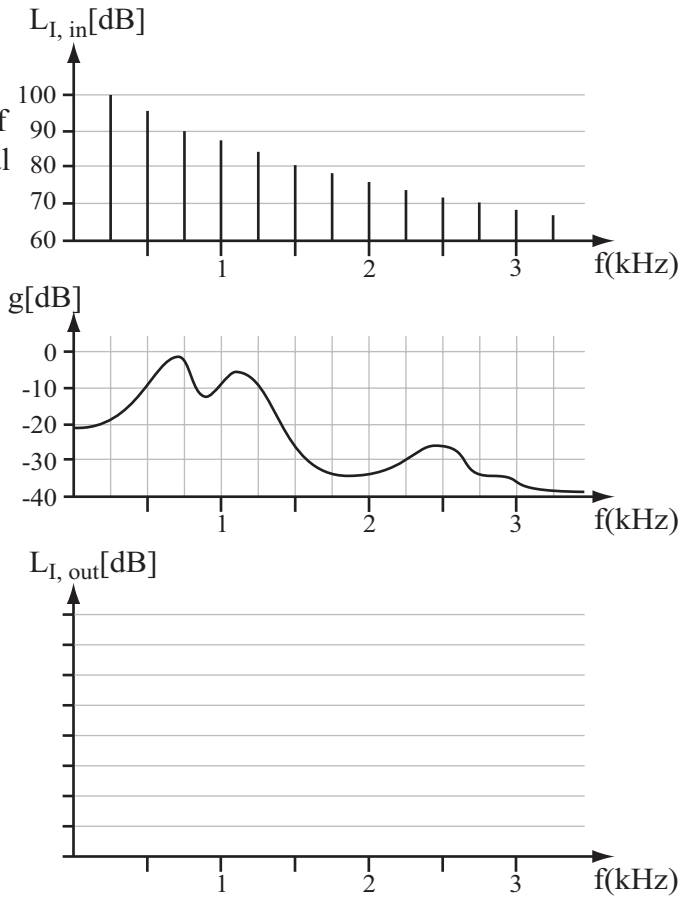
3rd partial : _____

10th partial : _____

2b) [5 pts] Sketch the complete output spectrum. Neatness counts. Suggestion: Do the rest of the MiniTest first.

2c) [5 pts] What is the pitch or frequency of this sound?

2d) [5 pts] At what frequency is the first formant placed?

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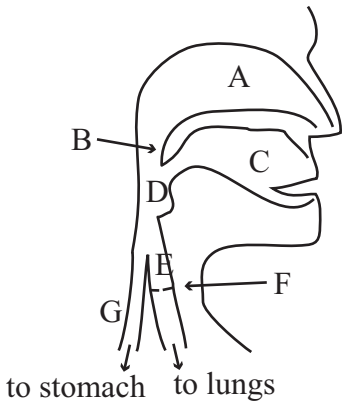
3) [10 pts] For each of the following parts of the vocal tract, give the letter which labels it on the schematic to the right.

larynx _____ nasal cavity _____

oral cavity _____ pharynx _____

vocal folds _____

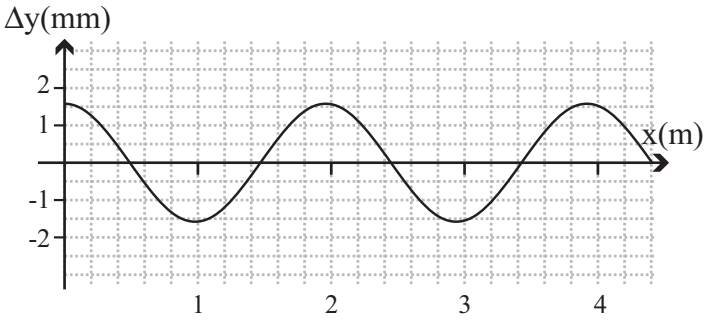


4) [15 pts] Give the following parameters of the wave graphed to the right, which is traveling down a rope at 26m/s.

Amplitude =

Wavelength =

Period =

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5) [20 pts] A rope hangs off your balcony with a bucket (weight 9N) tied to the lower end. You would like to vibrate the top with a frequency of 22Hz and create a traveling wave with a wavelength of 1.3m. What linear mass density of rope is required to achieve that?

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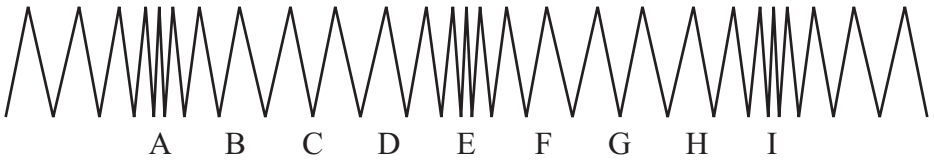


6) [15 pts] The picture shows a snapshot of a compression wave which is traveling along a slinky to the right. Circle True or False for the following statements.

True False E is at a maximum rarefaction

True False Near G the displacement is zero

True False The coil near D has been displaced to the right (relative to equilibrium)

True False A is at a maximum compression

True False Near B the displacement is zero

True False This could also be called a longitudinal wave