

# Physics 101: The Science of Sound

## Quiz 5a, 11/16/05

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

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

$$\text{acceleration due to gravity} = 9.81 \text{ m/s}^2$$

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

$$\text{semitone ratio} = 1.05946$$

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

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

$$\text{KE} = \frac{1}{2} m v^2$$

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

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

$$L_W = (10 \text{ dB}) \log\left(\frac{W}{W_0}\right)$$

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

$$L_{W,\text{out}} = L_{W,\text{in}} + g[\text{dB}]$$

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

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

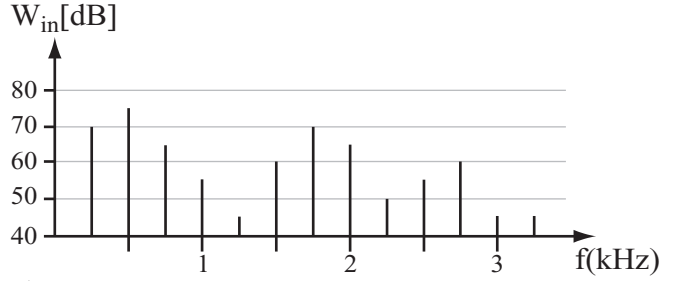
$$\frac{I_1}{I_2} = 10^{(\Delta L_I/10 \text{ dB})}$$

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

$$A = \pi r^2$$

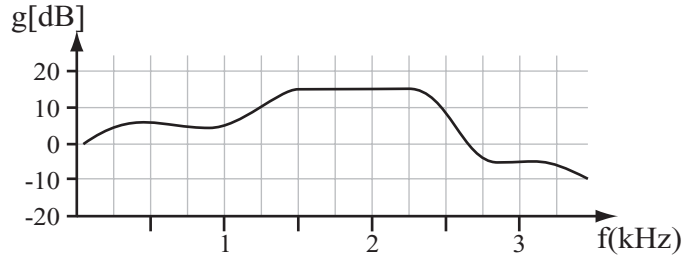
$$A = 4\pi r^2$$

1) [9 pts] To the right is shown a sound power level spectrum for an electrical signal entering an equalizer. Below that is the equalizer's response curve. In the output spectrum of the equalizer, the power level at 1kHz is...



- (A) 11 dB      (B) 60 dB      (C) 275 dB
- (D)  $1.0 \times 10^{-6} \text{W}$    (E) 50 dB      (F)  $3.16 \times 10^{-7} \text{W}$

2) [8 pts] Around 2 kHz, the gain could be expressed as roughly...



- (A) 32            (B) 0.176      (C) 1.176
- (E) 15            (F) 0.031      (G) 2000

3) [12 pts; 2 pts each] Check of the appropriate attributes of the following waves. Check ALL that apply (may be more than one).

	<i>transverse</i>	<i>longitudinal</i>	<i>compression</i>	<i>pulse</i>	<i>continuous</i>	<i>1 dimensional</i>	<i>2 dimensional</i>	<i>3 dimensional</i>
a) wave made on a horizontal rope by shaking the end up and down for a long time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) wave made in a vertical slinky by rapidly moving the end up and down only once	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) waves on a pond from dropping in a stone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) sound heard from the hum of an electric motor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) waves at an ocean beach	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) a very rapid "pop" sound made by bats for echo-location	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

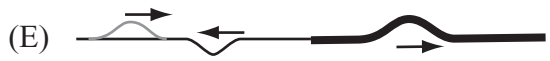
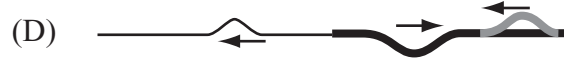
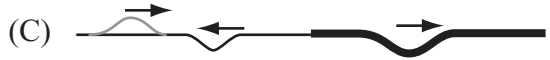
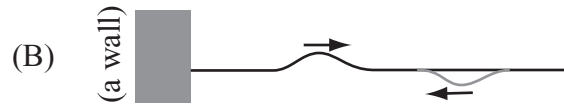
4) [9 pts] If a recording device has harmonic distortion, with a pure tone input at 360Hz, which frequencies might be present in the output spectrum (circle all that apply)?

- (A) 120Hz      (B) 180Hz      (C) 240Hz      (D) 300Hz
- (E) 360Hz      (F) 540Hz      (G) 720Hz      (H) 1080Hz

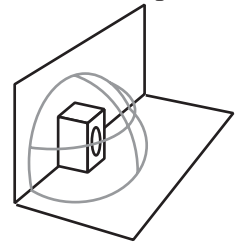
5) [9 pts] A tuning fork creates a sound with a frequency of 440Hz. What is the wavelength of that sound as it travels through the air?

- (A) 1.29mm      (B) 1.29m      (C) 773 $\mu\text{m}$       (D) 773mm      (E) 149.6m      (F) 149.6km

6) [9 pts] In the following pictures of ropes, incident (in gray), reflected, and transmitted pulses are all shown at once. Circle the letters of all the cases that could actually occur (may be more than one).



7) [22 pts] A speaker is rated to have an efficiency of 3.5%, and to produce a maximum SIL of 100dB (at a distance of 1.5m from the speaker). In order to make that maximum SIL, how much electrical power will your amplifier need to supply to the speaker? Assume that the specifications are for the speaker sitting on the floor next to a wall, so that the sound spreads equally over a shape that is 1/4 of a sphere.



8) [22 pts] You buy a package of clothesline rope that contains a 100m length and which weighs 1.25kg. The rope is stretched between a house and garage which are 14m apart. If you wiggle one end of this rope back and forth at a rate of 3 cycles each second, you can make a traveling wave, and you notice that 2 wavelengths of this wave fit between the house and garage. What is the tension in the rope?