PHYS/MUS 204, Sp 08 Prelim 2 Name: _____

The exam is 45 minutes long.

Write your name on ALL the pages.

Answer all of the questions.

Don't spend too long on any one question – if you get stuck, try another one.

There is a formula sheet on the last page of the exam.

A question marked * requires a verbal answer.

You will need to write anywhere from a couple of sentences to a whole paragraph. Remember that the style of your writing is important, as well as the content.

Instructions for calculational problems -

You may use only a non-graphing calculator.

Do all your work on these pages. Show all your work, so that we can give partial credit where appropriate. No credit will be given for just writing down the answer.

Put your final answers in the boxes provided.

Give all your answers to three significant figures. (Examples: 2.14, 0.145, 5400)
Always include units.

PLEASE DON'T WRITE BELOW THIS LINE

1.	/15 pts
2.	/15
3.	/15
4.	/15
5.	/20
6.	/20
TOTAL	/100 pts

1. (15 points) You play a note on your instrument, then you play second note which is a major third higher, and then you play a third note which is a minor third higher again.

What is the musical interval between the first and third notes you played?

NOTE: Even if you remember the answer, show how to calculate it!

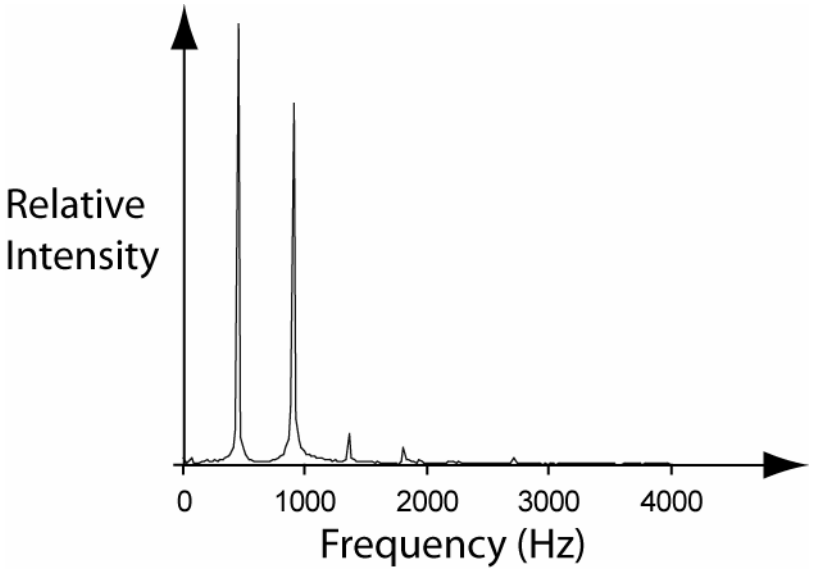
***2. (15 points)** A violin is much smaller than a guitar, yet it is much louder (if you compare each instrument playing on one string only).

Explain why this is so.

3. (15 pts) A cellist is playing with a total power of 7×10^{-6} Watts.

(a) What is the sound intensity level at a distance of 5 meters from the cello?

4. (15 pts) The spectrum shown below shows a note played on a certain wind instrument.



(a) Write down the name of an instrument for which this would be a typical spectrum.

_____

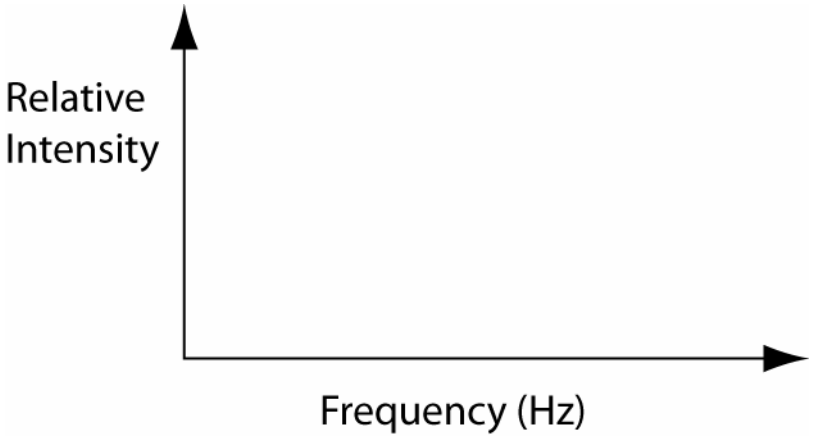
*(b) Explain why you chose the instrument you did.

Write about three sentences.

5. (20 points)

(a) Draw a spectrum for a singer singing a vowel sound at a steady low pitch. Use the axes below.

NOTE: you are not required to reproduce the exact features of a particular vowel sound, just make sure your spectrum indicates the general ideas you learned in lecture.



*(b) Explain how a listener can tell which vowel sound this is.

NOTE: (b), (c) and (d) require verbal answers. One sentence will be enough for each answer.

*(c) Which structures in the throat and/or vocal tract control the pitch of the note?

*(d) How does the singer control which vowel sound is being sung?

6. (20 points) A pianist and a violinist are playing together. The piano is tuned in equal temperament. This violinist is very stubborn and insists on playing in Just intonation. They both play their note A_4 at 440 Hz.

NOTE: A_4 to $C_5^{\#}$ is a major third, or four half-steps.

(a) At what frequency does the piano player play $C_5^{\#}$?

(b) At what frequency does the violinist play $C_5^{\#}$?

(c) What is the lowest beat frequency heard when they play $C_5^{\#}$ together?

P204 S04 Prelim 2 Name: _____

Temperature

Room temperature 20 °C

Human body temperature 37 °C

$T_{KELVIN} = T_{CENTIGRADE} + 273$ K

Speed of sound

$v = f \lambda$

Speed of sound in air = 344 m/s
at room temperature

$v = 20.1 \sqrt{T_{KELVIN}}$

$v = \sqrt{\frac{T}{\mu}}$ where T is tension

Standing waves

$f_n = \frac{nv}{2L}$ $n = 1, 2, 3, \ldots$

$f_n = \frac{nv}{4L}$ $n = 1, 3, 5, \ldots$

Logarithms

if $\log x = y$, then $x = 10^y$

$\log 2 = 0.3$

$\log 10 = 1$

$\log mx = \log x + \log m$

$\log x^n = n \log x$

Pitch

One octave = 1200 cents

$I = \left(\frac{1200}{\log 2}\right) \log \left(\frac{f_2}{f_1}\right)$

$\frac{f_2}{f_1} = 2^{I/1200}$

Tempered half step = 100 cents

or $\frac{f_2}{f_1} = 2^{1/12} = 1.059$

Standard pitch $A_4 = 440$ Hz

Sound Intensity

Sound intensity level $L_I = 10 \log \left(\frac{I}{I_0}\right)$,

where $I_0 = 10^{-12}$ W/m^2

$I = \frac{W}{4\pi r^2}$

$I = \frac{p^2}{400}$

$L_I = 20 \log \left(\frac{p}{p_0}\right)$, where $p_0 = 2 \times 10^{-5}$ Pa

$I_{tot} = I_1 + I_2 + I_3 + \ldots$

Strings, air cavity

String $f_n = \frac{nv}{2L}$ *where* $v = \sqrt{\frac{T}{\mu}}$

Helmholtz $f = \left(\frac{v}{2\pi}\right) \sqrt{\frac{a}{V l}}$

Intervals

Octave	12 half-steps
Perfect fifth	7 half-steps
Perfect fourth	5 half-steps
Major third	4 half-steps
Minor third	3 half-steps

"Just" Intervals

Octave	2
Perfect fifth	3/2
Perfect fourth	4/3
Major third	5/4
Minor third	6/5