1B SUM20 QUIZ 2

Full Name (Printed) _____

Full Name (Signature) _____

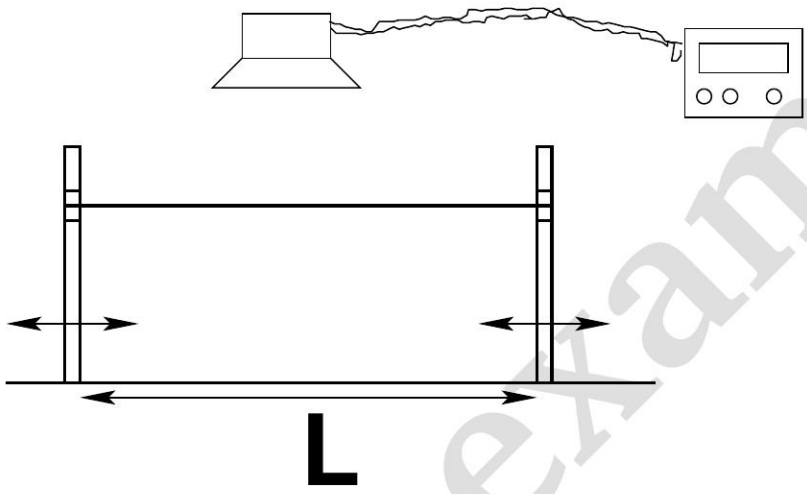
Student ID Number _____

- The exam is open-book and open notes. You will probably do better to limit yourself to a single page of notes you prepared well in advance.
- **All work must be your own.** You are not allowed to collaborate with anyone else, you are not allowed to discuss the exam with anyone until all the exams have been submitted (after the close of the submissions window for the exam).
- You have **30 minutes** to complete the exam and sufficient time to scan the exam and upload it to GradeScope. The exam *must* be uploaded to GradeScope within the time alloted (that is, by 12:30 pm PDT). We will only except submissions through GradeScope and will not accept any exam submitted after the submission window closes (CAE students must contact Corbin for instructions).
- **Given the limits of GradeScope, you must fit your work for each part into the space provided.** You may work on scratch paper, but you will not be able to upload the work you do on scratch paper, so it is essential that you copy your complete solution onto the exam form for final submission. We can only consider the work you submit on your exam form.
- **For full credit the grader must be able to follow your solution from first principles to your final answer.** ***There is a valid penalty for confusing the grader.***
- It is **YOUR** responsibility to make sure the exam is scanned correctly and uploaded before the end of the submission window. The graders may refuse to grade pages that are significantly blurred, solutions to problems that are not written in the correct place, pages submitted in landscape mode and/or work that is otherwise illegible - if any of this occurs, you may not receive *any* credit for the affected parts.
- Focus on the concepts involved in the problem, the tools to be used, and the set-up. If you get these right, all that's left is algebra.
- **Have Fun!**

The following must be signed before you submit your exam:

By my signature below, I hereby certify that all of the work on this exam was my own, that I did not collaborate with anyone else, nor did I discuss the exam with anyone while I was taking it.

Signature _____



Quiz 2) A very simple stringed instrument may be constructed from an elastic band strung between movable posts. For our purposes, let's say the band has a mass m, natural (ie, unstretched) length L_0 and an effective Hooke's Law constant k.

- 2a) (10 points) Suppose the posts are separated by a distance L (where $L > L_0$). Find the frequency emitted by the elastic band if it oscillates in its fundamental mode. Make a quick, qualitative plot of the fundamental frequency vs. L to make sure your answer trends correctly.

$F = -kx$

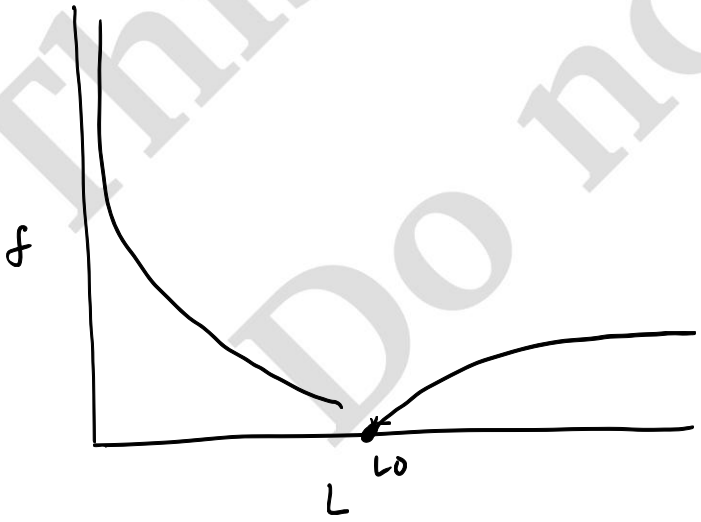
F = tension of the string

$(L - L_0)$ = amount stretched

$(-k)(L-L_0) = T_{string}$

$v_{string} = \sqrt{\frac{T}{m/L}}$ $\quad \mu = m/L_0$

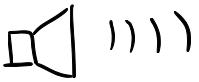
$f = \frac{1}{2L}\sqrt{\frac{T}{\mu}}$



$$\boxed{f = \frac{1}{2L}\sqrt{\frac{|(-k)(L-L_0)|}{m/L_0}}}$$

if $L = L_0$ there will be no tension in the string thus the velocity of sound through string will be 0. as

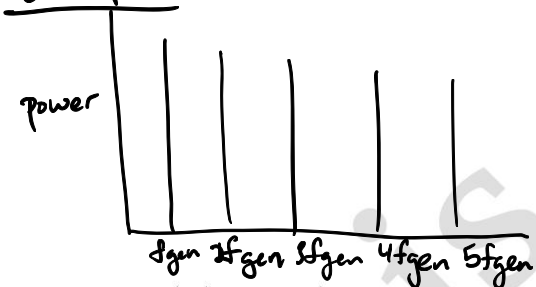
- 2b) (5 points) A speaker is placed nearby. It is driven by a signal generator that is set to a frequency f_{gen}. The speaker is not exactly top-of-the-line so there is some distortion of the sinusoidal signal from the generator. If we decompose the sound emitted by the speaker, what frequencies will be present? Explain.



f_{gen}

different harmonics of the speaker will be present. The harmonics will have the frequency $n \cdot f_{gen}$. If it is a crappy speaker, all harmonics might have high power level, distorting the sin signal.

example.



- 2c) (10 points) With the speaker and signal generator operating as described above, for what values of pole-separation (L) will the string exhibit large-amplitude vibrations?

$$f_{string} = \frac{1}{2L}\sqrt{\frac{(-k)(L-L_0)}{\mu}} \quad \text{where } \mu = m/L_0$$

f_{gen}

will have large amplitude due to superposition

$f_{beat} = |f_{string} - f_{gen}|$ to maximize f_{beat}

Set $f_{string} = 0$ while f_{gen} is similar to f_{string}. If f_{gen} is not close to 0, just minimize f_{string}.

$$0 = \frac{1}{2L}\sqrt{\frac{(-k)(L-L_0)}{\mu}}$$

$$\boxed{L = L_0}$$