Worksheet 28 **beats** **Name**

Relevant textbook sections covered: 21.8 (also includes parts from chap 21.3 and 20.7)

1. A piano tuner strikes his tuning fork (f = 523.3 Hz) and strikes a C-note (2^{nd} harmonic) at the same time. The two have nearly the same frequency and he hears 3.0 beats per second. As he tightens the piano string, the beat frequency decreases to 2.0 beats per second. The length of the piano string is 1.8 m and a linear mass density (μ) of 8.3×10^{-4} kg/m.

(a) What are the TWO OPTIONS for the frequency of the piano string *before* tightening?

(b) What is the frequency of the piano string *before and after* tightening?
Hint: Use the information about the change in tension and the change in beat frequency.

(c) What is the tension in the string *before* tightening?

(e) What is the percentage change in the tension (after tightening)?

2. A street-performing violinist is tuning the A-string (440 Hz - fundamental) on their violin on Granville St. They listen for beats with a tuning fork played simultaneously with a frequency 440 Hz. They hear 4 beats per second. When slightly increasing the tension in the A-string, the beat frequency increases to 5 beats per second.

(a) What is the frequency of the string *after* tightening?

(b) What is the average frequency heard *after* tightening?

CHALLENGE: The half-marathon passes by Granville St. The winner in 2011 averaged a speed of 20km/hr.

(c) What frequency would they hear when running towards the street-performing violinist?
Think about: What is the source frequency (or frequencies) in this case?

(d) Will the runner hear more beats (higher f_{beat}), less beats (lower f_{beat}) or the same f_{beat} as the violinist?

GOOD PRACTICE: The performer still needs to tune their violin. What percent change in tension is needed for the string to obtain the 440 Hz sound? Should the tension be increased or decreased? The length of the violin string is 32.5 cm and has a linear mass density (μ) of 6.1×10^{-4} kg/m.