**Harmonics**   Draw the first three harmonics for both the symmetric and antisymmetric set up of a traveling wave. Label & indicate all relevant information, including; harmonic number, m value, and all nodes (antinodes). Also mark the length of 1 period on your picture.

**Closed-closed**

**Open-closed**

**Open-open**

**Doppler Shift**   Suppose a train that has a 150Hz horn is moving at 35.0m/s in still air. What frequencies are observed by a stationary person at the side of the tracks as the train approaches and after it passes?
What frequency is observed by the train's engineer traveling on the train?

**String Properties**   The string is 5.0 meters long and is vibrating at the fourth harmonic. The string vibrates up and down with 48 cycles in 20 seconds. For this wave, determine the:

- frequency,

- period,

- wavelength, and

- speed.

If the string has a mass of 10g, what is the tension in the string?

**Superman**   Superman, foolishly attempting to turn back time, applies a constant force tangent to the Earth at the equator. He mistakenly believes that if he changes the direction the Earth rotates, the clocks will somehow run backwards. He should have taken physics. $M_E = 5.97x10^{24}kg$, $R_E = 6.37x10^6m$.
(a) If it takes him 2 mins to stop the rotation of the Earth, how much force did he apply?
(b) If he continues pushing with that same force, the Earth begins rotating in the opposite direction. How long will it take for some people to feel weightless?
(c) Where on the Earth will people first start feeling weightless?

**Pistons**   Two different masses, 1000 kg and 600 kg, are initially placed on top of equal 1.20-m-diameter low friction pistons. The pistons are connected to a third piston where a force F is applied such that it doesn't move. Water is the hydraulic fluid. Do the pistons move? If so, how much, if not, why?