O-short: *Principles and terms of oscillations and waves*

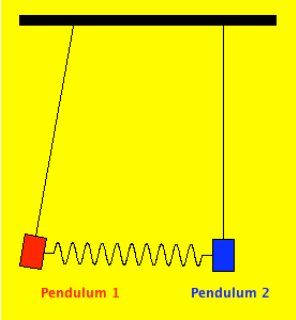
Explain succinctly (i.e. in four sentences or less) the meaning and significance of each of the following in the context of the oscillations and waves discussed in this course. Your answer should make clear not only what the term or concept is, but put it in context (ie. describe a real-life example) to make it clear why it is important.

i) normal modes of oscilliation
ii) transverse oscillations and longitudinal oscillations
iii) Critically damped oscillations
iv) The wave reflection and transmission coefficients

Problem 1: *Coupled Oscillations*

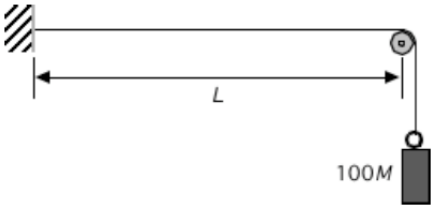
Two identical pendulums are connected by a spring attached to the bobs (as shown in the figure). Each bob has a mass of 0.100 kg and the stiffness, *s*, of the coupling spring is 0.800 N/m. When pendulum 2 is held fixed at its equilibrium point by an un-drawn clamp, the period of pendulum 1 is found to be 1.25 s. Find:

i) The length of the pendulum support strings;
ii) The periods of the two modes of the system if pendulum 2 is un-clamped and free to move.
iii) The time interval between successive maximum amplitudes (ie. distance between the two bobs) when both bobs are free.



Problem 2: *Transverse traveling waves*

A string is stretched between two points a distance *L* apart. The string has total mass *M*. The tension is produced by a mass 100*M* hanging from one end of the string after it passes over a pulley wheel.



i) It is observed that a pulse requires 0.1 s to travel from one end of the string to the other. What must be the length *L*? What are the frequencies of the normal modes?

ii) Derive the formula for the *total energy* of vibration for the string oscillating in its *n*th normal mode with amplitude A

iii) Calculate the total energy if the string has a mass of 10g, is vibrating with an amplitude of 2mm and only the fundamental mode is excited.