PHYS2063 Wave Physics Homework #19 Due Tuesday 8 Nov 2022

This homework assignment is due at the start of class on the date shown. You may submit a PDF of your solutions to the Canvas page for the course, or bring a paper copy to class.

(1) An ice pick is a device the size of a screwdriver with a sharp point connected to a handle:

Estimate the rough order of magnitude of the length of time that an ice pick can be balanced on its point if the only limitation is that set by the Heisenberg uncertainty principle. Assume that the point is sharp and that the point and the surface on which it rests are hard. You may make approximations which do not alter the general order of magnitude of the result. Assume reasonable values for the dimensions and weight of the ice pick. Obtain an approximate numerical result and express it *in seconds*.

(2) This question is a bit open ended. I want you to do some investigating about a fascinating phenomenon that has to do with the the wave nature of matter.

Helium turns into a liquid at atmospheric pressure at a temperature of about four degrees above absolute zero. Calculate the deBroglie wavelength of a helium atom at a temperature $T = 2K$. You can assume the energy of the atom is given by the thermal energy $E = (3/2)kT$, where k is Boltzmann's constant. Compare this wavelength to the size of helium atom. What does this suggest to you about the behavior of liquid helium at this very low temperature? Identify the phenomenon to which this corresponds.

You might enjoy the video http://www.alfredleitner.com/p/liquid-helium.html.