Homework 5
Due: Tuesday, October 16

Krane, Chapter 4, Question 4, 5
Problems 1, 5, 13, 17, 18, 21, 24, 28, 29, 30

Chappell

C-1 Use the Mathematica program superposition.nb to answer the following questions about the following superposition of traveling waves:

$$\psi(x,t) = A_1 \sin(k_1 x - \omega_1 t) + A_2 \sin(k_2 x - \omega_2 t)$$

Assume $A_1 = A_2$. For each part, do the following:

(a) Make a sketch of the waveform
(b) calculate the phase velocity
(c) calculate the group velocity
(d) Describe in words the dynamics of the resulting wave and relate your explanation to the phase and group velocities.

1. $k_1 = 4, \omega_1 = 4, k_2 = 4, \omega_2 = 4$

2. $k_1 = 4, \omega_1 = 4, k_2 = 4, \omega_2 = -4$

3. $k_1 = 4, \omega_1 = 4, k_2 = 3.8, \omega_2 = 4$

4. $k_1 = 4, \omega_1 = 4, k_2 = 3.5, \omega_2 = 4$

5. $k_1 = 4, \omega_1 = 4, k_2 = 3.5, \omega_2 = 3$

6. $k_1 = 4, \omega_1 = 4, k_2 = 4.5, \omega_2 = 3$

7. $k_1 = 4, \omega_1 = 4, k_2 = 4, \omega_2 = 3$

8. Construct a wave such that its group velocity equals its phase velocity. Derive a relationship between the wavenumbers and angular frequencies to satisfy this condition. Pick some values of the wavenumber and angular frequencies and plug them in the Mathematica notebook. Does your result make sense? Describe the dynamics.

9. Which of these scenarios act most like a de Broglie wave?