Computational Physics – HW #3

1. 3.4.18
2. 3.4.27
3. In the 4-D Euclidean vector space [you can think of this as position given by (x, y, z, w)] and the distance between the points:
    (a) (4m, -1m, 2m, 7m) and (2m, 3m, 1m, 9m)
    (b) (3m, 5m, 2m, 8m) and (2m, 6m, 2m, 8m)
4. In the 4-D Minkowski vector space [you can think of this as the locations of events in space-time given by (t, x, y, z)] consider the vectors pointing to the following events: (4ns, -1m, 2, 7) and (2ns, 3m, 1m, 9m)
    (a) Find the distance between the events.
    (b) Find the innerproduct between the two events.
5. Consider the generalized 2-D vector space with inner product $\vec{V_1} * \vec{V_2} = \int_0^{2\pi} V_1 V_2 dx$ spanned by the vectors $\vec{e}_1 = cos(x)$ and $\vec{e}_2 = sin(x)$.
    (a) What is the projection of the vector $\vec{v} = sin(x + \pi 3)$ on $\vec{e}_1$?
    (b) What is the projection of the vector $\vec{v} = sin(x + \pi 3)$ on $\vec{e}_2$?
    (c) What is the magnitude of $\vec{v}$?
6. 3.14.4
7. 3.11.13 (by hand and using a computer)
8. 3.11.22 (by hand and using a computer)
9. 3.12.15 (by hand and using a computer)
10. The air in a 12cm long sealed tube can be thought of as a large number of small chunks of matter in a line connected to each other and the walls at either end of the tube by springs. Imagine for the sake of this analysis that the tube contains 10 chunks, each with mass m and 11 springs with spring constant k.
    (a) Find the characteristic frequencies and modes of oscillation (not by hand).

(b) Graph the eigenvectors (displacement of mass vs equilibrium location of mass) that correspond to the three lowest frequencies. Fit these graphs with a function that makes sense (Data studio and Logger pro would both work for these
ts).