Phys106, II-Semester 2018/19, Assignment 5

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Hint: For all these questions (and later ones) you may use the math software `mathematica`*, available from CC. The little overhead in familiarising yourself with it now, will pay off manyfold later, regardless of your major.*

1. (i) Add the two waves $y_1(x,t) = \sin(k_1 x - \omega_1 t + \varphi_1)$ and $y_2(x,t) = \sin(k_2 x - \omega_2 t + \varphi_2)$ to form $y_{tot}(x,t) = y_1(x,t) + y_2(x,t)$ similarly to what was done in the lecture (*you may want to look at:* *this collection* .

   (ii) Make a computer script that can plot $y_1(x,t)$, $y_2(x,t)$ and $y_{tot}(x,t)$ and test your calculation is right. For this, use parameters e.g. $k_1 = 1$, $k_2 = 0.9$, $\omega_1 = 1.0$, $\omega_2 = 0.8$, $\varphi_1 = 0$, $\varphi_2 = \pi/2$. Plot $y_{tot}(x,t)$ for couple of values of t.

   (iii) Now fix t and plot for some different values of $\varphi_1 = 0$, $\varphi_2 = 0.1, 0.2, 0.3, \ldots$. What do you see?

2. *Await week 6 for this:* Find the de-Broglie wave-length of the objects below (treat the all non-relativistically). Discuss your results and expectations. Compare with the sizes of the objects.

   - An electron with velocity 1m/s.
   - An electron with velocity 5000m/s.
   - An proton with velocity $0.01c$.
   - A plane with mass $m = 150$ t and velocity 1000km/h.
   - A bacterium with mass $m = 10^{-12}$ g and velocity 50μm/s.