Phys106, II-Semester 2019/20, Tutorial 2, Fri 17.1.

Work in teams of three. Do "Stages" in the order below. When all teams finished a stage, make sure all students at your table understand the solution and agree on one by using the board (in Studio-Air), or paper sheets (in L1).

Stage 1

(i) For the following electro-magnetic waves, calculate the missing variable (wave-length λ or frequency ν): $\lambda = 5$ m, $\lambda = 200$ nm, $\nu = 2 \times 10^{14}$ Hz, $\nu = 1 \times 10^{24}$ Hz. What name do waves from that part of the electro-magnetic spectrum have? Discuss where they are used/ where they occur in nature.

(ii) For the following waves, calculate the phase velocity and guess which type of wave it might be: $\lambda = 5$ mm and $\nu = 1$ MHz, $\lambda = 10$ cm and $\nu = 3300$ Hz, $\lambda = 500$ km and $\nu = 600$ Hz (based on the speeds of waves given in the lecture or the internet).

Stage 2

(i) Consider the following functional shape: $y_{tot}(x,t) = y_1(x,t) + y_2(x,t)$ with $y_1(x,t) = A\cos(\frac{2\pi}{\lambda_1}(x - Vt))$ and $y_2(x,t) = A\cos(\frac{2\pi}{\lambda_2}(x - Vt))$, with almost but not quite equal wavelengths $\lambda_1 \approx \lambda_2$. Is this a solution to the wave equation for velocity V?

(ii) Make a drawing of $y_1(x,t)$ and $y_2(x,t)$ at $t = 0$ for some $\lambda_1 \approx \lambda_2$ of your choice. Make sure to draw it for *many* wavelengths. Using only your drawing "add" them together to form $y_{tot}(x,t)$. How does the result look? Does the pattern have a name?

(iii) Now lets do the same with math, at $t = 0$ using the trigonometric identity: $\cos(a) + \cos(b) = 2\cos\left(\frac{a+b}{2}\right)\cos\left(\frac{a-b}{2}\right)$ PLS CHECK. Compare with your drawing.

Stage 3 Do experiments with rope waves. Either ties a string onto a chair (or hold it in the air) or use the following online app: https://phet.colorado.edu/sims/html/wave-on-a-string/latest/waveonastring_en.html . Make contact with week3 of lectures notes, and try to generate: travelling waves, standing waves, and wave pulses. *Note for the app: Fixed end reflects the wave with phase-shift, loose end reflects without phase shift, no end does not reflect.*

Stage 4

(i) In the lecture we discussed double slit interference as arising from the superposition of waves coming from the two different slits. We can also treat a single slit as an infinitely dense collection of single point "emitters" as sketched in the figures below. On your table, discuss qualitatively how you would expect based on these pictures that waves passing through this single slit behave when they reach the far right side. How does this differ from a stream of particles? Does the effect depend on wave-length? Did you experience this in your lives already?

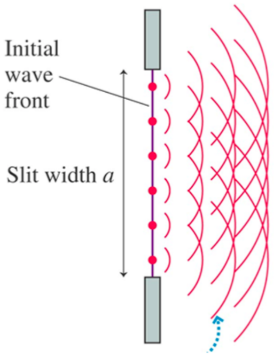

Fig. A

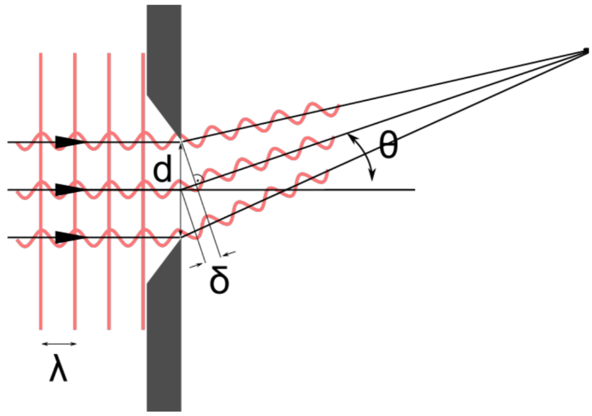

Fig. B