Phys106, II-Semester 2019/20, Tutorial 1, Fri 10.1.

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) Draw the functions $f(x) = \sqrt{x}$, $f(x) = x$, $f(x) = x^2$, $f(x) = x^3$, $f(x) = x^4$ into the same coordinate system.

(ii) Draw the functions $f(x) = \sin(x)$, $f(x) = \cos(x)$ into the same coordinate system.

(iii) Draw the functions $f(x) = \sin(x)$, $f(x) = \sin(x - \pi/4)$, $f(x) = \sin(x - \pi/2)$, into the same coordinate system, discuss what happens to the sine curve.

(iv) Draw the function $f(x) = e^x$.

(v) Draw the function $f(x) = e^{-x^2}$.

(vi) Draw an arbitrary function $f(x)$ of your choice. *(like the black line in Fig. 1, section 1.2. of the lecture notes, but pick a different function).* Then draw *qualitatively* the derivative $\frac{df(x)}{dx}$ and the second derivative $\frac{d^2f(x)}{dx^2}$.

Stage 2

(i) Draw the following wave forms accurately into a the same co-ordinate system: $y(x) = A\sin(\frac{2\pi}{\lambda}x + \varphi) + B$.

- $A = 2$, $\lambda = 3$, $\varphi = 0$, $B = 0$
- $A = 3$, $\lambda = 6$, $\varphi = 0$, $B = 0.5$
- $A = 1$, $\lambda = 3$, $\varphi = \pi/2$, $B = 1$

(ii) For the following waves, determine amplitude, frequency and phase velocity. What can you say about the units of these? (space is in meters (m) and time in seconds (s)).

- $y(x,t) = A\cos(\frac{\pi}{\lambda}x - 2rt + \pi/2) - B$
- $y(x,t) = [\frac{B}{2}\cos(\frac{2\pi}{\lambda}x - 2\pi ft + \varphi) + A]C$
- $y(x,t) = D\cos[\frac{2\pi}{\lambda}(x - \lambda mt) + pt + 42] - 2A$

Stage 3

(i) Do experiments with a driven Harmonic oscillator. Use the pendulum you brought or the online app at: https://www.walterfendt.de/html5/phen/resonance_en.htm or even better both. In the online app, use all the settings. *Note: you have to stop animation with "reset" to change parameters*
Based on those experiments and lecture notes, answer the following questions:

(ii) For fixed pendulum parameters and fixed amplitude of excitation/driving, which driving frequency gives you the largest oscillations?

(iii) Is there a qualitative difference between the early and late time behaviour of the pendulum? Which?

(iv) What happens when the external driving is very slow? Very fast?

Stage 4 (i) Discuss in your team, then on your table: Where/how do you typically experience black-body radiation? Where have you seen relations between emitted color and temperature of the kind discussed for black-body radiation in the lecture? In which phenomena of your experience is the visible colors different from the black-body scheme discussed in the lecture? Why? [advanced question]

(ii) What are the observations in the photo-effect experiment? What would you expect based on the classical physics that you know?