

Phys106, II-Semester 2018/19, Tutorial 1, Fri 11.1.

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) For $f(t) = \sin(t)$, find $\frac{df(t)}{dt}$, $\frac{d^2f(t)}{dt^2}$, find $\frac{d^3f(t)}{dt^3}$, find $\frac{d^4f(t)}{dt^4}$. Use online tools, your math knowledge, or the “draw slope” method from the lecture.
- 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 setting. *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 amplitude of excitation, 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 color-changes of the kind discussed in the lecture? In which phenomena do colors appear different from the scheme discussed in the lecture.
 - (ii) What are the observations in the photo-effect experiment? What would you expect based on what you know?