Phys106, II-Semester 2018/19, Assignment 1

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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 wit it now, will pay off manyfold later, regardless of your major.*

1. Show that $x(t) = Ae^{-\frac{\gamma}{2}t}\cos\left(\tilde{\omega}t + \varphi\right)$ is a solution of the differential equation for the damped harmonic oscillator without driving (Eq. (1) of lecture with $F_0 = 0$). Here $\tilde{\omega} = \sqrt{\omega_0^2 - \gamma^2/4}$. What does the solution imply? Discuss its physical meaning and that of all parameters in it.

2. Do the missing steps in the lecture for the solution of the driven, damped harmonic oscillator. To this end:

   (i) Insert the Ansatz $x(t) = A\sin(\omega t) + B\cos(\omega t)$ into Eq. (1).

   (ii) Separately equate coefficients of sin and of cos on the left-hand-side (lhs) and rhs.

   (iii) This gives you two equations for the two coefficients A and B. Solve these to get A and B.

   (iv) Find a rule how you can express $A\sin(\omega t) + B\cos(\omega t) = C\sin(\omega t + \varphi)$ online or in your math books/lextures, to find C and φ in terms of A and B.

   (v) Verify your C and φ agree with those given in the lecture, if need by by plotting them on top of each other.

3. Use a computer tool to plot the amplitude C and phase angle φ for different parameters. Try to explore some parameters where the curves plotted are much different from those in the lecture, and discuss why.

4. Try to guess, based on your knowledge from school, how one would find a classical solution to the spectrum of Black-body radiation.

5. Pick one of the keywords from"New physics after 1900" and one from "Open fundamental question" and read a wikipedia article on it each.