**Homework 10**
Physics 5A
Due Sa 11 / 23 / 24 @ 11:59PM

The clearer your presentation is, the easier it is for us to give you points! "K.K." refers to the **2nd** edition of the textbook "An Introduction to Mechanics" authored by Kleppner & Kolenkow. Remember, you are encouraged to work together, but please make sure the work you turn in is your own.

**Problem 1.** (15 pts)
A damped harmonic oscillator $\ddot{x} + \gamma\dot{x} + \omega_0^2 x = 0$ with $\omega_0 = 1$ radians/s begins with initial condition $x(0) = 1\ \text{m}, v(0) = 0$. Find and graph the analytic forms of the subsequent motion $x(t)$ (you can either draw these graphs by hand, or use your favorite mathematical coding platform) for three cases:
a) $\gamma = 4/\text{s}$.
b) $\gamma = 2/\text{s}$.
c) $\gamma = 1/\text{s}$.

**Problem 2.** (15 pts)
A damped harmonic oscillator $\ddot{x} + \gamma\dot{x} + \omega_0^2 x = 0$ is driven with an oscillating external force $F_{\text{ext}} = mf_o \cos(\omega_D t)$. Taking $\omega_o = 10$ radians /s, and $f_o = 1\ \text{m/s}^2$, find and graph the analytic forms of the amplitude of motion $A(\omega_D)$ and relative phase between the drive and the steady state motion $\phi(\omega_D)$ as a function of drive frequency $\omega_D$ for three cases with different quality factors $Q$ :
a) $Q = 1$.
b) $Q = 2$.
c) $Q = 10$.

**Problem 3.** (15 pts)
K.K. 11.7 (There is a typo in the problem: Part b) should ask for the time when the displacement will start to decrease, not the velocity.)

**Problem 4.** (15 pts)
K.K. 11.9 (Note that here you are asked to find when the velocity, rather than the displacement, is in phase with the drive.)

**Problem 5.** (15 pts)
K.K. 11.11

**Problem 6.** (15 pts)
K.K. 11.14