

Math 4560 Homework for Chapter 5

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Due Friday 30 September

1. Problems to think about: 5.1.1–5.2.13.
2. Problems to hand in: 5.1.10 (d), 5.2.4, and the problem given below.
3. Consider the damped harmonic oscillator $m\ddot{x} + b\dot{x} + kx = 0$. Change variables so that the equation is dimensionless and show that there is only one important parameter. What is it? Write the scaled equation as a first-order system. Show that its phase portrait changes as the parameter changes, but no bifurcation occurs. What does change? Draw illustrative examples of phase portraits for the scaled equation. Interpret your phase portraits as illustrating overdamped, critically damped, and underdamped motions. Say in words what the three possibilities mean for the motion of a spring modeled by $m\ddot{x} + b\dot{x} + kx = 0$. You can also make some computer pictures to help explain the various types of motions that can occur.