Math 51 **Homework 1** **Spring 2021**

Upcoming Deadlines:

Sunday, February 7, 5 p.m.:	HW 1 (§1.1, 1.2, Gradescope)
Sunday, February 7, 11:59 p.m.:	Quiz 1 (§1.1, 1.2, Canvas)
Friday, February 12, 5 p.m.:	HW 2 (1.3, 1.6, 1.7, 2.2, Gradescope)

Normally homework is due on Fridays. Since this is the first week, Homework 1 is due exceptionally on Sunday, February 7, at 5 p.m. You can scan your solutions into a pdf file using Notes in an iPhone or other scanning apps in an Android phone. Submit your solutions as a single pdf file in Gradescope. Do not submit a pdf converted from a photo. Photos have uneven lighting and are often difficult to read. You may submit your homework up to one day late, i.e., by 5 p.m., Monday, February 8, but if you do, you lose 10% of your grade.

This homework covers § 1.1−1.2. **Read first**: the following are some guidelines for answering homework in the course:

(1) **A correct answer does not guarantee credit**. Your goal in answering a problem should be to convince the grader of comprehension. Given that no assignments will be proctored and that there are many online tools available, a correct answer without work shown does little to demonstrate understanding and may receive little to no credit. In short: Show your work!

(2) **Use your words!** Many problems in this course can be answered purely in math terms. While that may at times be sufficient, it is often helpful to use words between steps and to use words to justify choices made in solving a problem. (In the future we will post solutions which may serve as examples in this regard.)

(3) **Neatness of work will be included in homework grades**. It is important that the graders can clearly read the work. If work cannot be read or easily followed, then the grader may not be convinced of complete understanding of the material and points may be lost.

Homework exercises:

1. Find all values of the constant k for which the given functions $x = \phi(t)$ are solutions of the given equations:

   (a) $x = t^k, \quad t > 0; \qquad 16t^2xx'' + 3x^2 = 0.$
   (b) $x = kte^{3t}; \qquad x'' - 3x' = e^{3t}.$

2. §1.1, exercise 24: A tanker carrying 100,000 gallons of oil runs aground off Nantucket. Water pours in the tanker at one end at 1000 gallons per hour while the polluted water-oil mixture pours out at the other end, also at 1000 gallons per hours. Set up a differential equation to predict the amount $x = x(t)$ of oil in the tanker. Explain how you arrived at your answer.

3. §1.2, exercise 22: Solve the differential equation found in exercise 24, §1.1. How much oil is left in the tanker after 10 days?

4. Find the general solution of the following o.d.e.

$$\frac{dx}{dt} = (x \sin t)^2$$

5. Find the specific solution of the following o.d.e. Explicitly verify your answer by plugging it into the equation.

$$t^2 x' = x^2 + 1, \qquad x(1) = 0.$$

6. Find the specific solution of the following o.d.e.

$$\frac{d^2x}{dt^2} = t \cos t, \qquad x(0) = x(\pi) = 0.$$