

## MA 114 Worksheet #27: Differential equations

- Is  $y = \sin(3x) + 2e^{4x}$  a solution to the differential equation  $y'' + 9y = 50e^{4x}$ ? Explain why or why not.
  - Explain why every solution of  $dy/dx = y^2 + 6$  must be an increasing function.
  - What does it mean to say that a differential equation is linear or nonlinear?
- Find all values of  $\alpha$  so that  $y(x) = e^{\alpha x}$  is a solution of the differential equation  $y'' + y' - 12y = 0$ .
- A tank has pure water flowing into it at 10 liters/min. The contents of the tank are kept thoroughly mixed, and the contents flow out at 10 liters/min. Salt is added to the tank at the rate of 0.1 kg/min. Initially, the tank contains 10 kg of salt in 100 liters of water. Formulate an initial value problem (that is, a differential equation along with initial conditions) whose solution is the quantity of salt in the tank at any time  $t$ . Do not solve the initial value problem.
- Consider a tank with 200 liters of salt-water solution. A salt-water solution, with a concentration of 2 grams per liter, pours into the tank at a rate of 4 liters per minute. The well-mixed solution in the tank pours out at the same rate of 4 liters/minute. Write a differential equation expressing the rate of change in the concentration,  $c(t)$ , of salt in the tank. Do not solve.