1. Use an appropriate Taylor polynomial for $f(x) = \cos(x)$ to approximate $\cos(0.1)$ to within 10^{-5}. Verify that your approximation satisfies the required level of accuracy.

2. A tank initially contains 1000 liters of a brine solution containing 10 kilograms of salt. A brine solution containing 0.5 kilograms of salt per liter enters the tank at the rate of 10 liters per minute, and a brine solution containing 1 kilogram of salt per liter enters the tank at the rate or 15 liters per minute. The solution is kept thoroughly mixed and drains from the tank at the rate of 25 liters per minute. Write down a differential equation which could be solved in order to find the amount of salt in the tank at any time t. Also specify the initial condition. **Do not solve the differential equation.**

3. Consider the differential equation

$$(D + 2)(D + 1)y = 0.$$

   (a) Write this equation in the form $ay'' + by' + cy = 0$.

   (b) (You will want to ignore part (a) when you do this part.) Suppose we let $v = (D+1)y$. What differential equation would you need to solve in order to find v? (Do not solve the equation. Just write it down.)

4. Find the general solution of each of the following differential equations by any method that you like. (Your final answer must be expressed in terms of real-valued functions, not complex-valued ones.)

   (a) $y'' + 4y' + 4 = 0$

   (b) $y'' + 4y' + 8y = 0$

5. Find a general solution to

   (a) $y'' - y' + 2y = 0$

   (b) $y'' - y' + 2y = 2x$

6. (a) Solve the differential equation $y' + 2xy = 4xe^{-x^2}$

(b) Find the solution to the differential equation $y' + 2xy = 4xe^{-x^2}$ that has $y = 3$ when $x = 0$.

(c) Does the differential equation in part (a) have any constant solutions?

7. Find the MacLaurin series (Taylor series around $x = 0$) for $\sin(x + \frac{\pi}{4})$.

8. Find the MacLaurin series for $\left(\frac{t}{(1+t)}\right)^2$.

9. What are the center, radius, and open interval of convergence of the power series
$$\sum_{n=0}^{\infty} \frac{n^2}{2^n + 1}(x + 2)^n?$$

10. Find a MacLaurin series representation for $\frac{\sin(x) - x}{x^3}$. For what values of x does it converge?