These problems should help prepare for the final exam. This collection is NOT comprehensive! (For example, it does not include any of the application problems.) Look over the previous worksheets, homework, class examples, quizzes, and exams.

1. Consider the equation $y' - 3x^2 y = 0$.
   a. Solve this equation using integrating factors.

   b. Solve this equation as a separable equation.

2. Consider the equation $y' = \dfrac{e^x y}{\cos y - be^x}$. Find a value of $b$ for which the equation is exact, and then solve the equation for that value of $b$.

3. Consider the equation $y'' + 7y' = x^2 - e^x \cos x$.
   a. Find a general solution for the homogeneous equation $y'' + 7y' = 0$.

   b. Write the appropriate form for the trial solution when using the method of undetermined coefficients.

4. Solve the initial value problem $y'' + y' + 1.25y = 0;\ y(0) = 3,\ y'(0) = 1$.

5. Use Laplace transforms to solve the initial value problem $y'' + 2y' + 3y = \sin t + \delta(t - 3\pi)$; $y(0) = 0,\ y'(0) = 0$. (notice both initial conditions should be zero)

6. Find the inverse Laplace transform of $\dfrac{e^{-3s} + 1}{s(s^2 + 4)}$. Hint: $\dfrac{1}{s(s^2 + 4)} = \dfrac{1}{4s} - \dfrac{s}{4(s^2 + 4)}$.

7. Consider the differential equation $y'' - xy' - y = 0$.
   a. Find the recurrence relation associated to the power series solution of the about the point $x_0 = 1$.

   b. Find the first three terms in the fundamental solutions $y_1$ and $y_2$.

8. Determine a lower bound for the radius of convergence of a series solution about each point $x_0$ for the differential equation $(x^2 - 4x)y'' - (x + 1)y' - y = 0:\ x_0 = -1;\ x_0 = 9$.