1. [15 pts.] Solve $(x^4 - x + y) - xy' = 0$ by finding by an integrating factor $\mu(x) = \exp\left(\int \dfrac{M_y - N_x}{N} dx\right)$

   or $\mu(y) = \exp\left(\int \dfrac{N_x - M_y}{M} dy\right)$.

2. [15 pts.] Find an integrating factor of the form $x^m y^n$ that will make the equation $y^2 + xy - x^2 y' = 0$ exact, and then solve the equation.

3. [10 pts.] Solve the homogeneous equation $y' = \dfrac{y^2 + x\sqrt{x^2 + y^2}}{xy}$.

4. [10 pts.] Solve the Bernoulli equation $y' - y = e^{2x}y^3$.

5. [20 pts.] A swimming pool whose volume is 10,000 gallons contains water that is 0.01% chlorine. Starting at time $t = 0$, city water containing 0.001% chlorine is pumped into the pool at a rate of 5 gal/min. The pool water flows out at the same rate. What is the percentage of chlorine in the pool after 1 hour? When will the pool water be 0.002% chlorine?

6. [10 pts.] Solve the initial value problem $y'' - 4y' - 5y = 0$, $y(-1) = 3$, $y'(-1) = 9$.

7. [10 pts.] Find the general solution to $y''' - 6y'' - y' + 6y = 0$.

8. [10 pts.] Find the general solution to $y'' - 2y' + 26y = 0$.

A couple trigonometric identities: $\sin(2\theta) = 2\sin\theta\cos\theta$, $\cos(2\theta) = 2\cos^2\theta - 1$.