1. Solve the initial value problem explicitly:

\[ \frac{dy}{dx} = \frac{\sqrt{y}}{4 + x^2}, \quad y(0) = 1 \]

2. Given the Bernoulli equation \[ \frac{dy}{dx} - x^2 y = x^7 y^3, \]
use an appropriate transformation to transform it to a linear equation in standard form.

DO NOT SOLVE THE EQUATION
3. Solve the linear equation

\[(2 - 3x) \frac{dy}{dx} - y = 1, \quad y(0) = 0.\]

4. Consider the equation

\[\left(\frac{3x^2}{y^2} + \frac{5}{y} + 4 + 5y\right) \, dx - \left(\frac{2x^3}{y^3} + \frac{5x}{y^2} + ax + 6y\right) \, dy = 0.\]

(a) Find the value of \(a\) so that this equation is exact.

(b) Use this value of \(a\), and solve the equation.
5. A particle of mass 10 kg is moved from rest at the origin on the $x$-axis by a force of $0.1 \ t$ Newtons to the right (where $t$ is in seconds). There is friction equal to the speed.

(a) Write a differential equation, with appropriate initial condition, to describe the velocity.

(b) Assuming that you wrote the correct equation, the solution is

$$v = 0.1 \ t + e^{-t/10} - 1, \ s = 0.05 \ t^2 - t + 10(1 - e^{-t/10})$$

Show that the acceleration is positive for $t > 0$.

6. A population of a species naturally grows subject to the equation $\frac{dP}{dt} = 0.1 \ P$, $t$ in years. Suppose that we start with 1000 individuals, and harvest at a rate $\pi \cos(\pi t)P$.

How many will we have when $t = 10$ years?
7. Use an appropriate substitution to find the general solution to

\[
\frac{dy}{dx} = \frac{y \sin \left( \frac{y}{x} \right) - 5x}{x \sin \left( \frac{y}{x} \right)}
\]

8. Use the substitution \( u = e^{2x} - y + 5 \) to find the general solution to \( \frac{dy}{dx} = 6 \sec^2(e^{2x} - y + 5) + 2e^{2x} \).