

Instructions: Show all work. Answers without work required to obtain the solution will not receive full credit. Some questions may contain multiple parts: be sure to answer all of them. Give exact answers unless specifically asked to estimate.

1. Use Euler's method to find $y(1)$ for the differential equation $\frac{dy}{dt} = y(y - 2t)$, $y(0) = -2$. Use $\Delta t = 0.05$. Verify two steps of your calculation by hand, and then complete the remaining steps with technology (such as Excel). Plot the resulting curve.
2. Solve the differential equation $\frac{dy}{dt} = 4 + y$ for the analytic solution. Solve for the missing constant if the initial condition is $y(0)=1$. (Use separation of variables.)
3. For the ODE $\frac{dy}{dt} = \frac{1+t^2}{3y-y^2}$, determine where a solution exists. Sketch the region in the plane. (Be sure to show explicitly that you check **both** conditions.)