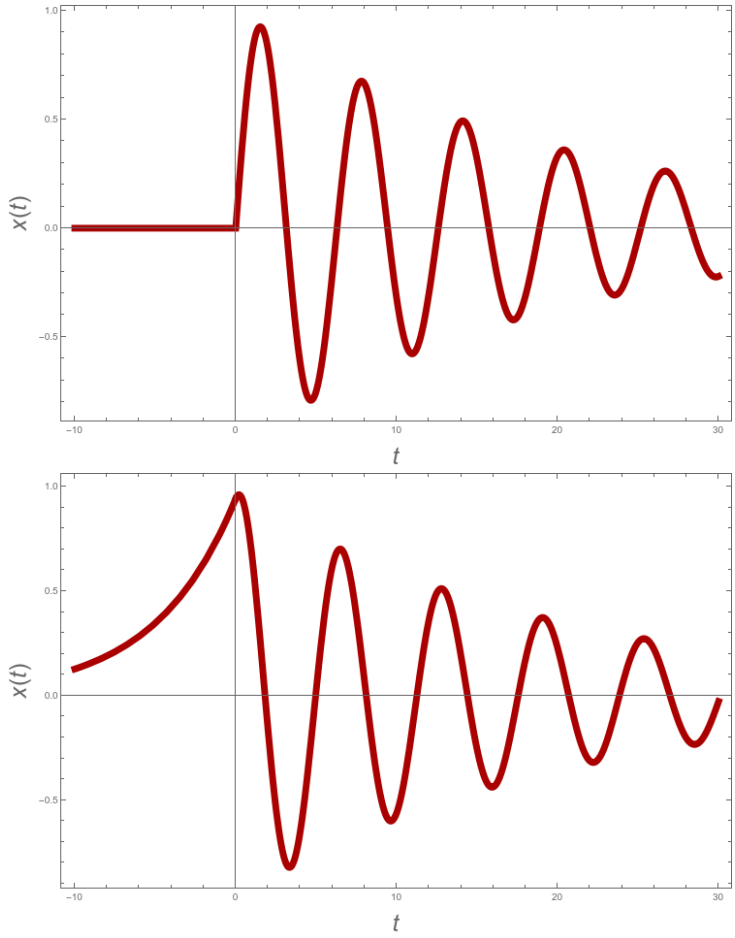
Task 1 (50 points)

Remember task #2 of exercise #6, whose grading has been delayed. Use a dimensionless, mathematical model problem, with $f_0 = 1$, $\tau = 5$, $\omega_0 = 1$, and $\gamma = 1/10$. (Some of these quantities actually carry physical units, but let us regard it as a mathematical model problem.) Show that, for the given parameters, the curves $x(t)$ of the solutions of task #2 of exercise #6 are as follows:



Interpret these plots in terms of a "roughening" of functions under differentiation, where, after subsequent differentiation, the sequence is (explanation as given in the lecture):

$$\text{differentiable} \to \text{kink (continuous)} \to \text{jump} \to \text{Dirac-}\delta.$$

Explain why "differentiation roughens up, while integration smoothens".

The tasks are due Thursday, 29–OCT–2026.