

Name: _____

1. A mass, $m = 3$, is attached to both a spring with spring constant $k = 63$ and a dashpot with damping constant $c = 30$. If the motion is started with initial position $x_0 = 2$ and initial velocity $v_0 = 2$, find the position function $x(t)$ and determine whether the motion is overdamped, critically damped, or underdamped. If it is underdamped, write it in the form $x(t) = C_1 e^{-pt} \cos(\omega_1 t - \alpha_1)$. Compare to the undamped function $u(t) = C_0 \cos(\omega_0 t - \alpha_0)$.

2. Determine the general solution to the following non-homogeneous differential equations.

a. $y'' + 4y = 3x^3$.

b. $y^{(4)} - 4y'' = x^2$.

3. Solve the following initial value problem:

$$y^{(3)} + 6y'' + 9y' = 27 + 12e^{-3x} - 36xe^{-3x}; y(0) = 2, y'(0) = -2, y''(0) = 21$$