Answer on Question #73083- Physics / Mechanics | Relativity

A block of mass $m = 1$ kg is attached to a spring of force constant $k = 25/4$ N/m. It is pulled $x_0 = 0.3$ m from its equilibrium position and released from rest. This spring-block apparatus is submerged in a viscous fluid medium which exerts a damping force of $F_{\text{frict}} = -4v$ (where v is the instantaneous velocity of the block). Determine of the position x(t) of the block at time t.

Solution:

The Newton's second law

$$ma = -kx + F_{\text{frict}}$$

$$m\ddot{x}(t) + 4\dot{x}(v) + kx = 0$$

$$\ddot{x} + 4\dot{x} + \frac{25}{4}x = 0$$

Solution

$$x \sim e^{\lambda t}$$

$$\lambda^2 + 4\lambda + \frac{25}{4} = 0$$

$$D = 16 - 25 = -9$$

$$\lambda = \frac{-4 \pm 3i}{2} = -2 \pm 1.5i$$

$$x(t) = e^{-2t} A \cos(1.5t)$$

$$x(0) = A = 0.3$$

Finally

$$x(t) = 0.3e^{-2t} \cos(1.5t)$$

Answer $x(t) = 0.3e^{-2t} \cos(1.5t)$