Introduction to Iterative Modeling Activity with Sample Explanation

A 1.0 kg mass is connected to a spring of spring constant 0.25 N/m. If the spring is displaced 0.50 m from equilibrium, how far does it travel in 1 second? Assume that this is not enough time for it to reach its equilibrium position

Relevant Equations:
$F = -kx$
$a = F/m$
$v = v_0 + at$
$x = x_0 + vt$

Let's choose 0.25 seconds to iterate over.

First Iteration: 0.00 - 0.25 seconds:
F= -kx = 0.25 N/m x 0.5m = -0.125 N
a = F/m = 0.125 N / 1kg = -0.125 m/s^2
v = v_0 + at = 0 + (-0.125 m/s^2)(0.25s) = -0.03125 m/s
x = x_0 + vt = 0.5 m + (-0.03125 m/s) (0.25 s) = 0.4922 m

Second Iteration: 0.25 - 0.50 seconds:
F= -kx = 0.25 N/m x 0.4922m = -0.1231 N
a = F/m = 0.1231 N / 1kg = -0.1231 m/s^2
v = v_0 + at = -0.03125 m/s + (-0.1231 m/s^2)(0.25s) = -0.06203 m/s
x = x_0 + vt = 0.4922 m + (-0.06203 m/s) (0.25 s) = 0.4767 m

Third Iteration: 0.50 seconds - 0.75 seconds:
F= -kx = 0.25 N/m x 0.4767m = -0.1192 N
a = F/m = 0.1192 N / 1kg = -0.1192 m/s^2
v = v_0 + at = -0.06203 m/s + (-0.1192 m/s^2)(0.25s) = -0.09183 m/s
x = x_0 + vt = 0.4767 m + (-0.09183 m/s) (0.25 s) = 0.4537 m

Fourth Iteration: 0.75 seconds - 1.00 seconds:
F= -kx = 0.25 N/m x 0.4537m = -0.1134 N
a = F/m = 0.1134 N / 1kg = -0.1134 m/s^2
v = v_0 + at = -0.09183 m/s + (-0.1134 m/s^2)(0.25s) = -0.1202 m/s
x = x_0 + vt = 0.4537 m + (-0.1202 m/s) (0.25 s) = 0.4237 m

*Note that this is one way to do it, but there are others. Such as using $x = x_0 + ½ a(t - t_0)^2 + v_o(t - t_0)$ to update the position over each time interval.