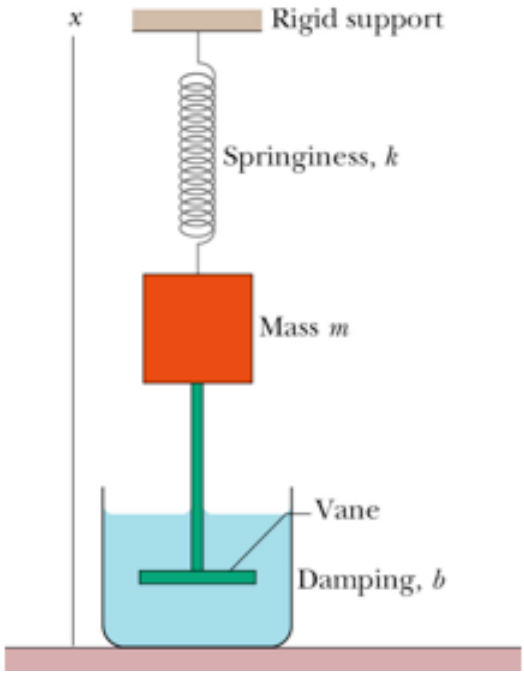
Damped Harmonic Motion Spread Sheet Problem
Due Friday July 17 9:00 AM

Figure 15-15 HRW



t = time

x = displacement of mass

v = velocity of mass

a = acceleration of the mass

x_0 = initial displacement =0.12 m

k = spring constant=8.0 N/m

b = damping constant= 0.230 kg/s

m = mass of block=1.50 kg

From Newtons 2nd Law, the following equation describes the motion of the mass on a spring with spring constant k and a damping mechanism with a damping constant b.

$$F = -kx - bv$$

$$ma = -kx - bv$$

$$mdv / dt = -kx - bv$$

$$dv / dt + kx / m + bv / m = 0$$

This equation is equivalent to eq. 15-41 in HRW, where v=dx/dt.

Using the method of numerical integration in an excel spreadsheet, solve the following differential equation by answering the questions below.

$$dv / dt + kx / m + bv / m = 0$$

Follow the example I gave in class, which can be found in class materials on the website for Lecture 3. Also see section 15-8 in HRW.

1.Create an excel spread sheet as I did in class. Make three columns: one for time, one for velocity, and one for displacement. Include enough rows to reach 15 seconds. Turn in your spread sheet as well as the results below.

2.Plot the velocity of the mass as a function of time for 15 seconds

3.Plot the displacement x as a function of time for 15 seconds

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4.Check your result in 2 to Fig. 15-16 in HRW. It should be similar.

5. Find the number of oscillations of the mass per second or frequency in units of inverse sec.

6.Find the time it takes for the amplitude of motion to fall to 1/3 of its initial value.

7.Set the damping constant b=0 and repeat answers to questions 1,2 and 3. These answers should correspond to results for a simple harmonic oscillator.

8. Submit your results using the digital drop box on Blackboard.