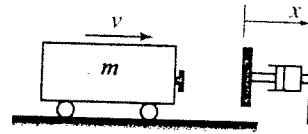


8. A railroad bumper is designed to slow down a rapidly moving railroad car. After a 20,000 kg railroad car traveling at 20 m/s engages the bumper, its displacement  $x$  (in meters) and velocity  $v$  (in m/s) as a function of time  $t$  (in seconds) is given by:



$$x(t) = 4.219(e^{-1.58t} - e^{-6.32t}) \quad \text{and} \quad v(t) = 26.67e^{-6.32t} - 6.67e^{-1.58t}$$

Determine  $x$  and  $v$  for every two hundredth of a second for the first half second after impact. Display the results in a three-column table in which the first column is time (s), the second is displacement (m), and the third is velocity (m/s).

9. Decay of radioactive materials can be modeled by the equation  $A = A_0 e^{kt}$ , where  $A$  is the amount at time  $t$ ,  $A_0$  is the amount at  $t = 0$ , and  $k$  is the decay constant ( $k \leq 0$ ). Iodine-132 is a radioisotope that is used in thyroid function tests. Its half-life time is 13.3 hours. Calculate the relative amount of Iodine-132 ( $A/A_0$ ) in a patient's body 48 hours after receiving a dose. After determining the value of  $k$ , define a vector  $t = 0, 4, 8, \dots, 48$  and calculate the corresponding values of  $A/A_0$ .
10. The value,  $B$ , of a savings account of an amount  $A$  that is deposited for  $n$  years with a yearly interest rate of  $r$  is given by:

$$B = A \left( 1 + \frac{r}{100} \right)^n$$

Write a MATLAB program in a script file that calculates the balance  $B$  after 10 years for an initial deposit of \$10,000 for yearly interest rates ranging from 2% to 6% with increments of 0.5%. Display the results in a table. The table should have two columns where the first column displays the interest rate and the second displays the corresponding value of  $B$ .

18. The variation of vapor pressure  $p$  (in units of mm Hg) of benzene with temperature in the range of  $0 \leq T \leq 42^\circ\text{C}$  can be modeled with the equation (Handbook of Chemistry and Physics, CRC Press)

$$\log_{10} p = b - \frac{0.05223a}{T}$$

where  $a = 34172$  and  $b = 7.9622$  are material constants and  $T$  is absolute temperature (K). Write a program in a script file that calculates the pressure for various temperatures. The program should create a vector of temperatures from  $T = 0^\circ\text{C}$  to  $T = 42^\circ\text{C}$  with increments of 2 degrees, and display a two-column table  $p$  and  $T$ , where the first column temperatures in  $^\circ\text{C}$ , and the second column the corresponding pressures in mm Hg.