# Boundary Value Problem II                    Homework 13

As discussed in Worksheet 23, a particle of mass $m$ is moving along the $x$ axis. But this time under the action of an exponentially decaying, time-dependent force $F(t)$ given by

$$F(t)/m = 40\,e^{-t}\ \text{N/kg}\,,\tag{1}$$

where $t$ is in seconds and $x$ is in meter. The motion of the particle is described by the solution to the boundary value problem

$$m\frac{d^2x}{dt^2} = F(t)\,,\qquad x(t_i = 0) = 0\,,\qquad x(t_f) = A\,,\tag{2}$$

where $x(t_i = 0)$ and $x(t_f)$ denote the particle's position at the initial and final time, respectively.

## Tasks

- Write a structured and well-commented Fortran program which computes the particle's path $x(t)$ for times $0 < t \le t_f$.

- The final time is $t_f = 1$ s and the final position is $A = 10$ m.

- The position as a function of time, $x(t)$, is to be written to an external data file.

- Run the code for $n = 10$ and $n = 100$ (grid points).

- The analytic solution of Eq. (2) is given by

$$x(t) = 40\left(e^{-t} - 1\right) + \left(35.7 - e^{-1}\right)t\,,\tag{3}$$

  where $t$ is in seconds and $x(t)$ is given in meters. Compute $x(t)$ from Eq. (3) for $0 \le t \le t_f$. The result is to written to an external data file.

- Show the results (three curves) graphically.

**Submitting your Homework:** Create a gzipped archive file named `LastFirst.tgz` which contains your Fortran source code and the `pdf` plot and email this file to `ewhart317@gmail.com`. Put PHYS 317 HW 13 in the subject line.