School of Basic Sciences

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PH621: Computational methods for physicists
(End Sen practicum)

A race car is taken on a test drive on a straight track. To test it's performance, the car is accelerated rapidly at 1 ms^{-2} for one minute, when the velocity of the car's velocity was 90 km/hr and at a distance of 250 m from the beginning of the track.

The equation of motion of the car is given by

$$\frac{d^2x}{dt^2} = a \tag{1}$$

where a is the acceleration.

The analytical result is given by

$$x(t) = x_0 + v(0)t + \frac{1}{2}at^2 \tag{2}$$

Question:
Write a program to solve the differential equation given in equation (1). You should have the following components in your program:

- Write a function to solve the differential equation using RK4 method for the suitable time period. Take a step size of $h = 1.0$.
- Write a function to obtain the analytical result for different values of t.
- Call functions from step (a) and (b) in `main()` to obtain the RK4 and analytical solutions. Programmatically store the values of t, $x(t)$ (RK4) and $x(t)$ (analytical) in a file named "RK4.dat". Plot the analytical result along with the results obtained from RK4.

Print on the terminal the final velocty of the car (in km/hr) and the total distance travelled by the car travels while it was accelerating.