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Subject No. PH39209 (Computational Physics Lab)

Lab Sheet - 2

§1. The differential equation is given by

$$\frac{dy}{dx} = x\,y \quad \text{with the initial condition} \quad y = 5 \quad \text{at} \quad x = 1.$$

Find the solution, using the following methods, in the interval $[1, 3]$ using step size $h = 0.1$.

(i) Euler's method, (ii) improved Euler's method, and (iii) RK - 2 method
Plot the behavior of y as a function of x.

§2. The differential equation is given by

$$\frac{dy}{dt} = y - t^2 + 1 \quad \text{with the initial condition} \quad y = 0.5 \quad \text{at} \quad t = 0$$

(i) Using RK - 2 method calculate y for $0 \leq t \leq 2$ using $\Delta t = 0.1$. Plot the behavior of y as a function of t.

(ii) If the analytical solution of the above differential equation is $y = t^2 + 2t + 1 - (1/2)e^t$ then estimate the error, i.e. the difference between the analytical and numerical result, at each time step. Plot the error as a function of t.