Computational physics

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Solve the following differential equation:

$$\frac{d^2y}{dt^2} - \frac{2\omega}{2\omega t + 1}\frac{dy}{dt} + (2\omega t + 1)^2 y = 0$$

defined in the interval $t \in [0, 5]$, for values of $\omega = 1, 2, 3, 4, 5$, by using a second order Runge-Kutta time scheme.

Use the following initial conditions:

$$y(t = 0) = 0; \qquad y'(t = 0) = 1$$

and compare the result with the analytical solution:

$$y = A \sin(\omega t^2 + t)$$

valid for $A = 1$ for the values of ω given above. Verify that the numerical error (difference, in absolute value, between the numerical and analytical solutions) for a fixed value of the time discretization h, is proportional to ω^3.