Home Work Problem 01a

Consider flow in a constant area pipe with heat transfer (Ref: Hill and Peterson, Mechanics and Thermodynamics of Propulsion, Addison-Wesley).
The equation may be solved numerically by using a suitable procedure for the solution of ordinary differential equation, such as the Runge-Kutta algorithm.

a) Using the Runge-Kutta method, numerically solve the equations for air for the following conditions: tube diameter = 30 cm., tube length = 3 m. Inlet: M = 0.25. Wall heat transfer, q = 600 kJ/kg. Calculate the following conditions at the pipe exit: M, T, T_0, p, p_0.

    i) T_{01} =1000 K, p_{01} = 1.5 MPa.
    ii) T_{01} = 300K, p_{01} = 1 atm (101325 N/m^2).

b) Compare the numerical solution with the analytical solution.