Home Work Problem 1

Consider flow in a constant area pipe with heat transfer and friction (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.
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. Assume a constant value for c_f given below. 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, c_f = 0.0.

ii) T_{01} = 300K, p_{01} = 1 atm (101325 N/m^2) , c_f = 0.01