1. **(Richardson Extrapolation Applied to Differentiation).**

   (a) Suppose that \( N(h) \) is an approximation to \( M \) for every \( h > 0 \) and that
   
   \[ M = N(h) + K_1 h^1 + K_2 h^2 + K_3 h^3 + \ldots \]
   
   for some constants \( K_1, K_2, K_3 \). Use the values \( N(h) \), \( N(h^3) \), and \( N(h^9) \) to produce an \( O(h^3) \) approximation to \( M \).

   (b) Recall that
   
   \[ \frac{df(x_0)}{dx} = \frac{f(x_0 + h) - f(x_0)}{h} + \sum_{i=2}^{\infty} \frac{h^{i-1}}{i!} f^{(i)}(x_0). \]
   
   Use the formula you constructed in part (a) to construct an \( O(h^3) \) approximation to \( \frac{df(x_0)}{dx} \).

2. **(Richardson Extrapolation Applied to Solving IVPs).** Perform one step of Richardson’s extrapolation to get an improved solution at \( x = 1 \), using values obtained with \( h = 0.1 \) and \( h = 0.05 \) by the second order Runge-Kutta method (Improved Euler method). Compare with exact solution.