

$$\#y'' = \frac{(y')^2}{x^3} - \frac{9 \cdot y^2}{x^5} + 4 \cdot x, \quad y(1) = 0, \quad y(2) = \ln(256)$$

with(LinearAlgebra) :

N := 9 :

a := 1 :

b := 2 :

alpha := 0 :

beta := ln(256) :

h := 'h' :

X := i → a + i · h :

$$f := (x, y, p) \rightarrow \frac{p^2}{x^3} - \frac{9 \cdot y^2}{x^5} + 4 \cdot x :$$

$$fy := (x, y, p) \rightarrow \frac{18 \cdot y}{x^5} :$$

$$fp := (x, y, p) \rightarrow \frac{2 \cdot p}{x^3} :$$

Y := Vector(N, i → alpha + (beta - alpha) · (X(i) - a)) :

y := i → if(i < 1, alpha, if(i > N, beta, Y[i])) :

A :=  $\frac{1}{h^2}$  · Matrix(N, (i, j) → if(i = j, -2, if(abs(i - j) = 1, 1, 0))) :

$$p := i \rightarrow fp\left(X(i), y(i), \frac{y(i+1) - y(i-1)}{2 \cdot h}\right) :$$

P := c →  $\frac{1}{2 \cdot h}$  · Matrix(N, (i, j) → if(abs(i - j) = 1, p(i) · (j - i), 0)) :

P(Y) ;

$$q := i \rightarrow fy\left(X(i), y(i), \frac{y(i+1) - y(i-1)}{2 \cdot h}\right) :$$

Q := c → Matrix(N, (i, j) → if(i = j, q(i), 0)) :

Q(Y) ;

J := c → A - P(c) - Q(c) :

J(Y) ;

$$F := c \rightarrow Vector\left(N, i \rightarrow \frac{y(i-1) - 2 \cdot y(i) + y(i+1)}{h^2} - f\left(X(i), y(i), \frac{y(i+1) - y(i-1)}{2 \cdot h}\right)\right) :$$

F(Y) ;

$$h := \frac{(b - a)}{N + 1} ;$$

**for k from 1 to 0 do**

Y := evalf(Y) - LinearSolve(evalf(J(Y)), evalf(F(Y))) :

**od:**

plot1 := plot(Vector(N, i → X(i)), Y, style = point, color = blue) :

g := x → x<sup>3</sup> · ln(x) :

plot2 := plot(g(x), x = 1 .. 2) :

plots[display](plot1, plot2) ;

residuals := abs(evalf(Y) - Vector([seq(evalf(g(X(i))), i = 1 .. N)])) ;