Sample Questions on Numerical ODEs: Euler's Method

Conceptual Questions

Q1. The Euler method is:

(a) An implicit method.
(b) An explicit method.
(c) A higher-order method.
(d) A method that uses random sampling.

Q2. The formula for Euler's method to approximate the solution of the differential equation $\frac{dy}{dx} = f(x, y)$ is:

(a) $y_{n+1} = y_n + h \cdot f(x_n)$
(b) $y_{n+1} = y_n + h \cdot f(x_n, y_n)$
(c) $y_{n+1} = y_n - h \cdot f(x_n, y_n)$
(d) $y_{n+1} = y_n \cdot h \cdot f(x_n, y_n)$

Q3. The local truncation error in Euler's method is proportional to:

(a) $O(h^2)$
(b) $O(h)$
(c) $O(1/h)$
(d) $O(h^3)$

Q4. Euler's method provides an approximation for:

(a) Only linear differential equations.
(b) Non-linear differential equations.
(c) Both linear and non-linear differential equations.
(d) Only higher-order differential equations.

Numerical Questions

Q5. Use Euler's method with step size $h = 0.1$ to approximate $y(0.1)$ for the differential equation $\frac{dy}{dx} = x + y$, with $y(0) = 1$:

(a) 1.11

(b) 1.10

(c) 1.12

(d) 1.13

Q6. Use Euler's method to approximate $y(0.2)$ for the differential equation $\frac{dy}{dx} = 2x - y$, with $y(0) = 1$ and step size $h = 0.1$:

(a) 0.84

(b) 0.85

(c) 0.86

(d) 0.83

Q7. Given $\frac{dy}{dx} = y - x^2 + 1$, $y(0) = 0.5$, and $h = 0.2$, use Euler's method to find $y(0.2)$:

(a) 0.62

(b) 0.64

(c) 0.66

(d) 0.68

Q8. Solve the equation $\frac{dy}{dx} = -2y$, with $y(0) = 1$, using Euler's method with step size $h = 0.1$. Approximate $y(0.1)$:

(a) 0.80

(b) 0.82

(c) 0.83

(d) 0.81

Q9. What is the main limitation of the Euler method compared to higher-order methods like Runge-Kutta?

(a) Euler's method is computationally expensive.

(b) Euler's method is unstable for large step sizes.

(c) Euler's method requires higher derivatives.

(d) Euler's method is implicit.