2. Using NR Method Solve $x \log_{10} x = 12.34$. Start with $x_0 = 10$.

Soln

$$f(x) = x \log_{10} x - 12.34$$

$$f'(x) = x \frac{1}{x} \log_{10} e + \log_{10} x$$

$$= \log_{10} e + \log_{10} x$$

Given $x_0 = 10$

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$

$$= 10 - \frac{10 \log_{10} 10 - 12.34}{\log_{10} e + \log_{10} 10}$$

$$= 10 - \left[\frac{-2.34}{1.4343} \right]$$

$$= 10 + \frac{2.34}{1.4343}$$

$$= 11.6315$$

$$x_2 = x_1 - \frac{f(x_1)}{f'(x_1)}$$

$$= 11.6315 - \left[\frac{1.6315 \log_{10} 11.6315 - 12.34}{\log_{10} e + \log_{10} 11.6315}\right]$$

$$= 11.6315 - \frac{0.0549}{1.5}$$

$$= 11.5949$$

$$x_3 = x_2 - \frac{f(x_2)}{f'(x_2)}$$

$$= 11.5949 - \frac{11.5949 \log_{10} 11.5949 - 12.34}{\log_{10} e + \log_{10} 11.5949}$$

$$= 11.5949 - \frac{0.00006}{1.4986}$$

$$= 11.5949$$

Hence the root is 11.5949