Numerical Methods for Engineers | (5th Edition)

Step 1 of 2

Consider the following equation,

$$x^2 - 5000.002x + 10 = 0$$

Consider the roots of quadratic equation $ax^2 + bx + c = 0$ is

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Compute the roots of the equation from the formula below

$$x = \frac{5000.002 \pm \sqrt{(5000.002)^2 - 4 \times 10}}{2}$$

So, $x_1 = 5000$ & $x_2 = 0.002$

Chop to 5 digits

$$\begin{aligned} x &= \frac{5000.0 \pm \sqrt{5000.0^2 - 4 \times 10}}{2} \\ &= \frac{5000.0 \pm \sqrt{25000000 - 4 \times 10}}{2} \\ &= \frac{5000.0 \pm \sqrt{24999960}}{2} \\ &= \frac{5000.0 \pm 4999.9}{2} \end{aligned}$$

Solve for two different roots:

$$\begin{aligned} \frac{5000.0 \pm 4999.9}{2} &= \frac{9999.9}{2} \text{ and } \frac{0.1}{2} \\ &= 4999.9 \text{ and } 0.05 \end{aligned}$$

Hence the relative percent error of the first root 4999.9 is

$$\begin{aligned} &= \left|\frac{5000 - 4999.9}{5000}\right| \times 100\% \\ &= \boxed{0.002\%} \end{aligned}$$

And the relative percent error of the second root 0.05 is

$$\begin{aligned} &= \left|\frac{0.002 - 0.05}{0.002}\right| \times 100\% \\ &= \boxed{2400\%} \end{aligned}$$

Comment

Step 2 of 2

Compute the roots again from the formula below:

$$\begin{aligned} \frac{-2c}{b \pm \sqrt{b^2 - 4ac}} &= \frac{-2(10)}{-5000.0 \pm \sqrt{25000000 - 4 \times 10}} \\ &= \frac{-20}{-5000.0 \pm \sqrt{24999960}} \\ &= \frac{-20}{-5000.0 \pm 4999.9} \end{aligned}$$

Solve for two different roots:

$$\begin{aligned} \frac{-20}{-5000.0 \pm 4999.9} &= \frac{-20}{-0.1} \& \frac{-20}{-9999.9} \\ &= 200 \;\; \& \; 0.00200002 \end{aligned}$$

Hence, the relative percent error of the first root 200 is

$$\begin{aligned} &= \left|\frac{5000 - 200}{5000}\right| \times 100\% \\ &= \boxed{96\%} \end{aligned}$$

And the relative percent error of the second root 0.00200002 is

$$\begin{aligned} &= \left|\frac{0.002 - 0.00200002}{0.002}\right| \times 100\% \\ &= \boxed{0.00001\%} \end{aligned}$$

Comment

Was this solution helpful? 0 2

Recommended solutions for you to review

Chapter 8, Solution 5P

$K = \frac{c_c}{c_a^2 c_b}$

Consider the statements from the textbook, the equilibrium relationship for a reversible chemical reaction is characterized by ...

View this solution

Chapter 25, Solution 27P

$I = \int_a^b f(x)\,dx$

Consider the following equation for the definite integral, This is identical to the solution for the differential equation...

View this solution