

Numerical Methods for Engineers | (5th Edition)

Chapter 3, Problem 10P

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Step 1 of 2

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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

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

Solve for two different roots:

$$\frac{5000.0 \pm 4999.9}{2} = \frac{9999.9}{2} \text{ and } \frac{0.1}{2}$$
$$= 4999.9 \text{ and } 0.05$$

Hence the relative percent error of the first root 4999.9 is

$$= \left| \frac{5000 - 4999.9}{5000} \right| \times 100\%$$
$$= 0.002\%$$

And the relative percent error of the second root 0.05 is

$$= \left| \frac{0.002 - 0.05}{0.002} \right| \times 100\%$$
$$= 2400\%$$

Comment

Step 2 of 2

Compute the roots again from the formula below:

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

Solve for two different roots:

$$\frac{-20}{-5000.0 \pm 4999.9} = \frac{-20}{-0.1} \text{ \& } \frac{-20}{-9999.9}$$
$$= 200 \text{ \& } 0.00200002$$

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

$$= \left| \frac{5000 - 200}{5000} \right| \times 100\%$$
$$= 96\%$$

And the relative percent error of the second root 0.00200002 is

$$= \left| \frac{0.002 - 0.00200002}{0.002} \right| \times 100\%$$
$$= 0.00001\%$$

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

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

Chapter 25, Solution 27P

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

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

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