Nonlinear Equations

Concept Questions

$$ax^5 + bx^4 + cx^3 + dx^2 + ex + f = 0$$

$$\tanh(x) = x$$

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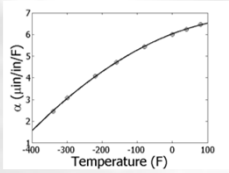
1

Finding The Temperature of the Fluid

$$\Delta D = D \int_{T_a}^{T_c} \alpha\,(T)dT$$

T_a =80 ^oF
T_c =??? ^oF
D = 12.363"
ΔD = −0.015"



$$\alpha = -1.228 \times 10^{-5}T^2 + 6.195 \times 10^{-3}T + 6.015$$

$$-0.015 = 12.363 \int_{80}^{T_c} (-1.228 \times 10^{-5}T^2 + 6.195 \times 10^{-3}T + 6.015)(1 \times 10^{-6})\,dT$$

$$-0.015 = -5.059 \times 10^{-11}{T_c}^3 + 3.829 \times 10^{-8}{T_c}^2 + 7.435 \times 10^{-5}T_c - 6.166 \times 10^{-3}$$

$$f(T_c) = -5.059 \times 10^{-11}{T_c}^3 + 3.829 \times 10^{-8}{T_c}^2 + 7.435 \times 10^{-5}T_c + 8.834 \times 10^{-3} = 0$$

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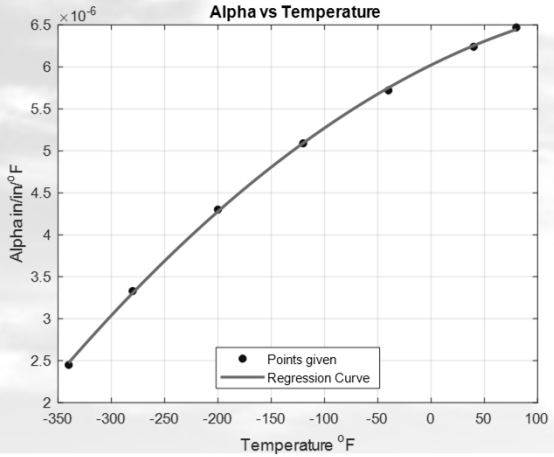

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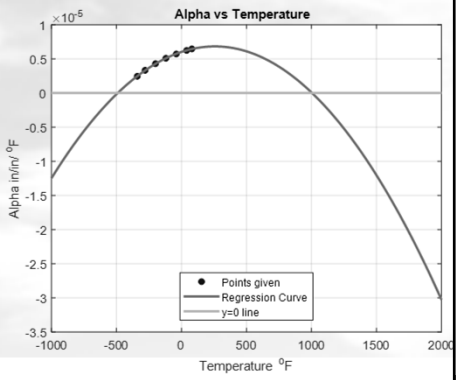
$$\Delta D = D \int_{T_a}^{T_c} \alpha\,(T)dT$$

$$-0.015 = 12.363 \int_{80}^{T_c} (-1.228 \times 10^{-5}T^2 + 6.195 \times 10^{-3}T + 6.015)(1 \times 10^{-6})\,dT$$

$$f(T_c) = -5.059 \times 10^{-9}{T_c}^3 + 3.829 \times 10^{-6}{T_c}^2 + 7.435 \times 10^{-5}T_c + 8.834 \times 10^{-3} = 0$$



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4

"The problem of not knowing what we missed is that we believe we haven't missed anything" – *Stephen Chew on Multitasking*

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5

If for a real continuous function $f(x)$, $f(a)f(b) < 0$, then in the domain $[a, b]$ for $f(x) = 0$, there is (are)

- one root
- undeterminable number of roots
- no roots
- at least one root

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To find the root of an equation $f(x) = 0$, a student started using the bisection method with a valid bracket of $[35, 55]$. At the end of the 2nd iteration, the smallest range for the absolute true error for the root of the equation is

- $0 \leq |E_t| < 2.5$
- $0 \leq |E_t| < 5$
- $0 \leq |E_t| < 10$
- $0 \leq |E_t| < 20$

Total Results: 0

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Name one pitfall of the bisection method of solving nonlinear equations

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Newton Raphson Method

The root of equation $f(x) = 0$ is found by using Newton-Raphson method.	-3.2470
The initial estimate of the root is $x_0 = 3, f(3) = 5$.	-0.2470
The angle the tangent to the function $f(x)$ at $x = 3$ makes with the x-axis is 57°.	3.2470
The next estimate of the root, x_1 most nearly is	6.2470

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The Newton-Raphson method formula for finding the square root of a real number R from the equation $x^2 - R = 0$ is,

$$x_{i+1} = \frac{x_i}{2}$$
$$x_{i+1} = \frac{x_i}{2}$$
$$x_{i+1} = \frac{1}{2}\left(x_i + \frac{R}{x_i}\right)$$
$$x_{i+1} = \frac{1}{2}\left(3x_i - \frac{R}{x_i}\right)$$

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Name one pitfall of the Newton-Raphson method of solving a nonlinear equation.

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