Nonlinear Equations

Your nonlinearity confuses me

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

$$\tanh(x) = x$$

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Example – General Engineering

You are working for 'DOWN THE TOILET COMPANY' that makes floats for ABC commodes. The floating ball has a specific gravity of 0.6 and has a radius of 5.5 cm. You are asked to find the depth to which the ball is submerged when floating in water.

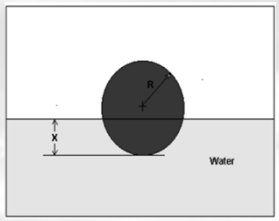
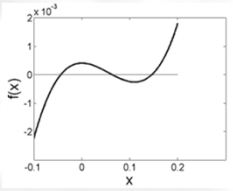


Figure: Diagram of the floating ball

$$x^3 - 0.165x^2 + 3.993 \times 10^{-4} = 0$$



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For the trunnion-hub problem discussed on the first day of class where we were seeking contraction of 0.015″, did the trunnion shrink enough when dipped in dry-ice/alcohol mixture?

Yes

No

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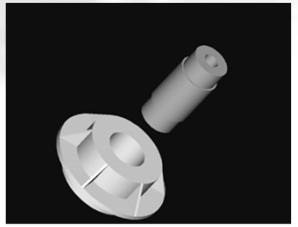
Example – Mechanical Engineering

Since the answer was a resounding NO, a logical question to ask would be:

If the temperature of -108°F is not enough for the contraction, what is?



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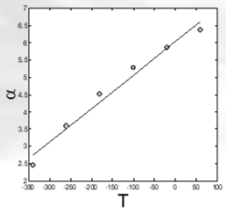
Finding The Temperature of the Fluid

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

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



$$\alpha(T) = 6.033 + 0.009696T$$

$$-0.015 = 12.363 \int_{80}^{T_c} (6.033 + 0.009696T)\,dT$$

$$-0.015 = 5.992 \times 10^{-8} {T_c}^2 + 7.457 \times 10^{-5} T_c - 6.349 \times 10^{-3}$$

$$f(T_c) = 5.992 \times 10^{-8} {T_c}^2 + 7.457 \times 10^{-5} T_c + 8.651 \times 10^{-3} = 0$$

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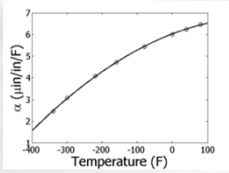
Finding The Temperature of the Fluid

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

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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How tall can a vertical mast be?

$$1 + \sum_{n=1}^{\infty} c_n \beta^n = 0$$

$$c_1 = -\frac{3}{8}$$

$$c_n = -\frac{3c_{n-1}}{4n(3n-1)}, n = 2,3,\ldots$$

$$L = \left(\frac{9\beta EI}{4w}\right)^{\frac{1}{3}}$$

E = Young's modulus of elasticity,
I = second moment of area,
w = weight per unit length

Thanks to Markus Gjengaar for sharing their work on Unsplash.

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Nonlinear Equations

(Background)

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Equations such as $\tan x = x$ has _____ root(s)

- zero
- one
- two
- infinite

Total Results: 0

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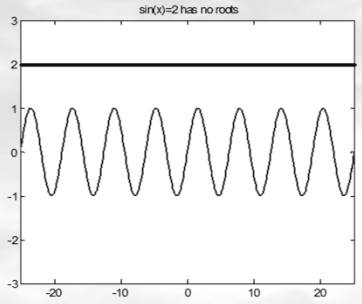
How many real roots can a nonlinear equation have?



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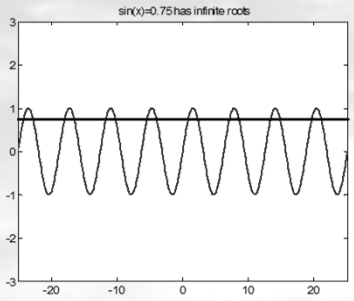
How many real roots can a nonlinear equation have?



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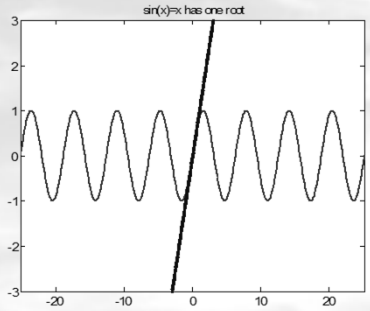
How many real roots can a nonlinear equation have?



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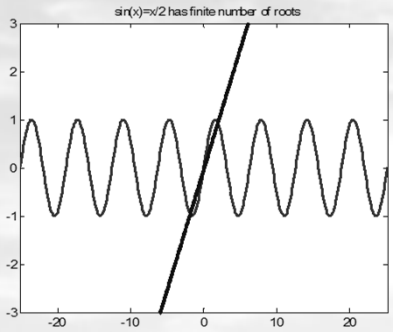
How many real roots can a nonlinear equation have?



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