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A Theoretical Estimate for the Frequency of the TNL Oscillator $\ddot{x} + x + x^{1/3} = 0$ DORIAN WILKENSON, RONALD MICKENS, Clark Atlanta University — Truly nonlinear (TNL) oscillators have the property of having no linear approximation at the fixed-point of the modeling differential equation [1]. For a conservative oscillator this means that the fixed-point is a nonlinear center. Another feature of TNL oscillators is that none of the standard perturbation expansion procedures can be applied to calculate analytical approximations to the periodic or oscillator solutions [2]. Using the initial conditions $x(0) = A$ and $\dot{x}(0) = 0$, we calculate the frequency $\omega(A)$ of the equation given in the title for small, $0 < A \ll 1$, and large $A \gg 1$, amplitudes. From these expressions a composite function, $\omega(A)$, is found such that these two special limits hold. This function should provide an accurate estimate of the frequency for the full range of amplitude values, i.e., $0 < A < \infty$.

[1] R. E. Mickens Journal of Sound and Vibration 292 (2006), 964-968.
[2] R. E. Mickens, "Nonlinear Oscillations" (Cambridge University Press, New York, 1981).

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