



Exact Solutions > Ordinary Differential Equations > Second-Order Linear Ordinary Differential Equations > Equation of Free Oscillations

1. $y''_{xx} + ay = 0.$

Equation of free oscillations.

$$\text{Solution: } y = \begin{cases} C_1 \sinh(x\sqrt{|a|}) + C_2 \cosh(x\sqrt{|a|}) & \text{if } a < 0, \\ C_1 + C_2 x & \text{if } a = 0, \\ C_1 \sin(x\sqrt{a}) + C_2 \cos(x\sqrt{a}) & \text{if } a > 0. \end{cases}$$

References

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Boyce, W. E. and DiPrima, R. C., *Elementary Differential Equations, 7th Edition*, Wiley, New York, 2000.

Polyanin, A. D. and Zaitsev, V. F., *Handbook of Exact Solutions for Ordinary Differential Equations, 2nd Edition*, Chapman & Hall/CRC, Boca Raton, 2003.

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