

The principle of superposition does not hold for nonhomogeneous equations.

so for example $2 \cdot \left(-\frac{1}{5} \sin(x)\right)$ is not a solution

But a related principle does apply

If we add a solution of the homogeneous equation to a solution of the nonhomogeneous equation, we get a solution of the nonhomogeneous equation

Let y_p be a solution of the nonhomogeneous equation
$$y'' + p(x)y' + q(x)y = f(x)$$
 "particular solution"

So let y_c be a solution of the homogeneous equation
$$y'' + p(x)y' + q(x)y = 0$$

Then $y_c + y_p$ satisfies $y'' + p(x)y' + q(x)y = f(x)$

* This also works for higher order equations.

• Possible analogy:

Even and odd numbers



homog solutions

non homog. solutions

Even + Even = Even

Odd + Even = Odd

Odd + Odd \neq Odd

Odd + Odd = even

This is where the analogy breaks down
So don't take it too seriously