

Differential Equations

$\frac{dy}{dx}$ ← differentials

$y = x^2$ $\frac{dy}{dx} = 2x$ ← D.E.!

1 → $\left(\frac{dy}{dx}\right) + 4 = 0$ ← $y = 4x \Rightarrow \frac{dy}{dx} = 4$ Substitute to test:

2 → $7 \frac{d^2y}{dx^2} - 3 \frac{dy}{dx} + 2x = 0$

$4 + 4 \stackrel{?}{=} 0$
 $8 \neq 0$

∴ $y = 4x$ not a solution.

Difficult to solve!!

Easy to test solution!?

What about $y = -4x$?

$\frac{dy}{dx} = -4$

Sub. $-4 + 4 \stackrel{?}{=} 0$
 $0 \stackrel{?}{=} 0$

Yes $y = -4x$ is a solution.

Test $y = -4x$

$\frac{dy}{dx} = -4$

$\frac{d^2y}{dx^2} = 0$

Sub: $7 \cdot 0 - 3 \cdot -4 + 2x \stackrel{?}{=} 0$
 $12 + 2x \stackrel{?}{=} 0$

Multi-variable Calculus.

Particular not a general solution.

Notation:

$7 \frac{d^2y}{dx^2} - 3 \frac{dy}{dx} + 2x = 0$

$7y'' - 3y' + 2x = 0$

$z = f(x, y)$

$\frac{\partial z}{\partial x}, \frac{\partial z}{\partial y}$

z' ← ambiguous



To test a proposed solution $y = f(x)$.

- 1) Find necessary derivatives.
- 2) Substitute into D.E.
- 3) Simplify
- 4) If equation is satisfied then $f(x)$ is a solution of the D.E.