Lecture 1

- Types of DE
- Slope fields
- Solve via separation of variables
- integrating factors

~~1.4~~ 1.5

ODE vs. PDE — Partial

$y(x)$ $u(x, y)$ ∂ (Partial)

$$\frac{dy(x)}{dx} \qquad \frac{\partial u(x,y)}{\partial x}$$

nth order

↑

n is the highest derivative

Dimens

Previous

$y'''(x) + y'(x) = 0$

$y(x)$ $\quad x^5$

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

linear vs. nonlinear

$$a_n(x)\frac{d^n y}{dx^n} + \dots + a_1(x)\frac{dy}{dx} + a_0(x)y = p(x)$$

$\cos(x)y''' + x^2 y = \sin(x)$

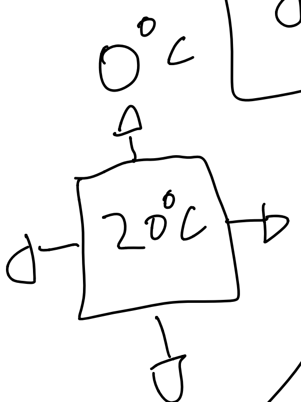
$y^2 \quad (y')^2$

$\sin(y) \dots$

↳ non-linear

Ex1 Newton's Law of cooling

$$\frac{dT}{dt} = -k(T - T_a)$$



$T(t)$: Temperature

t: time

T_a: Ambient Temp.

k: material cons. $k > 0$

$$\int \frac{dT}{-k(T-T_a)} = \int dt$$

$$\frac{1}{-k} \ln(T - T_a) = t + C$$

$$\cancel{e}^{\ln(T-T_a)} = e^{-kt+c}$$

$$T = T_a + e^{-kt+c}$$

$$T(0) = T_0$$

$$T_0 = T_a + \cancel{e} C_1$$

$$(T_0 - T_a) = C_1$$

$$T(t) = T_a + (T_0 - T_a)e^{-kt}$$

$t \to \infty$ $T(t) = T_a$

$$e^{-kt} \to 0$$

$T(t) = T_a$ ✓

$$\frac{dT}{dt} = -k(T - T_a)$$

Change in Temp in Time

difference in the current Temp and the ambient temp ...

... mult. by $k > 0$

$$\frac{dT}{dt} = 0 \quad T = T_a$$

$$T > T_a$$

$$\frac{dT}{dt} = -k(\Delta T)$$

$-$ $+$

$\ominus$

$T < T_a$

$$\frac{dT}{dt} = \oplus$$