Unit 1 Lesson 1 Notes: Conventions

- An exponential function is of the form
$$f(x) = e^{ax} \text{ where } a \text{ is a constant.}$$

- for positive a, e^{ax} dominates all polynomials

- for $y = f(x) = x^2$, y is a dependent variable and x is an independent variable

- A parameter is a place holder representing an infinite set of equations, for example C in
$$\int x^2 \, dx = \frac{x^3}{3} + C$$
which is a 1-parameter family of functions

- Derivative notation:
$$\frac{dy}{dx} = y' = Dy,$$
$$\frac{dx}{dt} = \dot{x}, \text{ and}$$
$$\frac{d^n x}{dy^n} = x^{(n)} = D^{(n)} x$$

- "A differential equation is an equation representing a relation between a function and its derivatives."

Basics of Differential Equations

- The order of a differential equation is highest n ~~derivitv~~ derivative in said equation;

$$\ddot{x} + 2\dot{x} + 7x = 0 \text{ is 2nd order,}$$

$$x^{(5)} + 3 = 0 \text{ is 5th order.}$$

- We can check if an x is valid by taking derivatives and checking for equality.

- Or, integrate:

$$\iint \ddot{x} = \iint 2t$$

$$\int \dot{x} = \int t^2 + C_1$$

$$x = \frac{t^3}{3} + C_1 t + C_2$$

- Given some initial values, such as $x(1) = 1$, $\dot{x}(1) = 2$, we can plug in

$$1 = \frac{1}{3} + C_1 + C_2,$$

$$2 = 1 + C_1, \text{ and thus}$$

$$C_1 = 1, \quad C_2 = -1/3$$

Unit 1 Lesson 1 Quiz: Conventions

Choices and logic

A: $y' = 2ce^{2x}$ $\neq 2ce^{2x} - 2 + 1$

B: $y' = 2x + 1$ $\neq 2(x^2 + x + c) + 1$

C: $y' = \frac{1}{2} e^{x/2}$ $\neq e^{x/2} + 2c + 1$

D: $y' = 2ce^{2x}$ $= 2(ce^{2x} - 1/2) + 1$ ✓

E: No, excess 1 on right side

F: