# Math 220, Week 1 Tuesday, Section 1.1

Spring 2020, XT

## 1.1 Background

1. Classify each as an ordinary differential equation (ODE) or a partial differential equation (PDE), give the order, and indicate the independent and dependent variables. If the equation is an ordinary differential equation, indicate whether the equation is linear or nonlinear.

(a) $5\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 9x = 2\cos 3t$

I.V. "t" D.V. "x"

2nd order ODE, Linear

(b) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$

2nd order PDE

I.V. x, y, D.V. u

(c) $y\left[1 + \left(\frac{dy}{dx}\right)^2\right] = C$, where $C$ is a constant

I.V: "x". D.V. "y"

1st order ODE

Nonlinear $\left(\frac{dy}{dx}\right)^2$ power 2

$y\left(\frac{dy}{dx}\right)^2$ product of y and $\frac{dy}{dx}$

(d) $\frac{dp}{dt} = kp(P - p)$, where $k$ and $P$ are constants

I.V. "t", D.V. "p". 1st order ODE

Nonlinear: $kp(P-p) = kpP - kp^2$ $kp^2$ - power 2 of p

2. Write a differential equation that fits the physical description.

(a) The velocity at time t of a particle moving along a straight line is proportional to the fourth power of its position $x$.

Position function $x = x(t)$, velocity at t: $\frac{dx}{dt}$

$\frac{dx}{dt} = kx^4$ k- constant

(b) The rate of change of the mass $A$ of salt at time $t$ is proportional to the square of the mass of salt present at time $t$.

rate of change of mass: $\frac{dA}{dt}$

$\frac{dA}{dt} = kA^2$ k- constant.