**Class 25** – **ODEs and Initial Value Problems (Chp. 22)**

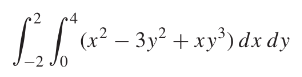
ChE310\_Sec1\_F2019 / 11.19.19

<http://www.reuelgroup.org/numerical-methods-che-310.html>

Announcements:

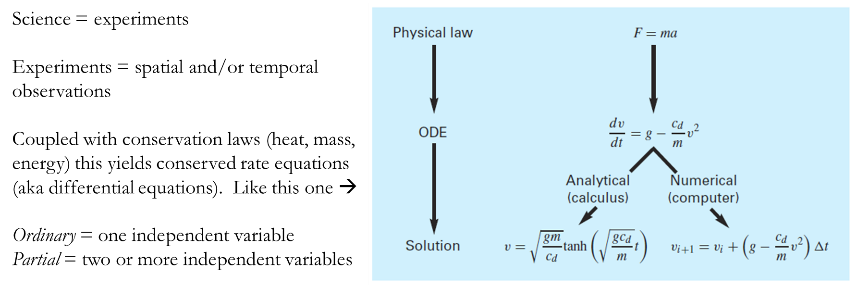
* Phase II memo returned. Class project due 12.10 for demo!
* Schedule review, Reuel absences in Dec.
* Final is Dec 19 from 7:30 to 9:30 AM

**Warm Up Group Activity:** submit to Slack by **2:20 pm**.

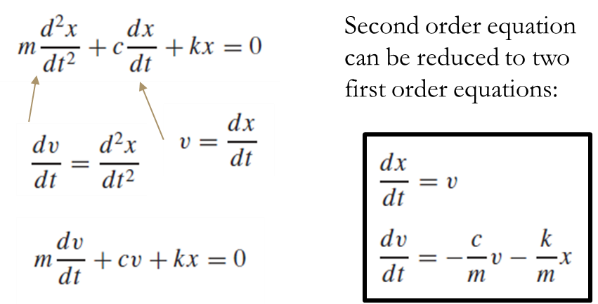
Solve with Matlab:

**Outline for Class 26 Lecture**

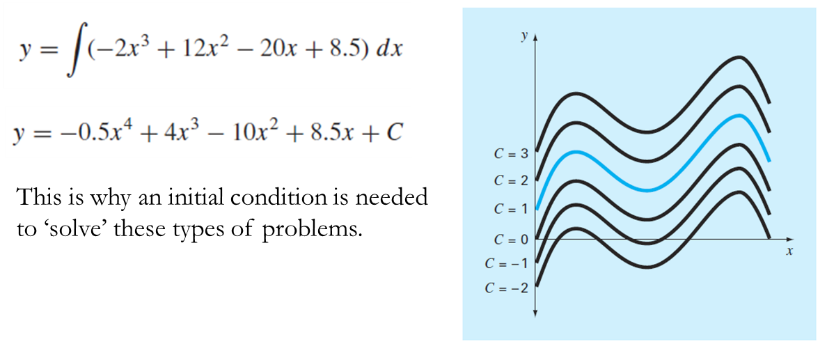
Ordinary differential equations (ODEs)



1. Order of equations



1. Need of an initial condition



1. Runge-Kutta methods (one step methods)

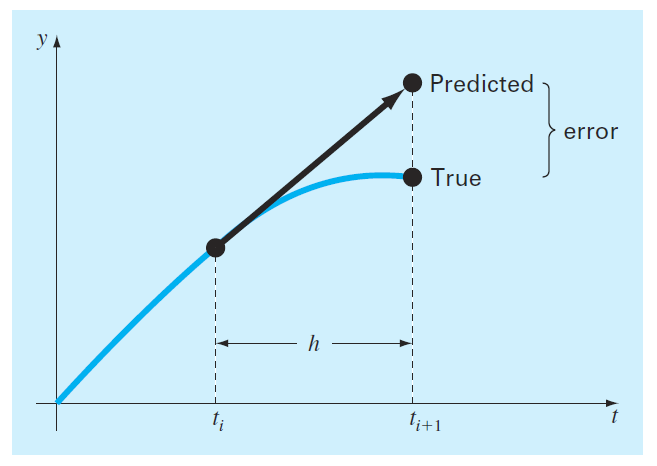




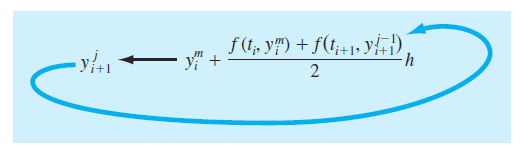
φ = increment function (method to calculate slope in interval)

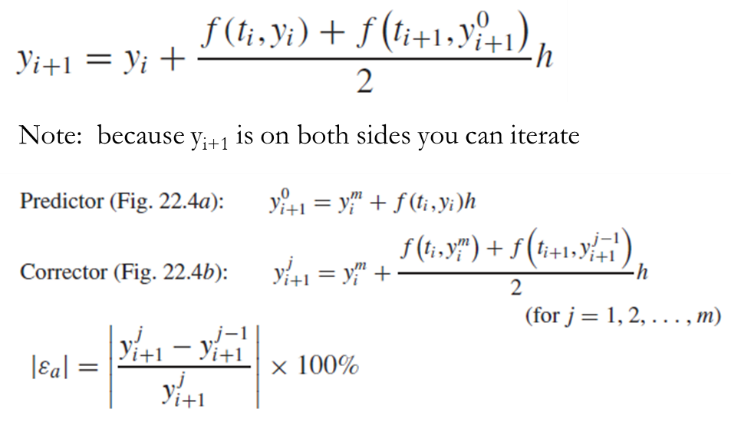
* 1. Euler
     1. You know so use directly for φ



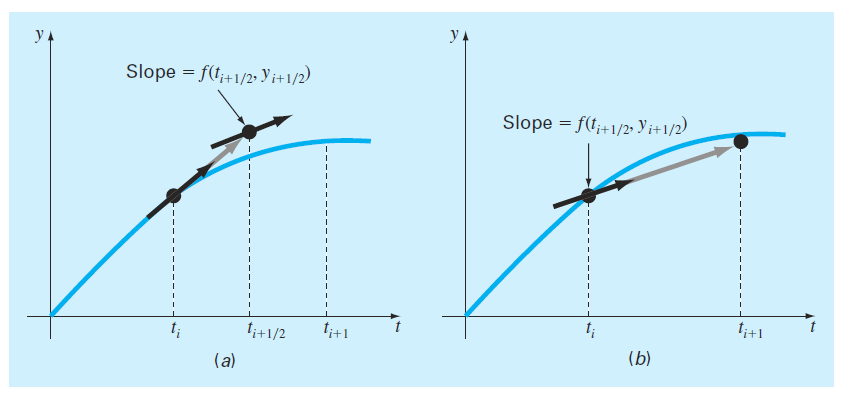
How to make better?

* 1. Huen – iterate on φ to make estimate better





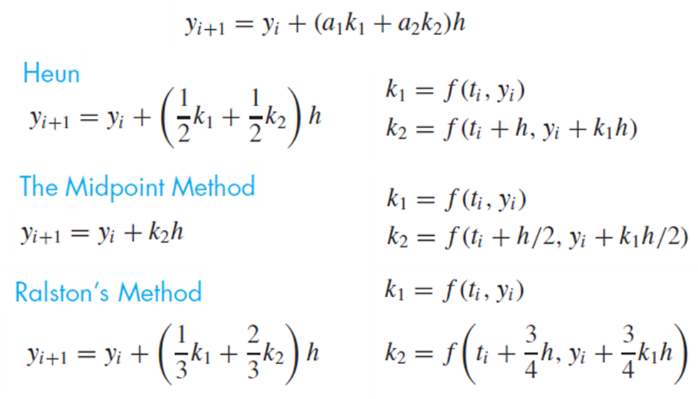
* 1. Midpoint – use slope of midpoint to improve Euler



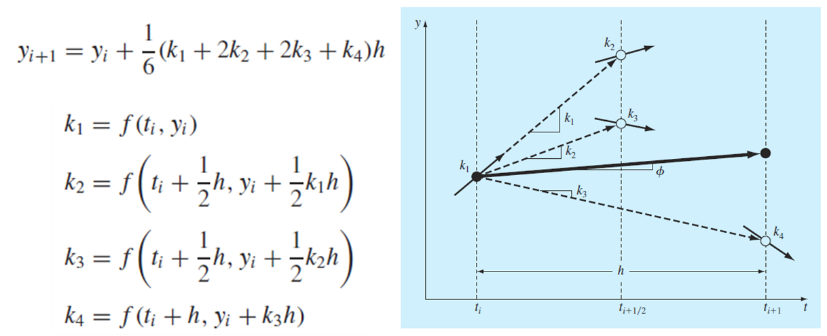
* 1. Runge Kutta Methods (2nd and 4th Order)

[Concept is to combine slope information at multiple points]

2nd Order



4th Order - Most common (good balance of computational cost and accuracy) called ‘*classical fourth order Runge Kutta’*



1. Systems of ODE
   1. Chapra equation – **rk4sys**
   2. Matlab built in – **ode45**
2. Phase plane plots (see handout)