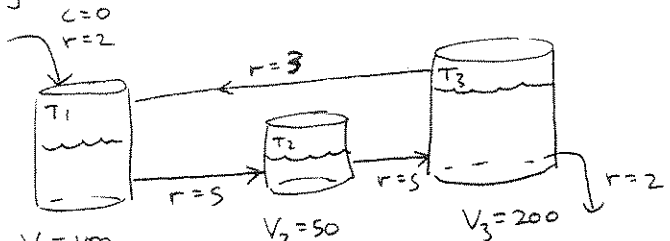
Math 2250-1
Tues 9/13

- Finish §2.3 – via last Friday's notes 9/9
  - quadratic drag set-up (page 4b)
  - remark on maple/matlab problems related to modeling drag. ~ homework
  - (no drag but) accounting for inverse square law of gravitation "escape velocity", (page 5)

Begin Chapter 3 (will post HW soon.)
We will digress from DE's to discuss linear algebra in chapters 3-4

Why?
- This is the context we need to discuss more complicated systems of DE's (also higher order DE's)

e.g. tank systems



vols	$V_1=100$	$V_2=50$	$V_3=200$
solute amts	$x_1(t)$	$x_2(t)$	$x_3(t)$

$$\frac{dx_1}{dt} = 3\frac{x_3}{V_3} - 5\frac{x_1}{V_1} = -\frac{5}{100}x_1 + \frac{3}{200}x_3$$

$$\frac{dx_2}{dt} = \frac{5x_1}{V_1} - 5\frac{x_2}{V_2} = \frac{5}{100}x_1 - \frac{5}{50}x_2$$

$$\frac{dx_3}{dt} = 5\frac{x_2}{V_2} - 5\frac{x_3}{V_3} = \frac{5}{50}x_2 - \frac{5}{200}x_3$$

Matrix form.

$$\begin{bmatrix} \frac{dx_1}{dt} \\ \frac{dx_2}{dt} \\ \frac{dx_3}{dt} \end{bmatrix} = \begin{bmatrix} -\frac{1}{20} & 0 & \frac{3}{200} \\ \frac{1}{20} & -\frac{1}{10} & 0 \\ 0 & \frac{1}{10} & -\frac{1}{40} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

$$\text{IVP} \begin{cases} \frac{d\vec{x}}{dt} = A\vec{x} \\ \vec{x}(t_0) = \vec{x}_0 \end{cases}$$

Why cont'd

- Chapter 3 begins with a review of the methods for solving linear systems of equations. These systems are pervasive in multivariable contexts.

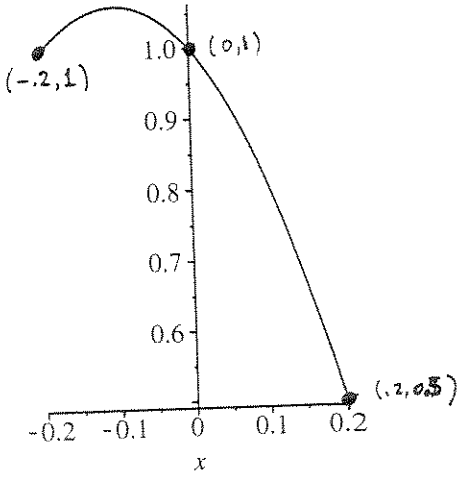
Example 1 : (relates to Hw).

Find the quadratic function

$$p(x) = ax^2 + bx + c$$

whose graph goes through the three points

$$(-h, y_{-1}), (0, y_0), (h, y_1)$$



$(-.2,1), (0,1), (.2,.5)$

$p(x) = 1 - \frac{5}{4}x - \frac{25}{4}x^2$!

$h = .2$

$y_{-1} = 1, \; y_0 = 1, \; y_1 = .5$

Example 2. Consider the 2nd order IVP

$$\begin{cases} y'' - 9y = 0 \\ y(0) = 7 \\ y'(0) = 9 \end{cases}$$

- Show $y(x) = Ae^{3x} + Be^{-3x}$ is always a soln to the DE (A, B constants)

$y' =$

$y'' =$

$y'' - 9y =$

- Solve the IVP. (You will need to solve a linear system to 2 eqns to get A & B).

sol'n
$y(x) = 5e^{3x} + 2e^{-3x}$

In §3.1-3.3 we will learn/review how to systematically solve linear systems of equations, using elementary equation operations; actually just recording coefficients and doing elementary row operations and Gaussian elimination. We start tomorrow.