Topics in Mathematical Physics (PHYS 320): 3 Spring 2019

(1) Slope fields with mathematica:
   (a) Explore the solution space of
   $$2u'(x) = 3(u(x) - 2)^{1/3}$$
   by plotting the slope field on a domain of $(-1, 3)$.
   (b) Find the 'general solution' to the non-linear equation. Add the specific or 'particular' (both terms are used) with $y(2) = 3$.
   (c) Now, find a specific solution to the differential equation that *cannot* be written as a specific case of the 'general' solution. Write the initial condition for this solution.
   (d) Plot this last solution, the specific solution of your general solution, and your slope field in one plot using `Show`.
   (e) Comment on the obvious lack of a true general solution in light of the existence and uniqueness theorems.

(2) Finish the problem of finding the number of particles of radon, $N_2(t)$ in the decay chain discussed in class on Tuesday.

Here are some mathematica snippets similar to what I used in class. I have used "ˆ" to designate the power symbol above the 6 on your keyboard. For the slope field plot I used
`Show[VectorPlot[{1, -2*x*yˆ2}, {x, -2, 2}, {y, -2, 2}, VectorStyle - > Arrowheads[0.017], VectorPoints - > Fine]`.
First just solving the ODE for a specific solution one can use,
`DSolve[{y'[x] == -2*x*y[x]ˆ2, y[-1] == .6}, y, x]`
Setting up the slope-field-with solution plot one can define a solution
`sol = DSolve[y'[x] == -2*x*y[x ]ˆ2, y, x]`
and for plot with a fixed constant
`Plot[Evaluate[y[x] /. sol /. {C[1] - > -2/3}], {x, -2, 2}]`
Typesetting the mathematica-speak was tricky - I hope I got it all correct here! Next time I should use the handy export to LaTex feature...