Physics 330: Spring 2020
Take Home Final Exam
due R 06/18 at Midnight

1. (50 points) MATLAB – **Quiver plot**

Consider two charges q and -2q at a distance of 2 units.

a) Calculate the electric potential on a 2d grid:

$$V(x,y) = \frac{q}{r_1} - \frac{2q}{r_2}$$

where r_1 and r_2 are the distances from each charge to the point (x,y) on the grid. Make a contour plot of $V(x,y)$.

b) Calculate the corresponding electric field $\mathbf{E}(x,y) = -\nabla V(x,y)$. Make a quiver plot of **E** superposing it to the contour plot of V.

c) Allow both charges to oscillate in time: $Q(t) = q\cos(t)$ and animate your plot.

2. (50 points) MATLAB – **Predator-prey simple model**

Consider the following system of 2 coupled nonlinear ODEs representing the populations of a predator $x(t)$ and its prey $y(t)$.

$$\frac{dx}{dt} = 2x - bxy$$

$$\frac{dy}{dt} = -2y + xy$$

where b is a control parameter. The linear terms represent the "natural" increase (decrease) of the prey (predator) population, while the nonlinear terms represent the predator-prey interaction.

a) **WITHOUT SOLVING THE EQUATIONS**, make a "flow plot" using the `quiver` command for three different values of b between 1 and 5.

b) Solve the equations for the same values of b and plot the prey population as a function of time. Use your flow plot to guide you in your choice of initial conditions.

Email me both scripts (email: berrondo@byu.edu). I will be able to give you partial credit more easily if you include enough comments in your code describing how you are trying to solve the problem.