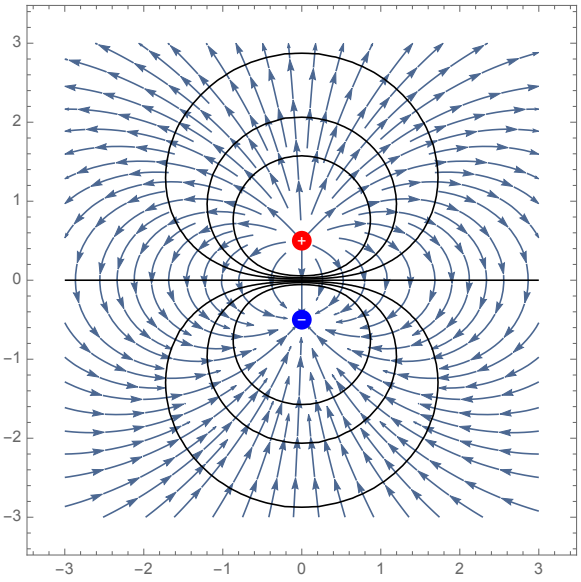
# Physics with Mathematica Fall 2019 Exercise #12 20 Nov 2019

Potential and Field from an Electric Dipole

An electric dipole is formed from two point charges $q = \pm 1$ which lie at positions $\pm 1/2$ on the $y$-axis. In units where the electric potential from a point charge $q$, located at position $\mathbf{r}_q$, is $V_q(\mathbf{r}) = q/|\mathbf{r} - \mathbf{r}_q|$, determine the electric potential $V(\mathbf{r}) = V(x, y)$ of the dipole. Then use the gradient operator to calculate the electric field $\mathbf{E}(\mathbf{r}) = -\boldsymbol{\nabla} V(\mathbf{r})$.

Use Show to overlay a contour plot of the electric potential with a StreamPlot of the electric field. Put these plots on a square grid covering $-1 \leq x, y \leq 1$. Draw a small solid red disk with a "+" sign in white in the middle of it, at the position of the positive charge. Similarly, draw a blue disk with "−" at the position of the negative charge. In other words, draw




You may need to review the use of Graphics to draw the dots with the symbols.

You get a gold star if you can make a nice looking figure using VectorPlot instead of StreamPlot for the electric field. (This is tricky because the electric field magnitude changes by a lot over the plot area.) If you are interested, the cover illustration for the textbook recommended for this course is uses VectorPlot3D to make a three dimensional version of this figure.

## Send the grader an email with your notebook as an attachment.