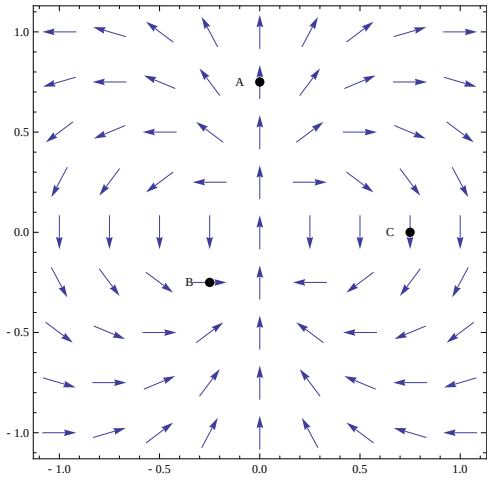

1 Energy of Four Charges

Three charges are situated at the corners of a square (side s). Two have charge $-q$ and are located on opposite corners. The third has charge $+q$ and is opposite an empty corner.

(a) How much work does it take to bring in another charge, $+q$, from far away and place it at the fourth corner?

(b) How much work does it take to assemble the whole configuration of four charges?

2 Magnetic Field and Current, Version II

Find the volume current density that produces the following magnetic field (expressed in cylindrical coordinates):

$$\vec{B}(\vec{r}) = \begin{cases} \dfrac{\mu_0 I s}{2\pi a^2}\hat{\phi} & s \leq a \\ \dfrac{\mu_0 I}{2\pi s}\hat{\phi} & a < s < b \\ 0 & s > b \end{cases} \tag{1}$$

What is a physical situation that corresponds to this current density?

3 Curl

Shown above is a two-dimensional cross-section of a vector field. All the parallel cross-sections of this field look exactly the same. Determine the direction of the curl at points A, B, and C.

4 Symmetry Arguments for Ampère's Law

Use good symmetry arguments to find the possible direction for the magnetic field due to a current carrying wire. Also, use good symmetry arguments to find the possible functional dependence of the magnetic field due to a current carrying wire. Rather than writing this up to turn in, you should find a member of the teaching team and make the arguments to them verbally.