**Static Fields Homework 9**

*Due 5/2/18 @ 4:00 pm*

Start your homework early and submit a question about it on Canvas before class on Tuesday!

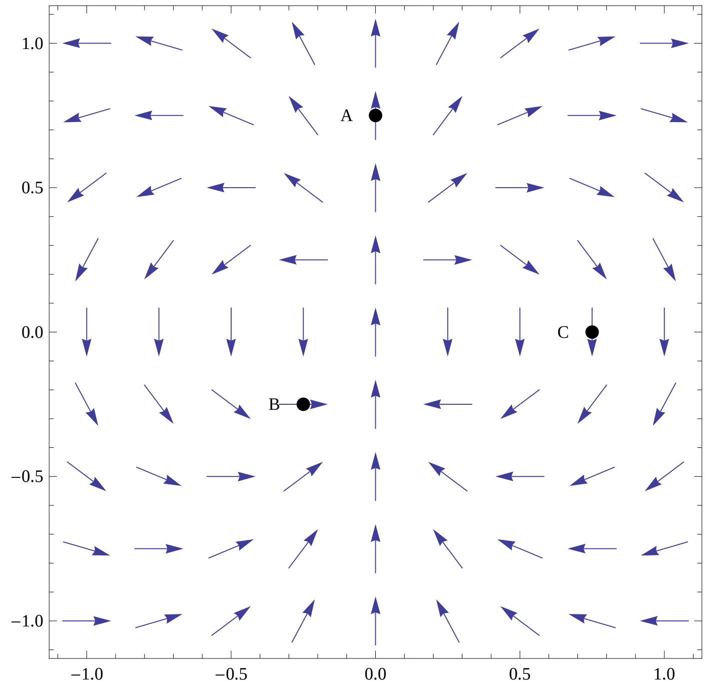
Remember that you should do some sense-making about every problem and result (*e.g.,* describe how you know a result is correct, interpret your answer non-symbolically, or describe new physics insight you gained). Solutions that contain exceptional sense-making will receive bonus points.

**PRACTICE:**

1. Calculate the curl of each of the following vector fields. You may look up the formulas for curl in curvilinear coordinates.
   (a) $\vec{\boldsymbol{F}} = z^2\,\hat{x} + x^2\,\hat{y} - y^2\,\hat{z}$
   (b) $\vec{\boldsymbol{G}} = e^{-x}\,\hat{x} + e^{-y}\,\hat{y} + e^{-z}\,\hat{z}$
   (c) $\vec{\boldsymbol{H}} = yz\,\hat{x} + zx\,\hat{y} + xy\,\hat{z}$
   (d) $\vec{\boldsymbol{I}} = x^2\,\hat{x} + z^2\,\hat{y} + y^2\,\hat{z}$
   (e) $\vec{\boldsymbol{J}} = xy\,\hat{x} + xz\,\hat{y} + yz\,\hat{z}$
   (f) $\vec{\boldsymbol{K}} = s^2\,\hat{s}$
   (g) $\vec{\boldsymbol{L}} = r^3\,\hat{\phi}$

**REQUIRED:**

1. A current $I$ flows down a wire of radius $a$.
   (a) If it is uniformly distributed over the surface, give a formula for the surface current density $\vec{K}$.
   (b) If it is distributed in such a way that the volume current density, $|\vec{J}|$, is inversely proportional to the distance from the axis, give a formula for $\vec{J}$.




2. Shown above is a two-dimensional vector field.

   (a) Determine whether the divergence at point A and at point C is positive, negative, or zero.

   (b) Determine the direction of the curl at points A, B, and C.

3. Find the magnetic vector potential for an infinite sheet of current (you may want to perform your integral by comparing it to the electric potential due to an infinite sheet of charge). In addition to your usual sense-making, show the behavior of the vector potential using vector field maps.

4. Find the magnetic vector potential for a finite segment of straight wire, carrying a uniform current $I$. Put the wire on the $z$ axis, from $z_1$ to $z_2$. In addition to your usual sense-making, show the behavior of the vector potential using vector field maps.