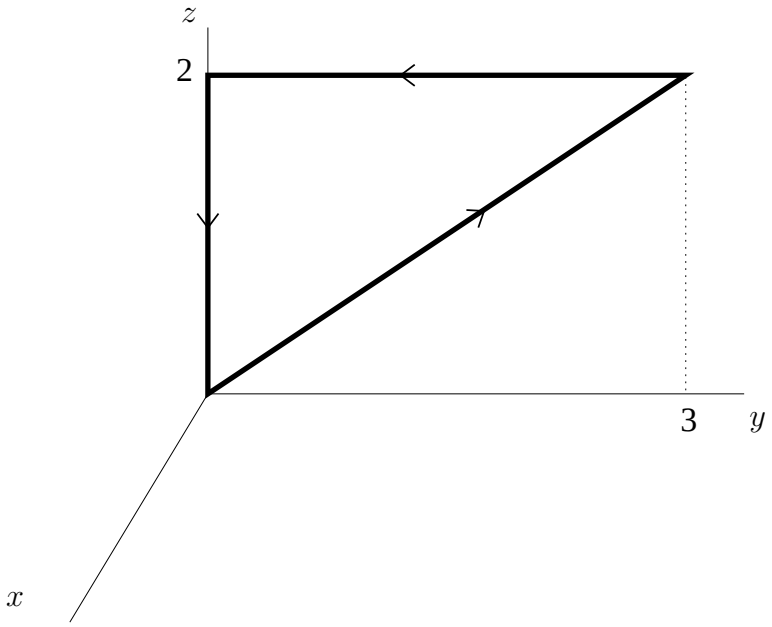
PHYS 333 — Exam #1
Friday, September 19, 2014

Name:_____

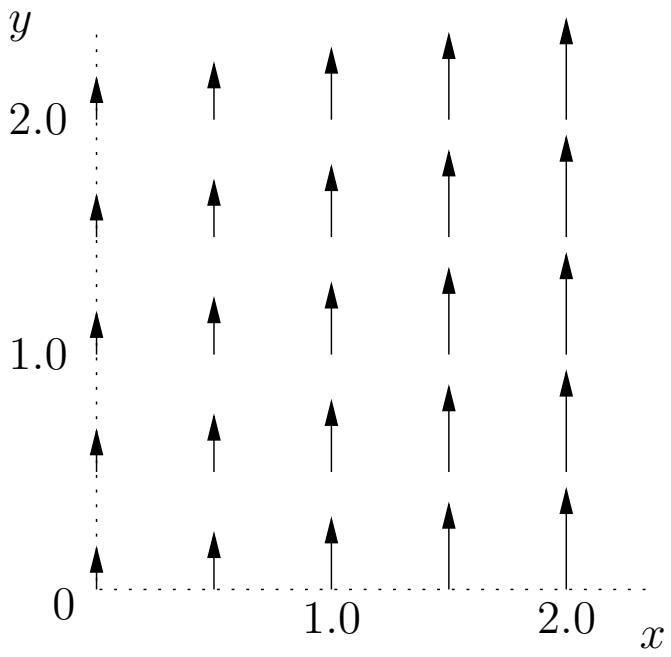
1. (30 pts) Consider the following vector field:

$$\mathbf{v}(\mathbf{r}) = (x+3)\,\hat{\mathbf{x}} + x\,\hat{\mathbf{y}} + y\,\hat{\mathbf{z}}.$$

Test Stokes Theorem, a.k.a. the Curl Theorem, a.k.a. the Fundamental Theorem for Curls, for the illustrated path.



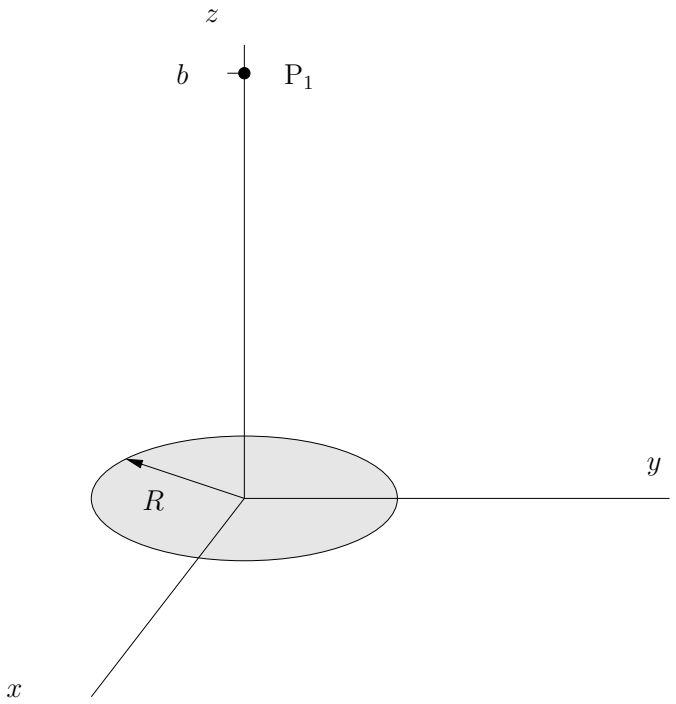
2. (10 pts) Consider the illustrated vector field. Assume that the field is the same in all planes parallel to the illustrated plane, i.e., the field at a point doesn't change as you move into or out of the page.



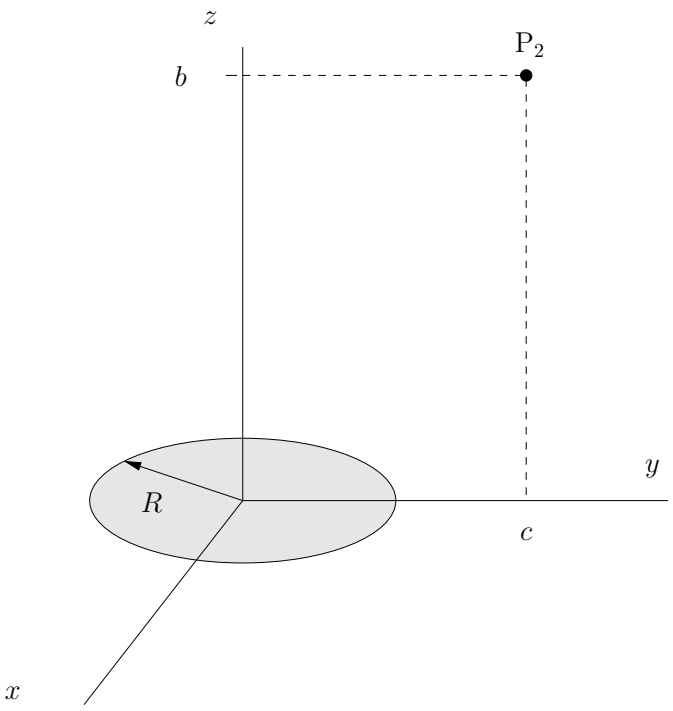
(a) Is the divergence of the field **at the center** of the illustrated region ($x = 1$, $y = 1$) positive, negative, or zero? Explain your reasoning.

(b) Is the z-component of the curl of the field **at the center** of the illustrated region ($x = 1$, $y = 1$) zero or non-zero? Explain your reasoning.

3. Consider the illustrated flat disk with radius R. The disk is covered with a uniform surface charge density σ.



(a) (24 pts) Determine an expression for the electric field at point $\mathbf{P}_1$ a distance b above the center of the disk. You do not need to evaluate any integrals, but the integrand, the variable(s) of integration, and the limits should be given. (Your expression should be in a form that could be evaluated by a calculator or computer.)



(b) (6 pts) Determine an expression for the electric field at point $\mathbf{P}_2$ a distance b above the plane of the disk and a distance c off center. You do not need to evaluate any integrals, but the integrand, the variable(s) of integration, and the limits should be given. (Your expression should be in a form that could be evaluated by a calculator or computer.)

4. (a) 22 (pts) An infinite plane carries a uniform surface charge density σ. Find the electric field everywhere. (You may assume that the plane is the x-z plane.)

   (b) (8 pts) Two infinite parallel planes carry equal but opposite surface charge densities, σ and $-\sigma$. Find the the electric field in each of the three regions: (i) to the left of both, (ii) in between them, and (iii) to the right of both.