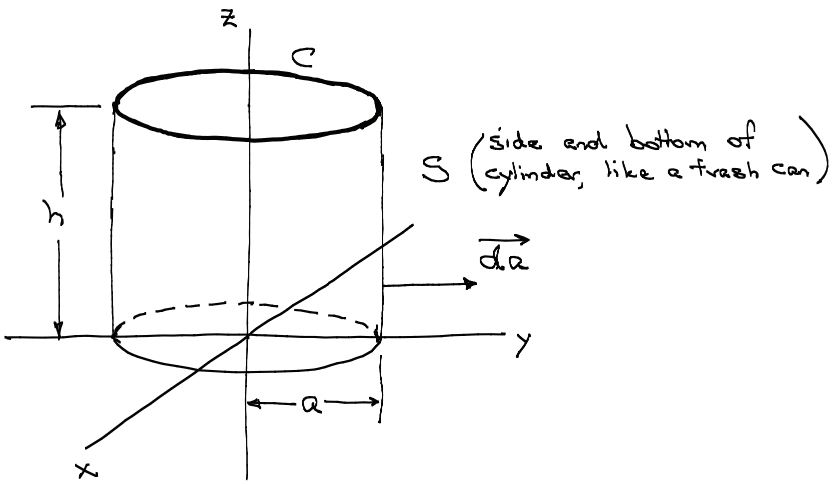
**Phys 366 Mathematical Methods of Physics Fall 2016**

**Homework Assignment #5 Due Friday, September 30**
**(40 points) (at lecture)**

5.4 (10 points) Challenge problem. Consider a vector field $\mathbf{A}$ defined in cylindrical coördinates by

$$\mathbf{A} = L\rho\,\hat{\mathbf{e}}_\phi + M\rho\sin\phi\,\hat{\mathbf{e}}_z\ ,$$

where $L$ and $M$ are constants. The drawing shows a cylinder of radius $a$ and height $h$, whose bottom lies in the $x$-$y$ plane. Let the surface $S$ consist of the side and the bottom of the cylinder ($S$ is like a trash can; it does not include the top of the cylinder), and let $d\mathbf{a}$ be the outward-directed area element on $S$, as indicated.




(a) *Evaluate* the surface integral

$$\int_S \nabla\times\mathbf{A}\cdot d\mathbf{a}$$

directly by doing the integral over the surface $S$.

(b) *Evaluate* the same surface integral by using Stokes's theorem to convert the surface integral into a line integral.

(c) *Evaluate* the same surface integral by using Stokes's theorem to convert the integral over $S$ into a surface integral over some other surface than that specified in part (a).