Department of Physics, IIT-Kanpur
PHY103A/N, 2014-15, Sem-II

Name:..... Roll No:..... Section: T

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1. Evaluate curl of the vector function $\mathbf{A} = A_0\hat{\phi}/s$ everywhere. Here, A_0 is a constant and ϕ and s are cylindrical coordinates. [**6** marks]
   In cylindrical coordinates,

$$\boldsymbol{\nabla} \times \mathbf{V} = \Big[\frac{1}{s}\frac{\partial V_z}{\partial \phi} - \frac{\partial V_\phi}{\partial z}\Big]\,\hat{s} + \Big[\frac{\partial V_s}{\partial z} - \frac{\partial V_z}{\partial s}\Big]\,\hat{\phi} + \frac{1}{s}\Big[\frac{\partial (sV_\phi)}{\partial s} - \frac{\partial V_s}{\partial \phi}\Big]\,\hat{z}.$$

2. The electrostatic potential due to some charge configuration is given by

$$V(x, y, z) = -\frac{V_0}{a^4}(x^2yz + xy^2z + xyz^2),$$

where V_0 and a are constants. Calculate charge density in the xy plane and at the point $P(a, a, a)$. [**6**]

3. A thick metallic shell of inner radius a and outer radius b has a charge Q on it. A point charge q is kept at the center of the shell. Calculate charge on each surface of the shell. Also, calculate electric field and potential everywhere. [**7**]

4. Consider an infinitely-long cylinder of radius R carrying a non-uniform volume charge density $\rho = ks^2$, with k being a constant. Using Gauss's law, find the electric field everywhere. [**6**]