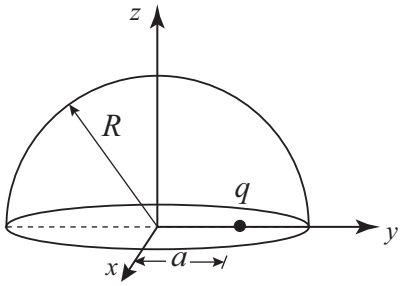
Department of Physics
IIT Kanpur, Semester II, 2017-18

PHY103A: Physics II **Quiz # 1** **Time: 15 Minutes** **Max Marks: 10**

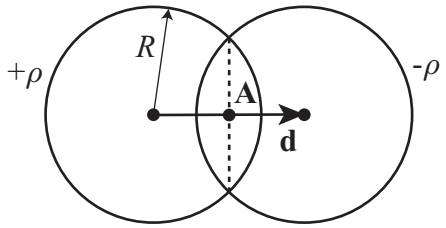
Name: ..... **Roll No.:** .....

Problem 1: The separation vector can be written as $\mathbf{R} = (x - x')\hat{\mathbf{x}} + (y - y')\hat{\mathbf{y}} + (z - z')\hat{\mathbf{z}}$. If $R = |\mathbf{R}|$ is the magnitude of the separation vector, calculate the gradient $\boldsymbol{\nabla} R$. (2.5 Marks)

Problem 2: Consider a hemispherical bowl of radius R. A charge q is placed at a distance a from the center of the bowl as shown in the figure. Calculate the total electric flux through the hemispherical surface. (2.5 Marks)



Problem 3: Two spheres, each of radius R and carrying charge densities $+\rho$ and $-\rho$, respectively, are placed so that they partially overlap. Call the vector from the positive center to the negative center **d**. Find the field at a point **A** midway between the centers in the overlap region. (2.5 Marks)



Problem 4: Consider two concentric spherical shells, of inner and outer radii a and b, respectively. Suppose the inner one carries a charge q, and the outer one a charge -q (both of them uniformly distributed over the surface). Calculate the energy of this configuration. (2.5 Marks)