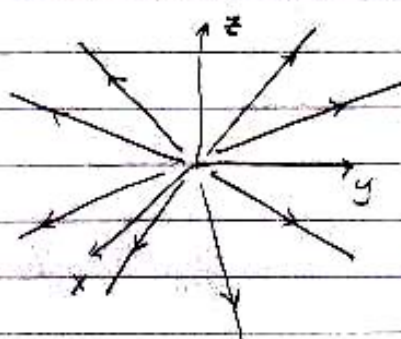


PHYS 13, F06
S. SEN

Set 1A3 Math Preliminaries

1. Find a solution for the Laplace's equation $\nabla^2 \Phi = 0$ that depends only on the absolute value r of the radius vector

2. Consider the vector function $\vec{F}(\vec{r}) = \vec{r}$. Calculate the divergence and curl of $\vec{F}(\vec{r})$, the flux through a sphere centered at the origin, and the circulation around any circle on the sphere. Verify that Gauss' theorem and Stokes' theorem are obeyed.



We show the tangent curves of $F(\vec{r}) = \vec{r}$. Tangent curves are a family of curves everywhere tangent to the vectors.

Problem 2

3. Consider the vector function $\vec{G}(\vec{r}) = \hat{k} \times \vec{r}$. In cylindrical coordinates, $\vec{G}(\vec{r}) = \hat{\phi} r$ where $r = \sqrt{x^2 + y^2}$. Find the curl and divergence, the circulation around a circle parallel to the x - y plane centered at the z -axis, and the flux through a sphere centered at the origin. Verify that Stokes' theorem and Gauss' theorem are obeyed.