1. **Find the equation of the tangent plane to the ellipsoid** $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ **at the point** $(x_0, y_0, z_0)$ **on the ellipsoid.**

2. **Prove that for any vector field** $\vec{\mathbf{A}}$**,** $\vec{\nabla} \cdot \vec{\mathbf{A}}$ **is a scalar.**

3. **Let** $\vec{\mathbf{A}} = \vec{\omega} \times \vec{\mathbf{r}}$ **where** $\vec{\omega}$ **is a fixed vector in space. Find** $\vec{\nabla} \times \vec{\mathbf{A}}$**.**

4. **Find the divergence of the following:**
   (a) $\vec{\mathbf{A}} = \hat{\mathbf{r}}$ **,**
   (b) $\vec{\mathbf{A}} = \frac{\hat{\mathbf{r}}}{r}$ **in 2 dimension**
   (c) $\vec{\mathbf{A}} = \frac{\hat{\mathbf{r}}}{r}$ **in 3 dimension**
   (d) $\vec{\mathbf{A}} = \frac{\hat{\mathbf{r}}}{r^2}$ **in 3 dimension. Plot this field.**
   (e) $\vec{\mathbf{A}} = \frac{\hat{\mathbf{r}}}{r^3}$ **in 3 dimension**

5. **Find the curl of the following:**
   (a) $\vec{\mathbf{A}} = y\hat{\mathbf{i}} - x\hat{\mathbf{j}}$
   (b) $\vec{\mathbf{A}} = \frac{1}{\sqrt{x^2+y^2}}(y\hat{\mathbf{i}} - x\hat{\mathbf{j}})$
   (c) $\vec{\mathbf{A}} = \frac{1}{x^2+y^2}(y\hat{\mathbf{i}} - x\hat{\mathbf{j}})$
   (d) $\vec{\mathbf{A}} = (x^2 + y^2)\hat{\mathbf{k}}$

6. **For any vector field** $\vec{\mathbf{A}}$ **and any scalar field** $F$ **show that**
   **(i)** $\vec{\nabla} \cdot (\vec{\nabla} \times \vec{\mathbf{A}}) = 0$ **;** **(ii)** $\vec{\nabla} \times (\vec{\nabla} F) = 0$**.**

7. **Can we find a scalar function** $F$ **such that** $\vec{\nabla} F = y\hat{\mathbf{i}} - x\hat{\mathbf{j}}$ **?**
   **What about** $\vec{\nabla} F = \frac{1}{x^2+y^2}(y\hat{\mathbf{i}} - x\hat{\mathbf{j}})$ **?**