1. **Calculate the laplacian of the following:**
   (i) $F = x^2 + 2xy + 3z + 4$ **(ii)** $F = \sin(\hat{\mathbf{k}} \cdot \vec{\mathbf{r}})$ **(iii)** $F = \frac{1}{r}$

2. **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) $\vec{\mathbf{A}} = (x^2 + y^2)\hat{\mathbf{k}}$

3. **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)** $\vec{\nabla} \times (\vec{\nabla} F) = 0$.

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

5. **Using the expressions for $\vec{\nabla} \cdot (\vec{A} \times \vec{B})$ and $\vec{\nabla} \times (\vec{A} \times \vec{B})$ evaluate $\vec{\nabla} \cdot (\vec{\omega} \times \vec{r})$ and $\vec{\nabla} \times (\vec{\omega} \times \vec{r})$ where $\vec{\omega}$ is a constant vector.**

6. **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.**