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. **Evaluate** $(\hat{r} \cdot \vec{\nabla})r$ **and** $(\hat{r} \cdot \vec{\nabla})\hat{r}$

3. **Find the volume of an ellipsoid** $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ **using the tripple integral** $\int\int\int dxdydz$ **with appropriate limits.**

4. **Consider** $\vec{\mathbf{A}} = x^2\hat{\mathbf{i}} + y^2\hat{\mathbf{j}} + z^2\hat{\mathbf{k}}$

   (a) **Evaluate** $\oint_S \vec{\mathbf{A}} \cdot \vec{\mathbf{da}}$ **where** S **is a cubical surface given by the planes** $x = a \pm l;\quad y = b \pm l;\quad z = c \pm l$**.**

   (b) **Verify that at the point** (a, b, c)**,**

$$\vec{\nabla} \cdot \vec{A} = \lim_{l \to 0} \frac{1}{8l^3} \oint_S \vec{\mathbf{A}} \cdot \vec{\mathbf{da}}$$

5. **Evaluate** $\int_P^Q \vec{\mathbf{A}} \cdot \vec{\mathbf{dl}}$ **for** $\vec{\mathbf{A}} = y\hat{\mathbf{i}} - x\hat{\mathbf{j}}$ **along the following paths :** $P \equiv (-a, 0);\quad Q \equiv (a, 0)$**.**

   (a) $(-a, 0) \to (0, a) \to (a, 0)$

   (b) $(-a, 0) \to (0, -a) \to (a, 0)$

   (c) a loop, forward along (a) and backward along (b)

   (d) Let I **be the value of the loop integral evaluated in (c). Let** S **be the flat area enclosed by the loop. Verify that at the origin**

$$(\vec{\nabla} \times \vec{A}) = \left[\lim_{a \to 0} \frac{I}{S}\right](-\hat{k})$$

   (e) Can we find a scalar function F **such that** $\vec{\nabla}F = y\hat{\mathbf{i}} - x\hat{\mathbf{j}}$ **?**