**Q.1** Use Green’s theorem to evaluate the line integral

\[
\oint_C \left( y^2 dx + 3xy dy \right),
\]
where \( C \) is the closed curve which is the boundary of the region bounded by the graphs of the equations \( y = x^3 \) and \( y^2 = x \).

**Answer:** \( \frac{1}{8} \).

**Q.2** Evaluate the surface integral

\[
\iint_S (x^2 + z^2) dS,
\]
where \( S \) is the surface of the graph of \( x^2 + y^2 - z^2 = 0 \) with \( 1 \leq z \leq 4 \).

**Answer:** \( \frac{45\sqrt{2}}{4} \pi \).

**Q.3** If \( \textbf{F} = -xi - yj + zk \) and \( S \) is the portion of the graph \( 2z = x^2 + y^2 \) cut off by the planes \( z = 1 \) and \( z = 2 \), find the flux of \( \textbf{F} \) through the surface \( S \).

**Answer:** \( 18\pi \).

**Q.4** If \( \textbf{F} = 2xi - yj - zk \) and \( S \) is the surface of the sphere \( x^2 + y^2 + z^2 = 4 \), verify the Divergence theorem.

**Q.5** Use Divergence theorem to find the flux of the force \( \textbf{F} = yi - xj + zk \) through the surface \( S \) of the region bounded by the graphs of \( 3z = 4 - x^2 - y^2 \) and \( z = \sqrt{x^2 + y^2} \).

**Answer:** \( \frac{\pi}{2} \).

**Q.6** Let \( \textbf{F} = -yi + xj - zk \) and \( S \) be the surface of the paraboloid \( z = 1 + x^2 + y^2 \) inside the cylinder \( x^2 + y^2 = 1 \). Evaluate the surface integral

\[
\iint_S (\nabla \times \textbf{F}) \cdot \textbf{n} dS.
\]

**Answer:** \( 2\pi \).

**Q.7** Let \( \textbf{F} = yi - xj + zk \) and \( S \) be the surface of the graph of \( z = 6 - x^2 - y^2 \) inside the cylinder \( x^2 + y^2 = 2 \). Verify the Stokes theorem.

**Answer:** Each side is \( -8\pi \).