1. Use spherical coordinates to find the center of mass of the solid region given by \( x^2 + y^2 + z^2 \leq 1, y \geq 0 \), with density 1.

2. Evaluate \( \iiint_E \sqrt{x^2 + z^2} \, dV \), where \( E \) is the region bounded by the paraboloid \( y = x^2 + z^2 \) and the plane \( y = 4 \).

3. Evaluate the line integral \( \int_C xy \, ds \) where \( C \) is the right half of the circle \( x^2 + y^2 = 16 \) with clockwise orientation.

4. Use cylindrical coordinates to find the moment of inertia \( I_z \) of the solid with constant density above the paraboloid \( z = x^2 + y^2 \) and below the cone \( z = \sqrt{x^2 + y^2} \).

5. Find the surface area of the part of the surface \( y = z^2 - x^2 \) that is inside the cylinder \( x^2 + z^2 = 4 \).

6. Find a parametric representation for the cylinder \( x^2 + y^2 = 4, 0 \leq z \leq 1 \).

7. Use integration in spherical coordinates to find the mass \( m \) and the moment \( M_{xy} \) of the solid region inside the sphere \( \rho = 3 \), below the cone \( \phi = \pi/3 \) and above the plane \( \phi = \pi/2 \).

8. Find the volume of the solid that lies in the first octant, above the cone \( \phi = \pi/6 \) and below the sphere \( \rho = 2\sqrt{2} \cos \phi \).

9. Evaluate the line integral \( \int_C \mathbf{F} \cdot d\mathbf{r} \), where \( \mathbf{F} = xi + yj + zk \) and \( C \) is the curve \( x = e^t, y = e^t, z = e^{-t}, 0 \leq t \leq \ln 2 \).

10. Evaluate the iterated integral \( \int_0^2 \int_{\sqrt{4-y^2}}^{\sqrt{x^2+y^2}} xzdz \, dy \) by changing to cylindrical coordinates.

11. Find an equation of the tangent plane to the surface with parametric equations \( x = u^2, y = v^2, z = u + 2v \) at \((1,1,3)\).

12. Evaluate \( \int_0^2 \int_0^{\sqrt{4-x^2}} \int_0^{\sqrt{8-x^2-y^2}} xyzdz \, dy \, dx \) by changing to spherical coordinates.

13. Find the curl and the divergence of the vector fields \( \mathbf{F}(x,y,z) = \frac{x}{y}i + \frac{y}{z}j + \frac{z}{x}k \) and \( \mathbf{G}(x,y,z) = \frac{x}{\sqrt{x^2 + y^2 + z^2}}i + \frac{y}{\sqrt{x^2 + y^2 + z^2}}j + \frac{z}{\sqrt{x^2 + y^2 + z^2}}k \).

14. Use a potential to evaluate \( \int_{(0,0)}^{(2,\pi)} \cos y \, dx - x \sin y \, dy \).

15. Apply Green’s theorem to evaluate \( \oint_C x \, dx + xy \, dy \), where \( C \) is the boundary of the region between the curves \( y = x^2 \) and \( y = 8 - x^2 \).