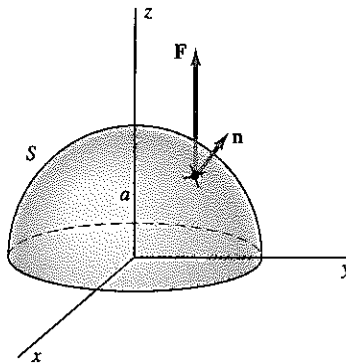
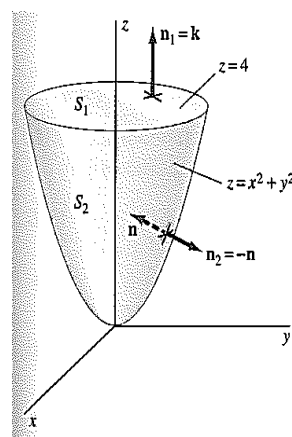


- Find the work done in moving a particle from $(0,0)$ to $(1,1)$ in the force field $\vec{F} = (xy + 2y^2)\vec{i} + (3x^2 + y)\vec{j}$ along the paths, (a) $y = x^2$; (b) $y = x$; (c) the y -axis and then $y = 1$. What work is done if the particle moves from $(0,0)$ to $(1,1)$ along path (b) and returns to the origin along path (a)?
- Prove that the vector field $\vec{F} = (3x^2 - y)\vec{i} + (2yz^2 - x)\vec{j} + 2y^2z\vec{k}$ is conservative, but not solenoidal. Hence find a scalar function $f(x, y, z)$ such that $F = \nabla f$ and evaluate $\int_C \vec{F} \cdot d\vec{r}$ along any curve C joining the point $(0,0,0)$ to the point $(1,2,3)$.
- Calculate the flux $\iint_S \vec{f} \cdot \vec{n} dS$ where $\vec{f} = v_0 \vec{k}$ and S is the hemispherical surface of radius a with equation $z = \sqrt{a^2 - x^2 - y^2}$ and with outer unit normal vector $\vec{n}$.

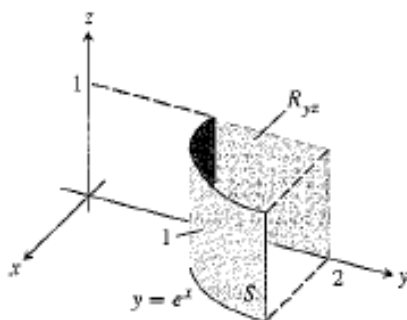


- Find the flux of the vector field $\vec{f} = x\vec{i} + y\vec{j} + 3\vec{k}$ out of S , where S is the closed surface of the region bounded by the paraboloid $z = x^2 + y^2$ and the plane $z = 4$. (i.e. to find $\iint_S \vec{F} \cdot d\vec{S}$.)



- Consider the magnetic field $\vec{B} = (x + 2)\vec{i} + (1 - 3y)\vec{j} + 2z\vec{k}$ and evaluate the total magnetic flux through each of the faces of the cube bounded by the planes $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$. Check that your result is consistent with the divergence theorem.

6. Use the divergence theorem to show that $\iint_S (x^2 + y + z) dS = \frac{4}{3}\pi$ where W is the solid ball $x^2 + y^2 + z^2 \leq 1$ and S is its boundary.
7. Verify the divergence theorem for the vector field $\vec{F} = (8 + z)\vec{j} + z^2\vec{k}$ and the region bounded by the planes $z = 0$, $z = 6$, $x = 2$, $y = 0$ and the surface $y^2 = 8x$ in the first octant.
8. Verify Stokes's theorem for the vector field $\vec{F} = (x - y)\vec{i} + 2z\vec{j} + x^2\vec{k}$ where S is the cone $z = \sqrt{x^2 + y^2}$ for $x^2 + y^2 \leq 4$.
9. Verify Stokes's theorem by evaluating both sides of $\iint_S \nabla \times \vec{F} \cdot \vec{n} dS = \oint_C \vec{F} \cdot d\vec{r}$ for the vector field $\vec{F} = (2x - y)\vec{i} - yz^2\vec{j} - y^2z\vec{k}$ where S is the curved surface of the hemisphere $x^2 + y^2 + z^2 = 16$, $z \geq 0$ and C is its boundary.
10. Let S be the portion of the cylinder $y = e^x$ in the first octant that projects parallel to the x -axis onto the rectangle $R_{yz} : 1 \leq y \leq 2, 0 \leq z \leq 1$ in the yz -plane. Let $\vec{n}$ be the unit vector normal to S that points away from the yz -plane. Find the flux of the field $\vec{F}(x, y, z) = -2\vec{i} + 2y\vec{j} + z\vec{k}$ across S in the direction of $\vec{n}$.



11. Let $\vec{F} = (y^2 - z^2)\vec{i} + (z^2 - x^2)\vec{j} + (x^2 - y^2)\vec{k}$. Use Stoke's Theorem to calculate $\oint_C \vec{F} \cdot d\vec{r}$ where C is the path which is the intersection of the plane $x + y + z = 2$ and the faces of a parallelepiped bounded by the planes $x = 0$, $x = 1$, $y = 0$, $y = 1$, $z = 0$, $z = 2$. The direction of the path C is anticlockwise when looking from the positive direction of x -axis.

-End-