

(1) Find the surface area of the part of the plane $z = 2 + 3x + 4y$ that lies above the rectangle $[0, 5] \times [1, 4]$.

(2) Find the surface area of the part of the surface $z = xy$ that lies within the cylinder $x^2 + y^2 = 1$.

(3) Evaluate $\int \int \int_E 2x \, dV$ where $E = \{(x, y, z) \in \mathbb{R}^3 \mid y \in [0, 2], x \in [0, \sqrt{4 - y^2}], z \in [x, 2x]\}$.

(4) Compute $\int \int \int_E 6xy \, dV$ where E lies under the plane $z = 1 + x + y$ and above the region in the xy -plane bounded by the curves $y = \sqrt{x}$, $y = 0$ and $x = 1$.

(5) Compute $\int \int \int_E xz \, dV$ where E is the solid tetrahedron with vertices $(0, 0, 0)$, $(0, 1, 0)$, $(1, 1, 0)$ and $(0, 1, 1)$.

(6) Evaluate $\int \int \int_E x^2 \, dV$ where E is the solid that lies within the cylinder $x^2 + y^2 = 1$, above the plane $z = 0$ and below the cone $z^2 = 4x^2 + 4y^2$.

(7) Evaluate the triple integral $\int \int \int_B (x^2 + y^2 + z^2) \, dV$ where B is the solid unit ball $x^2 + y^2 + z^2 \leq 1$.

(8) Find the surface area of the part of the plane $3x + 2y + z = 6$ that lies in the first octant.

(9) Use cylindrical coordinates to evaluate the integral

$$\int \int \int_E \sqrt{x^2 + y^2} \, dV$$

where E is the solid that lies inside the cylinder $x^2 + y^2 = 16$ and between the planes $z = -5$ and $z = 4$.

(10) Use spherical coordinates to evaluate the integral

$$\int \int \int_E z \, dV$$

where E is the solid that lies between the spheres $x^2 + y^2 + z^2 = 1$ and $x^2 + y^2 + z^2 = 4$ in the first octant.

(11) Compute the Jacobian determinant of the transformation $x = uv$, $y = vw$, $z = uw$.

(12) Use the transformation $x = 2u$, $y = 3v$ to evaluate $\int \int_R x^2 dA$ where R is the region bounded by the ellipse $9x^2 + 4y^2 = 36$.

(13) Compute the gradient vector fields of the following functions:

(i) $f(x, y, z) = \sqrt{x^2 + y^2 + z^2}$

(ii) $f(x, y,) = \ln(x + 2y)$

(14) Compute the following line integrals, where C is the given curve:

(i) $\int_C y \sin z ds$, C is the circular helix given by $t \mapsto (\cos t, \sin t, t)$ for $t \in [0, 2\pi]$.

(ii) $\int_C xy dx + (x - y) dy$ where C is the line segment from $(0, 0)$ to $(2, 0)$ followed by the line segment from $(2, 0)$ to $(3, 2)$.