

1. Compute $\int_C f(x, y) ds$, where $f(x, y) = x^2 + y^2$ and C is the curve given by $x = 4t, y = 3t$ and $0 \leq t \leq 1$.
2. Compute $\int_C \mathbf{F} \cdot d\mathbf{r}$, where $\mathbf{F}$ and C are given below.
 - (a) $\mathbf{F}(x, y) = \left\langle \frac{-y}{x^2 + y^2}, \frac{x}{x^2 + y^2} \right\rangle$, C is the unit circle oriented counter clockwise.
 - (b) $\mathbf{F}(x, y) = \langle xy, 3x + 2y \rangle$, C is the curve $y = x^2$ from $(0, 0)$ to $(1, 1)$.
 - (c) $\mathbf{F}(x, y) = \langle \sin(y) + y \cos x, \sin(x) + x \cos(y) \rangle$, C is any path from $\left(\frac{\pi}{2}, \frac{\pi}{2}\right)$ to (π, π) .
 - (d) $\mathbf{F}(x, y) = \langle -2y, 3x \rangle$ and C is the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$, oriented counter-clockwise.
3. Find the area of the surface parametrized by $\mathbf{r}(u, v) = \left\langle u^2, uv, \frac{1}{2}v^2 \right\rangle$, with $0 \leq u \leq 1, 0 \leq v \leq 2$.
4. Compute $\iint_S (x^2 + y^2)z dS$, where S is the surface $z = \sqrt{1 - x^2 - y^2}$.
5. Compute $\iint_S \mathbf{F} \cdot d\mathbf{S}$, where $\mathbf{F}(x, y, z) = \langle x + \cos(y), y + \sin(z), z + e^x \rangle$ and S is the surface bounded by $x^2 + y^2 = 1, z = 0$ and $z = 1$.
6. Let $f : \mathbb{R}^3 \rightarrow \mathbb{R}$ be a function with continuous second order partial derivatives. Prove
$$\operatorname{curl}(\nabla f) = \mathbf{0}.$$
7. Let S be the surface $z = \sqrt{9 - x^2 - y^2}$. Compute $\iint_S \mathbf{F} \cdot \mathbf{n} dS$, where $\mathbf{F}(x, y, z) = \left\langle \frac{6y}{2x^2 + 3y^2 + 1}, -\frac{4x}{2x^2 + 3y^2 + 1}, z + 1 \right\rangle$ and $\mathbf{n}$ is the outward unit normal.

1. Compute $\int_C f(x, y) ds$, where $f(x, y) = y^3$ and C is the curve given by $x = t^3, y = t$ and $0 \leq t \leq 2$.
2. Compute $\int_C \mathbf{F} \cdot d\mathbf{r}$, where $\mathbf{F}$ and C are given below.
 - (a) $\mathbf{F}(x, y) = \left\langle \frac{-y}{x^2 + y^2}, \frac{x}{x^2 + y^2} \right\rangle$, C is the unit circle oriented counter clockwise.
 - (b) $\mathbf{F}(x, y) = \langle 1 - ye^{-x}, e^{-x} \rangle$, C is any path from $(0, 1)$ to $(1, 2)$.
 - (c) $\mathbf{F}(x, y) = \langle x^4, xy \rangle$, C is the triangle with vertices $(0, 0)$, $(1, 0)$ and $(0, 1)$, oriented counterclockwise.
 - (d) $\mathbf{F}(x, y, z) = \langle -y^2, x, z^2 \rangle$, C is the curve of intersection of the surfaces $y + z = 2$ and $x^2 + y^2 = 1$, oriented counterclockwise when viewed from above.

3. Find the area of the surface

$$z = xy$$

that lies inside the surface

$$x^2 + y^2 = 1.$$

4. Compute $\iint_S xy dS$, where S is the surface with parametric equations $x = u \cos(v), y = u \sin(v), z = u^2$ with $0 \leq u \leq 1$ and $0 \leq v \leq \pi/2$.
5. Let f be a twice differentiable function of three variables. Define the Laplacian of f to be $\nabla^2 f = \text{div}(\nabla f)$. Prove

$$\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2}.$$

6. Evaluate $\iint_S \mathbf{F} \cdot \mathbf{n} dS$, where $\mathbf{F}(x, y, z) = \langle x, y, z \rangle$ and S is the surface bounded by the three coordinate planes $x = 0, y = 0, z = 0$ and the surface $x^2 + y^2 + z^2 = 9$.
7. Let S be the surface parametrized by $0 \leq u \leq 3$, and $0 \leq v \leq 2\pi$, $\mathbf{r}(u, v) = \langle u \cos(v), u \sin(v), u \rangle$. Suppose $f(x, y, z)$ is a twice continuously differentiable function. Compute $\iint_S \mathbf{F} \cdot \mathbf{n} dS$, where

$$\mathbf{F}(x, y, z) = \langle f_y, -f_x, 1 \rangle$$

and $\mathbf{n}$ is the outward unit normal.

1. Determine the area of the first quadrant region bounded by the curves $y = x$, $y = 3x$, $xy = 2$ and $xy = 3$.
2. Evaluate $\iint_R (x+y)e^{x^2-y^2} dx dy$, where R is the region enclosed by the lines $x - y = 0$, $x - y = 2$, $x + y = 0$ and $x + y = 3$.
3. Compute $\int_C f(x,y) ds$, where $f(x,y) = xy$ and C is the curve given by $x = t^2 + 1$, $y = t^2 - 1$ and $0 \leq t \leq 1$.
4. Compute $\int_C \mathbf{F} \cdot d\mathbf{r}$, where $\mathbf{F} = \left\langle \frac{-y}{x^2 + y^2}, \frac{x}{x^2 + y^2} \right\rangle$ and C is the unit circle oriented clockwise.
5. Compute $\int_C \mathbf{F} \cdot d\mathbf{r}$, where $\mathbf{F} = \langle 2xe^{-y}, 2y - x^2e^{-y} \rangle$ and C is any path from $(0,0)$ to $(1,-1)$.
6. Compute $\int_C \mathbf{F} \cdot d\mathbf{r}$, where $\mathbf{F}(x,y) = \langle x^2 + y, 4x - y^2 \rangle$ and C is the positively oriented simple closed boundary curve of a region D that has area 23.
7. Find the area of the surface $z = x^2 - y^2$ that lies inside the surface $x^2 + y^2 = 4$.
8. Find the area of the surface parametrized by

$$\mathbf{r}(u,v) = \langle u + v, u - v, 1 + 8u - 12v \rangle,$$

with $0 \leq u \leq 1, 0 \leq v \leq 1$.

9. Evaluate the integral $\int_C \mathbf{F} \cdot d\mathbf{r}$, where

$$\mathbf{F}(x,y,z) = \langle x + 2y, 3y + 4z, 5x + 6z \rangle,$$

where C is the curve of intersection of $x^2 + y^2 = 4$ and the plane $2x + 3y - z = 4$ oriented counterclockwise when viewed from above.

10. Evaluate the integral $\iint_S \mathbf{F} \cdot \mathbf{n} dS$, where

$$\mathbf{F}(x,y,z) = \langle 2x + y^2, 2y + z^2, 2z + x^2 \rangle,$$

and S is the surface $x^2 + y^2 = 9$ with $0 \leq z \leq 3$ and $\mathbf{n}$ is the outward unit normal.

1. Evaluate $\iint_R (x^2 + y^2) dx dy$, where R is the first quadrant region bounded by the curves $xy = 1$, $xy = 3$, $x^2 - y^2 = 2$ and $x^2 - y^2 = 4$.
2. Compute $\int_C f(x, y) ds$, where $f(x, y) = x^2 + y^2$ and C is the curve given by $x = \cos(t)$, $y = \sin(t)$ and $0 \leq t \leq \pi$.
3. Compute $\int_C \mathbf{F} \cdot d\mathbf{r}$, where $\mathbf{F}$ and C are given below.

(a) $\mathbf{F}(x, y) = \left\langle \frac{-y}{x^2 + y^2}, \frac{x}{x^2 + y^2} \right\rangle$, C is the unit circle oriented counter clockwise.

(b) $\mathbf{F}(x, y) = \langle xy, 3x + 2y \rangle$, C is the curve $y = x^2$ from $(0, 0)$ to $(1, 1)$.

(c) $\mathbf{F}(x, y) = \langle \sin(y) + y \cos x, \sin(x) + x \cos(y) \rangle$, C is any path from $\left(\frac{\pi}{2}, \frac{\pi}{2}\right)$ to (π, π) .

(d) $\mathbf{F}(x, y) = \langle -2y, 3x \rangle$ and C is the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$, oriented counter-clockwise.

4. Calculate the area of the part of the plane $4x + 5y + z = 10$ that lies in the cylinder $x^2 + y^2 = 9$.
5. Evaluate $\int_C (y^2 - 2y) dx + 2xy dy$, where C is the triangle with vertices $(0, 0)$, $(2, 0)$ and $(2, 2)$, oriented counterclockwise.
6. Evaluate $\iint_S \mathbf{F} \cdot \mathbf{n} dS$, where $\mathbf{F}(x, y, z) = \langle 2x, 2y, 2z \rangle$ and S is the surface $x^2 + y^2 + z^2 = 9$.
7. Evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$, where

$$\mathbf{F}(x, y, z) = \langle e^{-x^2} + \sin(x), e^{-y^2} - 2yz, x^2 + e^{-z^2} + 2z \rangle$$

and C is the boundary of the surface $z = \sqrt{1 - x^2 - y^2}$, oriented counter-clockwise.

1. Determine the area of the region bounded by the curves $xy = 1$, $xy = 3$, $\frac{y^2}{x} = 1$ and $\frac{y^2}{x} = 4$.

2. Evaluate $\int_C x^2 ds$ where C is the unit circle.

3. Compute $\int_C \mathbf{F} \cdot d\mathbf{r}$, where $\mathbf{F}$ and C are given below.

(a) $\mathbf{F}(x, y) = \left\langle \frac{-y}{x^2 + y^2}, \frac{x}{x^2 + y^2} \right\rangle$, C is the unit circle oriented counter clockwise.

(b) $\mathbf{F}(x, y) = \langle 2xy^2, x^2y \rangle$, C is the line segment from $(0, 0)$ to $(2, 3)$.

(c) $\mathbf{F}(x, y) = \langle \sin(y) + 3x^2, x \cos(y) + 1 \rangle$, C is any path from $(\pi, 0)$ to $(0, \pi)$.

(d) $\mathbf{F}(x, y) = \left\langle \frac{y}{1 + x^2} + y^3, x + \tan^{-1}(x) + 3xy^2 \right\rangle$ and C is the ellipse $\frac{x^2}{16} + \frac{y^2}{25} = 1$, oriented counter-clockwise.

4. Calculate the area of the part of the surface $z = 2xy$ that lies in the cylinder $x^2 + y^2 = 4$.

5. Calculate the area of the surface parametrized by $\mathbf{r}(u, v) = \left\langle u^2, uv, \frac{1}{2}v^2 \right\rangle$, with $0 \leq u \leq 1, 0 \leq v \leq 2$.

6. Evaluate $\iint_S \frac{1}{\sqrt{x^2 + y^2 + 1}} dS$, where S is the surface $z = \frac{1}{2}x^2 + \frac{1}{2}y^2$ contained in the cylinder $x^2 + y^2 = 2014$.

7. Evaluate $\iint_S \mathbf{F} \cdot \mathbf{n} dS$, where $\mathbf{F}(x, y, z) = \langle 2x, 2y, 2z \rangle$ and S is the part of the surface $x^2 + y^2 + z^2 = 9$ in the first octant with unit normal pointing away from the origin..

8. Evaluate $\int_C (y^2 - 2y) dx + 2xy dy$, where C is the triangle with vertices $(0, 0)$, $(2, 0)$ and $(2, 2)$, oriented counterclockwise.

9. Evaluate $\iint_S \mathbf{F} \cdot \mathbf{n} dS$, where $\mathbf{F}(x, y, z) = \langle x^3, y^3, x^3 + y^3 \rangle$ and S is the surface $x^2 + y^2 = 9, 0 \leq z \leq 2$.

10. Evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$, where

$$\mathbf{F}(x, y, z) = \langle e^{-x^2} + y, e^{-y^2} - 2yz, x^2 + e^{-z^2} + 2z \rangle$$

and C is the boundary of the surface $z = \sqrt{4 - x^2 - y^2}$, oriented counter-clockwise.

11. Let S be the surface parametrized by

$$\mathbf{r}(u, v) = \langle 2 \sin(u) \cos(v), 2 \sin(u) \sin(v), 2 \cos(u) \rangle, 0 \leq u \leq \frac{3\pi}{4}, 0 \leq v \leq 2\pi.$$

Evaluate $\iint_S \mathbf{F} \cdot \mathbf{n} dS$, where

$$\mathbf{F}(x, y, z) = \langle 2x^2 - 2y, 4x^3 - 4xy, 1 \rangle$$

and $\mathbf{n}$ is the outward unit normal.

1. Compute $\int_C \mathbf{F} \cdot d\mathbf{r}$, where $\mathbf{F}$ and C are given below.

(a) $\mathbf{F}(x, y) = \left\langle \frac{-y}{x^2 + y^2}, \frac{x}{x^2 + y^2} \right\rangle$, C is the unit circle oriented counter clockwise.

(b) $\mathbf{F}(x, y) = \langle 4y, 10x \rangle$, C is the curve $y = x^2, 0 \leq x \leq 1$.

(c) $\mathbf{F}(x, y) = \langle 2x + 2y, 2x + 6y \rangle$, C is any path from $(0, 0)$ to $(1, 1)$.

(d) $\mathbf{F}(x, y) = \left\langle 2x \tan^{-1}(y) + 8y, \frac{x^2}{1 + y^2} + 50x \right\rangle$ and C is the boundary of the region enclosed by the curves $y = x, y = x^2$, oriented counter-clockwise.

2. Evaluate $\frac{1}{\pi} \int_C y^2 ds$ where C is the circle of radius $\sqrt[3]{5}$ centered at the origin.

3. Evaluate $\iint_S 3 dS$, where S is the surface parametrized by

$$\mathbf{r}(u, v) = \left\langle u^2, uv, \frac{1}{2}v^2 \right\rangle, 0 \leq u \leq 1, 0 \leq v \leq 1.$$

4. Evaluate $\iint_S \mathbf{F} \cdot \mathbf{n} dS$, where $\mathbf{F}(x, y, z) = \langle y^3 + z^3, x^3 + z^3, x^3 + y^3 \rangle$ and S is the surface $x^2 + y^2 + z^2 = 9$.

5. Let S be the surface parametrized by $0 \leq u \leq 3$, and $0 \leq v \leq 2\pi$, with $\mathbf{r}(u, v) = \langle u \cos(v), u \sin(v), u \rangle$. Suppose $Q(x, y, z)$ is a continuously differentiable function. Compute $\frac{1}{2\pi} \iint_S (\text{curl } \mathbf{F}) \cdot \mathbf{n} dS$, where $\mathbf{n}$ is the outward unit normal and $\mathbf{F}(x, y, z) = \langle y, -x, Q(x, y, z) \rangle$.

1. Compute $\int_C \mathbf{F} \cdot d\mathbf{r}$, where $\mathbf{F}$ and C are given below.

(a) $\mathbf{F}(x, y) = \left\langle \frac{-y}{x^2 + y^2}, \frac{x}{x^2 + y^2} \right\rangle$, C is the unit circle oriented counter clockwise.

(b) $\mathbf{F}(x, y) = \langle 8x - 5y, -5x + 4y \rangle$, C is any smooth path from $(0, 0)$ to $(1, 1)$.

(c) $\mathbf{F}(x, y) = \langle x^4 + 3y, 4x + y^4 \rangle$ and C is the boundary of the triangular region with vertices $(0, 0)$, $(1, 0)$, and $(0, 2)$, oriented counter-clockwise.

(d) $\mathbf{F}(x, y) = \langle y, 2x \rangle$ and C is the curve parametrized by $\mathbf{r}(t) = \langle 2\cos^2(t), 2\cos(t)\sin(t) \rangle$, $0 \leq t \leq \pi$.

(e) $\mathbf{F}(x, y, z) = \frac{2}{3} \langle x + y + 2z, 2x + y + z, x + 2y + z \rangle$ and C is the triangle with vertices $(1, 0, 0)$, $(0, 1, 0)$ and $(0, 0, 1)$, oriented clockwise when viewed from the origin.

2. Evaluate $\int_C \frac{2x + 6y}{3\sqrt{1 + 4x^2}} ds$ where C is the curve $y = x^2$, $0 \leq x \leq 1$.

3. Determine the surface area of the surface

$$z = \sqrt{1 - x^2 - y^2}$$

that lies inside the cylinder

$$4x^2 + 4y^2 = 3.$$

4. Let S be the surface parametrized by $\mathbf{r}(u, v) = \left\langle u, v, \frac{1}{v} \right\rangle$ with $1 \leq u \leq 2$ and $1 \leq v \leq 3 - u$. Compute $\iint_S \mathbf{F} \cdot \mathbf{n} dS$, where $\mathbf{n}$ is the outward unit normal vector pointing away from the xy -plane, and $\mathbf{F}(x, y, z) = \langle x^2, y^2, 1 \rangle$.

5. Let S be the surface parametrized by $0 \leq u \leq 3$, and $0 \leq v \leq 2\pi$, with $\mathbf{r}(u, v) = \langle u \cos(v), u \sin(v), u \rangle$. Compute $\iint_S \mathbf{F} \cdot \mathbf{n} dS$, where $\mathbf{n}$ is the outward unit normal and $\mathbf{F}(x, y, z) = \frac{1}{18} \langle x + z, y + z, 2z \rangle$.

1. Compute $\int_C \mathbf{F} \cdot d\mathbf{r}$, where $\mathbf{F}$ and C are given below.

(a) $\mathbf{F}(x, y) = \left\langle \frac{-y}{x^2 + y^2}, \frac{x}{x^2 + y^2} \right\rangle$, C is the unit circle oriented counter clockwise.

(b) $\mathbf{F}(x, y) = \left\langle \sqrt{x^2 + 1}, \tan^{-1}(x) \right\rangle$ and C is the boundary of the triangular region with vertices $(0, 0)$, $(1, 1)$, and $(1, 0)$, oriented counter-clockwise.

(c) $\mathbf{F}(x, y) = \langle 3 + 2xy, x^2 - 3y^2 \rangle$ and C is the curve parametrized by $\mathbf{r}(t) = \langle e^t \sin(t), e^t \cos(t) \rangle$, $0 \leq t \leq \pi$.

(d) $\mathbf{F}(x, y, z) = \langle x + y^2, y + z^2, z + x^2 \rangle$ and C is the triangle with vertices $(1, 0, 0)$, $(0, 1, 0)$ and $(0, 0, 1)$, oriented counter clockwise when viewed from above.

2. Evaluate $\int_C y^3 ds$ where C is the curve $x = t^3, y = t, 0 \leq t \leq 1$.

3. Calculate the area of the part of the plane $2x + 2y - z = 2015$ that lies in the cylinder $x^2 + y^2 = 4$.

4. Compute $\iint_S 2y dS$, where S is the part of the surface $x + y + z = 1$ in the first octant (that is, $x \geq 0, y \geq 0, z \geq 0$).

5. Calculate $\iint_S \mathbf{F} \cdot \mathbf{n} dS$ where $\mathbf{F}(x, y, z) = \langle y - z, z - x, x - y \rangle$ and S is the surface with equation $x^2 + y^2 + z^2 = 4$ in the first octant (NOT including the coordinate planes) with unit normal $\mathbf{n}$ directed away from the origin.

6. Calculate $\iint_S \mathbf{F} \cdot \mathbf{n} dS$ where $\mathbf{F}(x, y, z) = \langle x, y, z \rangle$ and S is the closed surface having sides the coordinate planes and the plane with equation

$$\frac{x}{2} + \frac{y}{3} + \frac{z}{6} = 1.$$

7. The Laplacian of the twice differentiable scalar function f is defined to be $\nabla^2 f = \nabla \cdot \nabla f$.

(a) Prove that $\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2}$.

(b) Let $\frac{\partial f}{\partial n} = (\nabla f) \cdot \mathbf{n}$ denote the directional derivative of the scalar function f in the direction of the outer unit normal vector $\mathbf{n}$ to the closed surface S that bounds the region T . Suppose that $\nabla^2 f = 0$ in the region T with the closed boundary surface S . Prove that

$$\iint_S f \frac{\partial f}{\partial n} dS = \iiint_T |\nabla f|^2 dV.$$

1. Find the area of the region R bounded by the curves $xy = 1$, $xy = 3$, $y = x$, $y = 6x$ in the first quadrant.

2. Compute $\int_C \mathbf{F} \cdot d\mathbf{r}$, where $\mathbf{F}$ and C are given below.

(a) $\mathbf{F}(x, y) = \left\langle \frac{-y}{x^2 + y^2}, \frac{x}{x^2 + y^2} \right\rangle$, C is the unit circle oriented counter clockwise.

(b) $\mathbf{F}(x, y) = \langle \sin(x) + 3y, 5x + 7\cos(y) \rangle$ and C is the boundary of the ellipse $4x^2 + 9y^2 = 36$, oriented counter-clockwise.

(c) $\mathbf{F}(x, y) = \langle 1 - 2xy, 2y - x^2 \rangle$ and C is the curve parametrized by $\mathbf{r}(t) = \langle \cos(t^2), \sin(t^2) \rangle$, $0 \leq t \leq \sqrt{\pi}$.

(d) $\mathbf{F}(x, y, z) = \langle z, y, x \rangle$ and C is the curve parametrized by $\mathbf{r}(t) = \langle t, t^2, t^3 \rangle$, $0 \leq t \leq 2$.

3. Evaluate $\int_C 6y \, ds$ where C is the curve $x = t$, $y = t^3$, $0 \leq t \leq \sqrt[4]{11}$.

4. Calculate the area of the part of the surface $z = \sqrt{4 - x^2 - y^2}$ that lies outside the surface $z = \sqrt{3x^2 + 3y^2}$.

5. Compute $\iint_S z \, dS$, where S is the part of the surface $x + y + z = 1$ in the first octant (that is, $x \geq 0$, $y \geq 0$, $z \geq 0$).

6. Calculate $\iint_S \mathbf{F} \cdot \mathbf{n} \, dS$ where $\mathbf{F}(x, y, z) = \langle y - z, z - x, x - y \rangle$ and S is the part of the surface with equation $x + y + z = 2016$ in the first octant (NOT including the coordinate planes) with unit normal $\mathbf{n}$ directed away from the origin.

7. Calculate $\iint_S \mathbf{F} \cdot \mathbf{n} \, dS$ where $\mathbf{F}(x, y, z) = \langle x - \sin(y), y - \sin(z), z - \sin(x) \rangle$ and S is the closed surface $z = \sqrt{x^2 + y^2}$, $z = 4$.

8. Evaluate $\lim_{n \rightarrow \infty} \sum_{k=1}^n \left[\left(\cos \left(\frac{2\pi(k+1)}{n} \right) + \cos \left(\frac{2\pi k}{n} \right) \right) \left(\sin \left(\frac{2\pi(k+1)}{n} \right) - \sin \left(\frac{2\pi k}{n} \right) \right) \right]$.

1. Evaluate the double integral $\int_{x=0}^{2\pi} \int_{y=0}^{\pi} y^2 \cos(x) \sin(7y) dy dx$.
2. Evaluate the double integral $\int_{x=0}^1 \int_{y=\sqrt{x}}^1 \sqrt{y^3 + 1} dy dx$.
3. Evaluate the double integral $\iint_D (x^3 + y^3 + \sqrt{9 - x^2}) dA$ where $D = [-3, 3] \times [-1, 1]$.
4. Evaluate the double integral $\int_{x=0}^1 \int_{y=1}^{\sqrt{4-x^2}} \frac{1}{\sqrt{x^2 + y^2}} dy dx$.
5. Evaluate the triple integral $\int_{x=0}^1 \int_{y=0}^{2-2x} \int_{z=0}^{8-8x-4y} 3 dz dy dx$.
6. Find the volume of the region bounded by the surfaces $x^2 + y^2 = 1$, $z = 1008 - 2x - 3y$ and $z = 3x + 4y - 1008$.
7. Calculate the area of the part of the surface $z = \sqrt{1 - y^2}$ with $0 \leq x \leq 1$ and $0 \leq y \leq 1$.
8. Calculate the area of the part of the surface $z = x^2 + y^2$ above the disk $x^2 + y^2 \leq 4$.
9. Evaluate the double integral $\iint_R \frac{1}{y^2} dA$ where R is the region in the first and second quadrants with $-\frac{1}{2} \leq x \leq \frac{1}{2}$ and $y \geq \sqrt{1 - x^2}$.
10. Determine the volume of region inside both $x^2 + y^2 + z^2 = 4$ and $z = \sqrt{x^2 + y^2}$.
11. Evaluate

$$\iiint_S z^2 dx dy dz$$
 where S is the sphere $x^2 + y^2 + z^2 = 1$.
12. Evaluate the double integral

$$\iint_R xy dA$$
 where R is the region bounded by the curves $xy = 1$, $xy = 2$, $y = x$, $y = 3x$ in the first quadrant.
13. Compute $\int_C f(x, y) ds$, where $f(x, y) = x + y$ and C is the curve given by $x = 3e^t + 1$, $y = 4e^t - 1$ and $0 \leq t \leq \ln(2)$.
14. Compute $\int_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F}(x, y) = \left\langle \frac{-y}{x^2 + y^2}, \frac{x}{x^2 + y^2} \right\rangle$ and C is the unit circle oriented counter clockwise.
15. Evaluate $\int_C y dx$, where C is the triangle with vertices $(0, 0)$, $(2, 0)$ and $(2, 2)$, oriented clockwise.

1. Evaluate $\int_C \frac{x+2y}{\sqrt{9x^4+1}} ds$ where C is the curve $y = x^3, 0 \leq x \leq 1$.
2. Evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F}(x, y) = \left\langle \frac{-y}{x^2+y^2}, \frac{x}{x^2+y^2} \right\rangle$ and C is the unit circle oriented counter clockwise.
3. Evaluate $\int_C 2y dx + x dy$, where C is line segment from $(0, 0)$ to $(1, 5)$.
4. Evaluate $\int_C y dx + x dy$, where C is any smooth path from $(0, 0)$ to $(4, 5)$.
5. Evaluate $\int_C y dx + 2x dy$, where C is the boundary of the ellipse $x^2 + 4y^2 = 16$, oriented counter-clockwise.
6. Calculate the area of the surface parametrized by $\mathbf{r}(u, v) = \langle u^2, uv, \frac{1}{2}v^2 \rangle$, with $0 \leq u \leq 1, 0 \leq v \leq 2$.
7. Evaluate $\iint_S z dS$, where S is the surface $z = \sqrt{36 - x^2 - y^2}$.
8. Let S be the surface parametrized by $\mathbf{r}(u, v) = \left\langle v, u, \frac{2}{u} \right\rangle$ with $1 \leq u \leq 2$ and $0 \leq v \leq 3$. Evaluate $\iint_S \mathbf{F} \cdot \mathbf{n} dS$, where $\mathbf{n}$ is the outward unit normal vector pointing towards the xy -plane, and $\mathbf{F}(x, y, z) = \langle x^7, y^7, 0 \rangle$.
9. Evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F}(x, y, z) = \langle x + y + 2z, 2x + y + z, x + 2y + z \rangle$ and C is the triangle with vertices $(1, 0, 0)$, $(0, 1, 0)$ and $(0, 0, 1)$, oriented clockwise when viewed from the origin.
10. Let S be the surface parametrized by $0 \leq u \leq 3$, and $0 \leq v \leq 2\pi$, with $\mathbf{r}(u, v) = \langle u \cos(v), u \sin(v), u \rangle$. Compute $\iint_S \mathbf{F} \cdot \mathbf{n} dS$, where $\mathbf{n}$ is the outward unit normal and $\mathbf{F}(x, y, z) = \langle x + z, y + z, 2z \rangle$.

1. Evaluate $\int_C \frac{8x}{\sqrt{9y^4 + 1}} ds$ where C is the curve $x = y^3, 0 \leq y \leq 1$.
2. Evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F}(x, y) = \left\langle \frac{-y}{x^2 + y^2}, \frac{x}{x^2 + y^2} \right\rangle$ and C is the unit circle oriented counter clockwise.
3. Evaluate $\int_C 6y dx - 2x dy$, where C is line segment from $(1, 1)$ to $(0, 0)$.
4. Evaluate $\int_C (2x + y) dx + (x - 2y) dy$, where C is any smooth path from $(-3, 2)$ to $(1, 1)$.
5. Evaluate $\int_C (2xe^y + y) dx + (x^2e^y + 2x) dy$, where C is the boundary of the rectangle with vertices $(0, 0), (-2, 0), (-2, 1)$ and $(0, 1)$, oriented counter-clockwise.
6. Calculate the area of the surface parametrized by $\mathbf{r}(u, v) = \langle u \cos(v), u \sin(v), u\sqrt{3} \rangle$, with $0 \leq u \leq 1, 0 \leq v \leq 2\pi$.
7. Evaluate $\frac{3}{16} \iint_S x^2 dS$, where S is the surface $z = \sqrt{4 - x^2 - y^2}$.
8. Evaluate $\iint_S \mathbf{F} \cdot \mathbf{n} dS$, where $\mathbf{F}(x, y, z) = \langle 2x, 2y, 2z \rangle$, S is the surface $z = x + y - 1$ inside the cylinder $x^2 + y^2 = 1$, and $\mathbf{n}$ is the unit normal directed downward.
9. Evaluate $\iint_S \mathbf{F} \cdot \mathbf{n} dS$ where $\mathbf{F}(x, y, z) = \langle 3x, -5y, 4z \rangle$, S is the surface of the pyramid with vertices $(0, 0, 0), (1, 0, 0), (0, 2, 0)$ and $(0, 0, 3)$, and $\mathbf{n}$ is the outward unit normal.
10. Evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F}(x, y, z) = \langle x^2, y^2, 6yz \rangle$ and C is the triangle with vertices $(3, 0, 0), (0, 2, 0)$ and $(0, 0, 1)$, oriented counter clockwise when viewed from above.

1. Evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F}(x, y) = \left\langle \frac{-y}{x^2 + y^2}, \frac{x}{x^2 + y^2} \right\rangle$ and C is the unit circle oriented counter clockwise.
2. Evaluate $\int_C 2x^2 ds$ where C is the unit circle oriented counter clockwise.
3. Evaluate $\int_C y dx - x dy$, where C is the part of the circle centered at the origin in the first quadrant, from $(2, 0)$ to $(0, 2)$.
4. Evaluate $\int_C (2x + y) dx + (x + 2y) dy$, where C is any smooth path from $(2, 1)$ to $(3, 1)$.
5. Evaluate $\int_C (2xy^3 + 4y) dx + (3x^2y^2 + 5x) dy$, where C is the boundary of the rectangle with vertices $(1, 1)$, $(3, 1)$, $(3, 4)$ and $(1, 4)$, oriented counter-clockwise.
6. Determine the area of the surface parametrized by $\mathbf{r}(u, v) = \langle u, v, 2018 - 2u - 2v \rangle$, with $0 \leq u \leq 1, 0 \leq v \leq 2$.
7. Evaluate $\iint_S z dS$, where S is the surface $z = \sqrt{4 - x^2 - y^2}$.
8. Calculate $\iint_S \mathbf{F} \cdot \mathbf{n} dS$ where $\mathbf{F}(x, y, z) = \langle y + z, x + z, x + y \rangle$ and S is the part of the surface with equation $x + y + z = 1$ in the first octant (NOT including the coordinate planes) with unit normal $\mathbf{n}$ directed away from the origin.
9. Evaluate $\iint_S \mathbf{F} \cdot \mathbf{n} dS$ where $\mathbf{F}(x, y, z) = \langle x + y, y + z, x + z \rangle$, S is the closed surface bounded by $z = \sqrt{2x^2 + 2y^2}$, $z = 2$, and $\mathbf{n}$ is the outward unit normal.
10. Evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F}(x, y, z) = \langle x + y + 2z, 2x + y + z, x + 2y + z \rangle$ and C is the triangle with vertices $(1, 0, 0)$, $(0, 1, 0)$ and $(0, 0, 1)$, oriented counterclockwise when viewed from the origin.