1. *Let C be any curve in $\mathbb{R}^3$ from $(0,0,0)$ to $(1,1,1)$. Let $\mathbf{W}$ be the vector field $\langle y^2z^2, 2xyz^2, 2xy^2z\rangle$. Calculate $\int_C \mathbf{W}\cdot d\mathbf{s}$.*
2. *Let σ be the region parameterized by the following:*

$$\phi(u,v) = (uv^2, u^3v), \quad 1 \le u \le 2, \quad 1 \le v \le 2$$

Calculate

$$\int_{\partial\sigma} \langle 1, -\ln x\rangle \cdot d\mathbf{s}$$

3. *Let C_1 and C_2 be curves given by the following parameterizations (with the induced orientations):*

$$C_1 : \phi(t) = (t, 0, 0), \quad 2\pi \le t \le 4\pi$$
$$C_2 : \psi(t) = (t\cos t, t\sin t, 0), \quad 2\pi \le t \le 4\pi$$

Show that for any vector field $\mathbf{W}$ such that $\nabla \times \mathbf{W} = \langle 0,0,0\rangle$ the following is true:

$$\int_{C_1} \mathbf{W}\cdot d\mathbf{s} = \int_{C_2} \mathbf{W}\cdot d\mathbf{s}$$

1. *Find the curl of the following vector field:*

$$\left\langle \frac{-y}{x^2+y^2}, \frac{x}{x^2+y^2}, 0 \right\rangle$$

2. *Find the divergence of the following vector field:*

$$\langle x^2+y^2, y^2-x^2, 0\rangle$$

3. *Find the gradient of*

$$f(x,y,z) = x^2 \sin(y-z)$$

4. *Find two vector fields whose curls are* $\langle 0, 0, \frac{y}{x}\rangle$.

1. *Evaluate the following integrals:*

   a. $\int_1^2 \int_2^3 \cos(2x+y)\, dx\, dy$

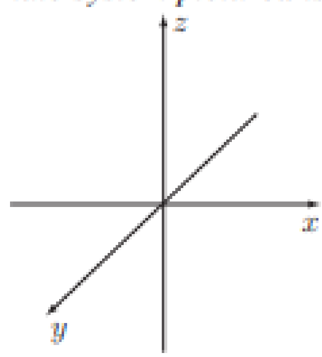
   b. $\int_0^1 \int_x^1 \sqrt{1+y^2}\, dy\, dx$

2. *Set up an integral for the volume which lies between the cone* $\sqrt{1-x^2-y^2}$ *and the* xy*-plane.*

Let $f(x, y) = x^2y + x^3y^2$.

1. Find $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$.
2. If $\phi(t) = (t^2, t-1)$, then what is $f(\phi(t))$?
3. Suppose you don't know what $\psi(t) = (x(t), y(t))$ is, but you know $\psi(2) = (1, 1)$, $\frac{dx}{dt}(2) = 3$, and $\frac{dy}{dt}(2) = 1$. Find the derivative of $f(\psi(t))$ when $t = 2$.
4. Suppose x and y are functions of u and v, $x(u, v) = u^2 + v$, and $y(1, 1) = 1$. What would $\frac{\partial y}{\partial u}$ have to be when $(u, v) = (1, 1)$, if $\frac{\partial f}{\partial u} = 12$?

1. Determine if the coordinate system pictured is left or right handed.



2. Let $f(x, y) = \frac{y}{x^2+1}$.

   a. Sketch the intersections of the graph of $f(x, y)$ with the xy-plane, the xz-plane, and the yz-plane.

   b. Sketch the level curves for $f(x, y)$.

   c. Sketch the graph of $f(x, y)$.

1. *Show that the function*

$$f(x, y) = \frac{x \sin y}{x^2 + y^2}$$

does not have a limit as $(x, y) \to (0, 0)$.

2. *Is the function*

$$f(x, y) = \begin{cases} \frac{x+y}{x+y} & (x, y) \neq (0, 0) \\ 1 & (x, y) = (0, 0) \end{cases}$$

continuous at $(0, 0)$*?*

3. *Find the domain of the function*

$$f(x, y) = \ln \frac{1}{x - y^2}.$$

1. *Let $f(x, y)$ be the following function:*

$$f(x, y) = xy + x - 2y + 4$$

   a. *Sketch the intersections of $f(x, y)$ with the xz- and yz-planes.*

   b. *Find the critical point(s) and compute the value of*

$$\begin{vmatrix} \dfrac{\partial^2 f}{\partial x^2} & \dfrac{\partial^2 f}{\partial x \partial y} \\ \dfrac{\partial^2 f}{\partial y \partial x} & \dfrac{\partial^2 f}{\partial y^2} \end{vmatrix}$$

   Can you say if the graph has a max, min, or saddle at the critical point(s)?

   c. *Find the slope of the tangent line to the graph of $f(x, y)$, in the direction of $\langle 1, 2 \rangle$, at the point $(0, 1)$.*

   d. *Find the volume under the graph of $f(x, y)$, and above the rectangle in the xy-plane with vertices at $(0, 0)$, $(1, 0)$, $(0, 2)$, and $(1, 2)$.*