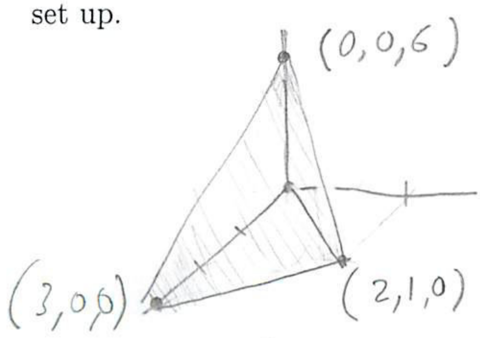
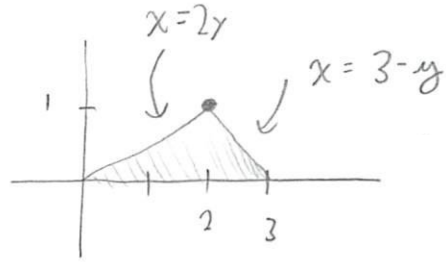
1. Set up the integral of the function $f(x, y, z) = zx + y$ over the tetrahedron with vertices (0,0,0), (3,0,0), (2,1,0), (0,0,6). Set up as just one triple integral. Don't integrate–just set up.





$z = 6 - 2x - 2y$

$$\int_{\boxed{0}}^{\boxed{1}} \int_{\boxed{2y}}^{\boxed{3-y}} \int_{\boxed{0}}^{\boxed{6-2x-2y}} \boxed{(zx + y)\, dz\, dx\, dy}$$

2. Let $\vec{\mathbf{F}} = \langle z2^x \ln 2 + \sin y,\ 6ye^z + x\cos y,\ 2^x + 3y^2e^z \rangle$.

(a) Find the divergence of $\vec{\mathbf{F}}$.

$$\nabla \cdot \vec{F} = \boxed{z2^x \ln 2 \ln 2} + \boxed{6e^z} \boxed{- x\sin y} + \boxed{3y^2 e^z}$$

(b) Find the potential function f for $\vec{\mathbf{F}}$. (It can be found!)

$$f = \boxed{z2^x} + \boxed{x\sin y} + \boxed{3y^2e^z}$$

(c) Find the curl of $\vec{\mathbf{F}}$.

$$\nabla \times \vec{F} = \boxed{\langle 0, 0, 0 \rangle}$$

* OR * $\boxed{\vec{0}}$

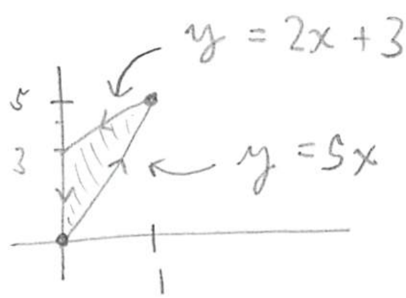
(d) Find $\int_C \vec{\mathbf{F}} \cdot d\vec{\mathbf{r}}$ where C is the triangle from (7,0,2) to (1,1,2) to (0,3,5) and back to (7,0,2).

FTC III $\Rightarrow$ $\boxed{0}$

3. Let $\vec{\mathbf{F}} = \left\langle y^2,\ 3x - z^2,\ \dfrac{y}{x-1} \right\rangle$, let $g(x, y) = x - e^{xy}$ and C be the curve on the surface $z = g(x, y)$ above the triangle that goes from (0,0) to (1,5) to (0,3) and back to (0,0).

Set up $\int_C \vec{\mathbf{F}} \cdot d\vec{\mathbf{r}}$ using Stokes' theorem and **only** variables x and y. Just set up, don't integrate, and **make sure** you have only variables x and y in your answer.

$$\nabla \times \vec{F} = \left\langle \frac{1}{x-1} + 2z,\ -\left(\frac{-y}{(x-1)^2} - 0\right),\ 3 - 2y \right\rangle$$



$$-\vec{n} = \left\langle -(1 - y e^{xy}),\ -(-x e^{xy}),\ 1 \right\rangle$$

$$z = x - e^{xy}$$

$$\int_C \vec{F} \cdot d\vec{r} = \int_0^1 \int_{5x}^{2x+3} \left\langle \frac{1}{x-1} + 2(x - e^{xy}),\ \frac{y}{(x-1)^2},\ 3 - 2y \right\rangle \cdot \left\langle y e^{xy} - 1,\ x e^{xy},\ 1 \right\rangle dy\, dx$$

$$\boxed{= \int_0^1 \int_{5x}^{2x+3} \left(\frac{y e^{xy} - 1}{x-1} + 2(x - e^{xy})(y e^{xy} - 1) + \frac{y x e^{xy}}{(x-1)^2} + 3 - 2y \right) dy\, dx}$$

4. Let $\vec{\mathbf{F}} = \langle 3y,\ (x-1)^6,\ zx+2 \rangle$.

Let C be the curve given by $\vec{\mathbf{r}}(t) = \langle e^t,\ \sin t,\ 3t \rangle$ for $2 \le t \le 5$. Set up the integral $\int_C \vec{\mathbf{F}} \cdot d\vec{\mathbf{r}}$ using **only** the variable t. Just set up, don't integrate, and **make sure** t is the only variable in your answer.

$$C = \begin{cases} x = e^t \\ y = \sin t \\ z = 3t \end{cases} \qquad \begin{aligned} dx &= e^t\,dt \\ dy &= \cos t\,dt \\ dz &= 3\,dt \end{aligned}$$

$$\int_C \vec{F} \cdot d\vec{r} =$$

$$\int_2^5 \left(3\sin t\, e^t + (e^t - 1)^6 \cos t + (3t\,e^t + 2)\,3 \right) dt$$