1. The volume of the solid in the first octant bounded by the cylinder $z = 4 - x^2$ and the plane $y = 4$ can be expressed as:

$$\text{I.} \quad \int_0^4 \int_0^4 4 - x^2 \; dy \; dx$$
$$\text{II.} \quad \int_0^2 \int_0^4 \int_0^{4-x^2} 1 \; dz \; dy \; dx$$
$$\text{III.} \quad \int_0^4 \int_0^4 4 - x^2 \; dx \; dy$$

A. I.

B. II.

C. III.

D. I. and III.

E. None of the above

2. Evaluate the integral $\displaystyle\int_0^1 \int_0^{u^2} \cos(u^3) \; dv \; du$.

3. The volume between $f(x, y) = x^2 + y^2$ and the $xy-$plane inside the region bounded by

$x^2 + y^2 = 1$ is?

4. Express $\displaystyle\iiint_E f(x, y, z) \; dV$ as an iterated integral in the two different ways below, where E is the solid bounded by the surfaces $y = 4 - x^2 - z^2$ and $y = 0$. **(Find the limits of integration).**

(a) $\displaystyle\iiint f(x, y, z) \; dy \; dz \; dx$

(b) $\displaystyle\iiint f(x, y, z) \; dz \; dy \; dx$

5. Evaluate the triple integral $\displaystyle\iiint_E z \; dV$ where E is the region in the first octant that lies between the spheres $x^2 + y^2 + z^2 = 1$ and $x^2 + y^2 + z^2 = 4$.

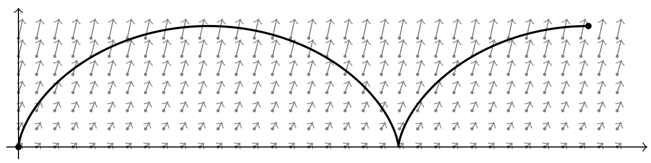
6. Setup a line integral for $\displaystyle\int_C xyz \; ds$ where C is parametrized by

$\mathbf{r}(t) = \langle \cos(2t), \sin(2t), 3 \rangle, 0 \le t \le \pi$. Simplify as much as possible but **do not evaluate the integral**.

7. Find the work done by the force field $\mathbf{F}(x, y) = \mathbf{i} + (2y + 1)\mathbf{j}$ in moving an object along an arch of the cycloid

$$\mathbf{r}(t) = (t - \sin t)\mathbf{i} + (1 - \cos t)\mathbf{j}, \quad 0 \leq t \leq 3\pi$$

depicted below.



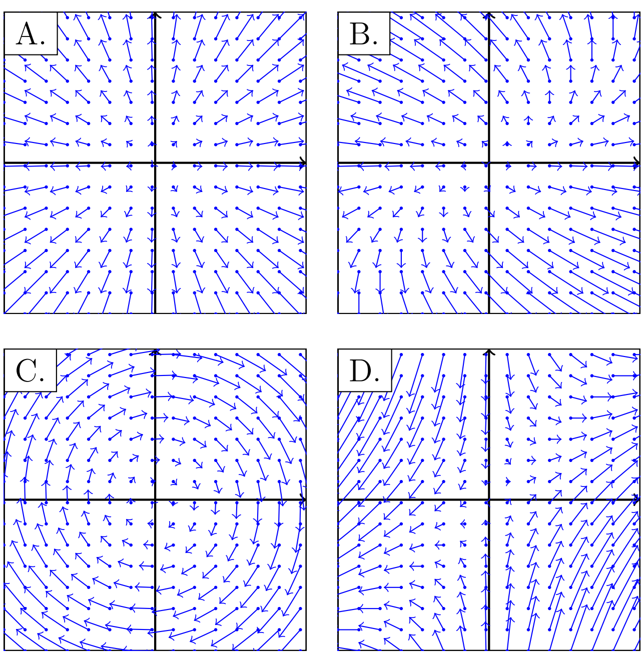
8. Use Greens Theorem to evaluate $\oint_C x^2y\ dx - xy^2\ dy$, where C is the circle $x^2 + y^2 = 4$.

9. Consider the vector field $\mathbf{F}(x, y) = (7ye^{7x})\mathbf{i} + (e^{7x} + 2y)\mathbf{j}$

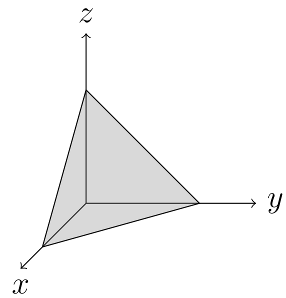
    (a) Use a systematic approach to find a potential function for $\mathbf{F}$. Even if you can do it in your head, instead show work.

    (b) Evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where C is parametrized by $\mathbf{r}(t) = \cos t\mathbf{i} + t\mathbf{j}, \quad t \in [0, 2\pi]$.

10. Which of the following vector field plots could be $\mathbf{F} = (x - y)\mathbf{i} + y\mathbf{j}$?



11. Express the volume in the first octant bounded by the plane $x + y + z = 1$ in spherical coordinates.



$$\int_0^{\theta_2} \int_0^{\phi_2} \int_{\rho_1}^{\rho_2}$$

where

$\rho_1 =$

$\rho_2 =$

$\phi_2 =$

$\theta_2 =$

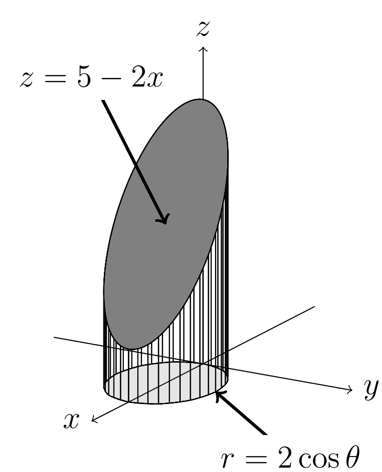
12. Sketch the region of integration for the integral below and write an equivalent integral with the order of integration reversed. **Do not evaluate the integral.**

$$\int_{-2}^{0} \int_{x^2-1}^{3} (y^2 \sin(x) + \tan(xy))\, dy\, dx$$

13. Evaluate the integral below.

$$\int_{-3}^{0} \int_{-\sqrt{9-x^2}}^{0} \cos(4x^2 + 4y^2)\, dy\, dx$$

14. Set up but **do not evaluate** the iterated integral for computing the volume of a region D if D is the right circular cylinder whose base is the disk $r = 2\cos\theta$ (in the xy-plane) and whose top lies in the plane $z = 5 - 2x$.



15. (a) Find a function f so that $\nabla f = (y^2 - 10xz)i + (2xy)j + (-5x^2)k$.
    (b) Evaluate the integral below.

$$\int_C (y^2 - 10xz)\,dx + (2xy)\,dy + (-5x^2)\,dz$$

    Here C is any path from $(1,1,0)$ to $(1,2,2)$.

16. Find the volume of the solid region $E = \{(x,y,z)\,|\,0 \le x \le z, 1 \le y \le 5, y \le z \le 5\}$.

17. Find the work done by the force $\mathbf{F} = (6xy + \sin(x))\mathbf{i} + (3x^2 + 2x - \tan(y))\,\mathbf{j}$ when moving a particle around the circle $x^2 + y^2 = 9$ starting and ending at $(-3,0)$ traveling in the counterclockwise direction.

18. The density of the half-hemisphere defined by

$$x^2 + y^2 + z^2 \le 4, \qquad z \ge 0$$

is equal to the distance above the xy-plane. Find the mass of this object.