1. Evaluate the integral $\int\int_{\mathcal{D}} \left(x^2 - 2y + xy\right) dA$ where $\mathcal{D} = [-1, 1] \times [0, 2]$.

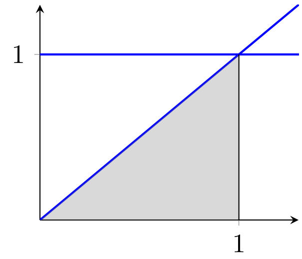
2. Evaluate the integral $\int\int_{\mathcal{R}} (2xy + e^x)\, dA$ where $\mathcal{R} = [0, 1] \times [0, 1]$.

3. Evaluate the integral $\int\int_{\mathcal{D}} \left(2x^2y^{-2} + 2y\right) dA$ where $\mathcal{D} = \{(x, y)\,|1 \leq x \leq 2,\ 1 \leq y \leq x\}$.

4. Evaluate the integral $\int\int_{\mathcal{D}} (1 + \cos x)\, dA$ where $\mathcal{D} = \{(x, y)\,|0 \leq x \leq \pi,\ 0 \leq y \leq \sin x\}$.

5. Find the volume between the surface $z = x + xy$ and $\mathcal{D} = [0, 2] \times [0, 1]$ on xy-plane.

6. Find the volume between the surface $z = e^{-x^2}$ and $\mathcal{D}$ on xy-plane, where $\mathcal{D}$ is as shown below:



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7. Evaluate the integral $\displaystyle\int\int_{\mathcal{D}} (x+y)\, dA$ where $\mathcal{D}$ is the region between the circles $x^2 + y^2 = 1$ and $x^2 + y^2 = 9$.

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8. Evaluate the integral $\displaystyle\int\int_{\mathcal{D}} \frac{1}{x^2+y^2} dA$ where $\mathcal{D}$ is the region between the circles $x^2 + y^2 = 1$ and $x^2 + y^2 = e^2$.

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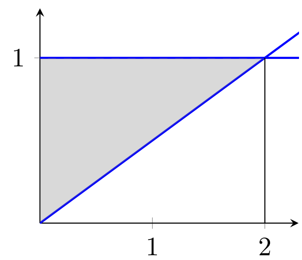
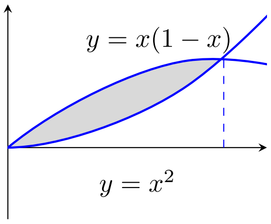
9. Evaluate the integral $\displaystyle\int_0^2 \int_{x/2}^1 e^{y^2}\, dydx$ by switching the order of integration to $dxdy$.



10. Evaluate $\int\int_{\mathcal{D}} x dy dx$ where $\mathcal{D}$ is as below;



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11. Determine whether the vector field $F(x,y) = \left\langle \cos x - 2xy, e^y - x^2 \right\rangle$ is conservative. Find a potential function if it is conservative.

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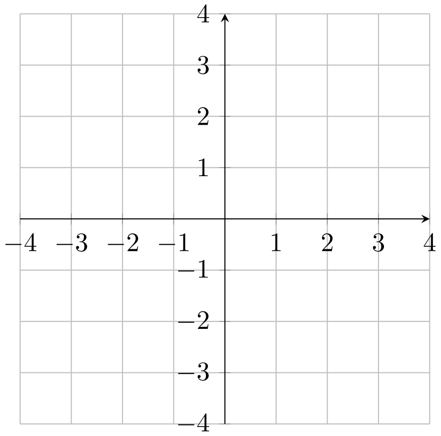
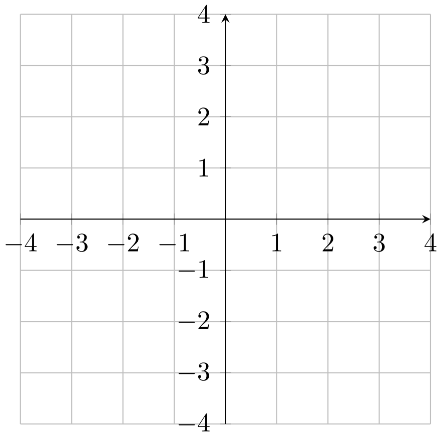
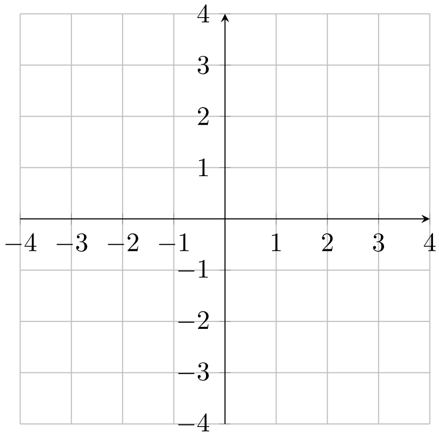
12. Sketch some vectors $F(x,y) = \langle -y, 2x \rangle$, $G(x,y) = \langle y, -x \rangle$ and $H(x,y) = \langle -x, x - y \rangle$







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13. Use Green's theorem to evaluate $\int_{\mathcal{C}} \vec{F} \cdot d\vec{r}$ where $\vec{F}(x,y) = \left\langle y^3, x^3 + 3x^2 y \right\rangle$ and $\mathcal{C}$ is the circle $x^2 + y^2 = 4$, oriented counter clockwise.

14. Use Green's theorem to evaluate $\int_{\mathcal{C}} \vec{F} \cdot d\vec{r}$ where $\vec{F}(x,y) = \langle \arctan x + y^2, e^y - x^2 \rangle$ and $\mathcal{C}$ is the unit circle $x^2 + y^2 = 1$, oriented clockwise.

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15. Find the work done by the force field $\vec{F}(x,y,z) = 3x^2\boldsymbol{i} + (2xz - y)\boldsymbol{j} + z\boldsymbol{k}$ to move a particle along the straight line from $(0,0,0)$ to $(2,1,3)$.

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16. Find the work done by the force field $\vec{F}(x,y,z) = x\boldsymbol{i} + y\boldsymbol{j} + 3\boldsymbol{k}$ on a particle that moves along the helix $r(t) = \langle \cos t, \sin t, t \rangle$ from $t = 0$ to $t = 2\pi$.