

4. Evaluate $\int_0^1 \int_y^1 e^{-x^2} dx dy$ by reversing the order of integration. [10 points]
5. Calculate the flow of the field $\{-y, x\}$ along the circle $x^2 + y^2 = 9$. Is the flow clockwise or counterclockwise? [8 points]
6. Calculate the flow of the field $\{x, y\}$ across the circle $x^2 + y^2 = 9$. Is the flow inward or outward? [8 points]

7. Is the flow of the vector field $\{x^4 - 6x^2y^2 + 5y^4, -4x^3y + 4xy^3\}$ suitable for modelling the flow of an incompressible fluid such as water? Why or why not? [8 points]
8. Suppose that a function $f(x, y)$ has no singularities and its Laplacian, $\Delta f = \frac{\partial^2 f(x, y)}{\partial x^2} + \frac{\partial^2 f(x, y)}{\partial y^2} = 0$. What do we know about the flow of $\nabla f(x, y)$ across any closed curve C and why? [10 points]
9. Calculate the net flow of the vector field $\{y \sin(2x), x^2 - e^{-y}\}$ along the boundary curve of the rectangle with corners at $(\pm\pi, \pm 2)$. [8 points]

10. Calculate the net flow of the vector field $\left\{x^2 + \frac{\sin y}{y}, e^{-x^2} - 2y^2\right\}$ across the region bounded by the lines $y = -x$, $y = 3 - x$, $y = x/2$, and $y = x/2 + 4$. [10 points]
11. Set up, but do not evaluate, the integral to find the volume under $f(x, y) = e^{-((x/3)^2 + y^2)}$ and over the inside and boundary of the ellipse $(x/3)^2 + y^2 = 1$. [10 points]
12. How would you change the integral above to calculate the volume under $f(x, y)$ but over the entire xy -plane? [6 points]