1. Evaluate the line integral $\oint_{\mathcal{C}} \sin(x^2)\,dx + x\,dy$ where $\mathcal{C}$ is the triangle with vertices $(0,0)$, $(3,0)$, and $(3,2)$ oriented clockwise.

2. A particle starts at the point $(-2,0)$, moves along the x-axis to $(2,0)$, and then along the semicircle $y = \sqrt{4-x^2}$ to the starting point. Find the work done on the particle by the force field $\mathbf{F}(x,y) = \langle x, x^3 + 3xy^2 \rangle$.

3. Let $\mathbf{F}(x,y) = \langle e^x + x^2 y, e^y - xy^2 \rangle$ and $\mathcal{C}$ be the circle $x^2 + y^2 = 25$ oriented clockwise. Evaluate $\oint_{\mathcal{C}} \mathbf{F} \cdot d\mathbf{r}$.

4. Evaluate $\int_{\mathcal{C}} (\sin x + 7y)\, dx + (6x + y)\, dy$ for the curve $\mathcal{C}$ given by line segments from $(0, 0)$ to $(1, 1)$ to $(1, 2)$ to $(0, 3)$.

5. Use Green's Theorem to compute the area inside the ellipse $\dfrac{x^2}{9} + \dfrac{y^2}{25} = 1$.

6. Find a parametrization of the curve $x^{2/3} + y^{2/3} = 9^{2/3}$ and use it to compute the area of the interior. *Hint:* Let $x(t) = 9\cos^3 t$.

7. Let $\mathbf{F}$ be the vector field

$$\mathbf{F}(x, y) = \left\langle \frac{-y}{x^2 + y^2}, \frac{x}{x^2 + y^2} \right\rangle.$$

Prove that $\oint_{\mathcal{C}} \mathbf{F} \cdot d\mathbf{r} = 2\pi$ for any simple closed path $\mathcal{C}$ with counterclockwise orientation that encloses the origin.

Hint: Consider a small circle centered at the origin, small enough so that it lies completely inside the region bounded by $\mathcal{C}$. Let $\mathcal{D}$ be the region bounded by the two curves and apply the general form of Green's Theorem.

8. Let $\mathcal{D}$ be a region bounded by a simple closed curve $\mathcal{C}$ in the xy-plane. Use Green's Theorem to prove the coordinates of the centroid $(\bar{x}, \bar{y})$ of $\mathcal{D}$ are given by

$$\bar{x} = \frac{1}{2A} \oint_{\mathcal{C}} x^2 \, dy \qquad \bar{y} = -\frac{1}{2A} \oint_{\mathcal{C}} y^2 \, dx$$

where A is the area of $\mathcal{D}$.